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PEI Alternative Insight

PRIVATE EQUITY INTERNATIONAL

CLEAN ENERGY INVESTING

A comprehensive guide for institutional investors focusing on private assets

Edited by
Capital Dynamics

With compliments of

Capital Dynamics

Dear Reader,

In today's volatile investment environment, both private and 'real' assets are playing increasingly important roles in traditional portfolios as investors seek new routes to return on investment. Simultaneously, considerations about environmental, social and governance issues are gaining prominence among investors all over the globe.

It is against this backdrop, and that of a changing climate, that clean energy investments in private assets have quickly become a mainstream investment choice. In particular, investments in clean energy infrastructure are especially attractive as they offer some of the most unique investment opportunities available within the private asset space. Capital Dynamics recognised the return potential early, and in 2010, launched a clean energy infrastructure investment platform to capture those opportunities.

We have gained extensive insight and practical experience during our pioneering work over these last years. We now have an occasion to share some of what we have learned and are thus delighted to present you with your personal copy of *Clean Energy Investing*. Edited by Capital Dynamics* and published by the highly respected private equity publisher PEI, this distinctive book provides a concise overview of clean investing in private assets. It features a collection of chapters contributed by experts in their respective clean energy fields – each of whom provides a high-level perspective on the clean energy market and practical information about investing into it.

Whether you are already a Capital Dynamics client or are considering a partnership with us, we hope this publication will inspire you to take a closer look at clean energy investing and our extensive experience within the field.

It is our hope that you will find *Clean Energy Investing's* 360-degree view on clean investments in private assets thought-provoking, informative, and a practical point of reference.

Thank you and best wishes from your Capital Dynamics team.

Capital Dynamics is an independent asset management firm focusing on private assets including private equity, clean energy infrastructure, and real estate. Capital Dynamics offers investors a range of products and services including funds of funds, direct investments, separate account solutions and structured private equity products. Our senior investment professionals hold an average of over 20 years of investing experience and due diligence expertise, gained through diverse backgrounds as fund investors, direct investors, and co-investors. With 160 professionals and 10 offices worldwide, Capital Dynamics is able to deliver top-quality service to its client base of sophisticated institutional investors such as pension funds, endowments, family offices, high net worth individuals, and advisors. Headquartered in Switzerland, Capital Dynamics has offices in London, New York, Zurich/Zug, Tokyo, Hong Kong, Silicon Valley, Sao Paulo, Munich, Birmingham (UK), and Brisbane.

* 'Capital Dynamics' comprises all affiliates of Capital Dynamics Holding AG.

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Published in June 2012 by
PEI
Second Floor
Sycamore House
Sycamore Street
London EC1Y 0SG
United Kingdom

Telephone: +44 (0)20 7566 5444
www.peimedia.com

THE QUEEN'S AWARDS
FOR ENTERPRISE
2009

ISBN 978-1-908783-04-2

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PEI editor: Anthony O'Connor
Production editor: Julie Foster

Printed in the UK by: Hobbs the Printers (www.hobbs.uk.com)

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About the editor

Dr Katharina Lichtner is a co-founder of Capital Dynamics AG, where she is a managing director, co-head of Investment Management, and head of Research. She is also a member of the board of directors and executive committee, and is vice chairman of the Investment Committee at Capital Dynamics.

Katharina established Capital Dynamics' dedicated Research department and is responsible for providing insight on current and future trends in private assets to clients, colleagues and the media. She has partnered with leading academics from the Technical University of Munich and the London Business School to conduct research projects, the joint findings of which have been published in various industry publications.

In 2010, Katharina was named one of the most influential women in European finance by Financial News. Her active role within the wider private equity and financial community is ongoing. Currently, Katharina serves on the International Private Equity and Venture Capital Valuation Guidelines Board, representing the European Private Equity and Venture Capital Association (EVCA). She is a member of the EVCA's Professional Standards Committee as well. Katharina frequently speaks and participates on panels at private equity conferences in both Europe and the US.

Katharina has been serving on the jury of the Deutscher Journalisten Preis since inception, and she also serves on the BAI (German association for alternative investments) Wissenschaftspreis jury. Katharina served as a juror and coach for the 2010 and 2012 Swiss Venture Business Plan Competitions.

Prior to co-founding Capital Dynamics, she was a consultant at McKinsey & Company. From 1992 to 1996, she conducted research at the Basel Institute for Immunology. Katharina holds a Master's degree in Molecular Biology and Biochemistry and a PhD in Immunology from the Biocenter Basel.

Message from the editor

My decision to edit *Clean Energy Investing* was driven by the increasing prominence of this rather new, and thoroughly fascinating, investment field. While investments in energy and clean technologies have been available through venture for some time, it was not until recently that pure-play cleantech funds became available. Next came clean-growth and buyout investments focused on products and services in clean or renewable energy. And only in the last few years have products emerged that provide investors access to private, clean energy infrastructure assets through limited partnership structures.

Today, clean-investment strategies are firmly established in the investment community. Despite their mainstream status and increasing attractiveness, many investors are not yet entirely comfortable with the particulars of clean-investment strategies. Others have expressed confusion over some of the terminology used in the sector. Still others, eager to include these strategies into their overall private asset portfolios, are struggling with asset-allocation considerations. In this context, and with the global community increasingly looking towards alternative energy sources and intelligent abatement technologies, *Clean Energy Investing* was conceived. Clearly, the time is ripe for a publication that brings a group of clean energy experts together to share their views and expertise on this exciting new space.

When *Private Equity International*, which we consider a leading publisher in private equity, invited us to become a partner on this project, we were flattered. We also felt it was a natural fit. Capital Dynamics is a pioneer in providing opportunities in clean energy infrastructure and is delighted to have this occasion to transfer some of our knowledge to those who are interested in investing in private, clean energy assets. I hope that you will find the book both informative and inspiring, and welcome you to delve in and enjoy. □

Editor's introduction

Ever since the United Nations Conference on Environment and Development (UNCED), or the Earth Summit as it is more commonly known, was held in Rio de Janeiro in 1992, and its principle update the Kyoto Protocol was signed in 1997, climate issues have become part of mainstream politics. The climate has inexorably been added to the global political and socio-economic agendas for most political parties and leaders, irrespective of their geographic location or political orientation. But despite all of the good intentions of the developed world to be less polluting, some emerging markets have dramatically increased their energy consumption, concomitantly increasing their CO_2 emissions. This has heightened competition for available resources, driving up prices and raising awareness that with current consumption levels, conventional energy sources such as crude oil and gas could become scarce as soon as 2050, according to the BP Statistical Review of World Energy, June 2011.

To underscore the sometimes skewed supply and demand dynamics of traditional resources, it is important to consider the disproportionate level of energy some nations consume. Despite the US and Europe (including the European Union plus EFTA countries Norway, Switzerland, Lichtenstein and Iceland) together accounting for 12 percent[1] of the global population, they consume 38 percent[2] of global oil and gas supplies. Much of the prosperity in the US and Europe has been aided by the availability of affordable energy, which is now becoming hampered by rising prices for natural resources, driven by increasing competition. Coupled with the fact that conventional energy resources often originate from countries with political instability, many developed economies with scarce natural resources have placed energy security squarely on their political agendas. Many are now developing strategies, as well as regulatory and legal frameworks, to curb energy consumption and develop sustainable energy sources so they can become less dependent on carbon-based resources and reduce CO_2 output.

Since the Kyoto Protocol was signed, it has been clear a substantial amount of research, innovation and capital are required to comply with the protocol's directive to reduce carbon output and increase the renewable energy produced. The political and societal commitment to the Kyoto Protocol has given birth to an investment industry revolving around technologies, companies and infrastructure aimed at reducing carbon output, cutting energy consumption and producing energy from sustainable resources.

It is encouraging that developments in politics and society have generally been mirrored by a similar call-for-action from the international investment community: there is

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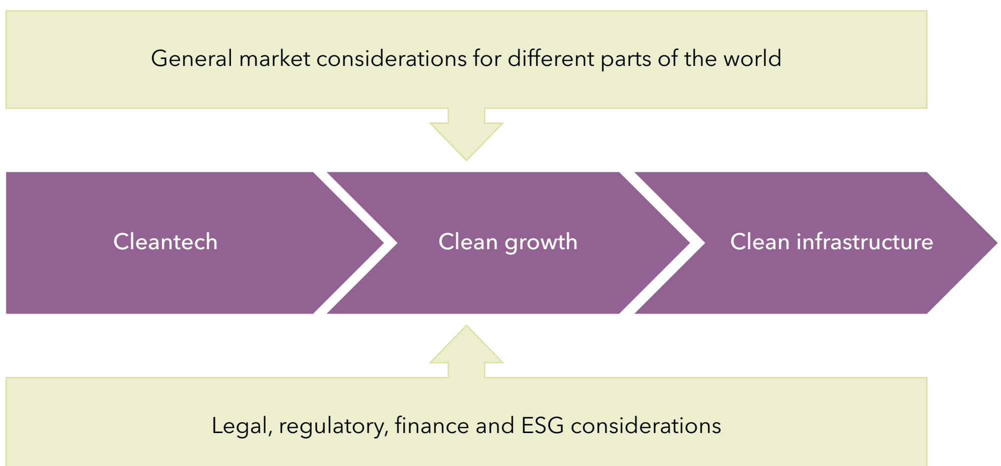
[1] United Nations, 2011.

[2] US Energy Information Administration, data on oil as of 2011, data on gas as of 2010.

a consensus that opportunities can arise out of the need to change our resource management and energy consumption.

Today, there are 'clean' investment opportunities available across all asset classes: fixed income, public equities and alternatives. These provide the ever-growing number of investors seeking to add clean investments to their portfolios with various options designed to fit their particular investor profiles. *Clean Energy Investing*, written by experienced practitioners for practitioners, is intended as a guide to investing in the clean-asset space. This expert publication examines the exciting and growing new field of attractive investment opportunities that will be available in the coming decades as the world transitions to a more advanced management of natural resources, energy consumption and CO_2 emissions. It has been expressly published to provide a 360-view of clean investment opportunities in private, or alternative, assets.

Broadly speaking, the clean-investment space features three main categories: cleantech, clean growth and buyouts as well as clean energy infrastructure. The book features chapters dedicated to these investment categories. Additionally, the book includes several chapters designed to help readers better understand the global and regional context in which these investment strategies are executed. Finally, in the interest of providing a panoramic view, the book features a number of expert discussions on ancillary topics. The following diagram shows how the topics interrelate.



Clean Energy Investing does not purport to be a collection of scientific papers or theoretical essays. Rather, it is a series of in-depth chapters written by senior experts in their respective fields who share with readers their extensive practical experience and insight. Particular care has been taken to ensure practical information is given to investors contemplating 'clean' investments in private assets to help them establish a suitable asset allocation for clean investments in a private-assets portfolio.

As well as investing in the clean space being relatively new and evolving at a rapid pace, it is also complex. Furthermore, regulatory and policy factors play a prominent role, which differentiates the clean-investment space from traditional investments in private assets and adds an additional layer of sophistication. Consequently, regulatory and policy factors run like a red thread throughout the book. It is outside of the scope of the book, however, to cover every global regulatory and policy development, or all research conducted on clean-investment opportunities.

Responsible investment considerations are continually gaining prominence and particularly in Europe. Such considerations have been crystallised by the United Nations Principles for Responsible Investment, which aim to help institutional investors integrate environmental, social and governance (ESG) issues into investment decision-making. There is a chapter devoted to responsible investment, and the topic appears throughout the book, outlining how investments in clean assets provide opportunities to those investors focusing increasing attention on responsible investing.

As *Clean Energy Investing* provides a forum for numerous experts within their fields to present their views, great care has been taken to invite well-respected professionals to contribute. Great care has also been taken to ensure assertions included in the book are well-founded and supported by respected sources. Where appropriate, references to additional, relevant literature are provided at the end of each chapter. A glossary has been included to facilitate better understanding of chapters that contain frequent use of technical terms.

The book is aimed at a wide group of participants in the clean-investing industry. For limited partners planning to enter this space, the book provides a solid framework for allocation in accordance with their desired risk-return profiles, and for conducting proper due diligence on emerging investment opportunities. More experienced limited partners will benefit from the exploration of many ideas to further evolve their portfolios of clean assets. All limited partners can profit from the inclusion of ancillary topics addressing financing, legal, tax and regulatory aspects associated with 'clean' investing.

Likewise, the book assists pension fund trustees to gain a better understanding of the clean-investment space necessary for developing their investment programmes together with their investment departments. The book can also help pension fund trustees to more clearly understand what they can and should expect from associated third-parties such as legal and accountancy advisers.

Considerable care has been taken to make the book easy to navigate. It is structured in four clearly defined sections. The first section gives a general overview of the different aspects of the clean energy and renewable agenda in different parts of the world – it comprises high-level thought pieces from pioneers in the field. The second section covers investing themes and trends in cleantech as well as clean growth strategies and the benefits of funds of funds in the space. Section three addresses the critical aspects of investing in clean energy infrastructure. The fourth section provides a platform for specialist practitioners to provide insights on ancillary topics such as tax, financing and legal aspects.

Each chapter is structured with introductory bullet points to present the discussion points and concludes, where relevant, with similar bullet points offering a summary of the content and findings. The book intentionally refrains from offering detailed overall summaries so as not to interfere with the reader forming his or her own opinions. As such, the ultimate objective is to provide you, the reader, with food for thought as you build your own portfolio in the exciting space of clean assets. □

Dr Katharina Lichtner

Section

General considerations

1 The energy horizon – 2012 and beyond

By Walt Patterson

Introduction

As the world of energy is in turmoil, the resulting turbulence is having a profound effect on energy investment, which means that the time is ripe for astute investors to prepare for dramatic developments in order to avoid unpleasant surprises and to seize upcoming opportunities.

This chapter establishes that energy consumers face a real choice between energy generated by carbon-intensive, traditional methods of power generation and infrastructure-based energy that relies on ambient sources and not fossil fuels. However, increased investment in clean energy will only become reality if traditional and newcomer suppliers of energy are required by law and incentivised financially to make the switch to a lower-carbon energy market. For clean energy generation to gain real traction today there needs to be constructive and intelligent debate at governmental, corporate, institutional and consumer levels, not least in presenting a meaningful lexicon for clean energy discourse, without which advancements in this new energy paradigm will falter.

In April 2011 Fatih Birol, chief economist of the International Energy Agency (IAE), declared that the agency, and presumably its sponsoring governments, believe that global production of petroleum peaked in 2006. At the time the IEA was confidently predicting global oil production increasing to 2030. Now, according to the IEA, the age of cheap oil is over. While the events that played out during the Arab Spring in 2011 have added a dimension of complication, which has been welcomed for various reasons by many, the consequences for oil supplies and prices may be yet more disruptive. Concerns over the supply of oil from producing countries in the Persian Gulf region are still very much subject to geopolitical risk factors.

Some industry observers and commentators expect natural gas to take up the slack. Natural gas supplies in North America are proving to be offering a steady supply to the region, and pipeline projects to supply liquefied natural gas (LNG) to Asia and Europe are being developed. In recent years Europe has had the unhappy experience of depending on Russian natural gas routed through Ukraine, as evidenced in the 2009 gap pipeline supply crisis.[1] Proposed new pipelines face additional uncertainty,

[1] Disputes between Russia and Ukraine have escalated in recent years, developing from commercial disagreements between Ukrainian oil and gas company Naftohaz Ukrainy and Russian gas supplier Gazprom over natural gas supplies, prices, and debts, to fully fledged international political disputes. The knock-on effects have introduced uncertainty to the supply of gas to Western Europe. It is estimated that Russia supplies approximately 25 percent of the natural gas consumed in the European Union, with approximately 80 percent of those Russian gas exports being piped through pipelines across Ukraine to the European Union.

caused by, for example, the rise of shale gas, produced by hydraulic fracturing – or fracking, which is the process of drilling into rock, injecting the well with millions of gallons of high-pressure water, sand and chemicals to precipitate the release of gas through the well, by essentially fracturing rock. Early reports claimed that shale gas would transform US and European gas markets beyond recognition, but no one yet knows for how long fractured strata will actually yield gas. Furthermore, contamination of underground water has made shale gas intensely controversial, as much of the water remains under the ground's surface, also potentially destabilising the land; wastewater, sand and chemicals from the process also need to be sent to landfill facilities. National opinions on fracking are split: Poland promotes its benefits whereas France has voted to ban it. A fracking project near Manchester in the UK might even have caused a mild earthquake, despite very little seismic activity ever having been recorded in the area. The uncertainties over shale gas may disrupt future investment not only for gas but also for other supply technologies.

A traditional alternative is coal, which although it continues to be abundant and cheap, has the most environmental impact of all fuels when measured by carbon emissions. The impact of surface extraction, airborne emissions of sulphur and nitrogen oxides and particulates, and contamination of water and land, make coal the focus of bitter protest. European governments, for example, have imposed evermore stringent constraints on the use of coal, particularly for generating electricity. In carbon-emissions-conscious countries around the world, many coal-fired power stations will face closure or face punishing costs to retrofit emission controls; proposed new stations will be far more expensive. Coal-fired electricity generation also faces mounting costs for permits to emit carbon. Moreover, the much-heralded clean-coal technology of carbon capture and storage (or sequestration) remains mostly theoretical.

Climate change and the lack of viable alternatives have appeared to have given a new lease of life for proponents of nuclear power. However, *The World Nuclear Industry Status Report 2010–11*[2] analyses official data and finds that worldwide appeal is doubtful and economically unproven, in contrast to political and media enthusiasm for a nuclear renaissance, which has been positive since 2005, with many governments having called for the proliferation of new nuclear programmes. Private finance, however, badly burned by earlier experience with surprisingly high costs, schedule over-runs and poor performance, has declined to participate without open-ended guarantees from taxpayers. Some governments have therefore been arranging ever-larger subsidies.

The aftermath of Fukushima

However, events in Japan after the earthquake and tsunami of March 11, 2011 have severely complicated matters. The impact of the Fukushima disaster will effectively take years to stabilise the reactors, fuel ponds and clean the contaminated land in the region surrounding the nuclear plant. The *Financial Times* reported that compensation claims alone may exceed $30 billion, which could result in Tokyo Electric Power failing

2 Schneider, M., Antony Froggatt, A., and Steve Thomas, S., Worldwatch Institute, 2011.

if the Japanese government does not prevent a collapse. Accordingly, Japan is now in the throes of a fundamental reappraisal of its energy policy and its energy future – both in terms of how the power is generated and how efficiently it is consumed.

As a consequence, it is increasingly clear that seemingly cheap nuclear power is in fact badly mispriced, particularly since a viable long-term spent-fuel storage solution has yet to be found. Policy decisions against maintaining or developing energy-based nuclear programmes are gaining traction. In Germany, Angela Merkel's political administration has decreed complete withdrawal from nuclear power by 2022 following political and societal support for such a move. The Italian parliament has voted to scrap a proposed restart of the country's nuclear programme. In Switzerland, the cabinet has called for a phase-out of the five Swiss nuclear plants, despite continuing to import nuclear power from neighbouring France. The European Union (EU) has agreed to undertake stress-tests on EU nuclear plants that might imply costly safety upgrades of existing plants. Although some EU countries, notably the UK and France, remain committed to new nuclear plant construction, the reality is that without essentially unlimited support from governments and taxpayers no new nuclear plants will be built anywhere except in centrally planned economies. The aftermath of the Fukushima disaster may make voters less willing to let their governments support nuclear advancement. Indeed, as existing plants reach the end of their operating lives, global output of nuclear electricity seems destined to inexorable decline.

Traditional electricity generation

Having examined the relative merits of fracking, coal-fired and nuclear power generation, it is important to take closer look at electricity itself. Traditional electricity, which supplies much of the world's power demand, is based on a common technical model, which is more than a century old. This technology requires very large remotely sited power stations, most of which operate either intermittently or at only partial output most of the time. The power stations that use fuel actually waste two-thirds of the generated energy before it even leaves the plant. The system requires extensive networks of transmission lines, from which even more energy inadvertently escapes. The system is inherently vulnerable to disruption, by mishap or malice, over a wide area and almost instantaneously; it can blackout entire countries in minutes, and does so with alarming frequency.

The power-generation system assumes that every application is sensitive, requiring high-quality electricity, with very stable voltage and frequency. A lot of this electricity then goes to waste; much of the rest supplies applications such as lighting, heating and cooling that do not require high-quality energy, or more specifically a higher quality of voltage. Most of the application that use electricity, such as lamps and motors, are inherently intermittent or variable, but the system's large fuel-based generators are inherently inflexible.

Yet probably the single worst feature of this inelegant arrangement is that the rest of the system is selling electricity to the user by the measured unit, which creates an entirely inappropriate incentive system. The more the user has to buy, the more revenue for the seller. The seller therefore wants the user to have inefficient lamps, inefficient motors and other inefficient user-technology. This perverse incentive to poor overall system performance has persisted ever since the invention of the electricity meter some 125 years ago. Consequently, electricity itself is overdue for transformation.

So far, however, progress has been erratic. Liberalisation of electricity, pioneered two decades ago, was based on the model for natural gas, breaking up the old monopoly system and introducing competition, in a so-called electricity market. However, natural gas is a physical commodity: it can be stored and kept from the market until the seller gets the desired price. Conversely, electricity is not a physical commodity: the way society uses electricity it cannot be stored. As a result the nature of feasible market transactions is totally different particularly in a world where there is a shift towards real assets away from complex derivative investments. Many now doubt that an electricity market can ever meet the investment required to actually keep the lights on.

Challenges for investors

Overall, looking towards the horizon, what today's energy investors see at first glance is a minefield, comprising risks of every kind – technical, political and environmental – many of which are unfamiliar and potentially crippling. That stated, the view is seriously incomplete because it omits the most important part of our energy systems.

Society manages energy wrongly: the debate is tainted by badly conceived concepts and disconnected perception. People use the term 'energy' when in fact they really mean oil, coal, natural gas or electricity. Energy and fuel are not the same and certainly not interchangeable, but using unspecific terminology can cause confusion, especially among politicians who often think fuel and energy are one and the same. Broadly, people talk about energy supply when they really mean, perhaps, oil supply, which is not the same as gas supply or electricity supply. What are these supplies used for? That is a key detail that is often missing from general understanding and the wider debate. Society uses fuels and electricity to operate appliances and technology. What matters are facilities such as lamps, motors, electronics, appliances, industrial plant, vehicles and especially buildings. In turn, these appliances and technologies provide comfort, light, motive power, refrigeration, mobility, information and communication. The technology is what matters. Oil by itself is almost useless; natural gas by itself is downright dangerous; and electricity does not even exist by itself as it is a process in technology. Fuel is only useful because of technology.

What most people call energy policy today still concentrates on fuels and electricity – what they used to call fuel and power policy. It takes user-technology for granted and ignores it, except as aggregates and averages of so-called energy demand. Society does not have energy demand or an energy problem; it has many different, specific and distinct problems: how best to provide many different energy services, with many different specific user-technologies, that may, or may not, require specific fuel or electricity.

Despite commonplace reference to energy markets, which gives the impression of a tradable, physical commodity, the actual focus should be on the investment in the power-generation facilities and transmission grids that provide power to devices, services and gadgets that people desire.

Although the focus is on energy markets, the crucially important form of energy business is not commodity trading. It is investment, in the physical assets that make up the system, including not only those that produce and deliver fuels and electricity but also – and arguably even more importantly – the assets, the things, that actually deliver the services people desire.

Governments, regulators and consumers: all at odds

Governments and regulators now promote competition to ensure optimum services to users. They presume that the key competition is between different suppliers of a particular fuel or electricity, and that the aim is to make the price of a unit of gas or electricity as low as possible. Most users, however, have no idea of what the unit price of their gas or electricity is, but what matters to them is the actual utility bill they pay, and the lower the cost the better. However, low energy prices may not necessarily lead to lower-cost bills; on the contrary the opposite may the case.

What society has to realise is that the real competition is between fuel and technology. Better user-technology requires less fuel to deliver the same or better services. Fuel and user-technology compete directly with each other. Key competitors for ExxonMobil are not Shell nor BP but Honda and Toyota; competitors for Gazprom are Europe's manufacturers and installers of thermal insulation; and competitors for EdF and E.On are the manufacturers of compact fluorescent and LED lamps. Real energy policy will foster this crucial competition between user-technology and fuel, to upgrade user-technology and infrastructure, as the direct objective of a coherent strategy for security and climate.

Problems associated with security and climate are not about energy. They are quite specifically about fuel, about the uncertain supplies and prices of imported hydrocarbons, and about the increasingly alarming consequences of burning fossil fuels. Politicians talk about a low-carbon future in a low-carbon world, and in that context low carbon means low fuel, which essentially means using less fuel.

At the moment, the large international corporations that call themselves energy companies make their money by selling fuels and electricity – the more they sell the higher their revenues. Although they extol the virtues of energy efficiency, their business plans expect society to continue using low-performance real estate, electrical fittings and appliances, and vehicles. The real energy policy, which enlightened governments are now embracing, will no longer focus on short-term transactions in commodity trading of fuels and electricity. Instead, an enlightened approach will have to focus on longer-term investment in energy performance, in order to optimise the whole system that delivers society's services. If governments and regulators change the rules, energy companies will change their business plans to make money by upgrading user-technology and infrastructure as part of the whole-system package.

Financial innovation for energy investment is burgeoning. In some countries electricity and gas suppliers, and indeed other entrepreneurially minded businesses such as supermarkets, are incentivised to invest in commercial and residential real estate energy-efficiency upgrades and retrofits, for which they receive a guaranteed return on the investment by way of a surcharge on utility bills or through a surcharge on local rates or property taxes, in some cases. The upside is potentially multi-faceted: tenants and occupiers enjoy lower energy costs; property owners can expect to retain content tenants for longer leases; and should tenants vacate upgraded premises, landlords can, in theory, quickly attract new tenants with the promise of lower operational costs.

Other financial innovations which have an upside for investors include leasing, service contracts, weather hedging and other novel forms of energy business, with impressive success stories to underline their potential.

Performances upgrades, whether in real estate or in technology, are the logical first step to achieve reductions in fuel consumption. The second step should start with recognition that society uses two different kinds of electricity: one kind uses the stored energy in fuel, such as coal, natural gas or uranium; the other kind uses technology to convert natural ambient energy, including hydro, wind, photovoltaic, solar thermal, wave, tidal and geothermal, into electricity. The clear distinction to make is that the latter type does not use fuel to generate energy and although most people refer to it as renewable energy, it is more accurately infrastructure electricity, that is, created and delivered by the function of physical assets, not by combustion or any other reaction. Once the infrastructure-electricity assets are in place and functioning and when the natural ambient energy is available, the infrastructure converts it into useful electricity.

Currently, however, the way society uses fuel threatens the security of energy supply and the planet's climate. In fact, of all the ways society uses fuel, generating electricity is the easiest scenario in which to effect change. In order to deliver better, more reliable, more universally available and sustainable electricity services, the aim should be to move as rapidly as possible away from fuel-based electricity to infrastructure-based electricity, for every feasible application, all over the world.

Incentives are badly needed

Fortunately, this is already happening. That said, proper investment incentives will have to pave the way, including tax breaks on dividends on investments in renewable energy, such as the tax break for solar in the US. It is clear that these incentives will need to grease the engine, but investors will need to maintain and increase the momentum. Electricity liberalisation – breaking up the traditional monopoly system and introducing competition – means that the risks of ill-advised investment become shareholders' and bankers' responsibilities and not captive customers'. Huge coal-fired and nuclear stations, taking six years or more to produce a single kilowatt hour or a cent of revenue, then become seriously unattractive investments. Smaller-scale generation, ordered, commissioned and operating in two years or less, becomes much more appealing. Traditional electricity is gradually giving way to more decentralised electricity, with many more much smaller generating units much closer to users, and this trend is accelerating.

As yet, however, networks have not kept pace, which could provide another area for investment. Smart grids will use information technology to enable generators and connected applications to interact directly, keeping systems stable with less dispatching, and keeping track not only of flows of electrons but of flows of value, tracking who gets paid by whom. It is still some way from full implementation, but it is happening. Decentralised electricity, especially infrastructure electricity and smart networks, will over time transform the way society produces, delivers and uses electricity, and indeed all forms of energy around the world.

Mandatory abatement regulation and legislation, including through relatively minor measures such as light sensors and energy-efficient light bulbs, will help to create a brighter future for energy, which in turn should create more opportunities for private investors. As well mandatory direction, there needs to be sustainable engagement from end-users to make this new paradigm as bright as it can be. Effective buy-in from end-users needs to be encouraged through various incentives, but perhaps more importantly, through meaningful educational programmes.

Performance upgrades and infrastructure electricity are complementary: both entail upfront investment, but with minimal operational costs, and the financial commitments are similar and require similar frameworks. Governments, as major energy users themselves, therefore need to play a key role in the way they manage their real estate, facilities and vehicles, many of which are due for vital upgrades. Governments can initiate performance upgrades and install decentralised energy systems in their own facilities, in order to set an example and stimulate innovative energy business. However, when it comes to funding such society-wide upgrades and improvements they lack the funds to fund change for all: that challenge must be met by private capital.

Governments must therefore set out and pursue long-term, ideally bipartisan energy policy – real energy policy, embracing whole systems. They need to enlist the commitment of the world's largest pool of capital: pension funds. They can open vast opportunities for new investment with manageable risks and long-term payoffs. □

Born in Canada in 1936, I came to the UK in 1960, married my English wife Cleone in 1966 and have been here ever since. Trained as a nuclear physicist, I have spent my life teaching, writing and troublemaking.

I have published 13 books and hundreds of papers, articles and reviews, on nuclear power, coal technology, renewable energy, energy systems, energy policy and electricity. Since 1991 I have been a fellow of what is now the Energy, Environment and Development Programme at Chatham House in London. I am a visiting fellow of the Science Policy Research Unit, University of Sussex. I am on the editorial board of European Energy Review.

My previous book was called Transforming Electricity. *My latest is* Keeping The Lights On: Towards Sustainable Electricity. *My current project for CH and SPRU is called 'Managing Energy: Rethinking The Fundamentals'. Three Working Papers, intended to be read in sequence, challenge the conventional view of energy in society, and proposes a more promising vision – WP1, 'Managing Energy Wrong', WP2, 'Managing Energy Data', and WP3, 'Managing Energy Technology'. What was to have been WP4, 'Managing Energy Business', is now evolving into a full-length book, entitled 'Rethinking Energy'.*

2 Managing the risk of climate change and climate change regulation

By Guido Schmidt-Traub, CDC Climat Asset Management

This chapter discusses:

- Global climate change-driven development of policy targets and requirements
- The adaptation challenges for investors
- Implementation status in key economies such as the US, Europe and China

Governments around the world are tightening regulation of greenhouse gas emissions and introducing subsidies for clean energy. However, in the absence of a global framework agreement on reducing emissions, investors are confronted with a patchwork of national and sub-national regulation that may have an important impact on investments in clean energy, infrastructure, real estate and a range of industrial sectors. This chapter reviews the main regulatory initiatives underway and identifies the implications for investors. Readers interested in the impact on particular asset classes are referred to investor briefings prepared by Mercer[1] and the publications by the Institutional Investor Group on Climate Change.[2]

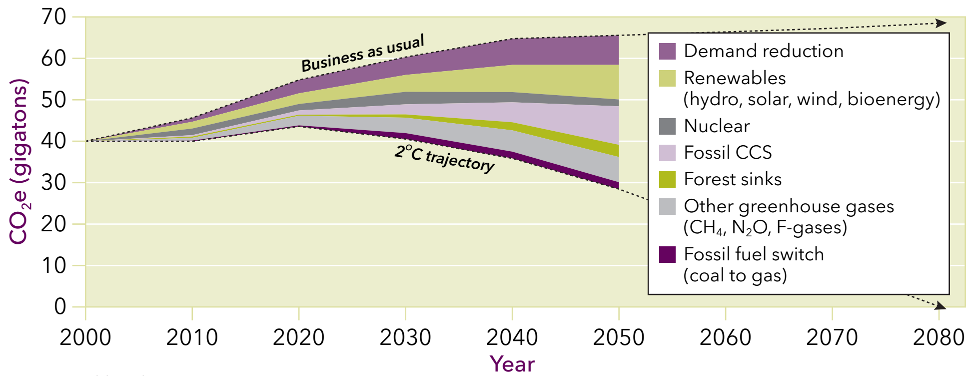
The case for reducing greenhouse gas emissions

Concentrations of greenhouse gases are now at 430 parts per million (ppm) compared with a pre-industrial level of some 280ppm. To avoid a temperature increase beyond two degrees Celsius above pre-industrial levels and avoid potentially catastrophic changes to the climate, greenhouse gas concentrations should stabilise at no more than 450–500ppm.[3]

In the 2009 Copenhagen Accord world leaders have endorsed the two degrees Celsius target. Reaching this target requires per capita emissions of greenhouse gases to fall from an average of 6.5 tons (6.5tCO_2e) of carbon dioxide equivalent in 2004 to 2tCO_2e by 2050.[4] A typical European country will need to lower emissions by some 80 percent from today's 11tCO_2e p.c. Australia, Canada and the US currently emit about

1 See Mercer (2010).
2 Available on http://www.iigcc.org/publications.
3 On the scientific evidence for climate change see IPCC (2007).
4 See Stern (2009).

Figure 2.1: **The technologies required to meet long-term climate targets**



Source: World Bank 2010.

twice as much per capita, so their reduction objectives must be correspondingly higher. The mitigation challenge is also stark in emerging markets, where emissions account for over half of the world's total and are growing fast.

If the climate targets are to be met, power generation, passenger transport, residential heating and cooling and industrial production will need to be virtually carbon neutral by 2050. Deforestation must be halted and large stretches of land must be reforested. Aviation must shift substantially towards biofuels or other fuel sources that are low in greenhouse gas emissions. Fortunately, the technologies exist to stabilise the climate at two degrees Celsius above pre-industrial average temperatures (Figure 2.1).

Massive investments will be required to reduce emissions, but these are ultimately affordable, as the Stern Review on Climate Change[5] has shown. Climate policies must mobilise investments to the tune of 1–2 percent of gross domestic product (GDP) to finance the transition to a low-carbon economy creating markets for low-carbon technologies that may be worth at least $500 billion by 2050.[6] Climate change mitigation could increase technology investments by a cumulative $5 trillion through to 2030 while the cumulative economic cost could amount to $4 trillion.[7]

Policy tools for mitigating greenhouse gas emissions

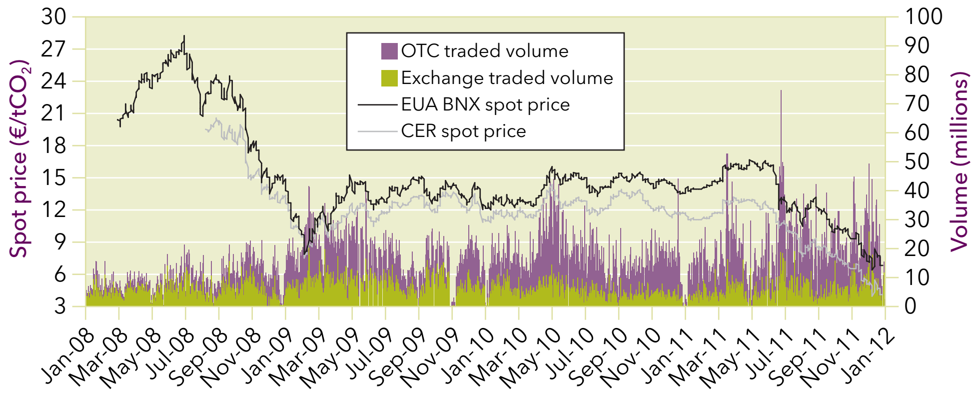
The market does not place a price on carbon emissions so governments need to step in to correct this failure using four families of policy tools:

1. Taxes on emissions, such as petrol taxes, put a price on greenhouse gas emissions and leave the market to determine the resulting volume of emissions.
2. Cap-and-trade carbon markets fix the volume of emissions by issuing a fixed volume of emission allowances and let the market determine the price. Examples

[5] See Stern (2006).
[6] See Stern (2006).
[7] See Mercer (2011).

Contents Previous view

Figure 2.2: **Emission allowance price and trading volumes 2008–2011**



Key: EUA denotes European Emission Allowances. CER stands for Certified Emission Reductions – carbon credits issued under the Kyoto Protocol.
Source: CDC Climat Research using Point Carbon data.

are the Emissions Trading Systems in Europe (EU-ETS) and similar systems in Australia, California and New Zealand. Under an emissions trading system, market participants, such as utilities or industrial companies, need to prepare audited accounts of the greenhouse gases they emit each year and surrender a corresponding number of emission allowances to the regulator. They may purchase or sell emissions allowances depending on their needs, thus creating a market price (Figure 2.2).

3. Subsidies, such as renewable energy feed-in tariffs, can promote low-emission activities.
4. Regulation can impose efficiency standards or ban certain activities regardless of the economic cost. For example, governments set vehicle mileage standards, require buildings to be insulated to certain norms or forbid the sale of energy-inefficient incandescent light bulbs.

Each of these tools affects the return of a range of asset classes by adding costs (taxes, purchase of emission allowances, compliance with regulation) or generating additional revenues (subsidies, sale of carbon credits resulting from emission reductions). It is becoming clear that taxes, subsidies, market mechanisms and regulation each have an important role in reducing greenhouse gas emissions.[8] Consequently, a rapidly growing number of countries in industrialised and developing countries are applying some or all of the tools.

Investors and the adaptation challenge

Rising concentrations of greenhouse gases will affect investments made today. As the Intergovernmental Panel on Climate Change reports make clear, relatively poor developing countries will experience the biggest changes, and they have of course the least capacity to adapt to droughts, floods or the expansion of vector-borne diseases. But as

[8] See PwC (2009).

the increasing ferocity of hurricanes in the Gulf of Mexico and the emergence of a British wine industry make clear, long-term investors need to factor adaptation into their appraisal of transactions in developed countries as well.

Some of the most notable climate risks experienced today include:[9]

- *Volatile agricultural output.* Output of core agricultural commodities has become more volatile as a result of climate change. For example, key wheat producers, such as Australia, Russia and the US have all experienced bumper crops as well as drastic falls in output in recent years. According to scientific forecasts, this volatility in agricultural output is expected to rise sharply.
- *Rising insurance costs.* Figures published by Munich Re show that the frequency and volume of insurance payouts in relation to extreme weather events have increased drastically since the 1950s.[10] With floods increasing in certain regions, properties located in flood plains face escalating insurance premiums and at times become uninsurable.
- *Rising infrastructure and maintenance costs.* Extreme weather events place a strain in transport and other infrastructure. In particular heat peaks that are becoming more frequent can drastically accelerate the wear and tear on roads and bridges, thus increasing operating costs for such infrastructure and requiring higher capital costs to increase resilience. Moreover, new infrastructure may become necessary to guard against rising sea levels.
- *Increasing water stress.* Climate change will aggravate the impact of rising populations and the unsustainable use of water resources, resulting in some major urban centres potentially running dry in the coming decades. Such changes pose a major threat (and opportunity) for investors in the water sector. Likewise, the return on hydropower investments may change as a result of climate change and exhibit increased volatility.

Long-term investors in infrastructure projects, technology companies, municipal bonds and other asset classes need to broaden their due diligence and valuation criteria to include the long-term effects of climate change, such as the growing incidence of extreme events. The physical impact of climate change may affect the profitability of entire industries and asset classes. It will also change the performance of individual companies and projects relative to their peers.

Government-led adaptation measures and regulatory changes remain in their infancy, but are becoming an increasingly important consideration for many long-term investments. For example, building standards and land-use regulation (for example, for flood plains) are being tightened across Europe and elsewhere. Similarly water pricing is likely to undergo major changes in industrialised and emerging markets alike. Long-term investors must consider such long-term policy changes in their appraisal of investment opportunities and portfolio management.

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[9] See IPCC (2007) and Stern (2006).
[10] See Höppe and Grimm (2008).

The emerging regulatory framework for climate change mitigation

Reducing global per capita emissions of greenhouse gases to $2tCO_2e$ by 2050 requires a legally binding international framework to pre-empt free-riding and to take low-carbon technologies to scale. Moreover, the unequal distribution of greenhouse gas emissions and their impact around the world demand burden-sharing mechanisms to support the poorer countries.

Alas, international cooperation is difficult and possibly even more so when 194 countries need to agree on one legally binding text to be ratified in every country. As a result, investors face tremendous uncertainty regarding the evolution of international, regional and national climate regulation. They must understand the ramifications of national bottom-up approaches and track the evolving top-down international policy framework.

The international climate framework

The international policy framework for regulating climate change goes back to The Earth Summit[11] held in Rio de Janeiro in 1992, which established the United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol adopted in 1997 and ratified by virtually all countries, except for the US, has set the first legally binding emission reduction targets. It divides the world into rich countries (called Annex I countries) and non-Annex I developing countries; only the former take on binding emission reductions.

Under the Kyoto Protocol developed countries have established monitoring systems and national climate registries. The protocol has also established the Clean Development Mechanism (CDM) under which project owners in developing countries can certify greenhouse gas emission reductions and sell the resulting carbon credits to developed countries, chiefly the European Union. In spite of the mechanism's complexity it has exceeded expectations by registering some 3500 projects, avoiding over 800 million tCO_2e in greenhouse gas emissions, and mobilising several billion dollars in financing for emission reduction projects.[12]

The CDM has established a small new industry comprising technical and financial expertise to certify, monitor and monetise emission reductions in developing countries, which can form the foundation for more ambitious international carbon markets. CDM revenues have become an important revenue stream for renewable energy, energy efficiency and methane-reduction projects in developing countries. While the CDM has become increasingly efficient at generating emission reductions, its future is uncertain since the supply of credits outstrips the demand from the EU-ETS and other smaller markets. As a result, prices for CDM credits have come under heavy pressure since mid-2011 and are unlikely to recover in the short term (see Figure 2.2).

Yet, in spite of the Kyoto Protocol, global greenhouse gas emissions have been increasing at faster rates than ever – largely due to rising emissions in China and

[11] Formally known as the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil, June 3–14, 1992.

[12] See World Bank (2011).

other large emerging economies. In a series of international climate conferences many developed and developing countries have stepped forward with voluntary pledges to reduce greenhouse gas emissions. But the combined pledges amount to a mere 60 per cent of the emission reductions needed to achieve the two degrees Celsius target.[13]

During the 17th Conference of the Parties (COP17) to the United Nations Framework Convention on Climate Change (UNFCCC) in Durban, South Africa in late 2011, countries agreed to replace the Kyoto Protocol with a new international agreement that will include the US and major emerging countries. The new agreement is to be agreed by 2015 and will take effect in 2020. If countries follow through on this commitment then the world may see a workable framework for reducing global greenhouse gas emissions. Until then, though, greenhouse gas emissions are projected to rise rapidly and may put the two degrees Celsius target out of reach.[14]

The Durban conference also established the Green Climate Fund that is slated to receive a share of the $100 billion in climate finance that developed countries have pledged to mobilise annually by 2020. However, the US and other developed countries have refused to specify how they plan to raise their share of the $100 billion. Progress has also been made in tackling deforestation, but several questions need to be resolved before Reducing Emissions from Deforestation and Forest Degradation (REDD) may see the light of day at the 2012 climate conference in Qatar.

Overall, the multilateral negotiation process requiring 194 countries to agree unanimously on highly complex texts is slow and consistently fails to meet expectations of participants. Over the short-to-medium term, the ongoing UNFCCC negotiations will have limited direct relevance for investors, except those focusing on the Clean Development Mechanism or forestry carbon projects. Even if national bottom-up initiatives to reduce greenhouse gas emissions fall behind what is needed to stay within two degrees Celsius they will remain the principal regulatory mechanism for putting a price on carbon. So investors will need to assess the regulatory and policy environment for climate change separately in each country.

National responses

Governments around the world are implementing the full range of climate change policy instruments described above: cap-and-trade markets, carbon taxes, subsidies and incentive scheme, as well as command-and-control regulation.[15] Renewable energy feed-in tariffs are tracked by REN21 and Ernst & Young,[16] and several authors have reviewed available carbon/energy taxes.[17] A comprehensive review of current and upcoming emission trading systems has been prepared by the International Energy

[13] See UNEP (2011).
[14] See UNEP (2011).
[15] For a list of major national initiatives see Deutsche Bank (2011).
[16] See REN21(2011) and Ernst & Young (2011).
[17] See Sumners et al. (2009), PwC (2009), Vermont Law School (2008).

Agency.[18] Some of these policy initiatives are motivated by considerations other than the fight against climate change, such as improving local air quality or improving the terms of trade in fossil-fuel importing countries, but all affect emissions of greenhouse gas emissions and will likely be scaled up as the international response to climate change gathers pace.

Members of the European Union have been leading the fight against climate change, followed by some of the large emerging economies, such as China. Perhaps surprisingly, the industrialised countries with the highest per capita emissions – Australia, Canada, and the US – have trailed behind. Indeed, the implicit price on carbon in the electricity sector in China is reportedly 60 percent higher than in Australia, Japan or the US.[19]

European Union

The European Union sets climate change regulation for its 27 member states. It has committed to reduce greenhouse gas emissions by 20 percent through to 2020 (relative to 1990 levels) and to generate 20 percent of its electricity from renewable sources. A non-binding target to increase energy efficiency by 20 percent and to replace 10 percent of transport fuels with biofuels may become EU law in coming years. In 2011 the EU Commission unveiled its Roadmap 2050 outlining a long-term strategy to reduce greenhouse gas emissions by 80 to 95 percent through to 2050.[20] Similar visioning exercises are underway in many European countries, notably in the UK and Germany.

The main instruments to achieve the EU targets are the so-called Effort Sharing Decision, which breaks down the EU-wide targets to the national level, and the EU Emissions Trading Scheme (EU-ETS) launched in 2005. The EU-ETS currently covers 40 percent of EU-wide greenhouse gas emissions by setting a binding cap on the collective emissions of the 10,000 largest installations in the energy and industrial sectors. Under the EU-ETS regulated installations need to monitor their greenhouse gas emissions and surrender EU Emission Allowances (EUAs) to cover their annual reductions. Allowances can be purchased or sold on a liquid market for EUAs. Historically, installations have received allowances for free, but the Commission is shifting towards auctioning a larger share of EUAs starting with the third phase of the EU-ETS, which runs from 2013 to 2020.

Figure 2.2 depicts prices for carbon allowances as well as trading volumes. The EU-ETS has achieved substantial liquidity and is sending a clear though volatile price signal. Unfortunately, the EU-ETS has been plagued by several design flaws that have permitted the theft of allowances from national registries and large-scale VAT fraud, which led to high trading volumes in early 2009 and early 2010. These teething problems have now been largely fixed.

The 2008 financial crisis and the ensuing euro crisis have drastically lowered greenhouse gas emissions across Europe. As a result the EU is now well on track to achieving

[18] See Hood (2010).
[19] See Vivid Economics (2010).
[20] See ECF (2011).

its 20 per cent reduction target by 2020 without any additional effort. At the time of writing the EU-ETS is projected to be long in carbon allowances through to 2020, which has sent EUA and CER prices tumbling to record lows below €7 and €4, respectively, at the end of 2011 (see Figure 2.2). EU-ETS carbon prices are now much too low to stimulate the large-scale investments in clean energy, energy efficiency and other abatement technologies needed to achieve the two degrees Celsius (see Figure 2.1). For comparison, the Grantham Institute for Climate Change at Imperial College, London estimates that in order to achieve this target carbon prices will need to reach \$110–\$220/tCO_2e by 2030.

At the time of writing, the EU Commission is considering a number of measures to introduce a floor price in the EU-ETS or set aside emission allowances to make the overall system short. Given the strong political commitment to maintain an adequate carbon price signal that will stimulate investments in the emission reduction technologies, it seems likely that measures will be taken to return the EUA price to levels seen during the first half of 2008.

An important feature of the EU-ETS is its link to the so-called Kyoto flexible mechanisms, notably the Clean Development Mechanism (CDM) and Joint Implementation (JI). Installations covered by the EU-ETS are allowed to surrender approximately 10 percent of their allowances in the form of CDM or JI credits. As a result the prices for these credits track the EUA price closely including a spread reflecting the reduced liquidity of the former two. In this way the EU-ETS has established the first global carbon price that facilitates investments in emission-reduction projects across developing countries.

However, the EU Commission is scaling back the use of Kyoto credits. CDM projects registered after 2012 will only be eligible in the EU-ETS if they are located in a Least Developed Country (LDC). The Commission's position is driven by the need to phase out offsets over time since per capita greenhouse gas emissions need to fall drastically in industrialised as well as emerging markets. In the absence of other demand centres for CDM credits, the mechanism will become a niche market for the poorest countries. As a result it will play a minor role for most mainstream investors and asset classes.

Sectors not covered by the EU-ETS are subject to national legislation, as is the achievement of the 20 per cent renewable energy target. Perhaps most importantly, renewable energy feed-in tariffs have been adopted by virtually all EU member states. As illustrated by experience in the German, Spanish and other markets, feed-in tariffs can be very effective in mobilising large volumes of private investment in renewable energy projects.

On balance, while the EU has succeeded in establishing a price on greenhouse gas emissions, two major challenges stand out for investors. First, with the notable exception of some renewable feed-in tariffs and subsidy schemes for energy efficiency, current carbon price levels are too volatile and too low to attract substantial new investments in low-carbon technologies. This situation would change if the EU tightened its emission-reduction target to -25 or even -30 percent, but this seems unlikely until the euro crisis has been resolved. Second, the EU has yet to commit itself to binding emission reduction targets beyond 2020. The political will exists today to tighten emission caps further, but long-term investors that rely on a post-2020 carbon price cannot base their investment decisions on any policy commitments that are remotely bankable.

US and Canada

The US has so far failed to enact a binding national target for reducing greenhouse gas emissions. President Obama promised a 17 percent reduction in national emissions by 2020 relative to 2005 (corresponding to merely 3 percent below 1990 levels), but this target has not been adopted by US Congress. With mainstream politicians and media questioning climate science it seems unlikely that the US Senate will pass federal climate legislation any time soon. Efforts by the US Environmental Protection Agency to regulate greenhouse gas emissions are unlikely to succeed in the face of stiff political opposition.

The most important federal policies for reducing greenhouse gas emissions are a target to produce 36 billion gallons of ethanol by 2020 (the Energy Independence and Security Act of 2007); a tightening of mileage standards for passenger cars; and a renewable energy target of 12 to 15 percent by 2020. Overall, these policies remain substantially less ambitious than in the EU, Japan and indeed major emerging markets, such as China.

In the face of relative inaction in Washington, several US states in the North East and on the West Coast are adopting more stringent measures. The most important initiative is the Western Climate Initiative (WCI), a cap-and-trade system comprising California and four Canadian provinces (British Columbia, Manitoba, Ontario and Quebec). Members of the WCI aim to reduce emissions by 15 per cent between 2005 and 2020. Since January 1, 2012 emissions from electricity generation and large point sources are covered. In a second phase, starting in 2015, the WCI will expand to cover all emissions from transport as well as commercial, industrial, residential fuel use.

Similarly but with less ambition, the Regional Greenhouse Gas Initiative (RGGI) in the US puts a cap on power plant emissions at 2009 levels and targets a reduction by 10 percent by 2018 in several states in the North East. The system has been operational since 2008, but prices have languished far below European levels.

Canada will not meet its Kyoto target of 6 percent below 1990 by 2012. In December 2011 the country stunned the world by repudiating the commitments it had ratified as part of the Kyoto Protocol. Therefore, the country's remaining target is equivalent to a 3 percent increase by 2020 relative to 1990 levels.

Australia and New Zealand

In spite of its very high per capita emissions of greenhouse gases, Australia has been lagging behind other developed countries in adopting clean energy policies and in introducing a price on carbon. To date the country has merely pledged to stabilise greenhouse gas emission at 13 percent above 1990 levels (excluding the effects of land use change). In November 2011 the country introduced a carbon tax of A$23 per ton of CO_2 starting in early 2013. In 2015 this tax is scheduled to be replaced by an economy-wide cap-and-trade system. Moreover, Australia has adopted the Renewable Energy Target Scheme aiming for 20 percent renewable energy production by 2020.

Established in 2008, the New Zealand ETS is the second national compliance carbon market to become operational after the EU-ETS. Notably, the market admits offsets from land-use change as well as CDM credits for compliance use. The country has pledged to reduce 2020 emissions by 10–20 percent relative to 1990.

Japan

Several governments have reiterated the country's aggressive target to reduce greenhouse gas emissions by 25 percent relative to 1990 – provided that other industrialised countries undertake similar cuts. Given the existing high level of energy efficiency across the country and large share of nuclear power in electricity generation this target requires deep cuts. Japan has been running a voluntary emission trading scheme, but with limited impact on greenhouse gas emissions to date. The national emissions trading scheme that was intended to be operational by 2013 has yet to be passed by the parliament. Yet, following the Fukushima disaster in early 2011 these plans appear effectively on hold. Beyond the drive to increase energy efficiency – in parts to compensate for the reduction in nuclear generation capacity – the country is unlikely to generate a strong carbon price in the near future.

China

China is becoming a leader in implementing policies to reduce greenhouse gas emissions without announcing them formally in international forums. For the past few years China has ranked first in renewable energy attractiveness indices, led the world in renewable energy investments and its implicit carbon price in the power sector is higher than in many developed countries. China is also the only major emerging economy to have increased net forest coverage through a massive reforestation plan.

For its China 12th Five-Year Plan (2011–15) China has identified energy efficiency, renewable energy, and the establishment of domestic emissions trading systems as key priorities. In fact, through its National Renewable Portfolio Standards the country is on course to achieve its target of 15 percent of power generation from renewable sources by 2020. If China follows through on its plans to set up domestic emission trading systems the country may host the world's largest carbon market by 2020.

Other emerging markets

Most other emerging countries are considering national policies to reduce greenhouse gas emissions. South Korea has pledged to reduce its emissions to 4 percent below its 2005 reference level by 2020, having adopted an economy-wide emission trading scheme, which is planned to help achieve these targets. By 2020 Brazil has pledged to lower its emissions by over 36 percent relative to a business-as-usual scenario – largely through reducing emissions from deforestation and expanding renewable energy as well as biofuels. Like Brazil, Mexico has made its -30 percent reduction target through to 2020 conditional on receiving adequate external financing. Meanwhile, India has opted for an energy-intensity target, pledging to reduce greenhouse gas emissions per unit of GDP by 20–25 percent through to 2020.

Perhaps the most important development across emerging countries has been the massive extension of feed-in tariffs for renewable power generation. Today virtually every emerging market has put in place feed-in tariffs for renewable energy and independent power producers are mushrooming.

Conclusion: What does climate change regulation imply for investors?

In the short-to-medium term (three to five years) climate change regulation is unlikely to substantially alter the cash-flow profile of investments. It is indeed very unlikely that during this period a global carbon price will be established, but local and regional climate change regulation will accelerate. On current trends the EU, China, and some smaller Asian countries will lead the low-carbon transformation. These countries will over time apply a higher implied price on greenhouse gas emissions, thus generating greater investment opportunities in low-carbon technologies, but also imposing the highest penalties on carbon-intensive industries.

The fact that commitments to reduce greenhouse gas emissions are not bankable will continue to be a central challenge for investors. Just like the next phase of the EU-ETS runs only through to 2020, most climate change regulation covers comparatively short time periods, which makes it difficult to structure long-term investments on the back of implied price signals. The one exception to this rule is the renewable energy feed-in tariffs that have generated substantial investment flows, particularly in China, Europe and the US.

In essence climate change regulation is politics in disguise, which means investors need to engage closely with climate policymakers in order to understand the long-term risks for their investments. Given the complexity of regulating global greenhouse gas emissions policies will be less predictable and will be more short-term-focused than optimal. Investors need to familiarise themselves with political processes in order to gauge the bankability of specific climate change regulation.

Another important caveat for investors is that historic trends are a poor indicator of the future since they cannot predict the impact of climate change and of climate change regulation on financial assets. Climate change regulation may be associated with drastic changes in the equity risk premium and other financial indicators. Likewise, the physical and economic implications of climate change and their timing are highly uncertain, making it very difficult to assign probabilities with acceptably high confidence to such events. Traditional quantitative approaches to portfolio management will therefore be of limited use and must be complemented by more qualitative approaches.

Finally, climate change introduces systemic risks across asset classes. In response investors need to think in terms of diversifying across sources of risk instead of just asset classes. For example, investors may hedge their exposure to climate change regulation by increasing the allocation towards sustainable assets – regardless of asset class. □

Summary findings:

- Climate change policy does not yet currently provide sufficient impetus to establish a global carbon price
- Europe and China lead the low-carbon transformation
- Investors targeting the space need to understand and follow the politics around climate change regulation in order to gauge the bankability of specific regulations

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3 International climate finance and clean-energy investing

By Dr Aled Jones, Global Sustainability Institute, Anglia Ruskin University

This chapter discusses:

- The current status of the policy situation and relevance for the investment community
- Challenges faced by venture capital, private equity, public equity and infrastructure investing
- Possible new ways for public private partnerships to develop solutions to climate change

Introduction

Climate change will challenge every aspect of investment decision-making over the next few years. The scale of change now dictated by international government agreements and national government legislation is akin to an industrial revolution but one that occurs over a much shorter timescale. However, clean-energy investing is still in its infancy and needs a radical increased effort.

This chapter explores the current state of play in policy and the investment communities. It highlights some of the challenges faced in venture capital, private equity, public equity and infrastructure investing and in the provision of debt. It also outlines some new thinking on the need for public private partnerships to develop new markets and to start the process of deploying solutions to climate change at scale. All of these types of investments are required and a thorough understanding of the real risks and uncertainties inherent in these transactions is the only way to ensure a market is developed at the scale that is required within the time that is needed to tackle the climate change challenge.

The United Nations and global expectations

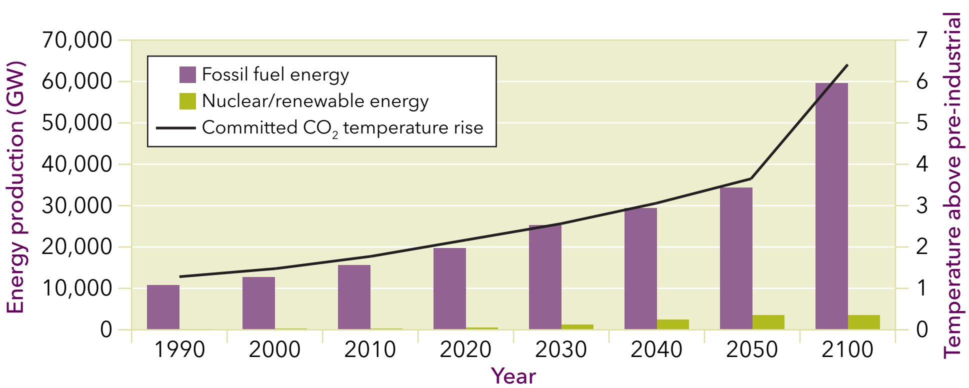
The Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (2007) noted that 'warming of the climate system is unequivocal, as is now evidenced from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level'. Given the current level of certainty over the fundamental science, climate change as a scientific discipline is now focused on developing a better understanding of likely future scenarios and better perceiving the uncertainties that still remain in the detailed predictions of impacts.

However, the current risk from climate change has already brought together governments from around the world in an unprecedented process to try and agree limits to future emissions and mechanisms to enhance the capacity for all countries to respond to this challenge.

Climate change as a political issue has changed dramatically over the past few years to late 2011. Following the publication of the IPCC 4th Assessment Report the United Nations Framework Convention on Climate Change (UNFCCC) conference in Bali, Indonesia, in late 2007 galvanised a political process that was set to deliver a follow-up to the international legally binding framework that expires in 2012 – the Kyoto Protocol. The UNFCCC process involves 194 countries in detailed negotiations culminating each year in the Conference of the Parties (COP). However, a near failure in Copenhagen, Denmark, in late 2009 led to erosion in confidence in the political process, which was only partially restored at the Cancun, Mexico conference in late 2010 when governments finally agreed to a basis for a future framework. In late 2011 this was again supported at Durban, South Africa.

The Cancun agreement included a commitment to limit global temperatures to two degrees Celsius above pre-industrial levels to avoid 'dangerous' climate change. However, what does a temperature commitment at international level mean and how can it be translated back into hard targets for industry? To answer this requires an understanding of how emissions are accumulated in the atmosphere and how the resulting concentrations of green house gases then influence temperature. This is not a simple task and requires a probabilistic analysis of the scientific evidence and models as well as an understanding of how society will respond through policies and implementation. However, taking average predictions for future emissions growth with the implications for temperature increases shows that this two-degree target will be exceeded by the year 2020 under business as usual investments in energy (see Figure 3.1).

Figure 3.1: **Temperature-rise predictions from climate science models and projections for energy-production capacity from fossil fuel and clean energy under a business-as-usual model**



Source: IEA 2003.

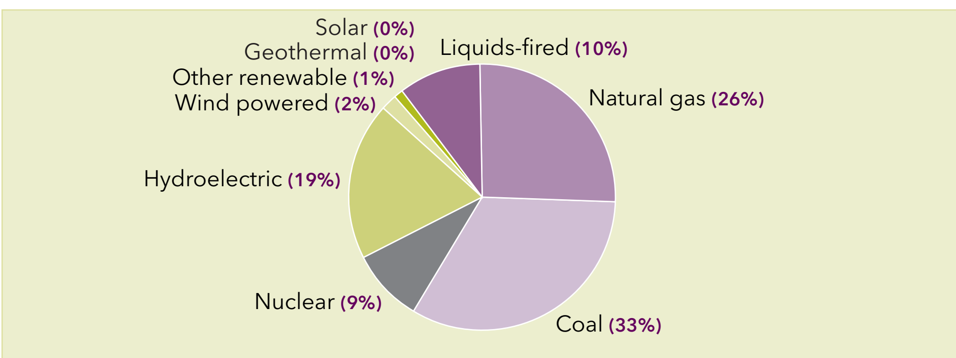
The International Energy Agency (2010) estimated that $270 trillion will be invested into energy supply and use under a business-as-usual scenario between 2007 and 2050. To avoid dangerous climate change (and meet the commitments made under the UNFCCC process) this increases by $46 trillion (17 percent) or approximately £1 trillion per annum. Over the past three years (2009–2011), annual investments in low-carbon energy technologies averaged approximately $165 billion. This necessitates a significant step-change in investments into clean technologies and solutions.

In parallel to this the global financial crisis had a significant impact on the investment market. Both the capital available (through institutional investors and sources of capital) and the ability of governments to create fiscal incentives to attract this capital has been reduced with severe constraints on public spending now in place in most developed countries. Governments did use stimulus package measures to invest significantly in climate change solutions although this will be short-lived. However, the scale of the challenge has not diminished and the commitments to emission reductions made by governments in Cancun remain ambitious and are likely to become more so as the political negotiations continue.

Allied to the challenge of scaling up investments into this space is the need for a global solution to the problem that creates a level playing field and encourages investments everywhere. The governments representing developed countries under the UNFCCC have committed to raise $100 billion a year by 2020 to invest in climate change solutions in developing and emerging markets. The Report of the (United Nations) Secretary-General's High-level Advisory Group on Climate Change Financing (UN AGF, November 5, 2010) outlined how this $100 billion could potentially be mobilised each year. However, creating the underlying investment opportunities and projects which would attract this scale of investment still remains an unknown challenge.

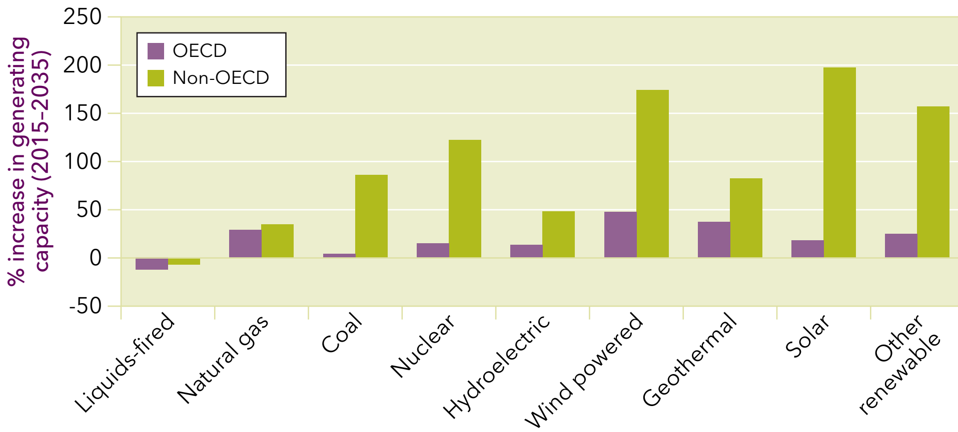
The scale of the challenge – and the inherent complexities – offers a huge opportunity for the investment community. Figure 3.2 shows the current global electricity generation

Figure 3.2: **2007 global electricity generation capacity**



Source: Derived from International Energy Outlook 2010, US Energy Information Administration.

Figure 3.3: **Projected percentage increase in generating capacity (2015–2035)**



Note: These projections were made before the nuclear incident in Japan in early 2011 and the impact of this on future energy generation technology choices remains uncertain.

Source: Derived from International Energy Outlook 2010, US Energy Information Administration.

capacity by source. To achieve the goals set out by the international community – a 50 percent reduction in global emissions by 2050 which translates to approximately 80–95 percent reductions in developed countries – requires a complete reversal of these shares of generation capacity or a massive deployment of technologies to capture carbon from fossil fuel sources.

This complete reversal in electricity generation and the investments that this requires should be seen as an investment into the low-carbon energy sector as opposed to a cost. Figure 3.3 shows the projected percentage increase in generating capacity by energy source between 2015 and 2035 in OECD and non-OECD countries. While these increases in capacity are significant if the world really decides to tackle climate change at an appropriate scale then we are likely to see much larger increases in clean energy over this period and so these estimates should be seen as a minimum. This opportunity for investment, alongside the projected increase in jobs and associated economic activity, has also been discussed as the world's best chance to exit from the current recession and to build a green growth economy that is more resilient in the future. This green growth economy will be implemented in different ways in different regions and countries. However, it is likely to include a rebalancing of taxes away from positives (such as jobs) and towards negatives (such as damage to the environment), better governance models to ensure that natural capital is managed as an asset in country and business balance sheets and proper measurement and verification of impacts.

The scale of the investment challenge now facing the global community in the clean energy space is vast. Even though it is possible to mobilise the necessary global investment as outlined by the UN AGF, the politics of how this will actually be done is still very uncertain. Developing countries expect the bulk of the investment into their climate solutions to come from developed country public sector sources while developed countries expect the majority of this investment to come from the private sector.

This political negotiation is unlikely to be resolved soon; however the problem is not going to go away.

The available capital required for this scale of investment is currently in the private sector and not the public sector. Despite strong pressure from developing country governments, in the absence of a major climate change related catastrophe resulting in a significant shift in attitudes towards developed country governments taxing individuals and businesses to raise the necessary capital, it will have to be the private sector that leads this global investment.

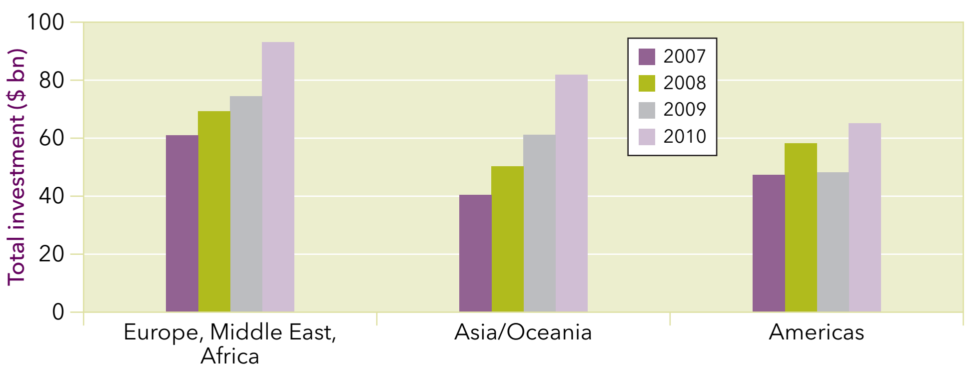
The rest of this chapter explores some of the potential investment opportunities in the clean energy space and outlines the current thinking about the best use of limited public sector funding to help achieve the scale of investment required globally.

Clean-energy investing

In 2010 global clean-energy investment reached $243 billion (World Economic Forum, April 2011 and Pew Charitable Trust, 2010). Infrastructure investing accounted for over half of this at $118 billion while venture capital and private equity investments totalled $8 billion, and investment in public equity amounted to $16 billion. The remainder was spent on research and development and other government spending. China attracted the most investment at $54 billion. The G20 countries accounted for over 90 percent of the total investment. Figure 3.4 shows the change in clean-energy investments around the world over the period 2007–2010. Apart from a decrease in the Americas in 2009, which was partly due to the global recession, investments in clean energy have increased each year.

Therefore, a good foundation exists, albeit a relatively low platform. Building up from this base, a large increase in equity investing in clean energy should be seen over the next decade. While the market has been slow to develop the solutions at scale the real challenges of clean-energy investing have not been tested. For example, it is important to note that in developing renewable and clean technology solutions the availability of

Figure 3.4: **Total investment in clean energy by region**



Source: World Economic Forum April 2011.

reasonably priced debt financing is critical to be able to achieve scale over time. The use of bonds to attract large investments of lower cost capital is thought to be a critical part to this and underpins future valuations (and the whole market) of clean-energy investments. The role of bonds and debt in general should not be forgotten in clean-energy investment strategies and a summary is therefore included here.

Parts of the investment market and policy community believe that there is plenty of capital available for clean-energy investing but there are no projects to invest in, while others believe there are plenty of projects but no capital. The difficulty in creating a clean-energy investment market is that both views are right. While capital is not flowing, projects are not developed and while projects are not being developed the investors do not inject the necessary capital.

To achieve what is required needs all parts of the investment community to act in unison – this is a large task. At one end it needs project developers to create projects at scale requiring venture capital, private equity and debt, and at the other end institutional investors need to move capital into appropriate vehicles requiring infrastructure and equity funds set up to anticipate a suite of investable projects.

Achieving this across the investment supply chain cannot be done just because 'it is the right thing to do' – it has to be driven by a vision and a clear mandate from policymakers that this is where the market is going as well as through more transparency of returns, which would allow real impact to be measured.

Cleantech venture capital

Investing in cleantech is no different from other venture capital investing. For venture capital investments returns of between 50 percent and 500 percent are expected with a typical investment period of four to seven years. Investments in venture capital have been impacted by the global recession although they have rebounded slightly. The US remains the world's largest market for venture capital in clean energy attracting $6 billion in 2010, followed by the UK with $367 million and China with $302 million (Pew Charitable Trust 2010).

A proxy for innovation (and therefore opportunities in venture capital) is patent filings. Lee, Iliev & Preston (2010) show that there was a steep increase in patents in wind and solar photovoltaic technologies from the mid-1990s followed by steep increases in carbon capture and storage and concentrated solar power from 2000 onwards. These rises coincide with the introduction of policies such as feed-in tariffs in various markets (the top-three wind patent holders are based in the US, Germany and Denmark, which all had generous feed-in tariffs around this period). According to Bloomberg New Energy Finance (2011) 59 percent of global wind capacity has been deployed in markets with a feed-in tariff.

The leading countries for patents are US, Germany, Japan, China, Denmark and South Korea, however a significant proportion of these patents are held by large multinationals. Clean energy venture capital is likely to remain dominated by investments in these

Table 3.1: **Top-five patent holders in wind, solar photovoltaics and carbon capture and storage**

Wind	Solar photovoltaic	Carbon capture and storage
Enercon **(612)** (Germany)	Sharp **(608)** (Japan)	ExxonMobil **(978)** (US)
General Electric **(525)** (US)	Canon **(561)** (Japan)	Shell **(414)** (Netherlands/UK)
Vestas Wind Systems **(316)** (Denmark)	Sanyo **(483)** (Japan)	UOP Inc **(223)** (US)
Mitsubishi **(239)** (Japan)	Asahi Glass **(478)** (Japan)	Air Products and Chemicals **(180)** (US)
LM Glasfiber **(171)** (Denmark)	Matsushita Electric **(359)** (Japan)	Texaco **(120)** (US)

Note: The number of patents held is in brackets and the countries in brackets denote where the companies are headquartered.
Source: Lee, Iliev & Preston (2010).

countries over the next decade or so. Table 3.1 shows the top-five patent holders across three different clean energy technologies.

There are a several successful clean technology and clean energy venture capital firms. California has been a focus for a significant proportion of global venture capital attracting $11.6 billion in clean-focused venture capital investment between 2006 and 2010 and accounting for 40 percent of global clean-focused venture capital in the first half of 2010 (Next 10, 2010). The venture capital industry in California was supported through the federal stimulus package which included a $1.8 billion investment in clean technology projects. In 2009 Khosla Ventures raised $1.1 billion in two venture capital funds focused on clean technology, including $260 million from CalPERS, the California Public Employees Retirement System.

The key challenge for venture capital investments is the ability to raise subsequent finance so that products can reach the market.

Private equity

Typical expectations for private equity investments remain at three-to-five-year investment horizons with a return of around 25 percent. Private equity investments in clean energy were significantly impacted by the global financial crisis as the availability of capital reduced and companies needed to divest of some equity positions to free up capital. However, even during this period there were some very large transactions in private equity-backed clean-energy investing.

For example, Better Place, the electricity infrastructure and battery car company, secured $350 million of new equity financing in early 2010 through an HSBC-led investor consortium, which valued Better Place at $1.25 billion – this is one of the largest clean technology equity investments made to date. Private equity is likely to be dominated by investments in developed countries and the BRICS countries (Brazil, Russia, India, China and South Africa). In addition, the opportunities for private equity deals involving larger organisations that have significant potential cost-savings from energy efficiency will rise. There is also likely to be a number of mergers and acquisitions in clean energy as markets mature and technologies are deployed.

While there are not many private equity deals at scale in the clean energy sector it is possible that valuations are too high. This could be creating a clean energy bubble and therefore future valuations and the ability to raise capital in this way may be at risk. In addition private equity deals are usually accompanied by debt financing which increase the costs of projects.

Public equity

There are many new 'green' indices that exist or are being launched on stock markets around the world and this trend does not seem to be slowing down. The performance of these funds remains variable and there is a perception that the global recession appears to have had a slightly larger impact on clean energy stocks although evidence for this is difficult to find. For example, the FTSE Environmental Opportunities All Share Index, which measures the performance of companies with significant environmental business, has shown good performance throughout the recession (see Table 3.2) although the S&P Global Clean Energy Index which tracks 30 companies has shown lower returns (-11.3 percent over a five-year period to April 2011).

Clean energy infrastructure

Infrastructure investment in general still remains a fairly new asset class for the majority of investors – the asset class features typical investments of seven to ten years and a 15 percent return expectation. Hydroelectricity is the largest infrastructure asset followed by wind power.

With a significant requirement for new clean energy at scale, the market for clean energy infrastructure is likely to see the largest growth of any asset class. As illustrated in

Table 3.2: **One-, three- and five-year returns on FTSE Environmental Opportunities All-Share Index compared with FTSE Global All Cap Index**

	One year return (%)	Three-year return (%)	Five-year return (%)
FTSE Environmental Opportunities All-Share Index	15.1	-22.4	41.0
FTSE Global All Cap Index	13.6	-26.2	11.5

Source: FTSE, 2010.

Figure 3.1 this level of investment needs to take place before 2020, but given the long lifetime of most energy assets leaving investment decisions until 2020 may be too late. As the political negotiations progress there is an expectation that the use of public sector finance and regulation to stimulate clean energy infrastructure investing will form a major part of the discussions.

For example, Asia Development Bank and partners are aiming to launch a clean infrastructure fund called the Climate Public Private Partnership (CP3), which will attempt to attract private sector infrastructure investing alongside risk management mechanisms offered by the public sector to stimulate a new market in clean infrastructure (including energy, road, rail and water) across Asia (Brown & Jacobs, 2011). The European Investment Bank has set a 20 percent target for its overall lending each year into clean projects (in 2010 the figure was actually €21 billion, which accounted for 29 percent of its total lending). The UK is about to set up a Green Investment Bank to help stimulate the market for clean infrastructure investing. Further developments of infrastructure funds, both private sector- and public sector-led, are expected over the next few years and this will be seen in both developed and developing countries.

Green bonds

To achieve the trillions of dollars in investment required over the next few decades green bonds will become an increasingly important part of the investment landscape. However, green bonds will only be purchased if they are competitive with existing bonds – offering similar terms, ratings and returns. A typical bond will expect to mature over a three-to-30-year period and, on average, have a return of between 2 percent and 5 percent.

There are several types of bonds which can be issued – providing a diversification of risk exposure and return to match asset allocation criteria. For example, the Climate Bonds Initiative (December 2009) highlights the following types of bonds:

- *Index-linking bonds to inflation rates or carbon prices.* Issued with a low base rate of interest, but have bonus payments if carbon prices reach certain higher levels.
- *Zero-coupon bonds.* These are most suitable when new technology needs to be developed, embryonic technology needs to be scaled up, or existing technology has to be invested in high-risk countries.
- *Convertible bonds.* These allow investors to convert their bonds to equity stakes in an entity at agreed points in the development.
- *Islamic bonds – Shari'ah-compliant bonds.* These have no interest payable (payments would be in other modes, such as fixed periodic payments, equivalent to a lease).
- *Regulated covered bonds.* In this proposal, guaranteed revenue streams generated by energy-generation projects that qualify for renewable energy feed-in tariffs are used as collateral.

Green bonds have proven to be popular in recent years and several organisations have raised significant capital in this way. In particular the multilateral development banks have led the way in green bond development. Since 2008 the World Bank has issued over $2 billion in green bonds in 15 different currencies. The first US dollar-denominated issue was in April 2009 and the total purchased was $300 million by the State of California Treasury (this was a three-year bond). The European Bank for Reconstruction and Development has issued over $40 million worth of bonds in the Japanese retail market and the International Finance Corporation (IFC) has issued $135 million. In addition, there have been a few commercial issuances such as Irish renewable energy company Airtricity's three-year bond in 2006 which raised $300 million for wind projects in Europe and the US. Also, Norway-headquartered REC Group's five-year bond in 2009 raised over $200 million for solar projects (for a list of climate-related bonds that have been issued see: http://climatebonds.net/resources/bonds-issued/).

Partnering for success

There are many challenges in creating new investment opportunities for clean energy, which is particularly true in emerging and developing countries. UNEP & Partners (2009) identified five different types of risk in private sector engagement in clean-energy investing. Two of these risks are general risks while investing globally:

- *Country risk:* Possibility of defaults or other factors leading to non-return on invested capital.
- *Currency risk:* Exchange rate fluctuations making returns volatile.

While the other three risks are more directly related to clean energy, they also exist in other sectors:

- *Low-carbon policy risk:* Possibility of changes to low-carbon policy resulting in lower valuations from invested assets.
- *Deal-flow problems:* Insufficient number of commercially attractive deals.
- *Difficultly evaluating multiple, overlapping risks:* Limited amount of time for investment decisions makes investing in new technologies and sectors less likely than business as usual investments.

While the UNEP & Partners analysis was limited to emerging and developing economies, these five risks are also true in any international investment strategy including developed countries.

The use of public finance mechanisms (PFM) to manage some of these risks has been proposed as a critical factor to allow capital to start flowing at scale across all asset classes. Several structures for PFMs have been proposed to manage some of these risks. A number of these risks have little if anything to do with climate change, including, for example, country or currency risk. There are already existing insurance mechanisms that can be used for these types of risks and in some cases all that is needed is to make these mechanisms better known. However, if investments are needed in countries that do not usually attract any sort of investment at the scale that is required then public subsidy and public sector-led investment opportunities to make these types of risk management mechanisms and guarantees available at little or no cost to the private sector investors is required.

Clean energy-specific risk management is required for low-carbon policy risk, deal-flow problems and to stimulate the market in the first instance (to overcome the reluctance of investors to enter a complex market). Low-carbon policy risk has become even more important following retrospective changes to feed-in-tariff regimes in European countries such as Spain. There is now a significant mistrust in policy-led investment decisions in developed countries, never mind developing countries. This type of risk management needs to be offered through a combination of public sector vehicles (limited guarantees on feed-in tariffs for example) as well as through innovative new insurance products from the private sector.

There is a number of proposed solutions to these risks involving offering some form of policy guarantees backed by the public sector, creating publicly funded bodies responsible for early-stage clean energy project development (linked to or run by private sector expertise to ensure projects are structured in such a way that they can attract private sector capital as soon as possible) and public sector investments into private equity or infrastructure funds with either first-loss equity positions or concessionary positions to lower the risks or increase the returns in the funds.

The use of public sector finance and expertise in such a way is central to the current negotiation process underway within the UNFCCC. Several funds are being set up over the next few years that will attempt to address some of these issues, which are likely to feature the concept of leveraging private sector capital as a core part of their mandates. In addition, several countries are separately looking at these types of investments while many have already been set up.

Among the developed economies, the UK's Green Investment Bank is an example of a specific vehicle designed to encourage and leverage other investment into this space. However, there still remains significant uncertainty in the market about the level of government commitment required to achieve the scale of deployment ultimately required under the UNFCCC process. Despite commitments from all major UK political parties to policies such as the UK Climate Change Bill a sharp decline in investments in clean energy was recorded in 2010 (Pew Charitable Trust 2010) following uncertainty in a new government approach to policy. These changes and the lack of long-term certainty in the market, however, make continued investment and achieving the appropriate scale of deployment difficult.

In addition to the risks outlined above there are other risks which need to be accounted for when developing clean energy opportunities, including physical and technology risk. Physical risks stem from climate change itself: changes to expected rain fall and water availability, as well as rising sea levels, will potentially have a significant impact on investments in the energy space. For example, Ceres (2010) shows that several US utilities have a large exposure to potential water shortages which could impact on their valuations and their ability to service long-term bonds.

Understanding the full extent of changing physical risks to infrastructure investments in particular is important.

Technology risks are those that are usually faced by venture capital investors. These risks are therefore not particular to the clean energy sector. However, as the scale of the deployment of new technologies and the timescales in which this is desired are comparatively short, managing these risks appropriately and pricing these risks is key.

Mercer's 2011 *Climate Change Scenarios – Implications for Strategic Asset Allocation* report examined the impacts of climate change on institutional investors and found that climate change could contribute up to 10 percent to portfolio risk over the next 20 years as well as offering huge investment opportunities at the same time.

Achieving the required scale

Even with all of the risks and risk management tools put in place clean-energy investing would struggle to achieve the required scale. The critical factor to unlock the real potential in this sector will be through appropriate public policy. A number of public policy tools exist that can drive capital into the clean energy space. The use of clean energy targets and mandates for certain generating capacity from renewables, such as the European Union's 20 percent of final energy from renewable sources, create a market demand for such technologies. Feed-in tariffs have demonstrably attracted significant investment into clean energy (Pew Charitable Trust 2010) although certain retrospective changes to feed-in tariffs have also helped to undermine investor confidence in this sector. Germany, for example, with a generous feed-in tariff accounted for 45 percent of total investment in the G20 for solar, with 83 percent of its total investments directed towards small-scale projects. Conversely, investment into Spanish clean energy projects fell by 54 percent in 2010 due to announced changes to the country's feed-in tariff. Therefore, appropriate and long-term public policy is a fundamental requirement for the clean energy sector.

In addition, while the vast majority of clean-energy investments over the next decade or so will be made into existing technologies that need to be deployed at scale, a need still exists for investment into research and development. In 2010 the total public and private investment into clean energy research and development in the G20 totalled $35 billion (Pew Charitable Trust 2010). However, if a future market of $1 trillion a year is required then this figure seems quite low.

Of course an important issue that should not be overlooked when envisaging a scale of change this large is the need for experienced investors and educated trustees. To be able to manage these risks and opportunities requires a significant investment in people – all the way from the project development to money management sides of the investment chain. At present it is likely that investors and financiers would be unable to develop the solutions at scale due to a lack of available expertise in this sector.

One final issue to consider is the availability of capital. While there is currently a relatively small deal flow the potential availability of capital is deemed to vastly exceed what is needed and therefore there is a sense of 'build it and they will come'. However, in the wake of the recent financial crisis, as well as limits to certain asset classes and internal investment structures, a dialogue is needed between the capital owners, project developers and policymakers to ensure that capital is indeed available when required. In particular there is some concern (see for example Helman le Pas de Sécheval, 2009) that Solvency II requirements may deter institutional investors in the insurance sector from certain long-term investments. How this will impact clean energy infrastructure investing remains unclear.

If these issues can be solved then institutional investors will need to develop strategies that respond to this challenge at the scale that is required. Therefore, integrating these risks and opportunities into investment decisions at each level of the organisation from trustees to investment managers is critical and strategies for doing this should be being implemented now.

Conclusions

The scale of investment in clean energy required over the next few decades requires a fundamental shift in the market. With estimated additional investments of $1 trillion required each year to tackle climate change, roughly equivalent to Brazil's entire gross domestic product (GDP) in 2006, resulting in total investments of approximately $7 trillion a year in energy infrastructure and equity, roughly equivalent to the combined 2006 GDP of the UK, Germany and France the scale of the change should not be underestimated (Goldman Sachs, 2007).

As many commentators have indicated the level of technological deployment that is envisaged resembles a new industrial revolution – this time a managed and quicker industrial revolution. All types of investment vehicle are required and all types of technology will require investment. However, the complexity of structuring deals and attracting the right investments at the right time at the right scale is still a big challenge. There will be many opportunities for investments and many places where new models of public private partnerships to develop new markets and to kick-start certain technology deployments are needed. There will be pressure to find qualified investors that understand the complex issues associated with climate investments and there is certainly a shortage of companies that have a track record of investing in this sector. In addition, managing investment portfolios and developing new allocation strategies need a new input of skills given the challenge of a radically different investment portfolio and increasing pressure for better and more transparent risk management around allocation decisions (Mercer 2011).

Encouraging private investors into clean-energy investing will attract a significant amount of government focus over the next few years. Deriving the most appropriate use of short-term public sector finance and long-term regulation is vital to build confidence in the market. With a deployment of capital at the necessary scale, and a strong partnership between the private sector and government, by mid-century clean-energy investing will just be called energy investing. □

Summary findings:

- Current climate targets command a limit of global temperature increase of 2° C above pre-industrial levels. The International Energy Agency has estimated a requirement of $46 trillion or approximately $1 trillion per annum until 2050 to achieve this
- Global debate currently revolves around how public and private investors can work together to achieve this goal
- Private investing is well positioned to profit from the opportunity, but careful risk monitoring is required. Those risks involve technology and investment risks but also physical risks such as rainfall, water availability and rising sea levels
- A new public private partnership is required to substantially increase momentum in the clean-energy investment space, where governments are stepping up policy to provide for a more stable and transparent policy framework for investments in the space

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4 Promoting investment in Asia's clean energy market

As energy demand continues to soar across the Asia Pacific region there is a critical need for more investment in the clean energy industry.* Private Equity International *talks to Bindu N. Lohani, Johanna Klein and Anil Terway of the Asian Development Bank to learn how the bank is playing a critical role in stimulating institutional investor interest

PEI: How does promoting the concept of and investing in clean energy, both directly and indirectly through funds, figure in Asian Development Bank's overall development strategy in Asia and the bank's overall investment strategy?

ADB: Asia, with its rapidly growing demand for energy, needs to pay greater attention to lowering carbon emissions if the world is to avoid an excessive temperature increase. Under the Asian Development Bank (ADB) long-term strategic framework – Strategy 2020 – and its 2009 Energy Policy, ADB is increasing its investments in clean energy, including renewable energy, energy efficiency and switching to cleaner fuels. Of course, ADB's direct investments are very small compared with the billions of dollars needed to build new energy supplies as power demand surges, economic growth continues and lowering carbon emissions becomes more urgent. Our strategy therefore is to partner with funds that can catalyse even more resources, and more importantly, can establish new and improved investment models to secure clean-energy investments. As such, the demonstration effect of ADB's clean energy activities has a much higher value than its direct and indirect investments.

PEI: What do fund managers need to focus on in their investment strategies to increase commitments from the existing, very low level of institutional investor allocations to clean energy?

ADB: In general, fund managers need to do one thing – prove that returns can be made in the clean energy private equity space. Institutional investors invest according to asset allocations that balance risk and return, and will only channel larger amounts of money into the clean energy asset class when they are convinced that consistent returns can be made. This means that it is very important for these early generations of private equity funds to demonstrate to the market that returns are indeed possible, and that profitable exits can be achieved.

PEI: How can investment managers in Asia, in particular, increase the region's share of cleantech/clean-energy fund investments?

ADB: Basically, commercial investors are attracted to returns and will invest within a set asset allocation framework. When they see that consistent, risk-adjusted returns can be made in Asia, they will be more inclined to invest more in the region.

Contents Previous view

PEI: Is ADB's objective devised to encourage commitments to more funds focused on investing in clean energy technologies, companies and project by becoming a cornerstone investor in funds? Is there data to back up this strategy?

ADB: Yes, ADB has served as an early or cornerstone investor in multiple clean-energy funds. It is the appropriate role of a development bank to invest in emerging asset classes early on, when they still need help attracting capital. We demonstrate to the market that returns can be made, such that commercial investors will be keen to invest in later generations of those funds or funds like them. In short, we 'crowd in' the private sector. This was exactly what happened with the China Environment Fund series, run by Tsing Capital. ADB invested in Tsing Capital's first fund in 2002 with only one other investor. By the next fund, other development finance institutions (DFI) were interested in investing, and by the third fund, the private sector was investing as well, because the fund manager had shown that they could do deals and exit from deals.

PEI: Does ADB consider co-investments and direct investment in clean energy to be potentially appealing or does the Asian region need to solidify its funds-based approach first?

ADB: We do both. ADB's private sector group invests in clean-energy funds through its Capital Markets Division and directly – and extensively – into clean energy projects through its Infrastructure divisions.

PEI: How will commitments to cleantech/clean-energy funds be best satisfied in Asia – will allocations to such funds come from intra-regional investors (or international investors)? And are there specific types of investors (including pensions, sovereign wealth funds and insurance companies) more likely to allocate to clean energy in Asia?

ADB: It is likely that most types of institutional investors will probably commit to clean-energy funds in the region. Currently, the way is being paved by DFIs and by strategic investors that want 'eyes on the ground' vis-a-vis clean technologies in Asia, which fund managers can provide, as well as some funds of funds that are specifically set up to invest in the clean-energy funds. Over time, however, more and more institutional investors will allocate capital to clean energy globally as a hedge against the risks of climate change, and part of that money will increasingly be directed towards Asia.

PEI: How much has ADB invested in cleantech and clean-energy funds, companies and projects? Has ADB seen specific returns on this data?

ADB: Over the eight-period year from 2003 to 2010, ADB's investments in clean energy totalled $7.4 billion, supporting $16.9 billion worth of total projects. Starting in 2008, ADB set an annual target of lending $1 billion for clean energy and during the period between 2008 and 2010 we averaged $1.6 billion a year and reached $2.13 billion in 2011, well above the target. With significant donor support, ADB was able to aggressively pursue and create new opportunities for clean-energy investments, thereby consistently exceeding the target. Given that ADB's developing member countries

Table 4.1: **ADB clean-energy investments, 2003–2010**

Year	Approved investments* ($ millions)	Clean energy ($ millions)
2003	1,263	226
2004	1,356	306
2005	1,805	757
2006	1,612	657
2007	1,801	668
2008	3,023	1,753
2009	2,688	1,313
2010	3,388	1,756
Total	**16,936**	**7,436**

* Total approved investments that have clean energy components.
Available: http://www.adb.org/sectors/energy/main

will likely agree to a post-Kyoto action plan for monitoring and lowering their carbon intensity, ADB has increased its annual lending target to $2 billion starting in 2013.

Of the investments in clean energy, from 2003 to 2011, ADB has invested $260 million in six private equity funds for clean energy. Unfortunately, at this time, the actual returns to these funds are not available.

PEI: What is the outlook for ADB's participation in public private partnership funds? Is there a move towards greater participation in clean energy infrastructure funds?

ADB: The investment needs for clean energy in Asia are very large and there is a real urgency to address climate change. While we implement demonstration projects, help increase the absorptive capacities of Asian enterprises and help establish a suitable investment climate in developing member countries, we also have to work to unlock the fund flow from the trillions of dollars held by institutional investors, including pension funds and private equity funds. The key is going to be stripping the risk associated with clean energy projects using public funds, which is a challenge, and ADB is working on various project concepts in this regard. For example, public and donor funds can be used to establish guarantee facilities that will address the off-take risks of weaker utilities in developing countries; carry out initial project preparatory activities like renewable energy (geothermal, solar and wind) resource assessments, laying approach roads and constructing required transmission facilities for evacuating power; and providing direct subsidy when the project proposal is economically sound but the financial returns are marginally lower (adder tariff and feed-in tariff programmes).

PEI: How does ADB assess the various investment stages in clean energy – that is, venture capital, private equity-backed growth companies and infrastructure? In terms of risk-reward assessment, is there a specific investment stage that proves to be a preferred investment for ADB?

ADB: ADB's process for assessing a fund investment is consistent across all investment stages, focusing on understanding (1) the fund's strategy and how it is placed in the markets it operates in; (2) the team members and their backgrounds; (3) pipeline and capacity for deal origination; (4) track record and performance of previous deals or funds; and (5) the processes by which the fund manager does deals, adds value, exits deals and engages with investors vis-a-vis reporting and administration. ADB has invested in all three types of funds – venture capital, private equity and infrastructure – in the clean energy space, although we have invested the most in private equity funds. Venture capital in this area carries a high degree of risk, which ADB is only beginning to take on.

PEI: As a development bank, does ABD invest as a fully commercial investor or are concessions made by the bank to help stimulate investments in clean energy?

ADB: ADB's private sector department invests as a fully commercial investor, but is willing to undertake projects that more typical commercial investors might not, for example, providing financing at longer tenors for infrastructure projects, providing financing in local currency, or working in markets where clean energy is still nascent. We always aim to make commercial returns, but we do that while keeping our developmental mandate firmly in mind. For example, we were one of the earliest investors in the China Environment Funds, which was one of the first clean-energy funds in China.

PEI: Are there regulatory hurdles in Asia for investors in clean energy? Are there incentives for those investors?

ADB: Yes. In many countries, regulatory, tax, and tariff structures are not yet stable, which presents burdens for funds investing in, for example, the power generation space. That said, there are countries such as the People's Republic of China which are providing numerous incentives for clean-energy investment, and in those countries, one can see the industry beginning to emerge in a major way.

PEI: What is the outlook for stimulating greater awareness of the clean-energy investing market in Asia? What can ADB, institutional investors and governments do to ensure suitable levels of institutional investment are invested in clean energy?

ADB: The best thing that ADB can do to attract institutional investment to the clean-energy funds in the region is to get into the sector early and try to pick among the best managers in the market and demonstrate to the private sector that returns can be made. That is what will attract additional interest in the space. Governments also have a critical role in crafting a regulatory, tax and tariff environment that is conducive to clean-energy investment and that appears to international investors as stable and transparent. All governments are struggling with this challenge right now, both in the developing world and in OECD countries, such as Spain. Investors need stable, clear rules in order to take risks in new markets and sectors.

ADB is committed to attracting investment into the clean energy private equity space in emerging Asia. Key to this goal is picking the best fund managers in the market, with strategies that make sense for their markets, experience in delivering value to portfolio companies and projects, and networks in the region that will provide them with consistent, quality deal flow. This plays out in different ways for different types of funds. For venture capital, returns could be driven by choice of technology and success in deployment. For private equity, returns would be driven by value creation in investee companies. For clean energy infrastructure funds, returns would be driven by getting projects build on time and to budget. Across all deal times, though, quality at entry in terms of fund managers is of critical importance to this emerging asset class. □

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Prior to assuming his current post, Bindu was vice president (finance and administration) of ADB. During his 25 years in the bank, he has held several positions, including director general of RSDD (responsible for sectoral and thematic areas like energy, water, transport, urban development, education, environment, gender and social development, and governance) concurrently chief compliance officer, special adviser to the president on clean energy, climate change and environment, the secretary of the bank, and deputy director general of Infrastructure Department and Office of Environment and Social Department. Before joining ADB, he worked for the government of Nepal and was division chairman of the Environmental Engineering Program at the Asian Institute of Technology (AIT), Bangkok. He holds a doctorate degree in Engineering.

__Johanna Klein__ was an investment officer in the capital markets and financial sectors division at the Asian Development Bank in Manila, Philippines. Johanna worked in the group's fund of funds, where she was responsible for making investments into private equity funds, and helping to monitor a portfolio of 40+ funds, representing about $700 million of commitments, across Asian emerging markets. She had helped ADB to select and incubate new fund managers in the clean energy sector. Her prior work experience included working in equity private placements at Credit Suisse First Boston, and for the global social investment funds unit of the Deutsche Bank Community Development Group. She has an AB from Harvard College, an MSc from the London School of Economics and an MBA from the MIT Sloan School of Management.

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5 A new opportunity in energy cooperation: The Europe-China Clean Energy Centre (EC2)

By Professor Shi Dan and Dr Alessandro Costa,
Europe-China Clean Energy Centre

This chapter discusses:

- An illustration of the Chinese renewable energy opportunity
- Co-operation of the European Union and China with respect to renewable energy and the nature of the Sino–EU renewable energy co-operation
- Future perspectives on Sino-EU co-operation

The rapid growth of China's economy during the past decade has led to a steady increase in the demand for primary energy. From a global standpoint, today, China accounts for approximately one-fifth of global energy demand. At the same time, looking at its national trend, the rise in China's energy consumption between 2000 and 2008 was over four times bigger than what was observed in the previous ten years. With over 1.3 billion inhabitants – making China the world's most populous nation – and its current patterns of economic development, there is a clear likelihood of further growth in China's energy needs. According to the 2010 World Energy Outlook (IEA 2010), China's energy demand will rise by 75 percent from 2008 to 2035. By 2035, China's energy demand is expected to account for 22 percent of global energy demand. However, the most startling statistic is that in 2009 China almost overtook the US to become the largest energy user worldwide, while just a decade earlier its energy consumption was barely half that of the US.

Investing in innovation

Indeed, China's energy demand statistics highlight the growing importance of China in the context of worldwide energy, where China's energy dynamics have – and will certainly continue to have – dramatic repercussions at a global level. At the same time, growing recognition of the need to control the environmental impacts of meeting China's energy demand has paved the way for the introduction of clean energy solutions. The country's push to increase the share of such technologies may play an important role in driving down their cost and promoting their deployment.

China is already making great strides in the field of clean energy, understood as a mix of clean coal, biofuels, renewable energy sources (including hydro, wind, solar and geothermal), efficient energy consumption and sustainable and efficient distribution systems, together with nuclear power. Current investments in China would be far less significant without the strong financial support of the Chinese government. In fact, China has become a world leader in renewable energy production (for example, wind and photovoltaic) and is pursuing a programme to increase the share of energy from non-fossil fuels in primary energy consumption to 15 percent by 2020. By the same year a target of reducing carbon intensity by between 40 percent and 45 percent of year 2005 values has been set, enabling the country to meet its existing carbon emissions-reduction targets. These efforts are supported by the implementation of a development plan that will mobilise investments for about Rmb4 trillion in wind, solar and biomass projects. Given the sheer scale of China's domestic market, boosting the share of innovative clean energy technologies – on both the supply and demand sides – is a critical factor for the success of national clean energy policies (IEA 2010).

Alongside China, the European Union (EU) is a key global player both economically and in terms of energy. In 2008, primary energy demand among EU member states accounted for approximately one-seventh of total global demand. In contrast to China, the EU demand trend is forecast to contract by 10 percent by 2035 (IEA 2010). However, the energy challenges facing the EU are similar to those facing China, including the need to tackle the environmental consequences of energy supply. Although different approaches have been taken to implementing policies and actions, the renewal of the EU energy sector may require an investment of €1 trillion during the course of the current decade (EC 2010).

In 2007, to demonstrate its commitment to transform into an energy-efficient and low-carbon economy by 2020, the EU adopted an integrated approach to climate and energy policy aimed at combating climate change while increasing the EU's energy security. The targets of the so-called 20-20-20 Strategy include: achieving 20 percent reduction of greenhouse gas emissions with respect to 1990 levels; supplying 20 percent of energy consumption from renewable resources; and reducing primary energy use by 20 percent. Results to date are encouraging: renewable energy sources have increased both in terms of use and potential, while primary energy output from clean energy technologies has steadily risen since 2008. Emphasis underlying this success, which has been achieved despite the recession, is acknowledged through the decision of EU member states to rely on clean energy advanced technologies to meet their energy-efficiency/energy-saving targets.

In more recent times, Chinese interest and efforts in achieving a more sustainable environment through the adoption of a scientific approach to national development has been explicitly put forward in the 12th Five-Year Plan for National and Social Development of PRC (2011–2015). In this top programmatic document, clean energy issues and technology innovation hold a strategic role in achieving the target of a low-carbon society.

It is in the light of such similar macro approaches that the EU and China have strengthened their cooperation to promote the introduction of advanced clean energy technologies, building on the cooperative initiative started in 1994 by the European Commission and the Chinese government. Through its Directorate General for Energy, the European Commission (EC) is currently engaged in two sector dialogues – with the Chinese Ministry of Science and Technology and with the Chinese National Energy Administration. At the same time, clean energy issues form part of those topics that are commonly being discussed during EU-China summits.

Spreading the message

Bearing in mind the huge impact of these two players on our planet, China and the EU have a clear motivation to build a thorough cooperation towards a low-carbon economy in general, and towards a strong clean energy sector in particular. Such a trend is particularly evident throughout the last five years: in 2007, China expressed its strong willingness to cooperate with other countries to tackle the above-mentioned challenges in the energy sector. In December 2007, the State Council of China released its white paper on China's Energy Situation and Policies, providing a comprehensive explanation on the country's energy policy and clearly stipulating that international cooperation had to be conducted in fields such as 'energy development and utilisation' and 'research and promotion of advanced technologies' (SCC 2007). Also in 2007, the EU also set as a priority to 'assist China in tackling global concerns and challenges over climate change, the environment and energy' (EC 2007a) and more specifically foresee to 'provide technical assistance to promote energy sector reforms, energy efficiency, energy savings and the use of renewable and clean energy and energy technologies' (EC 2007b). Hence, it is through these critical steps that EU and China have intensified their cooperation on energy issues both at policy and project level.

A new opportunity in Sino-EU clean energy cooperation

One of the most successful examples of this Sino-EU cooperation was launched in 2009 when the EC and the Government of the People's Republic of China (PRC) signed a financing agreement to support the establishment of the Europe-China Clean Energy Centre (EC2).

EC2 is a five-year cooperation project, started in year 2010, promoted by the European Commission, the National Energy Administration of China and the Ministry of Commerce of China, with the support of the Italian environment, land and sea ministry. The centre is managed by a consortium led by Politecnico di Torino (Italy), comprising eight further highly qualified partners from both China and Europe: the Institute of Industrial Economics/Chinese Academy of Social Sciences (IIE/CASS – China); the Commissariat à l'Energie Atomique et aux energies Alternatives (CEA – France); Chalmers University of Technology (Chalmers – Sweden); the Centro Euro-Mediterraneo per i Cambiamenti Climatici (CMCC – Italy); the Energy Research Institute/National Development and Reform Commission (ERI/NDRC – China); the Regional Environmental Center for Central and Eastern Europe (REC – Hungary); Tsinghua University (Tsinghua – China); Università della Calabria (UNICAL – Italy).

EC2 has funding of over €12 million and its main tasks are to promote an increased use of clean energy in China and to support the Chinese government's efforts to shape a more sustainable, environmentally friendly and efficient energy sector. To do so, the centre assists China and the EU in the development of clean energy policies by presenting a broad range of advisory reports, devised by its extensive network of qualified experts. Also a wide range of institutional capacity-building initiatives is being deployed: sector seminars, training courses and study tours are provided through innovative curriculums, methodologies, materials and programmes. Moreover, EC2 acts as a hub for information, promotion and communication on energy matters, contributing to raising awareness about the benefits of increasing the introduction of clean energy policies and technologies in China. Last but not least, the centre aims to foster technology transfer and development between EU and China, sharing best practices, facilitating market opportunities and enhancing cooperation among partners and players (that is, companies, research institutes and public national/international institutions). This is the realm where EC2 puts forward an innovative platform capable of providing added value to all stakeholders active in the field of clean and renewable energy.

The centre is hosted at the Sino-Italian Ecological and Energy-efficient Building (SIEEB), at Tsinghua University in Beijing. It is structured according to three divisions: the administrative and human resources division, which is responsible for all administrative, legal, financial and technical matters; the training and advisory division, which is in charge of operating, updating and maintaining the dynamic database on clean energy; and the information, promotion and communication division, which is responsible for dissemination, promotion and communication initiatives as well as for the organisation of awareness-raising campaigns. The EC2 team coordinates the implementation of all its activities, which are mainly carried out by a network of highly qualified short-term technical experts, who are either provided by the partner institutions or work externally in complementary fields.

Mapping the path for clean energy cooperation

In order to provide advisory support to Chinese and European players, fostering international technology transfer and cooperation and giving assistance on policy-making, the centre has been setting up a database on clean energy technologies and policies, gathering dynamic information about key players in this sector from all 27 EU member states plus China. Operating on this tool will allow a concrete interpretation of Sino-European clean energy dynamics both at a comprehensive as well as at a sectoral scale.

Such a thorough mapping is based on the collection and interaction of the following data layers:

- Stakeholders: data, mission, role and scope of action.
- Local and International donors active in China.
- Existing Chinese programmes, Chinese and international funding opportunities.
- Existing energy projects.
- Surveys of the status quo of clean energy policies in China and EU.
- Existing energy networks.
- Companies active in China in energy fields.

- EU companies interested in cooperation with China in energy field.
- Information on China and EU regulatory frameworks, including technical rules and the compliance with regional and/or international standards.
- Service providers.
- Special events dedicated to energy issues.

Moreover, the collection of data cross-cut with the available cutting-edge studies on energy issues (either collected or drafted by EC2) allow the database users to elaborate a more comprehensive assessments on key topics:

- Energy efficiency and introduction of clean energy technologies and processes according to different Chinese areas.
- Existing clean energy technologies.
- Adaptation of existing technologies to Chinese needs.
- Environmental impact reduction of traditional energy production processes and possibilities of making them more environment friendly.
- Renewable energy perspectives.
- Barriers hampering the introduction of clean energy technologies and renewable.

Combining together dynamic information on technologies and policies is based on the belief that there is a two-way relationship between energy technologies and energy policies: well-designed energy policies may act as a stimulus for the development/deployment of state-of-the-art energy technologies, while a clear understanding of state-of-the-art technical knowledge is a necessary condition to create credible and concrete policy roadmaps.

The database addresses all EC2 focus areas: clean coal (carbon capture and storage, and increased efficiency in power production); sustainable bio-fuels; renewable energy sources; energy efficiency in energy consumption (buildings, products, industry); and sustainable and efficient distribution systems.

The database, which will be constantly fed and updated throughout the entire project life, has therefore four main purposes:

1) To help to identify research and technological solutions, and market opportunities, worth attracting investments from EU and/or Chinese parties.
2) To identify and match-make partners for clean energy joint projects to be implemented both in China and EU.
3) To provide EC2 users with cross-cutting information on the clean energy sector including: stakeholders, programmes & projects, policies, products, events, funding opportunities, companies and service providers – from both geographical areas.
4) To combine EU-China energy technologies and energy policies know-how for identifying which technologies to develop/deploy and where, in the light of the present policy regulatory frameworks, on one hand; which policies to adopt, given the current energy technologies availability, on the other.

Looking into the future

China has abundant potential for new energy, including larger-scale development and utilisation. The country's usable capacity of wind, solar, ocean and biomass power can amount to hundreds of millions of tons of standard coal every year. This huge potential, together with the country's sophisticated new energy technologies means that China's development and use of new energy can be further accelerated. Due to the continuous advancement of the country's new energy technologies, the rising costs of fossil fuels and the commitment to reduce carbon dioxide emissions, new energy will play a growing role in China's energy consumption structure. However, whether or not new energy can become a genuine substitute for traditional energy sources in the future will be largely decided by their development costs, the degree of their technological maturity and their effects on the environment (Shi & Li 2011).

Therefore, although China is holding numerous patents and it is already number one in some new energy sectors – such as solar power – it is now critical for China to continue to cooperate with the EU in order to keep promoting the use of clean energy. It also needs to strengthen the new energy market from a technical perspective and from a policy and market regulation perspective. In that respect, EC2 is a very valuable means of cooperation to contribute in achieving those objectives. □

Summary findings:

- China's capacity of usable renewable energy has huge potential for accelerated growth
- Cooperation on all levels between the EU and China will have a very positive effect on China's supply of clean energy
- China faces real decisions to improve the technical aspects of clean energy and the industry's regulation

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The Europe-China Clean Energy Centre (EC2) is a project co-funded by the European Union and by the Italian Ministry for the Environment, Land and Sea and coordinated by Politecnico di Torino.

6

Is Japan on the verge of a new energy model?

A trilateral conversation held in Tokyo between Nobuo Tanaka, former executive director of the International Energy Agency, Tatsuo Masuda, professor, Nagoya University Commerce and Business Graduate School and Thomas Kubr, CEO of Capital Dynamics

Last year's earthquake and subsequent destruction of the Fukushima nuclear power plant profoundly affected Japan's energy market. In addition to the practical implications of the reduced availability of electrical energy, the disaster prompted a near reversal in attitude about nuclear power from the Japanese population. This sparked unprecedented and dynamic debates over what the desirable energy mix should be. Japan to date has not been a prominent player in the clean energy space, particularly as the structure of the Japanese energy market impedes the accommodation of clean energy. However, recent events might just change this. In the following discussion, Nobuo Tanaka, of the Global Association for Energy Security and Sustainability at the Institute of Energy Economics, Japan and former executive director of the International Energy Agency, Tatsuo Masuda, professor of energy policymaking and geopolitics at the Graduate School of Nagoya University of Commerce and Business, and Thomas Kubr, CEO of Capital Dynamics, discuss the impact of the disaster, the changes that followed and the possible opportunities to emerge:

- Effects of the Fukushima nuclear accident and its likely impact on Japanese energy policy and energy security for the rest of the world.
- Key problems in the Japanese electricity market.
- Thoughts about the other side of supply and demand: energy efficiency and energy savings.
- The future shape of the Japanese energy market.

This following conversation provides insight into how a crisis and the resulting unique dynamics can alter the course of energy policy and accelerate developments in the clean energy space.

Kubr: It's encouraging to see Japan's resilience following the natural and nuclear disasters that took place just over a year ago. What was Fukushima's impact on Japanese energy policy and what are the implications for the rest of the world?

Tanaka: We have to think about Japan's domestic energy policy and safety in connection with that of the entire region. Also, the Japanese government must look beyond nuclear energy to consider the use of more renewable energy as well as more grid connection regionally and nationally.

Kubr: What's the interplay between energy use, energy policy economics and national security, especially in relation to your neighbour China, as China's energy consumption expands?

Tanaka: It's important to have open discussions with China about energy security and sustainability. China needs electricity for economic growth – and even with its efforts to be more energy-efficient and conservative, and to invest in cleaner energy sources, it will be the heaviest user of nuclear power in the future. It's definitely in our interest to see China using coal power more efficiently, or using more gas or renewables, or carbon capturing, for example. We're encouraging China to join the International Energy Agency (IEA) and work together with us on energy security and sustainability.

Kubr: Especially in emerging economies, there's the chance of technology doing a 'leapfrog', which is more difficult to do in established economies. If you think of the telephone 20 years ago, developing countries had no telephone system. Then there was mobile phone technology and suddenly everybody has perfect telephone systems. Where do you see the next 'leapfrog'?

Tanaka: In China, for example, they are focusing on electric vehicles. In the 20th century, the combustion engine of the automobile was the basis for civilisation. Now in the 21st century the electricity supply is more stable, sustainable. It's cleaner. It's only a question of when, and not if, everything is electric. Simply speaking, there is no alternative. Fossil fuels are limited. All these bio-fuel projects are not without their issues. Electric in the end is far superior to anything else.

Kubr: I agree but don't think we have really solved the storage problem yet. In any case, we need some really strong economic incentives to help the technologies along.

Tanaka: Yes, that's right. We have to make things happen. Gasoline prices must be double, triple to cause behavioural changes in the consumer. But this is not the focus in politics in many countries – politicians can't make these changes because it's not sexy politics.

Kubr: Is it maybe a question of making the cost more transparent? In most countries the price of gasoline at the pump includes high taxation, often half to two thirds. But is uncovering the external costs of using fossil fuels enough to bring about behavioural changes?

Tanaka: Maybe you are right. By reducing tax on income, but putting the tax on gasoline, human consumption behaviour would change. The revenue would be the same so we would strongly recommend that as the best way for the future. The people would accept this, but politicians would never, ever accept it.

That's one role the IEA is playing – serving as a public source of information about what is right and what is true. Sometimes it is very inconvenient for the politicians! Cheap energy is simply over – that is what we are saying. Electricity, gasoline, oil – every price will go up. Make the taxes on energy higher, and put the taxes directly on the energy, and it will make consumers more energy-efficient in the future. That's the strong message we are trying to give, but it is very difficult to convince the politicians.

Masuda: It may be too early to judge at this stage, but so far, what has been the impact of the Japanese nuclear disaster on global energy policy making?

Tanaka: There really hasn't been much change yet. Only Germany is going back to phasing nuclear energy out quickly. Italy has already phased out, but then Italy is not a current user. Switzerland is cautious about its security policy, so the Swiss may reconsider phasing out. But these are the only three countries to make substantial changes, if any, to their nuclear energy policies.

Everybody is much more aware of the safety issues now. They are careful about installation, or will probably slow down the speed of installation. But they will not stop.

Eastern Europe is still very eager to continue with nuclear energy and to reduce the risks that come with their current supply of gas. Nordic countries are continuing; the UK, France. China, India, Korea, Russia, these are the four that will be the major users of nuclear in the future and they don't have any changes in their plans.

Japan is very much panicked, because Fukushima happened here. We know this, and safety is the issue… but probably, the world will not change that much. The world still depends on fuel, and that we are concerned with. This is what the IEA is talking about during this period.

Gas, coal – unfortunately they are a problem with respect to sustainability. Renewable energy will come back into focus, of course. Other than that, energy policy may not change very much. The lesson we should learn from Fukushima is how to make nuclear power, how to operate nuclear power much more safely and this is an asset for us. And why not use this knowledge to make our neighbours' nuclear power safer? Otherwise, we may have problems.

Kubr: Looking at the Japanese electricity market, what are the problems?

Tanaka: In Japan, the biggest issue is interconnection of the grid among different utilities. The Japanese electricity market is separated into nine regional utilities – they have a monopoly and there is very little competition. And this is what increases the risk to a secure supply – and it was proven in the disaster.

In addition, we use different frequencies in the west and the east, and the interconnection between those two areas is challenging. Unfortunately, the utilities have no interest in improving the interconnectivity.

Masuda: The Japanese electricity transmission system is composed of two different frequency zones, really a historical artefact following the Meiji Restoration, with 50 hertz (Hz) in the eastern part and 60 Hz in the western part. The limited frequency-conversion capacity makes interconnectivity very weak.

Kubr: It is very important to be able to shift power across the borders for overall security of supply. Entire system connectivity can be very powerful. For example, it's not that power produced by wind turbines in the North Sea is used in Spain. But power being produced in the North Sea can shift entire energy use a little bit south, and that ability to shift creates the supply security.

Tanaka: This is a very strong recommendation, following the idea that some kind of reform in the electricity market is a must. Otherwise, renewable energy cannot really be deployed or help to increase energy security. This is not only a matter of technology, but government – that is, electricity market policy is another very important element to making this kind of change happen.

Kubr: If I understand correctly, Japan now has nine different systems, each over-investing to gain supply security?

Tanaka: Exactly. For example, these planned blackouts provide an opportunity for new energy producers to get onto the smart grid – but with smart meters with demand-side management. With such real timing of electricity availability, yes, users will change their behaviour. But utilities don't seem to like it because it is a different pricing mechanism, a different way of providing energy. They say: "We provide enough supply by ourselves in a separate, nine-utility system." The interest of the power company is to sell power, not efficiency. The more power they sell, the better.

Kubr: That's true. That's the basic problem of energy efficiency: The party that should make the investments for greater efficiency has no incentive to do so, on the contrary! And a related problem: Who pays for the smart grid? A very large investment that again does not help sell more power. Here too, why should the power companies invest?

Tanaka: The utility companies should have the incentive to pass along savings by acquiring certificates, by whatever way. The utility companies must receive some kind of profit, otherwise they will not pass along savings.

Utilities know exactly where the consumption is happening. They have the best knowledge and information on how to conduct energy efficiently. But they have no incentives to do so.

Some change in the system must happen. Of course, investing in nuclear power is so costly, so likely there is some way of giving more incentives for more demand management or efficiency to the utilities. The cost of an investment in a facility will get more and more expensive in the future. But this is another interesting point – by connecting to Korea or Russia, we may have much cheaper electricity. Their cost of producing electricity is much, much lower than in Japan. But it is an unlikely scenario because utilities are not interested in competition. For the sake of security, for the sake of the use of renewable energy through hydropower in Russia, this is a wonderful idea. But it will never happen.

Kubr: That is of course very unfortunate. Wouldn't the net interconnection with Korea and Russia not produce substantial savings even without power import?

Tanaka: True. But it's also about different geopolitics if the grid is connected to Korea or Russia.

Kubr: That of course is another problem. Consider the example of Germany and Russian gas. Yes, in a sense, Russia and Europe are much more connected to each other than before. It does increase risks, but consider it from this different perspective: Does that make for a more stable relationship as each partner becomes more dependent on the other?

Tanaka: The geopolitics in East Asia are quite related to energy. That's true. We should not build energy policy in Japan without that consideration. Right – don't think about just domestic lines, separate markets, that is just ridiculous. The world is moving in a different way.

Kubr: I would imagine this is especially true for a country that has very limited independent energy production resources like Japan?

Tanaka: Exactly. The self-sufficiency rate is so low. But the self-sufficiency of single countries in Europe is also low, yet by joining with other European countries, or with Russia, or countries from North Africa, then one single European market can make a difference.

Kubr: The self-sufficiency rate could be much, much higher if we shift away from oil-based energy to renewable. It would take surprisingly little to substantially reduce our dependency. It is fascinating to look at the marginal use and production. That's what drives pricing, dependencies, and even small shifts to locally produced energy can have a large impact.

Tanaka: As we discussed, another problem is the lack of competition in Japan.

Kubr: It's a very tough thing. The lack of true competition is probably one of the biggest flaws of electricity markets today.

We have seen this in telecommunications. In every country, within five years of opening their phone markets to competition they had far higher quality telecommunications at one-tenth of the price as before. Competition is very powerful.

The basic economic arguments for energy are exactly the same. It's a bit of joke in Switzerland: the power companies are really just banks with their own power plant! But in all seriousness, would you agree that to have a public, competitive energy policy, you need to have a very strong government?

Masuda: The issue of 'strong government' is a very profound question, and should be considered in a broader context. It is also a matter of a government's sensitivity to the need of the civil society. What about the case in Japan? In my understanding, the Japanese energy policy had been decided by a limited number of people; bureaucrats, energy companies, academics and well-informed politicians. Competition in the power sector has not necessarily been a matter of high priority. But, so far so good… until the credibility of nuclear safety collapsed due to the Fukushima nuclear disaster. Now, for the first time, 'energy democracy' has been brought forth in this country. Without doubt, the call for more competition will increase. A good thing is that more people pay attention to energy issues. However, there is no guarantee that democracy will lead us to a better place.

Just imagine, there are three prefectures that already have nuclear power generation. One prefecture may choose not to rely on nuclear and completely close existing nuclear power plants. A neighbouring prefecture may close 50 percent of its nuclear power plants, and the third may support 100 percent nuclear power generation. This is what energy democracy is all about.

Tanaka: With regard to other new sources of energy: as an engineer Thomas, what do you think about this hydrogen economy? Storage of electricity or use of natural gas takes hydrogen out of the equation – do you believe the hydrogen economy may not come?

Kubr: This is my personal opinion – I don't believe so. Hydrogen has a very low density, it's very expensive to make, for starters. What's the cheapest way to make hydrogen? You crack oil; that doesn't help. OK – the hydrogen economy is predicated on water. Use electricity to divide the water and then use the gas. Well, wait a second. If I use electricity to do that, why don't I just use electricity directly?

Possibly the development of super caps (super capacitators) may offer new options for electricity storage. Up until now, batteries have not been the best way forward; they are expensive, heavy and slow. But I believe a combination of super caps and batteries will be the future. The energy density of electrical storage will improve, and it will improve very quickly to the point where hydrogen makes no sense. If you look at hydrogen cars, the prototypes out there, they have huge gas tanks and that stuff is highly combustible – not an easy thing for the public to accept.

Tanaka: How about nuclear? There used to be this notion that nuclear power would replace oil. That was when it started – nuclear was seen as an abundant or limitless source of energy.

Kubr: Now, at that time there was no alternative to producing electricity. Think back to the 1940s and 1950s. Electricity production was only possible with hydro or fossil fuels. It's only since then that we developed nuclear, and then much later solar and wind. It took a while to get to this point – but we have. So the question is: How to get rid of nuclear now? And in connection with that, what do you think the future of nuclear power is in Japan?

Tanaka: This is difficult to say. Economically speaking, the cost of power is getting so expensive. This means lots of industries may leave Japan and that is a serious concern. So yes, while building a nuclear plant on a new site will probably be prohibited, it's still very difficult to say. The government is saying they are going to review the energy policy from scratch, but renewable energy has yet to come and we have yet to see a policy change. So my guess is phasing out nuclear will be very difficult; maybe it will be a gradual shift away from the current level of nuclear toward renewable.

Kubr: But hasn't it been suggested that Japan produce 50 percent of its electricity from nuclear?

Tanaka: This plan is going to be revised. Yes, 50 percent was planned to achieve a 25 percent CO_2 emission reduction target. That is what METI (Japan's Ministry of Economy, Trade and Industry) calculated. Ultimately, with less nuclear, the 25 percent reduction target is probably impossible. How to achieve a balance between sustainability and security is still big question.

Kubr: Then the question is, what about solar?

Tanaka: The problem with solar is building a solar power plant. It's so costly because it takes land. Japanese land is enormously expensive. Of course, you can build in a very far away place, but then the grid transportation cost is high.

Kubr: I am right now building a solar panel on my roof. It will produce 11,000 kilowatt hours per year, and if I wanted to use my full roof I could increase the power to 17-18,000 kilowatt hours per year. That's enough to supply our house, my electric car, and four neighbouring houses. I was surprised about the relatively small space needed to produce that, but also surprised about the cost. It was expensive.

When I looked at the cost I was shocked to see over half is in the construction installation planning – the actual solar panels were only 40 percent of the total cost! When you fly over any country, you see the vast majority of roofs are not being used for solar panels. So what would happen if we worked with the empty roofs to install solar panels, would we also get rid of the distribution system cost issues because the power would be produced where it was needed? One of the neat things about solar power: it is usually produced precisely at peak usage times. So cost may well come down if enough of it was being produced, as well.

Masuda: To take effect in July 2012 – electricity utility companies will have to purchase all renewable power produced by others at fixed prices, set by the government. It's a feed-in tariff system like in Germany. The price will be set at a relatively favourable level for vendors, which will make the renewable energy business attractive.

Kubr: Energy is all very local in the end, right? In Switzerland, we also have a feed-in tariff system where there is a subsidy for renewable energy. It features two noteworthy aspects, one of which I believe should be removed – that's the limitation on volume. Per year, only a limited number of kilowatts are allowed to be added to the system. So there's a huge waiting list. The second is, they reduce the tariff every year – 18 percent between last year and this year. Because I was unable to install the panels last year, I had an 18 percent loss in net revenue. What's interesting though, is my installation cost came down by almost 30 percent in the same time period.

Masuda: An interesting phenomenon from an investment point of view is the potential massive flow of capital into renewable energy installations and power productions everywhere. I have friends living in the countryside in Japan who had no interest in energy whatsoever until recently. But due to the nuclear disaster and the awakening of the general public to energy issues, they started to invest in renewable power generation. They are investing $100, $200 and $1,000 for small and medium installations. At the same time, initiatives are being taken with local governments and large companies to build mega solar power plants.

Kubr: What do you think the other side of supply and demand of energy: energy savings?

Masuda: Currently, Japan is in the midst of an unprecedented energy-saving experiment. The greater Kanto area of over 30 million people, can you imagine, is using nearly 20 percent less peak electricity than a year ago. This is in no way without pain and inconvenience, however, we managed to run the economy and continue with our social lives. I was surprised to see that we had such room for demand-side management, leading to savings as well as efficiency gains.

Tanaka: The target was a 15 percent reduction in energy use so this has been much more than the expected. That consumption declined is really significant.

Masuda: It is happening partly because of targeted efforts by companies and offices to consume less, and partly due to the effect of decreased energy bills. Individuals and big companies both, they are constantly checking their power meters and energy bills: "Are we above or below the target? How much money have we saved this month?" Personally, I never paid much attention to my home energy bill before. It gave my wife and me a sense of accomplishment to see we saved some 30 percent on electricity last month.

Kubr: So by everybody now focusing on their energy supply and bill, they have reduced energy use significantly. Within any group of people, I usually ask: Do you remember how much you paid per gallon or litre of gasoline the last time you gassed up your car? Everybody says 'yes'. Next I ask: How much did you pay per kilowatt hour on your last electricity bill? Only one in 20 on average knows the kilowatt per hour price. People generally don't focus on the cost of electric power – but now, the Japanese are starting to save. Very intriguing.

Masuda: May I share with you a few examples of such efforts? My daughter is working at a mobile phone company. To help alleviate power consumption during peak hours, her company shifted the days off from Saturday and Sunday to Monday and Tuesday. So she now goes to her office during 'weekends', but enjoys her free time on Mondays and Tuesdays. This has happened at many companies and offices in Japan.

In similar efforts to cut the peak of power consumption, some energy-intensive manufacturers now operate 24 hours per day on Saturdays and Sundays and completely stop operating during some weekdays.

The last example is on innovation and business opportunity. I work for a manufacturer of micro-fuses called SOC. A week after the Fukushima nuclear disaster, my company got a call from a big electric-component company to jointly develop smart meters to facilitate power saving. The corporate dynamism of seizing such an innovative business opportunity is symbolic of the strength of the Japanese economy.

Kubr: The motivations of capitalism can be powerful...

Masuda: I am not too pessimistic about the future because of such innovative vitality. At the same time, the disaster is the disaster and we still have to face these difficulties we've been discussing.

Kubr: There is a fascinating story here that should be told much more broadly. If other countries could take similar measures to manage the marginal consumption of energy, imagine the geopolitical implications. Imagine the reduction in global energy use.

Masuda: This is about opportunity in innovation, technology, lifestyle, decision-making processes and all sorts of social and economic systems. Japan is acquiring new technologies and know-how in addressing all of these energy-related challenges, which will be shared with the rest of the world as the new Japanese energy model.

Kubr: How do you see the future?

Masuda: It will be pretty interesting to see how this society may change two years from now, after all these efforts and effects of the renewable energy purchase law to be introduced in July 2012. There is serious attention on how Japan will achieve a new energy architecture after all these difficulties. I believe many countries are very keen to take lessons from Japan. Among those, in particular, the lessons of the Fukushima nuclear disaster will be very valuable to improving nuclear safety. □

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He was responsible for pioneering the concept of 'comprehensive energy security' while also expanding the agency's focus on climate change, renewable energy and the transition to a low-carbon energy economy. He also played a crucial and personal role in the strengthening of ties with major IEA non-Member energy players, including China, India, Russia, etc.

He began his career in 1973 in the Ministry of Economy, Trade and Industry (METI) in Tokyo, and has served in a number of high-ranking positions in METI, including Director-General of the Multilateral Trade System Department. In this capacity, he led many trade negotiations at the World Trade Organization (WTO) and for bilateral Free Trade Agreements. He was deeply engaged in a range of bilateral trade and economic issues with the US as Minister for Industry, Trade and Energy at the Embassy of Japan, Washington DC from 1998 to 2000, as well serving as the first secretary of the Embassy from 1982 to 1985. With a strong background in international affairs, he has served as both deputy director and director for Science, Technology and Industry (DSTI) of the Paris-based Organization for Economic Co-operation and Development (OECD).

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Thomas Kubr *is a managing director and chief executive at Capital Dynamics, a position he has held since 1999. Thomas is also a member of the board of directors, executive committee, and the investment committee at Capital Dynamics. Previously, he was the head of private equity at Partners Group and a consultant with McKinsey & Company. He began his career as an aerospace engineer at the Space Division of Oerlikon Contraves. Thomas holds a Bachelor's degree in Aerospace Engineering from the University of Michigan, a Master's degree in Aeronautical Engineering from the California Institute of Technology, and an MBA from IMD.*

Section

II

Cleantech and clean growth

Introduction

Clean-investment opportunities in private assets can be divided into three sub-categories: cleantech, clean growth/buyouts and clean energy infrastructure.

Cleantech investing is a sub-strategy of venture investing and features many of the same risk-return characteristics. Cleantech funds finance start-up companies that develop new technologies and products focused on the clean-energy market and climate change in general. Those technologies draw on disciplines across the entire scientific spectrum: physics, materials science, computer science, engineering, biology and biochemistry. Development goals focus on improving the generation of clean energy or the creation of abatement technologies and on more efficient ways to use conventional energy sources. As is common with traditional venture investments, cleantech investments carry technology and company start-up risks.

The second sub-category covers clean-growth investments and buyouts focused on products or services in clean or renewable energy and abatement. Investments under this umbrella are made into firms that have successfully launched their first product(s) and need financing to expand. These firms are typically cash-flow positive, but on aggressive growth paths for which they need additional capital. Often, these firms are financed by equity only, and do not require any debt financing. Investments are usually majority stake, but can be minority stake as well. Buyout investments are made in established companies that provide products or services in the clean energy, abatement or renewable energy spaces. Only their industry orientation differentiates them from traditional buyout investments – otherwise, they follow the same investment rationale as buyouts, using a mix of debt and equity to finance a majority stake in the company.

Both investment types have risk-return profiles very similar to traditional private equity investments. They differ, however, in their exposure to regulation. Most firms in the clean growth market are heavily influenced by current, and ultimately future, governmental regulation and incentives for clean and renewable energies or abatement measures. Consequently, returns from clean-growth investments are linked more closely to exogenous regulation than traditional private equity investment returns. Thus, investors in clean growth and those wishing to invest would be prudent to familiarise themselves with corresponding regulation and incentives so they can make well-informed investments.

The third sub-category covers clean energy infrastructure investments, that is, investments in projects or factories that produce electricity from renewable resources. Clean energy infrastructure is covered in detail in section three of this publication. The topics covered are asset and portfolio allocation issues; capital protection features of renewable electricity projects; and risk valuation methodologies in US solar projects.

This section of the book addresses cleantech, clean-growth investments and buyouts connected to clean or renewable energy and abatement. Clean energy infrastructure will be discussed in detail in the next section of the book.

The first two chapters focus on cleantech opportunities in the US and Europe. The chapters review opportunities in each geography, discuss lessons learned from early ventures into cleantech and outline the key ingredients for a successful cleantech portfolio. Regulatory risks and technology considerations are addressed as well. Immediately following is an interview with Neil Auerbach of Hudson Capital Energy Partners, where opportunities in the clean growth and buyout spaces are examined in detail. The first part of the book concludes with a chapter that gives insight on how funds of funds fit into the clean-investing space. This offers an overview of the fund universe, associated risk/return characteristics and how they might be mitigated by funds of funds, as well as due diligence priorities and diversification requirements.

The first part of the book is designed to provide an informative overview for investors contemplating cleantech or clean growth and related buyout funds. Having read this part of the book, limited partners should be well equipped to determine how much to allocate to investments in cleantech, clean growth or buyouts. They should also be in a good position to know whether or not to invest in funds directly or whether investing through funds of funds is the appropriate way to reach their targets. In addition, readers will have gained an understanding of how to select opportunities or if working with a gatekeeper is the right approach for them. □

7 How to build a financially successful cleantech portfolio

By J. Stephan Dolezalek, VantagePoint Capital Partners and Spencer Punter, Capital Dynamics

This chapter discusses:

- How the opportunities in cleantech can lead to clean growth successes when they reach scale
- The lessons learned from the first decade on investing in cleantech businesses
- Insight and advice about how to make investing in cleantech become a successful strategy

Cleantech investing is typically synonymous with investors purchasing equity stakes in high-growth start-up companies that produce innovative technologies to address the renewable energy and clean-environment markets. This form of investment is made by venture capitalists and other investors that are prepared to take high risks in order to generate returns that will vastly exceed standard equity market returns. This chapter addresses the opportunity that exists in the cleantech market for generating above-market returns and provides some suggestions for constructing a diversified and successful portfolio of cleantech venture investments.

Cleantech: the opportunity

Over the last 30 years, major technological and business-model innovations have transformed IT, healthcare and communications. Today, these same kinds of innovations are being applied to create more efficient and less expensive ways of doing business in a world that is facing growing constraints in available energy, water and materials.

The global population is growing rapidly and emerging economies are not only industrialising but are also consuming more, thereby massively increasing their demand for energy, water and the resources that support urban living and consumer products – a set of resources that is largely finite and some of which are nearing limits that imply highly significant price shifts and/or rationing. This reality creates impetus for every major industry in the world to find new ways of doing business that use resources more efficiently and sustainably. Leading cleantech innovations address these challenges and also create better and higher-performing solutions for ageing industries such as manufacturing and energy production.

At the same time, governments in both the developed and developing worlds are seeking opportunities for economic growth and job creation, and they are also seeking energy and resource security and independence. Cleantech innovations can offer jobs, economic growth and energy security.

As the world's major industries, including manufacturing, energy production, natural resources, technology, healthcare, transport and telecommunications are modernised so that they use resources in a more sustainable manor, a new crop of leading companies will emerge as global powerhouses. The investors that can identify future cleantech leaders and help them to grow could reap massive returns on their investment.

Is the opportunity a mirage created by government regulation?

Cleantech's opponents often argue that cleantech innovations are too expensive and can only survive with the help of government programmes such as feed-in tariffs, subsidies and grants – and that consequently, they do not make sense as financial investments. The best way to think about government and the cleantech opportunity is as follows:

The cleantech opportunity: created by multiple major drivers

These multiple drivers go far beyond the role of government alone. These are fundamental, secular, long-term trends which include energy security and climate change, but the most important one of all is the sheer imbalance between the supply of energy that is available from traditional sources such as coal and oil and the rapidly growing demand from an increasingly industrialised and rapidly growing global population. According to the World Bank, the US accounts for 4.5 percent of the world's population yet consumes nearly 18 percent of the world's energy. The per capita energy usage in the US was nearly four times the global per capita energy usage in 2009. As the per capita energy usage in countries with large populations such as India and China moves closer to the US level, the global demand for energy will increase dramatically. Unless supply of energy from fossil fuels increases at the same rate, which appears highly unlikely, then the world will need to endure much higher energy prices or will seek out alternative methods of producing energy in cheaper, more sustainable and reliable ways.

Government support helps create independent technology companies

Governments have played an important role in helping new technologies achieve critical scale in order for the private sector to be cost-effective, but once these technologies are at scale, government support is no longer necessary. Governments often play highly influential roles in seeding early industries and helping them to achieve scale. In the US, for instance, government funding, procurement and supportive policies have played a significant role in the growth of the railroads, the automotive industry, the aerospace industry, the defence industry, the internet, computer hardware and software, semiconductors and more. They encouraged investment by companies and venture capitalists into new products because emerging companies knew with some certainty that these agencies would be their first customers and would endure glitches and high prices as products rode down the price performance curve towards mass market adoption.

Governments were the first large-scale purchasers of computers and other semiconductor devices. Without governments purchasing computers for space rockets or processing taxes, semiconductor production would have never reached the scale needed in order to cost-effectively address the mass market. The memory capacity of an Apple iPod is four million times greater than the memory capacity of the computers used on Apollo 11 and yet the computers used to power the Apollo space programme cost millions of dollars whereas an Apple iPod can be purchased today for less than $200. As with all technology, successive generations of semiconductor products have improved in performance and declined in price, on a per-unit-of-work basis, such that they can now affordably serve very large markets well beyond government demand.

The same effect is evident for solar photovoltaic panels. As recently as 2008, solar panel prices were $4.80 per watt – at the time it was widely deemed unlikely that they could ever get below $1.00 per watt. When compared to levelised cost of ownership (LCOE) of fossil fuel-burning power plants that are built and operated at costs of between $0.50 and $0.80 per watt, solar panels have, to date, been uncompetitive without government subsidies. However, solar panel prices have dropped to around $1.30 per watt and are continuing to fall rapidly. New technologies just going into pilot production today in 2012 could create even further jumps in efficiency and cost-effectiveness that could lead to solar panel prices below $0.25 per watt in the not too distant future. Costs have been dropping so rapidly in the solar market that industry forecasts consistently fall short of what is actually achieved.

Governments also have an important role to play with regard to infrastructure build-out. There are aspects of cleantech industries, such as electricity transmission lines, that are best built by government, as has been the case historically with telephone lines, national highways, railroads and more. Government decisions regarding these key infrastructure elements can certainly have significant impacts on whether and when newer technologies are enabled and when and how they are regionally advantaged.

The key point for venture capitalists is that government involvement in the evolution of cleantech is certainly not evidence of the investment opportunity being a mirage. It simply means that investors must be savvy about understanding and predicting the impact of various policies and potential policy changes on the exit timing and likely returns for any given cleantech investment.

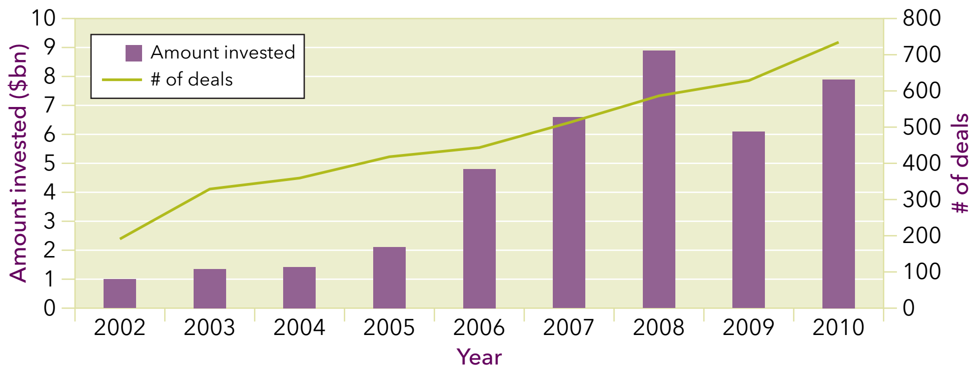
Lessons learned from the first decade of cleantech investing

A marathon is not won or lost based on what happens during the first five miles, an analogy that can be applied to cleantech: it is a long-term investment theme that is likely to play out in successive waves over the next 30-50 years. Prospective investors wishing to understand cleantech today would be well advised to consider information technology in 1985 or biotechnology in 1990, that is, ten years into active venture financing of those respective technologies and just prior to the investment heydays of those sectors. Since 2010 less than 1 percent of innovation finance has gone into cleantech investments, but by 2010, more than 20 percent of all global venture capital investments were in cleantech. More than 1400 private cleantech companies have received VC-funding over the past ten years, according to Ernst & Young and Dow Jones. While it is still early in the evolution of the sector, IPO activity has started and more than a dozen VC-backed cleantech start-ups have completed successful public offerings over the past two years.

So, one might ask, are we winning or losing this race? And, is it even worth running? Has anyone made any real money out of cleantech investing? Will anyone ever make any real money? Why hasn't there been a 'Netscape moment' yet? (A reference to numerous public comments by venture capitalist John Doerr referring to the IPO that is widely viewed as having started the great reward period for early internet investors).

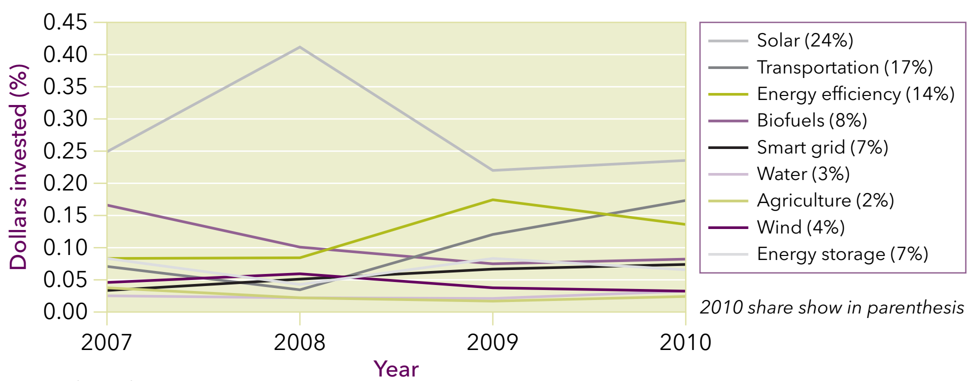
As Figure 7.1 below indicates, a tremendous amount of money has been invested globally into the cleantech sector, which first broke through the $2 billion mark, in terms of global VC investment, in 2005 and rose rapidly to nearly $9 billion in annual investment by 2008, according to research firm Cleantech Group LLC.

Figure 7.1: **Global cleantech VC investment by year (2002 to 2010)**



Source: Cleantech Group.

Figure 7.2: **Share of global cleantech VC investment by technology (2007 to 2010)**



Source: Cleantech Group.

Investments have been broadly placed, across many sectors within the cleantech universe, although solar-related technologies have garnered the largest share of investment dollars. Figure 7.2 shows cleantech investments by sector in the period between 2007 and 2010.

Clearly, large bets have been placed in the cleantech sector and some limited returns have been realised but many investors are left wondering if and when meaningful returns will be realised for this sector. Our observation at the ten-year mark is that a straight index of all cleantech activity would not, to date, have produced particularly attractive returns. (Of course, most of the cleantech investments made during the last ten years have not yet been exited by investors.) This is due partially to the longer timeframes needed to adopt energy technologies, which sometimes have 50-to-100 year useful lives and thus are not replaced frequently. However, the largest factor is likely due to the early stage of cleantech investing overall, which we view as much more akin to the volatile period for early-stage IT and telecoms investing in the 1980s, versus the high-return period typical during the dotcom boom period of the 1990s.

Not all of these factors have been understood or taken into account by those who have made cleantech investments since 2000, and thus there have been some unsuccessful investments and investment losses. However, we have also seen the birth and growth of very meaningful companies in the wind, solar and biofuels sectors and these companies have by no means reached the apex of their growth potential. As an example, we have seen many recent successful public offerings of companies in the biofuels and renewable chemical space (for example, Amyris, Codexis, Gevo, Kior, Solazyme) although many of these businesses are still in the early days of commercialisation and scale production. As these companies experience improved business outlook due major chemical producers and other industrial product companies on the volatility of oil prices and the desire to have better, renewable substitutes. The future for biofuels is also looking positive, as major chemical producers seek less price-volatile alternatives to crude oil as a base for their products and policy shifts in both the US and Europe are putting in place greater support for shifting to renewable fuels.

The biofuels and renewable chemicals sector, which includes production of fuels as well as traditionally oil-based chemicals such as plastics from algae, biomass or planted food, provides a good cautionary example of the risk of calling the game too soon, in any cleantech markets. Just a few years ago, biofuels were seen by many as a failed sector within cleantech – a black hole of sunk cost that was unlikely to generate interesting returns. But as the leading companies in this space have continued to mature and are now finally reaching commercial scale in a different global economic context, future prospects for the leaders seem much more promising.

To summarise the first ten years of cleantech investing, it is clear that a great amount of capital has been deployed in the sector and investment returns so far are mixed. There have been a few clear winners such as Tesla in the electric-vehicle market and Kior in the renewable biofuels market, as well as some big failures, most notably Solyndra in the solar PV sector. Cleantech companies are addressing large and global industries and any company that dominates a meaningful segment thereof is likely to produce enormous returns to its investors. However, it is clear from the results over the past decade that large returns are not going to come easily in this sector and successful companies are likely to take longer, perhaps more than a decade, to reach an exit and investors must be equipped with the financial resources to back their portfolio companies over the long haul. In other words, investors need to show up with capital commensurate to the scale at which they are playing.

Some 'rules to win by' in cleantech investing

Obviously, this is a chapter with advice and hard-earned lessons about how to build your own successful cleantech portfolio. This activity is not for everyone. Investors that have neither the patience nor the capital resources to properly support a diverse portfolio of start-up or growth-stage cleantech companies would be better served by gaining exposure to the cleantech market as a limited partner in one of the many cleantech-focused venture funds or by buying a diverse portfolio of publicly traded cleantech stocks, of which there are an increasing number thanks to IPO activity.

For those looking to create their own portfolio of start-up or growth-stage private cleantech companies, we offer below some of our rules to win by for cleantech investing. From the perspectives of VantagePoint and Capital Dynamics, the best way to invest in cleantech is to start with a macro perspective and identify areas that are most ripe for transformation at a given point in time. Then, within each of these areas, conduct extensive research to identify the company most likely to win, and invest substantially in that company's growth, typically seeking significant ownership of the business. The overall approach reflects two key macro perspectives on investing: first, that asset allocation among sectors likely trumps individual investment choices within sectors; and second, that as capital intensity increases, there is greater need to place fewer, more concentrated bets with a lower loss ratio.

Our seven rules to win by for increasing your likelihood of building a successful portfolio of cleantech investment follow.

1. Invest in truly disruptive innovation and innovators

Cleantech companies that offer the best investment opportunities must bring truly disruptive technology to the market and must be led by teams capable of making more than incremental improvement. This is one of the most fundamental tenets of traditional Silicon Valley venture capital investing and it must be as rigorously applied in cleantech as it is in IT or biotech. Cleantech innovators cannot rely solely on rising gas prices or government regulation to open a market opportunity.

A target rule of thumb: for a new company to strongly disrupt an existing market and significantly alter buyer behaviour, the company's product or solution should offer at least twice the performance improvement at half the price, or less, of the existing solution. Too often we have seen cleantech investors making exceptions to this rule just because they consider energy to be a large market. This is an easy trap for people to fall into, but in reality the size of the market is not correlated to the ease with which a new company can enter the market; in fact, they are often inversely correlated. Incremental advancements are usually best left to current incumbents.

2. Timing is important

Facebook is a good idea that has been executed well and has been implemented at the right time. Others, such as online services pioneers Prodigy and Compuserv and more recently social network Friendster, have tried similar ideas in the past but have not succeeded to the degree that Facebook has. Why? In part, because there wasn't the infrastructure in place to support them.

Facebook has come along at a time when broadband, personal computers, email, and high-powered connected mobile devices are widespread in the developed world and are being rapidly adopted in the developing world as well. This has given companies including Facebook, LinkedIn and Twitter a smooth road to drive on.

In the cleantech sector, some of the early failures have been companies that faced the challenge of creating not only their own product or service but also the infrastructure to support it. For example, early hydrogen fuel cell initiatives for transport suffered from the challenge of not only building a fuel cell engine powered by hydrogen but also needing to build an entire hydrogen distribution and retail refuelling infrastructure in order to compete with fully built infrastructures for gasoline-powered transport. The same goes for early biofuels companies that were producing fuel that was not compatible with existing fuel standards and delivery networks.

In contrast, microinverters, which are devices that translate direct current (DC) power that comes off solar panels into alternating current (AC) power that can be used in homes or on the electric grid, have capitalised on the growing demand and ample supply of residential solar panels as well as the established network of installers and financiers of residential solar equipment.

3. Build a portfolio that is diversified across sectors

We have been pleasantly surprised in the past two years by the number of successful public offerings and attractive returns from companies in the biofuel and renewable chemical sector. Conversely, we have been disappointed so far by the lack of attractive exits for companies addressing the smart grid or electricity utility upgrade sector. Different subsectors become ripe for transformation and reach tipping points at different points in time, and many of them have different risk profiles as well. A balanced portfolio of cleantech investments should seek exposure to more than one subsector within the cleantech space – in contrast to the often adopted approach of diversification via multiple (often competing) investments within a much smaller set of subsectors.

4. Anticipate technology curves

Technology leaders within the cleantech space are pursuing technology improvement curves that are similar to those seen in traditional information technology markets such as computer memory chips, which generally double or quadruple in per unit price performance every 18 to 24 months. LED lighting, in particular, has shown the type of rapid cost decreases and performance improvements that we see in the semiconductor industry. Solar has also continued to drop rapidly in price, just as common wisdom assumed we were approaching cost asymptotes that would not be broken. Other sectors, such as electric vehicles and batteries are still more nascent, but are also beginning to show real benefit from an increased global level of R&D into those technologies. Savvy cleantech investors anticipate where technology curves are headed and avoid making assumptions about future markets based on today's commercial technologies.

5. Be cognisant of the stage of each investment

One of the most frequent mistakes made by venture capitalist is investing in an early-stage companies at a late-stage prices. Companies often take far longer to reach critical scale than investors expect often because they are told by entrepreneurs that a breakthrough is just around the corner. Investments that take longer to exit but do not produce a commensurately higher return on invested capital will hurt the internal rate of return (IRR) performance of a portfolio. In cleantech, there are new start-ups being created every day and with more than 1400 cleantech companies funded since 2001 there should be no shortage of growth-stage investment opportunities as well.

Early-stage companies entail more risk, may have the potential for a higher ultimate return multiple, and within cleantech, will typically require a very substantial amount of additional capital before maturing. Growth-stage investments will have substantial customer and financial traction. They will entail less risk of capital loss, will require fewer, if any, additional rounds of private capital, and are likely also to generate slightly lower return multiples – but over a shorter time horizon.

6. Be prepared for capital-intensive investments

Most cleantech investments are capital-intensive. The exact nature of capital needs vary by sector, with some companies spending more on physical inputs and manufacturing development, and others spending more on software development and human resources. Capital needs come not only from what each company invests in for growth, but also from how long it can take a company to grow to cash-flow breakeven, given external factors influencing market development (that is, regulatory environment, global economic context and competition, utility deployment speed, etc.). For those seeking to invest in early-stage cleantech companies, it is wise to line up a strong syndicate that will have the resources to fund the company through multiple rounds, if needed.

7. Field the team necessary to scale the mountain

Cleantech presents more diverse investment opportunities than information technology and biotechnology combined. The notion that one or two investment professionals can handle the entire range of cleantech opportunities is myopic. Nobody today expects a software investor to be able to do biotech deals as well and the same should hold true of most cleantech investing. There has been a growing trend in cleantech investing towards the formation of larger, robust investment teams that share some of the characteristics of a venture fund and some of the characteristics of a private equity fund.

Overview of specific subsectors within cleantech

In building a cleantech portfolio, we would advise investors not to set any specific targets around what their portfolios should look like in terms of specific exposure across or within sectors. Our approach has been to look within the sectors below for investment opportunities that fit within our rules to win by discussed above. Below are some of the sectors that we are currently evaluating for investment opportunities.

Biofuels and renewable chemicals

There are multiple large potential markets for bio-based, renewable replacements for petroleum-derived products. One large and obvious category is biofuels: fuels such as ethanol, biodiesel, renewable diesel and biobutanol which can be derived from biomass and can be used instead of oil and gas, especially for transport.

Another opportunity category is the huge array of oil-based chemicals and oils that are used every day in our homes, buildings, clothing, cosmetics, food, vehicles, appliances, and in many key industrial processes (including, for instance, PVC plastic and nylon). To create these products, the chemical industry today depends on petroleum-based carbon feedstocks. However, as oil prices have become increasingly volatile, chemical producers are interested in finding alternative, more price-stable feedstocks and multiple cleantech companies have arisen to serve this demand.

Vehicle electrification

National governments see vehicle electrification as a path towards reducing dependence on foreign oil and improving national security while also reducing harmful emissions that create localised smog, especially in urban environments. At the same time, car manufacturers are seeking new avenues for growth in increasingly saturated developed world markets.

There are three major categories of opportunity within vehicle electrification: electric vehicles (EVs) (examples include the Tesla Roadster and the Nissan Leaf); improved battery technology for the EV market (such as battery maker A123); and EV infrastructure solutions (an example is battery-swapping infrastructure company Better Place).

Energy generation

There are multiple opportunities for investment within renewable energy generation, including, but not limited to, solar PV, solar-thermal, wind and processes for converting waste to energy.

Solar PV has received the majority of cleantech VC investment dollars over the last ten years and has become a fiercely competitive space, with Chinese PV manufacturers producing a substantial portion of the world's solar PV products. The first generation of PV cell and panel makers are maturing and we are seeing shake-out and consolidation among the first set of investments in this space. The best areas of opportunity for solar PV investment today are to be found within balance of system cost-reduction innovations, microinverters and solar finance and installation plays. There are also companies pursuing disruptive next-generation technologies that will dramatically decrease cost and increase efficiency.

Within solar-thermal energy generation, a number of VC-backed solar-thermal start-ups such as Brightsource Energy and Solar Reserve have received substantial investments from venture capitalists and major energy incumbents.

Within wind, the market for large turbines is quite mature, with major established global players like Vestas, GE, Goldwind, and Sinovel. Venture investment opportunities lie mostly in breakthrough component technologies, software and other technologies that increase intelligence.

The waste-to-energy industry is expected to grow significantly as waste production increases and as governments put constraints on available landfill space. The most promising technologies in this space use gasification – taking a solid or semi-solid carbon-based feedstock and thermally converting them into synthesis gas which can then be used to generate electricity or converted into liquid fuels or chemicals.

Lighting

The general lighting industry is a huge market, estimated to generate at least $130 billion of annual sales worldwide. Light-emitting-diode (LED) technology, which has already revolutionised the television, consumer electronics and auto-lighting industries, is now poised to completely transform general lighting as LEDs are increasingly capable of generating light that appears natural and feels warm, using a fraction (25 percent or less) of the energy that traditional incandescent light bulbs use. There are a number of existing VC-backed companies in this sector including Bridgelux, Switch Bulb and others that are beginning to reach critical scale.

Energy storage

There are two major types of storage investment opportunities: 1) power storage (fast-charging/discharging, and typically lower total wattage), and 2) energy storage (slower-charging/discharging, and typically much larger scale). The greatest opportunities within power storage are within improving batteries (typically lithium-ion) for electronics and for electric vehicles.

Within energy storage, the number-one objective in the industry is to develop large-scale technologies that enable electricity suppliers to store energy when it is generated for use later on. Existing electricity providers have very limited ability to do this. Pumped hydro, a very basic technology that involves pumping water uphill when electricity is cheap, and releasing it when additional capacity is needed, currently accounts for 98 percent of the world's large-scale energy storage. The potential market for large-scale energy storage is immense, with hundreds of billions expected to be spent over the next ten to 12 years.

Smart grid and energy management

Modernising the electricity grids, which were constructed in the last century, into what has been termed the 'smart grid' represents a significant cleantech investment opportunity. Today's electricity grids lack significant storage, security, multi-directional flow capabilities, redundancy and communication capabilities. Emerging smart-grid solutions aim to address all of these shortcomings and capitalise on the multi-billion dollar upgrade that major utilities are current undertaking to add more intelligence and control to their networks.

There is also an area of related opportunity around smart homes and buildings of the future: for instance, technologies that help to incorporate home energy management systems, plug-in-stations for hybrids or electric vehicles, distributed generation like rooftop solar panels, micro-wind turbines, 'smart' building materials, digital LED lights, and more. □

Summary findings:

- The investment opportunities within the cleantech sector are enormous and inevitable
- This sector is capital-intensive and investors need to be disciplined, discerning and patient in their investment approach – perhaps even more than they have been in other sectors in the past such as information technology and biotechnology
- Deep industry and technical knowledge can be critical for identifying truly disruptive technologies that bring new economic paradigms to large existing markets

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8 Investing in European cleantech

By Rolf Nagel, Munich Venture Partners

This chapter discusses:

- The opportunities for investors investing in the European clean energy industry
- An overview of the cleantech landscape and its drivers
- The different investment areas that prevail in Europe
- Insight into regulatory risks and technology considerations

Introduction

The world undoubtedly faces a series of stark challenges in the 21st century as its seven billion inhabitants increasingly compete for its diminishing supply of natural resources, the impact of greater industrialisation takes its heavy toll and societies everywhere strive for greater levels of wealth. More so than ever, there is an acute need to combat the negative effects of climate change with economic and environmentally friendly investments in new technologies that will go some way to reducing the drain on the planet's scarce resources.

Although Europe has acknowledged the need to combat these depleting resources by developing a solid track record of investing is clean energy and abatement technologies,

Table 8.1: **Cleantech classification**

Alternative fuels	Biofuels, other
Energy efficiency	Energy efficiency products, industrial products, power and efficiency management services
Energy storage	Batteries, fuel cells, other
Energy/electricity generation	Biofuels, gasification, hydro, solar, tidal/wave, wind, other
Environment	Air, recycling, waste, other
Industry focused products and services	Agriculture, *Industry:* Construction, *Industry:* Consumer products, *Industry:* Materials, *Industry:* Transportation, waste
Water	Conservation and monitoring, treatment processes

the region needs to increasingly develop these alternative technologies in order to meet the energy demand at an affordable cost. Europe still relies on importing about 75 per-cent of it fossil fuels, which is not only costly but also raises concerns over the security of its energy supply. To mitigate this risk and to lessen the overall cost burden of fossil fuels, as well politicians listening to citizens who continue to call for reduced carbon dioxide emissions, renewable energy supply in Europe is a becoming a viable alternative, and is also the case in other regions.

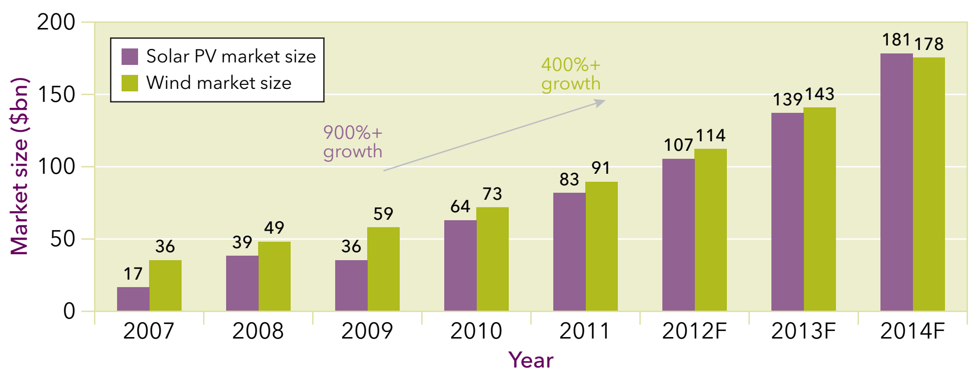
Logically, demand for these new technologies is expected to continue to grow, in turn stimulating innovation, attractive business cases and scalable growth for profitable companies. Investors have a key role to play by investing in specialised cleantech funds that will inject capital to support the environment-focused revolu-tion, an investment approach which should generate superior financial returns for long-term investors.

The growth of cleantech investment

While cleantech investments are a relatively new, they form an appealing investment strategy within the wider venture capital asset class because of cleantech's anti-cyclical nature, high demand for innovation and government and regulatory support. Figure 8.1 shows, for example, the rapid growth in the wind and solar markets, and how these renewable energies are likely to continue on an upward trajectory.

Cleantech innovation is generally concentrated in a number of verticals ranging from long-established industries (solar, wind, information technology and waste manage-ment) to more innovative nascent sectors (wave and tidal energy, light-emitting diodes (LED), green transport, green chemistry and energy storage). The steady increase in renewable energy supply is being led by solar and wind, followed by biomass, gasifi-cation, as well as wave and tidal energy, which are emerging technologies. Whereas energy storage in the past has consisted primarily of pumped hydro, new alternative technologies and projects across energy grids are emerging, creating opportunities for investors.

Figure 8.1: **Wind and solar PV market sizes by US dollar value (2007–2014F)**



Source: World Wind Association, Bloomberg, New Energy Finance, European PV Association, Strategies Unlimited, Lux Research.

Many of these types of energy supply are being viewed more and more as antidotes to some of the established energy generation methods that are impacting negatively on society.

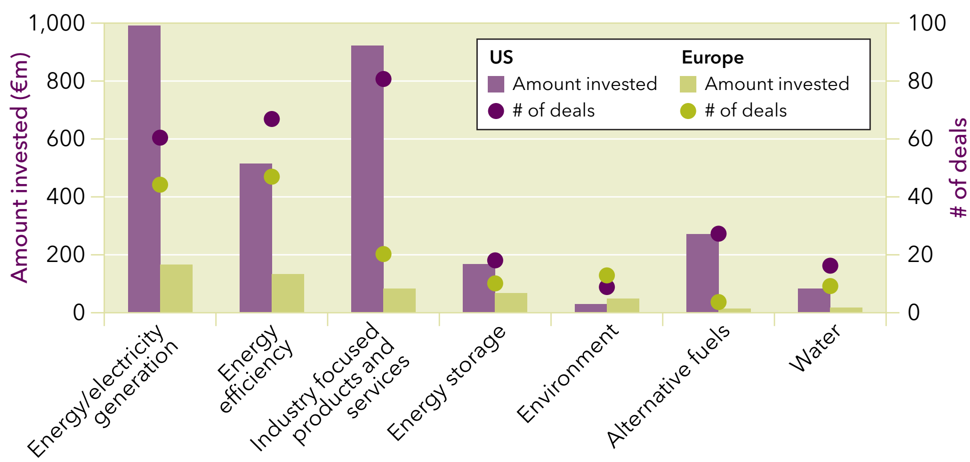
Specifically, ongoing public hostility to nuclear energy and the political responses in many developed countries in the aftermath of the Fukushima nuclear plant explosion in eastern Japan in March 2011 are also supporting greater government focus on clean energies, where this make economic and policy sense.

With reference to the make-up of the clean energy industry verticals mentioned above, it is possible to view that the European clean energy landscape is structured according to climatic variables. For example, northern Europe has a strong track record in hydro power, wind and biomass/wood-based energies. Given its sunnier climate, southern Europe offers significant opportunities for the solar energy industry. In Central & Eastern Europe there is a solid mixture of solar, wind and especially bio-energy-related technologies such as biogas, biowaste-to-energy and biomass gasification.

Although there is clearly strong interest and developing momentum across a broad range of investment themes in Europe, the amounts invested in VC-backed companies and the corresponding number of deals lags the US experience somewhat. Figure 8.2 represents a recent snapshot year, illustrating the investment gulfs between various VC-backed cleantech segments in the US and Europe.

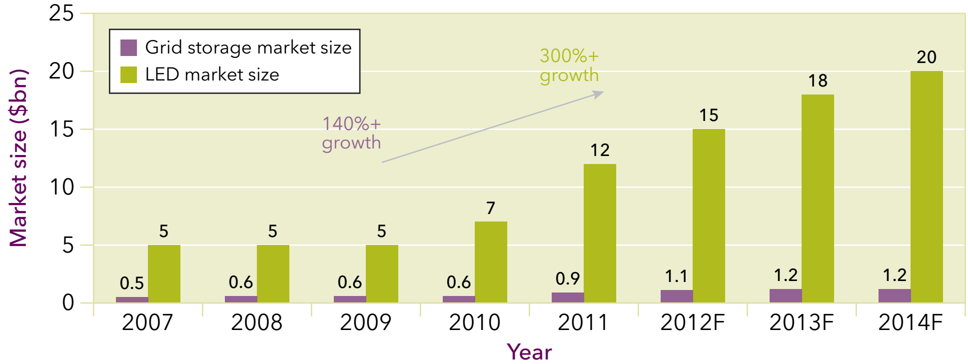
Apart from sustainable energy, production-abatement technologies are very attractive as well: energy efficiency will play an increasing source of productivity growth and competitiveness. Specifically, Scandinavia and certain countries in Europe have implemented aggressive low-carbon building programmes – including the CO_2

Figure 8.2: **Comparison of European and US investments in VC-backed cleantech companies, by number of deals and deal volume (€m) (2010)**



Source: Dow Jones VentureSource.

Figure 8.3: **LED and grid storage market sizes by US dollar value (2007–2014F)**



Source: Bloomberg, New Energy Finance, Strategies Unlimited and Lux Research.

passport for new and modernised buildings in Germany and the similar real estate energy-efficiency Green Deal in the UK – e-mobility concepts or energy-efficient manufacturing processes.

Clean energy generation and abatement technologies are rounded out by further emerging vertical technologies. These come from interdisciplinary research in the fields such as mechanics and electronics (also defined as mechatronics), chemical engineering, software and general IT, materials science, clean water, emissions handling, gas cleansing, waste management, biomass, energy storage and LED, all of which are needed in order to design an energy-efficient and cost-effective system. Figure 8.3 illustrates two examples – LED and grid storage – by actual market sizes, expressed in US dollars, between 2007 and 2011 and forecast market sizes between 2012 and 2014.

These ancillary technologies associated with the clean energy industry are particularly interesting considering that wind or solar technologies have become more commoditised, as Asian manufacturers, for example, have built significant production capacity. Cleantech successes usually require fundamental technology research in a research institute or university for five to ten years. European institutions, which have become centres of excellence in cleantech research for over 20 years, are located the length and breadth of the region.

European patents – a proxy for innovation

Europe's market attractiveness and the favourable ecosystem can also be seen in high levels of patent output per capita in Europe and this patent filing is a key component of the output from Europe's research organisations. For instance, Fraunhofer-Gesellschaft has over 1,000 patents in the cleantech and clean energies space effective in Germany and ranks fourteenth among the most active patent assignees in Germany across industries.[1] In France, the IFP Energies

[1] *Source:* Fraunhofer, German Patent and Trademark Office. Based on Capital Dynamics' estimates.

Table 8.2: **Innovation in clean technology – leaders in cleantech patents (1998–2007)**

Country ranking	Solar	Wind	Biofuels	Geothermal	Hydropower	Advanced hydrocarbon
1	Japan	Germany	US	US	US	US
2	US	US	Germany	Germany	Germany	Japan
3	Germany	Japan	Japan	Japan	Japan	Germany
4	South Korea	Denmark	France	Israel	UK	France
5	France	Spain	UK	Austria	France	UK
6	UK	UK	Italy	Canada	Italy	Norway
7	Taiwan	France	Austria	France	Canada	Canada
8	Netherlands	Netherlands	Canada	Netherlands	Norway	Netherlands
9	Italy	Canada	Netherlands	UK	Switzerland	Italy
10	Switzerland	Italy	Switzerland	Italy	Australia	India
Top emerging market patent issuers	China India Russia	China Russia Ukraine	China India Brazil	China Hungary CZ Republic	China Brazil Russia	India China Russia

Source: UNEP/EPO/ICTSD. *Patents and Clean Energy: Bridging the Gap Between Evidence and Policy*, September 2010.

Nouvelles[2] has over 12,900 live patents in cleantech worldwide and was ranked tenth among patent filers in France in 2010 in terms of the number of patents published and was ranked tenth out of French patent filers in the US in 2009.

Table 8.2 shows the rankings of countries which are home to the top patent filers across a selection of cleantech specialist areas – advanced hydrocarbon, biofuels, geothermal, hydropower, solar and wind. This also shows clearly that advancements in cleantech are gaining traction in Europe and Asia where there is continuing strong focus on innovations in cleantech.

The demand for innovation in most business areas today continues to be supportive for start-ups and, thus, also for venture capital. Whereas in the past business was targeted towards specific regions or business segments, these limitations continue to disappear in today's globally networked economy. Most successful innovations are no

[2] Some of the other leading research organisations in Europe include: Commissariat à l'énergie atomique et aux énergies alternatives (CEA), Centre National de la Recherche Scientifique (CNRS), Bureau de Recherche Géologiques et Minières (BGRM) in France; Imperial College London, British Geological Survey (BGS) and University of Cambridge in the UK; Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (TNO) in the Netherlands; Skandinavias største uavhengige forskningsorganisasjon (SINTEF) in Norway; and Fraunhofer Institute in Germany.

longer one-dimensional and do not stick to one single product or business area, but need a global perspective often transcending industry verticals. Google, Amazon and eBay demonstrated that solutions generated by combining technologies of different industry verticals – in these cases transport, marketing and internet technologies – can trigger massive paradigm shifts in existing business areas in unparalleled short time frames. This is even truer for many investments in the cleantech space.

In a globally networked world with numerous links between business systems, it is mandatory to tackle and solve problems in an overarching manner taking into account the dynamics of these systems. Clean energy technologies are the most recent examples in this regard. Protecting the environment is a multi-dimensional problem. The full potential of environmental improvements can only be achieved if technologies of more than one industry segment are combined effectively. For example, smart electricity grids have to be viewed in the context of decentralised power generation, broadband communication for metering and advanced IT-based business analytics. Similarly, reducing CO_2 emissions cannot simply be achieved by replacing a car's combustion engine with an electric motor. Making electric cars a broad success requires that today's fuel-centric infrastructure be transformed into a new electricity-based infrastructure, guaranteeing unobstructed traffic flows in the future.

Furthermore, when the above skills are combined with sound expertise and experience in building and accompanying young companies, real value for investors can be generated.

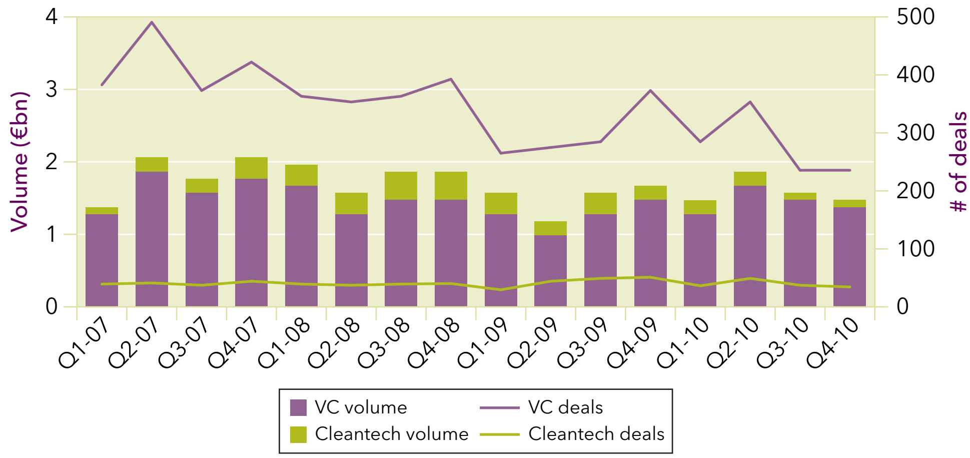
Europe's cleantech fund managers

For many cleantech funds, the majority of which have been raised in recent years, they are sitting on a large amount of dry powder readily available for investment, estimated at $12 billion globally by Preqin in 2010. About 40 percent of private equity fund managers investing in the sector are based in Europe and more than 60 percent of cleantech investing is considered to be venture capital,[3] with infrastructure, buyout and mezzanine funds completing the picture. The actual number of venture investors specialised in cleantech in Europe is still limited, however, and notably includes: BeCapital (Luxembourg), Emerald Technology Ventures (Zurich, Switzerland), Environmental Technology Fund (London, UK), Munich Venture Partners (Germany) Virgin Green Fund (London, UK) Sustainable Technologies Fund (Sweden) and WHEB Partners (London, UK). Figure 8.4 illustrates that the total amount, shown in euros, of VC-backed cleantech investment in Europe has remained relatively constant in the period between 2007 and 2010, whereas the total amount of venture capital deals has proved to be more erratic over the same timeframe.

Although a few venture investors have raised dedicated funds to invest in cleantech, European generalists entering the space have added cleantech to their focus, especially Capricorn Venture Partners, Earlybird Venture Capital, Sofinnova, Wellington Partners and Zouk Capital. Others have invested opportunistically but have not made it core to their investment strategies, including 3i, Amadeus Capital Partners, Octopus Ventures, Pitango Venture Capital and Scottish Equity Partners.

[3] Private Equity Cleantech, Preqin April 2010.

Figure 8.4: **Volume and number of VC-backed cleantech deals in Europe (2007–2010)**



Source: Venture Capital Barometer 2010, E&Y; Dow Jones VentureSource.

Other investors include government organisations and agencies (for example, CDC, Swedish Energy Agency), US venture firms (such as VantagePoint Venture Partners and RockPort Capital Partners), university venture funds (including University of Cambridge and Imperial College London), venture arms of industrial groups (some of which are Volvo Technology Transfer, BASF Venture Capital, Intel Capital and Siemens Venture Capital), as well as local venture investors located everywhere in Europe.

Focus on Germany's cleantech market

Legislation coupled with greater citizen activism have directly influenced the growth of cleantech industries, a result which is illustrated well in Germany where very restrictive laws on dumping waste in landfills, for example, has resulted in the country now being one of the global leaders in waste-to-energy technologies. Likewise, expensive electricity bills for consumers and corporate have led to extensive technology developments in low-emission power plants. Europe generally faces a high cost of energy, materials and other commodities, maintaining the pressure to innovate, recycle or save input factors, in turn producing a highly fertile ground for new technologies and companies in the energy markets.

Therefore, it is not surprising that cleantech developments and innovations in European countries such as Germany will serve as a benchmark for other European markets and further afield. The competitive biomass-related energy industry is an example, which is emulated by entrepreneurs in the US opening further markets for European technologies and suppliers in the sector.

Despite Germany having the largest installed base of solar plants and the third largest installed base of wind farms in 2010, the country's bio-energy power generation overshadowed power generated from solar and wind facilities (see Figure 8.5).

Case study: Agnion Energy

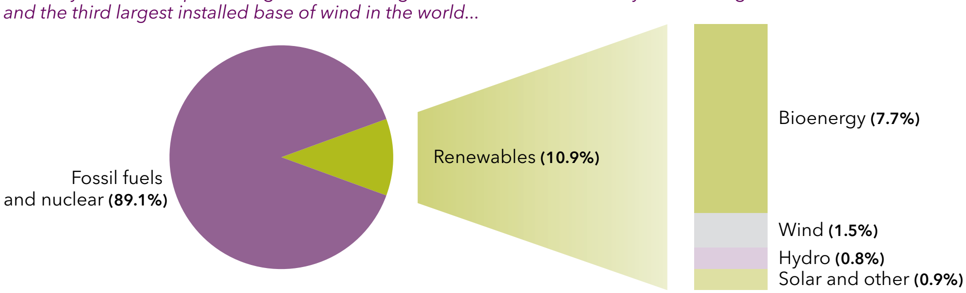
A great value-creation example in the European clean energy field is the company Agnion Energy, which was co-founded by Munich Venture Partners and the renowned international biomass expert, Professor Juergen Karl (now in University of Erlangen-Nuernberg from the State of Bavaria, Germany). Based in Pfaffenhofen (Germany, Agnion designs, tests and markets proprietary decentralised generation of substitute natural gas (or synthetic natural gas). The core innovation is based on a breakthrough resulting in a much higher heat transfer mechanism than in other gasification systems. This high heat transfer is enabled through a so-called heat pipe reformer within a very reliable and cost-effective gasification reactor.

The company's products convert solid biomass feedstock into a high hydrogen and carbon monoxide-rich synthetic gas. The gas is used for combined heat and power applications and can be converted into liquids, hydrogens and methanol dimethyl ether (DME) or substitute natural gas. Customers are end-users looking for solutions to their high heating and electricity demands, which include schools and universities, warehouses and distribution centres, shopping malls, hotels and hospitals.

MVP has been instrumental building up the company since inception. MVP co-founded the company in February 2007 as a spin-out of the Technical University of Munich, after Professor Karl and his team made a lot of inventions, basic research and rigorous testing in the Munich labs. In June 2007 and May 2009, MVP executed and led a syndicate of top-tier investors from the US – Kleiner Perkins Caufield & Byers, and Europe – Wellington Partners which took the lead role after a significant valuation step-up at the last round. Waste Management Inc., the Houston-based leading provider of waste management services in North America invested in a subsequent round in April 2011, creating further strategic options and making it an emerging cleantech success story in Europe.

Figure 8.5: **Breakdown of the sources of renewable energy consumed in Germany in 2010**

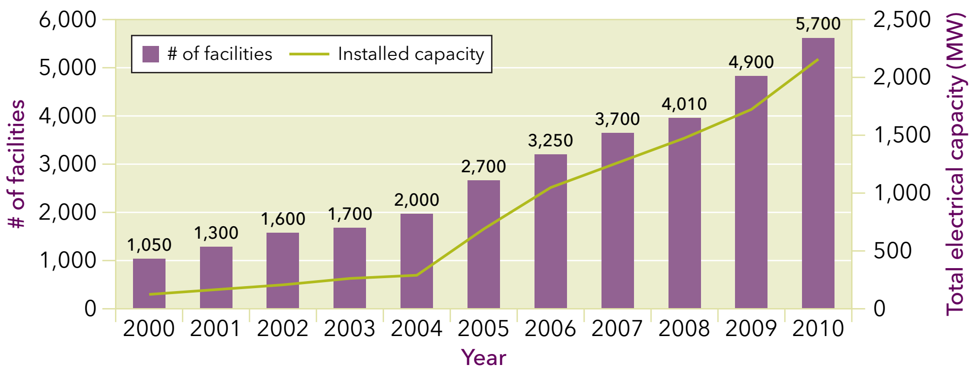
Germany serves as a potential guide to how big we can become...Germany has the largest installed base of solar and the third largest installed base of wind in the world...



... But actually produces more energy from organic materials through biogas than wind and solar combined.

Source: DENA, Berlin – Harvest Power, USA (2011).

Figure 8.6: **Growth in biogas in Germany – number of facilities and total capacity (MW) (2000–2010)**



Source: DENA Berlin, Harvest Power, US.

Germany's experience of meeting nearly 8 percent of its total energy consumption from bio-energy is indeed an encouraging statistic for other countries, especially those with a large and advanced agricultural base, including Brazil and the US. In fact, Figure 8.6 shows that Germany's biogas growth is the basis for its grand ambitions: the country aims supply 20 percent of its natural gas needs with biogas by 2020.

Whereas Germany offers some encouraging lessons for other jurisdictions, the following section covers concepts relevant to all market at various stages of adopting renewable energy. The section discusses whether renewable energy power generation should follow traditional planning approaches for power plants or whether whole-carbon calculations would suggest that a generation facility needs to be located close to its source of fuel.

Centralised versus distributed forms of energy

An important question arising for renewable energy businesses is the extent to which energy production will be centralised or decentralised in the future. It is clear that climate will dictate the location of solar parks or wind farms: without sunlight or wind they will not generate electricity. Despite large power plants having the advantage that technologies for high efficiency and low pollution can easily be adopted, they often cause significant issues if the feedstock fuel, in the context of biomass plants that is, has to be collected from a dispersed area using conventional carbon-emitting transport.

Decentralised, smaller power plants largely avoid this logistical problem, but make it more difficult to economically achieve low-emission values. Consequently, technologies improving the efficiency and reducing the pollution from decentralised renewable energy plants are met with high demand and provide for interesting investment opportunities. Aside from energy generation, decentralisation also causes issues for distribution. Most grids today are not 'smart' enough to cope with many small decentralised energy-production sites, resulting in technologies supporting a smarter grid are in high demand as well.

Biomass as a fuel for power plants is promising at it releases stored solar energy when burned – another upside is that such organic matter is available almost everywhere. Furthermore, a considerable percentage of our planet's domestic waste has a high organic content and could be used as fuel for such power plants. In this case, domestic waste disposal & treatment and energy production could potentially be economically combined. However, much of the biomass stock used today as an energy source presents some potentially serious food-supply conflicts with demand from the world's growing population. Unfortunately, the technologies currently available work best with food-stock biomass, that is, crops or corn. On the other hand, using wood or straw for energy generation would be in line with the world's nutrition ethics. However, both kinds of biomass as energy sources are problematic as currently the common approach is to simply burn them to use the heat for energy generation, which is effectively a low-efficiency process with associated severe pollution problems. Promising technologies for the efficient use of waste biomass, such as wood and straw, are currently in development and they are expected to be an increasing focus in cleantech investing circles.

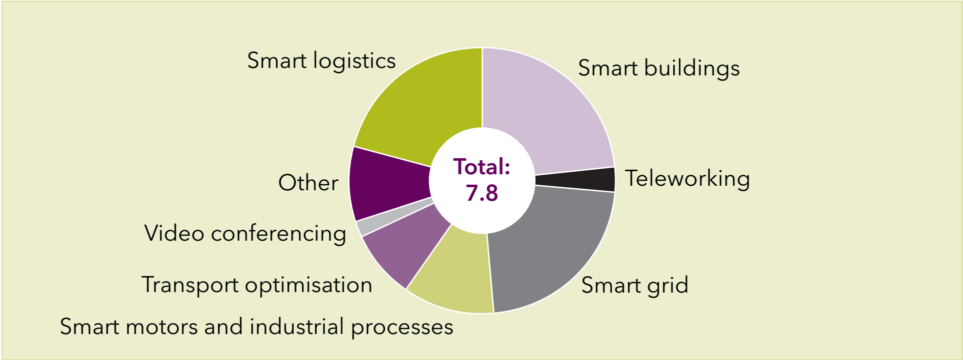
Wind power and photovoltaic power plants have historically been the fastest-growing clean energy sectors. Photovoltaic technologies still have a considerable potential for improvement and many start-ups are working on new materials, nanotechnologies or processes that have promising potential. This area still presents interesting opportunities for venture capital investments, albeit in technologies reaching efficiency ratios of more than 30 percent compared with today's typical 15 percent of primary energy used.

Energy storage will revolutionise cleantech

Although wind and sunlight are generally abundant, they are not always available when needed or expected. So, at night or when there is no wind, back-up solutions are required because these sources do not offer uninterrupted energy supply. Given these supply limitations, affordable and efficient energy-storage systems will play an important role in the future, resulting in a considerable impact on the planet's potential energy supply. Energy can be typically stored in batteries, as pressurised air, in magnetic fields, in gyros or thermal applications, but there is always pressure on technology to deliver better and more efficient storage solutions. Any inventor that could effectively capture the power of the sun or the wind in a cost-effective and scalable storage devise would have every VC very eager to invest.

Technology advances in energy storage are of particular interest for sustainable mobility, which is the other fast-growing segment of the clean technology market. Mobility is generally associated with petrol- or diesel-powered cars. Cars are a major source of environmental pollution, including noise and CO_2 emissions, so this is why alternative automotive technologies are always in the spotlight: hybrid cars, electrical cars based on batteries or fuel cells or cars with other forms of energy supply. For electric cars the biggest problem is the energy storage because a battery that could store the equivalent of a normal tank of fuel would cost more than a luxury car itself never mind the weight of the sheer weight of one of these batteries. On the other hand, fuel cells also require considerable cost improvements and size before they could become attractive for cars.

Figure 8.7: **ICT-enabled emissions reduction (year 2020; $GtCO_2e$)**



Source: Green ICT: A 'cool' factor in the wake of multiple meltdowns, ESCAP Technical Paper, December 2009.

Sustainable mobility in the future will therefore combine different disciplines to come up with an attractive solution: the weight will be reduced for lower fuel consumption, classical and electrical drives will be combined and intelligent traffic management systems (avoiding traffic jams and plotting efficient routes) will be implemented. This presents a broad variety of interesting investment opportunities, both, in clean energy technologies and green ICT or information and communications technology:

- *Dematerialisation* – replacing high-carbon activities with low-carbon alternatives such as e-billing, teleconferencing and e-media.
- *Virtualisation* – virtualising the physical world from hardware to work flows and optimising utilisation and efficiency.
- *Smart motors* – using ICT in the manufacturing sector such as the amount of energy used by the production lines.
- *Smart logistics* – facilitating better communication, cooperation and planning from sourcing to customer delivery.
- *Smart buildings* – from occupancy based lighting and heating solutions to automatic systems to capture sunlight or provide shade from unwanted warmth, ICT has a role to play.
- *Smart grids* – reducing energy loss through transmission (for example, a waste representing about one-sixth of India's carbon footprint). Demand management, smart grids, smart meters and real-time energy displays are changing energy suppliers and consumer behaviour.

Green ICT

ICT has fundamentally changed the world over the last 20 or 30 years and computational power is present in many of the devices we use in our everyday lives. In fact, as long as the functionality does not thwart us, we seldom consciously acknowledge that ICT is driving basically all of the products and services that we use today. ICT is perceived as an intrinsic part of our daily lives giving us ubiquitous communication capabilities and access to any kind of information we want. It is therefore not surprising that

ICT accounts for 25–30 percent of the annual GDP growth in industrialised countries, and it is safe to assume that it will continue to play a central role in the future. Green ICT is particularly promising as important megatrends which are crucial to the world's environmental integrity, including global transport and environmental protection, are likely to continue to offer promising investment opportunities.

Green ICT will be of major importance to developments protecting the environment. It is estimated that the Internet accounts for as much as 300 million tonnes of CO_2 at 2010 levels, which was more or less equivalent to half the fossil fuels burned in the UK.[4] Research published by NYSE-listed information technology research and advisory firm Gartner Inc.[5] in 2007 stated that the Internet accounted for 2 percent of global CO_2 emissions, which was equivalent to the amount produced by the entire commercial aviation industry. This could mean that the Internet will consume as much energy in 25 years as all of humanity does today, if policy and regulation do not curtail its growth.

Consequently, saving energy at data centres is an area of primary interest for new green ICT developments. In order to reach this goal, new green IT systems are needed at all levels of ICT, ranging from semiconductor components to novel computing and communications architectures.

In addition to the direct effects on energy consumption and, thus, environmental impact, green ICT will also play a major role in optimising processes and systems, and eliminating the inefficiencies which cause most of the negative issues today. Making our environment smarter is one of the key topics the world needs to achieve – green ICT will perhaps be the most important aspect in this challenge.

Value creation and due diligence

Cleantech investors commercialise high-tech innovations by identifying promising new technologies, supporting their development and generating returns through successful trade sales or IPOs. The technologies that qualify for investments must, in one way or another, be disruptive: they must have the potential to change markets in a fundamental way. This precondition is necessary because start-up companies can grasp significant business options, only if they are able to offset the market power and resource advantage of large incumbent competitors with substantially better products and speed. In cleantech this further entails that investment managers can think across disciplines in many cases. Therefore, it is important that limited partners considering investing in cleantech funds analyse managers' value-creation abilities when selecting their managers.

Leading investors should always have a bird's eye view and should consider the cleantech space in a holistic and systemic view. When selecting a fund manager, it is vital that investment teams should have demonstrable technical knowledge and market aptitude to assess attractive investment opportunities. They need to be able to follow

4 What's the carbon footprint of the internet? The Guardian, August 2010.

5 http://www.gartner.com/it/page.jsp?id=503867

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the megatrends across a number of areas including the global energy markets, such as environmental protection, globalisation (for example, wireless communication and in general green IT) as well as urbanisation.

No single individual can be an expert about everything however. In order to be successful in the long run, venture capitalists need to be very close to leading institutions of higher learning, science and technology.

Investors looking to invest in a cleantech fund should include these manager considerations in their due diligence as a matter of course. In addition, the following due diligence check-list provides some specific guidance for both direct and indirect investors in cleantech:

- Which technology risks are there in a cleantech investment?
- How asset-intensive is a specific investment?
- What would be the strategic exit routes? How long would an exit take?
- What is the investment team's previous sector-specific experience?
- Is a specific technology protected by patents?
- How dependent is the clean technology on government legislation and incentives?

Financing aspects

The leading cleantech investors in Europe have demonstrated that they are able to identify early-stage technologies with a high growth potential and to facilitate their development into successful companies paralleled by significant valuation increases. Investors will continue this successful investment model by predominantly investing in early-stage companies with proven technology and product maturity, that is, investments in high-tech start-ups at earlier stages of their lifecycle (seed, Series-A or Series-B rounds) which allow a rapid development and market success of their technology.

Financial risks can be significantly reduced, if the considered investment teams of the respective fund organisations excel not only in deal structuring and investment skills, but especially in technology and scientific experience and operational skills. For instance, a venture capitalist who is also an engineer is possibly more likely to help reduce the amount of financing risk in a company simply because he or she is able to understand better what the investment needs are compared with a non-specialist investor or consultant. Again, in the riskier domain of early-stage cleantech investments, this only goes to underscore that selecting the best manager can eradicate or at least temper some potential risks.

A growing number of venture capital firms are funding the development of new technologies in areas such as renewables, energy generation, advanced biofuels, electric vehicles, smart grids, battery technology, energy efficiency and grid storage. Similar to venture investing, only the best investors have produced outstanding performance in the area. The Cleantech Group's 2011 Global Greentech report[6] identified the top 100

[6] *Source:* http://www.cleantech.com/global-cleantech-100/

cleantech companies worldwide. More than 40 percent of them have dropped out, reflecting the high casualty rate and immature nature of the market.

While 2011 has been a steady year for cleantech and venture capital, surging interest in cleantech from global enterprises should support record results in 2012, replacing partly venture capital. Throughout 2011, investment totals grew while the number of deals declined by 7 percent compared to 2010, an indication that average round size is increasing. Of the 713 deals, 61 percent were Series-B or later rounds, accounting for 85 percent ($7.64 billion) of all money invested during the year. Syndication facilitates sharing the risks of asset-intensive investments requiring high upfront investments. Investments in North America grew significantly from $5.2 billion in 2010 to $6.8 billion in 2011 (a 30 percent increase). On the other hand, Europe and Israel took a step back, with $1.3 billion invested in 2011 compared to $1.8 billion in 2010. This decrease is due to broader economic and regulatory uncertainties but long-term upward trends are expected to resume in 2011. In Europe and Israel, the largest financing deals were for Better Place ($200 million – GE Capital and VantagePoint), Plastic Logic ($200 million – Rusnano) and Nexeon ($88 million – Imperial and Invesco).

Solar was the leading sector by amount invested ($1.8 billion), followed by energy efficiency ($1.5 billion) and transport ($1.1 billion). Energy efficiency was the most popular sector measured by the number of deals, with 150 funding rounds, ahead of solar (111 deals) and transport (61 deals). Kleiner Perkins Caufield & Byers, DFJ Global Network, New Enterprise Associates, Chrysalix Global Network, Rockport Capital Partners, Khosla Ventures and Generation Investment Management were among the most prolific investors in 2011. GE and Siemens are the most active strategic partners, followed by Google, IBM, Intel and PG&E.

Historically, M&A transactions have been a preferred route for exit. Totals were disclosed for 119 of the 391 cleantech M&A transactions, totalling $41.2 billion. Cleantech M&A started strong in 2012 with $15.1 billion across 77 deals, making it the fourth time that total amount exceeded $13 billion in the past.[7] Some 30 deals representing $4.3 billion and 29 percent of total acquisitions were bought by European buyers during the first quarter of 2012. The largest deal was DuPont's $6.3 billion acquisition of Danisco, a leading industrial biotechnology company based in Denmark. GE acquired France-based Converteam Group for $3.2 billion which is an electrical engineering company specialised in high operational efficiency motors and generators. Spain-based Iberdola (Qatar Investment Authority), Norway-based Elkem (BlueStar China), Netherlands-based IFCO Systems (Brambles), Sweden-based Vattenfall Asset Transmission Grid (Elia) were all landmarked deals passing the $1 billion deal value. Swiss electronic-metering company Landis+Gyr was acquired by Toshiba for $2.3 billion in 2011, a landmark deal and strategic play to enter the smart grid market. Noticeably, German Inge Watertechnologies, a developer of ultra-filtration membranes for water treatment applications, was acquired by BASF in an important exit for the water subsector in 2011, producing good returns for investors.

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7 *Source:* Cleantech Group LLC.

Public markets have been a secondary source of liquidity for investors (in terms of both size and value). The value of clean technology IPOs in 2011 totaling $9.6 billion was down from $16.4 billion in 2010. With 14 IPOs during Q1 2012 raising $1.03 billion in total – the lowest since Q3 2009, IPO numbers in Q1 2012 were not as impressive, continuing this downward trend. Large private venture-backed IPOs included Zipcar, KiOR and Gevo. With 28 of the 51 IPOs worldwide in 2011 filled in China, China remained strong for cleantech IPOs but many are state-owned groups. Several large offerings by renewable energy corporations such as Sinohydro, Sinovel Wind Group and Huaneng Renewable Energy were noticeable. The largest IPO was for Sinohydro, a Chinese state-owned hydropower company, which raised $2.1 billion on the Shanghai Stock Exchange. In Europe, two notable IPO filings are expected in Q1 2012, after $23 million 2011 revenue and $5 million 2011 net income. Backed by Samsung Ventures and Credit Agricole, Novaled is a German organic LED developer seeking $200 million. Norit is a Dutch water purification specialist targeting $200 million. Previous backers are Doughty Hanson and Gilde Buy Out Partners. The number of late-stage companies able to go public is still limited. The macro environment still dictates the IPO window, and the bar remains high requiring strong growth, healthy profitability and viable businesses. Markets distinguish stronger businesses based on profit margins, growth, competitive advantages and business models. Post-IPO consistency has been tested and resulted in mixed stock performance post-IPO. California-based Amyris is a case in point.

Regulatory risks

When investors invest indirectly or indirectly in cleantech there are some risks that would appear to be out of their immediate control: regulatory risk. While some degree of regulatory uncertainty or change is likely to impact on investment in renewable-power generation including solar and wind, the main impact that reduced feed-in tariffs are likely to have is in the supply chain, providing components and parts to solar parks and wind farms for example. Although a steady investment flow into these projects will no doubt improve the financial returns of VC-backed cleantech companies in the supply chain, there is a counter-argument that innovations in cleantech will eventually cancel out the need for subsidies. However, in the meantime, fund investors and VCs need to be just as vigilant as later-stage investment managers when committing capital in a climate of potential regulatory haze.

Conclusion

The global economy in 2012 is certainly in a difficult phase and it will only recover slowly over the next couple of years, which is arguably a positive state because it forces governments and industries to optimise their processes and to enhance their adaptive capabilities to prepare for further changes in the future. This is a great time for start-up companies to introduce new creative solutions and to capture opportunities for significant value creation.

ICT has reached a state which allows companies to globally optimise processes by integrating unprecedented computing power with ubiquitous broadband communication access. These developments are a fertile ground for new start-up companies in the green ICT space. Obviously, much of the developments will be based on proven infrastructure and systems, but new products and services will be required to really leap forward. Where green ICT can influence each industry segment, start-up companies have the opportunity to disrupt existing processes by introducing new ideas and establishing themselves as mandatory and highly valuable players in a future systems architecture.

In addition, there is a huge and fast growing market for new clean energy technologies products and solutions; these innovations harness renewable materials and energy sources, which dramatically reduce the use of natural resources, and cut or eliminate emissions and waste. Clean energy technologies are competitive with – if not superior to – conventional energy products and technologies. Tackling the global problems mentioned above requires an integrated approach of green ICT and clean energy technologies in each of the systems, such as water, electricity, transport, and healthcare. □

Summary findings:

- While cleantech investments are relatively new, they form an appealing investment strategy within the wider venture capital asset class because of cleantech's anti-cyclical nature, high demand for innovation and government and regulatory support
- A growing number of venture capital firms are funding the development of new technologies in areas such as renewables, energy generation, advanced biofuels, electric vehicles, smart grids, battery technology, energy efficiency and grid storage
- Europe benefits from strong research, leading innovation, favourable regulatory support and emerging broad venture interest and support
- Cleantech has established itself as a major focus in venture investing (along with ICT and life sciences), representing about a fifth of all venture capital invested

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9 Q&A: Clean-growth investment strategies and opportunities

Following a marked correction since the 2008 peak in clean energy valuations, Neil Auerbach of Hudson Clean Energy talks to* Private Equity International *about the upcoming attractive investment environment for experienced clean energy-focused private equity fund managers

Private Equity International: Which allocation buckets do your investors represent and what is the breakdown of investors by type and geography?

Neil Auerbach: We have more than 60 investors. Approximately two-thirds of our investors are based in North America and the rest are based outside of North America. Our investor base is also well diversified by type and comprises public pension funds, sovereign wealth funds, corporate pension funds, insurance companies, banks and high-net-worth investors. Certain of our investors focus on and have very deep expertise in conventional and/or clean energy whereas others maintain a more generalist investment approach.

PEI: Have you found there is a wave of newcomers to clean energy-focused investment funds or do you generally think that it tends to be more experienced investors?

Neil Auerbach: Headwinds facing clean energy public markets have been widely publicised, fuelling a degree of negative public sentiment that has kept certain potential new investors to remain on the sidelines. However, there are many experienced clean-energy investors that understand that clean energy markets are cyclical and perceive that we are at the tail end of a necessary correction after public market clean energy valuations increased to unsustainable levels in 2008. Hudson believes that clean energy is poised to achieve robust, long-term growth driven by strong underlying fundamentals, namely increased energy demand, environmental policy support (including a new focus on public health), increased energy security concerns and the increased cost competitiveness of clean energy versus conventional sources of energy. Furthermore, the divergence between market technicals (decreased public market valuations) and these strong fundamentals in our space suggests that mature companies with strong market positions that are generating positive cash flow can be acquired at attractive valuations. As a result, many clean-energy investors, both experienced and newly minted, anticipate that 2012 will present an attractive investment environment for experienced clean energy-focused private equity fund managers.

PEI: How can clean-energy investment managers convince so-called tourist investors to commit to clean energy at all stages of the economic cycle?

Neil Auerbach: It is useful to draw some interesting parallels to our space with the tech boom of the late 1990s that ended in 2000. If you compare the stock charts of the NASDAQ computer index and the NEX (clean energy) index, they are not identical, but they are very similar in terms of behaviour. The tech bubble bursting in 2000 did not signal the end of investing in the computer side of the technology sector; it was only the bursting of a bubble of irrational exuberance. The same can be said of clean energy – it has a variety of fundamentals that will continue to drive growth but in a different way. Investors will not be rewarded with quick doubling, tripling or quadrupling of profits, which was a function of momentum investors entering the market when it seemed as though everything was increasing in value and then subsequently abandoning the market when it began to decline.

Clean-energy investors were exposed to a period of unsustainably high valuations back in 2007 and 2008. That kind of phenomenon exists whenever you find a secular trend of high growth. We are still in a long-term secular trend of high growth in this sector. People do still care about the climate, but they also care about domestic energy security. Despite the fact that large shale gas reserves exist, consumers care that fossil fuels are considered to be a burden, not only because of carbon but also because of other pollutants, and the fact that many countries in the world don't have access to a steady supply of fossil fuels. Also, because clean technologies are becoming increasingly cost-competitive, they are a natural option for high-growth regions, such as Asia, which are very power-hungry, but not particularly rich in fossil fuels and therefore require a diverse source of supply. We are seeing a very strong value proposition for clean power now (more so than we've seen before) as clean power becomes cost-competitive with fossil fuels in more markets around the world. In fact, solar and wind have already reached grid parity[1] in many markets around the world. Furthermore, even at today's low natural gas prices in the US, new US wind farms are competitive with new combined-cycle power plants.

All of these considerations, plus the 'low-hanging fruit' of energy efficiency, the move towards clean alternative vehicles, the emergence of carbon storage and various sub themes all have real undercurrents where there is technology progress and real demand for these goods and services, that is either from the ultimate consumers or the middle consumers, the B2B market. There is demand for the products, goods and services supplied by our industry, and that fundamental growth trend is expected to continue.

PEI: When you speak to investors, are some of them still unconverted because the returns from old energy continue to be more appealing in certain circumstances?

Neil Auerbach: What kind of access do they actually have to those traditional energy investments? Are the returns actually the same? I'm not convinced. If you take an investment in nuclear power, it's an older type of clean energy or a different form of energy from what we consider to be part of the clean energy universe, but now the

[1] Grid parity is defined as the point at which means of generating electricity from alternative energy produces power at a levelised cost that is equal to or less than the price of purchasing power from the grid.

returns are actually at high risk. In terms of natural gas, prices in the US are depressed right now, so the supply outlook depends on whose information you use, which geologist you refer to in order to understand the flow rate of the wells and whether the depletion is measured accurately. I don't think investors in dry shale gas formations in the US are particularly pleased with their investments right now. In fact, one of the key current debates is the relative attractiveness of investing in shale gas versus renewable energy. We have to consider a number of issues about shale gas, not least of which is how the marginal cost varies dramatically depending on the location of the shale gas source, assumptions about depletion rates and whether there are environmental regulations in place. Shale gas projects may be generating cash, but they may not be generating a lot of value when you understand the depletion potential of those wells. Owners of merchant combined-cycle power plants are not pleased with today's low power price environment, even though fuel costs are low. Most wind farms operate under long-term contracts and earn attractive returns, as do solar power plants.

PEI: Should the yield on clean energy be inflation-hedged with the energy price movements or is it embedded particularly in the clean energy contract?

Neil Auerbach: It depends on the feed-in tariffs. Certain feed-in tariffs have explicit inflation protection built in. With respect to markets with bilateral power purchase agreements (PPAs), certain PPAs contain escalators related to Consumer Price Index (CPI). It is by no means universal. In general, power prices very weakly correlate with inflation. Hudson's sense is that many institutional investors have a preference for inflation-protected investments, but they do not always find it in the energy business.

If you're an investor in an asset that has secured a 20-year PPA or a feed-in tariff, where the contract is valid for 20 to 25 years, sufficient time to amortise your entire investment for yield, then why isn't it the same as buying a bond? If you look at the fixed income market, buying a bond typically does not provide inflation protection. If you can generate a yield in a market where the long-term rate for a high-quality sovereign ranges from 2 percent to five percent 5 percent, but you can generate a 10 percent yield on a product with very strong credit quality that has an implicit sovereign backing as well as the security of a tangible asset, many investors will view that investment as very attractive for their fixed income portfolio. For their inflation-protected portfolio, they are not looking to invest in bonds, or if they do, they invest in inflation-protected sovereign bonds such as US Treasury Inflation-Protected Securities (TIPS). That's a very big part of the bond market where you buy inflation protection and the sovereign, in this case the US Treasury, gives you that kind of a yield. As one would expect, with a floating-rate bond, the interest rate will go up and down in line with inflation.

PEI: In your view, is a feed-in tariff or a PPA a necessary element of making the business model work for a clean-energy investment?

Neil Auerbach: What a clean power asset has that is very different from a fossil fuel asset is very low operating costs, but much higher capital costs. If you think about investing in a combined-cycle natural gas plant or a coal plant, the capital intensity is not as high as in a clean power investment – the capital cost could be half. Your profit in fossil fuel assets is a function of the differential between your cost of the raw fuel and the cost of your product, which is the sale of electrons. In a clean power asset, the fuel, in general, is free (with the exception of biomass feedstock), so this choice tends to feature a longer payback and is more capital-intensive. If you are taking more risk by putting the capital upfront and you do not have visibility into the price for the output in which you are actually investing, some certainty is required to generate a more secure return. The host market enjoys greater operating certainty because the wind – even if it varies from day to day or month to month – is generally predictable over time. Solar energy is even more predictable, whereas hydro is definitely more volatile, but tends to even out over time. If you put up more capital for a renewable power plant compared to a fossil fuel plant, and you sell the power merchant, that is, you sell the power continuously at prevailing market prices, you are taking more risk. That should not be the case. PPAs and feed-in tariffs mitigate the risk to investors in clean power for investing in an asset with lower operating cost and higher capital cost.

The perceived problem is that the price for that feed-in tariff is too high relative to the cost of competing brown power. I would say two things about that. First, those prices are coming down precipitously. And second, it's worth it to the host country, to the end-user and to the utility to have more stable sources of energy supply, which are not subject to external price shocks. If you internalise the benefits you derive from clean power, that price differential diminishes rapidly. In any event, because the technologies are improving, the economies of scale are kicking in and the differentials are diminishing. In Brazil, the cheapest form of power you can buy is wind power. In many places in the world, including the Western US, you can buy solar power in bulk, actually either at the retail level or the utility resale level, for half the cost of that what that power cost just three or four years ago. And those prices are expected to continue to come down. Moreover, as the clean energy business expands into emerging markets with inferior access to fossil fuels and higher power prices, you will find more and more evidence that a PPA or feed-in tariff for a clean power asset can actually be cheaper than brown power.

PEI: Do you hear concerns from investors that there might be the threat of changes to those feed-in tariffs?

Neil Auerbach: We have heard these concerns, and some investors have shied away from feed-in-tariff markets as a result. Spain had historically been a leader in clean energy but its investment in the sector declined by 54 percent in 2010 as the nation addressed fiscal imbalances and rolled out retroactive feed-in-tariff reductions. I believe the Spanish government has caused more harm than good to its reputation and the reputation of the industry among certain institutional investors. However, that does not mean that institutional investors have abandoned Spain. Extra risk has to be borne by investors in Spain, and that has affected price and yield.

PEI: Generally speaking, do you think that funds are building up portfolios of similar types of businesses or is the industry developing in such a way that more opportunities are available?

Neil Auerbach: We define our clean-energy investment world to encompass a broad range of clean-energy businesses, including renewable energy, energy smart technologies (itself a broadly defined universe), and environmental remediation of fossil fuels. Under our definition of clean energy, not only are there uncorrelated investment opportunities, but they are truly differentiated. As an example, we owned part of one of the world's largest electricity meter and smart-meter companies. The company is very different from another of our investments, which is involved in energy-efficiency retrofits. They may be viewed as having something to do with one another as both businesses focus on more efficient consumption of energy, but they diverge completely in their profiles and business models, and therefore they are relatively uncorrelated. We study the correlation among various multi-billion dollar subsectors. There are also big differences in geography, because we have a global investment approach and we also take advantage of the fact that different geographies have different tempos in the local economy and investment activity. So we can create diversification in our portfolio by investing in different regions in the world, as well as different sectors and different parts of the value chain, whether we are investing in companies that are engaged in development, providing services or manufacturing.

So far, we have sourced over 2,600 investment opportunities since our firm's inception, and we expect to see an increased number of attractive opportunities in line with the industry growing and valuations normalising. The trend over much of the last decade shows that almost all of the action was centered in the US and in Western Europe. Over the past few years, the activity has spread to areas of high economic growth, which includes the BRIC (Brazil, Russia, India and China) countries and Asia in general. We see very attractive growth opportunities in China and Latin America. The geographical diversity and sheer number of attractive investment opportunities in the global clean energy sector enables us to put capital to work in a risk-mitigated, disciplined way.

PEI: Is that because of the regulatory environment and conditions in those markets?

Neil Auerbach: There is no question that our sector is driven primarily by three forces: markets, technology and policy. Policy relates to the regulatory or legislative environment in any particular locale or country, state or municipality. A more hospitable regulatory environment certainly makes it easier to deploy capital and generate an attractive return. That said, irrespective of the market, Hudson targets investments with protected margins, where technology, policy and market risk have been eliminated or substantially mitigated. The investment opportunity set today is broader than ever, and in many cases, the most attractive investment opportunities are those with little or no reliance on the regulatory environment.

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PEI: Which are your preferred top jurisdictions for investment?

Neil Auerbach: The US remains an attractive market as growth in clean energy deployment has been driven at the state level through renewable portfolio standard (RPS) targets. We are also excited about China. In recent years, China has emerged as a leader in both the pace of renewable energy policy adoption as well as the scope of its ambition to scale its clean energy deployment. During 2011, Hudson increased its presence in China by opening an office in Beijing and expanding origination efforts there to source high-quality deal flow in the region. There are many markets in Europe that remain attractive as renewables are targeted to double by 2020. Whereas Spain and Italy have been challenged, Germany is still an attractive market, although onshore renewables are clearly coming close to a saturation point. The UK has expressed a very strong commitment to being a low-carbon economy and is making efforts to try to ease the regulatory impediments to the inflow of capital. Japan is becoming interesting again as the post-Fukushima world has realised the need to reduce dependence on nuclear plants and increase investment in clean energy. Overall, there is broad, global acceptance of the need to rapidly expand investment in clean energy. I would also add that there are dozens of other markets that possess three critical criteria: high power prices, strong renewable resources and limited fossil fuel resources.

PEI: What control positions do you prefer in your investments? And are you seeing a growth in the number of GPs you can co-invest with?

Neil Auerbach: We prefer to pursue non-competitive opportunities where Hudson can be a control or control-orientated investor. For us, a control-orientated approach means ownership positions ranging from traditional majority control to significant minority stakes with board representation, negative controls and significant influence. That gives us the ability to actively work closely with portfolio-company management teams to focus on adding value and improving the companies' business models to the benefit of our investors. That said, we are also willing to invest alongside other GPs when it makes sense strategically to do so.

PEI: Do you think that there are any pressures or influences from the incentive and compensation models for clean-energy investing?

Neil Auerbach: Institutional investors, either directly with GPs or through organisations, such as the Institutional Limited Partners Association (ILPA), have worked to address perceived areas of weakness and/or conflicts of interest in the incentive and compensation models to make them more LP-friendly – this is part of an ongoing symbiotic relationship between limited partners and general partners which needs to evolve in line with market movement. Investors want greater alignment of interest that does not involve putting up more money, but does involve improving certain terms that govern the GP-LP relationship. I think this is influencing the Dodd Frank Act in the way financial institutions are regulated. I believe the private equity model creates a better alignment of interest with stakeholders than the investment banking compensation

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model does, for example. There is give and take in this area and dialogue about best practices should continue.

PEI: Which aspects of taxation are of most concern in clean-energy investing?

Neil Auerbach: As it relates to fund investing, taxation issues, including the Foreign Investment in Real Property Tax Act (FIRPTA), Unrelated Business Taxable Income (UBTI) and Effectively Connected Income (ECI), have been front of mind for fund investors. Hudson has gone to great lengths from a structuring perspective to minimise any tax burdens for our investors.

PEI: Do you have any general views of company portfolio fees? Are these fees subject to cyclical events or will they prevail?

Neil Auerbach: GPs need to be responsible stewards of investors' capital. At Hudson, our limited partners' interests come first – this is ingrained in our culture and our limited partners recognise and understand this. In the context of a GP providing a very important service to a portfolio company, which ultimately adds value to a limited partner's portfolio, the idea of charging a fee to the portfolio company for that service and then sharing the majority of that benefit with limited partners seems more than reasonable. At Hudson, we ask ourselves if we are acting as good fiduciaries – acting in the best interests of our limited partners. If there is compelling value for all parties in the GP/LP dynamic, then the alignment of interest is working well.

PEI: Looking forward, how can the market work towards attracting more than the often-quoted 2 percent of pension fund and sovereign wealth fund money that is invested in clean energy?

Neil Auerbach: It is important to understand that the investment mandates and guidelines of pension funds and sovereign wealth funds vary. Certain pension funds and sovereign wealth funds are likely to invest first in the lower-risk aspects of clean energy, that is, at the infrastructure end of the spectrum. In my experience, many pension funds and sovereign wealth funds are looking for a long-term investment horizon, so investment products need to address this. Overall, pension funds and sovereign wealth funds have diverse objectives, so fund managers need to understand that their approach is not one-size-fits all.

That said, in order to attract more investors (not only pension fund and sovereign wealth funds) to the clean energy space, it will be important to ensure investors are fully aware that clean energy is one of the global economy's fastest-growing industries and that energy demand, security concerns, environmental protection, and cost competitiveness will continue to drive growth in clean energy's multi-billion dollar subsectors. Clean energy is a key, long-term contributor to the global energy mix and investors should want exposure, especially sovereign wealth funds from the Persian Gulf region that are existentially overexposed to fossil fuels. It was another notable year for capital deployment in clean energy in 2011, with a record $260 billion invested in the sector globally. The more that we can do to educate investors on the space and increase awareness, the more investors will recognise that they should have an allocation to clean energy as it continues to grow in various parts in the world. In addition, as is the case for fund managers in any other sector, it is key to generate strong investment performance in our space by way of returning capital to investors. As you would expect, we take this very seriously at Hudson. □

Neil Z. Auerbach *is founder and managing partner of Hudson. Formerly, Neil was a partner at Goldman Sachs & Co. where he co-founded the US alternative energy investment business within the Special Situations Group and led several of Goldman Sachs' successful investments in renewable energy. Neil founded and managed several other businesses at Goldman during his seven-year tenure with the firm, supervising over 30 professionals in the US and Europe, and presiding over a $3 billion balance sheet. Neil worked in the firm's Debt Capital Markets and Credit Derivatives units before joining the Special Situations Group in 2003. From 1997 to 1999, he was managing director and head of Structured Capital Markets at Barclays Capital. Prior to that, Neil was principal (co-head) of a Morgan Stanley joint venture between the firm's Derivatives and Debt Capital Markets groups. After several years as tax attorney with McDermott, Will & Emery (1991 to 1992, partner), Shearman & Sterling (1985 to 1991, associate) and Cahill Gordon & Reindel (1984 to 1985, associate), Neil served as branch chief, assistant to the associate chief counsel of the Internal Revenue Service (1992 to 1994).*

Neil serves on the board of directors of Recurrent Energy, Element Power, Eagle Creek and Silicor Materials, Inc. on behalf of Hudson. Neil is a member of the Leadership Council, American Council on Renewable Energy (ACORE), and serves on the Executive Committee of ACORE's Partnership for Renewable Energy Finance. Neil is a member of the US Council on Competitiveness, serves on the advisory council of the Prince of Wales' Rainforest Project and was formerly a commissioner of the National Commission on Energy Policy (NCEP). Neil leads Hudson's global efforts to engage with the political and business communities to develop policy frameworks that best facilitate the scale-up of clean energy. Neil has earned a LLM degree from New York University School of Law and a J.D. degree from Boston University School of Law and holds a B.S. degree from the State University of New York at Albany.

10 Funds of funds in the clean growth space

By Keimpe Keuning and Nathalie Gresch, SAM Private Equity

This chapter discusses:

- Risk and return characteristics
- Fund universe
- Value creation and regulatory framework
- Due diligence priorities and diversification requirements

Introduction

When California-based venture firm Technology Partners earned its reputation in 1991 as a pioneer in cleantech by investing into CellNet Data Systems, it was considered a niche strategy and the word 'cleantech' was most likely to refer to dry cleaning. Today, cleantech is the fastest-growing sector in the venture capital business and according to John Doerr, partner at Kleiner Perkins Caufield & Byers, potentially "the biggest economic opportunity of the 21st century".[1]

While at the beginning of this century only a handful of dedicated cleantech funds capitalised on the emerging opportunity, mostly investing in early-stage green technologies, the sector has matured in recent years. It has become apparent that the IT venture business model of investing into early-stage technology and waiting for the Facebook moment in which a single portfolio company would return the whole fund, could not be transferred to the cleantech space. In spite of revolutionary concepts and compelling business ideas cleantech companies have typically needed more capital and longer lead times than was originally anticipated. As a result, a handful of cleantech firms are raising (successor) funds with differentiated investment strategies, frequently focused on the growth stage of companies. Instead of a widescale sowing of seeds and hoping for them to sprout and develop, a selection of saplings would be fostered and the low-hanging fruit harvested swiftly. In other words, instead of investing in the early, pre-revenue, technology-focused companies, the focus should be on companies that already generate revenues, have a customer base, are close to break-even and in need of expansion capital. It is this opportunity a clean-growth-focused fund of funds is both driving and profiting from.

[1] *Source:* TED2007, March 2007.

The following chapter sheds light on clean-growth investments from a fund of funds perspective and explains the associated risk and return characteristics specific to the space. It discusses the fund universe, value creation, regulatory aspects, due diligence priorities and diversification requirements.

What are clean-growth investments?

The 'green' investment space is often associated with companies such as Tesla Motors, Silver Spring Networks, First Solar, A123, Solazyme, Fisker Automotive, Better Place or any of the other companies which have been in the news frequently. In spite of operating in a diverse range of sectors and industries, these companies have a common denominator as they all offer solutions that are inherently designed to:

- improve the productive and responsible use of natural resources;
- greatly reduce or eliminate negative ecological impact; and
- provide superior performance at lower costs.

Typically, a clean growth-stage company is a mid-size company with strong growth potential (that is, operating in a large and growing market), substantial (or fast-growing) revenues, established technology and a competitive advantage whereas a cleantech company is a small, usually pre-revenue-stage company that is focused on developing technologies; that is, a company which is at the alpha stage of a product.

While the concept of clean growth embraces a diverse range of opportunities that gear economies towards greener development and spans many sectors (see Table 10.1), areas particularly suited to the growth space are energy efficiency, water and wastewater, recycling and waste and some areas of energy generation and electrification of transport. These segments show strong underlying growth, strong competitive clusters and strong international trends as well as sizable subsectors, with a large number of active companies. The rapid growth of these sectors has been fuelled by rapid technology advancement, reduced costs and growing concerns over high energy prices, energy-supply security, the effects of climate change and resource depletion as well as by increasing levels of investment from corporate, public and private investors.

An example of a subsector where high growth is expected is organic waste recycling and the transformation of waste to energy. This market is huge with the annual addressable market for organic waste in the US alone amounting up to 160 million tons – and growing rapidly. Today, 97.5 percent of all food waste in the US is land-filled.[2] By diverting waste streams away from landfills and incinerators to create renewable energy and organic soil, diverse revenue streams can be generated from i) collecting tipping fees (fees charged by landfill for each ton of waste); ii) selling renewable energy; and iii) selling organic soil. As established technologies are transferred from more mature markets (such as Europe) to regions where waste recycling is only starting to

[2] *Source:* Municipal Solid Waste in the United States: 2005 Facts and Figures, Executive Summary, US Environmental Protection Agency, Municipal and Industrial Solid Waste Division, Office of Solid Waste, (October 2006), page 7.

Table 10.1: **Clean technology sectors and technologies**

Sectors	Clean technology examples
Energy generation	Wind, solar, hydro, marine, biofuels, geothermal, clean coal technologies, coal bed methane
Energy storage	Fuel cells, advanced batteries, hybrid systems
Energy infrastructure	Management, smart grids, transmission
Energy efficiency	Lighting, buildings, glass, ESCOs, combined heat and power
Transport	Structures, fuels, hydrogen highways, biofuel distribution, electric vehicles, vehicle sharing
Water and wastewater	Water treatment, water conservation, wastewater treatment, desalination
Air and environment	Cleanup/safety, emissions control, monitoring/compliance, carbon capture, SOX/NOX removal
Materials	Nano, bio, chemical, other
Manufacturing/industrial	Advanced packaging, monitoring and control, smart production
Agriculture	Natural pesticides, land management, aquaculture
Recycling and waste	Recycling, waste treatment

Source: SAM Private Equity.

become bigger, such as the US or Asia, selecting and supporting the emerging category leader can provide substantial opportunities.

At the same time, investors should be wary of investing in what are arguably i) overvalued and overhyped areas, which is, for example, currently the case in some areas of the photovoltaic and batteries value chain; and ii) companies/projects with short-term business models which are heavily dependent on temporary subsidies or market dislocations.

To summarise, selecting the emerging leaders of attractive and growing subsectors and supporting them in commercialising their novel products and solutions may provide compelling investment opportunities, as their need for both operational assistance and additional growth capital can be met by the experienced clean-growth investor.

Value creation in the space

Generally, the technology value chain can be grouped into three major components: technology development, technology deployment and technology operations. Technologies are initially developed at universities or corporate research and development centers. Once companies have been created around them, their commercial development is often financed through venture capital funding. As these technologies

From cleantech to clean growth: Tesla Motors

Armed with nothing but a visionary idea, Martin Eberhard and his business partners Marc Tarpenning and Ian Wright incorporated Tesla Motors in 2003. Looking for an initial round of financing to develop an advanced prototype of what would later be known as the Tesla Roadster, they were able to attract Series-A funding of slightly more than $6 million. After several rounds of external financing to bring the company from development stage to an operational stage, Tesla started selling the first Roadsters in 2008. By the end of 2009, the company had raised an aggregate $187 million, sold 937 Tesla Roadsters to customers in 18 countries and generated more than $126 million in revenue, showing that the company had moved from the tech stage to the growth stage.

On June 29, 2010, Tesla Motors went public and raised $226 million, providing its investors and early supporters with substantial returns.

Tesla Motors' story exemplifies the typical cleantech-to-clean-growth value creation process, which ranges from an early-stage business plan and technology development, with no revenues and customers to a growth phase company, where market traction increases and first generation products are sold. At a next stage of the corporate maturity process, the business is scaled up, the strategy is rolled out internationally and products are sold on a commercial scale.

From cleantech to clean growth: A123

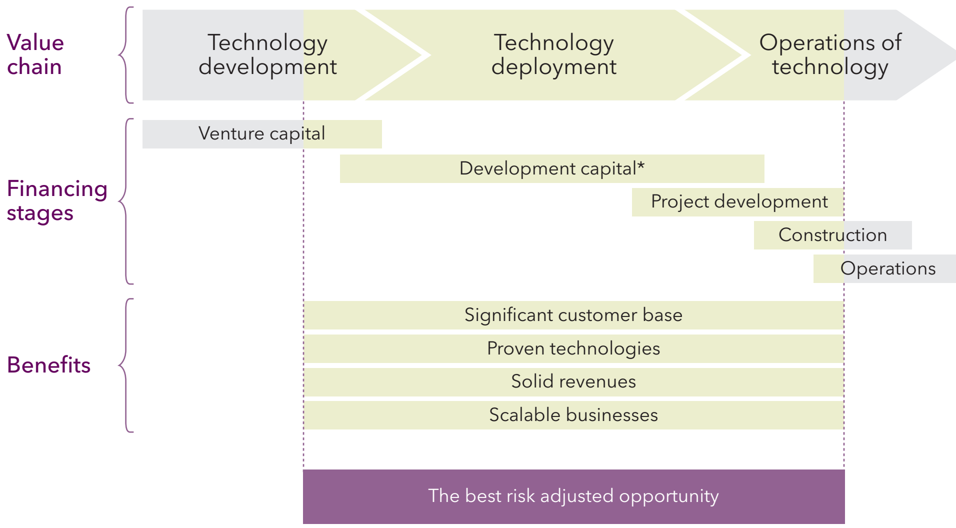
The story of A123 started in 2000 in the lab of MIT's Department of Materials Science and Engineering, where Dr. Yet-Ming Chiang hit on a potentially revolutionary way to fabricate batteries. After jump starting a battery company (together with Riley, an experienced engineer and Fulop, an entrepreneur) Chiang was able to raise an $8.3 million Series A round in 2001, which would be a typical tech-stage investment. The proceeds were used to develop the technology, which included a strategic shift from the original idea of a self-organising battery to the use of nanophosphate material.

In 2005, A123 Systems was able to show its product: a new higher-power, faster-recharging lithium-ion battery system. After new rounds of financing (this time growth-stage capital) to foster expansion, the company made three acquisitions, opened a series of plants in China, signed several strategic deals and in September 23, 2009 went public on the NASDAQ stock exchange.

Again, the A123 story exemplifies the typical clean growth value creation process as described above.

become commercially viable, development capital is needed to scale up these businesses. At this stage of its lifecycle, a clean growth company typically grows in two ways: (i) the scale-up of a manufacturing plant or a large investment into human capital (hiring

Figure 10.1: **Clean growth value chain and associated financing stages**



* Also referred to as growth capital.
Source: SAM Private Equity.

engineers for product development, etc.); or (ii) a deployment of a large amount of capital to build assets such as solar parks, wind farms and water-treatment facilities. The second type of growth requires investors with extensive knowledge and experience in project development, construction and project operations. The clean growth value chain and associated financing stages are illustrated and summarised in the Figure 10.1.

There have been three major developments during the evolution of the green private equity space comprising:

(i) allocations to the space have gradually increased over time, leading to a larger number of venture investors which in turn has led to larger fund sizes and investments;
(ii) a second generation of funds and an increase in fund sizes has caused investment groups to move up the value chain taking advantage of the rapid increase in available capital. This in turn allows for investments into later-stage companies; and
(iii) a natural moment in time to exit investments is at the realisation or just before realisation of a tipping point of product take-up and ramp-up of revenues and profitability.

As a result of these three factors, an attractive risk-adjusted opportunity is the development-capital stage (that is, growth capital) of the market with investments in (i) more proven technologies (companies with limited technology risk) and focus on scale up, business and commercial risk; and (ii) in companies that already have a significant customer base. From the perspective of a growth investor's return, it is crucial to support leading and winning companies and invest at the right inflection point where the most value is created.

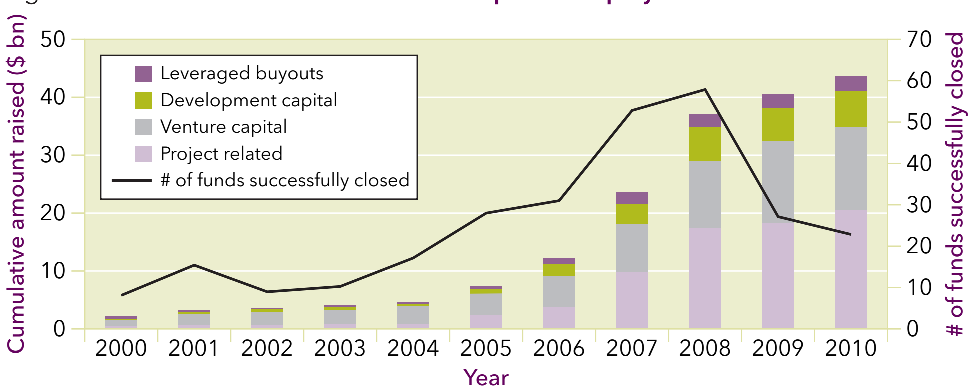
Who are the players?

In recent years, private sector investors and governments have begun initiatives to provide capital to clean growth companies, thereby facilitating growth and creating value within the industry. However, current funding is insufficient to meet the growing demand for capital to build new renewable energy assets, to maintain and improve existing (water) infrastructure and to develop new products. Therefore the private sector has an opportunity to provide additional capital and thereby help meeting the ambitious environmental targets that governments around the globe have set.

Even though the economic downturn had a significant impact on the ability of private equity fund managers to raise new capital, the clean growth private equity market has grown in importance in recent years, with the demand for socially and environmentally friendly investments from the institutional investor market fuelling a significant rise in number of clean-growth funds.

Since the first cleantech-focused private equity funds were formed in the 1990s, almost 300 funds have raised over $44 billion of capital available for investments.[3] The fastest-growing fund type is investing in environmental infrastructure (project-related). These are often managed by teams with extensive experience in the development of energy generating assets or transport infrastructure. These funds typically

Figure 10.2: **Growth of cleantech-focused private equity funds**



Type (1994–2010)	Total (%)	$ bn	Disclosed deals
Project related	46.9	20.6	92
Venture capital	32.7	14.3	150
Development capital	15.4	6.7	41
Leveraged buyouts	5.1	2.2	9
Total		43.9	292

Source: SAM Private Equity, Bloomberg New Energy Finance, Preqin, March 2011.

[3] *Source:* Bloomberg New Energy Finance; Robeco SAM Database as of February 2011.

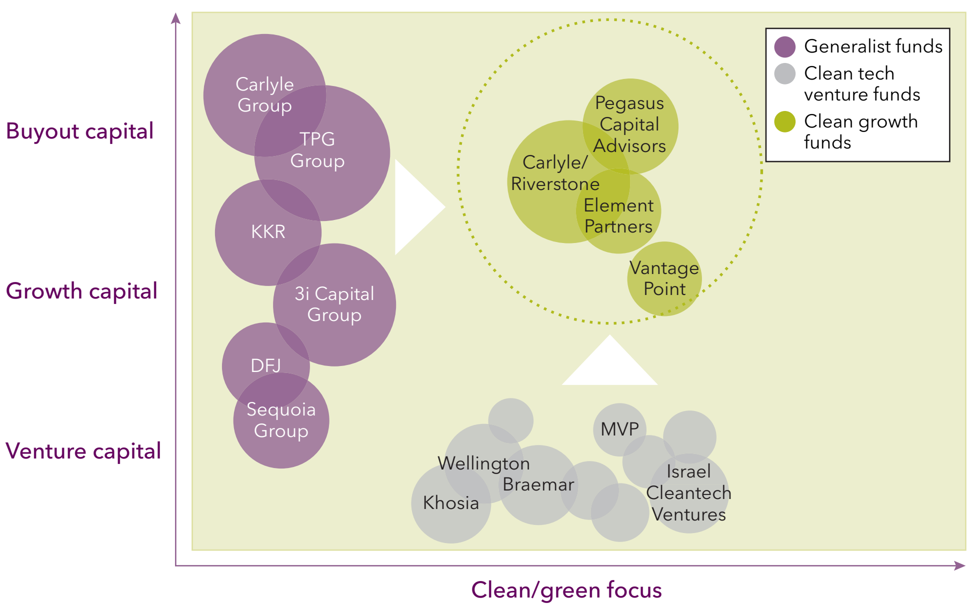
invest in environmental infrastructure projects from early development to beginning operations. A separate group of funds is focused on owning and operating (renewable energy) assets.

Amid continuous growth of available capital the initial investor universe (mainly North America-based venture capital investors) has matured and has become more equipped to support growth and development stage companies. This trend is also driven by the fact that an increasing number of venture-backed technologies are becoming commercially viable and now require significant further funding. History has shown that cleantech companies require longer holding periods, which is due to the slower adoption process of some end markets (such as power and water), the agricultural sector, the automotive industry and the inertia of governments.

Today, there is still a large focus on venture-type deals in the green investment space. Venture firms typically support technology development and have limited capabilities and capital resources to assist with scale-up and commercialisation. Generalist funds on the other hand have operational and capital resources to address growth equity generically, but lack expertise in cleantech and do not have an investment team with the relevant domain knowledge. So far, their focus within the space has primarily been on project finance for wind and solar parks.

In short, while generalist funds have typically invested in large companies and lacked sector focus, only few specialists have concentrated on the lower mid-market private equity growth segment.

Figure 10.3: **A select group of funds is dedicated to the clean growth space**



Source: SAM Private Equity.

The company names shown in Figure 10.3 are only for illustrative purposes and do not to reflect the entire universe.

However, as the development-capital stage is a natural growth area for cleantech, a number of both new and established fund managers have recently started to deploy capital in the segment. This is especially true for fund managers that are raising second-, third- or fourth-generation funds, which are larger in size and therefore better suited for investments into growth-stage companies. More recently, a handful of managers, mainly Europe-based, have also started to focus on clean buyout strategies.

Two examples of such managers are Alder and VantagePoint Venture Partners.

VC focus: VantagePoint Venture Partners and Alder

VantagePoint Venture Partners is one of the largest venture capital firms in North America with currently around $4.5 billion of capital under management.[4] The firm is organised around a number of key sectors, including cleantech, information technology, healthcare and emerging markets and in 2002 it became the first major venture firm to create a dedicated cleantech group.

Since VantagePoint's initial cleantech investment in 2003 they have committed $1 billion to the sector.[5] While the its first cleantech fund was dedicated to venture investing, its second fund included more development stage investments and its third green fund will have a specific focus on growth capital. This gradual stage change is also reflected in the change of the name of its newest fund; from VantagePoint CleanTech Partners to VantagePoint Cleantech Growth Fund. This growth fund will support companies that have progressed beyond the technology validation stage and that are undergoing the scale-up process necessary to commercially dominate important sectors.

Alder, on the other side of the spectrum, is a first-time fund manager that makes late-stage growth capital and small green buyout investments in the Nordics. The Nordic region was an early mover in developing environmental technologies and has many companies that are well positioned to take advantage of the growing worldwide demand for more environmentally sustainable products and services. Alder's first investment, the acquisition of a majority stake into an established and well-known family-owned biomass heating business is a good validation of the investment strategy. Besides bringing additional capital, Alder aims to support its portfolio companies with its network and experience to fuel both organic and international growth.

The largest pure clean-growth funds that have been raised to date are listed in Table 10.2. It is apparent that the fund universe is very diverse, both in terms of type of investments, geography as well as sector and stage.

[4] *Source:* http://www.vpcp.com/about_us, September 2011.
[5] *Source:* http://www.vpcp.com/about_us, September 2011.

Table 10.2: **Largest pure cleantech funds raised***

Fund name	Manager	Fund type	Vintage year	Currency	Size (m)	Geographic focus
Riverstone/Carlyle Renewable and Alternative Fund II	Riverstone Holdings	Natural resources	2009	$	3,418	US
Hudson Clean Energy Partners	Hudson Clean Energy Partners	Growth	2009	$	1,024	US
KPCB Green Growth Fund	Kleiner Perkins Caufield & Byers	Venture	2008	$	764**	US
Climate Change Capital Carbon Fund II	Climate Change Capital	Balanced	2006	€	750	ROW
Carlyle/Riverstone Renewable Energy Infrastructure Fund I	Riverstone Holdings	Natural resources	2006	$	685	US
Climate Solutions Fund	Generation Investment Management	Venture	2008	$	683	Europe
Element Partners II	Element Partners	Growth	2009	$	486	US
USRG Power and Biofuels Fund II	US Renewables Group	Infrastructure	2007	$	475	US
Rockport Capital Partners III	RockPort Capital Partners	Venture	2008	$	453	US
BNP Paribas Clean Energy Fund	BNP Paribas Clean Energy Partners	Infrastructure	2010	€	437	Europe
VantagePoint Cleantech Partners II	VantagePoint Capital Partners	Venture	2008	$	435	US
European Clean Energy Fund	TCW Group	Infrastructure	2007	€	354	Europe
Global Environment Emerging Markets Fund III	Global Environment Fund	Venture	2007	$	327	ROW
Angeleno Investors III	Angeleno Group	Growth	2010	$	311	US

* This table shows funds that are exclusively focused on cleantech.
** According to Bloomberg New Energy Finance, interim close as of March, 2 2009 was $764 million, according to Preqin final size is $500 million.
Source: The 2011 Preqin Private Equity Cleantech Review, Bloomberg New Energy Finance, SAM database as of May 2011.

While some of the managers listed in Table 10.2 are emerging from a background in oil and gas or the broader energy sector (Riverstone Holdings, Element Partners) or have grown with the IT industry (Kleiner Perkins Caufield & Byers), others are specialist shops within a larger asset management platform (Carlyle Group, BNP Paribas Clean Energy Partners). Finally, the last decade has seen an increasing number of new managers. Apart from the pure-play funds, there is a rising appetite for clean-growth investment funds among non-specialists firms such as ArcLight Capital Partners, Ashmore Investment Management, AXA Private Equity, Trident Capital or Blackstone Infrastructure Partners just to name a few.

Risks and other considerations

Investing in private equity always involves risks, many stemming from the long-term nature of commitments with limited liquidity. In addition there are risks that are specific to the green space or that are more pronounced in this area. One of these is technology risk, which is actually subdivided into three areas. In addition adoption risk and policy risk are considered below.

Technology risk

First, the technology being developed by a start-up may just not work. This is a typical risk associated with venture investing and can usually be avoided at the growth stage of a company.

Second, the technology works in the lab, but takes too long and too much capital to scale up to a point where a profitable sale is feasible. Solar cells produce electricity but not efficiently enough, batteries store energy but not cheaply enough, and bacteria make fuel but not fast enough. This is a risk that can apply to growth-stage investing but should normally be erased by further development at that stage.

Many cleantech companies are getting customer traction and are able to sell their products; however, often manufacturing processes and/or overhead are too costly, leaving the company with negative operating cash flows. Tesla Motors, for example, generated revenues of almost $100 million in 2010 but still recorded a net loss of over $150 million.[6]

Third, the technology works but something better comes along. As in any industry, a new product will have to be better than the incumbent leading products. However, as the green area is highly dynamic and rapidly changing, it is particularly hard to assess which technology will emerge as a winner in its industry. Once a rock star in the solar industry, evergreen solar was not able to keep up with the competition from China that was flooding the market with cheap solar cells and eventually had to file for bankruptcy.

Adoption risk

A further risk is related to the reluctance of customers to adapt to new products and concepts. Many purchasing decisions require significant capital and only pay off in the long run; therefore decision cycles are usually also longer as customers need to build

[6] *Source:* Company's Annual Report, 2010

up trust in the product and its supplier. The sectors that green technologies are used in and adopted by are by nature highly regulated (for example, utilities) and slow to react as they are very capital-intensive and have long product cycles (transport industry). These segments cannot be compared to fast-evolving and adapting segment such as the social media space, where Facebook, for example, managed to gain over 800 million users in less than eight years.[7]

The flipside is that the development of many ventures in the cleantech area is very capital-intensive. Whether a new wind turbine design, a new electric vehicle, a new storage idea, a new bio fuel technology or an innovative biochemical concept is developed, each of these requires a lot of technical equipment and engineering staff. Once a concept is proven it needs to be taken to the next level. The concept needs to be proven to work on a large-scale or it requires major manufacturing scale-up investments in order to achieve volumes and economies of scale.

Policy risk

Arguably the largest risk associated with clean-growth investing is policy risk. Changing environmental laws, tax incentives, permitting rules, utility regulation are on one hand potential returns drivers, but on the other hand are also a source of uncertainty as the economics and in some cases the feasibility of clean ventures can be completely altered. Changes of subsidies or feed-in tariffs for the solar industry have caused a wave of disruptions in different countries. More on regulatory aspects is covered below.

A study conducted by Mercer concludes that climate change will have a broad-ranging impact on economies and financial markets over the coming decades and that traditional approaches to modeling strategic asset allocation fails to take account of climate change risk.[8] According to Mercer's model, climate policy could contribute 10 percent to overall portfolio risk, which is almost as much as credit risk, estimated at 12 percent. To mitigate this risk Mercer advises to increase allocations to climate-sensitive assets, with an emphasis on those that can adapt to a low-carbon environment. While some of these climate sensitive investments might be traditionally deemed as more risky on a stand-alone basis, including these into a portfolio could actually reduce overall risk.

In summary, even though clean-growth investing is challenging, many risks can be mitigated through proper allocation decisions, with disciplined top-down and bottom-up selection processes, extensive due diligence and appropriate portfolio diversification.

Diversification considerations and due diligence priorities

A fund of funds manager is well positioned to potentially mitigate the above mentioned risks by diversifying across several dimensions. While primary funds typically hold stakes in around ten to 20 different companies within the same region, a fund of funds manager invests in several primary funds. As a result, the investments of a fund of funds are

7 *Source:* Company's website, December 2011

8 *Source:* Mercer, Climate Change Scenarios – Implications for Strategic Asset Allocation, February 15, 2011.

spread across several hundred non-listed companies which can be diversified in terms of (i) the value chain (venture capital, development capital and project-related investments); (ii) regions (North America, Western Europe, Asia and other regions); (iii) sectors (agriculture, air and environment, materials, energy generation, energy infrastructure, energy storage, energy efficiency, recycling and waste, manufacturing/industrial, transport, water and wastewater); and (iv) vintage years.

In addition, a fund of funds provides larger investors with the opportunity to invest with funds in the clean growth area that would otherwise be too small for them. At the same time, small investors are able to gain access to a diversified portfolio, which they, due to the minimum subscription amounts of most funds, would not be able to build.

A further key advantage of a fund of funds is its knowledge and understanding of the space, especially when it comes to niche strategies such as clean growth. Most investors would only find the largest and best-known funds and have difficulties in assessing differentiated strategies. In contrast, an established fund of funds is typically known in the market and therefore, as well as actively screening the market, will typically be approached by the individual fund managers. By meeting with these managers and studying their materials, a fund of funds manager will not only learn about specific investment opportunities but also about recent market developments, emerging opportunities and future expectations.

Many funds of funds also take the opportunity to invest directly in companies alongside their top fund managers (co-investments) and or acquire stakes in investment funds on the secondary markets.

In order to optimally capture the clean growth opportunity and overweight the development-capital stage of the cleantech market, a hybrid approach that includes investing in both primary funds and co-investments can be employed. In spite of an increasing number of clean-growth capital funds, the majority of managers still focus on venture or project capital. Therefore, including growth-stage co-investments in the portfolio can be useful in constructing a portfolio that overweighs the development-capital stage while still remaining diversified across fund managers and regions. In addition, such an investment approach adds alpha by allowing overweighting attractive clean growth subsectors and carefully selecting the best investments within the portfolio. Finally, the overall cost basis can be reduced, as capital is put to work alongside the top clean-growth managers and in general no fees to the general partner (that is, the primary fund manager) accrue.

In addition to committing capital to primary funds, a fund of funds may also purchase from existing investor positions in funds that are no longer open to new investors for subscription. These secondary transactions have the advantage of already being partially or fully invested, meaning that most of the investments of the fund are already known, which facilitates a comprehensive quality and potential return assessment of the fund manager. In addition, trades in the secondary market in the clean growth area – due to the limited number of actors in the space – have historically traded at substantial discounts. This, together with earlier expected return of capital due to more mature stage of the companies leads to a mitigation of the typical J-Curve of private equity fund investments.

The Dodd Frank Act and Basel III have increased banks' capital cost for holding private equity on their books and many institutions have begun to dispose of their holdings. This is causing deal flow in this segment to increase. As a number of first-generation cleantech funds are approaching the end of their terms with attractive non-liquidated investments, these developments have helped funds of funds to build attractive secondary fund portfolios.

In summary, in the clean growth area, a hybrid fund of funds strategy provides an attractive balance between greater diversification through primary funds and optimising the upside potential of the portfolio by carefully selecting the best opportunities within the funds portfolios and overweighting these by means of co-Investments. In addition, returns and cash-flow profiles can be enhanced through the purchase of secondary funds.

Due diligence

With respect to due diligence priorities, next to track record and returns, an important factor when assessing a manager is the mix of people within the investment team. As clean-growth investing requires a variety of skill sets, investment professionals need to come from different backgrounds and demonstrate a broad set of skills, ranging from energy, technology and engineering to legal, finance and business management. The latter becomes more and more important as focus shifts from early-stage venture investing to growth and buyout strategies.

Other due diligence items include an assessment of the clean-growth investment strategy, organisation and track record, including the fit of the organisation with the investment objectives and the chances of success given current and projected future clean growth market conditions, the size and growth potential of the particular market; an analysis of the investment processes and management practices, management information systems and controls, back office and workload management; as well as a thorough examination and general negotiation of terms and legal documentation.

Given the importance of the regulatory framework when it comes to clean-growth investing, emphasis also lies on the assessment of sensitivities with respect to regulatory changes and the ability of the fund manager to adjust the strategy in the event of unexpected changes. As there are many risks associated with clean-growth investing, as discussed above, diversification within a fund's strategy and portfolio are pivotal and therefore concentration clauses should be assessed closely. Optimally, a clean-growth fund is diversified over clean-growth sectors, investment years and geographies.

History has shown that companies in the clean-growth area have needed more capital than originally anticipated. Therefore, fund managers that have a representative track record are also assessed on their ability to invest in companies at the right time(s) and on whether they had left enough reserves to support their portfolio companies in further financing rounds, that is, whether they had estimated the capital intensity of the business model and scale-up capabilities correctly.

In addition, as experience in general terms shows that clean growth exits have shown to be different from IT exits in the 1990s, that is, most successful exits lying in the range of 1x to 3x multiples and only a few exits with multiples greater than 10x, it should be assessed whether managers are able to exit at the right time and do not hold on to companies for too long, and whether there is a clear and realistic path to exit at the time of investment.

Regulatory aspects specific to the space

When on December 29, 1965 a court ruled in favour of Scenic Hudson, a preservation group that had fought against New York utility company Consolidated Edison's plans to build a power plant on Storm King Mountain, this was a legal landmark and is seen for many as the start of protective environmental legislation in the US. Since then, increasing environmental concerns have resulted in the adoption of numerous legislative and policy initiatives not only in the US, but around the globe. Examples include renewable energy portfolio standards for utilities, subsidies for wind and solar power or green building and environmental procurement requirements for government agencies.

Naturally, this has fostered growth as a diverse set of regulations and incentives have helped to substantially speed up technological progress and technology deployment. Take China, for example. Due to government support[9] China has become the single largest driver for global wind power development. Its total installed capacity doubled every year between 2005 and 2009 and in 2010 every second wind turbine was installed in China.[10] While China holds on to its supportive policies in its Twelfth Five-Year Plan (2011–2015), there are, however, other examples where the regulatory environment has not been stable and where retroactive amendments to existing policies have lead to a great deal of uncertainty.

In Spain, Germany and Italy, the introduction of feed-in tariffs and tax breaks for renewable energy have accelerated the development of the wind and solar sectors in those countries. Again, when the incentive packages were reduced a few years later, the momentum stalled.

There are several ways to deal with these risks. One way is to diversify across technologies and countries. Clean energy policies differ significantly from country to country, in terms of content and timing, and have different impacts on varying sectors. For exam-

[9] During the Eleventh Five-Year Plan (2006–1010), China introduced a series of laws, supporting policies and detailed plans, such as the 'Renewable Energy Law', 'Notice Concerning Certain Requirements for Wind Farm Construction Management' and 'Medium and Long-term Renewable Energy Development Plan'.

[10] *Source:* REN21, Renewables 2011 Global Status Report, July, 2011.

ple, a cut in feed-in tariffs for solar might be an advantage for the wind industry in a given country. In addition, fund managers can increase ties with government by engaging with people – for example through advisory board seats – that have a strong political background. Accordingly they will be informed about policy developments on the one hand and can try to actively influence decisions made by the government on the other hand. Fund managers should also be able to assess the stability of a particular set of laws or regulations.

Regulation changes always present opportunities for businesses to concentrate on the most profitable areas and rethink their business models – companies that are able to adapt quickly can emerge as leaders. As companies are increasingly building their value proposition on market-based as opposed to incentive-based business strategies, investors are realising that there is a massive market opportunity in the clean growth space, with or without regulation.

Four key take-aways

The clean growth opportunity is here to stay, the clean growth drivers continue to remain strong, the capital needs to meet environmental targets are substantial and government incentives are becoming less significant with cost curves continuing to come down.

The green fund universe has evolved in the last decade from initially only a handful of primarily North America-focused venture capital firms to a global fund universe that invests in different stages along the value chain. As a result of this transition, funds of funds have seen increasingly attractive investment opportunities in the clean growth area.

Many of the risks inherent to clean-growth investing such as technology, adoption and policy risks can be mitigated by building diversified portfolios. Funds of funds are well equipped to diversify not only across different geographies, technologies, sectors and stages but also across different fund managers and vintage years. In addition, they have the potential to enhance returns by selectively co-investing into the most promising clean growth companies alongside their most successful fund managers and by purchasing funds at attractive discounts in the secondary markets. □

Summary findings:

- The clean-growth fund universe is evolving and may offer attractive opportunities for investors
- Risks in clean-growth capital remain but can be mitigated by adequate diversification especially at inflexion points
- Funds of funds have the ability to enhance returns by co-investing selectively and adding secondaries to their portfolio

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Section

III

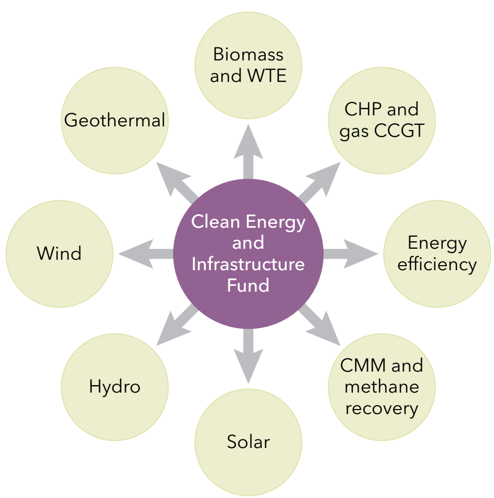
Clean energy infrastructure

Introduction

In recent years a new investment theme has emerged within the field of sustainable, private assets: clean energy infrastructure. This new theme has been fuelled by mounting global energy challenges as governments and economies around the world simultaneously face ongoing threats to energy security, possible climate change, and problems arising from ageing energy infrastructure.

The concerns arising from these energy challenges have manifested themselves in a paradigm-shift in global energy policy. By 2009, a host of unprecedented national and international regulatory reforms and incentive programmes had been introduced in all parts of the world, aimed at developing clean energy infrastructure that would increase indigenous renewable energy supplies and reduce emissions. By 2010, over 100 countries had enacted renewable energy support laws or policy targets – up from 55 at the end of 2005. Most country and regional targets now require by law that 15 to 25 percent of total energy consumed should be supplied by renewable energy by 2020. The European Union formally adopted its target of 20 percent renewable energy by 2020 in 2008 and set country-specific targets for all member states. Likewise, in 2008, Australia increased its renewable energy target to 20 percent while the UK – the first country in the world to legislate legally binding carbon-reduction targets – confirmed its commitment to a 20 percent renewable target and set a 30 percent aspirational target. In the US, more than 29 states plus Washington, DC have now introduced a Renewable Portfolio Standard, requiring additional renewable energy supply and announcing $150 billion in incentives for renewables over the next ten years.

Many of these incentives are direct-tax incentives or feed-in-tariff laws aimed at encouraging investment into clean energy. Such unprecedented support and novel investment incentives have spurred rapid evolution in investment opportunities in clean energy infrastructure. Clean energy infrastructure offers investment in real, asset-based infrastructure that produces energy; primarily electricity from renewable resources. Clean energy infrastructure projects employ proven technologies and in many cases operate with long-term power purchasing agreements, which lock in the revenue streams of a given project. The primary types of clean energy infrastructure assets are illustrated in the diagram opposite.



Investments can be made at different stages of a clean energy infrastructure project: pre-project financing, construction financing or the acquisition of assets that are already producing energy. A characteristic common to all clean energy infrastructure assets is current yield. Depending on the stage of maturity at the time of investment, these assets typically begin yielding revenue from as early as three months to several years from capital commitment, and can be expected to generate cash flows for at least 20 or more years. While the majority of the return to investors is generated through the current yield over the lifetime of the investment, some clean energy infrastructure assets can be sold or securitised after the majority of the returns have been collected, thus augmenting the overall return. The combination of current yield, inflation hedge characteristics and low technology risks have made clean energy infrastructure investments increasingly sought after. Furthermore, clean energy infrastructure investments directly relate to many investors' environmental, social and governance (ESG) considerations, allowing them to progress on their quests to increasingly address ESG considerations in their investment activities.

To date, one of the key challenges to investing in clean energy infrastructure assets has stemmed from a general lack of experience in allocating to these assets within the context of a wider investment portfolio. Compared to classic investments, there is an absence of extensive return figures and indices that could help investors integrate clean energy assets into traditional asset liability models.

Another challenge is understanding clean energy infrastructure assets' resiliency to inflation, given the long-term nature of the investments, as well as understanding the impact of regulatory changes on eventual net returns. Lastly, there has been little experience in valuing the assets to properly account for them during investment, post-investment monitoring and reporting, and exit phases.

The first chapter of this section aims to evaluate allocation considerations and provide investors with a framework for including clean energy infrastructure investments into their asset-liability models and identify appropriate allocation targets. The second chapter reviews the inflation hedge characteristics of clean energy infrastructure investments. It also reviews their dependency on regulation and the potential impact of regulatory changes. The section is rounded out with a discussion on appropriate valuation methodologies for clean energy infrastructure investments, which should help investors prepare for holding such assets in their portfolios and also give guidance for co-investing with their general partners.

Although aimed at investors, the section should also prove useful to trustees and others interested in gaining a concise overview of clean-energy infrastructure investing. It is our hope that those who are not strangers to the asset class, or not directly involved as investors – such as journalists or government regulators – may also gain insight from some of the expert contributions provided in the following pages. □

11 Asset and portfolio allocation issues

By Philippe Jost, Capital Dynamics

This chapter discusses:

- Risk-return attributes of CEI compared to other asset classes
- Benchmarking solutions for CEI
- Diversification attributes of CEI
- Hedging abilities of CEI

Introduction

Pension funds and other investors have greatly extended their investment universe beyond traditional assets such as equities and bonds during the last two decades. Most of the new asset classes are grouped into a generic category called 'alternative investments', often comprising hedge funds, private equity and commodities. Infrastructure is one of the last asset classes to enter the pantheon of alternative investments. Infrastructure assets are long-term investments with high development costs. Once almost exclusively funded by governments, they are now becoming accessible to private investors and are popular because they provide earnings that are independent from the stock market. In addition, infrastructure can deliver highly predictable and stable returns.

Alternative investments may provide a way for sophisticated investors to increase their portfolio diversification and exposure to potentially rewarding assets. Clean energy infrastructure (CEI) provides a perfect solution, which is why it is becoming popular. It has long-term predictable cash flows that can be analysed and transformed into monthly total return time series.

As a result of these appealing characteristics, many investors wish to integrate CEI into their portfolios and thus have to decide to which asset category it corresponds. Can it be treated as infrastructure? Is it private equity? Should it be added to the basket of socially/environmentally responsible investment? This chapter uses a quantitative approach to study the characteristics of CEI cash flows and advocates that CEI could be classified either as a real asset or as an inflation-linked investment.

From an asset allocation perspective, CEI should be compared to other asset classes in terms of risk, return and correlation. This chapter examines CEI from several aspects: (i) how to transform projected cash flows into time series of monthly returns to compare the risk and return attributes of CEI investments against other asset classes; (ii) benchmarking solutions and makes use of a proposed model to assess their respective validity; (iii) the impact of CEI in an investor's portfolio, mainly focusing on diversification and on the impact of adding CEI to a simple hypothetical portfolio made of equities and fixed income in the well-known mean-variance framework; and (iv) CEI's inflation-hedging abilities, by examining its correlation with the consumer price index (CPI).

This chapter summarises the main attributes of CEI from an asset allocation and risk management perspective. It ends by proposing practical solutions for risk managers and asset allocation specialists to include CEI in a portfolio of assets.

From cash flows to returns

An investment in CEI is long-term with high development costs. The typical life cycle of an investment can be laid out as follows:

- *Building phase.* The construction of the infrastructure corresponds to a substantial negative cash flow.
- *Operational phase.* The first positive cash flow begins one to four years after the start of the building phase. From this point on, regular positive cash flows can be generated by selling the produced energy.
- *Selling phase.* If the investment has a fixed time horizon, then the infrastructure is sold at the end for a fraction of its construction price.

A mathematical model mimicking the cash flows of a CEI investment requires the modelling of several parameters. Table 11.1 summarises them, including sample values that have been used for the various experiments made throughout this chapter. These values were chosen to match CEI practitioners' conservative expectations and takes into account fees and taxes.

Investing in infrastructure has the benefit that the returns are fixed in advance by a contract defining the selling prices of the energy produced. These contracts are typically

Table 11.1: **CEI model cash flow parameter**

Name	Description	Value
Initial investment	The capital invested during the building phase.	100
Coupon	The yearly cash flow the investor receives during the operational phase expressed as a percentage of the initial investment.	10%
Residual value	The unique cash flow received at the selling phase expressed as a percentage of the initial investment.	60%
Building years	The time needed to construct the infrastructure (that is, the waiting time for the first positive cash flow).	1
Investment horizon	The number of positive cash flows that are received before selling the infrastructure for its residual value.	10

Figure 11.1: **CEI cash flow model, including fixed and inflation-linked parts**

Source: Capital Dynamics.

called power purchase agreements (PPA). The prices are generally adjusted for inflation. Figure 11.1 presents the cash flow structure that corresponds to the parameters presented in Table 11.1. Inflation is taken into account; the cash flows are scaled according to the US consumer price index (CPI) which had an equivalent yearly growth of 2.35 percent between 2000 and 2010.

In CEI, profit is generated by selling the produced energy rather than by an increase in value of the underlying physical asset. The residual value is significantly lower than 100 percent. This early exit price is estimated using a fair value principle with the following hypotheses: that the infrastructure is up and running for 25 years, that its residual value after this period is nil and that it delivers regular yearly returns. The residual value is estimated by discounting the unrealised cash flow with a conservative discount rate.

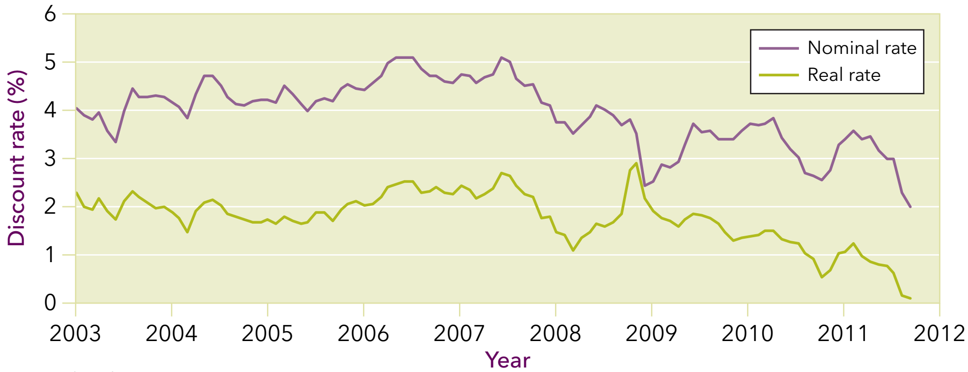
The transition from cash flows to a monthly total return time series requires additional information and hypotheses:

- The yearly cash flows are transformed into monthly cash flows (1/12 for every month).
- Payments take place on the last day of each month.
- The fair value of the investment is the discounted future cash flow.
- The discount rate is a medium to long-term risk-free rate.
- The inflation proxy is the US CPI.

For bonds, changes in the interest rate modify the present value of their future cash flows and account for an important part of their volatility. Fixed and highly predictable future cash flows are used to price the CEI investment; thus, the corresponding fair value fluctuates whenever the discount rate changes. Making use of a market-dependent discount rate makes sense as standard accounting rules use the mark-to-market principle. This principle states that assets must be valued using a market price whenever possible, or another reasonable fair value.

The discount rate used to compute the fair value of the investment has a significant impact on its returns. As discussed previously, inflation is explicitly taken into account

Figure 11.2: **Nominal and real discount rates**



Source: Bloomberg.

by the model. Therefore, the discount rate has to be a real rate (that is, such that the effects of inflation have been removed). Traditional government bonds are a good proxy for nominal risk-free rates; newly introduced inflation-indexed government bonds provide guaranteed real returns and also are a good proxy for real risk-free rates[1]. Figure 11.2 illustrates the difference between nominal and real rates by comparing both market yields based on US Treasury securities over a ten-year period. Apart from the 2008 crisis, the two rates mirror each other. The difference between the curves represents expected future inflation.

The historical data available for real rates of inflation-linked government bonds are relatively short (2003-today). A good approximation of the real risk-free interest rate can be constructed using the CPI and ten-year US Treasury yields. This data have been used whenever the real risk-free rate is not available.

The present value PV_i at time i is the sum of the discounted value of the future cash flows. This value depends on the coupon, the initial investment and inflation, which is known up to time i and is supposed to be nil afterwards.

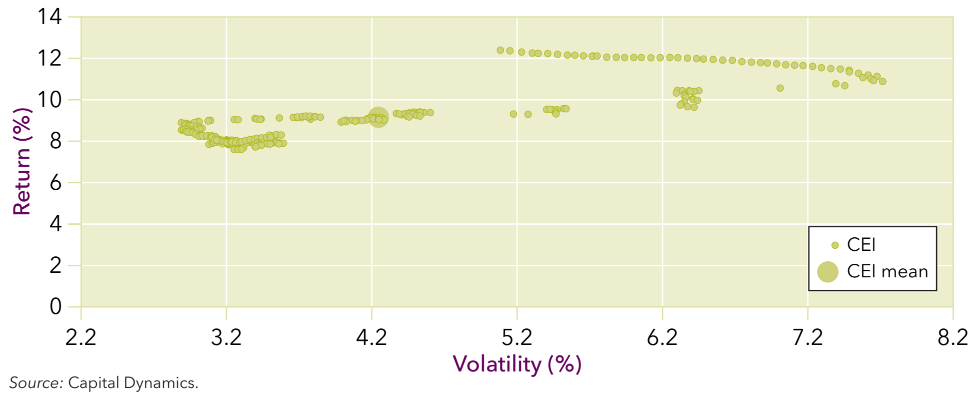
The periodic performances of the investment are computed using a time-weighted rate of return, which is the geometric mean of returns of smaller periods which have cash movements only at their start or at their end. The monthly returns are defined as follows:

$$\hat{r}_i = \frac{(PV_i + CF_i)}{PV_{i-1}} - 1, \qquad \forall i > 1$$

Where:
CF_i is the cash flow at month i
PV_{i-1} is the fair value at the end of the previous month

1 Damodaran, Aswath. Estimating Risk-free Rates. Stern School of Business, New York University: s.n. Tech. rep.

Figure 11.3: **The CEI risk-return profile varies through time**



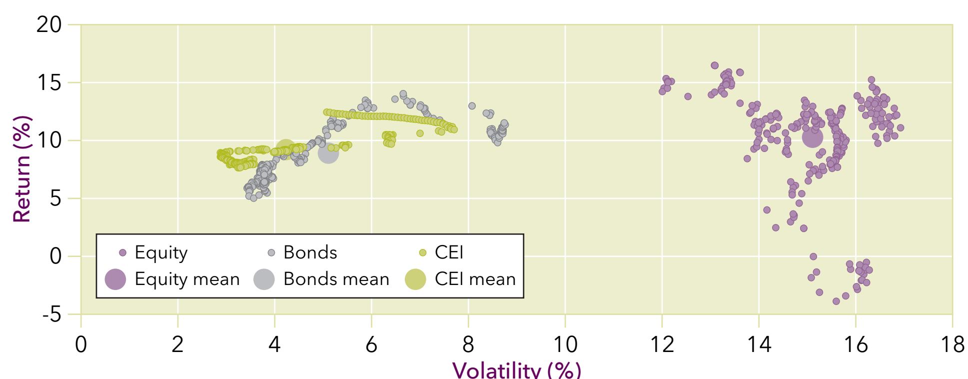
Source: Capital Dynamics.

The first return is defined in a slightly different way. It is the return between the invested capital and the first fair value. These values might differ significantly. Therefore, the first month's return might be very different from those in subsequent months. This instantaneous gain (or loss) is spread over the whole investment period.

Monthly returns can be used to compare CEI to other asset classes by comparing their volatilities, correlations and returns side by side. These are the most frequently used inputs in standard asset allocation frameworks. Figure 11.3 presents the diverse risk-return values obtained for the cash flow structure presented previously. The starting dates of the historical simulations range from 1976 to 2000. The mean annual return is 9.15 percent and the mean volatility is 4.25 percent.

Over the same time period, other assets have also evolved; Figure 11.4 presents the risk-return profile for bonds and equities. They are represented by the Barclays US Aggregate Total Return Bond Index and the S&P 500 Total Return Index, respectively.

Figure 11.4: **CEI risk-return profile compared with equity and bond benchmarks**



Source: Capital Dynamics, Bloomberg.

Apart from selling the produced energy, the performance of the investment is also closely linked to the price at which the infrastructure is ultimately sold. An important unique cash flow at the end significantly impacts the volatility as it increases the sensitivity of the investment to interest rate changes.

CEI benchmarking

Constructing a sensible benchmark is far simpler for liquid asset classes than for illiquid investments such as private equity and infrastructure. Finding a broadly accepted solution takes time as different stakeholders in the financial services industry do not always share the same interests when it comes to choosing a benchmark.

Often, a benchmark is required to be investable in order to provide a cheap and passive alternative to active investment in an asset class. To satisfy this constraint, the simplest solution is to create a benchmark by aggregating publicly traded instruments related to the CEI business that provide a decent volume of liquidity on a daily basis. However, doing so would not lead to a benchmark that is representative of a typical CEI investment because the volatility of publicly traded instruments is likely to be much higher than non-publicly traded CEI assets. The correlation of publicly traded instruments to the stock market would also be higher than expected. A similar problem arises when using listed private equity as benchmark for the private equity industry.

The major role of a benchmark is to be representative of an asset class in terms of risk, return and correlation compared to other asset classes. Based on these requirements, this section explores some alternative benchmarks, compares them, and makes use of the previously presented model in order to propose a robust and practical solution to benchmark CEI. The first step of the analysis consists of creating a list of benchmark candidates that could *a priori* fulfil this role.

The returns of CEI heavily depend on two exogenous factors: inflation and the discount rate. Both of them can be measured through diverse time series. The inflation proxy used previously as well as an inflation-linked bond index should both be seriously considered. Figure 11.4 exhibits the interesting finding that the chosen model leads to returns for CEI that are slightly more generous than bonds and slightly less volatile. However, since the differences are relatively small, a bond index would also be suitable for CEI benchmarking.

Different listed infrastructure indices have been created and today all major financial data providers have an infrastructure index. The Macquarie Global Infrastructure Index (calculated and managed by FTSE) has an electricity sector sub-index that is also on the list of possible alternatives. In addition to the infrastructure indices, a standard equity index is also a potential option.

Finally, the potential benchmarks can be classified in Table 11.2 as follows:

1. Economic-related indicators (in green).
2. Bond-related indices (in grey).
3. Equity-related indices (in purple).

Table 11.2: **List of CEI benchmark candidates**

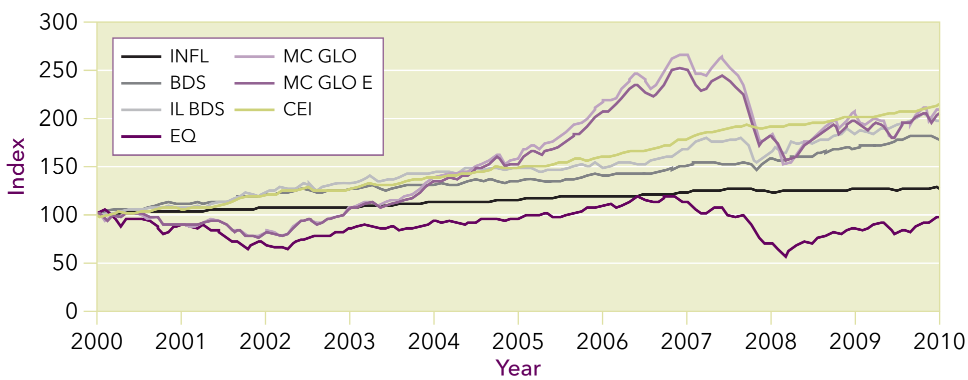
Description	Acronym	Source
Inflation	INFL	US Consumer Price Index
Bond Total Return Index	BDS	Barclays US Aggregate Bond Total Return Index
Inflation-Linked Bond Total Return Index	IL BDS	Barclays US Inflation Linked Bonds Total Return Index
Equity Total Return Index	EQ	S&P 500 Total Return Index
Infrastructure Index	MC GLO	Macquarie Global Infrastructure Index
Energy Infrastructure Index	MC GLO E	Macquarie Global Electricity Index

Consumer price, bonds and equity all have indices with a long history, whereas inflation-linked bonds and infrastructure indices have been created only recently. However, all possible benchmarks overlap during the 2000–2010 time period.

Figure 11.5 presents the performance of alternative benchmarks against a CEI investment. The equity family tracks the evolution of the CEI performance relatively poorly compared with the bond family or the CPI. On the other hand, bonds as well as inflation-linked bonds closely match CEI's performance. This is especially true at the start of the time period considered when the sensitivities to rate changes (duration) are comparable.

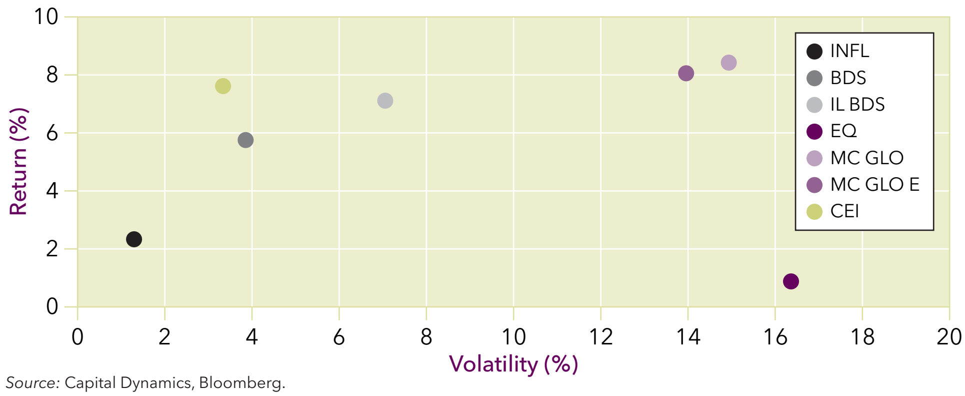
Figure 11.6 presents the alternative benchmarks in a risk-return universe – this figure actively removes equity indices from the list of alternatives due to their high volatility and because they do not reflect the risks faced by a CEI investor.

Figure 11.5: **Performance of potential CEI benchmarks (2000–2010)**



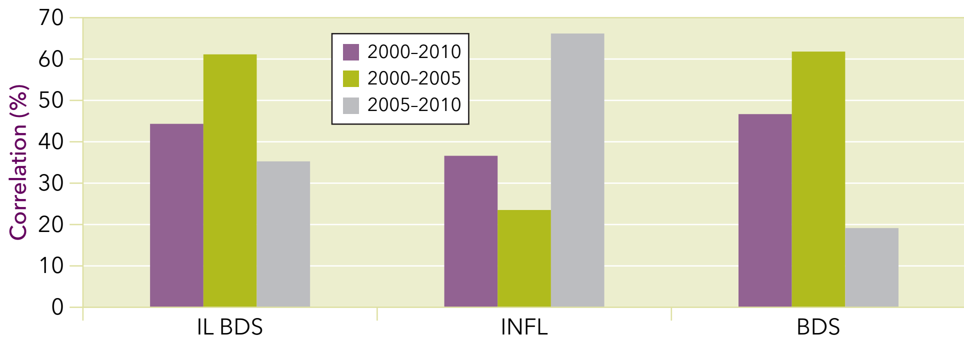
Source: Capital Dynamics, Bloomberg.

Figure 11.6: **Risk-return profile of potential benchmarks (2001–2010)**



Source: Capital Dynamics, Bloomberg.

Figure 11.7: **Correlation between CEI and remaining possible benchmarks, 2001-2010**



Source: Capital Dynamics, Bloomberg.

Figure 11.7 presents the correlation between the three remaining alternative benchmarks – CPI, bonds and inflation-linked bonds – and CEI. These values are shown for the whole period from 2001 to 2010, as well as for the first and second halves of the time period measured. The correlation of the three alternatives to CEI is comparable in their amplitude. An additional desirable property in benchmarks is stability; the correlation should ideally be constant over time. The inflation-linked bond index has the most stable correlation over time.

During the first-half period, the behaviour of the CEI investment is best captured by the bond family of indices. Afterwards, the development of the considered investment is closer to inflation. This is due to the fact that, as times goes on, the fair value of the future cash flows is becoming less and less sensitive to changes in the discount rate. However, this would not be the case for a portfolio of CEIs with different starting years.

From a qualitative point of view, the inflation-linked bond index best captures the risks faced by an investor that invests in well structured CEI assets. The other remaining alternative benchmarks each have a major drawback. A bond index includes an inflation risk that is not present in a typical CEI investment with inflation indexed revenues and an inflation index does not take into account the evolution of discount rates.

The returns of the CEI model are higher than the proposed benchmark's returns. The mean annual discrepancy is 50 basis points, which depends on the choice of the model's parameters. The appropriate benchmark would therefore be the inflation-linked bond index plus 50 basis points. However, the inflation-linked bond index does not take into account transaction costs and fees as does the proposed CEI model.

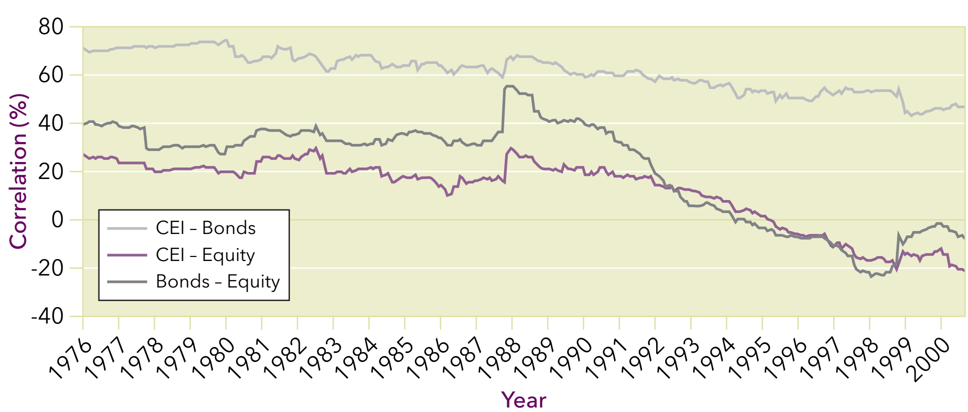
CEI in a portfolio of assets

The section examines the impact of CEI on a simple portfolio comprised of equities and bonds. The bond assets are represented by the Barclays US Aggregate Bond Total Return Index and the equities are represented by the S&P 500 Total Return Index.

The interaction between the different assets plays a central role in the development of a portfolio and this interaction is generally measured by correlation, which accounts for the linear dependence between two assets. Figure 11.8 presents the correlation between CEI, bonds and equities over a 25-year time period. The figure finds that CEI correlates to bonds but not to equities. Interestingly, the correlation between bonds and CEI decreases over time, which might suggest that CEI could add diversification when placed in a portfolio that has the two other assets.

A unique measure for diversification does not currently exist. Figure 11.9 presents the portfolio diversification measured through the intra-portfolio correlation[2] while Figure 11.10 makes use of the portfolio diversification index[3]. Both measures rely on proper-

Figure 11.8: **Evolution of the correlation between CEI, equity and bonds (1976–2000)**



Source: Capital Dynamics, Bloomberg.

[2] Meucci, Attilio. Managing Diversification, extended version. SYMMYS. 2010. Tech. rep.

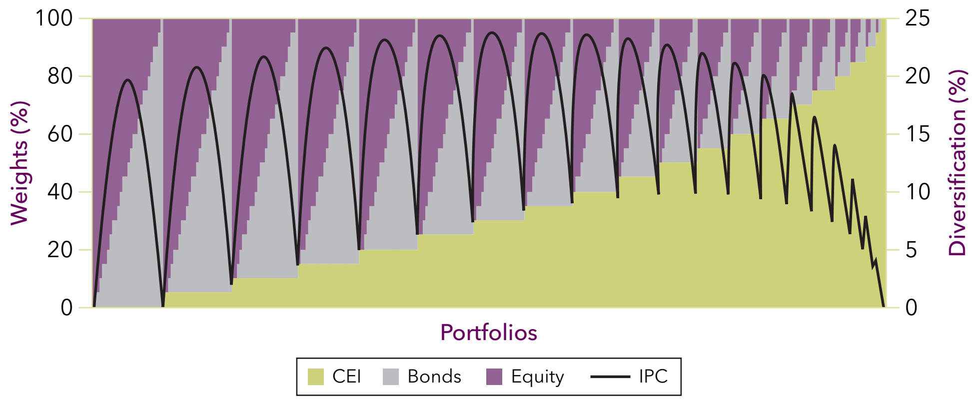
[3] Rudin, Alexander and Morgan, Jonathan. A Portfolio Diversification Index. The Journal of Portfolio Management, Winter 2006, Vol. 32, pp. 81-89. DOI: 10.3905/jpm.2006.611807.

Table 11.3: **Asset allocations in IPC and PDI optimal portfolios**

Asset category	IPC optimal portfolio	PDI optimal portfolio
CEI	35%	60%
Bonds	45%	15%
Equity	20%	25%

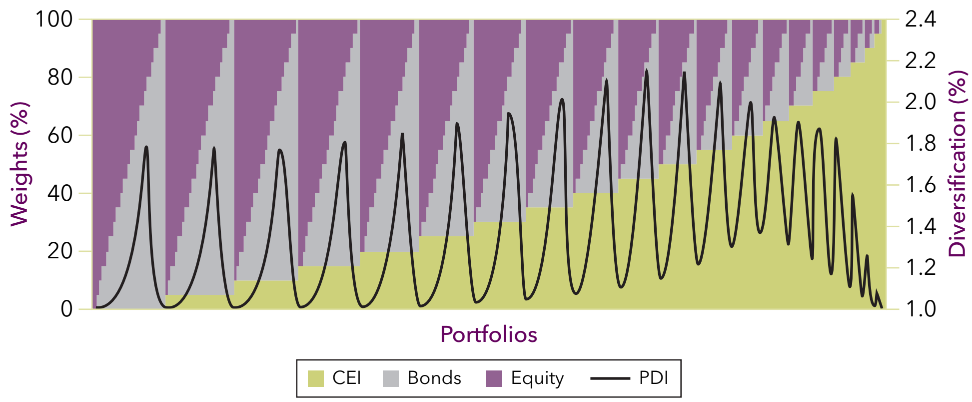
Source: Capital Dynamics.

Figure 11.9: **Portfolio diversification measured using the intra-portfolio correlation**



Source: Capital Dynamics.

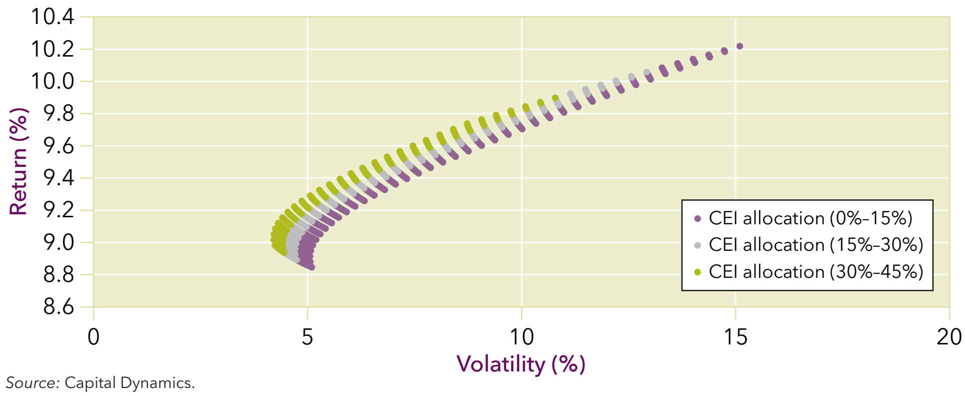
Figure 11.10: **Portfolio diversification measured using the portfolio diversification index**



Source: Capital Dynamics.

ties of the assets (return, volatility and correlation) and on the weights of the different assets in the portfolio. The diversification measures are presented for different allocations. In both Figure 11.10 and 11.11, the portion in green represents the proportion of

Figure 11.11: **Risk-return space of portfolios made of equities, bonds and CEI**



Source: Capital Dynamics.

CEI in the portfolio. The point furthest to the right in both figures is a portfolio comprised solely of CEI. All possible portfolios, in increments of 5 percent, have been constructed and tested. The conclusions that we can draw with PDI and IPC are similar: adding CEI to a portfolio will increase its diversification.

Based on the covariance matrix of expected returns and weights, it is possible to place a portfolio containing CEI in the greater investment risk-return space. The upper boundary of all possible combinations of assets in this space is known as the efficient frontier. Figure 11.11 presents the risk-return space of the portfolios used for diversification analysis. The colour of the dots relates to the amount of CEI present in the allocation.

For a fixed volatility, Modern Portfolio Theory (MPT) provides a methodology for selecting the portfolio with the highest expected return, and for a fixed return, MPT leads to the portfolio with the lowest volatility. From Figure 11.11 it can be concluded that the optimal solution for both problems is portfolios that contain the highest proportions of CEI.

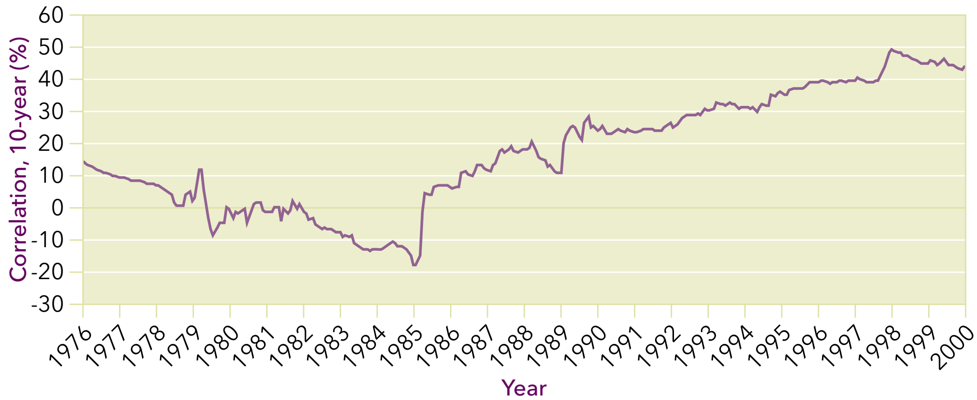
Adding CEI to a portfolio consisting of bonds and equities increases its diversification and leads to better overall asset allocation. As bonds and equities generally represent more than 70 percent of the assets of pension funds[4], CEI is an interesting solution to add diversification and to enhance the risk-return trade-off of their portfolios.

Inflation hedging

The increase in popularity of inflation-linked securities, real estate, commodities and infrastructure in investment portfolios might be a reliable indicator that inflation hedging is a major concern for investors. In the case of a pension fund, high inflation generally has

[4] OECD. Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries. s.l. : OECD Publishing, 2011, Asset Allocation of Pension Funds and Public Pension Reserve Funds, pp. 180–181.

Figure 11.12: **Evolution of the correlation between the considered asset classes and the CPI**



Source: Capital Dynamics.

a negative impact on its liabilities (that are often linked to inflation) as well as on their assets (which are generally not hedged against inflation).

The most commonly used methods to mitigate the inflation risk are hedging with inflation derivatives and hedging with assets. Inflation derivatives are over-the-counter (OTC) products that transfer inflation risks between two counterparties.

The correlation between returns and inflation rates facilitates the calculation of the hedging abilities of an asset by quantifying the existing linear relationship. Figure 11.12 presents the correlation between the returns of the previously introduced CEI model and the US CPI. These values are computed for ten-year investments with monthly returns and are plotted against their starting date. These values might be considered high. Therefore, CEI holds the ability to hedge against inflation.

Conclusion

This chapter presented a CEI investment model with a sensible cash flow scheme that is transformed into market-dependent time series of returns. This transformation enables an investor to derive risk characteristics that they can include in their own asset allocation or risk framework. If an investor solely makes use of volatilities and returns, the value pair of 4 percent volatility and 10 percent return makes sense.

When it comes to benchmarking, an inflation-linked bond index (plus margin) represents the best available solution to mimic the characteristics of a well structured CEI asset. It cuts out the inflation risk (representing the inflation hedging ability of CEI) and fluctuates according to changes of a real rate in the same way the fair value of a CEI investment would.

This chapter also studies the impact of adding CEI to a portfolio consisting of bonds and equities. Adding CEI increases overall diversification and leads to more favourable portfolios in terms of risk-return trade-off. Bonds and equities generally account for more than the majority of the assets. The results obtained are therefore valid for most investors. □

Summary findings:

- The risk-return profile of CEI is close to that of bonds, but shows a slightly lower volatility
- The BarCap Inflation Linked Bonds Total Return Index is the most suitable benchmark for CEI in the context of asset allocation considerations
- Adding CEI to a portfolio consisting of bonds and equities increases its diversification and leads to better overall asset allocation

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12 Capital protection features of renewable electricity projects

By David Scaysbrook and Tim Short, Capital Dynamics

This chapter discusses:

- Renewable electricity projects generate revenue from the sale of electrical energy and environmental attributes represented by tradable financial instruments
- Regulatory incentives exist in renewable electricity markets but prospective regulatory change is easier to manage than retrospective policy
- The contractual, risk and revenue-generating characteristics of bundled and unbundled markets in renewable electricity generation

Introduction

A concern often voiced by investors about renewable electricity projects is their reliance on revenue subsidies or regulated tariff premiums to deliver investment returns. This is often described as 'regulatory risk' and is heightened by the long-term nature of renewable infrastructure investments and the associated payback periods on committed equity capital. The degree of regulatory intervention in the energy sector the world over is increasing and will likely continue. Therefore, at face value, this concern is a reasonable one. However, what is often not appreciated is that renewable electricity projects earn core operating revenues by producing and selling electric power – independent from any regulated revenue subsidy or tradable 'environmental credits'. These core operating revenues have an enduring quality as contracts are generally long-term and are capable of protecting investor capital in the same manner as traditional energy and utility project investments.

Operating revenue streams enable renewable electricity projects to offer fundamental capital-loss-protection features to investors, even under adverse regulatory change scenarios where the premium pricing incentives enjoyed by eligible projects may be retrospectively abolished by the relevant political or regulatory agency. Such an outcome, albeit rare in practice, is the worst-case scenario feared by any investor and is a risk that is shared by both traditional fossil fuel and renewable energy investors alike. For example, retrospective regulatory action may impact a conventional oil and gas project (through, for example, a retrospective hike in the royalty tax rate) or a solar photovoltaic (PV) project (such as a retrospective cut to a regulated premium tariff rate).

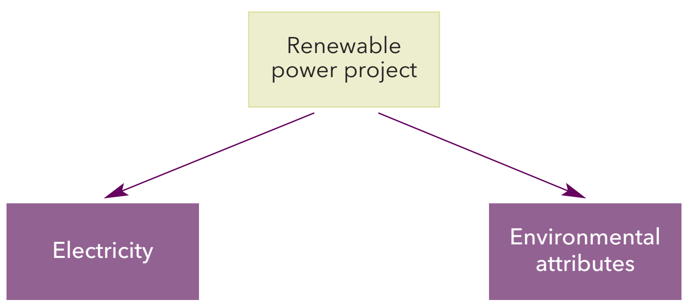
In this chapter, the ability of ongoing electricity revenues to ensure the return of invested capital, and thereby protect that capital over the long term, is examined under various regulatory change scenarios. Some recent, investment case studies are also discussed.

Typically, renewable energy infrastructure projects have an economic life of more than 20 years, creating a meaningful stream of ongoing revenue that serves to protect invested capital by progressively amortising the investment over time. For projects located in countries with high and increasing power prices, and in markets where the power produced can be monetised readily, the capital-payback periods are faster and provide additional comfort on loss protection. Similarly, for projects with generally higher or more constant baseload[1] electricity output (such as biomass, landfill methane and geothermal power projects), the revenue earned from the sale of electricity can deliver a reasonable return even in the absence of any subsidy or regulated revenue incentive. This puts the often-heard expression 'grid parity'[2] in proper context for investors, as it reflects the degree of reliance (or not) of the project on ongoing regulatory support.

Revenue streams and risks

Renewable electricity projects typically generate revenue from the sale of two commodities: (i) physical electrical energy; and (ii) environmental attributes represented by tradable financial instruments (such as Renewable Energy Credits). (See Figure 12.1)

Figure 12.1: **Project revenue streams**



Electricity:

- Liquid and transparent power markets with multiple buyers
- Long-term sales contracts of 15–20 years (Power Purchase Agreements (PPAs))
- Utility, commercial, municipal or industrial credit-rated purchasers with increasing demand for power, especially from renewable sources

Environmental attributes:

- Value relies on policy support mechanisms creating markets for environmental commodities
- May or may not be bundled with power sales under a PPA
- May or may not have deep and liquid markets for trading and monetisation

[1] Baseload means constant output for most hours of the day throughout the year.

[2] Grid parity is defined as the point at which a given means of generating electricity from alternative energy produces power at a levelised cost that is equal to or less than the price of purchasing power from the grid.

The value of each of these commodities is driven by a multitude of factors, many of which are linked to basic supply and demand drivers. Often viewed in isolation, however, are the regulated price premiums attached to 'environmental attributes', which to most investors are more obviously vulnerable to policy risk.

Prospective and retrospective risk

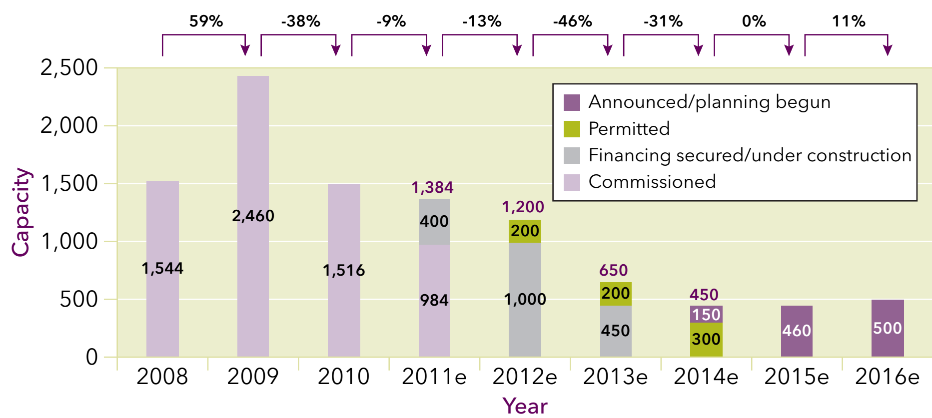
Policy risk can manifest in two main types of regulatory change: prospective change and retrospective change. Regulatory changes that impact future investment decisions are easier to manage, and pose less threat to capital already invested in a project if it involves no retrospective elements. In other words, investments made prior to regulatory changes are typically grandfathered and not subject to the regulation. There is a long list of precedents in developed markets where this has been the case. Furthermore, in many countries, including the US, policies creating renewable energy investment incentives are typically made at a state level, meaning that only projects located in that state can be subject to any change. In such cases, investors can simply shift their focus to other states that offer more compelling opportunities when and if a regulatory change is announced. For example, 29 US states currently offer some form of regulatory incentive that is enacted by state law, which promotes greater renewable energy investment than federal law. This gives investors quite a choice of markets within one single country.

Of greater concern, however, are retrospective regulatory changes. These regulatory changes take effect after an investor has already invested capital in a completed project, then the changes proceed to impact the investment adversely in ways not contemplated or known when the commitment was made. For example, regulations may be changed in a way that reduces the value of the premium pricing incentives offered to the investor through policies in place when the investor committed to the project. However unlikely and infrequent such retrospective change may be, such change still represents the key uncontrollable risk that most investors focus their attention on. Nevertheless, even in a worst-case scenario where 100 percent of all premium pricing incentives are abolished by a new policy, investors would still retain electricity sales as a revenue stream to recover invested capital.

What happened in Spain?

In recent times the most discussed case of political risk in renewable energy investing occured in Spain. Following the introduction of a feed-in tariff (FIT) system in 1997, in 2004 Spain amended the regulated tariff to (intentionally) become one of the most stable and ambitious renewable energy stimulus plans of any European Union member state. It was one of the most aggressive plans in the world at that time, with the Spanish government introducing by Royal Decree significant new incentives for solar energy and wind power. The new framework established a regulated system where sellers could choose between predictable, regulated, generously priced FIT contracts or a sale into the free market. The tariffs were 20-year fixed-price power purchase contracts at premium rates, above the market price of electricity in Spain at the time. The policy worked and in the years that followed, over $30 billion (according to Bloomberg reports; see Figure 12.2) was invested in new solar and wind power projects, taking Spain to a global leadership role by market size for several years running.

Figure 12.2: **Installed project capacity for Spain (2008–16)***



* Based on tariff proposal (mw).
Source: Bloomberg New Energy Finance, 2011.

However, unlike just about every other EU market using FITs to support their renewable programmes, the significant ongoing subsidy costs were not passed through to the eventual consumer of the power in real time. The subsidy costs remained with the state in effect, creating a fiscal liability estimated at around €17 billion. A new government announced on November 23, 2010 a drastic plan to retrospectively slash the volume of awarded FITs to reduce this liability. On December 23, 2010, the Spanish government approved new regulations which, when applied to existing photovoltaic plants, limited the maximum amount of energy that could be sold under the regulated tariff between 2011 and 2013 and reduced the cash flow available to projects in these early years. Given the significant sums invested by Spanish utilities, local and international project finance banks, institutions and family offices, there was an immediate outcry. The ensuing political tumult is not settled for some investor groups that are pursuing litigation against the state. The true impact of this on Spanish solar energy producers will only be properly assessed in 2012, as information on the full-year generation results from 2011 become available.

This Spanish experience has been touted as a reason to avoid the clean energy sector. Yet the reality of investor impact should not be overlooked. Despite concerns of material financial loss for investors flowing from the government's initial declarations, the FITs were amended retrospectively, but in ways intended to preserve the investors' capital over time and not destroy it. The FIT profiles were ultimately changed to reduce FITs awarded in the near term, but increase them in later years as well as to extend the contract terms overall. As some form of compensation, the

Spanish government offered an extension of the FIT from 25 to 28 years. On closer assessment of projects, this can result in a largely neutral overall impact on a present value basis and, accordingly, in net present value terms, the stated intent was to preserve value over the longer term but reduce the state's fiscal liability in the nearer term. Whilst any retrospective change of this type is regrettable, increases sovereign risk and undermines investor confidence, the Spanish retroactive story is not as bad as many make out and certainly not the pillaging of investor capital that some portray.

Regulatory incentives

Renewable portfolio standards (often referred to as RPS) or equivalent targets (mandatory or otherwise) are the dominant form of regulatory incentive offered in many countries such as the US to stimulate new investment in renewable energy projects. In Europe, there are standards and targets and regulatory incentives aimed at achieving them that operate in a similar way. These standards induce higher annual targets for the construction of more renewable energy capacity. The targets must be met each year until a specified future date. It is common for governments to impose a mandatory renewable purchasing requirement on electricity utilities, which increase in volume and must be satisfied each year until the overall target is met. The two most prevalent methods used to financially support new projects and their investors are feed-in tariffs (FIT) and renewable energy credits (REC). Both create revenue premiums for eligible renewable energy projects. The extent of the premium depends on power pricing in the relevant market. Both mechanisms are, however, set or heavily influenced by regulation and the prevailing energy policies of the day. Table 12.1 compares and contrasts key features of bundled and unbundled markets.

Table 12.1: **Features of bundled and unbundled PPA markets**

Bundled or PPA-driven	Unbundled or REC-driven
Renewable electricity is sold together (or bundled) with its environmental attributes for a single fixed price • Usually a single PPA with a utility buyer for between 15 and 20 years • An electricity utility is usually the buyer and uses the environmental attributes to meet their regulatory compliance obligations; the electric power is sold to serve their customers' load • Generally offer lower investment returns than unbundled or REC-based schemes, but have greater pricing certainty • Credit quality of buyer is critical to investment risk • Easier to debt finance where utility buyer has strong credit • Interconnection process and transmission issues can be significant hurdles	**Renewable electricity is sold separately (unbundled) from its environmental attributes at negotiated or market prices** • PPAs sell electricity either to an onsite buyer consuming the power in real time (behind the meter) or exported into the local grid and sold to a local utility • Utilities must buy RECs under regulated mandates (RPS targets) in increasing annual volumes • Regulatory and market design features are key to investment risks such as duration of programme, scale of target, compliance 'out' clauses for utilities, etc. • Higher return potential than PPA-driven markets (in most cases), but with more price/revenue volatility

Many governments at both state and country levels use different mechanisms to encourage private investment in new projects to satisfy the increased build-out of renewable energy infrastructure. Broadly speaking, markets can be characterised in two ways: (i) bundled or PPA-driven (including the FITs prevalent in continental Europe, Canada and US states such as California and Hawaii) and (ii) unbundled or REC-driven (such as in the UK, Australia and US states such as New Jersey and Massachusetts).

Protection of invested capital

Generally speaking, REC markets have been considered in the past to exhibit greater risk than bundled or PPA-based markets. This is because the value of the environmental attributes is often determined in ways similar to other traded commodities (for example, basic supply and demand) and may be more susceptible to regulatory change, as the market and many of its key drivers are created by regulation. Moreover, it is not uncommon to see tinkering on a regular basis by overzealous legislators or bias reactions in the market following potential policy statements, rumors or news.

In bundled or PPA-driven markets, there is typically a long-term, legally binding contract with a utility buyer that often deals explicitly with contractual risk-sharing in the event regulatory change impacts the core terms of the commercial deal. This change risk is often shifted to the utility to varying degrees as the utility is generally in a better position than any other party to bear the change-in-law risk given that all aspects of a entire business is heavily regulated. Regulations on utilities in many developed countries (such as carbon taxes, emissions controls and other environmental cost imposts) are routinely passed to utility customers in the form of rate increases. In many cases, regulators have actually approved passing on the increases, although the regulators are usually from a different department of government.

Therefore, the impact of an adverse regulatory change on future revenues can be mitigated by contract in PPA-supported investments, and often, this risk can be allocated to the utility buyer and priced into the deal accordingly. This is a common feature of independent power plant (IPP) financing arrangements which form the basis for most renewable energy project financing in developed markets today.

To illustrate these points, actual project examples – a landfill gas project and a solar PV project, both in the US – are compared below. Both generate RECs in addition to operating income from power sales. They are compared to show the different degrees of capital protection offered by power sales alone, depending on the type of project and the relative output they can generate. In short, higher output projects enjoy greater capital protection than lower output or intermittent projects.

The analysis focuses on the worst-case scenario where RECs and other policy-driven environmental incentives (such as carbon credits) are completely abolished overnight, the existing projects are not grandfathered from the impact of the abolition and REC and other environmental incentive values reduce to zero. This results in project revenues being reduced to the sale of electricity only. While less drastic changes are of course possible and arguably more probable than complete retrospective abolition, the worst case serves best to illustrate the relevant points.

Examples of less drastic changes may include:

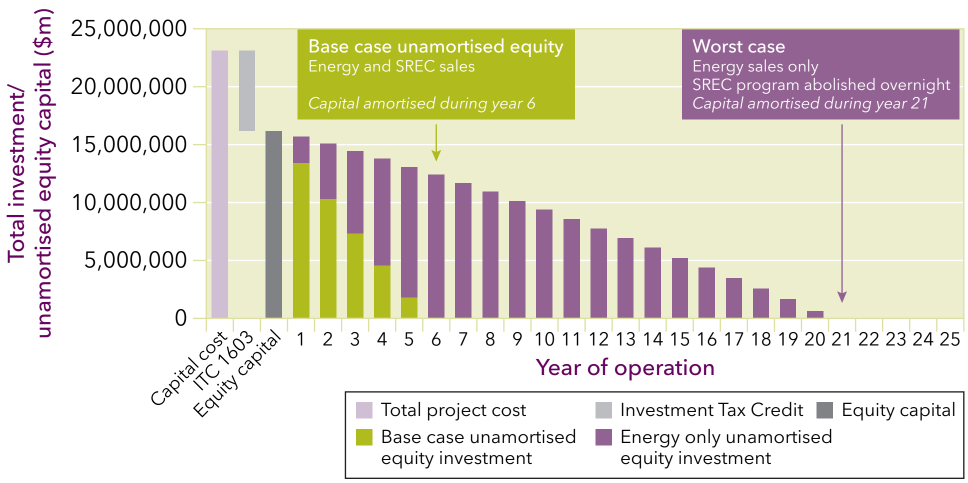
- a reduction in the RPS target so that the volume of new renewable energy capacity required in a given state is reduced;
- extension of the date by which the target has to be achieved; and
- reductions in the penalty or buyout price available to utilities (or equivalent) which puts downward pressure on prevailing REC prices.

In each of the above cases, revenue from RECs may be affected (positively or negatively), but usually not abolished altogether. A customary sensitivity analysis can be employed to test future revenue assumptions to ensure that under most credible adverse scenarios, reasonable rates of return are still achieved, even if they are less than the expected return when the investment was made. Refer to the examples below, which are extracted from the investment analysis.

The most important point to consider is that even in REC markets, the actual electricity produced by the project is typically sold under long-term, binding sales contracts at fixed prices. In many cases it is sold to creditworthy buyers (such as investment-grade municipal entities or electricity utilities). This revenue stream can therefore be reasonably considered as lower risk when coupled with:

- the long economic lives of proven renewable energy supply equipment of 20 years or more;

Figure 12.3: **Case study 1 – US solar PV project capital amortisation***



* The Investment Tax Credit grant illustrated refers to US Treasury section 1603 cash grant which was available to December 31, 2011. This grant was paid in lieu of the Federal Investment Tax Credit and provides a cash grant of 30 percent of eligible project costs, 60 days past commissioning of eligible projects completed in the US.

Source: Internal investment analysis.

- the long-term warranties on output performance from manufacturers of quality equipment; and/or
- the insurance cover available to cover major risks including material loss or damage to the equipment, business interruption and credit default.

Figure 12.3 shows how, using an actual investment opportunity for solar PV (being a lower output or intermittent technology) located in a US REC-based market, the capital investment made in the project is still ultimately protected. The chart also shows how annual cash distributions of at least 3 percent a year (rising to over 6 percent a year) are underpinned by the sale of electricity and most importantly, even when the RECs are abolished retrospectively.

Example returns sensitivity analysis – investment paper excerpt, US solar PV project

The example shown in Tables 12.2 to 12.4 is a 100 percent cash equity investment case, after receipt of the applicable Investment Tax Credit (ITC) available for solar PV projects in the US market. The base case, or Case 1, is the expected investment case if the US market RECs (referred to here as SRECs or solar renewable energy credits) are sustained for the life of the investment, as expected under current legislation. Figure 12.4 illustrates a comparison between the ongoing annual cash distributions under Case 1 and Case 3, the latter representing the worst case where no income from SRECs is received by the project and 100 percent of income must be sourced from electricity sales under the PPA.

Table 12.2: **Solar PV Case 1 – Base-case returns**

Unlevered economics – base case	Gross
	P50
Project IRR	14.9%
NPV @ 8% ($)	7,388,747
Average yield – 5-year	17.4%
Average yield – 12-year	14.6%
Average yield – project life	12.0%

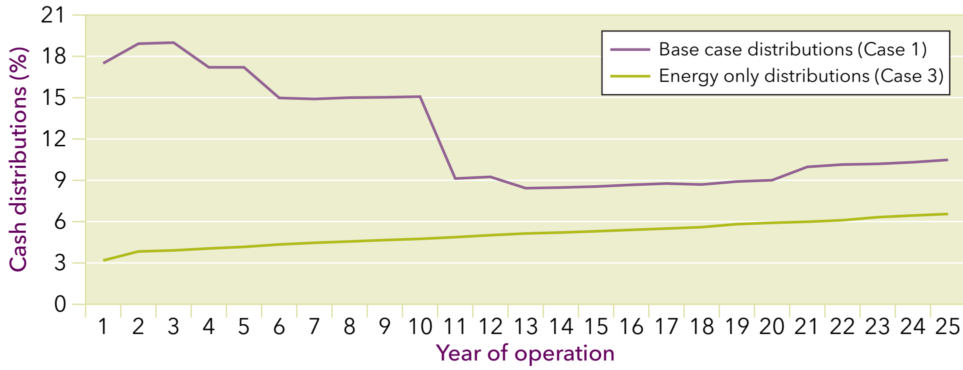
Table 12.3: **Solar PV Case 2 – Returns assuming no SREC contract is executed and all SRECs are sold at regulated floor price**

Unlevered economics – SREC floor	Gross
	P50
Project IRR	12.3%
NPV @ 8% ($)	5,062,454
Average yield – 5-year	13.9%
Average yield – 12-year	13.2%
Average yield – project life	11.2%

Table 12.4: **Solar PV Case 3 – No SREC revenue**

Unlevered economics – No SRECs	Gross
	P50
Project IRR	0.6%
NPV @ 8% ($)	(9,158,285)
Average yield – 5-year	3.3%
Average yield – 12-year	3.8%
Average yield – project life	4.1%

Figure 12.4: **Cash distributions under the base (Case 1) vs energy-only (Case 3) scenarios***



* Case 1 and Case 3 are illustrated in Table 12.2 and Table 12.4, respectively.
Source: Internal investment analysis.

Investment paper excerpts
Example capital protection analysis – investment paper excerpt, US solar PV project

The analysis below shows that in multiple scenarios of pricing weakness, reasonable returns are still achieved and most importantly, capital is protected. Most notably, in the adverse regulatory-change scenario where overnight the entire SREC incentive programme is abolished (unprecedented, yet still remotely possible) – returns are still positive on a buy-and-hold basis (and higher on an earlier-exit basis).

As a comparison, the projected capital investment and returns for a landfill gas portfolio, also located in the US market, is illustrated in the charts and tables below. Again,

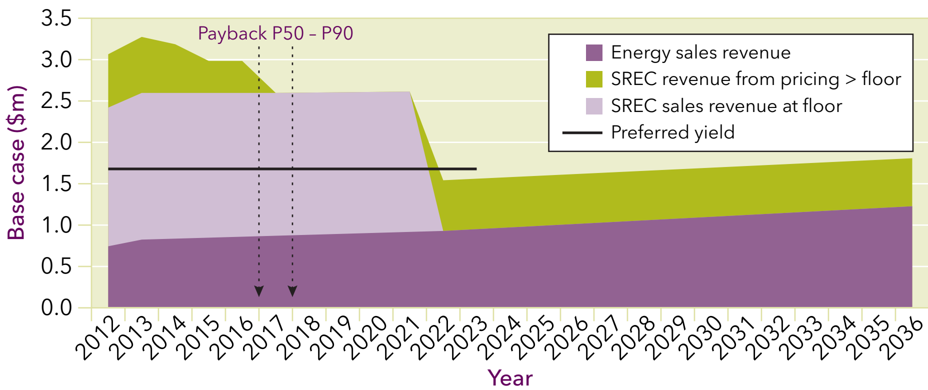
Capital protection

Invested capital is fully amortised during year six at P50[3] (year seven at P90[4]). Total energy sales revenue is over $25 million under P90 (25 years – PPAs have a five-year extension option) whereas post-1603 net equity investment amounts to $16.6 million. Therefore under both P50 and P90 energy production scenarios, capital is fully protected by energy sales only.

Figure 12.5 depicts (i) contracted revenues underpinned by PPAs; (ii) revenues arising from the SREC regulated floor price; and (iii) revenues arising due to SREC pricing assumptions above the floor. On a nominal basis over the life of the project, as little as 21 percent of total revenues are derived from exposure to SREC pricing above the ten-year regulated floor price. Over the first ten operating years of the project, only 5.2 percent of revenues are derived from SREC pricing assumptions above the regulated floor price.

[3,4] P50 and P90 refer to the expected certainty level, or probability, that a particular forecast level of electrical output will be achieved by the project.

Figure 12.5: **Revenue profile by source**



Source: Internal investment analysis.

this uses an actual project in the US for a base-load, higher capacity technology. While this investment is also located in a REC-based market, in the event that regulatory incentives are abolished entirely, the project is underpinned by the sale of electricity and is expected to return capital through annual distributions within eight years, and achieve a rate of return above 12 percent. Due to the production of electricity on a continual, rather than intermittent basis, this project is able to return capital significantly faster than a solar PV project.

Table 12.5: **LFG Case 1 – Base-case returns**

Unlevered economics – base case	Gross
	P50
Project IRR	17.7%
NPV @ 8% ($)	6,484,625
Average yield – 5-year	12.6%
Average yield – 12-year	14.7%
Average yield – project life	14.9%

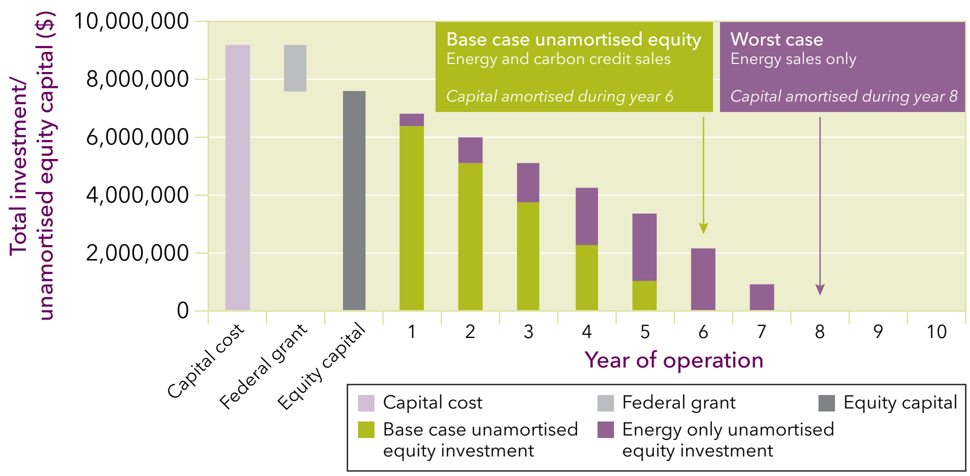
Example returns sensitivity analysis – investment paper excerpt, US landfill gas (LFG) project

Case 1 (see Table 12.5) shows the returns expected from the project, based on negotiated power purchase price agreements for the sale of electricity and additional revenue from carbon credits. Case 2 (equivalent to Case 3 in the solar project example above – see Table 12.6) reflects the expected returns if the sole source of revenue is from the sale of underlying electricity.

Table 12.6: **LFG Case 2 – No RECs and no carbon credit revenue ever**

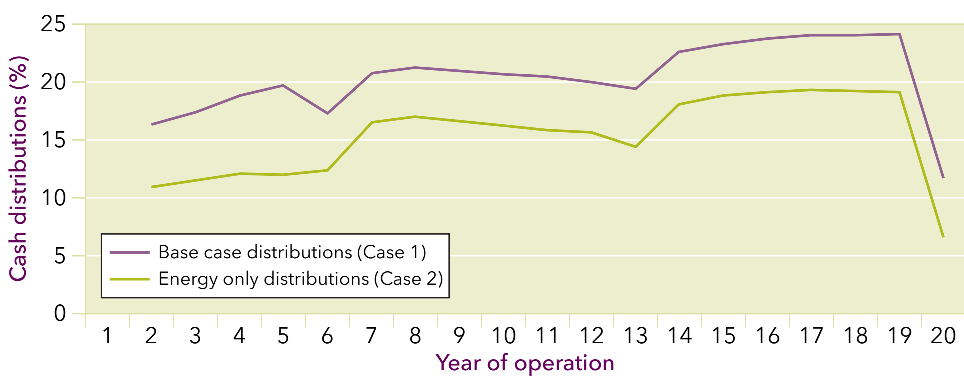
Unlevered economics – no credits	Gross
	P50
Project IRR	12.2%
NPV @ 8% ($)	2,781,450
Average yield – 5-year	10.6%
Average yield – 12-year	13.4%
Average yield – project life	14.2%

Figure 12.6: **Case study 2 – US landfill gas project capital amortisation**



Source: Internal investment analysis.

Figure 12.7: **Cash distributions under the base (Case 1) vs energy-only (Case 2) scenarios***



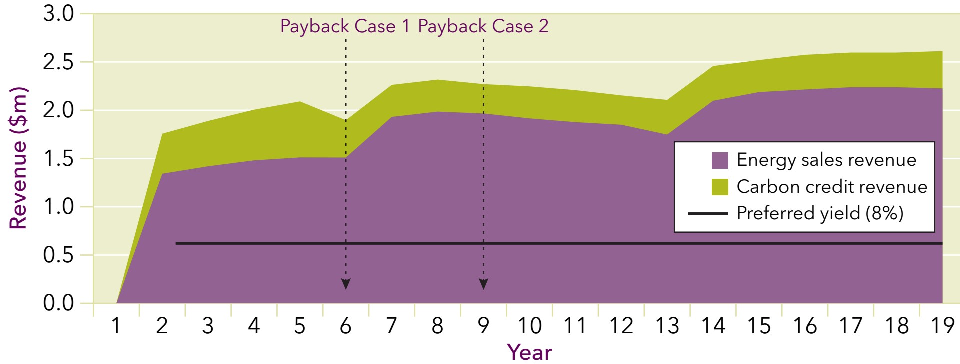
* Case 1 and Case 2 are illustrated in Table 12.5 and Table 12.6, respectively.
Source: Internal investment analysis.

Conclusion

Well-structured investments in renewable electricity projects can offer long-term capital protection to investors exclusively through the sale of electricity from projects otherwise operating in open power markets. Such capital protection is attainable through electricity sales despite regulatory changes that may occur in different markets. Even in the unlikely event of a worst-case regulatory scenario, investor capital can be protected through the long-term and stable nature of revenue streams flowing from contracts with public and private utilities.

The power sales contracts generally entered into by investors in renewable electricity assets are binding and enforceable agreements, and will customarily prevail irrespective

Figure 12.8: **Revenue profile by source**



Source: Internal investment analysis.

of a change in law affecting the availability and/or value of tradable environmental attributes such as RECs. In most cases, power is sold to utilities on a firm basis, under 15–20 year binding contracts, creating reliable future cash-flow streams. That revenue underpins the capital protection features of these investments.

Additional risk management strategies employed in portfolio-based investment programmes feature diversification of investments across multiple jurisdictions, further mitigating the impact of a worst-case retrospective regulatory change on investment returns. This can be managed through portfolio construction techniques that ensure balanced exposure to projects in multiple states (such as the US) or multiple countries (such as the EU only or select OECD countries).

Finally, as illustrated through the landfill gas project and a solar PV project cases described above, including both high- and lower-output projects within the same portfolio would also increase the capital protection available to an investor from what is often misunderstood as the key risk of clean-energy investing. □

Summary findings:

- Renewable electricity projects can offer long-term capital protection to investors given the stable nature of revenue streams flowing from contracts with public and private utilities
- Risk management strategies in portfolio-based investment programmes can mitigate the effects of worst-case regulatory change on investment returns by diversifying across multiple countries
- A portfolio comprising high- and lower-output projects would increase the capital protection available to investors

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Tim Short *is a vice president on the Clean Energy and Infrastructure team in Investment Management at Capital Dynamics. He has seven years of energy-related experience. Prior to joining, Tim held positions at UBS Investment Bank within the global power and utilities team and at Greentech Capital Advisors as an investment banking associate. He has also worked as a climate change advisor to the former Australian Federal Minister for the Environment. His involvement with clean technology began as a junior process engineer at BP Solar (Australia) and CSG Solar (Australia). Tim holds Bachelor's degrees in Commerce and Engineering, majoring in Photovoltaics and Solar Energy, from the University of New South Wales.*

13 Risk premium valuation methodologies: the cost of equity in US solar energy projects

By Rory Quinlan and Kathryn Rasmussen, Capital Dynamics

This chapter discusses:

- The three methods to calculate the cost of capital for solar energy projects
- The pros and cons of the three individual methods
- Insightful commentary on the most suitable methodology

Introduction

The chapter discusses alternative approaches of calculating an appropriate cost of equity in analysing US solar energy projects under consideration for investment. A firm's cost of equity represents the compensation that the market demands in exchange for owning the asset and bearing the risk of ownership, which typically equals the return that investors require for a company or assets. There are three well-established methodologies which are used to determine an appropriate cost of equity:

- *Build-up methodology:* Derived from the Capital Asset Pricing Model (CAPM) which introduces an Industry Risk Premium (IRP) applicable to solar energy investments. This methodology is based on that employed by Morningstar's valuation and research firm Ibbotson Associates, Inc. (Ibbotson) which is an industry standard for risk premium estimates across all industries.
- *Investor survey methodology:* Surveys of investors, industry professionals and valuation experts performed by consultants to gather the risk perceptions of an investment and the appropriate cost of equity to compensate for those risks. This method is most relevant in newer industries which may lack extensive historic data such as the solar energy industry. As an example, in 2011 Oxera, an independent UK-based consultant firm was commissioned by the UK Commission of Climate Change to assess the drivers of discount rates in low-carbon power plant technologies and we consider below the results of the findings.
- *Dividend discount model:* This methodology uses a derivation of the Gordon Growth Model in order to calculate the fund's specific cost of equity for solar photovoltaic (PV) investments. The expected dividend yield plus the expected dividend growth determines the required return on equity for investors. In this example, the fund's current expected five-year yield to investors generates a portfolio specific cost of equity.

The chapter concludes by identifying the most appropriate model outlining why it has proven to be the best to use in practice. It will then outline how far the example of a US solar project can be transposed and is useful for other clean energy infrastructure projects.

The chapter draws on the work of Capital Dynamics' Clean Energy and Infrastructure team, reference to which is made throughout this chapter as 'the team'.

Build-up methodology – CAPM

Portfolio theory attempts to determine the total risk of a specific investment and incorporate that risk into investment decisions through the estimation of unsystematic and systematic risks, or diversifiable and undiversifiable risks, respectively. Under this method, a Discounted Cash Flow (DCF) method is employed with the applied discount rate which is a composite of multiple factors designed to allow and compensate for specific risk factors. This build-up is undertaken by adding risk premium to the risk-free rate, usually ten-year AAA-rated government bonds.

It is important to note that there is considerable controversy in the financial community regarding the appropriateness of a risk-adjusted discount rate approach. Increasing the discount rate has been cited as a poor substitute for explicitly capturing the uncertainty in cash flow variables. In general, a somewhat arbitrary risk-based adjustment of the discount rate approach has been deemed inappropriate with respect to renewable energy, and the extent of the use in other energy investment is uncertain.

Additionally, it is important to note that many portfolio theorists conclude that individual projects should not utilise separate or unique discount rates. In June 2007, the California Energy Commission held an Integrated Energy Policy Report Workshop on portfolio analysis to address the following question: *Should different discount rates be used to evaluate cost streams with different volatilities/levels of uncertainty (that is, use of a higher rate for riskier cost streams)?*

The excerpt below summarises the response from Dr. C.K. Woo, a specialist in public utility economics, applied microeconomics and applied finance:

> *"The cost stream of a portfolio of energy resources is the aggregate of the underlying component-specific streams. The accepted practice is to use a single discount rate, regardless of whether one component's cost stream is more or less uncertain than another one. If a component of the portfolio's overall cash flow is highly uncertain, that uncertainty drives the portfolio's cost risk. All present value calculations should be performed with a single discount rate. Ironically, if differential uncertainties were to be internalised via varying discount rates, a portfolio with many uncertain cost streams would not have a cost variance, as all of the uncertainties would have been resolved by the varying discount rates."*

Systematic and unsystematic risks in the power-generation industry reflect many of the same principles as other industries although the risks represent industry-specific factors. The primary factor in determining the appropriate cost of equity and discount rate is to identify those risks which an investor can diversify away from the investment and those risks which cannot be diversified away. It is a widely accepted principle that discount rates should not be adjusted for unsystematic risks, whether it is the possibility of premature solar module failure or the probability of a state's Solar Renewable Energy Credit (SREC) incentive programme being discontinued, as these are all risks that should be incorporated into individual project cash flows and not compensated by an adjustment to the discount rate.

Systematic risk	Unsystematic risk
Any risk that cannot be diversified. Beta is a measure of systematic risk (that is, covariance risk) measuring the degree to which changes in a particular stock or cash flow co-vary with the returns of a broadly diversified market portfolio. **Example:** The economic impact related to the fuel cost of generation; as fuel costs rise, economic activity declines. This cannot be diversified away.	Any risk that is diversifiable or occurs randomly. These either will not be correlated to economic events or returns to a broadly diversified market portfolio. **Example:** Risk of technical failure at a solar site. Technical failure is uncorrelated and multiple sites can diversify this risk away.

Professor Stewart Myers of the Massachusetts Institute of Technology gave the below example (Roulette Example) to help illustrate the determination of systematic risk and how a business can contain significant risks (just like the solar industry) but have these risks addressed through portfolio diversification (as does an investor in solar PV assets).

> *"The owner of a roulette wheel is exposed to considerable business risk; fortunes can be made or lost by the house in any one night. But this business risk is random or unsystematic and the owner can easily diversify it by owning many roulette wheels so that on any given night some make money while others lose.*
>
> *Having diversified the random risk, the owner is exposed only to the remaining, non-diversifiable, systematic risk: when the economy is good more tourists show up to play than when the economy is poor. This remaining systematic risk cannot be diversified."*

The following considers what the primary solar energy-specific risk factors are and whether or not they should impact the discount rate applied to the evaluation of solar PV investments:

- *SREC revenue:* Like the Roulette Example, the revenue derived from the sale of Solar Renewable Energy Credits (SRECs) pose a risk to the expected future revenue generation of a specific solar PV project. Price is variable in line with changes in supply and demand as well as regulatory changes, such as an increase or decrease in a regulated compliance payment cap that directly impacts traded SREC values.

Just like a roulette table, this risk is diversifiable by owning multiple solar PV projects in a number of non-contiguous states as SREC markets are state-specific markets and pricing tends to be uncorrelated. This view holds, therefore, that what is considered by the team to be the single most significant 'uncontrollable' risk to investments in solar PV, is unsystematic, can be diversified and so this is a risk that should not impact the discount rate of a solar PV project or portfolio.

What makes this analysis interesting is that it is quite common in the industry to see riskier revenue streams (such as those derived from SREC sales compared to those executed under fixed-price power purchase agreements (PPA)) discounted at higher discount rates as a compensator.

If one accepts, however, that this risk should not affect the discount rate, it is nonetheless a very important project-specific risk. The appropriate treatment of this risk is through probability-weighted estimates of receiving or not receiving a certain amount of SREC revenue within overall cash flows for the life of the investment. Once this is estimated, the resulting reviews are then discounted using the appropriate unadjusted discount rate.

On this view, SREC risk can be reasonably viewed as an *unsystematic* risk so that no discount rate adjustment should be made.

- *Technology risk:* Technology risk is an important factor in any power-generation asset investment. This is a broad category of risk related fundamentally to asset performance in terms of production reliability and maintenance cost. However, many agree that this also is a diversifiable risk given the fact that any technology failure or replacement can be subsequently built into a known cost. Thus, it is argued that uncertainty around new technology (for example, life of a component) should be reflected by adjustment of expected future cash flows and not by increasing discount rates.

  Specifically with regards to solar modules, an investor can compensate for the unforeseen random failure of a solar module or inverter by setting aside replacement reserves, which increases estimated operating costs and reduces future net operating cash flow. Additionally, module and inverter manufacturers provide efficient financial risk-mitigation options by providing replacement warranties and guarantees to cover any deficiencies or failures. Like the Roulette Example, random failures can be viewed like the profits and losses of a given roulette wheel. The combination of multiple project diversification and use of risk mitigation (insurance, replacement warranties) means that this risk can be diversified.

  Therefore, solar technology risk may be viewed as an *unsystematic* risk and no discount rate adjustment made.

- *Counterparty risk:* This risk reflects fundamentally the risk of default by a customer in performing its obligations to purchase the energy output of the asset. This is also a diversifiable risk as a portfolio of solar PV assets can diversify the utility and non-utility off-takers with PPAs as well as for SREC counterparties with contracts. Alternative avenues to continue the sale of the output even after a default (such as selling power back into the grid) also demonstrates the available mitigation and diversifiable nature of this risk.

Therefore, counterparty risk too can be viewed as an *unsystematic* risk and no discount rate adjustment is required to be made.

- *Fuel cost risk:* Unlike fossil fuel-fired power plants, solar PV has no fuel costs, therefore does not have any systematic risks associated with fuel supply. Fossil fuel power-generation is impacted by a systematic risk because even with a high degree of certainty in fuel cost estimates, industry-wide factors can impact fuel costs to all fossil fuel plants at the same time and this is an undiversifiable risk for fossil fuel power generation that would seemingly warrant a risk-adjusted discount rate.

  Therefore, fuel cost risk for solar is arguably an *unsystematic* risk and so no discount rate adjustment is required to be made.

- *Utility industry risk:* Some financial research argues that solar PV assets are a zero-beta asset, meaning they are riskless assets which function essentially as a treasury bond. The team does not agree with this view as there is identifiable systematic risk which should be taken into account. The systematic risk of utilities provides an imperfect but acceptable proxy for any systemic market risk associated with the power-generation market as most solar-specific risks can be viewed as fairly unsystematic.

  Utility industry risk is a *systematic* risk and a discount rate adjustment is warranted.

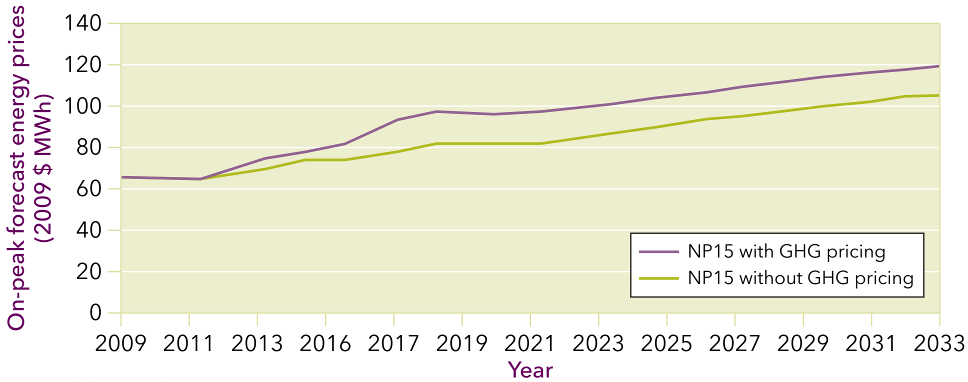
Example: rising electricity prices from carbon regulation

Certain economic and industry events could impact the power industry, including renewable energy, across the board and cannot be diversified. For instance, deregulated, carbon-intensive electricity markets in the US, Canada, the western EU member states and Australia are likely to experience material electricity price increases over the next five to ten years due to a combination of factors including but not limited to:

1) increasing compliance and capital-expenditure costs in meeting carbon and renewable energy mandate requirements which fall heavily on the power generation sector;
2) costs of refurbishment and replacement of ageing power infrastructure as well costs to accommodate decentralised generation and smart grid rollout; and
3) new capacity to meet ever-increasing growth in energy consumption.

Accordingly, the pricing of electricity (both at wholesale and retail) in the team's view, is likely to increase on a compounding basis, at a rate greater than the prevailing rate

Figure 13.1: **Impact of carbon prices on Californian wholesale energy prices**



Source: Black & Veatch.

of inflation. In the event of the introduction of emissions regulation that has a bottom-line impact on fossil fueled generators of electricity, those costs are likely to be passed through in the form of higher market prices for electricity.

Figure 13.1 shows one piece of analysis by Black and Veatch, an independent engineering consultant, of the potential impact of a carbon price on wholesale electricity prices in California. Similar analysis has been undertaken with comparable results in the electricity markets of Canada, Australia and the EU. The electricity price impact is proportional to the carbon cost impact introduced and can not be mitigated through diversification.

Application of CAPM

In the build-up methodology the factors are defined as follows:

Basic CAPM	Systematic risk
Cost of equity (R_e)	Industry-risk index (R_i)
Risk-free rate (R_f)	Small Company Risk Premium (SP)
Beta ($ß_a$) – also systematic risk	
Market Risk Premium (MRP)	

It is important to remember that CAPM is most prevalently used in the valuation of equity stocks and not illiquid project assets. In its simplest form, the CAPM is expressed as follows:

$$R_e = R_f + ß * (MRP)$$

In the context of solar energy projects, however, estimates of the beta have proven to be very difficult and impractical. Consequently, an Industry Risk Premium (IRP) has been developed, which is an attempt at the quantification of the systematic risk of the utility industry referenced in the previous section and would replace the beta in the classical equation. This method estimates IRP by incorporating data from relevant companies participating in an industry to capture the risk characteristics of that industry. This risk index, which is the beta for the industry, is then multiplied by the long-horizon equity risk premium.

$$IRP = (R_i * MRP) – MRP$$

Thus, accounting for the utility-specific industry risk as well as adding a small company risks results in the following equation can be derived (for details please review appendix):

$$R_e = R_f + R_i * MRP + SP$$

The above extension factors may be positive or negative, depending on how they relate to the base MRP. The SP is a valuation industry standard estimation by Ibbotson's 2010 Valuation Yearbook and seeks to compensate investors for the risks associated with smaller, illiquid investments.

Determining the IRP

Industry risk is an important component in calculating the cost of equity using the CAPM. The basic CAPM already includes some allowance for industry risk through the chosen beta measure. However, when using the build-up method, an additional industry risk premium is added.

The industry-risk index is a 'full-information' beta refined by Ibbotson and includes the proportionate risk of public companies that participate in a given industry rather than only pure-plays. This methodology is believed to capture more accurate covariance to the broader market. Given the lack of pure-play listed solar generation companies and the number of public utilities and generation companies that now own and operate solar generation, the team considers this methodology to be an imperfect yet best available choice to reflect the systematic industry risk of this sector.

Industry-risk index (R_i) and universe selection

Finding a large sample of pure-play companies which specialise in the exact line of business is extremely difficult, especially in the solar generation industry. Generally speaking, most renewable energy and power-generation assets that are publicly listed are owned by the (listed) utility holding company parent. The team has analysed the top US electricity utility owners of solar PV assets (as determined by SEPA, the Solar Electric Power Association). Given the lack of listed solar generators to determine the covariance of a diversified market, these companies serve as a 'best-available' proxy for systematic risk components solar generation is exposed to by operating within the utilities industry. Here R_i is approximated by a industry beta relevered to account for the specific utility situation.

Table 13.1: **Integrated electricity utilities – beta and cost of equity**

Integrated electricity utilities	Levered beta	Unlevered beta	Relevered beta	Cost of equity
Constellation Energy Group, Inc.	0.72	0.50	1.11	6.8%
Covanta Holding Corporation	0.85	0.51	1.08	7.7%
Duke Energy Corporation	0.39	0.27	0.57	4.6%
Xcel Energy Inc.	0.46	0.31	0.68	5.1%
Edison International	0.62	0.34	0.84	6.1%
Otter Tail Corporation	0.85	0.61	1.35	7.7%
Pinnacle West Capital Corporation	0.64	0.42	0.95	6.2%
Sempra Energy	0.69	0.40	1.06	6.6%
NV Energy, Inc.	0.69	0.36	0.80	6.6%
NextEra Energy, Inc.	0.56	0.33	0.80	5.7%
Median	0.66	0.38	0.90	6.4%

Note: Beta is relevered at the fund target of 65 percent debt to capitalisation. The relevered beta is used to eliminate the impact of a specific company's leverage on its beta in order to compare apples to apples in terms of capitalisation.
Source: Capital Dynamics.

Using the integrated electricity utilities' median relevered beta of 0.90 as a proxy for R_i, which is the median relevered beta of the integrated electric utilities comparable set, we can calculate our R_e as follows:

$$R_e = R_f + R_i * MRP + SP$$

Example: Cost-of-equity calculation by build-up methodology

Overall, the team considers the CAPM build-up method to be an inappropriate methodology to use in the valuation of solar PV project investments. It is a 'square peg in a round hole' with a rationale rooted in the public equities market that has little relevance to this class of real assets, so has serious shortcomings:

- The addition of the Small Company Premium as a proxy or substitute for project-specific risk is arbitrary and arguably inappropriate.

Table 13.2: **Cost-of-equity calculation by build-up methodology**

Risk-free rate (R_f) *	1.99%
Market Risk Premium (MRP) **	6.67%
Industry-risk index (R_i)	0.90%
Small Company Premium ***	2.85%
Company-specific cost of equity	**10.82%**

* Yield on the ten-year US Government Bond as of January 1, 2012.
** 2010 Ibbotson SBBI Valuation Yearbook US market risk premium.
*** 2010 Ibbotson SBBI Valuation Yearbook calculated premium on market capitalisation less than $431 million.
Source: xxxxxxxxx

- Overall build-up methodology can be somewhat subjective because each variable is assigned values presumed reasonable by comparison; however it is not an exact science. Small changes to certain assumptions could also potentially have a material impact on the discount rate and thus the valuation of the project.
- Often, calculating a project-specific discount rate for the CAPM proves to be difficult. This is due to the difficulty in finding the appropriate proxy for beta as the project specific risks are difficult to quantify with no direct pure-play public comparables to calculate a project specific beta (that is, cannot run a regression the same way you would for a company based on publicly traded comparable companies). This is one of the primary issues when valuing renewable projects.

However, it may have some utility for an investor that wishes to compare a listed solar PV investment opportunity with a private capital opportunity. The CAPM method would offer some insight into how the listed public markets would tend to value those assets. A build-up in the way of CAPM is a less appropriate way to compensate investors for risk as opposed to an estimation of future cash flows which account for the probability of certain cash-flow outcomes.

Investor survey methodology

The investor survey methodology is designed to estimate the discount rates that the general body of likely investors would apply to the valuation of relevant solar PV investments through interviews of investors, project sponsors and financial analysts. These surveys which are publicly available, address the systematic risk factors associated with low-carbon technologies as well as the impact of any changes in regulatory or market arrangements. This approach most closely resembles that used to determine fair market value (FMV) as it reflects the methodology and discount rate most commonly used by investors when considering investments in solar energy assets.

In April 2011, a survey was conducted by consulting firm Oxera[1] which identified and assessed the main drivers of discount rates for low-carbon technologies. The results determined the required equity return of investors that, in Oxera's view, compensated for the risks associated with a given technology. These results are illustrated in Table 13.3.

The analysis in Table 13.3 implies a cost of equity for solar projects between 6 percent and 9 percent. The team considers that this estimate is a fair range and is supported

[1] Oxera is a prominent European independent economic consultant looking at business economics principles across various sectors to spot trends, analyze how markets develop and assess the likely impact of these developments. This study was commissioned by the UK Commission of Climate Change. Per their commission by the UK CCC, Oxera surveyed investors, project sponsors, and financial issuers to gain knowledge on the following items below. The names of the respondents were not disclosed as part of survey anonymity.
1. Factors affecting cash flow risk
2. Comparison of risk and discounts rates of different low-carbon generation technologies
3. How discount rates for low-carbon technologies were affected by the elimination of specific risks
Full report: Discount rates for low-carbon and renewable generation technologies April 2011, available on the Oxera website.

Table 13.3: **Risk perception and discount rates for low-carbon and renewable-generation technology**

Generation technology	Risk perception	Discount rate (real, pre-tax)	
		Low	High
Conventional			
Turbines	Low	6%	9%
Low-carbon and renewable			
Hydro ROR	Low	6%	9%
Solar PV	Low	6%	9%
Dedicated biogas (AD)	Low	7%	10%
Onshore wind	Low	7%	10%
Biomass	Medium	9%	13%
Nuclear (new build)	Medium	9%	13%
Offshore wind	Medium	10%	14%
Wave (fixed)	Medium	10%	14%
Tidal stream	High	12%	17%
Tidal barrage	High	12%	17%
Carbon capture storage, coal	High	12%	17%
Carbon capture storage, gas	High	12%	17%
Wave (floating)	High	13%	18%

Source: Oxera April 2011 analysis Discount rates for low-carbon and renewable generation technology.

by what little transaction precedents there are supporting the estimation of a FMV for built and operating solar PV assets. However, as the study notes, it does not necessarily capture all the factors impacting the investment decision.

In the team's experience the predominant method used by acquirers and investors is the discounted cash-flow (DCF) model as cash flows themselves can be adjusted for risk.

The investor survey method is highly useful to the team when considering new investment opportunities, especially where the cost of the investment to the fund is materially lower than the net present value (NPV) derived from the application of discount rates of 6 to 9 percent. Moreover, an investment which generates a positive NPV using a much higher discount rate (such as 11 to 12 percent, for example) and especially one which is based primarily on known factors rather than assumptions (such as fixed sales prices in a 20-year contract), is indicative of an investment with an attractive risk-adjusted return – the expected return more than compensates for the assessed risk.

The positive NPV derived from the application of the lower market discount rates of 6 to 9 percent to the investment cash flows is an indicator of potential gain on that investment to a buyer at FMV.

A further discount in the range of 2 percent to 3 percent can then be added to provide for additional risks such as construction, commission and regulatory risks. Given the FMV methodology used in the determination of the valuation of assets under both IFRS and US GAAP is the same or substantially similar, the method proves to be very robust.

Despite the advantages, the investor survey method has issues investors need to consider:

- The method relies on actually implementing a detailed survey of industry participants. This needs to be developed to account for all the statistical shortcomings of large surveys including developing the appropriate participant samples and diversity.
- Almost always relies on an independent third party to conduct due to nature of the study.
- It can be time-consuming and updates sometimes not readily available for specific projects (renewable markets can change relatively quickly and a survey done five years ago will not be as representative as one done one year ago).

On balance the team believes the investor survey method to be the most appropriate approach to properly value solar energy projects, where the shortcomings are also part of the reason it is most preferred. It is detailed and assesses the risks seen by those closest to the specific types of projects. This essentially is a more "real-world" scenario for assessing a required rate of return on a project than any bottom-up method using multiple assumptions that are difficult to impossible to quantify and verify properly in the absence of large volumes of available data.

Dividend discount model

The dividend discount model (DDM) is one of the simpler models for calculating the cost of equity by relating the value of a company to its expected dividends with cost of equity and growth rate. As the fund's investments provide annual cash yields, the dividend capitalisation model is a formula that is an alternative approach to calculate the fund's portfolio cost of equity.

Of course this method treats the fund as if it were a dividend-paying company. This method implies that the appropriate risk compensation for investors is inherently determined by the cash yields generated, which has some inadequacies. There are clearly shortcomings with this approach but the focus on cash yield and how it pertains to the portfolio is the rationale here.

In the DDM the factors are defined as follows:

Dividend capitalisation model:
Value per share (P_0)
Dividend per share (DPS)
Dividend yield (yield)
Growth rate (g)
Cost of equity (k_e)

Dividend capitalisation model:

$$k_e = DPS / P_0 + g$$

Therefore:

$$k_e = yield + g$$

The solar industry is unique in that there is module degradation (typically around 0.5 percent p.a.) built into solar-generation facilities. In the majority of cases these sites have a terminal value of zero, thus a negative growth rate. Based on the current fund average five-year cash yield of 11.4 percent and declining average growth rate of -1.1 percent over the portfolio life, the implied cost of equity can be calculated as:

$$k_e = 11.4 + -1.1\%$$

$$k_e = 10.3\%$$

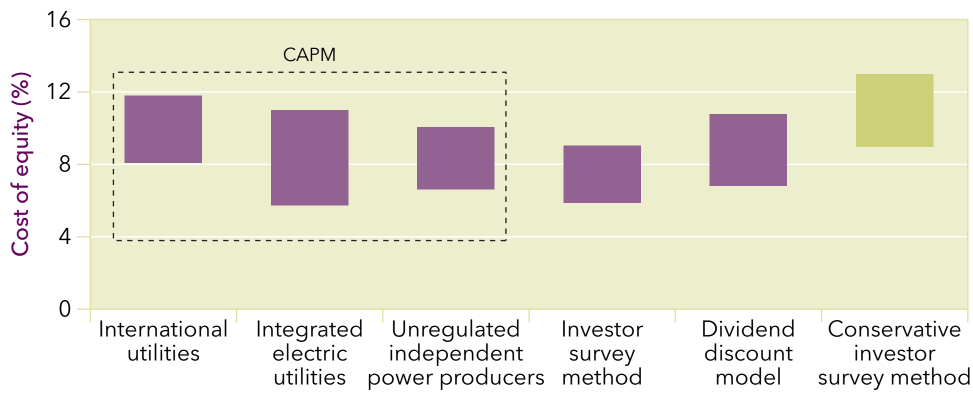
If you apply the target cash yield of the fund, a range can be determined as it relates to the actual current portfolio. The fund targets a cash yield between 8 percent and 12 percent, which gives an implied cost of equity range of 6.9 percent to 10.9 percent.

Nevertheless the team feels that the DDM model suffers much from the same shortcomings that are difficult to overcome like the CAPM model and on balance believes the investor survey model is the best option to determine the cost of capital for solar energy projects.

Conclusion

There is much debate within the financial community regarding the appropriateness of various valuation methodologies as they may apply to clean energy projects. Different methods have both merits and weaknesses. In order to build a robust asset valuation method, the team has compared appropriate discount rates using each generally accepted method.

Figure 13.2: **Comparative cost of equity across industry groupings, methodologies and models**



Source: Capital Dynamics.

Figure 13.2 depicts the various ranges of equity cost in relevant industry sectors and compares that to the results derived from applying the various methods. Currently, the preferred and best available method is a conservative approach with the investor survey method as a basis.

The CAPM build-up methodology implies a cost of equity ranging from 7.9 percent to 10.7 percent (median of three different categories of comparable, publicly listed entities engaged in the development and ownership of solar energy projects in the US). The investor survey methodology resulted in discount rates between 6 percent and 9 percent, specifically for solar energy projects. And finally, the DDM applied directly to the fund's portfolio implies a cost of equity between 6.9 percent and 10.9 percent. The Capital Dynamics' Clean Energy and Infrastructure team considers the investor survey method to be an appropriate indicator of the actual cost of equity that should be applied in project evaluation and importantly, is the method most aligned with the FMV methodology applied in the valuation of the fund's investments under IFRS and US GAAP.

It should be noted that determining the appropriate discount rate is an inexact exercise and no consensus exists about the single most appropriate approach to take when applying these theoretical frameworks. The team uses a discount rate for new investments of 10 percent-plus which is considered more than adequate to compensate for construction and commissioning risk; and fairly reflects the premium return opportunity that may be captured by asset value in excess of FMV. Finally, it should be noted that these conclusions can be extrapolated to other real assets as well. We see similar methodologies appropriate for wind, water power, landfill gas and other related real assets in cases where a robust publicly traded body of comparables is missing and where a cash flow derived from the sale of energy provides for the principle way of making a return. □

Contents Previous view

Summary findings:

- The investor survey methodology provides the closest approximation of FMV and therefore is the most relevant for clean energy assets evaluated by the fund

- A CAPM build-up produces discount rates at the higher end of the range as well but this is less applicable as it is a better method for publicly traded companies rather than private real assets. Moreover, the use of discount rate adjustments to compensate for systematic risk is questionable. The team prefers to adjust estimated cash flows to account for identified risk as far as practicable before the application of the relevant rate to discount those future cash flows

- The DDM is not as relevant to these assets due to their declining revenues over time through degradation and depreciation to the end of their economic lives. This contrasts with companies where dividend growth is assured in many cases to compound positively at or above the rate of inflation

Appendix I: **CAPM formula**

Basic CAPM formula:

$$R_e = R_f + \beta * (MRP)$$

Introduction of IRP defined as:

$$IRP = (R_i * MRP) - MRP$$

With the introduction of IRP, which contains an industry risk index beta can be set to have the value 1 resulting in:

$$R_e = R_f + MRP + IRP$$

Including the introduction of the Small Company Risk Premium (SP) the equation becomes:

$$R_e = R_f + MRP + IRP + SP$$

Substitution of IRP results in:

$$R_e = R_f + MRP + (R_i * MRP) - MRP + SP$$

Resulting in the final equation as the solar energy-specific adaptation of the CAPM model:

$$R_e = R_f + R_i * MRP + SP$$

Appendix II: **Comparable universe for industry risk premium calculation ($m)**

The following companies have significant renewable portfolios in the industry with a regulated/unregulated business mix that reflects similarly to solar generation within the power generation industry.

Company	Market value of equity	Total debt	Tax rate	% debt	% equity	Debt/ equity	Levered beta	Unlevered beta	Relevered beta*	Company cost of equity
International utilities										
Electricite de France SA	41,931.2	75,878.0	55.4%	64.4%	35.6%	181.0%	0.92	0.51	0.93	8.2%
Iberdrola SA	35,524.2	45,560.4	23.4%	56.2%	43.8%	128.3%	1.07	0.54	1.31	10.7%
Ormat Technologies Inc.	812.8	915.9	35.0%	53.0%	47.0%	112.7%	1.17	0.67	1.49	11.9%
Median			**35.0%**	**56.2%**	**43.8%**	**128.3%**	**1.07**	**0.54**	**1.31**	**10.7%**
Integrated electricity utilities										
Constellation Energy Group, Inc.	7,254.3	4,907.3	35.0%	40.4%	59.6%	67.6%	0.72	0.50	1.11	9.4%
Covanta Holding Corporation	1,994.8	2,239.0	40.2%	52.9%	47.1%	112.2%	0.85	0.51	1.08	9.2%
Duke Energy Corporation	28,387.2	20,112.0	40.3%	41.5%	58.5%	70.8%	0.39	0.27	0.57	5.8%
Xcel Energy Inc.	12,899.8	10,007.8	36.7%	43.7%	56.3%	77.6%	0.46	0.31	0.68	6.5%
Edison International	13,192.1	13,621.0	22.1%	50.8%	49.2%	103.3%	0.62	0.34	0.84	7.6%
Otter Tail Corporation	793.4	475.8	35.0%	37.5%	62.5%	60.0%	0.85	0.61	1.35	11.0%
Pinnacle West Capital Corporation	5,213.4	3,923.0	31.9%	42.9%	57.1%	75.2%	0.64	0.42	0.95	8.3%
Sempra Energy	13,492.8	10,811.0	12.4%	44.5%	55.5%	80.1%	0.69	0.40	1.06	9.0%
NV Energy, Inc.	3,747.7	5,174.4	33.4%	58.0%	42.0%	138.1%	0.69	0.36	0.80	7.4%
NextEra Energy, Inc.	25,060.6	22,778.0	21.4%	47.6%	52.4%	90.9%	0.56	0.33	0.80	7.3%
Median			**34.2%**	**44.1%**	**55.9%**	**78.9%**	**0.66**	**0.38**	**0.90**	**8.0%**

Appendix II: **Comparable universe for industry risk premium calculation ($m)** *continued*

Company	Market value of equity	Total debt	Tax rate	% debt	% equity	Debt/ equity	Levered beta	Unlevered beta	Relevered beta*	Company cost of equity
Unregulated independent power producers										
NRG Energy, Inc.	3,714.0	9,371.0	36.8%	71.6%	28.4%	252.3%	0.85	0.33	0.71	6.7%
The AES Corporation	10,024.2	21,465.0	25.0%	68.2%	31.8%	214.1%	1.32	0.51	1.21	10.1%
Calpine Corp.	7,293.3	10,765.0	35.0%	59.6%	40.4%	147.6%	0.91	0.46	1.02	8.8%
GenOn Energy, Inc.	1,605.1	4,102.0	35.0%	71.9%	28.1%	255.6%	0.90	0.34	0.75	7.0%
Median			35.0%	69.9%	30.1%	233.2%	0.90	0.40	0.88	7.9%
Median			**35.0%**	**52.9%**	**47.1%**	**112.2%**	**0.85**	**0.42**	**0.95**	**8.3%**

* Relevered at the fund's target leverage of 65 percent.
Source: Capital IQ; data as of January 20, 2012.

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Section

IV

Additional considerations

Introduction

Typically, investors focus on understanding the investment landscape, searching for opportunities, developing strategies for selecting the best opportunities and monitoring their investments post-investment. Frequently, however, tax and financing considerations are overlooked – though doing so can have a significant impact on investment returns.

Up until this point *Clean Energy Investing* has examined the clean energy market and the challenges related to investing in it. The final section of the book addresses three ancillary topics investors in 'clean', private assets should also be aware of: tax, financing and environmental, social and governance (ESG) issues. Each topic is covered in a dedicated chapter.

Financing and banking considerations have gained significant prominence post-crisis, driven by the much reduced amount of debt now available for financing private assets. In an interview with Dai Clement of Royal Bank of Canada Capital Markets, Chapter 14 explores how well clean-energy investment opportunities can compete for financing, and which of those opportunities are particularly well-suited for debt financing.

In recent years, ESG issues have become increasingly important for investors all over the globe. Today, ESG considerations appear in many investment policy statements, and are frequently part of due diligence conducted. The clean-investment opportunities described in earlier chapters present investors with options that satisfy the environmental component of the ESG framework. Consequently, most investors that have incorporated the framework into their investment considerations have made explicit allocations to several or all sub-categories of the clean-investing space, understanding that social and governance components are not yet available as pure-play investment strategies. In Chapter 15 Magnus Goodlad of Hermes GPE explains how to approach an ESG analysis and engagement in an environmental investment, how an institutional ESG risk management process can be established and how an appropriate due diligence can be performed on the individual components of the framework; providing investors with insight on how, if at all, to include ESG considerations into their investment approach.

Taxation is especially pertinent to those investing in clean energy. For clean energy infrastructure in particular, where current yield is a meaningful return component, tax planning for that cash yield is crucial. In addition to helping investors plan for current yield taxation, Chapter 16 helps investors understand the tax-optimisation features of fund structures and underlying portfolio company investments so they can better assess which investment approach is most appropriate. The chapter also prepares investors to better evaluate whether an investment manager employs sufficiently sophisticated tax planning in their investment activities to enhance returns. For those investors intending to co-invest with their general partners, the chapter provides a solid summary of the tax considerations an investor should expect in the documentation provided for a co-investment. □

14 Q&A: Finance and banking considerations

The need for financing in the clean energy industry is immense but the availability of long-term capital at attractive pricing is made uncertain by a number of macro factors. Dai Clement of Royal Bank of Canada Capital Markets in London shares his views with* Private Equity International *on what is driving demand for finance and how the banking industry fulfils the supply side of the equation

Private Equity International: What general themes are driving the finance trends in the renewable energy industry?

Dai Clement: There are many ongoing developments in the renewable energy industry. From a capex perspective in today's market, power generation is the main area of investment activity, whereas in time there may be more focus on nuclear and gas projects. Financing for new nuclear power plants and the power utilities, such as those in the UK which will be building new gas facilities, will tend to be structured as on-balance sheet finance.

In the power-generation area there will be appetite for debt financing as well as capital-raisings, whether equity or debt or both, because the utilities will want to recycle capital out of their operating companies ahead of the sizeable capex wall they have in front of them. To illustrate this, the European gas and electricity sectors require over €1 trillion in capital investment in the period between 2010 and 2020 – power generation will require €500 million whereas transmission and distribution will require €600 million.

Although some project finance professionals have set up funds to buy renewable energy assets, I think funds need to be made up of a cross-section of professionals, including those who also know how to make equity investments and not just those who know about lending. Ultimately a project finance bank has a coverage ratio, so as long as it has its interest and principal repaid then this is perfectly acceptable. If a project finance bank were to make an error when analysing a project by underestimating the operating costs by 10 percent, say, it is likely the bank would still be repaid in full. But the same marginal increase in operating costs would result in a loss for the equity investor, given the project economics.

PEI: Will there be a medium-term shift in favour of renewables for bankers and financiers compared with other energy projects and energy utilities?

Dai Clement: Most of the opportunities tend to be in the renewables space. When a regulated network's assets change hands there is generally a lot of appetite from the banks for those deals. Although bankers find gas projects to be appealing, the level of lending and finance in this area is limited because of the limited supply of deals. The focus on renewable energy projects is because this is where most of the opportunities for the banking and finance market have been in 2011, continuing through into 2012. However, a finance shortage for utility-scale clean energy projects in Europe emerged in the second quarter of 2012. Bloomberg New Energy Finance data showed that in the first quarter of 2012 that just $4.3 billion worth of projects had been financed in Europe, down from $7.5 billion in the final quarter of 2011 and also down on the first quarter 2011 financing total of $7.2 billion.

PEI: Has clean energy generally come out the global financial crisis relatively unscathed? Do bankers and financiers generally view clean energy as a positive industry?

Dai Clement: The positive and negative reactions we have seen in different European markets have stemmed from some localised factors. In the UK, for example, bankers and financers are generally quite positive. When you consider other countries, however, such as Spain, where the government has imposed retroactive changes to the feed-in tariff in the solar market, the reactions is clearly less positive. The situation in Spain, which was essentially driven by the financial crisis and the government's need to cut the solar subsidy, certainly impacted on appetite to do deals there. Before the global financial crisis, there was a whole host of German and Spanish banks involved in international project finance in clean energy, but you don't see them in the market so much any longer because they have retreated to their home markets. Although there are fewer banks active in clean energy they have relatively stronger balance sheets, and with less competition from other banks, such as the German banks that had been instrumental in driving debt pricing down, the banks are pricing their debt higher accordingly. The banking market is now understandably smaller.

The impact of Basel III means that banks have to put more capital aside to do more long-term project financings. Understandably, there is more appetite for shorter-tenor deals in today's market at seven or eight years as opposed to 17 years.

The supply and cost of finance also continue to be impacted by the sovereign debt crisis in Europe, which well into 2012 still hangs over the region like a threatening storm cloud.

PEI: Why are banks not really focusing on project finance deals in today's market?

Dai Clement: The North American banks have never typically been big lenders in project finance deals whereas the European banks have deployed their balance sheets to provide long-term project finance. Typically, even in North America the banks that are have dominated project finance deals have tended to be European banks and not the local banks. However, in response to the sovereign debt crisis, the capital adequacy ratios stipulated by Basel III and calls for some European state-owned banks to focus on lending in their home markets, there are likely to be opportunities to lend to North American project finance deals for non-traditional lenders and sources of finance.

PEI: Given the recent history of German landesbanks pushing down pricing, is there an expectation that there will be cyclicality in lending to renewables with upcoming downward pressure on debt pricing?

Dai Clement: In reality the pricing tracks the rest of the financial markets. As there were more banks active in lending to clean energy before the financial crisis the supply of debt pushed down pricing, but post-financial crisis with fewer banks actively lending the price of capital has increased. Margins have gone up significantly for clean energy but only in as much as they have increased for all project financings. Before the financial crisis an attractive clean energy project would have been financed at Libor plus 1 percent (100 basis points) but now a similar deal would be more realistically priced at Libor plus 2 percent (200 basis points). Although this is a considerable increase in pricing, the all-in cost of financing is not so much higher because the interest rates are so low compared with where they were before the financial crisis.

PEI: Are bankers and financiers seeing evidence in clean-energy financing where equity sponsors are funding deals with more equity because debt is priced higher or not so freely available?

Dai Clement: No, not really. Infrastructure fund managers would prefer to lock in financing and price it in their deals, so ultimately they will pay a bit less if in reality their financing costs are a bit higher. Deals are typically structured on a discounted cash-flow (DCF) basis, which means they will add the debt to the deal and discount the equity cash flow at a given return; this results in a slightly lower acquisition price. Overall, there is reasonable appetite for decent projects and they will generally be able to secure the required finance. However, when you consider the offshore wind market, for example, this is an area where it is more difficult to secure finance because of the project economics.

PEI: How important has relationship banking become after the global financial crisis?

Dai Clement: The project finance banks will prefer to use their capital to support deals sponsored by relationship partners rather than any developer that is looking for debt finance on a one-off basis. It is tough for first-time sponsors or developers and what they need to do is engage with the banking industry to develop those relationships. Generally, in any fund management business there should be members of the team who have good solid banking relationships and particularly in today's market they need to nurture these relationships to capitalise on available debt.

PEI: What should fund investors be considering when they perform due diligence on a fund with respect to banking and finance considerations?

Dai Clement: Obviously if institutional investors are looking at making direct investments then they should be interested in understanding the dynamics of the banking market and the availability of debt and debt pricing for the different types of transactions they will be investing in. If fund investors are looking at a new fund being raised by a first-time fund manager then they should be asking themselves how the fund manager would manage to raise debt in what is a tighter debt market compared with the finance market in 2008. If fund investors are backing a fund manager that needs levered returns of 12 or 13 percent but they just can't raise the required amount of leverage, they aren't going to compete with those project sponsors that can. A fund manager's ability to secure finance is an important issue for fund investors to consider before investing in a fund.

An investment manager's access to bank debt should influence a fund investor's manager selection because if the fund investor's money is tied up for a lengthy period of time with an investment manager that is unable to do cost-effective deals, then it could be ultimately a wasted financial opportunity for the fund investor.

PEI: What risk management checks should fund investors make before they commit to allocating to a fund?

Dai Clement: Fund investors need to assess prospective investment managers and should really ask themselves if the investment managers really understand what assets they are acquiring. For example, with multiple turbines on a wind farm, needing considerable operations and maintenance (O&M), at the asset level there is a strong need for people who need to understand how to run an O&M contract. It's not quite like owning a regulated utility company. You need to back a team with a reasonably detailed understanding of the industry, a team that insists on the latest due diligence materials, for example, and will not accept wind reports that are three or four years out of date. When it comes to asset management, there is usually no problem in using consultants and contractors.

PEI: How do investment managers generally seek advice from the banking community?

Dai Clement: Bankers advise general partners or investment managers that are focused on M&A transactions about the availability of debt, which third-party banks are able to supply debt and how debt is priced. Over the last few years banking relationships have become much more important to investment managers, not only because of scarcity of debt but ultimately because they know if they are unable to convince the banks to back them they are never going to be able to buy anything. Banking relationships are now a top-five business consideration for investment managers. This is in stark contrast to before the financial crisis when investment managers would put out a term sheet in the market and wait for the banks, expecting them to bid aggressively against each other, to come to them with offers. Today, there is more parity in the equation between borrowers and lenders.

PEI: What's the general outlook for refinancings over the next three to five years?

Dai Clement: I think project refinancings are generally fine as long as they are done on sensible terms, particularly in clean energy where there are amortising debt positions and as people write more power purchase agreement (PPA) contracts, for example, they will put more leverage in.

PEI: What ratio of debt to equity are bankers and financiers in clean energy comfortable with?

Dai Clement: For a renewable energy project the standard debt-to-equity ratio would be 70:30 to 80:20. Going forward this is likely to be the standard range or ratios. The way banks size the debt-to-equity ratio is based less on the contribution of capex and more on how the cash flows are leveraged. Unless you have a material increase in power prices that support more debt then I don't really see this standard debt-to-equity ratio moving that much.

PEI: Which skills do first-time funds need to be aware of?

Dai Clement: A new fund, whether a first-time investor or more made up of more experienced investors, needs to have a good mix of skills. You wouldn't want an investment team solely made of those experienced in private equity deals because they would be experienced mainly in leveraged buyouts – there is also a need for project finance deal professionals who know and how they are structured.

PEI: What is the outlook for different forms of finance and even debt funds for clean energy?

Dai Clement: In the clean energy market there are rare examples of high-yield bond issues and there are some mezzanine providers, but neither type of finance plays a great role. Debt funds have been around for a long time, but I'm not convinced about them. Debt funds are a good theoretical concept but I've never seen one that has been successful. Part of the reason for this is prospective investors in debt fund offerings are not so willing to invest in a fund structure which gives the fund manager blind rights for any project finance deals, all of which have very specific characteristics for lenders. Although this happens in equity funds it has not gained traction in debt funds.

PEI: How would describe the M&A market in the clean energy market?

Dai Clement: There is still a lot of M&A activity in the clean energy market, particularly for utilities focused on recycling capital. There are developers that achieve project consents but do not want to build the projects so they sell them. It's generally an active M&A market, but more on the power-generation side rather than on the technology side.

There is a good degree of M&A activity in wind power for both onshore and offshore projects. Hydro assets do not change hands that often and generally remain quite tightly held. When in comes to solar some M&A opportunities arise. However, the retrospective changes to solar in Spain have hit the Spanish market considerably; the tariffs are so much higher for solar than for wind to make them economic that there is always much more chance of the government clamping down on them. □

***Dai Clement** is managing director and co-head of infrastructure at Royal Bank of Canada Capital Markets based in London.*

15 ESG considerations for environmental and renewable energy infrastructure fund and co-investment strategies

By Magnus Goodlad, Hermes GPE

This chapter discusses:

- The areas that provide opportunities for ESG-compliant investments
- The aspects of how to approach an ESG analysis
- The outlook for ESG-related investing

Introduction

When investing in environmental and renewable energy projects, either indirectly through unlisted funds or directly as a co-investor, there are a number of environmental, social and governance (ESG) considerations and issues that investors and investment managers need to be aware of and be prepared for. As an investment manager with a long-standing commitment to ESG-focused investing, one of the key objectives of this chapter is to give readers the opportunity to share an understanding of Hermes GPE's well-developed processes and experiences for educational purposes.

The chapter also provide new and seasoned investors in environmental and renewable energy with an introduction to how ESG plays an important role in many investors' investment strategies, and how they can extrapolate and apply the constituent elements of ESG – environmental, social and governance – into their own individual portfolio considerations.

Hermes GPE's experience of environmental investing

One the best ways for investors and fund managers to continue to populate the world of environmental and renewable energy infrastructure is by learning from the experiences of practitioners at the vanguard of investing in this area. Hermes GPE continues to invest the proceeds of its £130 million Hermes GPE Environmental Innovation Fund that was raised in 2010, which includes a commitment from the government's UK Innovation Investment Fund and a number of UK institutional investors. The fund's investment strategy focuses on co-investment opportunities in the UK, as well as primary and secondary environmental fund commitments across the European region.

To provide some useful insight into how a fund strategy like this one works in practice, the three categories of fund manager that Hermes GPE expects to work with during the life of the fund would typically operate in the following areas for the following reasons:

1) *Focused environmental technology.* This covers venture capital and growth-capital funds and a range of subsectors including energy efficiency, new materials, water and transport. As yet, the market is not mature enough to support dedicated buy-out funds.
2) *Renewable infrastructure.* These funds have a focus on developers and projects in Europe across a range of renewable energy subsectors with a particular focus on wind, solar, hydro-electric power and biomass. Investments will be asset-backed and are typically yield-generating from the investment date. As managers are committing capital and engaging before the construction return phase, expected returns are higher in comparison to conventional core infrastructure investments.
3) *General technology.* Funds here will encompass broader technology investment strategies where an estimated 25 to 30 percent of their investments will be in the environmental space. These managers are included in the fund programme because this approach allows Hermes GPE to work with a group of general partners (GP) that have longer-established environmental franchises than is generally the case for dedicated environment-specialist GPs, thereby giving access to different deal flow, networks and more diverse investment approaches.

Environmental co-investments are sourced through Hermes GPE's long-standing relationships within the private markets arena, often from GPs Hermes GPE has existing (or historic) fund investments with. We are also keen to engage directly with private environmentally focused companies and developers to originate direct investment deal flow.

ESG analysis and engagement in environmental investment

The ESG investment approach is just as applicable to environmental fund and co-investment strategies as it is to any other private equity investment programme. Like other similar investment managers in this space, Hermes GPE has established a responsible investment framework that is integrated into all due diligence and monitoring processes across private equity and infrastructure investment mandates.

The exact weighting is defined by the geography, size and maturity of the relevant opportunity, with different ESG issues – whether the focus is more on environmental, social or governance factors – being considered for each individual investment. This ensures that our responsible investment framework is tailored to each GP and co-investment on a case-by-case basis, enabling the most appropriate benchmarking and relative-performance assessment to be applied. This helps to avoid an overly compliance-based or box-ticking approach which is not conducive to collaboration and does not necessarily identify the key potential risk areas in each situation.

Establishing and implementing ESG risk management processes

In addition to the responsible investment framework, Hermes GPE also monitors applicable and relevant ESG codes, regulations and other industry standards and keeps a precedent bank of ESG policies to provide relevant reference points. Investors and investment managers are well advised to stay on top of best practice in ESG procedures by engaging with leading industry bodies such as the Institutional Limited Partner Association (ILPA), the British Venture Capital Association (BCVA), the European Venture Capital Association (EVCA). Putting such ESG procedures into practice where relevant is also advisable. Industry bodies in all parts of the world also advise their members about relevant developments.

The United Nations Principles for Responsible Investment (UN PRI) – Hermes GPE is one of the 1000-plus signatories (as of May 2012) – comprise a set of well-defined guidelines on which many more detailed standards are based. The UN PRI is seeking more tangible outputs from signatories to support the implementation of the principle's objectives. In April 2012 a draft Reporting Framework was published with a set of mandatory and voluntary indicators of ESG activity for private equity managers. All UN PRI signatories should be considering their final details as they are required to be implemented from 2013.

In addition, the ILPA Private Equity Principles are a set of first principles on governance and transparency for fund investments, which form a common reference point for investors and GPs.

The real challenge, however, will be to get these processes and principles universally adopted. If the ILPA Principles and the UN PRI are to become standard practice within the private equity industry, both need to be referred to by all investors in due diligence, investment documentation negotiation and investment monitoring in order to ensure a common approach.

Investors with extensive private equity fund relationships are in pole position to take the lead and be at the vanguard of this process. However, GPs specialising in environmental investment will need more guidance and support in the adoption of international standards. The primary reason is based on resources. Typically these managers are smaller independent managers without wide institutional shareholder bases and lack critical mass to establish dedicated in-house ESG resources.

A sensible approach that balances the proportionality and application of the principles, industry standards and other responsible investment policies and procedures against the scale, geography, and investment focus of the relevant manager needs to be adopted. For example, a higher level of ESG resourcing, engagement and reporting should be more achievable within a global private equity manager with $10 billion-plus of assets under management than for a niche-strategy GP managing a $100 million fund. Managers of all sizes need to share a common attribute, that is, the motivation and willingness to incorporate ESG considerations into their investment management processes.

Certain fund managers, domiciled in certain markets or active in certain investment strategies, may be faced with a greater need to consider ESG, or the three constituent elements of ESG to a certain degree. The level of ESG due diligence, engagement and reporting which is necessary for emerging markets-focused funds with lighter regulatory and enforcement regimes, for example, will be greater than for US or Western European funds with a UK focus. Likewise the level of ESG due diligence, monitoring and reporting which is necessary for a minerals exploration or heavy manufacturing-focused funds will be far more extensive than will be the case with, for example, a healthcare or renewable energy specialist fund.

ESG due diligence on GP strategies

There are standard processes and considerations that investors should be familiar with when considering a new fund commitment or co-investment. A prospective investor would generally begin by looking at the ESG policy of the GP or the management team of a potential co-investment itself before looking at how they have sought to implement it. Hermes GPE has a responsible investment framework which shapes its formal approach.

Investors should be prepared to scrutinise the detail of a GP's ESG policy, which should include specific details including the following check list:

1) When the ESG policy was first put in place and how frequently it has been updated to keep pace with changes in industry practice.
2) The ESG policy should also outline whether the policy has been tailored to the GP's or company's operations or whether it has been provided 'off the shelf' by professional advisers.
3) Responsibility for oversight and implementation within the GP or management team is another critical factor to be assessed.

For investors performing due diligence on an environmental infrastructure GP they would expect the manager's ESG policy to place particular emphasis on assessing the environmental impact of any construction. This would be supplemented by looking at the GP's approach to engaging with local community stakeholders, responsible sourcing and supplier engagement. Proportionately less emphasis would be given to employment and welfare policies as portfolio projects will typically have no or very few direct employees.

The key elements of ESG

Environmental

As you might expect, in an environmental fund there is self-evidently a higher level of awareness of the issues among GPs and management teams and a lower inherent risk than investing in a generalist energy fund, for example, which might be making investments in open-cast mining projects as well.

However, there are still basic environmental considerations that we at Hermes GPE insist are applied to all investments and operations. This would generally include measuring and improving the environmental impact and performance at a company level as well as the operational performance of the company's product or services is one of these, no matter which sector is being considered. A recycling and emissions policy and track record at a solar wafer manufacturer is as important as the equivalent in a car manufacturer. Investors now look for management awareness, focus and engagement on environmental performance throughout the operations of a company. Measuring this performance as well as implementing and delivering performance improvements during the lifecycle of an investment are critical ways to demonstrate that management are on the ball in this respect.

On the renewable infrastructure side, the focus will be on responsible planning for any construction projects where there might be any harmful environmental impact, with investors expecting managers to act to mitigate these wherever possible. Social issues associated with newbuild or greenfield infrastructure projects, engagement with the neighbouring local communities, as well as the management of concerns raised are all additional and important factors in the overall success of particular investments.

The Institutional Investors Group on Climate Change (IIGCC) report, *A Guide on Climate Change for Private Equity Investors*, which is available online, is a helpful framework for climate change-related investment issues. The report poses a set of questions that investors and their advisers can ask GPs which will highlight levels of familiarity with and engagement on relevant issues.

Social

Social considerations in private equity due diligence and monitoring are heavily dependent on the individual strategy, geography and operations of the relevant manager or company – these lead to greater variance between GPs and co-investments.

In contrast, governance issues tend to map relatively uniformly across each manager, strategy and geography. For a European environmental investment, for example, there is a raft of threshold best practices to meet such as data protection, privacy, employment and labour relations, which means that there are often fewer additional obligations that need to be highlighted by investors to ensure effective and responsible operation.

In emerging markets, however, where the regulatory regimes tend to be lighter, there are more potential issues that an incoming investor will most likely need to consider. Investors need to make sure that they are be able understand the context of the legislative and regulatory framework within which social issues need to be considered. Human rights and indigenous rights are more likely to be more pertinent issues in emerging markets than in developed economies.

In terms of marketing communications, product misselling safety and liability, the risk profile and the due diligence approach will vary considerably depending on the GP's investment strategy the company's strategy.

The overarching concept of taking a proportionate approach is particularly applicable in the context of social considerations.

Governance

Governance covers a number of areas of environmental GP and company due diligence, monitoring and engagement.

As far as GPs are concerned, a governance review would typically cover the general partnership's overall risk management, financial and operational controls and regulatory compliance. Many specialist environmental GPs have been established within the last ten years and are relatively small organisations with limited central functions. For these groups, detailed engagement with the finance, compliance and operations teams is the best route. Some managers undertake an external compliance audit which they make available to investors which provides an additional level of scrutiny to internal records and checks with the relevant regulator. For managers that are running an environment-focused fund alongside other mandates across multiple investment strategies, due diligence will focus on the level of governance oversight and access to appropriate central functions which the environmental fund receives.

Governance is also addressed in the fund or portfolio company investment documentation, with the ILPA Guidelines, for example, setting out issues which should be considered by all funds. Environment-specific factors include the definition of the investment strategy and the inclusion of appropriate concentration limits by sector and geography and/or the allocation policies where a GP has mandates which overlap. Matters such as these should be reserved for consideration by a suitably structured investment advisory board which should consist of representatives from relevant investors. Overall, environmental issues arise less frequently in company investment documentation.

In due diligence, operations and strategy, governance in the context of engagement with government and regulators is of particular importance for environmental GPs and companies. They often operate in a highly regulated industry where eligibility for tariffs, subsidies or incentives is often an important part of the value proposition. Hermes GPE conducts detailed analysis on potential GPs' regulatory due diligence processes in each geography in which they are investing and may sometimes undertake referencing on relationships with relevant government departments or regulators. Recent examples of regulatory change which have had a material impact on certain environmental renewable infrastructure GPs has been the Spanish solar tariff revisions and the small-scale solar tariff review and revisions in the UK.

For private companies, the European Conference of Directors' Association (ecoDa) Corporate Governance Guidance and Principles for Unlisted Companies in Europe provides a useful corporate governance framework. The principles are comparable to those found in the combined code for listed companies in the UK and they provide a manual to define the relationship and engagement between the company's management, shareholders and other stakeholders.

In terms of reporting and transparency, management board and shareholder reports for co-investments and fund investment reports are clearly a matter of record for existing investors and potential investors. What investors will often do is to directly benchmark the reports received from a fund or company against comparable GPs or companies, in addition to measuring against applicable industry standards.

Hermes GPE has consistently focused on providing feedback to managers with which it invests to highlight and create a useful dialogue on best practice reporting. Looking forward to the UN PRI Reporting Framework implementation in 2013, this will require signatories to be more specific in the level of detail they provide on the implementation of ESG policies and procedures as well as the outputs. The framework draws a distinction between the responsibilities of the control or lead investor and minority co-investors whose scope to drive and implement change will be more limited. The framework includes a separate section for ESG themed GPs and mandates to report on the strategies and objectives of the relevant mandates and the way in which they are achieved.

The way ahead

There are a number of macroeconomic themes which continue to drive institutional investment interest in the environmental sector. These include:

- increased government regulation and incentives;
- continued consumer, government and corporate focus on resource efficiency and products and services which reduce energy;
- commodity and other material consumption and emissions; and
- increasing stakeholder interest on ESG issues and corporate social responsibility (CSR) issues and the desire to invest responsibly.

For this interest to continue to convert into sustained long-term investment programmes, environmental funds and their managers will have to be able to demonstrate that they are capable of implementing best practice in all aspects of ESG throughout the lifecycle of investment. Fund managers must also report effectively to clients about on how well the items are being implemented, making sure that they are well briefed on industry standards and thresholds. Qualified fund managers are exceptionally well placed to do this, ably guided by industry peer groups as well as representative industry bodies. □

Summary findings:

- It is currently still challenging to build an investment programme that covers all aspects of ESG, especially while simultaneously achieving sufficient diversification
- ESG analysis and requirements need to be tailored on a case-by-case basis to each investment situation
- ESG considerations should be applied across the board of investment activities

*As head of Renewables at Hermes GPE in London, **Magnus Goodlad** is responsible for all relationships with managers active in the renewables sector and for coordinating the analysis, due diligence and monitoring of Hermes GPE's investments in this sector. Hermes GPE is one of the leading independent specialist investors in global private markets, managing £4.2 billion (at 31 December 31, 2011) of capital in private equity and private infrastructure for leading institutional investors and pension funds worldwide.*

Magnus has over 11 years' private equity experience, including early-stage UK technology and venture capital investment. Magnus previously spent ten years at Top Technology Ventures/IP Group where he held various roles specialising in early-stage UK technology venture capital and intellectual property commercialisation investment. These include Chief Operating Officer where he was responsible for portfolio and fund management as well as investor relations and business development. Magnus commenced his career with Slaughter and May where as a solicitor he focused on corporate finance law.

16 Tax implications of investing in clean energy and cleantech

By Douglas Watkinson and David Lyons, Deloitte

This chapter discusses:

- The range of tax issues and structural options which investors need to be aware of to match their specific circumstances
- Asset-acquisition structures and tax-optimisation issues at the portfolio-company level
- The considerations investors need to be fully aware of when choosing a fund to invest in and fund managers when investing in assets or companies

Introduction

In addition to commercial, legal and regulatory issues, the tax implications associated with establishing a fund structure and making investments also need to be addressed by both investors and fund managers when selecting a fund or asset.

Aimed at fund investors, managers and fund portfolio group management and finance, this chapter sets out an overview of the key drivers of tax-efficient investments, a summary of the typical factors to consider when structuring acquisitions and a non-exhaustive summary of some of the key tax incentives available at investor and portfolio group level for European clean energy and cleantech portfolio groups.

This chapter is intended as general guidance only; fund managers and investors should always seek professional advice in respect of their individual positions.

Establishing the fund and structuring asset acquisitions

From a tax perspective, well-designed fund structures will typically afford investors, inter alia, the advantage of the amplified returns generated by leverage while minimising the potential tax inefficiencies which would otherwise arise on domestic or cross-border direct investments. This is usually achieved by:

- eliminating taxes on income and gains at fund level to avoid a ‘double-layer’ of tax (that is, at the fund level as well as in the hands of the investor);
- minimising capital duties and transfer taxes payable on establishment, acquisitions and disposals by the fund;

- mitigating (to the extent possible) withholding taxes on cross-border payments of interest and dividends enabling tax-efficient cash repatriation and servicing of debt; and
- facilitating future exit in a tax efficient manner.

In addition to the tax points above, fund structures should, as far as possible, be straightforward to operate and must be capable of being marketed to the target investor group(s). Clean-energy investment fund structures will often follow the established models adopted in the more mature private equity and infrastructure fund sectors giving both investors and fund managers the advantage of familiarity.

The underlying investment objective will also determine, to an extent, the acquisition and financing structure adopted. For example, the traditional PE/VC model of realising a profit (derived from an increase in value of the underlying business) via an exit over the short-to-medium term would typically seek protection from tax on gains realised. In addition to 'exit-strategy' planning, infrastructure-type assets with longer-term investment policies also seek the ability to extract a running yield in a tax-efficient manner.

Clean-energy investments can suit either model depending on the stage of their lifecycle. Many renewable energy projects have been acquired by yield-focused funds once they have become operational. These funds should be set up with a view to ensuring cash does not get trapped in the structures and that withholding taxes are minimised as annual distributions are paid out to investors. Without appropriate foresight, the incidence of cash traps can be particularly acute in renewable assets where high depreciation and interest costs in the early years mean that despite positive cash flow there will not be accounting profits and hence company law can prohibit the payment of dividends by the project companies.

An additional benefit of leverage is the ability in the majority of jurisdictions to set-off in full or in part the associated interest expense against underlying portfolio company taxable profits thereby reducing cash taxes payable. This is discussed in more detail later in the chapter but it is an area where careful attention is needed to optimise the position as the rules differ from country to country. It has also been an area targeted by tax authorities and policymakers in recent years. For renewable assets with a high degree of leverage such as those that have been project-financed, the value of the tax shield that arises through interest deductions can be an important contributor to project returns.

Jurisdictions which offer a degree of stability and certainty in the form of the ability to obtain advance clearance from the tax authorities (such as the UK and Luxembourg) are attractive locations through which to structure acquisitions for investors and fund managers.

Embedding tax efficiencies in portfolio companies

In the current climate, to attract, nurture and retain innovative businesses, governments across the world are offering an increasing array of tax incentives. Many of these should be available to clean energy and cleantech portfolio companies given the proliferation of knowledge-based products and services, associated with the sector. Consideration of the criteria to ensure eligibility to claim these incentives (including, for example, R&D tax relief, accelerated capital allowances and intellectual property (IP)/patent box regimes) when establishing and/or expanding portfolio group operations should further reduce cash taxes payable and increase the return on investment either through direct repatriation of the cash saved or via reinvestment into the underlying business.

Simplicity and certainty

The increase of anti-avoidance tax law targeting harmful tax practices, along with enhanced cooperation between tax authorities on an international scale and an increased political and public appetite to take action has led to the withdrawal of a number of off-the-shelf tax-planning initiatives. These factors, coupled with the potential cost of and distraction to management caused by tax authority challenge as well as the likely price adjustment on exit in respect of any uncertain tax positions has meant that, in practice, the cost benefit of undertaking off-the-shelf tax planning has diminished greatly.

Far better to get the basics right, embed tax efficiencies into the design of the fund structure and management and operation of portfolio companies and stay clear of aggressive tax-planning initiatives.

Monitoring developments

Finally, as ongoing reform continues in many countries, it is incumbent on management to monitor developments closely to ensure, taking into account commercial, legal and regulatory requirements, that structures are adjusted to maintain an optimal tax situation.

Establishing the fund

In our experience, fund managers and investors are comfortable following the traditional forms of fund and acquisition structure when establishing structures to facilitate investment in clean energy and cleantech portfolio groups.

Tax-efficient vehicles

Tax-efficient vehicles can be split into two broad categories, ‘non-transparent’ and ‘transparent’ vehicles.

Non-transparent vehicles

The first, where income and gains realised by the fund suffer no tax at fund level and tax arises only on the distribution of profits to investors, typically involves the use of a company resident or effectively managed in an offshore jurisdiction (for example, Guernsey) or a country providing an exemption from tax on income and gains (for example, certain European participation regimes).

Offshore jurisdictions typically do not have an established network of double-tax treaties and therefore further structuring is usually required to mitigate capital gains

Tax-efficient investment schemes

A number of countries offer tax-efficient schemes to encourage investment from residents (and in some case, non-residents). These often come with restrictions on the types of company in which investments can be made and on the amounts which can be invested.

The Venture Capital Trust (VCT) scheme, available in the UK, is one such scheme offering tax incentives for UK-resident individual investors.

A VCT is an investment company providing tax-free income and capital gains to individual investors who chose to invest in small, unquoted companies. Among other conditions, VCTs must be quoted, must invest at least 70 percent of their assets in companies which must also satisfy strict conditions (see below), and must distribute most of their income by way of dividend. They also must be able to demonstrate a spread of investments – none can account for more than 15 percent of the value of the overall portfolio.

Provided the shares are held for a minimum period (currently five years for shares issued on/after April 6, 2006), income tax relief at 30 percent is available for individuals who subscribe for new ordinary shares in VCTs up to £200,000 per year and dividends from up to £200,000 of VCT investments are not regarded as income for any income tax purposes.

Gains accruing to individuals on the disposal of ordinary shares in VCTs are exempt from tax, though no relief is available for losses.

In the current economic climate, the UK government has further encouraged investment by extending the scope of qualifying company, from April 2012 (and subject to EU state aid approval), to those with fewer than 250 employees and no more than £15 million of gross assets before the investment. There will also be an increase in the annual amount that can be invested in an individual company to £10 million.

and withholding tax imposed by the country in which the underlying portfolio company resides.

Furthermore, care should be taken to ensure income and distributions realised at fund level are not taxed as income (as opposed to capital gains at lower rates) in the hands of investors. For UK-resident individual investors this could potentially increase the tax rate by up to 22 percent[1] without the investor receiving any cash to pay the liability.

Governments are aware of the need to provide clarity around these points and, in certain countries (for example, the UK and offshore fund rules), are working with industry

[1] Based on a capital gains tax rate of 28 percent and the current 'additional' rate of income tax of 50 percent. The additional rate is scheduled to reduce to 45 percent from April 6, 2013.

in order to clarify the scope of the rules – designed to prevent investors accumulating income and gains offshore which have beneficial tax rates and exemptions – to ensure they do not inadvertently capture unintended structures.

Transparent vehicles

Transparent vehicles, such as limited partnerships, are effectively ignored for tax purposes and any income or gain realised at fund level from an underlying portfolio company is generally treated as being incurred directly by the investor. These structures should typically enable investors to benefit from any preferential treaty rate between their country of residence and that of the underlying portfolio company though care should be taken to ensure that no investor inadvertently creates an overseas permanent establishment in a country with a tax rate in excess of their domestic rate. Furthermore, the 'transparency' of different types of vehicle is open to interpretation and consequently is not treated consistently from country to country.

Considering these points, it is critical for fund managers and their advisers to evaluate upfront the alternative options available to structure the fund alongside their target portfolio assets, investment policy and target investor group(s).

Asset-acquisition structures

Once the fund structure is established, it will also be necessary to consider the specific structuring requirements for each asset acquisition on a case-by-case basis. For example, certain governments have negotiated more generous treaty rates than others so, in cases where a fund has the choice of investing in or financing through different jurisdictions, along with due consideration of the commercial, legal and regulatory issues, care should be taken to ensure the most tax-efficient structure is implemented.

A detailed review of the factors to consider when selecting a holding company location is beyond the scope of this article though, in brief, the following tax factors are typically considered:

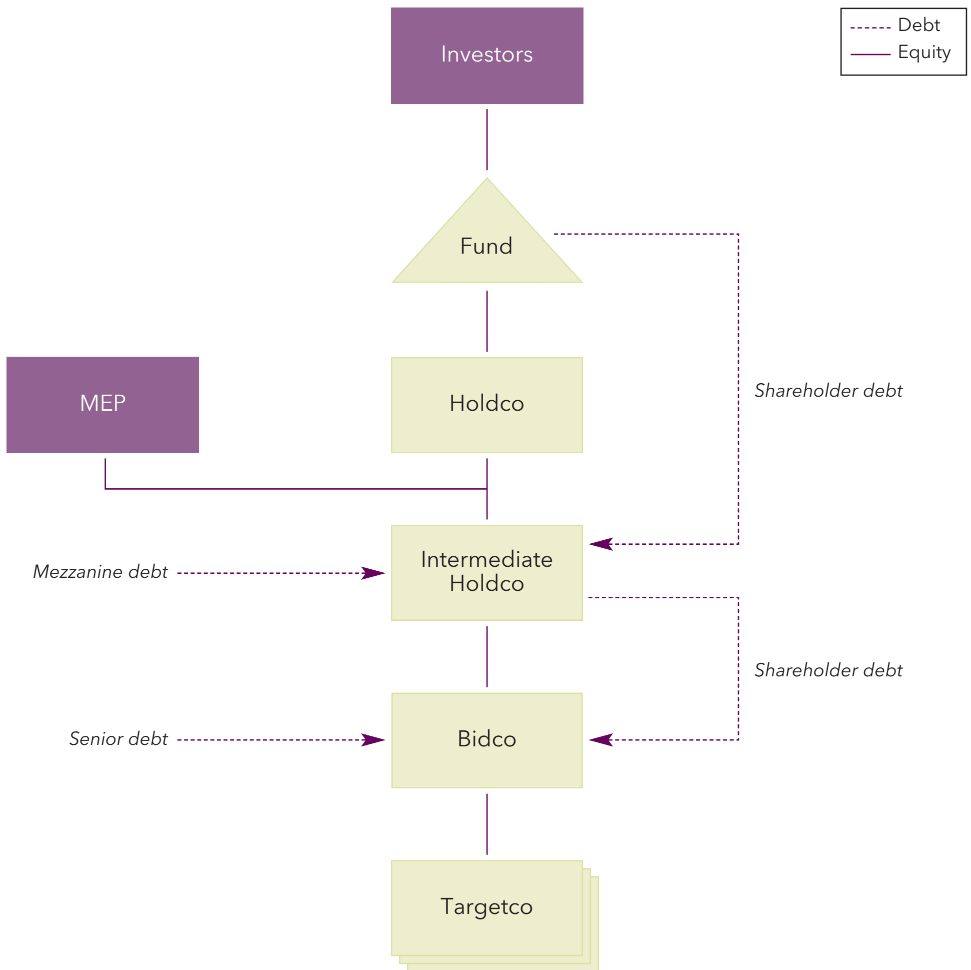
- Treatment of domestic income, foreign profits and passive income derived from overseas investments.
- Complexity and cost associated with local compliance requirements.
- Network of double-tax treaties.
- Political approach to fiscal policy.
- Stability of regime and approach of tax authorities.
- Ability to obtain advance clearances providing a degree of certainty.
- Availability of tax incentives to both investors and investments.

Tax treatment of leverage

As noted previously, many renewable assets are financed with a high degree of leverage. Investors may also choose to inject all or part of their funding into a structure through subordinated loans.

In addition, where clean energy businesses or portfolios of assets are acquired by investors the acquisition may be funded with additional leverage. This is typically

Figure 16.1: **A typical acquisition structure**



Note: Some of the features of this structure are discussed in the later sections of this chapter.
Source: Deloitte.

achieved through the bidco (the vehicle funded by equity and debt used to acquire the assets) forming a tax consolidation or fiscal unity with targetco (the underlying portfolio group or company, the 'asset') or via loss-surrender or profit-contribution mechanisms (for example, group relief in the UK and group contribution groups in Sweden).

The ability to claim interest expense deductions has come under increasing tax authority scrutiny over recent years and is frequently subject to a range of tax anti-avoidance rules. Examples include thin-capitalisation rules which seek to restrict interest deductions to those that arise on loans up to a certain ratio of debt to equity and transfer-pricing rules which generally can be used to attack interest deductions on loans from related parties when the level of debt or interest exceeds that which could have been obtained from a third party.

Tax authorities are increasingly targeting this area to the extent that getting it wrong or being overly aggressive can lead to in-depth scrutiny from and costly penalties being imposed by tax authorities. However, the fact remains that many clean energy assets have characteristics which can support a high degree of leverage and so when preparing competitive bids or calculating expected returns it is important to understand the rules of relevant country and to prepare supporting analysis for the structure adopted to be able to maximise the tax benefit of leverage while demonstrating adherence to those rules.

Policymakers have also targeted leveraged structures in recent years and a number of countries have changed or tightened up their rules on interest deductibility. One noticeable trend has been for the introduction of rules which restrict the deductibility of interest on both bank and other debt from unrelated parties as well as the more traditional target of debt from related parties. Within Europe countries that have substantial renewable energy sectors such as Germany and Italy have introduced rules that limit the deduction of interest on all debt (from both related and unrelated parties) to a percentage of earnings. At the time of writing Spain was also in the process of introducing a similar restriction.

When rules such as these are introduced without any grandfathering to exclude existing loans sectors such as renewable that rely heavily on project finance are among the most impacted.

In addition, tax authorities will wish to ensure that the recipient of interest income is the beneficial owner of that income before granting reliefs from withholding taxes that can be imposed on payment of interest. This is discussed in more detail later in the chapter and is a particular issue for yield-focused funds.

Planning for exits

The traditional PE/VC model of realising a profit derived from an increase in value of the business on exit (typically via a share sale or IPO) in the short-to-medium term would typically seek protection from tax on gains realised.

A number of jurisdictions offer an exemption from gains crystallised on the sale of shares held in subsidiaries. Many European countries operate a participation exemption regime (or a broadly equivalent alternative, such as the UK's substantial shareholding exemption) for participations over a certain threshold, in companies operating certain types of business held for a certain period.

Care should be taken to ensure any 'recapture' type rules (for example, Luxembourg) do not erode the benefit of the participation exemption in cases where expenses which relate to the qualifying participation have been used to offset other taxable income arising in the participating company. In most cases, it should be possible to manage the position such that the recapture rules do not give rise to any adverse tax implications.

In certain cases, capital-gains tax could arise in the country of residence of the portfolio company, payable by the non-resident investor on exit. In some countries these taxes levied on non-resident investors apply only where the gain arises from a sale of an asset that derives its value predominantly from local real estate. The extent to which renewable energy assets are considered to derive their value from real estate varies from country to country and also by sector. In some cases the value of wind turbines will be considered to form part of the value of the land on which they are located while in other countries they are regarded as separable for these purposes making it much less likely a charge will arise.

Where such a charge could arise on exit they can often be mitigated by careful structuring. For example, the Spain-Netherlands tax treaty provides an exemption from Spanish capital-gains tax on the disposal of the shares in a real estate-rich Spanish company by a Netherlands resident provided the latter has sufficient economic and organisational substance (and can therefore provide the Spanish company with a certificate of tax residence in the Netherlands for the purposes of the tax treaty).

Planning for a cash yield and servicing acquisition debt

In addition to exit considerations, the ability to extract cash in a tax-efficient manner is also paramount to maintain a running yield (that is, the traditional model operated by infrastructure funds) as well as servicing senior and shareholder acquisition debt.

The mechanisms available through which cash may be extracted vary on case-by-case basis but typically include:

- dividends (to the extent legally permissible); and
- repayment of interest and/or principal on debt (although it is important to note that the repayment of principal would effectively deleverage the structure and may reduce its tax efficiency to the extent interest deductions may be set off against taxable income).

And to a lesser extent, including:

- repayment of share premium;
- upstream loans (generally not advisable unless the corresponding interest income and expense can be offset for tax purposes); and
- redemptions of share capital.

The principal objective is to select an option or combination of options over the life of the investment or loan which enable cash to be extracted without giving rise to either tax levied by the repatriating jurisdiction (typically in the form of withholding tax) or tax in the hands of the recipient.

Considering the two key alternatives:

Dividends

Typically, dividends can only be paid out of retained profits and, in certain jurisdictions, can be further restricted by the additional legal and regulatory requirements (for example, for the maintenance of a separate legal reserve and a minimum net-equity position). These legal restrictions require careful modelling for yield-focused funds to ensure that trapped cash will not arise. Many renewable energy companies operate in multiple countries and can have multiple project companies and holding companies in each country. For example, if a number of wind farms have been developed and separately financed it is likely each will sit within a different legal entity. To understand the ability to extract cash it is not sufficient to model on a consolidated basis, a loss in one entity could be concealed by a profit in another or a deficit in a holding company could create a dividend block restricting access to cash in all of its subsidiaries.

Where a dividend can legally be paid unless a domestic exemption applies (as is the case in the UK), cross-border dividend payments are typically subject to withholding tax which can, in certain cases, be reduced or eliminated under an applicable tax treaty or, within the European Union, the EC Parent-Subsidiary Directive.

The requirements to qualify under the EC Parent-Subsidiary Directive vary between member states and, in certain cases, are also subject to anti-abuse provisions which may require, inter alia, that the recipient holds a minimum participation, is the effective beneficiary and maintains sufficient economic and organisational substance (for example, management and control exercised in the country of receipt, office premises, the provision of services and local-resident directors and members of staff).

Many European jurisdictions exempt dividend income to the extent a participation exemption or a domestic exemption applies (for example, the UK). As above, care should be taken to ensure any recapture-type rules do not erode the benefit of the participation exemption and, in the case of domestic exemptions, care is needed in cases where the reduced rate of withholding tax is conditional on the dividend being subject to tax – in which case it may sometimes be preferable to elect (if possible) for the income to be taxable in order to benefit from the treaty rate of withholding tax.

In certain jurisdictions such as Denmark and Germany withholding tax on dividends is frequently recognised as an absolute cost for financial investors (to the extent it is not creditable in the hands of the recipient), and alternative structures are implemented to preserve efficiency.

Repayment of interest and/or principal on debt

There is typically no incremental tax payable on the repayment of principal on senior and shareholder debt (other than the reduction in the future tax shelter which might otherwise be available for the interest expense).

Similar to dividends, subject to anti-abuse provisions, withholding tax on interest can, in certain cases, be reduced or eliminated under an applicable tax treaty or, within the EU, the EC Interest and Royalties Directive.

Many tax treaties enable interest to be paid gross though require the recipient to be a qualifying lender (for example, an EU lender) and also the beneficial owner of the interest, with new treaties containing anti-avoidance rules dealing with conduit arrangements or overriding limitation on benefits articles. Advance clearance may also be required to enable the treaty or directive rate to be applied.

Tax authorities are also increasingly scrutinising financing arrangements where intermediate holding companies in a third jurisdiction are inserted between funds and the ultimate borrower (for example, Luxembourg and the Netherlands).

It is therefore crucial that intermediate holding companies have adequate economic and organisational substance in accordance with the legislation of the relevant jurisdiction, that they are able to make their own decisions and are not simply a conduit for financing and instructions.

Interest income is typically subject to tax to the extent it cannot be offset against a corresponding expense from back-to-back financing arrangements, where it would be typical to recognise taxable income based on an arm's length margin under transfer pricing rules.

Some tax authorities are becoming increasingly aware of the onerous compliance requirements associated with withholding tax and, in certain cases, have taken steps to ease this administrative burden (for example, the UK Double Taxation Treaty Passport scheme eliminates the need for the overseas lender to prepare a treaty claim form in respect of each loan).

Management incentive or equity plans

In PE/VC-backed investments, the traditional exit strategy lends itself to incentivising management through participation in a management equity plan (MEP). MEPs may be structured in a variety of ways and typically seek to link the value of returns to the performance of the business such that returns fall within the favourable capital-gains tax regime rather than as employment income taxed under the income tax regime.

Care should be taken when designing acquisition structures to ensure the capital structure of the acquisition (including the existing capital structure of the portfolio group) and the financing structure facilitate the implementation MEPs.

This section briefly outlines three alternative options for MEPs:

- Management would acquire ordinary shares in a bidco which are leveraged (through shareholder loans advanced). The leverage would reduce the value of the ordinary shares, allowing management to purchase their shares at a low value.
  For example, if the acquisition at 100 is financed though 99 of debt and 1 equity and management will receive 10 percent of equity, they would purchase their shares for 0.1 but would receive 10 percent of all equity returns once the debt (plus accrued interest) has been paid off. The debt could also be partly in the form of fixed rate preference shares, if desired.

- If the bidco is not sufficiently leveraged to reduce the value of the ordinary shares, a new class of share could be created which entitles holders to participate in growth in value only.
  For example, if the acquisition at 100 is financed 100 percent through equity, the growth shares would participate in 10 percent of growth in value above 100. As the shares would only participate in growth in value, the shares should have a low value on acquisition.
- Management would acquire options to acquire shares in bidco on exit.

The long-term ownership policy of infrastructure funds has limited the widespread use of MEPs associated with infrastructure-type assets as there may not be a natural exit point for management to realise value during their tenure. However, it is possible to design plans which enable management to participate in the equity and/or yield from the underlying assets.

The traditional style of MEP is more applicable where an investor will be looking to sell its investment in the short-to-medium term than for example where they intend to hold an operational portfolio of renewable assets for cash yield.

The rules governing the employment tax issues to consider are complex and vary from country to country. Consequently, the options outlined above may not be applicable in all jurisdictions and specialist legal and tax advice should be sought on a case-by-case basis. As a general guide, to the extent that leverage is provided on commercial terms and management pay fair (and unrestricted) market value for their shares, returns should fall within the capital-gains regime. However, with all MEPs, there is a risk of tax authority challenge and the potential reclassification of capital gains to employment income, especially in cases where the return has links to employment.

Tax optimisation at portfolio company level

Maximising the various tax credits and incentives available should further reduce cash taxes payable and increase the return on investment either through direct repatriation or via reinvestment and growth of the underlying business. This section provides a summary of some of the key reliefs typically available for clean energy and cleantech companies.

R&D tax relief

R&D tax relief in the form of enhanced tax deductions (reducing taxable profits) and/or repayable tax credits is well established in a number of countries to encourage innovation and enterprise. Typically, more favourable reliefs are available for smaller companies.

By their nature, cleantech businesses focusing on R&D leading to the advancement and commercialisation of clean technology, and clean energy companies developing technologies, for example to enhance output efficiency, have a high probability of qualifying for some form of R&D tax relief to the extent it is available in the country in which they operate, and provided the various conditions imposed in order to qualify for the tax relief are satisfied.

Table 16.1: **Non-exhaustive summary of available R&D tax incentives across a range of jurisdictions**

Country	Tax incentive	Enhanced deduction	Tax credit	Economic risk required
UK*	✔	✔	✔	✘
France	✔	✘	✔	✘
Germany	✘	✘	✘	n/a
US	✔	✘	✔	✘
Belgium	✔	✔	✘	✔
Switzerland	✘	✘	✘	n/a
Netherlands	✔	✘	✘	✔

* Subject to ongoing reform in the UK, including ongoing consultation in respect of the introduction of an 'above-the-line' credit in the form of a credit against the company's tax bill, enhanced rates of deduction (e.g. £225 for each £100 of qualifying expenditure) and the removal of certain restrictions on cash-back tax credits.
Source: Deloitte.

The conditions vary from country to country though usually require some or all of the following: a defined R&D project, accurate recording of the expenditure associated with the R&D activity (for example, staff costs and consumables), an appreciable advance in science or technology and ownership of the resultant intellectual property (see Table 16.1 for a summary of select tax incentives).

Accelerated tax depreciation

Tax relief in the form of tax depreciation enables the cost of qualifying capital expenditure to be offset against taxable profits. To the extent enhanced rates enable tax depreciation to exceed the corresponding accounting depreciation, the cash tax benefit is accelerated (though, for accounting profit purposes, is typically removed by a corresponding deferred tax liability).

As part of wider programmes to tackle climate change and carbon reduction, certain jurisdictions offer enhanced rates of tax depreciation on certain types of environmentally friendly and energy-saving technology. Two examples which should be considered in relation to investments in clean energy and cleantech include:

- the UK's enhanced capital allowances (ECA) regime which enables the full cost of the investment to be offset in year one (that is, 100 percent tax relief as opposed to the current rates of 20 percent or 10 percent on a reducing-balance basis); and
- Spain's free-depreciation regime, where qualifying companies have in the past been free to decide the tax depreciation policy of the qualifying assets irrespective of the accounting depreciation method.

Recent rules changes to the free depreciation regime in Spain emphasise that close monitoring of these tax breaks is required and that particularly in these times of fiscal austerity the clean energy sector is not immune to tax breaks being reformed or removed.

Similarly there have been changes to the eligibility rules for ECAs in the UK to remove the ability to claim the enhanced allowances on renewable energy assets which are entitled to a feed in tariff.

IP and patent box regimes

Further tax incentives are available to companies undertaking R&D leading to the development, manufacture and exploitation of IP and patents has involved the evolution of patent or innovation box regimes which reduce the effective tax rate (ETR) applied to profits associated with the IP or patent. Two examples include:

- the Dutch innovation box regime which reduces the ETR to 5 percent and enables losses from intangible assets to be offset at the full rate of corporate income tax (currently 25 percent); and
- the UK's patent box regime, subject to ongoing consultation in the UK, to be introduced in 2013, under which profits arising from the ownership and/or commercialisation of qualifying patents will be taxed at a reduced rate of 10 percent.

Management of portfolio companies

As noted above, the ability to claim interest expense deductions on acquisition debt has come under increasing scrutiny over recent years and increased anti-avoidance rules have been introduced in a number of jurisdictions.

These rules, coupled with increases in transfer pricing requirements in respect of financing activities (for example, France and Luxembourg), and ongoing discussions in further jurisdictions (such as the Netherlands and Spain) to broaden rules seeking to reclassify shareholder loans as equity instruments – removing the tax deduction, have made it increasingly important for fund managers and their advisers to work with portfolio-company management to ensure that all available incentives and reliefs are maximised and that developments are taken into account.

As tax law and practice change over time with applicable reliefs being amended or repealed and new ones introduced, it is important for the tax profile of an investment to be monitored throughout the period of ownership by a fund or investor. Ongoing review allows changes to be assessed and options to mitigate the impact of adverse developments on project returns or to claim new reliefs can be explored.

Due consideration should also be given to intra-group transactions (including financing and the provision of management or technical services) to ensure transfer-pricing rules are adhered to and, where possible, tax efficiencies are embedded into portfolio group operations.

Conclusion

This chapter has set out an overview of the key drivers of tax-efficient investments, a summary of the typical factors to consider when structuring acquisitions and a non-exhaustive summary of some of the key tax incentives available at investor and portfolio group level for European clean energy and cleantech portfolio groups.

The following checklists set out a recap of the key tax factors to consider for investors and fund managers when selecting funds and assets respectively.

Investors
Checklist of tax factors to consider when selecting a fund:

- Type of fund vehicle and its classification (i.e. transparent or non-transparent)
- Preferred form of return and timing of income recognition
- Ability to benefit from preferential treaty rates, EU directives and transfer-pricing compensating adjustments (i.e. to remove any disadvantage)
- The fund's approach to evaluating and structuring asset acquisitions
- The fund's attitude to and process for monitoring tax risk and developments in tax law and accepted practice (both at fund level and portfolio company level)
- The extent of upfront and ongoing interaction with local management with a view to optimising the portfolio group's tax position

Fund managers
Checklist of tax factors to consider when selecting an asset:

- The portfolio group's compliance record, approach to tax planning and relationship with the tax authorities
- The extent to which management involve tax in the decision-making process to enable opportunities and risks to be identified
- Management's approach to identifying and maximising available tax credits and incentives
- Management's attitude to and process for monitoring tax risk and developments in tax law and accepted practice
- Existing incentives for management to optimise the tax position of the group (e.g. post-tax reporting and reward)
- Management's attitude to engaging with the fund manager and their advisers with a view to optimising the group's tax position

Consideration of the factors outlined above when establishing a fund structure and designing each asset acquisition structure as well as working with local portfolio company management teams over the life of investment should ensure that, as far as possible, the tax benefits designed at deal stage are not eroded and that returns to investors are maintained (and possibly enhanced).

As tax can play a significant part in the overall net return from an investment, financial modelling which supports any investment should take account of the particular circumstances of any investment and the profile which results from the intended investment structure.

As ongoing reform continues in many countries, it is incumbent on management to have in place a process to monitor developments closely to ensure that risks are managed and that the most cost-effective and efficient structure continues to be used from a tax perspective. □

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Glossary of terms*

* *Source:* United Nations, International Energy Agency, Investopedia and company websites.

Baseload – is the constant electricity output for most hours of the day throughout the year.

Basel III – a global regulation requiring banks to strengthen capital adequacy with the objective of creating a more resilient international banking system.

Bidco – a vehicle funded by debt and equity and used to acquire assets.

Biogas – gas that is produced from the biological breakdown of organic matter in the absence of oxygen to providing a clean source of renewable energy.

Biomass – biological material such as plant and animal matters that can be used to generate clean energy and biofuels.

Biowaste-to-energy – the process of using biowaste materials to generate energy.

BRIC – acronym that refers to the emerging markets of Brazil, Russia, India and China.

Bundled (or PPA-driven) markets – a term used to describe renewable energy that is sold together with its environmental attributes for a single fixed price (also see *Unbundled (or REC-driven) markets*).

Carbon credits – a tradable certificate that gives a right to produce one tonne of CO_2. They represent a reduction of greenhouse gases. Credits can then be sold to other businesses in the marketplace that can then use these certificates as a means to offset their emissions.

Carried interest – the share in a private equity fund's capital gains which is paid to the fund's general partner. Once a fund has made capital distributions to its investors which equal the total of all drawn capital, plus an agreed minimum rate of return on that capital, the general partner will take a percentage (usually 20 percent) of all subsequent capital gain.

CDM (Clean Development Mechanism) – a mechanism defined in the Kyoto Protocol to assist parties in achieving sustainable development, to meet commitments to greenhouse gas reductions and prevent climate change.

CEI (Clean Energy Infrastructure) – a term used to cover the physical plant, machinery and facilities that is used to generate zero-carbon energy from ambient sources, such as solar, wind and wave power.

CER (Certified Emission Reduction) – carbon credits issued by the Clean Development Mechanism's executive board for emission reductions achieved by CDM projects. Credits can be purchased on primary and secondary markets by countries that need to comply with emission limitations under the Kyoto Protocol or by operators of installations covered by the EU-ETS.

Combined-cycle power plants – process used to turn heat into mechanical energy for the purpose of power generation.

Copenhagen Accord (2009) – a series of non-legally binding commitments by the US, China, Brazil, India and South Africa to reduce their greenhouse gas emissions.

DCF (Discounted Cash Flow) – a method of valuation used to measure the attractiveness of a company or asset as an investment.

'Dirty' sector – a term for industry sectors that produce a high level of pollution.

Dodd-Frank Act – The Dodd–Frank Wall Street Reform and Consumer Protection Act is a US federal law regulating the financial sector with tighter rules on transparency, accountability and consumer protection.

EBITDA – Earnings before interest, tax, depreciation and amortisation (EBITDA) is generally used as a crude proxy for a company's operating cash flow and is, therefore, an indicator of the level of debt a company can service.

Effective tax rate (ETR) – average rate at which an individual is taxed on earned income or at which a corporation is taxed on pre-tax profits.

Efficient frontier – a set of optimal portfolios that offers the highest expected return for a defined level of risk or the lowest risk for a given level of expected return. Portfolios that lie below the efficient frontier are sub-optimal, because they do not provide enough return for the level of risk. Portfolios that cluster to the right of the efficient frontier are also sub-optimal, because they have a higher level of risk for the defined rate of return.

Enhanced Capital Allowances (ECA) – a scheme that allows a business to write off 100 percent of the capital cost of investing in qualifying clean technologies against their taxable profits in the period in which the investment is made.

E-mobility concepts – a term for vehicles that rely on electricity for energy rather than diesel or petrol.

ESG – environment, social and governance (ESG) is a term used to describe the non-financial indicators used by investors to value a company based on its response to, and adoption of, a range of environmental issues and practices (such as a company's carbon footprint).

EU – ETS (European Union Emission Trading Scheme) – a pillar of the EU's climate change policy. The scheme requires large emitters of CO_2 in the EU to monitor emissions, report them annually and return an amount of emission allowances to the government that is equivalent to their emissions.

EUAs (European Union Allowances) – credits allocated to companies under the EU – ETS. Each credit gives a company the right to emit one tonne of CO_2.

EVs (electric vehicles) – vehicles that are powered by electricity. See also *E-mobility concept*.

Feed-in tariffs – these are cash payments to households who use renewable energy (for example solar panels) to produce electricity.

Flow rate (of the wells) – a term used to denote the rate that water flows from surrounding soil into the well and the ability to deliver a sustained water supply to users.

Fracking – a mechanical process that injects chemicals at very high pressure to break up rock formations underneath the earth's surface to release natural gas and other substances for extraction. Also known as hydro-fracking or induced hydraulic fracturing.

Green Wave Initiative – a global campaign to educate children and young people on biodiversity issues.

IIGCC (Institutional Investors Group on Climate Change) – a members forum of European investors, including pension funds and asset managers, to collaborate on climate change and to engage with and influence policymakers, investors and companies on climate change issues.

IPC (Intra-portfolio correlation) – is a measurement of the degree to which assets within an investment portfolio are expected to perform in a similar way. It is a means of quantifying diversification.

IPO (initial public offering) – is the sale of a company's shares on a public stock market for the first time.

IPP (Independent power producer) – also known as a non-utility generator, generates electricity which is sold to power utilities and end-users.

ITC (Investment tax credit) – is a tax incentive that permits companies or individuals to deduct a specified percentage of certain investment costs from their tax liability in addition to the normal allowances for depreciation.

JI (Joint Implementation) – one of three market-based mechanisms under the Kyoto Protocol to help signatories meet targets for reducing greenhouse gas emissions. Each country with an emission reduction or limitation commitment can earn at ERU (Emission Reduction Unit) from each reduction or removal project. Each ERU is equivalent to one tonne of CO_2 and counts towards meeting the Kyoto targets.

Kyoto Protocol – international agreement setting binding targets on signatories to reduce greenhouse gas emissions.

LCOE (levelised cost of ownership) – the price at which electricity must be generated from a specific source to break even.

LDC (least developed countries) – term given by the United Nations to countries that have the lowest indicators of socioeconomic development.

Long-term secular trend – a market trend that continues over a long time period, that is, a non-cyclical trend.

Management incentive or equity plans – a scheme to promote or encourage specific actions or behaviour among senior company executives.

M&A (mergers and acquisitions) – a term to describe the strategy of combining two companies or one company acquiring another.

MPT (Modern Portfolio Theory) – is a theory on how risk-averse investors can construct portfolios to optimise or maximise expected return based on a given level of market risk.

Operations and management (O&M) – process of ensuring that a business operates efficiently in terms of use of resources and in the production of goods and services.

PE/VC-backed investments – investments in assets supported with money from private equity or venture capital funds.

PDI (Portfolio Diversification Index) – is a measure of the different investments held in a portfolio across the asset classes and can be used to assess the benefit of diversification.

PPA (Power-Purchase Agreement) – is a contract between the seller and purchaser of electricity. The contract defines the commercial terms for the sale of electricity between the parties.

Recapture rules – a rule that allows tax benefits paid out to be claimed back at a later date.

REC or SREC – (Solar) Renewable Energy Credits is a tradable credit. Every time 1000kWh of electricity is produced by a solar electric system, a SREC will be issued for sale. The credits are a means for electricity suppliers to demonstrate how much renewable energy they are generating.

RPS (Renewable Portfolio Standards) – is a regulation requiring an increase in energy production from renewable energy sources and used as an incentive to stimulate new investment in renewable energy projects.

Solar photovoltaic technology – technology that converts solar energy into electricity through the use of large solar panels.

SRI (socially responsible investing) – a strategy that allows investors to invest only in companies that promote certain ethical practices such as clean and renewable energy and to avoid investing in companies engaging in negative practices such as gambling or tobacco production.

Stern Review on Climate Change – a report for the UK government researched and written by economist Nicholas Stern, which discusses the impact of global warming on the world economy and suggests measures to minimise both social and economic disruptions.

Systematic risk – describes risk that cannot be diversified from an investment portfolio (i.e. the performance of an asset is correlated to wider market conditions).

Targetco – the underlying portfolio group or company or asset.

TIPS (Treasury Inflation Protected Securities) – are indexed to inflation in order to protect investors from the negative effects of inflation. Considered an extremely low-risk investment.

Tradable Certified Emission Reductions – see *carbon credits*.

Transparent vehicles – for tax purposes, a vehicle in which tax is levied on its participants, not the vehicle itself, for their share of the income gained from investments.

UN AGF (United Nations High Level Advisory Group on Climate Change Financing) – an advisory group on climate change financing set up to study potential sources of revenue to achieve the level of climate change financing promised at the 2009 UN Climate Change Conference in Copenhagen.

UNEP & Partners – a United Nations programme dedicated to providing global leadership in caring for the environment.

UNFCCC (United Nations Framework Convention on Climate Change) – an international treaty on limiting global temperature increases and preventing climate change.

UN PRI (United Nations Principles for Responsible Investing) – a network of global investors working together to bring about the practical implementation of six principles for responsible investment practice.

Unbundled (or REC-driven) markets – a term used to describe renewable energy that is sold separately from its environmental attributes at market prices.

Unsystematic risk – a term used to describe diversifiable risk (i.e. performance of an asset is uncorrelated to wider market conditions).

Venture Capital Trust (VCT) scheme – a tax-efficient vehicle to encourage investment in small, non-listed businesses. □

About Capital Dynamics

Capital Dynamics* is an independent asset management firm focusing on private assets including private equity, clean energy and infrastructure, and real estate. Capital Dynamics offers investors a range of products and services including funds of funds, direct investments, separate account solutions, and structured private equity products.

Our senior investment professionals hold an average of over 20 years of investing experience and due diligence expertise, gained through diverse backgrounds as fund investors, direct investors, and co-investors. With 160 professionals and 10 offices worldwide, Capital Dynamics is able to deliver top-quality service to its client base of sophisticated institutional investors such as pension funds, endowments, family offices, high net worth individuals, and advisors.

Headquartered in Switzerland, Capital Dynamics has offices in London, New York, Zurich/Zug, Tokyo, Hong Kong, Silicon Valley, Sao Paulo, Munich, Birmingham (UK) and Brisbane.

Investment types

- Primary fund investments
- Secondary fund investments
- Direct investments
- Clean energy and infrastructure
- Real estate

Global investment platform

Funds of funds – We provide primary private equity investments, allowing investors to implement a global allocation strategy through access to premier private equity managers.
Secondary fund investments – Active in the secondary market since the early 1990s, we raised one of Europe's first dedicated secondary funds.
Direct investments – Our extensive relationships with the globe's top-tier fund managers provide a consistent volume of high-quality investment opportunities. Our co-investment strategy is focused on mid-market buyouts, but also includes select development capital and special situations.
Clean energy and infrastructure – Our specialized team of senior industry investors employs a direct investment strategy focused on a diverse mix of clean and low-carbon energy assets that can offer attractive risk-adjusted returns and compelling diversification benefits from this emerging class of real assets.
Separate accounts – We assist clients to create individual programs to meet unique risk profiles and liquidity constraint parameters.
Structured products – Our structured solutions are designed to deliver compelling benefits such as early liquidity, enhanced return on investment, reduced risk, lower open commitments and/or decreased risk-weighted capital reserves.

Please contact us at info@capdyn.com, or visit our website at www.capdyn.com for further information.

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* 'Capital Dynamics' comprises Capital Dynamics Holding AG and its affiliates. Capital Dynamics is a signatory of the United Nations Principles for Responsible Investment (UNPRI). Our emphasis on quality has been recognized with the International Standard ISO 9001:2008 certification of compliance.

About PEI

PEI is the leading financial information group dedicated to the alternative asset classes of private equity, real estate and infrastructure globally. It is an independent company with over 70 staff based in three regional offices – London, New York and Hong Kong – and is wholly owned by its management and employees.

We started in London in November 2001 when a team of managers at financial media group Euromoney Institutional Investor PLC, with the backing of US-based investors, bought out a group of assets that centred on the website *PrivateEquityInternational.com*. At the time the new company was called InvestorAccess, and the aim was to grow a specialist media business that focused on alternative assets – and private equity in particular.

In December 2001 we launched our first magazine: *Private Equity International*. A year after, we had run our first conference in London and published our first book. A year later, we had opened our New York office and launched two more magazines: *PE Manager* and *PERE*. Next came the launch of our fourth magazine *PE Asia* in 2006. In 2007 we released our first online database and the year after we added specialist training to the portfolio as well as an awards business. In 2009 we launched our fifth magazine, *Infrastructure Investor*.

In May 2007 the same managers completed a secondary MBO that enabled us to own all of the business we had built and give our original co-investors a great exit too. Renamed PEI, the company remains one of the few independent financial media groups active worldwide.

Today we publish five magazines, host five news websites, manage a very extensive set of databases dedicated to alternative assets, run in excess of 25 annual conferences globally, publish a library of more than 30 books and directories and have a fast-growing training business.

We have grown into a well-known and highly regarded media business that delivers detailed coverage of the main alternative asset classes of private equity, real estate and infrastructure. We have worked hard to build a reputation for top-quality journalism that is written by our own staff and is delivered via accomplished print and digital channels. The same principles of accuracy, genuine market knowledge and excellence of delivery also inform our data, events and specialist publication activities.

In April 2009, PEI won *The Queen's Award for Enterprise 2009*. The award was made in the international trade category as we have more than doubled overseas earnings in just three years and we now conduct business in over 80 countries. As well as looking at our commercial performance, the judging process also examines the company's corporate social responsibility, the company's environmental impact and our relations with customers, employees and suppliers.

THE QUEEN'S AWARDS FOR ENTERPRISE 2009

Published by

PEI
Sycamore House,
Sycamore Street,
London EC1Y 0SG
United Kingdom

Capital Dynamics