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Carbon Capital

Financing the low carbon economy

BARCLAYS

Authors

Simon Whitehouse, Managing Director, Accenture Management Consulting, Financial Services
Client Executive Sponsor

Peter Lacy, Managing Director, Accenture Sustainability Services, EMEA and Latin America
Project Executive Lead

Xavier Veillard, Accenture Management Consulting, Strategy
Co-author

Justin Keeble, Accenture Sustainability Services
Co-author

Shaun Richardson, Accenture Management Consulting, Financial Services, Strategy
Co-author

Key contributors

Vedant Walia	Barclays Corporate Affairs, Sustainability
Rupesh Madlani	Barclays Capital, European Renewables and Clean Technology Equity Research
Irakli Elashvili	Barclays Corporate, Strategy
Richard Myerscough	Accenture Consulting Group

Study objectives

Climate change is one of the greatest challenges facing the global society today. Barclays and Accenture have partnered to produce this study to analyse the role of corporate and investment banks in accelerating the shift to a low carbon economy. In it, we seek to quantify the capital required to fund the development of low carbon technology (LCT) in the building, energy and transport sectors and the different financing mechanisms that could be developed to help meet the demand for capital. The study highlights the pivotal role that corporate and investment banks can play in rolling out low carbon technology and infrastructure on a wide scale, bridging the financing gap and helping to bring about the transition to a low carbon economy.

REPORT STRUCTURE

Scope	Method	Findings			Recommendations
I	II	III	IV	V	VI
What are the sources of the capital requirements for low carbon technologies?	How can these capital requirements be quantified?	What are the capital requirements and carbon and cost impact?	Which financing streams will provide these capital requirements?	What are the emerging financing schemes to support capital requirements?	What actions are required to enable these financing schemes?

Report sections

I	II	III	IV	V	VI
Sources of capital	Approach	Capital requirements and carbon impact	Financing LCT development and procurement	Emerging financing schemes to increase capital flows	Recommendations

Foreword

Climate change is a critical global social and economic challenge. It is set to affect us all for generations to come. The transition to a low carbon economy – which is essential if we are successfully to meet this challenge – will require significant investment from both the public and private sector. This report was commissioned by Barclays in order to help answer some of the questions as to how this transition will be made.

Barclays is already an active participant in the low carbon economy. We are providing a wide range of financial and risk management solutions across our core business lines. We help renewable energy firms access financing from the capital markets and offer strategic advisory services across the sector. Barclays was also the first major bank to establish a carbon trading desk. We are now leading intermediaries in the EU Emissions Trading Scheme and are transferring expertise to newer emissions markets. Our Equity Research teams provide coverage of the Global Clean Technology and Renewables sector to inform investor decision-making.

We engaged Accenture to develop a comprehensive bottom-up model to estimate the growth of low carbon technologies in Europe over the next decade. The research estimates a capital demand of €2.9trillion to finance the development and roll-out of new technology in five key sectors.

Barclays, and the wider banking sector, will play a key role in mobilising this capital but there are limits to what banks alone can accomplish. Uncertain policy frameworks and technology risk are increasing the difficulty of investing in low carbon technology. We need clear and consistent policy frameworks to help unlock the required flow of private capital.

This research also explores some new funding models that can be used to accelerate capital flows to the sector, particularly access to deep and liquid bond markets. These will require effective partnerships between banks, investors, project sponsors, rating agencies and public sector actors to increase bond market financing. There may also be a need to create instruments to share risk so that initial transactions can help build a track record and build investor confidence.

We at Barclays remain committed to playing a leading role in tackling climate change and enabling the transition to a lower carbon economy. I hope you find this research a helpful contribution to the debate on how we can address the climate change challenge in both Europe and globally.

MARCUS AGIUS
Barclays Group Chairman

> “We need clear and consistent policy frameworks to help unlock the required flow of private capital”

The shift to a low carbon economy is leading to a remarkable development of sustainable low carbon technologies which are transforming and reshaping core industry sectors and infrastructures across our society.

We, Accenture, play an active role in developing and integrating low carbon technologies in tomorrow's society by working with industries, governments and non-governmental organizations to reduce the global energy footprint, and ultimately achieve energy security and climate change mitigation. Our work on intelligent cities, smart buildings and smart grids are examples of transformational initiatives we aim to implement on a global scale.

However, we recognize that the shift to a low carbon economy requires an unprecedented level of capital investment. Through a distinctive modelling approach, this report provides unique insights on the sources and volume of capital required to fund a range of commercially viable low carbon technologies and quantifies the impact these will have on energy cost and carbon savings.

With an estimated €2.9trillion of capital required in Europe up to 2020 to fund low carbon technologies, this report confirms that the private sector will play a crucial role in the provision of capital. High level of sovereign debt and maturing technology now imply that private sector capital, primarily intermediated by banks, must be provided to accelerate the investments we need to meet our 2020 goals.

The financial services industry and more particularly banks, are still facing multiple challenges in recovering from the financial crisis. Financing low carbon technology represents a unique opportunity for banks to benefit from the significant growth of the low carbon technology sector whilst demonstrating a positive contribution in tackling climate change.

But this will require adaptation and innovation of core banking products and services to address the specific capital requirements, risk level and regulatory environment of low carbon technologies.

Having worked with banks for over two decades, I am confident that they have the capability to innovate and effectively intermediate the level of capital highlighted in this report; and you can be confident that we will be working with industry leaders like Barclays to achieve this goal. I hope that you enjoy reading this report and find the analysis insightful.

PIERRE NANTERME
Accenture Chief Executive Officer

> "Financing low carbon technology represents a unique opportunity for banks to benefit from the significant growth of the low carbon technology sector whilst demonstrating a positive contribution in tackling climate change"

Advisers

ACCENTURE INTERNAL ADVISERS

Lloyd Altman	Capital Markets Trading and Risk Management
Dorothy Armstrong	Financial Services, Strategy
Mauricio Bermudez Neubauer	Sustainability Services, Carbon Markets
Eric Clement	Capital Markets, Structured Finance
Piercarlo Gera	Financial Services, Strategy
Simon Giles	Resources, Smart Technology
Richard Hanks	Resources, Smart Metering
Jenny Hawes	Resources, Smart Grid
Seb Hoyle	Transport and Travel Services, Supply Chain
Frederick Jones	Financial Services
Richard Kho	Resources, Clean Energy
John Rhoads	Sustainability Services, Smart Buildings
Melissa Stark	Resources, Clean Technologies
Robert Stubbs	Banking, Research
Andy Tinlin	Financial Services, Strategy
James Woodhouse	Financial Services
Barbara Wynne	European Policy and Government Relations
Serge Younes	Sustainability Services, Clean Energy

BARCLAYS INTERNAL ADVISERS

Lorraine Connell	Director, Investment Banking Public Sector Team
Adam Darling	Vice President, Barclays Natural Resource Investments
James McKellar	Managing Director, Power, Utilities and Infrastructure, Head of Renewables, Barclays Capital
Gareth Miller	Director, Head of Renewables Project Finance, Barclays Corporate
Theodore Roosevelt IV	Managing Director & Chairman of Barclays Capital Cleantech Initiative
Nick Salisbury	Director, Barclays Corporate Real Estate
Alastair Tyler	Head of Strategic Asset Finance, Barclays Corporate

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United Kingdom Registered office:
1-Plantation Place
30 Fenchurch Street
London
EC3M 3BD
England
Tel: +44 (0) 20 7844 4000
Fax: +44 (0) 20 7844 4444
For more information visit: www.accenture.com/sustainability

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Barclays PLC
1 Churchill Place
London
E14 5HP

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Executive summary

SCIENTISTS BROADLY AGREE that if the world is to prevent irreversible climate change, levels of greenhouse gas emissions must be stabilized by 2015 and reduced in the years that follow[1]. Moving to a low carbon economy will be crucial to achieving these reductions and will require unprecedented levels of investment in low carbon technology (LCT): as much as two per cent of GDP[2] according to some estimates.

At present there is not sufficient investment to fund the transition to a low carbon economy, with the gap between the capital needed and that available widening. If this "carbon capital chasm" is not addressed, the EU will be in real danger of missing its emissions targets. With the world barely recovered from a severe economic downturn, public finances tightening and little real consensus on emissions targets, most of the funding for the low carbon economy is expected to come from the private sector.

How much capital will be required to fund the development and procurement of low carbon technology? In addition, how can banks develop financing schemes to support the provision of capital?

In this report we seek to:

- Quantify the amount of capital needed to fund essential LCT in the building, energy and transport sectors in Europe to 2020 and in selected countries globally up to 2020 for the energy sector only.
- Measure the cost and emissions savings that will come from investing in LCT.
- Identify various financing streams which could potentially provide sufficient capital to meet demand for the technology.
- Outline supporting financing schemes and instruments that stimulate more capital provision.
- Make recommendations to banks and policymakers on how they accelerate the provision of capital to the LCT sector.

Approach

We take a unique approach to quantifying the capital needed for the low carbon economy. Past models have been supply driven, estimating LCT capital requirements "top down" based on emission targets. By contrast, our model calculates the capital needed to finance the development and commercialization of LCT ("development capital") and the amount needed to finance the procurement of LCT assets ("procurement capital"). This is derived from a demand-driven model based on realistic adoption rates for a range of LCTs.

Findings

- Fifteen commercially viable LCT applications in Europe were considered in this report. These require €591billion in development capital and €2.3trillion in procurement capital. This would lead to savings of €261bn and 2.2 Gt CO_2e.
- Rolling out this technology would bring the EU emissions down to 83 per cent of 1990 levels by 2020. Taken together with the carbon savings expected from other sectors, such as manufacturing or chemicals, this would make the EU far more likely to meet its target of a 20 per cent reduction in emissions.
- Photovoltaic solar power is the most capital intensive within the LCTs identified. The technology is about five times more expensive than onshore wind, for example, and production efficiency remains below 20 per cent on average. It will cost about €365bn to procure both large-scale infrastructure and micro installations.
- €2.4trillion will be required to finance renewable energy (wind, solar, geothermal and biomass) in Europe (EU25), China, India, USA, Japan, Canada and Australia to 2020. This investment will lead to a 6.6Gt CO_2e reduction.

1 IPCC, Working Group II Report "Impacts, Adaptation and Vulnerability", 2007

2 Accenture Analysis, based on capital requirements presented in GIBC and new estimates from Lord Stern re-evaluating estimates presented in "Stern Review on the Economics of Climate Change", 2006

€2.2trillion is estimated to be financed by sources external to the entity procuring or developing the LCT.

New sources of finance

Out of all the capital required to fund LCT up to 2020, €2.2trillion is estimated to be financed by sources external to the entity procuring or developing the LCT. Corporate and investment banks as intermediaries have a significant role in mobilizing this financing. However, technology risk and policy uncertainty significantly increase investment risk, making it a significant funding challenge. Banks will need to work with investors and project sponsors to identify innovative solutions which meet investor needs and enable them to deploy capital to this space. Some emerging financing schemes include:

- Unlocking access to LCT finance through capital markets and "green bonds".
- Financing energy-efficient and micro-generation assets through leases.
- Creating new investment vehicles for LCT asset management.
- Investing equity in LCT assets and developers.
- Developing advisory services to improve LCT sector risks and opportunities assessments.

Recommendations

In the report we make a number of recommendations for banks and policymakers to speed up the introduction of financing for the low carbon economy.

Policymakers should:

- Provide a long-term and stable commitment to incentives that support the commercialization of LCT.
- Leverage public funding to stimulate private sector investments.
- Develop standards for asset-backed securities funding LCT assets and "green bonds".

Corporate and investment banks should:

- Develop the capabilities to provide LCT asset-backed securities.
- Set up dedicated investment funds to give investors strategic exposure to the LCT sector.
- Increase primary equity and debt contributions in LCT assets and developers.
- Provide debt financing for energy-efficient and micro-generation asset leases.
- Develop technical, regulatory, financial and commercial expertise to support the risk assessment of LCT assets and developers.

Introduction

This section examines:

- The drivers of the low carbon economy.
- The growing capital requirement.

The drivers of the low carbon economy

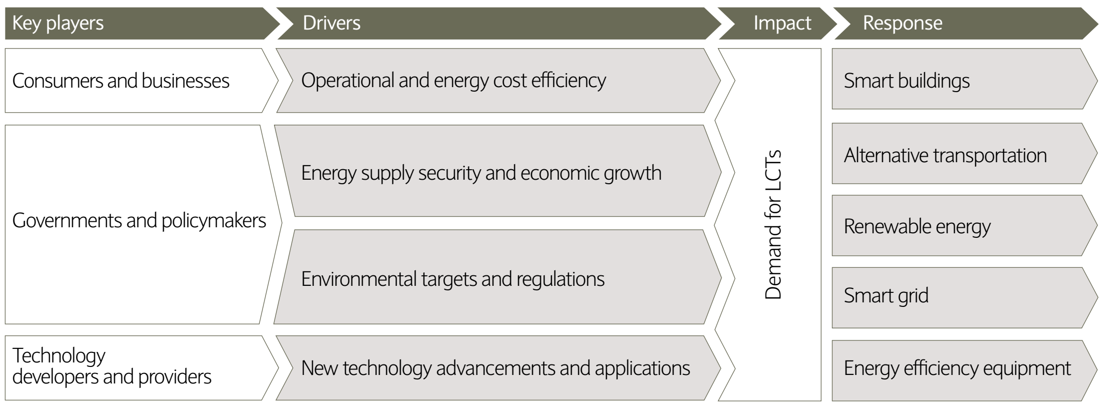
MANY FACTORS HAVE emerged in the past decade that highlight the urgent need to develop low carbon and renewables technology. Low carbon technologies (LCTs) are equipment and infrastructure that enable energy efficiency or alternative energy production and use, leading to a reduction of carbon emissions, directly or indirectly. The full range of technology considered in this study is in Appendix I and is categorized as follows:

- Buildings (e.g. smart buildings).
- Electricity distribution (e.g. smart grid).
- Electricity production (e.g. renewable energy).
- Transport vehicles (e.g. bio-fuel vehicles).
- Transport infrastructure (e.g. e-vehicle charging system).

A number of factors bolster the demand for LCT:

- Consumers and businesses are recognizing the case for action.
- Energy security is a primary concern for governments.
- LCT represents an opportunity for growth and job creation.
- Carbon emissions mitigation is supporting the emergence of carbon reduction targets and of carbon markets.
- Carbon markets are increasing cost pressure on carbon intensive industries.
- Technological advances and innovation have led to significant cost efficiencies.

1 THE DEMAND FOR LOW CARBON TECHNOLOGIES

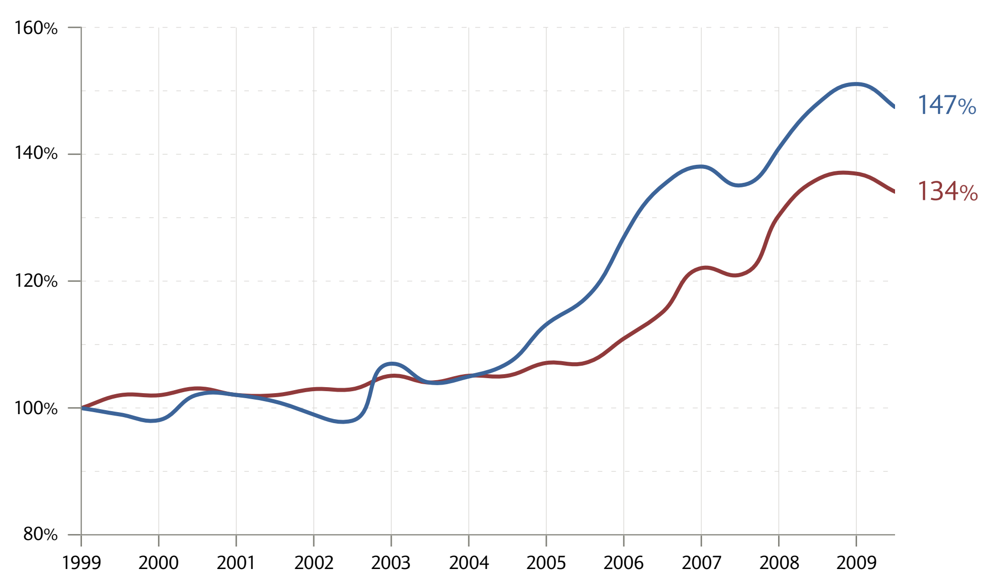


Consumers and businesses are recognizing the case for action

DEMAND FOR FOSSIL fuels has soared in developed and developing countries in the past decade. Consumers, businesses and industry are demanding more energy, whether to power new electrical appliances coming on to the market or to automate business processes. The stark increase in demand for electricity (10 per cent per capita on average between 1999 and 2009[3] in EU15) combined with rising energy prices (the price of electricity increased by 47 per cent for domestic and 34 per cent for industry between 1999 and 2009 in EU15[4]) have propelled energy cost efficiency up individual and corporate agendas.

3 Accenture Analysis, derived from Eurostat figures for energy consumption in Europe
4 Eurostat average for EU25 countries

2 ELECTRICITY RETAIL PRICE IN EUROPE (EU15) BETWEEN 1999 AND 2009 (100% IN 1999)



2

Domestic price (mid-band)

Industrial price (mid-band)

Source: Eurostat

Energy security is a primary concern for governments

IN 2007, CHINA imported 47 per cent of its crude oil, the US imported 35 per cent and the EU 94 per cent[5]. To reduce dependency on foreign imports, governments have developed a range of incentives and regulations to stimulate demand for renewable and LCT. New policies emphasize an increase in the use of renewable energy to reduce reliance on energy imports.

One prolific example is that of Feed-in-Tariffs (FITs) which typically guarantee a long-term premium price to clean electricity vendors. FITs have been introduced in most major European economies, including Germany, France, UK, Italy and Spain. China, which established an FIT in its Renewables Energy Law in 2005, is one of several other countries implementing the tariffs globally[6]. Other schemes force utilities to derive additional electricity from renewable sources, including Renewable Energy Certificates (RECs) in the US or Renewable Obligations Certificates (ROCs) in the UK.

LCT represents an opportunity for growth and job creation

IN ADDITION TO decreasing reliance on foreign energy sources, governments are using the transition to a "green economy" as an opportunity for economic growth, e.g. London's proposed carbon mitigation activities are estimated to deliver 14,000 gross jobs per annum and £600m per annum of gross value-added opportunities[7]. Accordingly, some governments have provided fiscal incentives (Green Funds tax-based incentive scheme in the Netherlands, Low Carbon Network Fund in the UK) to drive investment in the LCT sector.

Carbon emissions mitigation is supporting the emergence of carbon reduction targets and of carbon markets

DESPITE THE ABSENCE of a global agreement on carbon reduction, many governments have committed to aggressive targets in line with the Kyoto Protocol and Copenhagen agreements. The EU has set a target of taking emissions down to 20 per cent of 1990 levels[8], with some member countries striving for more ambitious targets: the UK wants a 34 per cent reduction, Germany 40 per cent and France 30 per cent compared with 1990 levels[9]. Globally, a number of countries have also committed to reduce the carbon intensity of their economy by 2020 with India pledging a 20-25 per cent[10] and China pledging 40-45 per cent[11] reduction in carbon emissions CO_2e/GDP compared with 2005 levels.

To achieve these targets, governments have begun to tax carbon intensive industries and activities directly (e.g. UK Carbon Reduction Commitment, Sweden Carbon Tax, France EcoTax). Emissions trading schemes brought in by governments seek to put a price on carbon. The most prominent scheme is the European Union Emissions Trading Scheme (EU ETS). Launched in 2005, the EU ETS was the world's first operational carbon emissions market.

5 IEA, derived from country energy balance
6 The Renewable Energy Law of the People's Republic of China, February 2005
7 Prospectus for London, The Low Carbon Capital, E&Y, 2009
8 Section 22, Council of European Union Presidency Conclusions, 12 December 2008
9 Annual European Union greenhouse gas inventory 1990-2008 and inventory report 2010, European Environmental agency, June 2010
10 Carbon reduction targets not up for re-negotiation: India, December 2009
11 China's carbon intensity targets explained, Financial Times, November 2009

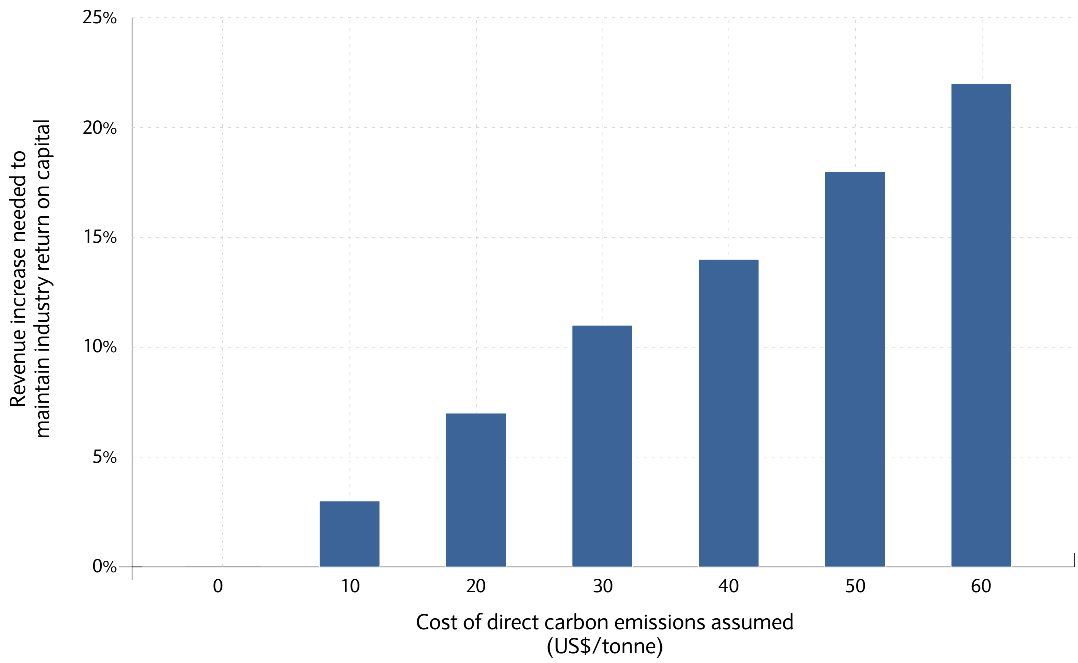
Carbon regulations are generating growing cost pressures

CARBON REGULATIONS SUCH as the EU ETS have forced companies to bear the cost of their carbon emissions. While some locally traded sectors such as utilities will be able to pass on the extra cost of complying with regulations to consumers through electricity bills for example, energy intensive sectors producing globally traded goods such as metals, cement and chemicals, will see the effect of stringent carbon regulations on their balance sheets and income statements.

"Emissions levels will be a liability and any emissions allowances an asset, and the difference between the two will determine the net impact on company accounts[12]*."*

Companies covered by regulations will compare their internal abatement cost to the market price of emissions permits on the carbon markets (approximately €15 during August 2010[13] on the EU ETS). The caps and the amount of credits allocated for free will decline in time, expanding the cost liability and reducing profitability, driving demand for lower carbon operations and therefore LCTs.

3 THE REVENUE INCREASE REQUIRED FOR UTILITIES TO MAINTAIN A CONSTANT RETURN ON CAPITAL FACTORING IN THE COST OF CARBON EMISSIONS



Source: GS SUSTAIN, Global Investment Research, Goldman Sachs

Technological advances and innovation have led to significant uptake

RECENT ADVANCEMENTS AND developments in cleantech have resulted in reduced procurement and operating costs. Solar PV cost per MW-capacity has decreased by more than 30 per cent between 2000 and 2010[14] and similarly, the cost of Light Emitting Diodes (LEDs) is expected to drop significantly due to advancements in material science[15]. The cost of micro-CHP, biodiesel vehicles, and other LCTs has also dropped substantially. This cost-reduction trend is expected to continue as technology matures, making LCT more affordable and accessible to industries and end customers.

The growing prevalence of LCT has led to a growth in support services such as engineering, operating and maintenance. This in turn has led to and steepened the innovation learning curve and led countries to adopt the technology at a faster rate. Germany's share of wind power as a proportion of electricity production was 6.3 per cent in 2009, while in Denmark it was 18.6 per cent[16]. This compares with much lower levels in 2000.

12 Seizing the Opportunities in the Low-Carbon Economy, Accenture, 2010
13 ECX EUA Futures Contract: Historic Data 2010, European Climate Exchange, 2010
14 TECHPOL database, European Commission World Energy Technology Outlook, 2050
15 DOE Solid-State lighting CLIPER Program Summary of Results, DOE, February 2009
16 Enerdata power production database

The growing capital requirement

AS DEMAND FOR LCT has risen, so has the need for capital to develop and deploy the technology.

THE AMOUNT OF capital available for developing LCT has risen sharply, yet remains vulnerable to the global economic cycle. As the LCT sector grows, demand for early stage capital to fund LCT developers is high. In 2009, $5.64bn[17] was invested globally in cleantech venture capital with the majority of the technology classified as alternative energy or energy efficiency[18].

A significant shift in venture capital investment towards cleantech is underway.

In the US in 2002, cleantech represented less than five per cent of venture capital investment compared with an estimated 25 per cent for software and 15 per cent for biotech[17]. In 2009, cleantech venture capital investment reached the same level as biotech at 20 per cent, ahead of software at about 17 per cent[17]. This trend is essential to anticipating the expected future demand in late-stage development capital for the cleantech sector.

However, this financing stream is highly volatile and carries a correlation to investor confidence and the global economic outlook. In 2009, LCT investment in development capital dropped by 49 per cent[19] as the global recession took hold, while procurement capital remained at a similar level to 2008.

With more LCT companies reaching the later development stage, demand for late- and growth-stage private and public equity has risen sharply. LCT initial public offerings (IPOs) totalled an estimated $6.5bn with 24 taking place around the world between July 2009 and June 2010[20], up 360 per cent on the same period in 2008/09 (Figure 4).

PROCUREMENT OF LCT equipment and infrastructure requires an increasing volume of capital.

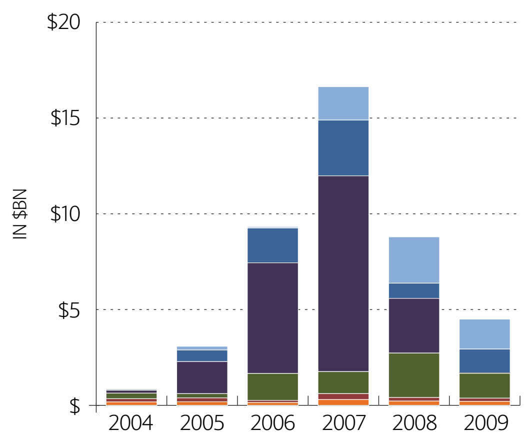
LCT INFRASTRUCTURE AND equipment tends to be capital intensive, requiring significant capital expenditure upfront. The average cost of building a wind farm in Europe was €140m[21], or €1.7m per MW-capacity[22] between 2004-2009. Implementing a smart grid (upgrading the electricity distribution network through dynamic monitoring and control) in a city of one million households is estimated to cost about €2.6bn[23] (including substation automation and distributed storage). Funding this infrastructure will require significant investment from utilities, local authorities or other operators.

For individuals, switching to LCT is also very costly. To mount a 2kWp solar panel on a roof would cost approximately €11,351[24], a significant outlay for most households.

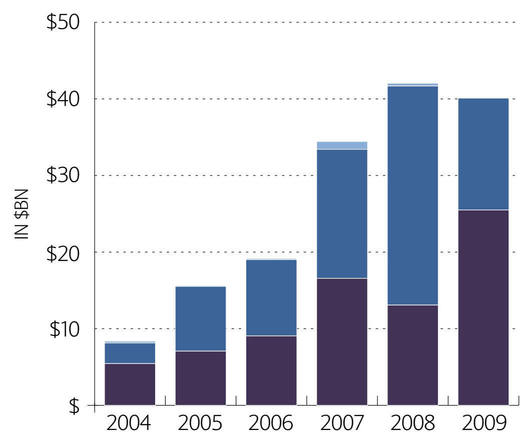
Nevertheless, with more people adopting LCT despite the high costs, the amount of capital invested soared to a record high of $42bn in Europe in 2008 (Figure 5). Despite the global recession, the amount of capital going into LCT procurement capital fell by only five per cent in 2009 compared to 2008, suggesting that the appetite for LCT equipment and infrastructure is not diminished by economic cycles.

17 Scaling Cleantech: Corporations, Innovation and Imperatives for the 2010s, Cleantech Group, April 2010
18 Share derived from the composition of the CTIUS Index
19 Bloomberg New Energy Finance
20 Bloomberg New Energy Finance, derived from transactions database
21 Bloomberg New Energy Finance, derived from transactions database
22 Bloomberg New Energy Finance, derived from transactions database
23 Accenture Smart Grid Services, derived from smart grid components price estimates
24 Global Renewables Demand Forecast 2010-2014E, Barclays Capital Equity Research, August 2010, derived from €/Wp cost provided

4 DEVELOPMENT CAPITAL ($BN) IN EUROPE BETWEEN 2004 AND 2009, BY FINANCING STREAM – EUROPE (EU25) ONLY



5 CAPITAL RAISED TO FUND ASSETS ($BN) IN EUROPE BETWEEN 2004 AND 2009 BY FINANCING STREAM – EUROPE (EU25) ONLY



4
- Convertible and other
- Secondary & PIPE
- IPO
- PE expansion capital
- VC late stage
- VC early stage

5
- Bond and other
- Project debt
- Balance sheet

Source: Bloomberg New Energy Finance

I
Sources of capital

This section examines the scope for capital required for both the development of the LCT industry and procurement of LCT equipment.

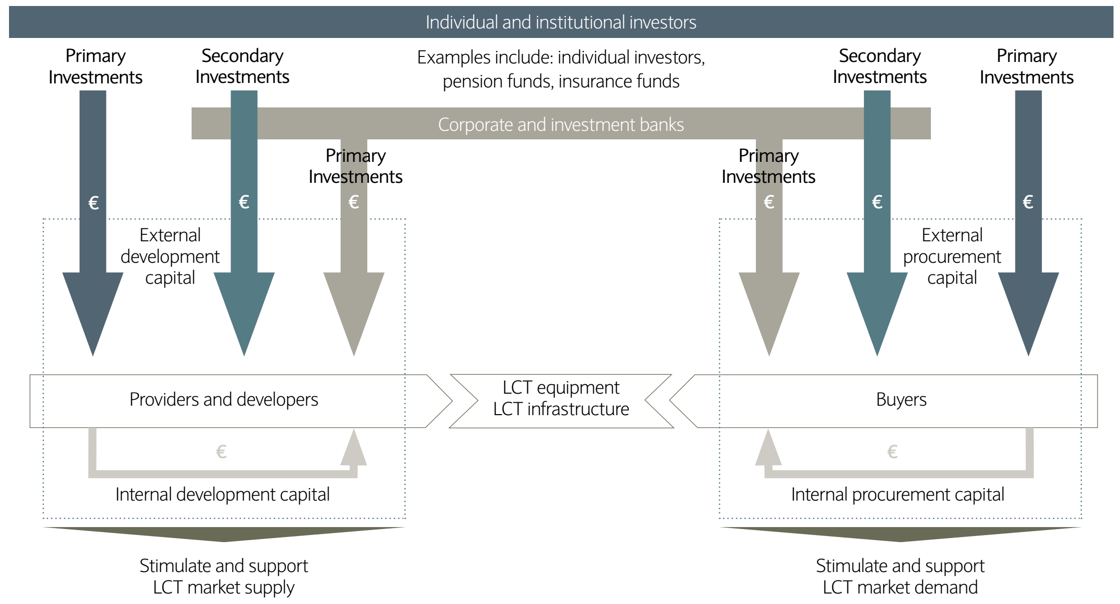
Key messages:

- Capital associated with financing the operations (R&D, production and commercialization) of companies developing LCT is defined as development capital.
- Capital associated with financing LCT asset procurement has been defined as procurement capital.
- This distinction is essential, as both streams will need to be stimulated differently to create market supply and demand for LCT equipment and infrastructure.
- Average transaction sizes involved in development capital including IPOs, bridge financing, mezzanine financing, junior debt and senior debt are lower than those in other sectors, creating demand for bespoke financial products and services.

In this report, LCT financing is segmented between Development capital and Procurement capital. Development capital includes banks providing equity and debt, for example to a company whose products or services are core to the LCT value chain. Procurement capital refers to financing the purchase and installation of LCT assets. Both streams address different entities and are considered distinct for the purpose of this study (Figure 6).

Both streams will need to be stimulated and supported differently to create supply and demand for LCT.

6 SOURCES OF DEVELOPMENT AND PROCUREMENT CAPITAL



Development capital

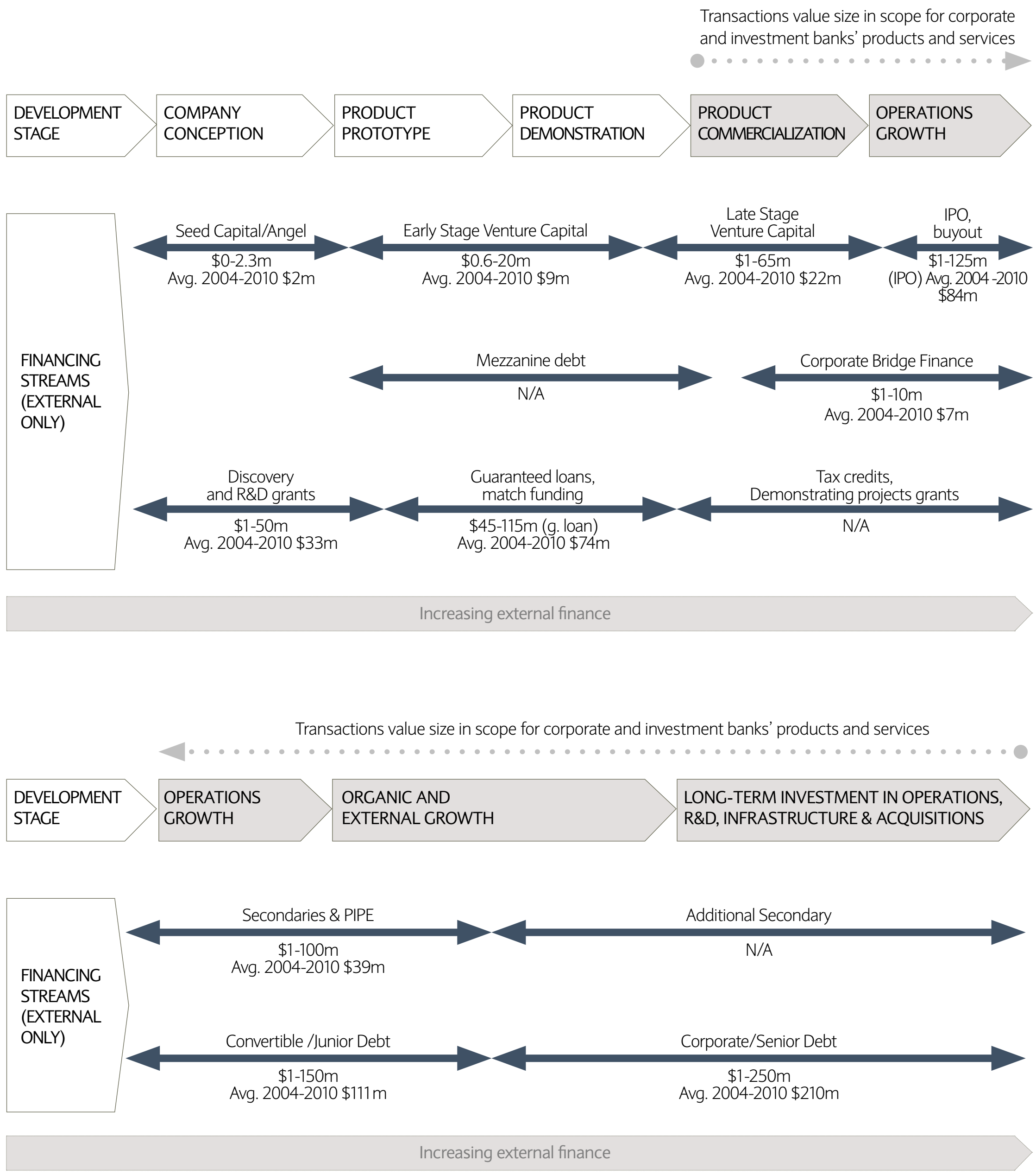
DEVELOPMENT CAPITAL IS necessary to drive innovation, product enhancement and operational efficiency in LCT.

In general, development capital only attracts interest from corporate and investment banks when companies reach growth stage, i.e. commercializing products for the mainstream market. Earlier financing streams rely on venture capital and private equity investment primarily from dedicated companies (examples include Carbon Trust Ventures, Emerald Technologies, SET Ventures, and others). We review the main sources of external development capital along with key financial characteristics of LCT transactions in Figure 7.

Examples of transactions include[25]:

- (France, Venture Capital): Margeriaz Energie, France-based operator of biogas power plants has raised €1.5m in a Series A funding round.
- (Netherlands, IPO): Sensata Technologies, maker of sensor and controls for alternative fuel vehicles and solar panels, raised $569m from its NYSE IPO.
- (United Kingdom, Secondary offering): Renewable Energy Generation Ltd raised £43m through the placement of new shares.
- (Spain, Corporate debt): Spanish PV manufacturer Siliken has signed a loan worth €31m with a syndicate of 10 banks.

7 DEVELOPMENT CAPITAL TRANSACTIONS



Ranges and averages of transactions segments were adjusted and derived from frequency and value of transactions, provided on Bloomberg New Energy Finance. Ranges and averages values were adjusted based on interviews with subject matter experts at Barclays and Accenture.

25 Bloomberg New Energy Finance

Procurement capital

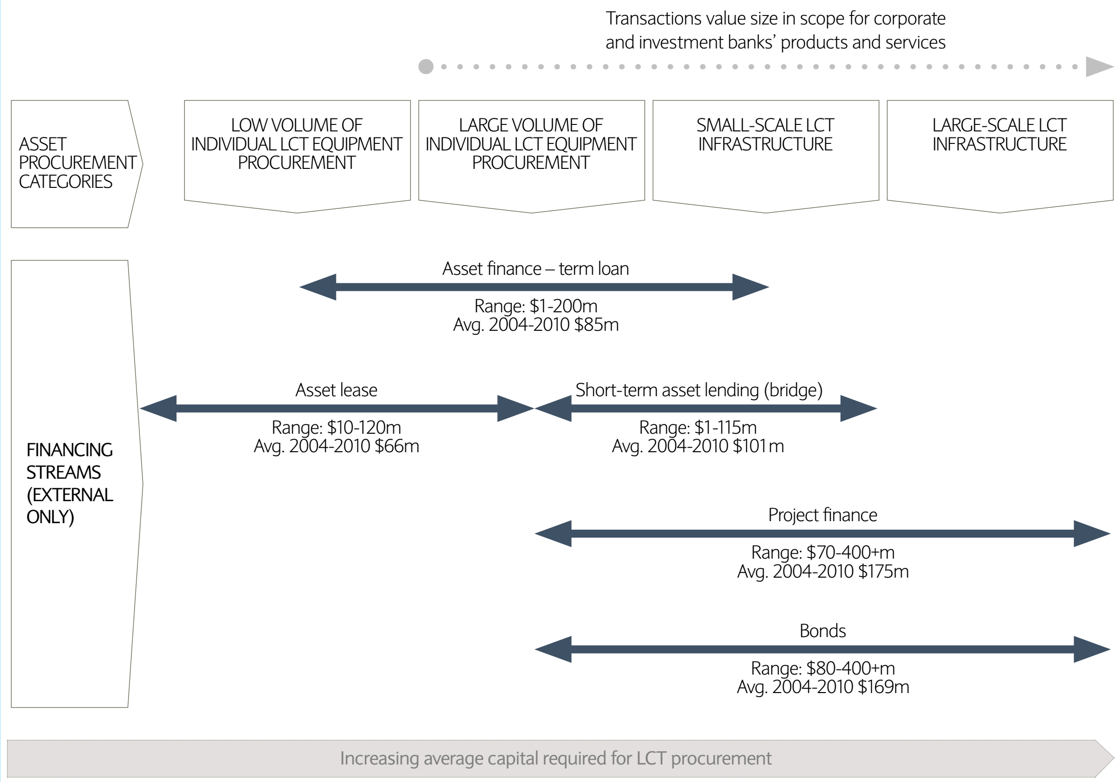
THE VALUE OF transactions in LCT procurement range from small individual investments to large project finance. Individual applications such as alternative vehicles, household PV panels and smart meters require small amounts of procurement capital compared with large renewables infrastructure projects. However, small-scale LCT can be rolled out in large volumes, either by service providers or equipment manufacturers. Examples include British Gas introducing two million smart meters between 2010 and 2012 in the UK[26], and TNT planning the roll-out of 200 electric freight vehicles[27]. Ultimately, the available funds of the buyer relative to the size of the investment needed will drive the demand for external capital.

The main sources of external procurement capital are reviewed along with key financial characteristics of transactions as they relate to the LCT sector in Figure 8[28].

Examples of transactions include[29]:

- (Portugal, Asset Finance): Novenergia II and Fotoparques Gest secured €32.55m in asset financing for the 5.3MW PV plant located in Fuente Alamo.
- (United Kingdom, Project Finance): Dong Energy has secured £250m in project finance to refinance the 630MW Phase I London Array Offshore Wind Farm.
- (Greece, Bonds): Acciona has secured €43m in bond financing from Alpha Bank for the development of the 48.45MW Panachaiko Wind Farm.

8 LCT PROCUREMENT CAPITAL TRANSACTIONS



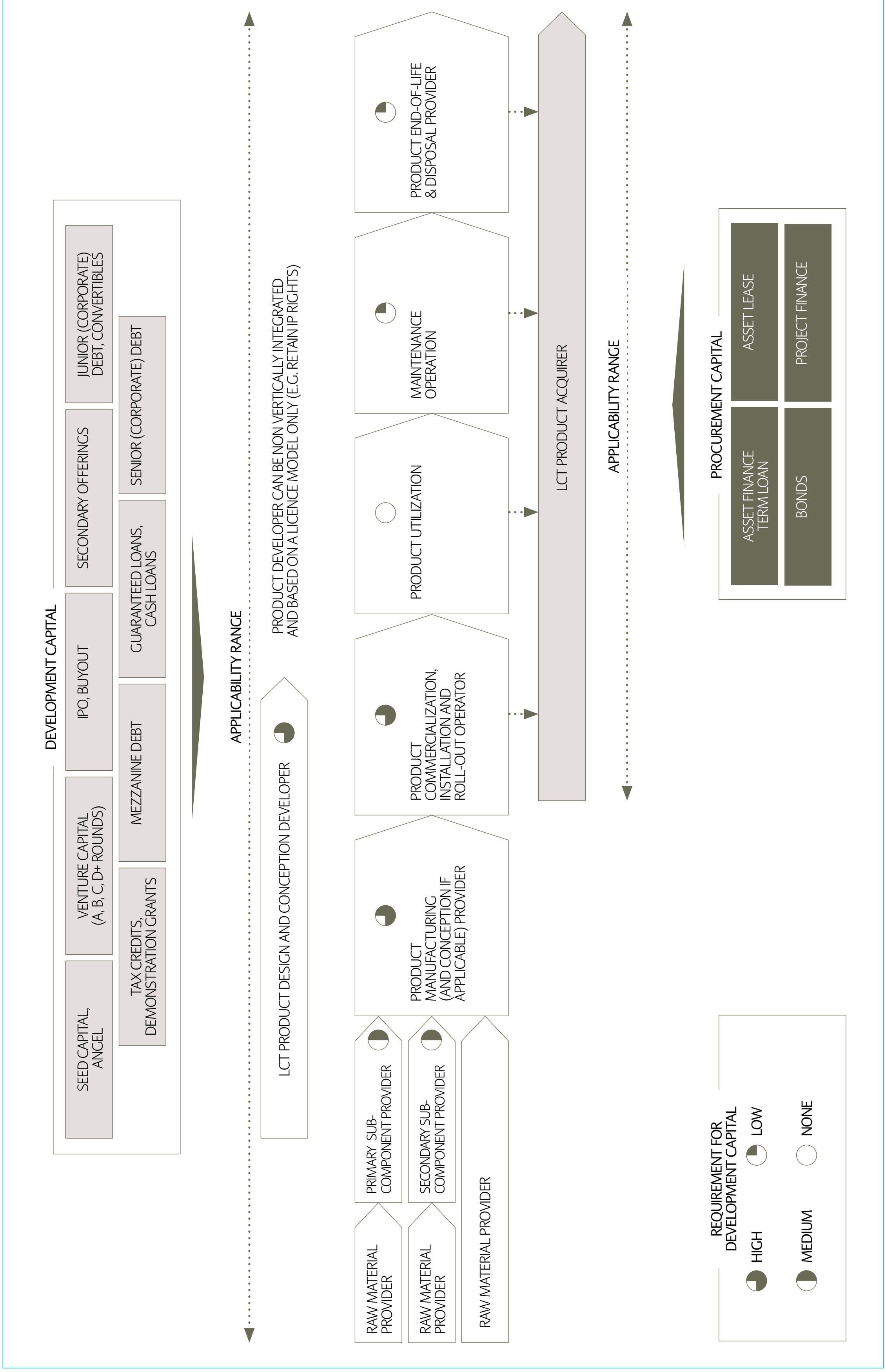
Ranges and averages of transactions segments were adjusted and derived from frequency and value of transactions, provided on Bloomberg New Energy Finance. Ranges and averages values were adjusted based on interviews with subject matter experts at Barclays and Accenture.

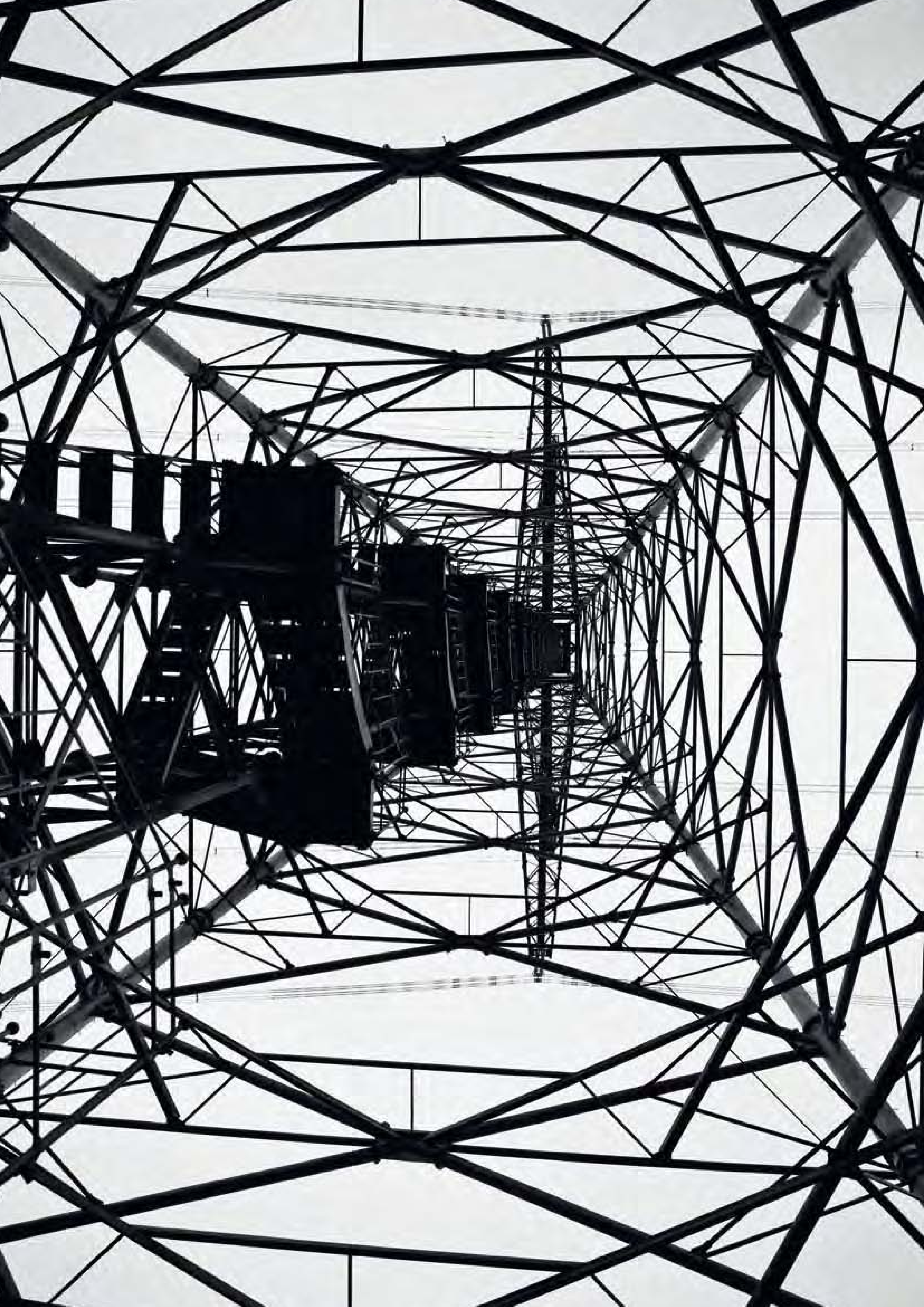
The value chain capital requirements

IT IS IMPORTANT to recognize that development capital will need to be supplied, not only to the primary LCT equipment providers but also to suppliers, service providers, manufacturers and developers which play an essential role across the LCT value chain. Procurement capital is concentrated on the purchaser of the LCT equipment or infrastructure.

26 British Gas plans two million smart meters in British homes by 2012, Centrica, March 2010
27 The "Big Orange's" Green Revolution, TNT, December 2006
28 Transactions values and examples retrieved from Bloomberg New Energy Finance
29 Bloomberg New Energy Finance

9 OVERVIEW OF THE LCT VALUE CHAIN





II
Approach

THIS SECTION DETAILS the approach taken in estimating the capital needed to deploy a range of LCT in Europe between 2011 and 2020 and the associated carbon and energy savings.

Key messages:

- We estimate the amount of procurement and development capital required for the adoption of LCT up to 2020, along with the impact on carbon and cost savings based on an s-curve adoption method.
- The study uses a demand-driven model based on a realistic adoption rate of a range of LCT applied to buildings, energy and transport up to 2020. This is supported by a number of existing forecasts and expert analysis.
- This approach differs from existing supply-driven approaches that estimate capital requirements based on adoption targets which match carbon reduction or renewables uptake targets.

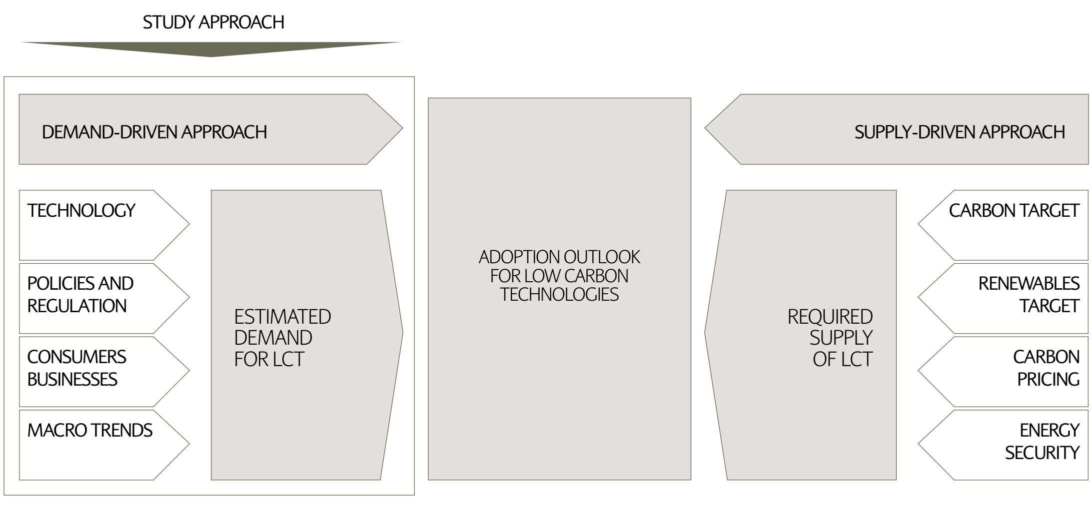
A detailed, quantitative, bottom-up approach has been developed to estimate the development and procurement capital likely to be demanded from the adoption of a range of LCT equipment or infrastructure, along with their associated carbon and energy cost savings.

Our model takes a demand-driven approach to estimate the adoption of LCT that could be achieved by 2020. This contrasts with alternative approaches based on the supply of capital required to achieve carbon reduction or renewables uptake targets[30]. The supply-driven approach risks overestimating capital requirements and may not be granular enough to permit identification of financing streams.

30 Roadmap 2050, A practical guide to a prosperous, low-carbon Europe, Technical Analysis, European Climate Foundation

How the approaches differ:

10 OVERVIEW OF THE STUDY'S MODELLING APPROACH



Applications and geographical scope

Selected commercially viable applications

LOW CARBON TECHNOLOGIES come into many areas including power generation, manufacturing, energy production, transport and buildings. We focus on commercially viable LCT for:

- Buildings.
- Electricity distribution.
- Electricity production.
- Transport vehicles.
- Transport infrastructure.

Nearly 40 different types of LCT equipment and infrastructure were evaluated (Appendix I) taking into account their probable market size by 2020, capital intensity and average number of LCT units acquired by the buyer (i.e. by the end or intermediate entity acquiring LCT). From this, 15 commercially viable and capital intensive technologies with a high requirement for external capital, were selected for detailed evaluation. For the purpose of this analysis, nuclear power, carbon capture storage and other applications not listed in Appendix I were excluded.

The detailed list is presented in Figure 11.

Geographical scope

ALL THE LCT equipment and infrastructure identified have been investigated on a per country basis for all EU25 countries. In addition, large-scale renewable power infrastructure (wind, solar, geothermal and biomass power) has been investigated on a global basis for the following countries:

- US.
- Canada.
- EU25.
- India.
- China.
- Japan.
- Australia.

Analysing the capital requirements of renewables infrastructure on a global scale is essential in order to understand the magnitude of the challenge faced by developers and buyers looking to secure financing.

An advanced modelling approach based on an s-curve adoption method

THE STUDY METHODOLOGY uses the following steps (additional details provided in Appendix II):

1. Identifies a selection of commercially viable and capital intensive LCT equipment and infrastructure (list in Appendix I).
2. Identifies and segments the applicable market into relevant sub-sectors (e.g. urban vs. rural or commercial vs. private).
3. Calibrates the 2011-2020 adoption rate of LCT in its applicable market based on historical and expected adoption rates.
4. Defines procurement cost of LCT.
5. Defines development capital associated with each technology based on sector analysis.
6. Identifies the energy consumption to be reduced by the technology.
7. Defines energy efficiency gains made by the technology from benchmark analysis.
8. Defines the energy price and carbon emissions factor for the energy source.
9. Calculates the following metrics:
   a. Procurement capital.
   b. Development capital.
   c. Carbon savings[31].
   d. Energy cost savings[31].
10. Links procurement and development capital to specific financing streams.

31 Carbon and energy cost savings may not be applicable to all LCT applications: e.g. e-vehicle charging infrastructure does not lead to direct energy cost savings nor carbon savings

11 LCT EQUIPMENT AND INFRASTRUCTURE SELECTED FOR THE STUDY

Sector	Category	Sub-category	No.	Equipment / infrastructure
BUILDINGS	BUILDING EQUIPMENT RETROFIT	Smart building – LCT equipment retrofit for commercial buildings	1.1	Micro-combined heat and power units (micro-CHP)
			1.2	Next generation LED lighting
			1.3	High efficiency HVAC cooling & heating system
			1.4	Integrated building management systems (BMS) for lighting, heating, cooling control & automation
	BUILDING CONSTRUCTION AND DESIGN	Smart building – Integrated solution for new commercial buildings	2.1	Smart buildings (new builds)
	DECENTRALIZED POWER UNITS	PV solar panels for decentralized power generation for households	3.1	PV electrical solar panels
ELECTRICITY DISTRIBUTION	ELECTRICITY TRANSMISSION & DISTRIBUTION	Smart grid infrastructure – Advanced control and management of electricity grid	4.1	Monitoring & control of electricity transmission and distribution infrastructure
			4.2	Demand & supply management infrastructure for electricity transmission and distribution automation and control
	ELECTRICITY CONSUMPTION	Advance metering infrastructure for electric smart meters (AMI with AMM meters)	5.1	Advance metering infrastructure for electricity consumption to optimize loading
			5.2	AMM Smart Meter roll-out to provide advanced consumer electricity monitoring functionalities
ELECTRICITY PRODUCTION	LARGE-SCALE POWER INFRASTRUCTURE	Large-scale wind power generation	6.1	Offshore wind power
			6.2	Onshore wind power
		Large-scale geothermal power	7.1	Geothermal power
		Large-scale biomass power generation	8.1	Waste to energy
		Large-scale solar power generation	9.1	Concentrated solar power – thermal (CSP)
			9.2	Photovoltaic solar power (PV)
TRANSPORT INFRASTRUCTURE	LARGE-SCALE TRANSPORT INFRASTRUCTURE	e-vehicle charging infrastructure	10.1	e-vehicle high-voltage charging stations (mix of large stations and pylons)
			10.2	Distributed energy storage units to reduce peak demand on grid loading
		Intelligent transport system infrastructure	11.1	Intelligent urban traffic system for traffic control
TRANSPORT VEHICLES	COMMERCIAL VEHICLES	Alternative fuel light commercial vehicles	12.1	Plug-in hybrid vehicles
			12.2	Electric vehicles
			12.3	Bio-ethanol vehicles
			12.4	Bio-diesel vehicles
			12.5	CNG fuel vehicles
	PUBLIC TRANSIT VEHICLES	Alternative fuel public transit vehicles	13.1	Electric vehicles
			13.2	Bio-ethanol vehicles
			13.3	Bio-diesel vehicles
	COMMERCIAL FREIGHT VEHICLES	Alternative fuel freight vehicles	14.1	Electric vehicles
			14.2	Bio-ethanol vehicles
			14.3	Bio-diesel vehicles
	SEA VESSELS	New design and fuel-efficient container freight sea vessels	15.1	New design and fuel-efficient container freight sea vessels

THIS METHODOLOGY IS applied to each country, where all applicable markets are country-dependent, and takes into account a number of specific factors such as the cost of electricity in a particular country.

A worked example of the model for smart meters in Germany is presented in Appendix II.

The model encompasses many factors to ensure accurate estimates of capital requirements, carbon abatement potential and possible cost savings between 2011 and 2020. The s-curve method is the fundamental principle used to reflect the changing adoption rates central to demand for LCT.

The most important characteristics and assumptions used in the model are:

- Quantifying the size of the applicable market for LCT.
- Defining the adoption outlook through an s-curve calibration.
- Integrating the technology cost learning curve.
- Anticipating the evolution of electricity grid emissions intensity.
- Incorporating in-depth technology understanding.
- Factoring the total cost of asset procurement.

Quantifying the size of the applicable market for LCT

ALL APPLICABLE MARKETS (e.g. electricity production for renewable or vehicles sold per year for alternative vehicles) are retrieved on a per country basis. This method ensures that factors specific to individual countries are taken into account. An example is electricity prices which differ substantially by country – e.g. France's commercial electricity price was 35 per cent less than the UK's in 2009[32].

Each market is divided in as detailed a way as possible to only retain the most relevant segments (e.g building retrofits differs from commercial, industrial and private usage).

The growth of each market (absolute size) has been calculated based on empirical business as usual CAGR.

Defining the adoption outlook through an s-curve calibration

THE RATE AT which this new technology is likely to be adopted is the most sensitive parameter in defining its potential market. The industry experts we interviewed agreed with a calibration of the adoption rates along with a review of existing forecasts and of several regulatory, technology, macro-economic and consumer drivers. This helped shape an outlook for the LCT market up to 2020 at a European level and on a per country basis where possible.

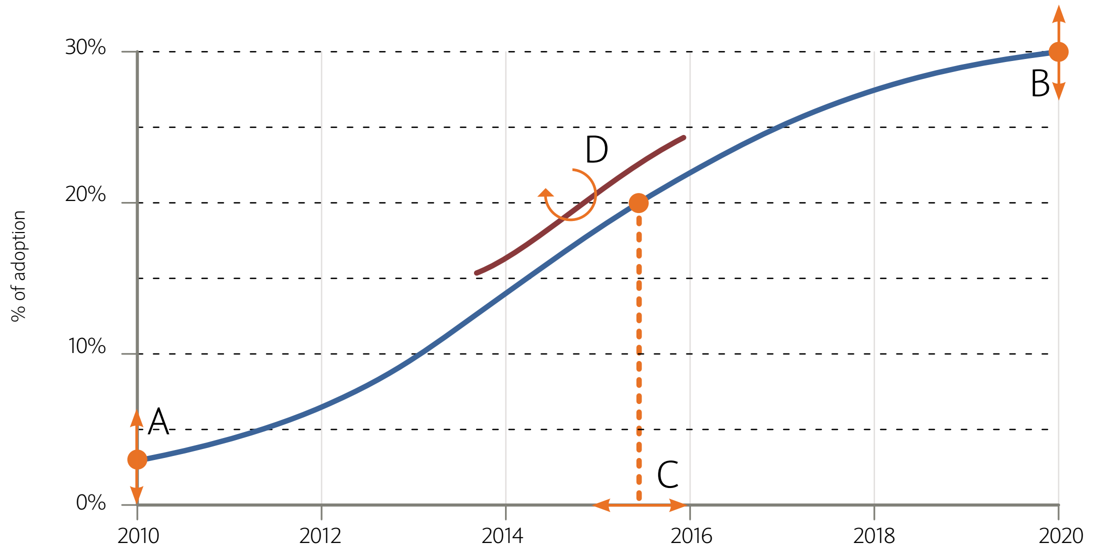
A standard four-point s-curve methodology (Figure 12) was used to calibrate the adoption rate of LCT based on their respective applicable markets.

- 2010 level of adoption (parameter A).
- 2020 level of adoption (parameter B).
- Year where 50 per cent of the 2010-2020 adoption is achieved (parameter C).
- Rate of adoption at point C year (parameter D).

For renewables, existing adoption rate forecasts were taken from well-established sources such as Enerdata's POLES[33,34] model to calibrate the 2020 adoption level. Barclays' equity research short- and medium-term forecasts for wind and solar power[35] were also used to calibrate the s-curve (e.g. up to year 2014).

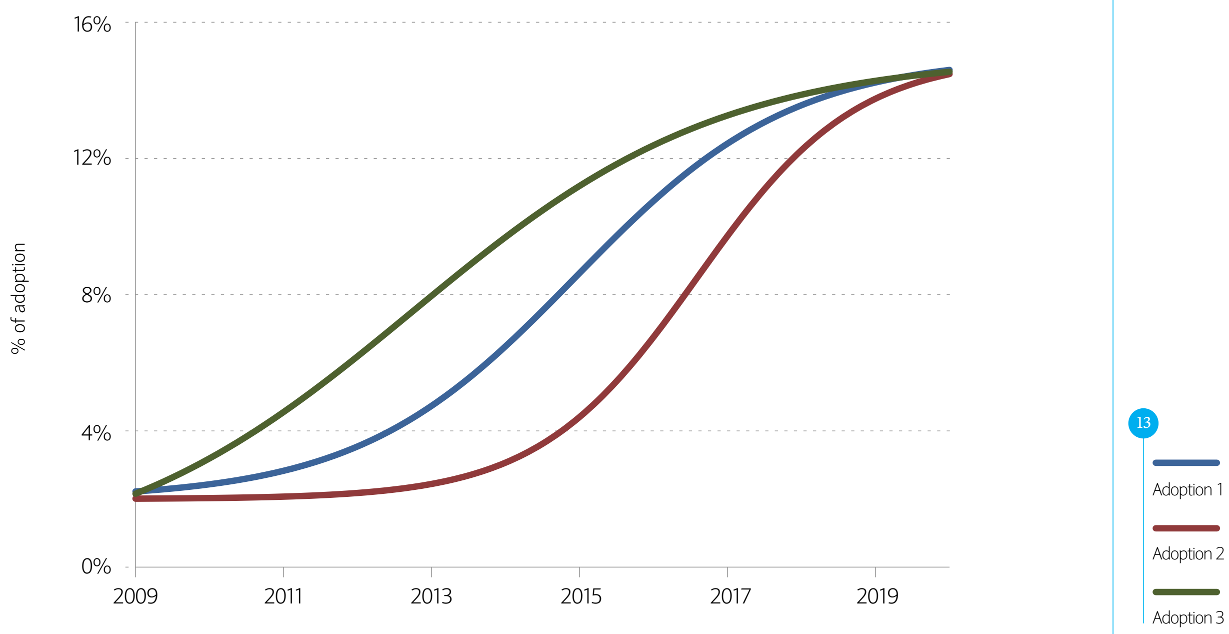
32 Derived from mid-band commercial electricity price, Eurostat
33 POLES Model, A World Energy Model, Enerdata
34 The study model has been calibrated using a base case which is an intermediate scenario generated by a linear combination of the results from the Renewal (S3) and Recovery (S1) scenarios, and which seeks to capture a world where economic recovery is confirmed, but where there is a moderate impact from climate change regulations
35 Global Wind and Solar demand forecast for 2010-2014E, 2009, Barclays

12 FOUR POINT S-CURVE ADOPTION RATE CALIBRATION METHODOLOGY



This approach allows the model to set an adoption rate for each of the different LCTs based on the existing forecast and drivers (examples of different adoption rate profiles are illustrated in Figure 13).

13 ILLUSTRATIVE ADOPTION RATE CONFIGURATIONS

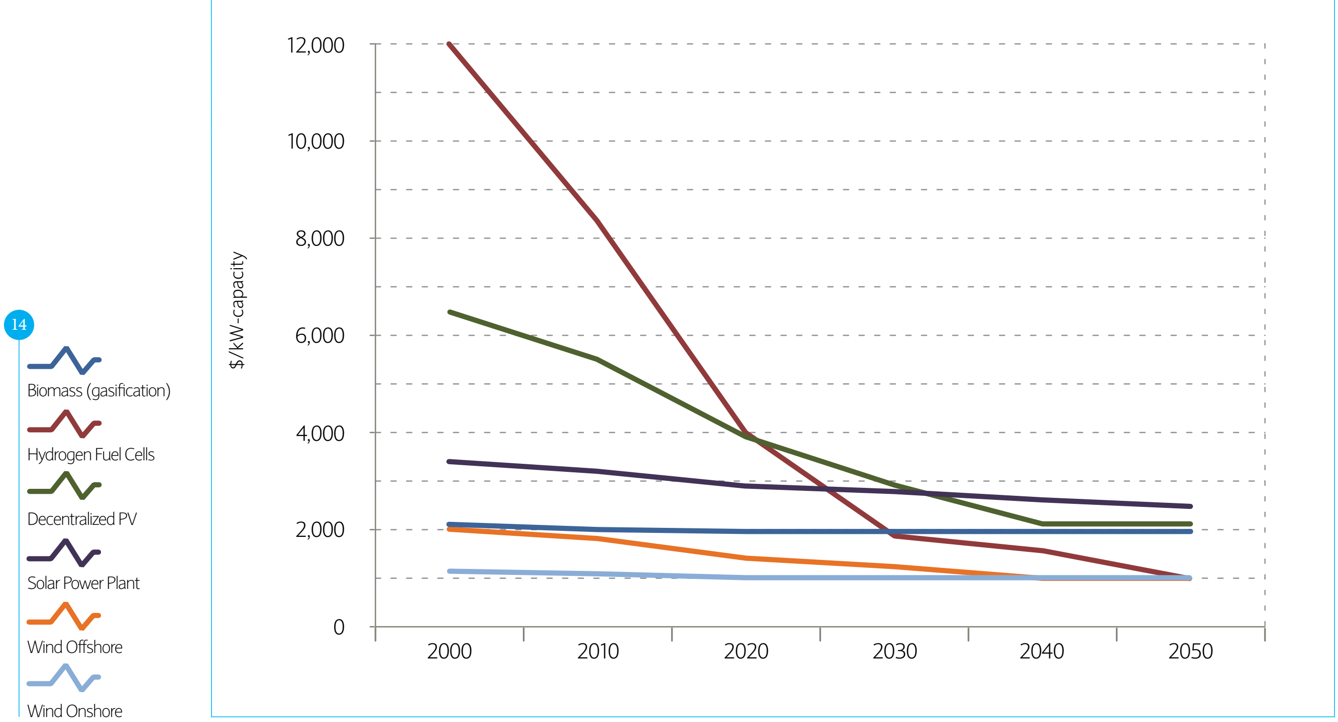


Integrating the technology cost learning curve

AS PREVIOUSLY DISCUSSED, the price of many technologies is highly sensitive to the volumes being rolled out. As more applications are produced, the unit price of the LCT will fall due to improvements in processes and other economies of scale. As many LCT products have not yet reached maturity, their cost learning curves are likely to decrease rapidly over the next 10 years. An example of how this might occur in renewables energy production[36] is outlined below. This cost reduction trend could, however, be reversed if raw materials used in LCT manufacturing were to increase substantially, e.g. price of monocrystalline silicon, polycrystalline silicon for solar photovoltaic.

This evolution of LCT cost was integrated for renewables and transport vehicles in the model to accurately size future capital requirements. All other LCT costs were assumed constant as there was no consensus on future cost evolution (more details in Appendix V).

14 COST-INTENSITY OF ALTERNATIVE POWER PRODUCTION



Anticipating the evolution of electricity grid emissions intensity

A NUMBER OF countries are undergoing significant changes in electricity production sources (e.g. installation of nuclear plants, decommissioning of coal plants). This directly impacts the average carbon emissions intensity associated with electricity consumption from the grid. For example, the UK's grid carbon emissions intensity is expected to decrease by 12 per cent between 2010 and 2015[37].

The evolution of the electricity grid emissions intensity was incorporated in the model for each country to accurately compute the emissions savings resulting from electricity consumption savings over time.

Incorporating in-depth technology understanding

TO ACCURATELY PRICE the costs of the different LCTs, experts have been engaged in each LCT area to identify the technical components of each application which determine associated costs, energy reduction impact and adoption outlook.

Accenture Smart Grid Solutions (ASGS), Accenture Smart Building Solutions (ASBS), Accenture Mobility Services (AMS), Accenture Intelligent City Network (AICN) and other groups provided in-depth technological expertise to

36 Poles world energy/technology outlook to 2030 (WETO 2030)
37 Accenture Analysis, derived from Enerdata power mix and emissions forecasts

calibrate the model based on empirical results taken from existing projects and pilots.

Pricing for smart grid technologies, for instance, was based on subcomponent pricing from live projects (e.g. SmartGridCity, Xcel & Accenture in Boulder, Colorado)[38].

For example, components included in the analysis of smart grid capital requirements included the following:

- Energy storage unit.
- Primary/secondary substation network sensing.
- Primary/secondary substation power factor equipment.
- Smart voltage control equipment.
- Primary/secondary substation fault current limiters.
- DER-based trading and risk management system.

Factoring the total cost of asset procurement

FOR ALL THE LCT analysed, the full cost of purchasing the technology was taken into account when estimating the value of procurement capital. For smart buildings (new-builds) for example, the premium attached to these buildings was added to the average cost of property construction.

The procurement capital required by LCT assets does not treat the costs of all the sub-components as separate, but simply uses the average procurement cost of the end product, excluding operational costs.

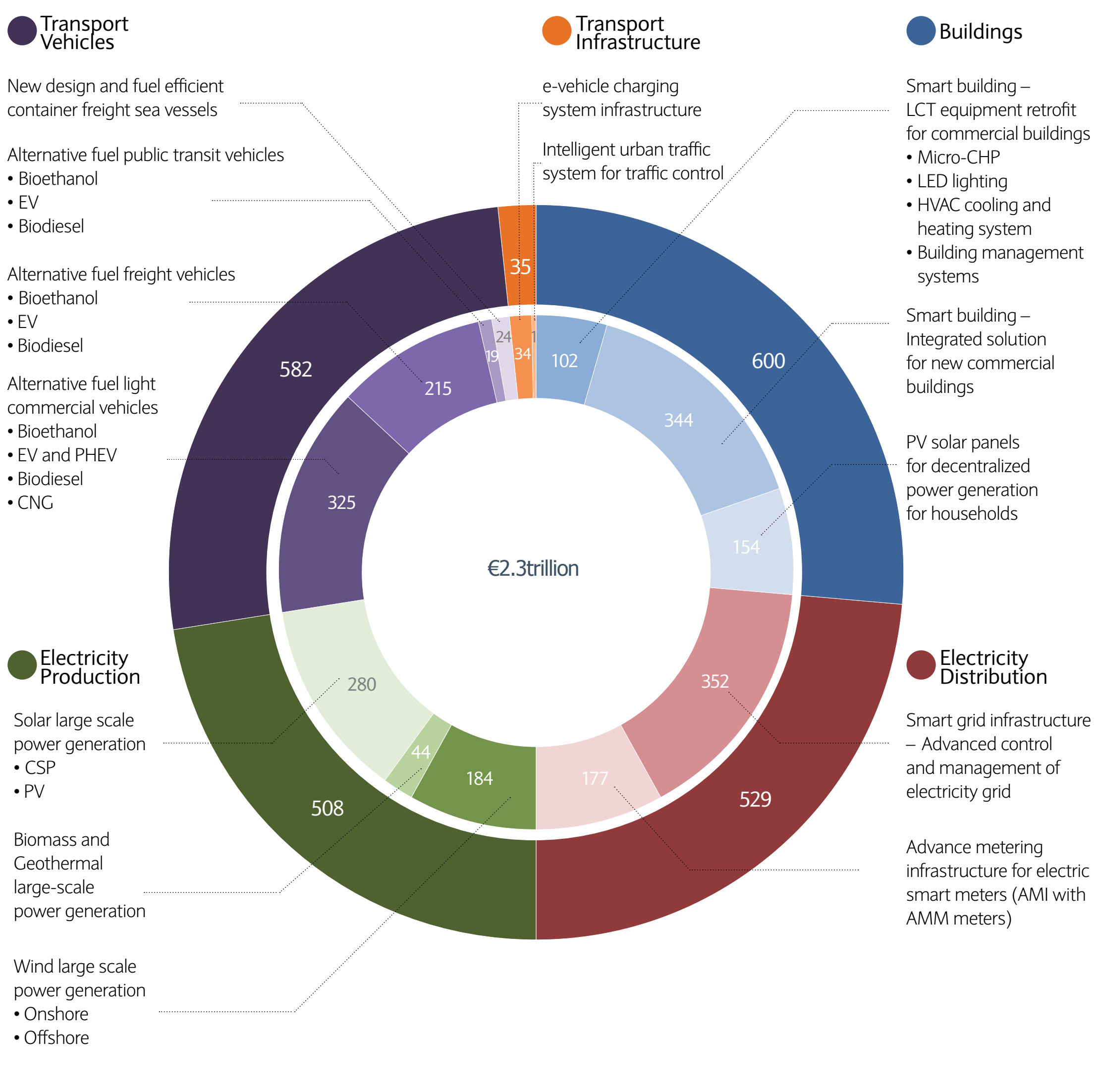
38 Helping Xcel Energy Achieve High Performance with a Revolutionary and Sustainable Smart Grid Solution, Accenture, 2008

As many LCT products have not yet reached maturity, their cost learning curves are likely to decrease rapidly over the next 10 years.

III
Capital requirements and carbon impact

THIS SECTION PRESENTS the capital requirements for LCT procurement and development in Europe between 2011 and 2020, along with the resulting energy cost and carbon savings. In addition, the section considers the impact of rolling out renewables on a global scale.*

15 CUMULATIVE PROCUREMENT CAPITAL: 2011-2020 (€BN) – EUROPE (EU25)



* *Numbers on graphs may have discrepancies due to rounding for numbers presentation only.*

Key messages:

- In Europe (EU25), between 2011 and 2020, the 15 commercially viable LCT applications would require a total of €2.3trillion in procurement capital (Figure 15) and €0.6trillion in development capital. This will enable carbon savings equivalent to 2.2 Gt CO_2e and cost savings equivalent to €261 bn.
- Solar PV power is the most expensive technology identified, requiring €365bn in funding for large-scale infrastructure and micro-generation installations. This is due to the high cost of technology (being over five times greater than that of onshore wind on a per MW-capacity basis), low production capacity, premium cost of micro-generation and high expected take-up.
- The cost of introducing renewables (wind, solar, geothermal and biomass) across Europe, China, India, USA, Japan, Canada and Australia will require investment of €2.4trillion in procurement, resulting in emissions savings of 6.6 Gt CO_2e.

Overall impact for Europe

In Europe (EU25), between 2011 and 2020, the 15 commercially viable LCT applications would require a total of €2.3trillion in procurement capital (Figure 16) and €591 bn (Figure 17) in development to be rolled out on a wide scale. This would save 2.2 Gt CO_2e (Figure 18) of carbon and energy cost savings of €261 bn (Figure 20). There are no energy cost savings to be derived from using renewables to produce electricity as these are only a substitute for other modes of electricity production.

The 15 technologies analysed require €591bn in development and €2.3trillion in procurement capital between 2011-2020, leading to carbon savings of 2.2Gt CO_2e and energy cost savings of €261bn.

15 LCT EQUIPMENT AND INFRASTRUCTURE LEGEND (FOR SUBSEQUENT FIGURES)

BUILDINGS
- Smart buildings – LCT equipment retrofit for commercial buildings
- Smart buildings – integrating LCT in new commercial buildings
- PV solar panels for decentralized power generation for households

ELECTRICITY DISTRIBUTION
- Smart grid infrastructure – advanced management of the electricity grid
- Advanced infrastructure for electric smart meters (AMI with AMM meters)

ELECTRICITY GENERATION
- Large-scale wind power generation (onshore and offshore)
- Large-scale geothermal power generation
- Large-scale biomass power generation
- Large-scale solar power generation (CSP & PV)

TRANSPORT VEHICLES
- Alternative fuel light commercial vehicles (PHEV, EV, bioethanol, biodiesel, CNG)
- Alternative freight vehicles (EV, bioethanol, biodiesel)
- Alternative public transit vehicles (EV, bioethanol, biodiesel)
- New design and fuel efficient container freight sea vessels

TRANSPORT INFRASTRUCTURE
- e-vehicle charging infrastructure
- Intelligent transport systems

Procurement capital

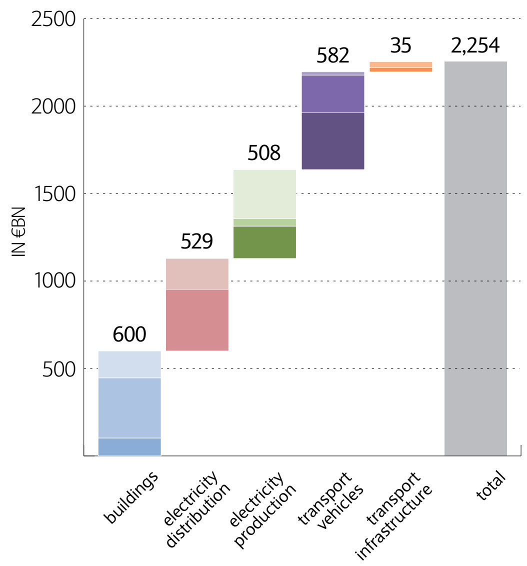
THE LARGEST SHARE of capital will be given over to buildings for retrofitting LCT equipment, constructing smart buildings and decentralizing energy production. This is due to the high cost of retrofitting buildings and the fact that smart buildings command a premium price (estimated between five to seven per cent of total construction costs). In addition, the cost of generating power from decentralized solar PV is expected to remain high, given the premium of installing roof-mounted PV over large-scale solar projects (estimated at 25 per cent[39] of non-roof-mounted PV) and the high per MW cost of producing energy from solar.

Solar PV is the most capital-intensive technology within the range of LCT reviewed, and will require up to €365bn invested in procurement. This is driven from a high cost of technology (five times more expensive than onshore wind), a low ratio of production to capacity and a high adoption rate forecast (the number of solar panels in Germany, for example, is expected to increase by 140 per cent between 2008 and 2010[40]).

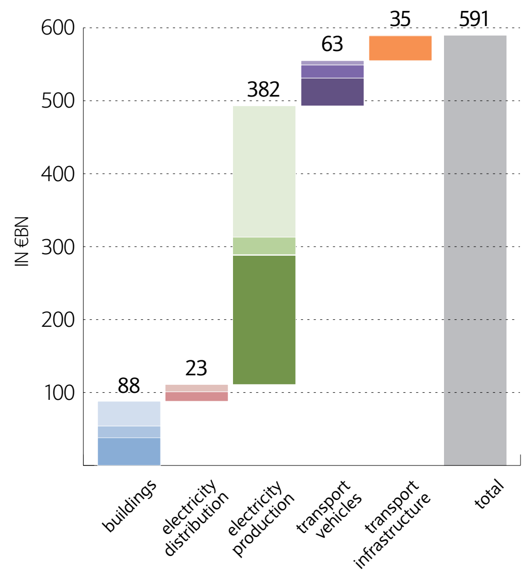
Smart grids, essential for managing intermittent power and decentralized energy production, will require €352bn in investment. The cost of smart grid infrastructure is spread across back-up electricity storage units, upgrading electricity substations, implementing central information management systems and additional network improvements.

We expect the uptake of e-vehicle charging to be concentrated in dense urban areas and estimate that €34bn will need to be invested to fund the infrastructure.

16 CUMULATIVE PROCUREMENT CAPITAL 2011-2020 (€BN) – EUROPE (EU25)



17 CUMULATIVE DEVELOPMENT CAPITAL 2011-2020 (€BN) – EUROPE (EU25)



Development capital

BASED ON AN analysis of investment in the LCT sector between 2004 and 2009 (detailed methodology in Appendix IV), alternative energy from wind and solar will require an overwhelming 66 per cent share of all development capital required by the sector.

Large IPOs of wind, solar and other diversified renewables companies will drive capital into this sub-sector. The recent IPO of Enel's renewables power division, Enel Green Power SpA raised €2.4bn and was the largest European IPO since 2008[41].

In other less mature sub-sectors, development capital will remain essential to help emerging technology to reach a more mature stage. Investment in these sectors is likely to be dominated by venture capital, private equity and initial public offerings (more details in section IV).

39 Roadmap 2050, A practical guide to a prosperous, low-carbon Europe, Technical Analysis, European Climate Foundation

40 Derived from accumulated capacity (Eurostat) and new added capacity (Global Renewables Demand Forecast 2010-2014E, Barclays Capital Equity Research)

41 Enel raised less than hoped in green IPO, Reuters, 2010

Emissions savings

SAVING 2.2 Gt CO_2e of carbon would reduce the EU's 2020 emissions to 83 per cent of the 1990 level, if subtracted from Europe's BAU projection of emissions levels (Figure 19). If additional carbon emission reductions are to be achieved in other sectors (e.g. manufacturing, other modes of transport, chemicals), the identified savings would put the EU on track to meet its 20 per cent carbon emissions reduction target.

Some 49 per cent of the emissions savings we identified are likely to originate from substituting renewables for conventional power. This is expected to save approximately 1.1 Gt CO_2e of carbon emissions.

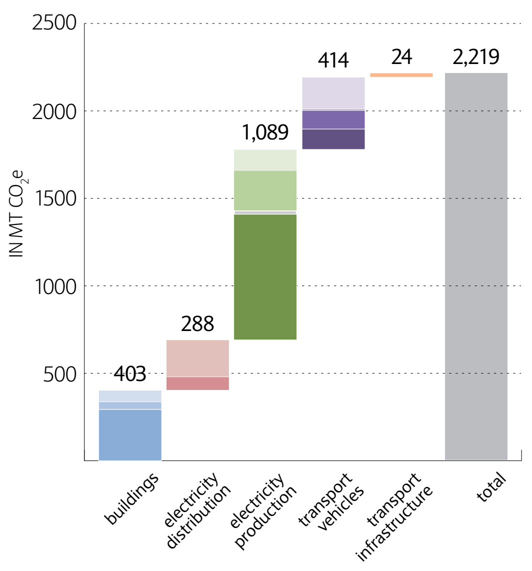
Transport and electricity distribution have a smaller impact on carbon emissions as they only influence urban congestion and network losses respectively. However, they are essential for rolling out e-vehicle charging and managing an intermittent power supply.

Alternative transport vehicles will require 26 per cent of the procurement capital and create the second source of emissions savings, with a potential abatement of 414 Mt CO_2e.

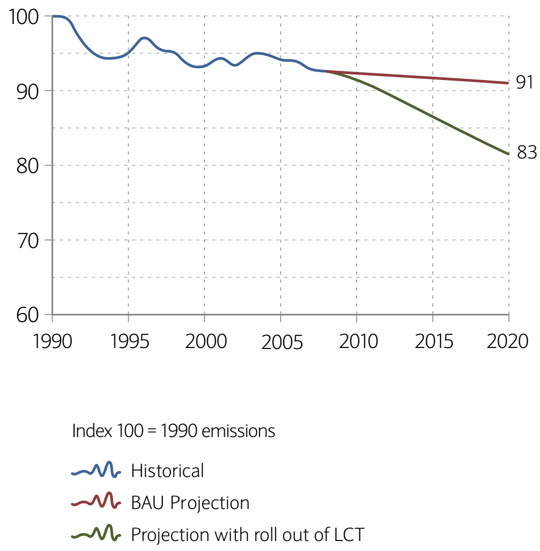
Buildings represent the third largest source of emissions savings, offering the possibility of abating 403 Mt CO_2e. This will be achieved through retrofitting buildings with energy-efficient equipment and decentralizing the power supply to reduce the amount of energy consumed from the grid.

Within transport, the replacement of existing freight sea vessels by new energy-efficient ships would create significant emissions savings, estimated at 182 Mt CO_2e between 2011 and 2020. This saving is generated for a very small procurement capital outlay, making it an extremely carbon-efficient use of capital.

18 CUMULATIVE EMISSIONS SAVINGS 2011-2020 (MT CO_2e) – EUROPE (EU25)



19 EUROPE (EU25) EMISSIONS PROFILE



Cost savings

WHEN ANALYSING LCT equipment and infrastructure, the energy cost savings for the end-user or operator were investigated in each case. For large-scale power generation from renewables, no energy cost savings were assumed as the use of renewables as a source of energy does not imply any cost savings for the end-users.

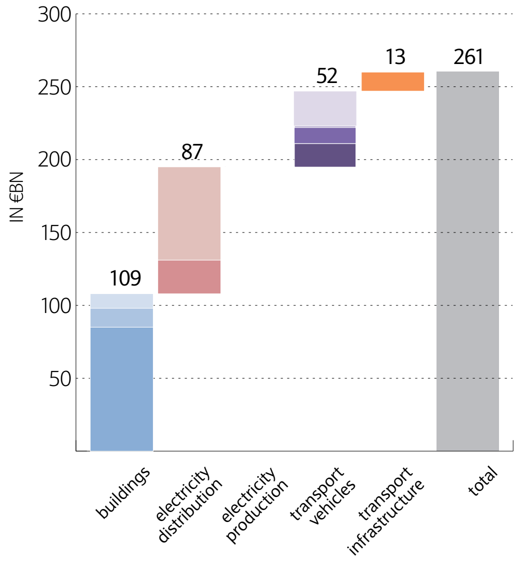
Buildings will account for 42 per cent of energy cost savings, by reducing tenants' energy consumption or substituting it with an alternative, cheaper energy source. Retrofitting buildings with LCT equipment is expected to save €85bn with the opportunity to use these savings to pay back the initial cost of purchasing the equipment. This strongly supports the business case for buildings retrofits.

Smart meters offer a significant opportunity for cost savings by improving people's awareness of their electricity consumption and motivating them to change their behaviour. We estimate smart meters could save consumers €64bn between 2011 and 2020 in Europe, 25 per cent of all cost savings identified.

Within the transport sector, alternative fuel vehicles also provide scope for cost savings. However, these are conditional on public subsidies which make alternative fuel vehicles attractive (e.g. bonus-malus scheme in France). Removal of these subsidies could remove the possibility of savings. For electric vehicles, the price of electricity can also alter the energy cost savings achievable with significant differences between countries (e.g. the average cost of electricity in France was 0.1052 €/kWh in the first semester of 2010, compared to 0.2446 €/kWh in Germany for the same period).

Lastly, we estimate that using intelligent urban traffic systems to control traffic would save €13bn. These savings derive from reducing congestion and the fuel consumption associated with it.

20 CUMULATIVE COST SAVINGS ON ENERGY 2011-2020 (€BN) – IN EUROPE (EU25)

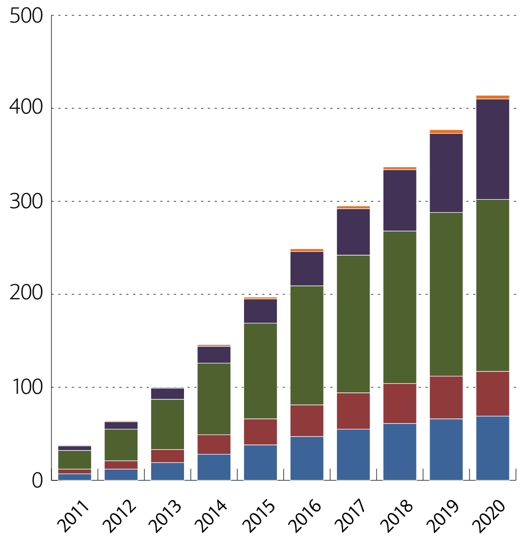


2011-2020 evolution of carbon and cost savings

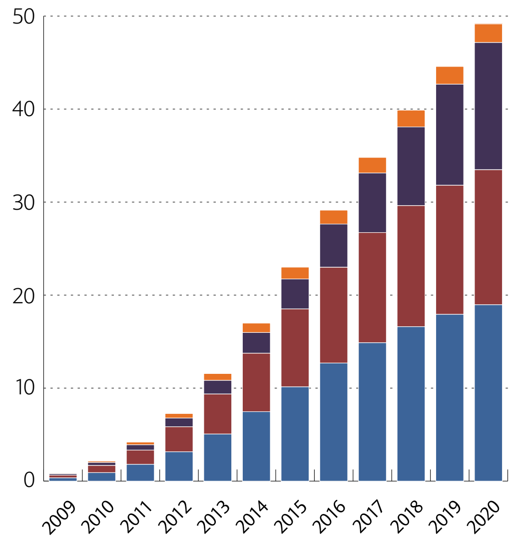
THE ADOPTION PROFILE of LCT between 2011 and 2020 will determine when specific kinds of equipment and infrastructure begin to deliver their carbon and cost savings. Certain LCT segments will begin to drive the different savings earlier than others.

Electricity production from low carbon sources is expected to drive emissions reductions in the first half of the decade as uptake is growing rapidly. By contrast, the second half of the decade is likely to see an acceleration in savings from technological advances in alternative fuel and electric vehicles as adoption becomes more widespread.

21 CUMULATIVE ANNUAL EMISSIONS SAVINGS (MT CO_2e) – IN EUROPE (EU25)



22 CUMULATIVE ANNUAL COST SAVINGS (€BN) – IN EUROPE (EU25)



21 22

- Transport Infrastructure
- Transport Vehicles
- Electricity Production
- Electricity Distribution & other equipment
- Buildings

Financing renewables: the global perspective

THE EXPECTED ADOPTION of selected renewables (wind, solar, geothermal and biomass) for the EU25 countries, China, India, USA, Japan, Canada and Australia would require €2.4trillion in procurement capital during the period 2011-2020, and would lead to a carbon abatement of 6.6 Gt CO_2e.

The overall emissions savings are significant. In the period 2011-2020 carbon emissions savings would represent approximately 10-15 per cent of the world's annual carbon emissions[42].

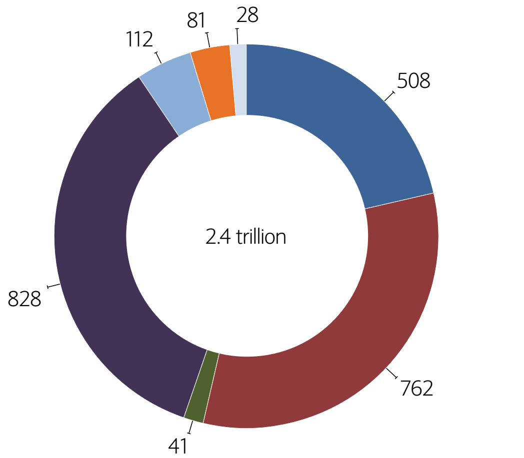
China and the United States are expected to invest more than Europe over the next 10 years. China is likely to dominate the emissions savings with a 43 per cent share, owing to its large electricity market and relatively high grid intensity (0.76 kg CO_2e/kWh in 2010). While India has a similar grid intensity, its electricity market is only a quarter of China's, historical growth in electricity production is about 50 per cent to 70 per cent of China's and the expected take-up of renewables is lower. This reduces the country's potential to lower carbon emissions: India is expected to save 0.4 Gt CO_2e compared with 2.8 Gt CO_2e for China.

Finally, the development, manufacturing and installation of renewables technology will require an estimated €1.7trillion in development capital. This is likely to create local gross value added (GVA) in countries with existing strong production capacity of LCT equipment. As China produces 30 per cent of the world's solar photovoltaic modules[43], major Chinese solar PV manufacturers are likely to benefit greatly from global increase in demand for procurement capital, along with soliciting development capital to support production scaling. Overall, the cost reduction of primary material and main components of solar PV are likely to benefit all manufacturers on a global basis.

Canada, Japan and Australia will face the same challenges in attracting investment in renewables as Europe, China or the US, although on a smaller scale in terms of the amount of investment required.

China and the United States are expected to invest more than Europe over the next 10 years.

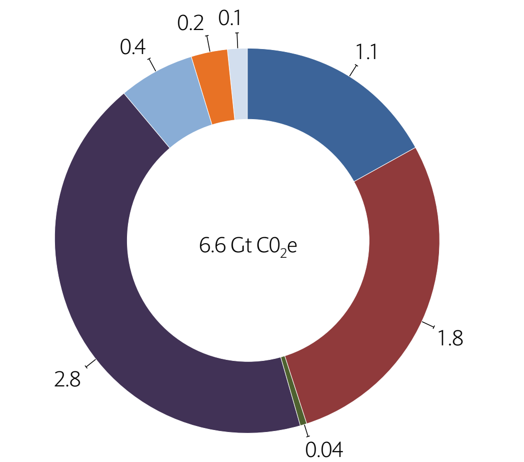
23 CUMULATIVE PROCUREMENT CAPITAL 2011-2020 (€BN)



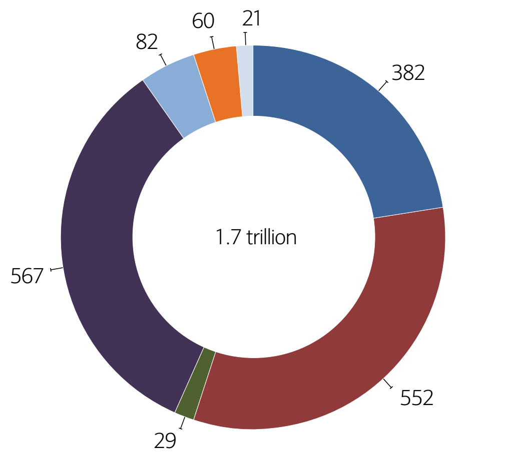
23 24 25

- Europe 25
- United States
- Canada
- China
- India
- Japan
- Australia

24 CUMULATIVE EMISSIONS SAVINGS 2011-2020 (GT CO_2e)



25 CUMULATIVE DEVELOPMENT CAPITAL 2011-2020 (€BN)



42 Derived from Supply Chain Decarbonization, Accenture and World Economic Forum, January 2009

43 Rising demand in China PV Market, Renewables Energy World, November 2009

Buildings

BUILDINGS

LOW CARBON TECHNOLOGY	OVERVIEW	APPLICATION ADOPTION INDICATOR* 2011	2020
Smart building – LCT equipment retrofits for commercial buildings	Installing smart building technologies to reduce energy consumption including: ● Micro combined heat and power units (micro-CHP). ● Next generation LED lighting. ● High efficiency HVAC cooling and heating system. ● Integrated building management systems (BMS) for lighting, heating, cooling control and automation.	0-5%	20-25%
Smart building – Integrated solution for new commercial buildings	Construction of smart commercial buildings (new-builds) which integrate BMS, high efficiency HVAC, new insulation material, LED lighting, optimal design for natural air circulation and heat convection, green roofs (where appropriate) and other embedded LCT.	5-10%	50-55%
PV solar panels – Decentralized power generation for households	Installing solar photovoltaic panels on existing building exteriors to generate electricity, some of which is used by the building and the rest sold to the grid.	0-5%	5-10%

KEY FINDINGS:

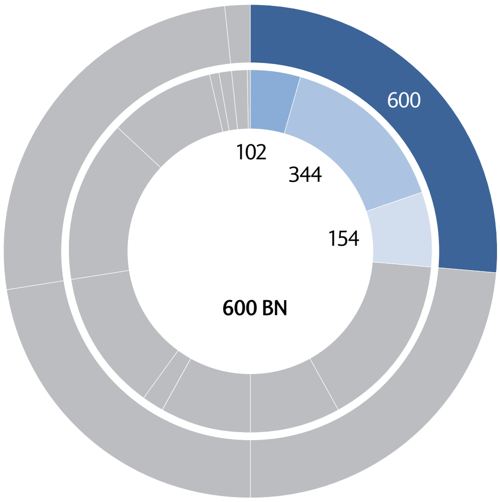
- Buildings will require the greatest amount of procurement capital: €600bn by 2020 (27 per cent of the overall total).
- The carbon emissions saved by retrofitting buildings are consistent with the level of investment required, representing 13 per cent of total emissions savings or 293 Mt CO_2e.
- Of the energy efficiency equipment to be retrofitted in buildings, LED lighting is expected to undergo rapid adoption with an expected 46 per cent of commercial buildings to be covered in 2020[44]. This is largely due to a high-cost recovery ratio and moderate capital expenditure requirements.
- We anticipate that building management systems (BMS) will also be retrofitted in many commercial properties to improve the control and integration of new energy appliances, with penetration set to reach 25 per cent by 2020[45].
- Smart design specifications for new buildings include using eco-efficient materials, optimized HVAC air circulation systems, and a range of LCT equipment (LED, micro-generation, BMS). We anticipate that these technologies will represent more than half of all commercial new-build properties past 2020, as new regulations on construction specifications are enforced across the EU[46]. €344bn procurement capital includes the total capital cost for Smart buildings, not just the "green" premium.
- FIT incentives and a sharp drop in the cost of technology (on a per kW capacity basis) will lead to widespread adoption of solar PV panels. Given the cost of roof-top panels – €11,351 for a 2 kWp household installation, solar PV for buildings represents €154bn in procurement capital – this is likely to be limited to high-income private home owners who plan to stay in their homes long-term.
- Significant energy cost savings of about €85bn will be generated from the integration of LCT retrofits in buildings. These will be achieved through reducing energy consumption from more efficient equipment and also by substituting energy sources with micro-generation. Cost savings will, however, be widely dependent on energy consumption and calibration of building management systems.
- Carbon emissions savings are expected to differ significantly by country. For example, the low carbon grid intensity of France (0.04kg CO_2e/kWh) is expected to result in a relatively low carbon emissions reduction of eight Mt. This compares to Germany where 83 Mt of savings is expected from a carbon emissions grid with a higher intensity (0.42kg CO_2e/kWh).

SELECTED EXAMPLE – BUILDING RETROFITS

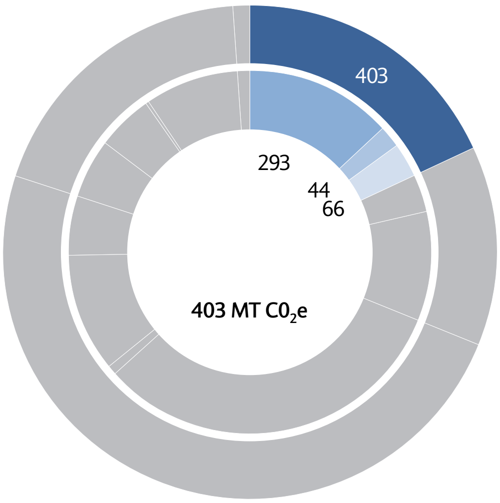
- To achieve its carbon reduction targets, the London Development Authority created the Building Energy Efficiency Program (BEEP) to focus on integrating LCT, such as energy-efficient condensing boilers, water recuperation systems, intelligent lighting and energy monitoring systems in public buildings in London (e.g. metropolitan police, universities, etc).

44 Bright forecast for LED lighting, CNET News, May 2010
45 Smart 2020: The Climate Group, 2008
46 European Union, Action Plan for Energy Efficiency, 2007

TOTAL PROCUREMENT CAPITAL, BUILDINGS, 2011-2020, EUROPE (€BN)



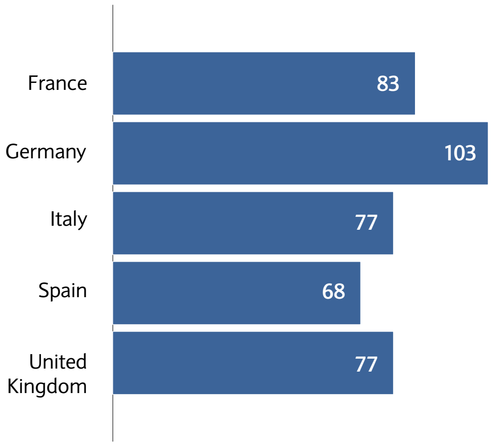
TOTAL EMISSIONS SAVINGS, BUILDINGS, 2011-2020, EUROPE (MT CO_2e)



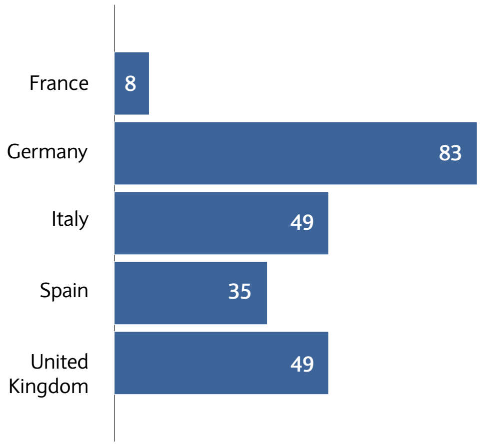
TOTAL DEVELOPMENT CAPITAL 2011-2020, EUROPE: €88BN

TOTAL COST SAVINGS 2011-2020, EUROPE: €109BN

TOTAL PROCUREMENT CAPITAL (€BN)



TOTAL EMISSIONS SAVINGS (MT CO_2e)



* PENETRATION OF LCT AS A PERCENTAGE OF THE APPLICABLE MARKET – MORE DETAILS IN APPENDIX V

Electricity Distribution

ELECTRICITY DISTRIBUTION

LOW CARBON TECHNOLOGY	OVERVIEW	APPLICATION ADOPTION INDICATOR*	
		2011	2020
Smart grid infrastructure – Advanced control and management of electricity grid	Upgrade of the electricity transmission and distribution network to automate monitoring and control of grids infrastructure equipment, including substations or power storage facilities. This in turn optimizes electricity loading, reduces network losses, better manages intermittent power sources and allows efficient integration of micro-generation.	0-5%	40-45%
Advance metering infrastructure for electric smart meters (AMI with AMM meters)	Monitoring of electricity consumption through AMM smart meters. It allows utility companies to anticipate electricity demand based on consumption data retrieved to optimize grid loading (e.g. consumption patterns, correlation with external factors such as weather). AMM smart meters also enable the end-user to optimize its electricity consumption behaviour and adjust daily consumption usage through a variable electricity tariff (if applicable) and interconnectivity between the meter and a number of smart appliances.	5-10%	80-85%

KEY FINDINGS:

- Electricity distribution will require an investment of €529bn in procurement, potentially saving 288 Mt CO_2e in carbon, 13 per cent of all identified emissions savings.
- Rolling out smart grid infrastructure will be capital intensive, requiring an estimated €352bn investment in Europe up to 2020, even though over only 40 per cent of the electricity grid is expected to be covered (i.e. in terms of number of substations included). The high capital intensity is explained by the large range of equipment that needs to be integrated into the smart grid. This includes energy storage units, primary substation network sensors, active network management systems and hardware.
- Implementing smart grid infrastructure is expected to reduce network losses (seven per cent of electricity consumption on average in EU25) through load optimization which implies carbon emissions savings of 77 Mt CO_2e. "A smart grid enables calculation and minimization of line losses by redistributing power flow and balancing current to maintain optimal balance between voltage, frequency, and reactive power" (Xcel Energy SmartGridCity™, Benefits Hypothesis Summary, 2008).
- Take-up of smart metering is currently strong in Europe. Italy is expected to reach full smart metering implementation by 2012 and consequently has a smaller capital requirement from 2011 through 2020. The EU directive on smart meter specifications and roll out[47] implies a compulsory roll-out of smart meters in all member states by 2022, with 80 per cent coverage to be reached by 2020. This is the primary driver for the large implementation plans and resulting high level of capital investment.
- Implementing smart meters allows the consumer to reduce his or her energy consumption by monitoring energy use and adapting it based on a variable tariff (ToU – Time-of-Use tariffs are used in a number of EU countries), as well as automatically through smart appliances. Smart meters are expected to save 211 Mt CO_2e in carbon emissions overall.
- Smart grids play a pivotal role in the LCT sector as they enable renewables to be rolled out on a broad scale, as well as facilitating micro-generation and e-vehicle charging. This makes smart grids responsible for a far greater share of emissions reductions than those they save directly. Smart grids will ensure stability of the grid by dynamically managing both intermittent power and abrupt peak consumption.

SELECTED EXAMPLE – SMART GRID

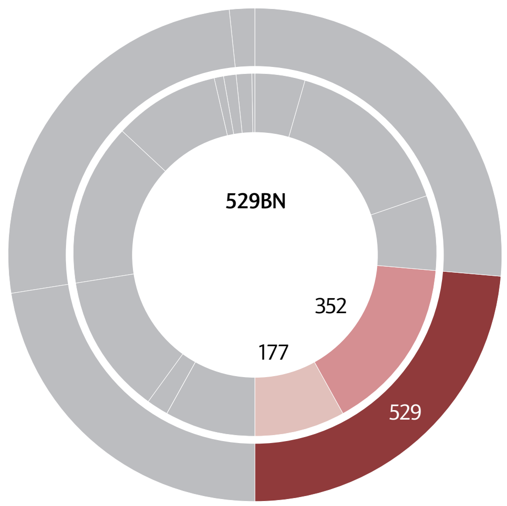
- Xcel Energy, with Accenture, has developed the SmartGridCity pilot in Colorado, US, to explore smart grid tools. Xcel Energy has implemented digital capabilities across the grid using two-way, high-speed communications. This has helped to automate the grid and, because the utility can now sense and predict energy conditions, it can proactively monitor the state of the grid and detect power outages before they occur[48].

SELECTED EXAMPLE – SMART METER

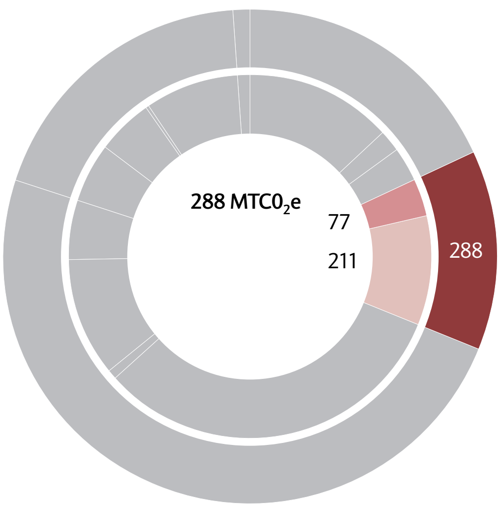
- British Gas is planning to roll out two million smart meters by the end of 2012 to improve customer interaction, reduce field engineering and maintenance, and enable consumers to change their energy consumption behaviour[49].

47 EU Derivatives 2009/72/EC and 2009/73/EC
48 Smart Grid City, smartgridcity.xcelenergy.com
49 British Gas plans 2 million Smart Meters in British homes by 2012, press release, March 2010

TOTAL PROCUREMENT CAPITAL 2011-2020, EUROPE (€BN)



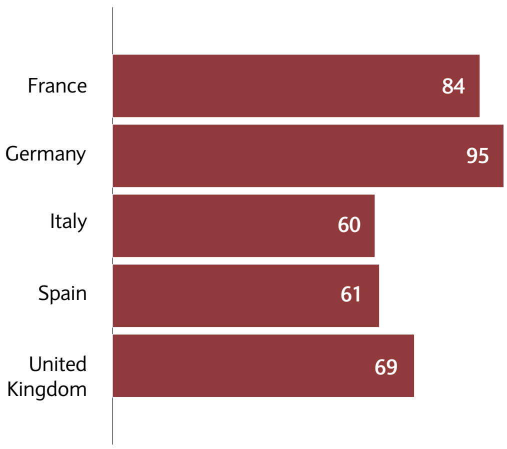
TOTAL EMISSIONS SAVINGS 2011-2020, EUROPE (MT CO_2e)



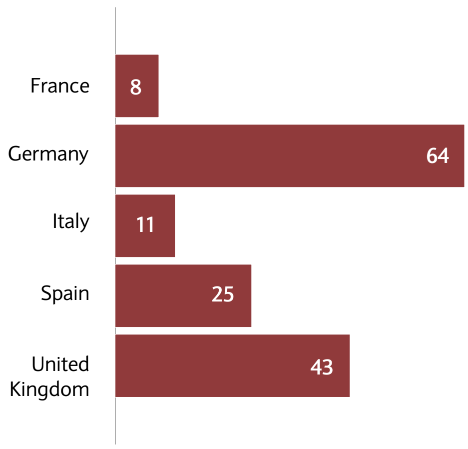
TOTAL DEVELOPMENT CAPITAL 2011-2020, EUROPE: €23BN

TOTAL COST SAVINGS 2011-2020, EUROPE: €87BN

TOTAL PROCUREMENT CAPITAL (€BN)



TOTAL EMISSIONS SAVINGS (MT CO_2e)



* PENETRATION OF LCT AS A PERCENTAGE OF THE APPLICABLE MARKET – MORE DETAILS IN APPENDIX V

Electricity Production

ELECTRICITY PRODUCTION (EU ONLY)

LOW CARBON TECHNOLOGY	OVERVIEW	APPLICATION ADOPTION INDICATOR* 2011	2020
Large-scale wind power generation	Onshore and offshore wind power on sites with installed capacity of greater than 1 MW.	0-5%	10-15%
Large-scale geothermal power generation	Production of geothermal power on sites with capacity greater than 1 MW. Geothermal power refers to extracting heat from the earth to produce electricity or heating.	0-5%	0-5%
Large-scale biomass power generation	Production of biomass power on sites with capacity greater than 1 MW. Biomass power results mainly from the combustion of items such as wood or food, which sequester carbon during their lifecycle, directly or indirectly.	0-5%	5-10%
Large-scale solar power generation	Production of both concentrated solar power and solar power PV on sites with capacity greater than 1 MW.	0-5%	0-5%

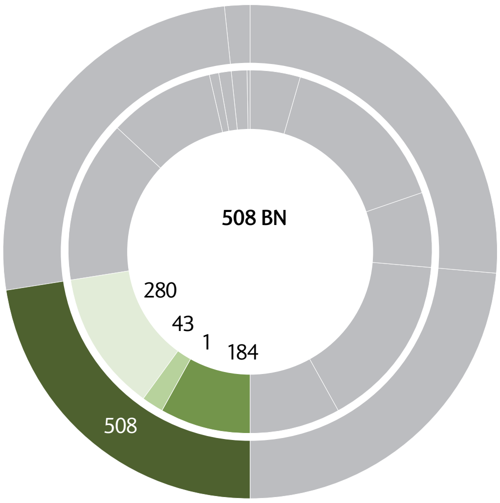
KEY FINDINGS:

- Electricity production from renewables is estimated to require €508bn in procurement capital between 2011 and 2020 whilst generating the largest share of identified carbon savings with 1,089 Mt CO_2e (49 per cent of all LCT carbon savings identified).
- The relatively high cost of solar PV and CSP power – greater than onshore wind power on a per MW-capacity basis – means it will require the greatest investment to purchase: an estimated €280bn or 55 per cent of all renewables procurement capital. The difference in cost per installed MW-capacity is also the result of PV solar's lower capacity factor of 5-15 per cent compared with wind 15-25 per cent.
- However, PV solar power's relatively small share of total electricity production and small capacity factor implies it will only substitute conventional power production in low volumes. This results in low carbon emission savings, 11 per cent of total identified savings from renewables. Although this is greatly disproportionate to the high procurement cost, PV solar power has unique operational benefits which facilitate adoption in a variety of geographical areas.
- Onshore and offshore wind power will have the biggest impact on carbon reduction, largely due to a positive outlook for adoption in a number of European countries. Projected emissions savings are 718 Mt CO_2e, 32 per cent of all LCT carbon savings, more than any other technology analysed.
- Biomass power is increasingly attracting investment and its production capacity is expected to grow rapidly in the next 10 years, although it will remain marginal compared with wind power. Similarly, geothermal power is expected to remain small requiring about £1bn in procurement capital although the potential for this energy source may increase beyond 2020.
- With rapid developments in technology and strong demand for renewable energy, investment of €382bn will need to be put into R&D, production scaling, 65 per cent of all development capital required.
- The procurement capital required for renewable power production across the large European geographies, excluding the UK ranges from €70bn-110bn per country. In contrast, the UK is expected to undertake a relatively modest roll-out of renewables for power production (three per cent for onshore wind, three to four per cent for offshore wind and less than 0.5 per cent for solar in terms of the share of total electricity production in 2020).
- In terms of carbon impact, Germany is likely to benefit the most from the substitution of its conventional coal and gas power production with renewables. This is expected to lead to significant carbon emissions savings: 289 Mt CO_2e between 2011 and 2020, approximately 12 per cent of all LCT carbon savings identified.

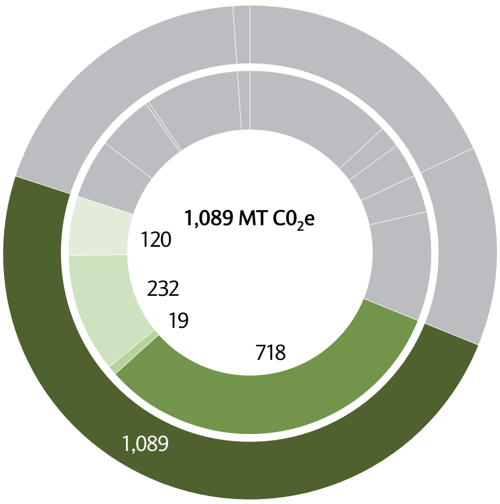
SELECTED EXAMPLE – RENEWABLES ADOPTION TARGETS

- Most European countries have targets for generating renewable energy for 2020, and action plans and incentives to achieve these targets (e.g. FIT, ROC). Below are some of the targets set out by selected EU countries: Denmark: 30 per cent, France: 23 per cent, Germany: 18 per cent, Italy: 17 per cent, Netherlands: 14 per cent, UK: 15 per cent ("Unlocking investment to deliver Britain's low carbon future", GIBC).

TOTAL PROCUREMENT CAPITAL 2011-2020, EUROPE (€BN)



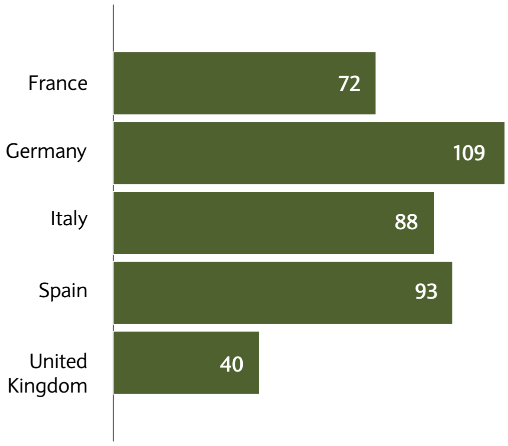
TOTAL EMISSIONS SAVINGS 2011-2020, EUROPE (MT CO_2e)



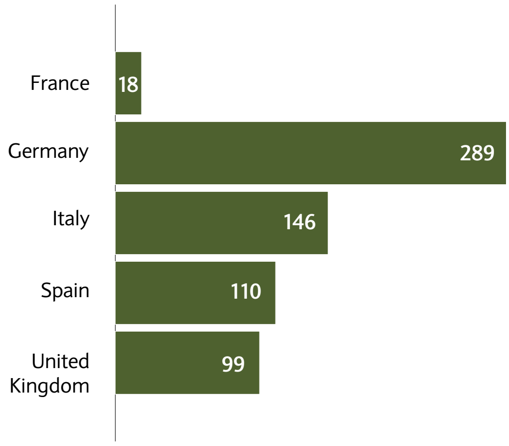
TOTAL DEVELOPMENT CAPITAL 2011-2020, EUROPE: €382BN

TOTAL COST SAVINGS 2011-2020, EUROPE: N/A

TOTAL PROCUREMENT CAPITAL (€BN)



TOTAL EMISSIONS SAVINGS (MT CO_2e)



* PENETRATION OF LCT AS A PERCENTAGE OF THE APPLICABLE MARKET – MORE DETAILS IN APPENDIX V

Transport vehicles

TRANSPORT VEHICLES

LOW CARBON TECHNOLOGY	OVERVIEW	APPLICATION ADOPTION INDICATOR*	
		2011	2020
Alternative light commercial vehicles	Substituting conventional internal combustion engine light commercial vehicles (diesel and petrol) with CNG, plug-in hybrid, bioethanol, biodiesel and electric vehicles. This is limited to light commercial vehicles with useful capacity of less than 1.5 tonnes.	0-5%	20-30%
Alternative freight vehicles	Substituting conventional internal combustion engine freight vehicles (diesel and petrol) with bioethanol, biodiesel and electric vehicles. This is limited to freight vehicles with useful capacity greater than 1.5 tonnes.	0-5%	10-20%
Alternative public transit vehicles	Substituting public transit buses with bioethanol, biodiesel and electric buses.	0-5%	15-20%
New design and fuel efficient container freight sea vessels	Substituting existing container and Roro[50] vessels with an average of 15+ years in service with a new generation of fuel efficient vessels.	10-15%	40-50%

KEY FINDINGS:

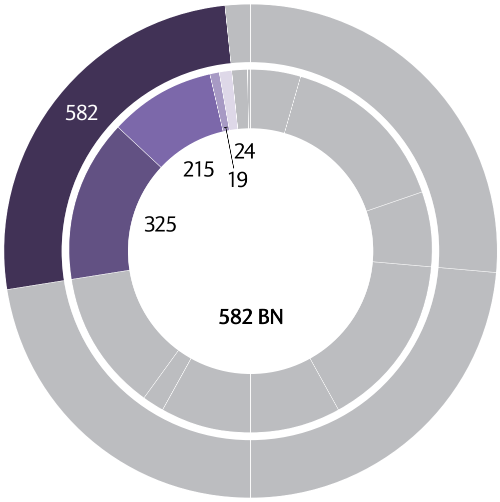
- Alternative fuel transport vehicles (commercial and public) are expected to require €582bn in procurement capital, with expected carbon emission reductions of 414 Mt CO_2e between 2011 and 2020 in Europe.
- Alternative light commercial vehicles will require the greatest share of procurement capital of all LCT transport (56 per cent) as they make up the largest volume of vehicles. Adoption of compressed natural gas (CNG), electric and bioethanol vehicles is expected to remain low while take-up of biodiesel and plug-in hybrid vehicles is expected to grow at non-negligible rates over the next 10 years, representing approximately 25 per cent and 10 per cent of light commercial vehicles sales respectively in Europe in 2020.
- Use of alternative vehicles in public transport and freight is expected to remain low. Although a number of pilot projects have been launched, these will continue to face barriers preventing wide scale adoption such as the cost of integration, maintaining fleets and operational difficulties arising from technology (e.g. battery life limiting freight routes, downtime requirements).
- Replacing ageing sea freight vessels such as container and bulk vessels with new vessels that meet energy efficiency and design standards (electric propellers, combined heat and power systems, optimal energy management systems) will require relatively little investment in procurement – €24bn – and will save 182 Mt CO_2e, or 7.5 Mt CO_2e in emissions for every billion euros invested. Although application of new design and fuel-efficient vessels in Europe is limited (the model is based on the location of ship production), replacing sea freight vessels elsewhere in the world represents a significant opportunity to make savings. The extension of environmental regulations to shipping will accelerate take-up of energy-efficient technology by ships.
- France and Germany, with their large transport sectors and high sales of freight and light commercial vehicles, represent important markets for alternative transport vehicle providers – their combined market is expected to be worth €104bn between 2011 and 2020.
- Public incentives for low carbon vehicles will help to create cost savings of €52bn. Removing these incentives (e.g. tax-rebate on biofuels or CNG) will substantially lower these cost savings and, in the worst case, remove the benefits completely.

SELECTED EXAMPLE – ALTERNATIVE ROAD TRANSPORT VEHICLES – CNG

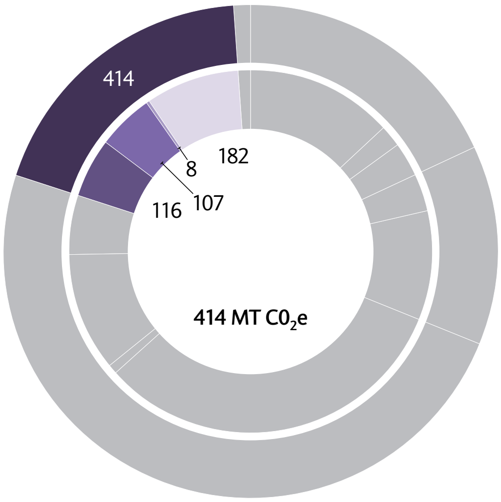
- UPS, the American freight and logistics company already has 25 hybrid diesel electric commercial vehicles in operation. UPS will expand its fleet of alternative vehicles after ordering an additional 300 CNG vehicles from Daimler's Freightliner Custom Chassis Corporation (FCCC)[51], thereby making UPS one of the world's largest operators of alternative vehicles.

50 Roro: Roll on, roll off ships
51 www.responsibility.ups.com

TOTAL PROCUREMENT CAPITAL 2011-2020, EUROPE (€BN)



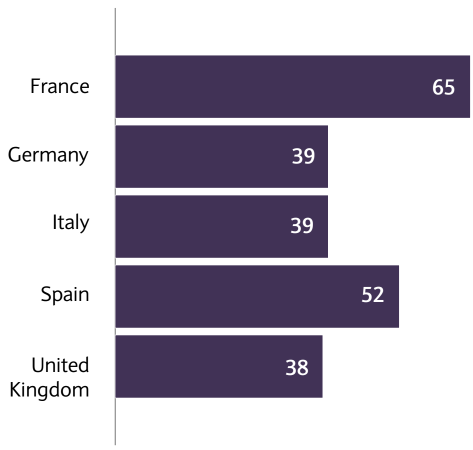
TOTAL EMISSIONS SAVINGS 2011-2020, EUROPE (MT CO_2e)



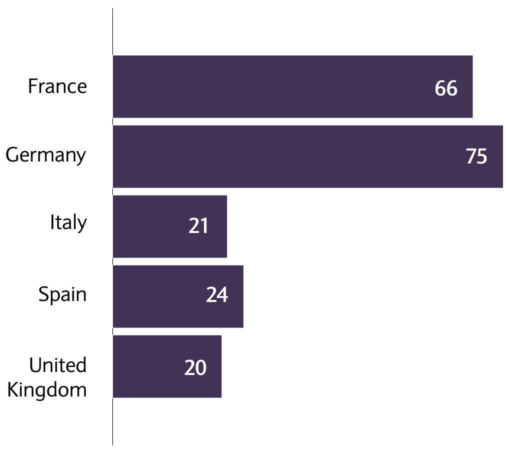
TOTAL DEVELOPMENT CAPITAL 2011-2020, EUROPE: €63BN

TOTAL COST SAVINGS 2011-2020, EUROPE: €52BN

TOTAL PROCUREMENT CAPITAL (€BN)



TOTAL EMISSIONS SAVINGS (MT CO_2e)



* PENETRATION OF LCT AS A PERCENTAGE OF THE APPLICABLE MARKET – MORE DETAILS IN APPENDIX V

Transport infrastructure

TRANSPORT INFRASTRUCTURE

LOW CARBON TECHNOLOGY	OVERVIEW	APPLICATION ADOPTION INDICATOR*	
		2011	2020
E-vehicle charging infrastructure	High voltage charging stations that allow e-vehicles to be recharged in urban areas. This includes charging poles, battery replacement sites and electricity storage units to manage peak demand.	0-5%	35-40%
Intelligent transport system infrastructure	Dynamic control of traffic routing (through traffic lights, notification boards), helps to optimize traffic and reduce congestion. This is done through traffic monitoring equipment installed along urban roads, which is connected to a traffic management platform.	0-5%	25-30%

KEY FINDINGS:

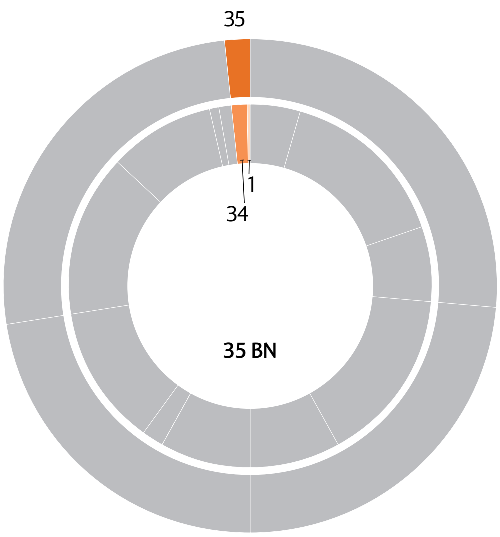
- The roll-out of e-vehicle charging infrastructure and intelligent transport systems is estimated to require €35bn in procurement capital between 2011 and 2020 for EU25.
- With ITS (intelligent traffic system) only enabling emissions savings through vehicle route and speed optimization, this transport infrastructure would lead to a modest saving of 24 Mt CO_2e in carbon emissions, with most of the benefits being operational (e.g. route or journey length). As only a small incremental improvement in vehicles' speed was taken into account, emissions savings for ITS are marginal. This could be re-assessed if additional benchmark data from large-scale implementation of ITS becomes available, which implies higher speed improvements.
- It is important to note that the increase in traffic fluidity resulting from the implementation of ITS may incentivize additional use of vehicles and lead to what is often referred to as "a rebound effect".
- E-vehicle charging infrastructure is expected to require investment of €34bn to cover 35-40 per cent of urban areas. This will comprise both high-voltage power supply stations and electricity storage infrastructure.
- With e-vehicle charging stations being introduced in large European cities (Seville has 75 stations, Barcelona 191 and Madrid 280[52]) , demand for e-vehicle charging is likely to increase drastically in the next decade. This will allow plug-in hybrid and regular electric vehicles to be adopted more widely.
- France is expected to generate the greatest investment in e-vehicle charging, as it has the largest urban area and large pilot programs in development (AutoLib). Funding the procurement of e-vehicle charging systems is expected to cost €10bn.
- Emissions savings achieved by ITS are linked to the number of passenger-km's covered by vehicles each year. This leads to a similar range of energy and carbon savings for the five major European geographies: between two and four Mt CO_2e.

SELECTED EXAMPLE – E-VEHICLE CHARGING LARGE-SCALE ROLL-OUT

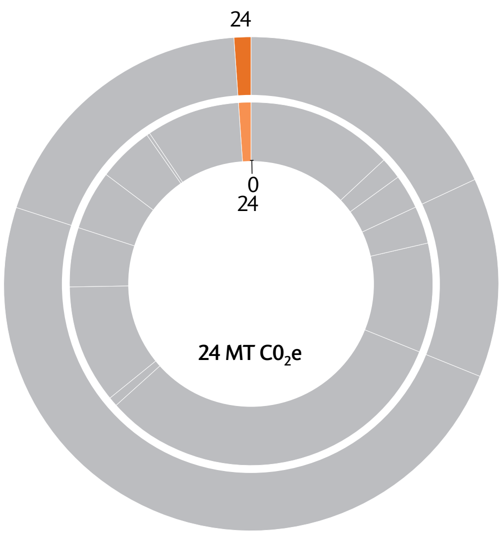
- Dutch grid companies created the e-Laad initiative to roll-out e-vehicle charging stations in the Netherlands with the aim of creating 10,000 charging points[53].
- The foundation will own the network of stations and assume the following responsibilities:
  - Electricity procurement.
  - Managing access to charging stations.
  - O&M oversight.
- The cost of installing 10,000 charging stations is estimated to be between €10m and €30m.

52 Source: Bloomberg New Energy Finance
53 Information session, R&D Projects, Foundation E-Laad.nl

TOTAL PROCUREMENT CAPITAL 2011-2020, EUROPE (€BN)



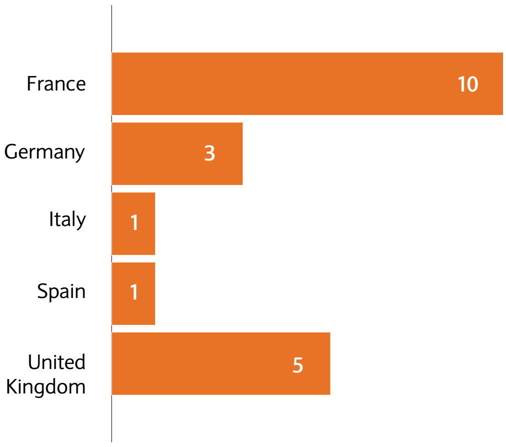
TOTAL EMISSIONS SAVINGS 2011-2020, EUROPE (MT CO_2e)



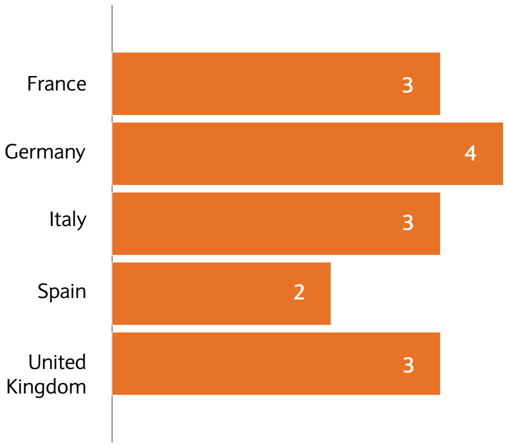
TOTAL DEVELOPMENT CAPITAL 2011-2020, EUROPE: €35BN

TOTAL COST SAVINGS 2011-2020, EUROPE: €13BN

TOTAL PROCUREMENT CAPITAL (€BN)



TOTAL EMISSIONS SAVINGS (MT CO_2e)



* PENETRATION OF LCT AS A PERCENTAGE OF THE APPLICABLE MARKET – MORE DETAILS IN APPENDIX V

Delivering a smart grid in an Intelligent City – SmartGridCity in Boulder, Colorado

IN MARCH 2008, Xcel Energy, a US-based utility company, announced its plan to create the US first SmartGridCity in Boulder, Colorado, representing the highest concentration of smart grid technology to date. Xcel Energy formed a consortium with developers, integrators and operators to bring together the best expertise available and deliver one of the world's most advanced smart grids[54].

A Smart grid allows for more efficient use of energy, enables micro-generation and much more

This pilot represents the first time that integrated smart technologies have been introduced on a broad scale, helping utilities, equipment and systems providers and customers assess the challenges and benefits of a smart grid. Most importantly, it provides a strong foundation for smart grid technology to be introduced in other cities around the world.

The objectives of the smart grid are to:

- Provide for real-time, two-way communications of electricity consumption and production data between the end-customer and utility provider.
- Enable greater monitoring and automation of the electricity transmission and distribution networks.
- Deliver real-time information on electricity sources, tariffs and consumption to customers.
- Enable remote fault identification on the network and mend faults automatically.
- Provide data on the environmental impact of electricity consumption.
- Integrate different sources of electricity generation (wind, solar, plug-in hybrid electric vehicles).

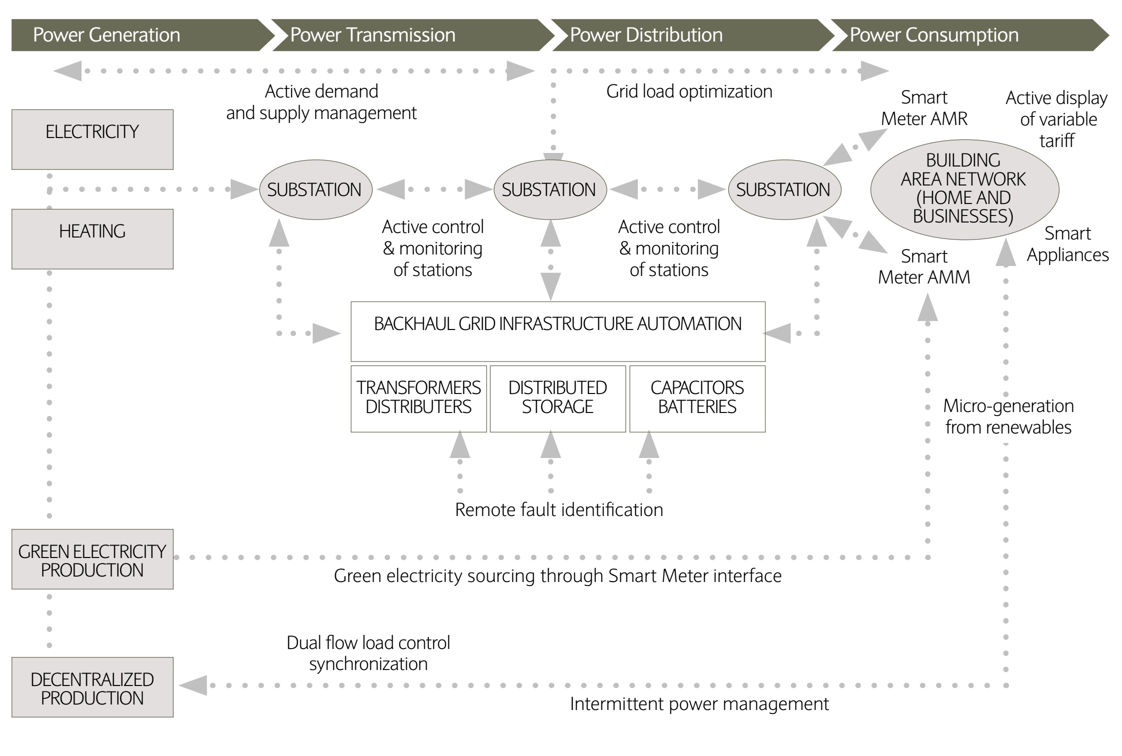
The smart grid went live in the summer of 2009 and is connected to nearly 47,000 premises throughout the city.

Xcel partnered with Accenture to help it manage the high volumes of data arising from the smart grid and integrate all the technological components into one infrastructure.

Accenture's role is to manage complex data extracted from the electricity grid to allow both Xcel and the end-customer to benefit fully from the range of smart grid technology in a real-time environment.

54 Xcel Energy SmartGridCity™, Xcel Energy, Accenture

26 OVERVIEW OF SMART GRID



IV Financing LCT development and procurement

THIS SECTION INVESTIGATES the different financing streams that will support the provision of development and procurement capital for low carbon technologies considered in the report.

Key messages:

- Of the €2.3trillion of procurement capital required, an estimated 73 per cent will be funded externally by entities purchasing LCT equipment or infrastructure, with most of this external funding being provided by corporate and investment banks, either directly or acting as intermediaries.
- The provision of primary debt through asset leases, asset finance – term loans and project finance debt will apply to an estimated €1.4trillion of procurement capital, representing 61 per cent of the total investment required for purchasing LCT.
- Equity provision to support the growth and development of LCT providers, originating from public equity Initial Public Offerings (IPO), Private Investments in Public Equity (PIPE), expansion capital and venture capital equity is expected to provide €348bn in development capital – 59 per cent of the total development capital required. Remaining development capital will originate from debt, mainly composed from mezzanine, junior and senior corporate debt.
- Both equity and debt underwriting (IPOs and bonds respectively), intermediated by banks, would provide public market access to capital estimated at €97bn and €147bn respectively.

Analysing existing capital flows to forecast future growth

Channelling €2.3trillion of procurement capital and €0.6trillion of development capital in Europe between 2011 and 2020, represents a major financing challenge as well as a significant opportunity if supportive policy frameworks, reduced technology risk and investor appetite combine to create a favourable environment for deploying capital to this space.

Financing the procurement of LCT infrastructure and equipment will be taken from both internal sources (on balance sheet) as well as external sources. Development capital, excluding capital re-invested from a company into R&D, will be provided only by external sources.

In an attempt to provide a more granular view of the different capital flows into the sector, we have analysed existing transactions derived from the database owned by Bloomberg New Energy Finance, one of the most comprehensive available. Details on the methodology used to provide the analysis here can be found in Appendix III and IV. Based on this approach, this section provides an analysis of the expected split between different equity and debt funding sources over the next decade. With the caveat that future capital flows will depend on a range of factors including policy frameworks, technology development and the macroeconomic environment, the analysis here provides an illustration of how the European low carbon transition could potentially be financed over the next decade.

Barriers to capital provision

THE INFLOW OF capital to the LCT sector, while significant, remains markedly below the minimum level we expect will be necessary to achieve wide-scale adoption of LCT in Europe. The Stern report[54] had estimated that one per cent of global GDP would be required annually to address climate change. This value is expected to be higher for developed countries but, taking this as a minimum requirement, it represents €164bn annually for Europe or approximately €1.6trillion between 2010 and 2020. In contrast, the Green Investment Bank Commission estimates that £550bn[55] would be required by the UK only to achieve its 2020 carbon reduction targets, implying higher investment requirements.

54 Stern Review on the Economics of Climate Change, 2006

55 Unlocking investment to deliver Britain's low carbon future, Green Investment Bank Commission, June 2010

The *Financial Times* recently estimated that about €1 trillion would be required from utilities to meet EU targets for renewables only, up to 2020[56] (the EU has a 20 per cent target for renewables roll-out which includes biomass, hydro, wind and solar[57]). This would need to be added to investments in transport, heavy industries and buildings to achieve the desired EU 20 per cent carbon reduction target in 2020[58].

The investment required to effect energy diversification towards a lower carbon energy mix and increase energy efficiency is enormous due to the high capital intensity of many low carbon technologies.

Currently, many of the energy alternatives are not competitive on a cost basis with fossil fuels. As a result, government policies will need to continue to provide incentive frameworks until technology costs drop and become cost competitive. In Europe, feed-in-tariffs have been used successfully to grow domestic clean energy markets in countries like Germany, but as we discuss later, Spain's recent changes to its incentive regime provide a clear reminder of the importance of policy stability in driving investment.

Venture Capital has invested in some potentially transformative technologies which have not obtained the large level of funding necessary to develop on a commercial scale. This funding gap is sometimes referred to as the "the valley of death", and also needs to be addressed in order to bring these emerging technologies to market.

There are significant barriers that are preventing capital provision at the levels required across the whole spectrum of financing sources, from early-stage company developing innovative technology, through to large infrastructure assets with mature technologies such as onshore wind. Three of the most significant barriers are reviewed here:

- Policy uncertainty.
- Restrictions on capital lending.
- Technology uncertainty.

Policy uncertainty

THE PUBLIC SECTOR has invested heavily in LCT at both local and national levels. In the $537bn European stimulus package set out in 2009, $54bn, or 10 per cent, was allocated to "green" initiatives and infrastructure[59].

Governments around the world are increasing their budgets for environmental and climate change mitigation measures. In the US, $12.3bn of the American Recovery & Reinvestment Act has been allocated to energy efficiency initiatives in cities, and support innovative technology[60]. In India, a new coal levy aims to raise $535m a year to fund a National Clean Energy Fund[61].

China has set aside an impressive 34 per cent share of its $649bn stimulus package to "green" investments, demonstrating an increasing commitment to environmental measures[62]. The International Monetary Fund intends to create a $100bn "green fund" by 2020 to meet the financial needs identified at the COP15 conference in Copenhagen[63].

Local governments have also pushed for faster procurement of LCT by rolling out schemes. Examples include The Amsterdam Smart City initiative in the Netherlands or the RE:FIT program developed by London[64].

However, stability and long-term public commitment of LCT incentives (FIT, guaranteed loans, tax-credits) and carbon policies (carbon tax, and emissions reduction commitments), whilst critical, are yet to be achieved.

National governments are under pressure to reduce sovereign debt, which has led to drastic cutbacks in public spending, impacting on LCT investments.

Following very rapid growth in solar investment, the Spanish government reduced subsidies by 20 per cent in 2008 on solar power, and introduced a cap on the maximum total capacity to be installed per year. The results were a sharp drop in solar PV investments in Spain in 2009 compared to 2008[65]. This illustrates how policy and incentive frameworks must be carefully designed to manage demand for renewables power without creating market instability.

Faced with increasing budget constraints, Spain had considered further reductions in subsidies for future investments, and unsettled the market by discussing retroactive change to existing subsidies, which were factored into financing for solar panels in previous years. However, the government decided not to implement retroactive reductions to previous fixed Feed-in-Tariffs. In 2011, the tariff regime will be adjusted quarterly based on demand in the previous quarter. With investment payback calculated on periods of 15 to 20 years, retroactive changes of subsidies or policy instability more generally can present a significant risk for renewable investments, and increase the perceptions of policy risk amongst investors.

In the short-term, incentives are essential to ensure investment in LCT is viable, although the sector will become less dependent on incentives in the medium- to long-term. FITs in France have been set up to provide an eight per cent IRR over 15 to 20 years for investments in solar-PV[66]. Without the FIT, the high cost of investing in PV solar panels would not make it commercially viable.

Furthermore, the recent economic downturn reduced the demand for carbon permits in regions with emissions trading schemes (ETS). Recent drops in the carbon allowance (EUA) price to €13 in March 2010[67] on the EU ETS have provided poor incentives for large industries and the power sector to fund alternative energy infrastructure or equipment. As investments often have long-term pay-back periods, the absence of a view on the long-term carbon price further limits LCT investments.

56 Resources: The power bill arrives, FT, February 2010
57 Renewable Energy Roadmap, EU Commission, January 2007
58 Section 22, Council of European Union Presidency Conclusions, 12 December 2008
59 From green stimulus to green austerity?, HSBC Global Research, April 2010
60 The Stimulus Plan: How to Spend $787 Billion, The New York Times, February 2010
61 India to Raise $535 Million From Carbon Tax on Coal, Bloomberg Businessweek, August, 2010
62 From green stimulus to green austerity?, HSBC Global Research, April 2010
63 Financing the Response to Climate Change, IMF, March 2010
64 RE:FIT, London Development Agency
65 Spain keeps subsidies for existing solar power plants, Bloomberg News, November 2010
66 Investing in Climate Change 2009, Deutsche Bank, October 2008
67 ECX EUA Futures Contract: Historic Data 2010, European Climate Exchange, 2010

Restrictions on capital lending

GOVERNMENTS HAVE BEEN encouraging aggressive lending targets for banks to support economic growth, e.g. SME lending targets. However, at the same time, banks are also under intense pressure to reduce risk and build their deposit base in order to ensure there is enough capital to satisfy new or anticipated regulations.

The requirement for banks to improve Tier 1 capital, which will increase under Basel III, is likely to limit balance sheet lending further (e.g. primary junior or senior debt, leases).

New regulations may also prevent banks from investing directly in private equity and numerous other types of privately offered funds. This is likely to restrict banks' ability to fund the development of early stage LCT companies. In the US, the Dodd-Frank Wall Street Reform and Consumer Protection Act will restrict investment in private equity and venture capital funds[68].

In addition, the absence of secondary markets for LCT project finance debt has restricted the capital provision from private investors and institutions (excluding direct lenders such as corporate and investment banks). For example, asset-backed securities or bonds, which allow investors to access secondary markets, make up less than three per cent of LCT asset financing[69].

The roll-out of LCT is often fragmented and unstructured, with many small-scale projects each requiring funding, rather than a small number of large-scale projects. This means that it is often not viable for large corporate and investment banks to provide finance. However, transactions involved in both large and small projects require similar resources to conduct regulatory, technical, commercial and financial due diligence. This has filtered out a number of proposals. Financing the retrofitting of energy-efficient and micro-generation equipment in buildings, for example, is often highly fragmented with the additional difficulty of the assets being often attached to the properties in which they are installed. Several European cities are struggling to achieve sufficient critical mass in their retrofit programmes to attract private sector finance.

Technology uncertainty

THE COMPLEXITY AND relative immaturity of LCT increase the risk attached to investing in it. Investors require the financial return on investment (from, for example, Power Purchase Agreements (PPAs), reduction in energy consumption) to be guaranteed over the often long timeframe required to match anticipated pay-back periods.

The revenue streams associated with LCT are more complex to estimate than those of traditional technologies. This increases uncertainty of the assets' performance and so heightens the risk associated with long-term cash flows. General intermittent power output from renewables makes revenue streams more uncertain, which in turn increases the investment risk. Onshore and offshore wind power, for example, is highly affected by weather conditions. Fitch recently downgraded the Breeze Finance bond which finances a number of wind farms in Germany. This was the result of actual performance being lower than original forecasts: energy production during 2009 was 12 per cent and 19 per cent lower than the P90 and P50 forecasts initially made[70]. Similarly, the power generated by solar PV can fall below estimates: the average capacity factor[71] of installed solar PV in Italy was 5.1 per cent in 2008[72], less than a third of the 14 per cent theoretically achievable for the country under normal conditions[73].

The projected energy savings from installing LED lighting or building management systems are also difficult to guarantee (e.g. they can be affected by the behaviour of the building's occupants and lead to a "rebound" effect as costs are reduced). Uncertainty in energy-saving measurements has been addressed through protocols such as the International Performance Measurement & Verification Protocol (IPMVP)[74].

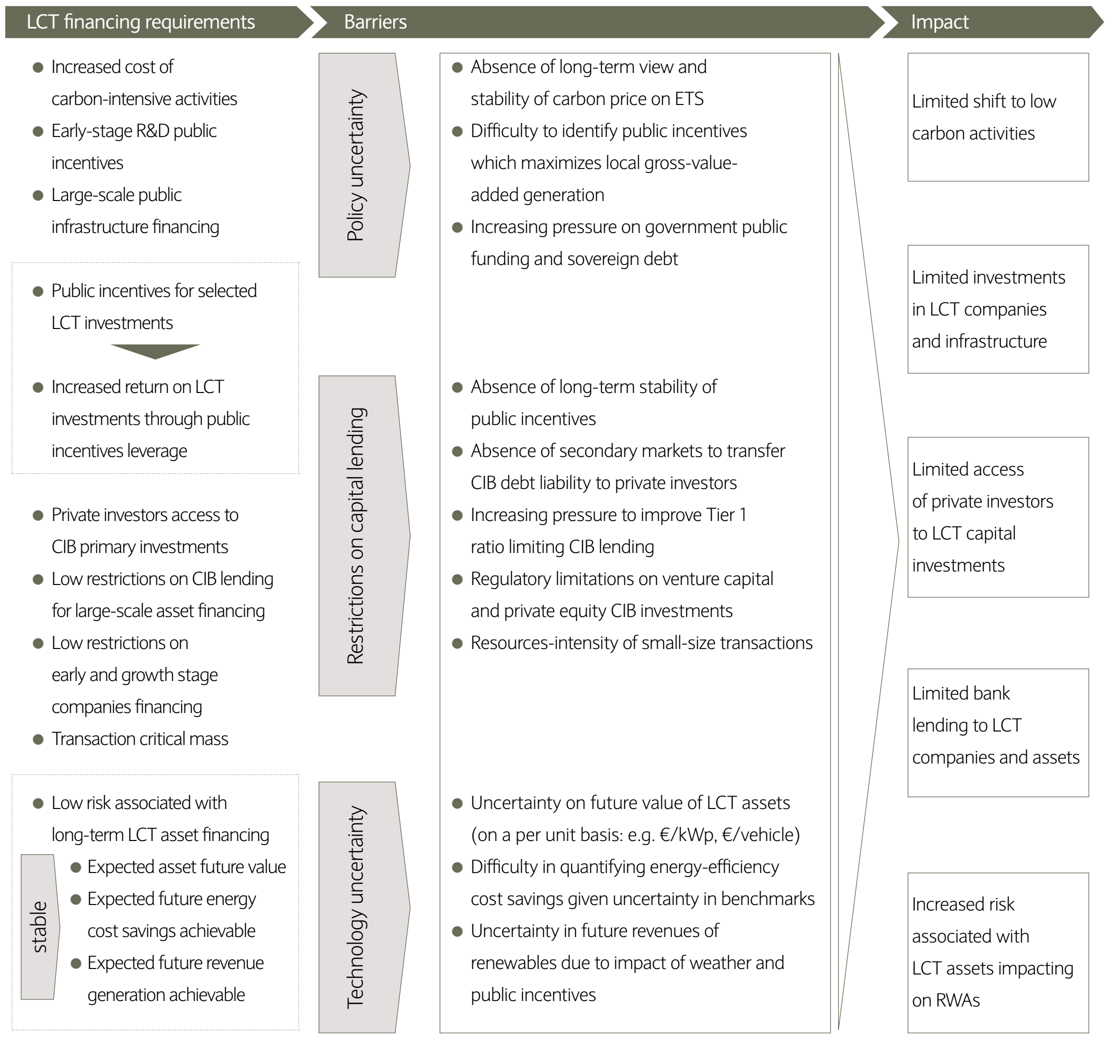
Uncertainty around revenue generation and cost reduction of LCT will increase the risk in investing.

LCT is a largely maturing sector. Accordingly, it is difficult to estimate the future asset value solely based on the asset's lifespan and its performance. The rapid change of LCT procurement and implementation cost over time compared to its useful output (e.g. €/kWh for renewables, €/km for vehicles, €/hours-in-operations for building retrofits applications) can drastically reduce over time. This will add further uncertainty to the future value, further complicating asset-based financing decisions. The extreme example is fuel-cell-enabled power (€/kW) which is expected to drop by more than 55 per cent between 2010 and 2020[75].

The complexity and relative immaturity of LCT increase the risk attached to investing in it.

68 Dodd-Frank Wall Street Reform and Consumer Protection Act, The Library of Congress, February 2009
69 As presented on Figure 5: Capital raised to fund LCT assets ($bn) in Europe between 2004 and 2009 by financing stream
70 Fitch downgrades Breeze Finance SA's Notes; Outlook Negative, Dow Jones, April 2010
71 Capacity factor defined as: MWh produced/MW-capacity x number of days per year x 24h
72 Eurostat, derived from installed capacity and production output
73 Geographical Information System (GIS) software, PVGIS, JRC, European Commission
74 International Performance Measurement & Verification Protocol, IPMVP.org, March 2002
75 TECHPOL database, European Commission World Energy Technology Outlook – 2050

27 THE BARRIERS OF LCT FINANCING



LCT is a largely maturing sector. Accordingly, it is difficult to estimate the future asset value solely based on the asset's lifespan and its performance; a key requirement to secure financing.

Development capital

THE STUDY QUANTIFIES the development capital raised by companies that produce and develop the 15 low carbon technologies analysed in the report (details on the methodology in Appendix IV)[76]. It then identifies and quantifies the financing streams relating to development capital, based on the demand for LCT in Europe between 2011 and 2020.

Primary equity provision from early and growth stage venture capital to PIPE, IPO and private equity can be expected to raise €348bn, the largest share of development capital required and 59 per cent of the total. As the majority of LCT companies are still at growth stage, most investments will be in the form of equity, not debt.

Debt finance represents €243bn (41 per cent of total development capital) and is composed of junior (subordinated) debt, senior debt, mezzanine debt and corporate credit facilities. Corporate debt makes up the largest share of debt financing, representing €182bn (76 per cent of total) which will mainly be used to fund capital spending on logistics, manufacturing and sales for LCT developers.

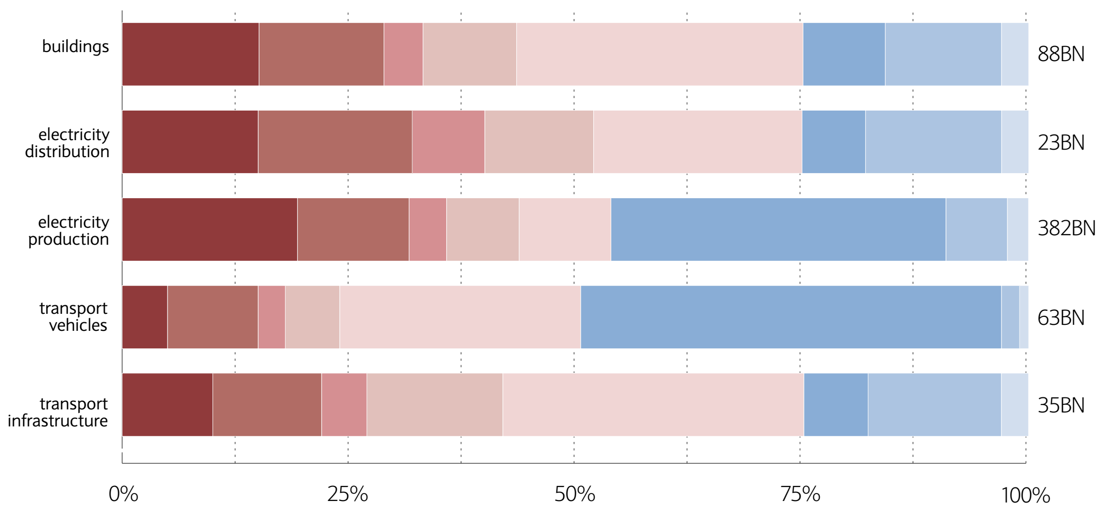
As the sector grows, more companies will look to public markets to raise equity from investors. Between 2008 and 2010, more than 40 LCT companies floated on the stockmarkets. Most of them were small, with an average transaction size of $84m[77], and most listed on secondary markets such as the London AIM stock exchange (most IPOs valued under $100m are floated on secondary stock exchanges). Access to public markets remains essential for growing LCT providers to reach the public equity stage, with €97bn (16 per cent of total) in funding predicted to come from IPOs on these markets.

As an alternative to secured corporate debt (which often results in a high capital cost) or primary issuance of public equity (which can result in important dilution of current equity holders if public equity is traded at low price), companies have also been relying on convertible bonds to secure development capital. Q-CELLS, the German solar cell manufacturers, issued guaranteed convertible bonds to "expand the production capacity in its core business"[78]. These bonds will mature after five years and be converted into equity upon maturity.

76 Bloomberg New Energy Finance – over 1,200 transactions retrieved to support the development capital model (Appendix V)
77 Derived from Bloomberg New Energy Finance
78 Q-Cells will issue guaranteed convertible bonds due 2012 to institutional investors; the book building for the offering will commence today (7 February 2007), Q-CELLS, February 2007

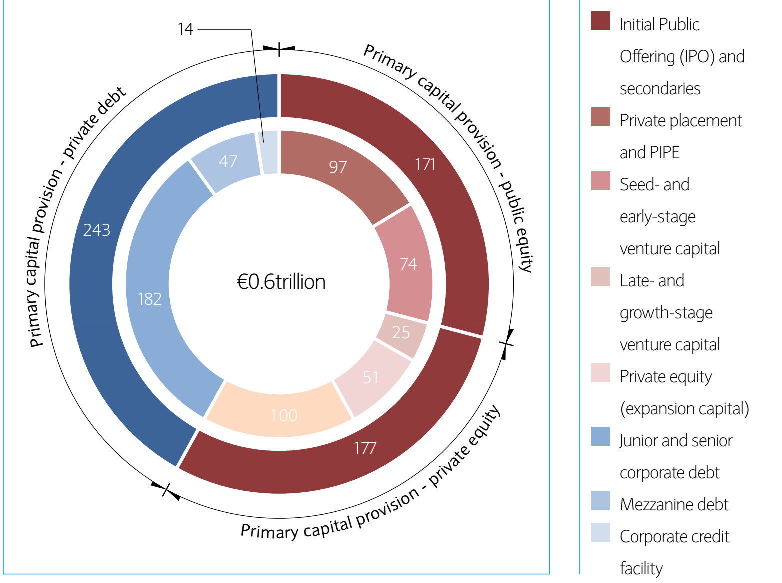
28 CUMULATIVE DEVELOPMENT CAPITAL PER LCT SEGMENT – 2011-2020 (IN €BN) (EU25)

28
- Initial Public Offering (IPO) and secondaries
- Private placement and PIPE
- Seed and early- stage venture capital
- Late and growth-stage venture capital
- Private equity (expansion capital)
- Junior and senior corporate debt
- Mezzanine debt
- Corporate credit facility



Equity investors will provide the majority of development capital, particularly for smaller companies.

29 CUMULATIVE DEVELOPMENT CAPITAL PER FINANCING STREAM – 2011-2020 (IN €BN) (EU25)

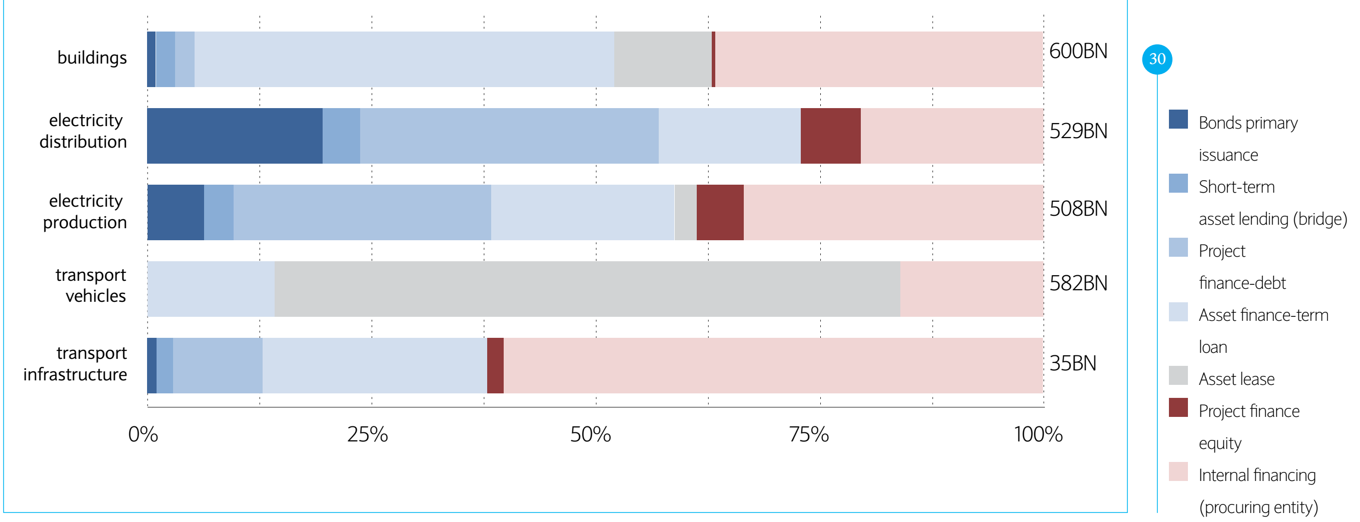


Procurement capital

OF THE €2.3TRILLION required for purchasing LCT in the EU25 to 2020, €1.65trillion (73 per cent) will be needed in external funding (details on the methodology in Appendix III). This is based on an analysis of more than 650 LCT asset financing transactions over the past two years, combined with the average cost of procuring assets and the corresponding cost curves. The remaining 27 per cent is expected to come directly from the balance sheet of technology buyers.

Some types of LCT equipment can be purchased for less than €100m (for example, aggregated building retrofits and smaller scale solar PV plants). This means that finance through secured term loans of less than €100m is likely to become the main source of debt, making up 25 per cent of external funding for procurement. Stand-alone equipment such as vehicles, or infrastructure, such as wind farms owned by a single entity, are ideal collateral for asset-backed loans. By contrast, it is more difficult to secure finance against individual assets or equipment integrated

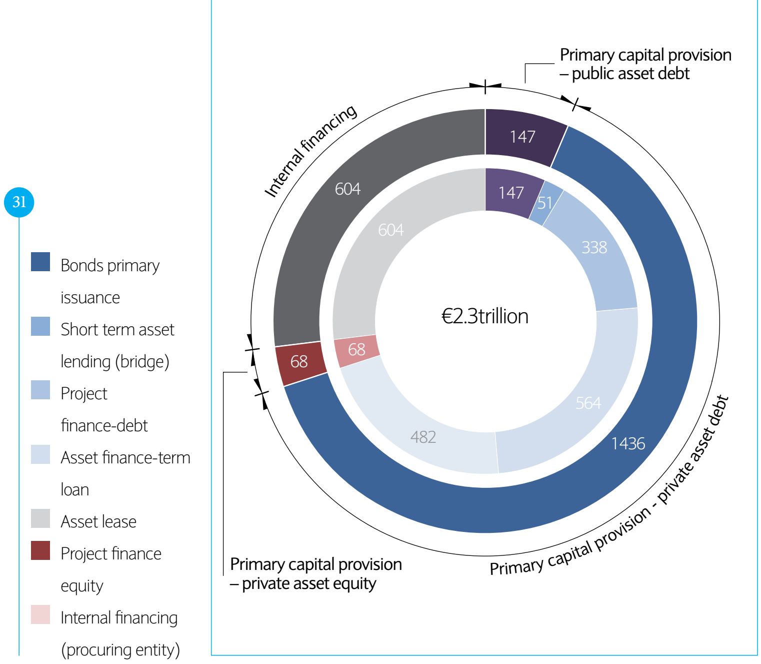
30 CUMULATIVE PROCUREMENT CAPITAL PER LCT SEGMENT – 2011-2020 (IN €BN) (EU25)



in properties, such as building retrofits or large-scale infrastructure, such as smart grids.

Asset leasing will form the second largest source of external capital and is expected to contribute €482bn in funding. Asset leases have proved to be suitable for purchasing LCT small-scale equipment, including vehicles and solar PV. Most assets cost between €10m and €50m[79] to procure, within the range of conventional leases[80].

31 CUMULATIVE PROCUREMENT CAPITAL PER FINANCING STREAM – 2011-2020 (IN €BN) (EU25)



Based on an analysis of 650 existing transactions, we estimate that technology buyers will need to raise €1.65trillion from external sources.

More interestingly, lease schemes where the generated cost savings apply to the lease payments are possible, as pay back periods of 10 years or less are expected[81]. This payback period includes the purchase price of the asset itself, along with interest and administration fees. Over a 10-year period this could mean repayment of a fully depreciated lease with no impact on the purchasing entity's cash flow.

Project finance, which is the most suitable solution for large-scale renewables, transport and grid infrastructure generating a constant cash-flow and costing more than €100m, is estimated to contribute €405bn in combined debt and equity, 18 per cent of procurement capital.

Bonds are increasingly becoming a viable alternative to project finance as bank balance sheet capacity may be restricted due to regulatory requirements. The model estimates that €147bn worth of bonds will be issued to support LCT procurement between 2011 and 2020. The role of banks in issuing bonds is limited to underwriting and placements and so does not require direct funding, unless the bank is associated with the conversion of a loan into a bond – construction loans, for example. Placing bonds with investors will therefore have minimal impact on banks' balance sheets and will not affect their Tier 1 capital ratios.

79 Barclays Specialist Interviews
80 Applied to both individual and aggregated LCT equipment purchase
81 Derived from model results analysis: On a per year basis the cost recovery ratio of LCT retrofit equipment is estimated at 14 per cent which suggests that only between seven and eight years would be required to pay back the equipment purchase

The role of corporate and investment banking products and services

CORPORATE AND INVESTMENT banks will act as intermediaries, allowing access to financing streams through their products and services. This will provide LCT investors with access to both primary and secondary markets.

The role of corporate and investment banks can be broken down into four areas:

- Primary capital provision.
- Capital markets.
- Advisory services.
- Asset management.

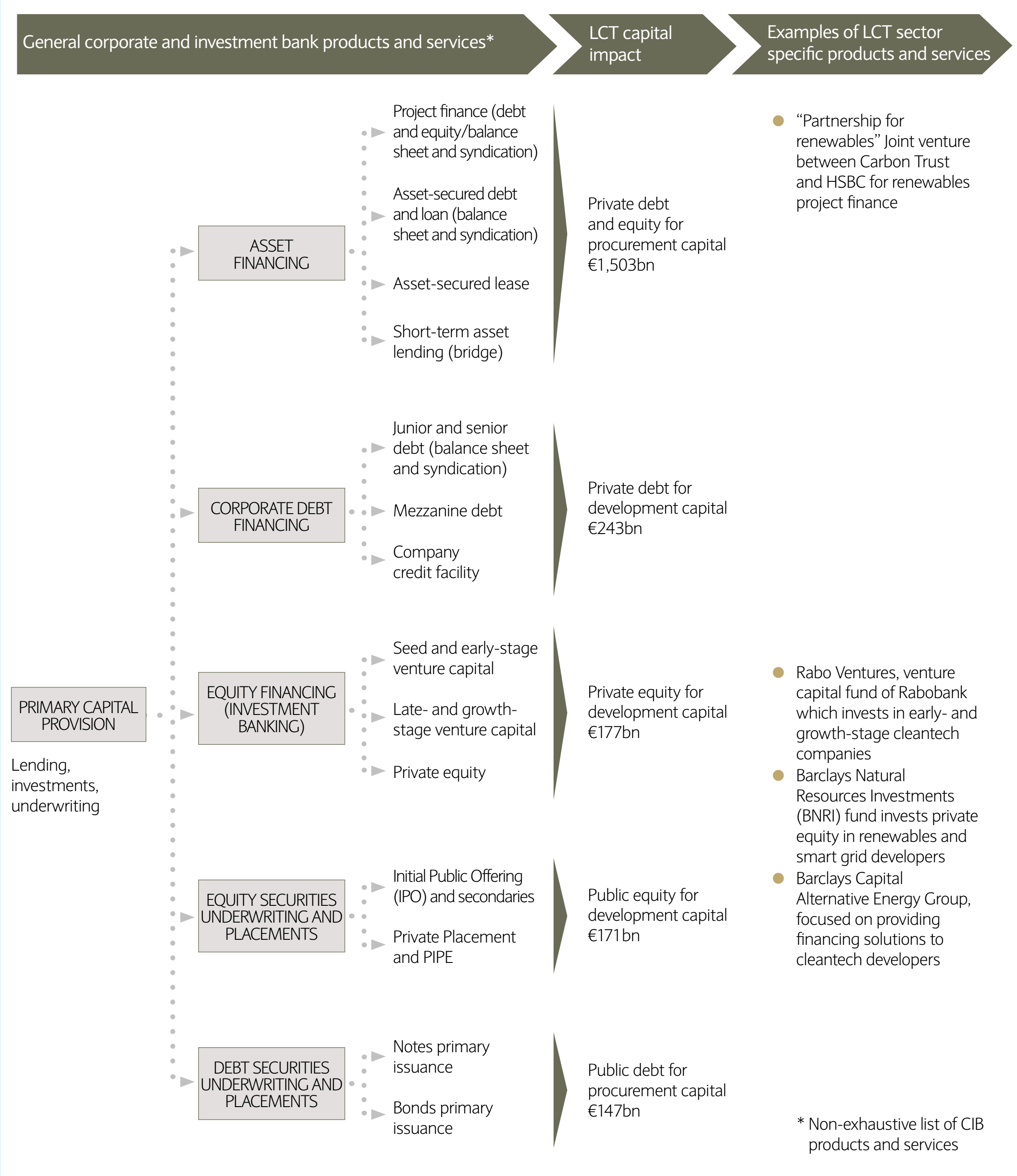
Primary capital provision covers all direct financing, whether directed at procurement or development, and delivers capital from the bank directly to the developer or buyer.

Capital market products, both equity and debt, provide a liquid marketplace where financial instruments issued within the primary capital can be exchanged between investors. Ultimately, the existence of secondary markets supports the issuing of primary capital. These two areas are pivotal for allowing LCT developers access to funding.

Advisory services are essential to provide expertise around technology, regulatory, financial and commercial due diligence issues for LCT transactions. These services can be applied across a number of areas including asset finance, project finance and equity investments. Accordingly, advisory services are critical for both banks and investors to understand this maturing and complex sector. Understanding product complexities, maturity and related regulations is critical in order to identify investment risks, trends and strategies. Corporate and investment banks typically engage third party expert consultants to provide technical support for due diligence, and therefore a broader group of such service porviders will be critical in helping to expand the capital markets for LCT financing.

Asset management helps to define the most effective investment strategies while tax incentives drive demand for specialized LCT investment vehicles.

32 CORPORATE AND INVESTMENT BANK PRODUCTS AND SERVICES (1/2)



33 CORPORATE AND INVESTMENT BANK PRODUCTS AND SERVICES (2/2)

General corporate and investment bank products and services*			LCT capital impact	Examples of LCT sector specific products and services
CAPITAL MARKETS Trade, securitization, structuring	COMMODITIES	Commodities futures Carbon market allowance futures		Barclays Capital Environmental Markets team provides carbon trading services for corporates, government and investors
	EQUITY	Common, preferred and convertible stocks Exchange traded fund (ETF)	Secondary market securities for development capital	iShares S&P Global Clean Energy ETF which tracks the performance of equity held in renewables providers
	FIXED INCOME	Fixed and indexed bonds or notes, convertibles Asset-back securities	Secondary market securities for procurement capital	Barclays Capital securitization of renewables assets using pass-through trust certificates (Alta Wind)
	DERIVATIVES AND STRUCTURED PRODUCTS	Swaps Options, Warrants Custom hedging solutions	Exposure, coverage, hedging of procurement and development capital	Goldman Sachs weather derivatives securities and trading used for hedging the future income of renewables
ADVISORY SERVICES Risk and opportunities assessment and tools	INVESTMENT BANKING SERVICES	Merger and acquisition advisory services Strategic alliance and JV	Consolidation and acquisition of development capital	Barclays Capital Alternative Energy Group, focused on providing financing solutions to cleantech developers
	CARBON MANAGEMENT ADVISORY SERVICES	Carbon financing services		
	RESEARCH	Industry sector research across different securities Investment and portfolio strategy research	Analysis of technology, regulatory, commercial, financial trends impacting development and procurement capital	Barclays Capital Equity Research on renewables provides market analysis for the solar and wind industry sectors
	BENCHMARK INDEX	Debt and Equity benchmark index Carbon and energy commodities benchmark index	Indices used to track the performance of equity development capital	Credit Suisse Global Warming TR Index Barclays Capital European Renewables Index Family provides exposure to the renewables industry
	RISK MANAGEMENT	Regulatory, technology, commercial and financial risk analysis	Risk assessment of development and procurement capital	Goldman Sachs GS Sustain which analyses the sustainability of corporate performance
ASSET MANAGEMENT Investment solutions	INVESTMENT VEHICLES	Mutual fund – active and passive Fund of funds	Investment strategies in development and procurement capital	Deutsche Bank DWS Invest Climate Change LC fund invests in companies active in sectors involving carbon- or energy-efficient technologies, or renewable or alternative energy
	WEALTH MANAGEMENT	High-net-worth individuals investment advisory Fund structuring and investment strategy		

* Non-exhaustive list of CIB products and services

V
Emerging financing schemes to increase capital flows

THIS SECTION OUTLINES emerging schemes expected to provide funding for the LCT sector using the financing streams outlined in Part IV. In it we investigate the functions, benefits and barriers of each scheme and offer examples of implementation.

Key messages:

- An estimated €1.4trillion of procurement capital could be securitized in "green bonds" (in the sense of asset-backed securities) across Europe between 2011 and 2020, making this the largest single financing instrument by value for the purchase of low carbon technology (expected to be 84 per cent of total external procurement capital).
- Banks could provide primary debt, securitize it into "green bonds" and place the securities on the mainstream public markets with minimal impact on their balance sheets. This would also avoid harming their Tier 1 capital ratios and risk weighted assets (RWAs).
- Energy-efficient equipment leases will fund an estimated €140bn of investment, eight per cent of total external procurement capital. This type of scheme is very attractive as it requires minimal to no capital expenditure from the purchaser of the technology and is highly suitable for building retrofits and decentralized power production equipment. Energy-efficient equipment leases also have the potential to aggregate large volumes of individual leases through partnerships between banks and utility or equipment providers.
- Tax equity/debt schemes, specialist investment vehicles and low carbon technology ETFs will boost investment in the sector. These schemes require banks to act as intermediaries and could benefit from tax incentives that leverage private investment.
- Banks require sector-specific expertise on technology, regulations and commercial dynamics to develop low carbon technology. Building up this expertise will allow banks to tailor their offerings to improve access to research on IPOs, M&A and equity for the LCT sector.

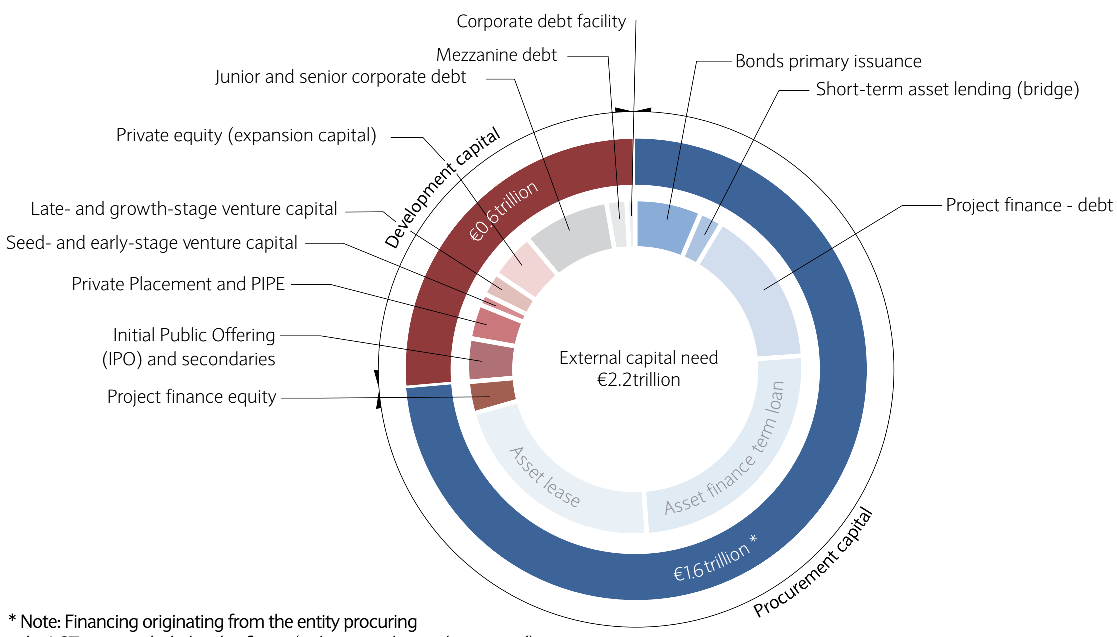
The study identifies €1.65trillion required in external capital for LCT procurement and €591bn required for development (Figure 34). This demand for capital is likely to lead to an important adaptation of corporate and investment banking products and services, combined with the support of public incentives. Financial sector innovation and prudent risk management can be used to support this adaptation.

Globally, financing schemes have emerged to incentivize and support investment in LCT. This has led to the development of specific banking products and services to address the need for capital.

- Unlocking access to LCT finance through capital markets.
- Financing energy-efficient and micro-generation assets through leases.
- Creating new investment vehicles for LCT asset management.
- Investing equity in low carbon technology assets and developers.
- Developing advisory services to improve LCT sector risks and opportunities assessments.

Capital markets will need to play a more important role in financing low carbon technologies, particularly through bond markets for low carbon assets.

34 EXTERNAL FINANCING STREAMS FOR LCT DEVELOPMENT AND PROCUREMENT CAPITAL (CUMULATIVE 2011-2020, EU25)



* Note: Financing originating from the entity procuring the LCT is not included in this figure (only external capital presented)

Unlocking access to LCT finance through capital markets

THE APPETITE OF institutional investors for low carbon technology has grown substantially over the past few years, primarily through investing in public and private equity. However, access to capital markets for financing LCT assets has been limited. Bonds secured on mature onshore wind or solar assets were issued before 2007, but the further development of liquid bond markets was restricted during the financial crisis.

At the end of 2008, pension funds were estimated to hold $25trillion of assets under management globally with 24-40 per cent of portfolios dedicated to fixed-income, including asset-backed securities[82]. However, the ability of institutions such as pension funds and insurance providers to access LCT investments has been limited, given small secondary debt markets and the absence of liquid, investment grade (Figure 35) asset-backed securities.

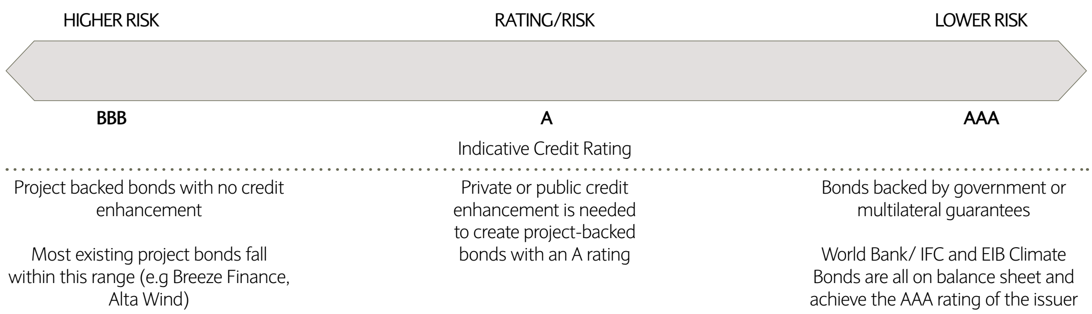
Securitization of the long-term LCT loans and leases as asset-backed securities, which we refer to as "green bonds", will significantly increase their liquidity. We estimate that this could unlock €1.4trillion[83] in finance that can be used to fund LCT equipment and infrastructure. This represents 84 per cent of all identified external capital required for purchasing LCT technology. These asset-backed securities would be similar to primary bonds in terms of the underlying LCT assets they would finance.

By unlocking access to 84 per cent of all external capital required for purchasing LCT, capital market products could form a significant share of institutional investments by 2020.

82 The Euromoney Environmental Finance Handbook 2010, WEST LB

83 Derived from the sum of project finance – debt, asset finance – term loan, asset lease and bonds

35 CLIMATE BONDS – THE SPECTRUM



Examples of supporting schemes

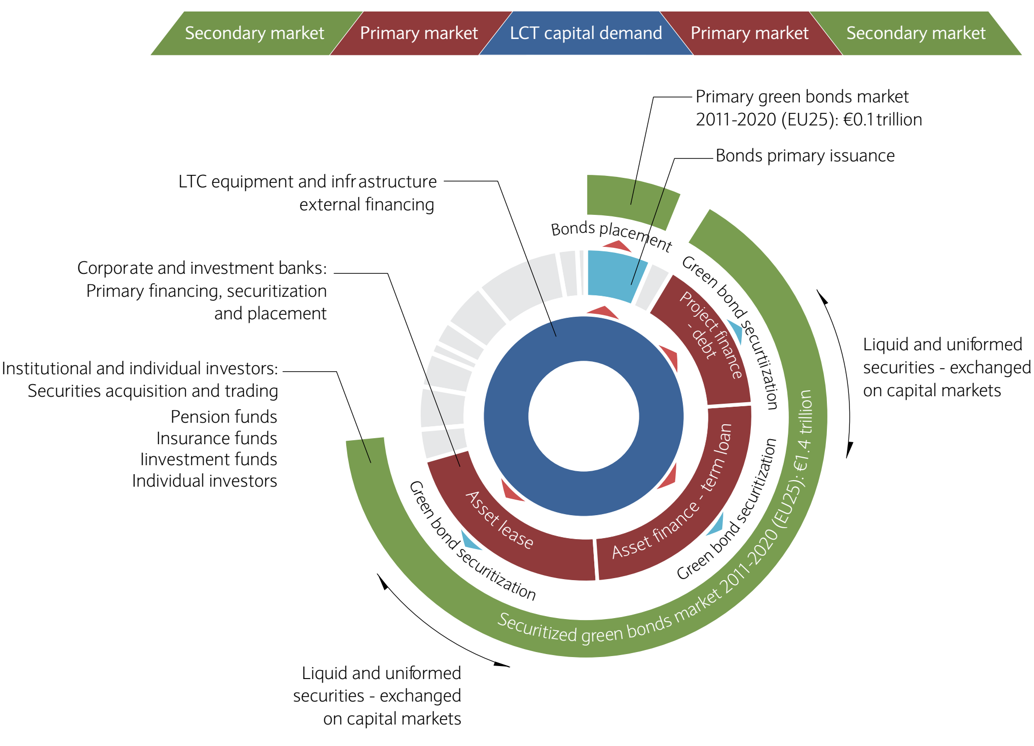
THREE MAIN FUNDING models for bond financing of low carbon assets are currently used for the majority of existing transactions.

1. Project bonds – These are mainly issued for mature renewable energy generating assets (large-scale onshore wind and utility scale solar) that have limited construction risk and are at a sufficient scale to justify bond financing. Institutional investors require investment grade credit ratings, but project bonds have not achieved ratings over BBB at the moment due to high risk and difficulty in reliably forecasting how much energy the project will generate, as wind and solar assets are intermittent. The key will be securing adequate credit enhancement to achieve the kind of investment grade profile that institutional investors might be looking to buy as the senior notes. Initially, any residual funding requirement might be met by multi-lateral institutions, such as the EIB or Export Credit Agencies taking the subordinated/first loss notes to enable institutional investors to purchase the bonds as part of their investment grade portfolios. Some existing wind securitizations such as the Breeze 3 portfolio, which issued three classes of notes in 2007 for an aggregate amount of €455m to finance the acquisition and completion of a portfolio of wind farms located in Germany and France, were downgraded in 2010 by Fitch Ratings and placed on a negative outlook. Fitch noted that the downgrades "reflect Fitch's opinion that the original energy production forecasts somewhat overestimated the portfolio's actually achievable energy yield. This marks a shift from previous reviews as, after approximately three years of operation, Fitch's projections are now primarily based on actual performance rather than on the original forecasts"[84]. However, some recent transactions, such as the Alta Wind pass-through certificates issued in June 2010, might point to some market appetite for a range of risk-return profiles for low carbon assets. Using a leveraged lease structure, Alta Wind was the first private placement bond issuance for wind assets since 2005 (refer to case study on Alta Wind on page 68 in this report). Aggregation vehicles may also become more important in bundling a range of smaller-scale projects into a pool that is div ersified and at the scale necessary to access bond markets.

2. Supranational Issuance – Some multilateral development banks have issued climate bonds that are secured on their balance sheets and can therefore be rated AAA. These bonds are not linked to specific projects but the

84 Press release: Fitch Downgrades Breeze Finance S.A.'s Notes; Outlook Negative, 01 April 2010

36 THE "GREEN BOND" SECONDARY MARKET (CUMULATIVE 2011-2020, EU25)



issuers have committed to match bond proceeds with their lending to the low carbon sector. Most of the bonds are issued for retail investors, with Japan the main market for these types of products. The World Bank and others have issued more than £1bn in climate bonds to back funding for carbon reduction projects[85]. EIB has an estimated £750m worth of "green bonds" outstanding, with AAA rating to finance a broad range of projects from climate change adaptation to mitigation. It recently launched a new €300m issue to Japanese retail investors[86].

3. US Municipal Bonds – Municipal authorities in the US can also access dedicated bond issuance schemes.

The CREB (Clean and Renewable Energy Bonds) and QECB (Qualified Energy Conservation Bonds) are the main schemes available. CREB is a tax-credit bond program expanded under the U.S. Recovery Act from a national limit of $800m to $2.4bn. Funds are used to finance programs that reduce GHGs as well as for energy conservation purposes[87]. CREBs may be used by issuers primarily in the public sector. CREBs are issued, theoretically, with a 0 per cent interest rate, the borrower pays back only the principal of the bond, and the buyer receives federal tax credits instead of interest payments. However, in practice, bonds have been issued at a discount or with additional interest payments in order to attract buyers[88].

85 Unlocking investment to deliver Britain's low carbon future, GIBC, June 2010
86 European Investment Bank issues latest green bonds, Responsible Investors, May 2010
87 Bonds and the Recovery Act, Good Jobs New York, January 2010
88 Database of State Incentives for Renewables and Efficiency. www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US45F&re=1&ee=1

The role of banks as enablers

"GREEN BONDS" DEPEND on banks to act as intermediaries between investors and purchasers. Banks provide the initial debt (construction loans, term-loans, lease), structured according to investment grade and convert the debt into asset-backed securities. These securities are then placed with individual or institutional investors through the capital markets (Figure 36). The impact on banks' balance sheets is therefore limited to the interval between the initial financing of the project and the securities being placed.

Additional requirements

FOR THIS FINANCING scheme to grow, "green bond" securities will need to become more liquid and uniform. A single set of standards is needed to specify and grade the characteristics of underlying investments. The role of risk sharing instruments to de-risk initial transactions will help build investor confidence and effective partnerships between banks, investors, project sponsors, rating agencies and public agencies. Achieving this uniformity would reduce the investment risk and lead to a progressive increase in issuing "green bonds", as investors become more comfortable with the new asset class. This would lead to greater investment in "green bonds", ultimately creating liquidity on capital markets.

Financing energy-efficient and micro-generation assets through leases

FINANCING ENERGY-EFFICIENT or micro-generation equipment can be expensive. To reduce the impact on cash-flow, a leasing scheme – "energy-efficient and micro-generation leases" – could be developed so that principal and interest repayments on the equipment are calculated based on the estimated amount of energy saved (Figure 37). Our analysis shows that principal and interest repayments for a number of building retrofits could be met solely by savings on energy costs over a period of seven to 10 years (see buildings section).

With demand for building retrofits and decentralized power estimated to require €140bn in leases and loans (equivalent to fully depreciated leases), the market is considerable and has the potential to grow far beyond this conservative estimate. Indeed, if equipment is provided without the need for capital upfront, take-up is likely to increase significantly as the end-user would benefit immediately from savings.

Energy-efficient leases would support €140bn in procurement capital while leading to savings estimated to be in excess of 350 Mt CO_2e.

Examples of supporting schemes

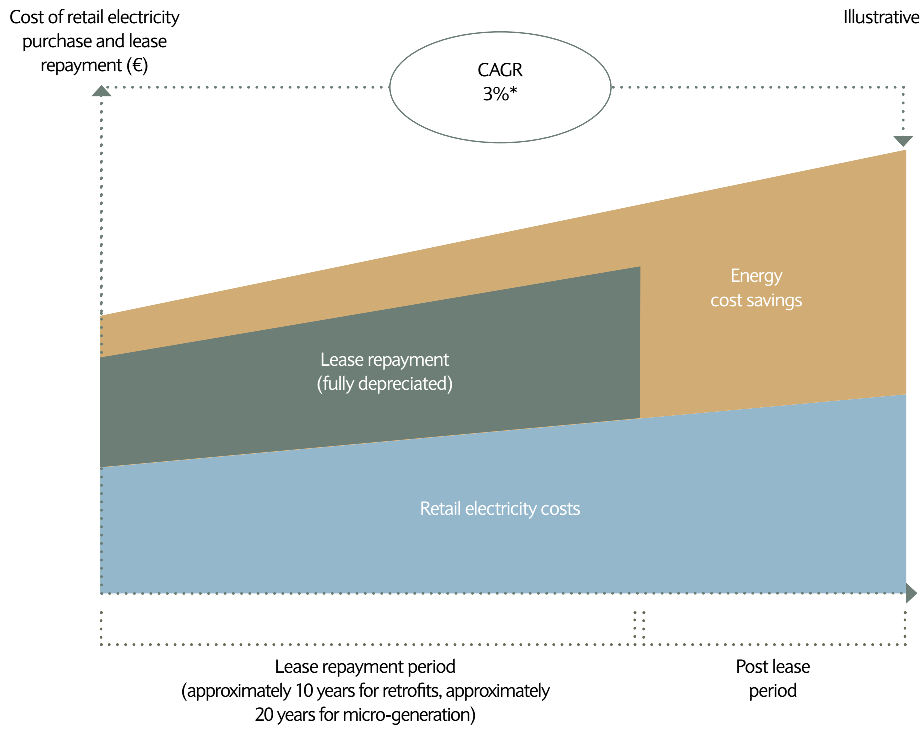
ENERGY-EFFICIENT AND micro-generation equipment leases are at present only used for small, individual projects. A number of pilot programs have already been launched to demonstrate the viability of such schemes. These leases are often backed by public incentives for energy efficiency:

- In the UK, the Carbon Trust is financing retrofits of LCT equipment in new buildings using loans of between £3,000 and £100,000 per loan[89], with more than £70m provided in 2010[90]. Loans are interest-free with anticipated savings expected to offset the loan repayments. The Carbon Trust bears the full cost of administration and loan management fees.

Companies have begun to develop leasing schemes which require no capital upfront. Sungevity in the US and the Green Home Company in the UK have designed solar electricity leases that eliminate upfront investment and lower energy bills[91].

89 The Carbon Trust, www.carbontrust.co.uk
90 The Carbon Trust, stakeholder interview
91 Sungevity, Green Home Company

37 IMPACT ON ELECTRICITY COST SAVINGS FROM RELIANCE ON AN ENERGY EFFICIENCY AND PRODUCTION LEASE



*Average retail electricity CAGR IN EU25 for past 10 years (Source: Eurostat)

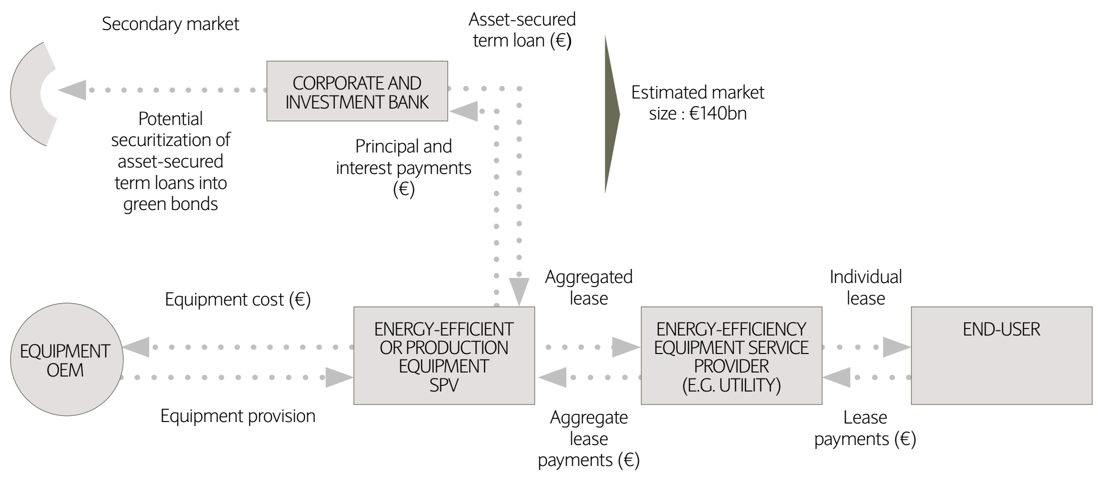
The role of corporate and investment banks

PROVIDING INDIVIDUAL LEASES for energy-efficient or micro-generation equipment is not viable from a bank's perspective due to the small scale. To make these types of leases possible, a large-scale debt facility of the type corporate and investment banks could provide is critical. Large equipment providers or utilities could use these debt facilities to offer energy-efficient or micro-generation leasing schemes to their customers (Figure 38).

Additional requirements

USING DEBT FINANCE to purchase equipment will have an impact on the balance sheet of both service providers and the bank providing the debt (if the Special Purpose Vehicle (SPV) which holds the assets is consolidated). This is a major barrier as it would influence the credit rating and debt ratio of the service provider whilst affecting the risk-weighted assets of banks. Alternative structuring of the SPV or securitization of the debt onto public markets could provide alternatives.

38 ENERGY-EFFICIENT AND MICRO-GENERATION ASSETS LEASES FINANCING SCHEME



Creating new investment vehicles for LCT asset management

AS DEMONSTRATED, DEMAND for investment in LCT is growing and the emergence of new providers of products and services tailored to the sector will accelerate to meet demand. As this occurs, more investors are likely to seek exposure to fast-growing segments of the LCT sector.

Fund managers will require an in-depth knowledge of the sector, specifically aspects around technology, regulations, commercial and financial due diligence to ensure they are able to structure investment vehicles appropriately and are mitigating risks.

An estimated €171bn in public equity is expected to be raised through IPOs or PIPE between 2011 and 2020 in EU25. Equity investment vehicles would support the demand for LCT equity common stocks by providing a tailored instrument to access these markets. Investment vehicles could also be formed to invest in LCT private equity, asset-backed securities (i.e. "green bonds"), regular bonds or liquid corporate debt. This is likely to stimulate the demand for a broad range of LCT securities.

Examples of investment vehicles and supporting schemes

LCT SPECIFIC FUNDS provided by corporate and investment banks have emerged, for example:

- BlackRock – New Energy Fund.
- Deutsche Bank – DWS Invest Climate Change LC fund.
- Rabobank – New Power Fund.

Additional tax incentives on LCT funds further stimulate the return on private investment whilst strongly leveraging public subsidies. Existing public incentives schemes include:

- The Green Funds Scheme in the Netherlands allows individual investors to buy bonds or shares in the "Green Fund", accepting a lower interest rate in exchange for 2.5 per cent tax advantage. Individuals in the Netherlands can offset up to €55,000 per year against their annual wealth tax liability for specific investments, including green business, social, cultural and seed capital.
- The Enterprise Investment Scheme (EIS) in the UK allows investors to offset 20 per cent of the cost of buying shares against their individual income tax liability. This includes:
  - Capital gains tax exemption on disposal.
  - Capital gains tax deferral by reinvestment.
  - Capital losses can be offset against income rather than capital gains.

ETFs to provide liquid securities for broad sector exposure

INDICES THAT MEASURE LCT sector performance, such as Bloomberg Wind Energy Index or FTSE Impax ET50 Index, can be tracked by ETF investment products which in turn need to purchase underlying securities (mostly common stocks) (Figure 39). ETFs could also track "green bonds" or corporate bonds if enough liquid securities were available on the market (this is unlikely for LCT corporate debt as most of the companies are small).

ETFs will ultimately reinforce demand for common stocks and bonds in the LCT sector. Considering equity and debt raised through IPO and bond issues, the study estimates LCT-specific ETFs could be formed of new underlying securities worth up to €244bn in public equity or bonds. As the investment profile of companies varies due to technology or regulatory risks, ETFs provide an easy and liquid way for investors to gain exposure to the sector without the risks of investing in one individual company.

39 LCT AND CLEANTECH BENCHMARK INDICES

Source: Bloomberg

Additional requirements

INVESTMENT VEHICLES THAT rely on public incentives (e.g. tax benefits) to provide returns that satisfy investor expectations, run the risk of having the incentive removed.

If the tax incentives are necessary to make the return competitive, governments need to commit to the scheme long-term to provide stability and support investment.

Investing equity in low carbon technology assets and developers

DIRECT BANKING SECTOR investments in a number of LCT developers and large asset financing vehicles are essential to provide stability and security to the underlying investments.

Tax-equity/debt schemes for large-scale asset financing

TAX-EQUITY/DEBT schemes, often used in the US to stimulate equity participation of private investors, would enable financial institutions to participate in the equity or debt financing of large scale LCT infrastructure projects. These schemes stimulate investments by allowing a write-off of a share of reported pre-profit taxes corresponding to investments in the LCT project.

Given the strong expected take-up of large-scale projects, such as transport infrastructure or smart grids, these schemes would help to raise equity investment. This would lower the debt–to-equity ratio and risks associated with the investment, while artificially increasing returns through tax write-offs. A number of transactions have demonstrated high demand for tax-equity investments in the past. For example:

- GE Energy Financial Services and Wachovia invested $387m in tax equity to refinance Babcock & Brown's US06 wind portfolio[92].
- Fortis, the investment bank, invested $26m in tax equity in Spanish wind developer Iberdola[93].

Demand for an additional €68bn in project finance equity was identified for the LCT infrastructure we considered between 2011 and 2020 in Europe.

Examples of tax-equity schemes

SEVERAL COUNTRIES HAVE developed tax-equity schemes aimed at renewables to stimulate asset finance:

- US – Tax-equity schemes: tax credits support the introduction of renewables by allowing companies investing in the sector to write-off their investment against profits from other operations.

Additional requirements

BECAUSE TAX-EQUITY/debt schemes are mainly used by institutions to offset their tax liabilities, any fall in profit typically leads to the investment being withdrawn. This creates volatility and instability for companies seeking equity for large infrastructure projects. Long-term commitment from governments is vital to provide stability for tax-equity or tax loss schemes.

At present, schemes only focus on investing equity in projects. Extending tax-equity schemes to cover debt investments would artificially increase interest payments earned on the debt and lower the financial strain on the project to deliver returns when drafting new legislation.

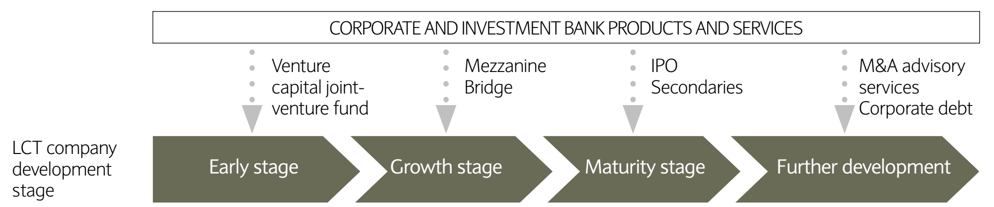
Venture capital investment vehicle

BANKS CAN PLAY a significant role in financing early and growth stage LCT, potentially supported by match funding from public institutions. This will enable LCT companies to build stable levels of equity allowing them to attract new investors.

Banks will then be able to share in the returns as the company matures (Figure 40). For example, banks would generate returns should the company go through an IPO or require mezzanine finance, bridge financing or additional capital. €177bn in additional venture capital and private equity expansion capital is likely to be required by the EU25 between 2011 and 2020 to fund the growth of LCT developers. Morgan Stanley's acquisition of Clean Technology Venture Investor NGEN Partners[94] demonstrates the desire of banks to play a more active role in early-stage firms.

92 Bloomberg New Energy Finance
93 Bloomberg New Energy Finance
94 Morgan Stanley Acquires Stake In Clean Technology Venture Investor NGEN Partners, LLC, Morgan Stanley, January 2008

40 VENTURE CAPITAL INVESTMENTS POSITIONING FOR CORPORATE AND INVESTMENT BANKS



Examples of corporate and investment bank venture capital vehicles

EXAMPLES OF CORPORATE and investment bank venture capital investments in LCT include:

- Barclays Natural Resource Investments (Active in renewables).
- Morgan Stanley Ventures Partners (Active in cleantech growth capital).
- Rabo Ventures (Focused on Cleantech early capital).

Additionally, public schemes are in place to incentivize equity contribution for venture capital investments further. Below is an example of a scheme in place in the UK:

The Innovation Investment Fund (IIF) in the UK committed £125m in equity funding for early-stage LCT businesses. Private funds have matched public equity contributions and helped bridge with venture capital private investments. Recent announcements suggest the IIF will be increased by £200m in 2010[95].

Additional requirements

NEW REGULATIONS ARE emerging that prevent banking entities from investing in private equity funds and numerous other types of privately offered funds, which may include venture capital funds (§ 619 of the Dodd-Frank Wall Street Reform and Consumer Protection Act). As early-stage LCT developers play an essential role in driving research, innovation and growth, it is important that governments recognize the positive contribution corporate and investment banks can achieve in this financing segment.

Developing advisory services to improve LCT sector risks and opportunities assessments

CORPORATE AND INVESTMENT banking research into LCT provides technical, regulatory, financial and commercial expertise on the sector. This works to de-risk investments by improving upfront risk and opportunity assessment in the development of low carbon technologies and infrastructure.

Building this capability is essential for banks to understand the complex dynamics of the LCT sector, which include a strong interdependency on public incentives, evolving regulations, and rapid technological developments. This in turn supports a broad range of horizontal capabilities for the banking sector to provide external capital by improving investors' understanding of the risk factors involved in both debt and equity-based LCT investments. Examples of internal expertise or research capabilities developed by corporate and investment banks in the LCT sector include:

- Barclays Capital cleantech and renewables equity research[96].
- Credit Suisse electric vehicles equity research[97].

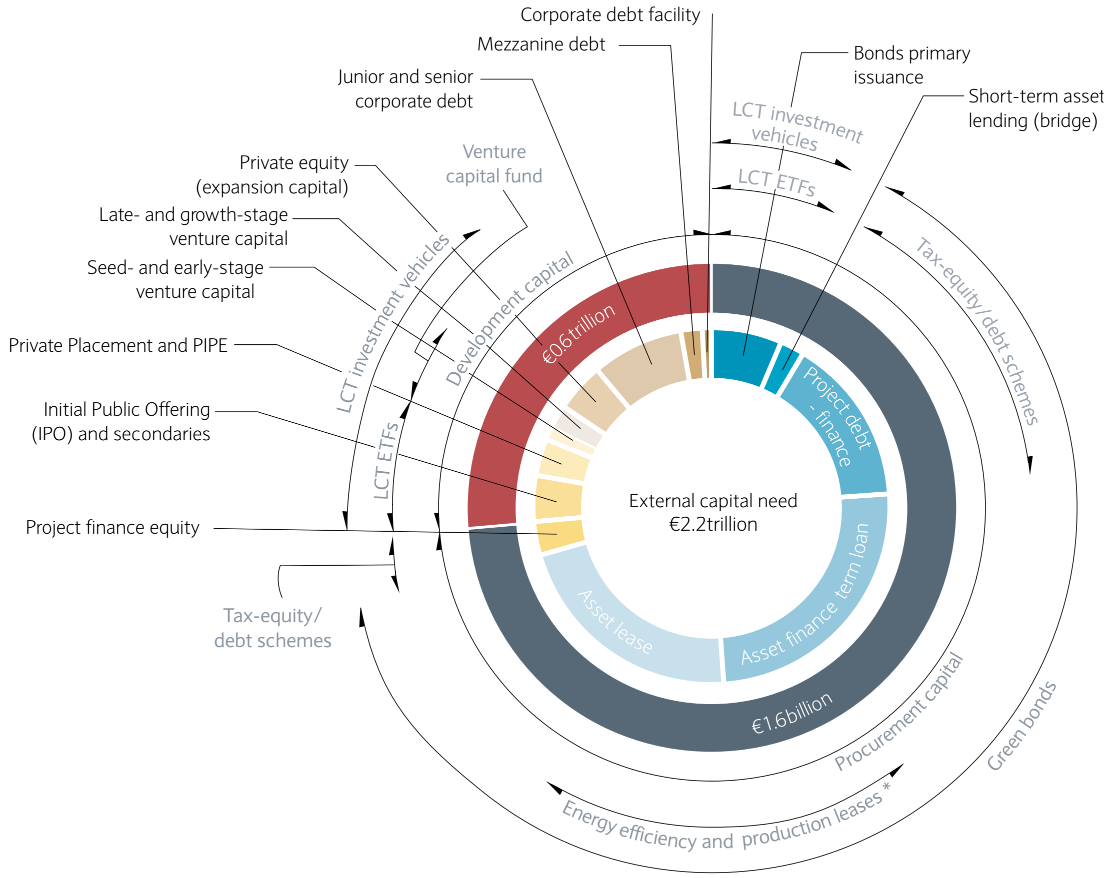
95 Global Investment Conference, UKTI, February 2010
96 Global Renewables Demand Forecast 2010-2014E, Barclays Capital Equity Research, August 2010
97 Equity Research, Energy Technology/ Auto Parts and Equipment, Electric Vehicles, Credit Suisse, October 2009

A wide range of different debt and equity financing solutions will be required to mobilise capital across the LCT value chain. Banks, investors and project sponsors will need to work in partnership to explore and create effective funding models.

Overall application of financing schemes to external capital needs

BELOW WE MAP the financing schemes examined against the external LCT capital requirements (Figure 41).

41 APPLICATION OF FINANCING SCHEMES TO THE DEVELOPMENT AND PROCUREMENT CAPITAL NEEDS IDENTIFIED



* Study applied to building retrofits and decentralized energy production

Case study: Innovation in financing renewables – the example of Alta Wind

IN JULY 2010, Terra-Gen secured $1.2bn for the development of the 570MW Alta Wind Energy Center Phase II[98].

Alta Windpower Development, a special purpose vehicle (SPV), was set up to develop the 3GW wind project. The 570MW Phase II wind farm consists of four wind farms: Alta Wind II, Alta Wind III, Alta Wind IV and Alta Wind V.

Phase II financing consists of a total of $1.2bn, including $580m of pass-through bond certificates, bridge loans of $499m and $127m in other credit facilities.

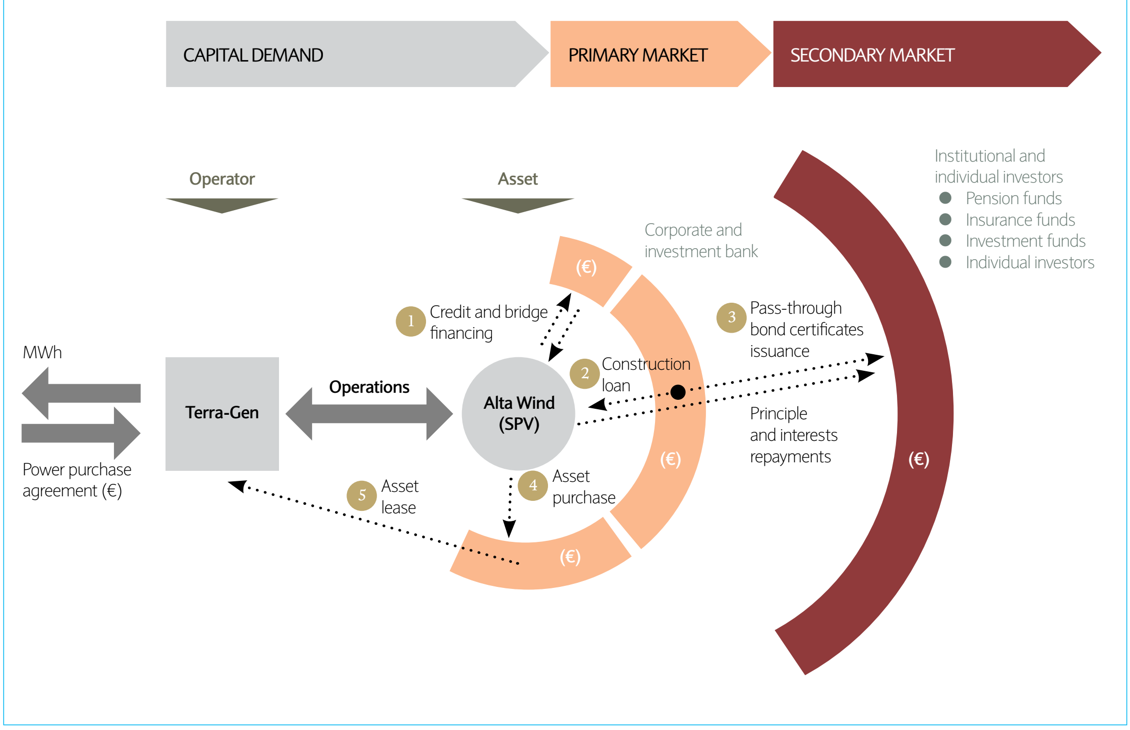
Alta Wind Holdings, a subsidiary of Terra-Gen Power, will sell the $580m in bonds maturing in 2035 to individual and institutional investors, to cover the construction of the wind farm. The offering was met with strong demand due to investors' desire to purchase renewable energy project bonds. Ultimately, Alta was able to raise the value of the deal from $412m to $580m by including an additional phase of the Alta Wind Energy Center. The final order book included high-quality insurance companies and money-managers and was significantly oversubscribed. This confirmed the strong market demand for clean energy.

Alta Wind II, III, IV and V are all accountable to a single unit called the Alta Wind 2010 Pass-Through Trust, which issues the certificates. The permanent financing will be a leveraged lease under which Citigroup had committed to buy the four projects once commissioned and lease them back to Terra-Gen, which would operate them under long-term agreements.

Citibank, Barclays Capital and Credit Suisse Group AG led the issuing of the pass-through certificates. Mitsubishi UFJ Securities, Credit Agricole Securities, ING and Rabo Securities acted as co-managers. Citibank, Barclays and Bank of Montreal provided the credit facilities.

98 Barclays, Bloomberg New Energy Finance

42 ALTA WIND FARM FINANCING SCHEME



VI Recommendations

Policymakers

THE MARKET FOR low carbon technology has emerged in the past decade, thanks to the increased cost of carbon intensive activities, a reduction in technology costs, a large number of fiscal incentives and a favourable regulatory environment. These incentives stem from a long-term commitment on the part of governments to improve energy security and reduce carbon emissions.

A long-term agreement on carbon reduction targets and a global financing framework is still needed to provide long-term visibility on emissions regulations.

Policy stability is a priority

DIRECT MEASURES, SUCH as FITs and subsidies, and indirect measures, such as emissions trading schemes, that lower the return of carbon-intensive industries, should be carefully balanced. In the absence of stability and clarity on carbon markets (such as the expected long-term cost of emissions allowances), direct subsidies are necessary to encourage investment in LCT.

Direct subsidies, such as FITs or public equity are essential in promoting the technologies that best satisfy environmental and energy security strategies. For example, the absence of incentives for renewables and the presence of a moderate carbon price may result simply in a shift from coal to gas power. This will increase exposure to foreign energy imports and lead to only a partial reduction in carbon emissions (the shift from coal to gas power reduces emissions by approximately 40-50 per cent on a per MW basis[99]).

These measures must be both stable and adaptable if they are to support the LCT sector in becoming mature and commercially viable. FITs should be adjusted based on installed capacity, efficiency gains and procurement cost reduction, perhaps more than once a year, as is currently seen in Germany. This is preferred to an overly generous tariff, which is likely to subsequently require a hard cap on installations as a corrective measure. Adaptation of the incentives would progressively lead the technology to be commercially viable without any public support on the medium- and long-term.

Policymakers can take additional measures to support the initiatives highlighted in this study.

99 Derived from enerdata power mix database

General policy on tax incentives

- LONG-TERM COMMITMENT to public incentives is vital to prevent any retroactive modification of incentives, for a period of time commensurate with the expected investment pay-back periods (i.e. 15-25 years).

Leveraging public funding

- POLICYMAKERS NEED TO set a range of fiscal incentives and subsidies which improve returns on LCT-focused investment and make use of public funds to leverage private investment, through, for example:
  - Capital gains tax credits (direct equity or funds).
  - Tax-equity/debt schemes.
  - Matching participation in venture capital equity investments.

Support the introduction of emerging low carbon technologies

- SUPPORT SCHEMES TARGETING the roll-out of emerging low carbon technologies not yet commercially viable such as:
  - Feed-in-Tariffs (FITs).
  - Alternative or low-carbon vehicle subsidies.
  - Tax deductible interest on finance for energy-efficient equipment purchase.
  - Direct regulation of the sale of green energy.

Standardisation of "green bonds"

- DEFINE STANDARDS FOR "green bond" securities and enforce compliance for securities that benefit from public incentives. This can be achieved privately through an auditing firm or publicly through a dedicated organization.

Local government infrastructure initiatives

- DEVELOP LARGE-SCALE LCT infrastructure programs for e-vehicle charging systems, building retrofits, decentralized electricity production and others to stimulate the demand for LCT equipment.

Corporate and investment banks

THE LCT MARKET will require €2.9trillion in investment over the next 10 years, presenting corporate and investment banks with an unprecedented opportunity as the finance will derive primarily from banking products and services.

There will be leaders and laggards in the emerging low carbon economy. Corporate and investment banks can take a leading role by unlocking primary and secondary capital markets, and so providing access to funds supporting the introduction of low carbon technology. This will require them to develop tailored products and expertise in LCT. Our study details a number of initiatives which could be considered in order to achieve this, along with the barriers that would need to be overcome.

Green bond securitization

- BANKS NEED TO develop capabilities for securitizing debt backed by LCT assets. This will require banks to find appropriate projects, then structure, underwrite and place securities with a range of investors.

Requirements and barriers:

- Global and national standards will be necessary to define "green bonds" as a security class.
- High volume of debt will be required to conduct securitization.
- Long-term tax incentives or guarantees may be needed to improve returns on securities.
- Public or private risk-sharing instruments.

Providing debt finance for energy-efficient and micro-generation asset leases

- BANKS WILL NEED to develop partnerships with energy-efficient or micro-generation equipment providers (e.g. utility or any large service providers) to fund aggregated large equipment purchases. This equipment will ultimately be leased to consumers.

Requirements and barriers:

- A high volume of LCT equipment financing will be necessary for leases to be aggregated into a single, large debt facility.
- Banks can use secondary markets for asset-backed leases and loans to reduce the impact on their balance sheets.

Using equity to provide capital for development

- BANKS WILL NEED to increase equity investment in small and medium-sized LCT companies through partnerships with existing venture capital or private equity firms.

Requirements and barriers:

- Regulations governing banks' private equity and venture capital investments in strategic industry sectors, such as LCT, present barriers to speculative investments (e.g. Dodd-Frank Wall Street Reform and Consumer Protection Act).
- Increasing investment in equity will require internal expertise on technology, regulations and commercial dynamics or partnerships with sector specialists.
- PE and VC LCT investments are small and complex transactions which can lead to a resource intensive due diligence process.

Integrated project finance

- THIS EXTENDS PROJECT finance for LCT infrastructure projects to include equity rather than simply debt. Banks will benefit from the synergies offered by carrying out due diligence across both financing streams.

Requirements and barriers:

- Tier 1 risk-based capital ratio requirements associated with debt provision would drastically increase with LCT equity participation and limit investment from banks.
- Integration of insurance coverage will be necessary to mitigate the increased risk profile associated with equity investment. This will secure long-term return and protect against volatile incomes (for example, intermittent power from adverse weather). Products to achieve this include weather derivatives or other types of hedging products indexed on a production indicator of the LCT infrastructure.

Structured LCT investment products

- BANKS COULD PROVIDE bespoke ETFs to support the demand for securities, creating a more liquid marketplace and broad sector exposure for investors. They could set up dedicated investment funds (based around public or private equity, or debt) to provide investors with strategic LCT sector exposure and access to tax-credits for qualifying investments.

Requirements and barriers:

- Internal ETF and investment fund product structuring and commercialization capability is required.
- LCT sector benchmark indices are required for ETFs to track a representative benchmark index of the sector.
- In-depth expertise of publicly listed LCT companies would be required to form benchmark indices.
- LCT securities would need to be liquid to allow funds to adapt to sector dynamics and changes such as emerging technologies or regulations impacting current LCT developers or operators.
- Securing long-term public commitment to tax-incentives targeting LCT-focused investments would be a crucial factor.

Appendix I

Full list of initially considered LCT

BUILDINGS

1. High-efficiency condensing boilers
2. Micro-combined heat and power units (CHP)
3. Retrofit of high-efficiency insulation material
4. Retrofit of next generation LED lighting
5. High-efficiency HVAC cooling and heating system for commercial buildings
6. Smart appliances in "connected homes" (refrigerator/washers)
7. Integrated building management systems (BMS) for lighting, heating, cooling control and automation
8. Smart buildings new builds – integrated smart building solution (equipment and design)
9. Decentralized energy production – Solar PV panels for electricity generation
10. Decentralized energy production – Solar thermal panels for heating and 'cooling' generation
11. Decentralized energy production – Geothermal power for heating and 'cooling' generation

ELECTRICITY DISTRIBUTION

12. Smart grid infrastructure – Advanced control and management of electricity grid
13. Advance metering system infrastructure for electric smart meters (AMI with AMM meters)
14. Distributed storage in households to support decentralized intermittent power generation and e-vehicles charging
15. Virtual power plant infrastructure system and to manage large volume of urban decentralized power

ELECTRICITY PRODUCTION

16. Carbon capture and storage
17. Offshore wind power
18. Onshore wind power
19. Wave power
20. Tidal power
21. Geothermal power
22. Waste to energy
23. PV solar power
24. CSP solar power

TRANSPORT VEHICLES

25. Plug-in hybrid vehicles (private/commercial/freight/public)
26. Electric vehicles (private/commercial/freight/public)
27. Bio-ethanol vehicles (private/commercial/freight/public)
28. Bio-diesel vehicles (private/commercial/freight/public)
29. CNG fuel vehicles (private/commercial/freight/public)
30. Biofuel provision
31. Telecommuting system infrastructure for large organizations
32. Telepresence system infrastructure for large organizations
33. Telematics-enabled navigation system retrofit in vehicles to support energy efficiency applications
34. Telematics-enabled navigation system retrofit in freight and logistics vehicles for network optimization
35. New design and fuel-efficient container freight sea vessels

TRANSPORT INFRASTRUCTURE

36. e-vehicle charging infrastructure with distributed batteries and charging stations
37. Intelligent urban traffic system
38. LED lighting infrastructure to cover road network

Appendix II

Capital, emissions and cost savings sizing model

THE SIZING MODEL developed is illustrated below. It estimates the procurement capital and carbon and cost savings between 2011 and 2020 in Europe for all LCTs and globally for renewables. The example of smart metering infrastructure for electric smart meters (AMI with AMM meters) in Germany in 2012 is used to illustrate the calculations steps of the model.

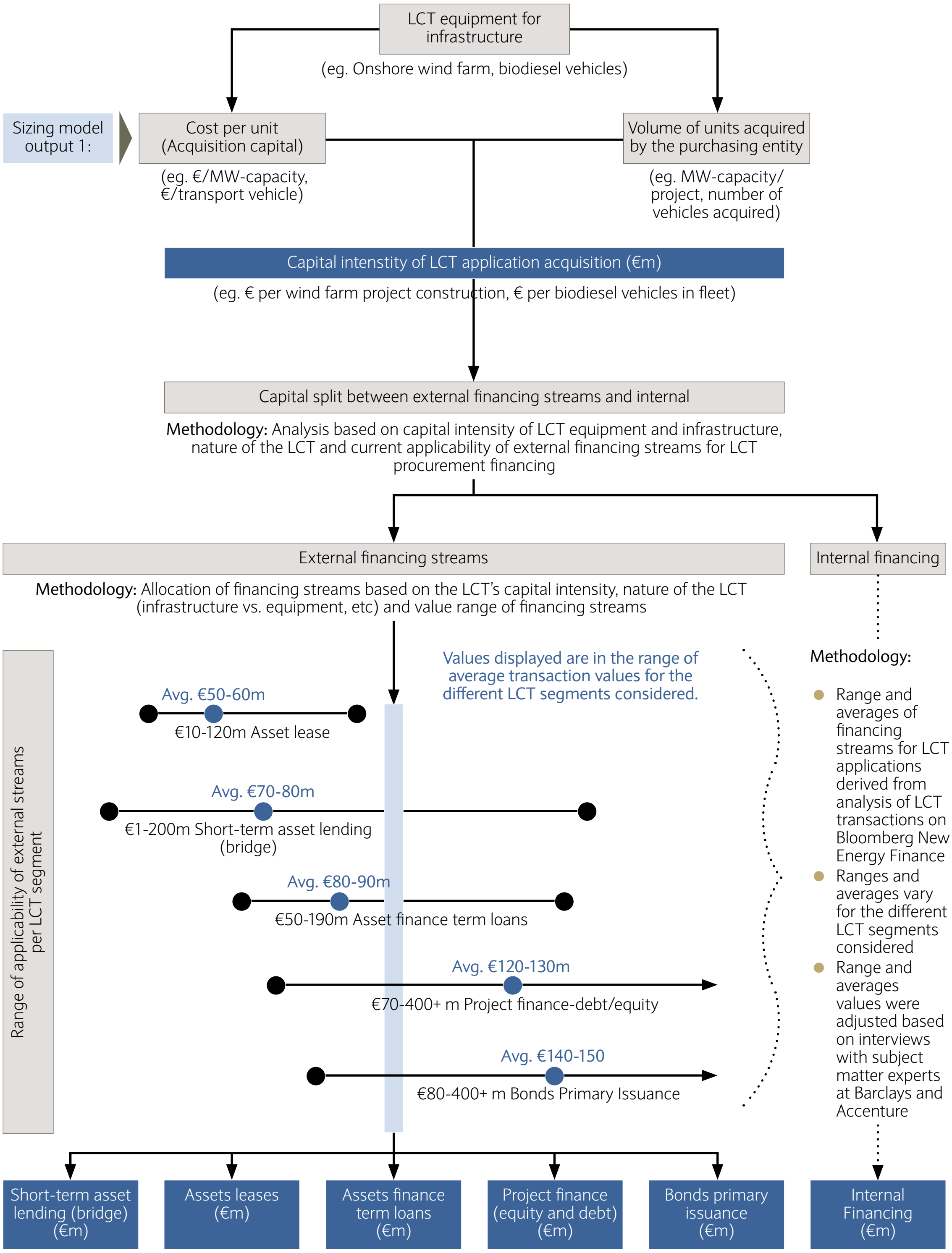
The key steps presented in the example are as generic as possible to demonstrate the model's applicability to other LCTs. However, some steps are not required for all LCTs, e.g. there are no energy efficiencies achieved by end-consumers or utilities from sourcing wind power versus gas power.

	Generic key model steps		Example of model parameters for smart metering in Germany in 2012
Main input 1	Low Carbon Technology (LCT) considered	1	Advance metering infrastructure for electricity (AMI with AMM) meters
Main input 2	Considered geography	2	Germany
	Applicable market where the selected LCT is commercially applicable	3	Total number of electricity meters installed
	Applicable market segmentation	4	Commercial segment
		5	Residential segment
	Applicable market growth	6	2004-2008 CAGR of total number of meters (%)
	2011-2020 adoption rate definition for LCT applicable market penetration	7	2010 market penetration (% of smart meters)
		8	Mid-2010-2020 adoption year
		9	Strength of adoption at mid-year (% changed)
		10	2020 market penetration (% of smart meters)
Main input 3	Considered year for LCT roll-out	11	2012
	Incremental LCT market in considered year	12	2011 applicable market (number of meters)
		13	2011 market penetration (% of smart meters)
		14	2012 applicable market (number of meters)
		15	2012 market penetration (% of smart meters)
		16	Incremental 2011-2012 LCT market (number of smart meters)
	Cost of LCT equipment and associated infrastructure	17	Cost per meter of AMI infrastructure with AMM smart meter components (e.g. AMR functionalities, Enterprise system, IHD, HAN, direct load control equipment) (€)
Main output 1	Procurement capital	18	2012 procurement capital required by added smart meters (€)
	Applicable energy consumption and production to be impacted	19	Electricity consumption – Commercial segment (kWh)
		20	Electricity consumption – Residential segment (kWh)
		21	Electricity distribution – Transmission distribution losses (kWh)
	Energy efficiency gains to be achieved	22	Commercial properties load control and operation efficiency gains (%)
		23	Private consumer behavioural change and load control efficiency gains (%)
		24	Optimal transmission and distribution network loading efficiency gains (%)
	Energy price	25	Price of electricity (€/kWh)
Main output 2	Energy cost savings	26	2012 cost savings enabled by added smart meters (€)
	Energy carbon intensity	27	Electricity grid carbon emissions intensity (kg CO_2e/kWh)
Main output 3	Carbon savings	28	2012 carbon savings enabled by added smart meters (€)

Appendix III

Financing streams for procurement capital model

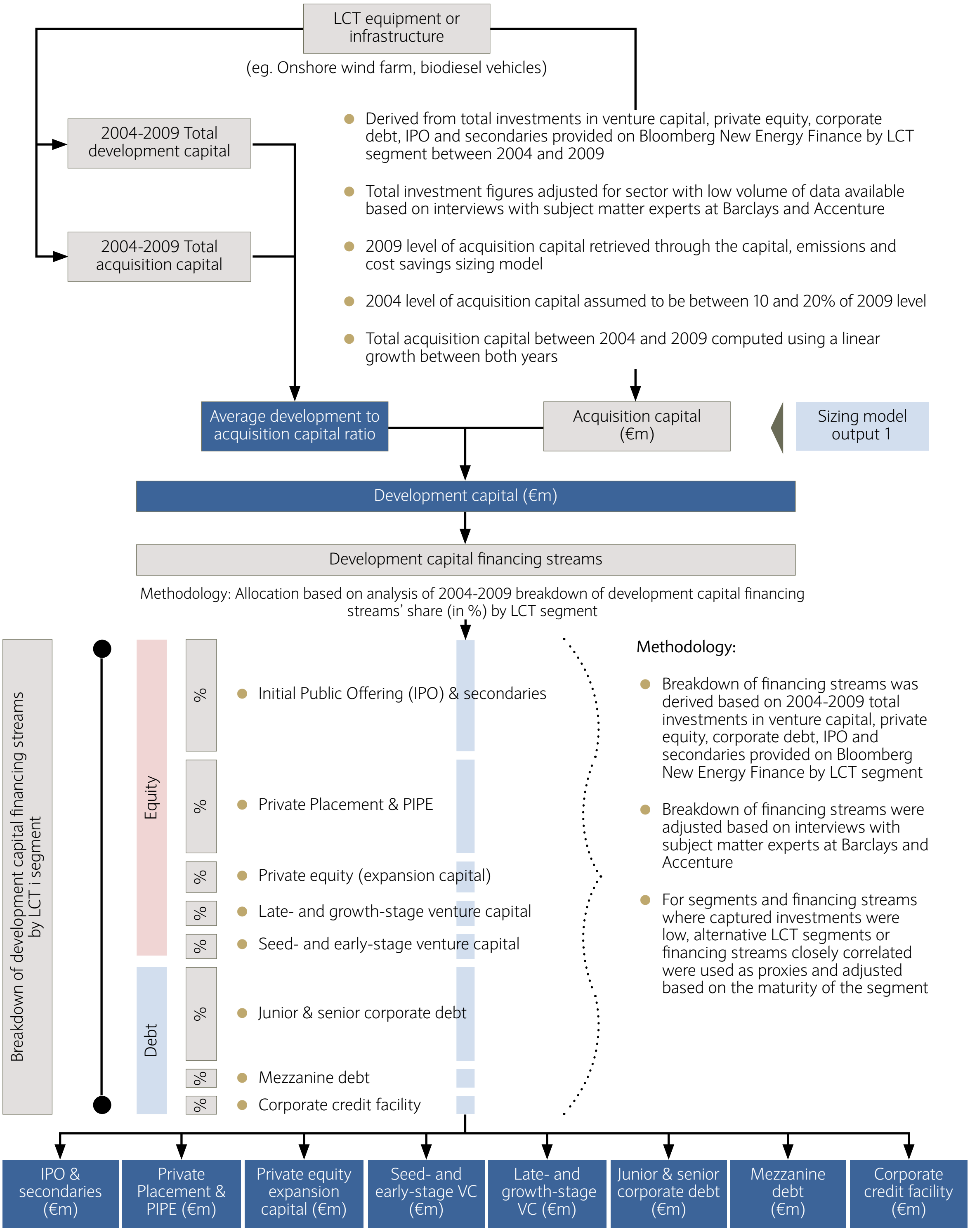
THE BELOW SCHEMATIC illustrates the process of allocating financing streams to the procurement capital identified in the Capital, emissions and cost savings sizing model:



Appendix IV

Financing streams for development capital model

THE BELOW SCHEMATIC illustrates the process of estimating development capital for LCT applications and of allocating financing streams:



Appendix V

Individual LCT models' details and assumptions

THIS APPENDIX PRESENTS the key parameters which are included in the calculation steps of the LCT models along with key assumptions used and range of adoption rate used.

Global assumptions (applies to all models):

- Grid carbon emissions intensities are derived from Enerdata's power mix forecasts (Appendix VI).
- The cost of electricity was assumed fixed in time (average July-December 2009).
- Emissions factors only account for GHG Scope 1 and 2 emissions of the application analysed, i.e. emissions associated with production, commercialization or decommissioning of the LCT application are not included in the analysis (exception applies to biodiesel and bioethanol vehicles where a carbon emissions credit is included based on the carbon sequestrated by biofuel crop).

Global sources (applies to all models):

- Eurostat is the primary source of data for applicable markets and specific segments.
- IEA and Enerdata are the primary sources of data for power production and consumption figures.
- Eurostat is the primary source of data for energy cost figures.
- DEFRA is the primary source of data for fuel emissions factors.

** Adoption rate outlook note: sources listed in tables are non-exhaustive and only the range of adoption is provided*

Smart building – LCT equipment retrofit for commercial buildings		● Micro combined heat and power units (micro-CHP) ● Next generation LED lighting ● High-efficiency HVAC cooling and heating system ● Integrated building management systems (BMS) for lighting, heating, cooling control and automation		
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
Building floor space	Building type ● Commercial Floor space size ● Large ● Medium ● Small	Adoption rate range: ● 2010: 0-5% ● 2020: 20-25% Main Sources: ● Internal subject matter experts analysis Secondary Sources: ● "Energy Efficient Lighting for Commercial Markets", Pike Research ● "SMART 2020: Enabling the low carbon economy in the information age", The Climate Group ● US Energy Information Administration: "Commercial Buildings Energy Consumption Survey"	General factors ● Average number of retrofitted applications per building ● Average building floor space Capital factors ● Cost per retrofitted application Energy factors ● Benchmark energy consumption per building floor space ● Efficiency premium for application Cost and carbon factors ● Grid carbon emissions factors ● Cost of electricity	Applicable market grows at average CAGR of 2005-2008 year range Split of total floor space according to size and type of buildings Cost of retrofitted applications is fixed in time Cost and carbon savings computed on the basis of efficiency premiums for each application

Smart building – Integrated solution for new commercial buildings	• Construction (new-builds) of smart commercial buildings which integrates BMS, high-efficiency HVAC, new insulation material, LED lighting, optimal design for natural air circulation and heat convection, green roof (where appropriate) and additional embedded LCT applications			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
New building floor space constructed per year	Building type • Commercial Floor space size • Large • Medium • Small	Adoption rate range: • 2010: 5-10% • 2020: 50-55% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "SMART 2020: Enabling the low carbon economy in the information age", The Climate Group • "Energy Efficiency in Buildings", World Business Council for Sustainable Development	Capital factors • Cost of construction of smart building Energy factors • Benchmark energy consumption per building floor space • Efficiency premium for smart buildings new builds Cost and carbon factors • Grid carbon emissions factors • Cost of electricity	Applicable market grows at average CAGR of 2005-2008 year range Cost of construction included – premium cost of embedding LCT estimated at 5-7% of conventional construction costs Cost and carbon savings computed on the basis of efficiency premiums for smart building relative to conventional building

PV solar panels for decentralized power generation for households	• PV solar panels			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Number of households	Building type • Households only	Adoption rate range: • 2010: 0-5% • 2020: 5-10% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Roadmap 2050, A practical guide to a prosperous, low-carbon Europe", European Climate Foundation • "Paying For Renewable Energy – TLC at the Right Price", Deutsche Bank	General factors • Average surface of solar panels coverage on households • Power intensity of solar panels per surface unit • Capacity factor (production/ capacity ratio – on a per country basis) Capital factors • Cost per kW of solar power capacity Energy factors • Share of energy used by households • Share of energy sold to grid Cost and carbon factors • Grid carbon emissions factors • Cost of electricity	Applicable market grows at average CAGR of 2004-2007 year range Assumed half of electricity is sold back to grid and other half is substituting conventional electricity supply (essentially due to time of use) Cost savings are calculated based on substituted power consumption Rooftop PVs are assumed to have a 25% higher cost compared to ground-mounted PVs A cost savings premium was added for countries with a FIT to account for additional revenues generated from installation of solar power

Smart grid infrastructure – Advanced control and management of electricity grid	• Monitoring and control of electricity distribution infrastructure • Demand and Supply Management infrastructure for electricity distribution automation and control			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Number of primary substations	Grid location • Urban • Non-urban	Adoption rate range: • 2010: 0-5% • 2020: 40-45% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Carbon Connections" report, Accenture and Vodafone • "Delivering smart metering in the UK market", Accenture • "The journey to smart grid communications infrastructure", Accenture	Capital factors • Cost of smart grid infrastructure per each subcomponent (back-up, substation, IT infrastructure) – based on Accenture Smart Grid Services data Energy factors • Total electricity production • Transmission and distribution losses • Reduction in losses from optimal loading Cost and carbon factors • Grid carbon emissions factors from Enerdata • Cost of electricity	Applicable market grows at average CAGR of 2004-2007 year range Number of primary substations directly related to number of households in grid location Reduction in losses only impacts non-physical losses Cost of electricity fixed in time Cost of smart grid infrastructure equipment is assumed fixed in time

Advance metering infrastructure for electric smart meters (AMI with AMM meters)	• Advance metering infrastructure for electricity consumption to optimize loading • AMM Smart Meter roll-out to provide advanced consumer electricity monitoring functionalities			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Number of meters	Meter use • Household • Commercial	Adoption rate range: • 2010: 5-10% • 2020: 80-85% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Smart metering – a review of experience and potential across multiple geographies", Datamonitor • "Delivering smart metering in the UK market", Accenture • "Annual Report on the Progress in Smart Metering", European Smart metering Alliance, January 2010	Capital factors • Cost of smart meter infrastructure per each subcomponent (AMM smart meter, AMI infrastructure, load control system, etc) Energy factors • Total electricity consumption • Total electricity production • Transmission and distribution losses • Change in consumer behaviour (AMM) • Operational efficiency gains for businesses • Network loading optimization Cost and carbon factors • Grid carbon emissions factors from Enerdata • Cost of electricity	Applicable market grows at average CAGR of 2004-2007 year range Number of private meters directly related to number of households Number of commercial meters derived from "The European Wireless M2M Market", Berg Insight Cost of equipment and efficiency savings derived from pilot and implementation projects – Accenture Smart Metering experts reviewed

Large-scale wind power generation	• Offshore wind power • Onshore wind power			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Gross electricity production per year (kWh)	Electricity production sources • Offshore wind power • Onshore wind power	Adoption rate range (Onshore): • 2010: 0-5% • 2020: 10-15% Adoption rate range (Offshore): • 2010: 0-5% • 2020: 0-5% Main Sources: • Enerdata 2020 power mix forecasts, POLES model • Barclays Capital Renewables 2015 Outlook • Eurostat and IEA database	General factors • Percentage of useful power of capacity, i.e. capacity factor (production/ capacity) Capital factors • Cost of technology per kW of capacity as a function of year (projections from TECHPOL) Energy factors • Total electricity consumption • Total electricity production Cost and carbon factors • Grid carbon emissions factors	Applicable market grows at average CAGR of 2005-2008 year range Operation of renewable electricity generation produces zero carbon emissions Assume linear decrease of technology cost between year data points provided in TECHPOL

Large-scale geothermal power generation	• Large-scale geothermal power			
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Gross electricity production per year (kWh)	Electricity production sources • N/A	Adoption rate range: • 2010: 0-5% • 2020: 0-5% Main Sources: • Enerdata 2020 power mix forecasts, POLES model • Eurostat and IEA database	General factors • Percentage of useful power of capacity, i.e. capacity factor (production/ capacity) Capital factors • Cost of technology per kW of capacity as a function of year (projections from TECHPOL) Energy factors • Total electricity consumption • Total electricity production Cost and carbon factors • Grid carbon emissions factors	Applicable market grows at average CAGR of 2005-2008 year range Operation of renewable electricity generation produces zero carbon emissions Assume linear decrease of technology cost between year data points provided in TECHPOL

Large-scale biomass power generation		Large-scale biomass power generation		
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
Gross electricity production per year (kWh)	Electricity production sources • N/A	Adoption rate range (Onshore): • 2010: 0-5% • 2020: 5-10% Main Sources: • Enerdata 2020 power mix forecasts, POLES model • Eurostat and IEA database	General factors • Percentage of useful power of capacity, i.e. capacity factor (production/ capacity) Capital factors • Cost of technology per kW of capacity as a function of year (projections from TECHPOL) Energy factors • Total electricity consumption • Total electricity production Cost and carbon factors • Grid carbon emissions factors	Applicable market grows at average CAGR of 2005-2008 year range Operation of renewable electricity generation produces zero carbon emissions Assume linear decrease of technology cost between year data points provided in TECHPOL

Large-scale solar power generation		• Concentrated solar power – thermal (CSP) • Photovoltaic solar power (PV)		
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
Gross electricity production per year (kWh)	Electricity production sources • CSP • PV	Adoption rate range: • 2010: 0-5% • 2020: CSP: 0-5% PV: 0-5% Main Sources: • Enerdata 2020 power mix forecasts, POLES model • Eurostat and IEA database • Barclays Capital Renewables 2015 Outlook	General factors • Percentage of useful power of capacity, i.e. capacity factor (production/ capacity) Capital factors • Cost of technology per kW of capacity as a function of year (projections from TECHPOL) Energy factors • Total electricity consumption • Total electricity production Cost and carbon factors • Grid carbon emissions factors	Applicable market grows at average CAGR of 2005-2008 year range Operation of renewable electricity generation produces zero carbon emissions Assume linear decrease of technology cost between year data points provided in TECHPOL

Alternative fuel light commercial vehicles	• Plug-in hybrid vehicles – PHEV • Electric vehicles – EV • Bio-ethanol vehicles – BE • Bio-diesel vehicles – BD • CNG fuel vehicles – CNG			
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
New registration of lorries	Lorries capacity • <1,500kg • >1,500kg Engine type • Plug-in hybrid • Electric • Bio-ethanol • Bio-diesel • CNG fuel	Adoption rate range (Onshore): • 2010: 0-5% • 2020: PHEV: 5-10% EV: 0-5% BE: 0-5% BD: 20-25% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Carbon Connections" report, Accenture and Vodafone • "Supply Chain Decarbonization", Accenture and World Economic Forum • "Roadmap 2050, A practical guide to a prosperous, low-carbon Europe", European Climate Foundation • "Equity Research, Energy Technology / Auto Parts and Equipment, Electric Vehicles", Credit Suisse	General factors • Average distance travelled per vehicle per year Capital factors • Cost premium for alternative fuel vehicles compared to standard diesel commercial light vehicle added to standard vehicle cost Energy factors • Price of fuel per type of fuel (or alternative energy supply – i.e. electricity) • Fuel consumption per vehicle type (for the vehicle's fuel of alternative energy supply) Cost and carbon factors • Cost of fuel or alternative energy supply • Emissions factor for fuel type	Applicable market grows at average CAGR of 2004-2007 year range Cost of alternative vehicle decreases linearly overtime to converge towards diesel vehicle cost by 2030 Fuel consumption calculated assuming a fixed energy requirement per unit distance across all vehicle types Price of fuel or electricity is assumed fixed in time Lifecycle emissions credit is allocated to biodiesel and bioethanol to account for carbon sequestration

Alternative fuel public transit vehicles		• Electric vehicles – EV • Bio-ethanol vehicles – BE • Bio-diesel vehicles – BD		
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
New registration of public buses and coaches	Vehicle type • Public buses • Coaches Engine type • Electric • Bio-ethanol • Bio-diesel	Adoption rate range: • 2010: 0-5% • 2020: EV:15-20% BE: 0-5% BD: 15-20% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Supply Chain Decarbonization", Accenture and World Economic Forum • "Roadmap 2050, A practical guide to a prosperous, low-carbon Europe", European Climate Foundation • "Equity Research, Energy Technology/ Auto Parts and Equipment, Electric Vehicles", Credit Suisse	General factors • Average distance travelled per vehicle per year Capital factors • Cost premium for alternative fuel vehicles compared to standard diesel public vehicle added to standard vehicle cost Energy factors • Price of fuel per type of fuel (or alternative energy supply – i.e. electricity) • Fuel consumption per vehicle type (for the vehicle's fuel of alternative energy supply) Cost and carbon factors • Cost of fuel or alternative energy supply • Emissions factor for fuel type	Applicable market grows at average CAGR of 2004-2007 year range Cost of alternative vehicle decreases linearly overtime to converge towards diesel vehicle cost by 2030 Fuel consumption calculated assuming a fixed energy requirement per unit distance across all vehicle types Price of fuel or electricity is assumed fixed in time Lifecycle emissions credit is allocated to biodiesel and bioethanol to account for carbon sequestration

Alternative fuel freight vehicles	• Electric vehicles – EV • Bio-ethanol vehicles – BE • Bio-diesel vehicles – BD			
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
New registration of lorries, semi trailers, trailers	Vehicle type • Lorries >1.5t • Lorries <1.5t • Semi-trailers Engine type • Electric • Bio-ethanol • Bio-diesel	Adoption rate range (Onshore): • 2010: 0-5% • 2020: EV: 0-5% BE: 0-5% BD: 15-20% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Supply Chain Decarbonization", Accenture and World Economic Forum • "Roadmap 2050, A practical guide to a prosperous, low-carbon Europe", European Climate Foundation	General factors • Average distance travelled per vehicle per year Capital factors • Cost premium for alternative fuel vehicles compared to standard freight public vehicle added to standard vehicle cost Energy factors • Price of fuel per type of fuel (or alternative energy supply – i.e. electricity) • Fuel consumption per vehicle type (for the vehicle's fuel of alternative energy supply) Cost and carbon factors • Cost of fuel or alternative energy supply • Emissions factor per fuel type	Applicable market grows at average CAGR of 2004-2007 year range Cost of alternative vehicle decreases linearly overtime to converge towards diesel vehicle cost by 2030 Fuel consumption calculated assuming a fixed energy requirement per unit distance across all vehicle types Price of fuel or electricity is assumed fixed in time Lifecycle emissions credit is allocated to biodiesel and bioethanol to account for carbon sequestration

New design and fuel-efficient container freight sea vessels	• New design and fuel-efficient container freight sea vessels (includes electric driven propellers, combined heat and power systems, optimal energy management systems)			
Applicable Market	Specific Segments	Adoption Rate Outlook*	Calculation Factors	Key Assumptions
Number of new vessels constructed per year	Vessel type • Container • Vehicle • Roll-on/roll-off	Adoption rate range: • 2010: 10-15% • 2020: 40-50% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Liner Industry Valuation Study", IHS Global Insight, World Shipping	Capital factors • Cost premium for new energy-efficient vessel compared to alternative standard vessel added to cost of standard vessel Energy factors • Average fuel consumption • Energy efficiency premium for new vessel Cost and carbon factors • Price of fuel • Emissions factor per fuel type	Applicable market grows at average CAGR of 2005-2009 year range Price of fuel is fixed in time Only new ships registered in EU countries were taken into account – efficiency gains on foreign ship movements has not been included

e-vehicle charging infrastructure		• e-vehicle charging end-points with high-voltage, high-amperage grid connection • distributed batteries and super-capacitors to reduce stress and peak demand on grid loading		
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Length of urban road network	Road type • Communal • Regional • National Equipment type • Charging pylons • Charging stations • Distributed batteries	Adoption rate range • 2010: 0-5% • 2020: 35-40% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Betting on Science Disruptive Technologies in Transport Fuels", Accenture	General factors • Number of charging stations per city • City size in terms of road network • Charging stations required per km of road • Number of distributed batteries required per station Capital factors • Cost of charging station (from benchmark of charging stations implementation projects)	Applicable market grows at CAGR of past four years Cost of charging stations fixed in time Relative proportion of distributed batteries, stations and pylons is assumed fixed for all areas

Intelligent transport system infrastructure		• Intelligent urban traffic system for traffic control		
Applicable Market	**Specific Segments**	**Adoption Rate Outlook***	**Calculation Factors**	**Key Assumptions**
Length of urban road network	Road type • Communal • Regional • National	Adoption rate range • 2010: 5-10% • 2020: 25-30% Main Sources: • Internal subject matter experts analysis Secondary Sources: • "Carbon Connections" report, Accenture and Vodafone • "SMART 2020: Enabling the low carbon economy in the information age", The Climate Group • "Equity Research, Energy Technology/ Auto Parts and Equipment, Electric Vehicles", Credit Suisse	General factors • Total distance travelled by passengers per year • Share of distance travelled in urban areas • Number of ITS units required per km Capital factors • Cost of ITS unit including subcomponents Energy factors • Increase in urban speed from ITS • Reduction in emissions from increased speed Cost and carbon factors • Price of fuel • Emissions factor per fuel type	Applicable market grows at CAGR of past four years Reduction in fuel consumption is inversely proportional to speed increase within the range of urban speeds (Ministry of Economy, Trade and Industry, Japan, International Meeting on Mid-Long Term Strategy for Climate Change, June 2008) Impact on urban speed improvement is proportional on ITS coverage

Appendix VI

Power mix forecasts methodology

THE POLES MODEL – Prospective Outlook on Long-term Energy Systems – was used to forecast the mix of energy sources for the electricity grid on a per country basis. This is required to estimate the emissions savings which result from a reduction or substitution of electricity consumption in the capital, emissions and cost savings sizing model.

Model details

ENERDATA, IN COLLABORATION with LEPII (formerly IEPE – Institute of Energy Policy and Economics) and IPTS, coordinates studies on long-term energy outlooks at world level with the POLES model. The POLES model provides a valuable tool for addressing the long-term energy, technology and climate change issues. Its world dimension makes explicit the linkages between the energy demand and supply.

The model simulates the energy demand and supply for 32 countries and 18 world regions. There are 15 energy demand sectors (main industrial branches, transport modes, residential and service sectors), about 40 technologies of power and hydrogen production. For the demand side, behavioural equations take into account the combination of price and revenue effects, technical and economic constraints and technological trends.

More details: http://www.enerdata.net/enerdatauk/tools/Model_POLES.html

Scenario calibration

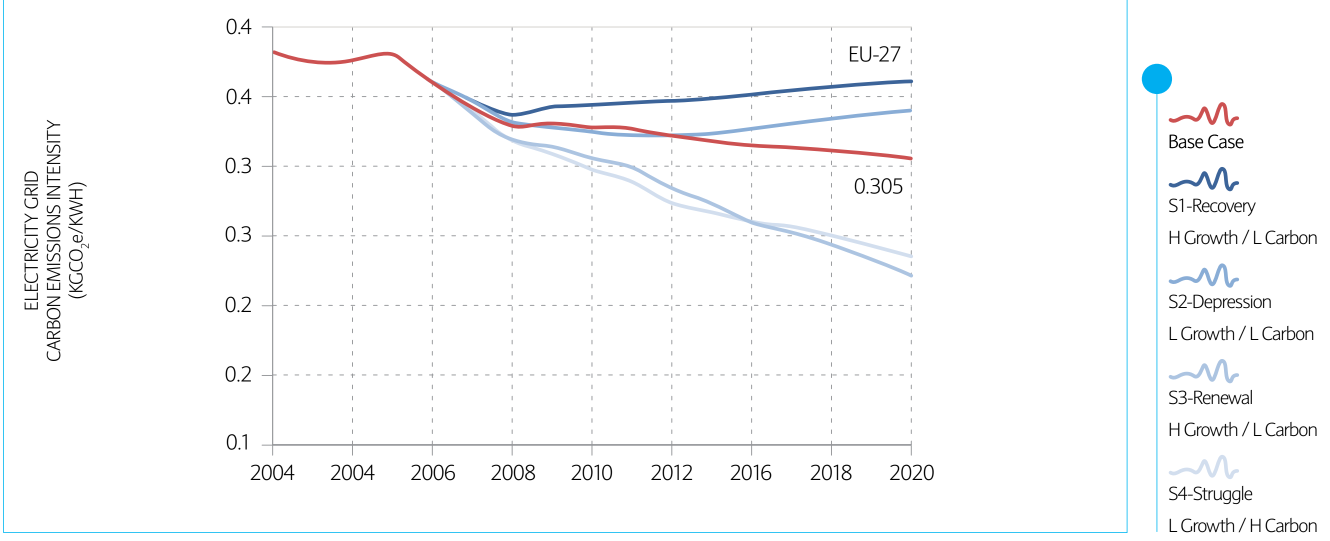
THE POLES MODEL provides four scenarios of long-term power mix forecasts:

- Renewal: sustained economic recovery and global implementation of climate change regulations and policies.
- Recovery: sustained economic recovery and no consensus on international climate change policies.
- Struggle: poor economic recovery further damped by restrictive climate change regulations.
- Depression: strong economic downturn and no consensus on international climate change policies.

The capital, emissions and cost savings sizing model has been calibrated using a base case which is an intermediate scenario that combines the Renewal and Recovery POLES model scenarios. The base case scenario is generated by a linear combination of the results from the Renewal (S3) and Recovery (S1) scenarios, and which seeks to capture a world where economic recovery is confirmed, but where there is a moderate impact from climate change regulations. The weighting in the linear combination was chosen based on consultations with internal experts.

An illustration of the different scenarios provided by the POLES model for EU-27 and the chosen base-case is presented below in terms of the electricity grid carbon emissions intensity:

ELECTRICITY GRID CARBON EMISSIONS INTENSITY – EU27



Appendix VII

Bibliography

Action amid uncertainty: The business response to climate change, Ernst & Young, May 2010

Barclays Capital Global Carbon Index Guide, Barclays Capital, May 2008

Barclays PLC 2009 Responsible Banking Review, Barclays PLC, 2009

Betting on Science: Disruptive Technologies in Transport Fuels, Accenture, 2009

Carbon Connections: Quantifying mobile's role in tackling climate change, Vodafone; Accenture, July 2009

Carbon Disclosure Project 2009 – Global 500 Report, Carbon Disclosure Project, 2009

Cleantech comes of age, PricewaterhouseCoopers, April 2008

Cleantech matters: Going big: the rising influence of corporations on cleantech growth, Ernst & Young, 2009

Cleantech matters: The Future of Energy, Ernst & Young; Bloomberg New Energy Finance, 2010

Climate Change 2007: Impacts, Adaptation and Vulnerability, IPCC Working Group II Report, 2007

Climate change – a business revolution? How tackling climate change could create or destroy company value, The Carbon Trust, 2008

Climate principles progress review, PricewaterhouseCoopers, January 2010

Deciding the Future: Energy Policy Scenarios to 2050, WEC, 2007

Delivering the low-carbon economy – Business opportunities for UK manufacturers, EEF; Deloitte, January 2008

DWS Climate Change Fund Prospectus, Deutsche Bank, October 2009

Energy Efficiency in Buildings: Business realities and opportunities, WBCSD, July 2008

Energy Efficiency in Buildings: Transforming the market, WBCSD, August 2009

Equity Research, Energy Technology/Auto Parts & Equipment, Electric Vehicles, Credit Suisse, December 2009

Financial Risk Management Instruments for Renewable Energy Projects, UNEP, 2004

Financing a private sector recovery, Department for Business, Innovation & Skills, HM Treasury, July 2010

Financing the Response to Climate Change, IMF, March 2010

Five Emerging U.S. Public Finance Model: Powering Clean-Tech Economic Growth and Job Creation, Clean Edge, October 2009

Focus for success: A new approach to commercializing low carbon technologies, The Carbon Trust, July 2009

GET FiT Program: Global Energy Transfer Feed-in-Tariffs for Developing Countries, Deutsche Bank Group, April 2010

Global Climate Change Policy Tracker: An Investor's Assessment, Deutsche Bank, October 2009

Global Industry Surveys – Banking: Europe, S&P, January 2010

Investing in Climate Change 2009: Necessity and Opportunity in Turbulent Times, Deutsche Bank Group, October 2008

Investing in Climate Change: An Asset Management Perspective, Deutsche Asset Management, October 2007

Low Carbon Refurbishment of Buildings: A guide to achieving carbon savings from refurbishment of non-domestic buildings, The Carbon Trust, 2007

Paying for Renewable Energy: TLC at the Right Price. Achieving Scale through Efficient Policy Design, Deutsche Bank Group, December, 2009

Private Financing of Renewable Energy: A Guide for Policymakers, UNEP; SEFI; Bloomberg, New Energy Finance; Chatham House, December 2009

Profiting from the low-carbon economy, McKinsey, 2009

Roadmap 2050: A practical guide to a prosperous low-carbon Europe Vol.1, The European Climate Foundation, April 2010

Seizing the Opportunities in the Low-Carbon Economy, Accenture, 2010

Smart 2020, The Climate Group, 2008

Supply Chain Decarbonization, Accenture; The World Economic Forum, January 2009

The Business of Climate Change: Challenges and Opportunities, Lehman Brothers, February 2007

The Stern Review on the Economics of Climate Change, Stern, Nicholas, October 2006

Transformation Cleantech: enabling the business response to climate change, Ernst & Young, 2008

Transitioning to a Renewable Energy Future, International Solar Energy Society, 2003

Unlocking investment to deliver Britain's low carbon future, The Green Investment Bank Commission, June 2010

World Energy Technology Outlook – 2050: WETO-H2, The European Commission, 2006

World energy, technology and climate policy outlook 2030: WETO, The European Commission, 2003

Glossary of terms

Financial services terminology

Asset Backed or Securitized Bonds
Similar to ordinary bonds but have a specific set of revenue generating assets, which are put into a special purpose vehicle (entity) and pay the bond holder their interest and principal

Asset Management
Management of various securities (shares, bonds and other securities) and assets which can be structured in funds made available to investors

Bonds
Debt securities which are similar to loans, usually providing access to debt on a long-term basis to fund large assets or corporate development. Bond usage (and debt in general) helps limit shareholders' equity dilution

Corporate and Investment Bank (CIB)
A financial institution that provides banking, finance, trading, investment, risk management and advisory services to large corporations and investors

Cost of Capital
The weighted average of a firm's costs of debt and equity, in turn linked to risk involved in the underlying project or company

Credit Ratings
Rating of debt borrowers which reflects the likelihood of defaults (usually provided by one of the major rating agencies: Moody's, Standard and Poor's (S&P) and Fitch)

Debt
Securities such as bonds, mortgages and other forms of notes that indicate the intent to repay an amount owed. A cash payment of interest and/or principal is made at a later date

Development Capital
Capital provision for growth or expansion of a company, supporting commercialization of its products and services and financing of its operations

Equity
An investment in exchange for part ownership of a company entitled to the earnings of a company after debt-holders have been paid

European Investment Bank (EIB)
European Union's long-term lending institution established in 1958

Exchange Traded Fund (ETF)
An investment fund traded on stock exchanges, much like stocks, which holds assets such as stocks, commodities, or bonds

Feed-in-Tariff (FIT)
A common policy mechanism to encourage the adoption of renewable energy sources. A FIT is essentially a premium rate paid for clean energy generation (e.g. from solar panels or small wind turbines), typically on a small scale, and is often guaranteed for a long-term period

Green Bond
A bond which results from the securitization of the debt of low carbon technologies infrastructure and equipment roll-out. The bond's underlying assets can be required to comply with environmental requirements to retain this label and benefit from fiscal incentives

Green Investment Bank Commission (GIBC)
An independent group which advises the UK Government on best practice for higher investment in low carbon infrastructure and technologies

Initial Public Offering (IPO)
Process of raising equity capital from public markets where common stocks of a company are issued to investors which can then hold these securities or trade them

Investment Vehicle
An investment structure such as a fund which is legally distinct and combines securities, assets or other financial instruments

Joint Venture (JV)
A venture undertaken by a partnership in which risks and profits are shared between participating entities

Mezzanine Finance
Lending which sits between the top level of senior bank debt and the equity ownership of a project or company. Mezzanine loans take more risk than senior debt because regular repayments of the mezzanine loan are made after those for senior debt; however, the risk is less than equity ownership in the company. Mezzanine loans are usually of shorter duration and more expensive for borrowers, but pay a greater return to the lender

Pay As You Save (PAYS)
A finance solution that gives an entity the opportunity to invest in energy efficiency equipment and micro-generation technologies

for their facilities, and pay back the capital expenditure based on the energy cost savings achieved

Private Equity (PE)
Equity capital invested in companies that are not publicly traded on a stock exchange

Private Investment in Public Equity (PIPE)
The purchase of privately issued securities directly from a publicly quoted company, typically at a discounted rate

Procurement Capital
Capital provision for procurement of equipment or roll-out of infrastructure

Project Finance
Debt and equity made available for a large project financing, usually linked to the revenue the project will generate over a period of time used to pay back the debt

Risk Weighted Assets (RWA)
Total of all assets held by a bank which are weighted for credit risk according to a formula determined by regulators

Special Purpose Vehicle (SPV)
A discrete business entity created around a project, in a legal form, to permit lending and equity investments, disconnected from other obligations or activities of a parent company

Tier 1 Capital
Assets that banks declare as its Tier 1 Capital (i.e. "core capital" used as the primary measure of a bank's financial strength), as defined in Basel II, must be purely composed of shareholders' equity and retained earnings

Tier 1 risk-based capital ratio
Ratio of a bank's Tier 1 capital to its total risk-weighted assets

Venture Capital (VC)
Early-stage or growth-stage financing of a company's development where product or service is being conceived, tested, piloted and progressively commercialized

Low carbon technology terminology

Advanced Metering Infrastructure (AMI)
An infrastructure supporting and including AMM smart meters which includes meter data management

Advanced Meter Management (AMM)
AMM configuration of smart meters enables the end user to optimize its energy consumption behaviour and adjust daily consumption usage and allows the utility provider to improve electricity distribution efficiency across the network

Capacity Factor
The ratio of energy production output over installed production capacity

Cleantech
The panel of technologies which, once implemented, lead to a significant positive impact on the environment. These mainly include applications in renewables, information technology, alternative transport, waste, water and agriculture

Combined Heat and Power (CHP)
Recovery of waste heat from power generation to provide heating, also known as cogeneration

Concentrated Solar Power (CSP)
A technology that converts solar energy into electricity by concentrating solar radiation

Decentralized Electricity Production
Generation of electricity from a number of small capacity electricity production units which are usually solar panels or CHP (also referred to as micro-generation)

HVAC
Heating, ventilating, and air conditioning

Light-Emitting Diode (LED)
Semiconductor light source originally used as a light indicator and now increasingly used for lighting

Low Carbon Technology (LCT)
Equipment and infrastructure which enable direct or indirect carbon emissions reduction, with application in buildings, electricity distribution, electricity production, transport vehicles and transport infrastructure (the full range of applications considered in this study is presented in Appendix I). Examples include bio-fuel vehicles, intelligent transport infrastructure, smart buildings, smart grid and renewable energy

Plug-in Hybrid (PHEV)
Hybrid vehicles with a battery which can be charged directly when plugged in

Photovoltaic (PV)
A technology that converts solar energy into electricity using solar cells

Low carbon technology terminology

Renewable Energy
Energy sources which include (for the purpose of this study): solar, wind, geothermal, biomass, tidal and wave energy

Renewable Energy Certificate (REC)
Digital certificates which hold details on electricity generation, origin and usage. They are used to provide a financial incentive to encourage investment in renewable energy production

Renewable Obligations Certificate (ROC)
REC scheme applied in the UK

Smart Building
Automation and control of lighting, heating, air ventilation and cooling to achieve optimal energy efficiency within buildings. Smart buildings can also integrate a number of additional features which improve energy efficiency and energy autonomy, including micro-generation, new insulation material and more

Smart Grid
Infrastructure improving efficiency of electricity grids through active monitoring and control of the transmission and distribution network

General terminology

Business as Usual (BAU)
Business as usual projection in the context of forecast scenarios

Carbon Dioxide Equivalent (CO_2e)
Expression of greenhouse gas emissions in equivalent units of carbon dioxide emissions

EU25 countries
The 25 European member countries of the European Union, before the accession of Romania and Bulgaria in January 2007

EU ETS
Emissions trading scheme in the EU. The scheme requires companies in selected industries (power, transport, chemicals, and materials) to limit their GHG emissions to a certain allowance and to purchase additional permits from the ETS market if they exceed this allowance

Green House Gas (GHG)
Gas which results in increased solar radiation reflectivity to the earth's surface, leading to an increase in temperature. Six GHGs are defined by the IPCC: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6)

Gt CO_2e
A billion tonnes of CO_2e, also known as one giga-tonne

kW, MW and GW
Watts (W) is the unit used to provide the power intensity of an energy production site:
1,000,000,000 W = 1,000,000 kW = 1,000 MW = 1 GW

kWh, MWh and GWh
Watt-hours (Wh) is the unit used to provide the power output over a fixed amount of time of an energy production site:
1,000,000,000 Wh = 1,000,000 kWh = 1,000 MWh = 1 GWh

Mt CO_2e
A million tonnes of CO_2e, also known as one mega-tonne

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