Bloomberg
NEW ENERGY FINANCE

Weathering the Storm

Public funding for low-carbon energy in the post financial crisis era

November 2010

UNEP

SEF ALLIANCE

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The development of this report was funded by the UNEP SEF Alliance. The presentation of the material in this publication does not imply the expression of any opinion or endorsement whatsoever on the part of the UNEP SEF Alliance. The responsibility for the content of this report lies solely with the authors.

Section 1. Executive Summary

Clean energy technology development has arrived at a crucial juncture.

Since the new century began, enormous progress has been made along practically all experience curves associated with low-carbon energy generation. As a result, the cost to manufacture wind, solar, biomass and geothermal equipment has plummeted, and operating efficiencies have soared. Yet generating a watt of clean power is for the most part not yet cost competitive with producing from coal and natural gas. While some of this gap is attributable to the current ultra-low price for natural gas – against which green technologies primarily compete – clearly more innovation, experience and scale are needed before price parity can be reached in the long run.

Exacerbating the situation is what may be a long-term change in global credit markets. While borrowing costs for the most creditworthy companies have touched all-time lows, funding is now relatively scarce for start-ups and other firms developing as yet unproven technologies. For many clean energy firms, access to conventional financing can be highly restricted and prohibitively expensive.

In the Great Recession of 2008-2009, public institutions played a critical role in providing capital otherwise unavailable from private sources. Collectively, governments around the world approved more than $190bn in stimulus funding for clean energy. Multilateral state-sponsored institutions made more than $21bn in credit available in 2009 alone. The bulk of these funds will have been disbursed by the end of 2011, raising an important question: where will the next wave of capital come from to propel low-carbon technologies further down their respective learning curves toward price parity?

In the West, national budgets have been hammered by the recession. Massive national debts in key clean energy markets such as Spain, the UK and Greece have prompted deep government spending cuts that have gone beyond green-oriented subsidies to broader social welfare programmes. In the US, efforts to pass a national renewable energy standard and carbon cap-and-trade fell victim to concerns about a fragile economic recovery.

Not all countries are cutting back, however. China has maintained its upward trajectory of support for nascent and advanced clean technologies. The China Development Bank alone has made more than $40bn in credit facilities available to the wind and solar sectors in 2010.

Other national governments have seized the opportunity to foster indigenous clean energy industry by establishing state-backed funding organisations. Whether those entities -- which include Sustainable Development Technology Canada, Chile's CORFO Renewable Energy Centre and Sitra of Finland – will remain steadfast is important for low-carbon technology start-ups and producers that have not yet attained commercial scale.

This report examines the current and future roles of government support for clean energy technologies, given their various stages of development. Our basic conclusion: until these technologies are truly cost-competitive on an unsubsidised basis with their dirtier rivals, governments have little choice but to subsidise their progress if the spectre of climate change is to be addressed. It should be noted that this also is the conclusion of the International Energy Agency, which devoted unprecedented attention to the role of government support in its recently issued World Energy Outlook. The IEA said governments around the world spent $312bn in 2009 subsidising the conventional energy industry but just $57bn on the clean energy sector.

This report also identifies four specific target technologies where state funding could make a critical difference between whether a new energy technology ultimately succeeds or fails in competing with its conventional energy sector rival: utility-scale power storage and advanced batteries, advanced transport, carbon capture and storage, and advanced biofuels.

Key Findings

- In 2009, China led the world in new clean energy funds invested with $34.6bn. In 2010, the gap between China and all other countries is widening. Much of this investment in China has been spurred by a strong policy environment plus heavy state support, particularly via state-backed financial institutions and state-owned companies.
- Bloomberg New Energy Finance projects that 2011 will mark the peak year for stimulus disbursements for clean energy. In 2012 and into 2012, stimulus will drop sharply.
- A new era of fiscal austerity could have significant negative consequences for clean energy. Early examples include Spain, which has slashed subsidies for new solar projects, and the US, where stimulus funds received by overseas firms provoked a protectionist backlash.

- As stimulus begins to wind down, national and government-sponsored organisations that supported pre-commercial low-carbon technologies prior to the economic downturn in 2008 stand to play an even more important role than they do today.
- Government dollars can be put to work more efficiently than ever before in the next several years in subsidising commercially-viable technologies. This is because per-watt prices of utility scale wind turbines and, in particular, photovoltaic modules, have dropped sharply over the past 18 months. Prices could well drop further in the coming year, particularly as Chinese-made equipment plays a more prominent role in the global market.
- Market risk – as demonstrated by the pullback in clean energy stock prices – has restricted access to public equity markets and amplified the importance of government grants and credits.
- There are certain critical areas where public financing will likely be needed for not just the short- but the long-term as well. The problem of the so-called financing "Valley of Death" confronting many new technologies is largely intractable. This valley cannot be traversed without public support in many cases.
- Utility scale storage and advanced batteries, advanced transport, carbon capture and storage and advanced biofuels are four technologies that, in particular, will require further public sector investment in coming years to scale up and become truly cost-competitive.

Section 2. Scope & Methodology

In October 2010, the Sustainable Energy Finance Alliance (SEF) of the United Nations Environment Programme (UNEP) commissioned Bloomberg New Energy Finance to examine the role public finance institutions have played in sustaining the low-carbon energy sector during the recent global economic downturn. UNEP SEF Alliance also sought an assessment of the role these institutions should play going forward to foster growth of clean energy.

2.1. About the authors

Bloomberg New Energy Finance is the world's leading independent provider of news, data, research and analysis to decision-makers in clean energy, carbon markets, energy smart technologies and carbon capture and storage. The company has staff of more than 180, located in London, Washington, New York, San Francisco, Beijing, New Delhi, Tokyo, Hong Kong, Sydney, Cape Town, and São Paulo. Founded in 2004 as an independent firm, the company was acquired by Bloomberg LP in December 2009.

The UNEP SEF Alliance is a member-driven coalition of public and publicly backed organisations that finance sustainable energy markets and technologies in various countries. It was established in January 2008 and operates under the remit of the Sustainable Energy Finance Initiative of the United Nations Environment Programme. The Clean Energy Group acts as Secretariat of the UNEP SEF Alliance.

Clean Energy Group is a U.S. non-profit organisation that promotes effective clean energy policies, develops low carbon technology innovation strategies and works on new financial tools to stabilize greenhouse gas emissions.

2.2. How this study was conducted

All figures in this report, unless otherwise credited, are based on the output from Bloomberg New Energy Finance's Intelligence service — an online portal to the world's most comprehensive database of investors, projects and transactions in clean energy. Data are categorized by country.

Bloomberg New Energy Finance Intelligence collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers over 11,000 transactions, 20,000 projects and 30,000 organisations (including start-ups, major publicly-traded corporations, venture capital and private equity providers, government and quasi-government organisations, banks and other investors).

Bloomberg New Energy Finance continuously monitors investment in clean energy and energy efficiency. This is a dynamic process: as the sector's visibility grows, information flow improves. New deals come to light and existing data are refined, meaning that historic figures are constantly updated. The company each year publishes figures on total global investment in the sector. Prior to the financial crisis beginning in Q3 2008, this information included an estimate of government spending.

Since the crisis began, Bloomberg New Energy Finance has also been closely tracking stimulus spending by governments. And the company has long kept track of financing from public finance institutions such as multilateral development banks. In-depth research was conducted on UNEP SEF Alliance member organisations to learn how they responded to the fall-off in private investment and debt capital resulting from the financial crisis.

The Bloomberg New Energy Finance Global Energy and Emissions Model (GE^2M) was used to perform analyses and test findings in this report. GE^2M covers more than 200 countries and regions of the world, projecting a wide range of economic, demographic, technical and policy factors that define future emissions, investment levels and commodity prices.

2.3. Investment levels

The recent history of financing for low-carbon energy technologies can be divided into two eras: pre- and post-economic crisis of 2008. Investment in wind, solar, geothermal, and other clean energy technologies surged from $46bn in 2004 to $173bn in 2008. In 2009, the impact of the financial crisis began to be felt in the sector as investment slipped by 7% to $162bn.

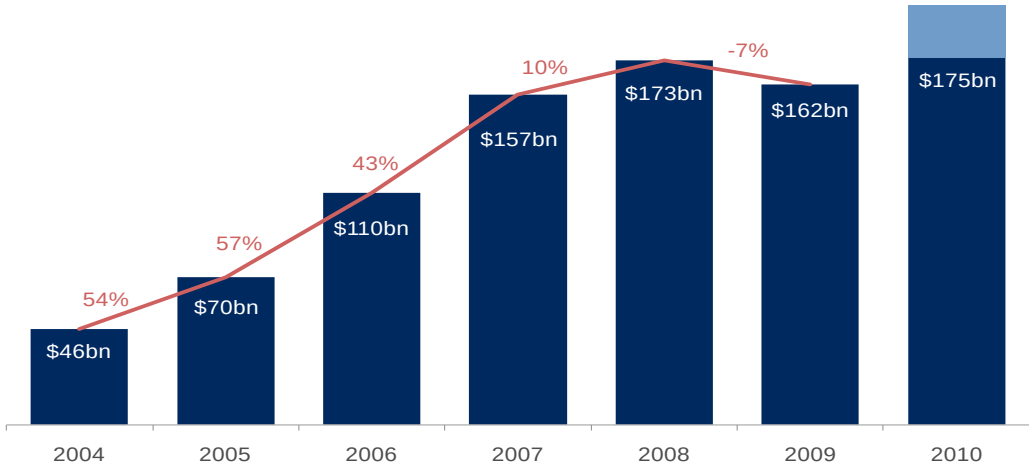
The adverse macroeconomic climate battered stock markets, hitting volatile clean energy stocks particularly hard. In the first nearly 11 months of 2010, the WilderHill New Energy Global Innovation Index, which tracks the performance of 87 clean energy stocks globally, fell 18.6%, compared with a gain of 7.2% by the MSCI World Index and 10.9% by the Nasdaq. The pullback has made it

considerably more difficult for clean energy companies to raise capital through the public equity markets.

Asset financing – funding to build wind farms, solar projects, biofuels plants and the like – was hit particularly hard by the financial crisis. Not only did lower energy prices squeeze margins, but capital became scarcer and more expensive around the world. Asset investment dropped from $21.7bn in Q1 2008 to just $18b.1n Q1 2009 then bounced back to $29.7bn in Q2 2009 and has not sunk below $25.8bn since. In Europe, despite central bank rates falling dramatically since August 2008, actual borrowing costs rose, as several lenders left the infrastructure finance business and the remaining banks demanded higher spreads.

Despite what have become difficult conditions, investment is poised for a bounce-back in 2010, to a total of $175-$200bn. Third-party financial investment in clean energy worldwide rose 12% in the third quarter of 2010 compared to Q2, helped by a burst of financings for offshore wind transmission infrastructure. Financial investment in Q3 hit $37.9bn, up from $33.9bn in the second quarter of 2010 and $34.4bn in Q2 2009.

Figure 1: Global clean energy investment ($bn), year-to-year growth rate



Source: Bloomberg New Energy Finance. Note: Red line indicates year-on-year growth rate. Includes all forms of financing, including venture capital/public equity, asset (project) finance, public market fund raisings, and government investment. Does not include merger and acquisition activity within the sector.

A disproportionate amount of the new investment is taking place in China. In 2009, China led the world in new clean energy funds invested with $34.6bn. The US finished a distant second with $18.6bn. China set a record for new wind capacity installed in one year with over 14GW added. By comparison, the US put 10GW new wind into the ground.

In 2010, the gap between China and the rest of the world stands to widen. For the first time since Bloomberg New Energy Finance began tracking investment the Asia/Oceania region will lead the world in total investment attracted. This surge in investment in China has been fuelled by support in the form of government directives, spending off the balance sheets of major government-owned conglomerates, and generous financing from Chinese financial institutions.

In another first for the industry, investment in solar photovoltaics is poised to top that for utility-scale wind in 2010. The cost of wind and solar equipment has declined dramatically in the past 18 months, but that is where the two technologies diverge. The wind sector is slumping; total onshore installations are expected to fall in 2010 to 36.4GW from 38GW in 2009. By contrast, solar is surging with 19.5GW possible in 2010, up from just 7GW in 2010. Given the higher per-Watt cost of solar, PV could well account for more total investment.

Section 3. Methods of Public Support

Public sector support for clean energy can take a variety of forms. Feed-in-tariffs establish artificially high prices for the sale of clean megawatt hours. Grants can cut capital expenditures for project developers or spur important technology research. National targets or mandates can give rise to credit trading schemes. We make no attempt to catalogue each one of these here. Rather, we shift our attention to the private sector perspective to examine places where government policies can be applied to various segments of the clean energy technology development and diffusion chain.

3.1. The green technology investment chain

There is no single, defined development path a new energy technology follows from laboratory to wide-scale deployment. Still, there are four broadly applicable phases most technologies pass through. These are:

1. Early R&D/Proof of Concept
2. Demonstration & Scale-Up
3. Commercial Roll-Out
4. Diffusion & Maturity

Each phase offers investors unique combinations of risk and potential reward. While some investors can and do participate in more than one stage of technology development, companies at different phases can have dramatically different levels of access to capital.

Early R&D/proof of concept

Encouraging innovation at a very early stage is the essential first step of bringing new ideas to market. Research and development of new energy technologies today takes place at major corporation laboratories or at small private companies. It is most often funded by governments either directly or through national labs or universities, or by venture investors. It can be helped by incubators or angel networks. Different clean energy technologies have very different characteristics in terms of capital intensity, level of innovation and intellectual property content, so a healthy system to accelerate and increase the volume of early-stage innovation is likely to bring together a range of different policy measures.

Demonstration & scale-up

Companies seeking to move their technology from the laboratory to the marketplace must bridge the notorious funding gap known as the “Valley of Death” -- the point when the lab work and proof-of-concept have been completed, and it is time to build the first few full-scale project or manufacturing plant. Energy technologies appear to suffer particularly high attrition at this point in the development cycle.

The fundamental problem is a dearth of capital with the right risk/reward profile combined with adequate capital resources. Venture capitalists will gladly take on significant risk but have limited capital. Banks have adequate capital but lack the appetite for risk. Bloomberg New Energy Finance and the Clean Energy Group discuss this problem in depth in the 21 June 2010 white paper "Crossing the Valley of Death: Solutions to the Next Generation Clean Energy Financing Gap".

Commercial roll-out

Proving that a new energy technology works effectively generating power at scale is not the end of the story, however. Fossil-based technologies, whether coal-fired power plants or internal combustion engines, benefit from over a hundred years’ worth of technology development and many billions of dollars of cumulative investment in their supply chains. It is no wonder that their levelised cost – the cost of generating a megawatt-hour of power without any subsidies or support mechanisms – is lower than those of new clean energy technologies.

During the commercial roll-out stage, the emphasis is on gaining experience and scaling as quickly and as efficiently as possible. This is the point at which efficacy insurance – under which the developer guarantees that if their technology fails to deliver the contracted performance they will pay another provider to step in and make good – can have a supporting role.

Technologies in this stage need economic support, but the key is to make sure such support is reduced at exactly the right speed: too fast, and you get boom-bust cycles; too slow and you create an expensive and distortive long-term subsidy. In addition, these technologies can be held back by barriers to rapid roll-out. These must be identified and removed by determined policymakers.

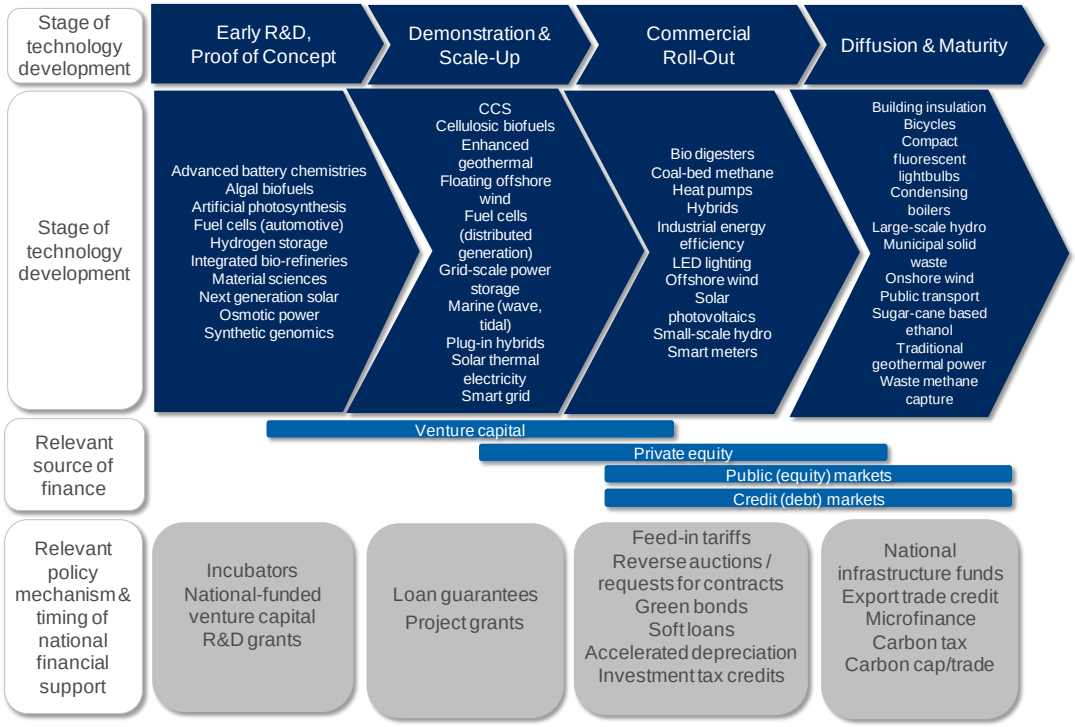
Diffusion & maturity

In an ideal world, once they have reached maturity, clean energy technologies would be able to compete on an unsubsidised basis with fossil fuels. In the very long term, this will no doubt be the case, as experience effects relentlessly drive down the cost of clean energy and depletion drives up the cost of fossil fuels.

3.2. Policy mechanisms

The day is coming when clean energy technologies can generate electricity at prices that are competitive with fossil fuels on a truly un-subsidised basis. Until then, there is an important role for government to play in helping to drive down costs and mitigate investment risks. Certain policy levers are best pulled at the earliest stages as a technology exits the labs. Others are better suited for large-scale deployment. Here we match the technology development chain against various policies.

Figure 2: Stages, sectors and public support mechanisms for green technology development



Source: Bloomberg New Energy Finance

California's Renewable Portfolio Standard is an example of a regulatory mechanism that has resulted in quantifiable effects. Established by state law in 2002 and accelerated later by an executive order of the governor, the RPS directs that 33% of the electricity sold in California come from renewable sources by 2020 – the highest state target in the US.

At the beginning of 2010, the state's major utilities served 15.4% of their collective market with renewable energy, up from 13% one year earlier. One of them, Southern California Edison, reports that in 2009 it purchased approximately 79% of all U.S. solar generation, 51% of geothermal and 5% of wind generation.

3.3. Risk mitigation: the Australian case

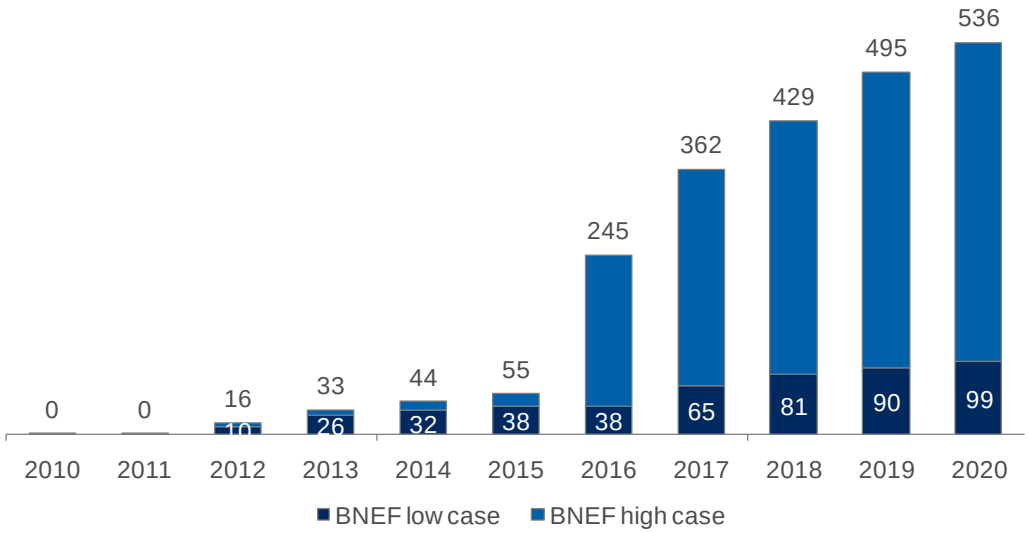
Australia is a case study of the role government funding can take in risk-mitigation. Great hopes are held for the geothermal industry in the country, but developers have had difficulty tapping extensive local resources. Risk is the biggest obstacle for the sector, and unless that risk can be addressed, geothermal capacity in Australia in 2020 may be much less than expected.

Geothermal projects in Australia are highly dependent on government funding due to the industry's early stage of development. Of the active geothermal projects in Australia, about half have so far received government grants, with AUD 231m (USD $233m) of the AUD 272m (USD $275m) allocated having come from the federal government.

The key challenge for most players in the sector at present is the cost of drilling. Based on Bloomberg New Energy Finance calculations, the cost for a single well will typically run to USD $4-7m. In Australia, however, costs have been considerably higher -- in the vicinity of AUD 10-12.5m (USD $10-12.4m). This is due to a number of factors including the remoteness of drilling sites, inexperience drilling geothermal wells and a lack of competition. In addition, Australian geothermal resources are typically located at greater depths than elsewhere in the world posing unusual challenges.

Most geothermal players in Australia have market capitalisations in the single digit millions, and with drilling of proof-of-concept wells a precursor to even building a pilot plant, raising sufficient private funds is a significant challenge. Government support will therefore continue to remain essential to the industry's development.

Figure 3: Projections of cumulative geothermal capacity in Australia



Source: Bloomberg New Energy Finance Note: The difference between the Low and High scenarios underlines the importance of reducing project risk for the geothermal industry in Australia.

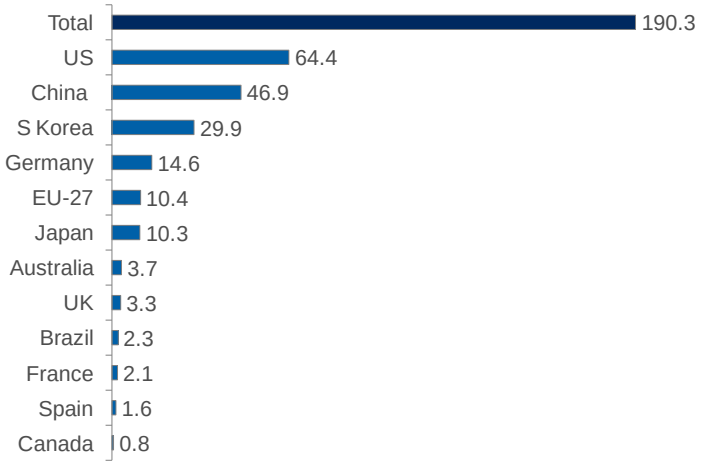
Section 4. The Great Recession and Public Sector Financing, 2008-2009

For clean energy firms of nearly every stripe, the collapse and bankruptcy of Lehman Brothers in September 2008 marked the beginning of a new and more challenging period to obtain private funding. As Western economies stared into the abyss of a potential depression, debt financing and private capital all but dried up. Governments and public financing institutions stepped into the breach with a variety of responses.

4.1. National government response: stimuli

For their part, national governments around the world created fiscal stimuli, and in almost every case earmarked a significant portion for green initiatives. Bloomberg New Energy Finance estimates that governments globally allocated no less than $190bn of stimulus funding to renewables, energy efficiency, advanced transportation, smart grid and other core clean energy technologies.

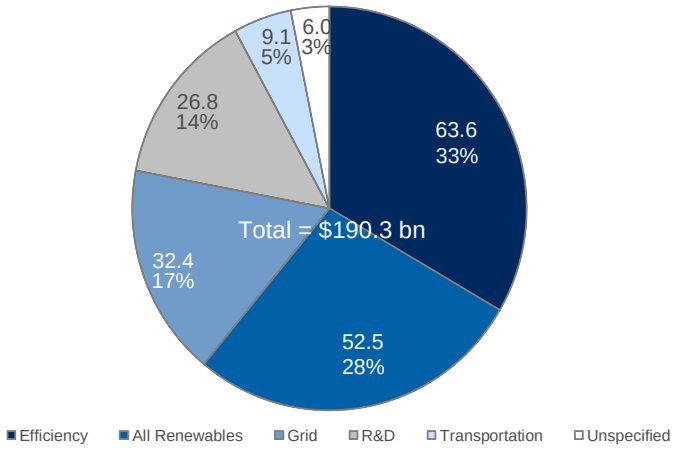
Figure 4: Global clean energy stimulus, by country ($bn)



Source: Bloomberg New Energy Finance

Energy efficiency, generally in the form of grants for the improvement of public sector buildings and for weatherizing homes, is set to take the largest slice of clean energy stimulus funds with $63.6bn globally. It is seen as a sector that not only can have a significant impact on emission reductions and reduce household energy expenditure, but also can be quickly ramped up and, critically, create local "green jobs" – ideal characteristics for stimulus funds.

Figure 5: Sector breakdown of global green stimuli



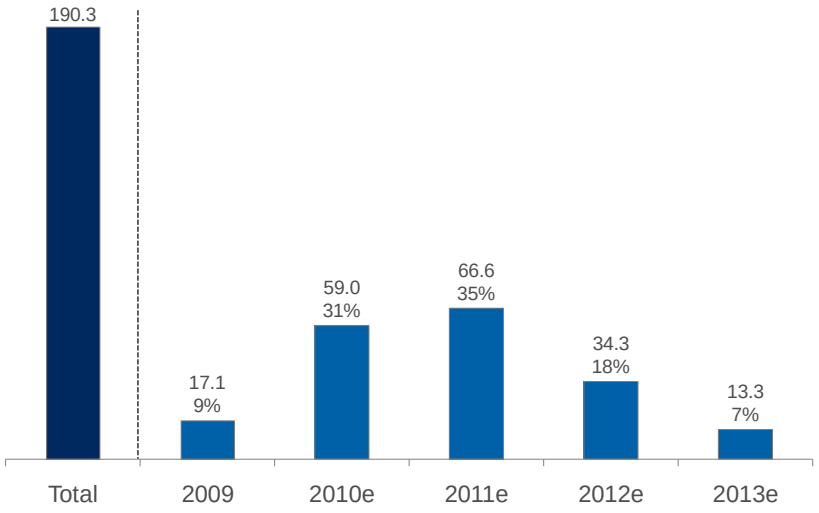
Source: Bloomberg New Energy Finance

Energy smart technologies improve the efficiency of existing processes rather than bringing additional capacity to the market. They encompass conventional energy efficiency programmes from lighting to insulation, digital energy, power storage, hydrogen and fuel cells and advanced transportation.

Overall, stimulus initiatives by national governments boosted confidence and investment just when it appeared the industry might be pulled under by the economic downdraft. Bloomberg New Energy Finance now projects that 2011 will be the peak year for stimulus disbursements. After that, the flow of funds is expected to drop sharply.

Figure 6: National government stimulus spending ($bn)

USD



Source: Bloomberg New Energy Finance

4.2. National public funding entities

As stimulus begins to wind down, national and government-sponsored organisations that historically have supported pre-commercial low-carbon technologies stand to play an even more important role than they do today. In an era of reduced venture and private capital – and higher financial hurdles for the projects they fund – these public and quasi-public organisations could be an essential vehicle in the race to a low-carbon future. Here is a look at six nations' relevant entities.

4.2.1. Carbon Trust (UK)

Table 1: Carbon Trust annual clean energy investment

Fiscal year	Disbursement ($m)
2008/09	180
2009/10	228
2010/11 (forecast)	277
Total	685

Source: Carbon Trust

Carbon Trust's mission is to accelerate the move to a low carbon economy. Its approach seeks to address not just the technology but also what it terms the company, regulatory and market "journeys" which, collectively, impact on the pace and magnitude of innovation from concept to consumer. In the fiscal year 2009/10, the trust more than doubled its investment from the prior year. In particular, the trust ramped up activity in a number of areas to use economic stimulus funding provided by the UK government. These included:

- Interest-free energy efficiency loans for businesses
- Interest-free loans for energy efficiency investment by public sector organisations through Salix Finance
- Applied research grants up to GBP 500,000
- Incubator support for early start ups
- Early stage venture capital investment
- A Marine Renewables Proving Fund to support the development of marine technology start-ups
- Expansion of the Offshore Wind Accelerator programme
- Research consortia exploring a range of clean energy technologies including next generation photovoltaics and algae for biofuels production

In September 2009, the Carbon Trust launched its Marine Renewables Proving Fund with $36m. The Fund aims to help the UK's most promising wave and tidal technologies progress toward deployment at scale in UK waters. Following a rigorous assessment process, six companies were selected for support. These firms have since received funding to help them develop full-scale, grid-connected test devices.

The demonstration of full-scale devices at sea is central to realising the full potential of marine energy and will help to 'de-risk' the technology and catalyse further investment. Beyond its initial investment, the fund has helped to leverage over $35m of private sector co-funding into these new technologies. All of the devices the fund has backed will be deployed in UK waters, which will help stimulate supply chain opportunities associated with their construction, deployment and operation.

CORFO Renewable Energy Center and National Energy Efficiency Programme (Chile)

Part of Chile's Economic Development Agency (CORFO), the Renewable Energy Center was launched in 2009 with a $1.6m budget to promote and facilitate clean energy development in the country. It followed the 2006 creation of Chile's National Energy Efficiency Programme, which has the mission of promoting efficient use as a source of energy.

Before the creation of the Renewable Energy Center, CORFO started providing funds through a series of instruments for renewable energy projects, through its divisions InvestChile and InnovaChile. It is expected that in 2011 the Renewable Energy Center will fully operate those promotion instruments, as well as designing new ones as needed.

Other examples of CORFO support include:

- The 6.3MW run-of-river Mariposas hydro plant in the Maule region -- $4.5m CORFO support
- The 108MW Lebu Sur wind farm in Region Biobío -- $33.6m
- The 1.9MW Santa Blanca sawmill cogeneration project Maule -- $2.3m

In addition, CORFO has provided support to Fibroven, a company developing products in the area of composite materials and injection systems. After its application of resin infusion moulding technology to create other products, the company identified as the production of wind-turbine blades as an entry opportunity. Fibrovent created a joint venture, Eozen América, with the Spanish wind turbine manufacturer company Eozen, CORFO supported this venture by providing a "specialized consulting" subsidy. The venture plans to have its first Chilean plant ready 2011, with a capacity of 150 blades per year.

FIRA - Agricultural Trust Funds Development Bank (Mexico)

Established in 1954 by Mexico's federal government, Trust Funds for Rural Development (FIRA) is a development bank that historically has offered credit and guarantees, training, technical assistance and technology-transfer support to the agriculture, livestock, fishing, forestry and agribusiness sectors in Mexico. Its portfolio has been expanded to promote a rural clean-energy sector in Mexico.

FIRA has two energy programmes under development. The first, FONAGA Verde, is a loan guarantee programme that aims to cover first credit defaults in energy efficiency and clean energy. The second aims to increase rural biodigester projects' profitability and operational reliability. It has focused on 18 hog-raising operations in the Yucatan Peninsula producing methane for clean electricity production.

Sitra (Finland)

Sitra is an independent public innovation fund charged with promoting stable and balanced development in Finland, the qualitative and quantitative growth of its economy, and its international competitiveness and cooperation. Its operations are funded with endowment capital and returns from capital investments. Sitra typically syndicates its early-stage investments with venture capitalists and business angels in an effort to complement the country's venture investment community. Investments are targeted at companies early in their development to fill the gap between public R&D funding and the private market. Development projects and demonstrations are targeted to develop the market for energy-efficient and clean energy investments in Finland.

Sitra is in the midst of a five-year energy programme with the objectives of promoting the transformation of Finland into an energy-efficient society; reversing the upward trend in energy consumption; encouraging Finns to save energy; creating opportunities for consumers to adopt sensible and energy-efficient solutions; and creating successful businesses in energy efficiency and sustainable energy production.

Since 2008, Sitra has made the following clean-energy disbursements:

- Development and experimental projects in Finland -- $6.5m

- Direct Venture Capital investments in Finnish companies -- $8.6m
- VC Fund investments -- in Finland $7m, internationally $20m

Sitra's energy programme has made venture capital investments in five companies with a focus on energy savings technologies and services, as well as clean energy production.

The programme has also backed the Jätkäsaari City Block for Sustainable Development project, located in the Jätkäsaari district of Helsinki. The project aims to contribute to a rapid reduction in the use of energy in the construction of blocks of flats and office blocks. Ambitious targets will be set for energy efficiency with an eye toward the block being an example of the construction of passive and plus-energy buildings.

Sitra organised an international sustainable development design competition to develop the city block and together with its partners, Sitra's energy programme will act as project developer. After the competition, further development and construction of the area will transfer to Sitra's partners. The City of Helsinki also participated in planning and allocation of the city block. Investment is expect total approximately EUR 60m.

Sustainable Development Technology Canada (SDTC)

SDTC is an arm's-length not-for-profit foundation funded by the government of Canada that operates two funds aimed at the development and demonstration of pre-commercial clean technologies. SDTC's SD Tech Fund™ supports projects that address climate change, air quality, clean water, and clean soil. Its NextGen Biofuels Fund™ supports the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation clean fuels.

Table 2: Sustainable Development Technology Canada Investments

Sector	SDTC Funding (CAD $m)	Project value (CAD $m)	% of total project value
Energy Exploration & Production	$111	$398	24%
Power generation	$92	$331	20%
Energy utilisation	$97	$321	20%
Transportation	$86	$294	18%
Waste management	$42	$131	8%
Agriculture	$36	$109	7%
Forestry, wood products, pulp & paper	$14	$57	3%
Total	**$478**	**$1,632**	**100%**

Source: Sustainable Development Technology Canada

SDTC has funded 195 clean technology projects valued at CAD 1.6bn, of which SDTC has contributed CAD 478m. SDTC's portfolio includes clean technologies being developed and demonstrated for end users in a wide range of commercial and industrial sectors.

To enable its portfolio companies' progress down the value chain towards commercialisation and market entry, SDTC actively assists and tracks investments made into its portfolio companies by the private sector following SDTC's funding. From 2005 through to September 2010, SDTC's portfolio companies raised CAD 1.6Bn in such follow-on funding from the private sector. It is further estimated that over 50% of all venture capital invested into Canadian clean technologies companies is directed towards SDTC portfolio companies. SDTC's investment selection process twins the applicant's economic or business case with the magnitude of the environmental benefits (as measured for example by tons of CO_2 avoided and other metrics) of the subject technologies once commercialized and deployed in the market. SDTC estimates that its portfolio technologies will yield a discounted GHG reduction forecast of between 7 and 17 Mt CO_2e by 2015.

Sustainable Energy Authority Ireland (SEAI)

SEAI seeks to play a leading role in transforming Ireland into a society based on sustainable energy structures, technologies and practices. SEAI's objectives include implementing strong energy efficiency actions that reduce energy demand; accelerating development and adoption of technologies to exploit clean energy sources; and supporting evidence-based responses that engage all actors.

SEAI operates multiple programmes for renewable research, development and demonstration, ocean energy, smart grid, sustainable transport, bioenergy, energy efficiency and renewable energy deployment. SEAI's recent Retrofit Programme represents a EUR 90m investment in residential, commercial and government facilities and leverages a total spend of EUR 400m. The programme's components include:

- The Home Energy Saving Scheme for the upgrade of homes built before 2006
- The Warmer Homes Scheme aimed at homes of those who are suffering from fuel poverty
- The Greener Homes Scheme, which funds the installation of renewable energy measures in homes – including solar, heat pumps and biomass boilers

In 2011, these initiatives will be brought under the umbrella of the National Energy Retrofit Programme for upgrade of Ireland's building stock to high standards of energy efficiency. It will be centred on engaging market actors to deliver upgrades efficiently and effectively, with SEAI in an oversight role ensuring quality and confidence as the new markets build.

4.3. Export finance institutions and multilateral development banks

Export finance institutions and multilateral development banks (MDB) provide vital capital for high-risk projects, as well as technical assistance and onsite monitoring to help mitigate the added risks associated with project development in developing countries. To a large extent, they have been the clean energy sector's unsung heroes, having stepped up their activities in the face of private capital's retreat. In Europe, as elsewhere, export credit agencies are continuing to play an important role in plugging the gap left by commercial lenders. "The main difference our involvement makes is that deals happen sooner," says Christopher Knowles, head of climate change and environment at the European Investment Bank.

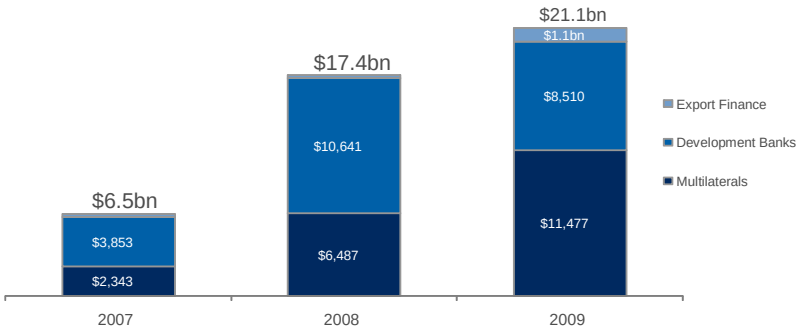
"We lend for longer than the commercial banks," Knowles said. "They may lend for tenors of perhaps seven to eight years, whereas we are happy to lend for 15 to 20 years to renewable power projects. We are also pretty competitive in terms of cost. Therefore our involvement substantially enhances the financial viability of a project." MDB loans to clean energy rose more than threefold from $6.5bn in 2007 to $21.1bn in 2009. This increase occurred partly because of international efforts to fill the gap left by commercial banks during the credit crisis, but it also indicates that the MDBs have independently raised clean energy and efficiency in their list of priorities in recent years.

The regional MDBs are among the most active lenders to clean energy, particularly in Europe, the Americas and Asia. MDBs have helped to free up the market by leveraging private sector finance that might not have been committed to projects without the input of the development banks. MDBs will continue to lend to renewable and efficiency projects in large size in 2010-11, but there are limits to their role both because they do not have unlimited funds and because they do not want their exposure to a particular sector to become too high. Development banks also play a particularly important role in the carbon markets, buying carbon credits up front to allow emissions-reducing projects to get off the ground.

According to Bloomberg New Energy Finance data, the development banks that increased lending most markedly between 2008 and 2009 included the European Investment Bank, the Inter-American Development Bank, the Asian Development Bank and the International Finance Corporation. Brazil's BNDES and Germany's KfW have maintained high levels of activity their countries as well.[1]

1 Note that the development banks themselves publish figures for renewable energy, climate-related or environmental lending that differs from the numbers in this note. The reasons are partly to do with definitions and partly to do with scale – Bloomberg New Energy Finance's data relates to utility-scale projects and corporate lending initiatives only. They exclude lending to energy efficiency improvements, for instance, and to small-scale generation.

Figure 7: Clean energy loans from multilateral finance institutions ($m unless otherwise noted)



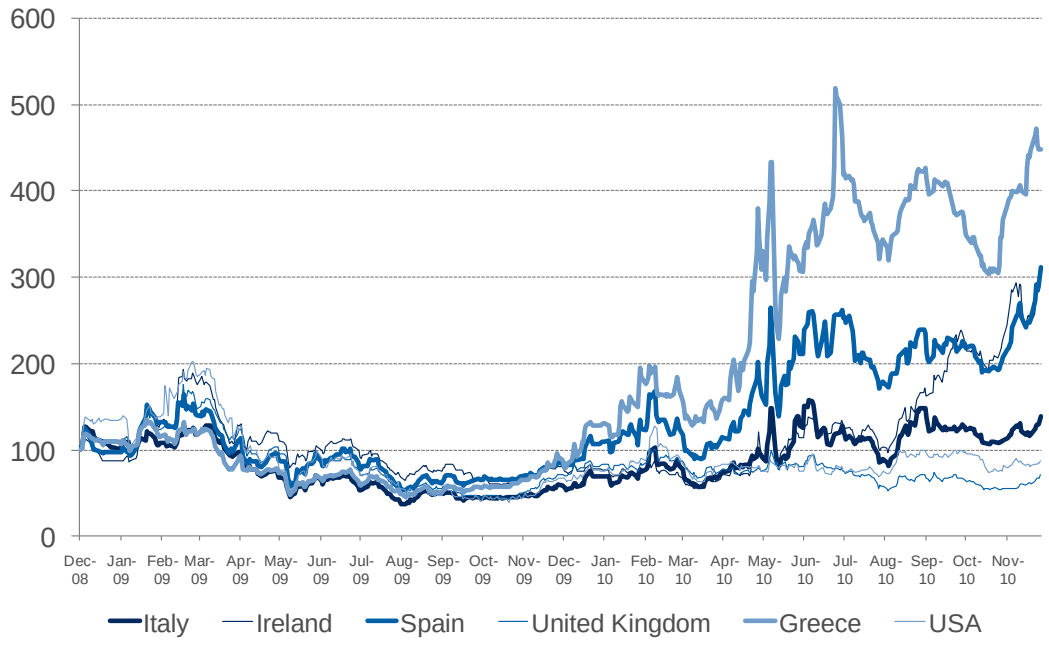
Source: Bloomberg New Energy Finance

Section 5. The Current Situation: Governments Contemplate Cutting Support

The Great Recession has spurred governments around the globe to step up their financial support for renewables. However, the downturn has also resulted in dramatically wider fiscal deficits and enormous national debts. Spain, Greece, and UK have all been forced to cut government spending significantly while substantial cuts could be on the way in the US in the wake of the recent midterm elections in which Republicans made major gains. Most recently, Ireland has required a major bailout from the International Monetary Fund and the EU.

The cost of central-government borrowing spiked then moderated in the immediate wake of 2008's capital crisis. But rates turned up again as the realization hit that certain countries, such as Greece, would be unable to service their sovereign debts without slashing expenditures in other areas.

Figure 8: Relative cost of sovereign debt, Q4 2008 - Q3 2010



Source: Bloomberg Note: Chart depicts the rising yields on collateralized debt securities with a five-year maturity. Rebased to zero starting two years ago.

A new era of fiscal austerity could have significant negative consequences for clean energy. Already, the Spanish government has said it was considering steps to disqualify retroactively some projects that were benefiting from the country's generous feed-in-tariff. In the US, the stimulus has provoked a protectionist backlash after clean energy opponent inaccurately said that projects using Chinese-made wind turbines have benefitted. The new Republican majority in the House of Representatives has suggested it might seek to rescind funds previously allocated under the 2009 stimulus law though that will prove difficult.

5.1. Spain: government cutbacks

At the recent peak of the subsidy era, Spain's 52,000 photovoltaic-panel installations earned as much as EUR 440 ($573) per megawatt-hour, or almost 10 times the coincident futures price for 2011 power in the wholesale market. Not surprisingly, the country was a magnet for investors, developers and component makers of all sizes and nationalities.

The effect on Spain's budget and the electricity bills of Spanish consumers might have been manageable if not for the global recession. In late 2008, the government slashed solar subsidies and limited the amount of solar power it would continue subsidising to just 500MW annually. To compound the setback to clean energy proponents, the cutbacks occurred just as production efficiencies were working to narrow the cost gap between solar and competing generation technologies.

Faced with the unravelling world economy and a deepening budget deficit, the Spanish government in late 2009 reduced the money it paid for solar electricity and capped the amount of subsidised solar power installed each year at 500MW. In November 2010, the Spanish government slashed feed-in tariffs for proposed solar projects to save EUR 600m (US $809m) over the next three years. Spain's solar-power capacity actually shrank in 2010 as a result.

5.2. US: protectionism grows

As governments around the world confronted the economic downturn, the clean energy sector was positioned as part of the answer; practically all announced economic recovery plans included measures to encourage the sector. The hope was that green jobs would head off massive unemployment, while investment in clean energy and efficiency would concurrently boost GDP while reducing the threat of global warming.

Today, however, policymakers are confronting the reality that some measures to stimulate clean energy investment ignored national boundaries. US stimulus grants intended to tie over the moribund project finance market often landed in the coffers of foreign-headquartered firms. There is also the growing, but incorrect, belief that Chinese wind turbine makers have benefitted from the stimulus. In September 2010, the US Steelworkers union filed a complaint with the US Trade Representative arguing that Chinese clean energy manufacturers have engaged in unfair competitive practices with their US competitors. The midterm Congressional campaigns then featured a crop of campaign advertisements that incorrectly charged the Obama administration with subsidising projects that used Chinese-made wind turbines.

At issue is the popular "Treasury grant programme" established under the 2009 stimulus law. Also known as "1603", the programme allows renewable energy project developers to apply for cash grants worth 30% of their total project costs in lieu of tax credits. In spring 2010, four Democratic senators asked Treasury Secretary Timothy Geithner to temporarily stop awarding grants under the programme while they attempt to pass legislation that would extend a “Buy American” provision from elsewhere in the stimulus law to cover the grants programme.

Geithner replied that he was unauthorized by law to suspend the programme, and the domestic-sourcing bill did not advance. But rising protectionist sentiment symbolized by the senators’ initiative has become the prevailing background in which US government support for clean energy will be considered.

Section 6. Government's roles and responsibilities

The pressure on national budgets from government support of clean energy programmes cannot be ignored in a time of increasing need for social services. Likewise, protectionism is an inescapable consequence of periods when there are insufficient domestic employment opportunities to meet demand.

But a warming planet represents a multi-decade challenge, and the race to create a vibrant low-carbon economy is of longer duration than term of office or one economic cycle. It is not possible to predict whether a technology will succeed – or when a breakthrough will appear as a speck on the horizon. If the goal is to have new energy technologies stand on their own eventually, governments have every reason to maintain current levels of support, or even step up the pace.

That sentiment was affirmed recently by the International Energy Agency (IEA). “Renewable energy sources will have to play a central role in moving the world onto a more secure, reliable and sustainable energy path,” the IEA said in its 2010 World Energy Outlook, issued 9 November. “The potential is unquestionably large, but how quickly their contribution to meeting the world’s energy needs grows hinges critically on the nature, magnitude and duration of government support to make renewable cost-competitive with other energy sources and technologies, and to stimulate technological advances.”

The gap between what governments of the world are spending on subsidising their conventional energy sectors and clean energy is vast. IEA estimates that governments around the world spent $312bn in 2009 subsidising fossils. That compares to $57bn for clean energy that same year. Bloomberg New Energy Finance has estimated the total for clean energy at $43-46bn.The challenge of clean energy technology innovation is such that markets alone will not deliver these technologies at scale and at prices which are comparable with conventional energy technologies.

6.1. Falling equipment prices

In the economic stagnation that emerged in 2008, conventional credit was choked off. However, the manufacture of turbines, modules, controllers, high-temperature drill bits, towers, switchgear, gearboxes, parabolic mirrors, digesters and various other clean energy components continued for some time as previous financings worked through the system. The result was a substantial overhang of supply compared with demand.

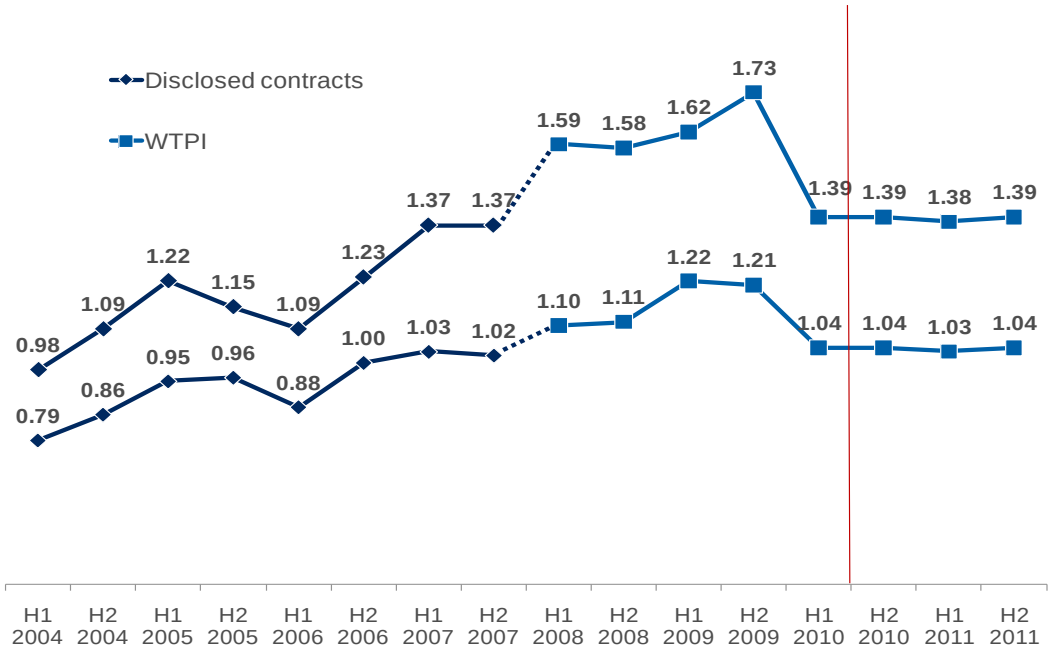
Eventually, the production glut came up against another feature of the recession: an unprecedented interruption in the growth of electricity demand in much of the developed world. The resulting availability of state-of-the art clean energy equipment and the facilities to produce it is a situation of which governments are now uniquely suited to exploit.

6.1.1. Wind

Each quarter, Bloomberg New Energy Finance evaluates the current and future price of wind equipment via its proprietary Wind Turbine Price Index. In the most recent survey, over 100 undisclosed turbine contracts totalling more than 5.5GW of capacity were reviewed. Key conclusions:

- Current global turbine prices have sunk to EUR1.04/MW, down by 14% from peak values of EUR1.21/MW.
- Under some contracts, prices are even lower. Prices for top tier manufacturers are in some cases being signed below the EUR1.00/MW benchmark.

Figure 9: Turbine prices by delivery date, 2004 –2010 ($m/MW & EUR m/MW)

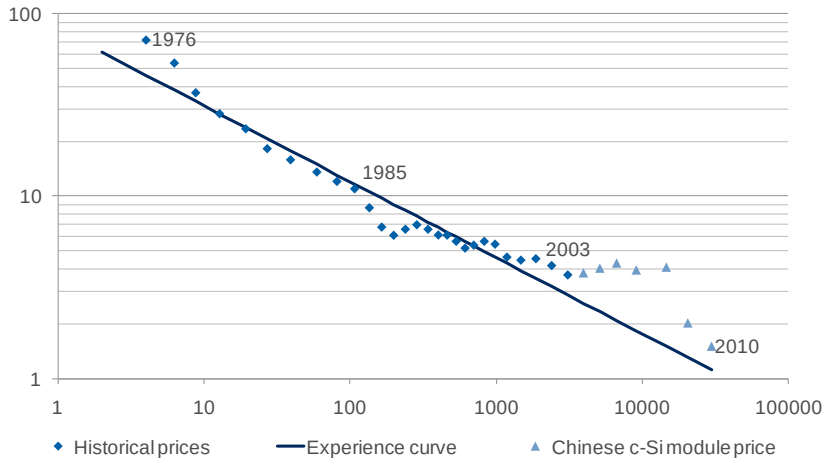


Source: Bloomberg New Energy Finance Note: Top curve shows turbine prices in US dollars; bottom curve shows prices in Euros

6.1.2. Solar photovoltaics

The shortage of photovoltaic-quality silicon that characterized the industry in 2007-2008 has eased, breaking a production bottleneck and allowing prices to plummet. Bloomberg New Energy Finance now predicts PV module prices could fall to as low as $1.40/W at the factory gate sometime in 2011.

Figure 10: Solar module experience curve, 1975-2020



Source: Bloomberg New Energy Finance, Paul Maycock Note: learning curve is least square regression on historic data, adjusted for inflation using US CPI; R2=0.93

6.1.3. Other carbon-displacing technologies

Alternatives such as geothermal, tidal and wave action, fuel cells, clean energy storage and carbon capture and sequestration offer great promise. To varying degrees, each faces the same hurdles as wind and solar. But each also bears unique technical and/or policy challenges that hinder their access to conventional capital streams.

The objective is “grid parity,” in which the all-in cost of using one or more carbon-displacing generation technologies is no more expensive than the carbon-emitting technology being displaced.

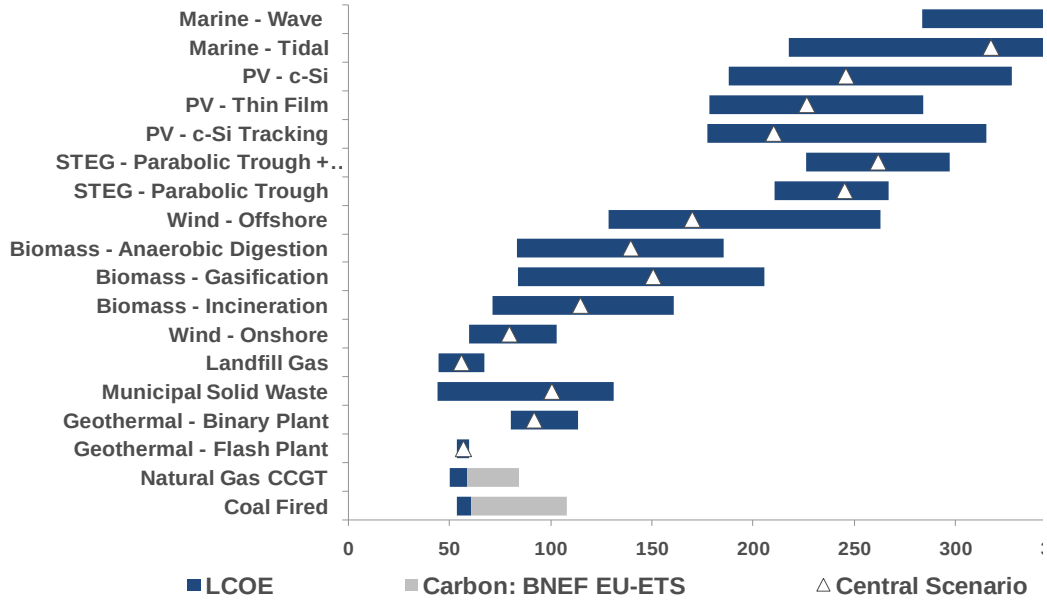
While the cost of certain clean technologies – notably wind and solar -- in recent years has declined relative to the primary carbon-emitting fuels coal and natural gas, the use of clean fuels is constrained by geographical and technical factors. Given that, the route to a low-carbon electrical future must most likely include a fully diversified range of green technologies, and only national governments are positioned to finance their ascendance.

6.1.4. Levelised cost of energy

According to current output from Bloomberg New Energy Finance's proprietary Levelised Cost of Energy model, the costs of clean energy generation continue to fall based on downward pressures in the macro environment. Global demand across most sectors is feeling belated recessionary effects, contributing to oversupply of many key components and intensified price competition.

Even as project finance spreads have compressed, the LIBOR inter-bank rate, which underpins the cost of debt funding, has fallen further, bringing down financing costs.

Figure 11: Levelised cost of energy, Q3 2010 ($/MWh)



Source: Bloomberg New Energy Finance Note: Carbon forecasts based on EU-ETS 10-year market horizon forecast from September 2010 Deep Dive. Coal and Natural gas LCOE estimated solely on EIA Annual Energy Outlook cost and fuel price estimates.

6.2. Future investment levels and target technologies

The sums involved in a shift to a low-carbon energy system are substantial. To truly address the threat of climate change, Bloomberg New Energy Finance has projected that over $500bn in new funds will have to be invested in clean energy projects annually starting in 2020.

As discussed above, the transition to a cleaner energy economy has already begun along with a surge in investment. This year, total new third-party financings should total $175-$200bn. Approximately at least one in every ten dollars invested in power generation today goes into clean energy projects. To reach over $500bn per year in less than a decade, much work remains, however. While the private sector must take the lead, additional public support is clearly needed to continue overall momentum. Furthermore, there are certain critical areas where public financing will likely always be needed. The so-called "Valley of Death" for new technologies will not be traversed without public support.

Clean energy – with its high initial investment and competition from amortized fossil assets – presents a higher-risk profile, a greater up-front commitment and more limited exit options. Research by Bloomberg New Energy Finance has identified four new energy technology segments that epitomize those characteristics. As such, we predict that their long-term viability in the low-carbon economy is likely to be at least somewhat contingent on public sector support.

6.2.1. Utility scale storage and advanced batteries

Power storage, which will be essential for utilities to manage rising penetrations of intermittent clean energy, has not historically generated the returns on investment needed to attract large-scale project investments. In fact, most energy storage technologies are still not economical to deploy today.

But finding a solution for grid-scale power storage is becoming increasingly urgent for utilities. At grid scale, power storage has two sets of applications: energy management, where energy stored during off-peak times is used to provide additional supply when demand rises; and power quality management, where short sharp bursts of energy are used to stabilize the grid by smoothing out irregularities in supply or demand.

Advanced batteries – installed on utility facilities or in electric vehicles (EVs) – are a critical component of smart grid applications that include distributed power storage. Both sodium- and lithium-based batteries have been deployed in a number of utility projects globally, while other options such as flywheels and compressed air energy storage are also being trialled at megawatt-scale.

However at present the capital costs of storage technologies remain prohibitively expensive. While there are numerous corporate- and privately-funded initiatives to develop advanced batteries, ultimately utilities will be looking to the electric vehicle revolution to bring lithium-ion battery manufacturing to scale, and drive costs down. At the same time, new regulatory structures and business models will be needed to allow storage technologies to play on the grid.

6.2.2. Advanced Transport

Transport accounts for more than 27% of all final energy consumed, according to the International Energy Agency, and 23% of global CO_2 emissions. The transport sector is almost entirely reliant on petroleum-derived fuels (94%).

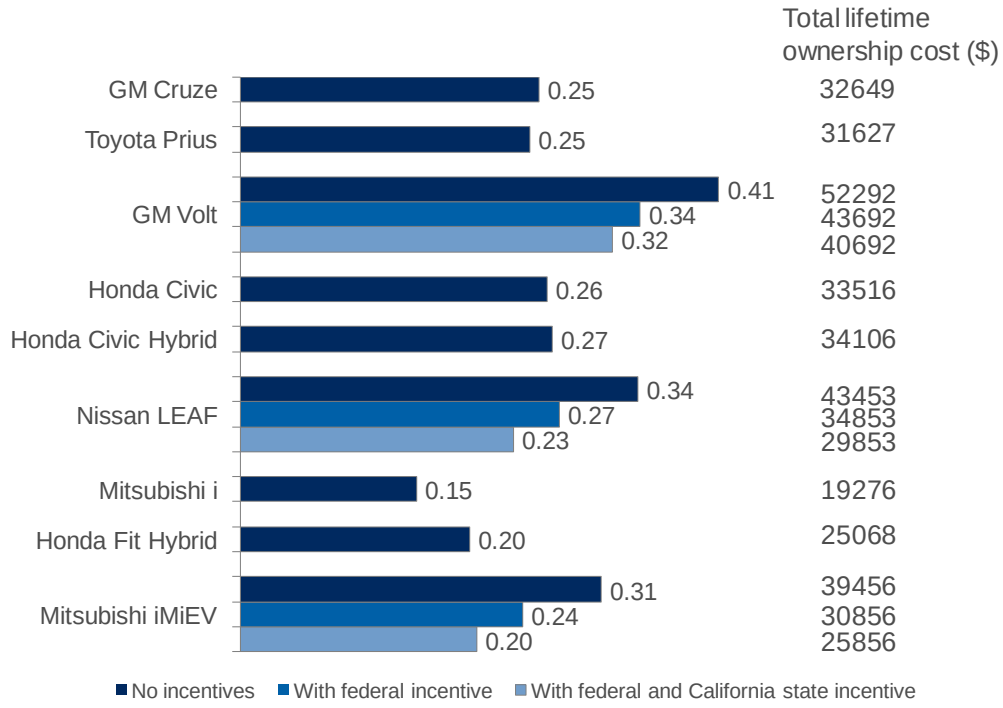
The sheer volume of greenhouse gas emissions from transport -- and the concomitant opportunity presented to confront that problem – elevate transport to a top level target for central government climate change initiatives. There are multiple programmatic approaches to reducing transport-sourced emissions: mass transit, biofuels, artificially synthesized fuels, improvement to the internal combustion engine and fuel cells. The dominant technologies are EVs: both plug-in hybrids and battery-powered electric-only vehicles.

EVs represent a nascent industry that can grow quickly with government support. Their role in a low-carbon future goes beyond pure transport. Because they also can be distributed storage devices, EVs are an enabler of higher levels of clean energy generation and the most powerful driver for a smart grid. Widespread EV adoption faces three roadblocks that need to be addressed: infrastructure; psychological barriers/range extension; and availability and cost competitiveness of vehicles.

Government funding can be applied against two of those. On infrastructure, the wide geographic distribution of government facilities in most developed countries provides an important platform for the installation of recharging stations. On cost-competitiveness, direct government support for efforts to develop high-performing batteries and propulsion systems can have rapid impact on the high unit costs of EVs. And continued and expanded government assistance to EV buyers, in the form of tax credits and purchase subsidies, would address the same problem by increasing demand and reducing ownership cost.

For example, in the US market a combination of federal and California state incentives combine to put the cost of ownership of an electric-gas General Motors Volt within 7 cents of a GM Cruz, a midsize car powered solely by petroleum fuel.

Figure 12: Ownership cost for an average US household passenger vehicle ($/mile)



Source: Source: Bloomberg New Energy Finance analysis

6.2.3. Carbon capture and storage

In a world dependent on coal for its energy for the foreseeable future, technology that captures and stores CO_2 emissions has a potentially important potential role to play in the shift to a low-carbon energy future. Industrializing countries, notably China, have rich domestic coal reserves that will be used to fuel economic growth, especially as other energy resources elsewhere in the world diminish and their prices rise.

Demand for CCS could top160-240MtCO_2e/year by 2020, equivalent to the emissions from 26-44 coal-fired power stations, or 8-12% of emission reductions required under global emission trading schemes. However, funding committed worldwide to date will be insufficient even to complete the commercial and demonstration projects announced to date, equivalent to an injection rate of 108MtCO_2e/yr in 2020.

Before CCS can begin to fulfil even this potential, scaled-up demonstration projects must be built - and as yet, none has. The costs involved -- $2.3-5.8bn for 100-300MW plants or $133-212/t$CO_2$e avoided – are prohibitive unless government creates a clear market incentive; e.g. a sufficiently high and stable price on CO2 emissions.

It should be noted that while CCS is an early-stage technology it can be profitable when combined with enhanced oil recovery or where a levy on CO_2 emissions is in place (such as in Norway). For the most part, simply adding CCS technology to a conventional power generation projects does not currently make economic sense unless additional government supports are in place. Funding for the first demonstration plants must therefore come directly from governments if CCS is to cross the gaping “Valley of Death” currently lying between it and commercialisation.

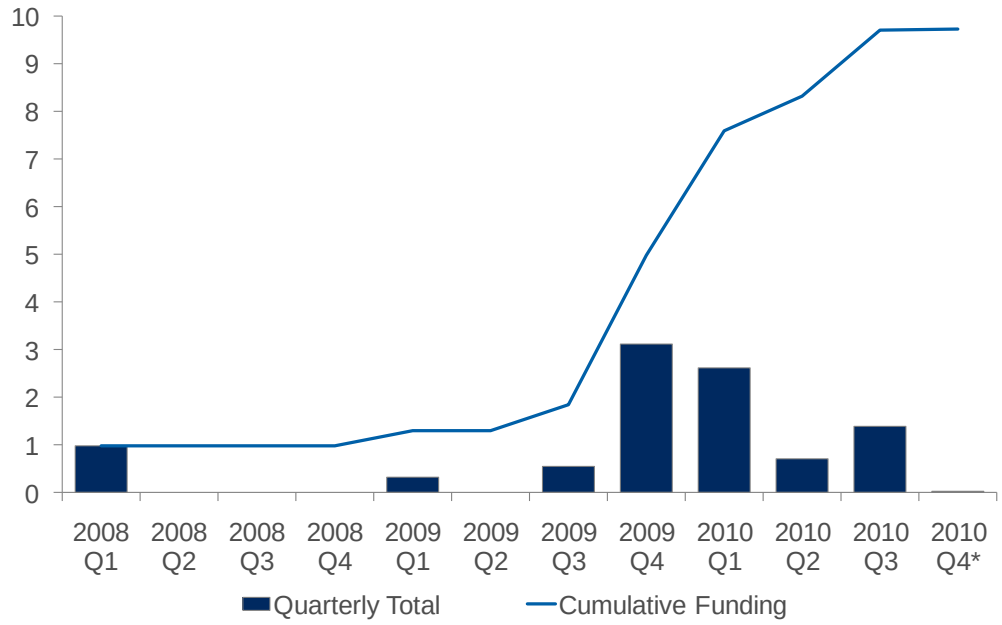
In fact, governments are making commitments to CCS projects with $23bn in public funds pledged to date. The G-20 has collectively set a goal of 20 demonstration projects by 2020. For its part the European Commission intends to facilitate construction of 10-12 demonstration projects and the US, Canada and Australia have also committed funds to large-scale projects. The EU has so far committed just over EUR 8bn ($11.2bn) to CCS funded by the EU-ETS’ New Entrants Reserve, EU member states and the European Economic Recovery Plan. Bloomberg New Energy Finance analysis finds that this funding, which will be matched in many cases with contributions from project participants, will be sufficient for only 3-10 projects instead of the intended 10-12.

Current commitments only close a small amount of the funding gap, estimated to be at least $80bn between now and 2020. Without question, further direct government funding is needed either in the

form of grants or incentives combined with investment from private sector players who stand to benefit most from CCS (or lose most by not dealing with their CO_2 emissions). This includes players in the oil & gas and utility sectors, which have already emerged as leaders in CCS.

Once the first demonstration projects have been built, other forms of financing will be needed. Later projects could be funded via levies on electricity or fossil fuel production (effectively a direct tax on those producing the CO2 that CCS is designed to mitigate), and ultimately CO2 financing where market incentives (carbon credits) would attract private sector investment.

Figure 13: CCS public funding history, 2008-10 ($bn)



*Source: Bloomberg New Energy Finance Note: * Indicates funding announcements in Q4 2010, up to the date of publication. Due to revised award dates for the US DOE's Industrial Carbon Capture and Storage Applications programme, we revised down the funding allocations of Q2 and shifted those awards to Q3.*

6.2.4. Advanced biofuels

Financing for next generation biofuels projects has been particularly difficult to secure since the beginning of the downturn in 2008. Oil prices have plummeted from their $150 per barrel highs that year to approximately $85 today. The lower fuel price compressed margins for developers just as capital was becoming scarcer and more expensive.

The US government, among others, offers a variety of supports for next generation biofuels, including a generous tax credit and loan guarantees. But in many cases, developers of these projects today find they cannot exploit the benefits because they are having difficulty finding private capital to match the public support.

Finding a way to convert agricultural waste into fuel remains a massive potential opportunity for addressing climate change. Furthermore, unlike conventional biofuels plants, the next generation technologies do not raise thorny questions about food vs. fuel usage. By definition, advanced biofuels rely less on food crops such as corn and sugar cane and more on plants, algae and other organisms that can be produced on non-agricultural land and don't directly affect food prices or availability.

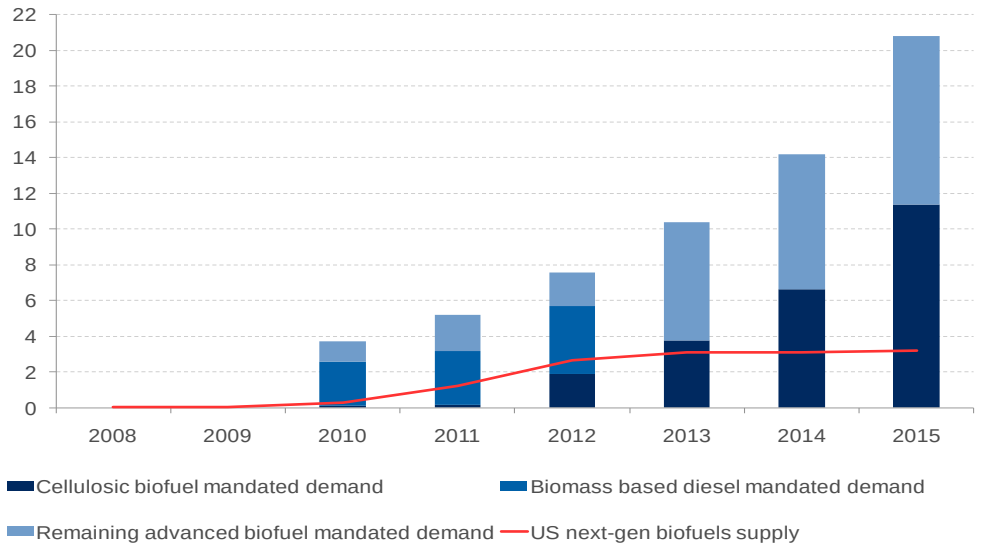
Unfortunately, today, cellulosic biofuels producers and others employing next generation technologies cannot process a gallon of fuel at a price that is truly price competitive without subsidies. More work remains to be done.

To continue their development toward the price parity with conventional fuels, advanced biofuels producers will all but certainly need additional support taking one of the following forms:

- Capital support from governments for demonstration-scale projects
- Blending subsidies to ensure demand – especially during periods of low oil prices
- Incentives for production of non-food feedstock crops, and

- Attractive tax treatment of RD&D.

Figure 14: US next-generation biofuel mandated demand and supply, 2008 to 2015 (bn litres)



Source: Bloomberg New Energy Finance

6.3. Conclusion

Government can play a uniquely amplifying effect in each of the four broad stages of clean energy development: Early R&D/Proof of Concept, Demonstration & Scale-Up, Commercial Roll-Out and Diffusion & Maturity. Early stage examples include incubators and grants while later stage versions include export trade credits and infrastructure funds. Between those exists an array of mechanisms for which there is no analogue in the commercial sector.

Governments can be most influential during recessions or their immediate aftermath. An economic downturn inevitably thins the ranks of lenders and investors and interrupts capital formation. As the money returns during the ensuing recovery, it often does so cautiously, seeking the lowest risk opportunities first. In the energy field, this can mean conventional technologies receive support before those less proven.

Today, the spectre of climate change is growing rapidly just as Western economies are stumbling back from the worst recession in more than half a century. Inevitably, many policymakers perceive a stark choice: address global warming *or* foster economic growth. But as some nations have shown, these two goals need not be mutually exclusive. Moreover, if the challenge of a warming planet is ultimately to be addressed, society must develop cleaner sources of energy that are truly cost-competitive without subsidies. Today, government has a critical role to play in the scale-up of these technologies so that they can compete on their own tomorrow.

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