Bloomberg
NEW ENERGY FINANCE

Crossing the Valley of Death

Solutions to the next generation clean energy project financing gap

21 June 2010

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Contents

Table of Figures

Priority Solutions

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

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 1. Executive Summary

Thanks to a massive investment surge, clean energy technologies have made extraordinary progress down their respective learning curves in recent years. Still, much work remains; the cost of generating a clean kilowatt-hour is still well above that of generating one from coal or natural gas on an un-subsidized basis, assuming no associated costs for carbon pollution. One of the biggest impediments to further progress is a persistent dearth of capital for potentially lower-cost breakthrough technologies that have advanced out of the laboratory but still require extensive and expensive field testing and trial installations before being deployed at scale. Financing exists for early stage, potentially high-risk/high-return technologies in the form of venture capital. It is available for late-stage, potentially low-risk/low-return technologies in the form of project financing. But what about those technologies that fall somewhere in between?

The challenge of traversing the so-called "Valley of Death" intrigued the nonprofit Clean Energy Group (CEG). With funding from The Annenberg Foundation, CEG commissioned Bloomberg New Energy Finance (BNEF) to join in an assessment of current gaps in clean energy financing, and in soliciting recommendations to address them. In 2009, CEG and BNEF conducted more than five dozen interviews with industry players across the EU and North America, seeking their input on how to address the quandary. A myriad of ideas emerged, but three were particularly novel and are worthy of further study:

Emerging Technology Reverse Auction Mechanism. Under such a programme, a public sector body would encourage developers of projects that employ novel technologies, which are deemed to hold special promise, to "bid in" alongside others in a competitive process to win a fixed-price contract under a pre-established utility-level programme cap. Those offering to sell their electricity at lowest cost within a targeted technology grouping would be awarded publicly-supported power purchase agreements, potentially at above-market rates. Such a plan takes its inspiration from European feed-in-tariffs (FITs) that offer developers fixed-price contracts and cash flow certainty. But unlike FITs, this scheme would see market participants, not policymakers, take the lead in setting prices. Such an approach is now being actively investigated by staff of the California Public Utilities Commission.

Efficacy Insurance. Clean energy projects that employ cutting-edge technologies by and large are regarded as too risky for conventional insurance coverage. But could the public and private sector play a joint role in offsetting some portion of that risk? Commercial insurers with appropriate levels of technical expertise could assess and support such selected technologies with "efficacy insurance" and receive support in turn for a portion of their risk in the form of publicly guaranteed or funded reinsurance pools. In the US, there is precedent at the federal level in the form of the Terrorism Reinsurance Act, which backstops commercial insurers in case another 9/11-style attack causes widespread damage. At the state level, government-organized capital pools exist to backstop the risk that property insurers shoulder when underwriting policies on homes in floodplains or other at-risk locations. Policymakers and insurers could establish a similar pool with the express purpose of backstopping specific, tailored, technology risk mitigation insurance policies for projects that employ promising, new, clean energy technologies that could result in transformative cost or performance breakthroughs.

A Government-backed Commercialisation Finance Investment Entity. Such an initiative is currently being considered by the US Congress in the form of the Clean Energy Deployment Administration (CEDA). It would be seeded with federal dollars and operate in a relatively autonomous manner, perhaps leveraged via a "delegated investment authority" partnership with already engaged private sector institutions. CEDA would be expected to make investments in projects that help advance key clean energy technologies deemed to be in the national interest. It could offer straight debt and loan guarantees, take direct equity stakes, or even provide other forms of risk mitigation or re-insurance to support early stage technology deployment. Questions remain about exactly how such a programme would be structured, and care must be taken that it in no way crowds out private capital, but the concept offers genuine promise.

More details of these three possible solution elements recommended for consideration can be found in highlighted boxes in the accompanying text. While each has value, if they could be deployed simultaneously, they could increase technology demand, reduce novel technology risk, and provide greater financial resources to support new technology rollout.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 2. Introduction

These are heady days for clean energy. Thanks to a combination of economic and geopolitical factors, investment in the sector has skyrocketed in recent years, rising from $46bn in 2004 to $173bn in 2008 and declining only 7% to $162bn in 2009, despite a severe global recession. Along the way, significant progress has been made down the so-called "learning curve" as the price of generating a kilowatt-hour of electricity from renewable sources such as the sun has declined precipitously.

Still, much work remains. With few exceptions, the cost of generating power cleanly is simply higher than generating it from fossil fuels, when embedded fossil fuel subsidies and the cost of carbon pollution remain un-priced. Fortunately, the recent boom has allowed thousands of firms, from start-ups to Fortune 500 companies, to research and develop new energy technologies that might someday compete – and beat – coal, oil, and natural gas on a completely equivalent cost basis.

The problem is that for clean energy technologies to really change the world, they must first be proven at commercial scale. While venture capital firms or corporate research & development departments will back initial research through pilot-scale installations, they rarely have the financial resources to deploy a 20 MW solar thermal electric generation demonstration project or a 50 million gallon cellulosic ethanol production facility.

Yet project finance capital for plants this size and larger can be routinely secured from major financial institutions for projects that deploy proven technologies. As the old adage among entrepreneurs goes, "*banks will always be the first in line to finance your second project."* This so-called Commercialisation "Valley of Death" – located somewhere between Silicon Valley VCs and Wall Street banks – poses a long-standing challenge to the clean energy sector, just as it has to other capital-intensive industries in the past.

Through good times and bad, traversing this Valley has proven to be a challenge for clean energy pioneers. From 2005 through 2008, venture capital totaling $11.8bn surged into the sector. Meanwhile, debt capital for projects employing proven equipment such as General Electric 1.5 MW wind turbines was both cheap and plentiful. Nonetheless, funding for "first of class" projects employing new technology remained scarce. As the economy went into a tailspin during the second half of 2008, conditions worsened across the board. If nothing else, the past five years have proved that securing financing for demonstration-scale projects is an intractable problem. Clearly, this is a challenge the private sector cannot meet on its own, given the current financing and policy tools available.

Against that backdrop, in March of 2009, Clean Energy Group (CEG) and Bloomberg New Energy Finance (BNEF) undertook a year-long study with two goals in mind: first, to survey and size the Valley of Death, and second, to examine potential financial or policy mechanisms that might allow companies to successfully traverse it.

Each organisation tapped its own extensive network of hundreds of contacts in the clean energy sector and conducted more than five dozen detailed interviews with technologists, entrepreneurs, project developers, venture capitalists, institutional investors, bankers, and policymakers. The interviews were open-ended, with an eye toward generating as many useful ideas as possible.

This paper seeks to summarize our interviewees' comments and contextualise them with quantitative research from BNEF's Intelligence database. It is structured in two principal elements.

A brief look at what the Valley of Death actually is and why traversing it is so critical. Leveraging investment and other data compiled by BNEF over five years, we document the meteoric rise in investment in clean energy generally, and in new technologies specifically. We then identify where cracks in the financing value chain have emerged, both through quantitative analysis and via interviews with participants in the marketplace.

An exploration of various potential financing or policy solutions to address the Valley of Death conundrum. The ideas presented here were brainstormed during interviews the CEG and BNEF team members carried out, or are summaries of relevant policies under consideration in various countries.

From the start, our aim in conducting this research was to be inclusive and to generate as many productive ideas as possible for addressing these crucial issues. While this paper is not entirely comprehensive, it did leave relatively few suggestions on the editing floor. While making detailed policy recommendations or demands is beyond the reach of our investigation, given the crucial need to close the Commercialisation Valley of Death facing global clean energy technologies, we do highlight those approaches that warrant immediate, next-step exploration.

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 3. About this study

In March 2009, Clean Energy Group (CEG), with the support of The Annenberg Foundation, commissioned Bloomberg New Energy Finance (BNEF) to join in an assessment of current gaps in clean energy financing, and in soliciting recommendations to address them.

The two organisations are uniquely positioned to undertake such a survey, given their respective histories in the sector and their relationships with many technologists, entrepreneurs, venture capitalists, project financiers, and policymakers in the US and internationally.

Founded in 1998, CEG is a national non-profit that promotes effective clean energy policies, develops low-carbon technology innovation strategies, and works on new financial tools to stabilize greenhouse gas emissions. CEG concentrates on climate and clean energy issues at the state, national, and international levels as it works with diverse stakeholders from governments as well as the private and non-profit sectors. CEG is based in Vermont with offices in Washington and Chicago.

Bloomberg New Energy Finance is the world's leading independent provider of news, data, research, and analysis to decision-makers in renewable energy, carbon markets, energy smart technologies, carbon capture and storage, and nuclear power. The group has staff of more than 130, based in London, Washington, New York, Beijing, New Delhi, Hyderabad, Cape Town, São Paulo, Singapore, and Sydney. Founded in 2004 as an independent firm, the company was acquired by Bloomberg LP in December 2009.

Between June and August 2009, CEG and BNEF conducted interviews with more than 60 sector thought leaders in 10 countries around the globe with the singular goal of soliciting all ideas on addressing the Commercialisation Valley of Death challenge facing new low-carbon energy technologies. Participants included venture capitalists, project developers, attorneys, insurers, private equity players, commercial bankers, and others. CEG focused its efforts on interviews with industry participants in North America, while London-based BNEF tapped its network of European and Asian clients. The questions asked were intended to be specific, in order to elicit concrete ideas, but open-ended, to allow participants to brainstorm new concepts.

In the course of our discussions, we became aware of another research effort on the Valley of Death topic being undertaken by the California Clean Energy Fund (CalCEF), and our research teams have had the opportunity to discuss our respective findings. Their report, "From Innovation to Infrastructure: Funding First Commercial Clean Energy Projects" will be available as a CalCEF Innovations White Paperlater in June 2010.

By the end of the interview process, CEG and BNEF had a collected a panoply of ideas reflecting the wide variety of study participants. The next step was categorizing them in some useful order for further analysis. Ultimately, all ideas were placed in one of the following five broad categories:

Demand-driven Innovation – Policies or initiatives intended to spur demand pull for clean energy goods and services. This includes feed-in tariffs as well as other methods intended to encourage governments and leading corporations to serve as first adopters of new technologies.

Novel Co-Investment Partnerships – Public/private partnerships between government and industry intended to leverage capital that might otherwise sit idle. Also included are: delegated investor programmes such as loan guarantees.

Project-level Policies to Attract Capital – Recommendations to streamline the development process at the local level, via a variety of relatively small but important policy adjustments highly visible to developers but not necessarily on the minds of most policymakers.

Insurance Products – Methods for insuring against the risk posed by new, pre-commercial clean energy projects and their technologies. Ideas mentioned included efficacy insurance as well as government risk management programmes**.**

Other Suggested Funding Options – A variety of other potential ideas for boosting access to capital, including: bolstering venture investment; using a carbon metric to fund projects; and the use of utility balance sheet support.

Each of the categories above will be explored in some detail on the following pages, but first we present some thoughts on the scope and nature of the commercialization Valley of Death itself.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 4. About the "valley of death"

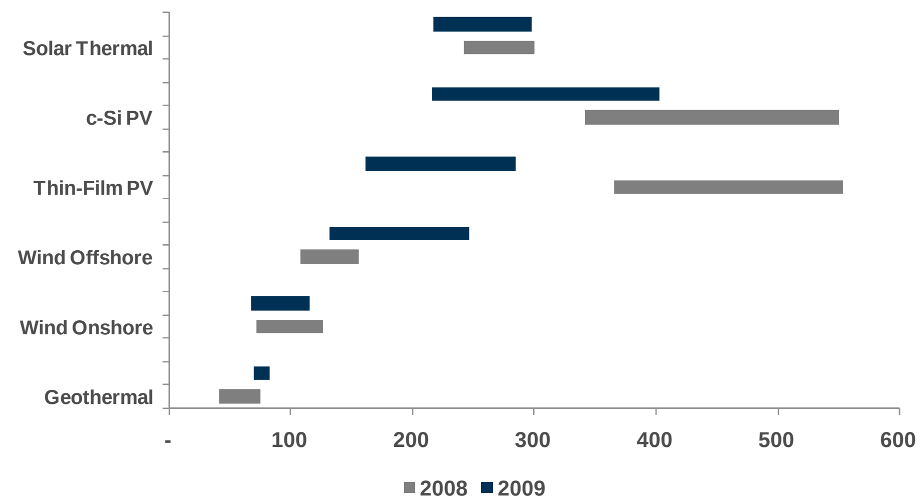
To address the spectre of climate change in a meaningful way, Bloomberg New Energy Finance estimates that at least $500bn will have be invested in new, low-carbon energy technologies each year starting in 2020. That represents no less than a tripling of what went into the sector in 2009.

Every bit as important as attracting new capital is making progress along the so-called clean energy technology "learning curves," with an eye toward making wind, solar, marine, and other clean energy generation and energy storage technologies cost-competitive with fossil sources of generation on an entirely un-subsidized basis. Transitioning to a low-carbon future will require cutting-edge, lower-cost generation technologies, which must move quickly from the lab to widespread deployment.

Thanks to a surge of new investment in clean energy over the past five years, the per-Watt cost for key clean energy technologies has been dropping. The progress has been most pronounced in solar photovoltaics (PV), as the factory price for new modules has fallen 50% or more in the past 18 months. Other technologies, such as those related to power storage, have also demonstrated important progress.

The chart below highlights the comparative "levelised costs of energy" (LCOEs) of different clean energy technologies. The dollar rates represent the price at which a development company would have to sell power from its project in order to earn an average internal rate of return of 10%.

Figure 1: Levelised costs of clean energy technologies compared: $/MWh



Source: Bloomberg New Energy Finance Note: "c-Si" is traditional crystalline silicon photovoltaic modules. The above is based on an assumed expected internal rate of return for investors in such power generating projects of 10%. For more details on the BNEF LCOE model, please contact BNEF.

While clear progress has been made in solar and, to a lesser extent, in onshore wind over the past two years, virtually all of the above technologies are more costly than conventional fossil generation when compared on a fully un-subsidized basis.[1] Much more work remains to drive down costs so that renewables can truly compete with and beat their fossil rivals on cost.

In addition to the trillions of dollars that will be needed in new investment from the private sector, new public policies or public financing mechanisms will also be required to support low-carbon technology innovation, deployment, and diffusion. The challenge is certainly global, but countries in the developed world must take the lead. Only developed nations have the requisite financial systems and government structures to address the problem on a broad scale. The exception may well be China, which, though considered part of the developing world, clearly has exceptional financial resources to support clean energy technology development. The country is already providing major support to established sectors in the form of feed-in-tariffs and other subsidies.

1 The concept of a truly "unsubsidised cost" can be a technically difficult one to assess, however; A 2000 US DOE study put US federal energy subsidies at $6bn, with half going to fossil fuels and only 5% to renewables.

Moving a technology from the research to the commercial phase is an arduous task, usually requiring it to proceed through the so-called Commercialisation “Valley of Death.” In this phase, entrepreneurs face the dangerous convergence of high cash demands and a significant scarcity of capital. Without directly addressing this important market disconnect, clean energy deployment cannot move forward at the pace the climate challenge demands.

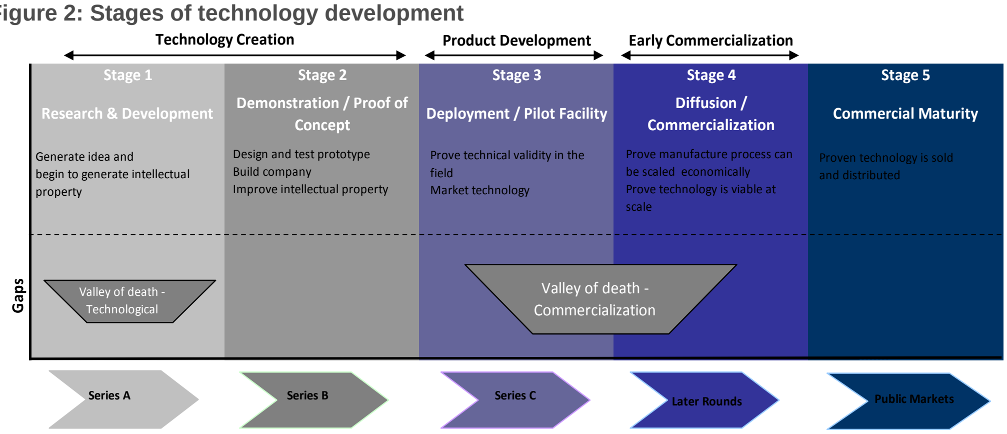
The problem posed by the Commercialisation Valley of Death has gained increased attention in recent years, as concerns over climate change have grown and policymakers have become more aware of the limitations of current clean energy technologies. The US, in particular, through a loan guarantee programme first established in 2005 but now being rolled out in earnest, is starting to take the lead in fostering next-generation low-carbon technologies (see Section 5 below). The country is also home to some of the most innovative and exciting early stage technology companies, which have in the past been backed by the country’s substantial pool of venture capital funds.

The location of the traditional Valley of Death has long been well identified – somewhere between when a technology has been financed at the laboratory or even pilot stage and when it is rolled out commercially at large scale. However, in conducting our research, CEG and BNEF made no pre-assumptions about where financing gaps might exist. Instead, we left it to respondents to identify what Valley, or even Valleys, there are.

As a result, participants actually identified *two* critical locations where a shortfall of capital often comes into play. The first occurs early in a technology’s development, just as it is ready to exit the lab. The second occurs later, when much more substantial levels of capital availability are needed to prove viability at commercial scale.

The first valley appears just after the Technology Creation stage (see below), when the public sector in some countries has focused investment via university or national laboratory funding, and before traditional venture capital has played its critical later-stage role. It includes the Research & Development and Demonstration / Proof of Concept stages, where a technology is developed, tested, and refined over an extended period (2 to 5 years).

Figure 2: Stages of technology development



Source: Bloomberg New Energy Finance

The next valley occurs around the Diffusion/Commercialisation stage, as companies seek scale-up capital to finance a major new manufacturing plant or power generating project. This valley is the one most commonly identified by our respondents in the clean energy sphere as being unaddressed and underfunded.

While the first valley identified by respondents certainly poses a legitimate challenge to emerging technologies, there are clear, well-proven, and fairly low-cost responses available. Additional funding support for government laboratories can help foster the very earliest technologies. More aggressive government disbursement of grants can also help address the issue. Already, the US government under the Obama administration has taken up this challenge via higher funding under the economic stimulus bill passed in February 2009 and more generous annual outlays for national labs. The administration has also launched the US ARPA-E programme (see Section 5 below), which to date has funded 74 early stage technology start-ups with $257m. In addition, a chain of clean energy business incubators exists around the globe to help address this issue.

It is the second financing gap – between late-stage venture capital financing and full-scale commercial roll-out – that has been found to be more intractable, and it is the primary focus of this report. The problems posed by this funding valley represent fundamental, structural market shortcomings that most respondents, along with CEG and BNEF, believe cannot be resolved by the private sector acting on its own. Even in good times, when lending standards are most flexible, banks and other financial institutions are simply not structurally positioned to back large-scale projects deploying new technologies.

This is not a problem caused by a lack of interest by the various parties involved. In fact, no private funder has the mandate to deploy capital addressed at this particularly challenging point in the risk/reward spectrum. Venture capital firms have high technology risk tolerance but relatively limited capital, and they demand short-to-medium returns. Project finance funders and bank lenders typically have high levels of capital and can commit to longer-term investments, but they have little or no technology risk tolerance. *No existing class of financing institutions is effectively positioned to address this particular risk/return category.*

Overall, the capital markets have been fickle in their support of new clean energy technologies. In 2005, clean energy attracted just $2.5bn in total investment from venture capital and private equity investors, those most likely to take a flyer on the newest technologies. That nearly quintupled to $11.9bn in 2008 but then dropped more than 40% to $6.8bn as the recession took hold.

Figure 3: Venture capital and private equity investment, 2004-1Q2010: $bn

Source: Bloomberg New Energy Finance, 2010. Note: Red line indicates 4-quarter running average. Total values include estimates for undisclosed deals.

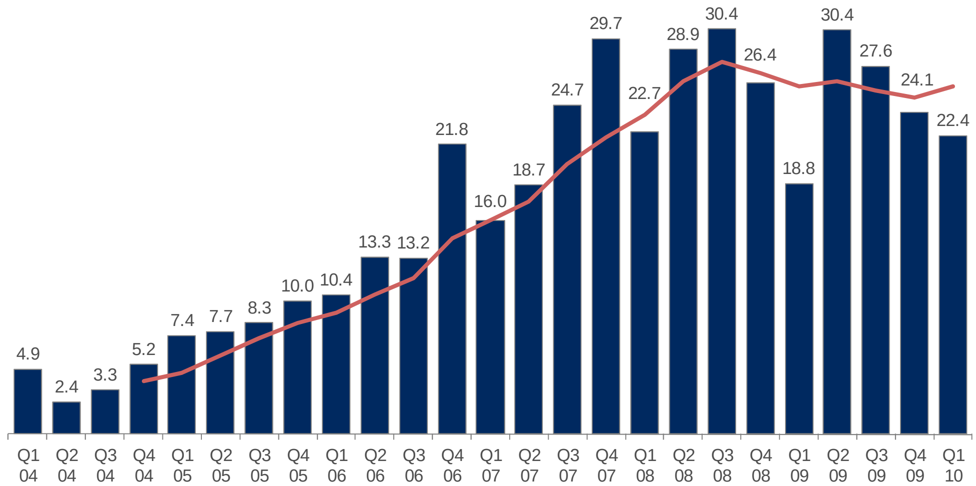
Even in the best of times, these investors can only have so much impact in testing new energy technologies at large scale, since the capital needs for such projects typically total in the hundreds of millions of dollars per investment. This is well beyond the scope of what most typically capitalized venture funds can support. A capital mobilisation challenge of that size typically necessitates debt finance from a bank or other financial institution, in addition to higher-risk equity investment.

The pool of capital available for projects that deploy commercially proven equipment such as GE 1.5 MW wind turbines or SunPower PV modules has typically been 10-15 times as large as that available for earlier-stage technologies. Such asset finance activity for large-scale power or biofuel-producing projects peaked at $108.4bn in 2008, then fell to $100.9bn in 2009.

Even in 2008, as stocks touched all-time highs and interest rates dipped to all-time lows, virtually no truly private project finance capital was available for projects that sought to deploy unproven technologies. Indeed, *the pre-recession boom years for clean energy offer virtually irrefutable proof that the Commercialisation Valley of Death challenge is one that the private sector will not address on its own.* Most economists and project financiers agree that the easy-lending days of 2007-2008 will not return anytime soon. Congress and financial regulators are poised to ensure that is the case through financial reform legislation and tougher enforcement of existing statutes.

The events of the past few years confirm that it is only with the public sector's help that the Commercialisation Valley of Death can be addressed, both in the short and the long term. Only public institutions have "public benefits" obligations and the associated mandated risk-tolerance for such classes of investments, along with the capital available to make a difference at scale. Project financiers have shown they are willing to pick up the ball and finance the third, 23rd, and 300th project that uses that new technology. It is the initial technology risk that credit committees and investment managers will not tolerate.

Figure 4: Asset finance for projects employing commercially proven clean energy equipment, 2004-2008: $bn



Source: Bloomberg New Energy Finance, 2010. Note: red line indicates 4-quarter running average. Total values include estimates for undisclosed deals.

There is historical precedent for such government intervention. Governments helped foster industries for aeroderivative turbines, semi-conductor chips, and even nuclear reactors. Given the importance of addressing climate change and energy security concerns, it is a mission that government has little choice but to accept. Moreover, despite the current lack of consensus in Washington and the less than spectacular results from Copenhagen, there does seem to be general agreement that the world urgently needs a paradigm to drive new energy technology breakthroughs. Whether this development is needed to address climate change, to allow nations to further enhance their energy security, or for some other more commercially competitive reason depends on who you ask.

Government can address the Commercialisation Valley of Death issue directly by providing the requisite resources through the necessary combinations of regulatory, financial, and/or commercial support. This report discusses some of the specific programmatic steps that might be taken, but before examining those in detail, it is worth noting that *any new programmes must have both perceived and real longevity*. Above all, the financial community seeks certainty that policies once established will remain in place and remain funded over the long term.

Significant steps have been taken in Spain, Germany, Japan, China, and, to a somewhat lesser degree, the US to bolster the development of clean energy technologies. In most cases, however, these efforts have been pursued with an eye toward economic development and job creation. Fostering development and widespread deployment of next generation technologies has often been a secondary goal, not the primary aim. Policymakers must take both a short- and long-term perspective when crafting these policies.

Section 5. Proposed solutions

5.1. Demand-driven solutions

The spectacular surge in clean energy investment seen from 2004-2008 coupled with rapidly growing Chinese investment in the sector has resulted in significant over-supply of a variety of technologies on the global market. The world simply has more wind and PV equipment production capacity available than it presently requires, given current and near-term projected demand. Global wind turbine manufacturing capacity could total nearly 79 GW/year by 2013 if all manufacturers worldwide follow through on current construction plans for new plants, according to BNEF research. But demand for such equipment is only expected to total approximately 50 GW by that year, BNEF predicts.

Such a situation suggests the need for more aggressive government policies to create more demand and soak up excess supply. But how far would such policies go toward specifically addressing the Commercialisation Valley of Death? Respondents to the CEG/BNEF questionnaire did not seek to answer that question directly, but did suggest two general policy solutions that are demand-driven in nature: government-managed feed-in tariffs and governments or leading corporations themselves serving as first adopters of new technology.

Feed-in Tariffs (FITs)

Renewable power has the great advantage of avoiding cost externalities caused by damage to the environment. Clean energy has typically been unable to capitalize on this because the externality costs of conventional fossil-fuel power generation are not actually ncluded in the price of power. Feed-in tariffs have been one way to begin to capture such externalities, and to otherwise promote clean energy for the range of its commercial and environmental benefits.

While cap-and-trade and carbon taxes aim to punish emitters, feed-in tariffs (FITs) look to do just the opposite by rewarding renewables project owners with a premium for producing clean power. FITs offer developers higher (often much higher) prices for every megawatt-hour of clean power produced and aim to create a proxy market for new clean energy technologies that roughly reflects the value of avoided externalities and/or reflects other public policy imperatives (improving energy security, increasing targeted industrial development, etc.). Properly designed feed-in-tariffs help assure entrepreneurs who invest in the successful generation of power from renewable resources that they can earn an acceptable return, as they can provide both enhanced prices with guaranteed purchases and advantageous grid access.

Feed-in tariffs are the dominant policy mechanism for incentivizing renewable generation in the European Union and are just now entering the US market in a few jurisdictions. FITs offer renewable energy system owners a technology-specific premium above the wholesale price of power. This can be either a long-term fixed price or a premium that floats with current power rates [or a guarantee up to a certain rate when power dips lower than a benchmark price, but nothing when power prices are higher than that benchmark]. The feed-in tariff is structured to provide project owners and investors with an acceptable rate of return and can also reflect the value of the power generated by incorporating factors such as generation during peak demand periods and avoided transmission upgrades. Because they guarantee grid access, a purchaser for the power, and a long-term, predictable revenue stream, FITs help to build investor confidence and reduce a project's required risk premium.

Feed-in tariffs have proven very effective in mobilizing private capital to support the sector. In Germany, in particular, the establishment of a feed-in tariff has helped foster an entire PV module manufacturing sector. It also made Germany a global leader in terms of systems installed. In December 2009, an amazing 1.5 GW of new solar PV capacity was installed in the country. (By comparison, a total of approximately 350 MW of rooftop solar has been installed since the start of 2007 in much sunnier California, which offers among the most generous state-level subsidies for solar in the US.) Spain has also seen its solar industry grow spectacularly, thanks to its generous FIT schemes.

The FITs in Germany for the 9,300 MW of wind, 4,800 MW of PV, and 2,700 MW of biomass projects built under the programme between 2004 and 2008 will cost consumers EUR 122.3bn ($166.4bn) between 2008 and 2030, which equates to EUR 55.7bn ($75.3bn) over and above the cost of generating power from other sources. However, to put this in context, that adds just 6/10 of a Euro cent (or 8/10 of a US cent) per KWh to each monthly consumer electricity bill.

In the US, Oregon is considering a FIT that would be applicable for PV only. Hawaii is considering a FIT for all renewable technologies. Approval of a FIT at the US federal level appears unlikely, despite

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

efforts by Representative Jay Inslee (D-Washington) and others. No FIT was contained in the comprehensive Waxman-Markey legislation that passed the House of Representatives in 2009.

One advantage of FITs is they eliminate the time and uncertainty of negotiating individual power purchase agreements. This in turn shortens the development cycle and facilitates financing. At a time when confidence in the securities markets is low, fostering long-term, public-supported investment opportunities is appealing to investors. The downside of FITs is that, if mis-priced, they can lead to development bubbles and excessive costs to ratepayers and governments. Spain has been a case in point. After a surge in projects caused by a generous solar FIT, the Spanish government retrenched on the programme, causing a near-collapse in the Spanish market. Each time the country's FIT is scheduled to "step down" in the benefit offered to developers, the country sees a surge of new development of projects, not always built in the best locations or with the best equipment, but rather with what is available at the time.

Priority Solution 1: State emerging technology reverse auction mechanisms

One potential strategic tool to support a new technology commercialisation demand pipeline would be a form of a "procurement-based," state-mandated tariff. This would provide supportive prices for desirable, but not yet fully commercialized "emerging technologies." Such an "emerging technology renewable auction mechanism" (ET-RAM) would require locally regulated utilities to procure clean energy project outputs from specific technology classes up to a predetermined cost limit, at guaranteed prices competitively bid by the winning developers. Such a mechanism would be designed to overcome the concerns about available demand and price levels that typically face efforts to finance emerging technologies. It would provide new technologies with guaranteed demand at a fixed energy price, supported by the purchasing power of financially robust regulated utilities. In states that have a desire to explore this ET-RAM structure, interested state power system regulators would establish a reverse (or "Dutch") auction program incorporating incentives for emerging technologies that are viewed to have special promise in their state or region.

This ET-RAM structure stands in contrast to existing FIT schemes popular in Europe. Those FIT structures largely fund conventional technologies at an administratively set price, which could either be too high or too low in market stimulation and technology-risk abatement terms. This US ET-RAM would be designed to be cost-sensitive and flexible. It might incorporate technology-specific price caps, perhaps set under a declining scale of support over time, and/or through a market price referent (possibly tied to costs associated with a combined cycle, natural gas generating system), to keep the mandated procurement system aligned with emerging power price trends. Instead of requiring utility acquisition of emerging technology projects at a government-set fixed price, it would require regulated utilities to offer standard contracts for a certain amount of power to be purchased, up to a pre-set cost cap, from specifically designated emerging technologies. The selection of the targeted technologies would require a careful, system–wide assessment of supply/demand balance issues, an analysis of the relevant technology value chains, and the gaps required to be filled by this form of financial intervention. Prices (perhaps set under market target caps designed to avoid exorbitant bidders claiming an unduly high price in a extremely thin auction) would be bid by developers to utilities through a confidential reverse auction process, with interested developers bidding in specific power types (i.e., "baseload," "peaking – as available," "non-peaking – as available," etc.) and proposed power volumes up to a target cost level mandated by the regulator.

If individual support price caps (above the referent prices) were to be used for selected emerging technologies, they could be set after careful consultation, and would be intended to allow support levels adequate to trigger new investment in the selected emerging technology, but not so high as to produce undue market price distortions. Such price caps could also incorporate staged development, with higher levels set for smaller initial deployments and lower ones used for later-stage, more mature (though still not fully commercialized), larger-scale installations. The California Public Utilities Commission (CPUC) staff is exploring this alternative approach for supporting emerging renewables within California's RPS program. Under their framework, a reverse auction would be utilized. Utilities would be required to procure power from specified technologies at the lowest prices bid by competing developers, until the utility has reached a predetermined cost cap. Such an approach would avoid the additional complexity of setting state-based, technology-specific, administratively determined prices. If approved by the CPUC and successfully demonstrated in California, such a program could be a template for other similar efforts at both the federal and the state level. Other states could presumably be brought into the discussion, as the California process progresses. Obviously, a federal funding support component of such a state policy is a complementary option, but as electricity rates are typically set at the state level, a state-led initiative would be logical and less likely to be subject to court challenge by forces opposed to the expansion of clean energy technology sector.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Government as first adopter

Federal and state governments are often the largest single buyers of power or other energy products in a given energy market. This suggests an opportunity for them to play a leading role in fostering the roll-out of cutting-edge, clean energy technologies, rather than simply investing in established practices and products.

Examples abound of governments around the globe taking a direct role in fostering clean energy technologies. In the UK, the quasi-governmental Crown Estate has agreed to purchase the first 7.5 MW Clipper wind turbine when it is complete in two to three years. In Brazil, state-owned utility Electrobras has guaranteed 20-year clean energy power purchase agreements totaling 3,300 MW and resells the power to distributors. In China, the central government has issued a plan to add more than 60,000 energy-saving or new energy government-owned vehicles by 2012.

In the US, President Obama has ordered federal agencies to increase their energy efficiency, reduce petroleum consumption, and leverage their federal purchasing power to promote environmentally responsible products and technologies. The US military has been an active first adopter of solar PV for use in remote, off-grid locations and has begun testing algae-based jet fuel in Air Force jets. However, federal government power purchase agreements (PPAs) are currently capped at no longer than 10 years, limiting the government's ability to interact with private developers, who typically seek 20-year deals. In addition, these purchases are not targeted at the earlier-stage technologies in commercialisation that are under discussion here

Due to their size, governments have substantial market power and can place orders large enough to allow the clean energy sector to ramp up production and enjoy economies of scale on the cost side. Given the current over-supply of clean energy products discussed above, governments can help empty warehouses, support margins, and spur further manufacturing.

All of that bodes well for the potential positive impact that could result from governments adopting new clean energy technologies. But governments, like all other electricity consumers, can afford only so much risk when purchasing power. A military base, for instance, cannot chance losing electricity in the midst of an operation due to malfunctioning experimental solar modules. Reliability is key.

This suggests that procurement efforts aimed at fostering next-generation clean energy technology development must therefore be targeted. Within the vast expanse of government, certain agencies or offices have higher risk tolerances. Future PPAs could include requirements for the procuring agency to accept a limited amount of "off-spec" power, to lower initial technical operating threshold risks and broaden the range of potential new technology suppliers.

Public authorities could also be required to incorporate an element of new commercializing technologies in designs when they tender for new buildings. This could lead to innovative tendering approaches, which could provide a market demand underpinning that would facilitate the rollout of new technologies to meet the defined demand from the public sector.

Incentivizing corporate first adopters

Bloomberg New Energy Finance estimates $10.3bn was spent by large corporations on clean energy R&D in 2008. The past two years have seen important developments as major international players such as Areva, Alstom, Hyundai, Samsung, and Lockheed Martin have stepped up their efforts in the sector. Still, more investment is clearly needed.

The entry of these industry behemoths offers an unusual opportunity for the smaller upstarts. As they seek to commercialize their technologies, clean energy companies could seek to negotiate deals with strategic corporate buyers, offering to share upside potential if they are a "first adopter." Under such an arrangement, a large corporation that was interested in the technology but not willing to make a direct strategic investment to purchase it outright might receive a share of future technology royalties, an enhanced warranty, a license for the rights to develop a fixed number of replica plants, or some other arrangement that gave it access to the future technology's upside values, compensating it for the technology risk taken by installing not-yet-commercialized technologies.

First adopters could also logically be rewarded with an equity carry or a royalty share, because they are not being fully compensated for the risks incurred through the project; instead, they are accepting a potential future return that could be generated by the technology company if its efforts prove successful. The upside of such an approach is that if a new technology is highly successful, a first adopter that is granted specific licensing rights or other preferential access could potentially design successor projects, taking advantage of its access to the now-commercialized technology, and then flip ownership through an asset sale in these projects to monetize some of the embedded value in the technology earned through its pioneering role.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

The ability of commercial firms to more easily share in the technology's future financial upside would make them more logical first adopters than governmental entities, which are not easily compensated for their higher-than-normal risk exposure. Strategic investors with interests allied with the new technology are particularly well suited to serve as first adopters.

Whether market conditions are currently ripe for such arrangements remains to be seen, however. Clearly, corporate interest in this sector has surged, but are there enough large-scale players available now to facilitate such arrangements in a meaningful way? While some large corporations and utilities have identified the upside potential of new clean energy technologies, many have not. In addition, utilities in particular often find themselves limited by state public utility commissions (PUCs) on how they are allowed to invest capital. That said, PUCs could use their authority to mandate greater utility activity in backing new clean energy technologies, to help address the public's need for deployment of more effective low-carbon technologies.

5.2. Novel co-investment partnerships

As discussed above, even in the best economic times, private investors have been reluctant to fund demonstration-scale projects that employ next-generation technologies on their own. But what if their capital is accompanied by public funds? What if government shoulders a disproportionately large portion of the financial risk in an investment, allowing private capital to come along for the ride with substantially reduced risk? This is the logic behind the various co-investment partnership ideas floated by respondents in the CEG/BNEF survey.

Public-private partnership funds

One way to merge public and private capital is to create a pooled strategic fund that includes some of both. The mandate for such a fund would be to invest in promising clean energy technologies. It could be structured in a number of different ways to provide private investors with flexibility while shielding them from some portion of the investments' associated technological risk.

One possibility is to allow private investors to buy out the government share of the fund at a nominal return on capital once the technology risks of the overall portfolio have been reduced with time, experience, and financial progress. This essentially creates a government subsidy for a privately managed fund that seeks a balance between public policy and private risk/return objectives. Because of their disproportionate risk position, the government sponsors could be entitled to identify the targeted technology investment sectors, or otherwise provide initial framing directives during the recruiting of the fund's management.

The concept of a public-private fund has gotten traction in Washington in the past 18 months as Congress has considered a Clean Energy Deployment Administration or a "Green Bank" (see Section 5 below). Both the House of Representatives-passed Waxman-Markey energy/climate bill and the Senate Energy and Natural Resources Committee-passed energy bill contain a version of the concept. Final action is contingent on a climate/energy bill's overall passage in both chambers, but the idea clearly has strong appeal in both parties.

Such public-private initiatives have proven successful in the past. The US Overseas Private Investment Corporation has long provided financial backing to privately-managed emerging markets funds, including six clean energy-related funds supporting overseas projects in targeted countries. The US Export-Import Bank has a similar mission and has been working to substantially expand its commitment to clean energy through a variety of loan guarantee programmes. Similarly, the South Korea Carbon Fund collaboration between the Korea Investment Trust, the Korea Investment and Securities Co., Samsung Securities, and Hyundai Securities aims to back emerging clean energy technologies and companies.

Funds with such a design can clearly have a role in addressing the Valley of Death issue, but they also have the potential to crowd out pure private capital, if they are not structured or timed correctly, or if given the wrong mandate. Consider that conventional venture capital and private equity investment in clean energy technologies and companies surged eightfold in just four years, from $1.5bn in 2004 to $11.9bn in 2008. A public/private fund that targeted these same traditional sectors could have competed directly with purely private investors and enjoyed a significant advantage due to access to more patient government capital. This could have had the unintended consequence of driving some VC and private equity investors from the market.

However, if such a fund has a highly targeted mission of *purely* addressing the Commercialisation Valley of Death, where neither VC nor PE investors are structurally able to participate directly, such disruptive competition could be minimized. A fund of this sort would need to be managed very

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

strategically, with its sponsors remaining in close contact with developments in the private market to insure it is truly addressing financing gaps while not crowding out actively interested private investors.

Delegated investor programme

A separate but related idea involves government establishing a delegated Commercialisation finance authority with responsibility for assessing and assuming technology risks with government support. This would effectively be an amalgamation of approaches under the US Department of Energy's current "Section 1703" and "Section 1705" loan guarantee programmes, discussed in greater detail in Section 6 below. This authority could distribute some of the decision-making responsibility via the diffusion of publicly-supported capital to existing, qualified, private sector institutions empowered to make decisions on a deal-by-deal basis. Banks, other investment managers, or experienced public-sector agencies could do the actual processing of applications. So instead of one "central bank" processing all requests, one could envision have a "Federal Reserve-style" decentralized approach, where regional banks – closer to their markets – would make the investment decisions.

The advantage of this approach is that it would speed the capital allocation process. Multiple private-sector delegated investor teams, perhaps composed of a combination of technical, late-stage venture, and project finance professionals, could work with the technical assistance of a central commercialisation risk assessment entity to deploy capital far more quickly than a single federal agency staff unit working in isolation. The challenge would be to find some way to apportion the various risks appropriately, something that could prove challenging given the currently limited pool of investors with adequate technical expertise to address the commercialisation finance issues.

5.3. Project level funding

The approaches discussed so far in this report all involve potential large-scale, or macro, solutions to addressing the commercialisation finance challenge. But a number of the participants in the BNEF/CEG survey offered much more specific ideas focused more directly on policy changes, rule changes, or financing structures that could make single projects viable on their own. The consensus among respondents was clear: any number of small-scale adjustments can be made at the local level to facilitate the development of demonstration-scale projects.

Permits / local incentive database / project planning

The siting of energy projects is a challenge for any developer. But those with the newest technologies tend to the have least capital and least time for onerous permitting processes. This raises the possibility of governments creating more hospitable environments in which these promising early technology projects can move forward.

In particular, federal, state, or local governments could resolve permit and regulatory issues by creating pre-approved approaches, or specific geographic zones in which to site/construct cutting-edge projects. China offers an interesting case in point in this regard. The central government there has announced specific concessions for designated wind and solar projects. While these concessions do not necessarily target cutting-edge technologies, they are expediting larger-scale construction of new clean energy capacity and could be used to address commercialisation finance.

One recent, promising example of a successful effort to pre-clear regulatory hurdles can be found in the US Fish and Wildlife Service's (FWS's) recent final recommendations on how to minimize the impacts of land-based wind farms on wildlife and habitats. The proposed siting and operational guidelines by a 22-member public/private Wind Turbine Guidelines Federal Advisory Committee (www.fws.gov/habitatconservation/windpower/wind_turbine_advisory_committee.html) produced a nationwide science-based "tiered" process that corresponds to the stage of development of each wind power project, ranging from preliminary assessments to post-construction impact studies, intended to assist developers in assessing the environmental footprint of their projects.

In addition, there is the issue of transparency and information flow. Every state or locality has its own set of guidelines pertaining to project development, but these are not always easy to access or even find. Governments can help developers understand what potential incentives are available for a proposed site, allowing the developers to more accurately assess the impact these incentives will have in obtaining further funding. In the US, the Database of State Incentives for Renewables and Efficiency's web-based database (http://www.dsireusa.org).is a good model of some core elements of this sort, but it would need to be expanded, upgraded, and *localized* to adequately augment its contributions for this purpose.

The advantages of such local policy approaches and adjustments are clear. Designating a single location where innovative projects can thrive allows developers to preserve capital they might otherwise have spent dealing with unproductive and time-consuming bureaucratic red tape. A pre-

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

assigned area that offers a full suite of all necessary permits for technology build-outs and operations could speed the rate at which technologies are put into the field to determine their viability.

That said, these approaches can only make a limited impact. While they do reduce the costs to developers of new technology projects, they do nothing to address the financial challenges project sponsors face. Moreover, to truly be effective, the technologies eligible for such development zones must be narrowly defined, to avoid exploitation by developers of conventional projects seeking to bypass more difficult permitting processes elsewhere.

De-risking the project

Some of the most intriguing and potentially most innovative clean energy technologies being rolled out today actually involve equipment that can be attached onto existing conventional projects. For instance, the Colorado-based startup Gevo seeks to produce biobutanol by strapping its technology onto conventional corn ethanol plants. In Brazil, Amyris Biotechnologies is looking to use its specialized yeasts to make ethanol plants there produce farmesene, a chemical that Amyris then plans to convert to jet fuel or other fuel.

These projects raise the prospect of "separating out the risk" on a given project – i.e., giving investors with little appetite for risk the opportunity to invest in the conventional portion of the overall venture, while bringing in more speculative investors for the higher-risk (and presumably higher-return) portions. The government could also potentially step in to provide capital for this riskiest tranche of investment.

Through creative financing, the portion of the project that has the greatest technology risk might be separated from the more traditional development elements. Standard leveraged project financing can be employed for the portion that does not have the heavy technology risk. The pure technology risk elements can be supported with 100% equity, possibly plus efficacy insurance (see Section 5.4). Such a structure requires identifying investors with properly aligned risk tolerances for different segments of the project, and aligning expected returns accordingly.

The advantage to such an approach is that investors with certain risk tolerances are matched to the segment of a project that fits them, best allowing the project overall to receive funding. In fact, examples of this approach are already taking place in the marketplace today. Amyris, for instance, has partnered with Brazilian owners of sugarcane ethanol plants so that the company itself does not have to develop them. Now Amyris plans a $100m IPO and hopes to put those funds toward further roll-out of its technology, focusing all its new funding on supporting only its cutting-edge technology elements.

Unfortunately, the Amyris example is more the exception than the rule. Only in rare occasions can the riskiest part of a project's development be successfully separated out. In most cases, virtually all the risk is tied together in a single package.

Streamlining testing and standards

Securing the necessary validation or qualification to connect to the grid is often the last, not the first, thing new technology developers consider. But interconnection standards play a critical role in determining which projects can get on-line, and difficulty in securing certification approvals can substantially slow financing or deployment of new technologies.

Obtaining acceptable third-party performance verification or, where appropriate, certification for innovative technologies that may not fit with existing certification or product testing regimes could speed their financing. One idea would be to have a public sector organisation such as the US National Institute of Standards and Technology work with private standard-setting organisations (Underwriters Laboratories and others) to develop expedited processes for certifying new energy technologies.

The advantage would be that facilitated certification or third-party testing to verify the commercial viability and efficacy of novel technology could cut the time needed for certification, thereby enhancing financing prospects and making these investors more comfortable with associated risks. This could also be used to back up warranties and provide comfort for commercial lenders.

5.4. Potential insurance products

New technologies by definition present new risks that are challenging, if not nearly impossible to quantify. It is this fear of the unknown and the inability to calculate chance of loss that tends to keep conventional project lenders on the sidelines when presented with opportunities to back power- or fuel-generating plants that deploy cutting-edge equipment.

But what if a third player were to step in to provide an insurance product that mitigated either risks involved with construction of a project or its performance over a lifetime? Such an insurance provider

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

could be a private sector player with unique capabilities to assess and quantify risk, or a government agency with an exceptionally large balance sheet and uniquely positioned to shoulder risk.

Priority Solution 2: Public/private efficacy insurance

Addressing the natural (and structurally appropriate) resistance of commercial energy project financiers to accepting heightened levels of technology risk will be key to spanning the Commercialisation Valley of Death. Efficacy insurance is an interesting tool that could be incorporated into a successful response to this challenge. Efficacy insurance provides protection against a technology that does not perform as its developer had projected. Its coverage pays out at a rate that supports bringing an underperforming piece of equipment up its original specification, or allows it to be upgraded or replaced. It can also provide liquidated damages up to the value covered by the policy.

While efficacy insurance is generally unavailable for new clean energy technologies, insurance products have in the past been designed for just such new, relatively untested devices. Most notably, the Hartford Steam Boiler company began insuring what were then cutting-edge locomotive steam engines as early as the 1850s, and developed associated technology insurance packages to support them, along with a range of other combustion technologies for more than a century. Nuclear power projects and others have all been able to secure this type of insurance in the past.

One potential structure for a clean energy technology insurance package involves investors pooling capital to underwrite such policies. Project owners or developers would pay a premium and transfer the performance risk of the specific novel technology elements to the new insurance pool. Arguably, technically skilled insurance underwriters would be better positioned (and compensated) to evaluate new technology risk, and provide cost-effective (though not inexpensive) surety policies. Incorporating private capital into the commercialisation process at the earliest possible date seems likely to both moderate required levels of public support and accelerate the involvement of private capital in clean energy funding.

Well-structured technology insurance products would remove much of the technology risk that keeps typical project finance institutions from backing new clean energy initiatives. They would allow new technology projects to structure financing in much the same way conventional projects do – via a combination of a number of debt and equity financing layers with varying risk/reward parameters, supported by an appropriate amount of technology risk insurance to raise comfort levels on the novel system components being deployed. Given the risks involved, private insurers are unlikely to create such a technology risk insurance pool on their own, particularly in light of the financial difficulties the sector has faced in the past few years. However, like the power sector, the insurance industry is highly regulated. Insurers could be compelled to participate in such a programme by regulators, and allowed to design it in such a manner that no single player is exposed to excessive risk.

There is precedent for such a move. In coastal states where homeowners have difficulty purchasing flood or storm insurance from private insurers, so-called "plans of last resort" have been mandated by regulators. In Massachusetts, for instance, the state's Fair Access to Insurance Requirements (FAIR) plan is available to homeowners who have been rejected by private insurers. The pool is funded collectively by all the insurers in the state. Similar pools could be created to back cutting-edge clean energy projects. There is also the opportunity (and likely a need) for government to take a more direct role in providing or supporting efficacy insurance or reinsurance. Since the accelerated deployment of low-carbon technologies essentially creates a social good (reduced pollution of the global atmospheric commons), such public support is merited. And utilizing a re-insurance mechanism both increases the early involvement of the commercial finance and investment sector and leverages public support with private sector expertise and funding. This approach can also be incorporated alongside other proposed public sector funding responses, such as the Clean Energy Deployment Administration (CEDA) concept currently in legislative development (see Section 6, below)

A special-purpose government institution could be designed to work in conjunction with debt and equity holders to identify specific risks in particular project development types that investors would not take, and then provide a highly targeted public insurance or reinsurance product to cover them, either directly or working in collaboration with existing private insurers. Groups of lenders and investors could be convened to establish minimum risk support parameters in terms of coverage or target productivity.

Again, there is precedent for such an initiative. In the wake of the September 11th attacks, the US Congress in 2002 passed the Terrorism Risk Insurance Act. The law puts the federal government in the role of providing reinsurance to insurers who might face catastrophic events related to acts of

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

terrorism. The act has been reauthorized two times since and is now on the books through 2014.

A similar federal reinsurance pool or fund could be established to backstop insurers who write products for cutting-edge clean energy projects. Risks faced by commercializing technologies that cannot be assessed in standard investment decision-making could be covered by this style of policy, where certain technical failures trigger the efficacy insurance policy, while other kinds of commercial failures are not covered by it.

There is an obvious challenge to such plans, however. Assessing the risk of new clean energy technologies is not necessarily any easier for government than it is for those in the private sector. Still, certain government entities have extensive expertise with which to make such estimations. And with its strong chain of national laboratories, the US federal government is, in fact, well positioned to organize a team of experts who could effectively study, analyze, and estimate such risks for low-carbon technologies in the public interest. Teams of internal and external risk assessment specialists are currently doing just that, underpinning the decisions of the revived DOE "Section 1703" innovative technology loan programme (see Section 5 below). Their activities will offer a case study in how such assessments can be carried out.

Some initial commercial interest in these efficacy insurance concepts is already appearing. Specialty brokers, such as Iridium Clean Energy and even leading international mainstream brokers, are investigating these opportunities or proposing possible structures that might help advance them. Work is ongoing in an effort to broaden and coordinate these initial efforts. An important next step in developing this concept further would be for interested parties to work more closely with major insurers on possible design, feasibility, and function elements of an "efficacy insurance" product. Discussions with state insurance regulatory communities would also be appropriate.

5.5. Other suggested funding options

Respondents to the CEG/BNEF survey also suggested a number of responses to the Commercialisation Valley of Death challenge that did not fit neatly into any particular category. Some of these highlighted the need for government involvement, while several others looked more to accelerated private market activities for solutions.

Bolstering venture investment

As discussed earlier, the broader venture capital community discovered the opportunities presented by clean energy in 2006-2008 and poured unprecedented sums into the sector.[2] Since then the flow of capital tapered off substantially in the face of broader macroeconomic impacts (though it rebounded somewhat in Q1 2010). Still, several respondents to the CEG/BNEF survey suggested that steps could be taken to encourage VCs to keep their interest level high in clean energy.

One way to achieve this is through structural incentives for projects in which VCs are prepared to extend their investment support and help commercialize some of the technologies that have been proven at pilot, but not demonstration, scale. Such incentives would potentially increase available yields on commercializing projects to the point that they would justify the higher-than-normal allocations or longer hold times for capital that would be required of the VC investors. Larger VC firms have already shown some capacity to undertake such investments. A number of funds are currently providing later-stage support, because the typical IPO exit options have not been available during the recent downturn.

There is clearly a precedent for larger funds to act in this manner, which demonstrates that at least some sophisticated VCs are capable of carrying out such investments, if the proper public incentives were made available for limited partner investors who backed such venture funds. These might take the form of specialized tax benefits for limited partners with the idea being that better-capitalized funds will be more willing to take greater risks on early stage technologies.

Governments can take a more direct role by establishing VC funds that they themselves oversee. The federal government of Canada has invested via its Sustainable Development Technology Canada (SDTC) fund, which features strong technology assessment capabilities and close collaborations with private VC firms. Somewhat less directly, the US government is today a limited partner investor in a series of clean energy funds focused on the developing world via the Overseas Private Investment Corporation. And the federal government is making very early stage investments (akin to advanced

2 In recent quarters, VC funds have actually increasingly been providing late stage support for companies. This is in part due to poor conditions on the public exchanges which might otherwise host clean energy company IPOs and secondary offerings.

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

R&D support) directly via the ARPA-E programme, which to date has allocated $257m to 74 of what the Department of Energy calls "transformational energy research projects."

A government-supported revolving loan fund for early stage investments

Such a fund would offer more financial rigor than typical grant programmes, and should be at least partially replenished by returns from successful investments, while incorporating either lower rates or lighter security requirements than traditional lenders. Such an idea is embedded in part in the newly proposed CEDA programme currently under consideration by the US Congress (see Section 6, below). A similar approach can be imagined based on the US Business Development Company (BDC), created under the Small Business Investment Incentive Act of 1980. Business Development Companies are in effect publicly traded private equity funds, which have developed a highly successful track record of mobilizing government-supported capital for a variety of early stage, small-business-led investment efforts. Such a fund could to some extent be de-risked via government backing to encourage further private investment in early stage commercializing ventures. This kind of innovative approach is important, given the limited long-term value of the largely tax-driven US clean energy incentives available today.

Approaches such as these can leverage the expertise that exists among venture capitalists and other early stage investors. Since 2005, BNEF has tracked well over 700 funds of various types and sizes that have expressed some form of interest in clean energy. Many are in the market making investments and have a clear understanding of the inherent opportunities and risks. Arguably, they are best positioned to pick clean energy technology winners and losers, and thereby should prove better channels for commercialisation risk assessment that typical government programme offices.

On the other hand, there would be a temptation for VC funds to put the new capital to use in more conventional channels, rather than properly investing in companies with potentially game-changing technologies. Even with new funding, some early stage investors may still be unwilling to traverse the expansive and expensive Commercialisation Valley of Death. That would suggest that carefully crafted systems that focused on targeted technologies or specific "technology readiness levels" would need to be developed to assure that firms correctly allocated incremental capital made available to them.

Using a carbon metric to fund projects

In the US, efforts continue in fits and starts on Capitol Hill to establish some form of national cap-and-trade programme that would limit harmful greenhouse gas emissions on a national basis. Meanwhile, somewhat more quietly, the US Environmental Protection Agency is studying regulations that could potentially have much the same basic impact.

Elsewhere in the world, most notably across the European Union, carbon is already a tradable commodity, and as a result, major funds with billions of dollars under management have been formed to participate in these markets. This raises the possibility that these pools of capital could be tapped in some useful way to foster accelerated clean energy innovation.

To date, few equity-side carbon investors have been willing to provide financing for innovative technologies. Major clean energy power plants, however, can generate material levels of potential carbon reductions (especially if deployed in a baseload mode). Thus, a carefully developed carbon emissions reduction profile associated with a new project could potentially yield significant investor interest. Exactly how such a mechanism would operate is unclear, and respondents to the CEG/BNEF survey offered few specifics. Currently, Congress is considering legislation that would subsidize carbon capture and storage projects by awarding "bonus allowances" under a new proposed cap-and-trade programme. Such a model could potentially serve as a template for subsidizing demonstration-scale clean energy projects as well.

However, any such plan is contingent both on the existence of a thriving carbon market and a belief in its longevity among its participants. In addition, traders must also believe the carbon price will remain at some substantial level, otherwise the credits that could be used to subsidize a new clean energy project will be useless.

There is also the concern that projects that deploy cutting-edge technologies do not automatically offer a higher carbon offset potential than do conventional clean energy projects. Thus, it will remain in carbon investors' best interest to pursue lower-risk opportunities. One potential solution: design a carbon scheme that offers advanced technology projects incremental credits per ton of CO_2 mitigated to attract greater investor interest in technological breakthroughs.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Tapping utility balances sheets for support

In Europe and Asia, power distributors and power generators are often one and the same. As a result, major electric companies on both continents have played a critical role in clean energy development there.

In the US, it has been a vastly different story. With some very notable exceptions, utilities there have been comparatively slow to seize on the opportunities offered by renewables. While many are now compelled to add clean generation to their portfolios thanks to approximately 30 state-level renewable portfolio standards (RPS), they often prefer (or are sometimes required to) sign power purchase agreements with project developers rather than buy the projects outright.

The RPS requirements only stand to get more stringent in coming years, however. And utilities are slowly starting to learn that renewables are here for the long term, and they are beginning to make the investments needed to secure their associated low-carbon energy supplies. Once a long-term PPA has been signed by a utility for a clean energy purchase from a commercializing technology developer, the utility has provided important commercial and referential support for that technology; this support can help projects secure key financing elements, based on the strong offtake commitment.

Of course, technology companies are not directly gaining the full benefit of the utilities' balance sheets, since the PPA is a performance-based contract, but the strength of the PPA and its indication of utility support is a resource that can often be leveraged with outside investors. For utilities deeply committed to a specific technology and interested in encouraging it for strategic purposes (perhaps related to its particular application to conditions in its local service territory), additional enhanced support mechanisms might include:

- A guarantee of a portion of the project's senior debt
- Advances on the first year's contracted revenue to help fund construction finance

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 6. Current programmes to bridge the commercialisation gap

Clean energy advocates in the US often lament that the country has been slow off the blocks in recent years to adopt renewables and that federal policy support for the sector has been insufficient. However, the country has been a global leader in generating and attracting venture capital investment in new clean energy start-ups. In addition, it has put in place a few key programmes that, if carried out effectively, have the potential to play a critical role in fostering new energy technologies. Several respondents to the CEG/BNEF survey from outside the US remarked that the country has already made moves in the right direction in terms of establishing important policies. The problem has been implementation.

6.1. US Department of Energy loan guarantees

In the Energy Policy Act passed by Congress in 2005, the US established a loan guarantee programme intended to foster the development of early stage clean energy projects and technologies. The idea was relatively simple: in order to mitigate the risk lenders face when financing a project that employs a relatively novel technology, the government would guarantee repayment of some portion of the project debt. The thought was that with most of the project risk removed, banks would feel more comfortable lending.

Specifically, under the so-called “Section 1703” loan guarantee programme from this legislation, the US Department of Energy proposed to unconditionally guarantee up to 80% of the debt on a given project. In turn, that debt could represent no more than 80% of the total cost of the project. An equity investor would have to cover the remaining 20%, and a participating lender would need to retain 20% of the loan amount on its own books on an unguaranteed basis.

The programme got off to a very slow start. The Department of Energy (DOE) did not move quickly to put proper personnel in place, and the initiative was under-funded. The programme essentially charged applicants some percentage of the overall assumed risk known as the “credit subsidy cost.” This cost could easily total in the tens of millions of dollars for a substantial project, and developers simply did not have the funding available to take advantage of the programme. The guarantees were originally structured to put the private lender in a first-loss position; many lenders would not be comfortable taking technology risk under such a financing structure. Finally, the programme imposed enormous documentary burdens on applicants (with applications running to more than a thousand pages), and it moved inexorably slowly in processing those few applications it did receive.

By the first quarter of 2009, however, things began to pick up steam. First, in February, President Obama signed into law the American Recovery and Reinvestment Act, which allocated $6bn in funding for the Section1703 programme, plus a similar loan guarantee programme intended to finance projects that use conventional clean energy technologies. Recovery Act funding has allowed DOE to relieve developers of paying the significant credit subsidy cost, rendering the programme potentially much more cost competitive. By March 2009, DOE had offered its first, $535m loan guarantee to Solyndra, a California-based firm looking to expand manufacturing of its unique, cylindrically-shaped thin-film PV modules. The agency later offered loan guarantees to flywheel maker Beacon Power, two-blade wind turbine maker Nordic Windpower, developer First Wind, and solar thermal electricity generation technology and project developer BrightSource. Each of these projects seeks to advance a new technology that could help revolutionize how the US generates substantial amounts of clean power.

Overall funding for the loan guarantee programmes was cut by $2bn in summer 2009 to provide additional funds to the so-called “cash for clunkers” programme. Efforts are now afoot on Capitol Hill to restore those funds, but significant funding still remains available from the original allocation. Decisions on as many as 10 additional projects could be made in coming months.

Additional changes to the programme are also being considered that could streamline the programme process even further. Utilizing independent lenders with delegated authority provisions would be the preferred structure, and is currently in development under the new Section 1705 Financial Institution Partnership Program (FIPP). Other ideas include a possible alternative structure for the loan guarantees, perhaps utilizing taxable bonds to serve as a senior debt component. Another possible alternative: rather than using the federal guarantee to collateralize a bond that runs to the entity, seek to attach the guarantee directly to the bond. A debt instrument that carries a direct federal guarantee could be more easily managed on the bond market.

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

6.2. Advanced Research Projects Agency-Energy (ARPA-E)

Also established by the 2009 stimulus bill, the US DOE's Advanced Research Projects Agency-Energy (ARPA-E) takes its inspiration from the Defense Advanced Research Projects Agency, the Pentagon's research and development office, which is credited with fostering a number of technologies, including advanced semiconductors, and creating the infrastructure that would later become Internet. Like DARPA, ARPA-E aims to fund some of the earliest technologies that may not be mature enough to attract venture capital investment. Its goal is not to bridge the scale-up Valley of Death but rather the gap that exists between the lab and private funding.

The ARPA-E programme aims to be a nimble, flat organisation that is willing to take on high-risk projects. It aims to create an intellectual property strategy, technical data strategy, and procurement or financial assistance instrument that best manages the high risk inherent in this kind of R&D and optimizes the likelihood that the technology will move forward to market.

The programme was allocated $400m, and DOE moved quickly to solicit eight-page "concept papers" from researchers seeking funding. No less than 3,500 applications were initially received. That was later narrowed to 350 finalists and, in October 2009, ARPA-E awarded $151m to 37 projects focusing on carbon capture, energy storage, biofuels, and electric vehicles, as well as renewable power and building efficiency. In April 2010, an additional $106m was awarded to an additional 37 projects, leaving $143m remaining to be spent. While this programme is intended to assist earlier-stage technologies, its architecture, flat operational structure, and heavy use of technical expertise out of DOE itself could provide important model elements for a public sector response to bridging the Commercialisation Valley of Death.

One issue that may hamper ARPA-E's effectiveness, however, is the lack of a guaranteed demand pipeline for funded projects. Unlike its DOD analogue, where DOD was the customer for the funded projects (with no absolute cost constraints imposed), ARPA-E-funded projects have no guaranteed customers; although a technology's commercial potential is considered in the award process, no evidence of purchasers in a "willing buyer-willing seller" environment are required of an applicant. The programme will need to address this issue if it is to be successful in the longer term. Strategies laid out in this paper, including the Emerging Technology Reverse Auction Mechanism for utility purchase of clean energy output from "emerging technologies" and the insurance risk pool, could help create a more robust state-level pipeline for funded projects.

Priority Solution 3: Clean Energy Deployment Administration (CEDA)

Unlike DOE's loan guarantee programme and ARPA-E, the proposed Clean Energy Deployment Administration (CEDA) has not been established by law. Rather, it has been delineated in legislation currently pending before the US Senate, having been approved by the House of Representatives. A similar but separate proposal that has been put forth in the House would establish a so-called federal "Green Bank" to finance clean energy investment more generally.

The explicit goal of CEDA as approved by the Senate Energy and Natural Resources Committee is "to encourage deployment of [clean energy] technologies that are perceived as too risky by commercial lenders." Its target is explicitly to bridge the Commercialisation Valley of Death.

The Clean Energy Deployment Administration was proposed to develop a methodology for assessing clean energy technologies and encouraging their more rapid commercial-scale deployment, and to advise on approaches for meeting national energy technology deployment goals. It would reform the existing DOE loan guarantee programmes for low-emission projects by replacing them with an entirely new quasi-governmental administration. The administrator of the CEDA would have broad authority to provide direct and indirect support to clean energy technologies by issuing loans, loan guarantees, letters of credit, and insurance support, and/or by taking direct equity stakes.

The federal government would provide initial funding to CEDA, though no specific funds have yet been appropriated. Whatever income the fund would generates would go back into its coffers. No single technology could receive more than 30% of CEDA's available funds.

Questions abound about how exactly CEDA would be structured. One proposal has it housed within DOE but independently managed by an administrator and an outside board of directors. Another has it operating outside the auspices of the agency altogether, instead reporting directly to the President.

There is some concern that the existing DOE loan guarantee programmes, which are starting to pick up momentum, could be rendered null and void by the passage of the CEDA legislation. However, some proposals call for the structure of the new DOE-FIPP delegated lending programme to be transferred in its entirely to a newly launched CEDA. This would represent an important and perhaps

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

critical step forward, since a FIPP-style programme that utilized a delegated lending authority to the maximum feasible extent would represent an important leverage of skilled non-governmental personnel and expertise in the ramp-up of the CEDA programme. One way or the other, CEDA will have to be staffed with highly skilled individuals with strong independence and private sector urgency on deliverables. More information on the actual final structure of the programme will be needed in order to assess its possible effectiveness.

6.3. Decentralized state funding

One of the major differences between the EU and the US is that in the US, state governments exert the majority of control over where and how new energy generation is located. Not surprisingly, a number of states already have established experience in supporting innovative clean energy deployments, and virtually all the new programme development in clean energy finance in the last decade has been at the state level.

This raises the possibility of the federal government working in concert with the states to promote demonstration-scale projects. One alternative would be to make use of the national government's guarantee authority and/or funding, but decentralize the distribution. The central government could lay down general parameters that would create a specific, uniform programmes administered at the state level, wherever states have sufficient interest to provide their associated level of support and/or administrative oversight.

Such an approach would incentivize states or regions to be proactive in their support for bridging the Commercialisation Valley of Death, and perhaps better position them to provide assistance to locally developed initiatives with which they are most familiar. To date, no such proposal has been expressly proposed at the federal level.

© Bloomberg New Energy Finance 2010 Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

Section 7. Conclusions – bridging the commercialisation finance gap

Constructing a policy and financial design that can prudently and cost effectively span the Commercialisation Valley of Death presents a structural financing challenge of the first order. That is particularly so when the finance challenge is to put commercial-ready products into the market at sufficient scale to have a significant impact on the trajectory of global GHG emissions.

There is no shortage of ideas on how address this issue. But few seem to deal directly with the current challenging circumstances facing clean energy finance: the battered economy has reduced capital availability; the investment community fears technology risk from new projects; there is lack of consensus on US national energy strategy; and major corporate players that formerly assumed the commercial technology and capital risk in an integrated buying and marketing approach are now largely in retreat. In summary, climate risks are escalating as the capacity of financial and institutional responses to support innovative commercial responses to them diminishes. Any new approach must address all these challenges in order to succeed.

Bloomberg New Energy Finance (BNEF) has worked with Clean Energy Group (CEG) to identify some new solutions to this problem. We have highlighted several new Commercialisation strategies that appear to merit further elaboration in collaboration with industry players. We believe that these strategies are sufficiently intriguing that further exploration is merited. The most interesting related strategies for assembling tools to support a sufficient clean energy technology commercialisation pipeline involve the combination of several basic mechanisms:

- A variation of a procurement-based, **"emerging technology reverse auction mechanism,"** which would set appropriate state or federally supported but market-based prices for not-yet-fully-commercialized emerging technologies and would require regulated utilities to procure project outputs up to various megawatt or other capacity limits.
- The creation of an "**efficacy insurance**" product that could mitigate certain early stage technology risks that hamper the investment needed to scale up projects, perhaps supported by a federal reinsurance programme.
- A federal programme to support **early capital deployment in commercialisation finance**, such as the proposed Clean Energy Deployment Administration.

These interrelated mechanisms could be extremely effective, particularly if they are made available simultaneously, to overcome the capital constraints that typically face efforts to finance emerging technologies. An important element of success is their reliance on the purchasing power of financially robust regulated utilities. The insurance product is designed to address the various technology risks associated with commercializing technologies, and broader underlying financial support from a dedicated federal commercialisation finance programme should help complete the commercialisation gap-spanning package. The combination of these programmes could serve as an incentive for other project funders to support required investment in large-scale, infrastructure-type emerging technology projects.

Our recent research has developed some interesting and novel approaches to overcome these clean energy commercialisation challenges. These ideas, however, need further research and development, and the industry needs to be brought more deeply into these discussions, before we can be assured that these strategies could work as projected to address the Commercialisation Valley of Death.

© Bloomberg New Energy Finance 2010

Strictly no copying, forwarding, shared passwords or redistribution allowed without prior written permission of Bloomberg New Energy Finance. For more information on terms of use, please contact sales@newenergyfinance.com. Copyright and Disclaimer notice on page 22 applies throughout.

About Us

Subscription Details

All Renewable Energy

sales@newenergyfinance.com

Contact Details

Ethan Zindler Global Head of Policy Analysis	ezindler@bloomberg.net +1 202 654 1276
Ken Locklin Director – Finance & Investment, Clean Energy Group	klocklin@cleanegroup.org +1 703 476 1561

Copyright

© Bloomberg New Energy Finance 2010. This publication is the copyright of Bloomberg New Energy Finance. No portion of this document may be photocopied, reproduced, scanned into an electronic system or transmitted, forwarded or distributed in any way without prior consent of Bloomberg New Energy Finance.

Disclaimer

The information contained in this publication is derived from carefully selected public sources we believe are reasonable. We do not guarantee its accuracy or completeness and nothing in this document shall be construed to be a representation of such a guarantee. Any opinions expressed reflect the current judgment of the author of the relevant article or features, and does not necessarily reflect the opinion of Bloomberg New Energy Finance. The opinions presented are subject to change without notice. Bloomberg New Energy Finance accepts no responsibility for any liability arising from use of this document or its contents. Bloomberg New Energy Finance does not consider itself to undertake Regulated Activities as defined in Section 22 of the Financial Services and Markets Act 2000 and is not registered with the Financial Services Authority of the UK.