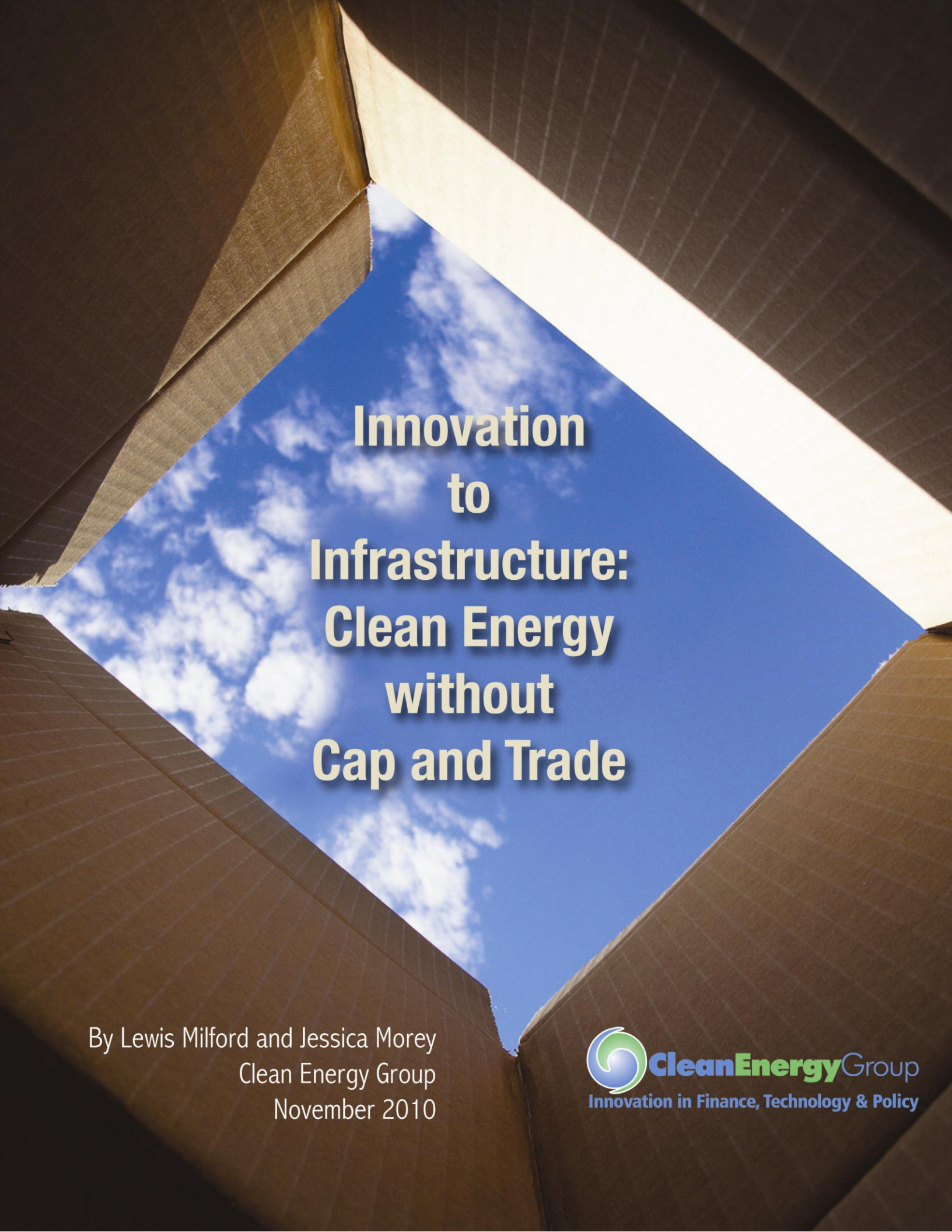

# Innovation to Infrastructure: Clean Energy without Cap and Trade

By Lewis Milford and Jessica Morey
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## About the Authors

**Lewis Milford** is President and founder of Clean Energy Group and the Clean Energy States Alliance, two nonprofit organizations that work with state, federal, and international organizations to promote clean energy technologies. He also works with many public agencies (including public pension funds) in the United States and Europe that invest in clean energy.

Mr. Milford is frequently asked to appear as an expert panelist at energy conferences throughout the United States and Europe. His articles promoting clean energy have appeared in the *New York Times*, *Boston Globe*, *Electricity Journal* and *Solar Today*.

Prior to founding CEG in 1998, Mr. Milford was a vice president of the Conservation Law Foundation, where he conducted litigation and advocacy relating to a variety of energy and environmental issues and testified before numerous legislative and regulatory agencies. Previously, Mr. Milford was a New York Assistant Attorney General representing the State of New York in the Love Canal hazardous waste case, and a law professor and director of the public interest law clinic at American University in Washington, D.C., where in federal court and before Congress he represented Vietnam War veterans harmed by Agent Orange.

Mr. Milford is the co-author of Wages of War, a social history of American war veterans, published by Simon and Schuster in 1989. He has a J.D. from Georgetown University Law Center and is a Phi Beta Kappa graduate of Rutgers College. LMilford@cleanegroup.org.

**Jessica Morey,** Washington Project Director with the Clean Energy Group (CEG), works primarily on CEG's Climate Technology Innovation Initiative in the U.S. and internationally. This initiative aims to accelerate breakthroughs in clean energy and climate technology costs and performance through improved collaborations and innovation strategies in the U.S. and globally.

Jessica also assists the Clean Energy States Alliance (CESA), a multi-state coalition of state programs working together to support clean energy technologies and markets, managed by CEG. Jessica directs the CESA's State/Federal Marine Energy Technology Advancement Partnership that works to accelerate the commercialization of marine hydrokinetic technologies in the U.S. through creation of a strategic partnership between states, DOE, NREL, and the industry. In addition, Jessica directs research for the Sustainable Energy Finance Alliance, an international consortium of publicly-backed funding agencies dedicated to building sustainable energy markets, convened by the United Nations Environment Programme and managed by CEG, which serves at the Secretariat.

Before joining CEG, Jessica worked as a clean energy analyst in the World Bank's central energy unit. Her projects included mainstreaming low-carbon analysis into Bank energy projects and improving coordination and knowledge sharing across the Bank's energy practice and international development partners. Jessica has also consulted with the Natural Resources Defense Council on the Carbon Neutral Costa Rica campaign and worked as the International Fellow at the Pew Center for Global Climate Change. She received her Bachelor's in Environmental Engineering from Dartmouth College, a Masters in International Affairs from American University and a Masters in Sustainable Development from the UN University for Peace in Costa Rica. Jessica@cleanegroup.org.

# Innovation to Infrastructure: Clean Energy without Cap and Trade

**Lewis Milford and Jessica Morey, Clean Energy Group**

## Section 1. Executive Summary

With the failure of cap and trade in Washington and in international negotiations, and the recent mid-term elections, it is time for clean energy pragmatism.

Clean energy pragmatism asks what a new set of policies would look like without cap and trade, without major new federal legislation, and without significantly more federal money. These are likely to be the boundary conditions in future energy policy debates.

If so, the real challenge is whether it is possible to make forward progress — to create "chunks" of energy policy, as President Obama has proposed — in this new environment. Can different clean energy policies answer President Obama's demand the day after the mid-term election that, without cap and trade, he wants "other means to address this problem …ways we can make progress in the short term and invest in technologies in the long term…?"[1]

It can be done, if we look beyond Washington for the answers. What is needed is a practical and bottom-up clean energy policy consisting of short-term measures to increase new technology investment in the long term — essentially what the President has called for, and that may well have bipartisan appeal.

It would target critical bottlenecks and opportunities in this new energy landscape, paid for with reprogrammed federal funds and supported by creative use of executive authority. It would not rely on major legislation, significantly more money, or new grand policy theories. Instead, it would rest on several new energy strategies in five areas to promote emerging clean energy technologies — whether offshore wind, marine, advanced solar, storage, or carbon capture and storage for coal or gas — the opportunities where the most work is needed to create environmental and economic benefits for the long term.

**New Energy Strategy #1:**

### Open and Distributed Technology Innovation — Copy Corporate Success

Even without any new research funding, the Department of Energy (DOE) and other clean energy technology programs such as those in the Department of Defense should use new innovation strategies from the corporate sector to move clean energy from lab to market. Open and distributed innovation strategies would create energy breakthroughs outside the traditional research and development structures. DOE and other agencies should reprogram at least $100 million from existing funds to institute several experimental, corporate-style, innovation programs to accelerate technology commerciali-zation breakthroughs. This would represent only 2% of the $5 billion DOE Office of Science budget.

**New Energy Strategy #2:**

### Clean Energy Federalism — States Lead, Washington Follows

The federal government should recognize that states are the key to a future clean energy transition. To that end, the federal government should invest additional existing funds to support a stronger technological and financing partnership with the states to deploy clean energy throughout the nation — a new "clean energy federalism." This funding, approximately $650 million, could come from multiple agencies, with intersecting mandates to support clean energy across the states to promote jobs and security, such as Department of Homeland Security, U.S. Department of Agriculture, Department of Defense, U.S. Small Business Administration, Department of Commerce, Environmental Protection Agency, and the DOE. Based on the states' track record, a $650 million federal investment could leverage more than $2 billion in additional private and public investment. In addition to funding, DOE should lead an effort to ensure regulatory coordination between states and federal agencies so that new clean energy technologies are permitted and sited more rapidly.

**New Energy Strategy #3:**

### Create Commercialization Finance Tools — Bring Emerging Clean Energy Technologies to Market

In order to create commercial products from technologies that have proven success in the lab and at pilot scale, the federal government should undertake two initiatives to overcome the major obstacles to private financing of new, pre-commercial technologies. It should reprogram $50 million to support a negotiated collaboration with the insurance industry to explore and develop "efficacy insurance" products — to reduce the technology risks of new clean energy technologies. It should also invest $50 million more to help state regulators develop programs for utilities to direct $1 billion of their ratepayer annual investments in power procurement for emerging clean energy technologies.

**New Energy Strategy #4:**

### Energy as Infrastructure — Federal and State Procurement Strategies for Clean Energy

The DOE should lead a coalition of federal and state agencies to commit to procure at least $1 billion in power from emerging technologies such as offshore wind and marine power, technologies that now receive significant research funds. In parallel, these federal agencies should commit $50 million to create a novel, procurement partnership with the states to treat clean energy investment and procurement as "infrastructure" in the same way that they now jointly fund roads and bridges.

**New Energy Strategy #5:**

### International Climate Technology and Finance Strategy that Builds on Success from Both North and South

On a global scale, the U.S. State Department and the DOE should reprogram $100 million in existing funding commitments to support greater cooperation in technology innovation, more coordination of public clean energy investors, and better link these activities with the private sector. This would support technology and finance initiatives among developed and developing countries. It would also recognize that innovation in the South and emerging economies is likely to be a growing source of new low-carbon products, and that the U.S. needs to finds its niche in that future economic activity.

These reprogrammed funds — in total, about a billion dollars with another billion dollars of existing procurement dollars — will not solve all energy problems. Other programs and funds surely will be needed to serve other energy needs. But as a start toward a more practical energy policy, $1 billion of existing funds represent less than 3% of the DOE's proposed $29 billion budget for 2011.

These approaches aim to do more with less — and to do it differently. They don't require the creation of new agencies or institutions. Rather, they target specific barriers to clean energy breakthroughs and commercialization problems that have plagued the field for years. If they are not solved, new expenditures might make little difference. These are the "must do" strategies to scale up clean energy activities to the next level of commercial success.

These energy ideas do not look like the conventional policy wisdom in Washington — cap and trade, a renewable mandate, a carbon tax, or billions in new funding — many good ideas that are highly worthy policy goals, but so far have not attracted enough support to become law. Instead they come from experiments outside of Washington — in the states, in companies, and in other regions or sectors of the world — at the edge,

the outer spaces where unexpected ideas typically emerge. They are based on either proven successes or emerging approaches in technology innovation and finance. They represent a decentralized, experimental collection of new innovation strategies.

This "innovation to infrastructure" initiative should appeal to both those who question climate change science and those who support it. For those who believe climate action is a serious problem, they need a new approach without cap and trade. For those who don't believe in climate change, these programs promise the economic and security benefits of a strong, diversified, U.S. clean energy industry. For both groups, new strategies could serve their seemingly conflicting, but possibly congruent, beliefs.

In clean energy, we have tried top-down, big, and conventional. It's now time for bottom-up, small, and innovative.

# Section 2. New Energy Strategies

## New Energy Strategy #1:

## Open and Distributed Technology Innovation–Copy Corporate Success

The collapse of cap and trade has ramped up calls for increased federal research and development funding. More funding would be desirable (though hard to come by), but more important is that the DOE and other federal agencies should spend existing clean energy research dollars, and any new funding, in smarter and more effective ways.[2]

The federal government, including agencies such as the DOE, Defense, and Commerce, should pursue more modern "open and distributed" technology innovation strategies that mimic corporate innovation. These approaches go beyond the old research models that are too common in the federal government, efforts that lag behind how leading companies today practice modern, global innovation.

It is undisputed that not enough federal funds are devoted to clean energy research and development. But instead of focusing only on more money, a common proposal recently, what is critical is new thinking. There must be a change in "how" energy innovation should be done by the federal government — to create energy breakthroughs, to bring new research to market faster, to reduce costs, to create new business models, and to scale up technologies for climate stabilization and economic benefits.

This is not about tinkering around the edges. It is about the fundamental transformation of the national energy infrastructure, and the creation of a vibrant, energy innovation economy.

The job is enormous — new low-carbon energy technologies need to compete and beat fossil fuel technologies on cost and emissions, even without rebalancing the currently skewed levels of public support for the fossil industry.[3] In virtually every clean energy area, new breakthroughs are needed. But lab breakthroughs mean little if they are not taken up in the marketplace at a pace and a scale that can make a real difference on job prospects and climate impacts.

That means a greater focus on commercializing new technologies, not just inventing them. This is where the federal government is missing opportunities for success.

Right now, with few exceptions, the federal clean energy programs focus chiefly on research and development (R&D) within the national lab and university systems. But that research funding rarely involves product development or deployment of that funded research. DOE research projects are seldom designed (or actually implemented in practice) to reach aggressively beyond their labs to seek creative solutions or share results with other energy experts — let alone across other sectors and disciplines where answers could be found — and they are not required to work downstream with investors and finance experts who are needed to bring those ideas to market.

In this way, DOE still generally operates in a "closed" R&D model. As energy technologies involve material science, nanotechnology, and related fields, cross-disciplinary learning and product development all along the value chain should be the rule for DOE funded research, rather than the exception.

A few decades ago in corporate America, most research and innovation also used this "closed innovation model." One business expert called it "knowledge creation for its own sake." It did not forge any links to downstream commercialization partners like venture capitalists, merchant banks, or corporate investors, and it did not look outside their own corporate research departments for new ideas and colleagues. Examples of this approach are the Bell Labs and Xerox's Palo Alto Research Center or PARC. These were in-firm, R&D shops based on the notion, said former Harvard president James Conant, of "picking a man of genius, giving him money, and leaving him alone."[4]

These "closed innovation" entities generated much prize-winning research but often floundered when they tried to commercialize this research into practical, marketable products. Over time, companies experienced fewer returns for their R&D investments in this closed system. Their conventional view—that if they did great research, the private sector automatically would turn that research into commercial products — was not working.

The failure of that internal innovation system changed corporate innovation dramatically in the last few decades.

### New Energy Strategy #1

DOE and other federal agencies should dedicate a minimum of $100 million out of existing funds, a mere 2% of the DOE's Office of Science's $5 billion budget, to support new "open and distributed" innovation initiative in clean energy research and development. This would be a down payment on a new approach to accelerate the movement of breakthrough research to commercial clean energy markets. Unless the U.S. adopts this new "open innovation" world, they risk falling further behind other countries that invest in the entire value chain from lab to market.

To accelerate commercialization and to make real products from their research, forward thinking companies came up with a different approach — an "open and distributed innovation model." The term "distributed innovation" (DI) refers to global, collaborative product development. Instead of funding more internal researchers working together only in a "skunk works," a solo company endeavor, companies looked outside their walls to capture expertise in other companies, institutions, sectors, and countries, to get good ideas quickly turned into new products for real markets.

They were able to do with this with the evolution of Internet tools that allowed companies to tap dispersed talent and create effective collaboration across virtual global networks.[5] This innovation world has changed dramatically with the advent of Internet-based tools. It offers exciting opportunities for global innovation projects to find solutions faster and better, and to move ideas more quickly into the marketplace.

The business literature has defined the open and distributed innovation trend as the leading corporate transformation in the last twenty years. It represents a wholesale change in "the process of managing innovation both within and across networks of organizations that have come together to co-design, co-produce and co-service the needs of customers."[6] DI uses the latest information technology, collaboration tools, and "open innovation" approaches to supplement in-house research and development capacity, all with the goal of accelerating the technology development cycle.

This type of collaboration builds linkages all along the value chain (from upstream R&D to downstream deployment) and across dozens, hundreds, and sometimes thousands of people throughout the world. This borderless environment fosters meaningful collaboration among an array of institutions. But more importantly, it removes barriers between experts in specific disciplines that have typically operated in discrete technical "silos." It also

bridges interactions and associations between the public and private sectors.[7] Often, commercial or nonprofit "matchmakers" make connections to accelerate collaborative problem solving.

Corporate examples of open innovation are now widespread and proven. Companies as diverse as IBM, Proctor and Gamble, Boeing, Ely Lilly, and scores more — in health, agricultural, and many diverse corporate sectors — have used it successfully. It relies on the Internet and other networking tools to seek outside institutions and expertise to help develop ideas and products faster, cheaper, and more creatively. Solution seekers are linked to solution providers who are financially rewarded for their answers. And answers can come from outside the industry, from unexpected places. Companies increasingly rely on external partnerships to make products together, to share research, and to create markets.

But governments in the energy space have been slow to adapt to the brave, new, innovation world — an odd response to one of the greatest technology challenges the world faces. Use of "open and distributed innovation" strategies could ensure that federally supported R&D is linked to a commercial strategy. We don't have enough time in the clean energy space to wait for lab breakthroughs to emerge through their historical, two decade-long process of commercialization.

Even the leading intellectual founder of the open innovation field in the business school community, Professor Henry Chesbrough of the Haas Business School, called for use of open innovation in clean energy when the Obama administration took office.

> The economic situation is as bad as it has been in decades. Innovation must be at the forefront of economic policies in [the new] administration. Innovation is widely distributed around the world, not concentrated in a few large firms in the U.S. alone. So policies must promote the division of innovation labor. These include support for start-ups and small businesses. Universities and national labs must be allowed to engage with industry on translating research results into commercial products…Open initiatives must be promoted, ...a new initiative in alternative energy led by the government — but involving universities, industry, venture capitalists, nonprofits and research labs — should be started immediately.[8]

A first step would be for DOE to fully support "open innovation" experiments for all key, clean energy technologies. Interestingly, a directive from the White House in the summer of 2009 called for all agencies, including DOE, to implement such open innovation strategies in all programs.[9] But the memorandum has been largely ignored. Instead, DOE has funded a few small projects around cluster initiatives or regional economic development strategies. While good, they are marginal in scope and effect.

Programs such as the Advanced Research Projects Agency Energy (ARPA-E) show that the DOE can think creatively about supporting clean energy. But even that program is missing one key component — a customer for its breakthrough technologies or programs to create markets for the early-stage technologies they support. Without that, many of the research programs may not lead to commercially useful products.

### New Energy Strategy #1:

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## New Energy Strategy #2:

## Clean Energy Federalism – States Lead, Washington Follows

States today are at the forefront of domestic efforts to address clean energy and climate change. They have shown extraordinary bipartisan leadership as they design and implement creative and diverse clean energy programs. Over the past decade, states have provided critical financial support to spur thousands of new, clean energy projects using a range of financial support tools, from rebates to competitive grants to loans. Complementing these tools is a set of aggressive public policies at the state level — from tax incentives, net metering, and interconnection rules to renewable portfolio standards.

It makes sense that states have been on the cutting edge of clean energy technology deployment. Through their utility regulators, states decide what kind of power plants — coal, oil, solar, or wind — are financed and built in the U.S. While the federal government can influence state energy investment decisions through research and development funding and tax incentives, federal agencies ultimately have little control over those electric power generation decisions.

To underscore the state role, electricity generation is not and never has been a "free market." It is the most tightly regulated technology market in the economic marketplace. State governments, through price setting, permitting policies, incentives, and approvals for utility procurement of power or investment in new generation capacity, mandate what kinds of power sources are used to create electricity in the United States.

### New Energy Strategy #2

The federal government should support several new initiatives with the states on clean energy deployment – to create a new "clean energy federalism." It could start by dedicating $650 million of existing funds from multiple federal agencies with mandates to promote jobs, energy security, and clean energy that intersect with the states. Federal agencies with existing related programs include Department of Homeland Security, U.S. Department of Agriculture, Department of Defense, U.S. Small Business Administration, Department of Commerce, Environmental Protection Agency, National Science Foundation and the DOE. Based on the states' track record, a $650 million federal investment could leverage as much as $2.0 billion in additional private and public investment.

Given this reality and the historical trends of state leadership in financing energy projects, the future of energy policy will not reside in Washington, if it ever did. Instead, states will be central to any clean energy transformation in the U.S.

State clean energy funds — now in over 20 states with others implementing an array of clean energy programs — are the clean energy experts. State policies and programs are now the main driving force for clean energy progress in this country, because states view clean energy as a foundation of their environmental and economic development strategies.

The most recent data show that between 1998 and 2009, states, through their own funds, have supported over 72,000 new, clean energy projects across the United States. To bring these projects to market over this eleven year period, states have invested $2.7 billion of their own public funds, almost a half a billion dollars in state funds in 2009 alone. This is separate and apart from any federal stimulus funds, a remarkable demonstration of the states' commitment to clean energy as part of their future economic development strategies.[10]

This public investment, in turn, leveraged at least $9.7 billion of additional private and public investment. In other words, in the last decade, states have been responsible for generating more than $12 billion of public and private investment in clean energy — a truly sensational public investment success story.

The question then is: *what can the federal government do to follow this leadership and expand on it to grow the clean energy market?*

The federal government could start by dedicating $650 million of existing funds to a new "*clean energy federalism* partnership." To date, the federal government has supported state-sponsored, demonstration projects. But what is needed now is a more systematic partnership where the federal government relies on state leadership to develop larger markets for all clean energy technologies through collaborative research, development, and deployment of those existing and emerging clean energy technologies.

This new partnership would merge federal policies and funding with state expertise and clean energy deployment to create a more durable American energy policy. This funding could come from multiple federal agencies with mandates to promote jobs, energy security, and clean energy deployment that intersect with the states, including Department of Homeland Security, U.S. Department of Agriculture, Department of Defense, U.S. Small Business Administration, Department of Commerce, Environmental Protection Agency, National Science Foundation, and the DOE. Based on the states' track record, a $650 million federal investment could leverage as much as $2.0 billion in additional private and public investment.

A clean energy federalism partnership would encompass some of the following initiatives:

- Match state funding and support for training and workforce development programs among the states.
- Create more state-based, economic development institutions needed to marry federal funding and state implementation, leading to more venture assistance, creation of accelerator parks and related support activities like regional centers of excellence.
- Ensure regulatory coordination between states and federal agencies to overcome major permitting and siting time delays.
- Create new collaborative technology funding partnerships between DOE and the states to encourage more joint demonstration funding across all high-value low carbon technologies.
- Support greater state investment in higher risk, breakthrough clean energy projects in contrast to funding only "safe bets" without technology risk.
- Support pooling of demonstration projects among and between the federal government and the states, to overcome various obstacles that now inhibit such interstate activity. [11]

### New Energy Strategy #2

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*Department of Defense, U.S. Small Business Administration, Department of Commerce, Environmental Protection Agency, National Science Foundation, and the DOE. Based on the states track record, a $650 million federal investment could leverage as much as $2.0 billion in additional private and public investment.*

## New Strategy #3:

## Create Commercialization Finance Tools – Bring Emerging Clean Energy Technologies to Market

While this public and private investment story at the state level is truly impressive, there are still many financing obstacles that prevent full development of new clean energy technologies. More innovative public and private financial engineering is required to overcome longstanding barriers and to attract much higher levels of private investments. To that end, federal and state governments must work together to create entirely new public and private insurance and investment vehicles. They are needed to overcome serious market gaps along the clean energy development chain, from lab to the marketplace.

This is a well known story to clean energy investors.

There are several problems facing the clean energy space that prevent full-scale commercialization of promising new technologies. One of the pressing challenges facing policy makers is how to sufficiently scale up first-of-a-kind clean energy projects involving cutting edge technologies.

This is the so called "Commercialization Valley of Death" — the gap where a huge amount of capital is needed to scale up first-of-a-kind clean energy technologies. They often are too risky to get conventional financing and cannot then be deployed at commercial scale.[12]

The nature of our investment institutions makes this problem worse. Early-stage, commercial venture investors typically do not fund technology companies for the long term. And they do not invest the large dollar commitments that are required to move a highly capital-intensive technology to commercial-scale production. Energy projects require much more capital than technology sectors like software or broadband. In addition, venture capitalists invest in projects with very limited technical risk — this creates a financial and technology mismatch, since energy breakthrough technologies deployed for the first time at scale have significant technological risk.

On all counts, new clean energy technologies can be a poor fit for the existing private, venture capital model that has financed other markets.

The result is, while large volumes of capital have been mobilized in support of expanded clean energy deployment, investment has gone predominantly to fully-commercialized and proven technologies. Capital for emerging technologies — commercialization finance — must fill these gaps with public sector funds to mitigate technology risk.

One way to address this risk mitigation challenge is to design and fund a specialized, public sector organization to address the finance "valley of death." This was the goal of the proposed U.S. Clean Energy Deployment Administration (CEDA). However, the failure of Washington energy policy, so far, has doomed this new public funding vehicle.

States and the private sector, then, will have to develop their own financing solutions for emerging clean energy technologies.

One part of the solution is to engage the private insurance industry to help address technology risk. This could involve constructing a public/private technology risk insurance offering, backstopped in whole or in part by governmental reinsurance. Such a program could induce private sector financing to support new technologies, if the technology risk is reduced by so-called "efficacy insurance" product.

Efficacy insurance is an interesting tool that could protect 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 to its original specification, or allows it to be upgraded or replaced.

While efficacy insurance is generally unavailable for new clean energy technologies today, such insurance products in the past were designed for 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, 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.

Therefore, there is both a need and a precedent for government and the private sector to take a more direct, coordinated role to provide and support efficacy insurance or reinsurance.

But this is only part of the solution. Even with efficacy insurance products, a guaranteed demand is needed to bring new clean energy technologies into the market.

That solution must involve state-regulated utilities. They typically finance existing and new power generation plants in the United States. In that role, they are the greatest source of investment capital for new clean energy technologies of any meaningful scale.

### New Energy Strategy #3

DOE should make a first investment of $100 million in reprogrammed federal funds to work with the states to create two new mechanisms to overcome this most critical, clean energy financing problem — the commercialization "valley of death." First, $50 million should be dedicated to an industry insurance collaboration to explore and create efficacy insurance products and possible reinsurance pools. Second, another $50 million should support design and implementation of new, state utility programs to procure power from emerging technologies. In tandem, both tools are critical to commercialize breakthrough technologies, to ensure technologies currently funded by research dollars reach a scale required to reduce emissions, and to produce significant economic development impacts.

Their capital investment numbers are staggering. From 2000 to 2008, total capital expenditures by investor- owned utilities totaled about $475 billion. This means that utilities spent somewhere near $42 billion a year in the early 2000s and increased capital investments to about $83 billion in 2008. To give a sense of the capital involved, investor-owned U.S. electric utility revenues were about $298 billion in 2008, a typical year.[13]

Even a rough analysis suggests that utility revenues represent the largest source of reliable capital in the country for investment in new energy technology. This is investment directed not by customer preferences but by state governments in the form of utility commissions. Without some commitment to redirect that utility capital toward cleaner energy, it is difficult to foresee major transformation in our electric power generation system.

(The irony is that this form of monopoly utility regulation was the brainchild of Thomas Edison and his partners, who could not find sufficient capital investment to build out his then new and risky electric power stations at the turn of the 20th century. His solution was to propose that his power plants be treated as regulated monopolies in exchange for enforced capital accumulation; he would finance his power plants from rates paid by electric customers, who would have no choice in the matter. State regulators would decide on and approve the utility investments instead. That is still the system of financing power generation we have in the U.S. today. Oddly enough, we have now come full circle. With the need to invest in newer technologies, utility capital may provide the surest source,

just like a hundred years ago when Edison was building out his then-modern and technologically risky central generating plants. We have the power systems today because of Edison's financial engineering schemes. Our challenge today is to use this same creativity to amass utility investments in the modern power technologies of the 21st century.)[14]

What is needed is a "first in the nation" example of how to use state-level, utility-scale, finance and procurement mechanisms to support game changing, pre-commercial clean energy technologies — and help bring them to scale in commercial markets. We need a new model for utility-scale planning and procurement for the next generation of clean energy technologies such as energy storage, advanced solar, offshore wind as well as and marine and tidal energy.

Many state-level solutions have been put in place or are proposed to solve the broader clean energy deployment problem. These include renewable portfolio standards or RPS, PACE financing, and various forms of feed-in-tariffs or FITs, now being explored in some states. While useful, these policies, at best, have potential to pull mostly conventional, commercially-financeable technologies into the marketplace.

None of these existing state-level solutions support emerging technology deployment. This is a missing link in all existing clean energy program proposals — how to create the right regulatory market signals to utilities at the state level, where the major investment decisions on power are made, to get full-scale uptake of these new technologies at rates that developers can rely upon to bring the technologies to scale.

One possible solution is an emerging technology "reverse auction mechanism" (ET-RAM). Through this process, the utility regulator would require that utilities acquire a certain amount of power from emerging technologies. The project developer would bid in to the utility the lowest price that would be needed to get the product to the marketplace; the state would mandate that the utility procure power at that negotiated price. The state need not set the price; the developers and utility would negotiate the rate. This would then set reasonable and stable long-term power purchase prices, as well as additional strategies to encourage capital formation behind emerging technologies. No such system is in place today in the U.S.

This approach would provide reliable financial support in the form of long–term, fixed power prices for emerging technologies. That would send the right signals to the market place, build investor and lender confidence, and draw targeted technologies into the market at scale. A reverse auction mechanism for utilities could bridge the commercialization valley of death in clean energy — to create a procurement and financing pipeline for emerging clean energy technologies.

### New Energy Strategy #3

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## New Strategy #4:

## Energy as Infrastructure – Federal and State Power Procurement Strategies for Clean Energy

Many new clean energy technologies that DOE now supports through loan guarantees or ARPA-E — such as storage or next generation solar — have no commercial markets today. The products are unproven, technically risky, and more expensive than fossil-fuel power sources. That is as expected; they are designed to produce big payoffs further down the road.

But a program that focuses only on early research, while ignoring the longer-term, market realities, is problematic. Indeed, ARPA-E officials once said at a public meeting that they have a major problem with their program — they have no guaranteed customers for the projects they fund with hundreds of millions of federal research and development dollars.[15] This is a major gap that can and must be overcome to make good on the excellent research funding that has been put in place.

The need for a customer was not a problem for the agency on which ARPA-E was modeled, the Defense Advanced Research Projects Agency (DARPA) of the Department of Defense (DOD). DARPA's advanced military technologies had a ready customer — DOD itself. DOD served as marketer, guarantor, and ultimate customer to get these emerging technologies, regardless of cost, off the ground and into commercial readiness. DOD served all these key functions because national security was at stake.[16]

Unfortunately, in the case of energy security, no such customer exists for early-stage, clean energy technologies funded by ARPA-E and DOE. Unless the federal government steps in to fill this procurement role, these emerging technology investments may well languish in a research limbo, and the country will be the loser for it.[17]

### New Energy Strategy #4

DOE should organize multiple federal agencies to jointly procure at least $1 billion in power from emerging clean energy technologies. These are the same technologies that receive hundreds of millions of dollars of research funding, but they have no clear commercial pipeline to market. The federal government should develop many "lighthouse projects in clean energy" such as offshore wind, marine, and energy storage by buying power from these, to take on technology risk from emerging technologies and to create an accelerated pathway to the marketplace.

To increase the odds that these research bets pay off in the commercial marketplace, there should be a coordinated, federal approach to use its procurement heft to acquire power from emerging clean energy technologies.

For all the reasons described above, private sector financing alone simply is not structured to assume the technical risks that must be overcome to move early stage energy technologies to commercial scale. This is a clear and obvious role for public finance. But to date, it is not clear that DOE and the government believe that it is their job to step up and assume an aggressive procurement role, like the DOD does with DARPA. It may be that they believe the private sector will take up these ideas and make them commercial. But, the risks and high capital investments needed to bring new technologies to scale have proven too large a "valley of death" for the private sector to bridge.

To overcome this gap, federal agencies, with states, could aggregate a small amount of their huge, annual electricity demand to pull early technologies into the market and at the same time prove their success to the private sector.

The federal government and the states together built the infrastructure we see every day – roads, bridges, highways, and rail. We need the same infrastructure partnership on clean energy, to create the power systems of this new century.

If the country is serious about clean energy, an aggressive, coordinated procurement of emerging clean energy technologies by multiple federal agencies — in partnership with states — is required.

Similarly, DOE and sisters agencies in the federal government should dedicate $50 million to support collaboration with the states to support

and develop state strategies to partner with the federal government to procure power from emerging technologies. Both federal and state agencies should work together to buy electricity from projects like offshore wind in the East, marine technologies in the Northwest or West or other similar, new technologies that require longer-term financial support.

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## New Energy Strategy #5:

## International Climate Technology and Finance Strategy that Builds on Success from Both North and South

As in the U.S., it is becoming clear that a cap and trade regime will not be put in place at the international level. Strategies that rely on direct technology and finance programs and policies will be key parts of any climate recovery regime. But there is little consensus about how these new programs will work.

Success could depend on creating an international body dedicated to technology innovation and cooperation. This could be a small "virtual" entity that would help orchestrate new innovation approaches to accelerate low-carbon technology development around the world. In fact, there are good models to follow that have worked successfully in the agricultural and health areas.[18]

A clean energy technology innovation initiative could be modeled after the "Global Fund to Fight AIDS, Malaria and Tuberculosis" (Global Fund), a "public goods" partnership institution linked to, but independent of, the UN, and other global and national agencies that are funded by private foundations as well as governments. The Global Fund has managed over $10 billion of public and private capital and made great progress toward its mission. It is a small, nimble, nonprofit entity with huge impacts in the health field.

It also could employ the modern, collaborative program strategy now successfully used in other private and public sectors: "distributed innovation" (DI), the strategy proposed for DOE. As described above,

DI focuses on technology product development against time milestones, relying on a global group of experts with differentiated strategies unique for each technology and for each geographic area. This new program strategy could follow that of the Consultative Group on International Agricultural Research or CGIAR (now recently reorganized) that employs distributed, coordinated, research strategies for agricultural product development in new markets. This is a successful a collaboration of the same donors and governments now part of the international climate process.[19]

International policy cooperation alone will not achieve the scale of technology development and deployment needed to address climate change. There are few examples of successful clean energy advancement that do not involve a strong, balanced portfolio of policy, investment, innovation, and industry support. These are common, complementary tools in use in even the most advanced economies such as the U.S. and in most OECD countries.

In the U.S., for example, state-level renewable portfolio laws mandating renewable power work only because they are complemented by state financial incentives, federal tax supports, and increasingly, state-level economic development strategies that support manufacturing and related innovation practices. If this combination of measures is needed to support clean energy in OECD countries, it is difficult to see how anything less will produce success in less developed countries.

The last decade of clean energy success amply shows that policies are necessary but clearly insufficient. Increasingly, sophisticated policymakers are exploring creative innovation strategies to move technologies into the marketplace. They realize that the institutional barriers to success cannot be overcome alone by the often blunt instrument of a broad policy.

Interestingly, there are examples of developing country projects that employ a form of creative market acceleration and intervention that would be the envy of the developed world. They have pursued more nuanced innovation strategies. They address barriers and develop products geared to specific country conditions, in conditions with less sophisticated institutional supports for finance, innovation, and technology development.

For example, the U.S. and other OECD donors have supported a successful initiative called *Lighting Africa*, which is the International Finance Corporation (IFC) program to develop and deploy solar lighting products in Africa. The *Lighting Africa* program uses innovative approaches to technology and finance cooperation that addresses specific technology and market barriers to build thriving private sector led markets.[20] The *Lighting Africa* approach is similar to the virtual technology innovation program proposed here and could be used throughout the world.

If similar programs are developed, *Lighting Africa* could become another example of "reverse innovation"— the process by which cheaper products and new business models coming from poor countries are transferred as cost-saving innovations to other parts of the South and the North. Corporate leaders such as CEO of General Electric now rely on these "reverse innovation" strategies in developing countries to create lower-cost products for use in upscale, developed world markets.[21]

In the same way that the "closed innovation" systems of Bell Labs and governments have been eclipsed by "open and distributed innovation" of leading corporate innovators, the technology development strategies of the past are in decline. The notion that the developed world alone will create new, low-carbon technologies and has the most desired policies, which will then simply be transferred to the developing world, seems almost quaint, if not outdated. (The unabashedly successful, clean energy, industrial policy approach of China in the last few years, while surely controversial, is the most recent reminder that old notions of development and technology transfer from North to South no longer represent real world conditions.)

New innovation programs throughout the world in clean energy, health, and agricultural technology challenge, if not debunk, these old models. The presumed one-way flow of goods and services and policy ideas from North to South is now reversing itself.

South to North and South to South clean energy innovation are the likely waves of the future.

U.S. clean energy technology policy should fully participate in this new world and determine how best to benefit from a flow of innovation from the "rest to the West."[22] The basic point is that technology innovation is now global and circular. As a result, it might be useful for the U.S. to explore a more robust international, clean energy strategy involving not only policy, but product development and innovation, to encourage, shape, and perhaps benefit from these evolving trends.[23]

As important, these new technology innovation strategies need more robust, private and public sector financial support. There should be coordinated approaches to use public investment to scale up these new technology innovation efforts, and leverage smart private capital in clean energy. This has to occur in the North and the South.

A global technology strategy must be joined with a global finance strategy. As with the states in the U.S. that have led the way on clean energy finance, many sub-national entities have led the way on finance at the international level. More "public investor" coordination, cooperation, and collaboration on best practices, technology development, and creation of more public funds in developed and developing countries are critical to scale up low-carbon technologies.

### New Energy Strategy #5

The U.S. State Department, with the DOE, should reprogram $100 million in existing funding commitments to support more international clean energy technology innovation and finance cooperation. These efforts should go beyond policy support, to work on cooperative technology innovation using new corporate "open and distributed" strategies, and actual product development and deployment. Such a comprehensive initiative should employ modern technology innovation strategies that mimic successful corporate and other innovation models. These would support cooperation among public clean energy investors and encourage more global, technology, and financial innovation from and among developing countries to help them and the U.S. create global economic and environmental benefits.

The benefits of more "public investor" coordination and cooperation could include greater "deal flow" of low-carbon projects, overcoming real or perceived barriers to deal flow presented by intellectual property rights concerns in technology transfer, and creating new models for public funding.

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# Section 3. Conclusion

With the failure of cap and trade in the U.S. and internationally, it is obvious that new ideas, not only new money, are needed to create a different conversation about clean energy. It would be even more compelling if these new energy strategies came from proven successes in states, in corporations, and in other countries and sectors. And it would be better yet if these strategies used the money we have, used it smarter, and focused on *bottlenecks* that have blocked clean energy progress for decades.

However, with the economic downturn, many would argue that this is the worst time for new ideas to promote clean energy. But history suggests otherwise. As odd as this may sound, a down economy may be the best time for innovative approaches to take root.

> "Moments of crisis have historically served as a powerful impetus for innovation, whether a Manhattan-Project, a moon shot, or industry-transforming "green" consciousness and its related initiatives. The entrepreneurs who thrive in the face of adversity are a different breed from those who flourish when resources are unlimited, such as in Silicon Valley during the 1990s."[24]

The "Great Recession" of this new century might encourage real innovation in clean energy to begin to take hold like no time in history.

But to help the process along in these uncertain times, our leaders must be open to new approaches, which come from the states, corporations, other sectors and other countries. It is time to reset energy policy, as others have argued, but not with repackaged ideas that did not gain enough traction to become law in the last Congress. What are needed are pragmatic and proven solutions that do not require new funding or major new policies, in what could be a fairly unforgiving political and financial climate. That's the climate that matters now, and the one that will shape the future of energy policy for the immediate future.

Admittedly, these programs alone are not big enough to move all clean energy fully into the marketplace. But they could make a major difference now. These initiatives could help to accelerate breakthrough technologies into the market sooner, to create near-term, significant progress.

In the end, it is important to move beyond the years of energy policy debates that have resulted in little action. It is time to experiment with smaller, innovative strategies that solve real technology problems, create durable markets, and leverage more public and private finance investment. It is time for energy pragmatism.

# Endnotes

[1] President Barack Obama, statement at press conference held November 3, 2010.

[2] The one exception is a joint paper of the American Enterprise Institute, Brookings Institute, and the Breakthrough Institute that called for a six-fold increase in clean energy research spending from $4 billion to $25 billion a year. See "Post Partisan Power" at http://thebreakthrough.org/blog/Post-artisan%20Power.pdf. The paper did call for a regional network of energy clusters, which Brookings has advocated for some time. One of the co-authors was asked if he thought this funding was likely out of the new Congress, and he was said to reply, "not in the near future." "A Climate Proposal Beyond Cap and Trade" by David Leonhardt, *New York Times*, October 21, 2010.

[3] See the numerous references to scientific literature supporting the need for energy breakthroughs to achieve climate stabilization in "Climate Crash Course for Copenhagen: The Six Simple Reasons Why We Need Global Technology Collaboration," by Clean Energy Group, December 2009. Available at http://www.cleanegroup.org/Reports/CEG_Climate_Course_Copenhagen_Dec2009.pdf.

[4] For a comparison of close versus open innovation systems, see George, Works and Watson-Hemphill, "Fast Innovation," at 93 (McGraw Hill 2005).

[5] For background information on distributed innovation, see:

- Lewis Milford and Daniel Dutcher, "Climate Choreography: How Distributed and Open Innovation Could Accelerate Technology Development and Deployment." Montpelier, VT. Clean Energy Group, 2008. Available at www.cleanegroup.org/Reports/Climate_Choreography_July08.pdf.
- Thomas Malone and Mark Klein, "Harnessing Collective Intelligence to Address Climate Change," *Innovations* 2, no. 3 (2007): 15-26.
- Diego Rodriguez and Doug Solomon, "Leadership and Innovation in a Networked World," *Innovations* 2, no. 3 (2007): 3-13.
- Philip Evans and Bob Wolf, "Collaboration Rules," *Harvard Business Review* 83, no. 7 (2005): 96-104.
- Clayton Christensen, Heiner Baumann, Rudy Ruggles and Thomas Sadtler, "Disruptive Innovation for Social Change," *Harvard Business Review* (2006): 94-101.
- Alan MacCormack, Theodore Forbath, Peter Brooks and Patrick Kalaher, "Innovation through Global Collaboration: A New Source of Competitive Advantage," *Harvard Business Review* (2007).
- Karim R. Lakhani and Jill A. Panetta, "The Principles of Distributed Innovation," *Innovations* 2, no. 3 (2007): 97-112.
- Steven Eppinger, "Innovation at the Speed of Information," *Harvard Business Review* 79, no. 1 (2001): 149-158.
- Larry Huston and Nabil Sakkab, "Connect and Develop: Inside Proctor and Gamble's New Model for Innovation," *Harvard Business Review* 83, no. 3 (2006): 53-66.
- William Taylor, "Here's an Idea: Let Everyone Have Ideas," *New York Times*, March 26, 2006.
- Meridian Institute, Open Source Models.

[6] Dooley, Lawrence and David O'Sullivan. "Managing Within Distributed Innovation Networks." I*nternational Journal of Innovation Management*, (2007) vol. 11, issue 03, pages 397-416.

[7] For more information on how open and distributed innovation could be used to accelerate clean energy commercialization, see "Accelerated Climate Technology Innovation Initiative (ACT II): A New Distributed Strategy to Reform the U.S. Energy Innovation System" by Clean Energy Group and Meridian Institute, November 2009. Available at http://www.cleanegroup.org/Reports/ACTII_Report_Final_November2009.pdf.

[8] "Dear Mr. President: Let's talk tech" - Top IT luminaries demand action from the next administration, *Computerworld*, by Gary Anthes, October 21, 2008, 12:00 PM ET.

[9] See August 4, 2009 White House Memorandum on Science and Technology Priorities for the FY 2011 Budget at http://www.cleanenergystates.org/library/WH_Memo_Science-Tech_080409.pdf

[10] Clean Energy States Alliance and Peregrine Energy Group, "CESA National Database," October 28, 2010.

[11] For more ideas, see "Federal Climate and Energy Legislation and the States: Legislative Principles and Recommendations for a New Clean Energy Federalism" by Clean Energy Group, April 2010. Available at http://www.cleanegroup.org/Reports/CEG_Clean_Energy_Federalism_v3_April2010.pdf.

[12] For a more complete description of this financial barrier, see "Crossing the Valley of Death: Solutions to the next generation clean energy project financing gap" by Bloomberg New Energy Finance and Clean Energy Group, June 21, 2010. Available at http://www.cleanegroup.org/Reports/CEG_BNEF-2010-06-21_valleyofdeath.pdf.

[13] See Energy Information Administration, "Revenue and Expenses Statistics for Major US Investor Owned Electric Utilities," Table 8.1 for 2008, dated January 21, 2010 (www.eia.gov/cneaf/electricity/epa/epat8pl.html and information provided by Clean Air Task Force that analyzed various federal filings on utility revenues and investments (Private papers on file at Clean Energy Group).

[14] See Wasik, "The Merchant of Power," at 79 (Palgrave 2006), and Hughes, Thomas P. "Networks of Power: Electrification in Western Society, 1880 – 1930." (The Johns Hopkins University Press, 1983).

[15] "Clean Energy Innovation Consortia: A Capitol Hill Briefing Event." Washington, DC. January 26, 2010. The author of this report was present at the meeting where the remark was made in front of a public audience.

[16] See Milford, "Climate Technology Innovation: Picking Winners - Some Thoughts to Consider". Clean Energy Group, May 2008 (citing, Lewis M. Branscomb and James H. Keller, Eds., "Investing in Innovation: Creating a Research and Innovation Policy that Works" (MIT Press, 1999) at 45). The authors argue that government always picks technology winners, and when it is

successful, goes beyond research and development, to support the full value chain from research to deployment. Available at http://www.cleanegroup.org/Reports/CEG_Picking_Winners-May_2008.pdf.

[17] This is a problem that has long been recognized, but the federal government has simply not developed any comprehensive measures to solve it. In fact, two major obstacles to greater uptake of emerging new technologies have remained on the books for years. First, most federal agencies, with the exception of the DOD, cannot enter into contracts for electric power beyond a ten year period. This is generally not long enough for developers to obtain financing for new or emerging technologies. Second, federal law imposes a cost test on new power that virtually ensures the cheapest power is procured, which discourages the options for purchasing more expensive, but clean electricity.

[18]A number of groups have recommended the creation of a new climate technology institution. E3G released a report in November 2008, "Innovation and Technology Transfer: Framework for a Global Climate Deal", in which they propose the creation of a Global Innovation and Diffusion Fund (see pgs. 104-118). While compatible in many ways with the E3G proposal, our proposal recommends that an institution be created that is independent of but linked to the UNFCCC. We further recommend that this single institution manage IPR challenges, which we believe are integral to its mission.

[19] In particular, as a starting point, such a facility could share the following characteristics:

- Be driven by science, not politics. The governance of such an entity should be linked to the UN but independently run by scientists and technology experts.
- Complementary to on-going efforts. Doesn't overlap with existing national and private sector efforts, but helps to coordinate, complement and accelerate these efforts.
- Aggregator of information. Procures the best research from established centers with proven track record of performance.
- A light-touch. A minimal administrative structure would maximize disbursement of finance with minimal bureaucracy.
- Product focused. It would rapidly drive upstream research to downstream product development and deployment within defined timeframes, going beyond existing research networks, information sharing agreements and centers of excellence.
- Open to many stakeholders. Engages both public and private research institutions and financial players as well as private industry.
- International in focus. Promotes the engagement of researchers and engineers in developed and developing countries.
- Use newest innovation strategies. Relies on modern research approaches, including open and distributed innovation, and IT systems that allow for robust networks and rapid information sharing.

[20] See Morey, Milford, Madiera, "Accelerating Climate Technologies: Innovative Market Strategies to Overcome Barriers to Scale-Up". Clean Energy Group, July 2010. Available at http://www.cleanegroup.org/Reports/CEG_Accelerating_Climate_Technologies_071410.pdf.

[21] Immelt, Jeffrey R., Vijay Govindarajan and Chris Trimble. "How GE is Disrupting Itself." *Harvard Business Review*. October 2009. Available at: http://hbr.org/2009/10/how-ge-is-disrupting-itself/ar/1.

[22] See Morey, Milford, Madiera, "Accelerating Climate Technologies: Innovative Market Strategies to Overcome Barriers to Scale-Up". Clean Energy Group, July 2010. Available at http://www.cleanegroup.org/Reports/CEG_Accelerating_Climate_Technologies_071410.pdf.

[23] The U.S. government's "research only" position – and no joint product development – was confirmed in a recent summary of the DOE's view of how its new U.S./India research center would operate. This is consistent with the old model of focusing on only research, with the hope that the private sector would somehow, sometime commercialize technology (closed model), rather than the modern corporate model that targets joint product development, with a nuanced, collaborative focus on product commercialization, finance, and intellectual property rights (open model). See DOE summary of India-U.S. Joint Clean Energy R&D Center, Washington Stakeholder Meeting, November 1, 2010, Q&A ("In the long term, we would hope that the research will bring costs down and lead to commercialization, but we are not funding commercialization activities (e.g., product development"). (Copy available upon request.)

[24] Chakravorti, Bhaskar, "Finding Competitive Advantage in Adversity," *Harvard Business Review*, November 2010. Available at http://hbr.org/2010/11/finding-competitive-advantage-in-adversity/ar/1

## About Clean Energy Group

**Clean Energy Group (CEG)**, a national, U.S. nonprofit organization, 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 nonprofit sectors.

CEG assists states to create and implement innovative practices and public funding programs to advance clean energy markets and project deployment; creates networks of U.S. and international policy makers to address climate stabilization; advances effective, 21st century distributed innovation theories for climate technology; develops new finance and commercialization tools; and works to attract new investors to move clean energy technologies to the market more quickly.

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www.cleanenergystates.org


CleanEnergyGroup
Innovation in Finance, Technology & Policy
Clean Energy Group
50 State Street, Suite 1
Montpelier, VT 05602 USA
Phone: +1-802-223-2554
www.cleanegroup.org