Economic Stimulus: The Case for “Green” Infrastructure, Energy Security and “Green” Jobs

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"Greening" an Economic Infrastructure Stimulus and Creating a National Infrastructure Bank in the US

In our recently-published Investing in Climate Change 2009: Necessity and Opportunity in Turbulent Times, we looked at the confluence of three key drivers:

1) The environmental impact of climate change;
2) Energy security;
3) The financial crisis.

These three drivers are interlinked: fossil fuels impact the environment through carbon emissions and, in some cases, are less secure in terms of long-term supply. Many countries are currently discussing the merits of stimulus packages in the face of the economic crisis, and some, like China, have already announced significant packages.

We believe this confluence opens up an historic opportunity for a new US administration and Congress to take a global leadership position on the issue of the environment and energy security, while addressing current financial problems.

In the long-run, climate change mitigation requires a carbon price, and we believe that well-designed market mechanisms, such as a cap-and-trade regime, are the best way to price the carbon externality, and indeed have the potential to raise funds for climate change solutions. In the short run, the debate appears to be concentrated more on energy policy and energy security in the context of reinvigorating the economy through an infrastructure stimulus package. However, we believe that energy security and addressing the environmental impact of climate change are not mutually exclusive – far from it. We agree with BP CEO Tony Hayward’s definition of energy security as “access to reliable sources of energy, at an affordable price, produced in an environmentally responsible and safe manner.”^1^  

The “sweet spot” for a “green” infrastructure stimulus brings together all three drivers we have discussed above, and is focused on projects in:

1) Energy efficient buildings – in tough economic times, these projects, which have long-term positive payback and are low-tech but labor-intensive, make even more sense;
2) The electric power grid – without a modern and optimized power grid, it is not possible for renewable power to scale-up. 7-9% of electric power is also lost in transmission, with significant potential savings from efficiency;
3) Renewable power – funding for technologically-proven renewables allows scale-up and the long-term shift away from fossil fuels;
4) Public transportation – reduces emissions and adds to efficiency of economy.

Other areas of particular interest for an infrastructure package include pipelines, energy efficient products (e.g. fuel-efficient automobiles) and water, each of which address at least two of the three critical elements. CCS is also a critical enabling

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technology that could move domestic fossil fuels into the "green sweet spot", but more R&D is necessary before this can function as a true infrastructure stimulus. See exhibit 1.

**EX 1: Defining the “green sweet spot” for an infrastructure stimulus**

One of the reasons that the “green sweet spot” is an attractive focus for an economic stimulus is the labor-intensity of many of its sectors. For instance, the Apollo Alliance estimates that every $1 million invested in the US in energy efficiency projects creates 21.5 new jobs, as compared to only 11.5 jobs for new natural gas generation. The University of California Berkeley’s Renewable and Appropriate Energy Laboratory also finds that renewable energy technologies create more jobs per average megawatt of power generated and per dollar invested than coal or natural gas. Finally, a 2008 Center for American Progress report states that a $100 billion investment in clean energy and efficiency would result in 2 million new jobs, whereas a similar investment in old energy would only create around 540,000 jobs.

In "green"-oriented infrastructure, there are economic stimulus options that would have an immediate impact on job creation, and those that would have a medium-term impact due to the planning horizons involved. These include:

- **Immediate impact**: Energy efficient buildings, energy efficient products, renewable power
- **Medium-term impact**: Pipelines, water, public transport and the electric power grid.

We believe a successful stimulus plan would include both immediate impact measures to confront the near-term economic challenge, as well as medium-term measures to prompt longer-term economic growth. **Government funding on infrastructure has the advantage that it can also unlock private sector funding and partnerships, which will augment government spending.**
Funding Options

There are three funding options for increased investment in “green” infrastructure:

1) Deficit spending, which offers immediate economic impact with long-term debt implications;
2) General tax increase, which is potentially unhelpful during difficult economic conditions;
3) Carbon price, cap-and-trade, which could entail auctioning of emission permits and link the carbon externality to funding.

In the long-term, we favor a cap-and-trade regime, which will fund “green” government spending. But in the current downturn, deficit spending is favored by many to reinvigorate the economy.

Opportunities for the new US administration – a US National Infrastructure Bank

This leads to a number of opportunities in the US, core among them being the creation of a “green” National Infrastructure Bank, which builds on a number of existing policies, such as the Department of Energy’s loan guarantee program\(^2\) for Nuclear and Renewables, as well as major strands in President-elect Obama’s policy platform (see Appendix I for more detail), particularly the National Infrastructure Reinvestment Bank, as well as the National Infrastructure Bank Act of 2007, which was originally proposed by Sen. Chris Dodd (D-Conn) and Sen. Chuck Hagel (R-Neb). This can be seen as part of an overall energy policy/climate change architecture.

The advantage of a “green” National Infrastructure Bank is that, among other financing options, it can enter into public-private partnerships, where the government partners with the private sector to scale-up infrastructure initiatives. The ability of a National Infrastructure Bank to tap into private capital through public-private partnerships, co-financing, loan de-risking by the federal government and other configurations will enable the government’s investment to be augmented – in effect providing preferential rates of financing to private-sector organizations engaged in the space. This is promising for long-term growth of opportunities that are past the demonstration stage and looking for commercialization and scale-up.

Creating up to 25 million “green” jobs

As former US Vice President Al Gore recently said, “today’s financial crisis can be a gateway to tomorrow’s environmentally responsible economy.” At a time when the global economy is stalling, unemployment is rising and poverty is threatening to overtake millions of people, we need growth, job creation and the promise of prosperity. All three can be achieved by aggressively investing in a new “green” economy that can unleash a wave of financial and environmental prosperity.

The most tangible economic and political outcome of these efforts would be job creation.

Globally, the UK Prime Minister has estimated that up to 25 million new “green” jobs could be created by 2050 with appropriate supportive policy in place. Based even on conservative estimates, this could result in between 5 and 10 million jobs worldwide over the next decade, an estimate in-line with President-elect Obama’s plan to create 5 million new “green” jobs in the US.

From a jobs perspective, a stimulus in the renewable energy sector is highly attractive, in part because of its labor-intensity and largely domestic nature. See exhibit 2.

**EX 2: Summary of studies conducted on the job creation potential of a “green” economic stimulus**

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of jobs actually/potentially created</th>
<th>Region examined</th>
<th>Timeframe</th>
<th>Other considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNEP, 2008. <em>Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World.</em></td>
<td>470,000</td>
<td>Worldwide</td>
<td>2006</td>
<td>Wind and solar for countries where data was available</td>
</tr>
<tr>
<td></td>
<td>624,000+</td>
<td>Worldwide</td>
<td>2006</td>
<td>Solar thermal for countries where data was available</td>
</tr>
<tr>
<td></td>
<td>1,174,000</td>
<td>Worldwide</td>
<td>2006</td>
<td>Biomass for countries where data was available</td>
</tr>
<tr>
<td></td>
<td>64,000+</td>
<td>Worldwide</td>
<td>2006</td>
<td>Geothermal and hydro for countries where data was available</td>
</tr>
<tr>
<td></td>
<td>145,000</td>
<td>Germany</td>
<td>2006</td>
<td>Energy efficient retrofit jobs based on €19 billion public and private investment</td>
</tr>
<tr>
<td></td>
<td>18,000</td>
<td>India</td>
<td>2009</td>
<td>Construction of natural gas buses</td>
</tr>
<tr>
<td>University of California, 2008. <em>Energy Efficiency, Innovation, and Job Creation in California.</em></td>
<td>1,500,000</td>
<td>California</td>
<td>1977-2007</td>
<td>Resulting from energy efficiency policies</td>
</tr>
<tr>
<td></td>
<td>403,000</td>
<td>California</td>
<td>2008-2020</td>
<td>Efficiency and climate-action driven jobs taking into account the potential for innovation</td>
</tr>
<tr>
<td></td>
<td>2,500,000</td>
<td>US</td>
<td>2008-2018</td>
<td>By increasing renewable use and implementing efficiency measures</td>
</tr>
<tr>
<td></td>
<td>4,200,000</td>
<td>US</td>
<td>2008-2038</td>
<td>By increasing renewable use and implementing efficiency measures</td>
</tr>
<tr>
<td>Political Economy Research, 2008. <em>A Program to Create Good Jobs &amp; Start Building a Low-Carbon Economy.</em></td>
<td>2,000,000</td>
<td>US</td>
<td>Present potential</td>
<td>Based on spending $100 billion in public funds in a “green” recovery program</td>
</tr>
<tr>
<td></td>
<td>25,000,000</td>
<td>Worldwide</td>
<td>2050</td>
<td></td>
</tr>
</tbody>
</table>
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As policy makers search for solutions to the current economic downturn, a well tried and understood response is an infrastructure spending program. A number of policymakers and economists have recently noted that in the current economic downturn, a large infrastructure stimulus would be desirable. These include former US Vice President Al Gore, who has been advocating for an investment in the electric power grid, US House Speaker Nancy Pelosi, who has discussed proposing a stimulus package of $150 billion or more, Nobel Prize-winning economist Paul Krugman, who recently noted that it is “a good time to engage in some serious infrastructure spending,” and Chairman of the US Federal Reserve Ben Bernanke, who believes that a stimulus would be appropriate, given current economic conditions.

It is a unique confluence of necessity and opportunity that brings together this need to tackle future environmental cost issues, such as climate change, an economic crisis and energy security at the start of a new administration in the United States.

A variety of attractive proposals are emerging in the US, including a National Infrastructure Bank that would provide direct federal spending, tax credits, and financing to states, municipalities and the private sector.

We strongly support the creation of a National Infrastructure Bank, which should have a primary clean or “green” focus. Alongside other supportive policies, a “green” National Infrastructure Bank will enable the scale-up of “green” industries and the creation of high-quality jobs.

The US National Infrastructure Bank – a proposal for a clean and “green” mandate:

A new push to invest in upgrading aging infrastructure networks began in the early days of the economic downturn, when Sen. Chris Dodd and Sen. Chuck Hagel proposed the National Infrastructure Bank Act of 2007. President-elect Obama’s economic policy also stipulates the creation of such a bank – and it is likely that this bill will play a key role in the development of the President-elect’s National Infrastructure Reinvestment Bank proposal.

“Green”-ing the National Infrastructure Bank

While an infrastructure stimulus might answer the challenge of reinvigorating the economy in these troubled times, it is critical that the stimulus also address the environmental impacts of the climate crisis along with energy security. In our view, there is a “green sweet spot” that is the critical area for the National Infrastructure Bank to focus on. See exhibit 3.
Addressing the Current Economic Crisis through “Green” Infrastructure Spending

EX 3: Defining the “green sweet spot” for the US National Infrastructure Bank

The National Infrastructure Bank can engage in a variety of financing activities, interacting with various public and private players across the economy. See exhibit 4.

EX 4: The National Infrastructure Bank can provide funding and coordination across the economy

Source: DeAM analysis, 2008.
Addressing the Current Economic Crisis through “Green” Infrastructure Spending

There are a number of ways in which the National Infrastructure Bank could act as a conduit for “green” funding for projects that are past the demonstration stage and looking for commercialization and scale-up:

1) **Direct federal funding:** The National Infrastructure Bank could provide direct federal funding to centrally-run projects, working, in effect, as a division of the Department of the Treasury;

2) **Grantmaking:** The National Infrastructure Bank could provide grants to state and local programs working, in effect, as a division of the Department of the Treasury;

3) **Lending:** The National Infrastructure Bank could make its own loans to state, local and private-sector projects, potentially enabling public-private partnerships or unlocking other appropriate financing for private-sector projects;

4) **Loan guarantees:** The National Infrastructure Bank could provide loan guarantees to state, local and private-sector projects, potentially enabling public-private partnerships or unlocking other appropriate financing for private-sector projects;

5) **Bond underwriting:** The National Infrastructure Bank could underwrite state, local and private-sector bonds, potentially enabling public-private partnerships or unlocking other appropriate financing for private-sector projects;

6) **Tax credits:** The National Infrastructure Bank could provide tax credits to private-sector projects, working, in effect, as a division of the Department of the Treasury, potentially enabling public-private partnerships or unlocking other appropriate financing for private-sector projects.

Looking at the sectors in the sweet spot, we prioritize:

1) Energy efficient buildings – in tough economic times, these projects, which have long-term positive payback and are low-tech but labor-intensive, make even more sense;

2) The electric power grid – without a modern and optimized power grid, it is not possible for renewables to scale-up. 7-9% of electric power is also lost in transmission, with significant potential savings from efficiency;

3) Renewable power – funding for technologically-proven renewables allows scale-up and the long-term shift away from fossil fuels;

4) Public transportation – reduces emissions and adds to efficiency of economy.

We should also mention water, which will require significant investment and has the potential to create thousands of jobs.

In the next sections, we map out potential areas where the US National Infrastructure Bank, coupled with other supportive policies, could enable significant progress in the “green” sector.

1. **Energy efficiency**

Buildings account for approximately 30-40% of current total global energy usage, while buildings in urban areas are responsible for up to 50% of total regional energy consumption. With a growing global population and increased economic prosperity, the demand for infrastructure development will lead to an increase in construction and electric power expenditure. See exhibit 5.

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3 UNEP’s Sustainable Building and Construction Initiative
The opportunity to roll-out improved energy efficiency measures in the US is outstanding, primarily due to a large amount of ageing infrastructure. Retrofitting existing buildings offers an appealing way to merge job stimulus and “green” initiatives.

Currently, local authorities have the ability to enact building codes, but must consider both cost and energy performance. Capturing the energy efficiency in buildings opportunity would benefit from the National Infrastructure Bank, as well as other supportive policies. Specifically:

A. **Scaling up building retrofit**

Building retrofit offers an opportunity to install energy efficient appliances and materials in an existing building. Building retrofit offers a number of benefits, such as a reduction in energy consumption and utility and water bills. According to the US Green Building Council, building owners can expect to pay at least 10% more to retrofit their buildings with energy efficient measures than if they installed them in new construction. But the long-term return on the investment is positive to all parties involved.

The proposed National Infrastructure Bank – using incentives such as energy efficiency tax credits, coupled with a major public education campaign and supportive policies – could permit the building retrofit opportunity to be scaled-up. The right combination of financing through the National Infrastructure Bank – potentially in the form of public-private partnership funding, co-financing, or government-facilitated private financing – with other supportive policies, could also lead to the creation of high-quality jobs, including opportunities for electricians, plumbers, heating/air conditioning installers, roofers, insulation workers, construction managers, building inspectors and carpenters.

B. **Maximizing construction of new low-carbon buildings.**

According to the US EPA, more than 1.8 million residential buildings are built annually, while 170,000 commercial buildings are constructed, and nearly 44,000 commercial buildings are demolished. With such a large mass of real estate development, there are a number of benefits associated with encouraging the construction of new low-carbon buildings, which would unlock significant environmental, economic and social benefits.

A financing package for construction of low-carbon buildings through the National Infrastructure Bank, which could include both generous incentives and mandated standards and may tap into public-private partnerships, would lead to increased size and cost of building projects. This would, in turn, lead to the provision of high-quality jobs.
C. Providing low-carbon building materials.

Materials such as solar panels, geothermal heat pumps, and heat recovery ventilation systems all involve the advanced development of clean technologies. See exhibit 6.

EX 6: Low-carbon building materials

![Image of building materials](source)


Favorable financing for the development of advanced building materials through the National Infrastructure Bank, potentially in the form of public-private partnership funding or in the form of seed capital, could be coupled with a buildings performance directive to prompt demand for cutting-edge building materials. According to a report issued by the US Climate Action program, a buildings performance directive, if implemented, could also:

- Compel states to require energy audits and energy certificates for all buildings when they are rented or sold. A more aggressive stance would be to require a national building census to measure energy performance of all commercial and government buildings;
- Enforce a minimum level of efficiency for existing buildings by requiring highly cost-effective efficiency investments for buildings with poor energy performance;
- Establish the necessary infrastructure to support the research, development, and deployment of new technologies;
- Establish comprehensive support for high-performance technology;
- Consider a federal feed-in tariff for distributed solar PV to ensure rapid progress towards broad grid parity over the next decade;
- Create a Super-Efficient Appliances and Devices (SEAD) deployment incentives program, funded with carbon auction proceeds, to improve market share of the most efficient appliances, in turn boosting their production volume and driving down prices.
2. Electric power grid

Electric power transmission and distribution is one of the most important components of modern infrastructure. Typically, electric power transmission takes place on high-voltage lines between a central generating plant and a sub-station near populated areas. Electricity is then distributed to consumers at lower voltage. For load balancing and reliability, a long-range transmission grid also ties together different power markets.

Currently, there are about 211,000 miles of high voltage electric transmission lines in operation in North America. See exhibit 7.

EX 7: The United States Transmission Grid

![Image showing the United States transmission grid]


As indicated in exhibit 7, local grids are tied together by broader regional grids. This infrastructure will need significant upgrades as:

- Substantial new generation capacity is added
- Centers of production and demand change;
- More intermittent renewable resources are brought on-line;
- More distributed renewable resources are brought on-line.

Electric power generation is also a significant contributor to greenhouse gas emissions. See exhibit 8.
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EX 8: CO2 emissions from power generation, 2006E

In order to mitigate climate change, the power generation landscape will need to shift, and current generation practices will need to be made more efficient. It is expected that over the few decades, large investments of capital will be deployed into power generating infrastructure, including coal with carbon capture and storage (CCS), nuclear, wind, and other renewables.

The current electricity grid suffers from inefficiency, disrepair and capacity constraints. According to a Sandia National Laboratory report, around $150 billion is lost each year from power outages and disturbance. This trend is set to be exacerbated as electric power demand increases. Revolutionary developments in information technology, materials science and engineering present the potential for significant improvements in the security, reliability, efficiency and cost effectiveness of the transmission system.

New Energy Finance estimates that in the US alone, $450 billion will be needed over the next 15 years to modernize the electric power grid. Investment opportunities exist throughout the value chain. As a way to jumpstart economic activity, critical investments in the electric power grid could be brought forward under the aegis of the National Infrastructure Bank. These investments can be used to prepare the electric power grid for the scale-up of renewable energy, as detailed below.

A. Creating a smart grid

Digitizing and automating the electric power grid could greatly reduce wastage, carbon emissions and cost. A smart-grid would deploy networks, microprocessors and digital sensing technologies to create a web of hi-tech components that would communicate with each other to accomplish real-time balancing of energy and production. There are many benefits of the smart grid of ‘tomorrow’ in comparison to the system of ‘yesterday’ – most importantly, reduced wastage and lower carbon emissions. See exhibit 9.

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Swaminathan and Sen estimated in their 1998 report that $150 billion is lost every year owing to power outages.
EX 9: Characteristics of a future Smart Grid

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yesterday</th>
<th>Tomorrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation and storage</td>
<td>Dominated by central generation. Little use of distributed generation, renewables or storage</td>
<td>Many distributed resources complement central generation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resiliency</td>
<td>Did not protect assets until a disruption (e.g. trips a relay after a fault). Vulnerable to terrorists and natural disasters</td>
<td>Self-healing: Prevents many disruptions, minimizes impacts from the rest. Resilient with rapid response</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimization</td>
<td>Little integration between grid and asset management</td>
<td>Deep integration of grid intelligence with asset management software</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power quality</td>
<td>Focus on reliability, not quality</td>
<td>Power quality a priority with a variety of quality/price options to choose from</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market empowerment</td>
<td>Limited wholesale markets, poorly integrated, Limited customer choice, no price visibility</td>
<td>Robust, well-integrated, computer-managed wholesale markets. Many choices, time-of-use pricing visible</td>
</tr>
</tbody>
</table>


Supercomputers would enable utilities – which currently use very basic communications systems to detect fluctuating demand – to manage and predict system-wide demand and supply, improving efficiency and reducing greenhouse gas emissions as a result of eliminating the need to run power plants at full capacity continuously. Internal building controls could adjust power demand, and new substations could take feedback from the sensors along transmission lines to better route the electricity flow. Implementation of smart grid technologies would create up to 7,000 jobs by 2025 in the Northwest US alone, according to Clean Edge. Importantly, these employment opportunities can be created in a variety of geographies, bringing technical jobs to the parts of the country hardest hit by the downturn.

In the near-term, these technologies include smart meters, digital sensors, demand-side management and energy efficiency software. In the mid-term, electric and plug-in hybrid vehicle integration and energy district planning are possible.

Regulatory issues remain a challenge to the widespread adoption of smart grid technologies, including lack of incentives for grid operators to provide new capacity. The Smart Grid Facilitation Act of 2007 requires utilities to look at ways to encourage smart grids. But even with favorable legislation in place, the most basic elements of a smart grid, such as automated meters, are not widespread. See exhibit 10.

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5 Clean Edge: Carbon-Free Prosperity 2025, October, 2008.
EX 10: Potential opportunity for automated metering in the US

While Transmission System Operators are responsible for maintenance of and investment in the electric power grid, the federal government may have a role in the scale-up of the smart grid. The government could offer Transmission System Operators a variety of attractive financing options through the National Infrastructure Bank, ranging from grants and direct loans to bond underwriting and tax credits. This could be configured as a public-private partnership.

B. Connecting renewables to the national grid

One of the biggest constraints to the expansion of clean energy in the US is the ability of renewables to link to the grid. The integration of new energy sources is challenging because:

- In the US, most of the nation’s best wind and solar resources are located in areas far from demand centers. Existing transmission capacity is either minimal or non-existent;
- Most new nuclear plants will not be sited in heavily-populated areas, and will therefore require additional transmission capacity;
- Clean coal with CCS will presumably be sited near geologic formations suitable for CO₂ storage, and may not be near existing transmission facilities;
- Current grid networks are vulnerable to disruptions such as an influx of power from an unexpected source, making renewable ‘plug-in’ more difficult;
- There are already existing transmission congestion ‘hot-spots’ where new electricity capacity cannot be accommodated on the grid.

Significant investment in hyperconductive power lines could allow efficient transmission of clean energy from windy and sunny areas to regions lacking these natural resources. Semiconductors promise to revolutionize power distribution by providing virtually lossless transmission of power, and the deployment of new interstate high voltage direct current (HVDC) lines with the capacity to deliver large volumes of renewable power from remote areas could allow the rapid scaling of the clean power industry.

Some proposals to improve the long-range transmission grid and allow the scale-up of renewables have already come forward. CMP and Maine Public Service Co have announced a project to connect a proposed 1,000 MW wind generation project in northern Maine to the CMP power grid and other parts of the New England grid to the south.

American Electric Power (AEP) and AWEA have also partnered to put forward a vision of a transmission superhighway. Their proposal would allow the US to obtain 20% of its electricity from wind energy, and would
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require 19,000 miles of new transmission lines serving as the backbone of an interstate transmission superhighway overlaying and reinforcing the existing grid. See exhibit 11.

**EX 11: AEP-AWEA Transmission Superhighway Vision**

![AEP-AWEA Transmission Superhighway Vision](source: AWEA, 2008)

The proposed lines in the transmission superhighway would be integrated with the existing high-voltage grid to interconnect new wind energy development in regions with significant natural resources. These lines would also serve to reduce transmission congestion and free up capacity, allowing new electricity sources to access the grid without the risk of outages when coupled with smart grid monitoring technology. Such improvements could increase local annual revenues by $1.5 billion and create around 500,000 jobs in planning, building and maintenance.

While Transmission System Operators are responsible for maintenance of and investment in the electric power grid, given the current difficulties in the markets, the federal government could offer these companies a variety of attractive financing options through the National Infrastructure Bank. This could be configured as a public-private partnership. Alternatively, a National Infrastructure Bank-financed public corporation could undertake the construction of the national grid superhighway, which could later be spun off into the private sector.

**C. Increasing energy storage**

The fundamental challenge for both solar and wind energy for electrical supply is their intermittent nature. This prevents most renewable power sources from acting as base-load power providers. One way to overcome this problem could be to significantly scale-up power storage capacity.

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Addressing the Current Economic Crisis through “Green” Infrastructure Spending

A recent Lux Research report noted that energy storage technologies play a key role in the changing energy economy, and developed a map of the energy storage technologies with applications in stationary power, portable power, micro-power and transportation. See exhibit 12.

### EX 12: Examples of Energy Storage technologies relevant to electricity generation

<table>
<thead>
<tr>
<th>Technology</th>
<th>Examples</th>
<th>Market Served</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries</td>
<td>Lithium-ion, lead acid, nickel-based, flow.</td>
<td>Micro-power, portable power, transportation, utilities</td>
</tr>
<tr>
<td>Capacitors</td>
<td>Supercapacitor, hybrid</td>
<td>Micro-power, portable power, transportation</td>
</tr>
<tr>
<td>Fuel cells</td>
<td>Solid oxide, alkaline, direct methanol</td>
<td>Stationary power, portable power, transportation</td>
</tr>
<tr>
<td>Energy Harvesting</td>
<td>Wireless power, thermoelectric</td>
<td>Micro-power</td>
</tr>
<tr>
<td>Non-electrochemical storage</td>
<td>Flywheel, pumped hydro, compressed air</td>
<td>Stationary power, utilities</td>
</tr>
</tbody>
</table>


Energy storage can be deployed in a variety of ways at renewable installations. In its simplest form, battery-based storage could provide reliable energy for remote signaling and telecommunications systems. Battery storage could also work in conjunction with smart-grids, ensuring that there is always enough power to respond in accordance to grid supercomputers. These storage options would increase security of supply and relative grid autonomy, easing the integration of renewables.

Of most importance for the grid though is bulk energy storage – shifting large amounts of energy from excess production times to peak usage times – such as pumped hydro, compressed air energy storage flow batteries, and flywheel systems that provide stability at the grid level. The US Department of Energy projected that the wind power-driven energy storage market has the potential to grow to 30GW in 15-20 years, driving the demand for kW- to MW-scale bulk energy storage. The total requirement for US bulk storage over the next 5-10 years has been estimated at between 10 and 100GW, translating into billions of dollars worth of opportunity.

The National Infrastructure Bank could finance increased energy storage in a number of ways. In its most decentralized form, the National Infrastructure Bank could provide attractive financing to private-sector programs to increase energy storage. This could be configured as a public-private partnership. In its most centralized form, the National Infrastructure Bank could finance a public corporation that would undertake the construction of large-scale flywheels to provide substantial power reserves.

### 3. Renewables

In order to meet atmospheric greenhouse gas concentration targets, the IEA estimates that $45 trillion will need to be invested in renewable energy by 2050. This will, in turn, lead to a meaningful scale-up of renewable power generation. See exhibit 13.
EX 13: Projected growth of renewable power generation

When compared to conventional energy sources, renewables often have significantly higher CAPEX/kWh. In order to address this issue – and to allow for the dramatic scale-up of renewable power – the National Infrastructure Bank could provide attractive financing to private-sector projects, including seed capital, loan guarantees, loans, tax credits, and bond underwriting.

4. Public transport

With increasing volatility in oil and gas prices, it is critical to invest in transportation infrastructure systems that are both secure and efficient. Investment in improved public transport infrastructure can address two significant problems: greenhouse gas emissions and congestion.

According to the UN Environment Program, personal and commercial transport accounts for approximately 20% of global energy supply, of which 80% comes from fossil fuels. This is a substantial contributor to greenhouse gas emissions. See exhibit 14.
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EX 14: Greenhouse gas emissions from transport

In addition, according to the US Census, Americans spend almost 100 hours annually commuting to work, resulting in 2.8 billion gallons of fuel loss due to congestion. Above and beyond road and vehicle congestion, railroads, freight trains and aircraft are all seeing increased traffic.

While some countries have developed renewable fuel standards, such measures have to be complemented with low carbon infrastructure to alleviate the dual problem of greenhouse gas emissions and congestion.

Cities and regions around the world are locally trying to solve the problem. In the US, New York, Chicago and Los Angeles are attempting to upgrade transportation infrastructure. For example, Chicago is at the center of the US transcontinental railroad network, handling approximately 40% of all US rail freight on 180,000 trains annually. Modernizing and improving the efficiency of this operation would cost anywhere from $1.5 to $4 billion over the next six years. Locally, the State of Illinois and the City of Chicago are teaming up with the US Department of Transportation to develop a program known as the Chicago Region Environmental and Transportation Efficiency Program (CREATE) to invest $1.5 billion into rail infrastructure improvements. But progress has been slow.

“The Chicago area freight network is choking on congestion, and freight traffic is expected to nearly double in the next twenty years,” said Jim LaBelle, Vice President of Chicago Metropolis 2020. "CREATE, the $1.5 billion project intended to make freight movement more efficient, has begun at a slow pace." More money would help accelerate this project, alleviating a major choke-point in the US rail network. Across the US and around the world, other major cities such as Beijing, London and Moscow are also facing similar challenges upgrading their transportation infrastructure.

Addressing the Current Economic Crisis through “Green” Infrastructure Spending

Though local authorities are attempting to alleviate public transport challenges, an extraordinary amount of investment is needed to address the problems in the national transport network. The American Society for Civil Engineers (ASCE) is calling for $1.6 trillion of public transportation investment from the US government. Of this, $300 billion would be allocated to bridges and roads, $39.5 billion to airports, and $10 billion to dams and levees.

There are a number of ways in which an infrastructure stimulus could be used to address climate-related public transport problems:

A. Direct funding of centrally-planned improvements

Centrally-planned improvements, funded through the National Infrastructure Bank, would allow for consistent upgrades to take place across nationwide, while providing for central coordination. Specific infrastructure projects that could be funded include national public transport networks, low carbon rail and freight alternative systems, as well as regional subways, bridges and roads. The benefit of having a central planning system would be that public transport alternatives and improvements could be scaled up to reach a suitable and sustainable position – and efforts could be coordinated across geographical boundaries. Some of the job opportunities that would result include those for civil engineers, rail track layers, welders, electricians and project managers – all high-quality, high-paying jobs.

B. Grants to states and municipalities

The National Infrastructure Bank could also provide grants to state and local authorities to develop efficient, low-carbon public transportation measures. As a result of localized guidance, clean technologies and energy efficient measures could be well-adapted to regional needs.

C. Preferential loan underwriting

The proposed National Infrastructure Bank could provide loan underwriting to local public transport projects. The benefit of such an initiative is that the interest charged on US government loans is generally less than the interest charged to individual states or municipalities, allowing for economies to be achieved. In the current credit crisis, this would also provide increased liquidity and available credit to public transport projects.

5. Water

As global population and economic prosperity have grown, water consumption has increased dramatically. Until about 25 years ago, water consumption grew faster than population. Since then, efficiency improvements have allowed population to increase faster than water consumption. See exhibit 15.
Addressing the Current Economic Crisis through “Green” Infrastructure Spending

EX 15: Population and water consumption are on the rise

Water systems have come under increasing stress as water consumption has grown. See exhibit 16.

EX 16: Global water stress by basin

Source: UN, World population prospects, the 2006 Revision: FAO of the United Nations

Source: World Resources Institute
As the climate changes, water stress is likely to increase, because the temporal and geographical patterns of precipitation are set to change. Research conducted by the IPCC indicates that the Southwest US, Southern Europe, Southern Africa, and other regions with fragile ecosystems will come under additional pressure as precipitation decreases and is concentrated into more extreme events.7

There are a number of actions the National Infrastructure Bank could take to address climate change-related water problems, specifically:

A. Constructing additional reservoir capacity

Droughts have become more common, especially in the tropics and sub-tropics, over the last 30 years. Under many climate change scenarios, precipitation will be increasingly concentrated in extreme events in the future, with longer intervening dry spells.8 This will reduce the regular availability of runoff for human use. In the US, these trends are most alarming in Florida, Georgia and the Southwest.

At the same time as regular availability of runoff is compromised in some regions, natural reservoir capacity is likely to be reduced. This is in part due to increased evapotranspirative demand at higher temperatures, aquifer depletion, reduced groundwater storage as the infiltration capacity of the soil is surpassed in extreme weather events, snowmelt, and potential glacial lake outbursts.9

Historically, investment in reservoirs have created meaningful employment opportunities, notably as part of the New Deal. The U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers and the Tennessee Valley Authority each undertook major reservoir projects during the 1930s, creating thousands of jobs. As a way to unlock this job-creation potential, the National Infrastructure Bank could provide financing for reservoir construction, either through direct funding of a centrally-run authority, or by providing attractive financing to regional, state and local entities.

B. Upgrading water capture infrastructure

As urbanization increases, concrete and other non-permeable surfaces cover ground that used to act as a catchment system for rainwater. Cities are often two-thirds concrete, and as a result, nearly all precipitation rushes into storm drains instead of being stored for later use in natural reservoirs.

At a local level, these issues can be addressed by building cisterns. Demonstration cisterns in Los Angeles collect 1.25 million gallons of water for every inch of rainfall. When paired with redirected downspouts and porous soil instead of concrete, efficiency of water use is radically improved.

Cistern construction can generate a meaningful number of local jobs. A $200 million cistern project in Sun Valley, California, is expected create 300 jobs to manufacture and install water-capture systems, adapt landscapes and maintain elements of the system. Cisterns also present an additional desirable trait in tough economic times: they can save cities a significant amount of money, because they are cheaper than most other options to increase water supply.

The National Infrastructure Bank could prompt construction of cisterns by providing attractive financing to state, local or regional authorities – augmenting the impact of the federal financing with co-investments from other parties.

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Addressing the Current Economic Crisis through “Green” Infrastructure Spending

C. Constructing additional canals and pipelines

As the spatial and temporal pattern of precipitation changes, water may need to be transported over longer distances to reach market. When cities like Atlanta have faced serious water shortages, proposals have emerged to pipe water in from far away, and climate change-related pipeline construction has already begun in some geographies.

There are significant legal challenges to piping water long distances across drainage basins. But where it is legal – and where it makes environmental sense to divert water from one basin to another – an infrastructure stimulus could invest in the canals and pipelines necessary to ensure safe and reliable transport of water from source to end-user. There is precedent for job creation through trans-basin canal projects. The Chicago Sanitary and Ship Canal – a 28-mile long, 202-foot wide, 24-foot deep waterway that connects the Great Lakes system to the Mississippi River system – was built during the severe recession of the 1890s, providing thousands of jobs.

The National Infrastructure Bank could provide direct funding to a government-owned canal-building corporation, or could provide attractive financing to local and regional authorities, augmenting federal funds with co-investments from the other involved parties.

D. Upgrading irrigation infrastructure and equipment

Approximately 70% of anthropogenic water use is tied to irrigation. As more regions come under water stress, the agricultural area under irrigation is likely to expand.

Most fields under irrigation today use inefficient ditches or sprinklers. These methods waste much of the water used.

The National Infrastructure Bank could provide attractive financing, either through loans, tax credits or grants, to private-sector programs to roll-out more sustainable irrigation techniques, such as drip irrigation. The right package of incentives, government financing, government-facilitated private financing and mandated standards could prompt significant demand to upgrade irrigation systems, creating thousands of jobs. There is also potential for public-private partnership working here.

12 Although the purpose of the Chicago Sanitary and Ship Canal is not to transport fresh water, it is part of the larger Chicago water system.
“Green” Jobs

A series of recent studies have pointed to the job-creation potential from a significant investment in scaling up clean technologies. We summarize these findings in exhibit 1, but look at them in more detail here.

1. “Green” Jobs: Towards decent work in a sustainable, low-carbon world

The UNEP published a major study on “green” jobs in September, 2008, that reviews jobs created to date in a variety of clean sectors, and points to the potential to create significantly more high-quality jobs through investment in low-carbon infrastructure and technologies.

The report collected data for “green” jobs by region, where information was available. The key findings for 2006 employment in “green” jobs are included in exhibit 17.

EX 17: “Green” jobs in 2006

<table>
<thead>
<tr>
<th>Sector</th>
<th>World jobs (for countries where data is available)</th>
<th>Jobs by region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>300,000</td>
<td>Germany: 82,100</td>
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<tr>
<td></td>
<td></td>
<td>United States: 36,800</td>
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<tr>
<td></td>
<td></td>
<td>Spain: 35,000</td>
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<tr>
<td></td>
<td></td>
<td>China: 22,200</td>
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<tr>
<td></td>
<td></td>
<td>Denmark: 21,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>India: 10,000</td>
</tr>
<tr>
<td>Solar PV</td>
<td>170,000</td>
<td>Germany: 35,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spain: 26,449</td>
</tr>
<tr>
<td></td>
<td></td>
<td>United States: 15,700</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>624,000-plus</td>
<td>China: 600,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Germany: 13,300</td>
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<tr>
<td></td>
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<td>Spain: 9,142</td>
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<tr>
<td></td>
<td></td>
<td>United States: 1,900</td>
</tr>
<tr>
<td>Biomass</td>
<td>1,174,000</td>
<td>Brazil: 500,000</td>
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<tr>
<td></td>
<td></td>
<td>United States: 312,200</td>
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<tr>
<td></td>
<td></td>
<td>China: 266,000</td>
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<td>Germany: 95,400</td>
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<td></td>
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<td>Spain: 10,349</td>
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<td></td>
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<td>United States: 19,000</td>
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<tr>
<td>Geothermal</td>
<td>25,000</td>
<td>United States: 21,000</td>
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<tr>
<td></td>
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<td>Germany: 4,200</td>
</tr>
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</table>

The study examines the impact of “green” investments for job creation by looking at a number of individual cases. These included:

- A 2000 study by the UK government that concludes that for every €1 million invested in residential energy efficiency, 11.3 to 13.5 FTE jobs were created;
- Approximately €3.8 billion in public investment and €15.2 billion in private investment in energy efficient retrofits in Germany led to the creation of 145,000 FTE jobs in 2006;
- In New Delhi, India, construction of 6,100 compressed natural gas buses by 2009 is expected to generate 18,000 new jobs;
II “Green” Jobs

The report notes that there are various shades of “green” jobs: “not all “green” jobs are equally “green.” The jobs discussed in the report run from those that are clearly linked to greenhouse gas mitigation – which we discuss above – to other “green” jobs less closely associated with climate change, such as organic farming and secondary steel and aluminum production.

2. Energy Efficiency, Innovation, and Job Creation in California

A University of California study published in October, 2008, examines the economic impact of California’s energy efficiency policies in detail. The study notes that California’s energy efficiency policies created almost 1.5 million jobs between 1977 and 2007. See exhibit 18.

EX 18: Job creation from household energy efficiency in California

<table>
<thead>
<tr>
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The study also finds significant employee compensation gains from household energy efficiency measures. See exhibit 19.

14 “green” Jobs: Towards decent work in a sustainable, low-carbon world, UNEP, p. 299.
II “Green” Jobs

EX 19: Employee compensation gains from household energy efficiency in California

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<td>11,211</td>
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The study conducted future scenario analysis based on the state’s current efficiency proposals, and found that they would achieve 100% of the greenhouse gas emissions reduction targets, as mandated by Assembly Bill 32, while increasing the Gross State Product by about $76 billion. The analysis also found that as many as 403,000 new efficiency and climate action-driven jobs could be created between now and 2020 when the potential for technology innovation is taken into account. While the authors recognize that some jobs have and will be lost in “dirty” sectors, they argue that the net economic impact has been, and will continue to be, overwhelmingly positive.


A study carried out by Global Insight for the US Conference of Mayors, highlights the number of “green” jobs currently in the US economy, and the potential to grow the sector over the next 30 years.

The study found that there are currently about 750,000 “green” jobs in the US economy. See exhibit 20.
II  “Green” Jobs


<table>
<thead>
<tr>
<th>“Green” Jobs by Major Category – US Total</th>
<th>Top 10 Metropolitan Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable power generation</td>
<td>New York</td>
</tr>
<tr>
<td></td>
<td>127,246</td>
</tr>
<tr>
<td>Agriculture and Forestry</td>
<td>Washington DC</td>
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<td></td>
<td>57,546</td>
</tr>
<tr>
<td>Construction &amp; Systems Installation</td>
<td>Houston</td>
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<td></td>
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<td>Manufacturing</td>
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<td>Equipment Dealers &amp; Wholesalers</td>
<td>Boston</td>
</tr>
<tr>
<td></td>
<td>6,205</td>
</tr>
<tr>
<td>Engineering, legal, research &amp; consulting</td>
<td>Chicago</td>
</tr>
<tr>
<td></td>
<td>418,715</td>
</tr>
<tr>
<td>Government administration</td>
<td>Philadelphia</td>
</tr>
<tr>
<td></td>
<td>71,900</td>
</tr>
<tr>
<td>Total</td>
<td>San Francisco</td>
</tr>
<tr>
<td></td>
<td>25,021</td>
</tr>
<tr>
<td></td>
<td>San Diego</td>
</tr>
<tr>
<td></td>
<td>19,799</td>
</tr>
<tr>
<td></td>
<td>Pittsburgh</td>
</tr>
<tr>
<td></td>
<td>13,848</td>
</tr>
<tr>
<td></td>
<td>Philadelphia</td>
</tr>
<tr>
<td></td>
<td>11,663</td>
</tr>
<tr>
<td></td>
<td>Pittsburgh</td>
</tr>
<tr>
<td></td>
<td>9,627</td>
</tr>
</tbody>
</table>

Source: “US Metro Economies: Current and Potential “green” Jobs in the U.S. Economy,” United States Conference of Mayors and Mayors Climate Protection Center, IHS Global Insight, 2008. To the extent that the data or information involve forecasts, it is understood that such forecasts are estimates which have been prepared on the basis of certain assumptions and hypotheses and are not a guarantee that the forecasts will in fact be achieved. No representation or warranty of any kind is or can be made with respect to the accuracy or completeness of, and no representation or warranty shall be inferred from, the forecasts. The forecasts are based on assumptions as to future events and, accordingly, are subject to varying degrees of uncertainty.

By increasing the use of renewable electricity and clean road transport fuels and implementing energy efficiency measures, the report finds that 2.5 million new “green” jobs could be created by 2018. This number could be increased to 4.2 million by 2038. See exhibit 21.

EX 21: Potential new “green” jobs in the US

<table>
<thead>
<tr>
<th>Potential New “green” Jobs 2038 – US Total</th>
<th>2018</th>
<th>2028</th>
<th>2038</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable power generation</td>
<td>407,200</td>
<td>802,000</td>
<td>1,236,800</td>
</tr>
<tr>
<td>Residential &amp; Commercial retrofitting</td>
<td>81,000</td>
<td>81,000</td>
<td>81,000</td>
</tr>
<tr>
<td>Renewable transportation fuels</td>
<td>1,205,700</td>
<td>1,437,700</td>
<td>1,492,000</td>
</tr>
<tr>
<td>Engineering, legal, research &amp; consulting</td>
<td>846,900</td>
<td>1,160,300</td>
<td>1,404,900</td>
</tr>
<tr>
<td>Total</td>
<td>2,540,800</td>
<td>3,481,000</td>
<td>4,214,700</td>
</tr>
</tbody>
</table>

Source: “US Metro Economies: Current and Potential “green” Jobs in the U.S. Economy,” United States Conference of Mayors and Mayors Climate Protection Center, IHS Global Insight, 2008. To the extent that the data or information involve forecasts, it is understood that such forecasts are estimates which have been prepared on the basis of certain assumptions and hypotheses and are not a guarantee that the forecasts will in fact be achieved. No representation or warranty of any kind is or can be made with respect to the accuracy or completeness of, and no representation or warranty shall be inferred from, the forecasts. The forecasts are based on assumptions as to future events and, accordingly, are subject to varying degrees of uncertainty.

The authors also examine the potential to create new “green” jobs metropolitan area-by-metropolitan area, developing a view of which regions stand to benefit the most from the scale-up of the “green” economy. See exhibit 22.
II  “Green” Jobs

EX 22: “Green” job potential by metropolitan area (top 20)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Potential New “green” Jobs 2038 – US Total</th>
<th>Existing through 2006</th>
<th>New through 2038</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New York-Northern New Jersey-Long Island, NY-NJ-PA (MSA)</td>
<td>25,021</td>
<td>197,971</td>
</tr>
<tr>
<td>2</td>
<td>Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)</td>
<td>24,287</td>
<td>192,165</td>
</tr>
<tr>
<td>3</td>
<td>Houston-Sugar Land-Baytown, TX</td>
<td>21,250</td>
<td>168,136</td>
</tr>
<tr>
<td>4</td>
<td>Los Angeles-Long Beach-Santa Ana, CA</td>
<td>20,136</td>
<td>159,321</td>
</tr>
<tr>
<td>5</td>
<td>Boston-Cambridge-Quincy, MA-NH (MSA)</td>
<td>19,799</td>
<td>156,660</td>
</tr>
<tr>
<td>6</td>
<td>Chicago-Naperville-Joliet, IL-IN-WI (MSA)</td>
<td>16,120</td>
<td>127,545</td>
</tr>
<tr>
<td>7</td>
<td>Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)</td>
<td>14,379</td>
<td>113,772</td>
</tr>
<tr>
<td>8</td>
<td>San Francisco-Oakland-Fremont, CA</td>
<td>13,848</td>
<td>109,570</td>
</tr>
<tr>
<td>9</td>
<td>San Diego-Carlsbad-San Marcos, CA</td>
<td>11,663</td>
<td>92,285</td>
</tr>
<tr>
<td>10</td>
<td>Pittsburgh, PA</td>
<td>9,627</td>
<td>76,174</td>
</tr>
<tr>
<td>11</td>
<td>Albany-Schenectady-Troy, NY</td>
<td>9,567</td>
<td>75,694</td>
</tr>
<tr>
<td>12</td>
<td>Indianapolis, IN</td>
<td>8,909</td>
<td>70,491</td>
</tr>
<tr>
<td>13</td>
<td>Dallas-Fort Worth-Arlington, TX</td>
<td>8,851</td>
<td>70,029</td>
</tr>
<tr>
<td>14</td>
<td>Trenton-Ewing, NJ</td>
<td>8,788</td>
<td>69,535</td>
</tr>
<tr>
<td>15</td>
<td>Sacramento--Arden-Arcade--Roseville, CA</td>
<td>8,236</td>
<td>65,162</td>
</tr>
<tr>
<td>16</td>
<td>Hartford-West Hartford-East Hartford, CT</td>
<td>8,019</td>
<td>63,448</td>
</tr>
<tr>
<td>17</td>
<td>Atlanta-Sandy Springs-Marietta, GA</td>
<td>7,354</td>
<td>58,186</td>
</tr>
<tr>
<td>18</td>
<td>Knoxville, TN</td>
<td>6,755</td>
<td>53,450</td>
</tr>
<tr>
<td>19</td>
<td>Miami-Fort Lauderdale-Miami Beach, FL</td>
<td>6,717</td>
<td>53,145</td>
</tr>
<tr>
<td>20</td>
<td>Portland-Vancouver-Beaverton, OR-WA</td>
<td>6,714</td>
<td>53,122</td>
</tr>
</tbody>
</table>

Source: “US Metro Economies: Current and Potential “green” Jobs in the U.S. Economy,” United States Conference of Mayors and Mayors Climate Protection Center, IHS Global Insight, 2008. To the extent that the data or information involve forecasts, it is understood that such forecasts are estimates which have been prepared on the basis of certain assumptions and hypotheses and are not a guarantee that the forecasts will in fact be achieved. No representation or warranty of any kind is or can be made with respect to the accuracy or completeness of, and no representation or warranty shall be inferred from, the forecasts. The forecasts are based on assumptions as to future events and, accordingly, are subject to varying degrees of uncertainty.

4. “Green” Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy

A report published by the Political Economy Research Institute at the University of Massachusetts Amherst, and developed by the Center for American Progress, analyzes the job-creation potential of a “green” stimulus. The study finds that a $100 billion stimulus could generate almost 2 million jobs. See exhibit 23.

EX 23: Job creation potential from a “green” stimulus

<table>
<thead>
<tr>
<th>Total Job Creation through $100 billion “green” Stimulus Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct jobs</td>
</tr>
<tr>
<td>Indirect jobs</td>
</tr>
<tr>
<td>Induced jobs</td>
</tr>
<tr>
<td>Total job creation</td>
</tr>
</tbody>
</table>

Source: “Green” Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy”, Political Economy Research Institute, University of Massachusetts Amherst, 2008.
The report notes that while the average pay for those associated with “green” jobs is about 20% less than that in the oil industry, “a “green” investment program will create roughly triple the number of good jobs – paying at least $16 an hour – as the same level of spending in the oil industry.” This is because of the higher labor intensity of “green” infrastructure, and also due to the more domestic nature of the sector.

The Political Economy Research Institute sketches out a proposed program of government spending that would include $50 billion in tax credits, $46 billion in direct government spending and $4 billion of federal loan guarantees for “green” investments. The authors note that this program would pay for itself relatively rapidly at the macroeconomic level, through returns on energy efficiency.
Appendix I: US Policy Positions

1. Existing policy initiatives

There are a number of policy initiatives already in existence that promote investments in infrastructure and "green" technology. These include:

A. The Production Tax Credit (PTC) and The Investment tax Credit (ITC)

- The PTC reduces renewable energy producers' tax burden by 1.5 to 2 cents per kWh, depending on the type of energy produced;
- The PTC has been extended for one year for large-scale wind projects as part of the Emergency Economic Stabilization Act of 2008.
- The ITC reduces capital expenses for solar electric and solar water heating equipment by 30%;
- The ITC has been extended for eight years for solar projects;
- New legislation also permits utilities to take advantage of the energy tax credits;
- $1.5 billion in tax credits, along with generous incentives for carbon capture, have also been granted for CCS projects;

B. The Department of Energy (DOE) Loan Guarantee Program

There is an existing Department of Energy Loan Guarantee Program under the Energy Policy Act of 2005. The program offers US government loan guarantees to eligible innovative energy projects that avoid, reduce, or sequester air pollutants or anthropogenic emissions of "green"house gases and are not currently in commercial use for energy production.

- The program authorizes issuing new loan guarantees until September 30, 2009;
- The program helps project developers bridge the financing gap between pilot and demonstration projects to full commercially viable projects;
- There have been three rounds of solicitation;
- The application submission due date for stand-alone and manufacturing projects has been extended from December 31st 2008 to February 26th 2009 due to heavy interest;
- $38.5 billion of loan guarantees have been authorized, as of June 2008:
  - $20.5 billion in funding is available for nuclear power facilities and advanced nuclear facilities;
  - $10 billion in funding is available for renewable and/or energy efficient systems, manufacturing and distributed energy generation/transmission and distribution;
  - $6 billion in funding is available for coal-based power generation and new facilities incorporating CCS;
  - $2 billion in funding is available for advanced coal gasification.
- The Secretary of Energy must determine that there is a "reasonable prospect" of repayment of the guaranteed debt before a loan guarantee may be issued;
- Guarantees can be issued for up to 100% of the debt financing – subject to the limitation that the DOE may not guarantee a debt instrument for more than 80% of the total cost of an eligible project;
- If a guarantee for 80% of project value is needed, financing must be obtained through the Treasury Department’s Federal Financing Bank;
- Congress is currently considering the Department’s Fiscal Year 2008 Budget request for $9 billion in loan guarantee authority and $8.4 million to run the Loan Guarantee office, both important for the successful execution of the program;
- The DOE have invited 16 sponsors, who submitted pre-applications last Fall, to submit full applications for loan guarantees. These projects include advanced technologies involving the uses of biomass, solar, industrial energy efficiency, electricity delivery and energy reliability, hydrogen and alternative fuel vehicles;
Appendix I: US Policy Positions

C. The proposed House Economic Stimulus bill

- The House passed a $61 billion plan to stimulate the economy through public works projects in September, 2008;
- The stimulus package is designed to have an immediate impact on job creation;
- It would include funding for the development of advanced batteries for fuel efficient cars;
- The Senate rejected a companion bill.
- There is the potential to pass this, either in the lame duck session or after President-elect Obama is inaugurated, due to increased Democratic power in the Senate, and amid calls for a new economic stimulus;
- Speaker of the House Nancy Pelosi signaled early in November, 2008 that the Democrats may push to resurrect this stimulus package in November, 2008 as a short-term measure before seeking a more expansive package as detailed in part 2;

D. The Economic Stimulus Act of 2008

This Act, passed in February, 2008, provides a number of stimuli including:
- Provision of tax rebates to low-and middle-income US taxpayers;
- Provision of tax incentives to stimulate business investment, including offering a one-time depreciation tax deduction equal to 50% of the cost of specified kinds of investment during 2008;
- $152 billion funds were allocated for 2008 with an additional $124 billion to be spent over 10 years.

2. President-elect Obama’s environment and energy policies

When looking to the future the key starting point is what the new administration will want to achieve. We therefore briefly review the energy, climate change and infrastructure policies from President-elect Obama’s campaign platform.

President-elect Obama has a comprehensive New Energy for America plan and his energy and economic policies outline the potential for a significant “green” stimulus in the new administration.

Obama’s policies outline ambitious targets for a national cap-and-trade program, generating 30% of energy from renewables by 2030, and investing at least $150 billion in clean infrastructure to create 5 million new jobs.

“Tackling climate change”

In his Blueprint for Change, President-elect Obama mentions climate change in the context of three areas: clean energy, stimulating the economy, and restoring America’s standing in the world.

President-elect Obama proposes the implementation of an economy-wide, national cap-and-trade program to reduce emissions 80% below 1990 levels by 2050. He also proposes that the US take a leadership position internationally in the debate on climate change. Specific medium-term targets include:

- A target to have 1 million plug-in-hybrids on the road by 2015;
- A $7,000 tax credit for purchasing advanced vehicles;
- A low-carbon fuel standard that targets reducing carbon in fuels by 5% by 2015 and 10% by 2020;
- A target to use 60 billion gallons of advanced biofuels by 2030;
- A plan for the Department of Energy to enter a private partnership to develop five commercial-scale clean coal plants using CCS.
Appendix I: US Policy Positions

“A clean energy future”

President-elect Obama mentions clean energy in the context of five areas: his emergency economic plan, his plan to create new jobs, his plan for clean energy, his plan for a universal voluntary public service corps, and in his plan to restore America’s standing in the world. The proposed policies in his “plan for a clean energy future” include:

- A target to produce 10% of electricity from renewable sources by 2012 and 25% by 2025;
- A proposal to create a federal investment program to help nurture America’s success in clean technology manufacturing;
- A proposal to double federal scientific research;
- Making the R&D tax credit permanent;
- Investing $50 billion to retool car manufacturing facilities to increase fuel economy standards;
- A target to ensure the federal government source at least 30% of its electricity from renewable sources by 2020;
- A program to reduce electricity demand 15% from projected levels by 2020 through deploying energy efficiency;
- Closing loopholes allowing excess energy speculation;
- Releasing light-sweet crude from the strategic petroleum reserve;
- Issuing energy rebates with revenue funded by a windfall profits tax;
- Eliminating current imports of foreign oil within 10 years.

President-elect Obama also proposes a 10-year, $150 billion “green” stimulus plan, which would “invest in a clean energy economy and create 5 million jobs.” The plan would develop a fund targeted at promoting advanced biofuels, fuel infrastructure, plug-in-hybrids, promote commercial-scale renewables, invest in low emissions coal plants, and begin transition to a new digital electricity grid. A focus of the fund will be ensuring that technologies are developed in the US, and then deployed across the country and around the globe.

“Green”-ing the “rescue plan for the middle class”

A number of policies in President-elect Obama’s rescue plan for the middle class lend themselves to a “green” economic stimulus as key enablers in that, while not specifically aimed at the “green” job story, they would provide a support for “green” initiatives. Among these are:

- Instituting a temporary tax credit of $3,000 for each new job created in the US – given the labor-intensive nature of “green” jobs, this would be a significant boost to their development and expansion;
- Extending the small business investment expensing limit increase to $250,000;
- Eliminating capital gains taxes in small businesses;
- Making $25 billion available immediately in a Jobs and Growth Fund to ensure that in-progress and fast-tracked infrastructure projects are not sidelined. This policy stipulates including energy efficient school and infrastructure repairs.

“Creating good-paying jobs” – and the National Infrastructure Reinvestment Bank

In addition to his energy-related job creation plans, Obama plans to boost employment by creating a National Infrastructure Reinvestment Bank. This $60 billion bank would be directed at transportation infrastructure issues across the United States. The proposal states that its investments could stimulate up to $35 billion per year in new economic activity and create as many as two million direct and indirect new jobs.

The investments would “expand and enhance, not supplant, existing federal transportation investments” in highways, bridges, roads, ports, air, and train systems. They would have a goal of strengthening the long-term economy and national competitiveness, in addition to enhancing national security.
Appendix I: US Policy Positions

We note that this proposal is not specifically “green” at this stage.

Other elements of the job creation plan include:

- Investing in producing “green” technologies in America’s manufacturing centers;
- Creating a national network of public-private business incubators;
- Creating an Advanced Manufacturing Fund to identify and invest in the most compelling advanced manufacturing strategies;
- Doubling funding for the Manufacturing Extension Partnership to improve efficiency, implement new technology and strengthen company growth;
- Weatherizing at least 1 million low-income homes every year for the next decade.
- Expanding federal grant programs to help states and localities build more efficient public buildings;
- Increasing funding for workforce training programs, and to include “green” technologies training in these;
- Establishing a goal of making all new buildings carbon neutral by 2030.

Funding for Obama’s proposals

There are three funding Options available to support the stimulus:

- Deficit Spending - Immediate economic impact, with long-term debt implications
- General tax Increase - Potentially unhelpful during difficult economic conditions, not tied to issue
- Carbon price, cap-and-trade - Auctioning of emission permits, direct connection with carbon externality

Many of President-elect Obama’s proposals have no specific funding attached to them. However there are very few official statements from the Obama campaign that directly link the funding for the $150 billion renewable energy fund to revenue generated by the auctioning of carbon credits under a cap-and-trade system. One of the few is a September 29 Bloomberg article, where Obama campaign-advisor Austan Goolsbee is quoted as saying that cap-and-trade would generate the capital to finance the $150 billion plan. As policy plans are elaborated, the funding plans for each of them will need to be made more explicit.
Appendix II: The National Infrastructure Investment Bank Act of 2007

A new push to invest in upgrading aging infrastructure networks began in the early days of the economic downturn, when Sen. Chris Dodd and Sen. Chuck Hagel proposed the National Infrastructure Bank Act of 2007. President-elect Obama’s economic policy also stipulates the creation of such a bank – and it is likely that this bill will play a key role in the development of the President-elect’s National Infrastructure Reinvestment Bank proposal.

According to the 2007 bill, the bank would:

- Invest $60 billion of financing for infrastructure and transportation upgrades over ten years;
- Potentially create up to 2 million new direct and indirect jobs per year and stimulate approximately $35 billion per year in new economic activity;
- Evaluate infrastructure project proposals and assemble a portfolio of funds to pay for them;
- Identify, evaluate and help finance infrastructure projects of substantial regional and national significance;
- Enable state and local governments to borrow money for infrastructure purposes in line with their ability to service debt and the strength of their credit ratings;
- Replace various ‘modal’ programs for highways, airports, mass transit, water projects and other infrastructure, streamlining them together into a new entity;
- Require that any project seeking federal participation over a set dollar threshold would have to be submitted to the bank with smaller projects being left to states, cities and towns, with the potential for accompanying federal grants to be used at state discretion;
- Redirect private efforts away from refinancing old facilities towards building new ones;
- Potentially produce almost a quarter-trillion of investments on a $60 billion annual bond issue, even with a conservative ratio of borrowing funds to capital of three to one;
- Be financed initially by the funds that are currently directed to existing infrastructure programs.
- Particularly benefit the industrial machinery and distribution equipment value chain area as this sector has the potential income and employment multiplier effects to create jobs.
Appendix III: Previous Major Governmental Spending Programs

There has been a long history of government spending to create significant value in job growth and economic stimulus. The following cases represent some of the efforts and examples made in history to combine infrastructure development with economic value.

1. The Suez Canal

Major French government investment in the construction of the Suez Canal dramatically reshaped international shipping, created a major international corporation and delivered attractive returns for investors.

2. The railroad boom

Large land grants given to railroads by the US federal government and individual states drove a railroad boom that saw the creation of significant value for investors and created what was then the largest company in the world (the Pennsylvania Railroad).

3. The Eisenhower Inter-State Highway program

Significant investment by the US federal government in constructing a national system of freeways. The investment provided attractive returns for investors in infrastructure and construction companies, as well as in corporations up the supply chain.

4. The space race

Significant investment by the US federal government in aerospace technology in the 1960s drove a boom that created significant value for investors in aerospace and technology companies.

5. The Japanese post war economic miracle

US investment and central coordination through the Japanese government prompted impressive economic growth. GDP grew from $91 billion in 1965 to over $1 trillion in 1980, and investors benefited from significant returns.

6. Nuclear power

Significant investment by the French government in nuclear power created a large industry and delivered attractive returns for investors upstream in the supply chain.

7. Star Wars

Significant investment by the US federal government in missile defense in the 1980s drove a boom that created value for investors in aerospace, defense and technology companies.

8. The tech boom

Initial government investment in computers and the internet created a multi-billion dollar industry in the 1990s.
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