

POWERING CITIES OF THE FUTURE



Seattle skyline

An energy upgrade for the US

By David M. Sweet

The credit rating downgrade of the United States, coupled with the threat of a double dip recession and abysmal employment outlook, has finally gained the undivided attention of the Obama Administration, Congress, and the phalanx of presidential hopefuls.

We know how to create jobs — almost a trillion dollars of stimulus spending did this at a whopping cost of somewhere between \$222,000 and \$586,000 per job, according to the Congressional Budget Office. The new round of stimulus announced by the Obama Administration will surely create more jobs — but at what cost and for how long?

Job creation is easy. Sustainable job creation is decidedly more complex.

A fascinating recent report

indicates that over the last decade multinational corporations cut 2.9 million jobs in the US and added 2.4 million jobs overseas. In other words, for almost every job that was cut here, a job sprouted somewhere else, primarily in the rapidly expanding economies of China, India and Brazil.

While economists argue that the global economy is not a zero sum game, when it comes to the global job market, it most surely seems to act like one.

There are billions of people around the world willing to work long and hard for far less than the wages paid in the US — many for the equivalent of a dollar an hour, or even less. To compete today we need to end the policies and strategies of yesterday.

If the story of natural gas is particularly remarkable, as just a few short years ago

the conventional wisdom was that the US was running out of natural gas and we needed to construct new receiving terminals for the import of Liquefied Natural Gas (LNG) to supplement our dwindling domestic supplies.

However, the convergence and refinement of complex production technologies, such as horizontal drilling, 3-D

What few in Washington seem to realize is that now one of our core strategic strengths is access to affordable, reliable and clean energy supplies

seismic and hydraulic fracturing, have allowed us to economically access vast shale resources and, almost overnight, reverse the domestic decline in production.

The rush is now underway to modify these import facilities to allow for export of US natural gas.

The impact on jobs is profound.

The natural gas industry is reported to directly employ about 622,000 people and indirectly sustain an additional 2.2 million jobs.

The recent activity around shale gas production created 88,000 jobs in Pennsylvania alone during 2010, according to Penn State University.

But where things really start to get interesting is when you look at the multiplier effect that reasonable and stable

see **An Energy Upgrade** ▶

US cities' experience can help developing countries find green path to energy access

By S. Vijay Iyer

Seen from outer space, America's cities form a network of exceptionally bright veins of light on the global landscape. It is evidence of America's industrial and innovative achievements, its breathtaking progress and—the current economic crisis notwithstanding—its wealth.

But shifting on this map from the U.S. to Africa, we see only the dim outline of a continent. In sub-Saharan Africa in particular, home to 840 million people, more than two-thirds—580 million—have no electricity.

The 48 countries of Sub-Saharan Africa have a generation capacity of 68 gigawatts, about the same as California. If we exclude South Africa, the total falls to 28 GW, equivalent to the installed capacity of North Carolina.

Energy poverty like this cripples development prospects. Where people don't have access to modern energy services, like reliable electricity, their ability to earn a livelihood or even live a healthy life is sabotaged.

reduce GHG emissions.

Meeting these targets will depend, in large measure, on enhanced energy efficiency. Reducing energy consumption can often be done more quickly, easily and cheaply than switching to alternative sources of energy—especially in the short-to-medium term. There is an energy security dimension to this as well: every barrel of oil not used is a barrel that doesn't have to be imported.

In many fast-growing developing and transition countries—both the energy-poor ones and booming emerging markets—city leaders are looking to cut energy costs and carbon emissions at the same time.

Some developing countries tax imports of renewable energy and energy-efficiency technologies; reducing or eliminating such import taxes is another important step.

Innovators in fast-growing, middle-income countries such as Brazil and Peru, often propelled by government policies that promote efficient and clean energy, are developing their energy efficiency



Credit: C2 Ringo

By 2030, 60 percent of the world's population will live in cities and will account for 73 percent of the world's energy consumption.

One World Bank study of impacts of a month-long blackout in Zanzibar found that incomes fell, and average birth-weight of babies born in local hospitals dropped during that period.

Without immediate action on multiple fronts, the number of people in sub-Saharan Africa without access to modern energy services will grow by almost 70 million by 2030.

Even as Africa's energy poverty is set to actually increase under business-as-usual scenarios, the booming growth of cities in Asia, Latin America and some African countries poses a parallel challenge.

By 2030, 60 percent of the world's population will live in cities. They will account for 73 percent of the world's energy consumption, and 76 percent of the world's greenhouse gas emissions.

Fully 81 percent of increased demand for urban energy will be from cities in developing countries, which are expected to triple their built-up area.

This expansion is driven by both population and economic growth, both of which result in more energy consumption.

Some of the globe's areas of darkness are lighting up quickly. The question is how to make this sustainable.

The International Energy Agency has analyzed what is needed to achieve pledges in the Copenhagen Accord, and to remove fossil fuel subsidies as announced by the G20 in 2009.

It cites energy efficiency measures in cities that could reduce the level of their GHG emissions by 2.5 billion tons. That's two-thirds of the total 3.8 billion tons of carbon emissions the IEA estimates would be abated if its recommended carbon-reducing measures are adopted worldwide.

Many American cities are becoming greener and smarter through expanded use of clean energy options. More than 900 US cities have signed on to global targets to

capacity, targeting their huge cities in particular.

Lima, for example, is replacing all of its thousands of incandescent traffic lights with long-lasting and energy-efficient light emitting diode signals.

Portland, Oregon, did the same thing 10 years ago, and cut energy usage by traffic lights by 80 percent and carbon emissions by almost 3,000 tons a year.

The C40 Cities Climate Leadership Group (C40), an organization of cities around the world—including 10 U.S. cities—working to address climate change, joined forces last June with the World Bank to adopt a consistent approach to city-led climate action plans and strategies.

By aligning municipal energy plans with consistent standards, city leaders help potential investors and grantors assess local projects in clean energy and energy efficiency, among others, thereby increasing the likelihood of financing.

The two groups have also agreed to pursue a common approach to measuring and reporting on city GHG emissions to allow verifiable and consistent monitoring of emissions reductions, identify actions that result in the greatest emission reductions, and facilitate access to carbon finance.

Clean energy initiatives successfully undertaken by U.S. cities can provide solutions for fast-growing cities of the global South. They can also help bring sustainable light to brighten the planet's enduring areas of darkness.

S. Vijay Iyer is Director of the World Bank's Sustainable Energy Department.

This special section was prepared to coincide with the Washington Energy Summit taking place at the Ronald Reagan Building and International Trade Center, September 27 and 28.

Our solar future

America's place in a globalized solar market

By Zack Baize

August proved to be an eventful month for the United States solar industry, with three notable manufacturing firms (Solyndra, Evergreen Solar, Spectra Watt) succumbing to unfavorable market conditions and filing for Chapter 11 bankruptcy.

While the dust has yet to settle in the wake of this industry shake-up, these bankruptcies have shed light on several challenges confronting US solar manufacturers moving forward. Namely, the industry's current difficulty in navigating an increasingly competitive international market unbuttressed by federally insured loans and aggressive national policies to fuel demand.

But what does this mean for the solar industry as a whole?

"In the long-term, it's basically a non-event for the industry," says Carbon War Room CEO and Sun Edison Founder Jigar Shah. "The solar industry will continue to grow exponentially, not only in countries that have traditionally attracted solar investment, but also in developing economies."

Shah says that while solar generation is still largely dependent on government support in America, it is cost-effective in about 10 percent of the US market.

He says this is not the case in some developing regions of the world, where solar generation can make economic sense.

"Millions in developing countries lacking electricity infrastructure are currently paying more for private generation than they would for solar," Shah says. "At this point, it's a multi-

trillion dollar global market opportunity and growing."

In addition to increasing cost-per-watt competitiveness, a big part of this opportunity lies in the versatility of solar generation. Solar installations can range in size from utility-scale to the smallest applications.

For example, in large urban areas where increasing congestion and transmission challenges raise costs, distributed



In large urban areas where congestion and transmission challenges raise costs, distributed solar has proved effective at increasing reliability and lowering costs overall for some consumers on the network.

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In countries like India, where the lack of access to electricity is a major factor impeding development, distributed solar can often prove to be a cost-effective and reliable solution.

According to Shah, small-scale (< 5 MW) distributed solar generation will increasingly become a central component to urban power matrices around the world.

Given these major financial

and developmental opportunities presented by the global solar market, the recent failures in the US solar industry seem to indicate that something was amiss in the companies and their products were simply not meeting market demand competitively.

The case of Solyndra has sparked considerable anger on the Hill where legislators are demanding to know what hap-

pened to \$535 million in DOE loan guarantees, just two years after they were granted amid Obama Administration cheers for what was touted as a great example of stimulus spending creating 'green' jobs.

Jobs were created, but with the bankruptcy 1100 workers have now been laid off, making Solyndra a major embarrassment to the Administration.

As with many other manufacturing operations in the United States, Solyndra and the other failed solar compa-

nies found that they could not compete with Chinese manufacturers, who now are dominant in the global market for solar panels.

Beijing is more than willing to propel its solar industry to a leadership position through a range of incentives including grants, cheap loans and protective policies. Then there are the lower labor costs in China.

While the US government has supported the solar industry through programs like the DOE's Sunshot Initiative and a handful of state governments have developed feed-in tariffs to spur consumption, the industry is clearly getting out-sponsored by the Chinese.

The recent debt crises and subsequent austerity measures on both sides of the Atlantic have highlighted the dependency of high-cost solar products, such as Solyndra's, on feed-in tariffs for demand in several key markets.

Recently, when three of the largest solar markets in Europe (Germany, Italy and France) began implementing cuts to "must buy" feed-in tariffs, manufacturers began to feel the pinch.

On the domestic front, Congress seems more and more likely to heavily scrutinize RE subsidies at the federal level while many state governments are reviewing their own feed-in tariffs in light of budget concerns.

However, not all is dark in the world of US solar manufacturing.

Advances in manufacturing processes and the declining cost of various inputs over the last

see **Our Solar Future** ▶

Green buildings to be the new normal

By Russ Davidson

Sustainable design of new buildings and renovations of older buildings by America's architects can reduce energy use in a building by 50 percent, which can have a major impact on overall energy use in the country. Just consider the following data from the Department of Energy:

- Buildings account for 40 percent of all energy use in the United States. This sector consumes more energy than either industry or transportation, having surpassed industrial use as the number one consuming sector in 1998.

- The growth in buildings' energy consumption resulted in carbon dioxide emissions rising from about a third of total U.S. emissions in 1980 to almost 40 percent by 2005.

- Of the total increase in retail electricity sales reported by the Energy Information Administration from 1985 to 2006, 87 percent was attributable to buildings sector demand.

The most visible differ-

ence in buildings of the future will be the generous and carefully conceived introduction of controlled daylight. Not only does daylight save energy used for lighting, which is a major portion of energy use in office buildings and schools, it also improves the performance of workers and students.

Like many innovations in architectural design, sustainable or "green" building practices started out as a novel and innovative approach, but they are now increasingly becoming typical or routine in architectural designs.

The energy crisis of the 1970s and 80s first highlighted how much energy is used by buildings, and architects responded by developing innovative passive solar and super-insulated designs.

Now, in response to concerns about the global effects of energy use, architects are responding with cost-effective and proven sustainable design strategies.

This evolution is reminiscent of the introduction of fireproof construction prompted

by large urban fires such as the one that devastated Chicago in the 1800s. That calamity prompted the formation of a "fireproof" political party, and ultimately led to new building codes that mandated many practices that now seem to be second nature.

Sustainable architectural design is in the process of being incorporated into land use planning as well as building design. The impact of incorporating these practices is now seen as so central to reducing energy consumption that they are likely to become the 'new normal' for architectural design of buildings for all functions.

The American Institute of Architects is deeply involved in the 'greening' of American buildings, and it was invited by the International Code Council to help lead the effort to develop the International Green Construction Code (IGCC).

AIA Vice-President Dennis Andrejko first started teaching and writing about Passive Solar design over 30 years ago. He now leads the AIA's family of knowledge communities

including the Committee on the Environment (COTE), this organization gives awards to the top ten sustainable design projects each year. (See www.aia.org.)

AIA President Clark Manus is the CEO of Heller Manus Architects, who designed the first LEED Gold rated high-rise building in San Francisco. His firm is also incorporating energy efficient designs in all its projects across China.

In America, many of the large older buildings, such as schools, libraries factories and religious buildings, were not built with energy efficiency in mind. This makes these buildings prime targets if we are to cut our consumption of energy.

In America, many of the large older structures, such as schools, libraries, factories and religious buildings, were not built with energy efficiency in mind. Renovating them and erecting new 'green' buildings will not only improve efficiency, but also create jobs in a time of recession.



Foliage helps cool this building in Santiago, Chile.

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Flexible power generation from a plant in Pearsall, Texas.

← from An energy upgrade

natural gas prices can have on other sectors of the economy.

For example, a recent study by the American Chemistry Council found that a modest increase in natural gas production from shale could generate more than 400,000 new jobs in the United States, more than \$132 billion in US economic output and \$4.4 billion in new annual tax revenues.

Another recent study by Wood Mackenzie found that if the US makes the right policy choices with respect to natural resource production, expanded activity could support an additional 1.4 million jobs by 2030.

And while studies are nice, the real proof is in the actual jobs and investments already underway, such as the announcements by a number of chemical companies to construct new facilities and restart plants that were idled as a result of the recession and natural gas prices that were several times higher than they are today.

But the story gets even better. The abundance of natural gas supplies will lead to a transformation in the way that the US generates electricity, from a system dominated by coal to one where natural gas is on the rise.

Smaller, natural gas fired, distributed power plants (power generated closer to the point of use) are cleaner and more efficient than large scale coal plants located far from the end user.

As a result of advancements in generation technology, these power plants can also be started and stopped quickly and often, unlike base load coal plants which do not allow for "cycling".

What this means, is that natural gas will also be an enabler of clean renewable generation, such as wind and solar. Because the wind does not always blow when we want, and the sun does not generally shine at night, natural gas-fired generation can balance out this intermittency and work hand in hand with clean renewable technologies.

Recent regulatory changes announced by the Federal Energy Regulatory Commission (FERC) will allow the integration of these renewable and distributed resources on a more seamless basis and eventually create a robust market for "ancillary services" to support the

transmission grid.

So if we really want to get America back to work with sustainable, market driven, high paying jobs, we need to couple the talents of our highly skilled, motivated, educated and creative labor force with other "comparative advantages" of the United States.

Our natural gas resource base is the foundation for a core advantage that can be leveraged across the economy.

The same technology that is revolutionizing natural gas production is also being applied to our vast oil fields. After a long downward slide in US oil production beginning in 1970, we are finally starting to see a reversal.

These fields hold billions of barrels of oil which, at today's prices, can be economically produced, create energy security, domestic jobs and make us even more competitive globally.

Einstein said that insanity is doing the same thing over and over again and expecting different results. We can't just continue spending more mon-

The revolution in natural gas production is driving a renaissance in manufacturing, power generation, transportation, and even the marine industry

ey that we don't have on marginal projects in the hope that this will drive growth. In other words, we need to develop policies that allow us to capture our comparative advantages.

That is not to say we need a wholesale rollback of the many environmental protections in place. Clean air, land and water are also a comparative advantage of the United States and the envy of our competitors in China and elsewhere.

A recent Department of Energy advisory report set forth a number of constructive suggestions to safeguard the environment and the public in the process of developing our shale resources. But we need to understand that poverty also kills and disables, and is a decidedly cruel executioner.

To get back on track, somebody needs to get out there and sell America to the global business community and let them know that we are open for business and the best place to locate.

There is over a trillion dollars of cash parked offshore by US companies waiting for a reason and opportunity for them to repatriate. Affordable, reliable and clean energy should become part of the mantra, the elevator pitch, the slide deck of everyone from the Department of Commerce, DOE and Environmental Protection Agency to the White House.

The next decade is not a sure thing for the US economy. If we go on our merry way thinking that we can just spend our way back to prosperity through more stimulus and negative interest rates, then we might as well pop all the champagne now and turn out the lights.

The usual strategy of a frequent flyer is to try to find some way to get an upgrade – pay for coach and sit in business or first. Given all the money spent on stimulus, with relatively little lasting effect, the United States has been paying for first class service and not even getting a seat on the plane.

While the new energy paradigm is not the only answer to our nation's economic plight, it is surely one of the key selling points that will allow us to compete globally and bring back the jobs that have been lost over the last decade.

Energy is the lifeblood of our economy, and these new supplies of natural gas and clean and efficient power will provide a much needed transfusion to a patient that is rapidly in decline.

It really isn't that complicated – we just need sensible government policies that protect the environment, safety and the economy. We need a strategy to capitalize on our strengths and minimize our weaknesses.

America has plenty of miles in the bank for an upgrade – now is the time to start cashing them in.

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Hydro plays key role in Ethiopia's power generation expansion

By Alemayehu Tegenu

Ethiopia has realized that energy is central to its economic development and the reduction of poverty in the country. This may seem like an obvious point, but it has taken fundamental restructuring of the power generation sector, along with an aggressive development program, to put power generation at the center of plans to expand the economy and reduce poverty.

Fundamental structural reforms were made in 1997 to the Ethiopian Electric Light and Power Authority, the Government of Ethiopia body charged with providing power, with the purpose of enhancing electricity genera-

tion of the power sector. The first is based on increasing large- and medium-scale, grid-based plants, and the second on small-scale, stand-alone/mini grid renewable energy projects.

There are a number of tangible positive advantages that large-scale, grid-based hydropower development schemes have brought for Ethiopia. These are:

(1) The Ethiopian hydropower resource is developed at cheaper investment costs compared to similar sized projects elsewhere, offering a reliable base for access expansion and power system development;

(2) Larger units have the advantage of distributing costs across wider numbers

lines have been built. This represents a 142 percent increase in the total capacity of transmission lines, and an expansion of the distribution network from 25,000 km to 126,000 km.

Currently, 47 percent of the population has access to electricity.

Ethiopia has also distributed 10 million compact fluorescent light bulbs to consumers throughout the country so that they can see for themselves the energy efficiency of these products.

The Energy Agency established in 1997 has been mainly involved in issuing electricity investment and operation licenses for both government and private entities in the electricity sector.



The Tekeze Arc Dam, one of the hydro plants completed in 2009, generates 300 MW.

tion, transmission, distribution, sales and other relevant business activities.

Prior to the reform, the public utility operated about 800 MW with an annual electricity production capacity of 35 GWh/year.

The reforms led to an aggressive power sector development program launched in 2004. During the 2004-2010 period, Ethiopia undertook the construction of five major hydro plants and one wind power project with a total capacity of 3200 MW.

To date, three of the hydro plants with a total capacity of 1,180 MW have been completed and connected to the grid. This has resulted in a 145 percent increase in the country's total generating capacity, which has risen from 800 MW to 2060 MW.

At the same time, electrification of the country has been developing apace.

The number of electrified towns and villages has reached 5,168 out of a total of about 7,000, with the number of customers growing from 250,000 to 1.85 million. This means access to electricity in Ethiopia grew to 41 percent of the population from a previous level of just 16 percent.

Two strategies have been employed for the expansion

of users without directly levying heavy tariffs on new customers;

(3) Large units enable the delivery of affordable modern energy services to low-income rural communities;

(4) Large plants mostly deliver good economies of scale as their planning, operation and management are done cost-effectively;

(5) Experience has shown that grid-based renewable energy tariffs tend to be cheaper than what private small-scale power providers would charge;

(6) The overall system appears to be more reliable as a failure in one location can be compensated for through the backup capacities of the whole network.

Ethiopia plans to increase its current 2060 MW capacity to 8,000 MW in the next five years, and to reach 16,000 MW in the coming ten years, through tapping its huge renewable resources of hydro, wind, geothermal and solar power.

Another remarkable achievement is in the power transmission, sub-station and distribution infrastructure development.

In the past five years more than 4,000 kilometers of 400 kV and 66 kV transmission

According to the Agency, it has issued some 45 investment and several operational licenses for projects with an initial capital of \$4 billion.

Ethiopia believes strongly in the importance of regional interconnection, and it is pursuing a strategy for accelerating cross-border electricity trading with the neighboring and nearby countries. In this way, Ethiopia's great hydro resources are contributing to regional economic development.

Regional integration of energy generation and distribution is important for Africa, where many of the smaller countries lack economies of scale in the sector, holding them back from economic expansion.

The Ethiopia-Sudan and Ethiopia-Djibouti interconnections study phases have been completed and these power lines are now at an early stage of construction.

Also, after several high-level negotiations, Ethiopia and Kenya have launched a feasibility study for the interconnection of the two countries' power systems.

Alemayehu Tegenu is Ethiopia's minister of water and energy.

Sustainable Urbanism

The pursuit of Eco-Utopia

By Dave Robau

When we think of a typical urban core, we think of traffic snarls with single-car drivers, pollution, and noise. While half of the world's population lives in these urban areas, these sectors are consuming about three quarters of the world's resources. This unsustainable model is a disaster in the making.

According to the National Resources Defense Council, by the year 2050 urban growth will continue to escalate, resulting in 89 million homes and 190 billion square feet of retail and other non residential space, in the United States alone.

Air pollution is a growing concern for cities big and small so it's no surprise that across the globe air managers and city planners are working to combat pollution with a great sense of urgency.

and fuels our entire economy. Without it our cities would cease to exist. However, by focusing on energy conservation and adopting sustainable building concepts and low impact development techniques, we can effectively reduce the energy demand and subsequently curb pollution.

Dockside Green, a LEED-Platinum mixed-used community, has been recognized globally as a leader in sustainable community design. The project is located in Victoria, British Columbia, and defines the path towards a bright and sustainable future.

By incorporating green roofs and urban parks, Dockside Green can effectively reduce the "heat island" effect, which can increase the temperature in a city core by 10 degrees Fahrenheit.

Transportation

A strong, multimodal transportation network is a critical

This technology can also be applied to heating water for domestic or industrial uses.

The United States Air Force has taken on a new initiative to contain all of the municipal solid waste generated at one of its installations as part of a beta test to treat the entire waste stream on-site. If the test proves to be successful, it may be replicated at other military installations.

Urban Food Production

City planners are working feverishly to redesign the downtown streets capes to feature mixed-use developments with a walkable urban layout to put residents in proximity to employment sectors, retail stores, recreation and entertainment. What is often left out of the conversation is food production.

Produce and other food supplies are harvested sometimes thousands of miles from your dinner table. Getting this



By incorporating green roofs and urban parks a city can effectively reduce the "heat island" effect.

Historically, those wanting to leave behind this pollution and traffic have fled the downtown areas for the suburban life and the promise of clean air and healthy living. This phenomenon has given rise to urban sprawl and has resulted in longer commutes and more air emissions from the tailpipes.

As our populations spread outward into the hinterlands an auto-dependent society emerges and with that comes an increase in fossil fuel emissions.

So how do we design and build a city that meets the needs of its residents and leaves a positive and lasting impression on the planet? Is a carbon-neutral city even possible?

First, we need to examine some basic concepts to frame the discussion and identify some very basic elements that are necessary for a modern, sustainable city that can respond to population growth and the increased demand on natural resources.

These critical areas are: energy & emissions, transportation, water, waste and materials selection, and food production.

And while these issues are the concern of urban planners, municipal leaders and businesses everywhere, the type of Eco-Utopia envisioned by some is still over the horizon, albeit with projects like Abu Dhabi's Masdar City spending many billions of dollars in an effort to make the ideal real.

Energy & Emissions

Energy is an absolute necessity. It powers our infrastructure



Credit: Valcent Products, Inc.

Vertical farming is in-city food production incorporated into a city's high-rise buildings.

aspect of any functional city. A well-planned system is designed to move people and goods in and around a city efficiently and in a way to allow for adequate capacity to sustain population increases and eliminate the pollution associated with traditional methods.

Masdar City serves as a unique example for renewable energy and clean technology applications (www.masdarcity.ae). The transportation planning goals of Masdar City are truly impressive and call for a zero-carbon footprint using a multimodal transportation system to connect Masdar City to Abu Dhabi's International Airport and surrounding areas.

Water

Water is the essence of life and it is becoming increasingly more expensive to meet the growing demand for it. The USEPA estimates that 36 states will face water shortages by 2013. By adopting green infrastructure, the cities of the future will store, treat and reuse water for many purposes, including potential reuse to supplement drinking water.

Seattle's King Street Center uses rainwater for toilet flushing and irrigation. The system provides 60 percent of the annual water needed for toilet flushing, conserving approximately 1.4 million gallons of potable water each year.

Investing in this type of green infrastructure has a strong return on investment. New York City's 2010 Green Infrastructure Plan estimates that every fully vegetated acre of green infrastructure will lead to \$8,522 in reduced energy demand, \$166 in reduced CO2 emissions, \$1,044 in improved air quality, and \$4,725 in increased property value.

Waste & Materials Selection

The cities of the future will all implement comprehensive waste management strategies to include material selection. If a material cannot be readily recycled or composed the city simply does not purchase it. This type of buying power can help to transform the entire packing industry.

Eco-Utopia and other cities like it will utilize advanced waste-to-energy gasification facilities as a cost effective means of turning municipal solid waste (and many other waste streams) into energy, mainly electricity and even fuel (using the Fischer-Tropsch process).

food to you often involves lots of fuel and lots of pollution.

A truly sustainable city will have the means to produce food by implementing vertical farming techniques.

Vertical farming is in-city food production incorporated into a city's high-rise buildings. It represents the vision of future sustainable food production, accommodating for the growing number of people living in future cities.

The idea of vertical farming is sustainable on several levels, in terms of energy, water, transport and waste but also in terms of organically produced food. The first vertical farming project is still on the horizon.

Sustainable Urbanism:**Eco-Utopia, USA**

Eco-Utopia aims to reduce or eliminate fossil-fuel use, adopt sustainable building practices, promote green space and clean air, implement energy-efficient and widely available public transportation, create walkable cities and develop well-organized mixed-use neighborhoods that combine living, working and shopping.

These qualities add up to sustainable urbanism, which gave rise to the concept of Smart Growth that will avoid urban sprawl.

The goal of smart growth is to implement regional considerations of sustainability to achieve a unique sense of community and place.

Through this process, planners expand the range of transportation, employment, and housing options. Low impact development strategies help to quantify the benefits of sustainable development, while preserving and enhancing natural and cultural resources and promote public health.

Smart city planning will help elected officials and city managers implement best practices in city planning by focusing on green infrastructure to help communities improve air quality and human health.

This proactive, long-range vision can create economic prosperity, lower the demand on energy and water by conserving resources, and ultimately make cities more resilient to the effects of climate change.

Dave Robau is an environmental scientist and LEED Green Associate with the U.S. Air Force Special Operations Command



We can reduce travel times by better monitoring and adjusting traffic signal timing.

A view from Siemens

Building infrastructure builds jobs

By Daryl Dulaney

Cities today are battling many challenges. Growing unemployment, deteriorating infrastructure, finite water supplies, congestion and shrinking budgets continue to plague some of America's biggest and most populated urban centers.

Experts predict that by 2050 some 6.2 billion people will live in cities worldwide — nearly as many as our current total worldwide population.

Today, 84 percent of United States residents already live in metropolitan areas, and that number will expand steadily. Cities will be forced to accommodate a huge influx of people — many more than their aging infrastructure was built to support.

But there's good news here too. According to a recent Brookings Institution study, 366 metropolitan areas in the country produce 85 percent of U.S. exports. The study found that "the economic future for states hinges largely on the performance of their metropolitan economies, which bring together the innovative firms, educated workers, and critical infrastructure that will propel the next wave of U.S. economic growth."

In short, we need to focus on our cities, and take another look at the importance of developing a strong, functioning, sustainable infrastructure to help turn cities — and our economies — around.

As a company that has helped many countries around the world further their development, we have seen the importance of a strong infrastructure to a region's ability to maintain economic growth.

And history bears this out as well, with an indisputable correlation between public infrastructure investment and economic growth. Between 1950 and 1979, public investments in core areas — transportation, water management, and electricity transmission — grew at an average annual rate of 4.0 percent. Overall

economic growth (GDP) averaged 4.1 percent per year over that same period.

And between 1980 and 2007, public investment growth slowed dramatically, to an average 2.3 percent. GDP growth also fell in this more recent period, to a 2.9 percent average annual rate.

We've seen this ourselves: building infrastructure creates jobs.

General upgrades to water and traffic solutions, as well as building updates, will not only help cities better meet today's population demands but also foster job creation in several hard-hit industries today.

According to a recent Department of Treasury report, 80 percent of jobs created by investing in infrastructure will likely be created in three occupations — construction, manufacturing and retail trade — which are among the hardest hit from the recession.

In Atlanta, for example, there are some immediate areas for infrastructure improvement. Let's look at traffic. We have found that we can reduce travel and wait times dramatically, just by better monitoring and adjusting traffic signal timing. When you improve travel times, you increase productivity, reduce waste and improve efficiencies for everyone.

One initial test of a control system for five intersections in metro-Atlanta, showed a decrease in morning rush hour travel time of an up to 32 percent, and an afternoon rush hour travel time reduction of 14 percent.

There were also substantial reductions in vehicle delays and stops which reduced fuel consumption and, importantly, emissions.

And then there's the issue of water, or lack of it in Atlanta's case. As we know, droughts affect agriculture and industry, key drivers of jobs in Georgia. But there are already many solutions being used in the country today that could be considered for Atlanta's dire water situation.

For example, some water recycling and purification technologies are being used very successfully in Orange County California right now, helping them produce millions of additional gallons of high-quality water for regularly drought-threatened areas.

It's true that many of these solutions cost money. City officials have said that the city of Atlanta needs \$922 million alone to update and repair its transportation infrastructure. However, there are several cost-effective solutions which are possible, and more appropriate than ever, given today's economic situation.

By simply incorporating some new, efficient building technologies, we can help lower lighting costs by up to 80 percent and overall energy consumption by up to 50 percent.

But do people realize that such retrofit investments can sometimes be made with little or no capital investment from cities? These investments can often be fully paid for within 10 years as a result of savings in energy consumption.

Municipalities can benefit from such savings through "performance contracting" which guarantees increased energy efficiency through the performance of new equipment upgrades.

When tied to energy rates that are based on historical increases, these upgrades can yield direct savings that can then be applied to pay back the financing of the upgrade.

Performance contracting can be a very attractive way to improve a city's energy efficiency and upgrade its infrastructure to accommodate a rapidly growing population, even though the municipality is challenged by a tight budget.

The technology is here. The workers are here. And now the financing is here too. What are we waiting for?

Daryl Dulaney is President and CEO of Siemens Industry, Inc.

◀ from Our Solar Future

year have significantly accelerated the ability of companies in this industry to turn out products that are competitive.

The two magic words in the realm of alternative power generation (using the sun, wind and other natural sources) are "grid parity," which is when the cost for production from alternatives matches the cost of producing power from fossil fuels, whether coal, oil or gas.

Achieving grid parity really means offering a product at competitive rates in a free market. For companies that can't meet this standard but depend on government support to stay in business, the Solyndra meltdown should serve as a warning that in future they will have to look to the market, and not the government, for viability.

Ironically, 2010 was a relatively good year for the US

solar industry, with nearly \$2 billion in export sales.

And while America produces just six percent of the global market for solar panels, against China's 60 percent, American innovation in this industry, as in others, could be the way for US solar companies to gain overall market share.

The United States has developed a strong position in regards to raw inputs for solar cells, particularly polysilicon materials. Calisolar, a California-based solar company, recently announced plans to develop a \$600 million new plant in Mississippi, adding to the US polysilicon manufacturing base.

Additionally, better financing options that allow for large-scale manufacturing of the most cost-effective solar technologies could help to revitalize the recently struggling industry.

Moving forward, the US solar industry can succeed by synthesizing its technological advantages with a shifted focus towards lowest-possible-cost production.

According to Shah, "Those that focus on technology don't understand this industry... it's all about the cost-per-watt delivery of KWh."

Note to Solyndra: At this point winners and losers in the solar industry are being defined on price and economies of scale, not proprietary cylindrical tubes.

If American solar companies and the agencies that underwrite them can internalize that, they will be better suited to compete in the race to win this global market.

Zack Baize is Ambassador at Inv/EST.org, a non-profit organization focused on developing US renewable energy initiatives.

Construction in Jordan melds old and new methods for energy efficiency

By *Yahya Kisbi*

With the world's population now at seven billion and rising rapidly, the growth in demand for shelter and consumable such as energy, water and food is set to increase dramatically. More than 50 percent of the world's population now lives in cities and the urbanization continues unabated.

In Jordan, 80 percent of our citizens now reside in urban areas and this proportion will only increase as our present population of 6 million passes 7.5 million in 2020 and 12 million in 2040.

Providing for our own needs while allowing for coming generations and simultaneously combating environmental degradation is a challenge for us all.

Jordan is already one of the world's most water-stressed countries, with 95 percent of our land desert and much of the rest susceptible to desertification. Unlike others in our re-

gion, we have no conventional oil reserves and currently import 96 percent of our energy requirement at a cost of 13 percent of GDP.

With present energy demand of 2,500 MW and predicted to grow to 4,550 MW by 2020 and 6,000 MW by 2030 we are left with no option but to adopt innovative, resource efficient and environmentally-responsive development.

With existing residential properties consuming 24 percent of our energy, approximately the same proportion as our industries, and commercial activities using 14 percent, initiatives to reduce the amount of energy used in both the construction and operation of buildings will increasingly contribute to attaining the National Energy Strategy 2007-2020 target of reducing total consumption by 20 percent through improved efficiency.

No longer can we afford to expand and operate our towns and cities according to the ways of the past. The 30,000 students

currently studying architecture and engineering at Jordanian universities will need to spend their careers pursuing a different set of environmental, geopolitical and social and cultural priorities from those who came before them.

We will, of course, learn from past successes, in which the Arab World has a head's start. Previous generations lived and prospered under adverse climatic conditions, adapting their culture and traditions to be environmentally-responsive.

Many of the urban planning and architec-

tural features now espoused by sustainability gurus and green building advocates have long characterized Arabian urban landscapes.

Buildings are positioned to maximize the benefits of cooling breezes and minimize solar gain. Tall, tightly-spaced buildings within high walls along narrow streets create shade, with interspersed barahaat, today's 'pocket parks' adding to natural cooling.

Arcaded souks improve outdoor comfort as well, while central courtyards with fountains, wind towers and traditional window screens, musharabia, greatly enhance the indoor environment and reduce the energy expended for space conditioning.

Like many of our neighbors, Jordanians at all levels of society are rising to meet the global energy challenge by rediscovering our traditions and adopting them in pursuit of modern metrics for sustainable development.

The Jordanian construction industry has been quick to realize the opportunities to reduce energy by rendering new construction, renovations and operational management energy efficient and cost effective.

Voluntary green building rating systems such as the USA's LEED and UK's BREEAM are being enthusiastically embraced by urban planners, design consultants, construction contractors, trade organizations, materials suppliers and others.

The Jordan National Building Council and the Building Research Centre at the Royal Scientific Society has initiated the development of an Energy Efficient Building Code for Jordan, to improve thermal performance and minimize energy consumption while maintaining thermal comfort, adequate lighting and other key performance indicators of modern living.

Since 2009 the Jordan Green Building Council has advocated for environmentally-responsive construction concepts and practices appropriate for the Kingdom.

Also like our neighbors, we are developing renewable energy sources and realistically



Amman, Jordan

expect them to account for 7 percent of peak demand by 2015 and 10 percent by 2020.

These estimates are based on plans to generate 600 MW from wind, 300-600 MW from solar thermal, and 30-50 MW from waste.

Jordan is also fortunate in having extensive reserves of oil shale that provide a cost-effective alternative to conventional hydrocarbons when the oil price exceeds \$65/barrel, a price not seen for any significant length of time for several years.

With our exposure to solar energy estimated at 5.5 kWh/m²/day, the potential for solar initiatives is particularly relevant to Jordan.

The future for all types of renewable energy was greatly assisted by the cabinet's 2010 approval of the Renewable Energy and Energy Efficiency Law allowing the Ministry of Energy and Mineral Resources to initiate energy conservation across various sectors of activity and to encourage renewable energy projects throughout the Kingdom.

A new Solar Energy Code and a Green Building Code have also been drafted.

Fiscal incentives to promote energy investment are also important. The 2007 Energy Strategy offers income tax exemptions of 100 percent over 10 years to independent energy projects that increase the contribution of local energy sources to the national energy mix through Build-Operate-Own (BOO) or Build-Operate-Transfer (BOT) projects.

In specifically targeting the use of renewables, the strategy provides for a number of incentives including:

- The progressive removal of oil and electricity price subsidies to make them cost reflexive;
- The establishment of an energy data bank;
- The provision of grants and soft loans for large renewable energy projects;
- The elimination or reduction of sales tax and/or custom duties on materials and equipment contributing to energy saving, such as thermal insulation;
- Creation of an Energy Efficiency label for local and imported appliances;
- The obligation for large industrial and commercial institutions to conduct energy audits.

Another important initiative has been the establishment of the Renewable Energy and Energy Efficiency Fund that promotes energy audits for industrial SMEs and offers limited assistance for energy efficiency implementation.

The overall investment package to meet the Strategy objectives is US\$1.4-2.2 billion.

Having adopted a strategy in which energy conservation is a fundamental tenet, it is inherent upon industry professionals to not only minimize operational energy demands of new and renovated buildings as required by the Energy Efficient Building Code and optional green building rating systems, but to also aim at reducing the energy used within the industry itself.

In the USA this equates to more than 11 percent of total national energy consumption, split almost equally between that consumed in the construction of buildings and that in providing infrastructure.

Yahya Kisbi is Jordan's minister of public works and housing.



The Jordanian construction industry has been quick to realize the opportunities to reduce energy costs by rendering new construction energy efficient and cost effective.

Developing and managing local clean energy using smart grids

By *Larisa Dobriansky*

As climate change, energy security and sustainable economic development goals proliferate, smart grid technologies are offering new solutions to our nation's most pressing challenges.

Cutting-edge pilot demonstrations across the United States are testing new smart grid functionalities to address more cost-effectively such growing concerns as rising greenhouse gas emissions; our power system's vulnerability to natural disasters, cyber attacks and energy supply disruptions; and the excesses of urbanization and the limits of growth.

These pilots, which are fusing power, information and communications capabilities, are showing how the deployment of smart grid technologies can help to redefine the organization of our power supply chain and enable all electric resources, including local energy and demand-side resources, to contribute to an efficient, affordable, reliable and sustainable electricity network.

The University of California San Diego (UCSD) is one such test-bed for smart grid innovations that can permit real-time, two-way flows of power and digital information from "source to sink" and extend the boundaries of electricity investments through the meter.

This pioneering project, which is funded by the California Energy Commission with matching contributions from UCSD's energy efficiency program collaborators, is demonstrating smart grid's focus upon optimal infrastructure investment and efficient and intelligent energy management toward a next generation power system.

In particular, this public-private partnership is revealing the potential of smart grid technologies to shape a new role for clean distributed energy in the transformation of our electricity grid.

In its pilot, UCSD is dem-

onstrating the use of "master controller" and optimizing software technology to increase significantly the market value of its micro-grid investments in such distributed energy resources as onsite renewable generation, distributed cooling, heating and power system, electric vehicles and thermal and electricity energy storage.

In employing the master controller technology with the optimizer-scheduler-aggregator software, the University will be able to combine, from any source within its micro-grid ecosystem, distributed generation, storage and loads into a "virtual power plant" that is fully dispatchable in the organized capacity, and real-time energy and ancillary services power markets.

This capability will allow UCSD to determine which sources of power and load control to employ and when in order to assure optimal performance, energy efficiency and overall reliability within its micro-grid system and to provide measurable and verifiable support to the grid.

In this way, this demonstration, like other ongoing pilots, is challenging with a new strategic approach, enabled by smart grid, the traditional "build and grow" utility paradigm of creating additional central power station capacity to meet increasing, massive peak demands that occur for a few hours each year.

It also is addressing the current situation in which distributed energy resource applications are undertaken in random and uncoordinated ways that yield environmental and economically sub-optimal results, with assets financially constrained by "behind the

meter" economics.

Building upon its communications assets and advanced metering infrastructure, UCSD will be able to develop, manage and deploy systemically and dynamically distributed resources within its campus in response to energy price signals and market conditions in



The University of California San Diego is a test-bed for smart grid innovations that can permit real-time, two-way flows of power and digital information.

real-time, both to meet most of the University's energy needs, as well as to benefit the grid through better balancing of supply and demand, more optimal asset utilization and active load management and demand reduction.

Without a doubt, this pilot will generate invaluable lessons regarding the use of smart grid technologies to integrate in real-time both supply and demand assets to meet customer demand for energy services; to contribute to the "true costing" of electricity services; and to changing the value proposition of distributed energy resources from just complementing baseload generating capabilities of utilities on an as-needed basis to providing customer solutions for

addressing onsite energy needs for clean, reliable and affordable power and thermal energy.

However, shifting to a more customer-driven electricity system, with cost-effective and strategic distributed energy resource applications and increased end user-controlled power management, is fraught

and incentive structures to motivate sufficient response from distributed resources that are not within the control of utilities.

And institutional barriers will need to be confronted in order to better link wholesale with retail electricity markets and replace organizational and technical "silos" with systems approaches for achieving "end-to-end" integration, from wholesale to retail markets and down to end-use.

In facing these daunting barriers, constructive partnerships between utilities, communities and other stakeholders are critical. The lessons, methods and technologies of pilot demonstrations such as UCSD's will need to be transferred and validated within the dynamic context of our electricity system, as well as within the infrastructure and built-environment of our communities.

Moreover, the efforts of utilities and local and regional governmental authorities will need to be mutually reinforcing to bring about a shift in how market success is measured, from providing reliable and affordable megawatts to "value creation," as customer needs are addressed in increasingly efficient, differentiated and intelligent ways.

In terms of developing the market for distributed resources using smart grid technologies, both utilities and local and regional governments will need to work together to leverage their unique positions, within their service areas and jurisdictions respectively, to educate consumers about the potential benefits of a smart grid, grow consumer acceptance and new relationships, and stimulate active participa-

tion with respect to expanding choices.

To achieve the economic, reliability and environmental objectives of a smart grid "eco-system," utilities and communities will need to interact with stakeholders in new ways to design and implement innovative and cross-cutting programs for capturing greater energy efficiency, sustainability and carbon emissions reductions. This will require the understanding of one another's planning and decision-making processes and using new tools and methods for evaluating the cost-effectiveness of alternative options.

Understanding and using smart grid technologies can facilitate the design of more energy and resource efficient communities and contribute to transforming local infrastructure.

However, this will require integrated planning that involves utilities, municipalities and all relevant stakeholders. This integrated planning will use "energy" as a means to assess how different sectors interact (electric, gas, water, transportation, and the built environment) in order to evaluate how energy performance and environmental quality could be substantially improved within a smart grid eco-system.

In this regard, utilities can offer critical decision support tools and methods for incorporating energy supply and demand and infrastructure analyses of alternative sustainability and resource development options into existing regional housing, land-use, water supply and wastewater, transportation, waste recycling and reuse and other municipal decision-making processes.

Larisa Dobriansky is a member of the National Energy Center for Sustainable Communities and director of the Global Energy Network. Previously, she was deputy assistant secretary of energy for national energy policy at the U.S. Department of Energy.