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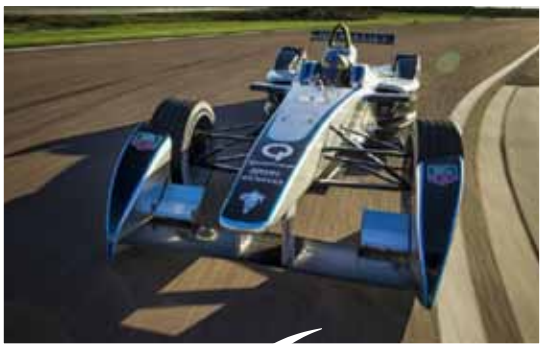

GLOBAL ENERGY INITIATIVE

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Energy in 2013: Changes and Constants

Vaclav Smil

Diversity of energy sources and uses guarantees that every year will bring some new, notable developments, and 2013 was no exception. In the US hydraulic fracturing lifted the output of crude oil and natural gas to such an extent that in 2013 the country became, once again, the world's largest producer of hydrocarbons (the USSR began to out-produce it in oil in 1975, and in gas in 1983). This has led to widespread expectations of the US also becoming a rising energy exporter. Domestic impact has already been clear, with coal-fired electricity generation in retreat, and with plans to expand industrial production based on the availability of cheap and abundant energy and petrochemical feedstocks. Domestic prices of natural gas diverged sharply from those of crude oil and differentials for natural gas on the world's markets reached record levels, with Americans paying a third of what the EU countries do and just a quarter of the price that Japan must pay for its LNG imports.

At the same time, China has just replaced the US as the world's largest crude oil importer and it has reaffirmed ambitious plans to develop more domestic gas. In fact, China's shale gas resources are larger than those of the US, but the country does not have the rich expertise of US drillers in developing such resources and, a serious drawback given water-intensive hydraulic fracturing, its North and West, where most of the shales are found, already have serious and chronic water shortages. That is why China also wants to import more LNG – but coal still dominates its energy supply and in 2013 all major industrial regions (including Beijing and Shanghai) experienced incredibly high levels of air pollution, an order of magnitude above the concentrations considered as harmful by international norms.

Russia lost its global primacy in hydrocarbon production – a shift that should, eventually, have some notable economic and strategic consequences: gas importers are already pressing for lower prices, Russia is circumventing Ukraine by building a pipeline across the Black Sea to bring more gas to the EU, and it hopes to sell more of its Siberian gas to China. Japan's closure of its nuclear power plants continued the necessity of importing more fossil fuels, incurring (after decades of surpluses) trade deficits, and generating more CO2. Fukushima clean-up experienced more problems and delays. While the future of the country's nuclear industry remains unsettled, the odds are that there will be no permanent total ban but rather a gradual restarting of some plants. Germany, Europe's leading economy, kept pursuing its infatuation with renewable energies, even as the country's ordinary ratepayers face higher electricity costs, while large companies have been sheltered from these rises in order to remain competitive.

All of these developments are interesting, some have been rather unexpected, but none of them change two of the world's energy fundamentals: the slow pace of energy transitions and the continued high inequality of energy use. This is not at all surprising, because the global system of energy production, trade and conversion is the world's most fundamental, most complex, and most costly, but, for all of these reasons, is also an exceedingly inertial arrangement: although it is constantly changing the rate of change is slow. At the beginning of the 20th century the global consumption of fossil fuels (at that time mostly coal with some crude oil and very little natural gas) surpassed the combustion of traditional biofuels (wood, charcoal, straws and stalks) – and we have been a fossil-fueled civilization ever since, albeit with non-negligible contribution of two kinds of primary electricity, hydro and (for the past 50 years) nuclear.

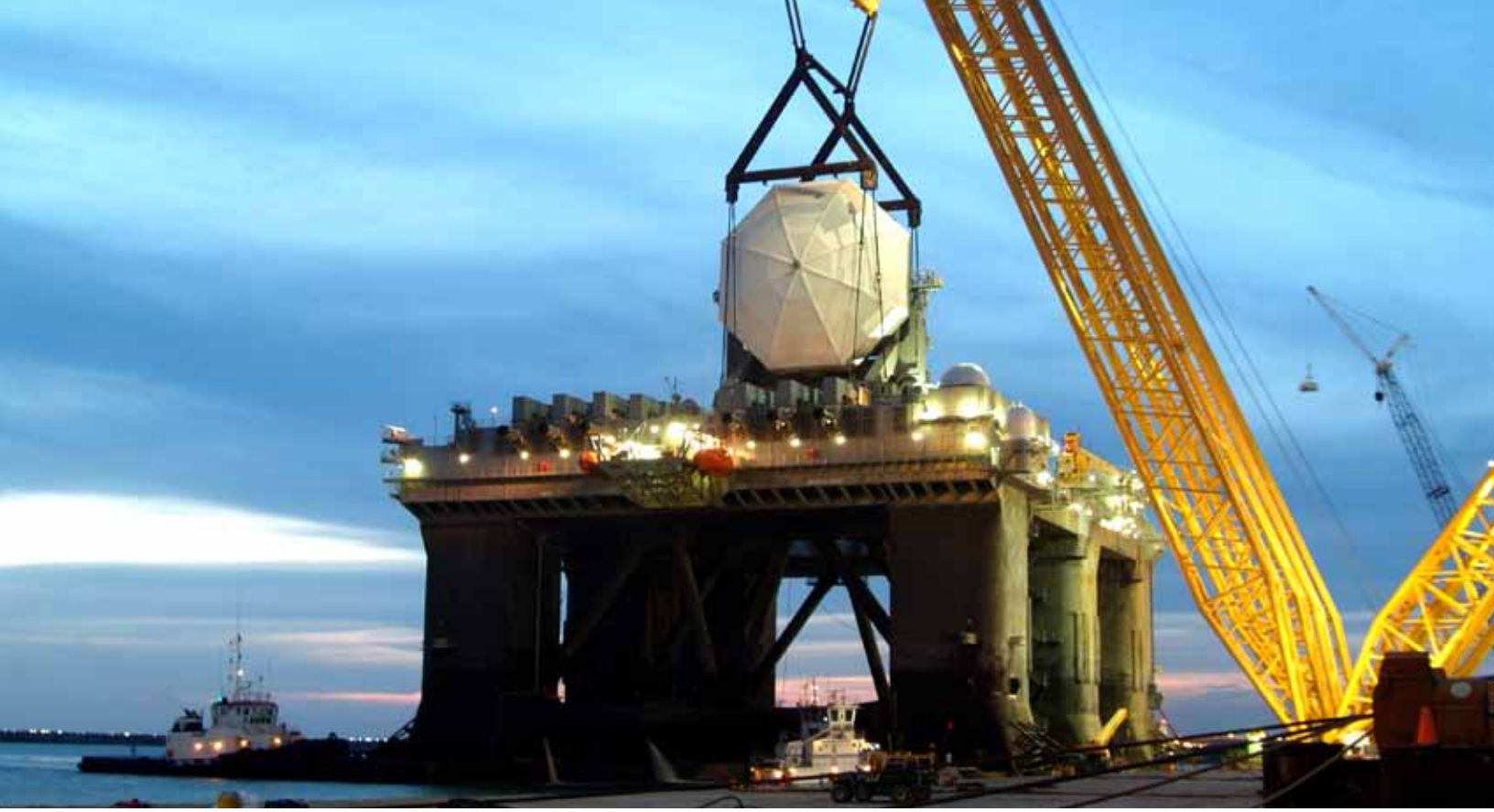
As we move through the second decade of the 21st century, media attention paid to solar and wind electricity and to new liquid biofuels has created a widespread impression that we are experiencing an accelerating transition from fossil fuels to new renewable sources of energy. Undoubtedly, these sources have grown strong in absolute terms, but the demand for fossil fuels has also been rising and in relative terms the transition to renewables is proceeding as all of the past energy transitions (from coal to crude oil, from coal and oil to natural gas) have done: slowly. In 1990 the world derived 88% of its primary commercial energy from fossil fuels, a generation later, in 2013, that share was only marginally lower at almost 87%. Some countries will move much faster in their quest to supply larger shares of their energy demand from renewables, but the world of 2020, 2030 or 2040 will be still energized mostly by fossil fuels.

During the past two decades the progress in narrowing the great energy gap between the affluent nations (USA, Canada, European Union, Japan, South Korea, Taiwan, Australia, New Zealand) and middle- and low-income economies has proceeded (largely because of gains in China and Brazil, also in India and parts of Africa) faster than in the preceding 20 years. China's progress has been unmatched: in 1990 the country's average annual per capita use of energy was only 10% of the US level, by 2013 it had surpassed 25% of the US rate, and it was equal to about 60% of the average European consumption. In contrast, Africa still has a long way to go before its energy use will be able to guarantee decent quality of life. The continent's mean per capita energy use is now just 20% of the Chinese level and it is actually a slightly lower share of the world's consumption than it was a generation ago.

Fortunately, raising energy use in low-income countries is not a challenge limited by resources: there is no imminent global output peak as far as any fossil fuels or hydro generation are concerned, and new renewables are still in early stages of expansion. But it is a major challenge of investing in requisite infrastructures and an enormous challenge of training new labor force. And because the world is so heavily dependent on fossil fuels the greatest challenge may be the way we will cope with global climate change.

Unfortunately, our models of global warming cannot tell us with a high level of confidence how rapid that change will be and how high the temperatures will rise in 50 or 100 years: difference of a single degree of Celsius translate into very different environmental and economic consequences. If we knew what was coming with certainty we could decide which one of the two main courses of action – gradual adaptation or an all-out effort aimed at emission reduction – is the more rational choice. But we do not, and this means that our production and use of energy, and hence our economic and social well-being, will continue to unfold in a world of profound uncertainty. That, too, is one constant that will not change for decades to come.

Vaclav Smil is a Distinguished Professor Emeritus at the University of Manitoba and a Fellow of the Royal Society of Canada (Science Academy). He has published more than 30 books to date and was listed by Foreign Policy in 2010 as one of the top 100 global thinkers. Smil's admirers include Bill Gates, who proclaimed, "There is no author whose books I look forward to more than Vaclav Smil".



Global Oil in 2014: Downside Range Breakout

Edward L. Morse

Oil markets are poised for a price fall in 2014, after trading in a range-bound market since early 2011. Even with a more robust outlook for global economic growth, demand for petroleum products look likely to increase by no more than 1.3-million barrels a day in 2014, a year in which production from countries that are not members of the OPEC oil producer group now appears likely to grow more than that, possibly by as much as 1.8-million b/d. And OPEC countries themselves are potentially on the verge of higher production as well.

Any change in prices would mark a significant divergence from what has occurred over the past two years. Ever since the first Libyan disruption, which took place in February 2011, Brent oil prices – the global benchmark for petroleum markets – have traded each quarter within one dollar of $110 per barrel. What's more the price of Brent has fluctuated within a narrow range, trading for a brief time just below $90 per barrel and at times above $120 per barrel. We are now forecasting that conditions that gave rise to range-bound prices are changing and more supply will be in the market putting pressure on prices. We now forecast Brent crude oil prices to fall below $100 per barrel in 2014, averaging around $97.50 for the year.

What's driving our forecast is a surge in supply, which we expect will last at least through this decade and possibly into the 2020s. That surge in supply is a function of a growing and record amount of capital expenditures for finding and developing oil and gas resources from unconventional sources, particularly from hydrocarbons found in oil sands, in tight formations (sometimes thought of as shale resources), and in deep water.

Total capital expenditures (capex) devoted to finding and developing oil and natural gas (F&D) has increased no less than four-fold since 2003, and it looks as though 2014 will result in yet another year of double digit (10%+) increases in capital deployed to the upstream sector. Much of this deployment is in the United States, where oil production is rising faster and to a larger extent than it has anywhere in the past. As a result of the US oil miracle, total production looks likely to reach record levels propelling the US into the largest oil producing country in the world within the next two years.

If the shale revolution continues to unfold at recent growth levels in the United States and if it starts to spread internationally, as now seems increasingly likely, oil production growth from outside of OPEC is likely to outpace demand through the end of this decade and possibly well beyond.

Meanwhile, OPEC and non-OPEC production from sources other than the United States and Canada is looking

increasingly difficult to project. That's in no small measure a function of the political conditions of what is known as "petro states," countries whose revenues are largely dependent on oil and natural gas sales, and countries which are increasingly seeing challenges to governance.

For 2014 it looks likely that oil demand will grow now by more than 1.3-million b/d. Oil production from the US and Canada looks likely to grow by a similar amount, and additional production appears likely from Brazil (+250-k b/d), Russia and China (a total of + 200-k b/d) and supplementary amounts from others, especially Kazakhstan. But in this latter case, output growth for 2014 of over 200-k b/d is now being seriously questioned. Elsewhere in these non-OPEC countries, output from Sudan is also being challenged and the margin of reliable output is potentially tenuous.

When it comes to OPEC countries, there is a huge level of uncertainty, perhaps larger than at any time in recent history. On the face of it, it would appear that OPEC countries will have to reduce production to balance markets and that issue lies at the core of our bearish outlook for oil prices.

But the fact of the matter is that there is great uncertainty about production from oil-producing countries, a predicament that appears to be becoming a permanent part of the global petroleum landscape. Before the winter of 2010-11, heralded as the birth of the Middle East/North African "Spring," oil disruptions due to unexpected domestic upheaval in oil producing countries, rarely exceeded 500-thousand barrels a day, a small percentage of total production in a world of just under 90-million barrels a day. But since then, starting with the Libyan disruption, disturbances to oil production due to domestic turbulence have rarely been less than 2-million barrels a day. In 2013 disrupted supplies of oil that otherwise could have been on the market have often been above 3.5-million barrels a day.

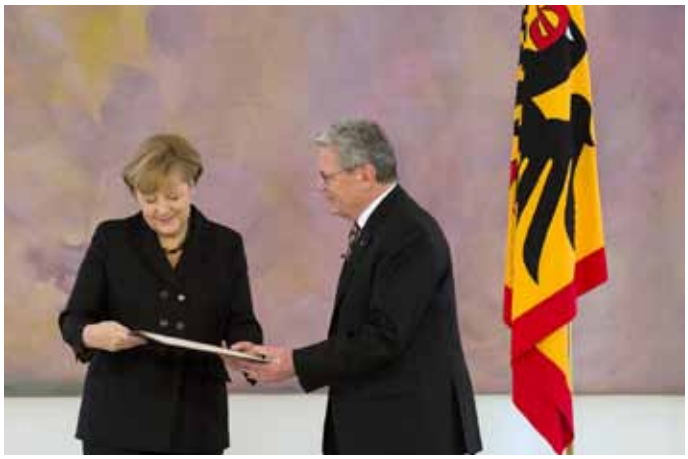
What is remarkable is that since early 2011, on a quarterly basis, Brent oil prices have been so stable and range-bound around an average of $110 per barrel. What's kept oil prices range-bound has not just been added production from Saudi Arabia and other Persian Gulf producing counties like Kuwait and the UAE, but more importantly output from unconventional resources in the US and Canada, which now stand almost 3 million barrels a day higher than was the case in February 2011.

Going into 2014, however, it appears that for the first time since 2011, oil production from both OPEC and non-OPEC countries currently off-line could rise rather than fall in the year ahead. This is particularly true of Libya, which once again sees its 1.6-million b/d of oil production capacity compromised by domestic turmoil. Its supplies cannot go down since they are in total disruption, but can only rise. For other OPEC producers the situation is more ambiguous. Iraq could theoretically see production rise by 800-k b/d or more, 400-k b/d or so both from the northern, quasi-independent Kurdistan Regional Government (KRG), and a similar amount from the South. But similarly higher domestic dissent and turmoil could see output fall. Such is also the case in Nigeria and Venezuela, where political factors could weigh-in either to boost or curtail production.

On top of these uncertainties, there are additional ones that relate to Saudi Arabia, which has been producing more than 9 million b/d since the winter of 2010-2011, and at times more than 10-million b/d. Basic assumptions about oil demand and supply point to a need for Saudi Arabia and other OPEC countries to reduce output. But will they? And what are the consequences if they don't?

In short, in the year ahead, production capacity and policy in critical OPEC countries are the key to oil prices. There is an extraordinary array of possibilities from a geopolitical perspective about where production will go, and therefore where prices will average. We at Citi believe that all other things being equal, there should be downward pressure on prices through 2014. We think there is a 50% likelihood that Brent prices will average $97-98 in 2014, more than $10 below average prices since 2011. Beyond that we think there is a higher probability that prices will be even lower than they will be higher with respect to our projected average number.

Ed Morse is Head of Global Commodities Research at Citi. He is a former US State Department official, and later was an advisor to the United Nations Compensation Commission on Iraq as well as to the US Departments of State, Energy and Defense and to the International Energy Agency on issues related to oil, natural gas and the impact of financial flows on energy prices.



Is Germany a Role Model for Energy Transition?

Claudia Kemfert

The energy transition in Germany aims to increase the share of renewable energy from almost 20 percent in 2011 to 80 percent in 2050. Presently, in Germany, electricity is primarily generated by coal (approximately almost 45 percent) and gas power stations (almost 14 percent). The nuclear phase-out envisages that all nuclear power stations currently still in operation will be gradually decommissioned by 2022. The plan is to increase the share of renewable energy from the current 20 percent to 35 percent by 2020, while, at the same time, significantly improving energy efficiency, particularly in buildings.

Germany's implementation of these targets is in line with EU Directives. The EU Roadmap suggests that, by 2050, the EU should increase its share of renewable energy to 80 percent. Further, the EU target is also to cut greenhouse gas emissions by between 80 and 95 percent in the same period. This is to be achieved primarily through the decarbonization of electricity generation, i.e., a significant increase in the use of renewable energy combined with improved energy efficiency.

Germany has resolved to reduce greenhouse gas emissions by 40 percent by 2020, compared to 1990 levels. The 25-percent drop in emissions achieved by 2010 is already evidence of success. The expansion of renewables and improvements in energy efficiency, particularly in the transport and mobility sectors, are key to meeting the climate targets.

In 2010, the CDU-FDP (Christian Democrat-Free Democrat) coalition government under Chancellor Angela Merkel initially extended the lifespan of Germany's nuclear power plants by approximately eight years. However, in spring 2011, the nuclear disaster in Japan, which struck in the aftermath of an earthquake, caused Germany to rethink its nuclear policy. As part of a moratorium, also in spring 2011, eight nuclear power stations were immediately and irreversibly taken off the grid. This saw Germany return to the decision it originally made in the year 2000, which, also as part of a nuclear consensus, committed to phasing out nuclear power by revising the Atomic Energy Act. As early as 2002, an amendment to the Act stipulated that nuclear power plants would only be permitted to produce limited volumes of electricity, which, assuming a normal service life would equally have brought about the gradual closure of nuclear power stations by 2022.

However, the actual energy transition is not only about withdrawal from the nuclear energy program but rather the comprehensive restructuring of German energy supply. If an average service life of 40 years is taken as a basis for power plants, then approximately half of all German coal-fired plants could be shut down in the next ten years due to age.

Across Germany, numerous new coal-fired power plants will either be in the planning stages or already under construction by 2017, with a total output of over 10 gigawatts. Thus, in purely mathematical terms, it would be possible to replace all the nuclear reactors presently in operation. However, fundamentally, coal-fired power plants are not compatible with the concept of a sustainable energy transition: they produce significantly more polluting greenhouse gases than other energy sources—twice the volume produced by gas, for example.

Gas-fired power plants would be far more suitable for the transitional period. They not only produce fewer emissions but are also easier to combine with fluctuating renewable energy sources, since the output of gas-fired plants can be quickly and easily ramped up and down. For electricity generation, particularly in combination with cogeneration, gas is the most efficient and also a climate-friendly form of energy supply. Further, for mobility, gas is a very interesting alternative to oil. Natural gas vehicles are subject to lower taxes which makes them very economically attractive.

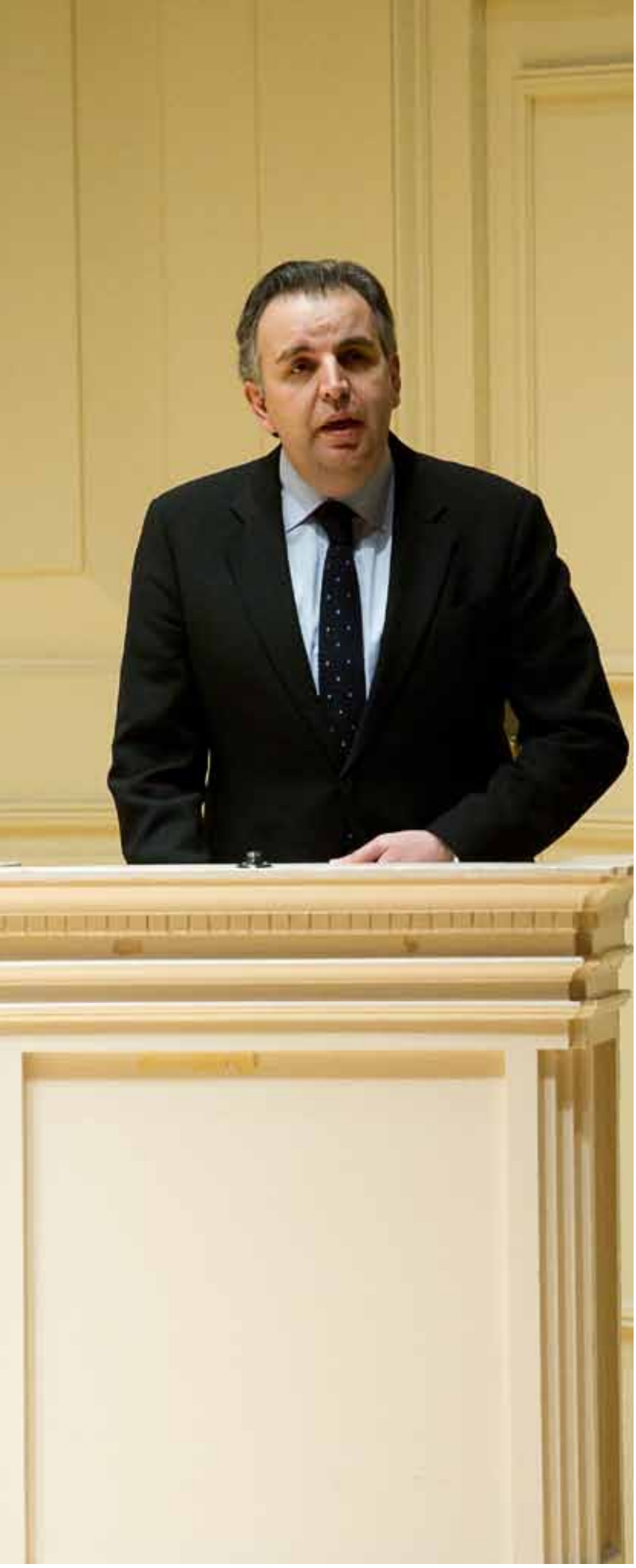
Renewables are very volatile. During periods when there is an abundant supply of renewable energy, the electricity networks often lack the capacity to feed the excess power to other parts of the country or abroad. With the expansion of renewables comes an increased need to upgrade, expand, and optimize the networks. First, power grids will be needed to connect northern and southern Germany, particularly to transport the electricity generated by the off-shore wind farms to regions where nuclear and coal-fired power stations will be increasingly decommissioned, i.e., western and southern Germany. Second, an expansion of the European electricity grid is also necessary, particularly to exploit geological advantages in electricity production using renewable energy sources, to improve trade, and to optimize networks. Further, intelligent distribution networks that can optimize the volatile power supply and corresponding demand will also be needed. Along with enhanced energy storage, demand management plays an equally important role here. For example, even energy-intensive industries can manage their demand patterns so as to combine them more easily with the increasingly volatile power supply generated by the growing share of renewable energy sources.

The funding of renewables is set out in the German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG), which enables guaranteed feed-in tariffs and priority access to the grid, both of which reduce the risk for investors. In recent years, the EEG surcharge has increased to 3.5 cents/kWh, primarily due to strong growth in photovoltaics. In 2014, this surcharge dramatically increased to 6.28 cents/kWh. This is not primarily because of the increased share of renewable energy, but rather because of the calculation method: the EEG surcharge is calculated as a difference to the wholesale price, which has declined drastically. The lower the wholesale price, the higher the EEG share. If the price declining effect would be passed through the electricity consumer as well, the total electricity price could remain constant.

Energiewende in Germany: a role model for other nations

The German energy transition is now in progress. In 40 years, electricity generation, which for the most part, is currently based on fossil fuels such as coal and gas, will be almost entirely converted to renewable energy sources. Presently, the share of electricity produced from renewables is about 23 percent, which is slightly more than nuclear power (18 percent). Further, as part of the energy transition, a commitment has been made to phase out nuclear power early: the remaining nuclear reactors will be decommissioned by 2022. The energy transition is also focused on improving energy efficiency, both in the building energy sector and to achieve more sustainable mobility. The energy transition is designed to facilitate the development of a sustainable energy supply. There will be no blackouts, provided that sufficient funds are invested in improving energy efficiency, optimizing the electricity grid management system, expanding the grid and storage capacity, and also in gas-fired reserve power plants during the transitional period. Only a slight increase in the price of electricity is anticipated since there are key factors exerting both a downward and an upward effect on prices. Although significant investment is required, this will, in turn, create added value and employment, however. Since Germany has sufficient plant, infrastructure, and power plant engineering and construction expertise, the German economy is in a better position than any other to profit from the energy transition, the boom in renewable energy, new power plants, improvements in energy efficiency, and sustainable urban development and mobility. The energy transition is expected to create hundreds of thousands of new jobs and thus undoubtedly brings more economic opportunities than risks.

Claudia Kemfert is Head of the Energy, Transportation, Environment Department at the German Institute of Economic Research (DIW Berlin) and Professor of Energy Economics and Sustainability at the Hertie School of Governance in Berlin. Kemfert advised EU president José Manuel Barroso in a High level Group on Energy and Climate, and acts as an external expert for the Intergovernmental Panel of Climate Change (IPCC).



Questions for the Ambassador

Garen Nazarian

Ambassador, Permanent Representative of the Republic of Armenia to the United Nations

Ambassador Nazarian answers questions on sustainable energy from students around the globe.

According to the UN report, "1.3 billion people – nearly one in five globally – continue to lack electricity. Forty five percent of the world's population – 3.2 billion people – still rely on wood, charcoal, animal or crop waste or other solid fuels to cook their food and heat their homes". As a UN Ambassador, what have been your personal contributions to alleviate the issues mentioned above?

Nduka Uzoamaka Chigoziri, Nigeria

To respond to your question, let me share a success story from Armenia. In my mountainous country the winters are long and harsh. Providing sustainable and reliable heat to all residents is a socio-economic challenge. That is why we started focusing on expanding sustainable energy in Armenia and make transformative changes in the lives of citizens. Until recently, residents of one of the rural outskirts of Yerevan, our capital city, had no heating or hot water in their apartments. Today, thanks to partnerships between the UN, the private sector and the government the construction of an environmentally friendly district heating system, from which a growing number of buildings tap reliable energy supplies, was made possible. The government agreed to guarantee the price of electricity and as a result a private company began building the system and investing in its infrastructure. Thirty large apartment buildings are connected to the system, along with a school and two kindergartens; approximately 50 buildings will soon benefit. Because of the success of this project, we intend to replicate this approach in the whole country.

Which is the role of energy education in Sustainable Energy for All initiative?

Marta Garcia, Spain

We have to start from schools: talk about good examples and good practices in different regions of the world, and encourage each country to introduce environmental education in their national curriculum in order to further sustainable development and poverty eradication. The Rio World Conference on Sustainable Development devoted an entire section regarding education in its outcome document that highlighted the role of educational institutions, particularly universities, in conducting research and innovation for sustainable development, including the field of energy education. It is important that we continue our incessant drive to develop quality and innovative programs in the context of the "Sustainable Energy for All" initiative.

Name 3 specific, measurable, achievable, realistic, time-bounded actions that every country can perform, towards faster attainment of a more sustainable production and usage of energies globally.

Calvin Lim, Singapore

I believe that the 'Think Global, Act Local' mantra is a sound approach. If I recall it correctly this was used in the context of environmental challenges, but can be applied to the sustainable production and usage of energies. Here are my three specifics:

- Each country should introduce environmental education in their national curriculum in the context of sustainable development and poverty eradication at various levels in the education system.
- Next, countries should invest in innovation and research programs in national higher educational hubs.
- Finally, countries should make changes in their policies and programs that would guarantee transformative change on the local, regional and eventually global levels in the fields of energy production and use through inclusive and accountable decision-making processes.

Why are climate and energy issues not more deeply integrated into the Millennium Development Goals? For example, many health and resource related issues are better approached through the lens of climate change, and sustainable sources of energy can play a large role in poverty reduction through business and home use. Climate and energy issues often cause these other problems, but they are treated as one would treat the symptom of a disease, though treating the source of the problems may be more effective in the long term.

David Rissman, USA

I agree with the premise of your question. I have heard the position of many member states at the UN underscoring that climate change impacts progress in achieving the MDGs in their respective countries and in many regions of the world. On the other hand, it is also true that progress with the MDGs contributes to environmental sustainability by reducing the vulnerability of those states and regions and their populations, and increasing their capacities to better respond to changing environmental factors. Renewable energy use and improving energy efficiency are part of broader national and international efforts to reduce poverty and achieve the MDGs.

What is the one piece of advice you would give to students looking to bring energy access to the world's poor?

Janice Tran, Canada

In developing countries energy access is fundamental to fulfilling basic social needs, advancing economic growth and human development. In Armenia for example, the United Nations promote energy access programs, expand renewable energy use, and improve energy efficiency, as part of broader international efforts to reduce poverty and achieve the MDGs (millennium development goals). In order to further this process, sharing experiences and expertise among students, schools, higher education institutions, and professionals on the good practices in this important field, particularly pertaining to energy access in rural areas, is necessary.

Dawn of the Climate Refugees

More than half a century has passed since the last mass migrations of World War II and the 1947 partition of British India. These events were triggered by violent political dissonance and the pursuit of ethnic cleansing, resulting in the resettlement of 30 million individuals. At this moment in time, we are dawning upon a new form of demographic change that threatens to bring forth the next mass migration. This phenomenon of "climate refugees", refers to individuals forced to relocate due to the effects of climate change.

Researchers have attempted to quantify the number of affected individuals worldwide, but it has proven to be a formidable task. The most widely cited figure was proposed by Norman Myers in 2005, who predicted 200 million climate refugees by 2050. Estimates by the International Organization for Migration state that figure could rise as high as 1 billion people over the same time frame. Despite the lack of consensus to enumerate populations of climate refugees, few can deny the significance of this issue.

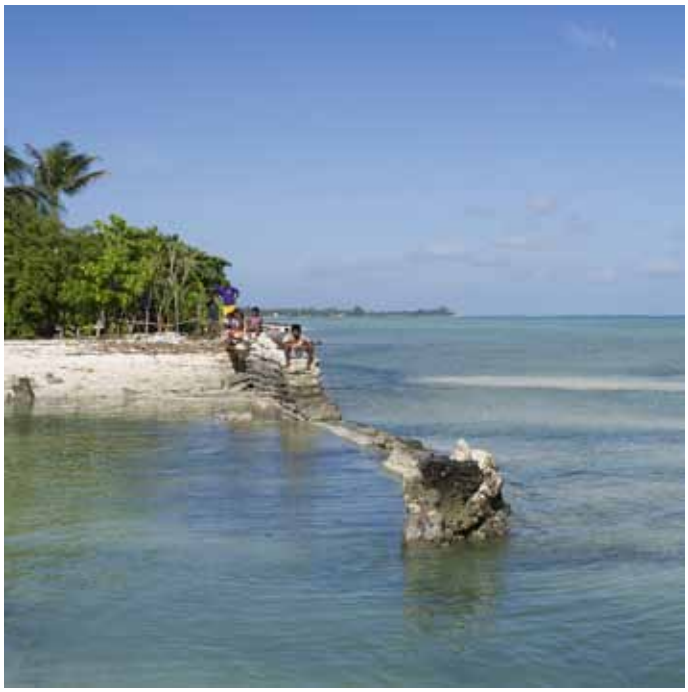
The story of Ioane Teitiota has increased the visibility of climate refugees worldwide, with Teitiota accepting the role of a poster child for the global campaign. Teitiota, a 37-year-old citizen of Kiribati, had sought refugee status in New Zealand but ultimately fell short in his bid to become the world's first climate refugee. It was a telling sign that the plight of climate refugees is far from a resolution.

History would indicate that the odds of success were never favorable for Teitiota. In particular, Teitiota could not provide convincing evidence that he would face persecution upon returning to his hometown – an important criteria for refugee status as outlined in the 1951 Refugee Convention adopted by the United Nations. In addition, the Tribunal determined that Teitiota was in no danger of being subjected to arbitrary deprivation of life or cruel treatment if deported from New Zealand. In the end, the Tribunal ruled that Teitiota was neither a refugee nor a protected individual.

Redefining the Refugee Definition and Seeking Alternative Solutions

With countries such as Kiribati predicted to disappear within 50 years, governments are shifting their attention towards long-term solutions to address the effects of climate change. Kiribati's President Anote Tong for instance is on a mission to find a new home for the country's 103,000 people and has its eyes set on the nearby Fiji islands. However, the process of cross-border relocation presents major hurdles.

The issue of climate migrants raises similar concerns to those imbedded in immigration reform debates. Opponents



will challenge the economic and social challenges of new migrants, such as competition in the labor market, increased burden on taxpayers and the loss of national unity. That is partly the rationale behind President Tong's proposal to send Kiribati's skilled workers to Fiji and prove competence in contributing towards the nation's economic growth.

On the other hand, one could argue that countries have the moral and ethical obligation to accommodate those displaced by climate change. This follows a similar argument to why rich nations ought to help the poor. Zambia once offered asylum to the people of Kiribati, but the President passed away before his offer could come to fulfilment and the proposal subsequently disappeared.

Moreover, there is also the issue of accountability and the ultimate unfolding of the tragedy of the commons. China and the US are the largest climate polluters and create the largest negative externalities, yet the tiny islands in the Pacific Ocean bear the burden of their industrial development. Island nations are likely to favor the view that nations with historically high records of carbon emissions bear greater responsibility for housing climate refugees.

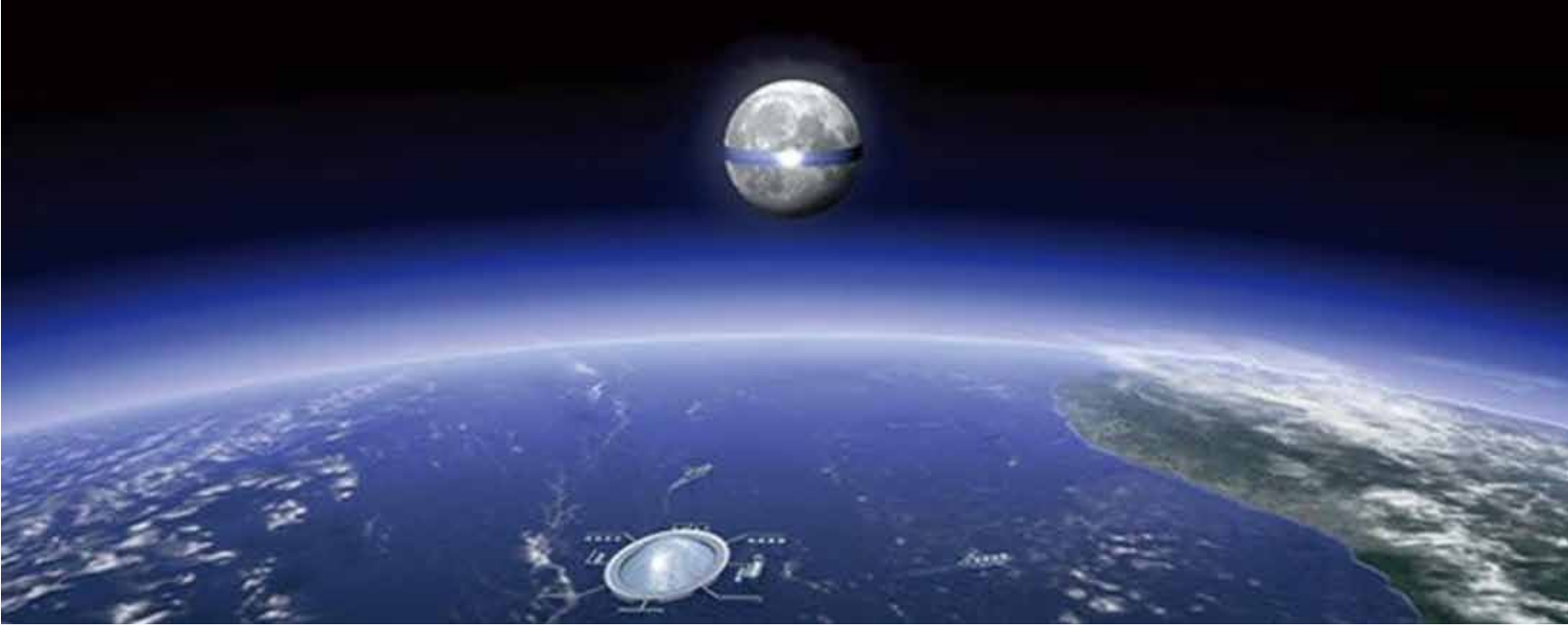
While the Dutch have opted for a future of floating homes and buildings on stilts, this is not the end-all of climate change solutions. In due time, intergovernmental organizations such as the UN will be faced with the task of creating a legal framework to address the problem of climate refugees. This may call for a revision of the definition of a refugee, and creating a new classification for climate refugees.

Some have already taken the initiative to lead climate refugee action. Last year, Prime Minister Moana Carcasses of Vanuatu announced plans to render the island a safe haven for affected victims. The declaration triggered internal discontent amongst the nation's leaders, prompting a prominent chief to state there was no room to house the displaced.

India has ventured further to prevent the possible influx of climate refugees, erecting a 2,100 mile Berlin Wall along its border with Bangladesh. The neighboring states have a troubled past dealing with illegal Bangladeshi immigrants, most notably through the Assam movement that ended in 1985. Overcoming such political disagreements will be a necessary precondition towards reaching a climate refugee solution.

THE LONG ROAD AHEAD

Teitiota's eldest child is five years of age, but demonstrates consciousness of the environmental developments surrounding her. When the Philippines was inflicted by the wrath of Typhoon Haiyan last year, she would cry to Teitiota's wife, "Oh mum, see that island. Is that the same as our island?" It is unsettling to hear these words muttered from a mere child, but they reflect the dire predicament of a generation born into environmental apocalypse.



Is Shimizu's Dream to Turn the Moon into a Solar Plant Merely a Dream?

Japan has long-been hailed for its innovation and technologically advanced products, most prominently in the electronics, robotics and automobiles sectors. The industrial foundation for technological modernization was established during Meiji era from 1868 to 1912, but it was not until the post-Second World War period that the industry began to flourish. In 2012, Japan had the second highest number of patents in force after the US, according to data by the World Intellectual Property Organization – a testament to the country's innovation prowess. Shimizu Corporation's LUNA RING is Japan's most ambitious plan to date, with a monolithic proposal to turn the Moon into a giant solar power plant.

Every once in a while, Shimizu puts forth a highly visionary concept that seeks to find solutions for sustainable future living. The series of megaprojects, aptly titled "Shimizu's Dream", include a "Pyramid City in the Air" structure and an environmental island floating on the Equatorial Pacific. While several of these such as the Shimizu TRY 2004 Mega-City Pyramid face technological constraints in the present, they serve as a focal point for advanced studies.

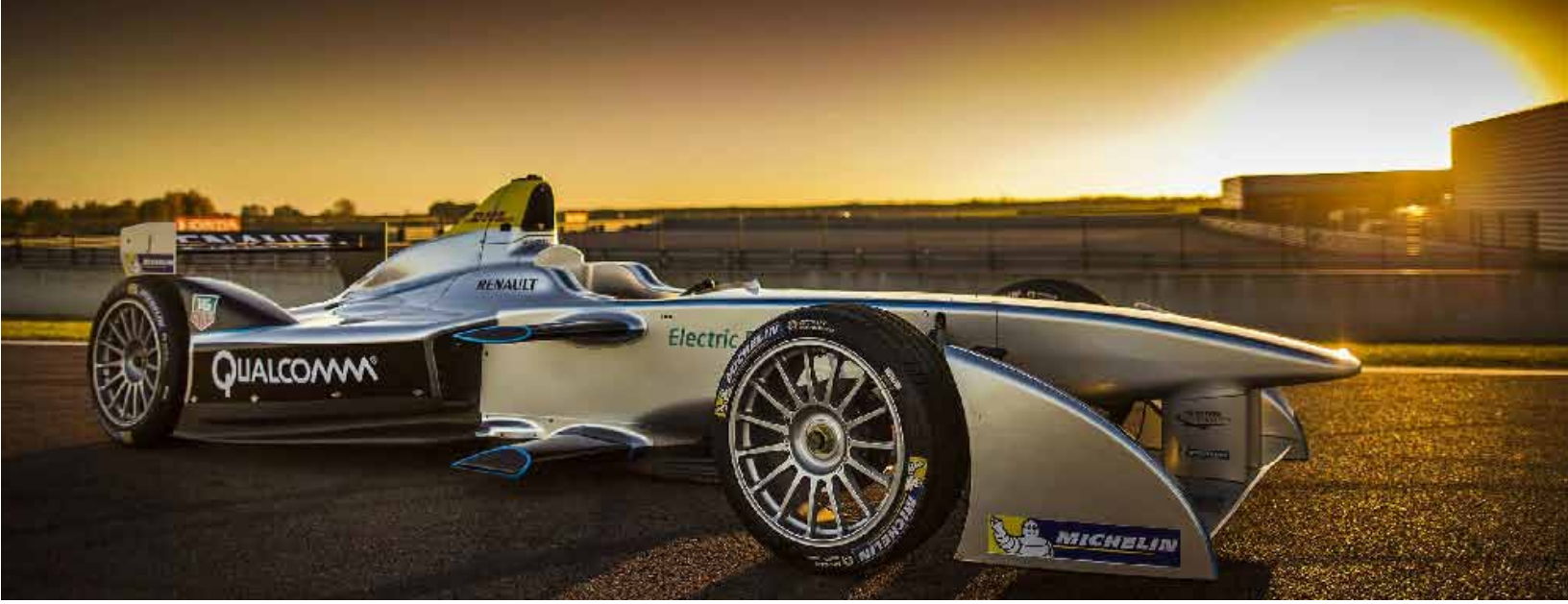
Shimizu's LUNA RING is not an entirely novel concept - the idea was first proposed by David Criswell at the University of Houston back in 2009. Shimizu's proposal involves an array of solar cells extended like a belt along the entire 11,000km lunar equator. This arrangement will ensure continuous power generation around the clock and eliminate inefficiencies due to unfavorable weather conditions. Electric power captured by the solar cells will be converted to microwave and laser power in order to transmit energy to the Earth, before passing through energy conversion facilities on the ground and fed into the grid system.

The concept in itself is revolutionary, overcoming several key issues of existing solar energy technologies. Nonetheless, one might also question whether this is simply another of Shimizu's Dreams that may never come to fruition. John Mankins, longtime NASA engineer and President of Artemis Innovation Management Solutions, noted, "The LUNA RING concept is technically feasible, but quite difficult, and the system would be extremely large in scale - encompassing a vast area of the Moon's surface if it were to be constructed. Moreover, economics of such an endeavor are likely to be very difficult, given the up-front costs for the needed infrastructures on the Moon."

Scientists have also emphasized the financial viability of the project. Argonne researcher Seth Darling said, "Given the availability of plentiful area on the surface of the Earth for installation of solar panels, it is not clear how space-based power can gain a cost advantage, even considering the fact that space-based panels can produce power 24 hours a day."

According to Mankins, a more energy-efficient mechanism to harvest solar energy in space for delivery to Earth is to use lunar materials to construct highly modular solar power satellites that are deployed to geostationary Earth orbit. Mankins designed the world's first practical orbital solar plant, named the Solar Power Satellite via Arbitrarily Large Phased Array or SPS-ALPHA, which could be launched as early as 2025.

Nevertheless, Shimizu are determined to convert their master plan into action, setting a target to begin construction in 2035. The firm has not addressed the financial cost of its project, leaving many uncertainties as to how or when its plan will be fulfilled.



Formula E to Complement, not Substitute Formula One

In August 2012, former Ferrari F1 chief Jean Todt signed an agreement with private investors to stage an entirely new class of auto racing. The plan was to establish the first internationally recognized competition for electrically-powered racing cars, which would consist of 10 teams and 20 drivers in its first season of operation. Todt will see his proposal realized in the second half of this year, with the inaugural FIA Formula E Championship is set to launch in September 2014. It signals a major shift towards sustainable mobility for Fédération Internationale de l'Automobile (FIA), the governing body for Formula One and World Rally Championship motor racing.

The 2014-15 season will feature ten host cities around the world, including Monte Carlo, Los Angeles and Rio de Janeiro. Beijing will host the first race of the season – the first time a Grand Prix has ever been held in the Chinese capital. It is a bold statement for a city where clean air is considered a luxury and the fog is so thick that it appears as layers of greyish-white paint strokes from outer space. More significantly, it demonstrates the country's commitment towards sustainability and alleviating its severe air pollution problems.

In contrast to its Formula One predecessor, the Formula E governing body has opted for street circuits rather than those specifically designed for races. Formula E's decision to move the competition to the streets was motivated in part by the desire to bring the races to the people, rather than the converse. Furthermore, Formula E wanted to demonstrate electric power in its natural habitat – an urban environment.

It seems premature to interpret Formula E's entrance as a herald to the impending downfall of fossil fuel vehicles. Formula E has stated explicitly that they are not trying to compete with their more established sibling, and perceive themselves to be a complement to Formula One. They also acknowledge that the industry for electric vehicles still faces many technological restraints, meaning that a showdown between the Formula series titans is improbable, at least in the short-term.

Electrically-powered racing is still in its nascent stages of development, with only one car manufacturer signed on for the 2014-15 Formula E season. The Spark-Renault SRT-01E battery has a projected run time of 25 minutes, meaning that drivers will have to make two mandatory pit stops during the hour-long race. Renault's model also lags behind in the speed department, clocking in a maximum of 225km/h. In comparison, the Red Bull RB9 that helped propel Sebastian Vettel to his fourth consecutive Formula One World Drivers' Championship has a maximum speed of 335km/h. Ironically, Red Bull's top speed falls at the lower end of the spectrum compared to rival car manufacturers.

Formula E has moderate expectations for the upcoming season, noting that it would be unreasonable to match the hype of the Formula One series, whose legacy dates back to 1950. Nevertheless, the competition has the support of influential figures such as Richard Branson, who will play a crucial role in inspiring a new legion of dedicated followers.

With its genetic makeup comprised of clean technology, the Formula E series aims to differentiate itself from other spectator sports and is on a mission to promote electric power in the industry. By the second season, 3-5 teams are expected to become car manufacturers, which will create a platform for the technological advancement of electric vehicles. This is the area in which Formula E has the greatest potential to impact society, by contributing towards the development of sustainable mobility.

What We Can Learn from Copenhagen?

Fifteen years ago, Copenhagen harbor was a body of wastewater that few would have dared to wade into. The thought of it being used for recreational purposes was inconceivable, with 93 overflow channels feeding pollutants into the waterfront. These days, it is hard to fathom the ghostly scene that was once Copenhagen harbor amidst the speckles of beach towels and swimmers that line the boardwalks in the summer months. The Danish capital will share its green revolution story with the world in the coming months, as it marks its crowning as the European Green Capital 2014.

Both the City of Copenhagen municipality and the Danish government have made it a priority to invest in clean energy, green mobility and urban planning. Copenhagen was the first city to introduce a large-scale urban bike-sharing program in 1995, which has since been abolished to make way for a new scheme. Nevertheless, the bicycle culture continues to strengthen, with 36% of the city's population commuting on the two-wheeled vehicle. Almost two decades later, the bicycle scheme has made its way across the Pacific to New York City, courtesy of Citigroup. It demonstrates that the world is learning from the Danish capital, gradually.

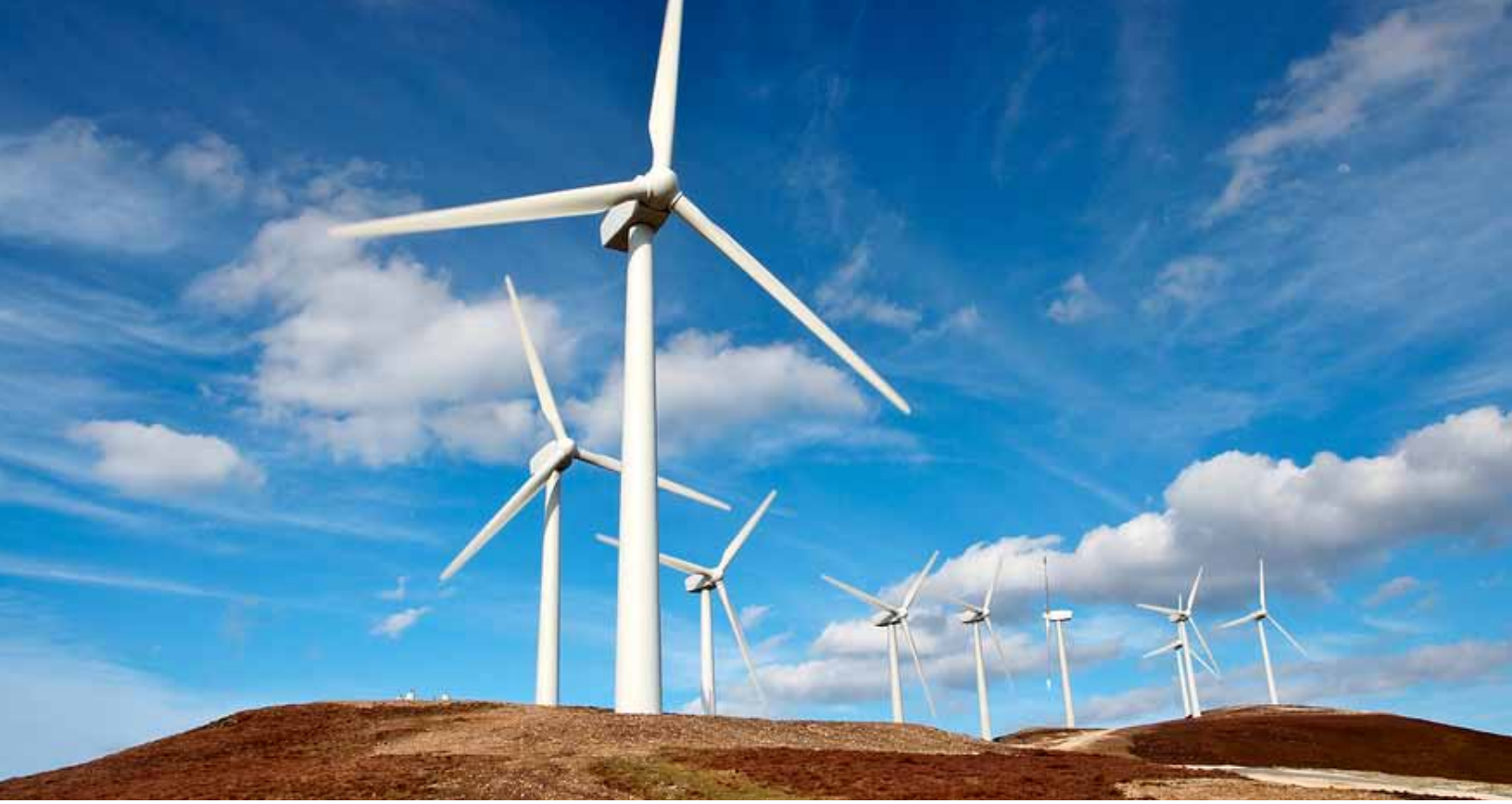
The success of Copenhagen's clean energy program lies partly in the establishment of a renewable energy infrastructure based on local ownership. Regulations mandate that domestic parties account for at least 20% of wind turbine ownership, ensuring that locals share the financial benefits of wind projects. Fostering of local support has helped the city overcome public disposition towards the noise factor associated with wind turbines and ruination of visual landscaping. It has also impacted the local market, with more than 25,000 employed in the Greater Copenhagen Area green sector.

Copenhagen's public transportation system and integrated use of technology are also worthy of international recognition. The three modes of available transportation – bus, train and metro, are unified under one ticketing system. What is most noteworthy about this development is the ingenuous use of SMS ticketing, which emerged in 2009. Passengers enter their departure and arrival details, after of which they receive a text reply, which serves as a travel ticket. The technology has become widely adopted among the masses, with 60% of one-way journeys paid for by SMS services. While the typical New Yorker agonizes over faulty magnetic stripes printed on flimsy laminated paper, Copenhagen expects to phase out paper ticketing entirely within the next few years.

Long-term government commitment to the development of renewable energy has also played a pivotal role in supporting industry growth, with plans to increase the share of electricity consumption generated from wind energy to 50% by 2020. At present, the country generates 22% of its electricity from wind power. Copenhagen is also bidding to become the first carbon neutral city by 2025, inspiring cities elsewhere to follow suit. The plan will cost the city $490 million and require an additional $4.6 billion from the private sector.

What is most apparent about Copenhagen's energy transition is that these initiatives are the culmination of decades of sustained investment. Denmark's wind industry dates back to the 1970s, when the government shifted focus to renewables in the aftermath of the oil crisis. A wind energy plan was unveiled in 1981 with plans to produce 1,000MW by 2000, thus paving the foundation stone for the country's wind industry. Establishment of the wind industry was further supported by financial support from the government, who covered 30% of initial investment costs.

Notwithstanding the many effective mechanisms to green the City of Copenhagen, this is by no means a replicable or recommended prototype for building sustainable cities. For instance, development of a district heating system is most practicable in concentrated areas with high heat demand. Cities must tailor sustainable development plans accordingly, taking into consideration a broad spectrum of solutions. Still, Copenhagen is a testament to the embracement of green initiatives and there are valuable lessons to be learned from the city.



Global Energy Developments to Watch in 2014

Japan: A Possible Nuclear Restart?

Japan's nuclear power remains crippled in the wake of the 2011 Fukushima incident, with no set date in sight for restarting the nation's 50 idled nuclear reactors. Prime Minister Shinzo Abe is pushing for a rapid return to nuclear generation as Japan sees its trade deficit balloon due to increased LNG imports and a weaker yen. Tohoku Electric Power Co. recently applied for a safety inspection of its nuclear reactor at the Onagawa power plant, making it the 16th reactor that has begun procedures for a possible restart. A new regulation standard for assessment came into effect in July 2013.

Tokyo Electric Power Co. (TEPCO) has also submitted a revised turnaround plan to resume operations at its Kashiwazaki-Kariwa nuclear plant. The government is expected to approve the program this month, which seeks to increase its interest-free loan ceiling from $48 billion to $86 billion. TEPCO will continue to repay loans for compensation payments related to the Fukushima disaster, which could amount to $51 billion.

Assuming a 9-month assessment period, the Institute of Energy Economics Japan (IEEJ) expects a maximum of 16 nuclear reactors will come online during the 2014 fiscal year. If the assessment period stretchers further to a year, this number will shrink to as few as six.

The extent of Japan's nuclear generation will have significant impacts on the nation's economy. In the scenario of low nuclear generation where only six nuclear reactors come online, Japan is predicted to spend approximately $253 billion on energy imports. IEEJ expects a difference of more than $14 billion between the best and worst-case scenarios of nuclear generation.

United States: The Day of Reckoning for Keystone XL and Ongoing Petroleum Export Ban Debates

The Keystone XL saga continues in 2014 amidst ongoing concern over property rights and environmental damage. President Obama has yet to make a final decision for the $7 billion pipeline that will transport tar sands oil from Canada to the US. Pipeline owner TransCanada is confident that the pipeline will be given the green light in early 2014, as the project enters its fifth year of pending approval.

Obama has made it clear that he will not go forth with the project if it significantly worsens carbon emissions. An initial environmental impact statement was released in March 2013 and concluded that the environmental effects of the pipeline

would be relatively small. The US State Department is preparing its final environmental review of the Keystone XL pipeline and is expected to be much more comprehensive. Democrats have urged Obama to delay his decision pending results from the investigation, while some have speculated that the Obama administration will postpone until after the 2014 election.

Meanwhile, the Obama administration will face growing dissent over a 40-year ban on petroleum exports, which was created in wake of the 1973 Arab oil embargo. Energy Secretary Ernest Moniz recently signaled his support for revisiting the issue, stating that the oil-export ban is outdated and that the world has changed since. Texas-based Exxon Mobil Corporation are the latest oil giants to signal public support for an export reform, following in the steps of Royal Dutch Shell and ConocoPhillips. Exxon intends to capitalize on growing oil demand, which it expects to rise 25% by 2040.

Mexico: Paving the Way for Private Oil Investment

They called it an early Christmas in mid-December 2013, when Mexican President Enrique Peña Nieto passed a historic energy bill to open its oil and gas sector to private investment for the first time in 76 years. Mexico's Department of Energy has hailed the reform, with foreign direct investor in the sector expected to increase by 50% to $10 billion in 2018.

While the first half of the year will be spent finalizing regulatory aspects of the energy reform, 2014 will nonetheless be a transitional year for Mexico. The secondary legislation, otherwise called "implementing laws", is expected to pass in the first quarter of 2014 and will flesh out the details of the reform. Analysts expect that it will take 2-3 years for the overhaul to take shape.

State-owned oil company Petroleos Mexicanos (Pemex) will start the bidding process for partnerships in March 2014, around which time it is expected to release a report detailing hydrocarbon exploitation areas in which it will work. The world's fifth-largest oil producer pumped an average of 2.523 million b/d in 2013, causing output to fall for the ninth consecutive year. Pemex expects the energy reforms to reverse its production slide, and predicts annual output to increase to 4 million b/d by 2025.

Ukraine: The Battleground for Gas Supply in Europe

Ukraine has been described as a divided nation since its independence from Soviet rule in 1991. Its eastern region insists on forging ties with Russia, while the western part seeks alliance with the EU. In recent times, Russia and the EU have tussled for political dominance over the Ukraine, which serves as an intermediary for delivering Russian gas to the EU. That battle will drag into 2014, as leaders of the respective regions attempt to create a gas consortium.

Ukranian Prime Minister Nikolai Azarov has declared plans to create a consortium with the EU. The announcement comes a month after the Ukraine turned down a trade and political cooperation pact with the EU, setting off rallies involving hundreds of thousands. In December, Ukraine accepted a $15 billion bailout from Russia, which agreed to lower the price of natural gas imports from $400 per tcm to $268.50 for the first quarter of 2014. The deal will put a bandage on the Ukraine's financial woes, which include $17 billion in gas bills and debt repayment due this year.

The invitation is still open for EU integration, despite the failure of last year's discussions. President Viktor Yanukovych is hopeful that Greece will step in to help Ukraine develop closer ties with the EU. Greece assumed presidency of the Council of the European Union on January 1.

China: Unlocking the Nation's Shale Gas Potential, Finding Resources Abroad

Natural gas consumption in China is expected to increase 25% annually over the next five years. China is eager to tap into its shale gas reserves, which are estimated to be the world's largest. However, China faces significant challenges that obstruct the development of its shale reserves; firstly inadequate technological expertise to exploit shale gas reserves; secondly the lack of pipeline infrastructure to transport the gas to urban populations.

In the coming year, China will seek the assistance of its western counterparts, who have managed to overcome these barriers. Shenhua Energy, the world's second largest coal company, has entered a joint venture with Energy Corp. of America to build 25 shale gas wells in the Marcellus shale reserve. The 30-year operation is Shenhua Energy's first foray into foreign shale gas, as it plans to push shale development in Guizhou province.

The prospect of a Chinese shale revolution is a while away, meaning that the nation will remain dependent on energy imports to satisfy the nation's increasing appetite for energy. Last year, President Xi Jinping ventured on a four-nation tour of Central Asia, securing $30 billion worth of energy agreements in Kazakhstan and a major gas project with Turkmenistan. China is expected to sign an agreement with Russia's Gazprom early this year to secure its supply of natural gas.

Australia: Revision of the Nationwide Renewable Energy Target and the Carbon Tax Repeal

Prime Minister Tony Abbott has vowed to revise the country's renewable energy target, citing a change in circumstances and increased pressure to reduce the cost of energy. The review, which is expected to be complete in June 2014, has raised concerns that the government will reduce its current mandate to generate 20% of electricity from renewable sources by 2020. Renewables accounted for 13% of Australia's total energy mix in 2012, according to the Clean Energy Council.

Australia's mandatory renewable target scheme dates back to 2001, when the Howard Government set a 9,500GWh target by 2010. Since then, the target has been revised once under the Gillard Government to increase renewable energy capacity by 45,000GWh between 2001 and 2020. Australia's Climate Change Authority last reviewed the renewable energy target in December 2012, noting that any changes to the target would reduce investor confidence in renewable energy projects.

Another item on Abbott's agenda is the upcoming carbon tax repeal, which are due to come into effect on July 1 – two years after their introduction under the Gillard Government. The carbon tax has put upward pressure on electricity bills across the nation, with average bills in the Australian Capital Territory increasing 12% during the first year of operation. The inefficiency of the carbon tax in decreasing carbon emissions has added further fuel to the fire; Australia's National Greenhouse Gas Inventory recently reported that emissions decreased by a mere 0.1% between 2012 and 2013.

My Vision for the Decade of Sustainable Energy for All (2014-2024)

Ross Collins,
Winner of Global Energy Essay Contest 2013

Dear Mr. Secretary General,

I could not agree more on the centrality of energy issues to sustainable development, and in particular the necessity of expanding access to the world's poor, but I think characterizing 2014-¬2024 as the "Decade of Sustainable Energy for All" is the wrong approach. Sustainable development is fundamentally an inter-¬temporal social planning problem; it asks whether people at the end of a decade are as well off as they were at the start. Access, affordability and the externalities of energy use will certainly factor into this dynamic calculus of well-¬□being, but so too will a myriad of other dimensions affected by energy choices. In this essay I will argue that human well-¬□being should be the central precept of sustainable development, and that a participatory, dynamic evaluation of energy policy is necessary to augment the currently incomplete policy analysis process. To fulfill this vision, I suggest first rebranding 2014-¬2024 as the "Sustainable Decade of Energy for All".

My assertion that sustainable development is fundamentally about people may be controversial, and it's admittedly a Western view of the world. But the Brundtland Commission (1987) made the same assertion, albeit implicitly, when it stated that sustainable development should "meet the needs of the present without compromising the ability of future generations to meet their own needs". While the usage of "needs" versus "well-□being" admits some differences, the underlying message that people should be at the forefront of sustainable development is the same. For instance, while renewable energy sources like wind and solar result in fewer emissions and less ecosystem degradation than fossil fuels, their intermittency and current expense may stifle the efforts of developing economies to create reliable manufacturing bases, keep their hospitals operational, and pull their people out of poverty. However, when one considers that certain emissions result in premature deaths and that ecosystem degradation undermines important regulating services upon which humans rely (e.g. air filtration and water purification), the renewable energy policy appears more attractive. This dynamic evaluation of the policy illustrates the tension between short and long--term impacts on well-being.

With this tension in mind, it is important to note that the preservation or advancement of human well-¬being does not translate into policies geared solely toward our betterment. For one, there are physical limits to our manipulation of nature and potential tipping points that when crossed render nature's services unusable (Lenton et al., 2008; Scheffer et al., 2001). And, given that the preservation of nature's services

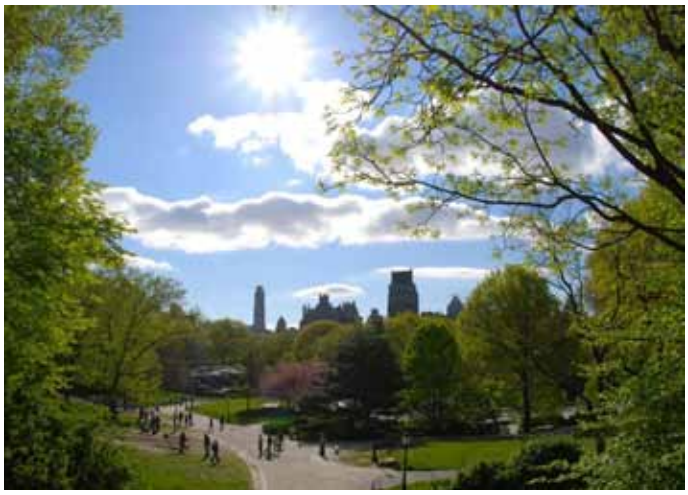
is a necessary condition for our advancement, human well-¬□being cannot progress if we're debilitating our life support functions. Second, my rebranding of 2014-¬2014 requires that the choices of people at the beginning of the decade not undermine the opportunities of those at the end. For example, it says that humans enjoying the benefits of today's nonrenewable energy sources without paying the full costs of their extraction and usage is unsustainable if, all else being equal, future generations will need to pay for the accumulation of associated externalities (e.g. climate change). The indirect costs may be huge due to the aforementioned, and poorly understood, environmental tipping points. In short, human progress in the long-¬term is not possible without some sacrifices in the short-¬term.

I've mentioned twice now this tension between short and long-¬term decisions. Confronting these tradeoffs head on is certainly a key aspect of my vision for the decade. The challenge is that their articulation is inherently difficult since they manifest over long time horizons, are the result of complex socioeconomic interdependencies, and the current policy analysis process does not embrace a long-term view. Thus, to develop a process for participatory, dynamic evaluation of energy policies, I believe we should focus on two crucial areas that are currently lacking: a coordinated sustainable development research agenda and a participatory policy process that embraces dynamic models of energy policy.

There is an emerging literature on sustainable development that is growing rapidly. For example, the Proceedings of the National Academy of Sciences (PNAS) launched a section in their journal dedicated to Sustainability Science in 2006. Still, multi-¬disciplinary collaboration and research in the field remain limited. This is unfortunate given that I have witnessed serious eagerness across graduate student communities to simply roll up their sleeves and work together to devise holistic solutions to sustainability problems6. But at least in the US, advancement in the academy is still very much geared toward publication in disciplinary journals. I believe there is opportunity for the National Science Foundation to be a vessel for change in this regard. For instance, creating a sustainable development track within the graduate student fellowship application would be a start, as would increasing the number of grants available for multi-¬disciplinary collaborations. As mentioned above, an important area for future research lies in development of dynamic models for longer-¬term evaluation of energy policies, where the socioeconomic complexity in outcomes is embraced through multi-¬□disciplinary approaches. While this might be an uphill political battle, it could also be a serious catalyst for breakthrough research.

Let's assume that the research agenda has been sufficiently advanced; now the problem lies in engaging governmental decision makers. The participatory objective of my vision requires that relevant decision makers (i.e. cabinet members, industry leaders, NGOs, public interest groups) engage the dynamic consequences of energy choices made today. This need not be a technical exercise; each decision maker could start by diagramming his or her mental model of the impacts of a policy. This involves having them sketch their projections of key variables over time. For example, if the policy were a carbon tax, each decision maker would start by mapping out the variables affected by the tax (e.g. electricity prices, manufacturing costs, consumer demand, etc.) and then sketch their trajectories over time. The idea here is not to be exact, but just to get a preliminary idea of the dynamics. After doing this in isolation, each would combine their mental models, perhaps with the help of a third party integrator. The objective of this group exercise is to get participants to discover together instances where the policy impacts may become complicated by factors not immediately evident in their individual mental models. These factors might include delays (in implementation or receipt of key information), feedback effects (future impacts may feedback, perhaps with delay, to undermine the initial policy intent) and other unintended consequences. While certainly imperfect, this approach could nonetheless be a first step toward decision makers actively employing dynamic evaluation tools when making energy policy choices.

The Sustainable Decade of Energy for All requires that we better understand the short and long-¬term impacts of energy policy on human well-¬being. I've proposed a research agenda and participatory policy process that attempts to move beyond problem diagnosis to projection of intervention outcomes over time. This dynamic evaluation approach is fundamentally a multi-disciplinary effort, owing to the vast amount of socioeconomic interdependency that complicates analysis of outcomes. The success of this scientific effort, and the ability of researchers to engage policy makers at various bureaucratic levels, will determine whether energy policy in the coming decade is truly sustainable for mankind.



Briefs

The EIA has increased its estimate for US gasoline demand in 2014 to 8.78 million b/d amid speculation that travel by car is gaining momentum. EIA's latest estimate is up 0.5% from its December outlook, but slightly less than the 8.79 million b/d average recorded in 2013. Gasoline pump prices will average $3.46 a gallon, compared to $3.51 in 2012.

Indonesia, the world's fifth-largest LNG exporter, is expected to increase output of the super-cooled fuel by 6% in 2014. Production is likely to reach 306 cargoes in 2013, compared to 318 in the previous year. LNG exports will remain unchanged from last year with 268 cargoes, the nation's energy regulator stated.

Coal use in Germany is on the rise, with energy output from lignite (otherwise known as brown coal) reaching their highest levels since 1990. Bituminous coal and lignite sources represented 45.5% of gross energy output – a 44% increase from the previous year. Germany has plans to build ten hard coal plants over the next two years, as it aims to phase out nuclear energy by 2022.

UK wind energy ended 2013 on a high, generating a record 2.8 million MWh of energy during the month of December. The previous record was set in October 2013, when wind generated 1.9 million MWh of energy – satisfying 8% of the UK's electricity demand. Analysts have suggested that the surge in wind energy was due in part to strong winds that swept through the region during the holiday.

The co-owners of Israel's Leviathan natural gas field have signed a $1.2 billion deal with the Palestine Power Generation Company (PPGC). According to the agreement, PPGC will purchase 4.75 billion bcm of gas over a 20-year period to power its future 200MW power plant in Jenin. Production at the Leviathan reservoir, which is located 130km west of Haifa, is scheduled to begin in 2017.

M&A activity in the global solar market last year increased 60% to $12.7 billion in 81 transactions, according to a report by Mercom Capital Group. Venture capital funding in the solar industry fell 40% globally in 2013 to $600 million from 97 deals, down from the $992 million in 106 deals the previous year. The US accounted for $432 million of the sector's venture capital investments.

Energy investment in Peru is forecast to reach a record $8.1 billion this year as the government aims to increase development and growth. Peru's Private Investment Promotion Agency will tender $7.3 billion worth of private investments in 2014, the country's energy and mines minister stated. Another $800 million will be allocated for rural electrification projects, primarily through solar generation.

China has agreed to provide a $6.5 billion loan to Pakistan to finance the construction of a twin nuclear power stations in the city of Karachi. The 2,200MW facility will increase Pakistan's power generation by 15% and is scheduled to be complete by 2019. Pakistan will repay the loan over a 20-year period through China Exim Bank.

The value of carbon markets worldwide dropped 38% in 2013 to $52.9 billion, according to new analysis by Thomson Reuters Point Carbon. Last year also saw a contraction in carbon trading, with 9.2 billion emission units changing hands compared to 10.7 billion units the previous year. The EU Emissions Trading Scheme, which accounts for 94% of the world's carbon market value, has seen prices fall almost $18 per ton over the past two years.

Greenhouse gas emissions in New York City have decreased 19% since 2005, said former Mayor Michael Bloomberg prior to his departure from office. The recent progress reports means that the city is two-thirds of the way to meeting his goal to reduce emissions 30% by 2030. In 2007, Bloomberg launched PlaNYC 2030 – a comprehensive climate action plan to green the city through various initiatives such as hybrid taxi cabs and building energy efficiency.

A recent study by the Chinese Academy of Sciences (CAS) concludes that motor vehicles are responsible for less than 4% of Beijing's PM2.5, the most harmful air pollutants to human health. Industrial production and coal-burning are the primary culprits of smog in the Chinese capital, the study says. Environmental experts have already challenged the findings, stating that the environmental impact of Beijing's 5.5 million vehicles is far greater than CAS estimates.

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