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Climate Accord Inches Towards Ratification

By formally ratifying the COP21 accord, US, China and India push it towards finish line

At last December's historic **Conference of Parties 21** (COP21) in Paris, every sovereign state on the globe endorsed the idea of cutting **greenhouse gas** (GHG) emissions sufficiently to keep global temperature increases "well below" 2°C. For the agreement to become binding, however, it has to be ratified by 55 countries covering at least 55% of global GHG emissions. So far, 60 countries representing 47.7% of global emissions have ratified it.

A critical step towards reaching the milestone was reached in September 2016 when **China**, which accounts for more than 20% of global emissions, and the **US**, with 17.9%, ratified the treaty. **Russia**, with 7.5% of global GHG emissions is yet to ratify, along with the **European Union** where some members such as **Poland** are dragging their feet. **India**, which is expected to ratify the pact, accounts for 4.1% of emissions. A globally binding treaty is within reach.

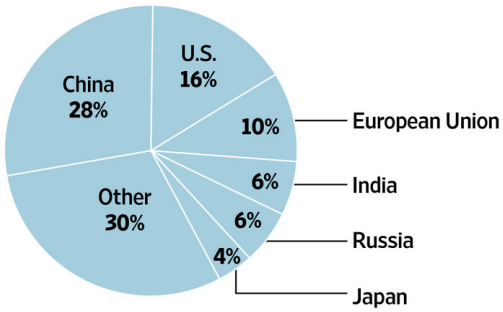
The race to formalize the treaty by the end of the year is critical on multiple dimensions with 2016 likely to be declared the hottest year ever since record keeping began. Moreover, **President Barak Obama** is keen on leaving the COP21 as one of the enduring legacies as he approaches the end of his presidency.

The fate of COP21 and environmental movement in the US is among many hotly contested issues in the November's presidential elections. The two contenders could not be further apart on environmental issues. Without the US participation, the UN treaty will fall apart, as it did with the **Kyoto Protocols** before, which is why the UN is nervously working behind the scenes to make it stick this time.

The more you emit, the more you have to cut

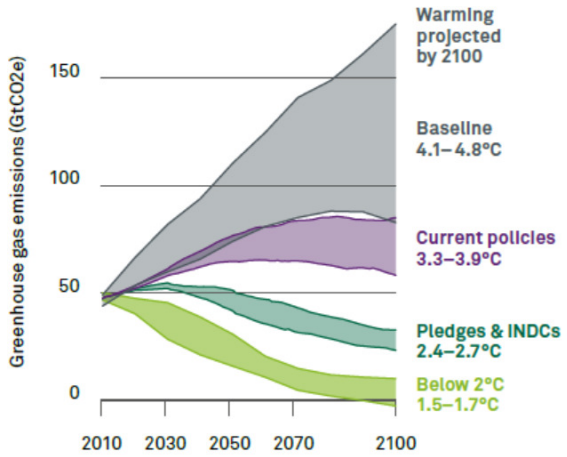
Country Count

Share of global carbon-dioxide emissions from fossil-fuel combustion and some industrial processes



Source: The Wall Street Journal, 14 Sept 2016

Warming paths: Alternative scenarios of global emissions to 2100



Source: Adapting portfolios to climate change, BlackRock, Sept 2016

The **Republican Party Platform** has questioned the *necessity* and the *legality* of the UN-sponsored Paris agreement. Moreover, at least 27 states have taken the **Environmental Protection Agency** (EPA) to court challenging the proposed **Clean Power Plan** (CPP) aimed at reducing CO2 emissions from the US power sector.

The outgoing UN's secretary general **Ban Ki-moon** is optimistic that the agreement will be ratified by the end of 2016 with at least 13 additional countries committed to join the other 60 already on board. Once the agreement goes into effect, the US cannot technically withdraw for at least 4 years, tying the hands of the next US president regardless of the rhetoric. But then in politics, one can never be sure of the outcome.

Clearly, there is a lot at stake in US presidential election in November. ■

Carbon Price No Longer Farfetched

A confluence of factors suggests it may be closer than you think

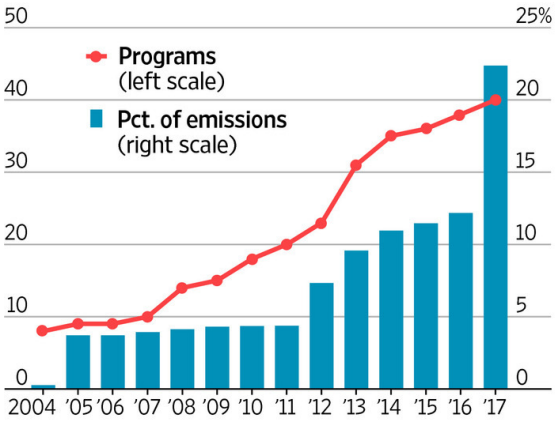
For years, economists have argued that putting a uniform technology-neutral price on carbon offers the best solution if the aim is to cut down carbon emissions over time. The markets will sort it out, cutting the least expensive ones first before moving to the pricier options. That is why most carbon price proponents prefer a slightly rising carbon price. Politically, however, it has been a non-starter. That, however, may be changing.

Amy Myers Jaffe, Ex. Dir. of energy & sustainability at the Univ. of California Davis, describes some of the reasons for the change in the 14 Sept 2016 issue of **The Wall Street Journal**:

> "For years, U.S. politicians have debated whether to impose a price on carbon. The time may finally have come."
>
> "That might seem hard for most people to fathom, given the yearlong, seemingly intractable political deadlock on the issue in the U.S."
>
> "But I believe we've reached a tipping point, where a tax on carbon emissions or some other price for emitting the gas is close to inevitable."

Pricing Power

The number of regional, national and subnational carbon-pricing programs in place world-wide, and the percentage of global greenhouse-gas emissions covered. China's plan to implement a cap-and-trade system next year would raise the share of emissions subject to a pricing program to nearly a quarter of the global total.



Note: Figures are as of Dec. 31 of each year, and figures for 2016 and 2017 are projections. Emissions are given as a share of global greenhouse-gas emissions in 2012; annual changes in GHG emissions aren't shown.

Source: "Carbon Pricing Watch 2016," World Bank and Ecofys

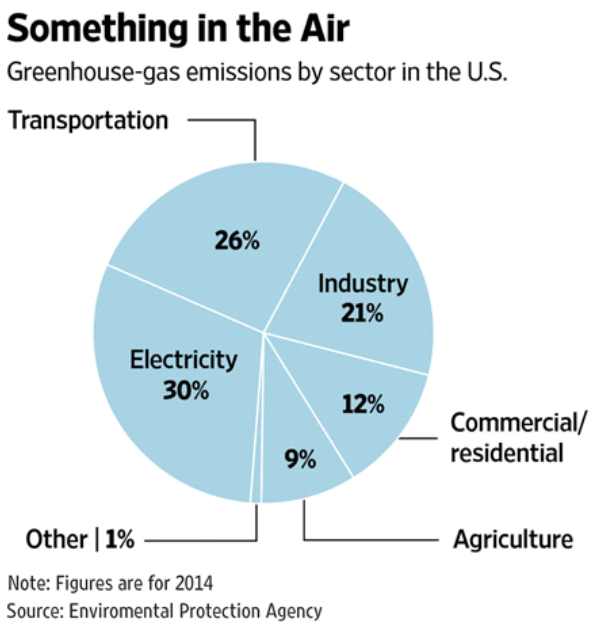
Source: A Price on Carbon May Be Coming Soon to the U.S., Amy Jaffe in 14 Sept 2016 issue of The Wall Street Journal

"What has changed?" she asks, offering the following reasons:

> "For one thing, the economic rationale for a carbon price is stronger than it ever has been. At the same time, technological advances have made it much cheaper to move away from carbon-emitting technologies, making a carbon price less punitive than it would have been in the past. Meanwhile, one of our biggest global rivals, **China**, is about to impose a carbon-pricing plan, meaning that the U.S. may not be at a competitive disadvantage if it institutes a similar program."

Other excerpts from her WSJ article offer additional reasons for why a de facto, opaque and undeclared carbon price may gradually turn into an official and transparent one.

> "But the most important reason is that big market players and the investors who back them are changing their minds on the issue—and they're prepared to use their muscle to try to make a carbon price happen. Companies and investors, after all, thrive on **transparency** and **predictability**, and they fear that the current state of carbon regulations is too convoluted, making planning difficult and exposing them to risk. They see a price on the emission of carbon as a way to resolve that uncertainty and get some clarity once and for all."



Source: A Price on Carbon May Be Coming Soon to the U.S., Amy Jaffe in 14 Sept 2016 issue of The Wall Street Journal

Ms. Jaffe argues – and this editor agrees – that,

"Having a carbon price, in other words, would allow the free market to do its best work."

There is, of course, an army of naysayers, opposing any carbon price or carbon tax any time and not just in the US. Many politicians – we won't mention any names – are not even convinced that we have a carbon problem that needs any solutions. Pointing to such opposition, Jaffe writes:

"Opponents argue that putting a price on carbon is too complex to implement and is bound to be plagued with problems. They point out that **Europe's emissions-trading program** is struggling with a number of issues ……."

Few would disagree that the **European Emission Trading Scheme** has been a fiasco. She adds,

> "Opponents also contend that requiring companies to pay to emit carbon could harm economic growth and that U.S. emissions reductions could prove meaningless if emissions from other countries are still high enough to cause global climate damage. Countries with a carbon price could also be disadvantaged in global trade if other large economies don't follow suit."

Some of these arguments are valid while others are falling apart assuming that the COP21 will be formally ratified and go into effect.

> "For years, this has largely been a theoretical debate, with the politics of imposing a carbon tax too daunting for many countries, including the U.S. ……," Jaffe writes.

Jaffe, like many other observers, believes that a new mindset may be replacing the old in the energy sector as well as other sectors of the global economy.

> "Now, though, there are forces at work that smash old arguments against carbon pricing and make a change much more likely."
>
> "Without a transparent, unified market value on carbon, there is no way to determine or offset the full extent of the risk, or to know when a risk could arise."

Based on her research and interviews with energy industry leaders, Jaffe concludes that,

> "A price on carbon is also likely because there is already a de facto price on carbon and energy companies have already accepted it as part of the cost of doing business—so accepting an official cost isn't a huge leap to make."

On a positive note, she says,

> "Meanwhile, the cost of technology that helps companies comply with those regulations and cut emissions has fallen drastically—and is much less burdensome than critics used to claim."
>
> "But perhaps the most important reason a carbon price is inevitable is that the big players that used to oppose it—such as utilities, oil companies and institutional investors—have started to back it, and more will follow."

The article on **BlackRock** on page 6 is an indication of the willingness of the investment community to accept **carbon price** as a new reality, as do a growing number of investors.

> "What is driving them? A **desire for clarity**. The current ad hoc nature of carbon rules leads to uncertainty. Because there's no coherent single policy, many of the rules conflict with one another and can change at a moment's notice, so projects that seem like good ideas under today's rules may turn out to be losers under tomorrow's. That uncertainty carries a heavy price, as companies risk making disastrous investments and institutional investors hold off making bets on the energy sector."
>
> "The lack of clarity also affects **investors and lenders**. There are signs that they may shy away from certain segments of the energy sector if they can't make informed decisions about where to put their funds ……."

The bottom line?

> "For all these reasons, I believe companies are wasting shareholder dollars suing to prevent or delay carbon policies. They would be better advised to prepare for the carbon-priced future that is already here."

This newsletter has been convinced of the inevitability of the gradual transition away from the over reliance on fossil fuels and their associated carbon emissions for some time. As time goes on, it is reassuring to find that others agree. ■

A Price on Carbon May Be Coming Soon to the U.S.

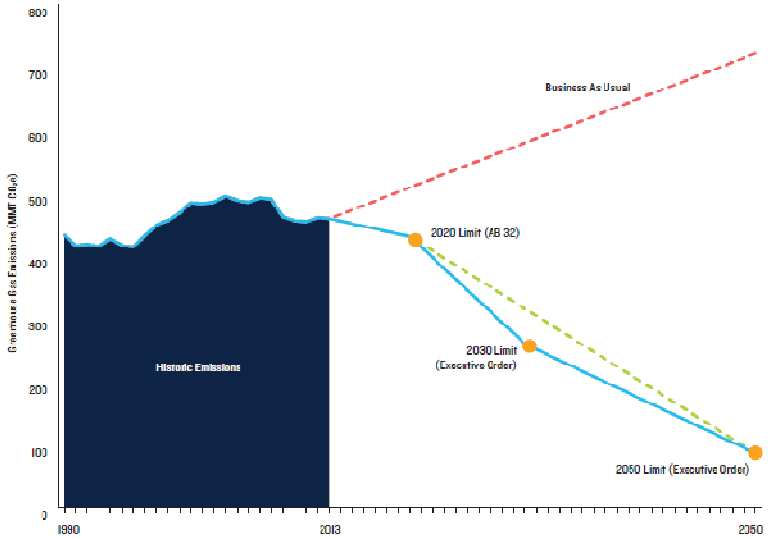
California's Brown Committed To Climate

To implement the law, "It's going to take battle and wisdom"

California's **Assembly Bill 32** (AB32), originally passed in 2006 and signed by then Republican Governor **Arnold Schwarzenegger**, which required statewide **greenhouse gas** (GHG) emissions to be reduced to their 1990 level by 2020, was mute on what happened after 2020. An **Executive Order** by Governor **Jerry Brown** set new targets and dates, but executive orders are not laws, they can be rescinded by following governors or simply ignored.

Millions of EVs will be needed to meet California's climate target

California Greenhouse Gas Emissions Reduction Goals



Source: California's golden energy efficiency opportunity: Ramping up success to save billions and meet climate goals, Natural Resources Defense Council, Aug 2015

Governor Brown, an ardent environmentalist, first challenged the state legislature to beef up the state's **renewable portfolio standards** (RPS) from 33% by 2020 to 50% by 2030, which they did. Next, he wanted to extend the seminal AB32 beyond 2020, which the legislature also did in 2 related bills passed in late August.

At a ceremony on 8 September 2016, the governor signed them into law making him among the greenest of the green governors in the land. **Senate Bill 32** (SB32), the more significant of the 2, requires the **California Air Resources Board** (CARB) to reduce state's GHG emissions 40% below 1990 levels by 2030. After signing the bills, Brown said, "This keeps California on the move to clean up the environment and to encourage vast innovation and environmental resilience."

Governor Brown addressing CAISO Symposium on 7 Sept in Sacramento a day before signing new laws in LA

The passage of SB32, along with **Assembly Bill 197** (AB197), provides clarity and continuity to all stakeholders that California is serious in moving forward on its lonely path towards a low carbon economy. It was not a slam dunk. The bill cleared the lower house 42-29, one vote more than the 41-vote minimum.

Brown, energetic at 75 (left photo), realizes that his passion to continue advancing climate protection faces fierce opposition from the powerful fossil fuel lobby as well as many in the business community who argue that California is unnecessarily leading the way when the US as a nation – and the rest of the world – is doing far less. Mindful of the uphill battles to achieve the newly signed law's mandate, he said, "It's going to take battle and wisdom." Many observers believe it will take more than a few battles and some wisdom. ■

BlackRock Rocks The Investment Boat

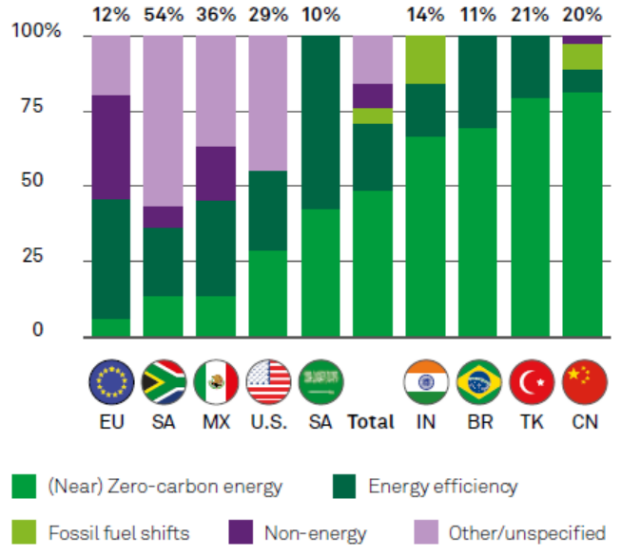
Climate risk is real and can no longer be ignored

BlackRock is not your average investment fund. With $4.9 trillion in assets, it is the biggest private investment fund in the world. Naturally, what it says, and more important, what it *does*, matters. In September 2016, it issued a report that, to put it mildly, may become a turning point in the annals of global investing and risk management. In unequivocal language, it said,

> "Investors can no longer ignore **climate change**. Some may question the science behind it, but all are faced with a swelling tide of climate-related regulations and technological disruption."

To each its own

Pledged emission reductions by 2030 by category



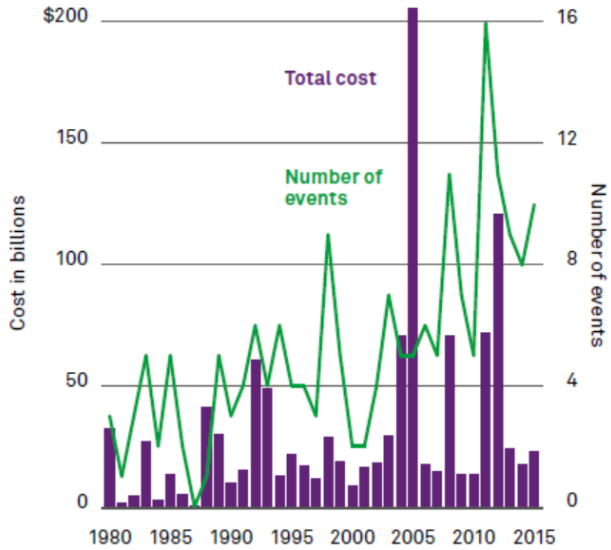
Source: Adapting portfolios to climate change: Implications & strategies for all investors, BlackRock Investment Inst., Sept 2016

Adding,

> "Drawing on the insights of BlackRock's investment professionals, we detail how investors can mitigate climate risks, exploit opportunities or have a positive impact. Climate-aware investing is possible without compromising on traditional goals of maximizing investment returns, we conclude. We then reflect on steps that stakeholders in the climate debate are considering, including the use of **carbon pricing** as a cost-effective way to reduce emissions."

Costly weather

U.S. billion-dollar disaster events, 1980-2015



Source: Adapting portfolios to climate change BlackRock., Sept 2016

The bottom line?

"Our overall conclusion: We believe **all investors should incorporate climate change awareness into their investment processes**."

You might say BlackRock does not mince words.

Moving forward, BlackRock said it will specifically include climate change as tangible factor in how it assigns risks to its investment portfolio. This, indeed, is a big deal and a tipping point.

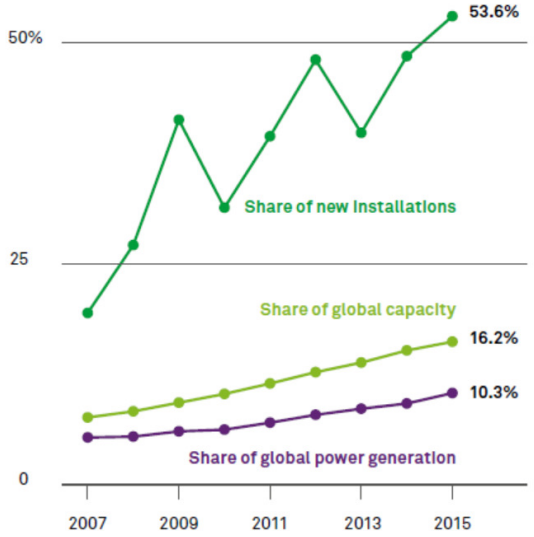
Investors and insurers are beginning to experience the impact of a warming climate, for example, in the frequency and severity of climate-related storms (on left).

As part of its new climate risk policy BlackRock will henceforth "calculate greenhouse gas emissions as a % of a company's sales, estimate firms' exposures to income shocks from rising temperatures and calculate the sales a company generates with little physical waste."

This means that for all its investments BlackRock will consider to what extent any enterprise is exposed to climate risks, whether it is climate-proof, or if it may gain from climate change. The implications should be obvious to anyone in the energy sector, in fact, all sectors of the economy since energy is a major input to nearly anything that is extracted, transformed, manufactured, transported, or consumed.

Rise of renewables

Renewable power generation and capacity share, 2007-2015



Source: Adapting portfolios to climate change BlackRock., Sept 2016

Assigning a price to carbon, already a reality for companies with long-term investment exposure, is likely to apply to virtually all. And regardless of whether the company applies a price or not, the investment community – such as BlackRock – is likely to do so.

Climate change rulebook

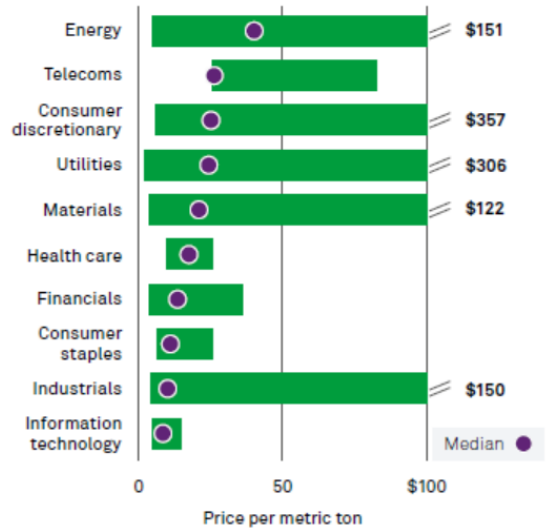
Rules used to make an insurer's corporate bond portfolio climate friendly, July 2016

Exclusions	Rule	Reasoning
Fossil fuel reserves	Companies reporting fossil fuel reserves as assets — unless 25% or more of their revenues are from renewables.	Reduces risks from the transition to a less carbon-intensive world and from stranded assets.
Carbon emissions intensity	Energy, materials, utilities and industrial companies with a carbon intensity greater than their subsector's average.	Screens out the worst performers in four sectors that account for the majority of CO_2 emissions.
Coal revenue or generation	Companies that receive 30% of revenue from extracting coal or using it for power generation.	Companies relying on coal face high regulatory, technological and energy transition risks.
Water withdrawal intensity	The top 50% most water-intensive companies in the metals and mining, beverage and utility sectors.	Companies that use the most water are most exposed to scarcity and regulatory risks.
Toxic emissions	The bottom 50% of companies that have toxic emissions as an environmental key performance indicator.	Reduces toxic emissions to limit damage to the environment and air pollution.
Forestry commitments	Companies failing to address deforestation risks in their supply chains, including retailers and food producers.	Deforestation and forest degradation contribute to 10%-20% of global CO_2 emissions.
Additions	**Rule**	**Reasoning**
Green bonds	Green bonds with similar maturity and risk profiles. They can be of excluded companies as proceeds are ring-fenced.	Uses debt capital markets to finance projects that have a positive impact on the environment.
Clean tech or green companies	Companies deriving 50%-100% of revenues from clean technologies such as renewables and energy efficiency.	Increases exposure to climate change solutions and sustainability initiatives.

Source: Adapting portfolios to climate change BlackRock., Sept 2016

Today, there is no consensus on what the carbon price is, leaving individual companies to assume prices over a wide range (graph on carbon price on page 8). As time goes on, perhaps more clarity will emerge as to what the appropriate price may be, as Ms. Jaffe suggests (article on page 2). These are among a number of compelling reasons for the investment community to seek further clarity and consistency in how exposure to carbon and climate change are factored in.

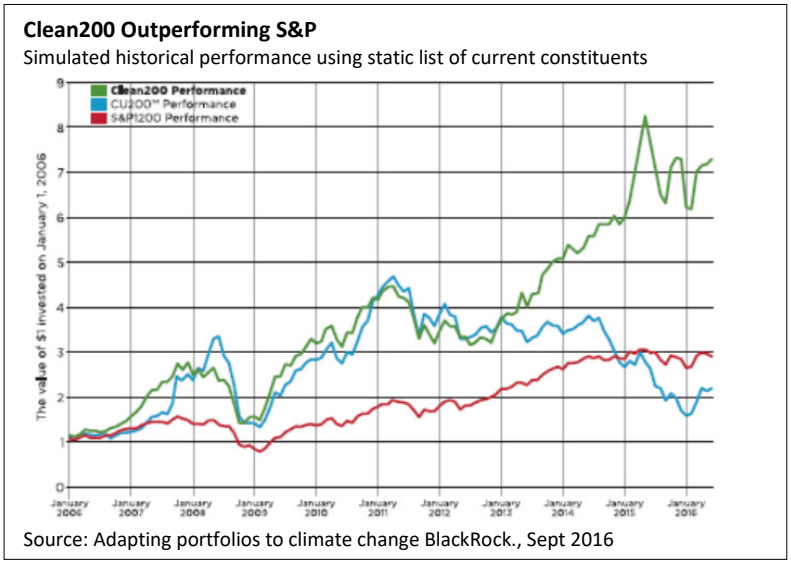
In places where **cap-and-trade** or carbon trading schemes are already in place, such clarity will emerge sooner than in other places.



Source: Adapting portfolios to climate change BlackRock., Sept 2016

BlackRock, of course, is not the least interested to scare away investors. On the contrary, it has decided that the time to sit on the fence and merely talk about climate risk has come to and end. Investors crave *clarity, security* and *transparency* above all. And if major funds such as BlackRock can offer these, they will find a receptive audience as the science and the art of assigning risks to various industries and enterprises evolves overtime.

Already, a number of organizations are beginning to offer ratings of companies based on their environmental record or carbon exposure. One such example is the **Carbon Clean 200** list prepared by **Corporate Knights** and **As You Sow**. They claim that green and clean companies have in fact outperformed the broader market over the past decade (visual below). If that is indeed the case, it would encourage more investors, and managed investment funds, to migrate to cleaner companies with less risk exposure to climate change, diverting capital and financing from dirty, polluting companies.



Source: Adapting portfolios to climate change BlackRock., Sept 2016

The study released in mid-August 2016, claims,

"You probably know that aligning your investments with your values can be both personally and financially rewarding. But did you know that certain clean energy investments have yielded over 19.4% annualized returns? Building a clean energy future while reaping financial gains is possible with the *Carbon Clean 200*."

The **Clean200** ranks the largest publicly listed companies by their total clean energy revenues. There are many others providing similar information. It says,

> "If you are divesting from fossil fuels for portfolio risk reduction or for moral reasons, the Clean200 can be a guide along the path of clean reinvestment."

The pressure on carbon-intensive businesses has only begun and it will intensify over time. Ignoring the carbon/climate risks is no longer optional. ■

BlackRock
Clean 200

UK Approves Hinkley Point

EDF can proceed on controversial nuclear project with Chinese investors

After years of deliberations, modifications, negotiations, postponements, and consultations on both side of the channel, EDF's board approved the controversial **Hinkley Point C nuclear project** in July 2016, only to be surprised by UK's new Prime Minister **Theresa May** that it needed more time to review the deal. In mid-September, the UK government announced its approval, to the delight of EDF and its Chinese investors.

The Hinkley Point C nuclear project, among the most expensive global investment projects in the electric power sector, consist of two 1,630 MW **Areva European Pressurized Reactors** (EPR) with an estimated cost of £18bn (€21.5bn, US$24 bn) is scheduled to start construction in 2019 with an operating date in 2025 at the earliest – neither the schedule nor the budget is guaranteed by the experience of the 2 other EPRs under construction in Finland and France.

Prior UK governments have been supportive of the project, the first new one in 2 decades, offering, among other incentives, a £2bn (€2.4bn) **loan guarantee** in September 2015. Making the project virtually risk-proof, UK has also offered to pay a fixed price of £92.5/MWh ($120/MWh) for the output of the plant, escalated over 35 years.

Be careful what you wish for
One more item on "to-do-list" for Jean-Bernard Levy, EDF's CEO

This, the project's critics contend, is far above current wholesale prices in the market and significantly above virtually risk-free alternatives available. ***The Economist***, once a supporter, referred to it as *Hinkley Pointless*. Others say the fixed price provision signals the end of UK's liberalized electricity market. Oh well.

As currently structured, EDF will own 66.5%, with the balance coming from **China General Nuclear Power Corporation** (CGNPC) and **China National Nuclear Corporation** (CNNC); all 3 are government owned and/or government controlled.

In giving its final consent, the UK's new government included several provisions to prevent the sale of EDF's controlling stake prior to the completion of construction and to intervene in any transactions after the project becomes operational. Given the size of the project and its sources of finance, the project has important foreign policy and financial implications.

Governments on both side of the English Channel have decided to preserve the nuclear option, with Chinese backing – with each party having is own reasons. Whether the British customers or French or Chinese taxpayers benefit from the agreement remains to be seen. As the article on TVA on page 24 illustrates, complex nuclear projects have had a rather mixed history. No reason to believe that this one will be any different.

For EDF, it is a classic case of you may get what you wished for. It will be a complex project to accomplish on time and on budget. It will remain on top of the CEO's "to-do-list" for some time.■

Germany's RWE And E.ON Splitting – Will They Prosper?

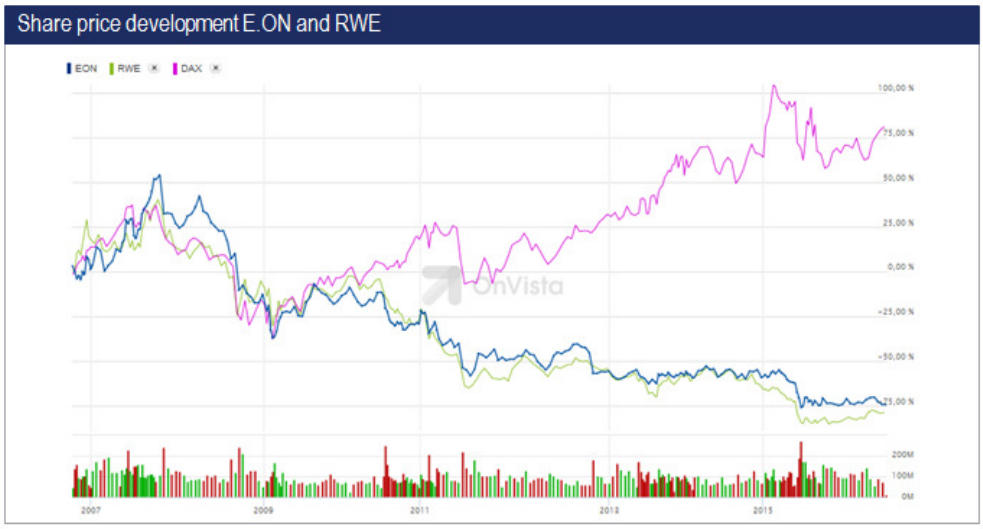
Model to follow or fate to avoid?

This is a guest article by **Christoph Burger** and **Jens Weinmann** at the **European School of Management & Technology** (ESMT) in Berlin, reproduced with minor editing.

With the rise of decentralized energy, German energy utilities have come under financial stress. Wholesale market prices have dropped below €30/MWh ($34/MWh). Solar and wind power are increasingly depressing peak prices. Many conventional power plants have been shut down, because each MWh they produce incurs losses.

While many municipal utilities that own generation also have to cope with the decline in prices, the two leading German power generators **E.ON** and **RWE** have been hit the hardest, exacerbated by the 2022 **nuclear phase-out** that deprives them from significant revenue streams while saddling them with **decommissioning costs**. The chart below shows the fate of the 2 German utilities with their share prices diverging from the **DAX index**.

E.ON and RWE have not done well



Source: OnVista (2016)

The two differ in terms of their generation portfolio: **E.ON** has a higher share of nuclear assets, whereas **RWE** has a higher share in lignite fired power plants – both considered liabilities. Also, RWE, with local municipalities as its main shareholders, has a more regional focus compared to E.ON, which owns major subsidiaries in Sweden, Russia, Eastern Europe, and wind power operations in North America.

Under immense pressure, both utilities have launched initiatives to adapt to the new market conditions. RWE has announced a Hi-Tech strategy which includes the construction of the world's longest super-conducting transmission line, investing in an efficient distribution network and a startup that develops a Blockchain-based charging and billing system for electric mobility. Both companies have established a presence in the **Silicon Valley**, engaging in venture-capital investing and strategic partnerships with promising start-ups, including, for example, E.On's alliance with **Sungevity**, the fifth-largest US rooftop solar company by market share.

Thus far, however, these efforts have not affected their share prices, forcing both companies to split.

E.ON was first to announce that it will split into 2 in April 2014 with E.ON focusing on renewables, distribution and customer solutions, while a new company called **Uniper** will focus on upstream activities, global commodities and conventional power generation. Many analysts suspected that E.ON was shifting its "underperforming" assets, including the nuclear fleet with a substantial financial

decommissioning risk, into the equivalent of a "toxic bank.' However, the top management by and large succeeded in conveying the message that Uniper has "the right assets, knowledge, and skills to succeed in the classic energy world," further described in https://www.uniper.energy/en/we-are-uniper/our-profile.html.

On September 12, 2016, **Uniper** went public with 46.65% of the shares still being held by E.ON. As the chart below shows, E.ON's share price fell – the market perceived the liabilities associated with the nuclear assets and the uncertainties associated with the new business model. By contrast, the share price of Uniper rose – potentially in the hope that the new company might serve as a target for consolidation or international expansion, be it triggered by French, Chinese or Arab investors.

It is tough to be at the top
Peter Terium, CEO of RWE with the newsletter editor at Eurelectric conference in Vilnius, Lithuania in early June 016

Likewise, in November 2015 RWE announced its own split. In this case, the new company named **Innogy** will be largely controlled by RWE with 90% of the shares.

The question for investors is will the new companies be able to prosper given the challenges of the rapidly transforming energy markets?

The conventional power generation fleet of both utilities is still the backbone of Germany's electricity supply. But the rapid rise of renewables will continue to erode their profitability while developments on the customer side of business will continue to erode demand. Self-organizing microgrids, industrial and commercial demand response schemes, incremental advances in building efficiency and autonomous residential supply will characterize tomorrow's energy markets.

E.ON's share price falls while Uniper's rises following the split

Future possibilities include **peer-to-peer (P2P) trading** by consumers/prosumers using the distribution network to exchange energy. **Load aggregators** and **virtual power plants** (VPPs) are also emerging, competing with traditional power plants while offering flexibility to the grid operators.

The fundamental paradox of the transformation of electricity markets is that traditional utilities are suffering, while new entrants including opportunistic startups identify and develop profitable niches in

downstream segments with clever digital business models.

If the newly established spin-offs of E.ON and RWE are able to reinvent themselves in time, they may survive and possibly thrive. But as traditional companies like **IBM, Microsoft, Dell, HP, Nintendo** or **Western Union** have shown – successful transition of the old into the new in the fast moving digital age cannot be taken for granted.

Thus far, the US utility incumbents have been largely shielded from competition by the regulatory compact that allows them to adjust their retail prices to remain viable – a luxury not available to E.ON and RWE. But for how much longer, is the big question.■

Supercapacitors To Make Batteries Obsolete

A new generation of batteries likely to make existing ones obsolete

Transportation is the biggest consumer of oil and the biggest source of pollution, greenhouse gases, soot and fine particles, in case of diesel, not to mention noise and road congestion. All bad, except the mobility, range and flexibility offered by the **internal combustion engine** (ICE). Gasoline and diesel have been the fuel that fuels the global transport and the lifeblood of international oil majors and national oil companies. That, however, may be changing.

Oil's power density and affordable price has made alternatives non-starters, pushed many mass transit systems to bankruptcy, while making auto, tire, road construction and insurance companies rich.

Then came **Tesla**, (on right) for the first time offering a slick high performance car with reasonable range – depending on your definition. Currently too expensive for the mass market, Tesla has nevertheless challenged the ICE industry, forcing virtually all automakers to get into electric vehicles.

With a $5 billion gigafactory just completed in July 2016 near Reno, Nevada, Tesla is promising to move mainstream, offering more affordable cars with decent range. That is all wonderful. But Tesla and all other electric and hybrid cars still suffer from lack of charging infrastructure, and even when that is in place, drivers must take long breaks on long drives to recharge their batteries. Depending on the details, 90 minutes or more are typically needed to more-or-less recharge an empty battery, an annoying wait compared to a 5-minute fill up at the corner gas station.

Moreover, even with Tesla's slick design, the batteries are heavy and can only be charged/discharged so many times, after which their performance drops. Who needs to carry all that deadweight around?

Trucks and heavy-duty vehicles pose even more difficult challenges unless they are recharged frequently – not always convenient or practical. Batteries, in other words, are not a perfect substitute for cheap gasoline available nearly everywhere you go – that must delight oil company executives.

What would be ideal is a *light*, *inexpensive* battery that can pack *large* amounts of energy in *small* space, can be charged more or less *instantly*, and discharged more or less *indefinitely* without loss of performance. That would be the *holy grail* of storage, not only challenging the ICEs but also make Tesla's gigafactory virtually obsolete before it starts mass production.

Unreal, you might say? Apparently not. A new generation of **supercapacitors** made from cheap and plentiful material – now in laboratories – are expected to become commercial in 3-5 years, according to UCLA Professor **Richard Kaner** (photo below) who vouched for their miraculous properties and superior performance at **ECM6** conference in **Inverness, Scotland** in mid-August 2016 attended by this newsletter's editor.

The company he is affiliated with, **Nanotech Energy**, is using **graphene** as the basic medium for storing energy. Kaner expects the technology to move from laboratory scale to market in 3-5 years, initially in high value applications such as mobile phones and computers, followed by other applications such as EVs and **electric buses** (photo above).

The ability to fast charge a supercapacitor, say in 2 minutes or so, will solve the range anxiety associated with current EVs. Imagine pulling into an electric charging station and getting more or less fully recharged in the amount of time it takes to fill up your tank with petrol. Who needs clunky, noisy, polluting cars, or even Tesla batteries?

The same fast charging supercapacitors can power **mass transit buses** in cities around the world. If the bus's supercapacitor can be charged in 2 minutes or less, then every bus stop can be a charging station, allowing the bus to travel long distances without ever running out of juice. That would be a game changer.

Another game changer among many?
UCLA Professor Richard Kaner vouches for superior properties of supercapacitors, soon to enter mass market

Source: www.chem.ucla.edu/dept/Faculty/kaner/images

Tesla, which is facing many daunting deadlines and competition from multiple directions, may find that its gigafactory is, in fact, obsolete if supercapacitors come to deliver as some of their proponents claim. And that would be yet another game changer. ■

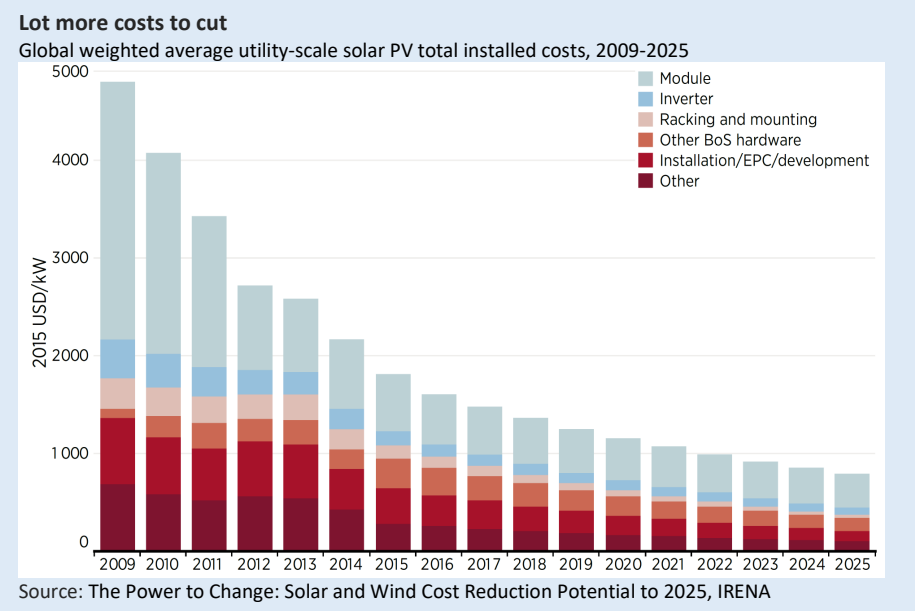
Nanotech Energy

US Renewable Share On The Rise

From nil in 2000, renewables have grown, with more to come

Starting from a small base, renewables have been on a steady rise in the US, gaining momentum in recent years. According to the US **Energy Information Administration's** (EIA) August 2016 "**Electric Power Monthly**," renewable generation – including hydro – accounted for 16.9% of US electricity generation for the first half of 2016 compared to 13.7% for all of 2015. Non-hydro renewable energy was 9.2% through the first half of 2016 compared to 7.6% for all of 2015.

Among non-hydro renewables, **wind** generation rose 23.5% and set a new six-month record of nearly 6% of total generation vs. 4.7% for 2015. **Solar** generation grew by 30.3%, nearly 0.9% of total. **Distributed solar** expanded by 34.3%. Combined, utility-scale and distributed solar now account for 1.26% of US generation compared to 0.94% in 2015.



US coal generation, by contrast, declined 20.1% while natural gas was up by 7.7%.

Despite its own figures, EIA's earlier growth forecast for all of 2016 was 9.5%. Call it institutional inertia or what you wish, but virtually everyone predicting the growth of renewables is *consistently* and *repeatedly* missing the mark.

What is happening, of course, is a confluence of factors. Subsidies, tax credits, R&D funding, and mandatory **renewable portfolio standards** (RPS) all play a part as do falling costs and improved performance of renewables. Climate concerns will only make renewables even more attractive over time. Experts believe 2017 could see non-hydro renewable energy rise to well over 10% of US generation.

To put things in perspective, in 2010, non-hydro renewable energy was just 4.2% of US generation, most experts believe it will at least triple by 2020.

Part of the explanation for the rapid growth is that US electric consumption has been virtually flat since its peak in 2007; it is down 2.5% this year compared with the first half of 2015. No significant growth is projected for the rest of the decade even with the projected growth of EVs.

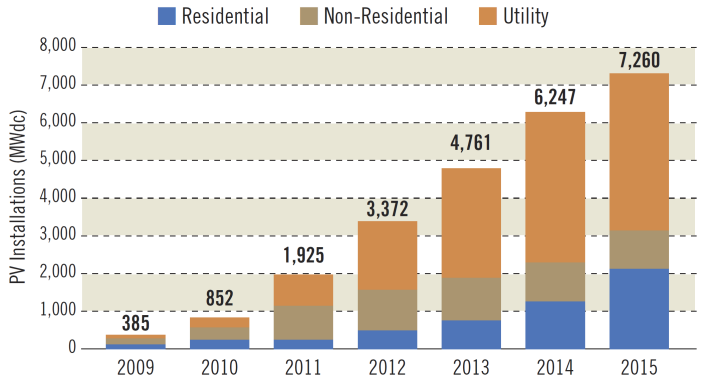
While renewables are on the rise in all 50 states, the capacity base, generation and growth varies tremendously from state to state.

For wind **Texas, Oklahoma, Kansas, Iowa**, and **Colorado** are expected to have the biggest growth in generation while solar growth is strongest in **California, North Carolina, Nevada, Arizona**, and **Georgia**.

Renewables already play a significant role in states such as **Iowa**, where wind generation is expected to exceed coal as early as 2017. **California** is already getting nearly 30% of its generation from non-hydro renewable energy, due to increase to 50% by 2030, same as **New York**. **Hawaii** is targeting a 100% renewable future by 2045. **Texas**, already with 19 GW of wind, is expected to add that much solar over the next 5 years (following article).

More solar PVs to come

U.S. Solar Photovoltaic (PV) installations – 2009-2015



Source: Benchmarking Utility Clean Energy Deployment: 2016, Ceres, June 2016

For a large economy the size of the US, this is a stunning feat. Setting aside hydro, wind and solar were virtually non-existent as late as 2000, compromising roughly 0.2% of US generation, mostly concentrated in California. Wind energy generation doubled between 2010 and 2015 while solar increased by more than 20 times over the same period. By the end of 2017 solar energy will likely double 2015 generation. ■

Renewables: Texas's New Energy Gusher

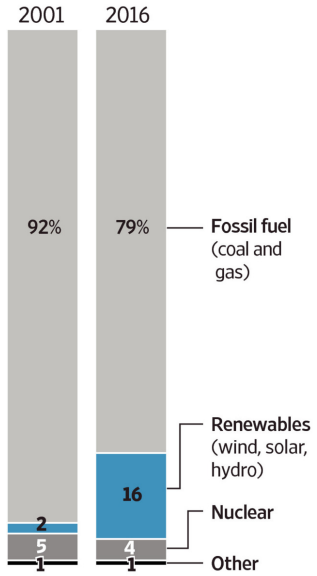
The Lone Star state has more wind than anywhere else in the US, more solar likely to follow

Mention **Texas** and most people think of oil, cowboys and barbecue. While all that may still be found in the **Lone Star state**, Texas has by far the biggest installed wind capacity of any state in the US by a wide margin, and if all goes as planned, soon will have more solar capacity than most. More surprising is that as a *red state* with strong Republican, conservative leanings, none of this can be attributed to political or ideological reasons. Texas, in other words, is no California, yet it is getting greener by the day.

As described in an article in **The Wall Street Journal** (29 Aug 2016), Texas has over 19 GW of wind, roughly 16% of its installed capacity. While its power sector energy mix is not nearly as low-carbon as California, it is certainly moving in that direction (graph on right).

Rising Renewables

Texas's energy sources



Source: Which State Is a Big Renewable Energy Pioneer? Texas, Bill Spindle and Rebecca Smith, The Wall Street Journal 29 Aug 2016

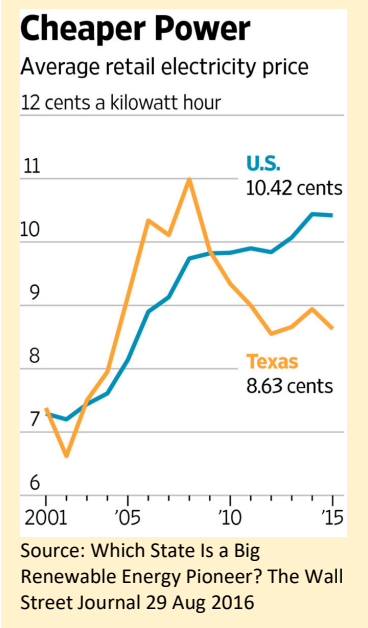
Moreover, Texas enjoys relatively low electricity prices, below national average (graph next page). While retail prices have been on the rise over time across the US, Texas has seen a *drop* in its prices, partly due to the abundance of low cost wind and a fiercely competitive retail market.

As reported in the same article, "Residents of Houston currently can pick from 107 different rate plans offering 5% to 100% renewable power. In general, they are willing to pay a bit more to go green. Top-rated **Reliant**, a unit of **NRG Energy Inc**., charges 7.1 cents/kWh for the plan that's all renewable versus 5.9 for one that's 5% green."

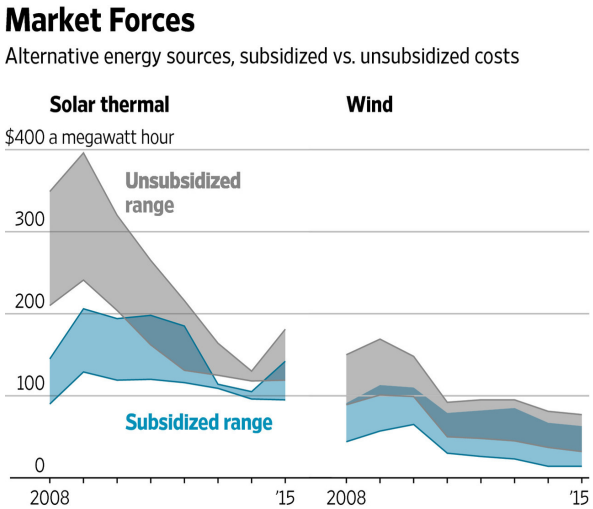
Next, according to the WSJ article is an explosion of solar, perhaps as much as 19 GW over the next 5 years from 500 MW today. The falling

cost of wind and solar (graph below), the extension of the federal solar **investment tax credit** (ITC) and the states' excellent solar resource are among the reasons mentioned. "The cost has come down to the point where people can really see the value," said **Cris Eugster**, the chief operating officer for San Antonio's utility, **CPS Energy**.

According to the **Solar Energy Industries Association** (SEIA), a pro-solar trade and lobbying organization, Texas could move from its current 10th place among the US states in solar capacity to second in the next 5 years, making it the second biggest after California.



Source: Which State Is a Big Renewable Energy Pioneer? The Wall Street Journal 29 Aug 2016



Source: Which State Is a Big Renewable Energy Pioneer? The Wall Street Journal 29 Aug 2016

Red or blue, wind is already a big job creator and a source of income for Texas farmers and ranchers who get paid for wind turbines installed on their property. The state now has more than 100,000 people working in renewable energy. At a time when many oil companies are laying off workers due to the depressed price of oil and gas, renewables are seen as a welcome substitute, and a sector with steady growth prospects.

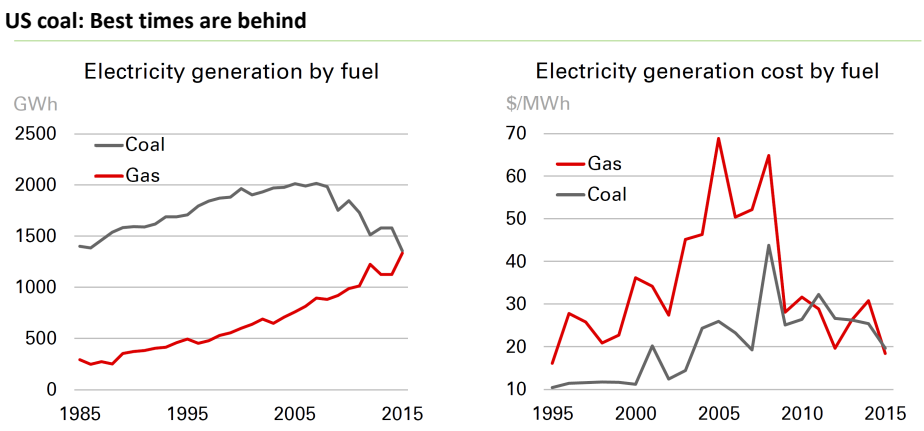
Next time someone mentions Texas, think of wind turbines and solar farms. ■

Wall Street Journal Article

Natural Gas Bridge To Nowhere?

Natural gas emissions from natural gas to exceed that of coal in US

For some time, natural gas was viewed as a **bridge fuel** to a low carbon future. Since it spews half as much carbon per kWh of electricity generated as coal, many saw it as a perfect substitute for coal. And since the stuff is currently plentiful and cheap in the US, that was how the fuel was marketed. Get out of coal and into natural gas and you can cut your emissions in half. And



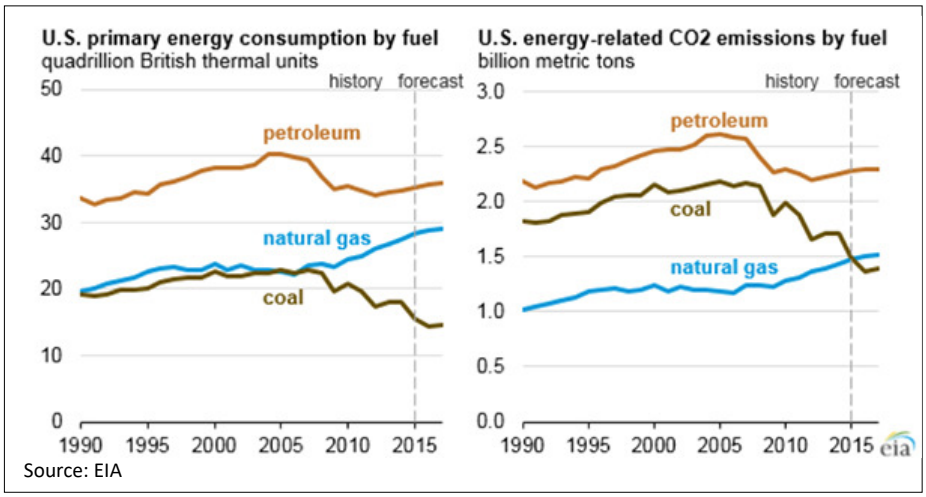
Source: Spencer Dale, Energy in 2015: A year of plenty, BP, 8 June 2016 and BP's Statistical Review of World Energy 2016 edition, BP June 2016

it won't cost you an arm and a leg, as the saying goes. Bingo.

That, you might say, is what has been taking place in the US for a good part of the past decade, with coal's share of electricity generation falling, substituted by natural gas, and increasingly non-carbon renewables (graphs on page 16).

The problem with this scenario is that natural gas, while significantly cleaner than coal, is *not* carbon-free. Hence, if you substitute a lot of natural gas for coal, the emissions eventually catches up with you. And – surprise – that is what is about to happen in the US.

According to projections by the **Energy Information Administration** (EIA), by the end of 2016, energy-related carbon dioxide (CO2) emissions from natural gas could surpass emissions from coal in the US for the first time in history (graph below on right).



Source: EIA

The EIA's latest ***Short-Term Energy Outlook*** released in Aug 2016 notes that consumption of natural gas in the US between 1990 and 2005 was about the same when measured in BTU terms (left graph), while coal emissions were higher (right graph).

The EIA notes, "The consumption of natural gas results in about 52 million metric tons of CO2 for every quadrillion British thermal units (MMmtCO2/quad Btu), while coal's carbon intensity is about 95 MMmtCO2/quad Btu, or about 82% higher than natural gas's carbon intensity."

"Because coal has a higher carbon intensity, even in a year when consumption of coal and natural gas were nearly equal, such as 2005, energy-related CO2 emissions from coal were about 84% higher than those from natural gas."

But in 2015, consumption of natural gas was 81% higher than coal consumption. Their energy-related CO2 emissions were nearly alike, both releasing about 1.5 billion metric tons.

This year, energy-related CO2 emissions from natural gas will be 10% greater than those from coal. It was bound to happen, and it has.

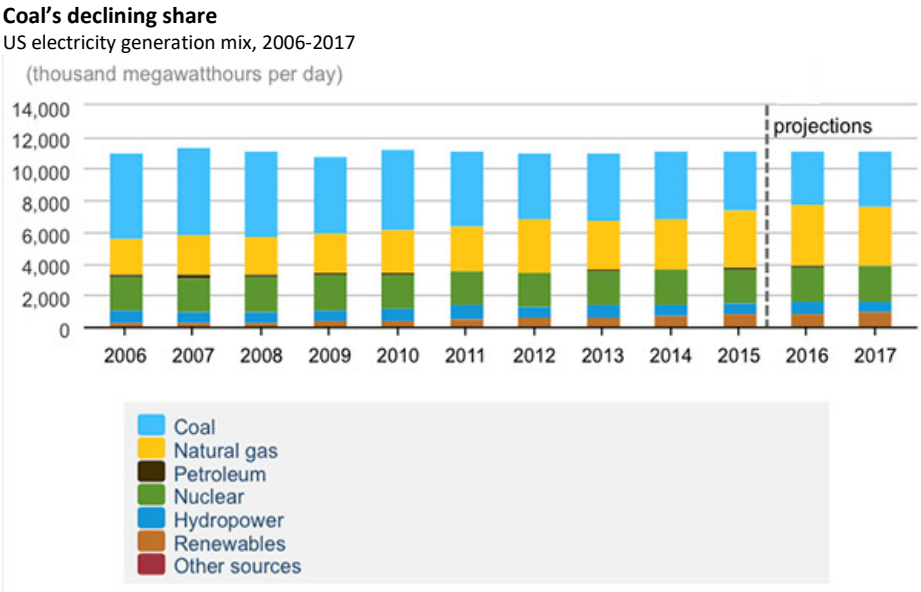
As previously observed in this newsletter, clearly, natural gas should now be viewed as a **bridge to nowhere**. Burning natural gas, all else being equal, is better than burning coal, but it does not address the fundamental issue, which is an ultimate transition away from fossil fuels and their associated carbon emissions.

For some time, this editor has pointed out that switching from coal to natural gas would be similar to a heavy smoker cutting from two packs per day to one. It is a step in the right direction but it would be much better to quit smoking altogether.

According to the EIA, US natural gas electricity generation reached a record 4.95 GWh per day in July

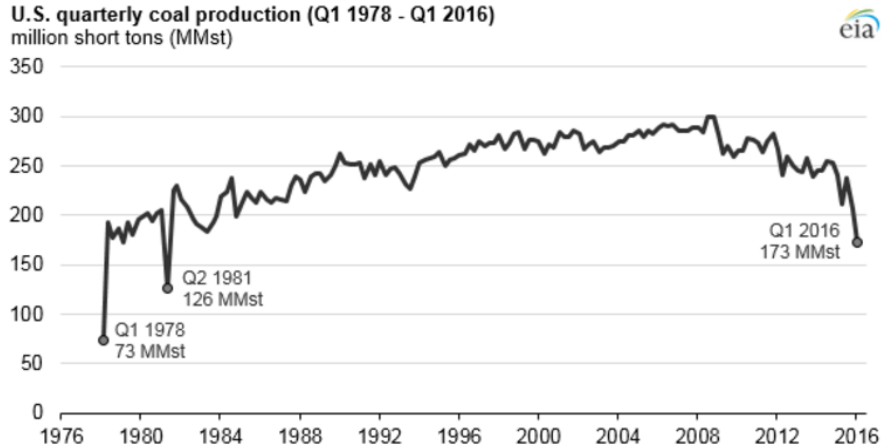
2016, nearly 9% higher than a previous record set in July 2015.

For all of 2016, natural gas is expected to supply 34.3% of US power generation; 30.3% for coal; 19.4% for nuclear and 14.8% for renewables, including hydro.



The issue of emissions aside, coal's prospects in the US do not look promising. In a blog posted on 22 Aug 2016, **Lucas Davis** of University of California at Berkeley noted that 2016 will go down as "the worst year in decades for US coal" with production in the first 6 months of 2016 down "…a staggering 28% compared to 2015, and down 33% compared to 2014." (graph below). Lukas says, "This is a remarkable decline. From its peak in 2008, U.S. coal production has declined by 500 million tons per year."

The silver lining, of course, is that less coal mining and combustion means less carbon emissions. Lukas points out that "… more than 90% of U.S. coal is used in electricity generation," which explains why US CO2 emissions are down 12% from 2005 as are other forms of pollution attributed to coal.



Source: King Coal is dethroned in the US and that is good news for the environment, David Lukas, Blog posted on 22 Aug 2016

Lukas notes that, "The global outlook for coal is more mixed. **India**, for example, has doubled coal consumption since 2005 and now exceeds US consumption," adding, "In middle-income countries, however, there are signs that coal consumption may be slowing down." In case of **China**, as previously reported in this newsletter, consumption appears to have already peaked – "an astonishing development, as China represents 50% of global coal consumption." ■

King Coal

What's Next? Zero Net Energy Buildings

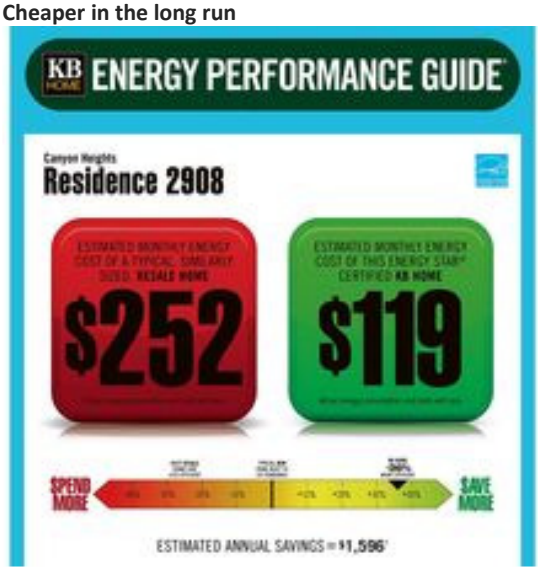
California dreaming again?

When policy makers at the **California Energy Commission** (CEC) announced that all *new* residential buildings in the state have to be **zero net energy** (ZNE) starting in 2020; and commercial buildings in 2030, many homebuilders scoffed, expecting the rules to be delayed, modified or scrapped. Zero net energy? you've got to be kidding. By 2020? No way. Affordable? Out of the question. Now with 2020 only 4 years away, some – but not all – homebuilders are embracing the ZNE home as an effective marketing feature and a way to distinguish themselves from the rest of the crowd.

The rough definition of ZNE is that, over the course of a year, the building consume no more energy than it generates from on-site sources such as rooftop solar panels. Sharing among neighboring buildings or a community of buildings is allowed, making it easier to meet the ZNE target. To make this happen, however, houses have to be ultra tight, use highly efficient appliances and lighting, and have some form of self-generation – most likely solar panels, which work well in sunny California, and possibly some form of storage or load shifting.

Writing in the 14 Sept 2016 issue of **The Wall Street Journal**, **Gabriel Khan** notes the success of one homebuilder, **KB home**. Referring to ZNE homes built in Santa Clarita in Southern California, **Jacob Atalla**, KB Home's vice president for sustainability is quoted saying, "We've turned the home into an airtight fortress." But that is not all. According to the WSJ article, "All of the nearly 2,300 houses the company built in California last year were equipped with similar energy-saving features. Some had even more. The company *presold all of them*, at premiums of 1.5% to 3.8% above the price of similar homes without those features."

Cheaper in the long run



Source: The Quest for Home Utility Bills of…Zero, by Gabriel Khan, The Wall Street Journal 14 Set 2016

The experience of KB Home, at least, suggests that those who claim that ZNE homes couldn't be built, wouldn't be affordable, and cannot be sold, are wrong.

One reason for the appeal of ZNE homes is that they use far less electricity for cooling and natural gas for heating. The savings, accumulated over the long life of typical homes, will more than offset the extra initial cost, as described in the article:

"The sticker (on left) displays the average monthly cost to heat and cool the home and run the appliances: $119, compared with $252 for a standard-built home of similar size. If an owner adds solar panels, the monthly bill would drop to near zero."

"Buried inside the extra-thick walls of these homes are layers of high-density fiberglass insulation flanked by rigid foam boards taped together at the seams to forge a thermal barrier. Every crevice, duct and electrical outlet is coated with a special sealant to prevent leakage."

With 2020 deadline not far off, the CEC is finalizing the rules and the definition of ZNE, insisting that it is sticking to its timetable. In the WSJ article, CEC commissioner **Andrew McAllister** is quoted saying, "We are sending a market signal (to the homebuilders), and we've been sending it since the mid-2000s," adding, "Not that they don't grumble about it."

Fancy better windows?
Transparent PV windows made by Solaria undergoing testing at FLEXLAB at Lawrence Berkeley National Laboratory can turn not just the roofs but windows into sources of energy

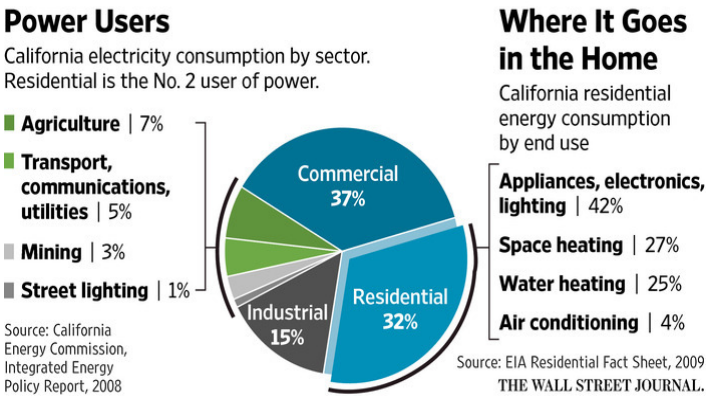
To meet its ambitious climate goals (article on page 5), California will have to fire on multiple cylinders, as the saying goes. The goal is to cut statewide **greenhouse-gas emissions** to 40% below 1990 level by 2030; 80% below 1990 level by 2050.

As noted in the WSJ article, some homebuilders began to make note of the ZNE requirement:

"…. **Meritage Homes Corp**., which builds about 7,000 homes nationwide every year and 1,000 in California, invited its suppliers to an energy-efficient prototype. "Half the hall left, they wanted nothing to do with it," recalls **C.R. Herro**, Meritage's vice president for environmental affairs, adding: "That was great, because the half who stayed were all in."

"Meritage began offering its first ZNE-standard homes 4 years ago, though they represent a tiny fraction of its overall production. In all it has built and sold 100 of these homes in the U.S., half in California. They are priced at the median market price for the local market."

"Having shown it can meet that standard, the company is now planning its next iteration—homes that will be sealed even more tightly and consume even less energy, meaning they'll need smaller solar arrays to power them. "ZNE is basically in my rearview mirror," says Mr. Herro."



Source: The Quest for Home Utility Bills of…Zero, by Gabriel Khan, The Wall Street Journal 14 Set 2016

The WSJ article describes how Meritage meets the stringent ZNE standard:

"He is designing homes in which the wooden two-by-fours, the mainstay of residential construction, are replaced with **insulated concrete panels** and **polystyrene walls** that create a **sealed envelope**. **Windows** automatically turn opaque to block summer sunshine and go clear during winter daylight hours to maintain a constant indoor temperature. **Light switches disappear**, replaced by sensors. Highly efficient **dishwashers** and **clothes dryers** are connected

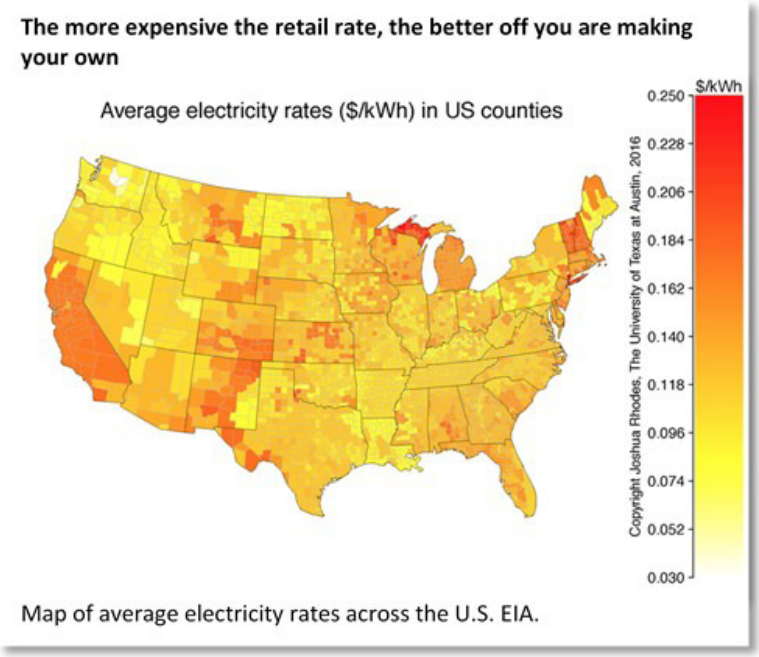
> to a **central management system** to automatically turn on when power rates are at their cheapest. In-home **batteries store electricity** from the **solar panels**." Occupants will barely have to touch a thing. "You will start using your house passively, instead of switching appliances on and off," says Mr. Herro.

Not everyone is as excited about ZNE homes as Mr. Herro, who is targeting a relatively upscale market where the ZNE standard is seen as an extra bonus, a major selling feature. The article explains:

> "**Mike Hodgson**, chairman of the **California Building Industry Association's** energy committee, estimates compliance with ZNE could raise the price of a $300,000 home by $23,000," adding "We'll have very efficient homes, but I don't know who is going to be able to afford them."

Mr. Hodgson is clearly missing a critical point: monthly cooling and heating costs, which in hot or cold parts of California can easily reach or exceed $500 or more per month. $23,000/$500/month = 46 months or 3.8 years. That is the simple payback period without any fancy discounting. Over the 30-40 year life of a typical house, ZNE house would be a handsome investment – assuming, of course, that you can afford to buy it in the first place. A ZNE home, like an efficient car or refrigerator more than makes up for the extra initial investment, and that is how it should be marketed.

Policymakers are now looking into ways of reflecting the longer-term economics of ZNE's in how homes are financed. Perhaps **mortgage companies** will make note as will real estate agents.



California regulators, like their counterparts elsewhere, are "betting that the costs of solar and other energy-saving features continue to fall, making efficiency more affordable, while electricity rates rise, making efficiency more valuable," over time, according to the WSJ article.

Defending CEC's decision to stick with the ZNE requirement, **Mr. McAllister** said, "You basically purchase an income stream in reduced energy bills," adding, "The barrier is getting the financial community to recognize the low operating costs."

As this editor sees it, California's ZNE requirement may seem absurd, expensive and unnecessary at first. But as with many other absurd, expensive and unnecessary things that started in California, this one has a chance to succeed and become a de facto national standard across the country – give it some time. And when it does, it won't seem so absurd, expensive or unnecessary. It will be how new buildings are designed, built and lived in. ■

The Quest for Home Utility Bills of…Zero
New regulations in California have builders scrambling to make houses more energy-efficient
By GABRIEL KAHN; Sept. 13, 2016

NREL Examines Feasibility Of High Renewable Penetration

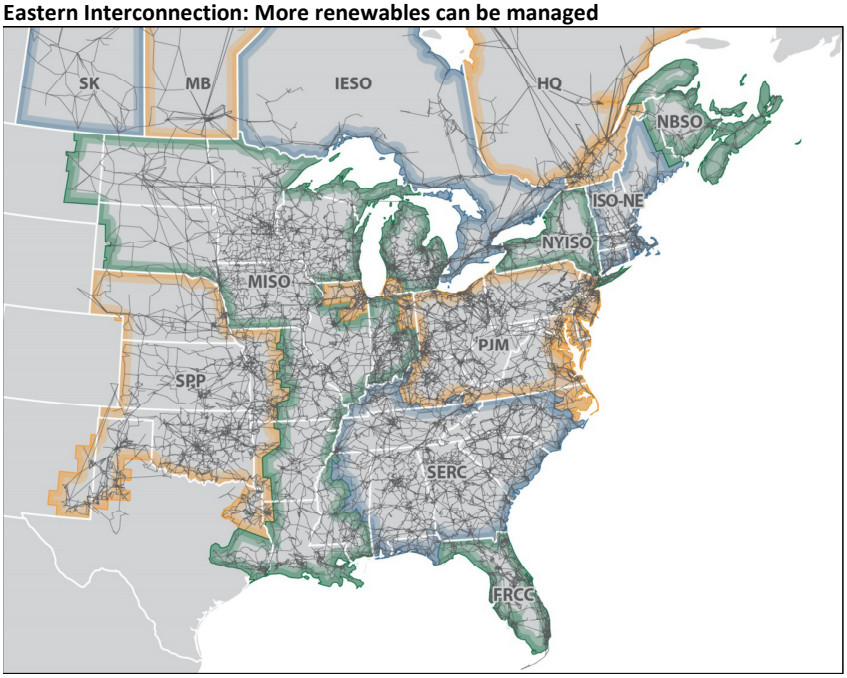
In short, it can be done, no problem

How much renewable generation can the grid handle before its operational integrity and reliability begins to suffer? That is no longer a theoretical question as states such as **California** and **New York** push for 50% renewable targets by 2030, 100% by 2045 for **Hawaii**, with numerous others in hot pursuit.

A study by the **National Renewable Energy Laboratory** (NREL) utilizing high-performance computers to examine the performance of the grid in unprecedented detail suggests that the power grid of the eastern US could operationally accommodate much higher levels of wind and solar generation exceeding 30% annual penetration levels.

The **Eastern Renewable Generation Integration Study** (ERGIS), released in late August 2016, examined a year of operations at 5-minute intervals, the same interval used by grid operators for scheduling resources.

Eastern Interconnection: More renewables can be managed



Source: Eastern Renewable Generation Integration Study, Aug 2016

In describing the findings, **Charlton Clark**, a DOE program manager for the NREL study said, "By modeling the power system in depth and detail, NREL has helped reset the conversation about how far we can go operationally with wind and solar in one of the largest power systems in the world," adding, "Releasing the production cost model, underlying data, and visualization tools alongside the final report reflects our commitment to giving power system planners, operators, regulators, and others the tools to anticipate and plan for operational and other important changes that may be needed in some cleaner energy futures."

For the study, NREL modeled more than 5,600 generators and more than 60,000 transmission lines in a power system that spans from Florida to Maine and portions of Canada and as far west as New Mexico (map above).

ERGIS considered four hypothetical scenarios – different amounts of wind, solar, natural gas and transmission – to analyze how the **Eastern Interconnection** might function in 2026, when the power system could have significantly more renewable generation in the mix.

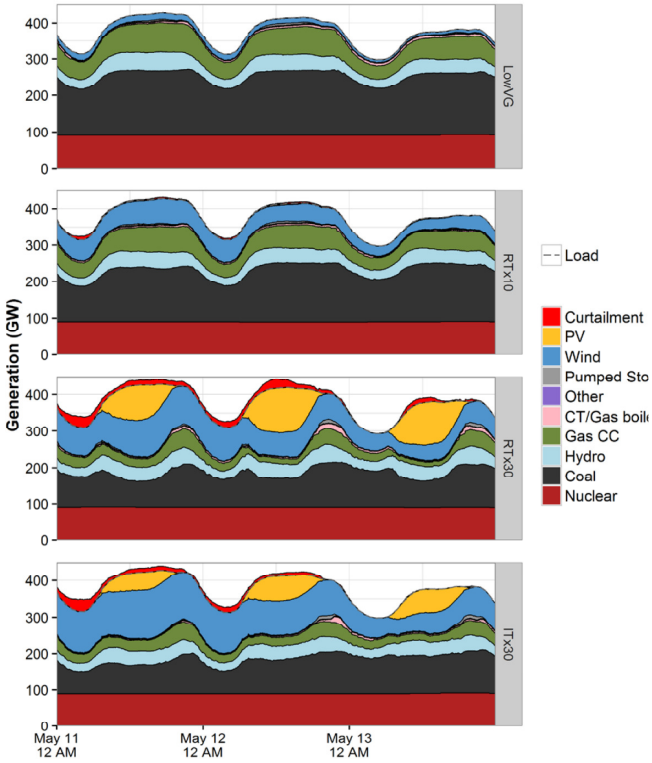
- The maximum **penetration** of wind and solar was 60% over a five-minute interval;
- The maximum annual **curtailment** of wind and solar was 6.2%;
- Wind and solar generation result in a 30% reduction in generation and commitment from **coal** and **natural gas** plants in the high wind and solar scenarios; and

- **CO_2 emissions** were reduced by up to 33% in high wind and solar scenarios.

The study's results, generally consistent with others looking at similar scenarios, suggest that

- Traditional dispatchable resources such as coal, natural gas and hydro generators will have to **ramp up or down** more **frequently** and **quickly** to accommodate seasonal and daily variations of wind and solar to maintain the balance between demand and supply;
- Additionally, traditional generators would likely operate for **shorter periods of time** as wind and solar resources meet more of the demand for electricity on the network;
- **Power flows** across the network **change** more **rapidly** and **frequently** during periods of high wind and solar generation, e.g., 40% or more of daily load; and
- **Flexible operational procedures** as well as different **market design** and regulatory changes need to be implemented to accommodate such future scenarios.

Maintaining grid reliability requires rapid and more frequent ramping



Source: Eastern Renewable Generation Integration Study, Aug 2016

At the high end of the penetration levels studied, there are times when the wind and sun together provide as much as 52% of the total demand and – on the other extreme – as little as 10%. Sunrise and sunset routinely become periods of intense system response. On some days, 140 GW of production must shift from solar and wind to gas or coal fired generators during a period lasting less than six hours.

These realities – the equivalent of California's famous **Duck Curve** – are becoming routine in many networks around the world, from **Denmark, Germany**, parts of **Australia, Texas** and elsewhere. The sooner the grid operators plan for innovative means of matching variable renewable generation with flexible demand, the better.

In short, ERGIS shows – again – that the grid *can* meet loads with far higher penetration of variable resources in a variety of extreme conditions. It may not be easy, but it can be done. ■

Integration Study

After 40 Years And $5 Billion TVA Pulls The Plug On Nuke

Not the sort of news the nuclear lobby wants to hear, Hinkley Point investors included

The **Tennessee Valley Authority** (TVA), the nation's largest federal power agency dating back to FDR's New Deal days, began the construction of **Bellefonte Nuclear Plant** (BNP) in **Alabama** in the mid-1970s when it was fashionable to do so. Originally 4 reactors were to be built on 1,600 acre of waterfront property on the Tennessee River. But the demand for power dropped as work progressed. Having spent roughly $5 billion at the site, construction was eventually halted in 1988, followed by decades of on-again, off-again debate on what to do with the unfinished project.

In May 2016, the TVA Board had to bite the bullet by declaring Bellefonte to be *surplus property* and authorizing its sale, after a public comment period. TVA has selected **Concentric Energy Advisors Inc**. to serve as the financial advisor and auction manager for the sale.

How about a few condos and a golf course instead?
Unfinished Bellefonte Nuclear Plant in Alabama

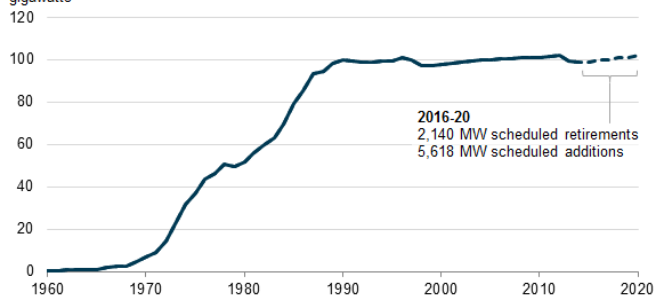
Source: TVA

In announcing the painful decision, TVA said its "primary goal in selling the site is to provide the best long-term economic return to the surrounding communities and the people of the Tennessee Valley," adding,

> "Over the life of this project the economic landscape and the need for electricity in the Valley has changed greatly. Selling the property now is a smart business decision because TVA's 2015 **Integrated Resource Plan** shows that large base-load capacity is *not* needed for more than 20 years. Putting the property on the market allows future owners to provide maximum long-term economic value."

With that, TVA has put the site on auction with a minimum asking price of $36.4 million – a trivial amount compared to roughly $5 billion spent at the site in over 4 decades.

Nuclear vs. renewables: There is no comparison
U.S. nuclear capacity (1960-2020)
gigawatts



Source: Energy Information Administration, Monthly Energy Review

To an economist it is a **sunk-cost**; get over it. For ordinary people it has reached the point when you stop spending good money after bad. The amazing thing is why it took TVA so long to come to the inevitable conclusion.

Phoenix Energy has already offered $38 million saying it plans to use the site for a new, non-nuclear technology to generate power. TVA plans to close the deal in October 2016. ■

TVA

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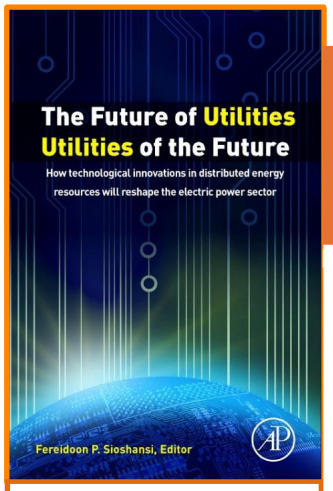

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Edited by: ***Fereidoon P. Sioshansi***, President, Menlo Energy Economics, San Francisco, CA, USA

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