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REVIEW OF THE YEAR – 13 DECEMBER 2016

A YEAR OF HECTIC CHANGE AND OFF-TARGET PREDICTIONS

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Every January, Bloomberg New Energy Finance's Chief Editor Angus McCrone and I don our Nostradamus hats and try to predict what the coming year will bring. Then, each December, to keep ourselves honest, we revisit our predictions and mark our homework. Frankly, if all pundits did the same, they might be respected more. Anyway, welcome to our December VIP briefing - it's time to see how we fared.

Overall, at the start of the year, we predicted that 2016 would be "sunny, with a hint of *Götterdämmerung*". We described the clean energy sector as being "in the best health of any time in its history". It was, we said, "a third-of-a-trillion-dollar industry, with a strong cadre of competitive suppliers, enjoying a generally supportive policy environment – now underpinned by the commitments made in Paris".

So why the *Götterdämmerung*? "There is certainly more than a whiff of sulfur in the air", we said, pointing to China's economic slowdown and South China Sea adventurism; the end of quantitative easing; turmoil in the financial and currency markets; almost daily terrorist outrages around the world; tragic levels of refugees; the rise of the far right in Europe and Donald Trump in the U.S.; Saudi Arabia and Iran squaring off in the Gulf; the eminent bankruptcy of Venezuela and other oil producing nations; North Korea's saber-rattling; the continuing failure of the EU to address its systemic problems, and the attendant risk of a British exit. "If you want to be scared about what 2016 might bring," we concluded, "there is ample cause".

We were not wrong. As it turned out, 2016 delivered more than just a hint of *Götterdämmerung*, it delivered the complete Wagnerian Ring Cycle, in political terms at least.

First, there was the U.K.'s Brexit vote on June 23, spelling at the very least a shock for the European Union, the world's biggest single market; then, on November 8, the election of Donald Trump as the U.S.'s 45th President; December 4 saw an Italian referendum rejecting Matteo Renzi's constitutional changes and forcing his resignation; and just before year end, months of protests against Park Geun-hye culminated in an impeachment vote by the South Korean Parliament.

These political earthquakes – and others that may strike next year during the EU election cycle – will have an impact on the energy sector, and we will look at this in detail in the 10 Predictions for 2017, to be published in January. Our head of Americas, Ethan Zindler, had a first look at the energy implications of Trump in this column last month. It is certainly a relief that The Donald got elected in 2016 and not in 2012, before the huge reductions in wind and solar costs transformed the competitiveness of those technologies!

As for our serenely sunny prediction for the clean energy sector itself, we were, on average right, with some sectors doing worse and some better than expected. It is worth highlighting three areas in which events surprised us.

First, when our advanced transport team forecast early in the year that EVs would ride a remorseless descent in battery prices to claim 35 percent of new car sales globally by 2040 (with the possibility of 50 percent on one scenario), the immediate reaction from the outside world was mainly disbelief. Yet within months, as one major motor manufacturer after another made decisive commitments to EVs, opinion swung round to agree with us, and most other major forecasters fell into line. By the end of the year, the most frequent comment we get when we present is: "Surely by 2040 more than half of new cars will be electric." We will be updating our forecasts for the electric vehicle market early in 2017 – watch this space.

The second surprise was a series of astonishingly low tariffs for solar projects in developing countries, starting in January with $64 per megawatt-hour in Rajasthan, India, then riding a downward escalator via Peru, Mexico, the United Arab Emirates and Morocco to a new record of just $29.10 per megawatt hour in Chile. With the world record for unsubsidised power from solar is now below $30 per megawatt hour, and that for wind not far behind, you can forget competitiveness, renewables are robustly entering the era of undercutting. If you need to build new generating capacity, and you can deal with the attendant variability at an affordable cost, renewable energy will beat any other technology in most of the world without subsidies.

The third unexpected development was less welcome, as wind and solar investment fell from their 2015 peaks in both China and Japan. This came as a major jolt to the sector, after many years of seemingly inexorable growth. It also helped to make a mess of the first of BNEF's "10 Predictions for 2016".

So, without further ado, let's get stuck in:

1. RECORD-BREAKING INVESTMENT

At the start of the year we said: "We expect total investment in clean energy to establish a new record in 2016." It didn't.

Clean energy investment worldwide looks likely to fall short of 2015's record $348.5 billion by between 15 and 20 percent. Our data experts will not be crunching final numbers for the year for a few weeks yet, so I cannot say with any certainty what the figure will be, but preliminary statistics for the first three quarters of the year show a drop of some 30 percent in large-scale asset finance.

In our defence, I would point out that in July we revised upwards the 2015 total by around 6% because of late-announced deals – so the shortfall compared to the originally stated figure for last year will be less that it seems. And it looks likely that our shockingly weak third-quarter 2016 total will be revised up a little, to reflect deals that have subsequently been announced. And the big fall in Japanese clean energy investment this year will owe more to sharply falling solar costs in that country than it will to lower activity levels.

However, we certainly got it wrong on clean energy's biggest market, when we wrote in January that we expected "further strong progress in China." In fact, what happened there was that booming solar installations of around 22 gigawatts in the first six months of 2016 gave way to a bone-crunching slowdown, with just 6 gigawatts or so installed in the second half, as feed-in tariffs were hacked back. Meanwhile, wind installations plateaued, costs in both technologies continued to fall and the yuan weakened, leading to a sharp slow-down in overall dollar investment.

We were also a bit too optimistic on clean energy investment in the U.S., expecting Congress' five-year extension of the Production Tax Credit and Investment Tax Credit at the end of 2015 to bring about a jump in new financings. The reality seems to have been that the unexpected duration of the extension has enabled project developers to take their time over negotiating finance and ordering equipment, attenuating the usual U.S. boom-bust cycle in the sector.

We also predicted that "more new markets would join the billion-dollar-a-year club" in terms of clean energy investment. We mentioned Pakistan, Egypt, Vietnam, Indonesia and United Arab Emirates as candidates. As it turned out, most of these countries made good progress but, ahead of the fourth-quarter figures, the only one certain to break the $1 billion barrier in 2016 is Pakistan.

SCORE: 3/10

2. FOSSIL FUEL PRICES BACK FROM THE ABYSS

In January, we pointed out: "The new game among oil analysts (remember them – they're the folks who were on your TV screens two years ago predicting $200 oil prices) is to predict new oil price lows at $20 or even $10 per barrel."

We refused to play the game of predicting the bottom of the market, saying instead that we expected "oil and coal prices to bottom out during 2016 and end the year somewhat higher than they are now." As it turns out, by pure luck, we timed the bottom of the fossil fuel market almost to the day. On January 18, the day our forecast was published, Brent crude opened at $28.73 amid a sea of pessimistic market views. It fell for just two more days, hit its low for the year of $27.10 on January 20, and then turned, climbing steadily for the rest of the year – helped during December by the stunning reversal of OPEC's two-year-old open-tap policy. The ARA steam coal contract took a little longer to hit bottom, but that came on February 17, some $1.20 below where it was when I made the prediction, before rallying strongly to the $78-a-tonne area now.

There is a message for those activists who convinced themselves that the world's coal and oil producers were on a smooth glide path to zero commodity prices and to capital starvation: dream on. Even commodities facing long-term structural decline will go through many cycles where supply constraints outstrip falling demand, or

where demand is unexpectedly resilient, particularly in a world showing signs of economic recovery.

SCORE: 10/10

3. PV TO BEAT WIND INSTALLATIONS

The latest projections from our solar and wind analysis teams are that there will be almost 70 gigawatts of photovoltaics added globally in 2016, up from 56 gigawatts in 2015, and that wind installations will total 59 gigawatts, down from 62 gigawatts last year. So the basic predictive statement made in January looks certain to be correct, and by a sizeable margin.

In the case of PV, we actually edged up our installation estimate during the course of this year by between 2 and 3 gigawatts. The Chinese market will see an extraordinary 26.5 gigawatts commissioned in 2016 as a whole, more than the global total as recently as 2010, while Japan should see nearly 9 gigawatts added (down from 11.5), and the U.S. 12.6 gigawatts (up from 7.6 last year). The other countries seeing the sharpest growth are likely to be India (more than doubling to 4.5 gigawatts), Turkey, Chile and the Philippines.

In terms of prices, back in January we said: "Technical innovation in cell process and structure continues and will drive down the module price by 5-7 percent during the course of 2016." However, prices do not just track costs: supply-demand balance matters too. By the end of the year, it looks like module prices will have tumbled by around 17 percent to an average of $0.48 per watt.

At the beginning of 2016 we thought that the biggest story in the solar manufacturing industry this year will be "the end of massive module oversupply," and indeed in the first half of the year demand was strong enough to put pressure on supply. However, the slump in Chinese demand in the third quarter produced a lurch back into oversupply. Our latest PV Market Outlook (clients can read it here), published at the end of November, said: "There is ample manufacturing capacity for every solar component to supply the market next year."

SCORE: 7/10

4. ANOTHER STRONG YEAR FOR WIND

We wrote in January that we expected around 63 gigawatts of new onshore and offshore wind to be added worldwide in 2016, including nearly 12 from the U.S. and 24-25 from China. As it turned out, we over-egged both, but particularly the U.S., where the end-year figure is likely to come in at about 8.8 gigawatts, roughly the same as last year. As mentioned above, it was great news for the American wind sector that Congress extended the PTC, but five years of stability meant there was no reason to rush to build in 2016.

The other main strand of our prediction on wind was "consolidation ahead of weaker conditions in 2017-19." That has certainly come to pass: in June, **Siemens AG** and **Gamesa SA**, two of the top 10 globally, agreed to merge their turbine manufacturing businesses into a new entity 59 percent owned by the German company and 41 percent by the Spanish concern. There were also smaller deals, with **Senvion SA** of Germany agreeing in August to buy **Kenersys GmbH**, a turbine maker with a presence in India, **Vestas Wind Systems A/S** purchasing turbine service company **Availon Holding GmbH**, and **General Electric Co** announcing in October plans to take over the leading independent blade maker, **LM Wind Power Holding A/S**, for $1.7 billion.

SCORE: 7/10

5. THE YIELDCO IS DEAD, LONG LIVE THE YIELDCO

Things looked dire for North American yieldcos at the start of 2016, after a vicious share price sell-off in the preceding months and, as a result, an almost-total end to their equity-raising from the stock market. However, we took a deep breath and said we expected them to "be back raising money this year."

2016 turned out to be a bit of a roller-coaster for yieldcos. Several of them saw further share price falls of some 25 percent in the first quarter, before bottoming out and enjoying a rebound of some 60 percent to highs in September. Then, however, the U.S. presidential election and worries about higher interest rates caused another slip in Q4. **Pattern Energy Group Inc**, for instance, is ending the year more or less where it started in stock price terms (see chart). Even sharper swings were experienced by the two yieldcos caught up in the bankruptcy of **SunEdison Inc**, namely **TerraForm Power Inc** and **TerraForm Global Inc**. But even they are now more or less back to where they started the year.

On the fund-raising point, there was some new investment, though far short of the $5 billion of new equity that yieldcos secured in the first seven months of 2015 before investors took fright. Three North American yieldcos – Pattern, **NextEra Energy Partners LP**, and **8Point3 Energy Partners LP** – raised almost $1 billion between them this year. In Europe, the six London-listed quoted project funds – the U.K. equivalent of yieldcos – raised the equivalent of some $700 million.

So it looks like these vehicles, set up to own operating-stage renewable energy projects and return the cash

flows to investors, have indeed survived 2016, shaken but intact, and as we predicted have regained at least some investor trust.

SCORE: 9/10

6. ELECTRIC VEHICLES BREAK HALF-MILLION MARK

At the start of the year we predicted that EVs "would shrug off low oil prices to deliver another year of strong growth", suggesting that global sales would total around 550,000 units in 2016, up about 30 percent from 2015.

Although we didn't say so explicitly, in fact we were forecasting a significant slow-down in the racy growth rates that EVs had registered for the past few years. Between 2014 and 2015 they clocked up growth of 56 percent; with the oil price below $30 on the day we published our forecast, with high-range new models being promised but not yet available, and apparently high levels of clean energy subsidy-fatigue among voters, we foresaw a few years of more measured growth. We were wrong.

During the year, the Tesla S and X saw continued strong demand, and the Chevy Bolt, with a more affordable price tag and a greater range, went on sale. China saw soaring uptake of models such as the BAIC D50 and the BYD e6, ahead of a reduction in purchase subsidies at the end of this year.

As a result, BNEF's latest Advanced Transportation Market Outlook, published in November, shows expected EV sales for full year 2016 of some 700,000, up another 56 percent from last year's revised 448,000.

In January we also said that we expected to see a 10-15 percent fall in EV lithium-ion battery prices. While we were directionally correct, we undercooked that quite a bit too. Our analysts now think that EV battery prices will be down 22 percent in 2016 on the back of fierce competition, manufacturing scale effects and improved use of materials and components. With so few years of data, we had been cautious in predicting the experience curve effect for batteries, looking at a figure of around 15 percent. It now looks almost certain it is much higher, at about 19 percent, boding well for the future of the sector.

SCORE: 6/10

7. GRID STORAGE ADDITIONS DOUBLE

This prediction was for additions of "at least 750 megawatts" of battery storage globally, double the 2015 figure, with momentum gathering in small-scale storage markets such as Japan, Germany and Australia, and bigger utility-scale projects going ahead in Canada, the U.S., Japan, Italy and Germany.

Our energy storage team reports that the industry is on track currently to hit 780 megawatts, as long as projects due to be commissioned in December are completed on time. These include a 27-megawatt battery system in California ordered in August following problems at the Aliso Canyon gas storage facility that threatened peak-time electricity supplies. There were also some big new orders for projects to be delivered in 2017 or after, including U.K. **National Grid PLC**'s 210-megawatt procurement of storage for frequency response, announced this summer.

SCORE: 9/10

8. GAS – DISTRESS BUT ALSO RESILIENCE

In January, we suggested there would be further pain among North American shale gas producers, but that innovation and falling production costs would cushion the blow. We said that with increasing volumes of LNG available from new export facilities in Australia and elsewhere, "international gas prices look at least as likely to drop in 2016 as increase modestly."

Well, there was indeed impressive resilience from North American producers, after the wave of bankruptcies in 2015. Marginal supply costs have fallen from $4.13 per MMBtu in 2011-12, to $2.60 per MMBtu by mid-2016, according to the BNEF gas markets team. Many players have also become more adept at quickly shutting down and then restarting wells in response to demand and price signals.

International gas prices over 2016 as a whole turned out modestly higher overall. The U.K. National Balancing Point went sideways for much of the year before rising from the 30 pence to 46 pence per therm; the Netherlands TTF contract is finishing the year close to where is started, as is the Japan-Korea market for international LNG, while the Singapore LNG benchmark is back slightly above where it started. Incidentally, though this was not part of our prediction, U.S. Henry Hub is currently at $3.40, compared to about $2.20 in January, thanks to 3 percent lower production in the wake of last winter's glut, the start of two LNG trains and expectations of a colder winter this year.

SCORE: 5/10

9. EUROPEAN CARBON PRICES RECOVER

At the start of the year we said that we saw European carbon prices "moving upwards as 2016 unfolds", driven by a firming economy, and long-awaited agreement on the introduction of the Market Stability Reserve. So confident were we that prices would firm, we even

warned that we might find ourselves in bubble territory: “It is entirely possible that prices drift up all year. Equally, it is possible that some alert traders spot the trend and pile in, which will reinforce it and build the foundation of the next entirely unhelpful boom-bust cycle in carbon prices. Sigh.”

We were not just wrong, we were wrong immediately. The December 2016 European Union Allowance (EUA), which was 6.76 euros per metric ton on publication day, plunged below 5 euros almost immediately, to 4.14 euros now. What went wrong?

First of all, it is worth noting that before our prediction there had been nearly three years of steady price recovery since early 2013, when allowances hit a low of just over 3 euros per metric ton. The European economy did indeed hold up fairly well in 2016 (GDP in the third quarter of 2016 was 1.6 percent up on the same period a year earlier) and China avoided a crash landing, our biggest worry at the start of the year.

Even now, any analysis of supply and demand for credits in the European carbon markets still shows the balance moving below a “healthy surplus level” by 2024.

So what did we miss? First, the combination of higher coal prices and weak power prices drove generators to switch from coal to gas, reducing the demand for credits in the Emission Trading System. Second, the so-called “backloading”, by which the supply of new allowances into the market is delayed, began to taper, effectively increasing the EUA supply.

The third, and perhaps biggest cause of our failure was that we misread the mood of the market: it is quite simply fatigued with the whole shambolic saga of the EU-ETS. The Market Stability Reserve reforms, due to kick in from 2019, were meant to send a signal of commitment to the scheme. Instead, they sent the signal that the scheme was failing and prone to political interference. After all, if politicians can resort to backloading and Market Stability Reserve whenever they think prices are too low, who is to say they won’t resort to Frontloading and a Market Moderating Reserve whenever they think prices are too high?

While EU-ETS prices have proven that they can drive short-term dispatch decisions, they have already proven that they are too volatile to drive investment decisions (other than in the U.K., but that’s because of its Carbon Floor Price). Now it seems even speculators have given up on them, and truly there is a need for a complete rethink.

SCORE: 0/10

10. CORPORATIONS AND CITIES BUY CLEAN ENERGY

Our final prediction at the start of the year was that we expected to see “a rush of corporate and city clean energy targets, as well as real, large-scale investment decisions, though mainly in the developed world.”

This was one of our safer predictions. Sure enough, 2016 has seen a continuation of keen interest on the part of large corporations in securing long-term deals on renewable energy purchase. They are heading in this direction partly in order to be able to advertise their sustainability credentials, and partly in order to lock affordable power prices for a period of years and insulate themselves from volatility in electricity markets.

Corporate power purchasing agreements, or PPAs, have had their best year by far in Europe, totalling more than 1 gigawatt so far, up from about 400 megawatts in 2015. One of the recent deals covered in our Corporate Renewable Energy Procurement Monthly Report was an agreement in October by a consortium of **Akzo Nobel NV, Koninklijke DSM NV, Google Inc** and **Koninklijke Philips NV** to buy 95 percent of the output from the 102-megawatt Krammer onshore wind farm in the Netherlands when it is operational in 2019. In the Americas, although this year has seen some 2 gigawatts of new transactions, the total for 2016 will fall some way short of last year’s 4.5 gigawatts. Nevertheless, our analysts estimate that corporations will have to sign another 17 gigawatts of wind and solar PPAs in the U.S. by 2025 in order to meet their publicly announced commitments.

As far as cities are concerned, the Australian city of Adelaide said in June that it wanted to be carbon-neutral by 2020 through a combination of increased renewable generation and big improvements in energy efficiency. The action has not been restricted to renewable energy: we are also seeing accelerating action at the city level to tackle the scourge of air pollution, as the fall-out from Dieselgate continued. By year end, four major cities – Paris, Madrid, Mexico City and Athens – had announced a complete ban on diesel vehicles by 2025. In London, new Mayor Sadiq Khan said in November that his city would phase out diesel buses from 2018, while Paris started to ban cars that were more than 20 years old.

SCORE 7/10

So there we have it: a fairly unimpressive score of 63 out of 100 for our 10 Predictions for 2016, compared to the much more impressive 77 percent we chalked up in 2015.

Next month, we'll be publishing our 10 predictions for 2017. Spare a thought for us over Christmas, scouring the works of literature looking for the right analogy. What could possibly come next after the Battle of Borodino, Cracking Ice on the River Neva, the Battle of the Dinosaurs and *Götterdämmerung*?

Meanwhile, we wish you the very best for the holiday season. Enjoy the time with your family, next year is likely to see more Valkyries and less sunbathing.

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