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HAWTHORN
— CLUB —

FOR EXECUTIVE WOMEN IN ENERGY

BloombergNEF

Global Trends in The Energy Transition

Perspectives from
The Hawthorn Club and
BloombergNEF

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Section 1. Executive summary

This paper, co-authored by The Hawthorn Club and BloombergNEF, summarizes the main insights from the Club's 2019 Global Summit, held in New York City in March. This event, which featured 75 executive women in the energy sector from North America, Europe and Australia, revolved around five key trends that are shaping the global energy transition today, and how the trends are playing out in different parts of the world. The trends are:

1. **EVs and batteries are coming of age** and are starting to have a significant impact, driven by technology cost reductions and supportive government policy – particularly in Northern Europe and the U.S. Globally, 2 million EVs were sold in 2018, and further growth is expected as automakers launch more models and the vehicles themselves approach price parity with conventional combustion vehicles. However, the EV revolution is not evenly distributed. EV adoption is approaching 50% in Norway, the “laboratory” for adoption, but is still at an early stage in Australia, thanks to a lack of policy support and model availability; this despite Australia being a testing ground for batteries themselves at the world's largest on-grid system. The revenue model for stationary energy storage is still maturing, but adoption is set to increase as costs are driven down.
2. **A clean power system is within sight in all regions**, thanks to the rapidly falling costs of wind, solar PV and battery storage. An increasing number of jurisdictions can now see a path to very high penetrations of clean power, whether driven by policy targets, such as in Europe, or changing economics on the grid, as in the U.S. In Australia, “six solar panels are installed on rooftops per minute”. However, all are struggling to find the answers to the same issues, including merchant risk and the impact of negative pricing, the technical impact of renewables on the grid and the social impact of the transition, particularly in Australia and the U.S.
3. Globally, thought leaders agree that **the commodity markets (especially gas, oil, and metals) are increasingly being shaped by the energy transition**. Commodities are truly a global resource: global markets for coal, oil and increasingly LNG are what tie the conversation between Australia, Europe and North America together. We have yet to see peak oil or gas demand, and it is clear that they will continue to be essential fuels for meeting growing energy demand. Natural gas in particular will be needed to provide flexible generation, complementing renewables. However, the question remains as to how the commodity markets could be affected by still-emerging technologies, such as carbon capture and storage and hydrogen. These may well be needed if longer-term decarbonization goals are to be achieved.
4. There is a clear consensus that **digitalization is crucial to the energy transition**, whether for energy companies, market operators or consumers. Data and digitalization have driven changes in the everyday lives of most of the world's inhabitants, disrupting ‘business-as-usual’ in nearly every way. As more distributed and variable resources come onto the grid, system operators will require more sophisticated monitoring, forecasting and dispatch systems to balance supply and demand. Customers will also take advantage of digital platforms to optimize their own production, storage and consumption of energy. In a broader sense, **innovation is also critical to the energy transition** – exemplified by the activities of

technology companies such as Apple, Google, Microsoft and Salesforce, which are all pushing to reduce their carbon footprints and engage in the energy sector, while continuing to grow their businesses.

5. Finally, all of the executives agree that the **social and political conversation on energy is changing** – but in different ways across the world. In the U.S., grassroots concerns have driven the argument for green energy in the absence of federal government support. That drive has grown and culminated in the recent announcement on the Green New Deal, which has brought the conversation back to Washington. While the substance of the Deal has been criticized, its intent and vision has certainly moved climate discussions forward. In Northern Europe, the climate conversation never dropped off the political agenda and policy ‘carrots and sticks’ drive the achievement of climate targets. European social movements, such as the School Strike for Climate that commenced in Sweden, have only confirmed the importance of continuing with this agenda, and governments are increasingly finding themselves having to respond to new, often youth-led movements pressing for a faster transition. In Australia, arguments on all sides of the energy transition debate are regularly front-page news, and climate change has already contributed to several leadership changes in the country. This debate looks set to continue.

“Customers have had enough reading about climate wars. We’ll know we’ll have successfully made the transition to a cleaner, modern system when energy is boring again.”

Catherine Tanna, EnergyAustralia

Section 2. Introduction

The Hawthorn Club is the international network for executive women in the energy industry. The mission of the Club is to promote the appointment of women to senior corporate positions and boards, and to facilitate gender diversity within the energy sector. With over 80 corporate members globally in energy and related sectors, the nearly 300 executives of the Hawthorn Club are helping to drive the global energy transition.

BloombergNEF is a leading provider of primary research on clean energy, advanced transport, digital industry, innovative materials, and commodities. BNEF's global team leverages the world's most sophisticated data sets to create clear perspectives and in-depth forecasts that frame the financial, economic and policy implications of industry-transforming trends and technologies.

The Hawthorn Club and BloombergNEF have a partnership to promote gender diversity in the energy sector. The Club's annual Global Summit was held in New York City on March 27, 2019 and was attended by 75 of the most influential women in energy from all of the Club's branches – North America, Europe and Asia Pacific. Albert Cheung, BNEF's Head of Global Analysis, opened the Summit by outlining five global trends in the energy transition. The thought leaders of the Hawthorn Club then discussed these global trends through a regional lens, with a particular focus on Australia, Northern Europe and the United States.

We think this paper is an important milestone. It is the first time that perspectives of leading women in the energy sector have been brought together to produce a holistic view of the global energy transformation.

Figure 1: Hawthorn Club leaders in New York City, March 27, 2019



“We are the last generation on earth that has an opportunity to combat climate change, and we have the opportunity to be the first generation to solve the poverty problem. If we figure out how to do renewables, microsystems, and decarbonize the sector, we can talk about how we can ensure access to energy for everyone. So I think the work we’re doing at the Hawthorn Club is essential; as women we’re good at collaboration. The issues are too big and too complex to solve on our own; and the issues are too important on an economic and social level not to solve.”

Audrey Zibelman, CEO Australian Energy Market Operator

Audrey Zibelman was the recipient of The Hawthorn Club's 2019 Change Agent Award.

Source: The Hawthorn Club. From left to right: Elisabeth Brinton, Vice President Strategy & Portfolio, New Energies at Shell; Audrey Zibelman, CEO Australian Energy Market Operator; and Meade Harris, CEO, The Hawthorn Club.

Section 3. Five global trends in the energy transition

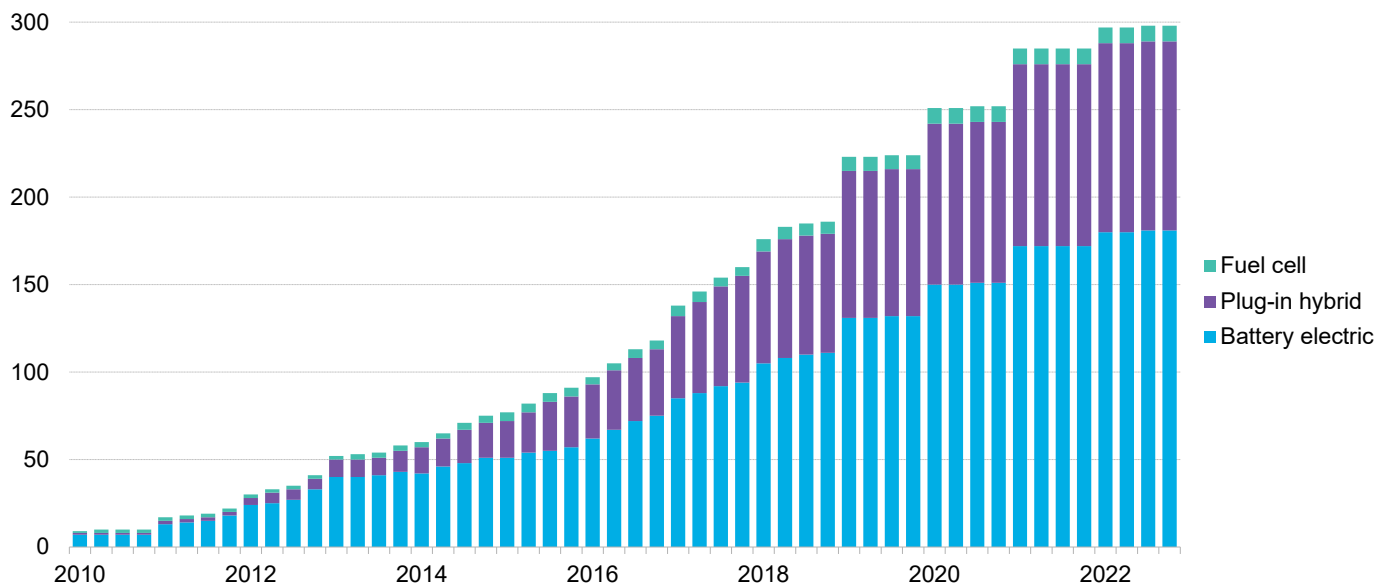
This Section summarizes the five key trends presented by Albert Cheung at the opening of the Summit, which formed the basis of the discussion throughout the day.

Electric vehicles and batteries are coming of age

In less than a decade electric vehicles (EVs) have ramped up from two models available in 2010 to over 200 models today. Annual sales have grown from 447,000 in 2015 to almost 2 million in 2018. The majority of these sales are in China (representing 7% of that country’s total car market in the final quarter of 2018), with Europe, North America, Japan and Korea also seeing significant EV buying. EV sales are expected to accelerate thanks to stringent emission regulations, such as the EU’s 37.5% carbon dioxide reduction target for new cars by 2030, compared to a 2021 baseline.

Figure 2: Global EV model availability

Number of EV models available globally



Source: BloombergNEF, Marklines, press releases from automakers

Four major car manufacturers currently loom large in the EV market. BAIC BJEV, BMW, BYD and Tesla are expected to account for over 1 million of the 2.6 million EVs sold globally in 2019. However, Volkswagen (VW) is expected to become a major competitor, with an aggressive investment strategy in EVs. VW has announced its plan to invest €30 billion by 2023, and provide 70 models by 2028.

As demand for EVs grows, manufacturing of lithium-ion batteries is expected to triple over the next ten years, driving down battery cost. In 2010 the weighted average pack price (in real 2018 \$/kWh) was close to \$1,200, which dropped to below \$200 in 2018. BNEF forecasts this to drop further to \$62 by 2030.

A clean power system is in sight

Figure 3: Albert Cheung presents the five trends



Source: The Hawthorn Club

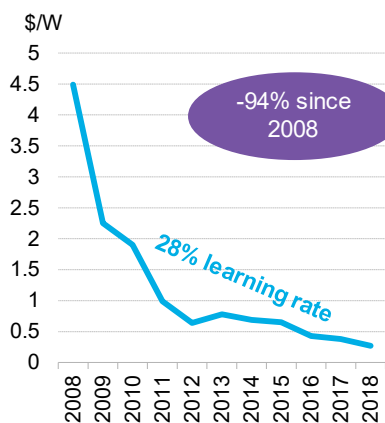
In leading ‘climate-conscious’ jurisdictions, a clean power system is not just an aspiration but is already in sight, driven by significant reductions in technology prices. Just as lithium-ion batteries are making huge strides on cost, solar and wind are already the cheapest forms of electricity in many countries. As can be seen in Figure 3, solar PV module prices have dropped by a remarkable 94% since 2008, to around \$0.24/W in 2018. Onshore wind turbine prices have dropped by 37% since 2008, to €0.80/W. Solar energy plus battery storage is becoming increasingly cost-competitive with combined-cycle gas turbines (CCGTs) in some jurisdictions, for example in the south-western U.S.

Although the transition to a clean power system will take many years and significant effort, the main building blocks can already be identified.

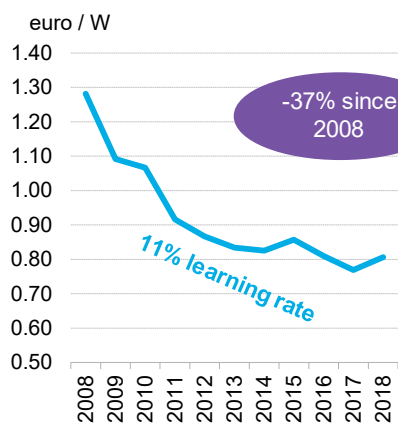
BNEF anticipates that the U.K. power system could be 94% zero-carbon by 2040, based on its New Energy Outlook report. This would require significant flexibility capacity, not currently in place. A typical week would see the majority of electricity provided by renewables (especially wind), with energy storage doing a lot of work each day; gas would continue to provide energy and capacity at times of low wind/sun. The increase in renewables on the grid brings new challenges. As the percentage of renewables rises – and excess electricity is generated when it is windy and sunny – negative power prices are becoming more common. In Germany for instance, the price drops below zero 2% of the time; in California the equivalent proportion is close to 7%. This complicates financing and contracting arrangements. In addition, support for communities that will be disadvantaged by the transition away from traditional fossil fuels is another significant challenge.

Figure 4: Technology cost reductions in solar PV, onshore wind and lithium-ion batteries

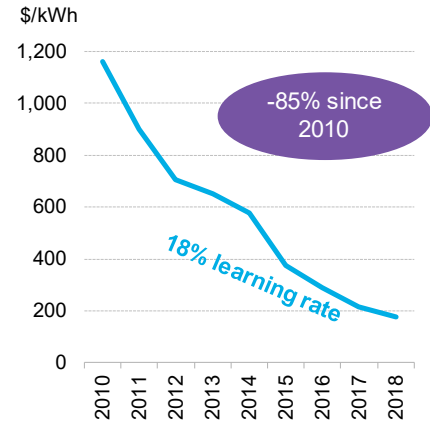
Solar PV module prices



Onshore wind turbine prices



Lithium-ion battery prices

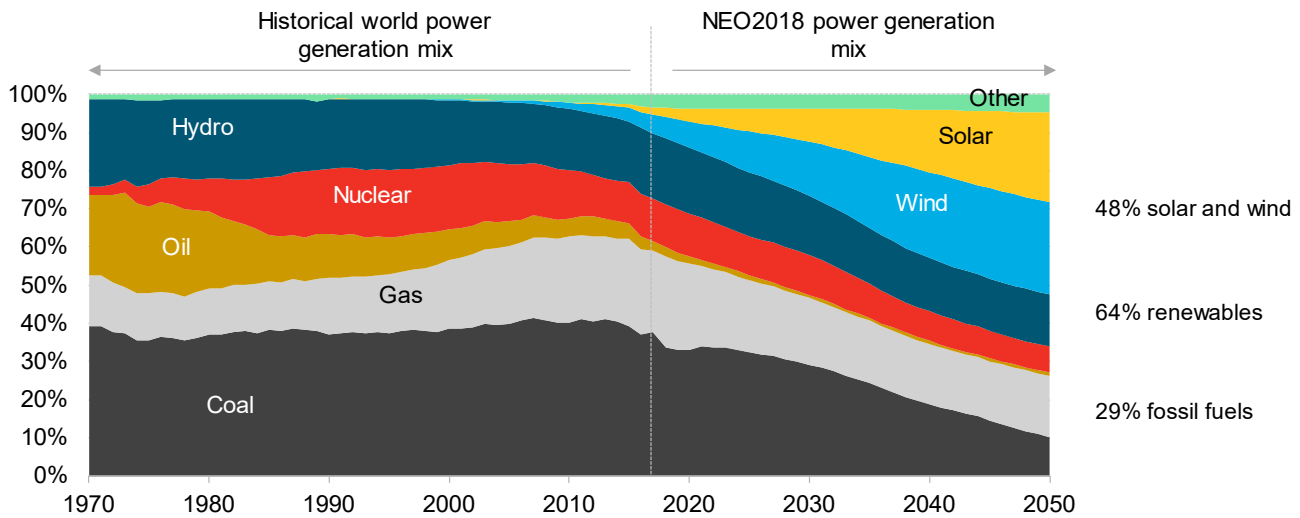


Source: BloombergNEF

Commodity markets will be increasingly shaped by the energy transition

BNEF’s New Energy Outlook 2018 found that wind and solar could account for approximately 50% of energy generation globally by 2050, on the basis of economics alone. This would significantly shift the commodity markets, for example in gas, coal, lithium, and petroleum. The geopolitical landscape will also shift as the commodity markets change.

Figure 5: New Energy Outlook: global power generation mix to 2050



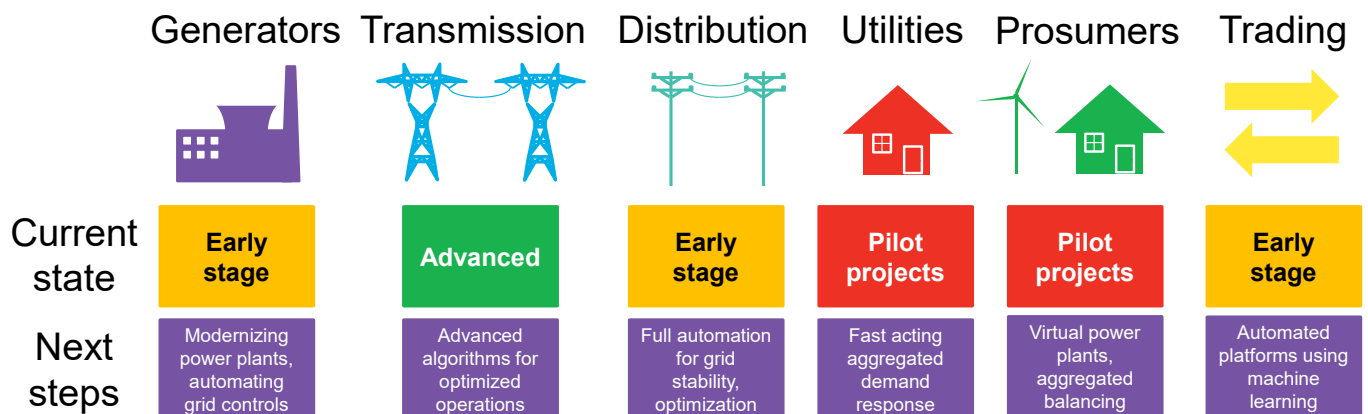
Source: BloombergNEF, IEA. Note: generation is in TWh.

The New Energy Outlook finds that gas power capacity could rise by 63% by 2050. However, gas consumption in the power sector would rise by only 6% as its main role will be to provide flexibility in a renewables-dominated market. Global thermal coal consumption would peak in 2027, even as coal decreases as a percentage of power generation. Lithium supply and demand will rise, driven largely by the EV market. With the rise of EVs, BNEF expects 8 million barrels per day of oil equivalent to be displaced by 2040 (compared with a business-as-usual, or BAU, baseline).

Digitalization is the new battleground for energy companies

Digitalization is increasingly needed to manage the global energy transition, and this will therefore be a significant driver of competitive advantage. Opportunities for digital technologies abound across the entire value chain and sector, whether in oil and gas, power generation, or energy retail.

Figure 6: Digitalization of the electricity value chain



Source: BloombergNEF

The landscape for digitalization is complex, and new innovations are disrupting traditional business models and partnerships. There are many old and new players wanting to capitalize on the opportunities, including technology companies, industrial equipment providers and small technology start-ups (focusing on particular applications). Utilities are partnering with a multiplicity of technology providers. Companies will need to develop a strategic competence in digitalization technology if they want to retain a competitive advantage, rather than considering them 'one-off projects'.

The social and political conversation is changing

The Green New Deal, proposed by New York District Democrat Alexandria Ocasio-Cortez and Ed Markey of Massachusetts, is a ten-year national mobilization plan to move toward 100% clean power, while also supporting jobs and health care. The U.S. Senate rejected the Deal on March 26, 2019. Nevertheless, it has had the effect of re-focusing political conversation on the importance of climate change, and moving the debate from one of 'is climate change real?' to 'what solutions can we bring to the table?'. The conversation has also highlighted the social justice and equity issues associated with climate change, and the Green New Deal looks as though it will play a role in the run-up to the 2020 presidential elections.

Similarly, the 'School Strike for Climate', which saw 1.4 million young people across 112 countries protest on March 15, 2019, also calls attention to the social interest and concern, particularly among future voters, over the lack of action on climate change. This increase in social concern is increasingly having an impact on policy. For instance, the U.K. Committee on Climate Change recommended to the U.K. government that no new homes be connected to the gas grid beyond 2025, in line with the 'social values of the community', a recommendation from the Committee that the government accepted.

Figure 7: Launch of the Green New Deal



Source: Image from Bloomberg.

Section 4. Asia Pacific: Australia as a catalyst

Following the introduction of the five trends, a panel of thought leaders from Australia discussed how each trend applies to the Australian market, and which resonate most strongly.

Panel discussion:

- Catherine Tanna, Managing Director, EnergyAustralia
- Sherry Duhe, Executive Vice President & Chief Financial Officer, Woodside
- Sylvia Wiggins, Executive Director, Finance & Commercial, Infigen
- Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator

Moderated by: Kobad Bhavnagri, Head of Special Projects, BloombergNEF

Figure 8: Panel discussion on “Australia as a catalyst”



Source: The Hawthorn Club. From left to right: Kobad Bhavnagri, Audrey Zibelman, Sherry Duhe, Sylvia Wiggins, Catherine Tanna.

A clean power system is in sight

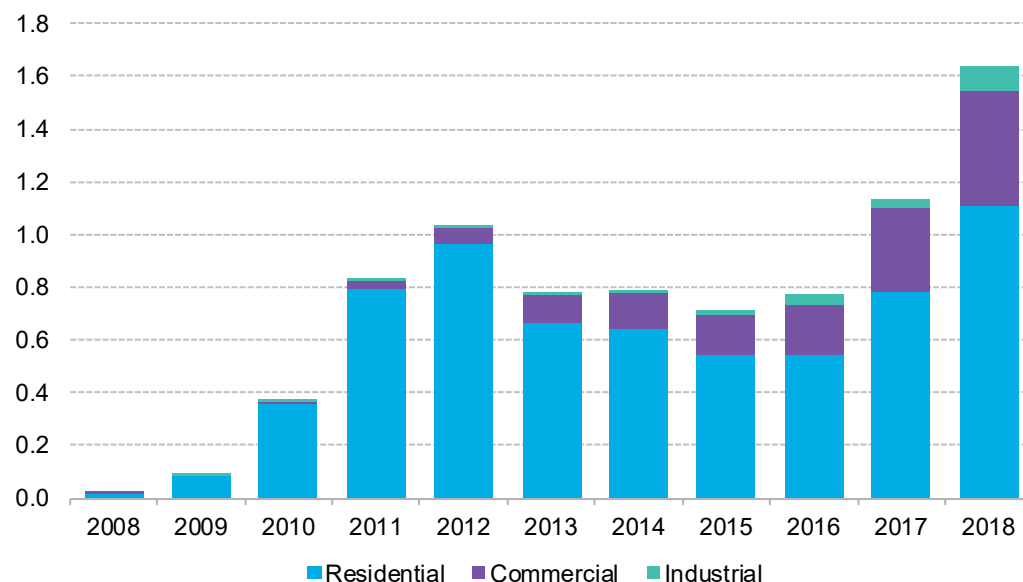
In 2018, the Australian Energy Market Operator (AEMO) developed its inaugural Integrated System Plan, which indicated that, as coal retires, the most economic replacement mix in Australia is wind, solar, storage and some gas. However, as Audrey Zibelman said, “It’s not going to happen by accident: we need a planned transition.” There are challenges requiring effective action to optimize the efficiency of this cleaner system. For example, wind and solar generation can at times exceed demand, leading to negative prices. According to Zibelman, “The Australian electricity spot market was designed around fossil fuels in the 1990s, and it needs to be re-designed for a new market. It’s not that it was a mistake, but we’ve moved on.”

The public focus of the electricity mix tends to be on the source of the electrons, and whether it is coal or renewables. Managing the system is more complex. Sylvia Wiggins noted, “All electrons

are created equally, but they are not all of equal value.” Electrons that are dispatchable are more useful than electrons produced at 3am when demand is very low. “We’re solving a lot of difficult issues for the first time globally, and we haven’t always got it right,” acknowledges Catherine Tanna. Ensuring the reliability of energy supply – as the percentage of renewables on the grid significantly increases – will be critical as Australia transitions to a cleaner system.

Managing the economic and social impact of the transition is also important. There are Australian communities that are highly dependent on coal, whether as export or power plant hubs. A move away from coal is likely to have an impact on the economic and social viability of these communities. In managing this transition, Australia can draw on lessons learnt from other sectors that have contracted or shut down, such as car manufacturing.

Figure 9: Annual rooftop solar installations in Australia



Source: BloombergNEF, Clean Energy Regulator, Australian Photovoltaic Institute.

There is strong public support for the transition to a cleaner system: “Six solar panels are installed on Australian rooftops per minute,” noted Zibelman. Solar rooftop installations are increasingly seen as valuable in Australia’s property market. EnergyAustralia has also seen a strong demand-side response. In 2018, some 9,000 of its residential customers actively changed their demand behavior, resulting in 50MW being fed back into the grid. However, while there is a small class of what can be called prosumers that can reliably provide and manage energy into the grid, most consumers will not be in a position to do this. “It is difficult for homeowners to think about this for more than seven minutes a year. We really need people in business to be thinking about it. I don’t think behavior will change until we create a true ‘internet-of-things’,” says Zibelman.

Digitalization is the new battleground for energy companies

The panelists agreed that digital technology will be essential in managing many of the challenges associated with the transition to a cleaner power system. Digitalization is essential not just for energy companies, but for market operators, because the technology and energy mix is more complex and fast-moving compared to the analogue, fossil fuel system of the previous century. Market operators will need to know how different energy resources behave in any situation,

requiring visibility of real-time data and longer-term trends, in order to manage the system efficiently. The energy transition is more than just good policy, it is important to managing the complexity and flexibility of the grid, which will require more sophisticated digital technology.

For energy companies across the spectrum, there are many opportunities for 'big data'. Sherry Duhe observes, "Data can be harnessed to identify what people want, what resources are coming onto the system, and where." Sherry agrees that energy companies in the coming decades will have increasingly to build on their strengths in technology to stay competitive.

Commodity markets will be increasingly shaped by the energy transition

Australia is known as 'the lucky country' for being blessed with resources such as coal, gas, lithium, and hydrogen. It is therefore well placed to meet demand for commodities that will power the global energy transition. However, political and policy decisions have a huge impact on how these resources are managed.

The social and political conversation is changing

Energy and climate change policy in Australia is currently a political battleground. "Until you start to give clean energy economic and political support, you're not going to drive change," observes Duhe.

The panel agreed it was essential for Australia to adopt a sensible transition plan. "What's important is not the percentage of decarbonization – we can get hung up on the numbers – what matters is the plan to decarbonize the economy," said Tanna. This is difficult given the complexity of the energy landscape and when the topic is a "political football". However, clear policy recommendations are possible. For example, the Finkel Review (named after its leading author, Australia's Chief Scientist) has made clear recommendations on emission trajectories and the establishment of an Energy Security Board to manage the transition.

EVs and batteries are coming of age

In Australia, EVs have not yet come of age. The uptake of EVs in Australia is not happening at the same rate as in other countries, and there are very few EV models available to buy. For instance, there are fewer EVs in Australia than in Hong Kong. This could be due to a combination of factors. Given the large distances in Australia, range anxiety might play a more significant role than in other countries. Although Australia has experienced 27 years of economic growth and inflation is low, wage growth is flat. This has had an impact on car sales, and an 'unconventional' car such as one that is battery-powered and is also more expensive may not be a priority for buyers.

Similarly, batteries have not come of age in Australian markets. This is despite Australia having the biggest battery in the world on its network (100MW in South Australia). At the industrial scale, they are not economic at this stage and still rely on government subsidies. Nevertheless, they are useful particularly in providing 'firming', and installation at industrial scale provides a good learning opportunity. At the residential scale, batteries are at an early-adopter stage, with the major barrier also being cost. The payback time to offset the cost of the battery is between 7 and 10 years, which means people have to stay in their homes to reap the benefit.

The ad-hoc installation of batteries across the energy system – especially at a residential level, but also at industrial scale – provides an operational challenge. AEMO does not always know where the batteries are, and the owners give little thought to their impact on the grid.

Section 5. Northern Europe: focus on the U.K. and Norway

In the next session, executives from the U.K. and Norway shared their insights on trends in those two countries.

Panel discussion:

- Trude Sundset, Chief Executive Officer, Gassnova
- Cynthia Dubin, Independent Board Director, United Kingdom Competition and Markets Authority, Babcock & Wilcox, and Hurco Group, Inc
- Zosia Riesner, Head of Corporate PPA, Lightsource BP
- Victoria Merton, Director of Corporate Affairs, The Peel Group

Moderated by: Meredith Annex, Head of Heat Decarbonization, BloombergNEF

Figure 10: Panel discussion on Northern Europe



Source: The Hawthorn Club. From left to right: Meredith Annex, Trude Sundset, Cynthia Dubin, Zosia Riesner, Victoria Merton

A clean power system is in sight

The panel started by noting that the trend toward a cleaner power system is heading in the right direction, but many challenges remain. For example, despite Germany's huge investment in renewables, that country is not meeting its emission targets, of a 40% reduction from 1990 levels by 2020. In the U.K., in order to achieve its emission reduction target of at least 80% from 1990 levels by 2050, the government has implemented a series of five-year 'carbon budgets', which set out emission targets until 2032. The first two 'carbon budgets' have been successful, but possibly the 'low-hanging fruit' has been taken, and the next three are likely to become harder to achieve, not easier. To facilitate this, it is important to stop thinking about energy in isolation, but think

about how it connects with industry, transport, housing, and retail. “Collaboration is key, exemplified at Protos in the Energy Innovation District in the North West Cluster in the UK, since energy lies right at the heart of driving the economy forward with industry and innovation in a combination of energies: low carbon, green and renewable,” said Victoria Merton.

This concept of ‘connectedness’ can be extended to Britain and Europe. Some 70% of energy produced in the U.K. is in summer, but its peak demand is in winter. “Let’s utilize the fact that there’s more sun, more hydro-energy and more hydrogen in Europe,” says Zosia Riesner.

Commodity markets will be increasingly shaped by the energy transition

Despite the gains made in moving toward a cleaner power system and toward EVs, the majority of the panel said they thought that oil and gas would remain the “dominant commodities” in the coming years. “You can’t look at averages or numbers in isolation. Eight million barrels per day of oil may be displaced by EVs, which sounds good, but when we think about how much oil is consumed every day, this is a small amount,” Cynthia Dubin observed. It was noted that Organization of the Petroleum Exporting Countries are predicting an increase in oil demand by 2030, while the Intergovernmental Panel on Climate Change (IPCC) is calling for a decrease. Some panellists thought gas in particular would always remain “part of the story” as a dispatchable energy source.

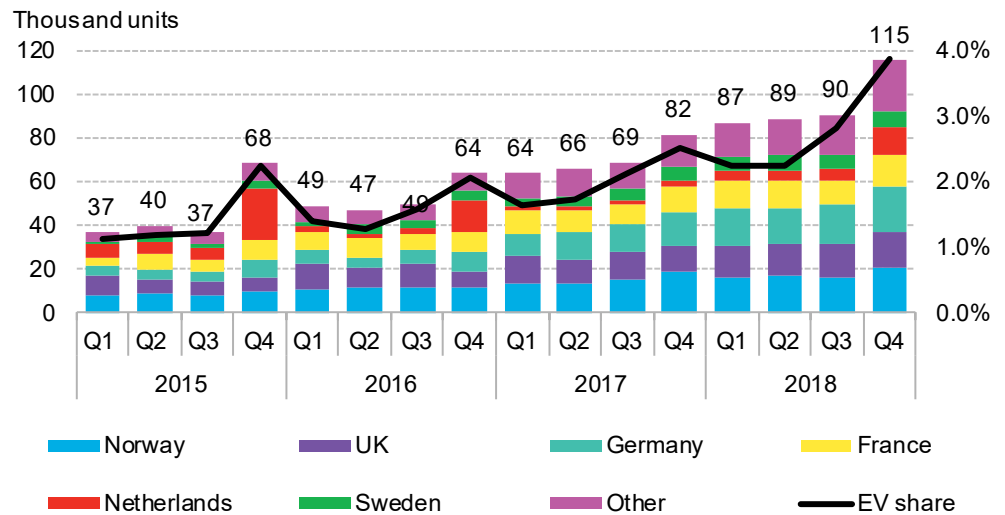
The panel considered whether the energy transition would drive greater demand for other commodities. “It’ll be interesting to see if hydrogen emerges as a solution” noted Trude Sundset, pointing out that “if it comes from natural gas, you’ll need to capture the resulting CO₂.” There are of course opportunities for utilizing that CO₂. The panel shared anecdotes about how the U.K. fizzy drink industry ran out of carbon dioxide due to unexpected heat waves; and in Norway how breweries were caught short, leaving them desperate for more CO₂. However, it should be noted that carbon dioxide uses cannot replace storage as a climate mitigation option, given that the volume of CO₂ which needs to be captured far outstrips global use requirements.

EVs and batteries are coming of age

In contrast to Australia, EVs are taking off in Europe. While adoption rates vary widely across European countries, the panellists agreed that both Britain and Norway are seeing substantial adoption. Many cities in Britain have pledged to become 100% green by 2050, and the electrification of the transport sector is a key plank in achieving this ambition. The U.K. government has announced its intention to ban diesel and petrol cars, which will also drive the uptake of EVs. Sundset thinks EVs make sense in Norway, which she says is becoming an increasingly electrified country, both upstream and down. Thanks to incentives, EVs already account for 45% of new car sales: taxation on new EVs is lower than on petrol cars; and there are no charges for EVs on toll roads. “We like to think of ourselves as the laboratory for the world, and we are happy to share our lessons,” said Sundset.

The largest factor cited in surveys with respect to EV uptake in the UK is range anxiety. It is why we need many and varied charging infrastructure solutions from high voltage, rapid charging facilities to in-home solutions. In addition, greater grid flexibility is required through storage solutions not only to balance the level of intermittent renewable power on the system but also address this in the context of future demand created by the electrification of transport. “Policy makers will need to consider the shape of supply and demand of the future energy system in designing frameworks which will ensure that we meet our both renewable power and EV goals,” said Dubin.

Figure 11: EV sales in Europe



Source: BloombergNEF, Marlines, various.

Like the U.S., shopping centres could provide a significant opportunity for supplying charging infrastructure; while in Norway, they are located near existing gas stations and McDonald’s restaurants. However, it might be uneconomic to lay power cables to existing infrastructure. A significant uptake in EVs will also place a significant new load on the grid that will have to be managed. Merton commented that publicly accessible charging infrastructure could become part of a ‘self-sustaining circle’: “EV car batteries can be charged in car parks and shopping centers and at airports where they are parked for long periods, then the car can be used to recharge battery storage at home.” The EV trend therefore provides exciting opportunities to address power and infrastructure challenges.

Digitalization is the new battleground for energy companies

The U.K. has a balancing mechanism that allows demand response to help stabilize the grid, but volatility is still growing in the wholesale electricity market. This is expected to increase, as more solar and wind assets continue to come online. There is an interest in “using data to manage this volatility”, which was another good example of where digitalization can support the energy transition.

The social and political conversation is changing

The panel agreed that young people are playing a significant role, by expressing their concern on climate change. For example in Norway, Sundset is impressed by the way young people are approaching issues of energy and climate change, making their voice heard. Yet while many young Norwegians are asking why the country cannot exit the oil and gas industry, it is the wealth it generates which helps fund renewable energy projects. Part of the issue, she thinks, is to do with narrative. “Helping young people understand that the world is transitioning over time will marry their idealism with realism” she said.

Section 6. North America: focus on the U.S.

Executives from the U.S. energy and technology sectors discussed the five trends and how North American markets are evolving within the global energy transition.

Panel discussion:

- Mary Anne Brelinisky, President, EDF
- Caroline Choi, Senior Vice President of Corporate Affairs, Southern California Edison
- Michelle Patron, Director of Sustainability Policy, Microsoft
- Christina Sistrunk, President & CEO, Aera Energy

Moderated by: Amy Harder, Energy & Climate Reporter, Axios

Figure 12: Panel discussion on the U.S.



Source: The Hawthorn Club. From left to right: Amy Harder, Christina Sistrunk, Caroline Choi, Michelle Patron, Mary Anne Brelinisky.

Commodity markets will be increasingly shaped by the energy transition

Some panelists put commodity markets at the top of their 'most important trend' list, arguing that it underpins everything else. Mary Anne Brelinisky commented that "Everything we're talking about is around moving commodities. This is what ties the conversation between Australia, Europe and North America." The commodity markets are becoming more complex and further inter-related. Back in 2001, in the Texas power markets, there were just over 100,000 settlement prices – enough to manage on a spreadsheet, albeit a large one. Last year, in Texas there were over 26 million power pricing points. Today a small gas pipeline in Canada can impact the spot power markets in Chicago. This complexity and interdependence is both an accomplishment and a challenge.

Digitalization is the new battleground for energy companies

Innovation is critical to the energy transition and this is underpinned by digitalization technology for industry, consumers and market operators. For example, digitalization can be used for everything from artificial intelligence for optimizing sub-surface oil production, to sophisticated data systems monitoring and optimizing that production on a real-time basis. As a consumer, digitalization can help optimize household running costs. When the energy spot price is high, energy-intensive appliances like an EV battery charger or a pool pump, for example, can be programmed to shut down automatically, resulting in significant cost savings over time. Echoing comments made on the Australia panel, modernizing the grid will also rely on digitalization to get the data needed to optimize efficiency. Digitalization helps shape and drive business; there is a complex process that underpins doing this well. Michelle Patron commented; “I wouldn’t call digitalization a ‘battleground’. It’s an imperative for every company in this space. It’s a unique moment in history.”

EVs and batteries are coming of age

EVs are coming of age in the U.S., and a cleaner power system will go hand in hand with the electrification of the transport sector. In time, EVs will be charged with renewable power, making them cleaner still. However, the panel raised similar concerns to the previous two panels: for instance, despite the trend towards more EVs being sold, vehicle miles driven in the U.S. are going up, and this might mean people will continue to rely on gas-powered cars to ‘go the distance’. More public charging stations could offset this concern. “Range anxiety continues to be a barrier for EV adoption. Customers are increasingly investing in public and workplace charging stations, with support from government funding and utility programs,” added Caroline Choi. Retailers such as Kohl’s, Ikea and Sears are providing charging facilities as a service to their customers, and this trend is likely to continue. However, the logistics of getting charging stations in the right place, and charging economic rates for both the consumer and provider, has been more difficult than anticipated.

The social and political conversation is changing

The panel agreed that the social and political conversation is changing, as epitomized by the debate on the Green New Deal. While the aspirations of the Deal were commendable, it was felt that they were not realistic. Regardless of outcome, it has generated a national conversation about action on climate change. However, there was some concern that the aspirations of the Deal were polarizing, and pushing people further into their own camps.

The Trump Administration’s withdrawal from the Paris Agreement has driven a transition of power and authority on climate change from the U.S. government to more decentralized players, including states, companies, other large organizations like universities, and even individuals. It has arguably had the effect of generating more individual action and interest.

Political pressure at grassroots is important to drive change. However, as Sistrunk observed, “If change is not managed well, and it forces prices to rise, there is often a public backlash, undermining a lot of the work that’s been done.”

A clean power system is in sight

As in all jurisdictions, the challenge for the U.S. lies in working out to how to achieve sustainability and economic feasibility simultaneously. As renewables become cheaper, coal and coal-fired power stations could “retire themselves” on cost grounds, with or without government policy. As in

the case of Europe, some panelists said they believed that gas will always play a role in the energy mix. For instance, in extreme weather events that outlast battery storage capacity, gas may be needed to ensure reliability and affordability.

Figure 13: New-build LCOE, solar vs. coal and gas

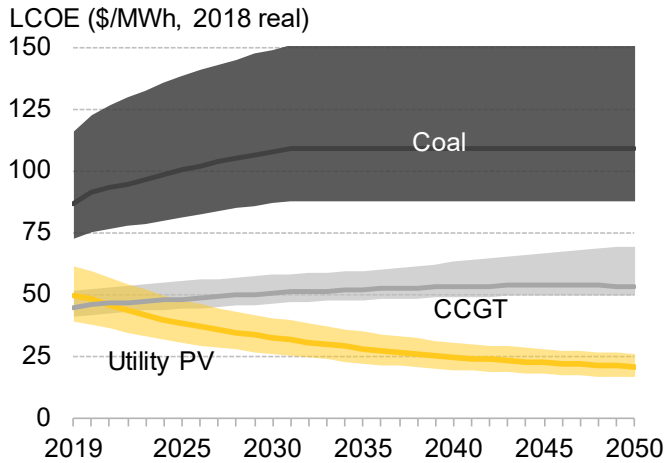
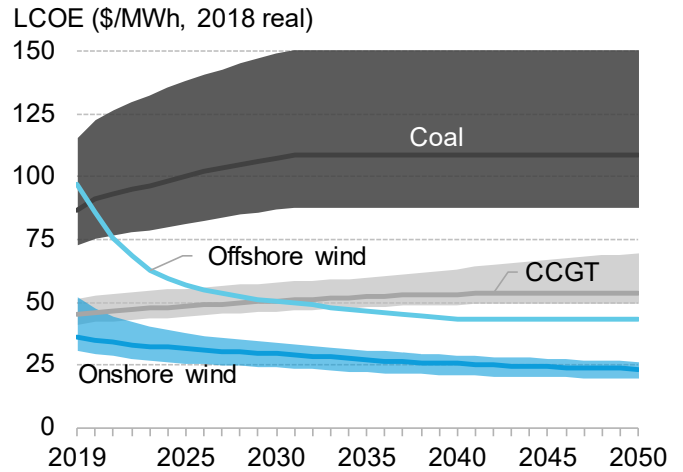


Figure 14: New-build LCOE, wind vs. coal and gas



Source: BloombergNEF. Note: Levelized cost of electricity (solar, wind, gas, coal) calculations are for utility-scale assets in the U.S. and exclude incentives such as the ITC and the PTC. Utility PV assumes tracking. EV price is for a medium segment vehicle in the U.S.

While many inroads have been made, it is important to remember that clean energy projects are still an uphill battle and take an “army of experts to get the deals done”. Considerations include policy barriers, government regulations, tariffs, site challenges and technology challenges. Companies cannot just “flick the switch” on these projects.

Section 7. Start-ups in the energy world

The energy transition is driving greater innovation in the energy sector than ever before, and with that innovation comes a need for investment in disruptive businesses and projects. Elisabeth Brinton, Vice President Strategy & Portfolio, New Energies at Shell, and Nancy Pfund, Founder and Managing Partner at DBL Partners, shared their views on how large energy companies and investors can help to accelerate the energy transition.

Figure 15: Elisabeth Brinton (right) in conversation with Alix Steel of Bloomberg Television



Source: *The Hawthorn Club*

Utility companies will increasingly need to become technology companies, and like technology start-ups, utilities will need to cross their own “valley of death”. Brinton said she thinks that utility companies run the risk of being trapped in a traditional mindset of how power companies were run last century, but technology is the ‘new poles and wires’. “We get caught up with the frosting on the cupcake – consumer marketing. But we have to remember that behind that is a whole infrastructure.”

Investors are interested in investing in ‘green projects’, and it is Brinton’s experience that there is a huge amount of investment capital available for scalable technologies and business models. One of the key reasons why Shell is such a popular equity partner for start-ups is that it represents a channel to consumers in a variety of ways. For example, Brinton said that Shell is the biggest coffee retailer globally, providing it with data on what people are buying where.

Figure 16: Nancy Pfund (left) in conversation with Emily Chasan of Bloomberg News



Source: The Hawthorn Club

Nancy Pfund agrees that data and digitalization are essential to facilitate the energy revolution. She gave an example of farmers being innovative with their land use, if they have the data to make informed decisions. Pfund is a high-profile impact investor, who makes venture capital investment in projects with social and environmental impact. Pfund identified her ‘trifecta’ for impact investment: “One, follow the carbon – and try to reduce it. Two, fix something that is broken – we try to move the needle on an issue that we care about. Three, disrupt established companies.” Pfund acknowledges there is a huge level of discomfort for most people in “investing ahead of the curve”, but she said that DBL does this constantly in order to ‘move the needle’.

Section 8. Financing the transition

The final session of the day discussed the role of finance in enabling and accelerating the energy transition.

Panel discussion:

- Joanne Spillane, Executive Director and Global Head of Private Capital Markets, Macquarie Capital
- Claudine Emeott, Director, Impact Investments, Salesforce
- Carla Tully, Executive Vice President and Managing Director, MAP Renewable Energy
- Kristina Lund, Chief Financial Officer, Mexico, Central America and the Caribbean, AES

Moderated by: Emily Chasan, Sustainable Finance, Bloomberg News

Figure 17: Panel discussion on “Financing the energy transition”



Source: The Hawthorn Club. From left to right: Emily Chasan, Kristina Lund, Joanne Spillane, Claudine Emeott, Carla Tully.

In all regions, one of the vital elements in the energy transition is funding. Two themes emerged as key to solving price issues: predictability and transmission congestion.

Carla Tully said, “The market is rapidly evolving. Storage is no longer considered new technology, but it will play a critical role as we decarbonize the grid. For instance, around firming power, grid congestion and in ways we haven’t even begun to see.”

The debate on predictability covered two things: power purchase agreements (PPAs) and firmness of on-sale value. The key to driving down price when it came to PPAs was, unsurprisingly, length: the longer, the better. A good example is Australia, where the cost of renewables is going up as the duration of PPAs shortens. Investors’ required returns are significantly lower for greenfield renewables projects in Taiwan for example, than in Australia due to the long-term revenue contracts available, protecting investors from merchant energy risk, noted Joanne Spillane.

In addition, short-term PPAs affect onward sale of an asset, since proving the ability of the asset to repay borrowings throughout its life is a key consideration for potential buyers. Another consideration on predictability is the issue of stranded assets and what falls into that category. The usual view of fossil-fuel-based assets is widening, particularly as regards stranding risk. However, it is currently unclear what distance an asset can be to “dirty” energy for the stranding risk to be present. It has been seen that transmission congestion can slice off up to 20% of revenue from projects in Australia. This is a significant funding issue if it cannot be solved. While storage may be a key response to this issue, the revenue model for batteries remains unclear. It was posited that digitalization may be an element to solving this issue.

“We believe that businesses can be powerful platforms for change and created the Salesforce Impact Fund to invest in diverse, world-class entrepreneurs. They are solving some of our greatest challenges across education, workforce development, equality, sustainability, and the social sector,” said Claudine Emeott, Senior Director, Impact Investing at Salesforce. “Portfolio companies receive funding to accelerate their growth, in addition to the credibility, access and advice they receive from Salesforce. While the impact investing industry continues to attract new investors and additional capital, corporations haven’t yet shown up in a big way. It’s time for others to step up and move faster. Impact investing is a strategic part of a broader effort for Salesforce to be good corporate citizens, and we hope to inspire others along the way.”

However, there was consensus that there is a significant incentive within the market for funding of green energy projects. There is currently more demand for green bonds than supply and a public push to see more investment in clean energy. In recent months, there have been several public cases of pension funds who are being sued over whether they have carried out their fiduciary duties by considering climate change as part of their investment strategy.

About BNEF

Contact details

Client enquiries:

- Bloomberg Terminal: press <Help> key twice
- Email: support.bnef@bloomberg.net

Meade Harris	CEO, The Hawthorn Club
Albert Cheung	Head of Global Analysis, BNEF
Alice Gibson	Asia-Pacific Advisor, The Hawthorn Club

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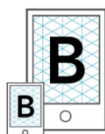
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