Technical Conference on Electrification and the Grid of the Future

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Panel 1: Projections, Drivers, and the Risks of Electrification

Good morning. My name is Katherine Hamilton and I am here as Co-Chair of the World Economic Forum's (Forum) Global Future Council on Clean Electrification. Adam Sieminski of King Abdullah Petroleum Studies and Research Center (KAPSARC), former head of the U.S. Energy Information Administration, and I co-lead a group of 21 global subject matter experts from industry, academia and civil society to amplify the value and role of clean electrification in the energy transition. Our members are from around the globe and share a multitude of experiences—from the United Kingdom (UK), Germany, Singapore, Spain, China, Australia, South Africa, India, Russia, and France, among others. As a group, we find ourselves sharing experiences that are not dissimilar from those we face here in the U.S., including the need for rapid transition to a zero-carbon future.

The Forum believes that "achieving net zero carbon targets will require clean electrification of energy uses, especially for buildings, transport and industry" and that "to meet these targets electrification needs access to renewable energy sources at scale combined with the availability of grid infrastructure to connect them."[1] To that end, our Council has taken a deep dive into electrification efforts globally to identify best practices and key drivers to enabling a fully electrified future.

[1] https://www.weforum.org/communities/gfc-on-clean-electrification

The main global driver is the scientific consensus that our planet will sustain increasingly devastating damage if temperatures rise above 1.5 and 2 degrees Celsius.[2] In the Paris Agreement, countries committed to actions that would keep them below 2 degrees with a goal of staying below 1.5 degrees; in the next Conference of Parties this fall in Glasgow, countries are required to ratchet up those commitments.[3] While there are no formal enforcement mechanisms, countries and regions have taken their goals seriously and have been developing policies to support their commitments. Over 125 nations have committed to carbon neutral goals; President Biden this week brought the U.S. back into the global conversation by committing to 50-52% carbon reductions economy-wide by 2030.[4] In addition to national and subnational governments, much of the global business sector has internalized these goals and their implementation policies as a long-term certainty and changed their business practices as a result. Recently, U.S. businesses have started making their own commitments for carbon reduction.[5]

Financial markets have reacted and are another driver toward electrification. The Task Force on Climate-related Financial Disclosures (TFCD) asserts that climate change poses a significant risk to the global economy.[6] In his 2021 letter to CEOs, Larry Fink of BlackRock asserts that "better technology and data are enabling asset managers to offer customized index portfolios to a much broader group of people – another capability once reserved for the largest

[2] https://www.ipcc.ch/sr15/
[3] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[4] https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/
[5] https://www.cnn.com/2021/04/18/business/business-climate-earth-day-roundup/index.html
[6] https://www.fsb-tcfd.org

investors. As more and more investors choose to tilt their investments towards sustainability-focused companies, the tectonic shift we are seeing will accelerate further."[7]

Rocky Mountain Institute estimates that if we decarbonize power generation on our electric grid in the U.S., we will reduce emissions by 30%; if we then electrify systems on that grid—in homes, businesses, transportation—we can decarbonize 70% of our system.[8] As I have noted, climate change creates an imperative to reduce our carbon emissions as quickly as possible. Luckily, increased digitalization, drastic reductions in the cost of clean energy technologies, and the increasingly uneconomic operation of incumbent fossil fuel systems, make possible a cost-effective transition to clean electrification.

IRENA, the International Renewable Energy Agency, in their recent World Energy Transitions Outlook states that "electrification of end-use sectors utilizing renewable power will play a significant role in the transition. In 2050, renewable energy (including renewable fuels and biomass-based carbon removal technologies), electrification and energy efficiency together offer over 90% of the mitigation measures needed to reduce CO2 emissions in the 1.5°C Scenario."[9] IRENA goes on to say that "to ensure a sustainable, climate-safe and more resilient future, significant investments need to flow into an energy system that prioritizes renewables, electrification, efficiency and associated energy infrastructure."[10]

[7] https://www.blackrock.com/us/individual/2021-larry-fink-ceo-letter?gclid=Cj0KCQjwvYSEBhDjARIsAJMn0lgkGvPkc0ByZNii5BYA_kUbzkM_35lJKsjchXeyceROcutL8RT5ymgaAsjwEALw_wcB&gclsrc=aw.ds
[8] https://rmi.org/insight/the-economics-of-electrifying-buildings/
[9] IRENA World Energy Transitions Outlook, page 17: https://irena.org/publications/2021/March/World-Energy-Transitions-Outlook
[10] IRENA Outlook, page 36.

Electrification technologies, such as heat pumps, are already widely available. CLASP, an international resource on appliance efficiency and policy, has stated that electrifying our heating systems is the next big opportunity for coordinated climate action, asserting that "tens of millions of gas furnaces, oil boilers, and coal stoves that emit CO_2, NOx, and other pollutants are candidates to be replaced with electric heat pumps, paving the way for a transition to greater use of clean, renewable energy for heating."[11]

IRENA looks across sectors and finds that "the buildings sector would see the highest direct electrification rates, reaching 73% compared to 32% today. A rise would also be observed in the industry sector, where the direct electrification rate would be 35% by 2050, up from 26% today (including indirect electrification, the rate of electrification would approach 40% by 2050).…Transport would see the most accelerated electrification in the coming decades with the share of electricity reaching 49% in 2050, up from just 1% today. The stock of electric cars would rise from 10 million today to over 380 million by 2030 and 1,780 million by 2050; the stock of electric trucks would rise to 28 million by 2050. Electric vehicles would account for more than 80% of all road transport activity by 2050 (88% of the light-duty vehicles stock and 70% of heavy-duty vehicles).[12] While Norway has already seen a tipping point in electric vehicle adoption, that same inflection point is predicted to happen globally between 2023 and 2025, depending on the analysis.[13]

In addition to a host of available technologies, the electric grid is becoming increasingly digitized, enabling more interaction and optimization of those technologies. The International

[11] https://www.clasp.ngo/updates/heating-electrification-the-next-opportunity-for-coordinated-climate-action/
[12] IRENA Outlook, page 23.
[13] https://www.intelligentliving.co/electric-vehicles-tipping-point-rapid-mass-uptake-worldwide/

Energy Agency (IEA) report "Digitalization and Energy" focuses on the impact digitalization will have on electrification. "Together with the progressive electrification of the energy system and the growth of decentralized sources of power, digitalization is blurring the distinction between supply and demand, and creating opportunities for consumers to interact directly in balancing demand with supply in real time."[14] IEA goes on to state that "policy will be key to the pace and success of this transformation. Deployment of digital technologies and decentralized resources, as well as the electrification of transport and other end uses, is already being supported by governments in many countries. This is helping to drive down technology costs and encourage faster diffusion."[15]

In 2017, one of our Council members, the Spanish utility Iberdrola worked with Accenture under the auspices of the World Economic Forum to develop a plan to unlock the value of digitization to the utility. The utility optimized their existing assets, deployed smart networks (which are now 95% digitized), enabled demand side participation, and payed attention to factors such as cybersecurity.[16] Since then, Accenture has developed a report that targets electrification for industrial consumers, highlighting that "research on the EU by the Potsdam Institute found that less CO_2-intensive sectors (e.g., paper, wood, textiles) can be nearly completely electrified with mature, commercially available technologies. These industries accounted for 40% of EU industrial emissions in 2015 and electrifying these industries would cut 36% of EU industry emissions by 2050."[17] What is important to note here is that these

[14] https://www.iea.org/reports/digitalisation-and-energy, page 82.
[15] IEA Report, page 99.
[16] https://www.accenture.com/t20170116T084450__w__/us-en/_acnmedia/Accenture/Conversion-Assets/WEF/PDF/Accenture-Electricity-Industry.pdf
[17] https://www.accenture.com/_acnmedia/PDF-147/Accenture-WEF-Industrial-Clusters-Report.pdf#zoom=40

technologies are available today; what is novel is the optimization of these diverse systems into one system that allows the customer side to be a resource.

An Imperial College report found that "flexibility in consumption, via demand response (DR), has the potential to save billions of pounds in avoided reinforcement of the distribution network and investment in new power plants. This is because flexibility can help ensure cost effective integration of variable renewable energy sources, such as wind and solar, as well as new loads such as electric vehicles or heat pumps. A more flexible and efficient system may also be able to offer consumers lower electricity bills through the adoption of time-varying pricing and supporting technologies."[18] Luis Badesa, a researcher and professor at Imperial College stresses that clean electrification can be a huge source of flexibility; that flexibility needs regulation so that it is incentivized; and that, while full electrification is not needed for this flexibility, digitalization is key.[19]

Ensuring that customers can participate in and benefit from electrification leads to an understanding that equity must be top of mind as we look to global solutions. I authored a piece for the Forum several years ago calling upon a fully inclusive transition that leaves no one behind.[20] We have the potential to bungle this transition if we do not have intentional policies in place to ensure that everyone is able to participate and benefit. On a very basic level, as we move to more digitization, it is imperative that everyone have access to internet. Universal broadband will enable all consumers to participate in electrification. In his *Rewiring America* handbook, Saul Griffith makes the case that electrifying everything will result in consumer savings, not

[18] Imperial College Energy Futures Lab Report, page 3. https://www.imperial.ac.uk/energy-futures-lab/reports/briefing-papers/paper-3/
[19] https://badber.github.io/docs/Cost_effective_low_inertia.pdf
[20] https://www.weforum.org/agenda/2017/11/energy-transition-leave-no-worker-behind-skills-jobs/

increased cost.[21] If electrification is done right--using less expensive renewable energy resources on the generation side and allowing full customer participation on the demand side--consumer costs should decrease.

It is important, however, that consumers have access to information and can participate and understand their usage in a granular way—using smart meters and settling actual usage at the meter rather through estimations based on averages. As we seek to ensure that underserved communities have access to clean energy, we must be intentional and specific in identifying solutions and programs and involve communities in determining their path forward. A recent roadmap for the U.S. was released by a coalition of civil rights, environmental, and business groups that can start that process.[22] Other countries, including the UK, have been thinking of this equitable transition as well and putting people at the heart of climate mitigation.[23]

In the UK, smart meters have been crucial to customer engagement and demand management. Ofgem, their electric and gas regulator, requires that any meter replaced must be done so with a smart meter.[24] One of the retailers in the UK, Octopus Energy, has deployed a flexible demand tariff that allows consumers to charge their electric vehicles and access lower cost energy when renewables are plentiful and prices low. This model is being exported to Japan as well.[25] These programs require settling at the meter so that each customer is able to fully participate and make decisions about their energy and economic choices in real time.

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[21] https://www.rewiringamerica.org/handbook

[22] https://static1.squarespace.com/static/5f4637895cfc8d77860d0dbc/t/607de3e8885bd43ae87deded/1618863082445/Building+Back+Better_+A+Roadmap+to+Expand+Solar+Access+for+All+-+FINAL.pdf

[23] https://www.ippr.org/environment-and-justice

[24] https://www.ofgem.gov.uk/consumers/household-gas-and-electricity-guide/consumer-guide-understanding-energy-meters-ofgem/smart-meters-guide-your-rights

[25] https://www.carscoops.com/2021/04/hondas-new-charging-solution-will-allow-uk-users-to-recharge-with-green-energy-and-save-money/

If electrification is planned and deployed correctly, reliability and resilience should increase, not decrease. A recent study released by the American Council for an Energy Efficient Economy shows an increase in reliability as a result of a combination of energy efficiency and electrification (which included heat pumps at a minimum, but in some cases heat pump water heaters, induction stoves, and electric vehicles). [26] In the U.S., experience in storms and other weather-related events has proven out that demand response and other consumer-sited resources can provide crucial resilience services.[27]

In conclusion, based on my experience with experts around the globe, no one has the perfect pathway to electrification, but most agree we need to get there. We can share experiences, learn from each other, and transition in a way that uses technology, a systems approach, smart regulatory policy, and financial incentives, underpinned by inclusivity to ensure that consumers benefit, economies grow, resilience increases, and that we protect our planet from further harm. Thank you for the opportunity to present at this Technical Conference.

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[26] https://www.aceee.org/sites/default/files/pdfs/programs_to_electrify_space_heating_brief_final_6-23-20.pdf
[27] Multiple FERC filings from Advanced Energy Management discuss examples of resilience, one such example: https://aem-alliance.org/aema-files-reply-comments-in-resilience-proceeding/