RAP®
REGULATORY
ASSISTANCE PROJECT

RETA
Regulatory
Energy Transition
Accelerator

Elevating the Priority of Decarbonization in Energy Regulators' Decision Making

This report was prepared by the Regulatory Assistance Project under the leadership of Richard Sedano. Alejandro Hernandez, Principal and India and Global Opportunities Program Director, directed the work. The report was authored by Peter Fraser and Poullette Faraon Chaul Corona, consultants.

This report is accompanied by a supplemental webpage, describing and categorizing the decarbonization implementation experiences of regulators from around the globe who were interviewed for this report. Please visit https://www.raponline.org/map-for-elevating-decarbonization-in-energy-regulation/ for further examples and insights.

Prepared for

Regulatory Energy Transition Accelerator

9 Rue de la Fédération
75015 Paris, France

admin@retatheaccelerator.org
retatheaccelerator.org

Prepared by

Regulatory Assistance Project (RAP)®

50 State Street, Suite 3
Montpelier, Vermont 05602
United States

+1 802 223 8199
info@raponline.org

raponline.org
linkedin.com/company/the-regulatory-assistance-project

Table of Contents

Introduction and Overview

Achieving rapid decarbonization of the economy requires acceleration in renewables additions, efficiency and electrification: To achieve the Paris Agreement objectives, the world's energy systems must be rapidly transformed. These include the electricity and natural gas sectors, which are commonly overseen by regulators. The International Energy Agency's (IEA) *Net Zero by 2050*[1] analysis shows that acceleration of three key trends is needed to put the world on track for rapid decarbonization:

1. The growth of the **share of low-carbon generation** in the global electricity system, averaging 0.7% per year since 2015 and reaching 39% in 2022, has to more than quintuple, averaging 4% per year, to reach 71% by 2030, with most of the incremental supply being provided by wind and by solar photovoltaic (PV).
2. The **rate of decline of energy intensity**, at 1.3% per year since 2015, must triple to over 4% per year, requiring an immediate great leap forward in energy efficiency.
3. The **share of electricity in final energy consumption**, which has been growing by 0.2% per year since 2015, reaching 20% in 2022, needs to grow around 1% a year to reach 28% by 2030.

Energy regulators are crucial to increasing the pace of the clean energy transition but they have had to be creative in elevating its priority. As overseers of the electricity and natural gas sectors in many countries, regulators have a vital say over the direction and pace of investments in these sectors that will contribute to the acceleration of decarbonization of the energy system. Yet most regulators are governed by their mandated responsibilities related to setting just and reasonable tariffs that ensure a reliable and affordable supply of energy. Regulators in many countries have been confronting decarbonization issues while, in most cases, also lacking a specific mandate to make decarbonization issues a priority. Nevertheless, regulators have been finding creative ways to ensure that decarbonization priorities are weighed appropriately in regulatory decisions by recognizing the other benefits (such as reduced pollution, energy security and reduced price volatility) that investment in decarbonization brings.

This Regulatory Energy Transition Accelerator (RETA) flagship project aims to gather the insights derived from regulators' experiences in elevating the priority of decarbonization in regulatory decision making. RETA (https://retatheaccelerator.org/) works directly with energy regulators to facilitate knowledge sharing, peer-to-peer learning and thought leadership on regulatory issues to accelerate the energy transition. At the request of the RETA steering committee, this project, *Elevating the Priority of Decarbonization in Energy Regulators' Decision Making*, has gathered insights from regulators around the world who have been addressing decarbonization issues in their decision making. This was carried out by interviewing regulatory agencies and regulatory experts on this topic.

1 International Energy Agency (IEA). (2021). *Net Zero by 2050: A Roadmap For the Global Energy Sector.* https://www.iea.org/reports/net-zero-by-2050

The chapters of this report cover the rationale for acceleration of the clean energy transition, highlights of the interviews and an in-depth look at certain examples, findings and recommendations. After an overview of the reasons for the acceleration of the energy transition and the role of regulators (Chapter 1), the core of this report is a series of interviews conducted with 25 regulatory agencies and five regulatory experts that cites 34 examples of how regulators are addressing decarbonization issues in decision making today (Chapter 2). Chapter 3 does a deep dive into nine examples from Chapter 2 to show how regulators are currently addressing decarbonization issues ranging from renewables approvals and transmission siting to new dynamic electricity rates. Chapter 4 highlights good practices in current regulatory frameworks that have been used to better integrate decarbonization into regulatory decision making, identifies shortcoming in the current regulatory framework and concludes with a series of recommendations for governments, regulators and RETA itself.

The report has recommendations for policymakers, regulators and RETA to support the elevation of decarbonization in regulatory decision making. For policymakers, we recommend that they include a statutory mandate for decarbonization for regulators to ensure decarbonization is included in decision making, provide guidance on a carbon price, ensure that the regulator is adequately resourced and talk to them — regulators can provide public interest inputs to decarbonization policies. For regulators, we recommend that in the meantime they work creatively within the existing boundaries of their authority to advance decarbonization consistent with the government's policies, work with governments on addressing gaps in regulatory mandates and, where needed, reform their processes to be timely with their key decisions. Finally, we propose that RETA supports capacity building of regulatory expertise and use of a peer review process to help regulators manage the profound changes expected in the energy systems they regulate.

Chapter 1. Decarbonization — Implications for Regulators of Net Zero Emissions by 2050

Achieving the Temperature Goal of the Paris Agreement Will Require a Rapid Decarbonization of the Global Energy System

The Paris Agreement[2] aims to strengthen global response to the threat of climate change. It sets out, in Article 2, a long-term temperature goal of "[…] holding the increase in the global average temperature to well below 2 °C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5 °C."

Achieving this long-term temperature goal requires a transformation of the energy system to effectively eliminate unabated emissions of fossil fuels — thus achieving net zero emissions (NZE), where any remaining emissions are offset by carbon sinks. To achieve the higher goal of limiting the temperature increase to 1.5 °C, analyses indicate that global greenhouse gas emissions would need to start falling immediately, reaching net zero by 2050.

In response to this, 94 countries and the European Union have pledged to achieve net zero emissions. Most of them aim to achieve that goal at or before the 2050 date, and 27 countries have passed legislation to back up their pledge.

This requires transformation of global electricity and natural gas systems starting now, as outlined in the IEA's Net Zero report

The most comprehensive analysis of what it would take to transform the global energy system to reach the 1.5 ºC goal is the IEA's report titled *Net Zero by 2050, A Roadmap for the Global Energy Sector*, published in 2021[3] and updated in 2023.[4]

The report is global in scope, and while it does not specify all the actions that need to be taken by a single country or region, it recognizes that the pace of change required differs. Figure 1 (next page), adapted from the IEA's analysis, *World Energy Outlook 2022*,[5] shows that advanced economies need to reduce emissions by 55% by 2030 and 92% by 2040; emerging markets and developing economies (EMDEs) should achieve the same percentage cuts in 2035 and 2045, respectively.

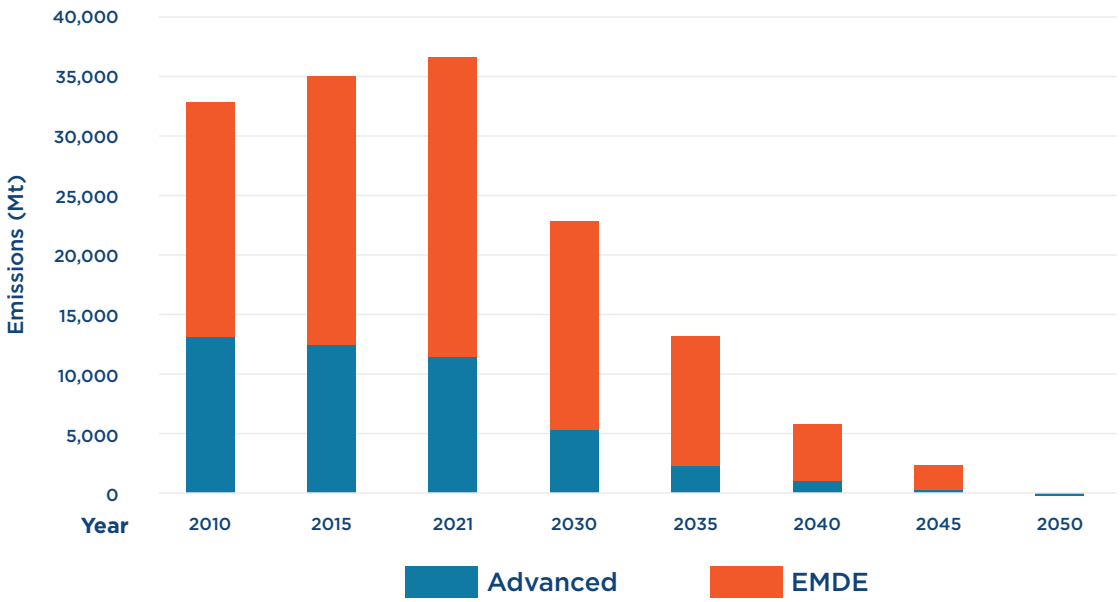
2 United Nations Framework Convention on Climate Change. (2015, December 12). *Paris agreement* [T.I.A.S. No. 16-1104]. https://unfccc.int/process/conferences/pastconferences/paris-climate-change-conference-november-2015/paris-agreement

3 International Energy Agency (IEA). (2021, May). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. https://www.iea.org/reports/net-zero-by-2050

4 International Energy Agency (IEA). (2023, September). *Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach*. https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach#overview

5 International Energy Agency (IEA). (2022, November). *World Energy Outlook 2022*. https://www.iea.org/reports/world-energy-outlook-2022

Figure 1. Carbon Dioxide Emissions from Advanced and EMDE Economies Historical (until 2021) and IEA Net Zero Emissions by 2050 Scenario (2030-2050)



Source: *Adapted from IEA (2022, November)*

Six Key Takeaways for Energy Regulators from the IEA's Net Zero Report

While achieving these emissions reductions will require many actions affecting all sectors of the economy, the IEA's Net Zero report has important implications for electricity and natural gas — the two most commonly regulated energy sectors — as well as hydrogen, whose distribution may become a sector subject to regulation in the future. The six key takeaways for energy regulators of the IEA's Net Zero report are:

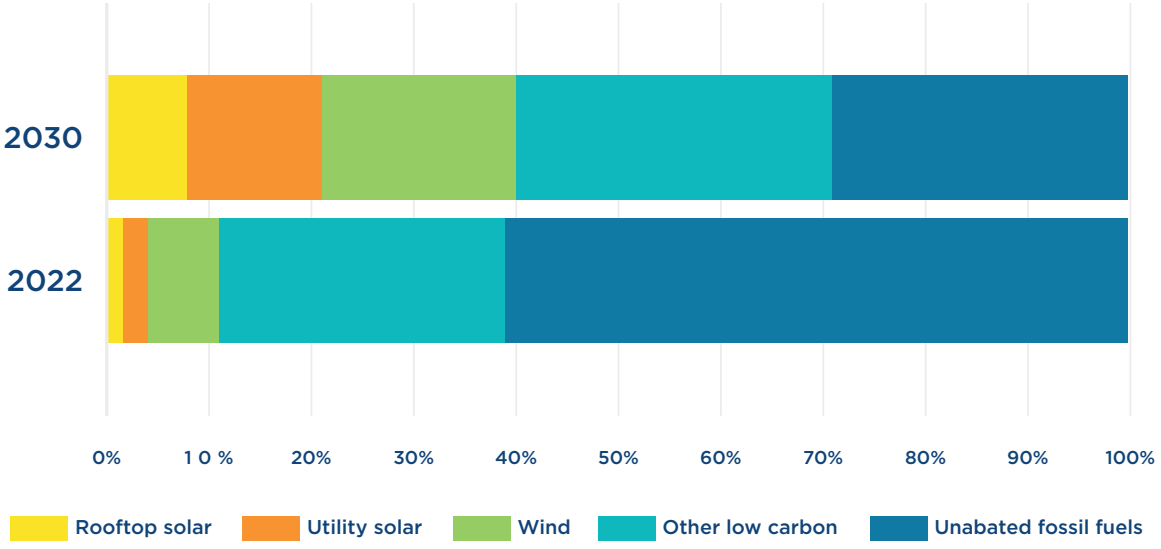
Electricity

1. **Decarbonizing the power sector is this decade's most important initiative.** By far the most important measure in decarbonizing the energy system this decade is the growth of low-carbon generation to meet demand growth and displace fossil fuel generation. The IEA's analysis projects that the share of low-carbon generation in the global mix will need to grow from 39% in 2022 to 71% in 2030 (see Figure 2[6], next page). This requires averaging an annual increase of 4%, compared to annual growth since 2015 of 0.7%. The emissions intensity of the global power system will need to drop by 60% to 186 g CO_2/kWh by 2030, representing a savings of over 10 Gt of CO_2 annually compared to today's mix. While hydro, biomass and other low-carbon generation (including nuclear) will need to grow by over 40% by 2030, three-quarters of the growth in low-carbon generation will come from solar PV and wind. Wind output will need to triple by 2030, surpassing hydropower to supply 19% of the world's electricity, but the growth of solar PV will need to be spectacular, going from supplying

6 International Energy Agency (IEA). (2023, September).

Figure 2. Global electricity generation shares - 2022, 2030

2022 (actual), 2030 (IEA NZE scenario)



Source: *Adapted from IEA (2023, September)*

only 4% of the world's electricity in 2022 to 21% in 2030. While most of the additional solar PV will be at utility scale, 8% of the world's electricity in 2030 will be produced on over 100 million rooftops of residential, commercial or industrial buildings.[7] The global power system's battery capacity will grow 20 times, to over 1 TW, to help manage fluctuations in output from variable renewable sources.

2. **Electricity demand in advanced economies, which had been stagnant or declining, will start to grow again, boosted by electric vehicles, electrification in industry and electrification of building heat.** Since 2010, electricity demand has changed little in the advanced economies. But changes underway in the electrification of vehicle fleets, industry and building heating are shifting matters. It is expected that by 2030, electric vehicles (EVs) will constitute two-thirds of new light-vehicle sales and industrial electricity demand will have grown by 30%, while a quarter of building heating demand will be met by heat pumps. Electricity demand in advanced economies is expected to shift back into growth mode, growing by 25% to 2030. By contrast, emerging markets and developing economies will continue to see rapid electricity demand growth, increasing 40% to 2030 as economies grow and industrialize. Globally, the share of electricity in total final consumption of energy, which had been increasing since 2015 by about 0.2% per year to reach 20% by 2022, is anticipated to grow at around 1% per year to 28% by 2030.

7 IEA. (2022, September). *Approximately 100 million households rely on rooftop solar PV by 2030.* https://www.iea.org/reports/approximately-100-million-households-rely-on-rooftop-solar-pv-by-2030

3. **The massive expansion of wind and solar, the closing of existing fossil fuel plants and the growth of demand will require substantial network investment to balance supply and demand.** Global generating capacity will nearly double by 2030, despite the closure of one-fifth of the world's fossil fuel generation facilities. Connecting this new generation in new locations to growing loads will require significant investment in both transmission and distribution. A large increase in distribution system investment will be needed to accommodate increased demand and more distributed generation. Figure 3 shows that annual network investment levels must more than double by 2030 to around 700 billion USD globally, of which 70% needs to be focused on distribution systems.[8]

Natural Gas

4. **A great leap forward in energy efficiency will be needed to reduce the demand for fossil fuels.** Energy intensity has been declining at a rate of 1.3% per year since 2015. According to the IEA, energy intensity would need to improve at 4.1% per year to 2030 to put the global energy system on a net zero trajectory. A combination of tighter efficiency standards, increased electrification and behavioral changes will be required to achieve this rate of improvement.
5. **The global demand for all fossil fuels, including natural gas, will need to shrink.** In the NZE scenario, electrification, end-use energy efficiency, and the rapid growth of renewables in the power sector will displace fossil fuels, and demand for all fossil fuels will decline almost immediately. Coal is expected to shrink most rapidly, as the power sector's use of coal will decline (in advanced

Figure 3. Global grid investment 2023-2030, trend versus NZE

Source: *Adapted from IEA (2023)*[9]

8 International Energy Agency (IEA). (2023, May). World energy investment 2023. https://iea.org/reports/world-energy-investment-2023

9 International Energy Agency (IEA). (2023, May). World energy investment 2023. https://iea.org/reports/world-energy-investment-2023

economies, it is expected to fall by 85% by 2030) through investment in alternatives and regulated phaseouts. But it is expected that even natural gas demand will fall by 18% globally by 2030 through increased efficiency, electrification and displacement in power supply. The decline in natural gas demand would be particularly marked in the building sector with a reduction of 37% globally by 2030. Some natural gas will be displaced by biomethane, which is anticipated to grow to account for 6% of gas supplies in 2030.

6. **Hydrogen begins to emerge as an energy carrier that requires new or repurposed infrastructure.** Hydrogen also begins to emerge as a low-carbon fuel for industry (including displacing existing high-carbon hydrogen production) and in power generation and is foreseen to grow quite significantly beyond 2030. The IEA's scenario anticipates that 19 000 km of hydrogen pipeline will be in service by 2030 to serve demand at industrial and power generation facilities, a figure that could reach 209 000 km in 2050. Some gas infrastructure could be repurposed to supply hydrogen.[0] The scenario does not expect hydrogen to play a significant role in building heating, even in 2050.

The Needed Acceleration in Clean Energy Transitions Will Challenge Regulators

Most energy regulators are created by governments to regulate the electricity and natural gas sectors to ensure that energy consumers have a secure supply of energy at a reasonable cost supplied by an efficient energy system.

While governments will set policies to encourage the acceleration of the transition toward net zero, most energy regulators, through their oversight of investments and the recovery of the costs of those investments, can have a decisive influence on the rate of acceleration. While the precise powers of regulators vary by jurisdiction, a strong push for decarbonization creates a long list of tasks for energy regulators, including:

Infrastructure development

Procure and connect significant renewable electricity generation

With annual additions of solar PV and wind globally expected to quadruple by 2030 in the IEA's NZE Scenario, renewables procurement processes will need to ramp up to achieve higher levels of capacity. In many jurisdictions, these procurement processes (such as auctions) are either the responsibility of regulators or subject to regulatory oversight. Furthermore, even once contracted, obtaining grid connection is already proving challenging. A recent IEA report[11] estimated that over 3000 GW of renewable energy projects are waiting in grid connection queues worldwide.

Approve more generation facilities

Some energy regulators have a role in approving the siting of generation infrastructure. New laws and regulations are being passed to require these approvals to be accelerated, which in turn may lead to more intensive involvement by regulators.

Approve significant investment in electricity network infrastructure

The transmission and distribution network investments needed exceed 4 trillion USD for the remainder of this decade. The higher investments are being driven by higher demand

10 European Commission. (2022, November 15). *In focus: Renewable hydrogen to decarbonise the EU's energy system*. https://commission.europa.eu/news/focus-renewable-hydrogen-decarbonise-eus-energy-system-2022-11-15-0_en

11 International Energy Agency (IEA). (2023, October 17). *Electricity grids and secure energy transitions*. https://www.iea.org/reports/electricity-grids-and-secure-energy-transitions

(e.g., because of industrial electrification) and new types of demand (e.g., EV charging).

More transmission facilities whose siting would require regulatory approval

A minority of energy regulators have responsibility for approving the siting of new transmission lines. As pointed out in the IEA report on electricity grids in the energy transition,[12] the much longer lead times for transmission investment, compared to the lead times for solar and wind farms, make the alignment of transmission expansion and renewables integration particularly challenging. The report estimates that a significant delay in grid expansion could lead to an extra 58 Gt of CO_2 emissions,[13] about 21% of the remaining global carbon budget[14] to keep the temperature increase under 1.5°C.

Electricity market design

Changes to market design and oversight

Electricity market design has seen renewed interest, particularly in the EU, with debates on how the current design should change to successfully integrate increasing shares of renewables, and some changes have now been agreed.[15] Australia[16] has likewise considered some wide-ranging changes to its national electricity market. Regulators may be responsible for advising on changes in wholesale electricity market design and managing the impacts of these changes for consumers.[17]

12 International Energy Agency (IEA). (2023, October 17).
13 International Energy Agency (IEA). (2023, October 17).
14 Global Carbon Project. (2023). *Carbon budget 2023*. Retrieved January 24, 2024, from https://globalcarbonbudget.org/carbonbudget2023/
15 European Commission. (2023, December 14). *Commission welcomes deal on electricity market reform* [Press Release]. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6602
16 Australian Energy Market Commission. (n.d.). *Post 2025 electricity market design*. https://esb-post2025-market-design.aemc.gov.au/
17 Agency for the Cooperation of Energy Regulators (ACER). (2022). *Final assessment of the EU wholesale electricity market design*. https://www.acer.europa.eu/sites/default/files/documents/Publications/Final_Assessment_EU_Wholesale_Electricity_Market_Design.pdf

Distributed energy resources and pricing

A large expansion of utility programs to encourage much greater end-use efficiency, demand-side flexibility and electrification to replace fossil fuels

Regulatory oversight of utilities' energy efficiency programs offered to customers, for either electricity and/or natural gas is common and can be expected to expand significantly. Programs to encourage electrification have started to emerge. Programs that combine greater end-use efficiency, shift consumption to periods where grid emissions are lower, and substitute the use of electricity for fossil fuels aim to reduce the carbon footprint of the customer or improve their "carbon efficiency."

Rules for connecting, paying and managing more-distributed PV and batteries

To a large extent, regulation will shape the incentives given to customers to invest in solar PV systems, EVs and batteries, all of which can provide services to the grid. Regulators have a role in making sure those incentives are well aligned with the public interest, especially since they will approve both the rules of connection and grid access and, in some cases, how these resources will be paid or managed by the regulated utility. Regulatory rules (e.g., access to smart meter data) can also encourage or limit retailer offerings for distributed resources.

Reforming how electricity is priced

The growth in the share of variable electricity supply will increase the value of demand that is flexible; that is, demand that consumes more when electricity supply is plentiful (e.g., in the middle of a sunny day) and less when supplies are tighter (e.g., when the sun sets). Electricity rate designs can encourage demand-side flexibility and electrification by offering electricity more cheaply when it is in surplus.

Natural gas market evolution

Managing how gas networks are operated and planned in light of reduced use of natural gas

The networks that distribute natural gas are likely to be most affected by the energy transition toward net zero emissions. In a few jurisdictions, new laws are banning gas connections to new construction,[18] and there are now examples of jurisdictions moving ahead with restrictions on gas heating in existing buildings.[19] Regulators are just beginning to confront some of the issues related to reduced use of gas, as increasing numbers of customers leave the natural gas system. Lower demand for gas and higher costs for gas (driven by higher CO_2 prices and increased use of more expensive low-carbon alternatives) can be expected to increase cost pressures on natural gas customers.

Low-carbon gases

Assessing the role of low-carbon gases and potentially regulating hydrogen distribution

The use of low-carbon gases is expected to increase significantly in the coming decades. In the near term, the IEA analysis[20] suggests a large increase in biomethane, and potentially hydrogen, that may be introduced in the natural gas supply to assist in the decarbonization of the natural gas system. In the medium term, hydrogen is expected to become a significant energy carrier supplying certain heavy industries and a transport fuel for some heavy vehicles. Regulators will be expected to consider[21] the extent to which some natural gas facilities can be converted for hydrogen use and, potentially, the regulation of pipelines used to transport and distribute hydrogen.

These are issues that need to be tackled by regulators today and examples exist of how they are confronting these challenges, even without explicit mandates.

The regulators we spoke to agreed that decarbonization was becoming important and that they faced new challenges. While some could point to decisions dating back decades that anticipated clean energy transitions (e.g., related to efficiency or renewables), decarbonization has clearly become a more central issue for regulators to address today.

Yet regulators are governed by their mandated responsibilities; most of them have specific responsibilities related to setting just and reasonable tariffs that ensure a reliable and affordable supply of energy. Regulators have been confronting decarbonization issues while, in most cases, lacking a specific mandate to make decarbonization issues a priority. Nevertheless, as shown in the interviews summarized in the following chapters, regulators have found creative ways to ensure that decarbonization priorities are weighed appropriately in regulatory decisions by recognizing their other benefits (such as reduced pollution, energy security and reduced price volatility).

Regulators Are Already Under Pressure to Deal with Rising Costs, Particularly in Electricity

While the exercise of creativity has assisted regulators in prioritizing decarbonization issues in the past, matters are about to get much more

18 Victoria State Government. (2022) *Gas substitution roadmap*. https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap

19 Kurmayer, N. (2023, September 11). *Germany adopts watered-down fossil boiler ban for 2028*. EURACTIV. https://www.euractiv.com/section/energy-environment/news/germany-adopts-watered-down-fossil-boiler-ban-for-2028/

20 International Energy Agency (IEA). (2022.) *An updated roadmap to Net Zero Emissions by 2050*. https://www.iea.org/reports/world-energy-outlook-2022/an-updated-roadmap-to-net-zero-emissions-by-2050

21 Commission de Régulation de l'Énergie (CRE). (2022, April 12). *Contribution of the Commission de régulation de l'énergie to the feedback period on the legislative proposal of the European Commission on the revision of the European Union rules on access to the gas market and networks*. [Energy Regulatory Commission]. [Answer to a Consultation] https://www.cre.fr/en/news/contribution-of-the-commission-de-regulation-de-l-energie-to-the-public-consultation-on-the-revision-of-the-european-union-rules-on-access-to-the-g

challenging. The ambition to reduce emissions rapidly means that energy system change must speed up compared to that of the last decade. In addition to the pressure to accelerate the transition to a clean energy system, there will be pressure to manage cost increases. And the cost pressures are mounting.

In our assessment, there are three main drivers of increased electricity costs. The first driver is **the increase in the wholesale cost of power**. Costs of power from fossil fuels have been rising thanks to a combination of increasing fuel prices as well as the increasing prevalence of carbon pricing. This will be of concern both in regulated jurisdictions with high proportions of fossil fuels in the generating mix as well as in those with wholesale markets, where fossil fuel generation tends to set the market price for electricity. Although higher electricity prices improve the economic attractiveness of renewable energy sources, the dominant position of fossil fuels in setting market prices means it will take some time before the rise in the share of renewable and other low-carbon generation begins to drive down the average market price.[22]

The second cost-pressure driver is **the need for increased capital expenditure in electricity networks** to meet decarbonization goals. As noted above, total investment in networks will need to more than double by 2030 while demand increases 30–40%, implying electricity network charges will need to increase. Network investment costs have been increasing because of cost inflation in capital equipment, which has increased significantly[23] in the past few years.[24]

The third driver is the **increase in the cost of capital for financing investments**. This not only affects the financing of new investments but also the allowed return on existing capital stock is expected to be higher than that of the previous decade owing to an increase in interest rates.[25]

In addition to electricity cost pressures, falling numbers of natural gas customers will raise natural gas rates, even as natural gas remains an essential part of the energy supply of many customers. As the customer base begins to shrink, it will become increasingly expensive per customer to operate the natural gas system. Gas utilities will also press regulators to allow them to depreciate assets more quickly, which, if allowed, will further raise rates.

The purpose of this document is to show examples of how regulators from all over the world are tackling these new challenges while trying to fulfill their unique role in the energy sector governance. By showing the types of challenges faced, the dilemmas confronted, and the lessons learned from these experiences, we hope to demonstrate both the effectiveness of existing regulatory tools, creatively used, as well as where the existing regulatory toolkit is clearly insufficient and needs to be supplemented. It will also highlight the tension between decarbonization mandates and obligations to ensure a reliable and affordable supply of energy for society.

22 In certain hours, however (for example, in the middle of a sunny mild day), some electricity markets are already experiencing negative prices thanks to the growth of solar PV. Most smaller customers have electricity rates that protect them from hour-to-hour volatility and so. conversely, have no incentive to take advantage of this inexpensive grid electricity.

23 Midcontinent Independent System Operator (MISO). (2023, May 5). *Transmission cost estimation guide for MTEP23* [PDF document]. https://cdn.misoenergy.org/MISO%20Transmission%20Cost%20Estimation%20Guide%20for%20MTEP23337433.pdf

24 Midcontinent Independent System Operator (MISO). (2019, April 16). *Transmission cost estimation guide MTEP19* [PDF document]. https://nocapx2020.info/wp-content/uploads/2019/07/Transmission-Cost-Estimation-Guide-for-MTEP-2019337433.pdf

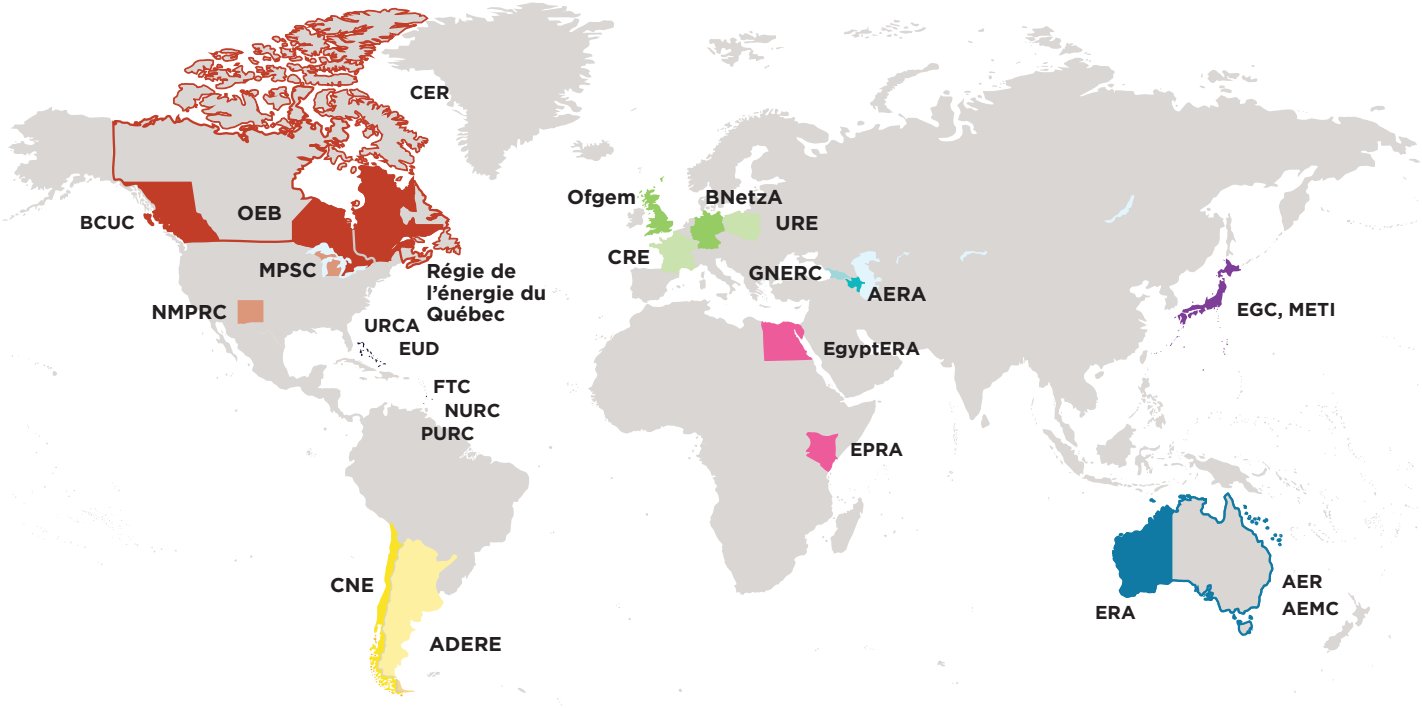
25 FRED, Federal Reserve Bank of St. Louis. Board of Governors of the Federal Reserve System (US). (n.d.) *Market yield on U.S. treasury securities at 10-year constant maturity, quoted on an investment basis* [DGS10]. Retrieved January 24, 2024, from https://fred.stlouisfed.org/series/DGS10/

Chapter 2. Interview Results

An Overview of the Methodology Employed

We conducted 30 interviews, of which 25 were regulatory agencies and five regulatory experts. The 25 regulators were geographically dispersed, with six from North America, five from the Caribbean, two from South America, four from Europe, two from Eurasia, three from Australia, two from Africa, and one from Asia (Figure 4). Equally, the regulatory agencies are diverse in terms of size (some with only a few employees[26] and the largest with over 1,300 permanent staff)[27] and even mandate (some overseeing a single incumbent utility and others responsible for oversight of wholesale and retail energy markets). The list of those we interviewed is included in this report (Annex A). The interviews were conducted virtually between July 24 and October 6, 2023. To encourage a free and open discussion, comments made in the interviews were not for attribution.

Figure 4. Jurisdictions of regulators interviewed for this report



26 National Utilities Regulatory Commission (NURC). (n.d.). *NURC structure*. https://nurc.org.lc/about/nurc-structure/

27 Office of Gas and Electricity Markets (Ofgem). (2023, July 14). *Ofgem annual report and accounts 2022–2023*. https://ofgem.gov.uk/publications/ofgem-annual-report-and-accounts-2022-2023-html

The interview questions covered five areas:

- **Government-regulator relationship:** These questions explored how government commitments to decarbonization, and government's expectations regarding how regulators are to address these issues, are communicated to regulators.
- **Application of decarbonization criteria in recent decisions:** These questions focused on how decarbonization considerations are being applied currently. We asked regulators to give us specific examples of how decarbonization is being considered currently in their regulatory decision making.
- **Appropriateness of existing legal/regulatory framework in addressing decarbonization:** These questions aimed to uncover regulators' perceptions of the effectiveness, and conversely the limitations, of their current legal and regulatory framework with respect to prioritizing decarbonization in their decision making. In addition, the questions and discussion explored how regulators were balancing decarbonization with other concerns, such as energy security and affordability.
- **Potential enhancements to the legal/regulatory framework:** Interviewees were asked for their thoughts on legal or regulatory changes that would enhance the ability of regulators to incorporate decarbonization in regulatory decision making. They were further asked, if they could make one change, what would it be?
- **Final thoughts:** Interviewees were invited to share their thoughts about the project or other points to be kept in mind.

The full lists of questions posed to regulators and stakeholders are attached as Annex B.1 and Annex B.2, respectively.

Key Insights from the Interviews

Spending 45 hours questioning regulators and regulatory experts on these topics and listening to their answers has left us with several key insights about these issues. Below we present insights from each of the five topic areas and final suggestions for RETA.

Government-regulator relationship

Many regulators saw themselves both as allies of the government and as decision-makers whose independence was protected by statute. They made a distinction between independence in the making of regulatory decisions (e.g., approving a tariff) versus ensuring that the decisions and activities of the regulator were broadly aligned with the government's priorities. Although formal consultation between the government and regulator on decarbonization policy was not common, informal consultations were. Some regulators were consulted for policy advice, others to offer their specialized technical advice. More often, regulators were consulted on the implications for implementation of the proposed policies. Several emphasized that regulators could play a key role in advising governments on the implied practicalities. They know the sectors that they regulate and can advise on the likely effectiveness of policies under consideration and what "micro policies" they as regulators would need to create to support implementation of the broader government policies.

Application of decarbonization criteria in recent decisions

Decarbonization is not a new issue, and most regulators have had to deal with it for years, though often decarbonization is the indirect outcome.

The promotion of renewable energy appears to be a central concern of most regulators, second only to tariff setting in their responsibilities. For some, such as the Caribbean regulators we interviewed, providing a stable investment framework for renewable generators to support government goals for renewable energy is a core responsibility. Regulators in other jurisdictions were working to overcome limitations in renewable expansion. For example, in the U.S.,[28] UK[29] and Western Australia,[30] regulators were acting to address the long connection queues that have formed because of the relative economic attractiveness of renewable electricity generation investments.

In addition to direct promotion, **regulators have been adjusting planning requirements** in ways that level the playing field between renewable (or other low-carbon generation) sources relative to fossil fuel options. Some techniques have raised the planning cost of fossil fuel options, by internalizing an externality cost (Mexico)[31] or by attributing commodity risk to fossil fuels (Michigan).[32] In addition to these quantitative adjustments, the requirement of some regulators to incorporate climate resilience in electricity system plans (Grenada),[33] or more generally to encourage utilities to consider nonenergy benefits (Québec),[34] also balances assessments of costs and benefits of low-carbon sources relative to fossil fuels. Others are requiring utilities to include low-emissions options consistent with government decarbonization goals (Michigan)[35] or requiring gas and electric utilities to plan jointly so that a consistent approach to planning is used across fuels (British Columbia).[36] The Canadian Energy Regulator also has the responsibility of performing NZE analysis[37] for Canada to inform federal government policymaking.

Regulators are also approving **investments that support the increase in renewables**. In Poland, the approved network investment plan[38] has become more forward-looking, anticipating much higher levels of renewable energy consistent with the government's 2030 target. The regulator in Germany has siting authority over transmission lines and recently approved an early start to construction[39] of two major lines intended to accommodate additional renewables supply. Ofgem, together with the UK government, recently

28 Federal Energy Regulatory Commission (FERC) [U.S.], Docket No. RM-22-14-000, Order 2023 on July 28, 2023. https://www.ferc.gov/media/e-1-order-2023-rm22-14-000

29 Department for Energy Security and Net Zero and Ofgem [UK]. (2023, November 22). *Electricity networks: Connections action plan*. https://gov.uk/government/publications/electricity-networks-connections-action-plan

30 Economic Regulation Authority Western Australia (ERAWA) [AU]. (2023, March 31). *Final decision on proposed revisions to the access arrangement for the Western Power network 2022/23 – 2026/27*. Attachment 12: Policies and contracts. https://www.erawa.com.au/AA5

31 Secretaría de Hacienda y Crédito Público [Ministry of Finance and Public Credit] [Mexico]. (2012, December 14). *Metodología para valorar externalidades asociadas con la generación de electricidad en México* [Methodology for valuing externalities associated with electricity generation in Mexico]. https://dof.gob.mx/nota_detalle.php?codigo=5282384&fecha=14/12/2012

32 Michigan Public Service Commission. (n.d.). *Low carbon energy infrastructure enhancement and development grant*. Retrieved January 23, 2024, from https://michigan.gov/mpsc/commission/low-carbon-energy-infrastructure-enhancement-and-development-grant

33 Public Utilities Regulatory Commission of Grenada (PURC). (2023, July 10). *Renewable energy brochure*. https://purc.gd/renewable-energy-brochure/

34 Régie de l'énergie. (2022). *Summary of decision D-2022-061 rendered in case R-4169-2021 concerning support measures for the decarbonization of building heating*. R-4169-2021-A-0065 [PDF document]. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4169-2021/doc/R-4169-2021-A-0065-Dec-Som-2022_07_06.pdf

35 Michigan Public Service Commission. (n.d.). *Low carbon energy infrastructure enhancement and development grant*. Retrieved January 23, 2024, from https://michigan.gov/mpsc/commission/low-carbon-energy-infrastructure-enhancement-and-development-grant

36 British Columbia Utilities Commission. (2022). *Application ID 959. Energy scenarios for BC Hydro and FEI*. https://bcuc.com/OurWork/ViewProceeding?applicationid=959

37 Canada Energy Regulator. (2023, June 20). *Canada Energy Regulator projects major transformation of Canada's energy system to a net-zero world* [News release]. http://www.cer-rec.gc.ca/en/about/news-room/news-releases/2023/canada-energy-regulator-projects-major-transformation-canada-energy-system-net-zero-world.html

38 Ministerstwo Klimatu i Środowiska [Ministry of Climate and Environment] [Poland]. (2021). *Polityka energetyczna Polski do 2040 r. [Poland's energy policy until 2040]*. https://www.gov.pl/web/klimat/polityka-energetyczna-polski

39 Bundesnetzagentur. (2023, October 20). *Bundesnetzagentur genehmigt vorzeitigen Baubeginn für Stromleitung A-Nord* [Federal Network Agency approves early construction start for the A-Nord power line] [Press release]. https://bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2023/20231020_ANord.html?nn=265778

announced an action plan[40] to speed up expansion of networks. Similarly, other regulators have been pushing for **increased system flexibility** by encouraging integration into regional electricity markets (New Mexico)[41] or operating procurements for electricity storage (Barbados).[42]

The regulatory framework can also **influence system flexibility**. In France, the regulator is adjusting the regulatory incentives (TURPE 6)[43] to encourage distributors to get customers to shift energy demand.[44] Italy has been quite advanced in using output-based regulation[45] to encourage distributors to adjust their investment plans and tariffs to address the increasing share of solar PV. The regulatory scheme is evolving to a total-expenditure approach, referred to in Italy as "ROSS base"[46] and intended in part to mitigate bias that tended to favor capital-intensive solutions.[47]

Regulatory requirements for utilities (or retailers) **to undertake energy efficiency programs** have been in place in some jurisdictions for decades, but in others (such as Egypt)[48] have been introduced more recently. Regulatory expectations are changing:[49] utilities are increasingly expected to encourage their customers to electrify their end uses.

Electrification is also a driver for a new type of electricity rate: **one that encourages EV owners to charge smartly**. New rates are emerging: including very low overnight electricity rates (Ontario)[50] and those specific to EVs (Kenya).[51]

While hydrogen as an energy carrier is still at the nascent stage, some regulators have been advising governments on how to address the implications of **regulating the development of hydrogen infrastructure**. In Australia, taking into account advice from the Australian Energy Market Commission (AEMC),[52] the Australian Energy Regulator (AER)[53] and the Western Australia Economic Regulation Authority, Australian energy ministers agreed to extend[54] the national natural gas regulatory framework to include hydrogen and renewable gases. Supporting legislation at the state level[55] is now being passed. In the European

40 UK Government, Department for Energy Security & Net Zero. (2023, November). *Transmission acceleration action plan. Government response to the Electricity Networks Commissioner's report on accelerating electricity transmission network build* [PDF document]. https://assets.publishing.service.gov.uk/media/65646bd31fd90c0013ac3bd8/transmission-acceleration-action-plan.pdf

41 New Mexico Energy, Minerals and Natural Resources Department. (2021, January). *Whitepaper series #5: Establishing a New Mexico RTO task force* [PDF document]. Grid Modernization Advisory Group. https://emnrd.nm.gov/ecmd/wp-content/uploads/sites/3/RTOTaskforce_1.29.21.pdf

42 Fair Trading Commission [BB], FTCUR/DECEST/2023-03, Decision on energy storage framework and tariffs on June 28, 2023. http://www.ftc.gov.bb/index.php?option=com_content&task=view&id=19&Itemid=46

43 Commission de Régulation de l'Énergie (CRE). (2021, July). *Publication de la méthodologie de la structure du TURPE 6* [Publication of the methodology for the structure of TURPE 6]. https://www.cre.fr/Lettres-d-information/publication-de-la-methodologie-de-la-structure-du-turpe-6

44 Commission de Régulation de l'Énergie (CRE). (2022, June 01). *Rapport D'Activitie 2021* [Activity report 2021]. https://www.cre.fr/en/documents/Publications/Annual-reports/activity-report-2021

45 Schiavo, L., Delfanti, M., Fumagalli, E., & Olivieri, V. (2012). *Changing the regulation for regulating the change*. International Confederation of Energy Regulators (ICER). http://icer-regulators.net/ds-award/

46 Directorate of Infrastructure Energy and Unbundling (DIEU), Consultazione 12 luglio 2022, 317/2022/R/com, *Ambito di applicazione dell'approccio ROSS e criteri di determinazione del costo riconosciuto secondo l'approccio ROSS BASE - Orientamenti* [Scope of the ROSS approach and cost-resetting criteria recognized according to the ROSS BASE approach – Guidelines]. Autorità di Regolazione per Energia Reti e Ambiente (ARERA). https://www.arera.it/atti-e-provvedimenti/dettaglio/22/317-22

47 Schiavo, L. (2019, September 12). *Electricity smart metering: regulatory experience in Italy* [Presentation]. ARERA. https://www.e-control.at/documents/1785851/0/LucaLoSchiavo_DRUCK.pdf/22ca345e-f3f9-d84e-dbb4-3ea0ce602286?t=1568359149736

48 Egyptian Electric Utility and Consumer Protection Regulatory Agency. (n.d.). *Generation energy efficiency*. Retrieved January 23, 2024, from http://egyptera.org/en/GenEffecient.aspx

49 American Council for an Energy-Efficient Economy. (2021, December 2). *The need for climate-forward efficiency: Early experience and principles for evolution* [Research report]. https://aceee.org/research-report/u2106

50 King's Printer for Ontario. (2023, April 11). *Ontario launches new ultra-low overnight electricity price plan* [News Release]. https://news.ontario.ca/en/release/1002916/ontario-launches-new-ultra-low-overnight-electricity-price-plan

51 Energy and Petroleum Regulatory Authority (EPRA). (2023). *Retail electricity tariff review for the 2022-23 – 2025-26 4th tariff control period (TCP) effective 1st April 2023*. https://epra.go.ke/retail-electricity-tariff-review-for-the-2022-23-2025-26-4th-tariff-control-period-tcp-effective-1st-april-2023/

52 Australian Energy Market Commission (AEMC). (2022, November 24). *Review into extending the regulatory frameworks to hydrogen and renewable gases, final rules report*. https://www.aemc.gov.au/market-reviews-advice/review-extending-regulatory-frameworks-hydrogen-and-renewable-gases

53 Australian Energy Regulator (AER). (2021, November 15). *Regulating gas pipelines under uncertainty*. https://www.aer.gov.au/publications/reports/performance/regulating-gas-pipelines-under-uncertainty-information-paper

54 Australian Government. Department of Climate Change, Energy, the Environment and Water. (2023, July 14). *Extending the national gas regulatory framework to hydrogen, biomethane and other renewable gases*. Energy and Climate Change Ministerial Council. https://www.energy.gov.au/energy-and-climate-change-ministerial-council/working-groups/gas-working-group/gas/extending-national-gas-regulatory-framework-hydrogen-and-renewable-gases

55 How, B. (2023, October 11). *Qld pipeline regulation repurposed for hydrogen*. InnovationAus. https://www.innovationaus.com/qld-pipeline-regulation-repurposed-for-hydrogen/

Union, the European Commission's proposal[56] on the development and regulation of hydrogen infrastructure, to which European regulators had early input,[57] is in negotiations, which are expected to conclude soon. In France,[58] the CRE will take a progressive approach and aims to regulate hydrogen pipelines and storage over the medium term.

Regulators have just begun to grapple with the questions regarding the **future of the natural gas network**. The issue was explored in depth in an information paper: *Regulating gas pipelines under uncertainty*,[59] published by the AER. The AER was also responsible for changing the policy on the recovery of gas disconnection costs, thus reducing disconnection charges[60] when increasing household disconnections from the gas grid raised concerns about safety. The French regulator looked at future scenarios for the use of natural gas infrastructure in France[61] and concluded that most of the existing gas infrastructure will be needed until 2050. Several have approved programs[62] to allow utilities to market biomethane as a premium gas product (British Columbia). Others have recognized the need for faster depreciation of new gas infrastructure (Québec)[63] and developed policies with respect to the treatment of abandoned pipelines (Canada Energy Regulator).[64]

We heard from several regulators about initiatives to encourage innovation[65] on the part of regulated entities, recognizing that current regulations might be an impediment to such innovation. Regulatory sandboxes, where regulated entities are permitted to trial new products, services or business models without some of the usual rules applying,[66] have been implemented in the UK,[67] Canada (Ontario),[68] Italy,[69] France[70] and Australia.[71] Some regulators saw the use of pilot programs or voluntary programs (e.g., customers choosing to pay a premium for renewable natural gas)[72] as opportunities to encourage innovation in ways that support decarbonization.

56 International Energy Agency (IEA). (2023, September). *Global hydrogen review 2023*. https://www.iea.org/reports/global-hydrogen-review-2023

57 European Union Agency for the Cooperation of Energy Regulators (ACER), Council of European Energy Regulators (CEER). (2021, February 9). *When and how to regulate hydrogen networks? "European Green Deal" regulatory white paper series (paper #1) relevant to the European Commission's hydrogen and energy system integration strategies* [White paper]. https://www.ceer.eu/documents/104400/7155350/ACER_CEER_WhitePaper_on_the_regulation_of_hydrogen_networks_2021-02-09_FINAL_CEER_V2/d44b8193-24aa-c314-9428-bc4ccf94fd6d

58 Commission de Régulation de l'Énergie (CRE). (2023, September). *Contribution de la Commission de regulation de l'énergie à la stratégie française énergie-climat* [Contribution of the Commission of Energy Regulation to the French energy-climate strategy]. https://www.cre.fr/actualites/la-cre-presente-sa-contribution-a-la-strategie-francaise-energie-climat

59 Australian Energy Regulator (AER). (2021, November 15).

60 Australian Energy Regulator (AER). (2023, June). *Final decision – AusNet Gas Services gas distribution access arrangement 1 July 2023 to 30 June 2028 Overview*. https://www.aer.gov.au/documents/aer-final-decision-ausnet-2023-28-overview-june-2023

61 CRE. (2023, April). *Avenir des infrastructures gazières aux horizons 2030 et 2050, dans un contexte d'atteinte de la neutralité carbone* [Future of gas infrastructure by 2030 and 2050, in a context of achieving carbon neutrality]. https://www.cre.fr/documents/Publications/Rapports-thematiques/avenir-des-infrastructures-gazieres-aux-horizons-2030-et-2050-dans-un-contexte-d-atteinte-de-la-neutralite-carbone

62 British Columbia Utilities Commission (BCUC), Order 6-242-21-Stage 1 on August 12, 2021. *FortisBC Energy Inc. biomethane energy recovery charge rate methodology*. https://www.bcuc.com/OurWork/ViewProceeding?applicationid=807

63 Régie de l'énergie Québec, D-2020-096, Dossier R-4119-2020 of July 24, 2020. *Décision sur l'amortissement accéléré du solde complet du compte d'écart de coût cumulatif projeté de la fourniture de gaz naturel à compter du 1er août 2020* [Decision on accelerated amortization of the full balance of the projected cumulative cost variance account of the supply of natural gas from August 1, 2020]. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4119-2020/doc/R-4119-2020-A-0053-Dec-Dec-2020_12_11.pdf (Permalink: https://www.regie-energie.qc.ca/fr/participants/decisions/2020)

64 Canada Energy Regulator (CER). (2023). *Abandonment of a pipeline*. https://www.cer-rec.gc.ca/en/consultation-engagement/land-matters-guide/abandonment-pipeline.html

65 International Smart Grid Action Network (ISGAN), International Energy Agency (IEA), (2019, May). *Casebook on innovative regulatory approaches with focus on experimental sandboxes*. https://iea-isgan.org/casebook-on-innovative-regulatory-approaches-with-focus-on-experimental-sandboxes/

66 Ofgem. (2018, September 7). *What is a regulatory sandbox?* https://www.ofgem.gov.uk/publications/what-regulatory-sandbox

67 Ofgem (n.d.). *Innovation link: Policy and regulatory programmes*. Retrieved January 23, 2024, from https://ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/innovation-link

68 Ontario Energy Board. (n.d.). *Regulatory sandbox*. Retrieved January 23, 2024, from https://oeb.ca/_html/sandbox/index.php

69 Schiavo, L. (2021, June 25). *The regulatory toolbox for supporting innovation — Experience of the Italian Regulatory Authority: Regulatory experiments and pilot regulations* [PDF document]. https://www.ceer.eu/documents/104400/7244045/Luca+Lo+Schiavo+-+CEER+Internal+Workshop.pdf/a346cbc0-ffbf-8b34-0112-4814d87d1ee0?version=1.0

70 Commission de Régulation de l'Énergie. (2023, July 13). *Regulatory sandbox*. https://www.cre.fr/en/Energetic-transition-and-technologic-innovation/regulatory-sandbox

71 Australian Energy Regulator. (n.d.). *Regulatory sandboxing – Energy innovation toolkit*. https://aer.gov.au/networks-pipelines/regulatory-sandboxing-%E2%80%93-energy-innovation-toolkit

72 Michigan Public Service Commission. (n.d.). *Voluntary green pricing programs*. Retrieved January 23, 2024, from https://michigan.gov/mpsc/consumer/electricity/voluntary-green-pricing-programs

Interplay of decarbonization with other criteria. Even when decarbonization is a priority in a regulatory decision, there are several examples where it is not the only factor that regulators have taken into consideration in major decarbonization initiatives. In practice, this can mean regulators opt for a compromise solution over what might be seen as an ideal solution when viewed solely as a decarbonization issue. Two examples:

1. **Approval of hybrid heating/electrification program:** For example, when the electricity distributor and gas distributor in Québec proposed a joint program to get gas heating customers to switch to electric heat with natural gas backup, the regulator concluded[73] that an alternative, namely a switch to an all-electric heating system would be far more costly to the power system (and to other consumers not involved in the program) than the hybrid system proposed, and therefore approved the program.
2. **Limits on rooftop solar to mitigate impact on other customers and "protect security of supply."** The falling cost of solar PV has made its installation on rooftops particularly attractive in the Caribbean islands, where most of the electricity is generated by oil (or in some cases, natural gas). But rapid uptake of solar PV has led to concerns about impact on other customers, and limits have been imposed in some countries. In St Lucia, the regulator limits the size of individual rooftop PV installations to 5 kW for residential units and 25 kW for commercial facilities, and it is currently considering[74] whether to revise these limits and the compensation paid. Grenada[75] introduced limits on PV size per customer as well as capping of total rooftop PV capacity eligible for net metering at 1 MW because of concerns about ratepayer impact and security of supply.

Appropriateness of existing legal/regulatory framework in addressing decarbonization

Affordability loomed large as a major concern for many of the regulators with whom we spoke. Regulators recognized that the impact of adopting solar PV, EVs or heat pumps could be rather different between those who adopted the new technologies (who tended to be wealthier) and those who did not. For example, the loss of revenue from net metering could lead to price increases for other customers. One response has been to manage the pace of investments to mitigate cost increases to nonparticipating customers (as referred to above with Grenada). A similar concern about affordability motivated the British Columbia Utilities Commission (BCUC) to request[76] that the government provide explicit guidance on how the regulator should address affordability in the context of decarbonization (British Columbia).

Economic efficiency was of higher priority for most European energy regulators. Though still concerned about affordability, the role of economic efficiency in their decision making was marked. This may well be due to a difference in context, as most European regulators came into existence only when markets for electricity and natural gas were being opened. and economic efficiency was a top driver of these reforms, in contrast with some other jurisdictions

73 Régie de l'énergie. (2022, May 19). *Summary of Decision D-2022-061 rendered in case R-4169-2021 concerning support measures for the decarbonization of building heating*. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4169-2021/doc/R-4169-2021-A-0065-Dec-Som-2022_07_06.pdf

74 National Utilities Regulatory Commission. (2023, April 21). *The NURC held a public consultation on renewable energy pricing and capacity limits* [Press release]. https://nurc.org.lc/press-release-the-nurc-held-a-public-consultation-on-renewable-energy-pricing-and-capacity-limits/

75 Public Utilities Regulatory Commission of Grenada. (2021). *Self-generator programme 2021*. https://purc.gd/purc_doc/applications/

76 British Columbia Utilities Commission. (2022, April 12). *Letter from BCUC's chair to Minister of Energy, Mines and Low Carbon Innovation. BCUC's role in the energy transition* [Sent via email]. It outlines BCUC's perspective on its role in supporting British Columbia's energy transition, specifically regarding greenhouse gas emissions reduction. Key points include: BCUC's role in energy transition (ensuring safe, reliable and affordable energy services amidst efforts to reduce greenhouse gas emissions); challenges and recommendations (increasing electricity demand, decreasing natural gas demand, the impact on affordability, rising electricity needs, the risk of natural gas infrastructure becoming obsolete and the necessity for significant renewable energy investments); and legislative and regulatory suggestions (for greenhouse gas reduction targets in public utility energy delivery, focusing on affordability, recommending more flexibility for BCUC in applying these targets, including customer-driven initiatives and offsets).

where protection of consumers from the excesses of a monopoly has had the central role. For some, economic efficiency has also been a rationale for the internalization of external environmental costs in energy planning.

Duplication of initiatives from different levels of government was also highlighted as a potential problem. Several regulators noted that multiple levels of government are issuing policies and regulations that impact decarbonization of the energy system and are often not consistent with one another, posing problems both for the entities that are regulated by multiple jurisdictions and for their regulators. This situation can encompass regional markets, where national regulations must adapt/follow regional directives, as in the EU.

Some decarbonization initiatives have proven hard to justify **without an explicit regulatory goal to reduce greenhouse gas emissions**. In Michigan,[77] a gas utility proposed several decarbonization initiatives, including methane reduction. The regulator, Michigan Public Service Commission (MPSC), found[78] that lacking an explicit decarbonization objective, it could not approve these expenditures, although the decision also pointed out other criteria, such as business continuity or resilience, that could be used in a future application to justify these expenditures.

Other decarbonization initiatives have been turned down because **the decarbonization benefits were not clear.** British Columbia's regulator[79] turned down an application to expand a district heating system, as it was still run on fossil fuels without a clear plan to convert it to a low-carbon alternative and thus would have had little impact on greenhouse gas emissions.

Timeliness also emerged as a growing concern. As the time it takes to get approval and construct new generation (mainly from wind and solar farms) is now shorter than the time it takes to build new transmission lines, including local required permits, there is the risk of a serious mismatch between the rapid growth of renewable electricity generation and the expansion of the transmission lines needed to support it.

This issue was particularly evident with the challenges that Germany has been facing to connect its new wind resources in northern Germany to load centers in the southern part of the country where existing resources were being retired. Germany[80] identified in 2011 a need for new transmission lines[81] to replace output from closing nuclear power plants. Additional responsibilities were given to the regulator, Bundesnetzagentur (BNetzA),[82] to approve both the investments and the routes chosen for the new transmission corridors. The BNetzA approved three new power lines,[83] but at the time of this writing, over a decade after they were first proposed, these lines are not built. Construction of the first two[84,85] started

77 Michigan Public Service Commission. (2021, May 28). *In the matter of the application of Consumers Energy Company for approval of an integrated resource plan under MCL 460.6t, certain accounting approvals, and for other relief.* Case Number U-21090. https://mi-psc.my.site.com/s/case/500t000000md6sCAAQ/in-the-matter-of-the-application-of-consumers-energy-company-for-approval-of-an-integrated-resource-plan-under-mcl-4606t-certain-accounting-approvals-and-for-other-relief

78 Michigan Public Service Commission, Court of Appeals, Case Number U-21090, Decision in IN RE APPLICATION OF CONSUMERS ENERGY RE INTEGRATED RESOURCE PLAN, Docket No. 362294, on March 23, 2023 [Court Order]. https://mi-psc.my.site.com/s/filing/a008y000003R3vDAAS/u210900915

79 British Columbia Utilities Commission, Decision on Creative Energy Vancouver Platforms Inc. Application for certificate of public convenience for a low carbon neighbourhood energy system for Northeast False Creek and Chinatown neighbourhoods of Vancouver, on December 8, 2015. https://www.ordersdecisions.bcuc.com/bcuc/decisions/en/item/126938/index.do?q=vancouver+Northeast+False+Creek+hot+water+low-carbon+source

80 Federal Foreign Office, Germany. (n.d.). *The German Energiewende* [PDF document]. https://auswaertiges-amt.de/blob/610620/5d9bfec0ab35695b9db548d10c94e57d/the-german-energiewende-data.pdf

81 Federal Ministry for Economic Affairs and Climate Action, Germany. (n.d.). *Rahmenbedingungen für den Netzausbau* [Regulatory framework for network expansion]. https://bmwk.de/Redaktion/DE/Artikel/Energie/stromnetze-und-netzausbau-regulierung-rahmenbedingungen.html

82 Bundesnetzagentur. (n.d.). *Bundesnetzagentur and grid expansion*. Retrieved January 23, 2024, from https://netzausbau.de/EN/Englisch-node.html

83 Groebel A. (2018, April 10). *BNetzA's role in energy infrastructure regulation and planning/permitting* [Presentation]. Conference on "The governance of maintenance and investment in infrastructures," organized by the Club of Regulators in cooperation with the OECD Network of Economic Regulators. https://chairgovreg.fondation-dauphine.fr/fr/publication/615/bnetza-s-role-energy-infrastructure-regulation-and-planning-permitting

84 Dietl K. (2023, March 21). *Starting signal given for European electricity highway: Converter for SuedOstLink connection enters construction phase* [Press Release]. 50Hertz. https://50hertz.com/en/News/Details/13316/starting-signal-given-for-european-electricity-highway-converter-for-suedostlink-connection-enters-construction-phase

85 Haffke I. (2023, September 13). *TenneT: The energy transition is becoming a reality – Construction of SuedLink has begun* [Press Release]. TenneT. https://www.tennet.eu/news/tennet-energy-transition-becoming-reality-construction-suedlink-has-begun

only in 2023, and the last of the three "electric superhighways" is not expected in service until 2028, six years later than originally projected.

Following through on innovation. While interviewed regulators thought their efforts in encouraging innovation through regulatory sandboxes were positive, they were also concerned about the follow-up. If a pilot program is undertaken and shows clear benefits to a change in regulations to allow the activity, the program must nonetheless end without any guarantee of when or whether the necessary regulatory changes would be made so that the innovation could be implemented on a more permanent basis.

Potential Enhancements to the legal/regulatory framework

Introduction of a statutory requirement to consider decarbonization. Several of the regulators we spoke to suggested that a statutory requirement that explicitly recognizes the need to achieve decarbonization goals would be useful for their decision making. Two jurisdictions (Australia[86] and the United Kingdom[87]) have recently passed legislation requiring regulators to weigh these decarbonization goals explicitly in their regulatory decision making. Some suggested that a requirement to adhere to sector-based targets (e.g., renewable targets for the electricity sector) would be desirable, whereas others suggested a more general duty to be weighed among others would be sufficient.

In the U.S., New Mexico's regulator has an additional important responsibility related **to ensuring a just transition.**[88] The legislation, which mandates a coal phaseout and its replacement with renewables, creates three funds aimed at providing support to communities affected by the coal closures. These funds are supported by utility payments that are to be made when a coal plant is closed. The regulator ensures that the money from the utility is transferred to the funds. In Michigan, also in the U.S., the regulator[89] is responsible for overseeing a fund financed by the state for low-carbon infrastructure.

Others suggested that a more specific instrument, such as **the carbon price to be applied in regulatory decisions, or sector-specific emissions targets,** would be most helpful and could be most readily incorporated into utility planning and regulatory decisions.

Final thoughts

The regulators we interviewed were not shy about raising other points that we should consider in our report. Several emphasized **the role regulators could have in shaping energy transition policies of governments.** Regulators are at the very end of the policymaking chain — they are "closer to the coal face" than other public officials in the sector. Regulatory oversight demands closer observation of those being regulated than policymakers are normally aware. Regulators are therefore in a privileged position to provide technical and practical advice to policymakers on what policies can be successfully implemented.

On implementation, several regulators pointed out that the increase of activity expected from regulators is not being matched by a commensurate increase in **regulatory resources**. This is already emerging as a constraint to timely decision making. Regulators are

86 Government of South Australia. (2023, September 21). *Statutes amendment (National Energy Laws) (Emissions reduction objectives) Act 2023*. https://www.legislation.sa.gov.au/__legislation/lz/v/a/2023/statutes%20amendment%20(national%20energy%20laws)%20(emissions%20reduction%20objectives)%20act%202023_26/2023.26.un.pdf

87 Office of Gas and Electricity Markets (Ofgem). (2023, October 25). *Ofgem welcomes Energy Act getting royal assent* [Press Release] https://ofgem.gov.uk/publications/ofgem-welcomes-energy-act-getting-royal-assent

88 New Mexico Legislature, *Senate Bill 489, 2019* [PDF document]. https://nmlegis.gov/Sessions/19%20Regular/final/SB0489.pdf

89 Helms M. (2023, June 9). *MPSC approves $50m in low-carbon energy infrastructure grants* [Press Release]. Michigan Public Service Commission. https://www.michigan.gov/mpsc/commission/news-releases/2023/06/09/mpsc-approves-$50m-in-low-carbon-energy-infrastructure-grants

going to have to be equipped to handle the relevant data to set the right targets for utilities to invest in the energy transition and better justify their decisions.

One of the most striking comments we heard was a plea from a former regulator that **regulators need to move away from incrementalism.** Incrementalism is built into the regulatory approach, particularly in North America, where stability and predictability for both the customers and the utility itself is seen as a regulatory virtue. Even when regulators realize that a regulatory transformation is needed, the shift is made very gradually to minimize disruption to customers and investors. Yet the scale and tempo of the change required to achieve timely decarbonization of the energy system is far too great for the deliberate step-by-step approach that regulators are prone to employ.

In this sense, economic regulators are also in a privileged position to assess when current approaches are not fit for purpose. Market failures, including externalities, economies of scale, natural monopolies and so on, call for corrections and policies to address market shortcomings. Technological changes will create a constant flow of challenges needed to restore economic efficiency in a broad sense, one that includes the decarbonization imperative and that makes a constant assessment of the regulatory framework needed to take advantage of all technological options at our disposal.

Suggestions for RETA

In addition, the regulators were invited to share their views on what RETA could be doing to promote the energy transition. There was a notable difference in perspective from regulators in more advanced economies compared to developing economies. In brief, regulators in the Caribbean countries we interviewed, with relatively few staff, were most keen for RETA to play a role in capacity building. By contrast, regulators from advanced economies, particularly in Europe, already had significant existing international cooperation arrangements and were keen to ensure that RETA's role did not duplicate the activities of the international regulatory bodies. That said, two major themes stood out:

1. **More opportunities to directly interact with peers:** Several regulators indicated they were very interested in discussing the administrative, technical, financial and legal/regulatory challenges associated with the energy transition. While wary of duplication with existing regulatory forums, bringing in regulators from further afield could provide a fresh perspective on how issues can be addressed.
2. **Building capacity:** The smaller jurisdictions we interviewed said they needed RETA's help to build their capacity as regulators, as some of them have only a handful of staff to support the regulatory decision-makers. Most of these jurisdictions have great potential to advance the energy transition, as they would be replacing relatively expensive oil-based generation with cheaper solar, but the regulators face challenges in developing the right regulatory approach to ensure an efficient, secure and equitable transition. More contact with peers, support for attending international regulatory meetings (in person or virtual), assistance in identifying and managing data needs and technical and legal assistance (in designing rates or regulatory frameworks) were all identified as potentially useful.

Chapter 3. Examples of Addressing Decarbonization in Regulatory Decision Making

Our interviews provided an overview of how regulators were addressing decarbonization in regulatory decision making, but they also showcased solid examples. This chapter takes a deeper dive into nine instances that show how regulators are responding to address decarbonization. The examples chosen follow four themes: (i) how regulators are creatively addressing decarbonization issues through planning requirements (Michigan), addressing carbon content in solar PV procurement (France), assessing ratepayer funding of a hybrid heating program (Québec) and dealing with a loss of gas customers (Australia); (ii) acceleration of regulatory processes to advance decarbonization through regulatory sandboxes (Italy) and changes in transmission permitting (Germany); (iii) importance of the government-regulator relationship in implementing sensitive decarbonization initiatives by getting government support for an electrification tariff (Ontario); (iv) changes in the legal framework to make decarbonization an explicit priority, extend regulatory mandates and incorporate carbon pricing in decision making (UK and Australia).

These examples are also summarized in Table 2 at the end of the chapter, page 38.

(i) How Regulators Are Creatively Addressing Decarbonization

1. Planning requirements — Requiring utilities to model a decarbonized future (Michigan)

Michigan law[90] requires regulated electric utilities to submit to the regulator an integrated resource plan. The plan's filing requirements[91], which are developed and approved by the regulator, include an obligation for the regulated utilities (in the more populated part of the state) to undertake a series of scenarios.

One of these, the environmental policy scenario,[92] examines the implications of moving more quickly than current policy requires to decarbonize the power system. It includes an assessment of the scenario's impact on reliability, emissions and annual revenue requirements and a risk assessment for each scenario modeled. The advantage of including the scenario in the required plan is to assist the regulator in understanding the costs and benefits of moving more quickly to a decarbonized system by presenting a quantification of these costs and benefits.

The requirement to develop the scenario led to analyses that demonstrated that closing a coal plant earlier than planned would have both environmental and economic benefits. The regulator

90 State of Michigan, Senate Bill No. 437, Act No. 341, 2016. https://www.legislature.mi.gov/documents/2015-2016/publicact/pdf/2016-PA-0341.pdf

91 Michigan Public Service Commission, Case U-15896-0013, Order on December 20, 2017. https://mi-psc.my.site.com/s/filing/a00t0000005pjSgAAI/u158960013

92 Michigan Public Service Commission. (2017, December 20). Integrated resource planning [Issue Brief]. https://michigan.gov/mpsc/-/media/Project/Websites/mpsc/consumer/info/briefs/IRP_Issue_Brief_V2_12-20-17.pdf

(MPSC) approved a plan that was negotiated with stakeholders for which the early closing was included as part of the environmental policy scenario. The MPSC's ruling was challenged by another utility but upheld by the courts.[93]

2. Addressing carbon content in solar PV procurement (France)

In several jurisdictions where we conducted interviews, regulators have responsibilities for carrying out or overseeing procurements of new renewable electricity generation. While the primary objective of these procurements is to increase renewable energy generation and thereby decrease emissions from electricity supply, decarbonization objectives of governments are becoming broader. It has been shown that a large share of emissions attributed to France come through embedded emissions from manufactured imports. As such, the carbon dioxide emitted in producing the generating equipment is also a consideration in the procurement of that equipment. Solar panels produced in China, where most of the world's panels are made, result in more emissions than solar panels made in low-emissions jurisdictions such as France, primarily because of the relative low emissions from electricity needed to manufacture the panel components.

In France, the government procures new renewable electricity generation sources, including solar PV, through tenders operated by the regulator, Commission de Régulation de l'Énergie (CRE).

Since 2017, the CRE has carried out 14 such procurements[94] for large solar farms, procuring over 10 GWp.

The CRE publishes its methodology for evaluating the applications, known as the Cahier des Charges[95] (which is drafted by the government). Central to the methodology is the rating of criteria according to a points system for which the maximum possible score is 100 points, which are allocated to a small number of criteria. Currently, for ground-based solar PV installations, price is by far the most important criterion, with up to 70 points allocated based on the price offered (more points for a lower price). Other criteria include if the project will be developed on a site that is already environmentally degraded (worth 9 points) or if the project is governed and/or financed by a local community (worth up to 5 points).

The remaining 16 points are allocated according to the embodied carbon content of the production of the panels and related equipment. The intent is to provide an incentive for developers to consider explicitly the carbon content of the equipment they plan to use in the solar farm. All major components of the installation are considered, from the manufacturing of the polysilicon used to the inverters employed. While developers are encouraged to produce a specific life cycle assessment for their project, the CRE also produces

93 Michigan Court of Appeals Filing. (2023, March 23). *The decision and opinion of the Court of Appeals in IN RE APPLICATION OF CONSUMERS ENERGY RE INTEGRATED RESOURCE PLAN, Docket No. 362294.* Case U-21090-0915. https://mi-psc.my.site.com/s/filing/a008y000003R3vDAAS/u210900915

94 Commission de Régulation de l'Énergie (CRE). (2021, September 16). *Délibération de la CRE du 16 septembre 2021 portant décision relative à l'instruction des dossiers de candidature à la dixième période de l'appel d'offres sur la réalisation et l'exploitation d'installations de production d'électricité à partir de l'énergie solaire « Centrales au sol »* [CRE deliberation of September 16, 2021 regarding the decision on the processing of application files for the tenth period of the call for tenders on the construction and operation of electricity production installations using solar energy "solar ground-based plants."]. https://www.cre.fr/documents/Deliberations/Decision/instruction-des-dossiers-de-candidature-a-la-dixieme-periode-de-l-appel-d-offres-sur-la-realisation-et-l-exploitation-d-installations-de-production

95 Commission de Régulation de l'Énergie (CRE). (2023, November). *Cahier des charges de l'appel d'offres portant sur la réalisation et l'exploitation d'Installations de production d'électricité à partir de l'énergie solaire « Centrales au sol ». AO PPE2 PV Sol* [Tender specifications for the call for tenders for the construction and operation of electricity production installations using solar energy "solar ground-based plants." AO PPE2 PV Ground]. https://www.cre.fr/documents/Appels-d-offres/appel-d-offres-portant-sur-la-realisation-et-l-exploitation-d-installations-de-production-d-electricite-a-partir-de-l-energie-solaire-centrales-a2

Table 1. Default emissions factors for c-Si solar panel components for selected countries of origin

All figures are kg CO_2 equivalent per kg of material (unless otherwise indicated)

Material/process	France	China	U.S.
PolySi Siemens process	23.117	141.023	93.149
Ingot processing multi	9.856	18.323	11.583
Wafer processing multi (per wafer)	0.349	0.891	0.792
Cell processing multi (per cell)	0.202	0.577	0.425
Glass	1.045	1.164	1.115
Module processing multi	7.448	11.446	9.822

Source: Extracted from Table 3, (Commission de régulation de l'énergie (CRE). (2023, November). (p. 59–63)

a default table of estimates per kilogram of material that can be used. The results vary by country primarily because of the different emissions associated with the electricity that is used to produce the components.[96]

Applicants must demonstrate that the embodied carbon content for their solar farm falls below a ceiling value (now 550 kg CO_2/kWp): any proposal with total emissions per kWp above the ceiling will not be considered. Conversely, any proposal with carbon content below a floor level (currently 200 kg CO_2/kWp) will receive all 16 points. Those in between are awarded points according to the following formula.

$$NC = NCo \quad X \quad \frac{ECS_{sup} - ECS}{ECSsup - ECSinf}$$

Where ECS = CO_2 emissions intensity of the project (kg CO_2/kWp)
NC = number of points to be awarded to the project for its carbon content
NCo = maximum number of points (16)
ECSsup = ceiling value for emissions intensity (550 kg CO_2/kWp)
ECSinf = floor value for emissions intensity (200 kg CO_2/kWp)

In effect, what a points award does is reward lower carbon content in the same way a lower price is rewarded, for which there is a similar formula. It is therefore possible to deduce that a decrease of 38 kg CO_2/kWp earns the same number of points as a decrease of 1 euro per MWh in the bid price. This implies a carbon price of around 480 euros per tonne of CO_2 avoided.[97]

96 Commission de Régulation de l'Énergie (CRE). (2023, November). *Cahier des charges de l'appel d'offres portant sur la réalisation et l'exploitation d'Installations de production d'électricité à partir de l'énergie solaire « Centrales au sol ». AO PPE2 PV Sol* [Tender specifications for the call for tenders for the construction and operation of electricity production installations using solar energy "solar ground-based plants." AO PPE2 PV Ground]. https://www.cre.fr/documents/Appels-d-offres/appel-d-offres-portant-sur-la-realisation-et-l-exploitation-d-installations-de-production-d-electricite-a-partir-de-l-energie-solaire-centrales-a2

97 The implied carbon price is calculated by assuming the bidder increases their bid price to offset their lower carbon content. The additional revenue is discounted at 4%.

The CRE administers the tender, makes awards to the points system and then publishes a (redacted) synthesis report[98] on the tender results. The transparency that the regulator uses is helpful to both policymakers and potential bidders. They can learn the average prices paid, the share of bids accepted and the performance of the bids against the various criteria. This includes the mean carbon content, which, in the latest tender, has stayed within a range of around 400–500 kg CO_2/kWp. They also publish the national origin of the panels: in the latest round, nearly all the panels came from China, although in earlier rounds, European and American suppliers had also played a significant role.

3. Assessing ratepayer funding of a hybrid heating program (Québec)

One of the great challenges in decarbonizing energy systems will be the decarbonization of building heating. Heating demand is highly seasonal, and fuels (mostly natural gas where available, but also fuel oil) are drawn on most heavily on the coldest days. In many jurisdictions they remain the lowest-cost options for heating. With their high efficiency, electrification of heating through heat pumps offers a very good solution in many situations, and they have been successfully deployed even in relatively cold climates such as Scandinavia. Regulators will be faced with the increasingly challenging task of encouraging this electrification of heating as it affects both the electricity system and the natural gas system. In jurisdictions where gas heating currently predominates, the switch to electric heating will affect both natural gas and electricity systems, the former from the loss of revenues and the latter from increases in costs, particularly to meet higher winter peak demands for electricity.

In the Canadian province of Québec, the government has announced targets[99] to reduce greenhouse gas emissions by 37.5% by 2030 (compared to 1990 levels) and, in particular, to reduce building heating emissions by 50% by 2030.

Decarbonization of building heating is particularly challenging in Québec because of the very cold winters. Temperatures can fall to levels at which even "cold climate" heat pumps will struggle to supply sufficient heat, necessitating either electrical resistance or some fuel-based heating as a backup supply. Furthermore, as the annual system demand already peaks in winter, more electric heat will drive an increase in the peak load and therefore system costs. In its *Plan for a Green Economy 2030,*[100] the government noted that it had asked Hydro Québec — the government-owned supplier responsible for nearly all of Québec's electricity supply, which it obtains from renewable (mainly hydroelectric) sources — and Énergir, the largest natural gas distributor, to team up to achieve "a partial conversion from natural gas to electricity [as] part of a balanced approach, based on optimum complementarity between the electricity and gas networks, in order to maximize economic benefits and minimize costs for customers."

In response, the two companies reached an agreement to offer a building heating electrification program known as the Dual Energy Offer.[101] The Dual Energy Offer is aimed at natural-gas-heating residential customers and involves installing a heat pump to supply heat with the existing gas furnace

98 Commission de Régulation de l'Énergie (CRE). (2023, August 31). *Rapport de synthese (version publique) de la quatrieme periode de candidature. Appel d'offres portant sur la réalisation et l'exploitation d'installations de production d'électricité à partir de l'énergie solaire « Centrales au sol »* [Summary Report (Public Version) of the Fourth Application Period. Call for tenders for the Construction and Operation of Electricity Production Installations Using Solar Energy "Solar Ground-based Plants".] https://www.cre.fr/documents/Appels-d-offres/appel-d-offres-portant-sur-la-realisation-et-l-exploitation-d-installations-de-production-d-electricite-a-partir-de-l-energie-solaire-centrales-a2

99 Gouvernement du Québec. (2020). *Plan pour une economie verte 2030* [Plan for a green economy 2023]. https://www.quebec.ca/gouvernement/politiques-orientations/plan-economie-verte/plan-mise-en-oeuvre

100 Gouvernement du Québec. (2020).

101 Hydro Québec. (n.d.) *Dual energy for sustainable decarbonization.* Retrieved November 20, 2023, from https://www.hydroquebec.com/residential/energy-wise/windows-heating-air-conditioning/dual-energy-offer/

or boiler. Customers would rely on the heat pump to supply their heating needs on all but the coldest days, when heating would be supplied by natural gas. Customers with the Dual Energy Offer would also have access to an existing special electricity rate, the DT rate,[102] which charges more than four times the standard rate for electricity on colder days, to encourage the customer to switch to natural gas during those periods, but is 28% cheaper than the standard rate at other times. In addition, residential customers will be encouraged to switch their water heaters to electricity, regardless of the temperature. A later phase of the program will be aimed at commercial and institutional customers.

The Dual Energy Offer will lead to increases in costs for Hydro Québec (as it must procure additional generation, transmission and distribution) and for Énergir, because of a significant loss of revenue from its customers. To encourage Énergir to proceed with the offer, Hydro Québec agreed to make a financial contribution to Énergir each year, depending on the amounts of natural gas displaced by the program. A hearing was held for the purpose of Hydro Québec to get approval to recover from its electricity customers the amounts paid to Énergir.

In their proposal, the proponents stated two principal alternatives — an all-electrification scenario (TAE) and the dual energy scenario (bienergie). The dual energy proposal had significantly lower financial impacts, particularly for Hydro Québec, while achieving about two-thirds of the emissions savings compared to the all-electrification scenario. As pointed out by some intervenors in their submissions, however, the dual energy proposal would prolong dependence on continued use of fossil fuels for space heating for these customers.

The regulator's decision[103] was in favor of the financial contribution from Hydro Québec to Énergir. The main reasons given in the decision were that the dual energy alternative had much lower impacts on electricity and gas ratepayers than an all-electrification scenario, while still obtaining about two-thirds of the emissions savings of the all-electrification scenario. It was estimated that the cumulative additional greenhouse gas emissions savings to 2030 of the all-electrification scenario would amount to just over one million tonnes, but the cumulative impact on Hydro Québec's revenues would amount to over 1.68 billion CAD(Canadian) dollars,[104] owing mainly to the need to increase generation and network capacity. In response to the concern raised about a continued reliance on fossil fuels, the regulator noted the government's statement that it saw the complementary qualities of the natural gas and electric systems as a vector to achieving their 2030 decarbonization goals.

Upon appeal by some intervenors, however, this decision was overturned[105] by a different panel of the regulator, stating the current law did not allow Hydro Québec to recover these costs from customers. Hydro Québec has indicated

102 Hydro Québec. (n.d.) *Rate DT—Dual energy for residential and agricultural customers*. Retrieved November 20, 2023, from https://www.hydroquebec.com/residential/customer-space/rates/rate-dt.html

103 Régie de l'énergie. (2022, July 6). *Summary of Decision D-2022-061 rendered in case R-4169-2021 concerning support measures for the decarbonization of building heating.* https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4169-2021/doc/R-4169-2021-A-0065-Dec-Som-2022_07_06.pdf

104 Hydro Québec Distribution, Energir. (2021, December 08). *Offre d'Hydro-Québec Distribution et d'eÉnergir en réponse aux objectifs de décarbonation du chauffage des bâtiments énoncés dans le Plan pour une Économie Verte 2030* [Offer from Hydro-Québec Distribution and Énergir in response to the building heating decarbonization goals outlined in the Green Economy Plan 2030]. [HQD-Énergir-1, document 1]. Tableau 40 : Impact net sur les revenus requis (m$) et sur les émissions de GES (mt. De CO_2 eq.) Des scénarios TAE et biénergie [Table 40: Net impact on required revenues (in million dollars) and on greenhouse gas emissions (in million tonnes of CO_2 equivalent) of the TAE and Dual Energy Scenarios] (p. 40). https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4169-2021/doc/R-4169-2021-B-0034-Demande-PieceRev-2021_12_08.pdf#page=40 Docket R-4169-2021. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4169-2021

105 Régie de l'énergie, Dockets R-4195-2022, R-4196-2022, R-4197-2022, Decision on 2023, February 22. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4197-2022/doc/R-4197-2022-A-0018-Dec-Dec-2023_02_22.pdf. https://www.regie-energie.qc.ca/fr/participants/dossiers/r-4196-2022.

it will proceed with the program and pay the compensation to Énergir, but it is challenging the regulator's decision in the courts.[106]

4. Dealing with a loss of gas customers — Addressing implications of electrification: gas disconnection policy (Australia)

A government's decarbonization policy will have implications for natural gas networks and how they are regulated. Regulations may prohibit new gas connections, and subsidies may encourage electrification. Demand for natural gas is expected to decline over time.

As noted in Chapter 2, the Australian Energy Regulator has already begun to think about the long-term implications of a reduction in natural gas use by households in its information paper *Regulating Gas Pipelines Under Uncertainty*.[107] The AER, however, has also recognized that this is not a purely theoretical issue and has had to deal with the issue in its latest hearing on a gas distributor (Gas Net Australia, which serves the state of Victoria), leading to a final decision published in June 2023.[108] This included proposals from the gas distributor, such as the pass-through of carbon emissions permit costs (which was granted) and a request for accelerated depreciation of assets (which was granted only in part, to limit rate increases). But one of the more surprising issues that arose related to gas disconnections, specifically how much to charge residential customers who decide that they wish to disconnect from the gas system.

When a customer ceases taking gas service and wishes to disconnect permanently from the gas system, safety requirements set by the gas safety regulator in Victoria (Energy Safe Victoria) mean that the connection pipe from the gas main to the property should be removed and the gas main sealed at the connection point. Other options, such as disconnecting the meter and capping the pipe, are not considered sufficiently safe. The customer requesting disconnection is responsible for paying the disconnection costs, which are estimated to be around 1,000 AUD per disconnection. With increasing electrification of customers (Victoria has banned new gas connections), the number of small customers getting off gas has significantly increased and can be expected to increase in the future. Faced with the high disconnection costs, however, many of these customers are instead opting for temporary disconnection, which is much cheaper but is neither a permanent nor a safe solution when gas is no longer needed. Concerned about the safety of this practice, the regulator considered whether to do away with disconnection charges altogether, to ensure all departing customers were safely disconnected, or retain the full cost charge, which would minimize the impacts of the departure on other customers. In the end, the regulator decided[109] to adopt a hybrid approach: it cut the disconnection fee to 220 AUD per customer, or less than a quarter of the fully allocated cost of disconnection, with the remainder of the costs to be recovered from other customers through the rates (the haulage tariff). It also recognized that shifting costs onto remaining customers could not be "a long-term solution. Combined with declining throughput on remaining connections, it will put upwards pressure on haulage tariffs in the 2023–28 period until a more sustainable solution is identified. If, in future periods, we see further decline in demand and an

106 Baril H. La Presse. (2023, March 28). *Entente de biénergie avec Énergir: Hydro-Québec veut faire annuler la décision de la Régie de l'énergie* [Hydro-Québec's bid to annul the Energy Board's decision on the Dual Energy agreement with Énergir]. https://lapresse.ca/affaires/2023-03-28/entente-de-bienergie-avec-energir/hydro-quebec-veut-faire-annuler-la-decision-de-la-regie-de-l-energie.php

107 Australian Energy Regulator. (2021, November 15). *Regulating gas pipelines under uncertainty* [Information Paper]. https://www.aer.gov.au/publications/reports/performance/regulating-gas-pipelines-under-uncertainty-information-paper

108 Australian Energy Regulator. (2023, June 2). *AusNet gas services gas distribution access arrangement 1 July 2023 to 30 June 2028 — Overview* [Final Decision]. https://www.aer.gov.au/industry/registers/access-arrangements/ausnet-services-access-arrangement-2023-28

109 Australian Energy Regulator. (2023, June 2).

increase in customers leaving the network, the upwards pressure on tariffs for remaining customers will only grow."[110]

(ii) Acceleration of Regulatory Processes to Advance Decarbonization

5. Enabling regulatory change through regulatory sandboxes (Italy)

The shift in the electricity sector from a system that is dominated by a few large, fuel-based generators to one based on variable renewable energies with many owners and operators will require very different operating rules. Consequently, the regulator needs to allow a great deal of innovation so that changes to the rules can be made as quickly as possible and deliver more cost-effective, reliable supply. One of the regulatory experts we spoke to cited the Italian Regulatory Authority for Energy, Networks and Environment (ARERA)[111] as a leading user of a "regulatory sandbox" approach to help adjust its regulatory rules to adapt to a changing power system. The work of the authority was also cited in Ofgem's latest proposals for its Future Regulation Sandbox.[112]

ARERA has been active in encouraging "regulatory experiments" in the power sector since 2010, in response to a very rapid increase in variable renewable energy in the power system. ARERA recognized that changes to regulations would be needed[113] to adapt the power system to these new variables in the most cost-effective way. The first phase of regulatory experiments was focused on regions of the country where penetration of distributed variable renewable energy was relatively high and thus potential smart grid solutions could be tested. The proven success of some of the experiments resulted in the modification of regulatory framework for the distribution system operators to implement these changes at a larger scale in a subsequent regulatory period.

The second phase of changes focused more on system-wide modifications such as the need for increased system flexibility to manage the increment in renewable energy. In Italy, for example, a series of pilot projects managed by the sole transmission system operator (TSO), Terna, developed aggregation of customers to offer flexibility services. While early pilots allowed only aggregation of either consumers or producers, in 2018 Terna, with the approval of ARERA, introduced a pilot for "Virtual Aggregated Mixed Units" (UVAM), similar to a Virtual Power Plant. For this pilot, ARERA agreed to relax the 1 MW limit for each individual participant and to allow a mix of consumers and producers to participate in the same offer. These projects, with a minimum aggregate size of 1 MW, are still mainly aimed at commercial and industrial customers, but residential projects are being gradually introduced. UVAM are paid both an energy fee (euros per MWh) and a resource availability fee (euros per MW) and can participate in balancing and ancillary service markets. As of December 2021, there were 220 UVAM offering 1280 MW of capacity.[114] Early analysis of these projects finds that the approach has been quite successful at tapping into a new source of system flexibility.[115] Another more recent

110 Australian Energy Regulator. (2023, June 2).
111 Autorità di Regolazione per Energia Reti e Ambiente (ARERA) (Italy) [Regulatory Authority for Energy, Networks, and Environment]. (n.d.). https://arera.it/en
112 Office of Gas and Electricity Markets (Ofgem). (2023, October 31). *Proposal to introduce the Future Regulation Sandbox*. https://www.ofgem.gov.uk/publications/proposal-introduce-future-regulation-sandbox
113 International Smart Grid Action Network (ISGAN), International Energy Agency (IEA). (2019, May).
114 Lightbox. (2022, January 6). *Things you need to know about UVAM.* https://lightbox.terna.it/en/insight/distributed-resources-uvam

example is examining the issue of home charging of EVs. While most EVs have onboard charging that allows for charging at home at a rate of 5–6 kW, the typical capacity limit for most Italian households is 3 kW, and those exceeding this demand will have an automatic trip of the power supply, due to the activation of a breaker in the smart meter. Network users wishing to upgrade to higher capacity will normally have to pay one-off charges for the capacity increase and pay higher monthly fees. ARERA[116] has approved a pilot project with a derogation from the higher fees,[117] provided the customer's EV charging equipment is capable of remote communications.

6. Changes in transmission permitting — Becoming more deeply involved in transmission line siting (Germany)

The rise in the share of variable renewable energy will increase the importance of investment in transmission and distribution to link the new generation resources to the loads. It has long been recognized that the speed at which new transmission facilities have been developed could become a brake,[118] rather than an accelerator, of the clean energy transition. Greater regulatory involvement in transmission siting has been suggested as one solution to this issue.

Germany's Energiewende[119] policy aims to replace nuclear energy (which was fully phased out in April 2023) and, eventually, coal-fired generation with renewable sources of energy, mainly wind and solar PV. As most of the country's wind resources (and all of its offshore wind resources) are located in the north and east, while most of its industrial demand and retiring power plants are located in the west and southwest parts of Germany, it was long recognized that major investments in transmission were going to be required to link the new supplies with demand. The government estimated that over 7,500 km of new power lines[120] needed to be upgraded or developed, and it started to adapt[121] the country's electricity transmission grid through a coordinated network expansion.[122]

The Power Grid Expansion Act (EnLAG) of 2009 was the first law to address the urgent need for a grid expansion for the energy transition. Among other things, it aimed to complete priority transmission lines by 2015. It listed 22 priority projects that are the exclusive responsibility of the federal states and are referred to as the "start network," since they would be the basis for any further transmission system expansion in the country. This legal framework was further enhanced in 2011 with the Grid Expansion Acceleration Act (NABEG),[123] which established the planning of network expansion projects that crossed interstate or international borders, set the responsibilities of

115 Schwidtal J., Agostini M., Bignucolo F., et al. (2021, March 30). Integration of flexibility from distributed energy resources: Mapping the innovative Italian pilot project UVAM. *Energies 2021, 14*(7), 1910. https://doi.org/10.3390/en14071910

116 Autorità di Regolazione per Energia Reti e Ambiente (ARERA). (2020, December 15). *Ricarica dei veicoli elettrici in luoghi non accessibili al pubblico: avvio di una sperimentazione finalizzata a facilitare la ricarica nelle fasce orarie notturne e festive* [Charging of electric vehicles in nonpublic areas: Initiation of a trial aimed at facilitating charging during nighttime and holiday hours]. [Delibera 15 dicembre 2020 541/2020/R/eel][Resolution 15 December 2020 541/2020/R/eel]. https://arera.it/atti-e-provvedimenti/dettaglio/20/541-20

117 International Smart Grid Action Network (ISGAN), International Energy Agency (IEA). (2021, October) *(Casebook) Innovative regulatory approaches with focus on experimental sandboxes 2.0*. https://www.iea-isgan.org/case-book-innovative-regulatory-approaches-with-focus-on-experimental-sandboxes-2-0/

118 International Energy Agency (IEA). (2023, October 17).

119 Federal Foreign Office, Germany. (n.d.)

120 Federal Ministry for Economic Affairs and Climate Action, Germany. (n.d.). *An electricity grid for the energy transition*. Retrieved January 23, 2024, from https://bmwk.de/Redaktion/EN/Dossier/grids-grid-expansion.html

121 Federal Ministry for Economic Affairs and Climate Action, Germany. (n.d.). *Rahmenbedingungen für den Netzausbau* [Framework conditions for network expansion]. Retrieved January 23, 2024, from https://bmwk.de/Redaktion/DE/Artikel/Energie/stromnetze-und-netzausbau-regulierung-rahmenbedingungen.html

122 Bundesnetzagentur (BNetzA), Germany. (n.d.). *Gesetze Verstehen* [Understanding laws]. Netzausbau (Network Expansion). https://netzausbau.de/Wissen/GesetzeVerstehen/de.html

123 Climate Policy Radar (a service of the Federal Ministry of Justice and Consumer Protection in collaboration with juris GmbH – www.juris.de). (2001). *Grid expansion acceleration act (NABEG).* https://app.climatepolicyradar.org/document/grid-expansion-acceleration-act-nabeg_621b?q=NABEG

the energy regulator Bundesnetzagentur (BNetzA) and set out the detailed planning process for the electricity network development plan, which the BNetzA must approve. Further enhancements were made in 2013 when the Federal Requirements Plan Act (BBPlG),[124] which defines the starting and finishing points of the identified projects, came into force and established the BNetzA as responsible for selecting the line routing for interstate or international projects. A further change in 2015 was particularly significant in terms of its impact on cost and timing of transmission projects. An amendment to the Federal Requirements Plan Act was made that stipulates, by general rule, that underground cables are the standard[125] for high-voltage projects, and hence, only under strictly limited circumstances can overhead line sections be used. Still more changes were made in 2019 through an amendment[126] to the Grid Expansion Acceleration Act (NABEG 2.0). The changes[127] involved the legalization and standardization of compensation procedures to landowners affected by the network expansion, the establishment of a national offshore test field for system security and the regulation of network bottleneck management to achieve more efficient and cost-effective management in the future. Further modifications were made in 2022. New rules were put in place that allow the BNetzA to grant approval to start construction work before final planning approval is received. This allows the project developer to begin construction; however, their activities would need to be reversed and the original condition of the land restored if final approval is ultimately not given.

This series of six legislative reforms over 13 years has ensured that one of the BNetzA's main tasks in the energy sector is "promoting efficient permit granting processes for Germany's extra-high voltage network to accommodate the growing importance of renewable energy."[128] Today, specific powers of the regulator with respect to transmission planning and siting include: (i) **Approving the overall framework for network expansion** developed by the four transmission system operators. The BNetzA holds a public consultation on the proposals and approves the framework, which binds the TSOs for the system plans; (ii) **Reviewing and approving the network development plans** of the TSOs, which include the corridors needed for grid expansion. These plans (Netzentwicklungsplan or NEP) are updated regularly and progress on implementation must be reported annually; (iii) **Submitting to the government the NEP as a draft for the Federal Requirements plan that identifies the priority transmission expansion projects and includes an environmental report** to the government at least every four years. The government submits the Federal Requirements Plan Act draft to the parliament. These plans become binding upon adoption by the parliament; (iv) **Assessing the environmental impact of transmission projects** that cross state or national boundaries, establishing the exact routes for the projects; and (v) **Allowing early sectoral construction to begin** before final planning approval is obtained on limited portions of the project to accelerate overall project completion. These new powers were in addition to the regulator's existing authorities to set network tariffs for the TSOs and to ensure an efficient level of investment in transmission.

124 Bundesministerium der Justiz und für Verbraucherschutz (Federal Ministry of Justice and Consumer Protection), Germany. (2013, July 07). *Gesetz über den Bundesbedarfsplan (Bundesbedarfsplangesetz - BBPlG)* [Act on the Federal Requirements Plan]. https://www.gesetze-im-internet.de/bbplg/

125 BBPlG *§ 3 Erdkabel für Leitungen zur Höchstspannungs-Gleichstrom-Übertragung* [§ 3 Underground cable for lines for high-voltage direct current transmission]. https://www.gesetze-im-internet.de/bbplg/__3.html

126 Bundestag. (2019, May 13). *Gesetz zur Beschleunigung des Energieleitungsausbaus* [Law on accelerating the expansion of energy lines]. https://bgbl.de/xaver/bgbl/start.xav?start=%2F%2F*%5B%40attr_id%3D%27bgbl111043.pdf%27%5D

127 Federal Ministry for Economic Affairs and Climate Action, Germany. (2018, December 12). *Gesetz zur Beschleunigung des Energieleitungsausbaus* [Law to accelerate the expansion of energy lines] [Article]. [https://bmwk.de/Redaktion/DE/Artikel/Service/Gesetzesvorhaben/gesetz-zur-beschleunigung-des-energieleitungsausbaus.html

128 Bundesnetzagentur (BNetzA), Germany. (n.d.). *Tasks & structure*. https://bundesnetzagentur.de/EN/General/Bundesnetzagentur/TasksStructure/start.html

The three electricity highways consist of direct current, ultra-high voltage lines known as SuedLink (https://suedlink.com), SuedOstLink,[129] and the A Corridor[130] that comprises the A-Nord and the Ultranet projects. The BNetzA had originally started the approval procedures for these three major electricity highways in 2013, with the intention that all three lines would be in operation by the end of 2022, which was the planned phaseout date for nuclear power plants. Despite all the regulatory changes made to speed up planning and permitting, none of the three projects are yet operational. Construction started in 2023. Despite the possibility for sectoral approval and constructions, direct current connection lines cannot become operational in sections, but only as a whole.

In the case of the SuedLink[131] line, strong local objections[132] regarding people not wanting the lines to affect their lands[133] ("not in my backyard" concerns) and concerns about the technology and its further relation to policy have considerably delayed the project. The project was originally expected to be finished by the end of 2022, but now, with sectoral construction just started[134] in September 2023, the project will not be in service until 2028. Additional delays have been caused by permitting and compensation bottlenecks — tens of thousands of landowners need to be approached, not an easy nor a fast task. Undergrounding the line has also increased costs and time, both to redesign the project and because it will take longer to construct.

SuedOstLink[135] has suffered similar delays. Thanks to the acceleration of permitting procedures, SuedOstLink's first converter station started construction[136] in March 2023; the permit's approval took only seven months and the station is scheduled for completion in 2025.

The projects known as A-Nord[137] and Ultranet,[138] which are part of Corridor A (about 600 km in total), received siting approval in 2021.[139] Small sections of the A-Nord part of the project (totaling 6 km in length) began construction in October 2023,[140] thanks to a provisional approval of early start of construction from the BNetzA[141] in October 2023. Final planning approval is expected by 2024, and completion of the line is now expected in 2027.[142] The Ultranet project, which does not require undergrounding, since it will mostly be using existing power lines,[143] has yet to begin construction but is expected to be completed in 2025.

129 50Hertz. (n.d.). *SuedOstLink*. https://50hertz.com/en/Grid/Griddevelopement/Onshoreprojects/SuedOstLink

130 Bundesnetzagentur (BNetzA), Germany. (2021, June 7). *Bundesnetzagentur sets out route corridors around Osterath* [Press Release]. https://bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/PressReleases/2021/20210607_ANord.pdf?__blob=publicationFile&v=2

131 Bundesnetzagentur (BNetzA), Germany. (n.d.). *Brunsbüttel – Großgartach (SuedLink).* https://netzausbau.de/Vorhaben/ansicht/de.html?cms_gruppe=bbplg&cms_nummer=3

132 Galvin, R. (2018). Trouble at the end of the line: Local activism and social acceptance in low-carbon electricity transmission in Lower Franconia, Germany. *Energy Research & Social Science, Volume 38* (April), 114–126. ISSN 2214-6296. https://doi.org/10.1016/j.erss.2018.01.022

133 World Today News. (n.d.). *Controversy surrounding SuedLink drilling: Farmer files complaints and challenges environmental protection measures*. https://www.world-today-news.com/controversy-surrounding-suedlink-drilling-farmer-files-complaints-and-challenges-environmental-protection-measures/

134 TenneT. (2023, September 13). *TenneT: The energy transition is becoming a reality — Construction of SuedLink has begun*. https://tennet.eu/news/tennet-energy-transition-becoming-reality-construction-suedlink-has-begun

135 Bundesnetzagentur (BNetzA), Germany. (n.d.). *Wolmirstedt — Isar (SuedOstLink).* https://netzausbau.de/Vorhaben/ansicht/de.html?cms_nummer=5&cms_gruppe=bbplg

136 50hertz. (2023, March 21). *Starting signal given for European electricity highway — converter for SuedOstLink connection enters construction phase* [Press Release]. https://www.50hertz.com/en/News/Details/13316/starting-signal-given-for-european-electricity-highway-converter-for-suedostlink-connection-enters-construction-phase

137 Bundesnetzagentur (BNetzA), Germany. (n.d.) *Emden Ost — Osterath (A-Nord).* https://www.netzausbau.de/Vorhaben/ansicht/de.html?cms_nummer=1&cms_gruppe=bbplg

138 Bundesnetzagentur (BNetzA), Germany. (n.d.) *Osterath — Philippsburg (Ultranet).* https://www.netzausbau.de/Vorhaben/ansicht/de.html?cms_gruppe=bbplg&cms_nummer=2

139 Bundesnetzagentur (BNetzA), Germany. (2021, June 7).

140 Renewables Now. (n.d.). *Construction begins on German wind power corridor A-Nord.* https://renewablesnow.com/news/construction-begins-on-german-wind-power-corridor-a-nord-837587/

141 Bundesnetzagentur (BNetzA), Germany. (2023, October 20). *Bundesnetzagentur genehmigt vorzeitigen Baubeginn für Stromleitung A-Nord* [The Federal Network Agency approved an early start of construction for the A-Nord power line] [Press Release]. https://bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2023/20231020_ANord.html?nn=265778

142 Renewables Now. (n.d.).

143 Amprion Verbindet. (n.d.). *Ultranet*. https://amprion.net/Netzausbau/Aktuelle-Projekte/Ultranet/

Despite its expanded authority over the approval of 7,400 km of new high-voltage power lines, the BNetzA is not responsible for the 14,000 permits that local and state authorities must issue. The BNetzA does monitor the status of these approvals and found that by the end of October 2023[144] only 857 km of lines had the necessary approvals. It is worth noting that under new legislation, the lack of final planning approval (and hence permit issuance) is no longer a barrier to beginning construction and that the rate of permit issue is expected to accelerate beginning in mid-2024 after final approvals are received.

The BNetzA[145] expects that permits covering an additional 4,400 km of lines will be issued by mid-2025 and that these will also cover most of the SuedLink and SuedOstLink projects.

In summary, expanding the regulator's authority for transmission line approvals did not, in this instance, enable it to proceed quickly with major transmission expansions needed to support the energy transition in Germany. Six legislative reforms over 13 years have improved matters, but overcoming local environmental and acceptance barriers have remained the main obstacles.

(iii) Importance of Government-Regulator Relationship in Implementing Sensitive Decarbonization Initiatives

7. Getting government support for electricity tariffs that promote electrification (Ontario)

Charging different prices for electricity by the time of day has long been a tool used by electric utilities and approved by regulators to discourage the use of energy during peak periods and encourage consumption at off peak. Most programs of this kind offer a relatively modest difference in the price[146] between peak and off-peak periods (a ratio of less than 3:1), but most were aimed at reducing peak consumption rather than encouraging greater use of electricity.

Electrification provides the opportunity to rethink that policy.[147] For example, the owner of an EV with an ability to recharge at home can choose when to start or stop recharging the vehicle. Small differences in the price are unlikely to encourage them to charge during periods when the cost to supply electricity is lower. Conversely, the availability of very low-cost charging may encourage electrification of other flexible services such as domestic hot water heating to make them more competitive with fossil fuel alternatives.

144 Bundesnetzagentur (BNetzA), Germany. (2023, October). *Stromnetzausbau. Stand der Genehmigungsverfahren der Bundesnetzagentur [Electricity network expansion: Status of approval processes by the Federal Network Agency]* [PDF document]. [Retrieved October 25, 2023]. https://netzausbau.de/SharedDocs/Downloads/DE/Monitoringberichte/Netzausbauprognose/Netzausbauprognose.pdf?__blob=publicationFile

145 Bundesnetzagentur (BNetzA), Germany. (2023, October).

146 Faruqui, A., Hledik, R., & Sergici, S. (2019, November 12). *A survey of residential time-of-use (TOU) rates* [Presentation]. The Brattle Group. https://www.brattle.com/insights-events/publications/a-survey-of-residential-time-of-use-tou-rates/

147 Fraser, P. (2019, October 9). *More of a good thing — Is surplus renewable electricity an opportunity for early decarbonisation?* [Commentary]. International Energy Agency (IEA). https://www.iea.org/commentaries/more-of-a-good-thing-is-surplus-renewable-electricity-an-opportunity-for-early-decarbonisation

Furthermore, the issue of electricity rates is a sensitive one for policymakers, and electricity subsidies to protect consumers against price increases has become very common in the past few years, reaching 400 billion USD[148] globally in 2022. Getting policymakers to support changes in electricity rates, where prices at certain periods will be higher than previously, is crucial for a successful program.

The Canadian province of Ontario provides an example where the regulator has worked closely with the government and stakeholders to introduce a new rate that supports electrification. In that province, virtually all customers have a smart meter and most residential customers are on default time-of-use rates that are set by the regulator, the Ontario Energy Board (OEB). The Ontario time-of-use rates have a relatively modest difference between the price at the peak hours and the price at the off-peak hours (roughly a 2:1 ratio). The regulator had previously undertaken on its own initiative a number of alternative pricing pilot programs.[149] One of these programs, targeted to EV owners, was able to demonstrate the effectiveness of an alternative rate, where prices would be very low at night and up to ten times higher during peak hours. This pilot program was highly effective at shifting consumption of EV-owning customers to overnight hours, when non-emitting generation (largely nuclear power, hydroelectric or wind) predominates compared to peak hours, when natural gas is often the marginal fuel.

Some years later, the government asked the OEB[150] to develop an alternative rate that would encourage shifting to overnight hours. The OEB developed a detailed proposal[151] for which it also carried out a stakeholder consultation. The government approved the new optional rate and amended a regulation[152] to allow the OEB to implement it.

The new rate has received the full support of the government. In fact, the government has taken ownership of the initiative: its press release[1153] announcing the implementation of the new rate mentions the regulator only in passing. The regulator chose not to issue any press release on its role in developing the new rate, releasing instead its price report[154] outlining the new rates and how they were established, and more detailed information as to how the new rate would operate. The new rate has been progressively rolled out to customers across Ontario since May 1, 2023.

(iv) Changes to the Legal Framework

8. Interpreting new requirements to consider decarbonization in regulatory decision making (Australia)

One issue that came up repeatedly in our interviews with regulators was the value of having an explicit objective to address decarbonization, along with more traditional objectives such as price, quality, safety, reliability and security of supply. The most

148 International Energy Agency (IEA). (2023, February). *Fossil fuels consumption subsidies 2022*. https://iea.org/reports/fossil-fuels-consumption-subsidies-2022

149 Simon, J., Steele-Mosey, P., Lai, J., et al. (2020, December 22). *Regulated price plan pilot meta-analysis, final report*. Guidehouse Canada. Prepared for Ontario Energy Board. https://www.oeb.ca/industry/policy-initiatives-and-consultations/rpp-roadmap

150 Ministry of Energy (Ontario, Canada). (2021, November 16). *Design(s) of an optional enhanced time-of-use rate to enable additional customer choice* [Letter from the minister of energy to the chief executive officer of the Ontario Energy Board]. https://www.oeb.ca/consultations-and-projects/policy-initiatives-and-consultations/design-optional-enhanced-time-use

151 Ontario Energy Board. (2022, March 31). *Report to the minister of energy. Design of an optional enhanced time of use price*. https://www.oeb.ca/consultations-and-projects/policy-initiatives-and-consultations/design-optional-enhanced-time-use

152 Ontario Energy Board. (2023, April 11). *Ultra-low overnight prices May 1, 2023 to October 31, 2023. Addendum to the regulated price plan price report November 1, 2022 to October 31, 2023*. https://www.oeb.ca/consultations-and-projects/policy-initiatives-and-consultations/regulated-price-plan-rpp

153 Government of Ontario. (2023, April 11). *Ontario launches new ultra-low overnight electricity price plan* [Press Release]. https://news.ontario.ca/en/release/1002916/ontario-launches-new-ultra-low-overnight-electricity-price-plan

154 Ontario Energy Board. (2023, April 11).

practical implication of this is that having such an objective would make it relatively straightforward to include the value of saved emissions in regulatory decision making. Other examples included efforts by gas utilities to reduce methane losses: these could not be ratepayer-funded on decarbonization grounds if there was no explicit objective to do so.

In fact, Australia is one of two jurisdictions (along with the United Kingdom) where that change to incorporate decarbonization as a regulatory objective has recently been made.

The legislation in Australia,[155] known as the Statutes Amendment (National Energy Laws) (Emissions Reduction Objectives) Act 2023, which received Royal Assent on September 21, 2023, incorporates decarbonization objectives in the national laws respecting electricity, natural gas and energy retailing. The decarbonization objective for all three laws is the same. It requires energy regulators (the AEMC and the AER) as well as the system operator, the Australian Energy Market Operator (AEMO) to give regard to the following objective by which the long-term interests of consumers are to be served by:

> *the achievement of targets set by a participating jurisdiction— (i) for reducing Australia's greenhouse gas emissions; or (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions.*

The AEMC and the AER have each published guidance as to how they will interpret the new objective in their decision making. In the case of the AEMC,[156] which makes and amends the rules for the energy markets, they have emphasized that inclusion of the new objective elevates the role of decarbonization in their decisions. Whereas before such targets were part of the external context, now they are one of the central considerations, along with price, quality, safety, reliability and security of supply, that the AEMC must balance in making its decisions. The new objective also means that changes to the market rules for electricity or natural gas could be proposed based on achieving emissions reduction targets, something that would not have been a sufficient criterion before. For each proposed rule change, the AEMC will assess whether the emissions reduction impact of the proposed change is likely to be a material part of the benefits (or costs) of the changes that are being proposed. If so, it will address the emissions objective and how it is being evaluated in its consultation and decision documents. The evaluation could be either quantitative or qualitative depending on the context. One issue if a quantitative assessment is used is the need to use an appropriate methodology to value emissions reductions. The AER and AEMC plan to rely on the methodology being developed by the Commonwealth government. Separately, the AEMC has published the targets[157] for jurisdiction (state, territory or commonwealth) that it (and the AER) must have regard to in its decision making.

The AEMC is also amending the national electricity and gas rules[158] to harmonize with the new objective. These changes include requiring network and pipeline operators to consider emissions benefits and costs in their regulated expenditure proposals, and in applying the regulatory investment tests.

The AER, which regulates the gas and electricity networks and oversees energy retailing, published its own guidance[159] on how it deals with the new

155 Government of South Australia. (2023, September 21). Statutes amendment (National Energy Laws) (Emissions reduction objectives) Act 2023. https://www.legislation.sa.gov.au/lz?path=/v/a/2023/statutes%20amendment%20(national%20energy%20laws)%20(emissions%20reduction%20objectives)%20act%202023_26

156 Australian Energy Market Commission. (2023, September). *How the National Energy Objectives Shape Our Decisions* [Guide]. https://www.aemc.gov.au/market-reviews-advice/consultation-aemc-guide-applying-emissions-component-national-energy-objectives

157 Australian Energy Market Commission. (2023, September). *Emissions Targets Statement Under the National Energy Laws* [Guide]. https://www.aemc.gov.au/regulation/targets-statement-emissions

158 Australian Energy Market Commission. (2023, October). *Harmonising the national energy rules with the updated national energy objectives (electricity).* https://www.aemc.gov.au/rule-changes/harmonising-national-energy-rules-updated-national-energy-objectives-electricity

159 Australian Energy Regulator. (2023, September). *Guidance on Amended National Energy Objectives* . https://www.aer.gov.au/industry/registers/resources/guidelines/guidance-amended-national-energy-objectives

objective. In it, the AER indicates a requirement to consider the new objective for applications currently underway for electricity transmitters and distributors. They point to a need to revise the regulatory investment tests that they apply to the network investment plans of electricity transmitters and distributors. These tests estimate the carbon dioxide savings that would be made by the investment, as well as the value of those savings, in determining whether an investment proposal should be approved. The AER also identifies the inclusion of the value of emissions saving as another area likely to be affected in evaluation of investments by network owners to support distributed energy resources (now referred to as consumer energy resources by the AER).

9. Responding to a broader regulatory mandate (United Kingdom)

Some of the regulators interviewed raised the issue of the extent to which they might be expected by government to take on more responsibility to assist the clean energy transition. The United Kingdom has passed the Energy Act 2023,[160] which is a broad piece of legislation to support the clean energy transition. The energy regulator for the United Kingdom, Ofgem, emerges as a linchpin in support of the government's net zero mandate. There are four major changes in the legislation that directly affect Ofgem's ability to influence the clean energy transition:

A. **Mandate to consider net zero in regulatory decision making:** The legislation adds a specific duty[161] to assist the government's achievement of both the 2050 net zero emissions goal (which itself is enshrined in legislation) as well as achieving the five-year carbon budgets that restrict total carbon dioxide emissions over a five-year period (currently 2023–27 inclusive). Ofgem will be required to apply this new duty in its decision making and to document how it has done so.

B. **Development of a regulatory framework for heat networks:** The government had identified heat networks (both district heating networks, which might supply multiple buildings, and communal networks, which would supply multiple residences in a single building) as an important provider of heat in a decarbonized energy system. Heat networks currently supply 2% of heat in the United Kingdom, and government policy is for this to increase to 18% by 2050. The government sees the regulator as the key player to spur growth and investment in heat networks so that they become more common. With the legislation just passed, Ofgem will have authority to regulate[162] the 14,000 existing heat networks. Ofgem will now have the ability to address disproportionate prices and establish standards for reliability and quality of service.

C. **Development of a regulatory framework for CO_2 transport and storage networks:** The government identified Carbon Capture, Usage and Storage (CCUS) as an essential element of a net zero energy system. The Energy Act 2023 gives Ofgem legal powers[163] as the economic regulator for CO_2 transport and storage networks and makes the transportation and storage of CO_2 a licensable activity. The regulatory regime will set the allowed revenue

160 United Kingdom Parliament. (2023, November 28). Energy Act 2023. https://bills.parliament.uk/bills/3311

161 Government of the United Kingdom. (2023, September, 1). *Guidance. Energy Security Bill Factsheet: Ofgem net zero duty (added 6 June 2023).* https://www.gov.uk/government/publications/energy-security-bill-factsheets/energy-security-bill-factsheet-ofgem-net-zero-duty-added-6-june-2023

162 Office of Gas and Electricity Markets (Ofgem) (UK). (n.d.). *Heat Networks. Ofgem appointment as Heat Networks Regulator for Great Britain.* https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/heat-networks

163 Government of the United Kingdom. (2023, September, 1). *Guidance. Energy Security Bill factsheet: Carbon dioxide transport and storage regulatory investment model.* https://www.gov.uk/government/publications/energy-security-bill-factsheets/energy-security-bill-factsheet-carbon-dioxide-transport-and-storage-regulatory-investment-model

that a licensee will recover from use-of-system charges paid by users of the network. The allowed revenue will enable licensees to earn a regulated return on their investment whilst allowing the economic and efficient development of the network.

D. **Greater oversight over energy market rules:** The legislation shifts responsibility for energy codes — which cover the wholesale and retail market rules for the gas and electricity markets, as well as connections — from an industry responsibility to one that is overseen by Ofgem.[164] Ofgem will set the strategic direction for energy codes, including expectations of changes in codes to be delivered by code managers (licensed by Ofgem) for each year. Ofgem has identified consolidation to reduce the number of different codes (currently 11) as an early priority.

Ofgem has already been active in anticipation of the new responsibilities, two of which (heat networks and energy code reform) were set out by the government well in advance of the legislation. For heat networks, Ofgem has been active in government consultations on the topic,[165] as well as participating in a joint consultation[166] with the government on consumer protection issues with respect to heat networks. On energy code oversight, Ofgem is currently working with the government on the regulations[167] that will need to be passed to establish Ofgem's oversight of the codes.

164 Office of Gas and Electricity Markets (Ofgem) (UK). (n.d.). *Energy Code Reform.* https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/energy-code-reform.

165 Office of Gas and Electricity Markets (Ofgem) (UK). (2021, November 19). *Ofgem's response to Heat Networks zoning consultation.* https://www.ofgem.gov.uk/publications/ofgem-response-governments-heat-networks-zoning-consultation

166 Government of the United Kingdom. (2023, August, 4). *Heat networks regulation — consumer protection*. https://www.gov.uk/government/consultations/heat-networks-regulation-consumer-protection

167 Office of Gas and Electricity Markets (Ofgem) (UK). (n.d.). *Energy code reform.*

Table 2. Summary of Examples

#	Theme	Example	Country/ State	Issue	Approach
1	(i)How regulators are creatively addressing decarbonization	Planning requirements-Requiring utilities to model a decarbonized future	United States-Michigan	How to better undertsand and quantify costs and benefits of moving more quickly to a decarbonized system	Integrated Resource Plan, that is approved by the regulator, includes an Environmental Policy Scenario that examines the implications of moving more quickly than current policy requires to decarbonize the power system; includes an assessment of the impact of the scnario on reliability, emissions, annual revenue requirements and a risk assessment.
2		Addressing carbon content in solar PV procurement	France	High share of emissions coming from the manufactured panels (solar PV) produced in high emissions jurisdiction is.	The regulator that operates the tenders to procure new renewable electricty generation defined a methodology to evaluate the applications with the rating of criteria according to a points system. For ground-based solar PV installations, price is the most important criterion (70 points out of 100), also up to 16 points are allocated according to the embodied carbon content of the production of the panels and related equipment. The intent is to provide an incentive for developers to consider explicitly the carbon content of the equipment they plan to use in the solar farm.
3		Assessing ratepayer funding of a hybrid heating program	Canada-Québec	To tackle the challanges from the decarbonization of building heating, with further heat pumps penetration, mainly in jurisdictions where cold winters are considerable, that might not allow all time usage of heat pumps. The switch to electric heating will affect both natural gas and electricity systems, the former from the loss of revevnues and the latter from increase in costs, particularly to meet higher winter peak demands for electricity	The governement-owned distributor responsible for nearly all electricity distribution in Quebed, and the largest natural gas distributor were asked to team up to achieve "A partial conversion from natural gas to electricity [as] part of a balanced approach, based on optimum complementarity between the electricity and gas networks, in order to maximize economic benefits and minimize the costs for customers." In response, the two companies reach an agreement to offer a building heating electrification program known as the Dual Energy Offer aimed at natural gas heating residential customers, with access to an existing special electricity rate (DT rate) and involves installing a heat pump to supply heat with the existing gas furnace or boiler. Customers would rely on heat pump to supply their heating needs on all but the coldest days, when heating would be supplied by natural gas.
4		Dealing with a loss of gas customers-Addressing implications of electrification: gas disconnection policy	Australia	A governement's decarbonization policy will have implications for the natural gas networks and how they are regulated. Regulations may prohibit new gas connections and subsidies may encourage electrification. Demand for natural gas is expected to decline over time.	The regulator decided to cut the disconnection fee to AUD 220 (from 1000 AUD) per customer, or less than a quarter of teh fully allocated cost of disconnection, with the remainder of the costs to be recovered from other customers through the rates (the haulage tariff). However, it also recognized that shifting costs onto remaining customers could not be a permanent answer.

#	Theme	Example	Country/ State	Issue	Approach
5	(ii)Acceleration of regulatory processes to advance decarbonization	Enabling regulatory change through regulatory sandboxes	Italy	Need to adjust the regulatory rules to adapt to a changing power system that will require a great deal of change and consequently a great deal of innovation- need to do it as cost-effecitvely as possible.	Italian Regulatory Authority for Energy, Networks and Environment (ARERA) has been active in encouraging "regulatory experiments" in the power sector since 2010- 1st phase (pilot and smart grid projects): regions where distributed VRE penetration was relatively high and so where potential smart grid solutions could be tested. The proven success of some of the experiments resulted in the modification of regulatory framework fro the DSOs to implement these changes at a larger scale in a subsequent regulatory period. 2nd phase: focused more on system-wide changes such has the need for increased system flexibility to manage the increase in renewable
6		Changes in transmission permitting- Becoming more deeply involved in transmission line siting	Germany	The rise in the share of variable renewable energy will increase the importance of investment in transmission and distribution to link the new generation resources to the loads.	Six legislative reforms over 13 years were enacted to speed up transmission permitting. BNetzA has specific powers to: Approve the overall framework for network expansion; Review and approve the network development plans; Submit a draft transmission plan; Assess the environmental impact of transmission projects that cross state or national boundaries, to establish the exact routes for the projects; Allow early construction to begin before obtaining final planning approval. Despite these reforms the "electricity highways" are greatly delayed, due mostly to permitting delays, compensation bottlenecks and local objections.
7	(iii)Importance of government-regulator relationship in implementing sensitive decarbonization initiatives	Getting government support for electricity tariffs that promote electrification	Canada-Ontario	Electrification brings the need to change the policies of traditional electricity tariffs, usuaslly a sensative issue, (most were aimed at reducing peak consumption rather than encouraging greater use of electricty), and subsidies to protect consumers against price increases.	The regulator worked closely with the government and stakeholders to introduce a new rate that supports electrification. Most customers have a smart meter. The regulator launched some pricing pilot programs that demonstrated the effectiveness of an alternative rate where prices would be very low at night and up to ten times higher during peak hours. One of these pilot progrmas was highly effective at shifting consumption of EV-owning customers to overnight hours, when non-emitting generation (largely nuclear power, hydroelectric or wind) predominates compared to peak hours, when natural gas is often the marginal fuel.
8	(iv)Changes to the legal framework	Interpreting new requirements to consider decarbonization in regulatory decision making	Australia	No clear mandate or explicit objective to address decarbonization- difficult to justify regulatory decisions- ex. by quantifying the value of saved emissions	The Statutes Amendment (National Energy Laws) (Emissions Reduction Objectives) Act 2023, which received Royal Assent on 21 September 2023, incorporates decarbonization objectives in the national laws respecting electricity, natural gas and energy retailing.
9		Responding to a broader regulatory mandate	United Kingdom	Concerns about the governments' expectations regarding the regulators' extent to take on more responsibility to assist the clean energy transition	The United Kingdom has just passed the Energy Act 2023 which is a broad piece of legislation to support the clean energy transition. The energy regulator (Ofgem) emerges as a keystone to support the government's net zero mandate with specific powers regarding: mandate to consider net zero in its decision making; developing regulatory frameworks for heat networks; greater oversight over energy makret rules, and rate regulation of CO_2 and storage networks.

Chapter 4. Findings and Recommendations

The purpose of this report is to document some recent experiences of regulators in addressing the challenge of accelerating decarbonization of the energy system (for reasons given in Chapter 1 of the report), how they are changing regulatory decision making and the limits they are facing in addressing decarbonization within the existing regulatory framework.

Through 45 hours of interviews with regulators from 25 countries and five regulatory experts, we documented many experiences in Chapter 2 of this report. Chapter 3 delved deeper into nine of those experiences, addressing issues as diverse as dealing with new regulatory authorities associated with the energy transition, adapting rates and regulation to deal with challenges of electrification, managing an extremely difficult transmission siting process and addressing some of the early symptoms of customer loss in gas networks as decarbonization proceeds, among others.

In this chapter we present our main findings. First, we saw many examples of regulators being creative in advancing decarbonization. Second, we saw fewer examples of regulatory processes being reformed to advance decarbonization. Third, the government-regulator relationship is of central importance if regulators are to be effective in implementing an acceleration of the decarbonization of the energy system. Fourth, we also find that legislative changes to make decarbonization an explicit objective, along with clarity on a carbon price, would be most helpful for regulators to accelerate the clean energy transition and deal with potentially expanded mandates. Finally, we observe that regulators themselves are a resource to help each other adapt to these challenges.

We also present a set of recommendations. Three recommendations are aimed at regulators encouraging them to be creative in applying decarbonization when carrying out their mandates, to be timely in their decision making (including reforming processes where possible), and to communicate with governments on the practical implications of policies and on gaps in the regulatory framework. It is recommended for governments to, in turn, ensure they have a channel to listen to the practical insights regulators can offer on the implications of energy transition policies, provide guidance on carbon pricing, strengthen regulatory mandates to include decarbonization and provide adequate resources for regulators to carry out these mandates. Finally, RETA has a role in helping regulators help each other. More generally, we recommend the development of a peer review process to assist regulators in managing the changes to energy systems that decarbonization will bring. For smaller regulators, where capacity-building efforts are most pressing, we identify several measures to support their work.

Findings

1. ***Many regulators have used their mandates creatively to address decarbonization even without an explicit mandate to do so.*** Some of this is related to (in many cases) long-standing obligations to promote energy efficiency and renewable energy. Increasingly regulators recognize that the move to a low-carbon energy system will require substantial changes. Above all, this means recognizing that while governments set the ultimate goals and the general directions, regulators are influential in the precise direction

and the pace of change. They have been doing the following:

a. Investigating the cost-effectiveness of low-carbon scenarios to inform system planning and create a shared vision of potential paths in the future: This includes modelling a net zero scenario itself (Canada, CER), getting utilities to develop scenarios based on the low-carbon goals of the state government (Michigan) to understand what is possible and what is cost-effective or requiring gas and electric utilities to agree on a common view of the future gas and electricity demand to encourage coherent energy planning (British Columbia).

b. Enabling the infrastructure needed for the transition to happen: Regulators are recognizing that the longer timelines for transmission mean that network investment to support government renewables targets needs to begin in advance (Poland). Regulators are becoming more deeply involved in transmission siting, although as can be seen in Germany, making the regulator responsible for siting does not guarantee a fast result.

c. Reforming regulations to encourage electrification: Regulators have been identifying rule changes that are needed to promote the most viable alternatives for EV charging (Italy), new rate options to favor electrification (Ontario) and the assessment of a hybrid heating/electrification program (Québec).

d. Addressing the social and economic implications of decarbonization policies: Some regulators have been given a role in addressing the social and economic implications of decarbonization policies, such as the impact of phasing out coal generation on coal communities or in administering key steps in the just transition for affected communities (as is the case in New Mexico). Regulators, by delivering practical, detailed decisions, will make policies work.

e. Evolving the regulatory framework to support decarbonization: Regulators are adopting different regulatory innovations to allow the regulatory framework to evolve more quickly. The use of regulatory sandboxes and similar pilot program techniques (Italy, UK) are increasingly being adopted to test potential changes in regulations before they are committed.

f. Beginning to manage impacts that are going to be felt by gas system customers: Much of the transition focus has been on the positive changes and challenges to the electricity system, but regulators with natural gas customers are beginning to address issues from the fall in natural gas consumption (as with the gas disconnection issue in Australia).

2. ***There are two major gaps in the regulatory framework. Filling them would assist regulators in making decarbonization a priority.*** It was clear from the regulators we spoke to that there were two major gaps in their existing frameworks. The first was to establish **decarbonization as an objective of regulatory decision making.** This has recently been done in two jurisdictions (Australia and the UK), as discussed in Chapter 3. The other regulators we spoke to noted that the lack of such objectives meant that certain decarbonization initiatives for a gas utility or programs that encouraged switching from gas to electricity were harder to justify. Secondly, **government guidance on a suitable value a country is willing to pay to avoid emissions**, either in the form of a "shadow" carbon price or an explicit carbon price, would permit regulators to internalize more readily this cost into regulatory decision making (such as regulatory investment tests for transmission upgrades). Guidance, with enough legal power to be considered by regulators, on how fast these emissions reductions should be achieved, and on the amount of abated emissions for a specific year, are also required for regulators to be able to take

decisions and implement the required mechanisms to achieve them.

By including decarbonization (and pricing it through guidance on a carbon price) regulators have sufficient input from the government to make what might be uncomfortable tradeoffs between the speed of transformation of the energy system, its impact on price and concerns about the effects on reliability and the quality of the energy service. It is a complex task, one best suited to the open, transparent processes that regulators undertake to ascertain the facts and reach a decision.

3. ***Regulatory processes may themselves require acceleration.*** One concern that emerged from the discussions with regulators is how quickly regulators can move forward given the urgency implied by the Paris Agreement, its objectives, the strategies described to achieve various decarbonization scenarios and the increasing ambition of government emissions-reduction objectives. Most of the regulators we spoke to highlighted that limited resources, including a lack of appropriate data, in turn limited the capacity of the regulator to deal with these many challenges arising from a rapid clean energy transition.

   But timing remains an issue. How does one achieve an "acceleration" of the energy transition without changes to regulatory processes? The concern, as noted in Chapter 2, is that incrementalism is so deeply seated into the regulatory approach (particularly in North America) that the necessary speed of change is unattainable.

   Incrementalism does have its advantages, providing stability and predictability for both the customers and the utility and making it easier for utilities and customers to adapt to a changing energy system. Yet the scale and tempo of the change required to achieve timely decarbonization of the energy system is far too great for the deliberate step-by-step approach that regulators are prone to employ. The size of investments, particularly in the electricity sector, and the speed of implementation required need to be supported by timely regulatory decisions. Regulators need to adopt mechanisms (such as the regulatory sandbox mechanisms) to speed progress.

4. ***The government-regulator relationship is important to ensure a consistent approach toward the clean energy transition, to help identify additional functions that the regulator could carry out and to get government support for some of the changes that are going to be needed in regulation.***

   a. Governments will need to continue making policy decisions throughout the transition: their implementation will depend on regulators. Regulators, while responsible for administering the implementation of a policy, can, in turn, offer a technical and public interest perspective on what can practically be achieved.

   b. As the government identifies challenges (e.g., in encouraging investment in new sectors), regulators can work with governments to identify how regulatory oversight could address this. In the case of the UK, this led to an early policy decision for the regulator to take on responsibilities for regulating heat networks and CO_2 transport and storage.

   c. Government support may also be needed to enhance regulatory authority (e.g., transmission line approvals in Germany) or to make politically sensitive changes to electricity rate design (as seen in Ontario).

5. ***Regulators can help each other "accelerate" the energy transition:*** One potential resource energy regulators have is the practical experience of their fellow regulators. There were rather different problems depending on the size and resources of the regulator. Many RETA members interviewed from smaller jurisdictions operate with very limited resources and no capacity at all to research best practices in other jurisdictions. Yet many are confronted with similar issues to those being

addressed elsewhere and could greatly benefit from the experience of others. Larger regulators, which generally already had access to several forums to share expertise and cooperate, are less interested in additional cooperation that could duplicate existing activities.

While reports (such as this one) documenting experiences elsewhere can be helpful, regulators were clear that nothing compares to meeting with fellow energy regulators and providing constructive feedback on how the challenges of a particular regulatory mandate can be met most effectively. The provision of technical assistance (such as legal advice, advice on rate design and data needs), information about best practices (e.g., in the design of renewables auctions) applicable to smaller regulators, and training and secondment opportunities for regulatory staff would be particularly useful for smaller regulators.

It is apparent that the scope of changes required and the speed at which regulatory changes need to take place — at a level comparable to the opening and evolution of electricity and gas markets — calls for a new level of cooperation to help regulators manage these profound changes.

A peer review process could be a catalyst for peer-to-peer learning among energy regulators. An obvious analogy is with the Energy Policy peer review process conducted by the IEA, which "regularly conducts peer reviews of the energy policies of its member countries. This process supports energy policy development and encourages the exchange of international best practices and experiences to help drive secure and affordable energy transitions." [168]

The IEA Energy Policy peer review process includes a mission to the jurisdiction under consideration. Members of the peer review team are energy policy practitioners from other member countries, supported by the IEA secretariat. The team is encouraged to make observations and recommendations that will support the clean energy transition efforts of the governments.

One can envisage a similar peer review process for energy regulators with a mandate "to encourage the exchange of best practices and experiences to help drive secure and affordable energy transitions." Members of the team would include regulatory practitioners (decision-makers and regulatory staff) from the RETA membership. The scope of the review would be decided ex ante in consultation with the host regulator through a series of preparatory meetings that can be conducted virtually. It can therefore be customized to serve the rather different needs of regulators who need to build their own capacity and those wishing to benefit from regulatory practitioners who have hands-on experiences to share.

The initial aim of the peer review process should be to support smaller regulators where the need is greatest and duplication with existing initiatives is lowest.

Finally, RETA could be present so that regulatory concerns are considered at large international gatherings like COP, the IEA Ministerial or the IRENA Council.

168 International Energy Agency (IEA). (n.d.). https://www.iea.org/reports/switzerland-2023

Recommendations

The findings discussed above have been distilled into a set of ten recommendations.

The first three are directed to regulators

Regulators can

- Be creative in pursuing decarbonization consistent with the government's policy even without an explicit mandate to do so.
- Communicate with governments on the practical and technical implications of energy policies and gaps in the current regulatory framework.
- Be timely with their key decisions — to the extent that resources permit — through reforms of regulatory processes.

The next four are directed to policymakers

Governments can

- Amend the regulator's mandate to include a statutory objective for decarbonization.
- Provide guidance on the price of carbon to be used in regulatory analysis, the speed of decarbonization and the acceptable impact on affordability.
- Ensure regulators are adequately resourced to carry out their duties but also held to account to carry out their duties in a timely manner.
- Create informal and formal communication channels to gather regulators' inputs relevant for policies.

The final three are directed to RETA

RETA can

- Develop an energy regulatory peer review process.
- Support capacity building among smaller members through provision of technical assistance, information about best practices (appropriate for smaller regulators) or training and secondment opportunities.
- Ensure regulatory representation at major international energy and climate forums.

These practicable recommendations would enable regulators to play their part in advancing secure and affordable clean energy transitions.

Acknowledgements

We would like to thank the 25 regulatory agencies that agreed to meet with us and participate in this project: Argentinian Association of Regulatory Entities for Electricity (Asociación de Entes Reguladores Eléctricos- ADERE), Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER), Australian (Western) Economic Regulation Authority (ERA), Azerbaijan Energy Regulatory Agency (AERA), The Bahamas's Utilities Regulation & Competition Authority (URCA), Barbados's Fair Trading Commission of Barbados (FTC), Canada British Columbia Utilities Commission (BCUC), Canada Energy Regulator (CER), Canada Ontario Energy Board (OEB), Canada Régie de l'énergie du Québec, Chile's National Energy Commission (Comisión Nacional de Energía- CNE), Egypt's Electric Utility and Consumer Protection Regulatory Agency (EgyptERA), French Energy Regulatory Commission (CRE), Georgian National Energy and Water Supply Regulatory Commission (GNERC), German Energy regulator (Bundesnetzagentur- BNetzA), Grenada's Public Utilities Regulatory Commission (PURC), Japan's Electricity and Gas Market Surveillance Commission (EGC, METI), Kenya's Energy & Petroleum Regulatory Authority (EPRA), Polish Energy Regulatory Office (URE), Saint Lucia's National Utilities Regulatory Commission (NURC), Turks and Caicos Islands' Energy and Utilities Department (EUD), United Kingdom's Office of Gas and Electricity Markets (Ofgem), the United States' Michigan Public Service Commission (MPSC) and the United States' New Mexico Public Regulation Commission (NMPRC).

The team would especially like to thank the following individuals (from regulatory agencies and other stakeholders) who participated and shared their insights for this project: Adrienne Greene, Alberto Pototschnig, Alice Franz, Allison Jean, Anesia Peters, Annegret Groebel, Audrey Zibelman, Bernard Magnan, Brian A. P. Reece, Carolyn Calwell, Chris Ridings, Claire Hellich-Praquin, Claudio Damiano, Dan Scripps, Danuta Sierocińska, David Morton, Dina Said, Elizabeth Walters, Elmar Gulaliyev, Eric F. Salamanca, Félix Turgeon, Francisco Salazar, Jarosław Szymanowski, Javier Toro, Jean-Denis Charlebois, Jeff Hardy, Jennar Jacob, Jerson Reyes, Jonathan Hudson, Kathyann Belle, Kerollee McLee, Krzysztof Liwanowski, Lee Alubala Okombe, Lily Mitchell, Linaldo Jackman, Luciano Gastón Paulin, Lynne Anderson, Marco Mancilla, Mark Feather, Mathias Laffont, Patrick O'Connell, Rafał Gawin, Reiko Kojima, Richard Hibble, Sherif Mohamed Zoheir, Stewart Carter, Tamar Parunashvili, Tanya Dettlof and Yuki Tanaka.

We also want to thank the following people from whose peer review we benefited: Andrew Flagg (Regulatory Energy Transition Accelerator- RETA), Andrew Lewis (Global Green Growth Institute- GGGI), Annegret Groebel (German Energy regulator (Bundesnetzagentur- BNetzA), Carolyn Calwell (Canada Ontario Energy Board- OEB), Christoph Kellermann (Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ] GmbH), Cyril Michaud (Canada Régie de l'énergie du Québec), Enrique Gutierrez (International Energy Agency- IEA), Félix Turgeon (Canada Régie de l'énergie du Québec), Francisco Salazar (International Confederation of Energy Regulators- ICER), Jeff Hardy (Imperial College London-ICL, academic), Lily Mitchell (Australian Energy Market Commission- AEMC), Mathias Laffont (Union Française de l'Electricité- UFE), Oskar Schickhofer (International Energy Agency- IEA), Patricia Dépôt (Canada Régie de l'énergie du Québec), Rachel Gold (Rocky Mountain Institute- RMI), Riccardo Vailati (Italian Autorità di Regolazione per Energia Reti e Ambiente- ARERA) and Richard Hibble (United Kingdom's Office of Gas and Electricity Markets- Ofgem).

The team also thanks the following for their support: Richard Sedano, Alejandro Hernandez, Shravya Reddy, Tim Simard, Steena Williams, Becky Wigg, Molly Caballero, Nick Georges, and all of RAP's team members who helped make this report possible. We would like to give special appreciation for the design work of Brandon Hunt on this report and its accompanying webpage supplemental.

We also want to thank Crux Alliance for sponsoring this project.

Finally, we are thankful for support from the Regulatory Energy Transition Accelerator's team, with special thanks to Andrew Flagg and Matthieu Coget, as well as RETA's Steering Committee for their final review of the report.

We want to emphasize that all views and insights shared in the present report, as well as any errors or omissions, are the sole responsibility of the authors. No statements have been directly attributed to any of the participants acknowledged herein.

Annex A. List of Interviewees

**The people interviewed shared personal opinions that do not represent the views of their institutions.*

Regulators

#	Region	Country	Organization	Organization Full Name	Legal System	Link Organization
1	Africa	Kenya	**EPRA**	Energy & Petroleum Regulatory Authority	Common Law	https://www.epra.go.ke
2	Africa	Egypt	**EgyptERA**	Electric Utility and Consumer Protection Regulatory Agency	Civil Law	http://egyptera.org/en/
3	Asia	Japan	**EGC, METI**	Electricity and Gas Market Surveillance Commission	Civil Law	https://www.emsc.meti.go.jp/english/
4	Australia	Australia	**AER**	Australian Energy Regulator	Common Law	https://www.aer.gov.au/
5	Australia	Australia	**AEMC**	Australian Energy Market Commission	Common Law	https://www.aemc.gov.au
6	Australia	Australia	**ERA**	Economic Regulation Authority (Western Australia)	Common Law	http://www.erawa.com.au/
7	Caribbean	Bahamas	**URCA**	Utilities Regulation & Competition Authority	Common Law	https://www.urcabahamas.bs
8	Caribbean	Barbados	**FTC**	Fair Trading Commission of Barbados	Common Law	https://www.ftc.gov.bb
9	Caribbean	Grenada	**PURC**	Public Utilities Regulatory Commission	Common Law	https://purc.gd
10	Caribbean	Saint Lucia	**NURC**	National Utilities Regulatory Commission	Civil Law, Common Law	https://nurc.org.lc
11	Caribbean	Turks and Caicos Islands	**EUD**	Energy and Utilities Department	Common Law	https://www.gov.tc/eud/
12	Eurasia	Azerbaijan	**AERA**	Azerbaijan Energy Regulatory Agency	Civil Law	https://regulator.gov.az/en/
13	Eurasia	Georgia	**GNERC**	Georgian National Energy and Water Supply Regulatory Commission	Civil Law	https://gnerc.org/en/home
14	Europe	France	**CRE**	Energy Regulatory Commission	Civil Law	http://www.cre.fr/
15	Europe	Germany	**BNetzA**	Bundesnetzagentur - German Energy regulator	Civil Law	https://www.bundesnetzagentur.de/EN/Home/home_node.html
16	Europe	Poland	**URE**	Energy Regulatory Office	Civil Law	https://www.ure.gov.pl/en/
17	Europe	United Kingdom	**Ofgem**	Office of Gas and Electricity Markets	Common Law	https://www.ofgem.gov.uk/
18	North America	Canada	**CER**	Canada Energy Regulator	Common Law	https://www.cer-rec.gc.ca/en/index.html
19	North America	Canada	**BCUC**	British Columbia Utilities Commission	Common Law	https://www.bcuc.com
20	North America	Canada	**OEB**	Ontario Energy Board	Common Law	https://www.oeb.ca
21	North America	Canada	**Régie de l'énergie du Québec**	Régie de l'énergie du Québec	Civil Law	https://www.regie-energie.qc.ca/fr
22	North America	United States	**MPSC**	Michigan Public Service Commission	Common Law	https://www.michigan.gov/mpsc
23	North America	United States	**NMPRC**	New Mexico Public Regulation Commission	Common Law	https://www.prc.nm.gov/
24	South America	Argentina	**ADERE**	Argentinian Association of Regulatory Entities for Electricity (Asociación de Entes Reguladores Eléctricos)	Civil Law	https://adere.org.ar/web/
25	South America	Chile	**CNE**	Chile's National Energy Commission (Comisión Nacional de Energía)	Civil Law	https://www.cne.cl

Stakeholders

#	Region	Country	Organization	Organization Full Name	Type of interview	Link Organization
1	Europe	France	**UFE**	Union Française de l'Electricité	Stakeholder	https://ufe-electricite.fr
2	Europe	Italy	**FSR**	Florence School of Regulation	Stakeholder (academic)	https://fsr.eui.eu
3	Europe	United Kingdom	**ICL**	Imperial College London	Stakeholder (academic)	https://www.imperial.ac.uk
4	International	International	**ICER**	International Confederation of Energy Regulators	Stakeholder	http://icer-regulators.net
5	International	International	**International Consultant**	International Consultant	Stakeholder	

Annex B.1 Questions for Interviews. Regulators

July 2023

Questions for Interviews on decarbonization in regulatory decision-making

RETA (the Regulatory Energy Transition Accelerator)[1] works directly with energy regulators in order to facilitate knowledge sharing, peer to peer learning and thought leadership on regulatory issues. Our flagship project, entitled "Elevating the Priority of Decarbonization in Energy Regulators Decision-making" aims to gather from regulators examples of how their decisions have been able, or not, to consider decarbonization of the energy sector, if they believe the current rules need to evolve to integrate energy sector decarbonization in the core mission of the regulator and if so, what kinds of legal and regulatory changes are needed.

This interview is a key part of the information gathering stage of this project. It is designed to help us understand your situation as a regulator of the electricity and natural gas sectors in dealing with decarbonization issues. At the end, we will ask if you have suggestions for how RETA can help your agency with new issues pertaining to decarbonization.

I. Regulator-government relationship

Most governments have international commitments related to the emissions of greenhouse gases. We would like to understand better how these commitments are communicated to regulators through their relationship to government.

1. What do you see your role as an energy regulator in advancing the decarbonization of the energy system?
    a) Do you regard yourselves as allies of the government, as independent decisionmakers, other?
2. Are you bound by any government targets with respect to decarbonization, e.g., power sector has to reduce emissions by a certain date?
3. Policy coordination with government – how does the government communicate its policy priorities with respect to decarbonization?
    a) Do they involve you in coordinating bodies where the issue is discussed (climate councils)?
    b) Is it useful?

II. Application of decarbonization criteria in recent decisions

Let's talk about how decarbonization considerations are being applied currently. We are interested in collecting examples of how decarbonization is being considered currently in regulatory decision making. To the extent you can provide supporting documentation of examples, it would be very helpful for our report. Feel free to share any links in advance.

4. How is decarbonization considered today, implicitly, or explicitly in current regulatory decisions undertaken by your agency?
    a) Have you an example where you have had to be creative (in your interpretation of your mandate or in the process you used) to include decarbonization in your decision making?

[1] Further information available at https://retatheaccelerator.org/

5. Could you give us some other recent examples of decisions where decarbonization was successfully included into decision making, and how this reflects a change with respect to previous approaches?
6. Do you have any recent examples where you believe the regulatory decision has been portrayed as an obstacle to decarbonization?
    a) Would you agree with that characterization?

III. Appropriateness of existing legal/regulatory framework to incorporate decarbonization

*We also want to understand better how far you can use the **existing** legal/regulatory framework in incorporating decarbonization. The answer will depend on the national context, and even on the legal tradition (civil law vs common law). We would also like to better understand regulatory concerns about balancing decarbonization, security and affordability and about considering risk in your decision-making.*

7. Could the regulatory agency do more to contribute to national decarbonization objectives within the existing legal and regulatory framework?
8. Are there important gaps remaining in the regulatory framework leading to decisions not consistent with national climate goals?
    a) What are they?
9. Are you concerned that a stronger direction from the government to encourage decarbonization might affect the affordability or reliability of energy supply or introduces other risk?
    a) Do you have the tools to manage these potential impacts?
10. Do you think that some government policies and interventions would be better handled if decisions were properly delegated to the regulator, or the current division of labour and responsibilities is the right one to achieve an effective decarbonization path for your country?

IV. Potential enhancements to the legal/regulatory framework

We would like to have your thoughts on legal or regulatory changes that would enhance your ability to incorporate decarbonization in your regulatory decision making. This could be as simple as an explicit high-level objective, or something more detailed. This applies to your oversight of both electricity and of natural gas.

11. What changes to the legal and regulatory framework, if any, would be needed to provide regulators with the necessary tools to elevate the priority of decarbonization in their decision making to support the achievement of decarbonization targets, such as the complete decarbonization of the power sector? Potential changes could encompass (but are not limited to):
    a) High level regulatory goal with respect to decarbonization
    b) Oversight of coordinated planning of the electricity and natural gas networks
    c) Approvals of electricity network investment plans
    d) Goals with respect to electrification and energy efficiency

e) Expanding the scope of regulatory authority for facility approvals (e.g., for transmission)

f) Coordination of transmission and distribution networks planning and operations

g) Changes to natural gas regulation facing declining demand for fossil natural gas and potential replacement by low-carbon alternatives

h) Establishing a stable investment framework for customer-owned resources (PV and/or storage)

i) Support for innovation by network owners to manage the transition

12. If you make only one recommendation for a change, what would it be?

V. Final thoughts

13. As we indicated at the beginning, we would like to know if you have suggestions for how RETA might help you handle current and emerging issues pertaining to decarbonization. If you have suggestions, please tell us these now (if they need prompts: peer opportunities to speak with counterparts from other jurisdictions, case studies, research)
14. Do you have any questions? Is there something else you'd like to add or wish us to think about in drafting our report?

Annex B.2 Questions for Interviews. Non Regulators — Stakeholders

July 2023

Questions for Interviews on decarbonization in regulatory decision-making

RETA (the Regulatory Energy Transition Accelerator)[1] works directly with energy regulators in order to facilitate knowledge sharing, peer to peer learning and thought leadership on regulatory issues. Our flagship project, entitled "Elevating the Priority of Decarbonization in Energy Regulators Decision-making" aims to gather from regulators examples of how their decisions have been able, or not, to consider decarbonization of the energy sector, if they believe the current rules need to evolve to integrate energy sector decarbonization in the core mission of the regulator and if so, what kinds of legal and regulatory changes are needed.

This interview is a key part of the information gathering stage of this project. It is designed to help us understand your situation as a stakeholder of the electricity and natural gas sectors in dealing with decarbonization issues. At the end, we will ask if you have suggestions for how RETA can help your agency with new issues pertaining to decarbonization.

I. Regulator-government relationship

Most governments have international commitments related to the emissions of greenhouse gases. We would like to understand better how these commitments are communicated to regulators through their relationship to government.

1. What do you see the role of an energy regulator in advancing the decarbonization of the energy system?
    a) As allies of the government, as independent decisionmakers, other?
2. Should regulators be bound by any government targets with respect to decarbonization, e.g., power sector has to reduce emissions by a certain date?
3. Should regulators be active participants in Policy coordination with government – how does the government communicate its policy priorities with respect to decarbonization?
    a) Do they involve you in coordinating bodies where the issue is discussed (climate councils)?
    b) Is it useful?

II. Application of decarbonization criteria in recent decisions

Let's talk about how decarbonization considerations are being applied currently. We are interested in collecting examples of how decarbonization is being considered currently in regulatory decision making. To the extent you can provide supporting documentation of examples, it would be very helpful for our report.

4. How is decarbonization considered today, implicitly, or explicitly in current regulatory decisions undertaken by your agency?
    a) Have you an example where you have had to be creative (in your interpretation of your mandate or in the process you used) to include decarbonization in your decision making?

[1] Further information available at https://retatheaccelerator.org/

5. Could you give us some other recent examples of decisions where decarbonization was successfully included into decision making, and how this reflects a change with respect to previous approaches?
6. Do you have any recent examples where you believe the regulatory decision has been portrayed as an obstacle to decarbonization?
    a) Would you agree with that characterization?

III. Appropriateness of existing legal/regulatory framework to incorporate decarbonization

*We also want to understand better how far one can use the **existing** legal/regulatory framework in incorporating decarbonization. The answer will depend on the national context, and even on the legal tradition (civil law vs common law). We would also like to better understand regulatory concerns about balancing decarbonization, security and affordability.*

7. Could the regulatory agency do more to contribute to national decarbonization objectives within the existing legal and regulatory framework?
8. Are there important gaps remaining in the regulatory framework leading to decisions not consistent with national climate goals?
    a) What are they?
9. Are you concerned that a stronger direction from the government to encourage decarbonization might affect the affordability or reliability of energy supply?
    a) Do you have the tools to manage these potential impacts?

IV. Potential enhancements to the legal/regulatory framework

We would like to have your thoughts on legal or regulatory changes that would enhance your ability to incorporate decarbonization in your regulatory decision making. This could be as simple as an explicit high-level objective, or something more detailed. This applies to your oversight of both electricity and of natural gas.

10. What changes to the legal and regulatory framework would be needed to provide regulators with the necessary tools to elevate the priority of decarbonization in their decision making to support the achievement of decarbonization targets, such as the complete decarbonization of the power sector? Potential changes could encompass (but are not limited to):
    a) High level regulatory goal with respect to decarbonization
    b) Oversight of coordinated planning of the electricity and natural gas networks
    c) Approvals of electricity network investment plans
    d) Goals with respect to electrification and energy efficiency
    e) Expanding the scope of regulatory authority for facility approvals (e.g., for transmission)
    f) Coordination of transmission and distribution networks planning and operations
    g) Changes to natural gas regulation facing declining demand for fossil natural gas and potential replacement by low-carbon alternatives

h) Establishing a stable investment framework for customer-owned resources (PV and/or storage)

i) Support for innovation by network owners to manage the transition

11. If you make only one recommendation for a change, what would it be?

V. Final thoughts

12. Do you have any questions? Is there something else you'd like to add or wish us to think about in drafting our report?