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Technological Change and the Politics of Decarbonization: A *Re*-making of Vested Interests?

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A R T I C L E I N F O

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A B S T R A C T

A growing body of research shows that incumbents employ heterogenous strategies in advancing energy transitions. We analyze how shifts in the policy positions of European power producers relate to technological changes on the firm level. We find that substitution of fossil-fuel assets with hydropower and nuclear, or new renewable energy (NRE) assets is strongly associated with cessation of opposition and the emergence of partial and strong support for more ambitious policies. However, utilities with notable new investment in NRE, but a dominant share of incumbent hydropower or nuclear in their portfolios, have not become more supportive of more ambitious renewable energy policies. We argue that substantial substitution is needed to re-make vested interests and engender more broad-based business support for accelerating the energy transition. Co-option by incumbents suggests that NRE is beyond the stage of niche technology, and that change may increasingly come from within the existing socio-technical regime.

1. Introduction

Studies of the politics of low-carbon transitions often portray business incumbents as political obstacles to decarbonization due to their entrenchment in existing socio-technical regimes. Over several decades of climate policymaking, major polluters have sought to block or weaken climate and renewable energy policies (Newell and Paterson 1998; Vormedal 2012; Geels 2014; Hess 2014; Roberts, Geels et al. 2018; Lockwood, Mitchell et al. 2020; Stokes 2020). Incumbents are thus a key component of the vested interests (Moe 2015) that have strong incentives to act as gatekeepers of policy institutions enabling the continuation of fossil-fuel-based industrial practices.

However, a growing body of research has revealed increasingly heterogeneous business responses to decarbonization efforts—also within polluting industries (Steen and Weaver 2017; Turnheim and Sovacool 2020; Lindberg and Kammermann 2021; Vormedal and Meckling 2021). Some traditional polluters have "entered niches" by investing in and integrating disruptive, low-carbon technologies with existing business models (Bergek, Berggren et al. 2013; Berggren, Magnusson et al. 2015; Bohnsack, Kolk et al. 2020). It is increasingly acknowledged that some businesses which traditionally represented "old" technologies have begun to re-orient their strategies towards niche innovations (Steen and Weaver 2017; van Mossel, van Rijnsoever et al. 2018; Turnheim and Sovacool 2020). However, our understanding of how technological changes away from fossil fuels relate to behavioral shifts among incumbents, and the extent to which such changes may alter previous patterns of political mobilization, remains limited. Although incumbent utilities

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represent a substantial share of new renewable energy (NRE) deployment in the power sector (Frei, Sinsel et al. 2018; Gielen, Boshella et al. 2019; Kattirtzi, Ketsopoulou et al. 2021),[1] there are no systematic studies of how technological change—defined here as change in the production technology portfolio of companies—relates to shifts in the political mobilization of vested interests. Such an investigation is important, as technological and political change are key sources of regime fragmentation, decline or transformation (Turnheim and Geels 2013; Steen and Weaver 2017).

With this article, we seek to advance knowledge on how technology may shift the role of vested interests in climate politics, by investigating how changes in the production technology portfolios of the 15 largest electric-power producers (utilities) in Europe relate to changes in their policy positioning, 2008–2020. The power sector is dominated by large, vertically integrated utilities that produce, transmit and sell electricity. These are considered to be politically influential due to their size and connection to public entities (Frei, Sinsel et al. 2018), which makes the sector an ideal case for studying the changing technological and political role of incumbents. First, we use the "Utility Data Institute World Electric Power Plants Database" (WEPP) developed by S&P Global Market Intelligence (Gotzens, Heinrichs et al. 2019) to categorize power-plant data by parent company, enabling a novel quantitative assessment of company-level change in power-production technology. Secondly, we assess change in the utilities' positioning towards key EU policies, using a comprehensive coding scheme for consultation responses that enables us to assess parallel change in patterns of political mobilization. This unique data combination allows us to analyze the heterogeneity of utility strategies, as well as the relationship between technology and politics at both company and industry level—an important contribution to the debate on incumbencies in low-carbon transitions (see Sovacool, Turnheim et al. 2020).

The article proceeds as follows. We first discuss the changing role of incumbents in low-carbon transitions, and research needs pertaining to how technology may alter previous patterns of political mobilization. Second, we offer a short overview of developments in EU policies and power production technologies over the past decade. Third, we describe our quantitative and qualitative methodologies. Fourth, we present our assessment and analysis of how change in production technologies relates to change in policy positions, and of the heterogenous behavior within the sector. We find that substantial company-level substitution of fossil-fuel based production technology with clean technologies can re-make vested business interests towards policy regimes. However, we also find that fundamental shifts in technology will be needed to engender strong incumbent support for accelerating transitions.

2. Technological change and the *re*-making of vested interests

Research on business and climate politics often distinguishes between two types of industry actors. First, established firms in polluting sectors have typically been cast as political obstacles to transformative policy change. Transition scholars traditionally view incumbents as components of the existing socio-technical regime—'the deep-structure of socio technical systems' (Geels 2004:905)—although recent literature presents a more nuanced perspective on incumbency (Stirling 2019; Turnheim and Sovacool 2020). Building on institutional theory, Geels distinguishes between regulative, normative, and cognitive sets of rules that govern regimes, forming a 'locus of established practices and associated rules that enable and constrain incumbent actors in relation to existing systems' (Geels 2014:23). A substantial body of research show how incumbents have formed alliances with politicians and policymakers to prevent regime changes, thereby contributing to the reproduction and lock-in of fossil-fuel-based economic activities (Unruh 2000; Levy and Newell 2005; Geels 2014; Seto, Davis et al. 2016). The political mobilization of incumbents to prevent regime change has been seen as a major impediment to realizing ambitious climate policies to accelerate low-carbon transitions (Sovacool 2016; Roberts, Geels et al. 2018; Meckling 2019). The second type of industry actors are challengers—firms involved in the development of niches that advance innovative and potentially disruptive technologies. Niches have been defined as 'protected spaces' where radical innovations are shielded from full market exposure (Smith and Raven 2012). Disruptive innovations expand from a niche and erode the market share of incumbents, disrupting the technological system (Bower and Christensen, 1995). The result is often that incumbent technologies become stranded assets (Seba 2014). Challengers have typically been cast as political counterweights to vested interests, and as key to strengthening the support base for more ambitious climate policies (Jacobsson and Lauber 2006; Levin, Cashore et al. 2012; Jordan and Matt 2014; Meckling, Kelsey et al. 2015; Meckling, Sterner et al. 2017). Business challengers are thus understood as agents instigating change from outside the existing socio-technical regime, which may eventually help destabilize incumbent power.

However, with transitions advancing into an acceleration phase, this dichotomous conceptualization of the technological and political role of business is becoming increasingly untenable. Transition scholars have recently called for, and sought to develop a more nuanced perspective that recognizes how incumbents employ different strategies with respect to the development and diffusion of niche innovations (Berggren, Magnusson et al. 2015; Turnheim and Sovacool 2019; Lindberg and Kammermann 2021; Ruggiero, Kangas et al. 2021).

In the electric power sector, innovations driven largely by national and subnational policies have pushed new renewable energy (NRE) generation technologies such as solar and wind power along their learning curves, resulting in cost advantages and performance competitiveness with established fossil-fuel generation technologies (Schmidt and Sewerin 2017; Breetz, Mildenberger et al. 2018; Gielen, Boshella et al. 2019; Schmid 2020). As a result, some incumbents have begun to invest massively in NRE and divest from fossil-fuel intensive electricity generation such as coal power (Kattirtzi, Ketsopoulou et al. 2021)—engaging in a process of technological substitution (Anderson and Tushman 1990).

[1] In terms of power generation, renewables have accounted for more than half of all global capacity additions since 2012. In 2017, newly installed renewable power capacity achieved a new record of 167 GW. This was another record year where more than 60% of all new electricity capacity came from renewables.

This has implications for transitions theory. Importantly, NRE should not necessarily be categorized niche technologies anymore. NRE has structurally disruptive potential (Foxon, Gross et al. 2005), as exponential growth in smaller-scale, decentralized solar and wind generation by end-consumers would destabilize and threaten incumbent control over the production, transportation, and distribution of electricity. However, the growth of investment in centralized, utility-scale solar and wind generation by utilities does not represent a process of disruption from below, but rather a co-option of NRE and thus the decarbonization process by incumbents.[3] This suggests that the dominating socio-techno regime may become increasingly fragmented, with regime actors heavily involved in traditional, fossil-fuel technologies and clean technologies at the same time. We may expect that incumbents who become market leaders on NRE by substituting fossil-fuel generation with solar and wind generation will begin to favor forms of NRE deployment that suits their centralized business models and strategies.

Yet, as Schmidt and Sewerin (2017) point out, the relationship between technological change and political change remains largely understudied (Fig. 1).

We build on classic works in comparative political economy which indicate that when the material interests of established producers change, emerging support for related policy changes is likely to materialize (Milner 1988; Gourevitch 1989; Hall 1997). We propose that a strategic re-orientation towards investment in NRE by incumbents is likely to shift opposition or strengthen support for accelerating the transition to renewable energy. As such, technological change may shift political agency, representing change from within, rather than outside of the socio-technical regime.

However, considerable variation in incumbent strategies should be expected. Firms are subject to differing political and societal expectations, policy incentives and regulatory pressures (Meckling 2015; Vormedal and Meckling 2021). They also have varying dynamic capabilities, leading to differences in business models of firms within industries (Teece 2017). As Stenzel and Frenzel (2008) demonstrated, variation in company capabilities and the institutional environments of German, Spanish and UK utilities caused large divergence in their strategic responses to RE policies.

Drawing on various organizational theories, van Mossel et al. (2018) propose four typical modes of incumbent behavior related to technological niches that are helpful for categorizing the heterogenous strategies of established firms during transitions. These are i) first to enter niches, ii) following into niches, iii) remaining inert, and iv) delaying the transition. In the first mode, the incumbent takes a sizable risk in becoming an early mover, entering the niche either out of necessity or to exploit an opportunity. In the second mode, the incumbent firm enters the niche after others have pioneered the relevant technology. In the third mode, the incumbent firm suffers from inertia, and does not significantly change its behavior. Finally, in the fourth mode, the incumbent clings to established regime technologies, and continues to employ strategies to slow down or prevent climate policies. These modes are not mutually exclusive, as an incumbent may diversify into new technologies and still exploit traditional activities (van Mossel, van Rijnsoever et al. 2018).

Here we explore two related research questions: How does technological change, measured as change in the production technology portfolio of incumbent electric utilities, relate to change in their climate policy positions—and thus patterns of political mobilization? What variation in incumbent behavior can be observed?

Before investigating these questions, we first provide a brief account of the development of EU policies and power-production technologies.

3. Developments in EU policy and power production technology

Emissions trading and renewable energy deployment have been at the core of the EU’s power-sector decarbonization policy (Görlach et al., 2017). A formal policy for renewable energy (RE) was first implemented in 2001 with the renewable energy directive (RED) (2001/77/EC), which specified indicative, quantitative targets for renewable shares for each member-state. Targets were set to 12% renewable energy and 22.1% renewable electricity by 2010 for EU-24 (Fouquet and Johansson 2008). In 2009, the EU adopted a revised RED setting a 20%-RE target for 2020 and nationally binding targets for member-states. It also specified rules for renewable energy support schemes, guarantees of origins and benefits for renewable producers like priority dispatch and free grid connection. The EU emissions trading scheme (ETS) was first enacted in 2005, largely to fulfill commitments under the Kyoto Protocol (J. Meckling 2011; Görlach, Duwe et al. 2017). The ETS reform of 2009 set the emissions reduction target to 21% by 2020 compared to 2005 levels.

With these policies in place, the deployment of RE in electric power generation increased, led by onshore wind. However, the relative shares of NRE were still marginal compared to incumbent production technologies, including coal, oil and natural gas, as well as hydropower and nuclear. Then, during the 2010s, both solar and windpower technologies became increasingly competitive, as prices continued to fall rapidly due to emerging economies of scale. According to the International Renewable Energy Agency (IRENA 2020), the global weighted-average LCOE (levelized cost of electricity) of solar PV fell by 82% between 2010 and 2019 along with large increases in installed generation capacity from 40 GW to 580 GW. Overall, a 90% decline in module prices, combined with substantial reductions in system costs, led the total cost of utility-scale solar PV electricity generation to fall by almost four-fifths in this period. The global weighted-average LCOE of more developed onshore windpower technology fell by 39%, whereas installed capacity increased from 178 GW to 594 GW. According to the European Commission, onshore wind generation became cheaper than coal, natural gas and

[2] Adapted from Schmidt, T. S. and S. Sewerin (2017). "Technology as a driver of climate and energy politics." Nature Energy **2**(6).

[3] Decentralized NRE generation refers to on-site power production by end-consumers, including private houses and corporate buildings, rather than by utility owned facilities. Decentralized NRE generation often comes from small wind power generators or solar photovoltaic (PV) panels. By contrast, centralized, utility-scale NRE generation refers to electricity produced from power plants operated and transmitted by (often vertically integrated) utilities via distribution networks to the end-consumer.

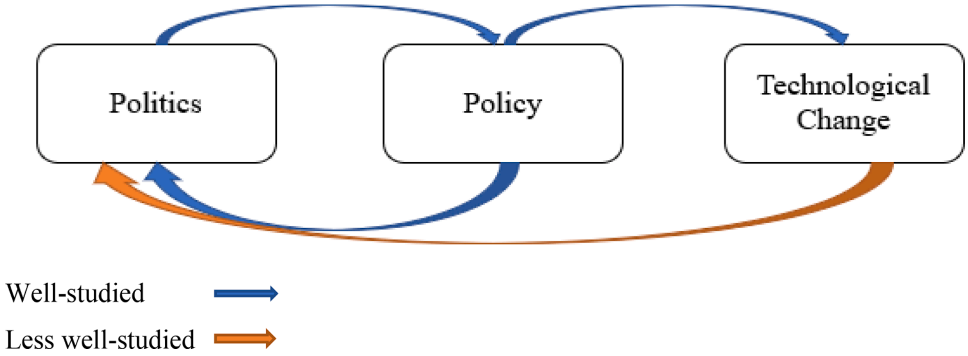

Fig. 1. Relationship between policy, technological change and politics.[2]

nuclear generation in 2014.[4] This opened up new space for RE technologies to substitute and reduce the advantages of dominant technologies.

The increasing competitiveness of NRE with incumbent technologies also had important repercussions for EU policy reform. For instance, during negotiations for a new Renewable Energy Directive for 2020–2030 (RED II), some argued wind and solar power should no longer be eligible for support. RE proponents maintained that sinking costs implied that the overall ambition of 27% RE by 2030 should be further increased, and the need for support to accelerate deployment remained (Kulovesi and Oberthür 2020). This argument won through, and the RED II adopted in 2018 included a higher ambition of 32% RE by 2030. Member-states were still allowed to have support schemes, and the Directive included similar prescriptions for market-based RE support outlined in the State Aid Guidelines (2014–2020) (Lindberg 2019).

As for the reform of the EU-ETS, low carbon prices after the financial crises and a large surplus of emissions allowances, a "back-loading" of EU emission allowances (EUAs) in 2014–2016 was adopted as a short-term measure, alongside the establishment of a Market Stability Reserve (MSR) in 2015. The MSR, operational as of 2019, regulates the annual volumes of EUAs.

In 2020 the EU launched the Green Deal, which involved a substantial increase in the EU's overall climate ambition and renewable energy target. To reach a 55% cut of GHG by 2030, the Commission proposed a 40% RE target as part of the 'fit-for 55′-package in 2021. Accordingly, it also proposed to lower the overall emission cap of the ETS for 2030 and increase the annual rate of reduction.[5] In the spring of 2022, the Commission elevated the RE target to 45% after Russia's invasion of Ukraine, as part of the REpowerEU initiative. Going forward, the EU will provide support and subsidies for RE deployment until 2030. The design and size of renewable policy support measures will depend on various factors, including the price levels in the whole-sale market (Kraan, Kramer et al. 2019), interest rates levels (Schmidt, Steffen et al. 2019) and level of the carbon price (Lindberg 2019).

4. Methodology

We mapped changes in the production technology and policy positions of 13 large European electric utilities using market data and responses to relevant EU public consultations. Our original sample included the 15 largest utilities, measured by total MW capacity in 2020[6] (see Table 1), representing about 60% of total European MW capacity.[7] Two utilities, SSE and EPH, were excluded from our sample, due to lack of consultation responses.

To assess technological change at the level of individual utilities, we use the *Utility Data Institute World Electric Power Plants Database* (WEPP) by S&P Global Market Intelligence. WEPP is considered one of the most comprehensive databases for the electricity sector (Gotzens, Heinrichs et al. 2019). It provides consistently structured records for power capacity; as of 2022 it contained information on over 118 thousand power plants owned by nearly 42 thousand parent owners.[8] For Europe, the total number of records is more than 70 thousand[9] in 2020. The records include information on ownership, fuel and technology types, capacity measurements, unit-level ownership and operations, proposed and under construction project details. Unit information, including the in-service year, is updated quarterly. It preferentially reports unit capacity as gross electric capacity. Our selection is based on the 2020 December WEPP database, and all generating units except for UDI status as "Cancelled" were included in the selection process.

[4] European Commission, 2021, https://ec.europa.eu/info/news/focus-renewable-energy-europe-2020-mar-18_en. However, identifying when annual wind and solar PV reached the cost-levels of fossil fuel is difficult, as various cost ranges exist for fossil and RE energy (see Strauch, Y. (2020). "Beyond the low-carbon niche: Global tipping points in the rise of wind, solar, and electric vehicles to regime scale systems." Energy Research & Social Science **62**: 101364.

[5] URL: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541.

[6] As according to WEPP database 2020 ("in operation" and planned capacity).

[7] Considering the work of developing a detailed database on change in each utility's position on both RED and the ETS, we decided to keep the total sample utilities below 15.

[8] https://www.spglobal.com/marketintelligence/en/campaigns/energy.

[9] WEPP, 2020, Database description and research methodology, world electric power plants data base.

Table 1
The 15 largest electric power producers in Europe.

Company	Member State HQ	Founded	Total assets 2020 (in MW)
Electricite de France S. A (EDF)	France	1946	143,727
Enel S.p.A.	Italy	1962	71,092
RWE AG	Germany	1898	52,299
Engie SA	France	2008	44,495
Vattenfall AB	Sweden	1909	40,102
Iberdrola	Spain	1992	38,257
Fortum Oyj	Finland	1998	33,593
Polska Grupa Energetyczna	Poland	1990	27,052
Skupina ČEZ' České Energetické Závody (PGE)	Czech Republic	1992	22,336
Statkraft AS	Norway	1895	19,870
E.ON AG	Germany	2000	17,563
Energie Baden-Württemberg AG (ENBW)	Germany	1997	17,068
Ørsted A/S	Denmark	1972	16,750

We define "production technology" as the technology, or group of technologies, that are used to generate electricity from a given fuel or energy source (e.g. coal, natural gas, hydro, nuclear, solar, wind). We analyze growth in shares of new renewable energy (NRE) technology, focusing on wind and solar power generation, thus excluding biofuels, and incumbent hydropower from our definition of NRE. This is because the focus of study is substitution of incumbent technologies with *new* RE technologies.

For each selected company, the data are sorted on primary fuel, regardless of specific technology types used for combustion. We use historical WEPP releases for the period 2008–2020, which were merged into time-series dataset. To examine annual production capacity 2008–2019 we include all units with status as "in operation" or "unknown"; i.e. for the year 2020 we also include data in the pipeline (under construction and planned, deferred w/o construction start, delayed after construction, still in development or design). The term "asset" refers to a company's portfolio of power-generation technologies, which are either operational or under construction (as with pipeline power plant projects).

As with any databases of such coverage, limitations such as inconsistencies and lack information are to be expected. According to WEPP, some smaller assets, selected countries, company types and technology might be missing. For instance, for wind turbines, the coverage is stated as "comprehensive" for units sized >= 1 MW, but only "representative" or "adequate" for units less than 1 MW. For solar PV, the data set is stated as "comprehensive" for units larger than 10 MW.

There are also possible inconsistencies in capacity ratings, given the lack of standardization in definitions and use of various terms (Alova, 2020). Although WEPP preferentially reports plant gross capacity, other information might be included if these data are unavailable. There could also be discrepancies and delays in accounting for power-plant upgrading or downgrading, which might result in deviations from the reality in plant capacity.

Another limitation which can lead to inconsistencies is that the aggregation "parent company" was not recorded prior 2011. Therefore, we undertook a thorough examination of the companies structure and history of acquisition, mergers, and divestments, 2008–2020. This information is gathered from various sources, as company's annual reports, publications and homepages. If a company owns more than 50% (controlling interest) in another company, the company's units are included in the analysis as a subsidiary the year that the acquisition/ merger was executed; if it has less than 50% interest, that company is excluded from the analysis from the year of divestment execution. To ensure consistency, this approach was also performed for the years post-2011.

We used the WEPP data to establish the absolute and relative shares of production technology assets at specific times, and change between specific times, 2008–2020. We also used these data to establish the extent of future expansions, i.e. investments in future projects.

To assess the policy positions of electric utilities regarding ETS and RED reform, we utilized the companies' responses to EU public consultations. The documents are publicly available, enhancing transparency, and lend themselves well to qualitative analysis. For each utility included in our sample, we investigated consultation responses, including answers and additional company statements provided in the official questionnaires submitted to the EU Commission. We focused on public consultations from two periods: consultations for REDII and ETS reform in 2015/16 ;[10] and consultations for revision of REDII and the ETS in 2020/21, as well as consultation responses to the 2030 Climate Target Plan (leading up to the European Green Deal) containing answers relevant to both the REDII and ETS reforms. We also provide an overview of utilities' positions on RED and ETS prior to 2015, based on previous scholarly literature.

We use three distinct levels for categorizing the utilities' positions on RED and ETS reform: support, partial support and oppose:

Strong support (value: 1) captures unambiguous support expressed for ratcheting up the ambitions of RED and ETS in the revision/ reform. This involves support for implementing or going further than the most ambitious policy-reform alternatives proposed by the

[10] For E.ON, EnBW and Ørsted (previously Dong), due to missing consultation responses in the ETS consultation from 2015, consultation responses from the 2013 ETS consultation were used instead. For PGE, due to missing responses to the ETS and RED 2015/16 consultations, the response from the Polish Electricity Association was used instead. As PGE is Poland's largest energy- sector company and is state- owned, it appears very likely that PGE has influenced the Polish Electricity Association's responses, and highly improbable that the association would submit responses counter to PGE's interests. See Table A in the Appendix for an overview.

Table 2
Overview of coding scheme.

Key dimensions and lead questions	Score		Example from 2020/21 consultations
Policy position: Renewable Energy Directive (RED) and Emissions Trading System (EU ETS)			
Overall ambition. Does the company support increasing overall ambition levels (including GHG and RE targets)?	Strong support	+1	At least −55% GHG by 2030; at least 40% RE by 2030
	Partial support	0	At least −50% GHG by 2030; at least 35% RE by 2030
	Oppose	−1	No support for increasing targets; rejects need for targets
Sector burden. Does the company support increasing the ambition level in its own sector?	Strong support	+1	At least −63% GHG in ETS-sectors by 2030; higher RE ambition in electricity generation
	Partial support	0	More than −43% GHG in ETS-sectors by 2030; Somewhat higher RE ambition in electricity generation
	Oppose	−1	−43% GHG in ETS-sectors by 2030 (no change); Emphasize need for action in other sectors rather than electricity generation
Fossil fuel phase-out. Does the company support a rapid phase-out of fossil fuels?	Strong support	+1	Phase-out of solid fossil fuels now; limited role for bridge fuels; phase out support
	Partial support	0	Phase-out of fossil fuels in the long term but room for bridging fuels
	Oppose	−1	Does not support phase-out: this should be up to the member-states
Policy position: Emissions Trading System (EU ETS) only			
ETS cap and carbon price. Does the company support ETS instruments and designs that will guarantee a stable and high carbon price?	Strong support	+1	Support many such instruments and designs (e.g., increase LRF and rebase cap; early application; lower MSR thresholds and keep increased intake rate; reduce free allocation; carbon-price floor)
	Partial support	0	Support some such instruments
	Oppose	−1	Support few such instruments; higher carbon price not needed
Policy position: Renewable Energy Directive (RED) only			
ETS vs RED. Does the company support a strong RED to complement the ETS?	Strong support	+1	Both are important instruments; RE development needed in addition to ETS
	Partial support	0	Accept RED but hold that a strong carbon price alone is better or more efficient
	Oppose	−1	RED is not needed, and undermines the ETS
Binding targets. Does the company support legally binding RE targets in the EU and at the member-state level?	Strong support	+1	Binding at national and EU levels
	Partial support	0	Binding only at EU level
	Oppose	−1	No binding targets; emphasis on member-state flexibility
Prioritization of fuels and technologies. Does the company support prioritizing RE (incl. infrastructure) over non-RE low-carbon fuels (incl. infrastructure)?	Strong support	+1	Exclude non-renewable low-carbon fuels from RED; emphasize RE electricity and grid
	Partial support	0	Emphasize both RE electricity and low-carbon fuels; balance grid and gas infrastructure
	Oppose	−1	No prioritization of RE electricity and grid (e.g., level playing field for all technologies; decarbonizing electricity generation using CCS)
Renewable electricity demand. Does the company support regulatory instruments that will require electricity consumers to purchase/use renewable electricity?	Strong support	+1	Support many such instruments (e.g., binding sub-sector RE targets; mandatory green public procurement; greater consumer information and choice)
	Partial support	0	Support some such instruments
	Oppose	−1	Support few such instruments

EU Commission. Responses and statements coded as "strongly support" approximate the positions of environmental advocates and NGOs.

Partial support (value 0) captures moderate, inconsistent and/or conditional support for some type of strengthening of the RED and ETS. Often responses and statements coded as "partial support" involve support for less-ambitious policy-strengthening alternatives than what proposed by the Commission, or support for only some of the proposed elements. It also involves support or advocacy for production technologies/fuels that are not carbon-free and would delay the transition to net-zero emissions. Finally, it captures inconsistencies between various consultation responses within the same time period.[11]

Oppose (value −1) captures expressed opposition to, or rejection of, the Commission's aim to increase the ambition levels of RED and ETS further. This does not necessarily imply that the utility calls for a regulatory roll-back—only that it opposes strengthening policy ambition and related regulatory instruments at the time.

To classify the utilities' reform positions as *oppose, partial support*, or *strong support,* we developed a comprehensive coding scheme. The coding scheme was developed bottom–up from the data to capture the dividing lines that differentiated the companies. Using test

[11] Inconsistencies may imply ingenuine and politically strategic responses. Companies may overstate their support for climate policy to gain political influence, or to avoid being criticized by civil society groups. See Vormedal, I. and J. Meckling (2021). The Business of Policy Reform: When Does Opposition Become Support for Climate Regulation? Manuscript presented at the Annual Convention of the International Studies Association.

cases, we identified eight coding dimensions based on these dividing lines and relevant questions shedding light on them. Predefined response alternatives and statements in free-text responses were then assigned as "strong support," "partial support," or "oppose" in the relevant category, producing two comprehensive coding manuals—one for 2015/16 and one for 2020/21. The dimensions are the same for both periods, but as we assess the companies' support for *strengthening* the existing policies at the time, the specific indicators differ in the two periods. The coding manuals were then used to guide the coding of the data material. Thus, the analysis and coding process were partly inductive, creating the coding manuals, and partly deductive, using the coding manuals to guide the textual analysis and ensure uniform coding, thus enhancing reliability. An overview of the coding scheme is presented below in Table 2, showing the eight dimensions' lead questions and scores based on examples from the 2020/21 consultations (see also Table B in the Annex) All relevant answers were coded to the appropriate dimension and scored according to the coding manual. The qualitative data analysis software NVivo was used to conduct the document analyses, as this allows for a systematic and transparent coding process. After assigning a score (strong support, partial support, oppose) to a utility on each of the eight dimensions, the research team conduced a qualitative assessment of the totality of answers and statements, to arrive at a total score (strong support, partial support, oppose) on RED and ETS in the two periods.

The score of "strong support" was reserved for the most ambitious utilities and was benchmarked against the consultation responses of actors known to support an acceleration of climate and energy policies. In cases where a company bordered on two scores, it was placed closer to the category towards which it leaned, as evident in Fig. 3 and Fig. 4 (and the Appendix). This was done to capture the nuances in cross-company variation. As noted, we assess company support for *strengthening* policies compared to what had been adopted and implemented in previous rounds of ETS and RED reform. Thus, positions are assessed relative to the ambition level at the time of the consultation.

5. Baseline period 2008–2015: production technology and policy positioning

In 2008, before RED and the first ETS reform had been adopted, fossil fuels accounted for 46% of the largest utilities' production technology asset portfolios. While many grew their share of low-carbon production technologies between 2008 and 2015, others also grew their share of coal plants (see Fig. 2). Only a few utilities reduced their share of coal generation (e.g. CEZ, E.ON and Ørsted). By 2015, the average share of fossil-fueled assets was down only slightly to 43%, whereas the share of windpower assets had risen by four percentage points to 6%.

Before 2008 and during the establishment of the ETS in 2003, utilities opposed binding climate regulation, arguing that all policies should be voluntary. However, as utilities would receive free emissions allowances in the first phase, and could pass on the cost of a carbon price to consumers through higher electricity tariffs, Eurelectric shifted to supporting the ETS and accepted auctioning as the main method of allocation in the 2009 reform (J. Meckling 2011; Eikeland 2013). But they continued to oppose binding renewable energy (RE) targets at the EU and the member-state level for some time (Gullberg 2013). Most utilities favored the abolition of technology-specific renewable energy support schemes, particularly feed-in tariffs (FiTs) (Boasson and Wettestad 2013; Ydersbond 2014). In 2013, ten utilities formed the "*Magritte group*", a lobbying platform headed by GDF Suez (now ENGIE), which included Vattenfall (until 2014), E.ON (until 2017), CEZ, ENEL, Fortum, Iberdrola and RWE. They argued that emissions trading should be the main decarbonization policy, opposed binding RE targets, and advocated for abolishing RE subsidies (Reuters 2015). Only DONG (now Ørsted) joined the "*group of progressive energy companies*", which begun to support RE policy, calling for binding and legally enforceable renewable energy targets for 2030 (Neslen 2012).

Table A
Consultations used as data sources to determine utilities' policy positions.

Initiated by	Name of consultation	Consultation period	Abbreviation	Respondents
DG Climate	Consultation on structural options to strengthen the EU Emissions Trading System	December 2012 to February 2013	ETS 2013	E.ON*, EnBW*, Ørsted (previously Dong)*
DG Climate	Consultation on revision of the EU Emission Trading System (EU ETS) Directive	December 2014 to March 2015	ETS 2015	ČEZ, EDF, Enel, ENGIE (previously GDF Suez), Fortum, Iberdrola, Polish Electricity Association (for PGE)**, RWE, Statkraft, Vattenfall
DG Energy	Preparation of a new Renewable Energy Directive for the period after 2020	November 2015 to February 2016	RED 2016	ČEZ, EDF, EnBW, Enel, ENGIE, E.ON, Fortum, Iberdrola, Polish Electricity Association (for PGE)** RWE, Statkraft, Vattenfall, Ørsted
DG Climate	2030 Climate Target Plan	March 2020 to June 2020	EGD 2020	ČEZ, EDF, EnBW, Enel, ENGIE, Fortum, Iberdrola, RWE, Statkraft, Vattenfall, Ørsted
DG Climate	Climate change – updating the EU emissions trading system (ETS)	November 2020 to February 2021	ETS 2021	ČEZ, EDF, EnBW, Enel, ENGIE, E.ON, Fortum, Iberdrola, PGE, RWE, Statkraft, Vattenfall, Ørsted
DG Energy	EU renewable energy rules – review	November 2020 to February 2021	RED 2021	ČEZ, EDF, EnBW, Enel, ENGIE, E.ON, Fortum, Iberdrola, PGE, RWE, Statkraft, Vattenfall, Ørsted

* Due to missing consultation responses in the consultation from 2015, consultation responses from the 2013 consultation were utilized instead.
** Due to missing consultation responses from PGE, the response from the Polish Electricity Association was utilized instead. As PGE is Poland's largest energy sector company and state owned, it is considered very likely that PGE has influenced the Polish Electricity Association's responses and highly improbable that the association would submit responses that go against PGE's interests.

Table B
Overview of Coding Guidelines.

Key aspect	Lead question and ranking values	Policy preference captured
Overall ambition	Does the company support or advocate for increasing the overall ambition level, including renewable energy and greenhouse gas targets? **Strongly support:** Supports substantially increasing ambition and targets (e.g., in 2020/21 consultations: supports raising 2030 greenhouse gas target to at least 55% reduction; supports raising 2030 renewable energy target to at least 40%) **Partial support**: Supports increasing ambition and targets (e.g., in 2020/21 consultations: supports raising 2030 greenhouse gas target to at least 50% reduction; supports raising 2030 renewable energy target to at least 35%) **Oppose:** Does not support increasing ambition and targets; questions or rejects the need for targets	RED and ETS
Binding targets	Does the company support legally binding renewable energy targets in the EU and at the member state level? **Strongly support:** Supports binding targets at national level and EU level; advocates for stronger enforcement **Partial support:** Supports binding targets only at EU level **Oppose:** Does not support binding targets; underlines the need for member-state flexibility	RED
Sector burden	Does the company support increasing the renewable ambition level in the power sector/electricity generation? **Strongly support:** Supports higher renewable ambition in electricity generation (e.g., argues that the power sector must take its share of the responsibility; ranks it as one of the two most important sectors to take action) **Partial support**: Supports higher renewable ambition in electricity generation somewhat (e.g., acknowledges that the power sector must do more while also pointing to other sectors; ranks it as a somewhat important sector to take action) **Oppose**: Does not support higher renewable ambition in electricity generation (e.g., argues that electricity sector has done enough; emphasizes the need for action in other sectors with little electrification such as industry and agriculture; does not rank it as an important sector to take action)	RED and ETS
Prioritization of fuels and technologies	Does the company support prioritizing renewable energy (including related technologies and infrastructure) and advocate for not prioritizing non-renewable low-carbon fuels (including related technologies and infrastructure)? **Strongly support:** Supports prioritizing renewable energy and related infrastructure (e.g., exclude non-renewable low-carbon fuels from the scope of the Renewable Energy Directive, prioritize renewables in support schemes, improve renewable electricity integration and electricity transmission infrastructure) **Partial support:** Supports prioritizing renewable energy and related infrastructure but also wants to expand non-renewable technologies and infrastructure (e.g., express that renewable energy is important and that there is a need to facilitate more renewable integration, but stress the need for a level playing field between all low-carbon technologies; include non-renewables and related technology in support schemes; include non-renewable low-carbon fuels in the scope of the Renewable Energy Directive) **Oppose**: Does not support prioritizing renewable energy and related infrastructure (e.g., stress the need for a level playing field between all technologies, not just low-carbon; argue that measures to further integrate renewable energy will create an unlevel playing field for other generation technologies; express support for decarbonizing electricity generation using carbon capture and storage)	RED
Renewable electricity demand	Does the company support regulatory instruments that will stimulate or require electricity consumers to purchase or use renewable electricity? **Strongly support:** Supports many requirements to include a certain share of renewable electricity in consumption (e.g., binding sector targets for demand-side sectors, mandatory green public procurement, guarantees of origin, requirements for buildings and transport, strengthen consumer information and choice) **Partial support:** Supports some requirements to include a certain share of renewable electricity in consumption **Oppose:** Does not support requirements to include a certain share of renewable electricity in consumption	RED
ETS cap and carbon Price	Does the company support ETS instruments and designs that will guarantee a tight cap and a stable and high carbon price? **Strongly support:** Supports many strong instruments and designs expected to lead to a substantially higher carbon price and tighter cap (e.g., in 2020/21 consultations: supports a combination of substantially increasing the linear reduction factor and rebasing the cap, alternatively a very high linear reduction factor; supports early application of a strengthened cap; supports strengthening the market stability reserve through reducing the thresholds, keeping the intake rate at least 24% beyond 2023 and keeping the invalidation rule; supports eliminating free allocation; possibly supports carbon price floor) **Partial support**: Supports some instruments and design changes expected to lead to a higher carbon price and tighter cap **Oppose:** Does mainly not support instruments and design changes expected to lead to a higher carbon price and tighter cap	ETS

(*continued on next page*)

Table B (*continued*)

Key aspect	Lead question and ranking values	Policy preference captured
Fossil fuel phase-out	Does the company support a rapid phase-out of fossil fuels? **Strongly support:** Supports a rapid phase-out (e.g., wants to phase out solid fossil fuels now; wants to phase out all support for fossils; limited role for natural gas; argues that natural gas is a fossil fuel that will make it harder to meet 2030 targets and create lock-in effects) **Partial support:** Supports phase-out (e.g., wants strong price signal on EU and national level for fuel switch; argues that natural gas has a role as transition fuel) **Oppose:** Does not support phase out (e.g., wants to regulate phase-out on national level; argues that natural gas can help the EU reach the 2030 targets)	RED and ETS
Renewable Energy Directive v. emission trading	Does the company support or advocate for the need to have a strong Renewable Energy Directive to complement the EU Emission Trading System? **Strongly support:** Argues that both are important instruments and that strong renewable energy deployment goals in the power sector are needed in addition to a high carbon price **Partial support:** Expresses support for or accept the Renewable Energy Directive, but argues that a strong emission trading system/carbon price alone without additional support or requirements for renewable energy is a better way to reduce emissions **Oppose:** Argue that we don't need the Renewable Energy Directive and that it undermines the effectiveness/efficiency of the emission trading system	RED

The table is an overview of the comprehensive coding books used to determine the utilities' policy positions.

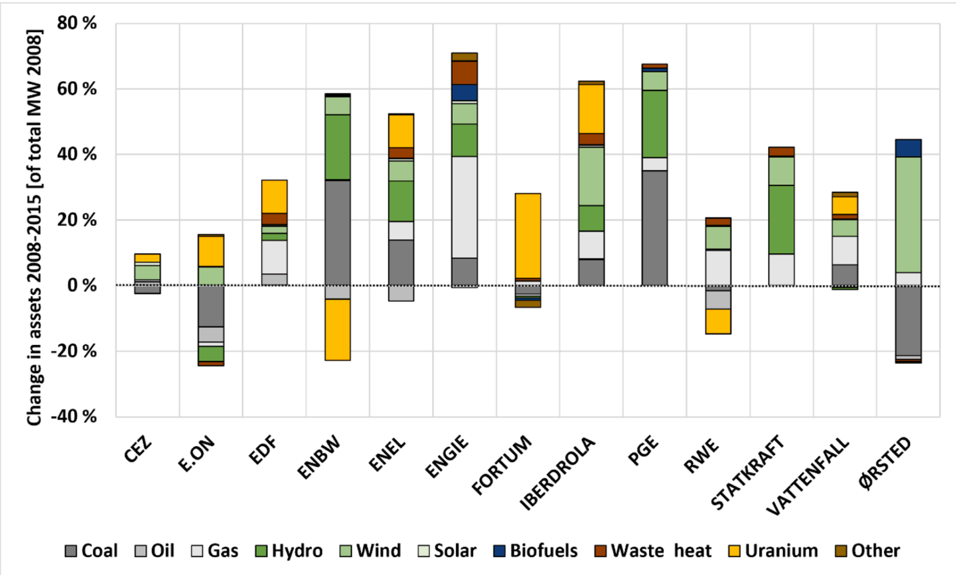

Fig. 2. Change in production technology portfolios 2008–2015.[12]

6. Period 1 2015-/16: production technology and policy positions

We now investigate the relationship between production technology assets and positions on reform of the ETS and RED in 2015/16. Generally, positions on RED ranged from oppose to partial support, and from opposition to strong support for ETS (see Fig. 3 and Table C in the Appendix for firm-specific compositions of technology assets).

Four utilities, Statskraft, EDF, Fortum, and CEZ opposed REDII and partially or strongly supported ETS reform. All of them had small shares of NRE assets. These utilities all argued that the deployment of renewable energy should not be incentivized by RE support or deployment targets, but an economy-wide price on carbon. Statkraft and Fortum called for phasing out all national RE support schemes. CEZ and EDF argued that existing schemes had proven inefficient and costly. On the ETS, the utilities called for backloading of allowances and early implementation of the Market Stability Reserve as measures for securing a stable high carbon price.

Nine utilities now partially supported RED reform. Two of these, RWE and PGE, opposed strengthening the ETS. Both these utilities had over 80% fossil-fuel assets, and low shares of NRE, giving them a competitive disadvantage under a higher carbon price. Opposing

[12] The figure shows the utilities' change in assets from 2008 to 2015 as share of their total capacity in 2008. With this representation we can better compare the change in individual assets across utilities independent of different company's size.

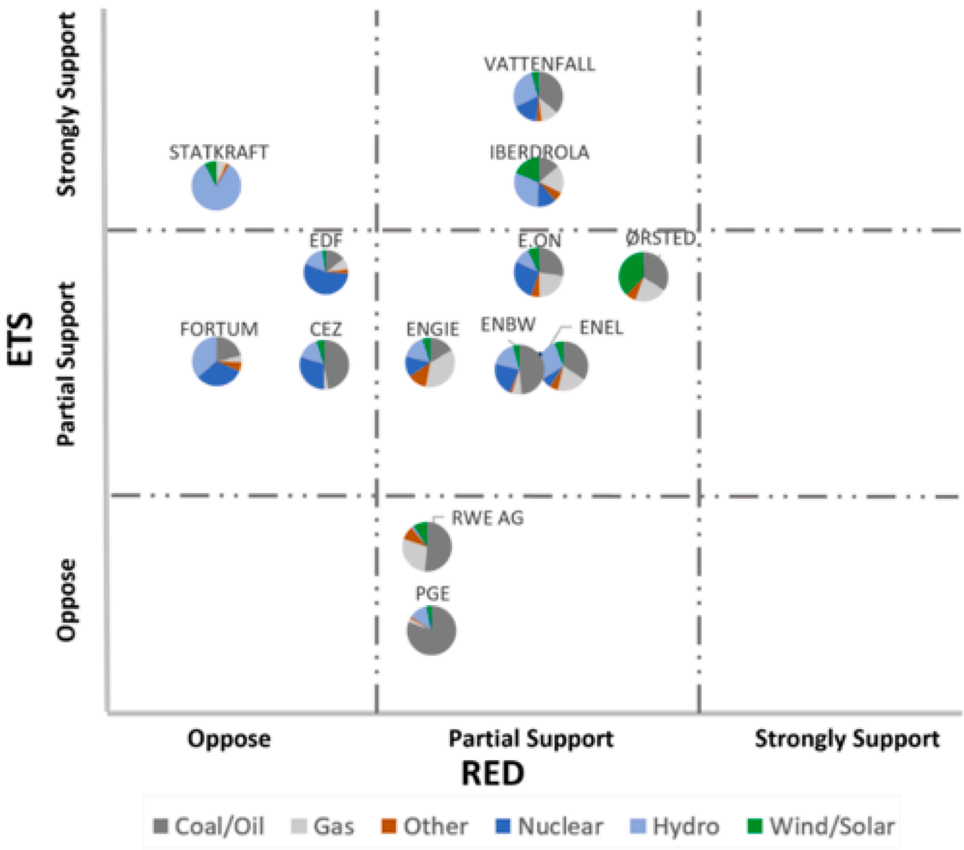

Fig. 3. Policy positions and production technology shares 2015/16.

ETS reform, RWE argued, "low carbon prices help the European industry recover while at the same time delivering against targets" (RWE, ETS 2016 question 6.1). Similarly, PGE,[13] held that a lower carbon price was cost-efficient. Concerning REDII, both companies supported EU-level support to RE, but neither favored enhanced regulatory measures for RE deployment.

Five of the utilities partially supported RED reform (ENGIE, EnBW, Enel, E.ON, Ørsted), also partially supported strengthening the ETS. With the exception of Ørsted, who had a notably high share of NRE, all of them had rather small shares of NRE, and all of them had substantial shares of fossil fuels, including coal and natural gas. Within this group, ENGIE was the least supportive of strengthening RED, arguing that carbon pricing should be the main driver of RE investment and deployment. However, it strongly opposed introducing RE national targets "through the backdoor" of national plans (ENGIE, RED 2016 p. 11). As the most supportive within the group, Ørsted called for a strong governance system enshrined in legislation, with technology-specific linear trajectories for each member-state and an EU-level gap-filler mechanism to be activated in case member-states collectively failed to meet the 2030 target. Enel called for special accommodation of renewable electricity until the markets in all member-states were "fit for renewables". EnBW favored technology-specific targets and differentiated national support schemes until at least 2030. E.ON, however, did not support a continuation of national support schemes, but favored an alignment of national support schemes and EU-level quotas for renewable energy.

Two of the utilities that partially supported REDII—Iberdrola and Vattenfall—voiced strong support for strengthening the ETS. Both had substantial shares of hydro and nuclear, and Iberdrola a substantial share of NRE. Vattenfall was the only utility that advocated a permanent set-aside of allowances, in addition to the other proposed mechanisms for strengthening the carbon price, thus expressing the strongest support for bold ETS reform.[14] Both utilities wanted a strong carbon price to drive decarbonization of power generation, which would make hydropower and nuclear more profitable. The also favored increasing the demand for renewable electricity.

Overall, comparing the utilities policy positioning to the pre-2015 phase, a disintegration of the Magritte group is apparent. A notable share of utilities had now shifted from opposing to partially supporting RE support and deployment targets. Most utilities,

[13] PGE is here represented by the Polish Electricity Association. See Appendix Table A.

[14] In 2016, Vattenfall sold all its coal plants in Germany. See URL: https://www.reuters.com/article/us-vattenfall-germany-lignite-idUSKCN0XF1DV.

Table C
Production Technology Asset Compositions and Policy Positions
Strongly Support (SS); Partial Support (PS); Oppose (O).

Period 1: 2015/16 Utilities	Asset composition	Policy position
Statkraft	8% RE; 83% hydro; 7% fossil (only gas); 2% other	O RED & SS ETS
Fortum	No RE; 36% hydro; 33% nuclear; 25% fossil (21% coal/oil); 6% other	O RED & PS ETS
EDF	3% RE; 16% hydro; 55% nuclear; 23% fossil (15% coal/oil); 3% other	O RED & PS ETS
CEZ	5% RE; 15% hydro, 30% nuclear; 50% fossil (47% coal/oil);	O RED & PS ETS
PGE	4% RE; 12% hydro; 83% fossil (81% coal/oil); 1% other	PS RED & O ETS
RWE AG	9% RE; 2% hydro; 80% fossil (51% coal/oil); 9% other	PS RED & O ETS
Engie	5% RE; 16% hydro; 13% nuclear; 53% fossil (17% coal/oil); 13% other	PS RED & PS ETS
ENBW	4% RE; 17% hydro; 22% nuclear; 55% fossil (49% coal/oil); 2% other	PS RED & PS ETS
ENEL	6% RE; 28% hydro; 7% nuclear;53% fossil (34% coal/oil); 6% other	PS RED & PS ETS
E.ON.	7% RE; 11% hydro; 27% nuclear; 49% fossil (27% coal/oil); 6% other	PS RED & PS ETS
Ørsted	38% RE; 55% fossil (34% coal/oil); 7% other	PS RED & PS ETS
Iberdrola	19% RE; 30% hydro; 13% nuclear; 32% fossil (14% coal/oil);6% other	PS RED & SS ETS
Vattenfall	4% RE; 28% hydro; 17% nuclear; 48% fossil (36% coal/oil); 3% other	PS RED & SS ETS
Period 2: 2020/21 Utilities	**Asset composition**	**Policy position**
Statkraft	24% RE; 69% hydro; 5% fossil (only gas); 2% other	O RED & SS ETS
Vattenfall	30% RE; 29% hydro; 16% nuclear; 22% fossil (10% coal/oil); 3% other	O RED & SS ETS
Fortum	2% RE; 26% hydro; 12% nuclear;52% fossil (~31% coal/oil); 8% other	O RED & PS ETS
CEZ	4% RE; 9% hydro; 43% nuclear; 41% fossil (29% coal/oil); 3% other	O RED & PS ETS
PGE	14% RE; 6% hydro; 11% nuclear;68% fossil (57% coal/oil); 1% other	PS RED & O ETS
RWE AG	24% RE; 5% hydro; 8% nuclear; 57% fossil (29% coal/oil): 6% other	PS RED & PS ETS
Engie	18% RE; 16% hydro; 14% nuclear; 41% fossil (6% coal/oil)11% other	PS RED & PS ETS
ENBW	14% RE; 18% hydro; 8% nuclear; 58% fossil (42% coal/oil); 2% other	PS RED & PS ETS
ENEL	12% RE; 30% hydro; 7% nuclear; 46% fossil (23% coal/oil); 5% other	PS RED & PS ETS
E.ON.	6% RE; 58% nuclear; 30% fossils (7% coal/oil); 6% other	PS RED & PS ETS
EDF	6% RE; 15% hydro; 60% nuclear;16% fossil (6% coal/oil); 3% other	PS RED & SS ETS
Ørsted	75% RE; 16% fossil; 9% other	SS RED & SS ETS
Iberdrola	34% RE; 32% hydro; 11% nuclear; 19% fossil (only nat gas); 4% other	SS RED & SS ETS

except Fortum, had increased their share of RE assets since 2008, which may explain the shift towards partial support for REDII. Concerning the ETS, no notable shift was evident. Only a few utilities had significantly reduced their share of fossil-fuel production 2008–2015, which may explain this.

7. Production technology and policy positions: 2020/21

By 2020, the average share of fossil-fuel assets across all companies had been reduced from 43% in 2015 to 33% (including projects in the pipeline). The total share of NRE assets had grown from 6% in 2015 to 16% by 2020 (see also Fig. 5). The range of policy positions had also changed on REDII, now ranging from opposition to strong support (Figure 4; see also Table C in the Appendix for technology asset compositions).

As before, four utilities opposed strengthening REDII, and partially or strongly supported strengthening the ETS: These were Statkraft and Vattenfall (strongly supported ETS) and Fortum and CEZ (partially supported ETS). However, both Statkraft and Vattenfall had increased their shares of NRE to 24% and 30%, while Fortum – who had no NRE assets in 2015/2016 - had increased its NRE share to only 2%, and CEZ's shares of NRE were slightly reduced since 2015. All four utilities wanted a carbon price to incentivize renewable expansion. Statkraft opposed RE production targets, and wanted a RED revision to address only the consumption side. Fortum and CEZ were most strongly opposed to strengthening RED.

Seven utilities now partially supported strengthening REDII. Most of them had increased their shares of NRE substantially, while lessening their shares of fossil-fuel assets. An exception is PGE, who maintained its opposition to ETS reform. Since 2015 PGE had reduced its share of fossil fuels somewhat, and increased its share of NRE, while partially supporting RE support schemes and increasing targets for renewable electricity deployment.

Furthermore, E.ON, ENGIE, RWE, ENBW and ENEL partially supported strengthening both the REDII and the ETS. Except for RWE, most of these utilities had substantial shares of either no-carbon nuclear or hydropower (see Fig. 4 and Table C). ENGIE, EnBW, E.ON and RWE voiced support for higher and binding (at the member-state and EU levels) RE targets, while at the same time advocating for non-renewable low-carbon fuels (e.g. natural gas) as part of the range of production technologies covered by the RED. In addition, especially RWE and EnBW, but also ENGIE, opposed a rapid fossil-fuel phase-out. In this group, ENEL displayed the strongest support for upping the renewables ambition, also supporting measures that would require consumers to use electricity from renewable sources. Lastly, EDF strongly supported ETS, having substantially reduced its share of fossil fuels. It also strongly supported of a fossil-fuel phase-out, rejecting gas as a transitional fuel.

Two utilities now demonstrated strong support to strengthening RED, while also strongly supporting ETS reform. Ørsted had increased its share of NRE to an impressive 75%, and reduced its share of fossil-fuel assets to 16%. Iberdrola now had about 35% NRE

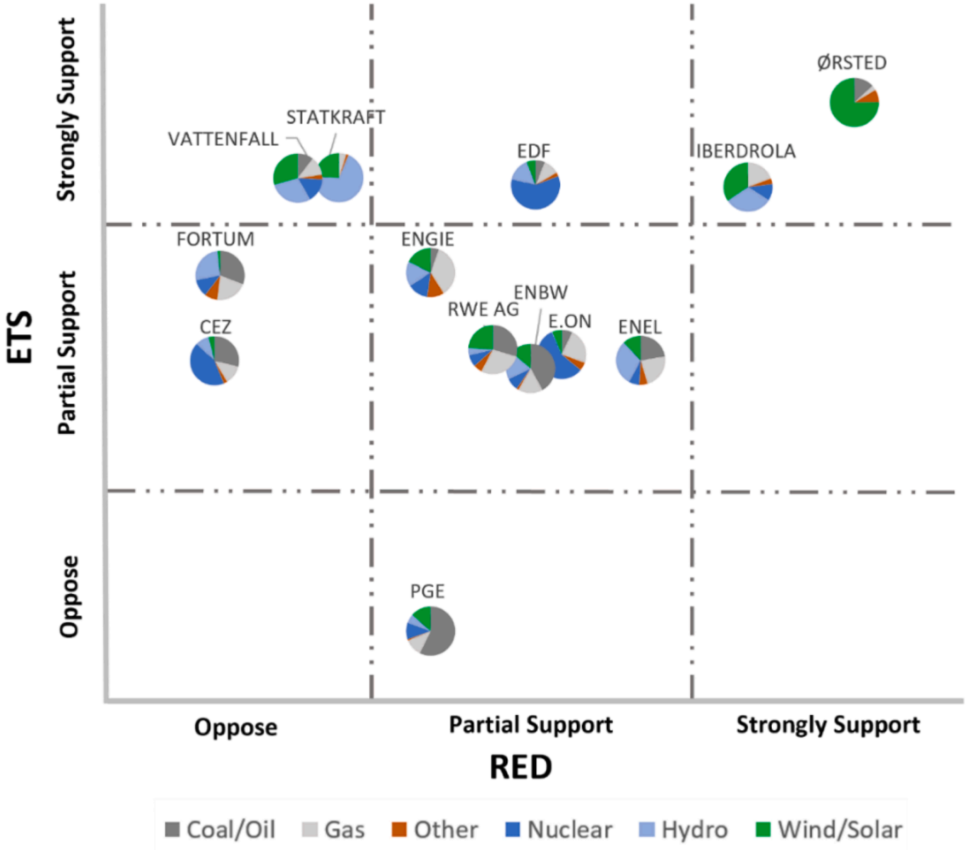

Fig. 4. Policy positions and production technology shares, 2020/21.

and had reduced its fossil assets to 19%—which included no coal. Both favored an ambitious and binding (at member-state and EU level) RE target of over 40% by 2030, and opposed the inclusion of non-renewable low-carbon fuels in REDII. They also both supported policy instruments that would require consumers to use renewable electricity. Ørsted called for a rapid phase-out of all fossil fuels and backed all the proposed policies for raising the carbon price, such as introducing an auction reserve price and cancelling all unsold allowances.

Overall, we observe a shift towards more and stronger support for higher renewable energy ambitions in 2020/21 compared to 2015/16. Most of the former members of the Magritte Group, which lobbied against RE targets at the COP 21, now supported ambitious, binding renewable targets through REDII. We also observe that the utilities' support for strengthening the carbon price through the ETS continued to grow, as five utilities received a strong support score, with PGE as the only one in opposition.

8. Analyzing the relationship between production technology and policy positions

We find that utilities opposing ETS reform, and thus a higher carbon price, have a larger share of highly carbon-intensive assets[15] (measured in MW) compared to utilities that strongly supported ETS reform (Fig. 3 and 4). Utilities opposing RED reform, and thus more ambitious RE deployment targets, tend to have a lower share of NRE assets than utilities that support RED reform (Fig. 3 and 4). However, the opposition of Vattenfall and Statkraft to RED reform remains puzzling, as these grew their NRE shares substantially between 2015/16 and 2020/21 (Fig. 5).

We now analyze the relationship between *changes* in the utilities' proportion of highly carbon-intensive (HC) assets and *changes* in their positions towards ETS reform (and thus a higher carbon price). We do so by testing the following assumptions: i) Utilities that became more supportive of ETS reform in 2020/21 compared to 2015/16 reduced their share of HC assets significantly; ii) the utilities that had become less supportive, or had begun to oppose or continued to oppose ETS reform, maintained a similar share or slightly increased their share of HC assets; and iii) the utilities that maintained the same level of support in 2015/16 and 2020/21 reduced their share of HC assets slightly.

We find that several of the utilities that became more supportive of ETS reform in 2020/21 compared to 2015/16 reduced their

[15] We use the proportion of coal- and oil-fueled plant capacity as an indicator of *highly carbon-intensive assets* (HC assets).

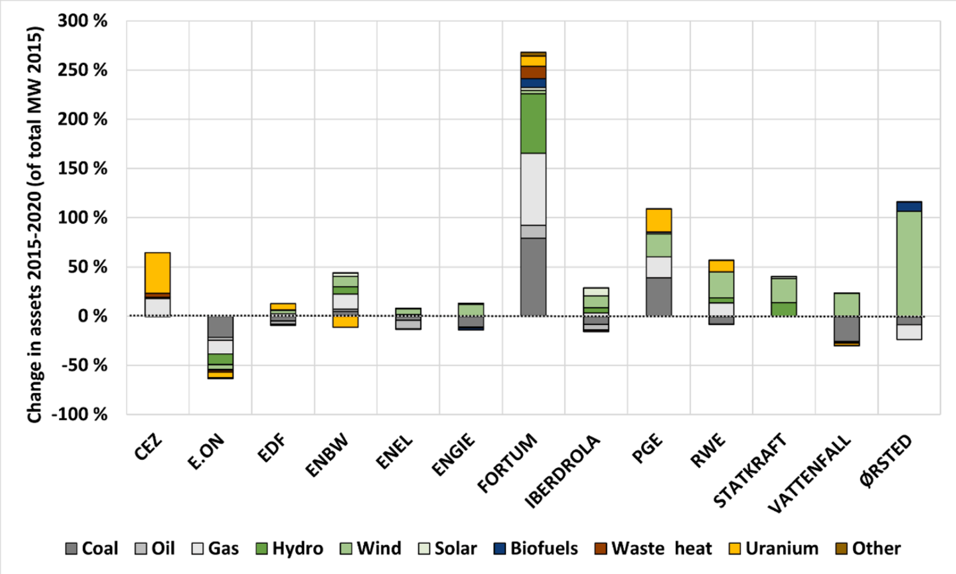

Fig. 5. Change production technology portfolios 2015–2020.

share of HC assets significantly (EDF, Ørsted, RWE, ENGIE). Fortum moved slightly towards strongly support, but had, contrary to the trend, increased its share of HC assets from 21% to 33%. Some utilities became slightly less supportive of ETS reform in 2020/21 compared to 2015/16. Vattenfall moved somewhat within the strongly support category, and E.ON. within the partial support category. Both had reduced their share of HC assets. Finally, many utilities expressed the same level of support in both periods. Most of them reduced their share of HC assets (Iberdrola, ENEL, EnBW and CEZ). Statkraft owned no HC assets in neither period. PGE, who continued to oppose ETS reform, decreased their share of HC assets.

These findings mostly match our assumptions. Four of the five utilities that became more supportive of ETS reform also reduced their share of HC assets by more than 8 percentage points. And four of the five utilities that expressed the same level of support reduced or maintained the same low share of HC assets. However, four utilities did not match our assumptions. The only utility that continued to oppose ETS reform, PGE, had reduced its share of fossil fuels. However, it maintained a high share of 57% HC assets, which may explain this. Further, Fortum, which became slightly more supportive yet maintaining a partial support score, increased their share of HC assets. And the utilities that slightly reduced their support for ETS reform, Vattenfall and E.ON, also reduced their share of HC assets. Thus, our assumptions about the relationship between change in HC assets and change in positions on ETS reform hold for nine of the thirteen utilities in our sample. Note however that three of these utilities did not shift category. We attempt to explain such deviations below.

Finally, we investigate the relationship between *changes* in the utilities' proportion of RE assets, and change in their positions on RED reform (and thus strengthening RE targets). We do so by testing the following assumptions: i) The utilities that became more supportive significantly increased their share of NRE assets, ii) utilities maintaining the same level of support slightly increased their share of NRE assets; iii) utilities maintaining the lowest score or who expressed less support for RED did not change or reduced their share of NRE assets.

We find that the utilities who became more supportive of RED reform significantly grew their share of NRE assets (Ørsted, Iberdrola, RWE, ENEL and EDF). Statkraft on the other hand, who still opposed RED reform (although slightly less so in 2020/21), also grew their share of NRE assets. Only Vattenfall shifted from partially supporting to opposing RED despite having increased its share of NRE assets. Fortum and CEZ both continued to oppose strengthening RED, also continued to have low shares of NRE assets. Finally, four utilities maintained their partial support: ENBW, ENGIE and PGE increased their shares of NRE assets, while E.ON, decreased their share. These findings mostly match our assumptions: All the utilities that became more supportive also increased their share of NRE assets. However, four utilities did not match our assumptions. What may explain the three deviations from our assumptions?

First, it is likely that Statkraft's large share of hydropower and Vattenfall's large share of hydro and nuclear power—which make them more competitive with a high carbon price than under a regime focused on scaling up NRE deployment—explains their preference for ETS over RED. Thus, hydropower and nuclear have strong competitive advantages under a decarbonization policy that is driven by carbon pricing. Such a preference for the ETS over RED is evident among all the utilities that have sizable shares of hydropower and nuclear assets (Vattenfall, Statkraft, Fortum, and CEZ).

Second, E.ON separated its conventional power generation and energy-trading operations into Uniper in 2016, and in 2018 it sold its Uniper stocks to Fortum. Then in 2019/20, E.ON went through a large and complex deal with RWE, which resulted in E.ON becoming a pure retail and distribution company. For these reasons, E.ON may be considered an outlier in our sample. Another possible explanation is that E.ON has been acting strategically, voicing stronger support for policy changes than what is actually in its economic interest, to please policymakers and maintain political influence (Vormedal and Meckling 2021).

Finally, Fortum, continued to support ETS reform despite increasing its share of highly carbon-intensive (HC) assets by 10 percentage points. A plausible explanation is that Fortum's relatively large shares of hydropower and nuclear are profitable with a carbon price. It is also possible that, like E.ON., Fortum positioned itself strategically in support of the ETS to appear more progressive as regards decarbonization than was actually the case. As a Finland-based company it may well have faced considerable public and political pressure to support decarbonization—for instance, compared to the other coal-intensive utility PGE, which directly opposed the ETS but faced a home government (Poland) that had also opposed carbon pricing.

9. Discussion

Our empirical analysis of production technology and policy positions shows that substitution of carbon-intensive assets with either hydropower and nuclear, or new renewable energy (NRE) assets, is evident among a significant share of the firms in our sample. We find that substitution is related to a diversification of policy positions over time, and notably shifts from opposition to either partial or strong support for policy changes that will accelerate the energy transition.

However, we observe large variation within the industry. A few utilities have not changed their policy positions and continue to oppose more ambitious decarbonization and renewable energy (RE) targets. This lack of position change correlates with a lack of substantial substitution, especially of highly carbon-intensive (HC) assets with cleaner assets, as well as low investment in NRE. The behavior of these firms can be categorized as "remaining inert" and as still seeking to "delay the transition." Yet, most of the utilities have become more supportive of a higher carbon price through ETS reform, and, notably, of ratcheting up the ambition level of RE deployment through the revised RE directive—which all of them opposed in the pre-2015 phase. This shift in policy positioning correlates with significant substitution of HC assets with NRE and/or hydropower and nuclear. Nevertheless, most of them only partially support policy measures that will accelerate the transition to RE, and many favor a stronger carbon price over more stringent RE targets. We categorize the behavior of these utilities as "following into the niche". Two leading incumbents are early movers and thus "first to enter the niche". These have substituted their HC assets with hydropower and nuclear, and substantially high levels of NRE. They have shifted to strongly supporting both a high carbon price and ambitious RE targets on the supply- and demand-side of the system, while advocating for a rapid phase-out of fossil-fuel based electricity.

We also find that a lower carbon intensity of production portfolios relates to stronger support for a higher carbon price through a robust ETS, and that increasing the share of NRE is generally related to growing support for ambitious RE targets. However, utilities with notable investment in NRE, but a dominant share of incumbent hydropower or nuclear, have not become more supportive and some even oppose more ambitious RE deployment targets. They argue that carbon pricing should drive decarbonization, and that the energy transition must be technology-neutral. This is because a strong carbon price leads to higher electricity prices, and all "clean" power producers that do not pay the increased price for CO2 will hence experience a substantial income gain. Both Lindberg (2019) and Fitch-Roy (2017) find that the possibility for "indirect windfall profits" drives the policy preference of some utilities. At the same time, RE support schemes lead to lower electricity prices because they add electricity production into the market with low marginal costs. This explains why only actors that quite radically substituted fossil assets with NRE assets have shifted to strongly supporting RED reform. Our findings suggest that the dominant type of production technology in a utility's generation portfolio determines the type of policy instruments it prefers to drive the energy transition. Thus, it appears that investments in NRE assets must be relatively high for an incumbent to begin supporting policies that will accelerate substitution.

10. Conclusion

Our study of how change in the power production technology portfolios of European utilities relate to shifts in their policy positions suggests that technology constitutes a key driver of change in traditional patterns of political mobilization. Incumbents that have substituted carbon-intensive power generation with clean power and NRE technologies, have become more supportive of a higher carbon price through ETS reform, and, in the case of substantial NRE portfolio growth, of ratcheting up the ambition level of REDII.

Our findings show that the traditional dichotomy between incumbents as political obstacles and challengers as enablers of the energy transition, is flawed. Rather, they lend support to the recently more nuanced perspective on incumbency in transitions, which suggests a wider range of incumbent technological responses and political strategies in advancing energy transitions. In line with Mossel et al. (2018) we find that some incumbents continue to remain inert and seek to delay the transition, many have followed into the niche and become more supportive of ambitious policies, while others yet are leaders in the process of substitution, and have become strong advocates of market transformation—similarly to environmental NGOs or other niche-related actors. This also aligns with Frei et al. (2018) who find that European utilities have become more proactive in embracing decarbonization. However, it contradicts US studies who have found utilities to be strongly opposed to- and mobilize against RE deployment policies (Downie 2017; Stokes 2020). Future research should investigate whether growing levels of technology substitution have begun to alter previous patterns of counter-mobilization also in the US.

Substitution and co-option of NRE by some leading incumbents shows how change may increasingly come from within the existing socio-technical regime. While such change processes may lead to virtuous snowballs of capability development and political support, it also enables incumbent control over decarbonization. It is likely that emerging incumbent support may hinge on policies being non-disruptive, to fit their business models and not threaten established industry structures. In the case of electricity production, this may imply the prioritization of centralized NRE generation by incumbents over decentralized NRE production by challengers.

Nevertheless, the existing socio-technical regime appears to become increasingly destabilized (Kivimaa, Hyysalo et al. 2019): significant changes among key regime actors (Kivimaa and Kern 2016) and a re-making of vested interests is evident. This may help weaken continued opposition by some inert incumbents, and drive growth in more broad-based and powerful business support for accelerating the energy transition.

To the extent that established, industry actors will drive the process of technology substitution out of emerging self-interests, and to enable high shares of RE in the electricity system—system reconfiguration (McMeekin, Geels et al. 2019) and development of infrastructure, including electricity grids and storage technologies (Markard 2018), may be even more important than RE subsidies.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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