The Failures of the Entrepreneurial State: Subsidies to Renewable Energies in Europe

Carlo Amenta and Carlo Stagnaro

Abstract Since the 1990s, the European Union has committed to gaining global leadership in clean energies such as solar photovoltaic and wind power. The joint amount of wind and solar capacity grew from 12.5 GW (or 2% of total installed electricity capacity) in 2000 to 261.2 GW in 2018 (or 28.1% of total installed electricity capacity). This came at a cost: In 2018 alone, the European Union (excluding the United Kingdom) spent €73 billion to subsidize green energy production. These financial aids were paid for by European energy consumers, mainly through levies charged on top of their power bills. According to proponents, these subsidies were needed to achieve sustainability while promoting the emergence of the European renewable industry. This chapter focuses on the European venture into renewable energies to answer the following three questions: (1) Was the subsidization of green electricity sources an effective environmental policy? (2) Was it an effective industrial policy? (3) Was it an effective social policy? The answer is: no, no, no.

Keywords Energy · Climate change · Green taxation · Subsidies · Competition · Regulation

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1 Introduction

Since the 1990s, the European Union has set the goal of gaining global leadership in clean energies. After joining the Kyoto Protocol and committing to cut emissions in 2008–2012 by 8% below the 1990 benchmark, the Union progressively raised its ambition by setting further goals of cutting emissions by 20% below 1990 levels in 2020, then by 40% (more recently raised to 55%) in 2030, and eventually to net-zero emissions in 2050.

In the light of these goals, both the European Union and the member states have adopted several policy tools, including high taxes on the use of fossil fuels, technical standards, renewable portfolio standards, a cap-and-trade scheme called the Emissions Trading System, subsidies to clean energies, and other regulations intended to curb carbon-based energies. Moreover, on top of the emissions reduction goals, Europe adopted binding targets concerning the share of renewable energies in final consumption and investments in energy efficiency. In order to meet the targets, member states introduced generous subsidies to renewable energy sources. Recent estimates indicate that subsidies to the production of green energies in 2018 amounted to about €73 billion, or some 0.5% of E.U. GDP (excluding the U.K.) (EC, 2020a). More financial aid was granted to energy consumers (€52 billion in 2018), energy efficiency (€15 billion), energy infrastructure (€1.45 billion), industry restructuring (€1.85 billion), R&D (€4.55 billion), and the production of non-green energy (€12 billion). Subsidies to renewable energies mainly took the form of direct financial transfers, such as feed-in tariffs or other forms of income or price support.

Subsidies to green energies fit with the idea of "mission-oriented innovation," which is frequently employed by the supporters of the entrepreneurial state. For example, in a report on behalf of the E.U. Commission, economist Mariana Mazzucato (2018, p. 4) cites carbon-neutral cities as a quintessential example of mission-oriented innovation and argues, "Mission-oriented policies can be defined as systemic public policies that draw on frontier knowledge to attain specific goals." According to the proponents of the entrepreneurial state, mission-oriented innovation can pursue three goals simultaneously, i.e., an environmental goal (cutting emissions), an industrial policy goal (promoting growth), and a social goal (promoting equality and fairness). In another influential paper, Mazzucato (2015) calls for a more interventionist role of the governments to drive—rather than pushing—the green transformation of the economy: She argues that the "green entrepreneurial state" should push the "green industrial revolution" by engaging in various forms of "entrepreneurial risk-taking" in order to "launch specific green technologies" such as "wind turbines and solar photovoltaic panels." Given the magnitude of the climate challenge, these proposals deserve scrutiny. All the broader criticisms of the entrepreneurial state hold (McCloskey & Mingardi, 2020). This chapter will try to develop a more specific argument that considers the peculiarities of climate policy, on one hand, and of energy systems and industries, on the other hand.

Mazzucato claims that some governments, including Germany, Denmark, and China, have already played this role. This may be true to an extent, as we shall see in the following (and as chapter "Less from More: China Built Wind Power, but Gained Little Electricity" shows concerning China) (Grafström, 2022). The stated objective of Europe's green policy is to achieve global leadership in clean technologies, as Mazzucato suggests. This goes well beyond what a textbook-like environmental policy would look like: In fact, the latter would rely on carbon pricing to minimize the use of fossil and other polluting fuels, rather than employing subsidies and regulations aimed at maximizing the production of *clean* energy from selected technologies. It also goes beyond the mere and reasonable attempt to design environmental policy in a way that induces innovation. It reduces social costs (Porter & Van der Linde, 1995), rather than hampering European businesses' competitiveness and unintentionally accelerating the process of deindustrialization of the Old Continent.

If one takes the aims of green policies at face value, subsidies to the production of clean energies delivered: the joint amount of wind and solar capacity in the European Union grew from 12.5 GW (or 2% of total installed electricity capacity) in 2000 to 261.2 GW in 2018 (or 28.1% of total installed electricity capacity) (EC, 2020b). However, did it work? Was it the best way to meet the climate goals? This chapter focuses on the experience of green subsidies.[1] Moreover, it tries to answer the following questions:

- Was the support of renewable generators a cost-effective environmental policy?
- Did it work? Did Europe become a global powerhouse for renewable technologies manufacturing?
- Did European consumers and businesses benefit, on balance, from the push toward renewable energies?

The chapter is structured as follows. Section 2 after this introduction shows the progress in the penetration of Renewable Energy Source in Electricity (RES-E) and their direct and indirect costs, along with environmental benefits. Section 3 answers the first research question, i.e., whether—by subsidizing the deployment of renewable energies—the European Union was able to cost-effectively cut carbon emissions. Section 4 addresses the subsidization of green energies as a form of industrial policy. Section 5 addresses the social dimension of the policy, i.e., whether it promoted economic growth and fairness. Section 6 shows how the green entrepreneurial state is turning into a green central banker and discusses the underlying risks. Section 7 summarizes and concludes.

[1] Henceforth, when we speak about subsidies, green subsidies, renewable subsidies, and other similar expressions, we specifically refer to subsidies to the production of energy, unless otherwise specified.

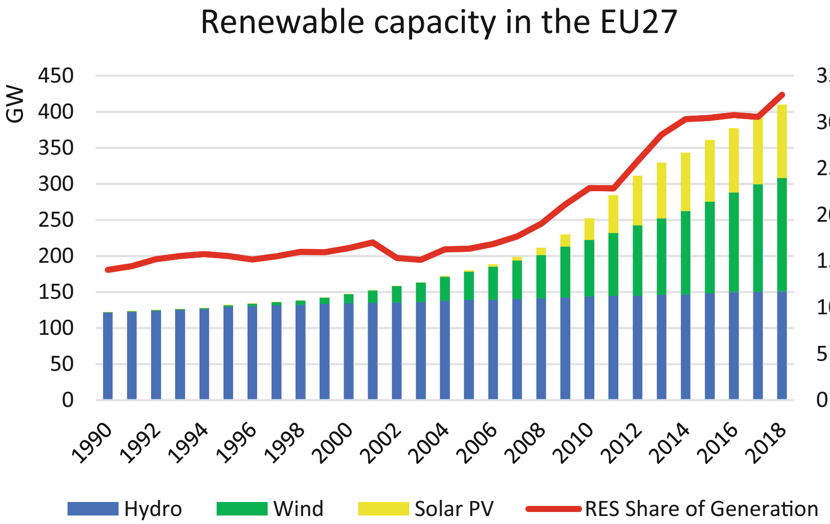

Fig. 1 Installed Generation Capacity From Hydro, Solar, and Wind (left axis) and RES-E Generation as a Share of Total Generation in the E.U.27 (right axis). Source: Author's elaboration on data from Eurostat

2 The Growth of Renewable Energy Sources of Electricity in the European Union

The support of renewable energies, particularly in electricity generation, has been the subject of several E.U. and national regulations.[2] The support has taken many different forms, both cross-country and over time, including renewable portfolio standards, green certificate schemes, and direct subsidies of various kinds (such as feed-in tariffs, feed-in premiums, contract for differences, etc.) on top of other subsidies to research and development, infrastructure, etc. (Stagnaro, 2015).

The installed renewable capacity and the share of electricity production (or consumption) from RES-E increased dramatically in Europe. Figure 1 shows the increase in electrical, renewable energy sources (RES-E) in terms of capacity and generation in 1990–2018.

Behind this dramatic increase stand many drivers, both market- and policy-driven. The former include the impressive reduction in the cost of renewable technologies, the evolving preferences of consumers, and more stringent environmental standards: The levelized cost of electricity from wind and solar photovoltaic (solar PV)—a standard estimate of the *average* cost of generating electricity from different sources—fell by 48–56% and 85%, respectively, in 2010–2020 (Irena, 2021). Nevertheless, political support for investment was crucial, too. Attributing

[2] Directives 2001/77/EC, 2009/28/EC, and 2018/2001/EU.

this expansion of renewable energies entirely to the subsidies would be naïve. However, it would be even more naïve to rule out subsidies as a cause, and possibly a major one, of the rapid growth of renewable installed capacity. In the first place, subsidies made any investment in renewable capacity almost risk-free. Secondly, as production costs declined, high subsidies attracted even more investments, looking for high-return, low-risk opportunities. Thirdly, this rush to investments created a demand large enough to allow for scale economies and fast learning curves, thereby providing low-cost technologies and, at least for some time, even higher returns (Kavlak et al., 2018). A counterproof of how substantial subsidies were in driving investments in new renewable capacity lies in the fact that—as subsidies were reduced, phased-out or eliminated for new installations—the capital flow toward the renewable sector slowed down.

According to CEER—the Council of European Energy Regulators—RES-E was awarded €60 billion worth of subsidies in 2018,[3] up from about €25 billion in 2010, with an average cost per unit of gross electricity of €19.12/MWh. The country that invested the most in public support of RES-E was Italy (€38.48/MWh of gross electricity), versus just €2.53/MWh of gross electricity in Sweden. In the same year, the average wholesale price of electricity in Europe was around €50/MWh. The average support varies across technologies, ranging from €6.92/MWh for offshore wind in Ireland to €501.07/MWh for solar photovoltaic in the Czech Republic (CEER, 2021).

As time passed and the amount of green installed capacity grew, the average level of *unit* subsidies decreased, following the average generating costs, but the overall expenditure increased. This trend was magnified by the falling rates of growth—or even reductions—in total energy consumption due to improvements in energy efficiency and the economic crises of 2009–2011 and 2020. In 2018, RES-E subsidization amounted to about 8% of the average yearly spending on electricity by households; but it was as high as 23% in Germany, 21% in the United Kingdom, and 22% in Portugal (Acer, 2020). These data should be taken with a pinch of salt, as some countries may subsidize RES-E through fiscal schemes that have little or no effect on the power bill. Moreover, other RES-E-related costs—such as higher costs for network connections or from imbalances in the power system due to the variability of green energies—cannot be easily disentangled from the overall price, but they are still there. Finally, some governments may shift the burden of subsidization almost entirely onto households (as is the case of Germany). In contrast, others may spread the costs over a more significant basis that includes small and medium-sized enterprises and households and, to a lesser extent, large enterprises (as happens in Italy).

[3]The estimate also includes North Macedonia, Norway, and the United Kingdom. The estimate partly differs from the one cited above because it is limited to renewable electricity and does not include other renewable energies such as biofuels or heat from solar thermal panels and renewable-powered district heating.

RES-E produced economic benefits, on top of the environmental ones. In particular, given the price-formation mechanisms in most E.U. power markets, greater RES-E penetration is associated with a significant reduction in the wholesale price of electricity. For example, based on Italian data, Clò et al. (2015) found 1 extra GWh from solar and wind power reduced prices by €2.3 and €4.2/MWh, respectively, albeit it also amplified volatility. However, the net effect on end-user prices points toward a net increase of electricity prices, given how large subsidies are—in the case of Italy, about one order of magnitude.

The policy of supporting RES-E had three stated goals:

- Reducing CO_2 emissions
- Promoting Europe's renewable industry
- Contributing to a fairer distribution of wealth and income

Most economists would agree that some policy intervention is required to address such a complex and global problem as climate change. They would also agree that pricing carbon—through a carbon tax, a cap-and-trade scheme, or a hybrid system—should be the cornerstone of an economically sound and cost-effective strategy (Nordhaus, 2018). Subsidizing renewables, instead of merely letting market forces find out the optimal energy mix given a specific carbon price or cap, is a much less obvious strategy from an economic point of view. It is, however, the preferred strategy of the proponents of the entrepreneurial state and mission-oriented innovation. In the following sections, we will check whether the strategy was delivered.

3 Are Green Subsidies an Efficient Environmental Policy?

Subsidized, carbon-free energy displaces conventional generators that emit CO_2. There is little doubt that subsidies made a fundamental contribution to the greening of the power grid in Europe, through one obvious channel (increasing the amount of emissions-free energy) and a less obvious one (higher energy prices result in reduced consumption, which in turn implies lower emissions; for a quantitative estimate of the size of this effect, see Faiella & Lavecchia, 2021a). The question is, at what cost? Was it the most effective *environmental* policy?

In the following, we will provide a back-of-the-envelope calculation about the implicit abatement cost of carbon, based on 2018 data. According to the Council of European Energy Regulators, in 2018, around one-fifth of Europe's gross electricity production, or 594.3 TWh, received the support of almost €60 billion worth of subsidies, equal to about €100.0/MWh.

In order to estimate the volume of emissions abated by green generators, one must figure out what kind of power plants are displaced: in most cases, it is reasonable to assume natural gas-fueled generators, whose emissions factor may be estimated at around 400 g CO_2/kWh. That is likely to underestimate the actual emissions abatement in the least carbon-efficient countries. However, it also overestimates the actual environmental outcome in countries such as France and Sweden, which

Table 1 Supported renewable generation, subsidy expenditure, unit support, and average CO_2 abatement cost in the European Union (2018)

Country	Supported energy [TWh]	Total support [M euro]	Unit support [euro/ MWh]	CO_2 abatement cost (high) [euro/ ton CO_2]	CO_2 abatement cost (low) [euro/ ton CO_2]
Austria	9.8	671	68.6	171.5	85.8
Belgium	3.4	350	103.2	258.1	129.1
Croatia	2.1	153	74.6	186.6	93.3
Cyprus	0.4	67	176.3	440.8	220.4
Czech Republic	8.0	1710	213.0	532.4	266.2
Denmark	20.0	578	28.9	72.1	36.1
Estonia	1.5	83	53.9	134.7	67.4
Finland	0	0	–	–	–
France	51.6	4413	85.6	213.9	106.9
Germany	195.3	23,691	121.3	303.3	151.7
Greece	11.1	1197	107.7	269.4	134.7
Hungary	2.8	133	47.3	118.3	59.2
Ireland	8.0	87	10.9	27.3	13.7
Italy	63.3	11,147	176.2	440.4	220.2
Latvia	0.9	95	103.3	258.2	129.1
Lithuania	1.7	84	50.3	125.7	62.9
Luxembourg	0.0.5	52	98.1	245.3	122.6
Malta	0.2	17	113.3	283.3	141.7
Netherlands	15.8	1072	68.0	170.1	85.0
Portugal	17.1	827	48.4	121.1	60.6
Romania	9.1	412	45.4	113.4	56.7
Slovakia	2.7	301	113.2	282.9	141.4
Slovenia	0.6	101	162.9	407.3	203.6
Spain	56.2	5751	102.4	255.9	128.0
Sweden	23.3	413	17.7	44.2	22.1
United Kingdom	89.1	6556	73.6	184.0	92.0
E.U.	**594.3**	**59,991**	**100.9**	**226.4**	**113.2**

Source: Author's elaboration on data from CEER

rely primarily on carbon-free energy sources (nuclear and hydropower) already. At any rate, we will also consider an overly optimistic scenario in which coal plants, instead of natural gas, are displaced: In this case, each additional green MWh results in the abatement of about 800 g CO_2. Depending on the scenario, the unweighted average abatement cost is €113.2–226.4/ton CO_2. Table 1 summarizes.

Table 2 shows the support to renewable power by generation technology and the corresponding carbon abatement cost in the same optimistic and pessimistic scenarios discussed above.

Table 2 Support to renewable generation in the European Union by Technology (2018)

Technology	Min support euro/MWh]	Max support [euro/MWh]	CO_2 abatement cost (high) [euro/ton CO_2]	CO_2 abatement cost (low) [euro/ton CO_2]
Bioenergy	15.0	174.3	37.5–435.8	18.8–217.9
Geothermal energy	27.1	204.4	67.8–511.0	33.9–255.5
Hydropower	101.5	11.2	28.0–253.8	14.0–126.9
Solar PV	501.1	12.1	30.2–1252.7	15.1–626.3
Onshore wind	166.0	6.9	17.3–415.0	8.7–207.5
Offshore wind	148.6	15.0	37.5–371.5	18.8–185.8
Others	264.6	10.9	27.1–661.4	13.6–330.7

Source: Author's elaboration on data from CEER

The cost of subsidizing green power—and the implicit abatement cost of CO_2—varies substantially by technology and country. That is irrespective of the environmental benefit, which does not depend on the specific technology employed (while it may change according to the country, even though in the above calculations we have made a simplistic assumption that one unit of green power displaces either natural gas or coal). Hence, the cost of abating one ton of CO_2 may be as low as €8.7–17.3 (which is the case of onshore wind in Ireland) or as high as €626.3–1252.7 (as happens with solar PV in the Czech Republic).

From an environmental perspective, policy should maximize the amount of CO_2 abated for any given level of expenditure or minimize the cost, given the abatement target. Such a significant variance suggests that emissions could have been cut more aggressively had expenditure been better targeted. Of course, differences may also depend on site-specific circumstances: not all countries have places as windy as the North Sea or as sunny as Southern Europe. In 2018, the average price of emission allowances (EUAs) in the Emissions Trading System—Europe's cap-and-trade scheme—was €15.5/ton CO_2. That means that one ton of CO_2 could be cut, somewhere in Europe, at a cost that was one or even two orders of magnitude below what Europeans have paid so far in green subsidies. Even in 2021, when this chapter is being written, EUAs are traded at an all-time high of more than €60/ton CO_2, the average cost of cutting carbon via green electricity subsidies exceeds by far the cost of many alternatives such as energy efficiency.

Future subsidization policies may be better designed, but they have not been an effective environmental policy so far.

4 Are Green Subsidies an Effective Industrial Policy?

Reducing emissions was not the only objective of green subsidies: proponents of the entrepreneurial state argued that generous incentives would spur a new industry and create jobs.

Europe is the second-largest market for both wind and solar power after China. In 2019, total wind and solar capacity installed in the European Union was 203.5 GW and 146.7 GW, respectively, or 32.7% and 25.0% of the global installed capacity. Nevertheless, is Europe a *producer* or an *importer* of renewable technologies? From a more comprehensive economic perspective, this may be of relative relevance, but—if green subsidization is thought of as an industrial policy—it is the manufacturing of clean energies, not the installation, that matters. Most *permanent* jobs are created in the production of wind turbines and solar panels, while some *temporary* jobs are involved in their installation, and just a little in their operations and maintenance (Popp et al., 2020) and the overall employment impact is unclear (Aldieri et al., 2020; Bijnens et al., 2021).

Europe—particularly Denmark, Spain, and Germany—has traditionally been a powerhouse for wind power. This historical competitive advantage is well reflected by today's market shares of wind turbine producers: Vestas, a Danish company, ranked first globally in 2018 with a market share of 20.3%. Other European manufacturers include Spain's Gamesa (12.3% of the global market in 2018), and Germany's Enercom (5.5%), and Nordex Acciona (5%) (Statista, 2018). Green incentives have certainly supported the deployment and, indirectly, R&D activities in the European wind industry, thereby making it more competitive abroad as investments in other regions have taken off. However, it should be emphasized that the European wind industry was already at the forefront of innovation in this technology. One may well argue that it was precisely the *green entrepreneurial state* in Denmark, Germany, and elsewhere that created (or at least nourished) the wind industry. Still, this is a dog chasing its tail: From an industrial policy perspective, a case can be made for subsidizing (or protecting) infant industries. However, the European wind industry came of age quite a few years ago and is still the recipient of large subsidies.

Moreover, as the global market grows and lower-cost producers make their appearance—particularly in the Far East—it is ever-harder for Europe to defend its industrial leadership. As this chapter is being written, the E.U. Commission is pursuing an anti-dumping investigation concerning imports of steel wind towers from China (European Commission, 2020). On a trade basis, the investigation may or may not be founded; in fact, Chinese steel-makers are already subject to defensive measures in Europe because of the ongoing trade war with Beijing. This suggests that the competitive edge of Europe's wind industry may not be secured in the long run despite the very high spending that has supported domestic installations. The manufacturing of wind turbines, blades, and other components is a competitive industry and a relatively mature one, for which market shares can be hardly defended, and costs, prices, and margins are on a declining track.

Solar photovoltaics has also benefitted from substantial subsidies, higher than wind subsidies in terms of subsidy per unit of electricity. In this field, Europe has been a front runner, too, even though the take-off of installations started later than in the case of wind. In fact, in 2000, there was only 0.65 GW of solar capacity worldwide, of which about one-third was in Europe. In 2010, Europe had about three-quarters of global solar capacity (30.9 GW out of 40.1 GW globally). Ten years later, solar capacity in Europe had grown about five-fold, whereas global capacity had skyrocketed by more than 14-times to 586.5 GW. Unfortunately, Europe's solar industry benefited only marginally from this spectacular growth. Of the 12 largest solar module manufacturers (with a joint market share of about 61%), nine are from China. Only one is European (German), while the remaining two are from South Korea and the United States. The European Union reacted to the Chinese dominance by introducing trade duties on imported panels in 2013; duties were removed in 2018, provided that importers sell panels above a specific price (Blenkinsop, 2018). Some member states also awarded lower subsidies to imported panels. Still, a substantial share of the solar panels in Europe come from China or elsewhere. Moreover, according to the European Solar Manufacturing Council, the European industry has satisfied just 15% of global demand (Enkhardt, 2021).

In the case of solar PV—even more than in wind power—generous subsidies failed to breed a European industry. Of course, to some extent, they succeeded, but firms eventually appropriated much of the value paid by European energy consumers in third countries, particularly China. Subsidies to clean energy can hardly be regarded as a compelling example of industrial policy.

Another critical aspect of industrial policy is its impact on firms. In general, it can be said that when sectoral policies are targeted toward competitive sectors or allocated in such a way as to preserve or increase competition, then these policies increase productivity growth (Aghion et al., 2015). This does not seem the case with the intervention of the entrepreneurial state in the RES-E sector. The intervention created an incentive to produce and invest in these technologies, whatever the level of competition in the sector, thus giving way to rent-seeking and creating firms interested in getting subsidies.

Firms use resources and combine them to create specific competencies to enjoy a competitive advantage over their competitors. If a sector is flooded with subsidies, the firm's primary resource is state intervention. The firms in a subsidized sector develop competencies to understand the main changes in the industrial policies, the political scenario, and they try to develop political connections to protect their rents. They do not try to innovate to better satisfy consumer demand because they only need to produce or invest according to the prescription of the entrepreneurial state that is their only customer (Böhringer et al., 2017).

When the entrepreneurial state is invoked, the risk of going from the invisible-hand model to the helping-hand and finally to the grabbing-hand one (Frye & Shleifer, 1997) is very high, especially in sectors already regulated whereby subsidies and state intervention exacerbate price distortions.

When the firms are not capable of efficiently allocating factors and do not compete for the market but for rent-seeking, economic growth very often languishes, since entrepreneurs and firms are a relevant determinant of economic growth. Subsidies can also favor big firms that often have extensive legal departments and can exert more lobbying capacity, thus favoring concentration in the sector. Moreover, when the state support fades out, or when low-cost competitors step in, the protected industry finds itself in trouble, if not on the brink of collapse, as has happened in France and Spain after generous solar subsidies were reduced (Del Río & Mir-Artigues, 2012; de La Tour et al., 2013).

5 Are Green Subsidies an Effective Social Policy?

All else being equal, subsidies to green energies increase the average price of electricity. While they may result in lower *wholesale* prices due to the price-formation mechanism in most E.U. power markets, they are generally funded by levies that build up onto the end price consumers pay to their energy suppliers. Figure 2 shows the composition of electricity prices in E.U. member states for households. The figure should also be taken with a pinch of salt: some member states fund clean energy incentives with tax revenues rather than tariff levies. Moreover, some member states, such as Germany, shift most of the burden onto households, while others, such as Italy, place a heavier toll on small and medium-sized enterprises. Still, the figure shows that one effect of green energy subsidies is to raise the price of energy for the average household.

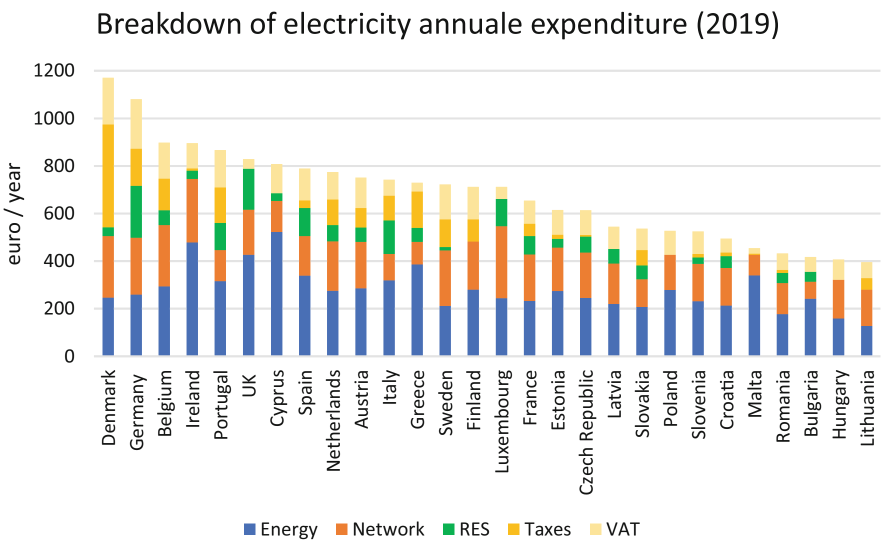

Fig. 2 Breakdown of Incumbents' Standard Electricity Offers for Households in Capital Cities – November/December 2019 (annual expenditure). Source: Author's elaboration on data from Acer

Electricity—and, more broadly, energy—expenditure tends to be regressive, meaning that poorer households spend a disproportionate share of their income on energy. Energy poverty—defined as the situation whereby a household fails to meet its own domestic energy needs—is a real and growing problem in Europe (Faiella & Lavecchia, 2021). According to the EU Energy Poverty Observatory, about 7.3% of European households could not keep their home warm in 2018 (Bouzarovski & Thomson, 2020). Electricity prices for household consumers in Europe, on average, grew faster than inflation, from 16.4 euro cents/kWh in 2009 to 21.6 euro cents/kWh in 2019. The European Agency for the Cooperation of Energy Regulators claims that the observed increase in the price of electricity for households "mainly reflects increases in non-contestable charges of the electricity consumers' bill." In particular, "the average share of RES charges in final electricity prices for households has more than doubled over the 2012–2019 period" (ACER, 2020, p. 18).

Both the European Union and member states have adopted, or are in the process of adopting, measures to address energy poverty, including conditional cash transfers, social tariffs, and means-tested energy efficiency incentives. Of course, the fight against energy poverty is part of the broader campaign against poverty, even though there may be differences in the affected groups. Moreover, energy poverty has many causes, including poverty, unemployment, high commodity prices, the failure of the less affluent households to retrofit their homes, and rising energy prices. However, the latter is peculiar insofar as it is an unintended consequence of policy decisions that are either *intended* to increase the price of energy (such as carbon taxes) or have price increases as an *unintended* consequence (such as green subsidies), or both. One obvious way to address energy poverty is to stop introducing policies that may exacerbate it.

Incidentally, while most economists agree that pricing carbon is a good policy for the environment and economic growth, many would suggest using the revenues from carbon taxes or other forms of carbon prices to mitigate their unintended consequences. This could be done by transferring the proceeds from carbon taxation to the low-income, such as reducing labor taxes or cutting the existing levies in the price of energy. As we write, our country, Italy, has decided to use some of the revenues from auctioning CO_2 allowances in the Emissions Trading System to mitigate increases in the cost of power. Austria is considering introducing a revenue-neutral carbon tax whose revenues would be recycled to cut taxes for middle-income earners, not just as a reaction to soaring energy prices in the short run but as a structural component of climate policy (Jones, 2021). That is a textbook example of market-based environmental policy (ARERA, 2021). On the contrary, green subsidies require funds to be extracted, either from tax-payers or from electricity consumers, and cannot be designed in a revenue-neutral guise.

The proponents of the entrepreneurial state and mission-oriented innovation would strongly disagree with the above statements and policies. They support carbon taxes and other forms of carbon prices not as a mere allocative instrument that helps internalize the external costs from using fossil fuels. Instead, they call for raising more revenues (from environmental and other taxes) to spend on the preferred technologies, such as solar and wind power. They advocate policies that may have many merits but contribute to increasing the cost of energy and fall disproportionately on low-income households.

6 From the Entrepreneurial State to the Entrepreneurial Central Bank

As we have shown, the effort from the entrepreneurial state on climate change and the shift toward RES-E may be effective in cutting carbon emissions, but it is costly as well. Maybe this is the reason why proponents of the entrepreneurial state called the central banks to weigh in. Since the financial crisis of 2007–2008, central banks have adopted unconventional monetary policy tools such as quantitative easing to avert financial disaster and soften the consequences of the crisis. The Euro crisis immediately followed, and the use of unconventional monetary policy tools followed, becoming structural and almost *conventional* when the pandemic crisis hit. When purchasing assets in a quantitative easing program, central banks should be as neutral and independent as possible, trying not to distort capital allocation and the proper functioning of the market.

While Jerome Powell, the Federal Reserve chairman, declared that climate change is not something that the central bank considers in setting monetary policy (Derby, 2021), on July 8, 2021, the European Central Bank (ECB) presented an action plan to explicitly include climate change considerations in its monetary policy strategy (ECB, 2021). Both institutions properly act when they actively explore what climate implications are for their supervisory, regulatory, and financial stability responsibilities. However, the ECB upped its game by considering relevant climate change risks in its due diligence procedures for its corporate sector asset purchases by considering the alignment of issuers with, at a minimum, E.U. legislation implementing the Paris Agreement through climate change-related metrics or commitments of the issuers to such goals. The rationale for this intervention is that climate change supposedly affects price stability through its impact on relevant macroeconomic indicators. Carbon transition also affects the value and the risk profile of the assets held on the central bank's balance sheet with a potential undesirable accumulation of climate-related financial risks.

Climate change risks are relevant for the financial sector, and the ECB must support research, studies, and the disclosure of relevant information. We find it very dangerous to adopt strategies to force banks and private companies to defund fossil fuel industries and provide subsidized funding to *green* projects that are not easy to define. The energy transition from fossil fuels is a crucial process that calls both public and private stakeholders to contribute. However, setting the targets and the policies is an inherently political process that should be taken care of by governments, not by independent bodies such as central banks. What will the central banks do? Will they feel obliged to intervene with unconventional (now structural) monetary tools to tackle the next crisis? Maybe the choice to use unconventional tools in exceptional circumstances to mitigate the effect of the financial crisis put in peril the independence of central banks, putting all the pressures on the shoulders of boards that must resist the calls by politicians to act. Nevertheless, now that these tools are used extensively, we need more neutrality and clear guidelines from central banks to avoid distortions in markets and capital allocation.

Central banks' independence, authority, and credibility have been essential features that have allowed us to enjoy a long period of low inflation and financial stability. Their boldness in using unconventional monetary tools when needed stems from their independence from political power. However, power corrupts, and absolute power corrupts absolutely. Unconventional and temporary interventions have become structural and permanent, and the desire to play God in deciding winners and losers on the markets is tempting but is also dangerous for financial stability and the proper functioning of the markets. The state already has enough power and through the democratic process, the legitimacy to intervene in the market, even if the results are very often disappointing. Imagine what could happen if its most powerful ally is a formally independent central bank that becomes an entrepreneur without the proper checks of a democratic process that appoint its representatives (Cochrane, 2020).

7 Conclusion

This chapter has reviewed one prominent example of the entrepreneurial state and so-called mission-oriented innovation in practice, i.e., Europe's policy of subsidizing renewable energy sources. The European Union and its member states have consistently pushed toward making investments in renewable energies as a flagship initiative to combat climate change while achieving global industrial leadership in clean energies. According to the narrative, this would have turned emissions reduction from a cost into an investment and, ultimately, an economic benefit: Europe would spur growth, promote innovation, and create jobs while curbing its environmental footprint. In order to meet these goals, Europe's environmental policy of setting emissions-reduction targets was accompanied by other targets concerning the penetration of renewables and energy efficiency. Did this deliver?

Data suggest that yes, it was a successful strategy to reduce emissions, but no, it was not an efficient one. In fact, by setting renewable and energy efficiency targets on top of the carbon reduction one, the European Union and member states redirected investments toward potentially less effective technologies and behavioral changes, increasing the implicit cost of CO_2 abatement—or, to put it another way, cutting emissions less could have been done with an optimal mix of interventions. In other words, Europe gave up—at least to some extent—environmental goals and policy in order to pursue other goals in the field of industrial policy.

Even from this point of view, though, the results are disappointing. As shown regarding the most important RES-E, i.e., wind power and solar photovoltaics, generous subsidies have only partially prompted European industry. In the case of wind, Europe was able to effectively breed its champions. However, it should be noted that the industry was already there. Moreover, it is not clear that the economic benefits (in terms of investments, innovation, and employment) exceed the cost from energy subsidization, even factoring in the environmental benefit.

Moreover, as global markets for wind power grow thanks to subsidies from third countries and the increasing economic competitiveness of wind turbines, new actors emerge that may (and do) compete with European producers. The policy was much less effective in the case of solar PV: Europe is far from being a powerhouse for this technology. Most panels in the European Union are imported from China, despite trade duties in 2013–2018 and subsequently other trade measures that limit the ability of foreign producers to engage in price competition with their European counterparts.

The European Union does not seem to have fully learned from this experience, in any case. The Commission has launched a "battery strategy" aimed at "mak[ing] Europe a global leader in sustainable battery production and use" (European Commission, 2021a). The strategy allocates massive amounts of money to support Europe's battery manufacturers both in their R&D efforts and in increasing the volume of their production. While R&D subsidies may be seen as part of a broader strategy that falls outside the scope of this chapter, direct subsidies to the use or the production of batteries provide a good example of how the entrepreneurial state works and, in the light of previous experiences, how it can fail to reach its targets. And similar initiatives are seen in the fields of the circular economy (European Commission, 2021b), hydrogen (European Commission, 2021c), and other environment-related technologies.

Even more so, in the relief package from the Covid-19 crisis, the so-called Next Generation E.U. program, the European Union has directed a large share of the €750 billion recovery fund to investments in the "energy transition," whereby precise areas for investments have been identified top-down (including clean technologies and renewables; energy efficiency of buildings; sustainable transport, and charging stations) (Darvas et al., 2021). Of course, investing in green transformation is a legitimate and desirable goal of environmental policy. Climate change poses major threats to developed and developing countries alike, but developed countries have greater historical responsibility and more resources and know-how. However, *promoting* the ecological transition is not the same as *designing* the ecological transition. In the process, the European Union also started to put pressure on the European Central Bank which, contrary to what the Fed did, explicitly introduced climate change issues into its monetary policy strategies. This sets a dangerous path for the independence of central banks and for the financial stability and the proper functioning of markets in allocating capital. Climate change is a major threat that governments, not central banks, should address. Central banks should support research and the circulation of information about this threat and promote more precise definitions and taxonomies, thus helping investors have the information needed to choose on the market.

Until a few years ago, subsidies to the installation of RES-E and/or the production of renewable power was able to support a growing niche in European industry. From the perspective of free markets, they may have been questionable, but, in practice, they entailed a limited amount of money and did not affect capital allocation beyond a certain limit. A few years after, though, green subsidies represent perhaps the greatest example of industrial policy in Europe, with a committed expenditure of dozens of billions of euros over 15 or 20 years. Before more resources are committed to the same or other technologies, a serious assessment of the program's outcomes is much needed.

Environmental policy and climate change are serious issues. They require significant changes in the way energy is produced and consumed. Nearly everybody would agree that pricing carbon is both necessary and long overdue. However, the European Union has adopted a policy of pricing carbon and directly subsidizing specific technologies. By so doing, it is messing up competition in electricity and other markets, profoundly distorting the allocation of capital and labor, and possibly negatively impacting GDP growth. That is, again, a legitimate policy choice if it reflects social preferences. Nevertheless, more transparency of the costs of such a policy is needed, and a better understanding of market-based alternatives—such as pure carbon pricing—would greatly benefit the public debate and a sound decision-making process.

In designing future climate and monetary policies, the European experience may provide helpful hints. We have reviewed the policy of subsidizing the production of green electricity, particularly from wind power and solar photovoltaics, and asked three research questions: (1) was it an effective environmental policy? (2) was it an effective industrial policy? (3) was it an effective social policy? The answer is: no, no, no.

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