

# **The Green Shift**

## **An evolutionary economic perspective on renewable innovation**

**Robin Kirknes Andreassen**

### **I. INTRODUCTION**

On august 9<sup>th</sup>, the IPCC published the first instalment of a climate assessment report. They estimate that within the next few decades we might see the global temperature rise to the critical level of 1,5 degrees Celsius or beyond (IPCC, 2021). The IPCC find that it is predominantly an effect of greenhouse gas emissions caused by human activity (IPCC, 2021). As we could see during the Norwegian election of this year, the “climate issue” was a central theme during debates. The major theme revolving around Norway as an oil nation and our aggregate emissions. Although there is still a dividing line between the traditional left and right on this issue, the 2021 election showed a greater willingness for most parties to accept that changes need to be made.

Where does this leave Norway? In the process of reducing its carbon footprint, Norway might create the downfall of the most profitable industry in its history. Is the capitalist economic system able to create the change needed to save the environment when such a large part of the system is based on appropriation of nature for private gain (Patterson, 2010)?

In this paper I will look at how a so-called “heavy” tax on carbon emissions and if it is the right response to bring emissions down. By using an evolutionary economics perspective, more specifically Joseph Schumpeter’s theory of creative destruction, I will seek to answer the following research question:

*Should Norway reduce or remove carbon taxes as a way for private enterprise to realize a greater profit that could be used to invest in new technologies?*

The notion of “greater profit” is partially based in an orthodox understanding that with higher profit margins there is a higher amount of capital available for investment in innovation. I will argue, somewhat counterintuitively, that a carbon tax might be a necessary tool to force fossil fuel dependent businesses to seek innovation in order to realize more profit. By looking into how China conducts its renewable energy

management I seek to contrast this with the situation Norway finds itself in. There are however, two major confounding variables at play that effect a possible “green creative destruction” in Norway: The nation’s biggest industry the interdependencies among trading nations.

The first part of this paper will consist of a clarification of the theoretical perspective before I move over to more current research on the topic of climate and the economy. The second part will be a comparative analysis of the Chinese and Norwegian model of action. Lastly, I will discuss how the two countries diverge and the need for the state to take on the entrepreneurial function as proposed by Schumpeter.

## II. CREATIVE DESTRUCTION

Through the concept of creative destruction, Schumpeter is arguing for an evolutionary take on what is the driving factor of capitalism. Whereas the economic orthodoxy focuses heavily on how fluctuations around a general equilibrium effects the many elements and mechanisms of the economic system, Schumpeter, instead puts forth the notion of historic waves of innovation (Burlamaqui & Kattel, 2020). To Schumpeter, the process of capitalism isn’t stationary, it is a continuous forge of “industrial revolutions” (Burlamaqui & Kattel, 2020; Schumpeter, 1976). There is an incessant drive to innovate, fueled by competition. The innovators are the firms and they become the central object of analysis. In order to better compete they will seek to gain advantage in any area they can, be it, methods of production, markets, sources of supply, organizational structuring etc. When new technology becomes available, that is better than anything currently utilized, there is a period of turmoil (Burlamaqui & Kattel, 2020; Schumpeter, 1976). It becomes a “sink or swim” scenario for the competitors (Schumpeterian competition). The process of creative destruction is underway and who comes out the other side is dependent on whether they adapt to the new paradigm or not. In its essence, creative destruction is about structural change among providers of goods and services as a result of competitive innovation and how this process lies at the heart of the capitalist economic system.

Central to this theory is the entrepreneurial function. Schumpeter doesn’t limit this function to the individual capitalist but expands this function to be performed by corporate teams, big or small corporations or cooperatives (Burlamaqui & Kattel, 2020). A noticeable omission here is the entrepreneurial function of the state. Although Schumpeter recognized the state as a possible driving factor of innovation, he never outright acknowledges it in his theory (Burlamaqui & Kattel, 2020). In this paper I will expand on the state as an

entrepreneurial function and its importance in bridging the gap between the current climate crisis and Schumpeter's traditional unit of analysis, the firms.

### III. THE CLIMATE CRISIS AND INNOVATION

There is broad consensus among scientists that technological innovation is central to dealing with the concurrent climate crisis (Gerlagh & Lise, 2005; Sun et al., 2008 ; Wang & Yu, 2021; Weber & Neuhoff, 2010). What separates scholars is whether carbon taxes create initiative for innovation (Gerlagh & Lise, 2005; Karmaker et al., 2021; Wang & Yu, 2021) or not (Gerlagh & Lise, 2005; Khan et al., 2021; Weber & Neuhoff, 2010). At first glance it might seem clear that a carbon tax will lead to reduced emissions as taxes, and other forms of governmental regulation, historically has proved a useful tool to discourage unwanted activity. The question then arises, whether carbon taxes is the most effective way of reaching climate goals. Norway has had a carbon tax since 1991 (Finansdepartementet, 2020) but data from the environmental directorate shows that CO<sup>2</sup> emissions gone up, while the total emissions has remained relatively stable from 1990 onwards (Miljødirektoratet, 2021). Herein lies another area of contention that is central: does the carbon tax stimulate abatement technology that offputs the dangers of a stabile emission level? Karmaker et al. (2021) suggest that for high and middle-income countries this is very much the case. Their models showed that a 1% increase in environmental taxes had a subsequent 0,57-0,78% increase in environment-related innovation (Karmaker et al., 2021). Others find similar results but make important distinctions when it comes to induced technological change. Induced change through the mediation of an overarching authority (the state) can, when paired with taxes, accelerate the substitution of fossil fuels for renewable energy (Gerlagh & Lise, 2005). This is somewhat backed up by the data supplied by the Norwegian environmental directorate which shows that CCUS (carbon capture, utilization, and storage) capabilities experienced a steady increase up until the mid-2010s (Miljødirektoratet, 2021). It doesn't imply that this is due to technological innovation, but we've experienced an induced change in the form of carbon capture as opposed to a heavy reduction of emissions.

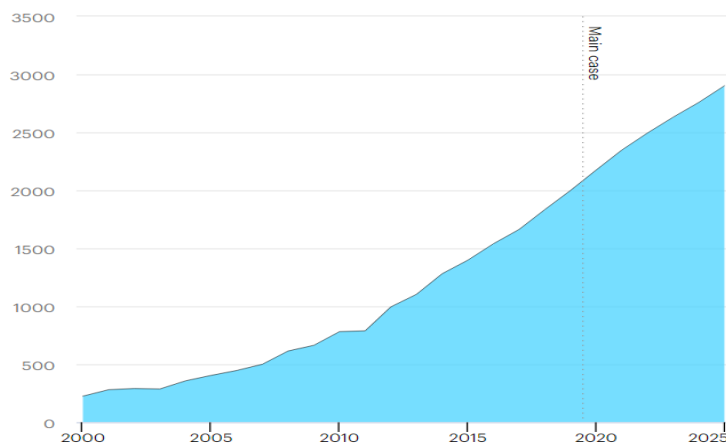
### IV. CHINA AS AN OUTLIER

The key contributor to the tumultuous process of creative destruction is the entrepreneur. Through the utilization of a more effective technology the entrepreneur gets an upper hand on the competition that they (the

competition), in turn, need to address. The Boulton and Watt partnership inhabited this entrepreneurial function when they sought to produce Watt's steam engine design for commercial use (Burlamaqui & Kattel, 2020). Then what about the issue of climate? Will there be another privately owned enterprise that sparks the process of creative destruction, and, if so, when can we expect it to happen? Burlamaqui and Kattel (2020) have a concrete idea. It is already happening, and China is spearheading the process. China has undergone an industrial revolution of its own and is now the second largest economy in the world, behind the US. The main source of revenue comes through exporting manufactured goods (IBISWorld, 2021), as a consequence of western manufacturing industries being outsourced and moving eastwards (Burlamaqui & Kattel, 2020). China needs to fuel its manufacturing industry and although fossil fuels represent the cheapest option to many other nations, it is somewhat more difficult for a Chinese state being a direct rival to the US (Burlamaqui & Kattel, 2020). The geopolitical relations between the two nations have deteriorated further during the last decade and China seem to be the spiritual successor to the Soviet Union in a renewed conflict between the East and the West. China thus needs to create energy security through stronger energy independence.

When looking at the total generation of electricity using renewables by the IEA (figure 1.), China is showing a clear upwards trend, expecting to reach close to 3000 TWh by 2025. Although large economies like the European Union and the US show the same upwards trajectory, their projections put them at about half the capacity of China by 2025.

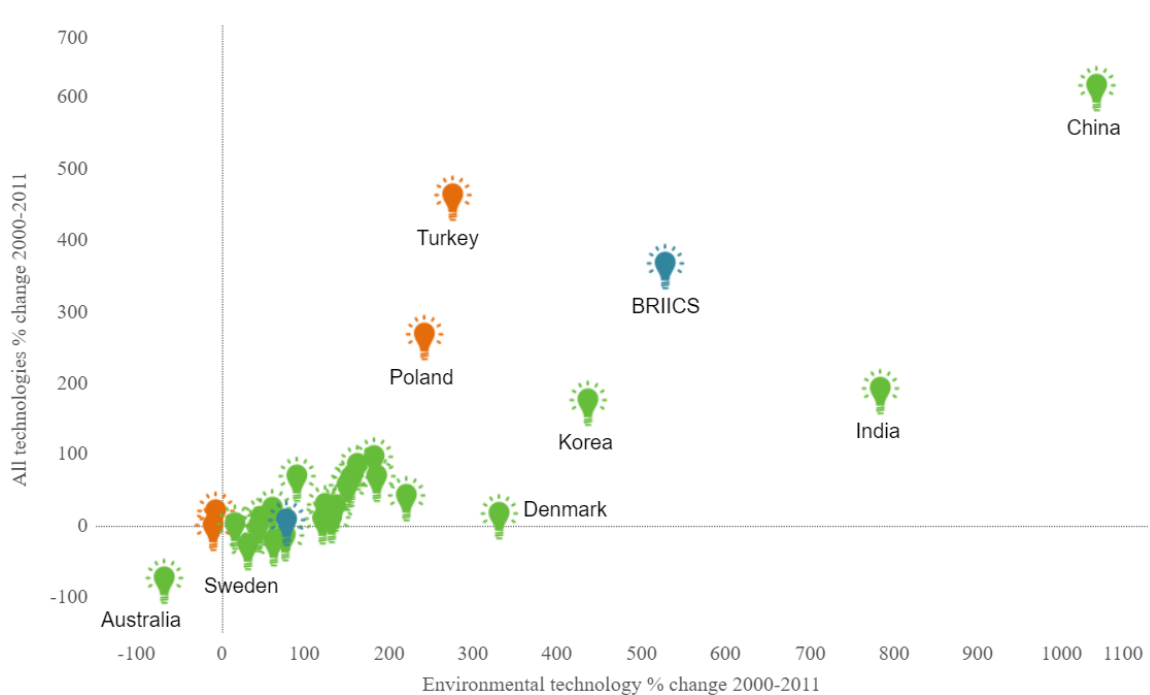
Total generation, main case, China, 1990-2025  
TWh



(IEA, 2020)

Looking at similar data generated by the IEA there seems to be a diffusion between the East and the West. While China is outpacing both the US and the European Union in electricity generation through renewable energy, the two western economic powers are performing better in other categories such as biofuels and heat generation. This might indicate a greater appetite for diversifying the renewable energy output among the EU and the US.

A commonly used indicator for technological change are patents (Sun et al., 2008 ). *Figure 2* shows the OECD overview of green technology development by country. It shows the relationship between green technology patent applications and applications for patents in other areas that does not qualify as environmental innovation. The nations highlighted in green has a greater difference between environmentally related patents and all other patents. While most developed western nations are in the green they are, visually at least, being outcompeted by China. China's environmentally related patent applications have increased to a bit above 1000% while all other applications grew by about 600%. This is somewhat misleading since nations like India, South Korea and Denmark show similar differentiations but with less total output, which can be attributed to the sheer size of the economies discussed. Regardless, the graph shows a tendency for China to invest more in renewable energy in their search for energy security.



(OECD, 2015)

The Chinese state is bankrolling most of these green innovation initiatives through the China Development Bank and other “policy banks” (Burlamaqui & Kattel, 2020). By 2019 Chinese firms had already invested over

83 billion dollars in clean energy, 30 billion more than the world's biggest economy (Statista, 2020). In addition, only 15% of the financing comes through tax-based investment while the rest is from the private sector through green initiatives, green loans and bonds (Burlamaqui & Kattel, 2020). China is inducing technological change by heavily incentivizing private enterprise to create the technology needed for a self-sufficient energy industry. Thereby taking on an indirect role as the entrepreneurial function needed for creative destruction.

## V. NORWEGIAN PROTECTIONISM

If Norway were to follow the Chinese example, based on the assumption that creative destruction is the driving force of capitalism, arguments could be made for a reduction (or outright removal) of the carbon tax and a bigger focus on private investments as an induced incentive for technological change. There are however certain variables at play that effect the same processual options being employed here. Firstly, Norway is an energy exporting nation, utilizing renewable energy (predominantly hydropower) for almost all its energy consumption (Samland, 2016). Norway is also an oil-extracting nation, and the majority of energy exports is this fossil fuel. Equinor, the Norwegian oil and gas company, is by far the largest company in Norway by revenue and therefore holds significant bargaining power, not only through their financial contributions to the Norwegian economy (20% of state income and 39% of total income from exports) (NPD, 2021), but also through the number of Norwegians they employ. Creative destruction is based on competition as a force for technological change, but by the same reasoning it is possible to assume that existing companies would protect their industries against the process of creative destruction by any means necessary. This is also something Schumpeter accounted for (Burlamaqui & Kattel, 2020). If the process of creative destruction would occur with renewable energy, the fossil fuel sector would produce a product which by all intents and purposes would be an "outdated" product, no longer able to compete with the newer, better product. Therefore, it is in their interest to hinder and stop creative destruction from occurring. One-way Equinor has tackled the issue is through public opinion. By trying to sway public opinion away from the issue of climate change and towards the "green initiatives" Equinor themselves are responsible for (so-called "green oil") they are effectively trying to relieve public pressure on elected officials to aim for an induced technological change. Second, by being an oil-exporting country Norway is also prone to influence from abroad. A large part of the oil exports goes to EU member states. Therefore, Norway is not just under pressure from its largest domestic revenue producer but also from other states dependent on the product of that producer. Any technological change towards a more renewable energy utilizing economy would be dependent on the forces for change within the EU also. But herein lies a possibility for creative destruction as

Burlamaqui and Kettel (2020) envisioned. Norway accounts for only 2% of the total oil exports in the world while also being very dependent on it as a revenue source. This makes Norway especially prone to demand-shifts in the international market, even more so since 15% of all oil exported in 2020 (NPD, 2021) went to China. As China might have already become the “first entrepreneur”, the initiator of creative destruction, their need for oil will, given the accuracy of the theory, gradually go down. This in turn might be offloaded by an increased demand in Europe or other new markets opening elsewhere. But China’s entrepreneurial role coupled with added public pressure as an effect of observing another nation’s successful green shift might reverberate through the EU and other Western markets and thus prove too difficult to handle for the protectionist industries.

## VI. CONCLUSION

In this paper I have tried to shed light on how a carbon tax would affect the process of creative destruction within renewable (or “green”) technologies in Norway. I’ve been trying to answer the question: should Norway reduce or remove carbon taxes as a way for private enterprise to realize a greater profit that could be used to invest in new technologies? This has been done with an understanding that competition between companies to innovate is the driving force of capitalism as opposed to the more orthodox notions of competition and equilibrium. That is not to say that more orthodox arguments are not valid, but by focusing on one perspective I try to avoid a normative debate between the two sides.

China might be on its way to becoming a leading nation in renewable energy innovation. Since they are achieving this without a clear carbon tax, but rather by incentivizing investment and utilizing an emission-trading scheme, it could be natural to assume that taxing carbon emissions restricts potential capital investments in green technology. There has, however, been conducted a lot of promising research indicating that carbon taxes might do more good than harm in this regard. I would argue that carbon taxes are especially pertinent when it comes to Western states, like Norway, who’s a) biggest industry is fossil fuels, and b) have created certain interdependencies with other states who, in turn, rely on the extraction of said fossil fuels. These intervening factors make it easier for the fossil fuel industry to protect itself against creative destruction by actively stopping new technology from being implemented. The carbon tax might prove a necessary tool to combat, or at the very least limit, the protectionist power of the fossil fuel industry (in Norway), and to change. What needs to be highlighted is whether or not it’s an effective tool for change on its own. Unless it is coupled

with induced technological change by the state fulfilling its entrepreneurial function there will be difficulties creating a sufficient substitution of fossil fuels for renewable energy within timeframes suggested by various scholars. By taking a closer look at China it becomes evident that their success supports the idea that the state needs to induce change, as they couple their incentives with restrictive legislation in the form of emission-trading schemes.

## VII. SOURCES

- Burlamaqui, L., & Kattel, R. (Eds.). (2020). *Schumpeter's Capitalism, Socialism and Democracy: a Twenty First-Century Agenda* (1 ed.). Routledge.
- Finansdepartementet. (2020, 10.01.2020). *CO2-Avgiften*. Regjeringen. <https://www.regjeringen.no/no/tema/okonomi-og-budsjett/skatter-og-avgifter/veibruksavgift-pa-drivstoff/co2-avgiften/id2603484/>
- Gerlagh, R., & Lise, W. (2005). Carbon taxes: a drop in the ocean, or a drop that erodes the stone? The Effect of Carbon Taxes on Technological Change. *Ecological Economics*, 54(2-3), 241-260. <https://doi.org/10.1016/j.ecolecon.2004.12.037>
- IBISWorld. (2021). *Biggest Exporting Industries in China in 2021*. IBISWorld. <https://www.ibisworld.com/china/industry-trends/biggest-exporting-industries/>
- IEA. (2020). *Renewables 2020 Data Explorer*. IEA. <https://www.iea.org/articles/renewables-2020-data-explorer>
- IPCC. (2021, 09.08.2021). *Climate Change Widespread, Rapid and Intensifying* IPCC. <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/>
- Karmaker, S. C., Hosan, S., Chapman, A. J., & Saha, B. B. (2021). The Role of Environmental Taxes on Technological Innovation. *Energy (Oxford)*, 232, 121052. <https://doi.org/10.1016/j.energy.2021.121052>
- Khan, S. A. R., Ponce, P., & Yu, Z. (2021). Technological Innovation and Environmental Taxes Toward a Carbon-free Economy: An empirical Study in the Context of COP-21. *Journal of Environmental Management*, 298, 113418. <https://doi.org/https://doi.org/10.1016/j.jenvman.2021.113418>
- Miljødirektoratet. (2021, 11.08.2021). *Norske Utslipp og Opptak av Klimagasser*. Miljødirektoratet. <https://miljostatus.miljodirektoratet.no/tema/klima/norske-utslipp-av-klimagasser/>
- NPD. (2021, 24.03.2021). *Norwegian Oil Deliveries in 2020, by first delivery point*. Norwegian Petroleum Directorate <https://www.norskipetroleum.no/en/production-and-exports/exports-of-oil-and-gas/>
- OECD. (2015). *New Green Growth Indicator: Green Patents*. OECD. <https://www.oecd.org/env/indicators-modelling-outlooks/green-patents.htm>
- Patterson, R. (2010). A Great Dilemma Generates Another Great Transformation: Incompatibility of Capitalism and Sustainable Environments. *Perspectives on Global Development and Technology*, 9(1-2), 74-83. <http://doi.org/10.1163/156914910X487924>
- Samland, A. (2016, 11.05.2016). *Renewable Energy Production in Norway*. Ministry of Petroleum and Energy. <https://www.regjeringen.no/en/topics/energy/renewable-energy/renewable-energy-production-in-norway/id2343462/>
- Schumpeter, J. A. (1976). *Capitalism, Socialism and Democracy* (1, Ed.). Taylor & Francis Group.



- Statista. (2020). *Investment in Clean Energy Globally in 2019*. Statista. <https://www.statista.com/statistics/799098/global-clean-energy-investment-by-country/>
- Sun, Y., Lu, Y., Wang, T., Ma, H., & He, G. (2008 ). Pattern of Patent-Based Environmental Technology Innovation in China. *Technological Forecasting and Social Change*, 75(7), 1032-1042. <https://doi.org/10.1016/j.techfore.2007.09.004>
- Wang, Y., & Yu, L. (2021). Can the Current Environmental Tax Rate Promote Green Technology Innovation? - Evidence from China's Resource-based Industries. *Journal of Cleaner Production*, 278, 123443. <https://doi.org/10.1016/j.jclepro.2020.123443>
- Weber, T. A., & Neuhoﬀ, K. (2010). Carbon Markets and Technological Innovation. *Journal of Environmental Economics and Management*, 60(2), 115-132. <https://doi.org/10.1016/j.jeem.2010.04.004>