

From competition state to green entrepreneurialial state: New challenges for Denmark

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From competition state to green entrepreneurial state: New challenges for Denmark

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1. Introduction

The 2019 Danish Climate Law marks a shift from the growth-focused competition state towards a mission-oriented entrepreneurial state that promises to bring the Danish way of life within planetary boundaries. In this article, we analyse the institutional challenges that arise when reorienting the state in this direction.

While countries and corporations race to embrace net-zero carbon reduction targets, we face two immediate concerns. Firstly, even the most climate progressive countries are not ambitious enough (Anderson et al., 2020) and secondly, there is still uncertainty about their ability to achieve the targets. There is a circularity to these two challenges. Capable states can adopt more ambitious goals, while ambitious goals can galvanise states to invest in new institutional and economic capabilities to realise their goals. In this article, we examine how Denmark – widely recognized as a climate progressive country – is pursuing its climate goals. While tighter climate goals are warranted (KOR, 2022), we suggest the key for Denmark to both realise their goals and eventually tighten them is to transform the state model to that of a *green entrepreneurial state*, designed to foster structural and sustainable economic change.

We therefore analyse Denmark's state model shift from a *competition state* (Pedersen, 2011) towards a *green entrepreneurial state* (Mazzucato, 2015). A shift that was instigated by the adoption of the new Climate Law in 2020 that imposes legally binding decarbonisation targets (KEFM, 2021). A new state model entails new challenges for public policy making and implementation. Recently, the challenges presented by this state model shift have led to political acrimony and a rhetoric and reality gap between the new law and legacy policy priorities which include road infrastructure expansion to 2035 and subsidies for polluting hybrid cars. Such frictions are unlikely to subside without a clear diagnosis of their institutional origins in the legacy state model and associated institutions. We deploy the ROAR-framework (Mazzucato et al., 2020b) to analyse four dimensions of the ongoing state model shift: *Routes and directionality*, *organisations*, *assessment tools*, and the principles for *risks and rewards*. We observe worthwhile efforts undertaken, such as experimentation with sectoral research missions and better accountancy for biophysical impacts of economic decisions, but legacy competition state institutions still hold back Denmark's potential as a green entrepreneurial state. We suggest Denmark would benefit from more comprehensive use of mission governance, a new Climate Action Agency to accelerate and innovation and coordinate policy levers, a critical reassessment of the pursuit of a balanced public budget, new policy appraisal tools founded in evolutionary economic perspectives and a new attitude to risk in the state investment banks to go along with the increase of funding.

2. Green industrial policy has put climate targets within reach

While the Paris Agreement has driven policy progress around the world, current climate policies still steer the globe on a trajectory towards 2.7°C heating (CAT, 2021) with considerable uncertainty looming in the self-reinforcing feedbacks in the earth system's carbon cycle (Lenton et al., 2019). Even the most climate progressive countries are falling short (Anderson et al., 2020), including Denmark (Lund et al., 2019; Tilsted et al., 2021). Another major source of concern is that while we are observing progress towards economic decarbonisation, “major new policy developments are not the driving factor” (CAT, 2021: 1). Rather, we are benefitting from the positive spirals catalysed by the return of industrial policy (Cherif and Hasanov, 2019; Rodrik, 2014), such as Denmark’s early pioneering in wind energy (Karnøe and Garud, 2012; Mazzucato, 2013; Voldsgaard and Rüdiger, 2021), Germany’s Energiewende that created a sizeable market for industrialising wind and solar production (Nahm, 2017; Rechsteiner, 2021), and China’s scaled-up manufacturing of green capital goods (Nahm, 2017; Nemet, 2019).

These industrial policy programmes have contributed by mitigating historical GHG emissions, but their primary achievement has been to lower the cost of renewable energy to and below fossil fuel alternatives (IRENA, 2021). The knock-on effect of this change of technological conditions has been to enable new levels of ambition to proliferate among governments globally to take advantage of new low-cost clean technologies and opportunities for international inter-firm collaboration to grow green industries (Lema et al., 2020; Nahm, 2021). But this is not enough. We argue that a crucial missing component for policy to support decarbonisation is institutional and organisational innovation. More specifically, it requires *reform of the state* from a mere facilitator of export prowess to one that can take on substantial societal grand challenges. In other words, a shift from the *competition state* model (Cerny, 1997; Pedersen, 2011) to the *green entrepreneurial state* (Mazzucato, 2015).

The green entrepreneurial state is an ideational state model commensurate with the net-zero emission targets that advanced economies must make rapid strides towards. The adjective ‘green’ is important. It signifies the gulf between the new generation of institutions that are required for addressing the grand challenge and the particular security-oriented institutional configurations in the United States (Weiss, 2014; Weiss and Thurbon, 2021) that have to a large extent inspired the *entrepreneurial state* (Mazzucato, 2013) as a state model due to the numerous general purpose breakthrough technologies for civil use that were generated as a by-product of the strong US priority to dominate technologies with relevance to national security. The green entrepreneurial state combines the innovation lessons learned from this network of decentralised, risk-embracing public organisations (Block and Keller, 2011) with a new primary public purpose. It is further distinguished from green growth-oriented neo-developmental states that chiefly view the green transitioning as an opportunity to develop high value-added production or lower energy import dependency by leveraging their traditions for industrial policy (Kalinowski, 2021; Kim and Thurbon, 2015). Decarbonisation is positioned front and center of politics by broad-based public opinion and mobilisation, rather than as an act of strategic statecraft for geopolitical or geoeconomic concern (Weiss and Thurbon, 2021). Nonetheless, a rapid decarbonisation will unavoidably have decisive impacts on geopolitical relations that are always affected by energy flows and each country’s proximity to the technological frontier in a decarbonising world.

3. From a competition state...

Since Pedersen (2011) presented the case that Denmark has evolved from a *welfare state* to a *competition state*, his diagnosis has become broad consensus in the Danish public sphere. According to Pedersen's thesis, the welfare state was not able to finance itself in the 1970s due to several system failures that misaligned incentives to spend and obtain financial resources for the government. This led to an "infinite reform process" (Ibid. 206) where the purpose of the state shifted towards a state that "actively seeks to mobilise the population and corporations to participate in global competition" (ibid. 12), rather than compensate or shield the public against the consequences of global competition.

Classical political ideologies were displaced by a new ideology of 'economism' founded in neoclassical microeconomics. The adoption of this microeconomic reasoning imposed individual responsibility for one's own predicament, approached policy-making with a supply-side perspective (Larsen and Andersen, 2009) and informed the new public management reorganisation of the public sector. This was not a neoliberal downsizing of the state, but rather a neoliberal re-purposing, where the government was ascribed responsibility for 'institutional competitiveness' by enhancing the business 'input' conditions in terms of labour power offered to businesses, an innovation system delivering marketable research inputs and a lean public sector to reduce tax on households and businesses.

Alongside this shift, Denmark was also an early pioneer in clean energy. Following the oil shock in the 1970s (Rüdiger, 2019), the Danish state sought energy security via its own production of renewable energy and energy efficiency technologies through a comprehensive industrial policy programme. The outcome has delivered both indispensable solutions to tackle climate change (Karnøe and Garud, 2012; Mazzucato, 2013; Voldsgaard and Rüdiger, 2021) and a vibrant, exporting cleantech sector. However, this has to a large extent been dependent on passionate individuals, especially wind pioneers in civil society and Svend Auken as Minister for the Environment (1993-2001), and subject to political stop-and-go policies (Sovacool, 2013). Now, despite its recognition as a climate leader, Denmark is not living within planetary boundaries (GFN, 2021; Lund et al., 2019; Tilsted et al., 2021) and has, in short, become a *competition state with green characteristics*.

While the competition state has been heralded as the saviour of the embedded remainder of the welfare state by enabling fiscal surpluses, the model has faced a cacophony of critiques for promoting a neoliberal society (for a collection see Andersen and Pedersen, 2017), for neglecting sustainability (Willig and Blok, 2021) and on a more practical, yet fundamental, level for the inability to solve 'wicked problems' with unstable problem descriptions, uncertainty of effective solutions and many actors with competing interests, such as social mobility, green transitioning, tech regulation, integration and unemployment policy (Nielsen, 2021: 27, 332). The competition state perceives its role as a market fixer in the event of market or coordination failures, as opposed to a market shaper with a vision for the directionality of change based on one or more grand challenges. This view neglects to see the potential in market shaping – where governments support innovation to solve societal challenges, thereby creating competitive firms in future markets as a by-product of their involvement in solving the challenge. The Danish Climate

Partnerships are a step in this direction, since the premise of the social dialogue is that businesses - and not just policies - must change.

Table 1: The characteristics of the competition state versus the green entrepreneurial state

	Competition state	Green entrepreneurial state
Role of government	Promote innovation for global competition and export-led growth. Innovation policy goal is to grow net exports.	Seek transformative innovation solutions to the climate crisis and promote innovation-led, directional growth.
Policy priorities	Efficiency, labour supply and exports. Supply-side policies and economic incentives aim to bolster private actors' ability to 'optimally' supply goods and services.	Problem solving. Innovation policy oriented toward rapid decarbonization and finding solutions to societal challenges.
Innovation approach	Upstream-focused reliance on grant-giving R&D agencies. Focus on sectors and technologies with indirect stimulation of innovation and expectations of incremental change.	New market frameworks that include institutional, social and organisational innovation to integrate the innovation chain. Public investment in clean infrastructure and startups, and experimentation involving multiple actors including citizens to generate transformative innovation and change.
Perception of markets	Conservative ideas of public-private relations: Government only acts as an ex-post market fixer, levelling the playing field so firms compete on an equal footing to offer individual consumers choice and value for money.	Proactive approach to market shaping: Actively seeks to tilt the playing field towards climate change mitigation and generate competitive firms as a by-product. Use of conditionalities in public/private partnerships is necessary for problem resolution.
Perception of the citizen	Individualistic consumers with responsibility for wellbeing passed to individual citizens by the state. Assumes behavioural norms are opportunistic (responding to economic incentives).	Participatory and issue focused recognising that shift from unsustainable lifestyles and occupations requires an articulated approach to a <i>just transition</i> .
Problem framing of the climate challenge	Market failure: Climate change is a market failure to price externalities, where the solution is to tax pollution and subsidise basic R&D.	System failure: Climate change is a systemic challenge that requires non-marginal changes incl. proactive and transformative innovation across sectors to break engrained path dependencies.

Note: Authors' own illustration with insights drawn from Breitinger et al. (2021); Kattel and Mazzucato (2018); Rosenbloom et al. (2020).

In the era of burgeoning climate crisis, the competition state model suffers from a legitimacy challenge, despite its success at achieving net exports and sustaining public spending on welfare (Pedersen, 2019). Moreover, the display of fiscal power by Denmark and other states during COVID-19 has raised doubts about the theory of fragile public finances underpinning the rationale for promoting exports above all else (Bennike, 2020) and the state's perceived inability to counter the post-financial crisis recession with sufficient demand stimulus (Andersen, 2014), which led to a decade of missed opportunities to invest in the green transition.

4. ...towards a green entrepreneurial state

The adoption of a new Climate Law in 2020 with binding targets for 2030 and 2050 (KEFM, 2021) has the potential to transform the Danish state model. Targeting bold missions at wicked problems requires new organisations, policy tools and principles for how to achieve the goals. In other words, to be at the forefront of the green solution frontier requires the competition state to be reformed into a green entrepreneurial state (Mazzucato, 2016, 2015). Going green can thereby become the new driving force and leitmotif of policymaking across sectors. Rather than focusing on exports, competitiveness and private sector dynamism, these become a welcome by-product of prioritising tackling grand challenges. This was indeed the lesson from NASA's moon-shot mission and defence investments during the Cold War (Block, 2008; Mazzucato, 2021, 2013; Weiss, 2014).

Today's competition state has been premised on optimising static efficiency to be internationally competitive and avoiding the threat of 'disruption'. In contrast, the green entrepreneurial state is designed to promote dynamic efficiency and fears not delivering on its mission mandates (Mazzucato et al., 2020b). Schumpeter rightly warned against the lure of static efficiency:

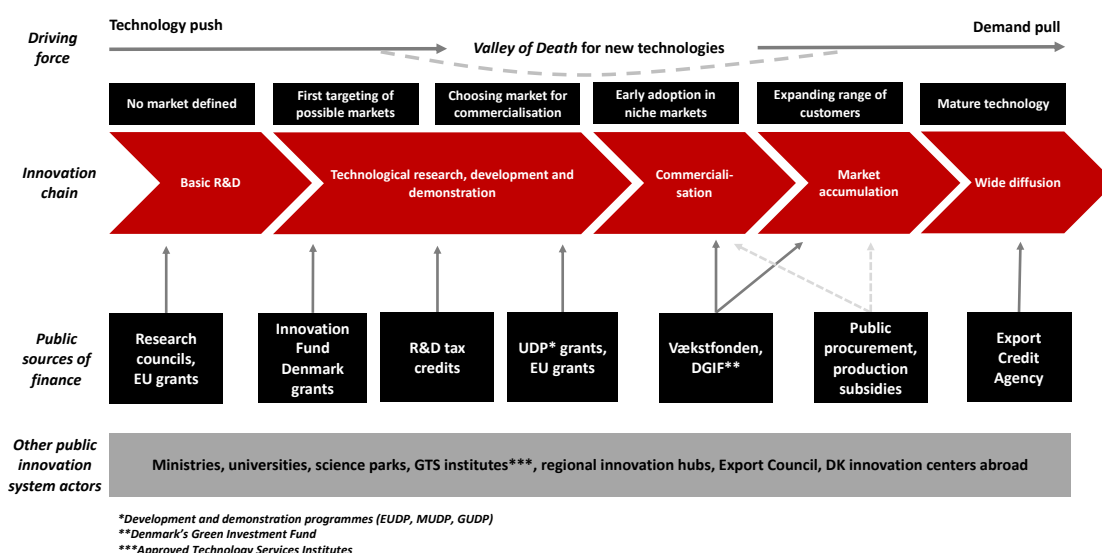
*A system—any system, economic or other—that at every given point of time fully utilizes its possibilities to the best advantage **may yet in the long run be inferior** to a system that does so at no given point of time, because the latter's failure to do so may be a condition for the level or speed of long-run performance (emphasis added) (Schumpeter, [1943] 2013, 83).*

Indeed, a core role of the state is to ensure enough resources are dedicated to tasks and technologies that are not yet superior solutions to explore and develop their future viability. Given the complex nature of innovation, this is a role much beyond basic R&D spending and grant-giving. Innovation is an uncertain, cumulative and collective endeavour (Lazonick and Mazzucato, 2013), which is prone to path dependency and inertia when targeted at legacy production systems (Acemoglu et al., 2012; Geels et al., 2017; Grubb et al., 2021). Especially for the energy sector and heavy industries, which has developed with fossil-based path dependency for a century (Perez, 2002), there is a great risk for new innovations to get caught in the 'valley of death' between the push for new technologies on the supply side and the pull from market demand at the user end of the innovation chain (Grubb et al., 2021, 2017, see figure 1 below). With fruition, The Danish Minister for Energy and the Environment Svend Auken secured an opportunity in Denmark for offshore wind technology to cross from the demonstration stage to utility scale by requiring two energy companies to build the world's two largest offshore wind farms (Horns Rev 1

& Rødsand 1) that deployed new technologies that later became industry standards, such as steel monopile foundations and designated offshore substations (Ørsted, 2019; Voldsgaard and Rüdiger, 2021).

Increasing CO2-taxation is unlikely to be the best route to systems change, although it should have a role in an integrated policy mix (Rosenbloom et al., 2020). Transforming the socio-technical systems that shape how we produce and consume therefore requires new organisation, new policy tools and new policy principles (Mazzucato et al., 2020b). However, the status quo is embedded in and upheld by institutions that select which problems we prioritise to solve and the tools we try to solve them with (Blyth, 2002; Campbell, 2010). New tools are undoubtedly needed to address the challenge of delivering non-marginal change, and we should expect institutional friction when the state gets a new mandate, such as binding GHG reduction targets.

Figure 1: Financing in the Danish innovation system



Note: Authors' own illustration based on Grubb et al. (2017); Nielsen and Freja Englund (2021). The dashed arrows illustrate the under-utilised potential of policy tools closer to the user end of the innovation chain.

5. New state, new challenges

To identify the reform challenges facing the Danish state, we use the ROAR framework as analytical lens (Mazzucato, 2018; Mazzucato et al., 2020b). The ROAR framework highlights how mission-oriented states need 1) clear *routes* and directionality set by policies, 2) new *organisations* and coordination mechanisms, 3) dynamic policy *assessment* tools, and 4) the right level and distribution of *risk and rewards*.

5.1 Routes and directionality

The precondition for a mission-orientated state organisation is a clear, measurable, and binding challenge statement. Danish policymaking has hitherto been constrained by two directionless core rules: to maintain a fixed exchange rate between the Danish krone and the euro; and to prevent

public spending net of taxes to cross the arbitrary thresholds of the Budget Law. Both are competition state policies that have tilted all decision-making towards improving conditions for exporters as a precondition for promoting the public purpose.

However, following the 2019 parliamentary 'climate election' (Stubager and Møller Hansen, 2021) and a public petition for a binding climate law, the adoption of the new Climate Law provided a clear direction for Danish policymaking with binding GHG emission reduction targets for 2030 and 2050 (KEFM, 2021). The law stipulates that GHG emissions should decline by 70% in 2030 compared to 1990 and become a "climate neutral" society by 2050 and states that Denmark has a "historical and moral responsibility to lead the way". The targets are qualified by the principles to transition cost efficiently considering preservation of business competitiveness, the welfare society, and 'sound' public finances, and that emissions are not simply moved abroad. Yet, the government has a 'duty to act' if the economy is not on track to fulfil the goal.

The Climate Law thus provides a clear steer for Danish policymaking and a green straitjacket for the government. Yet, it is questionable whether the path to the 2050 net-zero grand challenge is ambitious enough both in temporal and spatial terms. In order to tighten the mission steering, Denmark could seek inspiration from the UK's decision to include emissions from international transport and adopt five-year GHG budgets to incentivise early action and give more clarity for investors about the pace required. After all, what ultimately matters is the stock of emitted carbon. GHG budgets would also instigate a concrete discussion about the law's climate justice principles when the Danish share of the global GHG budget is determined (for a recent climate justice assessment, see KOR, 2022).

In response to the law, policymakers have set out a mission-oriented green research strategy to "develop new technologies and solutions" (UFM, 2020) in four mission areas: Carbon capture and usage or storage (CCUS), green fuels for transport and industry, sustainable agriculture, and circular economy. This strategy focuses resources for innovation in the research sector, but remains vague on delivery except for in the waste sector (DEA, 2021). Effective mission-orientation requires clearer targets than "development of new technologies and solutions". More measurable targets could be sourced from the political strategies and agreements settled in parliament for the respective areas. However, this speaks to the adjacent challenge of using missions at the right level of government. While research is crucial for providing new solutions, it is too narrow to isolate the mission approach to the research sector. The use of missions could benefit from being elevated to the cross-governmental level as a commitment device to foster cross-ministerial cooperation and policy coordination. For instance, the strategic use of procurement policy can be a powerful lever to increase the benefits derived from upstream research and demonstrations (Edler and Boon, 2018), which can be coordinated in a cross-sectoral mission framework (Grubb et al., 2017).

Moreover, the mission selection process raises concerns regarding whether the missions were formulated with incumbent interests in mind, i.e., preservation of existing competitiveness and jobs, rather than the most effective intervention points, which would in turn create new sources of competitiveness and incumbency. Meanwhile, pertinent challenges with less prominent proponents, such as deep electrification and grid flexibility services, could be overlooked (DEA, 2021).

5.2 Organisations

Clear, measurable, and binding missions require organisations designed to focus on delivery through mission governance and coordination with stakeholders, including, innovation system actors, the business community, municipalities, trade unions, and civil society (Kattel and Mazzucato, 2018). The EU's peer review of the Danish research and innovation system noticed “an insufficiently systemic approach to innovation” with lack of strategic direction, too much fragmentation, lack of a central platform, and too much focus on the efficiency of the parts rather than the system as a whole (Ketels et al., 2019, 55). This room for improvement has partly been addressed via the mission-oriented research strategy, the creation of a Green Business Forum and the Innovation Fund Denmark assuming a more central role both in terms of funding and innovation system interaction. However, our illustration of the Danish innovation system in figure 1 reflects that the Danish innovation system is indeed still fragmented.

The research mission framework will be implemented via four “Innomission” non-governmental partnerships in a public tender by the Innovation Fund Denmark. In this way, the government is outsourcing the governance of its own missions to non-state actors, which raises questions concerning accountability, effectiveness, and efficiency. It is not clear who has the responsibility for delivering the public missions, whether the public purpose interests in the mission will be front and centre, nor if the actors have the relevant tools and intra-governmental connections at their disposal to achieve the mission. For instance, increased policy coordination should seek to bring public procurement into action in the innovation system, which has been identified by analysts as an underutilized tool by (DEA, 2021; Ketels et al., 2019).

These coordination and governance issues have been noticed in the policy community in Denmark. In policy briefings by the Danish Council for Research and Innovation Policy, Blaabjerg and Keiding (2021a) note a pressing need to build facilities and research capacity for the new mission areas, including bringing in trained staff and coordinating the full value chain from research to implementation and system integration of the new green technologies. This speaks to the broader challenge of ensuring not just grant-funded innovation *inputs* from the push-end of the innovation chain (figure 1), but also ensuring the technologies traverse the chain to become *outputs* that address the mission target. They suggest a green mission agency or a “green NASA” could “ensure a coordinated and prioritised research and innovation effort” (Blaabjerg and Keiding, 2021b).

To pivot in this way provides an opportunity to build-up dynamic public sector capabilities either in the Danish Energy Agency or a new climate mission delivery body. This has indeed been the historical response to new long-term challenges, incl. the Danish Environmental Agency to tackle the pollution challenge (1972), the energy agency in response to the oil crisis (1975) and the Danish Critical Supply Agency to enhance resiliency in response to COVID-19. The EU review also recommended the establishment of a quasi-autonomous innovation agency that is involved in both the design and implementation of the innovation policy mix (Ketels et al., 2019, 115). We suggest a *Climate Action Agency* that governs the climate missions could both collaborate with public and private innovation system actors and at the policy-level across government to promote a continually aligned policy mix. This would be a systemic approach to governing the missions based on investment in dynamic public sector capabilities, which is currently being explored in the

US, Germany, Japan and UK with inspiration from the US 'ARPA' model (Bonvillian, 2018; Haley, 2017; Tollefson, 2021).

5.3 Assessment

A government determined to transform the way its country produces, transports, and consumes must have a policy appraisal toolkit fit for purpose (Mazzucato et al., 2020b). Existing toolkits that assess marginal changes ultimately only support competition states. As Pedersen (2019, 2011, 15-17) has examined, Danish policymaking is dominated and constrained by an emergent cross-party ideology, which he labels 'economism', where neoclassical microeconomic reasoning on the effects of marginal changes is used as foundation for political reforms and this body of theory "directs the way in which reforms are developed" (Pedersen, 2019, 175) regardless of politically ideological position. Any actor who seeks political influence "is bound to follow the calculation principles determined by the Ministry of Finance" (Ibid. 184; see also Campbell and Pedersen, 2014). These calculation principles shape policymaking through comprehensive macroeconomic models and the Ministry of Finance's (MoF) guidance for cost-benefit policy appraisal across the public sector (MoF, 2017; Tilsted et al., 2020).

The primary response to the climate challenge has been to develop an environmental extension to the neoclassical macro model already under development, called GreenREFORM (Berg et al., 2019; DREAM, 2021) and advise public bodies to use both a low and a high cost of carbon in cost-benefit analyses. However, central questions remain unanswered. While it is undoubtedly valuable to bring clarity to environmental impacts from economic activities with GreenREFORM, it is important for policymakers to be aware of the limitations to this approach. One omission is mechanisms for how climate- and nature-related financial risks may impact economic activity, i.e. the feedback effect (Bolton et al., 2020; Dasgupta, 2021; Kedward et al., 2020). Crucially, policy-induced innovation (Mercure et al., 2019) is also excluded (Hebsgaard, 2021), which is paradoxical given the emphasis on innovation in the political strategy. In addition, the increased reliance on general equilibrium dynamics in the new model family may contribute to under-utilisation of productive resources that could be used for green investments, as seen in the slow recovery after the Great Financial Crisis (Andersen, 2014), by expecting market processes to deliver full employment on their own. Models based on post-Keynesian or complexity economics would avoid such faith in markets (Kirman, 2011; Mercure et al., 2019). The model choices risk biasing policymaking away from approaches that are necessary to accelerate clean innovation, such as niche market creation.

The economic policy toolkit should therefore be complemented by policy appraisal tools that are targeted at delivering non-marginal changes while embracing the uncertainties involved. This caveat has recently been pointed out by the (Danish Energy Agency (2021, 6-7) in relation to its task of assessing the conditionally agreed construction of an 'energy island' in the North Sea – a potentially transformational investment shrouded in uncertainty due to the scale and time horizon. Also, the underappreciation of social and technological change can compromise sound policymaking by conferring a status-quo bias. The calculations by the Ministry of Finance to guide the car tax reform from 2020 were outdated from the outset as the microeconomic baseline

assumptions underestimated the combination of social and technical changes in favour of electric vehicles, as noted by the Danish Council on Climate Change (DCCC, 2021, 48).

New policy toolkits are already under consideration in the OECD (2017) with inspiration from complexity and evolutionary economics (Balland et al., 2022; Beinhocker, 2007; Kirman, 2011). One source of inspiration for Denmark could be the UK Department for Business, Energy and Industrial Strategy's (BEIS, 2020) latest policy appraisal guidance (*The Green Book*), which has been amended to assist civil servants in policy appraisal for transformational change. BEIS has also worked with scholars with complexity and evolutionary approaches to survey methodological options (Mazzucato et al., 2020a) and develop new alternatives such as the 'risk-opportunity analysis' framework (Mercure et al., 2021).

5.4 Risks and rewards

Despite its history of taking bold chances in cleantech, Denmark has a shortage of risk-embracing capital in this capital-intensive field, as acknowledged by the climate partnership for the financial sector. The venture capital community is focused on funding software and biotech, while cleantech is not among the top 10 sectors (Vækstfonden, 2021, 19). At the same time, the Danish state investment funds have a relatively minor role in the Danish economy compared to other countries and the investments are heavily skewed towards export credit (Nielsen and Freja Englund, 2021). There is therefore a great risk that opportunities created by the upstream R&D support (see figure 1) do not get the complementary financing and market conditions needed to bridge the *Valley of Death*.

The increased funding for state investment funds earmarked for green purposes, incl. a quadrupling of the total lending allowance of Denmark's Green Investment Fund from DKK 2bn to DKK 8bn (from 0.08% to 0.32% of GDP), is a step in the right direction – although one that should be repeated as the frame is used up. It should also be examined whether Denmark benefits sufficiently from the funding and expertise located in the European Investment Bank that aims to be Europe's green bank. But the quantitative change should also provide a moment to consider qualitative changes to the state's investment policy. The state investment funds are designed to invest on 'market terms' with a commercial focus. Since the *raison d'être* of public investment is to finance publicly valuable projects when private financiers abstain (Griffith-Jones et al., 2020), this investment policy should be examined to see if it reaches far enough back along the innovation chain with the right kind of instruments to help new solutions traverse the innovation chain. This could be coordinated with a proposed Climate Action Agency and grant institutions further upstream, where hybrid grant-equity instruments could find use to ensure the state is not simply socialising the risks while the rewards from entrepreneurial state activity are privatised. In the labour market, a green job guarantee can keep the economy at full employment to preserve livelihoods and sustain political support for change (Voldsgaard and Højmark, 2021).

6. Conclusion

With the adoption of Denmark's Climate Law in 2020 and the commitment to reach net zero emissions by 2050, the country has taken a decisive step towards a *green entrepreneurial state*. While the Danish *competition state* has unmistakably featured green characteristics, the electorate sent a clear message in 2019 of the need for a change of pace. This is uncharted territory since the hitherto reigning competition state model has been dominated by the imperative to assist the private sector to prosper in global competition (Pedersen, 2011). This article provides a first analysis of the institutional innovations needed to transform the state model to one that places decarbonisation front and centre.

We note that the Danish state has made promising strides to reconfigure itself to advance decarbonisation. Most notably, the 2030 emission reduction target has led to a multi-sectoral focus on decarbonisation that has generated new policy strategies accompanied by four green research missions. However, there is still unrealised potential for institutional innovation in the state to provide a stronger drive towards decarbonisation. The logic and practices of the *competition state* are still embedded in its institutions, why ongoing scrutiny of the directionality, public organisation, policy assessment methodologies, and risk-reward dynamics is warranted.

While the 2030 reduction target is comparatively ambitious, it should strongly be considered to tighten the commitment to the Paris Agreement (KOR, 2022). The mission approach is implemented narrowly in the field of research, why potential synergies in cross-governmental policy-coordination may be missed. Since this is a long-term challenge, Denmark should consider how to invest in dynamic public sector capabilities suited for governing the cross-sectoral climate missions (Kattel and Mazzucato, 2018). These capabilities include new policy appraisal tools for designing non-marginal changes and new principles for bold investments at the technological frontier. These institutional challenges could be anchored in a *Climate Action Agency* designed to fill out the structural hole in the innovation system (Ketels et al., 2019) and ensure new solutions advance along the innovation chain (figure 1). Setting a bold target is the easy part. We hope this article stimulates discussion of the more complex public sector reforms needed to achieve it.

References

- Acemoglu, D., Aghion, P., Bursztyn, L., Hemous, D. (2012). The Environment and Directed Technical Change. *Am. Econ. Rev.* 102, 131–166.
- Andersen, J.G. (2014). *Krisens navn: bekæmper regeringen den forkerte økonomiske krise?*, 1. udg., 2. opl. ed. Frydenlund Academic, Frederiksberg.
- Andersen, S.K. and Pedersen, O.K. (Eds.). (2017). *Konkurrencestaten og dens kritikere*, 1. udgave. ed. Jurist- og Økonomforbundets Forlag, København K.
- Anderson, K., Broderick, J.F. Stoddard, I. (2020). A factor of two: how the mitigation plans of 'climate progressive' nations fall far short of Paris-compliant pathways. *Clim. Policy* 20, 1290–1304. <https://doi.org/10.1080/14693062.2020.1728209>
- Balland, P.-A., Broekel, T., Diodato, D., Giuliani, E., Hausmann, R., O'Clery, N., Rigby, D. (2022). The new paradigm of economic complexity. *Res. Policy* 51, 104450. <https://doi.org/10.1016/j.respol.2021.104450>
- Beinhocker, E. (2007). *The Origin Of Wealth: Evolution, Complexity, and the Radical Remaking of Economics*. Random House Business, London.
- BEIS. (2020). *The Green Book*.
- Bennike, C. (2020). *Ove Kaj Pedersen: Vi står i politikens øjeblik. Det er nu, vi kan forme fremtiden*. Information.
- Berg, R.K., Eskildsen, J.B., Hoff, J.V., Jacobsen, J.B., Pedersen, O.G., Rasmussen, M.M.B., Stephensen, P.P., Sørensen, P.B. (2019). Hvordan kan miljø- og klimahensyn integreres i den økonomiske politik? *Politik* 22. <https://doi.org/10.7146/politik.v22i3.117728>
- Blaabjerg, F. and Keiding, S.R. (2021a). Green research infrastructure. *Dfir Brief* 28.
- Blaabjerg, F. and Keiding, S.R. (2021b). Can the Climate Act be carried through by a "green NASA"? *Dfir Brief*.
- Block, F. (2008). Swimming Against the Current: The Rise of a Hidden Developmental State in the United States: *Polit. Soc.* <https://doi.org/10.1177/0032329208318731>
- Block, F.L. and Keller, M.R. (2011). *State of Innovation: The U.S. Government's Role in Technology Development*, 1st edition. ed. Routledge.
- Blyth, M. (2002). *Great Transformations: Economic Ideas and Institutional Change in the Twentieth Century*. Cambridge University Press, New York.
- Bolton, P., Despres, M., Pereira da Silva, L.A., Svartzman, R., Samama, F., Bank for International Settlements. (2020). *The green swan: central banking and financial stability in the age of climate change*.
- Bonvillian, W.B. (2018). DARPA and its ARPA-E and IARPA clones: a unique innovation organization model. *Ind. Corp. Change* 27, 897–914. <https://doi.org/10.1093/icc/dty026>
- Breitinger, J.C., Edler, J., Jackwerth-Rice, T., Lindner, R., Schraad-Tischler, D. (2021). Good practices in mission-oriented innovation strategies and their implementation.
- Campbell, J.L. (2010). *Institutional Reproduction and Change*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199233762.003.0005>
- Campbell, J.L. and Pedersen, O.K. (2014). *The National Origins of Policy Ideas: Knowledge Regimes in the United States, France, Germany, and Denmark*. Princeton University Press, Princeton, New Jersey.
- CAT. (2021). Glasgow's 2030 credibility gap: net zero's lip service to climate action. *Climate Action Tracker*.
- Cerny, P.G. (1997). Paradoxes of the Competition State: The Dynamics of Political Globalization. *Gov. Oppos.* 32, 251–274.
- Cherif, R. and Hasanov, F. (2019). *The Return of the Policy That Shall Not Be Named: Principles of Industrial Policy*. IMF Work. Pap.
- Danish Energy Agency. (2021). *Analysemetoder vedrørende energiøernes økonomi og rentabilitet*.
- Dasgupta, P. (2021). *The economics of biodiversity: the Dasgupta review: full report*, Updated: 18 February 2021. ed. HM Treasury, London.
- DCCC. (2021). *Statusrapport 2021*. Danish Council on Climate Change.

- DEA. (2021). Forskning og innovation målrettet et klima-neutralt Danmark. Tænk tanken DEA.
- DREAM. (2021). GrønREFORM Projektbeskrivelse. DREAM.
- Eidler, J. and Boon, W.P. (2018). 'The next generation of innovation policy: Directionality and the role of demand-oriented instruments'—Introduction to the special section. *Sci. Public Policy* 45, 433–434. <https://doi.org/10.1093/scipol/scy026>
- Geels, F.W., Sovacool, B.K., Schwanen, T., Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. *Science* 357, 1242–1244. <https://doi.org/10.1126/science.aao3760>
- GFN. (2021). Compare Countries - Ecological Footprints of Countries 2017. Global Footprint Network.
- Griffith-Jones, S., Ocampo, J.A., Rezende, F., Schclarek, A., Brei, M. (2020). *The Future of National Development Banks, The Future of National Development Banks*. Oxford University Press.
- Grubb, M., McDowall, W., Drummond, P. (2017). On order and complexity in innovations systems: Conceptual frameworks for policy mixes in sustainability transitions. *Energy Res. Soc. Sci., Policy mixes for energy transitions* 33, 21–34. <https://doi.org/10.1016/j.erss.2017.09.016>
- Grubb, M., Wieners, C., Yang, P. (2021). Modeling myths: On DICE and dynamic realism in integrated assessment models of climate change mitigation. *WIREs Clim. Change* n/a, e698. <https://doi.org/10.1002/wcc.698>
- Haley, B. (2017). Designing the public sector to promote sustainability transitions: Institutional principles and a case study of ARPA-E. *Environ. Innov. Soc. Transit.* 25, 107–121. <https://doi.org/10.1016/j.eist.2017.01.002>
- Hebsgaard, T. (2021). Finansministeriet er ved at blive grønt. Det kan ændre dansk politik for altid. *Zetland*.
- IRENA. (2021). *Renewable Power Generation Costs in 2020*. International Renewable Energy Agency.
- Kalinowski, T. (2021). The politics of climate change in a neo-developmental state: The case of South Korea. *Int. Polit. Sci. Rev.* 42, 48–63. <https://doi.org/10.1177/0192512120924741>
- Karnøe, P. and Garud, R. (2012). Path Creation: Co-creation of Heterogeneous Resources in the Emergence of the Danish Wind Turbine Cluster. *Eur. Plan. Stud.* 20, 733–752. <https://doi.org/10.1080/09654313.2012.667923>
- Kattel, R. and Mazzucato, M. (2018). Mission-oriented innovation policy and dynamic capabilities in the public sector. *Ind. Corp. Change* 27, 787–801. <https://doi.org/10.1093/icc/dty032>
- Kedward, K., Ryan-Collins, J., Chenet, H. (2020). *Managing nature-related financial risks*. UCL Inst. Innov. Public Purp. Work. Pap. 2020.
- KEFM. (2021). *Bekendtgørelse af lov om klima - Klima-, Energi- og Forsyningsministeriet*.
- Ketels, C., Drzeniek Hanouz, M., Hunter, J., Kuhlmann, S., Raven, T., Heringa, P., Gabai, U., Marklund, G., Palmberg, C. (2019). *Peer Review of the Danish R&I System: Ten steps, and a leap forward: Taking Danish innovation to the next level*. Publications Office of the European Union.
- Kim, S.-Y. and Thurbon, E. (2015). Developmental Environmentalism: Explaining South Korea's Ambitious Pursuit of Green Growth. *Polit. Soc.* 43, 213–240. <https://doi.org/10.1177/0032329215571287>
- Kirman, A.P. (2011). *Complex economics: individual and collective rationality*. Routledge, London ; New York, NY.
- KOR. (2022). Er 70 % retfærdigt? Danmarks klimamål i lyset af global retfærdighed. Klima- og Omstillingsrådet.
- Larsen, C.A. and Andersen, J.G. (2009). How New Economic Ideas Changed the Danish Welfare State: The Case of Neoliberal Ideas and Highly Organized Social Democratic Interests. *Governance* 22, 239–261. <https://doi.org/10.1111/j.1468-0491.2009.01434.x>
- Lazonick, W. and Mazzucato, M. (2013). The risk-reward nexus in the innovation-inequality relationship: who takes the risks? Who gets the rewards? *Ind. Corp. Change* 22, 1093–1128. <https://doi.org/10.1093/icc/dtt019>
- Lema, R., Fu, X., Rabellotti, R. (2020). Green windows of opportunity: latecomer development in the age of transformation toward sustainability. *Ind. Corp. Change* 29, 1193–1209. <https://doi.org/10.1093/icc/dtaa044>
- Lenton, T.M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., Schellnhuber, H.J. (2019). Climate tipping points — too risky to bet against. *Nature* 575, 592–595. <https://doi.org/10.1038/d41586-019-03595-0>
- Lund, J.F., Bjørn, A., Simonsen, M.B., Jacobsen, S.G., Blok, A., Jensen, C.L. (2019). Outsourcing og omstilling: de danske drivhusgasudledninger genfortolket. *Samfundsøkonomen* 2019, 15–24.

- Mazzucato, M. (2021). *Mission Economy: A Moonshot Guide to Changing Capitalism*. Penguin.
- Mazzucato, M. (2018). Mission-oriented innovation policies: challenges and opportunities. *Ind. Corp. Change* 27, 803–815. <https://doi.org/10.1093/icc/dty034>
- Mazzucato, M. (2016). From market fixing to market-creating: a new framework for innovation policy. *Ind. Innov.* 23, 140–156. <https://doi.org/10.1080/13662716.2016.1146124>
- Mazzucato, M. (2015). *The green entrepreneurial state*, in: *The Politics of Green Transformations*. Routledge.
- Mazzucato, M. (2013). *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, First Edition edition. ed. Anthem Press, London ; New York.
- Mazzucato, M., Kattel, R., Albala, S., Dibb, G., McPherson, M., Voldsgaard, A. (2020a). *Alternative policy evaluation frameworks and tools: exploratory study* (No. 2020/044), BEIS Research Paper Number. BEIS.
- Mazzucato, M., Kattel, R., Ryan-Collins, J. (2020b). *Challenge-Driven Innovation Policy: Towards a New Policy Toolkit*. *J. Ind. Compet. Trade* 20, 421–437. <https://doi.org/10.1007/s10842-019-00329-w>
- Mercure, J.-F., Knobloch, F., Pollitt, H., Paroussos, L., Scricciu, S.S., Lewney, R. (2019). Modelling innovation and the macroeconomics of low-carbon transitions: theory, perspectives and practical use. *Clim. Policy* 19, 1019–1037. <https://doi.org/10.1080/14693062.2019.1617665>
- Mercure, J.-F., Sharpe, S., Vinuales, J.E., Ives, M., Grubb, M., Lam, A., Drummond, P., Pollitt, H., Knobloch, F., Nijse, F.J.M.M. (2021). Risk-opportunity analysis for transformative policy design and appraisal. *Glob. Environ. Change* 70, 102359. <https://doi.org/10.1016/j.gloenvcha.2021.102359>
- MoF. (2017). *Vejledning i samfundsøkonomiske konsekvensvurderinger*. Ministry of Finance.
- Nahm, J. (2021). *Collaborative advantage: forging green industries in the new global economy*, 1 Edition. ed. Oxford University Press, New York.
- Nahm, J. (2017). Renewable futures and industrial legacies: Wind and solar sectors in China, Germany, and the United States. *Bus. Polit.* 19, 68–106. <https://doi.org/10.1017/bap.2016.5>
- Nemet, G.F. (2019). *How solar energy became cheap: a model for low-carbon innovation*. Routledge, Taylor & Francis Group, London ; New York, NY.
- Nielsen, J., Freja Englund. (2021). *Forskning, uddannelse og kredit kan øge den grønne innovation*. AE-Rådet.
- Nielsen, S.W. (2021). *Entrepreneurstaten: hvorfor vælgernes ønsker forsvinder op i den blå luft - og hvordan vi fikser det*. Gads forlag, København.
- OECD. (2017). *Debate the Issues: Complexity and Policy making*, OECD Insights. OECD. <https://doi.org/10.1787/9789264271531-en>
- Ørsted. (2019). *Making green energy affordable: How the offshore wind energy industry matured – and what we can learn from it*.
- Pedersen, O.K. (2019). *Reaktionens tid: konkurrencestaten mellem reaktion og reform*, 1. udgave. ed. Informations Forlag, København.
- Pedersen, O.K. (2011). *Konkurrencestaten*, 1. udg. ed, Samfund i forandring. Hans Reitzels forlag, København.
- Perez, C. (2002). *Technological revolutions and financial capital: the dynamics of bubbles and golden ages*. E. Elgar Pub, Cheltenham, UK ; Northampton, MA, USA.
- Rechsteiner, R. (2021). German energy transition (Energiewende) and what politicians can learn for environmental and climate policy. *Clean Technol. Environ. Policy* 23, 305–342. <https://doi.org/10.1007/s10098-020-01939-3>
- Rodrik, D. (2014). Green industrial policy. *Oxf. Rev. Econ. Policy* 30, 469–491. <https://doi.org/10.1093/oxrep/gru025>
- Rosenbloom, D., Markard, J., Geels, F.W., Fuentschilling, L. (2020). Opinion: Why carbon pricing is not sufficient to mitigate climate change—and how “sustainability transition policy” can help. *Proc. Natl. Acad. Sci.* 117, 8664–8668. <https://doi.org/10.1073/pnas.2004093117>
- Rüdiger, M. (2019). *Oliekrisen, 100 danmarkshistorier*. Aarhus Universitetsforlag, Aarhus.
- Sovacool, B.K. (2013). Energy policymaking in Denmark: Implications for global energy security and sustainability. *Energy Policy* 61, 829–839. <https://doi.org/10.1016/j.enpol.2013.06.106>
- Stubager, R. and Møller Hansen, K. (2021). *Klimavalget: folketingsvalget 2019*. Djøf, Kbh.

- Tilsted, J.P., Bjørn, A., Majeau-Bettez, G., Lund, J.F. (2021). Accounting matters: Revisiting claims of decoupling and genuine green growth in Nordic countries. *Ecol. Econ.* 187, 107101. <https://doi.org/10.1016/j.ecolecon.2021.107101>
- Tilsted, J.P., Luscombe, P.K., Fuglsang, N. (2020). Finansministeriet som vagt- og overhund | *Samfundsøkonomen*. *Samfundsøkonomen*.
- Tollefson, J. (2021). The rise of 'ARPA-everything' and what it means for science. *Nat. News*.
- UFM. (2020). Regeringens forslag til missioner i 2021. Uddannelses- og Forskningsministeriet.
- Vækstfonden. (2021). From startup to scale-up: Status on the capital market for Danish entrepreneurs and growth companies, 2021H1. *Vækstfonden*.
- Voldsgaard, A. and Højmark, E. (2021). Jobgaranti-reform: Potentialer og udfordringer i en dansk kontekst. *Samfundsøkonomen* 2021, 62–77.
- Voldsgaard, A., Rüdiger, M. (2021). Innovative Enterprise, Industrial Ecosystems and Sustainable Transition: The Case of Transforming DONG Energy to Ørsted, in: Lackner, M., Sajjadi, B., Chen, W.-Y. (Eds.), *Handbook of Climate Change Mitigation and Adaptation*. Springer New York, New York, NY, pp. 1–52. https://doi.org/10.1007/978-1-4614-6431-0_160-1
- Weiss, L. (2014). *America Inc.?: Innovation and Enterprise in the National Security State*, America Inc.? Cornell University Press. <https://doi.org/10.7591/9780801471131>
- Weiss, L., Thurbon, E. (2021). Developmental State or Economic Statecraft? Where, Why and How the Difference Matters. *New Polit. Econ.* 26, 472–489. <https://doi.org/10.1080/13563467.2020.1766431>
- Willig, R., Blok, A. (2021). *Den bæredygtige stat*. Hans Reitzel, Kbh.

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