FORUM FOR A NEW ECONOMY

NO. 01
2025

Working Papers

Beyond externalities - a new framework for climate policies

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Abstract

Building on previous discussions and research facilitated by the Forum New Economy, this paper lays out the economic rationale behind approaching climate policy beyond a focus on externalities and discusses the synthesis of strategic investment support, positive incentives, and carbon pricing to design effective policy mixes. Traditional climate economics have assumed that the climate crisis can be solved by using an environmental pollution framework, to which the classic policy response is a form of carbon tax. However, addressing the climate crisis differs fundamentally from a pollution problem and requires the transformation of several major economic sectors so that carbon emissions collapse.
Key to such a systemic transformation is sustainable energy production, and the electrification of other key sectors. This changes the policy handbook: to accelerate investment spending in clean energy technologies, we need policies that address the cost of capital and the return on capital, while also reducing financial risks. Alongside this, to induce changes in consumption, it is essential to target the price elasticity of demand by creating near-perfect low-carbon alternatives, including by accelerating innovation and low-carbon infrastructure.

What does this mean for the practical design of climate policy mixes? In reality, finance is not neutral, and to support strategic investment in green energy technologies, financial de-risking policies and policies addressing revenue risks play a vital role. To help decarbonise consumption patterns and promote electrification and low-carbon alternatives in the rest of the economy, deploying Targeted Positive Incentives, i.e., policies that make sustainable choices cheaper, easier, and more attractive, is essential, especially in cases that involve high upfront capital expenditure. Carbon prices play a critical role as a signal in favour of sustainable substitutes and can also serve as a revenue-raising tool during transition periods. However, a broader understanding of the economics of price elasticity suggests that sequencing carbon prices with other policies can significantly enhance their effectiveness.

One of the key complementary factors that can either support or hinder the implementation of climate and energy policy is Political Economy, i.e., the ideas and public perceptions, interests, and power dynamics that influence policymaking. What are the main challenges in current narratives around climate policy and cleantech – such as the widespread perception of it as a burden for consumers and businesses? And what strategies would help make the political economy of climate policy more conducive to ambitious and socially accepted transformation?

JEL Codes: Q58, L52, P48, E61

Keywords: Climate policy; Climate economics; Energy transition; Policy mix; Industrial policy; Political Economy

CONTENT

1. INTRODUCTION

While climate policy frameworks employ a variety of instruments, many economists continue to regard carbon pricing as the 'first-best' option - a view that has significantly influenced policymakers. Its revenue-generating potential, short-term cost-efficiency, technology neutrality, and ability to hold polluters financially accountable have made carbon pricing a central feature of many policy mixes and debates, particularly in Europe.

This perspective has come under increasing criticism, particularly for the limited ability of carbon pricing to drive behavioural change, foster disruptive innovation, or support large-scale infrastructure investment. Concerns have also been raised about historically low or volatile carbon prices and negative distributional impacts, and carbon pricing has proved politically problematic in many countries.

As an alternative, critics have advocated for the use of positive instead of negative market incentives, as well as public investment in infrastructure, to leverage technology diffusion, overcome political economy constraints, and enable transformative change towards a low-carbon economy. The New Economy Forum paper 'A positive approach to climate policy: What are preliminary lessons learnt from the US Inflation Reduction Act?' (Wedl & Fricke, 2025) emphasized the opportunities and advantages of an industrial policy approach to climate policy, illustrated by the cleantech investment boom triggered by the Inflation Reduction Act (IRA).

This paper moves beyond the either/or framing of carbon pricing versus positive incentives and focuses on the key question of what kind of policy mixes and sequencing would be most effective in delivering climate goals, combining both economic efficiency and political feasibility. The view that effective climate policy requires a smart combination of different instruments was one of the key points emerging from a discussion on ‘Modern Climate Policy’ at the Berlin Summit 2024.

While there was a consensus that carbon pricing alone will not generate the necessary momentum for a green transition, it still has a role to play. We argue that, in many contexts, a policy sequence that uses positive incentives to enable clean technology deployment and makes affordable low-carbon alternatives available at scale can facilitate both the effectiveness and feasibility of carbon pricing, and reduce the costs associated with a high carbon price.

A draft of this paper was presented at the Berlin Summit 2025, and we incorporated important discussion points that emerged during the session as well as feedback from conference participants.

2. THE DOMINANT PARADIGM AND ITS SHORTCOMINGS

Economic thinking on climate change policy has been overwhelmingly shaped by the concept of externalities (Economist, 2022). This framework is most prominently articulated by Nobel Prize winner William Nordhaus. In “The Climate Casino” (pp18-19), Nordhaus spells it out (Nordhaus, 2013):

“The economics of climate change is straightforward. Virtually everything we do involves, directly or indirectly, the combustion of fossil fuels, which has resulted in emissions of carbon dioxide in the atmosphere. […] The problem is that those who produce the emissions do not pay for that privilege, and those who are harmed are not compensated. […] Economists call such costs externalities because they are external to (i.e., not reflected in), market transactions or prices. An externality is a by-product of economic activity that causes damage to innocent bystanders. These are also called public goods in the economics literature …”

The standard prescription to impose a tax or quota equivalent to the estimated damage (the "social cost of carbon") to internalise this externality and correct the market failure has become deeply embedded, influencing policy instruments like carbon taxes[1] and cap-and-trade systems. This framing continues to have significant implications for public debate and the political economy of climate change, despite the political obstacles evident from more than three decades of such advocacy, and most dedicated policymakers within the field espousing much more nuanced and sophisticated policy approaches.

[1] Throughout this paper, we use the terms ‘carbon tax’ and ‘carbon price’ synonymously for any carbon pricing policies.

Broadening the economic framework to match the practical challenges of achieving net-zero

When confronting the practical challenges of net-zero policies, the theory of externalities is not so much incorrect but is inadequate, and risks being unhelpful when it becomes the focal point. The limitations relate to three practical observations:

A. **Structural change towards sustainable electricity & electrification requires accelerated investment in new technologies.** The core of any successful path to net zero is sustainable electricity and the electrification of transport, buildings and manufacturing. Electrification of these sectors, and provision of clean electricity is estimated to reduce emissions by approximately 75% (House of Commons Library, 2024). Sustainable electricity is mission-critical and typically involves regulated utilities (at least, for the networks), and (in Europe) short-run spot markets based on operating cost, not investment. No chapter of any economics book on utility regulation would start a plan to accelerate investment spending in newer technologies with a tax on legacy assets. Accelerating investment in regulated utilities typically focuses on regulatory design and targeting the cost of capital. Given the relatively high and often dominant role that capital costs play in the levelized costs of sustainable power generation, this focus is even more paramount (Wilson et al, 2024).

B. **Innovation in both production and demand is vital.** Economics typically acknowledges a valuable role for innovation – a need which is even greater faced with the need for major change – but economies typically under-invest in innovation for multiple reasons (including spillovers, coordination challenges, and more). Innovation is about far more than just R&D – indeed, important innovations and cost reduction typically are associated with economies of scale, learning-by-doing, and multiple other factors associated with deployment as outlined below.

C. **Price inelasticity impedes necessary behaviour change.** Many emission-intensive goods and services suffer from high price inelasticity (Rosen, 2021). By definition, this implies that consumers and industries are more likely to absorb the added cost of a carbon price, without substantially altering their behavioural responses. The price inelasticity of demand straightforwardly explains many of the problems facing net-zero policies, from regressive tax effects on consumers to political resistance to regulatory gaming of pricing regimes. The scale of transition required demands major changes in purchase choices or other behaviour, not a response driven by marginal price changes, given current technologies and systems.

D. Near-perfect substitutes are needed to alter price elasticity. Economics tells us that altering price elasticity requires the creation of substitutes. High price elasticity is largely a function of the existence of near-perfect substitutes. Any carbon tax policy can only be effective if the conditions exist, or are created, for people to move to low-carbon substitutes. A tax will then raise very little revenue and have a substantial impact on behaviour, particularly if it alters relative prices firmly in favour of low-carbon substitutes.

These observations about which aspects of economic theory are most helpful in framing decarbonisation policies are too easily dismissed as trivial. This reflects in part limited economic theories of innovation & technology, and infrastructure cost reduction, as well as the real drivers of consumer choices.

Implications for the sequencing of climate policies

Clarity on the economics significantly alters one's perspective on policy appropriateness and sequencing. Initiating the decarbonisation of the transport sector by taxing fuel, for instance, has a limited impact on driving habits if viable electric vehicles (EVs) are not yet a competitive alternative, and underinvestment in charging infrastructure does not make them close substitutes. Similarly, industries like cement and steel, where carbon-intensive processes are essential and there is little incentive to invest in alternatives, often exhibit low price elasticity, so carbon costs are simply passed on, or (if constrained by international competition) absorbed in ways which reduce rather than increase capacity to invest in new technologies

Prioritising carbon prices also creates high political costs, which have often made them self-defeating. Carbon taxes are often regressive, disproportionately affecting lower-income households, making them politically contentious and vulnerable to demonisation. This frequently results in taxes being set at levels too low to drive significant emissions reductions, or in policy instability that undermines long-term investment.

In areas where behaviour change is more intransigent – such as food consumption or retrofitting of property – evidence suggests that Targeted Positive Incentives (see section 4) are required. Sequencing these policies ahead of carbon taxation and pricing is not just more likely to deliver results but dramatically alter public perceptions and the political economy of climate change.

3. SUPPORTING STRATEGIC INVESTMENT BY TARGETING THE COST OF CAPITAL

A rapid transition to sustainable electricity generation, coupled with the widespread electrification of end uses like transport, heating, and industrial processes, forms the indispensable core of any credible decarbonisation strategy. This requires strategic investment in clean energy and other low-carbon technologies. Innovation is an important dimension of this, but it is vital to recognize that strategic investment refers to far more than 'just' R&D: it also includes various processes that reduce the costs of new technologies (see list below).

While private R&D in the electric sector was – until the early 2000s – exceptionally low, the economics of the energy transition have become increasingly favourable because the costs of key renewable energy technologies, particularly solar photovoltaics (PV) and wind power, have fallen dramatically over the past two decades. The renewable revolution was built on early foundations of public R&D, but in practice only emerged as a result of multiple other instruments that supported innovation through multiple iterations of cost reductions – such as in the case of solar PV (Nemet, 2019); a study of offshore wind identifies **four main cost-reduction processes** (Jennings et al., 2020):

- Private R&D stimulated by the prospect of large, government-backed deployment
- Learning-by-doing, from earlier and less successful designs
- Economies of scale at all stages, from turbine size through to the scale of factories and supply chain development
- Reductions in financing costs as experience and confidence grew

Economically, these factors are reflected as *market-induced innovation* – innovation which is not driven by public R&D expenditure but is driven largely by private sector responses to expectations and incentives which foster learning, scale, and industrial and financial development.

Policies driving capital cost reduction in green innovation

The specific policies that drove these trends can be broadly grouped into three main categories:

A. **Loan guarantees and targeted (concessional) lending:** Public finance institutions can play a vital role in lowering capital costs. The most famous example of scale is the role of the Chinese central bank in providing low-interest loans for renewables. As part of an international strategy, Export Credit Agencies (ECAs) can provide guarantees or concessional finance to unlock investment in renewable projects in developing countries, where financing costs can be a major barrier (UK Export Finance, 2024). This could be a powerful win-win strategy in the current political environment, where the case for decarbonisation in industrialised countries is undermined by perceptions of increased carbon emissions coming from the global South.

B. **Grants and fiscal instruments**. Direct financial support in the form of grants or subsidies, and fiscal instruments, such as tax credits, directly lower financing costs of investment projects but also indirectly reduce the effective cost of capital by increasing expected returns. These instruments have, for instance, been used extensively in the US Inflation Reduction Act. The policy package included not just tax credits for the investment in clean electricity generation and related manufacturing but also applied this instrument to the production of electricity from renewables and of necessary components.

C. **Financial de-risking policies addressing revenue volatility, risk asymmetry and structural uncertainty:** In competitive electricity markets, renewables are primarily price-takers because they are cheaper to run than fossil fuels; the latter then set the wholesale price. This creates a particular risk for renewables investors: the revenues are uncertain, in ways that depend on the vagaries of volatile fossil fuel and carbon markets - whilst fossil fuel investors are self-hedged since they set the price. Risk structures in electricity markets are thus intrinsically biased in favour of fossil fuels and against clean energy. Dependence on wholesale revenues thus creates a high cost-of-capital for renewables investors, which is all the more crippling given they are essentially asset investments, with almost zero running costs. Consequently, the cost of capital can be reduced substantially by de-risking electricity prices. Evidence from the UK's Contracts for Difference (CfDs) scheme provides a powerful example. By guaranteeing a fixed price (strike price) for renewable electricity generated, CfDs provide long-term revenue certainty for developers. When wholesale market prices exceed the strike price, generators pay back the difference, protecting consumers from excessive costs. The resulting lower financing costs have been instrumental in driving the UK's world-leading offshore wind deployment; an estimate from the 'natural experiment' of their introduction alongside the previous support mechanism is that the move to CfDs saved the UK around £2bn per year in the cost of its offshore wind programme (Grubb and Newbery, 2018). This focus on revenue stability directly addresses the primary concern of investors in large-scale energy projects.

At present, there remains some debate in the EU about appropriate instruments for sustaining the electricity transition. Whilst recognising the value of fixed-price contracts in reducing investment costs, some suggest that the same could be achieved through 'encouraging' private Power Purchase Agreements (PPAs). However, the appetite of private consumer companies to strike sufficiently long-term contracts is limited; many such contracts in fact still have clauses linking to the wholesale price; the cost is increased since both parties face elements of counterparty risks; and PPAs cannot secure the benefits of aggregation across diverse renewables and consumer profits, that the wholesale market represents. PPAs may be a useful way to engage the consumer side, but there is no evidence that they can realistically supplant CfDs as the major engine of low-cost renewables investments, particularly for larger assets like big windfarms.

Whilst the specific instruments may vary, the general lesson for other sectors from the success with renewables is the need to prioritise policies which can establish low-carbon technologies at scale, including by targeting the cost-of-capital. This could, for example, also be achieved through green public procurement schemes that provide revenue certainty for investors.

The post-Ukraine war experience underscores the centrality of capital and related financing costs. Even with rising carbon prices, higher interest rates and inflation derailed many renewable energy projects. In the US and UK, multiple offshore wind projects were cancelled over the past few years because soaring debt costs rendered them unviable – even though strategically, they would be an obvious response to enhancing energy security.

In addition to financing, regulatory certainty and appropriate market design are crucial: governments should provide clear long-term policy signals, including timelines for phasing out approvals for new unabated fossil fuel generation. Significant investment is needed in grid infrastructure, including transmission lines, interconnectors, and distribution network upgrades, to accommodate high shares of variable renewables like wind and solar, with a clear role for government in coordination of transmission and generation. Market rules must also be adapted to value flexibility and ensure efficient integration.

4. CREATING SUBSTITUTES AND DEPLOYING TARGETED POSITIVE INCENTIVES

The shift to sustainable electricity generation is fundamental, but achieving deep decarbonisation requires significant changes in consumer and corporate choices, particularly in transport, buildings, and food. For goods with inelastic demand or where low-carbon alternatives involve high upfront costs (like EVs or heat pumps), politically tolerable price signals from a carbon tax are unlikely to drive rapid change. Currently available sustainable options may also entail significant inconvenience, a shift in cultural norms, or a significant capital cost. People do not operate as *homo economicus* but are creatures of habit and have a tendency towards preferring the known, familiar technologies and practices, often influenced by subconscious cues, or not fully considering the implications of alternative choices and therefore missing out on better or cheaper options (Grubb et al, 2023). A small financial incentive – for example in retrofitting residential property – is unlikely to offset significant inconvenience. Instead, the key is to create affordable and attractive low-carbon substitutes.

Targeted Positive Incentives in practice

Targeted Positive Incentives offer a more direct and potent approach to changing consumer behaviour (Lonergan and Sawers, 2022). By making sustainable choices cheaper, easier, and more attractive, they aim to trigger rapid market transformation. This often involves creating a relative price advantage for the green alternative, or at least parity, where alternatives offer significant nonmonetary benefits. Contrasting approaches toward transport are revealing. The UK has very high fuel taxes by global standards, but very modest electric vehicle penetration. Taxing fuel does not target the relative price of a substitute: without good zero-carbon alternatives to petrol or gas, petrol use is price inelastic. By contrast, Norway and China have had astonishing success in electrifying the auto market by using a relative price strategy targeting the price of the capital good – the vehicle – and ensuring adequate infrastructure. Norway implemented a suite of powerful positive incentives for EVs starting in the 1990s (Sharpe & Lenton, 2021), including: exemption from vehicle import taxes and 25% VAT; significantly reduced or waived road tolls, ferry charges, and public parking fees; and access to bus lanes in congested areas. These financial and convenience benefits were coupled with substantial investment in public charging infrastructure, addressing range anxiety and creating a near-perfect substitute. The strategy effectively eliminated the upfront cost disadvantage of EVs and added significant user benefits. As a result, EVs captured around 90% of new car sales by the early 2020s, and also now dominate in China.

This success demonstrates the power of creating near-perfect substitutes and then targeting relative prices in influencing consumer choices. Most importantly, Norway used tax exemptions to ensure the list price of electric cars was below that of the fossil fuel alternative. As EV technology matured and costs fell, Norway began phasing out some of the most generous incentives, demonstrating that Targeted Positive Incentives can act as powerful catalysts that need not be permanent.

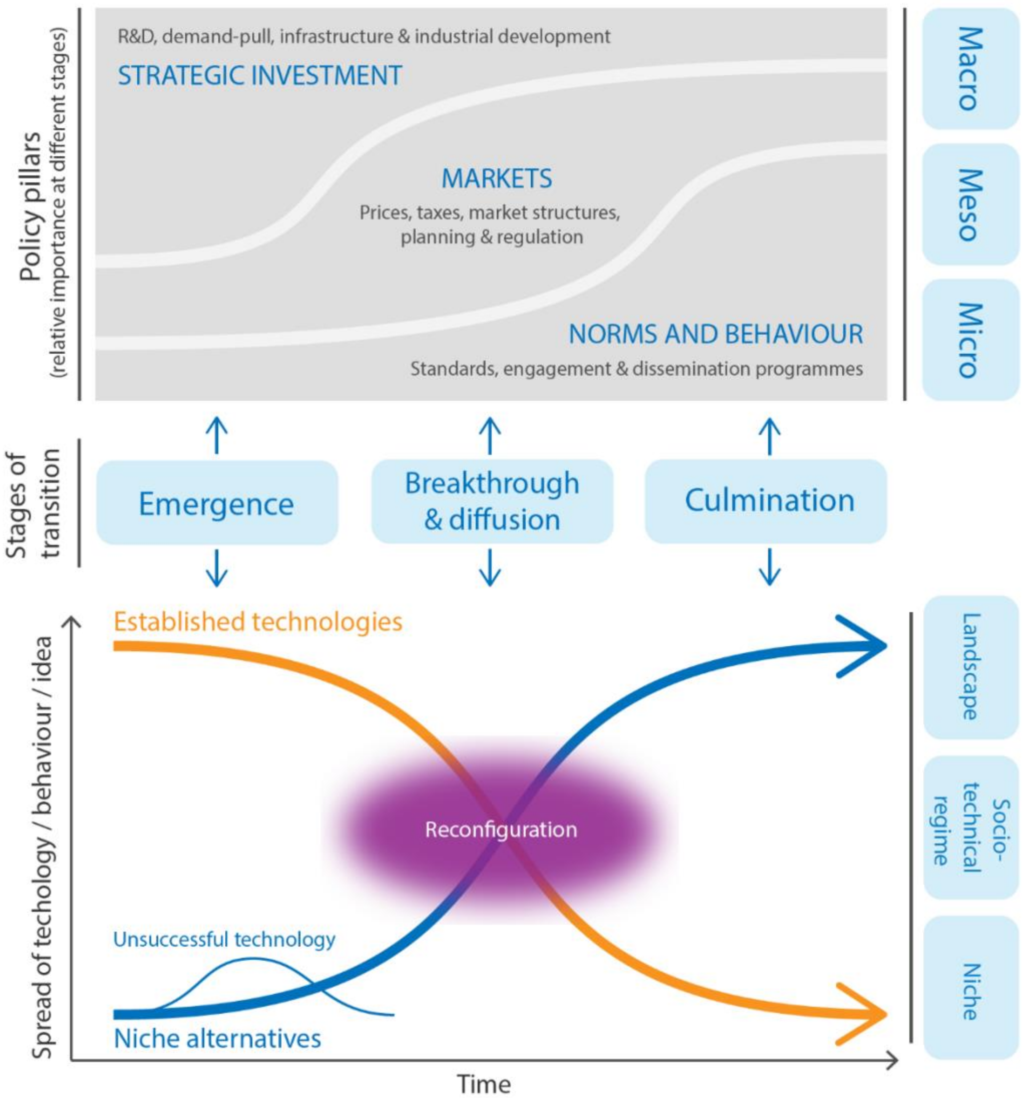
Another example is residential energy efficiency: The Residential Energy Efficiency & Electrification programme in the US Inflation Reduction Act (IRA) incorporates Targeted Positive Incentives principles for home energy upgrades. Programs like the High-Efficiency Electric Home Rebate Program offer substantial point-of-sale rebates (up to 100% of costs for low-income households, capped at $14,000) for installing heat pumps, upgrading electrical panels, and improving insulation and air sealing. The revamped 25C tax credit provides a 30% credit (up to $2,000 annually for heat pumps) on efficiency investments. These measures directly reduce the significant upfront cost barrier for homeowners, accelerating the adoption of efficient electric heating and improved building envelopes. The significant uptake, with 3.4 million households claiming credits, points to the effectiveness of such direct financial support (US Treasury, 2024).

The principle can be applied elsewhere. Policy should be focused, sector-by-sector, on the relative price of substitutes. In simple form: accelerate processes that make the green option cheaper. Significant subsidies could make plant-based meat alternatives significantly cheaper than conventional meat, driving dietary shifts, or make low-carbon building materials like green cement or steel substantially more cost-effective. As part of this broader approach, carbon prices can help to bridge any remaining cost gap or otherwise accelerate the adoption of clean technology.

5. POLICY SEQUENCING AND THE ROLE OF CARBON PRICING

The need for a combination of different types of policies was emphasised across many chapters in the IPCC's Sixth Assessment Report on Mitigation – and especially, the sectoral chapters which drew on the realities of transition in key sectors. Figure 1 shows how the IPCC report suggested thinking about the dynamics of transition (lower panel) and associated main categories of policies with a generalised indication of how their relative importance might evolve over time (upper panel).

Figure 1: The dynamics of transition and associated main categories of policies over time



Source: (IPCC, 2022), Chapter 1 Figure 6.

Carbon taxes will always play a critical role within that policy mix. First, as an incentive to switch to lower-carbon options where price elasticity is already high, e.g., encouraging the switch from coal-fired to gas-based power generation. Second, carbon prices can prevent backsliding to carbon-intensive options, once targeted positive incentives have successfully helped to create near-perfect, affordable low-carbon alternatives. By increasing the relative price advantage of green technologies, they function as a phase-out signal for incumbent technologies and allow targeted support to be removed more quickly as cost reductions of new technologies continue. Third, carbon prices can potentially be used as a revenue-raising device to finance support policies during transition periods. Ensuring that consumers are aware of how this revenue is applied is essential for building trust and mitigating potential political-economy challenges. Finally, the ability of carbon pricing to drive incremental innovation can be leveraged in industries where more radical solutions are not yet viable, such as in the cement industry (Grubb et al, 2023).

Benefits-to-costs policy sequence

A broader perspective on the economics of price elasticity suggests that the effectiveness of carbon taxes and pricing schemes will depend on their sequencing with respect to other policies that rapidly reduce the cost of technologies required for emissions reductions in sectors and contexts where price elasticity is low.

Policy sequencing 'from benefits to costs' also helps to overcome major political challenges by increasing political acceptance of climate policies and building interest groups that support decarbonization policies, including carbon pricing. In particular, technology cost reductions induced by support policies, e.g., in the case of solar energy, lower the opposition to climate policy from energy consumers such as households and energy-intensive manufacturers (Meckling, 2017).

Despite the prevailing economic policy advice to prioritize carbon pricing, we have seen a version of this policy sequence being applied in in the power sector in various world regions: In the EU, California, and China, various targeted support policies predated direct carbon pricing, creating more favourable market conditions for renewable technologies (Meckling, 2017; Grubb et al, 2023).

Countries have varied in the nature and extent of such sequencing – which in some cases was driven more by political feasibility than by an underlying economic understanding. Indeed, some of the policies that have proven most effective (with hindsight) were adopted 'despite, not because of, the prevailing economic advice'; coherent and enduring policy would be enhanced if set in such a broadened economic understanding of the real economic dynamics of energy transition (Grubb et al, 2021).

6. ADDRESSING POLITICAL ECONOMY CHALLENGES

Public narratives keep linking decarbonization to economic hardship and underestimating opportunities and benefits

Public narratives around climate policy often reflect an assumption that climate action comes at the expense of economic well-being. In the media, this shows up in different variations of the 'economic hardship narrative': that while elites push their vision of a net-zero future, ordinary people face job losses, unaffordable bills, and rising economic insecurity - and companies risk going out of business as the state overreaches into markets. Overall, climate policy is perceived as costly and as requiring sacrifice. These frames partly reflect how traditional economic paradigms that assume a trade-off between emission reduction measures and current living standards have shaped public perception. They also benefit those who have an interest in maintaining the status quo by portraying climate policy as being out-of-touch, anti-growth, or anti-worker.

On the other hand, scientific language, warnings of ecological catastrophe, and command-and-control messaging, which are often used by climate proponents themselves, might feel distant, abstract, and disconnected from people's lived experiences and the pressures they face.

Establishing a shared narrative and communicating it in ways that foster common ground across diverse segments of society could significantly enhance public support and the political viability of climate policy frameworks. If there is one lesson to be drawn from successful populist movements, it is that people respond to language they can relate to, and to messages that speak directly to their lived concerns.

There are mainly two positive frames of climate policy being discussed in this context: a) shifting the narrative from scarcity and sacrifice to opportunity and prosperity, and b) focusing on the contribution of the energy transition to safety and resilience in a more volatile world, where defence has returned to the centre of national agendas.

Renewables are driving down electricity prices – with benefits for competitiveness and defence

Consider energy costs, in particular: There is still a pervasive misconception that switching to clean energy is costly and means sacrifices. In reality, renewables not only helped to mitigate the most severe impacts of the 2022 energy price shock, but also the energy transition itself can be a significant driver of a durable reduction in wholesale electricity prices in the future. Some clean technologies, solar PV in particular, are already cheaper than fossil fuels in many situations, and the falling demand for gas due to a higher share of renewables in the energy mix will lower wholesale gas prices, also reducing consumer energy bills.

Similarly, the electrification of end-uses typically comes with built-in energy efficiency gains. Fossil fuels tend to have large end-use conversion losses in comparison to electricity, i.e., significantly more final energy is required to obtain a given amount of useful energy. Switching to energy carriers with higher conversion efficiencies (e.g., moving to EVs) significantly reduces final energy consumption.

These efficiency gains and price advantages will not just affect energy security but also countries' competitiveness, in particular in using electrified defence logistics and taking a leadership role in

Artificial Intelligence research and deployment, which require high amounts of electricity. In general, the high cost of energy has been a major brake on the competitiveness of European businesses, since their competitors in the US and China enjoy substantially lower prices (Tordoir et al, 2024).

One example, where the benefits of renewables for economic competitiveness are starting to be realized, is South Australia, which has an advanced renewable grid with a 74 % share of wind and solar (and on track to meet its target of 100 % net renewables by 2027). According to a report by Renew Economy (2025), a large number of companies – the combined electricity demand of which would amount to 15 GW - have recently expressed interest in setting up a major business in the state, specifically due to the opportunity to source low-cost solar and wind electricity (Rethinkx, 2025).

Empirical evidence shows that, for decades, projections made by standard economic models (Integrated assessment models), which are used to inform global and domestic climate policy, have badly overestimated future costs of clean energy technologies. The real cost of solar energy, for example, dropped twice as fast as the most ambitious and optimistic projections in major energy-economy models: While mainstream models projected average investment cost reductions of 2.6% per year between 2010 and 2020, solar PV costs actually fell by 15% per year (Way et al, 2022).

The reason for this extreme gap between projections and reality is that rates of improvement for most clean energy technologies are different from incumbent fossil fuel technologies: For the latter, costs have remained roughly constant through time because technological progress is balanced out by resources becoming less accessible as they are depleted. By contrast, technologies such as solar PV, batteries, and transistors have high rates of improvement, where costs have dropped roughly exponentially while deployment has increased exponentially, reflecting the broad processes of induced innovation. Cost forecasting methods that take this difference into account to estimate future energy system costs depending on deployment are thus more relevant and useful for planning the energy transition.

Changes in electricity market structures are required to make cost benefits more tangible

To help embed the cost advantage of renewables in public perceptions, it must become directly tangible for citizens. In many regions, the sharp rise in energy bills following the invasion of Ukraine has been driven primarily by higher and more volatile gas prices. Gas continues to influence electricity and heating costs significantly, both because of its price-setting role in energy markets and its use as an industrial feedstock. The structure of electricity markets, i.e., short-term marginal pricing and risk-based premium pricing in wholesale electricity markets, currently prevents consumers from accessing grid-based renewables on terms which reflect the cheaper or more stable generating costs.

Structural solutions are required to separate the average electricity price from the cost of gas and facilitate consumer access to such prices.

In the long run, this could look like further developing tradeable long-term contracts which deliver a fixed price of electricity over a fixed time horizon. The Draghi report suggests expanding the use of long-term contracts for electricity and facilitating their uptake through government guarantees (Tordoir et al, 2024). The immediate opportunity is to explore ways in which at least the most vulnerable business and consumer groups can better gain direct access to cheap renewable energy. This could be enabled by designing a 'green power pool' scheme – which would pool the electricity from renewables already operating on government-backed fixed prices (such as the 'contracts for difference' (CfDs) mentioned above) and make it available to the priority groups (Grubb et al, 2022).

While deeply entrenched narratives take time to change, linking low-carbon alternatives to socioeconomic benefits has the potential to shift public perception towards climate policy as an economic opportunity. Beneficiaries who have been enabled to change their consumption choices towards low-carbon alternatives will also be more likely to support follow-up policies like strengthened regulation or the pricing of carbon-intensive options.

Misperceptions about the cost implications of supporting renewable energy deployment and electrification also persist among policymakers. Finance Departments, in particular, may dismiss policy proposals that emphasize tax incentives or public infrastructure investments as too expensive and prefer to rely on carbon pricing as the more cost-efficient option. However, overfocusing on the lowest-cost abatement opportunities in the short term can unintentionally lock in carbon-intensive technologies and cause inefficiencies in the longer term. In fact, research shows that from a total cost perspective over the time horizon until 2050, it can be more efficient to focus on implementing the more long-lived abatement measures, even if more expensive, before the cheapest (Vogt-Schilb et al, 2018).

7. FISCAL COSTS: FICTION AND REALITY

In the same way that the theory of externalities has oversimplified the economics of climate policy, so too has our analytical framework for understanding fiscal costs. In considering the 'costs' of climate change policies, very diverse consequences for the public sector balance sheet (the stock of assets and liabilities owned by the state) and fiscal balance (the difference between government taxes and revenues) are frequently conflated. For example, the highly influential McKinsey Global Institute study (McKinsey, 2022) led with the headline that the transition to net zero would 'cost an additional $3.5 trillion annually'. The media coverage seized on this headline, and the BBC quoted a climate economist as follows: “Where is the money coming from? Ratepayers, taxpayers or shareholders?” (BBC, 2022). ‘Cost’ in this context seems to be used synonymously with ‘spending’, implying that policies to achieve net zero will impose an astronomical burden on taxpayers and businesses.

Untangling the notion of ‘cost’ through policies’ actual fiscal implications

In assessing the consequences of different climate policies for the public sector balance sheet and fiscal balance, it becomes clear that the catch-all concept of ‘cost’ is too broad and frequently misleading.

Two very different ‘costs’ are frequently conflated: On the one hand, cash transfer payments to consumers incentivising behavioural change, for example, a subsidy providing direct cash transfers to households installing heat pumps or non-income generating grants to the corporate sector, need to be funded with taxes or debt issuances. It seems appropriate to consider these ‘subsidies’ or fiscal ‘costs’, as the fiscal burden is real - even if there are spillover effects which may render the policies desirable. On the other hand, policy interventions like equity co-investments, lending or credit insurance are manifestly different in their fiscal consequences, as they may, in fact, have net gains through time to the public sector as they create modest income streams and assets for the state. For example, although creating contingent liabilities, credit guarantees in the renewable electricity sector may create a positive income stream – in the same way that some public sector banks and credit agencies do (UK Export Credit, 2025; KfW Reporting, 2023).

Furthermore, there is a powerful case for the state providing insurance against volatile electricity prices, through interventions such as CfDs. While the economy as a whole benefits from lower electricity prices, private providers of electricity see them as a risk. Policy intervention that provides insurance to the private sector against falling prices is likely welfare-enhancing, particularly because it lowers the cost of capital, which is the critical variable in the levelized cost of renewables. This makes this kind of policy potentially a win-win intervention.

Fiscal rules are also sensitive to these distinctions. Under the fiscal rules in many jurisdictions, intervention in credit markets along these lines is not considered government borrowing.

Thus, Targeted Positive Incentive policies – if well designed – can minimise fiscal consequences and produce significant economic benefits, particularly when applied to areas where private credit markets have tried and failed to find solutions. Green Mortgages, loans or hire-purchase agreements for electric vehicles, green export credit and other state lending programmes do not necessitate any fiscal cost for taxpayers and, if well designed and executed, may well result in a stronger state balance sheet.

These conceptual distinctions are extremely important to differentiating between policy choices and changing the nature of the political debate. If the case for sustainable electricity is purely about climate change, many parts of the political spectrum will argue it is a waste of money given accelerating emissions in economies like China or India – this is already a repeated line of attack in the UK's political discourse. On the other hand, if the argument is that we are creating assets to reduce the cost and volatility of electricity prices and raise growth rates, the burden of proof is on opponents.

In summary, we need to abandon estimates of catch-all 'costs' and the unhelpful description of all interventions as 'subsidies' when many may be efficiency or welfare-enhancing, even independently of their effects on carbon emissions. It is helpful to consider their fiscal implications along a series of axes: (1) interventions that generate income streams or create assets for the public sector, such as credit insurance, credit guarantees, direct lending, or co-investments; (2) interventions that negatively impact the fiscal balance sheet but create new, low-carbon assets for the private sector, such as grants or tax exemptions for households and firms (but may also accelerate depreciation in the private sector); and (3) interventions that create assets benefiting the economy as a whole, such as public support for R&D.

While strictly speaking, a theoretical economist may consider all of these costs in the sense of the opportunity cost of utilizing these resources elsewhere, this is not what is commonly understood by a cost and can be doubly misleading. Given the positive economic spillovers from lower electricity prices and energy security, the opposite may be true. Modelling by Way et al (2022) even suggests that a rapid green energy transition is likely to result in large overall net savings, even without accounting for climate damages. They estimate that a global scenario where fossil fuel technologies are rapidly replaced by low-cost key green technologies, in power and transport in particular, would overall cost $12 trillion less compared to a scenario where we continue relying on fossil fuels. In short: a faster energy transition is likely to reach lower costs sooner (Way et al, 2022).

8. THE DISTRIBUTIONAL CONSEQUENCES OF NET ZERO POLICIES

A focus on carbon pricing has clearly led to a distortion in the discussion on the distributional impacts of net-zero policies. Complicated schemes have been devised or discussed which would compensate low-income households for taxes which are otherwise regressive – fuel duties being a good example. The notorious reaction of the French 'yellow jackets' is often cited in this regard. However, if policies are sequenced effectively, there is less or no need for compensation, because the creation of near-perfect, low-carbon substitutes facilitates consumption changes, and the taxes will raise little revenue. Similarly, if policies are oriented towards expanding the supply of renewable energy and a secular decline in electricity prices, the impact on the real incomes of those in the lower deciles should be beneficial.

Who are the losers of the 'redistribution of wealth' from carbon-intensive to sustainable assets?

But the green transition also involves profound restructuring of our capital stock (Pisani-Ferri & Mahfouz, 2023) - which means that we are accelerating the depreciation of carbon-intensive assets and creating new sustainable assets. The transition is, in fact, a redistribution of wealth. Who are the losers and who bears the cost of this redistribution? The most significant consequences are related to who currently owns the carbon-intensive assets and who will own the new sustainable assets. This is also highly relevant to the vested interests of varying actors. For example, in an economy like South Africa, there is a structural obstacle to progress because the polluting assets are owned by the state-owned utility, and attempts to develop renewables are concentrated in the private sector. In this instance, the state utility is a serious obstacle to progress. This, however, is more an exception than a rule, at least among democracies. Typically, carbon-intensive assets are privately owned, and future sustainable assets are held by the private sector or through public-private arrangements - a policy choice which, again, could strengthen the state's balance sheet. Analyses show that the losses from accelerated depreciation of carbon-intensive assets may well be concentrated in the hands of very few (Lonergan and Sawers, 2022). For example, if we look at the listed oil-producing sector's share of global stock markets, it is less than 6%, and stock ownership is highly concentrated in the top 10% of the wealth and income distribution.

Considering distributional impacts when designing Targeted Positive Incentive policies

With regard to the household balance sheet, in general, policies focused on positive incentives and the cost of capital can create wealth. For example, a well-designed policy using government-backed credit insurance for low-interest heat pump loans could boost demand for green mortgages and help households accumulate wealth.

But positive incentive policies should also consider distributional consequences across households with different incomes, and potentially scope for regional economic development. For instance, green mortgage programmes creating a skills base, expertise, and broader infrastructure around heat pumps could be targeted initially in regions where unemployment is higher.

Similarly, as France has illustrated admirably, positive incentives can be aimed at those on low incomes. The French 'social-leasing' scheme is a perfect example of a Targeted Positive Incentive whereby the state's intervention makes the relative price to the consumer of the green option far cheaper than the carbon-intensive alternative. The policy has been both highly successful and popular (after being inundated with demand, the scheme was suspended in 2024 and is being re-launched in September 2025).

In summary, good economics – which takes into account behavioural and fiscal realities, as well as distributional and broader welfare considerations – points towards policy mixes which are focused first on the creation of close substitutes, and then on targeting material relative prices in favour of the sustainable option.

Potential impact on inflation

A final consideration relevant to distributional consequences relates to the impact on inflation. In recent years, and particularly in light of the gas price shock following Russia's invasion of Ukraine, there has been a growing focus on the impact of higher electricity prices on inflation and the cost of living, with regressive effects on middle- and lower-income families. Policies which lead to lower and more stable electricity prices – e.g., by reducing the interest costs of renewables - should therefore also be beneficial in reducing inflation. This raises important questions for the implementation of dual interest rates by central banks –a policy that emerged originally to provide targeted stimulus when conventional interest rates were stuck near zero (see Lonergan and Sawers, 2022). Targeted lending programmes such as the ECB's TLTRO (Targeted Longer-Term Refinancing Operations) should have been maintained, but only to support lending to the clean energy sector, where capital expenditures are the main driver of the levelized cost of capital. By raising interest costs in these sectors, the central banks – perversely – may have raised inflationary pressures. Dual interest rates and targeted lending programmes would have the opposite effect.

9. CONCLUSION: A PRAGMATIC PATH TO ACCELERATED DECARBONISATION

The urgency of the climate crisis demands policy frameworks that deliver rapid, large-scale decarbonisation. This paper argues that the insights of economic theory for net-zero policies go well beyond the focus on CO_2 as an externality. In particular, they underscore the importance of lowering capital costs for accelerating investment in new technologies, accelerating market-induced innovation and associated infrastructure, and thereby altering the price elasticity of demand to change collective behaviour at speed – as illustrated by actual policy examples. While some of these interventions will carry (upfront) fiscal cost, a range of suggested policies are, in fact, asset-creating and may, in fact, create modest income streams and assets for the state, thereby even strengthening public finances. Carbon pricing still plays a vital role as part of the policy mix, but in order to be effective, it must be sequenced with policy aimed at creating close, low-carbon substitutes.

This framework is pragmatic in the sense that it aligns with economic realities, behavioural insights, and political constraints. It draws lessons from policies that have demonstrably succeeded in accelerating technology deployment and adoption, such as the UK's CfDs for offshore wind and Norway's comprehensive EV incentive package. By emphasizing positive incentives and tangible benefits, it offers a politically viable pathway, reframing the transition as an opportunity for competitiveness, innovation, and improved living standards. Adopting this framework requires a subtle but significant shift in the policymaker's mindset – from primarily seeing their role as correcting a market failure due to an externality, to actively targeting the cost of capital and strategically developing sustainable substitutes through Targeted Positive Incentives.

When applying these insights to the European context, one of the main questions that arises is how ready European countries really are for the launch of the EU's Emissions Trading System 2 (ETS-2) in 2027, which will introduce carbon pricing for consumer-facing sectors like transport and buildings. Given that price elasticities are usually low in these sectors, and low-carbon substitutes are not mainstreamed yet, the new ETS expansion might disproportionately affect low- and middle-income households and provoke public and political opposition. Further research is needed to explore short- and mid-term policy strategies to prepare for the ETS-2 implementation, or even in the case that it might be abandoned due to political opposition.

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