INPUT PAPER FOR THE OECD
KEY POLITICAL ECONOMY AND
ENTANGLEMENT ISSUES OF THE LOW-
CARBON TRANSITION IN G20 COUNTRIES

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E3G is an independent climate change think tank operating to accelerate the global transition to a low-carbon economy. E3G builds cross-sectoral coalitions to achieve carefully defined outcomes, chosen for their capacity to leverage change. E3G works closely with like-minded partners in government, politics, business, civil society, science, the media, public interest foundations and elsewhere. In 2016, E3G was ranked the number one environmental think tank in the UK. www.e3g.org

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INTRODUCTION
POLITICAL ECONOMY AND HIGH CARBON ENTANGLEMENT

The transformational nature of the transition to a low-carbon economy is now being recognised by policy makers in countries at the leading edge of climate mitigation. Over recent years policy action and economic drivers have combined to present structural challenges to existing market structures, regulatory systems and incumbent interest groups. These structural impacts cannot be effectively managed through marginal policy instruments such as carbon taxes or energy regulation alone but require more cross-cutting sectoral reforms. Such political economy effects will become more important as the low-carbon transition deepens in a larger number of countries.

Introduction

Deepening low-carbon transitions drive transformational change

The past five years have seen many countries enter a new, deeper, phase of the low-carbon transition, particularly in the EU and China. Figure 1 provides a schematic framework for thinking through the stages of the low-carbon transition. Many countries have to date been working through the transition from Stage 1 (the setting of targets and flagship policies) to Stage 2 (where significant investment is beginning to flow into low-carbon solutions, particularly in the energy sector). Stage 2 focuses on developing sectoral budgets, roadmaps and policies but investment is not yet at a level where it has a disruptive impact on broader sectoral dynamics.

However, as countries progress into Stage 3 of the transition, more fundamental impacts occur. For example, as the amount of zero marginal cost renewable generation began to exceed around 20% of power produced in some EU countries it depressed the price of power significantly, making some fossil generation unprofitable. This, combined with successful electrical efficiency regulations depressing power demand, and the impact of the financial crisis, served to undermine the financial attractiveness of several large European utilities who had not anticipated these changes. The disruptive effects in European electricity markets are described in more detail in Box 1 below.
Figure 1: The Three Stages of Climate Transformation

The Three Stages of Climate Transformation

First Stage
- Targets, Cost Curves and Flagship Policies
- Headline National Goals (X% reduction by 2030)
- Macro-economic modelling of targets
- Bottom-up “cost-curve” assessments of possible interventions
- Flagship policies

Second Stage
- Carbon Budgets, Roadmaps and Policies
- Carbon budgets, roadmaps and timetables
- Sectoral budgets and policy programmes
- Cross-government co-ordination mechanism

Third Stage
- Integration into Risk Management and Economy-wide economic reforms
- Multi-objective, scenario-based sectoral transformation plans
- Market reform processes
- Integrated financial and budgetary reforms
- Industrial and regional development strategies

Source: E3G

Box 1: European Utility Business Strategy

European Utilities E.ON and RWE were formed as part of a strategy to move from industrial conglomerates to international energy companies. Size, scale and earnings power gave them the opportunity to invest in big infrastructure projects. Utilities companies have always been viewed as long term and low risk investments by their public or private owners and have been managed to deliver yields to shareholders i.e. maintaining a steady increase in profit, as measured by ‘earnings before interest and tax’ (EBIT).

This approach has a number of strategic consequences: earnings risks are managed through scope and scale as the businesses focus on delivering short term profits, and organic growth is difficult to deliver since it usually dilutes earnings (the critical success variable) in the early years. As a result, small incremental opportunities for growth are missed and the focus is on driving earnings from existing assets. This effect can be described as the ‘EBIT trap’.

Pursuing growth through small renewable projects did not fit this strategy as returns did not exceed the weighted average cost of capital (WACC) and E.ON and RWE initially fought growth in renewables as there was no basis for strategic competitive advantage for investment.
By the time this strategy was overturned at Board level, both companies had missed the investment opportunity and were not key players in the growth of the renewables market. The loss of share to renewables in their home markets (plus increasing regulation) squeezed cash generation (exacerbated by the wholesale price collapse in the last 5-10 years) and reduced their ability to invest. Over the past five years, the share prices of RWE and E.ON have declined by 59% and 50% respectively.

When the next potential energy transformation cycle became apparent - to a smart, consumer focused, decentralized energy system – both utilities wanted to make sure they were part of the new world. However, the need for investment to participate in the new world had the effect of destroying value in their existing assets. The EBIT trap meant that investment could only be justified if the earnings generated outweighed any loss in existing asset earnings – which was a very difficult proposition to square. Further, diverging internal strategic objectives between new and old businesses meant that it was impossible to manage capital allocation processes that were meant to meet the needs of both businesses.

Consequently, the utilities set up two businesses, E.ON creating Uniper to focus on high carbon assets, and RWE creating Innogy to focus on renewables. From the perspective of the new shareholders of the separated companies, it allows a more focused and coherent business strategy each based on a different and ultimately competing view of the future low-carbon energy mix. This also reflects the increasing pressure from retail consumers and competitor companies (particularly new entrants to the market) to provide ‘clean’ energy. This has already had an impact in the UK, where Uniper has been more vocal about seeking to extend the operation of its Ratcliffe coal plant, in comparison to the previous E.ON management.

A consequence may be that the impact of the low-carbon transition on the loser may be felt harder and faster due to the isolation of this business from other generation streams. The individual portfolio owners may take a more aggressive and polarised stance than that taken by the previous larger conglomerates, this may make it harder for governments to seek and obtain consensus over future trajectories and pathways. Indeed, marked changes in asset ownership represent a non-linear political economy effect that would lie outside of traditional technoeconomic modelling approaches.

The critical point to note was that despite extensive impact assessment and modeling at European and national levels, these changes were not anticipated by policy makers or industry analysts when the renewable and energy efficiency polices were put into place. Their analysis did not look at the interaction of financial and power markets or the interaction between incumbent and new players in the sector.
As a result of these impacts, European power markets are now undergoing fundamental reforms to make them fit for a high renewable energy future and capable of providing a level playing field for investments in demand, supply, transmission, storage and smart energy services.

**Least cost low-carbon transition requires structural and distributional analysis**

As the low-carbon transition deepens it is likely that similar disruptions will be observed in a wider range of sectors e.g. heating, urban infrastructure, transportation and agriculture. As countries progress with climate change policy implementation they will increasingly need to address these issues through economy wide transformational plans and economic reforms. This has significant implications for how the transformation is governed; requiring a move from line ministry responsibilities to a whole of government approach.

Traditional macroeconomic and sectoral economic modeling approaches usually fail to pick up structural changes because they are designed to model marginal shifts inside relatively established sectoral boundaries. While engineering based models can reflect more fundamental changes in the use of new technology (for example, replacing petrol cars with electric vehicles) they are not capable of analyzing the market and institutional shifts needed to support their deployment.

Practical experience over the past decade suggests that these modeling approaches must be supplemented by analysis of wider impacts covering four key dimensions if countries are to undertake effective, least cost low-carbon transitions:

- **Institutional & Market Shifts**: much traditional economic analysis abstracts away from the institutional structure of the economy (e.g. business models, financing, regulation) to simplify assessment of the costs and benefits of change. However, real transitions must be delivered through real public and private institutions which are designed around existing technologies and assumptions; for example, centralized power systems or passive consumer demand. Public and private institutions are not infinitely flexible in the face of policy change, price signals or technology change and so will tend to limit the pace of change unless explicitly reformed and/or disrupted.

- **Investment Dynamics**: the dynamics of least cost change will depend on a range of non-climate issues such as overall market growth rates, turnover of fixed capital, availability of new capital and amount of fully depreciated high carbon assets which will impact the effectiveness of marginal price signals and regulation. Investment dynamics will be a critical consideration in designing least cost climate policy.

- **Distributional Impacts**: the distributional effects of the low-carbon transition, “who wins, who loses, how and why?”1, are critical in determining both the political acceptability and practical impacts of climate policy. Climate policy has a

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variety of impacts at different levels of society, within and between sectors and along supply chains. For example, climate policy may increase or decrease sectoral tax burdens and rents at the national level; will differentially impact transport industry supply chains depending on specialization in internal combustion drive trains; and will have different net benefits for rural and urban populations who have different energy use patterns and exposure to air pollution.

- **Sectoral interlinkages:** for tractability climate policy is often modeled and assessed as a standalone issue. However, in the real world climate policy impacts other policy objectives; for example, climate policy may increase or decrease energy security and national financial stability. Climate policy has strong synergies with other policy objectives, particularly energy poverty and air pollution requiring integrated policy making. Optimal low-carbon transitions may also imply major structural reforms, such as devolution of infrastructure and taxation powers to city level, which are unlikely to be driven solely by climate change priorities. The optimal pathways for climate action will therefore also depend on the ability to “piggyback” on other policy reforms.

**Technical and economic analysis is not sufficient**
The areas above all have technical and economic aspects which can be analyzed using various industrial economics, game-theoretic and agent based analytical techniques. While these tools are important, however, they are not sufficient without consideration of broader political conditions and dynamics. Attention needs to be given to the role and influence of business leaders and vested interests and or lobby groups in arguing for special treatment. The political dynamics around the low-carbon transition will be influenced by broader issues of accountability and stability of the Executive and key supporting institutions at a national level e.g. civil service or judiciary. The balance of power between state and local authority actors is an important consideration, particularly when seeking to understand the likely strength of feedback surrounding local costs and benefits and their influence on the decision making process.

The Civil Society perspective needs to be examined for its role in shaping narratives and influencing the debate, alongside the nature and the role of the media and its positioning on climate change. The strength of the public voice and the public awareness or perception of climate change as an issue is a key factor.

These factors are seldom included in national analysis of low-carbon transitions but are often considered by inward investors as part of a “political risk” calculation on the stability and predictability of national economic regimes. In national debates it is vital to consider how the overall governance of the low-carbon transition is embedded inside political institutions. For example, the UK Climate Change Act gives a very strong role to independent assessment of progress towards climate targets and Parliamentary oversight of Executive actions. This “constitutional” structure makes trade-offs more transparent and limits the ability of special interest groups to impose costs on other interest groups. This approach to climate legislation is now being copied globally.
Political Economy analysis is critical to delivering successful low-carbon transitions

Taken together these different factors define why a “political economy” approach is essential in understanding how to define an effective, least cost approach to the low-carbon transition.

The OECD has suggested the following definition of political economy: “the interaction of political and economic processes in a society; including the distribution of power and wealth between groups and individuals, and the processes that create, sustain and transform these relationships over time”.

It is critical to determine how different actors, organizations and institutions respond based on their national conditions, rather than just define macroeconomic trajectories or targets. Government and policy makers’ ability to anticipate and influence these participants depends upon disaggregating the precise nature of the relationships between different institutions and competitors.

A failure to adequately manage these interactions has been seen to result in negative impacts:

- **National governments**: if national governments fail to manage the impacts of climate policy on specific groups (e.g. poor consumers or energy intensive industries) they may face at a minimum policy failure and at worst a backlash against climate policy as a whole which means they fail to deliver against international obligations.

- **Investors**: failure to manage political economy effects well can lead to abrupt policy reversal due to political changes (e.g. reversal in Spanish solar tariffs or UK renewable policies) or technical policy failure (e.g. failure of CCS demonstration projects across the EU). Though investors cannot expect complete certainty, volatile or reactive management of the low-carbon transition will raise risk perceptions and thus lower the availability of affordably priced capital.

- **Consumers and tax payers**: failing to adequately account for political economy effects is likely to increase the costs of delivering the low-carbon transition on consumers and tax payers; either through policy failure, the need for higher taxes/incentives or disproportionate burdens being placed on end consumers (for example, the cost of German renewable subsidies only falls on domestic and commercial consumers as powerful industry lobbies have secured exemptions).

A consideration of political economy as part of any analysis of national conditions is essential to understand how different policy approaches engage with the interests of economic actors across different sectors and in the national economy as a whole.

**Understanding Political Economy Dynamics**

The precise nature of these political economy effects at the national level will depend on the combination of sector and national conditions, the patterns described are likely to be generic to a number of scenarios. By understanding these patterns, policy
makers will be better equipped to ameliorate these effects in the way that they design their climate actions and interventions.

From a practical perspective, policy makers need to consider political economy questions for climate change policy implementation at different levels. This section presents variables which have been seen in practice to influence low-carbon transitions in multiple countries. This is not an exhaustive list but rather a compendium of existing examples:

**Macro-variables that act to influence on the level of ambition and distribution of action at a country level**
- “Fiscal entanglement” due to impacts of climate policy on royalties or tax revenues from fossil fuel production and use, including potential impacts on financial stability of investments;
- National technology and innovation systems capabilities determine whether a country sees itself as a “maker” or “taker” of low-carbon technologies and services, and thus how its industrial strategy correlates to its climate policies;
- Climate risk and vulnerability of assets and infrastructure determines how the perceived cost of inaction and the political importance of impacted groups influence national debates;
- Energy security concerns, including import/export dependency and the broader role of high carbon fuels in energy security impact the economic, security and political costs and benefits of climate action;
- Relative importance of the high/low-carbon industries to the economy.

**Sectoral variables that impact the pace and scale of change in the real economy**
- Critical infrastructure and the role and impact of existing infrastructure (wires, pipes, railways and ports) in creating path dependencies for high carbon or specific low-carbon solutions;
- Regulation and incumbent players including the risks of regulatory failure and attempts by incumbents to seek rents and / or capture regulators;
- Governance of critical technology choices for example between electricity/gas interconnectors and between demand and supply side investments;
- Balance of ownership of key infrastructure as the structure of private or public ownership will have a large impact on the ability to “strand” unprofitable assets outside public balance sheets.

**Local/Regional variables which can feedback either in support of or act against the national level of ambition for climate action**
- Local growth impacts or opportunities for specific communities either in high carbon dependent or renewable energy rich regions;
- Local control and policy integration impacts how significant local benefits of low-carbon actions, e.g. reductions in air pollution and energy poverty, are reflected;
- Role of bankruptcy or vulture funds in avoiding exit of stranded assets by moving costs to creditors and public sector (e.g. pension and environmental liabilities).
Climate Change and Political Economy

Context
This section discusses influencing factors shaping the interplay between attempts to drive action on climate change and underlying political economy dynamics. The discussion highlights the critical need to adopt approaches that extend beyond traditional approaches to technical modeling, the setting of smooth linear trajectories and a heavy reliance on a carbon price to drive implementation and delivery. It explores why this approach will underestimate political economy effects in the real economy, risking a backlash that will act to undermine the degree of ambition at the national level.

Anthropogenic climate change is a global issue, requiring an international response and multilateral agreements and yet by definition the implementation of policies to deal with this issue must be national, regional and local in nature. There is a risk that the level of commitment to international climate agreements fails to translate into domestic level policy making, with the effect that countries continue to be constrained by political economy effects and national conditions, preventing them delivering what is required for a successful collective global response on climate change.

Climate and Energy
There is an inherent interdependency between the need to reduce greenhouse gas (GHG) emissions and the energy system, as a significant proportion of GHG emissions arise from the production and consumption of energy in the economy. Existing energy infrastructure has been developed for the supply of fossil fuel based energy, and as such represents a significant challenge.

The energy sector presents a distinct set of complex challenges. Goldthau and Sovacool describe four degrees of difference which apply to the energy sector2:

> **Stronger vertical complexity**, in that energy production requires support from advanced manufacturing, extractive industries and transport and grid infrastructure;

> **Horizontal complexity**, involving many actors on a geographic scale e.g. around the availability or fossil reserves;

> **Higher entailed costs** e.g. from the high capital intensity of energy infrastructure; and

> **Path dependency and inertia**, with a stronger ‘stickiness’ arising from the ‘lock in’ effect characterizing large scale social-technological systems, plus that individual choices regarding changes in energy technology come with longer time horizons e.g. changing to renewable heating in a house or changing travel behaviors to public transportation.

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The complexity of the sector adds greater challenge when trying to address related issues of energy security, energy justice and of course the transition to low-carbon energy.

**Energy Transformation and Incumbency**

The scale and time required for energy transformation should not be underestimated. Fouquet has reviewed past transitions in the UK energy sector\(^3\). As the first economy to make the transition to fossil fuels, this provides an interesting comparison for learning, as no country has yet made the transition to low-carbon energy. Fouquet notes that a frequent driver for previous transitions was better or additional services e.g. cleaner or more flexible to use but suggests that success will depend on whether consumers or governments place sufficient value and demonstrate willingness to pay for the better service, determined on a case by case basis.

Based on historical experience since the industrial revolution, the average diffusion time of new energy technology might be expected to be just under 50 years, although it is noted that the greater development of markets and flow of information may increase the speed of the low-carbon technology transitions. This underlines the imperative for a proactive and progressive approach to stimulating and supporting the low-carbon energy transition.

At the domestic level, there are strong incumbency and entrenchment effects resulting from historical economic development based on fossil fuels. This results in concentrations of high carbon energy services and carbon intensive industrial sectors. These sectors have provided long-term revenue streams for government’s and stable employment prospects for local and regional communities. These sectors may also provide a strong competitive base for national economies. Strong political entanglement issues are unavoidable when trying to transition to an alternative low-carbon economy.

**Traditional Energy and Climate Policy Responses**

With respect to climate and energy, the policy making challenge is to solve the ‘Energy Trilemma’, seeking to balance policies across climate mitigation, energy security and energy affordability/access. To date, policy makers have largely taken a ‘three pillar’ approach to climate mitigation, through the setting of a price signal for GHG emissions, actions to remove market barriers, and through support for new low-carbon technologies. Mainstream policy approaches have typically taken a linear, technical and managerial approach to the problem, which misses the significant role of political economy effects in determining the outcome of these policy interventions\(^4\). For example, setting a carbon price at a national or international level is unlikely to yield a successful transition on its own as the ability of nations to respond to this price signal will depend heavily on national and sectoral conditions.

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The limitations of relying on a carbon price to drive the scale of the transition required are severe. As Roberts notes\(^5\), carbon pricing ‘is not the only legitimate climate policy, the one true sign of seriousness on global warming, or a substitute for the difficult and painstaking political work that will be required to transition to a sustainable energy system’. While carbon taxes are meant to solve a specific market failure, the wider energy market is far from perfect and contains many other failures and dependencies on government regulation, public infrastructure and public subsidy. Complex layers of existing monopolies, barriers to entry, legacy infrastructure and complicated regulatory systems make it essential that government’s look beyond a simple carbon pricing tool and play a more active role in reforming, shaping and designing new markets.

Further, while Pigouvian taxes and price based policies can generate efficient change at the margins, they are unlikely to lead to the rapid and widespread transformation of the global economy that is required. This will require greater technology innovation and more proactive industrial policy working in combination with more conventional market instruments.

**Climate and Energy System Complexity**

Climate change is increasingly understood as being a so-called ‘wicked problem’ (multidimensional challenges which are hard to resolve due to incomplete or contradictory information, differing views on the nature of the problem, or complex interactions with other issues\(^6\)). Wicked problems need to be viewed in a more dynamic and complex way, involving the fragmentation of industries and organizations. Sun and Yang have explained that the policy response to climate change has economic, social and political ramifications, and relies heavily on the behavioral decisions made by countries and organizations\(^7\). This means that there is no simple cause-effect linearity, and evidence suggests that the application of a linear approach to decision making (and negotiations) on climate change tends to lead to ineffective outcomes or impasse\(^8\). Consideration of this complexity suggests that an alternative political economy approach needs to be pursued.

**Energy Infrastructure Transitions**

Mitigation of emissions from energy infrastructure requires investment and cost in the short-term to reduce long-term impact on the climate. This presents a temporal conflict in the proximity of these costs against the long-term benefits of reducing climate risk: ‘‘the long-term calculus of climate change confounds both the economic and political calculus of how best to address it’’\(^9\).

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This will become even more of a critical factor as we move from lower cost mitigation options such as energy efficiency with shorter term paybacks to larger infrastructure investments (e.g. in carbon dioxide transport and geological storage for CCS) which will require greater investment. Given the dynamic and long-term nature of these large scale investment decisions, they must inherently rely upon an anticipation or expectation of high carbon pricing in the future, thereby exposing a fundamental weakness in an approach which expects transformation by means of the existence of an ‘efficient’ carbon price alone.

In many economies, control and stewardship of the system for energy production, distribution and consumption has been transferred to the private sector, leaving a crucial split between government actors who are now charged with developing and implementing climate policy and the current owners of energy infrastructure. The case studies described below, demonstrate that governments have taken a leading role in setting long-term mitigation pathways, but have been reliant on the actions of private asset owners in responding to these pathways. Governments need to consider the case for greater intervention in situations whereby the short-term decisions of investors conflict with the needs of long term pathways.

This reveals a deeper issue around infrastructure provision. A successful transition needs to deal with both existing and new infrastructure and will need to factor in the different investment cycles that occur. Energy infrastructure has been constructed in distinct bulges and waves (as shown in Figure 2 below), and this will set a profile for further investment and replacement. An additional challenge is presented where there is a need to synchronize the development of new innovative technology deployment with an investment cycle for incumbent technology. There is a strong argument that the deployment of Carbon Capture and Storage in Europe missed the critical timing point for replacement of existing coal fired power generation.

2050 Pathway Planning
The use of 2050 Pathway approaches can help policy makers identify where alignment is needed between sectors. The case study below provides recommendations on how to undertake these activities effectively based on recent experiences. However, predicting political economy effects goes beyond the capability of the techno-economic modeling frequently used to generate low-carbon trajectories and scenarios. Such models simplify the approach by treating the availability of technology for example as an exogenous variable, and will tend to predict smooth transitions. In this way the models are limited in their capability to predict the nature and timing of disruptive moments of transition which are caused by a deeper interplay of political and economic factors.

The disruption of the EU electricity market (as illustrated in the case studies below) demonstrates that the growth of renewable capacity and the breakdown of the marginal cost model for power generation have caused large scale restructuring and divestment decisions by the major European Utilities.
There is a wider need to tackle emissions from all sectors of the economy requiring policy makers to work to better align policies in a range of diverse areas. This was discussed by the OECD, which presented a first attempt at a broad diagnosis of these misalignments across a range of areas including taxation, international trade, electricity markets, transport and land use. The report confirms that many policies are not well aligned with climate policy objectives and in some cases are in direct conflict. For example, several existing provisions guide consumers and companies towards higher fossil fuel energy and consumption. The effect of the misalignment can be to undermine the effectiveness of climate policy efforts.

**Financial Entanglement**

The case studies also consider the question of the financial entanglement of current high-carbon sectors and incumbent interests. There will inevitably be financial impacts from an accelerated move to low-carbon technologies. Whilst there has been increasing awareness of the potential impact that climate-related risks present to the stability of existing financial investments in specific sectors, there is still relatively little

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10 https://www.carbonbrief.org/mapped-how-the-uk-generates-its-electricity

understanding of the scale of the potential impacts that will be triggered as climate policies are implemented to deliver on the speed of transition required under the commitments made in the Paris Agreement. This is discussed further in Box 2.

**Box 2: Fiscal erosion from a low-carbon transition**

Accelerating the low-carbon transition will lead to a decreasing share of fossil fuel in power production and transport. The shift will have significant fiscal entanglement effects on governments. This will impact on government revenue streams both from the production of fossil fuels and from the taxation of consumer use of fossil fuels.

The transition to a clean economy will require fundamental changes in many sectors of the economy. Most obviously, the decreasing share of fossil fuels in electricity generation and transport poses challenges for the producers and consumers of oil and gas.

There are likely to be significant long-term impacts on oil demand and the wider economy from an accelerated global effort to tackle climate change. In a world where climate policies are implemented to drive investment in low-carbon technologies, analysis suggests that demand for oil from transport could be significantly lower, e.g. by around 11 million barrels per day in 2030 and by 60 million barrels per day in 2050\(^2\). The trajectory for global oil consumption in a scenario where the 2 degree goal is met results in 35% lower demand by 2030 compared with business as usual\(^3\).

In producer countries fossil fuel taxes can provide the main source of government revenues. For example, in Russia and Saudi Arabia, fossil fuel income accounts for more than two thirds of government revenue\(^4\). However, fossil fuels also provide significant tax revenue in consumer countries as well. In the UK £28bn per annum of tax income alone comes from fuel duty\(^5\), an income that is tied to a transport sector based on combustion engines.

This suggests that both fossil fuel producing and consuming economies will face fiscal challenges from the global clean economy transition, although the nature of this impact will depend on the different structure of these economies. The scale of the fiscal challenge underlines that a clean economy transition is a transformation that goes beyond Environment, Energy or Transport Ministries. Long-term planning needs to involve Finance Ministries to ensure a successful and fiscally sustainable transition.

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\(^{13}\) IEA, World Energy Outlook 2016, Figure 1.4, upon subscription


At the same time the impact of the transition on new infrastructure investment needs to be considered. If demand impacts are fully anticipated then investment in new infrastructure is likely to slow down and producers that are not able to cover their operating costs will exit the market leading to a reduction in average production prices. However, the pace and scale of the transformation is likely to challenge the ability of government and the private sector to respond, leading to the creation of significant stranded assets.

A fossil fuel exporting economy can choose from a range of strategies to deal with the transition – usually composed of two elements: maximizing revenue from its resource wealth in the short run and identifying new sources of income in the long run.

For example, Saudi Arabia has already proposed a 2030 diversification strategy, including the creation of a Sovereign Wealth Fund\textsuperscript{16}. To make this happen and develop infant industries that require public support, financial and economic planning will need to go hand in hand.

For the UK, as a consumer country faced with the challenge of managing the financial impact of Government policy, the low carbon transition may create perverse incentives for institutions such as the UK Treasury. The UK has set a legally binding target to reduce GHG emissions by at least 80\% below the 1990 baseline by 2050, delivered through carbon budgets which restrict what can be emitted over a given 5-year period.

As a result the UK Treasury may have an incentive to maximise income being generated from fossil fuel use taxation in the short-term i.e. encourage greater conventional vehicle use, subject to the headroom of the current 5-year budget period. However, this may prove to be contradictory with the longer term need to provide transformational stimulus to move away from fossil fuel use for transportation for subsequent tighter carbon budgets e.g. the budget for 2008-2012 was 3,018MtCO$_{2}$e whereas the budget for 2028-2032 is 1,725MtCO$_{2}$e\textsuperscript{17}.

In particular, there is a tension between setting taxation levels that maximise revenue while minimising deadweight loss (which is arguably how fuel taxation currently operates in the UK), and the use of tax policy as a tool to change behaviour (whereby ‘pricing out’ socially bad behaviour means that a policy should raise little revenue in the long-term). For the UK, Treasury might consider radically increasing fuel duty for fossil fuels, to accelerate the consumer shift towards low emission vehicles, again increasing tax income in the short run but promoting a transformational change in support of the long-term climate targets. However, this would require the Government to implement new revenue raising taxes elsewhere in the long-term to make up for the revenue

\textsuperscript{16}IEA, World Energy Outlook 2016, upon subscription

\textsuperscript{17}https://www.gov.uk/guidance/carbon-budgets
shortfall, for example through increasing income tax or Value Added Tax, which could prove to be politically controversial.

In both cases, there is likely to be significant resistance to diversification away from existing revenue streams due to intense political lobbying by vested interest groups with strong vested interests in preserving the existing status quo.

A recent Bank of England report examined the impact of climate change on the monetary policy and financial stability objectives of central banks, identifying four main ways in which climate change and policies on carbon emissions could affect central bank’s objectives. These impacts include:

> physical risks (e.g. weather related natural disasters);
> the impact of climate change on economic growth rates;
> transition risks caused by an unexpected tightening of carbon emission policies leading to a disorderly outcome generating significant balance sheet losses and financial instability; and
> increased volatility of food and energy prices feeding through to volatile headline inflation rates.

Research estimates of the Value at Risk (VaR) from climate change are, by nature, highly uncertain. However, one recent estimate puts VaR to the global stock of manageable assets at $4.2tn. To put this in perspective, this is roughly equivalent to the total value of the world’s listed oil and gas companies or Japan’s entire GDP. The research suggests opportunities to reduce this systemic environmental risk, including by investing in projects that finance the transition to a lower carbon economy. For example, the Norwegian Government Pension Fund of $6bn is largely invested in alternative energy and energy efficiency. The critical importance of better information and more thorough disclosure by market participants are highlighted.

The scale and pace of the global transition to low-carbon will have profound impacts on both the producers of fossil fuels and the recipients of their earnings – whether in the private sector (shareholders, pension investors) or public sector (via taxation and resource rents). The case studies below explore this from the angle of recent restructuring of the electricity utility sector in Europe. Policy makers in each need to understand and deploy effective policies to deal with significant changes of revenue flows.

**Aligning Win-Win Outcomes**

Taking a high-level or aggregate approach can also fail to harness important co-benefits from low-carbon policy implementation at the local level with strong social

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benefits e.g. improvements in local air quality. There are parallel policy drivers, not caused by climate change policy which can be harnessed to set up coalitions for change providing win-win situations. For instance, from a UK perspective, the increasing devolution of decision making on energy to Local Authorities offers significant opportunities for the development of low-carbon energy (as long as adequate financial resources are provided). For example, this shift could aid improvement of the energy efficiency of existing housing stocks with associated impacts on fuel poverty and the transition to a more decentralized energy system.

Additionally, the focus on health impacts of poor air quality has been a significant factor in driving policy efforts to limit the construction of new coal-fired power plants and accelerate the retirement of older inefficient units. While China has been the most prominent example of this, there has been increasing awareness of the scale of the negative impacts on health and wellbeing across Asia with similar analyses and policy interventions emerging in India, Korea and South East Asian countries. These seek to address the multiple causes of smog and haze air pollution events while also accelerating the redirection of investment flows away from coal towards clean energy. Going forward, governments will need to seek out these win-win alignments and develop them in a more structured and programmatic way.

**Increasing Policy Effectiveness**

Policy approaches to date have not driven the speed of transition required. A more direct and targeted approach is required, including through reform of market structures and mechanisms, as well as stronger intervention to replace incumbent high carbon infrastructure with low-carbon alternatives. The transformational nature of the change required will demand a response from the institutions that govern the economy. Existing institutions have evolved in response to the prevailing economic model of fossil fuel driven growth and as such will not be suited to govern the radical transition to low-carbon. This applies to the range of traditional energy institutions that have evolved from a history of fossil fuel use. On this basis, a recommendation for policy makers is that they should not limit their interventions to the market alone, but also look at reform of the institutional players that control and shape the function of the market more widely.

21 See for example the real time air quality index resource at http://aqicn.org/map/#/g/24.4639/108.501/4z
Over recent decades, governments have typically taken a neo-liberal approach to energy markets, anticipating that further competition will drive down the costs of energy, thereby improving affordability. A constrained carbon trajectory means that governments are faced with the challenge of intervening in markets to drive an accelerated transition away from existing high carbon assets and into investment in low-carbon replacement infrastructure.

This will mean that existing high carbon assets will face accelerated retirement from the electricity generation system and may mean that society will need to bear the cost of their removal. This applies equally to the re-cultivation of coal mines and the decommissioning of oil and gas infrastructure. In such cases, a narrow industrial focus will be insufficient, and policy makers must also address the need for interventions and investments at a community level to help support workers whose jobs may no longer be needed because of the transition.

Taking all these factors into account suggests that understanding the absolute cost of the low-carbon transition may be of lower importance to understanding the relative costs to different actors in society. Figure 3 below shows how global aggregate energy infrastructure investment requirements to 2030 are projected to be around US$89 trillion. Shifting to low-carbon infrastructure would add about US$4 trillion in investments, an increase of less than 5%.

**Figure 3: Global investment requirements for the low-carbon transition.**


**Source:** *The New Climate Economy: Seizing the Opportunity, 2015*

Effective transition policies should consider distributional implications in addition to potential overall macroeconomic effects on the economy. It is not sufficient for low-carbon investment to generate growth or financial returns, understanding the dynamics of the winners and the losers can determine the political viability of any
given policy response. As stated by Goldthau and Sovacool, ‘the political economy of energy transition is a vastly understudied area’26.

There is increasing recognition that policy makers should further consider the political economy interactions of actors within national political contexts and economic sectors. An improved understanding of aligned or divergent interests can help to identify opportunities for policy making that addresses multiple needs and enables broader coalitions of support within national decision making processes. Such an approach in turn contributes insights into how governments seek to cooperate within the international climate regime.

Political Economy Case Studies
The case studies presented below have been selected to illustrate key points regarding the value of applying political economy insights:

> The study of the sale of Vattenfall lignite assets captures the real world investment response of large utilities to climate policy and exposes the risk to the public sector that this creates;

> A review of the lack of progress on Carbon Capture and Storage in Europe explores why deeper political economy and investment issues proved obstacles to realising the commercialisation of this technology over the past decade;

> A case study on previous experiences of 2050 planning reveals the value of these processes but also the implications for incumbent interests, thereby providing wider points for learning for other countries now undertaking similar efforts.

Using these examples, the report makes several recommendations for policy makers to consider when framing new policy approaches.

Recommendations for Policy Makers
Political economy effects will vary according to the policy in question and the combination of domestic national and political conditions. This section attempts to summarise high-level suggestions for policy makers based on the discussion and case studies presented.

Policy makers need to:

> recognize that the absolute cost of the low-carbon transition may be of lower importance to understanding the relative costs to different actors in society;

> form a broad supporting coalition around the generation of 2050 pathway approaches to increase the pace and likelihood of implementation through different institutions and businesses across sectors of the economy;

> plan and give visibility to a structured process of updates and revisions to low-carbon pathways to remain responsive to unpredictable shifts and changes in the real economy;

> understand the inherent limitations of techno-economic approaches to pathway planning, recognising that these cannot easily cope with political economy factors such as technology availability or social impacts of the transition;

> combine techno economic approaches with political economic analysis to better understand the winners and losers from the transition to a low-carbon economy;

> adopt a ‘mixed economy’ approach to the transition recognising that greater strategic intervention is needed from the state because existing market structures and institutions reflect the historic high carbon incumbent position of fossil fuels interests and infrastructures;

> realize that government needs to be an active player within this mixed economy approach regardless of their ideology or approach to market operation;

> recognise that there are stranded assets and social liabilities which need to be handled in order that they do not present a barrier to the low-carbon transition, simply increasing the carbon price will not remove these obstacles;

> anticipate that a failure of governments to grasp this new reality will result in the state reactively mopping up high carbon liabilities when they arise. Such an inefficient and unplanned approach will be more costly to implement overall due to investor uncertainties as to how and when these issues will be resolved;

> take full advantage of the potential to align low-carbon policy objectives with other drivers such as improvements in local air quality or devolution of power to local authorities;

> not limit their interventions to the market alone, but also look at reform of the institutional players that control and shape the function of the market more widely e.g. as in the case of the UK’s Electricity Market Reform which led to the creation of long-term contracts for low-carbon electricity generation;

> adopt a whole government response to the delivery of climate action which goes beyond attempting to embed climate change into existing policies.
CASE STUDY #1

POWER SECTOR DIVESTMENT – VATTENFALL LIGNITE ASSET SALE

The Swedish and German Governments missed a historic opportunity in allowing the sale of Vattenfall’s lignite business to the Czech Investor EPH. The sales process could have set a significant precedent in demonstrating a process for the negotiation and agreement of a long-term plan to close the lignite mines and power plants in a way that was both fair to workers but which also minimized environmental damage.

Context

Vattenfall announced its intention to divest its East German lignite business in October 2014, to improve its carbon emissions performance. The German Government immediately intervened with a personal letter to Swedish Prime minister Löfven in an attempt to stop the Swedish State-owned company from selling – without success. In September 2015, the company formally opened the bidding process. In April 2016, Vattenfall signed a deal with Czech investor EPH. The Swedish Government approved the deal in July 2016 after a contentious public debate.

The divested portfolio included the lignite-fired power plants Jänschwalde, Boxberg, Lippendorf and Schwarze Pumpe, which amounted to 7.6 GW of generation capacity, along with the associated opencast mines containing about 1bn tons of reserves. Several bids were initially submitted including from the German utility Steag, as well as the Czech companies EPH, ČEZ and Czech Coal. The significance of the sale was reflected in the fact that Greenpeace Nordic also submitted a statement of interest, but it was subsequently rejected by Citibank as a potential buyer.

As the sales process dragged on, the majority of prospective buyers lost interest. While the market conditions for lignite power were already difficult in 2014, they kept deteriorating throughout 2015 as power prices fell, with political pressure on the lignite industry growing as different measures to reduce power sector emissions were discussed.

27 http://www.reuters.com/article/vattenfall-results-idUSL5N0SP1XE20141030
28 https://www.ft.com/content/5061a3e6-7347-11e4-907b-00144feabcd0
In the end, only EPH and Czech Coal remained. Steag instead submitted a political proposal together with German mining union IG Bergbau, Chemie, Energie (IGBCE) to move the assets into a charitable foundation\(^\text{30}\). Under this proposal, the plants would have kept operating until 2047, accruing capital in the early years of operations to then support workers and recultivation, as well as continued operations\(^\text{31}\). This followed an earlier proposal of a “Beyond Lignite Foundation” by Greenpeace to close the business by 2030 in line with climate targets while guaranteeing land recultivation and creating alternative jobs in sustainable economic activities\(^\text{32}\). The start-up capital was to be provided mainly by Vattenfall.

However, this emerging debate on the potential for a managed shut-down of the lignite business became redundant when Vattenfall, with the blessing of the Swedish Government, finalised the sale to EPH in July 2016. The portfolio, initially valued at €2-3bn, was eventually sold for a “symbolic price” to EPH, with Vattenfall additionally having to make a cash transfer of €1.7bn to its ‘buyer’ to cover high expected land reclamation costs\(^\text{33}\). In the end, Vattenfall preferred to pay money to EPH to take the lignite business off its hands rather than keep it. This was in no way a conventional asset sale.

**National Conditions**

This case study demonstrates the interplay between long-term climate policy and short-term economic conditions playing out in financial investment strategy. The Vattenfall sale occurred against the backdrop of the decline of the coal industry in Germany, due to market and political pressures.

Germany has adopted an ambitious commitment to remove carbon dioxide emissions from its economy almost completely by 2050\(^\text{34}\). The country aims for an emissions reduction of 80-95% by 2050 with interim reduction of 40% by 2020 and 55% by 2030, against a 1990 baseline. These targets were agreed by the conservative-liberal coalition, which was in power during the last parliamentary term, within the “Energy Concept 2010”\(^\text{35}\). They were substantiated and confirmed in the “Climate Action Programme 2020”\(^\text{36}\) adopted by the current Government in December 2014.

According to a number of studies, Germany needs to phase-out coal by 2040 at the latest to achieve this climate objective, with the use of lignite ending even earlier\(^\text{37}\).

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\(^{31}\) IGBCE Chairman Michael Vassiliadis is also on the supervisory board of Steag. The proposal was generally seen as an attempt to prolong the viability of lignite mining in the region.


\(^{33}\) [http://www.reuters.com/article/us-vattenfall-germany-lignite-idUSKCN0XF1DV](http://www.reuters.com/article/us-vattenfall-germany-lignite-idUSKCN0XF1DV)

\(^{34}\) German Federal Government (2010) *Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung*

\(^{35}\) German Federal Government (2010) *Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung*


\(^{37}\) E3G (2015) *G7 coal phase out: Germany – A review for Oxfam*
This is because the mitigation potentials in other sectors such as transport, industry or agriculture are either limited or very costly. Yet, German energy policy had until 2015 avoided explicitly addressing the necessity of phasing out coal, arguing the European Emissions Trading System (ETS) would be sufficient to drive out coal power production, or that deploying Carbon Capture Storage (CCS) would enable coal power plants to keep running without contributing to global warming.

The scale of the challenge was increased by a wave of new coal power plant builds, which had been actively encouraged in the 2000-2010 period\(^\text{38}\). As a result, 14 coal power units equalling 10 GW of capacity were completed after 2005. It is highly unlikely that these plants will remain profitable for long enough to recoup their investment costs.

Similarly, the ‘Energy Concept 2010’, assumed coal could be made compatible with a low-carbon economy via CCS. When Vattenfall and RWE both cancelled their CCS demonstration projects less than a year later, no adjustments were made to official plans\(^\text{39}\). At the same time, carbon prices under the ETS remained too weak to trigger a shift away from coal.

This implicit contradiction in German climate policy became explicit in March 2015, when the Ministry for Economic Affairs and Energy proposed a climate levy that would have penalised older coal power stations for emitting carbon above a certain yearly threshold\(^\text{40}\). But the governing coalition buried the levy proposal after protests from industry and unions, instead negotiating a deal with the utilities to decommission some older lignite power plants via a ‘so-called’ lignite reserve\(^\text{41}\). This was defended on the grounds of maintaining security of electricity supply, but was in reality a means of paying utilities to retire some of the worst polluting lignite units.

While this approach was considerably less ambitious than the earlier proposal, it remains the first and only time that the German Government has explicitly taken action to reduce coal power generation. Following this, a German coal phase-out was debated throughout 2015 and 2016 in the run-up to the Paris Climate Conference and during the development of Germany’s Climate Action Plan 2050. Through these discussions, it became very clear that coal does not have a long-term future in the German economy. However, no political decision has yet been reached to proactively address this necessary transition.

In addition to the mounting political pressure, market conditions kept deteriorating. Wholesale power prices fell by 47% between 2012 and 2016. In the two months before the Vattenfall sale, power prices had fallen to €20-22 per MWh\(^\text{42}\), the lowest

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\(^{38}\) [https://www.oeko.de/fileadmin/oekodoc/Stromsystem-Kohleausstieg-2035.pdf](https://www.oeko.de/fileadmin/oekodoc/Stromsystem-Kohleausstieg-2035.pdf), see p. 29


level in years. This plunged conventional power plants, and the utilities operating them, into crisis as it compressed profit margins of power plants to the point of becoming uneconomic. Renewable energy installations, of which the “Big Four” utilities RWE, Vattenfall, E.On and EnBW own only 5%, sell at a higher power price guaranteed by the renewable energy surcharge.

The German power generation market still has large amounts of inflexible coal and nuclear capacity, generating 42% and 12% of electricity respectively in 2015, which run at very high load factors. Gas power plants have largely been priced out of the market due to higher gas prices pushing them up the merit order compared to coal, whereas carbon prices remain far too low to trigger a coal to gas switch. Renewable energy sources, meanwhile, have increased rapidly to cover 31.5% of electricity production. In periods of high renewable power generation, the coal and nuclear power plants do not ramp down quickly enough to compensate, thereby producing a surplus of electricity. Overall, Germany has built up an overcapacity of 10 GW, i.e. 12% of peak demand, which is also driving down power prices.

Caught between the impact of falling power prices and the anticipation of further legislation to reduce carbon emissions, profit expectations from hard coal and lignite have evaporated over the last 5 years. There is a significant risk that any new investments into coal power generation will be unable to recoup their costs and essentially become stranded assets.

This trend is clearly shown in Vattenfall’s financial results for January-July 2016. Revenues from the lignite business were down 22% year-on-year, with a negative cash flow from operating activities of €150m for the first half of 2016. The plants that Vattenfall was selling were not profitable in the current market environment. This situation caused Vattenfall to make an enormous impairment charge of €2.26 bn on the assets in 2016, following a previous similar write-down of €2 bn in 2015. Profit expectations were insufficient for Vattenfall to justify keeping a business that would entail an estimated total of €3 bn in land reclamation and environmental clean-up.

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43 They have since risen slightly to around €30 per MWh.
45 The big German utilities are additionally under pressure because of nuclear decommissioning costs amounting to €23 bn, to be paid into a public fund. http://www.zeit.de/wirtschaft/2016-04/atomausstieg-stromkonzerne-sollen-23-34-milliarden-euro-zahlen
49 Vattenfall (2016) Interim Report January-June 2016. In the context of the sale of Vattenfall’s lignite business to Czech investor EPH, the financial report lists separate figures for the lignite business, which are usually not made available. Many of RWE’s lignite plants are likely similarly unprofitable – see https://www.e3g.org/docs/RWE_briefing_FINAL_with_cover_image_REvised_150709.pdf
50 Energy and Carbon (2016) Vattenfall shows stranded asset risk in European lignite
costs after the mines and power plants have been closed. According to Vattenfall, paying EPH to take over its lignite business was the cheaper option. The decline of coal threatens the remaining 25,000 jobs in the coal sector, which are highly unionised and well-paid. The unions, IGBCE and Ver.di have in recent years been the allies of German utilities, trying to stop this decline. In the case of lignite, the employment impact is intensified by the regional concentration of these jobs. Lignite power plants are often clustered in one area and typically connected to dedicated open cast mines as transporting lignite over long distances is uneconomic. In German Lusatia, the lignite industry provides around 15,000 jobs, including indirect employment in supplier companies, which amounts to 3.7% of local employment. It is also an important source of tax revenue for municipal budgets. This in turn puts politicians at the federal and local level in an uncomfortable position, as they can be easily attacked for having caused job losses if they don’t accommodate the coal industry.

The Vattenfall sale happened in a situation where the coal sector was already under considerable pressure and politically sensitized, with unions and utilities fighting side-by-side to prevent any additional burden on coal. The sale added further pressure as it raised the stark possibility that no buyer might be found at all, which would have further increased the likelihood of the closure of the plants and mines in the foreseeable future.

Political Environment

In Germany, both the Federal Government and the State Governments of Brandenburg and Saxony (where Vattenfall’s former plants and mines are located) acted to prevent a closure of the coal power plants. The Social Democratic Party (SPD) is politically vulnerable on coal jobs as it has traditionally relied on strong backing from the unions Ver.di and IGBCE which represent coal sector workers. The fact that the SPD held the Energy and Environment Ministries and also was a coalition partner in the Governments of Brandenburg and Saxony, raised the stakes for decision makers. The Christian Democratic Party (CDU), on the other hand, has mostly stayed out of the coal debate in recent years, content to leave this difficult issue to their coalition partner and main rival.

Both the Federal Ministry for Economic Affairs and Energy and the State Governments sent several letters directly to the Swedish Government and Parliament, attempting to stop the sale and urge Vattenfall to keep the lignite business. At the same time, steps were taken to sweeten the deal to ensure a potential buyer could be found if the sale couldn’t be stopped.

52 Brandenburg Energy Ministry internal documents, accessed by Greenpeace via freedom of information request (seen by E3G)
55 https://www.e3g.org/docs/E3G_Lausitzstudie_FINAL_EN.pdf
56 https://www.ft.com/content/5061a3e6-7347-11e4-907b-00144feabcd0; http://www.mdr.de/sachsen/braunkohle-tillich-woidke104.html
According to recently revealed documents from Brandenburg’s Energy Ministry, there were several meetings with potential buyers, including EPH, before the sale was even announced. Minutes from internal meetings reveal that the ministry discussed options for lowering the sale price with potential buyers. The high expected recultivation costs in particular were brought up in meetings with Vattenfall as a factor that would lower the value of the portfolio. The Ministry also refrained from asking EPH for securities to safeguard future recultivation expenses, ignoring advice by the State Mining Authority which had indicated concerns that these might not be secure under a new buyer.

At the national level, the lignite reserve that the Government adopted during the sales process included two units at the Jänschwalde power plant. This had the effect of granting a potential buyer a taxpayer subsidy of an estimated €600 million over four years. The climate levy would have had the opposite effect. While the lignite reserve deal was an immediate response to the failure of the climate levy proposal, it is very likely that the role of the reserve deal in facilitating the sale was an additional consideration.

The Swedish Government, by contrast, wanted desperately to get rid of the lignite assets. In 2014, Social Democratic Prime Minister Löfven had won office in a coalition with the Green party after an election campaign where Vattenfall’s climate footprint was a prominent issue. Before the sale, Vattenfall emitted more carbon emissions per year than all of Sweden. After the sale, the company had met their internal climate targets in one stroke, at least on paper. An additional concern for the Social Democrats was to minimise losses to Swedish taxpayers. The position of the Social Democratic Party was that the sale would provide a clean break and end up being cheaper than managing a gradual phase-out or setting up a foundation.

The Swedish Green Party had campaigned actively on the Vattenfall issue in the 2014 elections. Throughout the sales process, the party leadership stressed that environmental and sustainability concerns should be observed, but invested little political capital in actually shaping the conditions of the sale, which was under the purview of the Social Democrat-controlled Economy Ministry. This changed in May 2016, shortly after Vattenfall had announced its intention to sell to EPH, when the Green party leadership was reshuffled after several high-profile resignations following a series of political scandals. The new Green party leadership took a much harder

line on the issue than its coalition partner, which delayed Government approval of the sale.\footnote{http://www.rbb-online.de/wirtschaft/thema/braunkohle/beitraege/Vattenfall-Braunkohle-EPH-Schweden.html}

According to insider reports, the German and Swedish Governments held last-minute talks over the sale to find an alternative to selling to EPH. However, no agreement was reached and in the end the Swedish Government approved the sale in July 2016 on purely economic grounds, despite widespread concerns about the sustainability and environmental responsibility of the buyer.\footnote{https://www.bloomberg.com/news/articles/2016-07-02/sweden-clears-sale-of-vattenfall-s-german-lignite-plants-to-eph}

The conclusion of the sales process was accompanied by determined civil society activism, with demonstrations taking place in Sweden, Germany and Belgium.\footnote{http://treealerts.org/region/europe/2016/05/pressure-mounts-on-sweden-to-ditch-vattenfall-coal-sale/} Amid the elevated publicity of the issue, a debate on the sale was held in the Swedish Parliament in May 2016. German NGOs sent an open letter to Swedish MPs to make the case that shutting down the lignite business would be the most significant contribution Sweden could make to addressing climate change.\footnote{http://www.die-klima-allianz.de/wp-content/uploads/Swedish-Parliament_A-sale-is-not-a-phase-out_May-2016.pdf} But the debate ended in disarray as it was interrupted by protesters in Parliament.\footnote{http://bigstory.ap.org/article/56834e13f0e541e08a1dad359b072944/protesters-interrupt-coal-debate-swedish-parliament}

Throughout the sale process, there was significant media coverage reflecting the environmental concerns, questions about the future of coal and the risks inherent in the deal. A network of NGOs across Sweden, Germany and Czech Republic actively engaged the media, which was productive in terms of the public debate, and amplifying their core messages, but ultimately not decisive. As an unintended side-effect, this coverage probably helped drive the sale price down by publicising the risks.

Overall, the sales process was deeply inconvenient for politicians dependent on union support in Germany. The Economy Ministry, as well as the affected State Governments wanted to keep the lignite assets open at any cost, whether this meant selling or having Vattenfall maintain ownership. The Swedish Government, on the other hand, wanted to rid itself of Vattenfall’s lignite assets which had become a political and economic liability.

**Political Economy Interaction**

We are currently observing a divestment from coal assets, as profit expectations from coal decline due to political and economic pressures. Aside from Vattenfall, other established utilities such as ENEL, EDF and Engie are also selling their coal power plants. The pressure to divest coal assets and reorient their conventional energy business towards clean and smart power generation is especially strong for state-owned companies such as Vattenfall (which can be used as a vehicle for emissions

reductions by Governments) and public-facing utilities with a retail customer base (who face consumer pressure to provide ‘clean’ electricity).

In the case of the Vattenfall sale, the difficult conditions for the coal sector led to strong advocacy by unions and local stakeholders which was very effective in capturing the position of SPD politicians, who did not want to be seen as responsible for job losses. A managed closure of the assets would have been the socially and environmentally responsible long-term option, and there were several opportunities for making this happen. But union activism and local political economy concerns around job losses created real political costs that politicians at all levels needed to respect. These can be amplified in the run-up to elections, and especially if the politicians concerned have ambitions for re-election. Governments that seek to avoid having to deal with the social fallout of mining closures are placed in a position to either prevent such sales or to create an enabling environment for buyers.

The national conditions would have been very different if the German Government had adopted a managed coal phase-out and prevented new coal power plants from being built after 2000. The political battle about the future of coal would then already have been fought and the economic situation of the lignite portfolio would – counterintuitively – have been much less dire.

The conclusion is now inescapable that Germany’s long-term climate and energy plans had a blind spot for coal. This inconsistency left many unresolved questions about how to manage the power system transformation, how to reduce power sector emissions in line with targets, how to address the social impacts of phasing out coal and how to resolve the crisis of German energy utilities. This created a contentious environment and tremendous uncertainty during the sales process, with short-term political manoeuvring ruling the day rather than long-term planning.

Outcome and Learning

This case study demonstrates a number of pitfalls that can arise when government takes a high-level approach to long-term carbon reduction while avoiding politically unpopular but necessary changes to make the transition work. The Vattenfall sale exposed some of the internal contradictions of German climate and energy policy.

The critical gap in the Energiewende has been the absence of an accelerated phase-out timetable for coal power generation, or at least a stop of new plant builds. This could have addressed both power sector emissions and prevented the freefall of German power prices. While utilities were too slow to adapt to new energy market realities (and are now suffering considerable losses due to poor investment decisions), politicians failed to send clear signals about the direction of travel to power market participants. In this case, the short-term divestment decision by Vattenfall has only compounded this lack of clarity and produced additional difficulties in the low-carbon transition.
Serious doubts have been raised about the long-term intentions of the purchasing company EPH, and in particular about its willingness to pay land reclamation costs\(^{67}\). If the new owner defaults on these responsibilities, there is a strong risk that these will fall again on the public sector\(^{68}\).

It is now generally accepted that, for political and social reasons, Germany needs a negotiated coal phase-out which will most likely involve compensation payments to affected workers and structural funds for the affected regions. Germany’s recently adopted Climate Action Plan 2050 aims to put in place just such a process by setting up a “commission on growth, structural change and regional development”, which will attempt to generate consensus on a socially acceptable coal phase-out pathway and accompanying policy measures to cushion impacts on the affected workers and regions. This approach has a long tradition in German energy policymaking and the structural challenges associated with the reunification of Germany. Recently, the German Government has employed the commission model to clarify questions regarding the nuclear phase-out and nuclear waste disposal\(^{69}\).

However, EPH will now be the main negotiating partner of the German Government in this process, rather than Vattenfall. After having already bought the German lignite company Mibrag back in 2010, EPH now owns the entire East German lignite industry, which is politically vital given that East German lignite regions are much more reliant on the industry than their West German counterpart. EPH is a financial conglomerate almost entirely in the hands of a single private investor, operating through letterbox companies in tax havens\(^{70}\). Vattenfall, on the other hand, is a fully state-owned company with a strong social and environmental mandate.

Divestment of coal assets alone is not a straightforward answer – the identity and intentions of the buyer are very important. Governments require political courage to shift social and union incentives and to strike broader deals that make it less costly socially and politically to handle the closure of these high-carbon assets. The sale of the Vattenfall assets was a critical test case for divestment more broadly, as an increasing number utilities seek to sell their European fossil fuel power plants. A number of Eastern European investors, as well as Australian investments funds such as Macquarie, are currently looking to buy these assets at a low price – with the expectation that they will seek to sweat assets, offload liabilities, and seek rents from capacity markets and / or ‘compensation’ payments for closures. Such an approach is highly likely to be accompanied by company lobbying against proactive climate policies and transition pathways, representing additional barriers to political action and increasing the likelihood of disorderly transition moments.

\(^{68}\) [https://www.boell.de/sites/default/files/2016-06_foes_iass_finanzielle_vorsorge_im_braunkohlebereich.pdf](https://www.boell.de/sites/default/files/2016-06_foes_iass_finanzielle_vorsorge_im_braunkohlebereich.pdf)  
Uncertainty abounds in this period of power sector transition as utilities scramble to reinvent their business models and political battles are fought over sectoral emissions reductions and high-carbon jobs. To manage these risks and drive investment, governments will need to take a more active approach in negotiating divestment deals with companies. If it is clear that there will need to be a political solution, as has long been the case regarding German coal, it is much better to do this sooner rather than later.

While a managed phase-out wasn’t achieved in the case of the Vattenfall sale, the experience clearly illustrates that such a solution would have been possible if both Governments had been willing to cooperate and put finding a sustainable long-term solution ahead of satisfying their short-term electoral interests.
CASE STUDY #2

2050 PLANS: A TOOL FOR ORDERLY TRANSITION OR A SHIELD FOR VESTED INTERESTS?

Since the early 2000s several G20 countries have been engaging in long-term climate planning as a tool for managing the complexity of the transition to climate resilient economies. The creation of 2050 plans in South Africa, the UK and Germany offer evidence of opportunities gained and limitations encountered in taking a long-term approach to climate planning. Long-term plans are both shaped by the political economy they are created in and can shape emerging political economies.

Context
The Paris Agreement recognised the value of long-term climate planning by inviting Parties to submit ‘mid-century, long-term low greenhouse gas emissions strategies’ compatible with reaching net zero emissions in the second half of the century. However, 2050 planning is not a simple exercise. Transformational change assumes the disruption of long-held economic and political norms. In some instances, a plan’s transformational potential can be limited by the contemporary political economy it is formed in. This can result in policy makers relying too heavily on linear trends that are most closely aligned with contemporary priorities and interests.

On the other hand, a purely technical approach which fails to accommodate contemporary political economy insights can inadequately respond to transition opportunities and challenges, so limiting buy-in for implementation.

In all cases, 2050 planning processes have initiated debate and have deepened understanding of the low-carbon transition. Long-term planning has been instrumental in exposing the inadequacy of technical quick fixes and the reality of political economy challenges for delivering the transition.

71 http://unfccc.int/paris_agreement/items/9485.php
This case study explores how the experience of long-term climate planning in South Africa, the UK and Germany can offer valuable lessons learned for future exercises of this kind.

**South Africa**

In 2005, the South African cabinet mandated an independent process to determine ‘Long-term Mitigation Strategies’ (LTMS). The scenario building exercise was led by the Department of Environmental Affairs and Tourism, facilitated by Tokiso (an independent organisation specialising in mediation), and informed by four research groups coordinated by the Energy Research Centre (ERC). The process blended technical research with a facilitated stakeholder process to create four mitigation reduction scenarios. In 2008, the Government adopted one of the scenarios as South Africa’s contribution to COP15 in Copenhagen.

Subsequently, in 2011 the National Climate Change Response Policy White Paper (NCCRP) was approved by the cabinet. The NCCRP outlines short, medium and long-term climate objectives on both adaptation and mitigation to be reviewed every 5 years. In parallel, the national planning commission was established in 2010 to create a 2030 development plan for South Africa of which low-carbon transition formed one chapter. More recently, in November 2016, a 2050 plan for the energy sector was also launched by the Government for consultation. There have been subsequent calls to revive the LTMS process and engage stakeholders again but the Government has been reluctant to navigate this spectrum of views.

**Lessons Learnt**

1. **Lack of transparency in the consultation and decision-making process can nullify the numerous benefits of stakeholder involvement.**

The LTMS process was pioneering in its combination of multi-stakeholder process together with complimentary research inputs. When it was initiated, climate change was largely considered an abstract concept which needed further enquiry and research. Stakeholders were open-minded and curious in their engagement with the scenario exercise. The process served to deepen understanding of the low-carbon transition and expose future challenges and opportunities. Headline emission reductions targets gave room for each stakeholder to assume they would not be the ones required to transform their approach in the near-term. What’s more, the layered, cross-sector approach to mitigation measures meant there was an array of options that could be taken. The LTMS process did not attempt to make conclusive decisions on any one direction and concluded with four scenario options.

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72 This chapter draws on interviews with practitioners from South Africa, the UK and Germany.

73 https://open.uct.ac.za/bitstream/handle/11427/16804/Scenario_Building_Team_Long_Term_Mitigation_2007.pdf?sequence=1


75 https://nationalplanningcommission.wordpress.com/

Characteristically, the LTMS was an intellectual exercise, which served its function of raising awareness and triggering debate, but was not seen to pose a particular threat to any one stakeholder.

However, many stakeholders were taken aback, when in 2008 the Government took the decision to present one of the LTMS scenarios as South Africa’s contribution to COP15 in Copenhagen. Many stakeholders who had engaged in good faith without prejudice were now concerned that the Government was not accounting for their needs in the policy making process. On returning from Copenhagen the industry backlash was substantial and crucial stakeholder relationships were considerably damaged. There has been no follow up to the LTMS multi-stakeholder process and experts comment that the Government is tainted by this experience and reluctant to face the political economy realities of the low-carbon transition.

The awareness that long-term mitigation strategies will inevitably require economic and political transformation is now understood. However, without debate and participation by all stakeholders, only those with the most access and resources will be effective in shaping government policy. As at present there is limited appetite from the current Government to revive a stakeholder process, vested interests are left to dominate policy discussions.

Recommendation: Stakeholder involvement processes must be consistent and transparent to maintain the benefits of stakeholder involvement, including buy-in for implementation and confidence in an orderly transition. Given the recognition that delivery of the Paris Agreement requires a transformational shift, it would be advisable to make it explicit that long-term planning will inherently require consideration of political economy issues. This could expose the process to manipulation by vested interests, but transparent processes can help support evidence-based decision-making.

2. When the costs of inaction are not linked to long-term planning the appetite for transformation is limited.

In the original LTMS process, scenario planning was not informed by climate impact scenarios or consideration of other disruptive national and international trends. As a result there was little awareness or sense of jeopardy regarding the likely consequences of inaction. The resulting plan was seen as a means of enabling low-carbon opportunities but inspiring little agency to overcome vested interests in the fossil sectors necessary to curb emissions.

The South African ‘Renewable Energy Independent Power Producer procurement Programme’ (REIPPPP) was launched to attract private sector investment in renewables. From 2011 to 2016 it has procured over 6GW across 102 projects77. However, the South African electricity grid is perceived to be a limiting factor for

large-scale renewables deployment. For renewables to grow further the Government and public utility Eskom will need to invest in the grid. However, both stakeholders are heavily invested in the coal industry, with dependencies of both a financial and social nature, particularly the importance of employment in coal mining and the influence of coal unions within ANC party politics. As such, the rate of renewables growth is slowing and the Government is looking to pursue nuclear power, which is viewed as being more compatible with the current electricity grid, and which coincidentally delays confrontation with vested interests in the coal sector.

While the costs of inaction and climate risks of a mismanaged transition were not sufficiently appreciated during the LTMS stakeholder consultation, it is now understood that a disorderly low-carbon transition would be disastrous for South African employment. Similarly, it is recognised that climate change will prove disastrous for food security and employment in the agriculture and fishing sectors. Furthermore, the potential for rapid shifts in technology availability and costs were not considered in the process, yet subsequently the business cases for electricity generation from coal-fired power plants and solar PV have been transformed in diverging directions. The price of coal has crashed (reducing export earnings) whilst the cost of coal-fired power plant construction has soared. At the same time, the cost of solar has fallen below all expectations. This understanding would have strengthened the business case for investment in climate action for a range of stakeholders. For example, during the LTMS process, the labour movement was a minor contributor to the debate. However today, with falling costs of solar and coal and increased strain on the agriculture sector, the benefits of low-carbon employment better align with the Labour movement’s objectives. The consequences of climate change are now increasingly recognised as being much more immediate than first considered.

Holistic scenario planning provides a more honest assessment of the costs and benefits of climate action and better identifies the likely winners and losers of structural change and political economy transformation.

Recommendation: aspire to long-term holistic scenario planning which incorporates climate impact scenarios, employment trajectories and geopolitical futures. Regular reviews and updates of long-term plans will help to respond to contemporary political economy realities.

United Kingdom
Following the lead given by the 1992 Rio conference and 1997 Kyoto Protocol, by 2000 the UK had established science-based targets to cut GHG emissions. These were for a 12.5% reduction in the period 2008-12 (under the Kyoto Protocol) and all GHG


79 http://www.climateemergencyinstitute.com/cc_s_africa_griffin.html
emissions by 20% by 2010 (a domestic target), both compared to 1990 levels. But by 2006 it was clear that the UK was on track to miss its internal target of 20%. In response the then Labour Government set up a process to deliver a cross-party approved Climate Change Act (CCA) for the UK. The CCA was to be informed by the best available climate science, Markal modelling of the energy sector, and oversight from a new independent body, the Committee on Climate Change (CCC).

Initially, the second IPCC report (1995) suggested that -60% GHG emissions reductions by 2050 would provide an adequate trajectory for reducing climate risk, but by 2008 the latest climate science showed that the UK’s reductions would need to reach -80%. When the CCA was passed in 2008 it included a -80% GHG emissions reduction target by 2050. Subsequently, the Low Carbon Transition plan was launched in 200980, followed by the 2011 Carbon Plan81. Cross-ministerial and stakeholder engagement featured in both processes but the transport, heat and agriculture sectors intervened to distance themselves from the planning processes, refocusing priority on the electricity sector. A series of five-year carbon budgets are progressively set in law to provide stepping stones on the way to -80% by 2050. The confirmation of the 5th carbon budget last year triggered a review of the 2050 Carbon Plan, which should be finalised in 2017.

Lessons Learnt

3. A technical process will have technical solutions. Exclusive focus on gradual carbon reduction over time does not transpose effectively onto timelines for economic transformation. However, sectoral change is most effective when aligned with investment cycles and trends.

It came as a surprise to the Government that they were on course to miss their 2010 target. The policy they had implemented to facilitate its delivery had been inadequate. At the time there was little awareness of what was required to deliver a resilient low-carbon transition, from either a technical or political economic perspective. As a means of addressing this information deficit and informing the creation of the CCA the Government used the Markal model to generate scenarios for achieving -80% GHG emissions reductions by 205082.

The model depended heavily on emergent CCS and bioenergy technologies. At the time these technologies were not considered threatening to industry. Climate risks were still considered a distant threat and these technologies were expected to be absorbed within the standard cycle of evolution in the energy sector. The model did not attempt to find political economy solutions but instead relied on technical solutions which projected a future version of the status quo. The alternative view that

82 https://www.ucl.ac.uk/energy-models/models/uk-markal
emissions reduction presented an existential threat to the fossil fuel industry’s business model was not considered a real or near-term threat. The central assumption made by policy makers was that emissions trading under the EU ETS would smooth the bumps in the transition, enabling market forces to correct the market failure of escalating CO₂ emissions. However, by 2009 and then 2011, the UK’s domestic long-term plans made clear that the EU ETS would not be sufficient both in scope (as not all sectors were covered, requiring alternative incentives and policies elsewhere) and speed. Government intervention would be necessary to stimulate the low-carbon sector, unwind the political economy of fossil fuel dependency and invest in innovation for new technologies.

For the UK in particular, the age profile and technology mix of the electricity generating sector provided an immediate real world demonstration that broad-based policy instruments did not necessarily provide sufficient incentives at the right times. The replacement of ageing coal- and nuclear- power plants will need to take place over the coming two decades. While the logic of replacing them with low-carbon technologies was clear, their replacement would need to proceed over a more rapid timetable than would be incentivised under the continued low carbon prices of the EU ETS.

This presented a fundamental challenge to policy logic, where the pursuit of overall ‘efficiency’ of ‘least cost’ reductions in CO₂ across Europe was misaligned with the domestic investment timetable of the UK. Ultimately, this resulted in the Coalition Government of 2010-15 bringing forward an Electricity Market Reform package that combined financial incentives and regulatory measures with a strengthened domestic carbon price.

Significant opportunities for the transformation of the fossil sector were not prompted by the long-term plan alone but instead by the intersection of investment cycles, the political will for change and the CCA. For example, by 2009, the UK Government had already recognised that there could be ‘no new coal without CCS’ due to the lifetime emissions associated with any new coal power plant.

Investment timelines can create step changes in emissions reduction which do not tally with gradual emissions reduction trajectories. Analysis which accounts for opportunities of this kind can inform planning for alternative low-carbon capacity or demand-side reduction and curtail fossil fuel use to observe step changes in emissions reduction.

Recommendation: make political economy dynamics explicit, including investment timelines when developing decarbonisation targets and trajectories. Recognise the limitations of technical approaches and evaluate assumptions against lived realities through regular review and update every 5 years.

4. Oversight bodies can help ensure vested interests do not skew perspectives and provide additional weight to scientific perspectives.
The Committee on Climate Change (CCC) was established with the Climate Change Act to oversee implementation and provide tailored scientific evidence and advice. This arrangement introduced under the Climate Change Act has helped protect climate action in even the most challenging of periods. For example, the Fifth Carbon Budget was approved in the week following the UK’s vote to leave the EU amidst the resignation of Prime Minister Cameron. The formal role of the CCC in reporting to Parliament has been important in requiring government to respond in a timely and formal fashion to such advice.

The CCC was also instrumental in setting the ambition of the long-term plan. Initially the plan was set to include a -60% emissions reduction by 2050. However, progressive MPs, civil society, members of the public and business championed the latest climate science calling for a -80% reduction. The CCC was tasked with producing a recommendation regarding the ambition of the long-term target. Following their recommendation the -80% reduction by 2050 was included in the CCA adopted by the Government in 2008.

In addition to its annual progress reports and advice on Carbon Budgets and adaptation measures, the CCC has provided evidence on several topics requested by the Government including on shale gas and the implications of infrastructure investments such as the proposed third runway at Heathrow Airport. Whilst these contributions have aided decision-making, this evidence does not always represent the full story, which includes analysis of all factors which inform climate action. The strongest CCC analysis has incorporated other related factors such as, energy market and employment opportunities, impacts on air pollution and health as well as international reputation. The CCC has also been an important truth-teller in raising the profile of the need for emissions reduction in reluctant sectors including heat, transport and aviation.

The CCC also has the complimentary function of informing the Government on climate impact-related risks (not including transition risks) facing the UK and the options for improved adaptation actions. The Climate Change Act requires the UK Government to compile an assessment of the risks for the UK arising from climate change, and then to develop an adaptation programme. To support this, the CCA established the Adaptation Sub-Committee of the CCC specifically to provide advice on climate change risks and opportunities and to report regularly on UK progress on adaptation. The Government presented its second UK Climate Change Risk Assessment in 2017.

The government has been slow to act on this advice, however, and resisted prioritising even the most urgent responses such as those relating to flood risk management and food security, in part reflecting different levels of departmental engagement with this agenda. This is visible in respect to the disconnect between mitigation and adaptation responses to climate risks. Mitigation measures to reduce CO₂ emissions are not recommended as a means of responding (adapting) to escalating temperature trajectories. Nor are adaptation planning decisions informed by projected mitigation trajectories. The interconnection between the political
economy of escalating climate impacts and low-carbon transition will inevitably increase over time as each trend deepens and broadens. A strength of the CCC has been its capacity to respond to emergent transition challenges and opportunities. In the future, fully assessing the political economy of low-carbon resilient transition will require analytical oversight of intersecting climate action and impact dynamics.

Recommendation: independent institutional oversight should be created to accompany long-term planning. These institutions help to maintain scientific integrity and bolster implementation especially in the absence of political will. They should have the flexibility to evolve and respond to emergent political economy understandings of what the transition to low-carbon resilient economies will entail and its intersection with climate impact risks and adaptation.

Germany

In 2010, the German Government launched the Energiekonzept 2050 which gave headline targets for the energy sector to achieve by 2050. The plan was helpful in stimulating Government incentives for energy efficiency in housing, modernisation of industry and stimulating renewables deployment. However, the plan did not take a holistic approach to the low-carbon transition. As such the 2013 coalition treaty between the CDU/SU and SPD established a requirement to deliver a 2050 climate and energy plan during the Government’s term.

In 2015, the Environment Ministry launched a process to establish a 2050 plan, beginning with invitation-only stakeholder consultation workshops. A wide spectrum of sectors were involved, however industry did not immediately play an active role. As the plan developed it became clear that the implications would be broad and deep for an array of sectors. Industry elevated their engagement and worked in conjunction with the Finance Ministry to reorient initial policy suggestions. Measures to explicitly phase-out coal and a deadline to make all new cars emission free were both removed from draft plans. The medium-term sector targets were also removed at one point but were included in the final plan after encouragement from business for final sign off from Chancellor Merkel. The plan will be reviewed every five years and mandates the creation of a commission for ‘Growth Structural Change and Regional Development’ which will further aid implementation. The plan was announced during COP22 in Marrakech and complimented announcements of 2050 plans by the USA, Canada and Mexico.

Lessons Learnt

5. Failure to build in mechanisms which prompt revisions to long-term plans in the face of radical change limit a plans usefulness for investor planning.

The vision articulated by the 2010 Energiekonzept was quickly diverted when in March 2011 the Fukushima disaster reinstated the German nuclear phase-out. However, no revision process was triggered despite the upheaval. As a result the plan had less credibility with investors and did less to shape Government intervention.
However, although the plan was inconsistent with the market and policy framework, the plan continued to be deployed to maintain the status quo within incumbent sectors such as coal. Here it was assumed that CCS would make coal a viable option. Yet when CCS demonstration projects were cancelled by Vattenfall and RWE there was no response from planners, policy makers or the coal sector.

The Energiekonzept also failed to forecast the 2013 increase in electricity overcapacity prompted by efficiency improvements and the uptick in renewable energy. This halted investment in new coal and gas power plants which coincidentally corresponded with the Energiekonzept objectives of curtailing new investment in fossil fuels, but the plan could not be considered the driving force. The cascade of political economy effects of the growth of the low-carbon economy were not well understood and inadequately reflected in the plan. While the 2010 Energiekonzept did promote renewables, by neglecting to take a holistic view of the energy system, it contributed to issues such as coal overcapacity, falling power prices and grid insufficiency.

Despite the limitations of the Energiekonzept it did provide a crucial marker. It offered a baseline for debate, highlighting unforeseen considerations and was able to prompt investment in the low-carbon economy. It was not a plan for structural change but informed the creation of Germany’s 2050 plan which took the next steps towards more effectively addressing the political economy considerations of transition.

Recommendation: changes in foundational policy assumptions should prompt analytical assessment of their impact on the long-term plan. If deemed appropriate the process for review and update should be brought forward. In any case, long-term plans should be reviewed and updated regularly on a five year cycle.

6. Sectoral targets are contentious but are a gateway to greater structural transformation.

The technical approach taken by the Energiekonzept gave headline targets which could be considered too general or too distant for any particular sector to express significant concern. There was a general acceptance that the fossil fuel sector would be required to change but that technical solutions could be found. However, by 2015 the inescapable visibility of national and international market and policy changes resulted in the 2050 plan being intended as a vehicle for more explicit discussion of the need for, and delivery of, structural change.

As a result, the first leaked draft of the 2050 plan included sectoral targets. But the second appeared to have dropped this approach following consultation with the Ministry for Economic Affairs and Energy. However, the sector targets reappeared in the next draft following further inter-ministerial negotiation, intervention from business leaders and engagement from Chancellor Merkel. Whilst the German mining union (IG BCE) and industry group (BDI) would be resistant to the change that sectoral

targets would cause, others in retail, telecoms and finance\(^84\), wanted the explicit guidance that targets could give to investors and planners.

Early drafts also included more stringent targets for the auto industry. The subsequent weakening of targets suggested the industry (which provides 1 in 10 German jobs) had intervened to curb the impact on their sector. It is understandable that a stakeholder who has such an impact of the German economy and society would hold influence. However, this should require the need for more, not less, guidance and support for an orderly transition. The demand for electric cars is escalating and a more stringent target could have served to drive German innovation and Government support for transforming the sector. Instead, the sector will have to seek other routes forward if Germany wants to maintain its market-leader status and to combat the current high-carbon inertia which could limit transformation in this sector.

A real benefit of sector target setting was articulated by Environment Minister Barbara Hendricks who said ‘from today on, no one can talk her- or himself into believing that climate protection only affects others’. This is of course a disruptive reality but by exposing it in an anticipatory planning process, a proactive orderly transition is far more feasible. In this way all sectors can be mobilised to understand their respective climate risks and begin planning for alternative futures. Unlike the South African and UK examples the German 2050 plan is very recent: today we know that political economic implications of the low-carbon transition are inescapable. In taking a sector target-setting approach, vested interests were able to shape the ultimate plan but transparency measures and the inclusion of other stakeholders and interests helped to reduce bias. All sectors can now be considered aware and implicated in achieving the low-carbon transition: they would now struggle to feign ignorance.

*Recommendation: short, medium and/or long-term sectoral targets should be set to broaden buy-in and gives more precise guidance for investment and planning. Transparency and independence should be maintained to ensure vested interests do not unfairly bias long-term planning.*

**Conclusions**

2050 planning is both imperfect and essential to facilitating a low-carbon resilient transition. 2050 planning exercises are learning processes which expose the political economy realities of low-carbon transition. Technical modelling can aid discussion but can also be used to mask vested interests by relying too heavily on technical solutions, particularly those that are not yet considered proven as scalable solutions.

Whilst domination by vested interests can create bias which distorts outcomes it is also crucial that the rationale for their inertia is exposed. Financial, social and employment dependencies are all credible challenges which should be managed. Reducing emissions should not and will not be the sole output from low-carbon

resilient transition. What’s more, to succeed in implementation, vested interests will have to be addressed or accommodated.

Climate science is a foundational component for long-term transition planning. However, planning is best served by combining both forecasted and lived experience of climate impacts; investment trends and cycles; orderly and disorderly transition scenarios; and other geopolitical trends. As understanding and expertise related to low-carbon resilient transition grows, so should the considerations which inform long-term planning.

Drawing from these examples a number of recommendations can be made to inform future long-term planning for low-carbon resilient transition:

> **Stakeholder engagement** is crucial to exposing vested interest, priorities as well as buy-in for implementation;

> **Holistic scenario planning** incorporating all actors should be created using the best available climate science and political economy analysis;

> **Transparency** is the best tool for exposing bias and attempts to mask responsibilities;

> **Independent oversight** maintains political focus, credibility and scientific integrity;

> **Iterative review and updating should be undertaken on a five year cycle**, with mechanisms which trigger responses to significant shifts in foundational policy and market assumptions;

> **Sector targets** should be included in long-term planning to inform short and medium-term investment and planning.
CASE STUDY #3
CARBON CAPTURE AND STORAGE: IN SEARCH OF COMMERCIALISATION

This case study explores lessons learnt in the UK and the EU following the failure of policy efforts to accelerate the demonstration of commercial scale carbon capture and storage (CCS) for coal fired power generation. The weaknesses of the approach taken are discussed from the perspective of political economy barriers to deployment that were not appreciated or addressed.

Context
From the early 2000s it was widely realised that no credible 2 degree pathway existed which did not deal with the scale of coal use in power generation. From a narrow emissions perspective CCS technology was seen as a critical wedge in all serious abatement scenarios enabling decarbonisation of the fossil fuelled power sector and also for wider energy intensive industry.

At a political level, the availability of this technology was seen a critical enabler that could help to raise the ambition of key coal dependent economies within UNFCCC negotiations. Countries such as China were experiencing a huge increase in coal power plant construction, while coal played a significant role in the economies of other countries including Australia, South Africa and the USA. CCS was seen as potentially offering a route forward which addressed climate and energy security requirements simultaneously.

The original impulse in favour of CCS was therefore informed by an understanding of macro level political economy concerns in key countries, and sought to build new coalitions of interest that might be able to bring forward low-carbon technology in ways that engaged with the concerns of national decision makers.

In 2005, Europe led global efforts to avoid dangerous climate change and advance action on CCS. But this political commitment has not resulted in real world delivery over the past decade, despite Europe’s continued commitments to deep decarbonisation objectives for 2050. Indeed, in late 2014 the European Council confirmed Europe’s plans for the period to 2030, with only a very limited place for CCS envisaged as a continued topic for ‘Innovation’.

This case study considers how underlying political economy interests at the sectoral level did not align with what was considered ‘logical’ by European policy makers who...
assumed that it would be in the interests of incumbent players to advance the deployment of CCS. In order to understand the political economy drivers affecting CCS deployment in Europe, we discuss this here via an historical review of EU CCS efforts and their outcome.

2005-09: Political leadership but poor policy choices

In the 2005-09 period, CCS received strong support from political leaders following the impetus given by the UK Presidencies of the G8 and EU during 2005. As a result, the EU acted to:

- co-fund development of a ‘Near Zero Emissions Coal’ plant in China (2005);
- deliver a domestic ‘demonstration’ programme of 12 CCS projects by 2015 (2007), supported by a funding mechanism (NER300) linked to auction revenues from the EU ETS (2008), plus economic stimulus support for 6 leading projects (2009);
- create a regulatory framework for geological storage of CO₂ (2008).

However, the policy approach taken was almost entirely focused on the initial ‘demonstration’ of CCS for coal power generation as part of a ‘cleaner fossil fuels’ agenda. Any consideration of longer-term incentives for subsequent commercial deployment was limited to the inclusion of CCS under the EU Emissions Trading System (ETS). Regulatory measures such as Emissions Performance Standards were not supported by the European Commission and Member States, despite support from NGOs and the European Parliament.

This approach fitted with the international prioritization of the time which foresaw the deployment of CCS on (and via) new coal plants and / or future retrofits. However it had a number of failings:

- it excluded broader conceptions of CCS on industry, gas power generation and for carbon reduction / negative emissions. Not only do these options all receive higher public support than does the prospect of CCS on coal and lignite, but they can also provide cheaper CO₂ capture opportunities. By limiting its initial efforts to coal the EU trapped itself in an unpopular and high cost approach to CCS.
- it assumed that utilities would be delivery agents for end-to-end CCS projects, creating a market for technology suppliers, and engaging the oil and gas sector for CO₂ storage. But utilities and the coal sector have consistently retreated from action on climate change and delayed efforts on CCS. Similarly, there was no immediate business case made for oil and gas companies to provide CO₂ transportation and storage services. While a proactive approach would have played to their existing skills and assets (and long-term interests) it would also have assisted their ‘competitors’ in the coal-fired generating sector.
- it provoked a negative backlash in Germany and other Member States, where campaign groups attacked CCS as a fig leaf for continued coal and lignite
extraction without clear climate benefits,85 sometimes as a result of seemingly deliberately provocative projects that were always likely to attract a negative reaction. This poisoned the debate about CCS in Germany and undermined previous political support as well as limiting the scope of national CO\textsubscript{2} storage legislation, resulting in the cancellation of demonstration projects.

This approach was largely delivered by incumbent policy makers with a predominant focus on fossil fuel development rather than climate change. They paid insufficient attention to the application of CCS to energy intensive industries, despite two of the most advanced (but ultimately not delivered) projects in Europe being proposed for steel and hydrogen production. By tying CCS to coal, policy makers failed to provide a clear public interest case for CCS deployment. Additionally, policy makers leading on climate change sought to reduce the scope for technology-specific policies and regulatory measures, preferring to use only the ETS. Even the creation of NER300 was a struggle against policy maker resistance, and was driven by lawmakers in the European Parliament as a series of amendments to policy dossiers in the 2020 Energy and Climate Package. Advocacy efforts in this period were led by a small group of NGOs and companies – even at this early stage the utilities and coal sectors were passive participants rather than cheerleaders.

2010-15: Political disinterest and policy inertia

The subsequent experience of CCS in Europe was one of stasis. The economic crash and collapse of the carbon price destroyed the putative business case for CCS and radically reduced the level of financial support for demonstration projects via the NER300. Just one ‘large-scale’ project (ROAD in Rotterdam) survives to date, but is unlikely to be operating until after 2020, assuming a positive final investment decision is still taken. As a result of the past decade of delay, ROAD is now the wrong project, ten years too late. See Box 3 below for more details.

During this period, CCS disappeared from the list of political priorities, even within the climate change arena. Most Member States were seen as having a lack of interest or a negative view of CCS – viewing it as an expensive distraction from efforts to tackle the economic crisis, and preferring to wait to see the outcome of the demonstration programme. Furthermore, the continued growth of renewables meant that there has been a near total collapse of the proposed pipeline of new coal plants in Europe86. Only a few ‘new’ coal plants are proposed in Poland, which is more generally unwilling to make significant efforts to address CO\textsubscript{2} emissions, and is therefore not persuaded of the merits of investing in CCS.

85 This contrasts with the situation in the UK, where a strong policy framework of ‘no new coal without CCS’ was secured, which enabled (quiet) NGO support for CCS deployment within a clear decarbonisation framework.

86 Note: recent media coverage of ‘new coal’ in Germany and The Netherlands refers to plants that were permitted in 2007-08 but have been delayed in construction. Latest analysis shows that these plants will struggle to ever recover their investment costs. The case for CCS retrofit on these plants is currently implausible from a financial perspective, even though these plants are among the few which might have sufficiently high efficiencies to justify CCS retrofit on a technical basis. It should also be noted that these plants were not constructed as ‘capture ready’. A notable exception could be plants located in Rotterdam, which have the prospect of close access to CO\textsubscript{2} storage and CO\textsubscript{2} infrastructure being developed by the ROAD project.
At EU level, the European Commission began to recognize in its analyses that CCS could play a valuable role for industrial processes and even saw a greater role for gas CCS in power generation than that for coal. However, when it came to policy action the Commission remained wedded to an ETS-driven policy framework, meaning that it does not foresee substantial deployment of CCS until after 2030. Additionally, the Commission has also recognized the importance of access to CO₂ Transport and Storage infrastructures as an enabler of CCS deployment. However, the Commission is yet to drive the development of cross-border CO₂ transportation projects, instead prioritizing efforts on gas and electricity interconnections.

This combination of political disinterest and policy inertia resulted in CCS only receiving passing reference in the EU 2030 climate and energy package agreed in October 2014. This did at least include the continuation of funding for CCS under a new Innovation fund that will extend the current NER300 approach.

Box 3: CCS Status report

Original EU aim – fund CCS demonstration project in China.

Status: not delivered. Initial phases completed, but large-scale funding not provided. Some bilateral engagement with China continues at academic level, but limited Government support. US-China cooperation became more advanced.

Original EU aim – deliver 12 CCS demonstration projects in Europe by 2015.

Status: not delivered. Only the ROAD project (post-combustion coal, Netherlands – EEPR recipient) remains under development out of both EU funding programmes, but is unlikely to be operational by 2020, if ever.

Two UK power generation CCS projects (Peterhead, post-combustion gas and White Rose Oxyfuel coal) were close to submitting final bids under the UK CCS Commercialization Programme in late 2015 when capital funding was unexpectedly removed and the programme was cancelled87.

In both the EU and UK, competitive procurement processes have killed off CCS projects rather than expanding industry interest and engagement. Such competitive tendering processes has ended up pitting potentially mutually supportive projects against each other, rather than seeking to create a coherent infrastructure platform for subsequent technology deployment.

A key insight from these failed attempts is that it is incoherent for policy makers to aim for ‘commercial scale demonstration’ without providing a business case for investment that functions at similar commercial scale. CCS ‘demonstration’ projects would be expected to operate for 15+ years and would entail the


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construction of costly network infrastructure for CO₂ transport and storage. Such projects inherently require a longer view forward that typical short-term R&D projects, and requires that incentive mechanisms and regulatory frameworks are made ‘bankable’. Furthermore, in the absence of a clear view of an expected deployment pathway there is little incentive for private sector interests to shoulder increased costs and commercial risks. In the case of CCS, the supposed neat divide between ‘demonstration’ and ‘deployment’ has been found to be an undeliverable theoretical abstraction.

Original EU aim – create regulatory framework for CO₂ storage.

Status: EU legislation enacted in 2009. Slow transposition into national laws since then, with some countries (e.g. Germany, Austria) incorporating more restrictive provisions. An official evaluation of the EU directive found no need to re-open legislation, but recommended improvements to guidance on liability issues and implementation of currently loose ‘capture readiness’ requirements.

Practically, however, just one CO₂ storage site has a valid permit at present (for the ROAD project). Europe has suffered from a chronic underinvestment in storage characterization which will require targeted action to correct over the coming decade. This further reinforces the importance of maximizing the value of CO₂ stored, rather than seeking to maximize CO₂ volumes from coal and lignite (as would typically be the case for CO₂-EOR projects elsewhere). Throughout this period, the utilities and coal sector firmly retreated from CCS. The economic crisis and continued deployment of renewables combined to challenge their business models, with their response being to priorities pursuit of capacity payments for existing fossil fuel power plants. They also put pressure on equipment suppliers to neuter their nascent support for CCS deployment incentives and regulation, and blocked attempts to develop alternative policy options via the CCS technology platform ZEP. The reality has been that they have been effective at delaying action and over-claiming the costs and difficulty of CCS88 (See Box 3 below).

As a consequence, CCS technology has been left in the strange position where it has not had a dedicated industry ‘lobby’ proactively pushing for its rapid deployment. Beyond a handful of specialist (but small) CCS project developers, even those companies who have been most positive about the prospects for CCS have always had more pressing priorities for policy action. The vast majority of private sector actors around CCS have been content to see it take a slow path, which resulted in only weak

88 CCS is of course costly and difficult, particularly when compared with the low-cost and ease associated with unabated CO₂ emissions. But its cost and difficulty is within the bounds of real-world investments and engineering deliverability on mega projects regularly delivered by private sector companies and / or governments. A comparison with the capital costs and timescales for delivery of mammoth oil and gas exploration, production and export projects shows that CCS could of course be delivered – but only if policy makers were to provide a robust business case and private sector interests were to actively want to do it. In this light, the Gorgon CCS project in Australia provides an example of how large-scale CCS can be mandated as part of the regulatory framework for gas production and export. While expensive, the $2bn AUD CCS portion of the project is small compared with the gargantuan overall cost of $55bn AUD. See https://sequestration.mit.edu/tools/projects/gorgon.html.
efforts to counteract the efforts by utilities and coal companies to actively slow down progress.

At the same time, CCS has also suffered from having very few ‘friends’ in civil society and policy making. The majority of campaigning NGOs have taken hostile or agnostic positions on CCS in the face of supporter antipathy and concerns over its association with fossil fuel interests. Those NGOs with a more positive outlook on CCS have had very limited resource to help keep CCS alive in the EU policy debate, but with insufficient capacity to rebuild a more effective public interest advocacy network to counteract the negativity of utilities and fossil fuel interests.

Box 4: Political Economy trumps Economic Theory
The experience of CCS in Europe over the past decade has been that underlying political economy interests at the sectoral level were at odds with what was assumed to be a ‘logical’ approach. Policy makers had assumed that incumbent players would want to advance CCS deployment as a means of protecting high carbon assets and business models. In reality, utility companies and the coal sector perceived CCS as a threat to their assets and in conflict with lobbying positions.

Drawing on close engagement in CCS policy debates and multi-stakeholder coalitions and official technology platforms, we can identify six core strands to this opposition:

1. The starting point for corporate positions of coal companies and some utilities was that climate change was not a problem – either through overt denial of climate science or as part of political delaying tactics. A willingness to act on CCS would have meant that they recognized the need to act on climate change, undermining their positions of denial.

2. Utilities in particular took a lobbying position that was nominally supportive of the EU ETS, but only in a weak form. They used this as a shield to push back against proposals for regulation. (Their market fundamentalism was deeply ironic, given they had only recently emerged from complaining against liberalization).

3. Interestingly, the early engagement in CCS from some of the leading utilities was from a proactive engineering R&D standpoint that sought to respond to the climate challenge. This was particularly the case with companies such as Vattenfall that had strong internal R&D pedigree. However as CCS became closer to policy corporate executives moved in to remove frontline engineers from the discussions and took a much more negative and obstructive corporate position.

89 A notable exception is the continued significant presence of CCS deployment in modelling exercises and policy scenarios, which says more about the ability of theoretical CCS to generate attractive pathways than any real world influence from the analytical community in favour of CCS deployment.
4. Utilities did not want to see CCS ‘demonstrated’ in the short-term as this would then provide a benchmark for new coal power plants. This was in conflict with their efforts to continue building new unabated coal power plants at the time.

5. Utilities also feared that if CCS were to be demonstrated (or, worse, determined to be ‘Best Available Technology’) then they would be under pressure to retrofit CCS to existing plants (particularly the newest ones) via regulatory measures. This would have resulted in significant costs and/or reduced the value of existing assets. The further irony here is that these write-downs happened anyway as a result of their failure to anticipate increased renewables deployment (as discussed in the introductory section to this paper).

6. All of the above points were further compounded by the fact that the coal sector and utilities realized that even beyond the R&D and scale up phase (which governments might support), CCS was going to be expensive due to the efficiency penalty and also be a new and difficult business model to make work, i.e. areas outside of coal expertise in terms of CO₂ transportation infrastructure and geological storage, adding risks and liabilities to coal generation.

2016 and beyond: Rebuilding the public interest case for CCS

Despite the absence of a central role for CCS within the EU2030 package, there have been a small number of more positive developments in the broader CCS landscape. These offer an opportunity to rebuild advocacy networks on the basis of positive intent from participants and enable the communication of a public interest case to policy makers, politicians and citizens.

This includes:

> Most importantly, the EU has maintained its support for overall CO₂ emissions of 80-95% by 2050. EU Member States are also among the group of countries most positively considering further deep decarbonisation options in the UNFCCC process, including ‘net zero’ goals. These approaches increase the likelihood of further consideration of CCS and negative emissions / carbon reduction strategies by policy makers.

> In early 2015, utility members decided to leave ZEP (the EU technology platform on CCS). They instead retreated to a non-functioning taskforce within their existing industry association. This is positive news, as they had been barriers to collective agreement within ZEP, particularly in respect to policy options that could drive CCS deployment. (Notably this extended to financing options as well as regulatory measures). In parallel to the challenges presented by the shape and scale of CCS technology, the economic crisis combined with increasing renewable penetration to challenge utility business models. Their response was to prioritize the pursuit of capacity payments for existing power plants, and to drop any pretence at pursuing proactive CCS solutions.
On a related point, the prospects of new unabated coal construction in Europe are now at a standstill (beyond a handful of projects in Poland and the Western Balkans). The prospects for any proactive pursuit of CCS retrofits to existing coal plants in Europe are currently non-existent. Any progress on CCS will be made beyond its application to coal power generation.

There are positive signs that key companies from the cement, steel, biofuels and chemicals sectors may now be willing to join a refreshed ZEP that can focus on the broader CCS agenda (rather than its previously narrower official remit as the ‘European Technology Platform for Zero Emission Fossil Fuelled Power Plants’).

More broadly, the ‘2050 Roadmap’ exercises undertaken by the trade associations for Iron & Steel, Cement, and Chemicals have all identified CCS availability as a key enabler of their ability to meet deep decarbonisation objectives out to 2050. While there are still significant differences of opinion within industrial sectors, the positive engagement of progressive companies is a major shift from the blocking approach taken by utilities. However, the risk remains that industrial sectors will try to use the prospect of the future application of CCS as a shield against needing to act in the short-term, just as the utilities positioned themselves previously. The ‘enthusiasm’ of some industry players for carbon capture USE and storage (CCUS) must therefore be viewed with scepticism. Beyond a few niche high value applications, CO2 utilisation is currently unlikely to make any significant contribution to climate mitigation.

A common theme emerging across sectors and locations is a recognition that CO2 transport and storage infrastructures should be provided in advance (ideally by publically-owned infrastructure providers or via a contractor-to-the-state business model), and that they should be overseen by regulators to enable equitable access to emitters. These challenges are all amenable to resolution through European policy initiatives and regional prioritisation of the North Sea and Baltic.

The Norwegian Government has taken this approach in its renewed efforts on CCS. Currently, three industrial emitters (Fertiliser production, cement, and waste-to-energy) are undertaking development work on CO2 capture solutions ahead of a final selection of project(s) for full scale operation by 2022. The Norwegian Government has taken on the strategic development and delivery of CO2 transportation and storage solutions via national oil company Statoil, leaving industrial emitters to concentrate on development of capture solutions90.

This industrial recognition of the need for proactive solutions to the CO2 infrastructure challenge is also being taken forward on a collaborative regional basis elsewhere, providing a positive reference point for policy makers and politicians.

The Teesside Collective in North East England is bringing together local governments and industrial players to develop an engineering masterplan for a CO2 network that can enable cost-effective decarbonisation of multiple

industrial emitters. The core project participants come from Hydrogen, Chemicals and Plastics sectors. Importantly, the project is also undertaking analysis of potential financial incentives that could drive deployment of CCS on industry.

> In Rotterdam, the CO₂ Smart Grid concept is being advanced by a coalition of 26 public, private, and non-profit stakeholders. The project considers how it can expand on the existing use of captured CO₂ from industry in greenhouses and create opportunities for CO₂ use within the circular economy as well as for geological storage.

> Research institutes and industrial emitters in Nordic and Baltic countries are cooperating on assessments of CO₂ storage opportunities and the development of combined pipeline/shipping networks for CO₂ transport, through projects such as NORDICCS.

> In parallel, several players within the gas sector are advocating for further efforts to deploy Hydrogen as a low-carbon energy vector, with gas-to-hydrogen conversion (with CCS integrated as is already the case at the Port Arthur (USA) and QUEST (Canada) refineries) as a means of providing sufficient scale ahead of potential future renewables-to-hydrogen production via electrolysis. The Oil and Gas Climate Initiative is likewise prioritising CCUS as one of its priority areas, but its proposed shared $1bn investment over 10 years has been criticised as a ‘miniscule’ contribution compared with their combined annual profits or capex commitments to continued exploration and production⁹¹. Beyond Statoil’s role in the Norwegian CCS strategy there are no signs that other oil and gas companies are proactively pushing to develop new business models for CO₂ transportation and storage.

Lessons learned: Europe’s failure to deliver

Overall, important international lessons can be drawn from Europe’s experience:

> the coal sector and (liberalised) utilities have proven themselves incapable of delivering CCS, even within the context of an overarching climate policy and emissions trading. In Europe, it is clear that delivery of CCS will have to go round them, not through them. They have continually blocked action on CCS and undermined political and public support, paying only lip service to the prospect of longer-term deployment. Engaging the gas sector and industrial emitters at an earlier point would have been more productive.

> the assumption that new unabated coal construction would provide the basis for CCS deployment in Europe has not held true. Reduced demand for electricity and the continued deployment of renewables have combined with campaign efforts to bring new coal construction to a near standstill. There is very limited scope for CCS retrofit on existing plants. Policy makers and regulators must now push back against attempts to secure life extensions and capacity payments for

inefficient old coal power plants. A number of EU Member States may be able to agree accelerated coal phase-outs over the coming year. CCS retrofit options may feature in these as a potential compliance mechanism (as is already the case in Canada) but are unlikely to result in any significant deployment of CCS.

> **a narrow focus on deploying CCS via a carbon price / emissions trading does not work.** New business models are instead required that combine the provision of enabling infrastructures of CO\(_2\) transport and storage with targeted deployment incentives. There is no prospect of a carbon price sufficiently high to drive CCS deployment this side of 2030, let alone one that is also politically sustainable. More fundamentally, an ETS-led approach would drive CCS on lignite and coal power generation, rather than on gas power generation, industrial processes and carbon reduction / negative emissions. Yet these uses offer the most social value per t/CO\(_2\) stored, and an engaging public interest case for CCS.

> **without a proactive approach led by the state to develop the necessary enabling infrastructures of CO\(_2\) Transport and Storage, negative emissions will remain only a theoretical means of mitigation in climate models.** Even if negative emissions were to be rewarded via a carbon price regime, there is no means for any private sector entity to take on the anticipatory and capital-intensive investments required to create CO\(_2\) transport and storage infrastructures. The failure to deploy CCS in Europe shows the weakness of relying on ‘logical’ technology deployment pathways that fail to engage with business models and the interests of incumbent actors.

> **Governments cannot expect to overcome incumbent interests through the provision of project finance or vague statements of political intent.** The private sector is unlikely to respond and bring forward the technology as anticipated in economic theory or climate-economy models. Policy makers must proactively shape market frameworks and create new regulators and delivery institutions able to fast track the creation and operation of new public interest infrastructures for CO\(_2\) transportation and storage.

> **To date CCS has proven to be more robust as a modelling concept than as a scalable real world decarbonisation technology option.** This in turn poses a challenge to modellers, analysts and policy makers to better consider the plausibility of CCS deployment pathways and its path dependency on anticipatory investments in CO\(_2\) transportation and storage infrastructure that have not yet taken place. Modelling scenarios and policy approaches need to be robust to the increasing likelihood of the non-availability of CCS and should identify alternatives (and any associated increased costs). Only by forcing a time-bound decision point will policy makers be able to grasp the scale of the CCS deployment challenge.

These lessons must be taken into consideration if the prospect of commercial CCS technology is to become a reality. This is critical as current pathways to limiting climate change to 2 degrees C (or below) still contain considerable reliance on abatement potential coming from the use of CCS for remaining fossil fuel combustion, energy intensive industry, and negative emissions.
What could have been done differently?
Proactive efforts to engage the gas sector and industrial emitters from the cement, steel, biofuels and chemicals sectors at an earlier point would have been more productive, as their long-term interests and skill sets are more closely aligned with the deployment of CCS.

More emphasis should also have been given to developing new business models that combined the provision of enabling infrastructures of CO$_2$ transport and storage with targeted deployment incentives. But this requires greater willingness for strategic engagement by the state to create ‘market maker’ infrastructure providers (as has often been done in the past to accelerate the deployment of public interest infrastructures as diverse as sewage systems and gas pipelines). This is not a question of ‘picking technology winners’, but does require a willingness to identify the key geographies and geologies that can provide cluster locations for targeted CCS deployment.

Experience shows that Europe will only be able to advance CCS deployment if it can adequately address sectoral political economy challenges, requiring a more proactive approach by policy makers. Despite the delays of the past decade, Europe has valuable assets that it can further develop over the coming 5 years as a contribution to international climate efforts:

> an existing overarching regulatory framework that can provide confidence in the safe and effective delivery of CO$_2$ storage as a climate mitigation strategy;
> the opportunity to re-define and communicate a clear public interest case for CCS, which positions CCS in support of deep decarbonisation and renewables deployment, not in opposition to them;
> the tentative engagement in CCS from industrial emitters, local and regional governments, and gas sector players as potential positive advocates for CCS, providing a better basis for future CCS deployment than that possible via utilities and coal sector;
> the emergence of a new policy agenda centred on the creation of enabling the CO$_2$ transport and storage infrastructure around a series of CCS clusters and hubs, with regulatory oversight to enable equitable access by industrial emitters; and
> Norway’s proactive approach to industrial CCS and CO$_2$ transportation and storage infrastructure. This provides a real world laboratory for efforts seeking to create the new institutions and incentives that will be required to shape the combination of business models, market structures, and infrastructure platforms necessary for deep decarbonisation.