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Climate risks and regulation

Conference report

**Conference organised by the Club of Regulators in cooperation with
the OECD Network of Economic Regulators**

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OECD Network of Economic Regulators



Table of contents

1st roundtable: Financial Stakes	3
Uncertainties about the economic consequences of climatic change.....	3
French banking and insurance sectors facing climate change-related risks	5
Climate risk and financial regulation	7
Promoting transparent sustainability reporting and market disclosure.....	9
Climate change in Africa: macroeconomic impact.....	11
Debate.....	12
2nd roundtable: Critical network infrastructures	14
Climate change risk regulation: safety, security, environment and health	14
Energy: transitions and risks.....	16
From traditional to clean energy: insights from the German energy transition	18
Debate.....	20

Climate risks and regulation

Conference of the Club of Regulators
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Climate change triggers a new set of risks: transition risks derived from a shift in the socio-technic paradigm in many domains, physical risks driven by extreme and unforeseeable events, and domestic and international political risks. These intertwined risks challenge the ability of regulators to guarantee a level playing field and to offer predictability and security to investors, operators and users. New risk transmission mechanisms might emerge in the financial and insurance sectors to tackle climate-related issues.

This conference was an opportunity to discuss both the evolution of risks and potential solutions in network industries and the financial and insurance sectors.

1st roundtable: Financial Stakes

Eric Brousseau
Scientific Director, Club of Regulators

Climate change is associated with three types of risk: the risk that natural disasters will damage existing infrastructure; the risk of transitioning to low-carbon economic models and the associated risk of re-shaping entire sectors and business models; and the risk of geo-political impacts, particularly in less developed countries where migration and territorial conflicts could compound problems and spill across borders. Many industries, sectors and countries are not prepared to understand or deal with these risks.

Uncertainties about the economic consequences of climatic change

Philippe Trainar
Former Chief Risk Officer, SCOR Group & Director, Chair on Insurance – CNAM

Risk is a very important notion for educating people about climate change and convincing them that it poses a genuine threat. Presenting climate risk as a stochastic risk encourages denial of those risks, but it does remain possible to intervene and take appropriate action. The vast and multiple possible consequences of climate change give rise to a huge number of uncertainties. In addition, climate change is only one of an increasing number of risks that the world needs to confront so a degree of arbitrage is required to weigh these risks and allocate resources to managing them. From a macro-economic perspective, the greatest uncertainty is not climate risk itself, but the economic consequences of climate change. We must also consider how to manage climate risk given the need to involve climate change deniers in the conversation.

The number of natural disasters is increasing everywhere around the world and the cost of natural disasters is also increasingly dramatically. This increase in natural disasters cannot, however, be unequivocally linked to climate change. A detailed examination of these events provides little certainty about their causes. Observations showing that climate change will result in more hot days with higher temperatures and fewer cold days can be verified and linked to climate change. Events such as droughts, storms, tropical cyclones and major floods, on the other hand, are often related to local climatic variations and it is difficult to demonstrate a strong, clear correlation with global climate change. It is possible that climate change may even reduce the frequency of events such as hurricanes, although those that occur are likely to be powerful. The complexity of the relationships between climatic events means that risk can be interpreted as stable, increasing or decreasing in line with the chosen data. It is extremely difficult to predict future risk.

The cost of natural disasters is increasing: as the world becomes wealthier, natural disasters destroy more property and that property tends to be more expensive to replace. Political decisions, such as the French compensation system which creates a perverse incentive to build in areas that are susceptible to flooding, can also increase the cost of

natural disasters.

Different models of climate change adopt different strategies for assessing risk and probability. The reality is that this is a stochastic world and not a deterministic world. The climate debate, however, is taking place between deniers – who claim zero risk – and people who are convinced that the world is heading towards a climate catastrophe with temperatures rising by more than three degrees. Reasoned debate is difficult. In addition, there is little understanding of how sea floors and ocean currents influence and are influenced by warming, even though these factors could have a major impact on climate change. Existing predictive models are limited and even small variations in simple assumptions can have a huge impact on a model.

As a result, there are many uncertainties about the economic impact of climate change. There is a global trend towards decarbonisation but it is unclear whether that curve is a short-term fluctuation or a long-term shift. Again, there is uncertainty and a number of scenarios based on speculation about future behaviour. Some people believe that we must work on the basis that an increase in temperature of two degrees by 2050 is realistic and inevitable; others argue that this is fatalistic and that current efforts should be focused on keeping the increase below that level. Whatever the truth of the matter, this argument is effectively delaying a decision on the price of carbon, making it an argument in favour of immobility.

The degree of uncertainty in current models cannot be over-estimated and the results of these models are uncertain and continue to evolve over time. In a scenario of profound uncertainty, the only strategy that makes sense is that of Pascal's Wager: if climate change is anthropogenic and we do nothing, the cost will be vast; if climate change turns out not to be anthropogenic then even if we do something, the cost will be limited. From a strategic risk management approach, it is totally legitimate to act on climate change if only 30% of the population think it is a problem. Currently, around 54% of the global population think very rapid action is required and 78% support an international agreement on the subject. It is strange, therefore, that an international agreement on carbon pricing has not been reached. One issue around the discount rate relates to the question of whether future generations will be more wealthy than current generations, namely the degree to which climate risk will affect economic growth and whether the cost of fighting climate change now will outweigh the economic benefit of those measures to future generations.

Personally, I believe that it makes more sense to price carbon than to tax carbon-generating activity, and that it is better to tax than to regulate through formal limitations. I believe that carbon pricing is the most flexible, rapid and effective way to reduce the use of carbon. Responsible governments should act to protect populations from the risks associated with warming above 2°C. Insurance companies should expand their product portfolios to enable people to protect themselves more effectively.

French banking and insurance sectors facing climate change-related risks

Anne-Lise Bontemps-Chanel

Head of the Insurance Risk Analysis Department, French Prudential Regulation Authority (ACPR)

The ACPR recently released two reports that present the current climate change-related risk management strategy of French banks and insurance companies. The ACPR aims to implement favourable financial conditions that will foster an orderly transition to a balanced and sustainable economy and incentivise the sector to provide more information on its risk exposure. It is also working to protect financial institutions from the detrimental effects of climate change and any instability that arises during the transition to a low-carbon economy. Finally, the ACPR is monitoring the way in which banks and insurers are implementing the 2015 Energy Transition Act for Green Growth and are mobilising around the goals of the Network for Greening the Financial System (NGFS), which was launched by the Banque de France in 2017.

As part of the 2015 Energy Transition Act for Green Growth, companies must be more transparent about their exposure to climate risk. Banks must perform regular stress-testing around climate change-related risks, while institutional investors must state how their investment policies take account of environmental, social and governance criteria, including climate change. The first report of the NGFS makes recommendations on supervision and micro-prudential regulation, scenarios and macro-financial impacts, and support for the development of green finance.

The ACPR has conducted several surveys among banks and insurance companies to assess progress on the governance of climate change risks and also discusses these issues with stakeholders. Since 2016, there has been a trend towards increasing implication at board level and a progressive integration of climate change risk into companies' broader risk management frameworks. However, practices remain heterogeneous, in part due to non-prescriptive laws.

Insurers are focusing primarily on the physical risks of climate change, followed by transitional and liability risks. Changes in temperature are expected to have a relatively low impact in North America and Europe so insurers and banks in these areas are likely to have relatively low exposure. French banks assess physical risks as not material due to their low exposure. The concern is that banks expect insurers to bear the risk. Although insurers are adopting a broad range of measures to mitigate physical risks, they still expect reinsurance companies – or possibly the state – to further mitigate those risks for them.

Transition risk is an increasing concern and practices and exposures are heterogeneous across the sector. One of the main difficulties faced by the financial is that there is still no consensus on how to measure this risk. Another is that banks and insurers feel no emergency to adapt their practices, as they do not foresee any deep and sharp readjustment of the markets due to climate changes. At end 2017, the general exposure to transition risk in France is roughly estimated at at least 10% of assets, the main driver in investment decisions being potential revenues of the investments. Insurers are

progressively implementing tools to analyse these risks but they tend to perform analysis on the basis of carbon footprint which, while it marks a positive shift, provides inadequate information as it is based on historical data. More prospective, forward-looking analysis is required. It would also be positive to see banks reduce their exposure to the fossil fuel sector.

In general, banks and insurers are failing to consider their exposure to liability risk. Although direct liability is difficult to establish, indirect liabilities could expose them to significant fines or damages. The sector lacks specific processes to assess exposure in this area and tends to view it as a form of reputational risk.

The ACPR recommends that banks and insurers should define their climate change-related strategy and operational management more precisely; improve their internal governance and risk management by clarifying and allocating roles and responsibilities in this area; explicitly integrate climate-related issues into their internal risk management frameworks; and adopt forward-looking risk assessment methods that enable climate-related risk scenarios to be linked to their usual risk parameters. To support this, the ACPR is creating two dedicated working groups covering the governance of climate risk and the metrics and analysis of simulated climate change scenarios.

Climate risk and financial regulation

Matteo Rava

Senior Policy Officer, European Securities and Markets Authority (ESMA)

ESMA is an independent authority of the European Union (EU) tasked with ensuring the stability of the EU financial markets and enhancing investor protection. It works with co-legislators to establish a common rulebook for financial legislation across the EU, promote supervisory convergence and protect investors. It is currently working closely with the European Commission, the European Banking Authority and the European Insurance and Pensions Authority to develop harmonised rules on sustainable finance across all European financial sectors.

Sustainable finance is high on the agenda of the European Commission, which issued an ambitious ten-point Action Plan in 2018 designed to ensure the financial system supports the goals of the Paris Accord. ESMA has provided technical advice to the European Commission on some of these topics and is working on its own guidelines for firms and national competent authorities. ESMA is focusing on sustainability in financial advice and on the duties of institutional investors and asset managers because it believes that intermediaries can play an important role in re-focusing the entire financial sector towards sustainability. European financial legislation is already clear that intermediaries must act in the client's best interests. However, the importance of promoting sustainability and limiting sustainability risk as part of that duty is not clearly spelled out. Consumers can access information about sustainability when they want to buy something in a supermarket but, when it comes to investing their life savings, they often have no way to understand the climate and social consequences of their decisions. The Commission wishes to address this paradox to ensure that consumers are able to make informed choices.

The technical advice provided by ESMA to integrate sustainability risk into the corporate governance of investment firms follows a principle-based approach to EU legislation and amendments to general organisational requirements, risk management, internal audit processes and methodologies, and conflicts of interest. The evolving nature of sustainable finance phenomenon means that setting out precise legislation with detailed requirements could create difficulties around arbitrage and implementation. These changes will have a huge impact on the daily activity and culture of financial firms that are used to managing complex financial risks but will have to adopt a new set of skills and knowledge to manage more challenging and nebulous concepts like climate and social risk. A tightening of rules around conflicts of interest is intended to protect consumers to ensure that the inclusion of Environmental, Social and Governance (ESG) considerations in the advisory process does not lead to mis-selling practices or misrepresentations and does not damage the interest of the client. Discussions are ongoing around how firms should disclose their sustainability risk management approach to stakeholders, the development of a standard, meaningful and reliable methodology for calculating sustainability risk, and the availability and reliability of data sets.

Product governance requires investment firms to consider their end customer from the initial design and development of a financial product through to the point when it is sold. Manufacturers and distributors must specify the complexity and risk of the product and,

when relevant, to specify its sustainability risk. According to ESMA's technical advice, firms will need to consider ESG characteristics of investment products (where relevant) when they define their target market. Issues currently under discussion include the update of systems and processes before an official EU-wide labelling system is complete, and granularity, namely the challenge of identifying products that are sustainable in some respects but not others.

Investment firms providing investment advice and portfolio management services have an obligation to ensure that products match their clients' objectives, investment experience and financial situation. In future, firms will also need to seek information about their clients' sustainability preferences and understand the sustainability profile of the products they offer. ESMA, at this stage, is not imposing a specific methodology for how to perform the assessment of suitability but has provided firms with some initial guidance on approaches that could be used. Financial intermediaries will need to pay attention to their clients' ability to self-assess their capabilities and experience and accurately reflect their preferences through questionnaires. This is already a consideration in purely financial discussions and the results are likely to be even more complex and inaccurate when people are asked to make judgements around sustainability.

Promoting transparent sustainability reporting and market disclosure

Julie Ansidei

Head of Strategy and Sustainable Finance, French Financial Markets Authority (AMF)

The European Commission's ambitious and comprehensive action plan aims to change how the financial markets work and how they assess risks. It contains a number of useful levers and considers the full range of actors, alongside financial intermediaries, including listed companies and retail investors, as well as facilitators such as ratings agencies and index providers. It seeks to encourage greater sustainability on the demand (by incorporating sustainability into investment advice, and asking the client preferences for environmental, social or governance (ESG) considerations), and supply (by encouraging the supply of more sustainable products) sides. It looks not only at risks, but also at opportunities, and support the emergence of new, greener sectors (notably via the development of a green taxonomy).

The Commission's Action Plan three main priorities are managing risk, reorienting capital towards more sustainable investments, and increasing transparency and market disclosures. Climate risk lies beyond the horizons of most political and financial actors and more extensive and higher quality information is needed to facilitate effective decision making. In recent years, the focus on climate risk has significantly increased in the financial sector and investors and shareholders are demanding more transparent communications around sustainability. Corporations are realising that transparency around their corporate social responsibility strategy can have a positive effect on their reputation and perceived resilience to climate and other ESG risk, in part by enabling them to be included in the growing number of sustainability indexes.

Since 2015, the privately-led Taskforce on Climate-Related Financial Disclosure (TCFD) has produced a series of recommendations on corporate disclosure around governance, strategy (including scenario analysis), risk management and metrics and targets. It includes specific, challenging recommendations for the financial system and for economic sectors that are particularly exposed, including transport, energy and agriculture. At European level, the European Commission has proposed that the TCFD recommendations on corporate disclosure should be implemented to facilitate the assessment of climate risks and opportunities. This voluntary measure will be rolled out through amendments to existing Commission's Guidelines on non-financial reporting. Given their relevance to investors, employees and other stakeholders, the European Commission is also considering expanding these recommendations to cover both financial and environmental materiality: if climate-related information is essential for the understanding of a company's development and performance or its positive and negative external impacts, then it should be disclosed to the market.

This approach represents a shift in mindset in corporate reporting, which is still heavily debated. On the one hand, sustainability reporting is focused on the impact of sustainability issues on the company and its future financial performance. On the other hand, sustainability reporting is also about the company's contribution to the public good, its non-financial performance, and the consideration of externalities.

This change also reflects a growing trend for investors to seek not only to avoid investing in unsustainable activities, such as coal, but also to consider the potential impact of their investment alongside more traditional objectives of risk and return. Again, transparency is central to avoiding greenwashing and ensuring investors have access to effective, accurate metrics around the environmental or social impact of their investments. Will transparency be sufficient to help solve the obvious market failures attached to climate change? We should not expect it to be sufficient to persuade companies to “prioritize the planet over profit”, as recently pointed out by the Chair of the International Accounting Standards Board (IASB), but it is an important prerequisite.

Challenges are numerous, starting from the quality of data (e.g. scope 3), the ability of supervisors to review the information, the risk of information overload, and the issue of comparability between companies. But there are some encouraging signs: more consistent reporting frameworks are being developed; regulators are testing their supervisory approaches and how they can help improve the quality and relevance of the information, and major market participants such as credit rating agencies and largest investors such as Blackrock are progressively changing their approach to ESG. A growing number of jurisdictions are now considering extra-financial information as key, including outside Europe. For instance, Japan will be implementing the TCFD recommendations and China, which has developed a very comprehensive strategy for green finance, will make climate disclosure compulsory by 2020.

The AMF has two key responsibilities in this area. First, to help market participants (issuers, asset managers) by raising awareness and helping them to improve the way they address and manage climate risk. Second, to supervise the quality of the information available to the market and to clients to maintain investor confidence and avoid greenwashing. The new French legislation PACTE has acknowledged this role by defining an explicit mission for the regulator, which should be watchful of the quality of the information provided by asset management companies on their strategy regarding climate change. This clearly reinforces our responsibility in the area.

Climate change in Africa: macroeconomic impact

Maëlan Le Goff

Research Economist in the Franc Zone and Development Financing Division, Banque de France

The macroeconomic impact of climate change in low-income countries, particularly in Africa, is important for central banks. Africa is experiencing rapid demographic and economic growth and is becoming a major actor in the world economy. At the same time, along with Asia it is one of the regions that is most vulnerable to climate change. Climate change is expected to have a significant impact on migration, trade and conflicts. For example, by 2060, the OECD expects climate change to result in GDP losses of 3.8% in sub-Saharan Africa and 3.7% in South-East Asia. Understanding this situation is important for climate-change stress testing and for designing systems to mitigate the impact of these changes.

Africa faces a wide range of climate change risks, notably desertification in southern and western Africa, deforestation, and coastal flooding that will reduce the amount of usable agricultural land. Droughts are expected to cause significant loss of life: deaths from African droughts between 1980 and 2018 exceeded the death toll from all natural disasters elsewhere in the world during the period. A new index that measures the vulnerability of countries to climate change by assessing their exposure to factors such as aridity, rainfall, temperature rises and storms emphasises the exposure of African countries and highlights the particular vulnerability of countries around the Sahara and on the coast.

Climate change is expected to have a significant effect on African food output and food security. An increase in temperatures and natural disasters will negatively affect food production, although this will be partially offset by opportunities created by increased rainfall in other areas. High temperatures and natural disasters will damage infrastructure and capital stock with knock-on effects on trade, transport and tourism. Countries will have to invest in adaption, re-allocating capital from productive targets. Firms affected by natural disasters will be less productive, have less liquidity and be at greater risk of default although there are also likely to be some minor benefits, including the potential to invest in more modern, sustainable infrastructure if existing low-quality infrastructure is damaged by climate events. Labour productivity is projected to decline as extreme temperatures, particularly in conjunction with humidity and air pollution, tend to increase absenteeism, increase mortality and morbidity, and reduce cognitive capability.

These factors will negatively impact government revenues and public finances while simultaneously increasing demand for spending on infrastructure, creating a vicious cycle that will make it increasingly difficult for governments to react to shocks. Climate change will also worsen poverty and inequality, with the less well-off being more exposed to negative impacts. It is currently estimated that 25 million to one billion people will migrate due to climate change by 2050. These mass migrations will create conflicts.

As the Bank of England recently noted, a consensus is emerging around the consequences of global warming and the channels of transmission. Nevertheless, it remains difficult to quantify the effects on growth rates. Although less research has been conducted into natural disasters, their negative impact on infrastructure in the short-term can be replaced by a positive impact over the long term due to reconstruction work.

More research is required into the impact of climate change on economies, notably transition risks, the difference between oil-producing and oil-importing countries and the impact of technological changes, and to increase data collection in low-income countries. Examining the effect of climate change in low-income countries is also important to enable the design of appropriate policy responses to help these countries increase their resilience and highlight the wider public good of protecting these countries from climate risk.

Debate

The Mexican government is promoting climate-related insurance as climate change presents broad-ranging risks that will affect everyone and will need to be funded. It pays the premiums for farmers. Regarding the effect of natural disasters on financial stability, France should take advantage of the extensive statistical and actuarial expertise that exists to upgrade its old-fashioned approach. As a meteorologist, I was surprised to hear the claim that global warming is not necessarily the most significant factor driving increased risk. What factor could be more significant?

Philippe Trainar

Natural disasters are also driven by human activity, such as increasing population density in areas that are prone to flooding. These developments have not created the risk but they have changed the nature of the risk and dramatically increased its cost. Hurricanes and flooding have extremely complex causes that cannot simply be attributed to climate change.

I am not convinced regulation is the best tool for tackling climate change. We must invest to increase the number of tools at our disposal and reduce uncertainty. The current regulatory approach serves to increase uncertainty by raising the question of liability, which brings the question back to our current activities rather than on investments in future activities. If governments knew the price of carbon, they would have a clear idea of the economic consequences of climate change and that would stabilise questions around liability for companies, insurers and financial institutions.

Toutes ces interventions ont été très intéressantes, mais aussi très centrées sur les activités financières et bancaires. Peut-être la gouvernance des institutions dont il a été ici question n'est-elles pas suffisamment représentative des différents aspects de ce débat mondial. Peut-être le débat y gagnerait-il si ces travaux étaient davantage connectés avec le monde scientifique – je pense notamment à Jean Jouzel – et avec le monde des ONG environnementales. Un consensus est ressorti des accords de Paris pour se limiter à une augmentation de température de 1,5°C. Or, je vois qu'il est ici question de 2,5°C : c'est courir à la catastrophe. Il est essentiel de s'en tenir aux accords de Paris.

Anne-Lise Bontemps-Chanel

Some insurers use sophisticated analytical methods or buy in appropriate expertise but many do not truly understand what the measures mean or how they should affect decisions. The extent to which insurers implement climate-related measures is usually closely related to the involvement and degree of understanding demonstrated by the management board.

Matteo Rava

We do not underestimate the complexity of this topic. Investors and asset managers place funds over very long periods and must consider the impact of their decisions. Legislation is required to ensure this happens, but legislating too quickly could also introduce errors into the system. We do not have much time to get this right but we are doing the best we can.

Julie Ansidei

Accessing and developing relevant climate expertise and adequate resources is a challenge. Progress is speeding up but there is an expertise gap at regulators. The recent French legislation PACTE has specified a new mission for the AMF, which should be watchful of the quality of the information provided by asset management companies on their strategy regarding climate change. This is the continuation of a work we had started (with the monitoring of the implementation of Article 173 of the French legislation on Energy Transition and Green Growth), but it reinforces our responsibility in the area. It means we also now work with outreach to a broader set of stakeholders, including the French Ministry for Transition, NGOs, think-tanks and other experts on climate change.

Eric Brousseau

The challenges in this area are extensive, both in terms of calculating and mitigating risk and managing the political fallout. The public often does not want to change its behaviour or pay to mitigate these risks.

2nd roundtable: Critical network infrastructures

Anne-Yvrande Billon

President, Club of Regulators & Vice-President, French Rail and Road Regulatory (ARAFER)

The transition to a low-carbon economy challenges our existing models of production and consumption, especially in the energy and transport sectors. Climate change is also liable to cause serious damage to vital infrastructure. In this context, investment choices must be oriented towards sustainable projects. This raises questions around the impact of climate change on the cost of capital, the orientation of investment and consumption choices, and the sustainability tools and powers available to infrastructure regulators.

Climate change risk regulation: safety, security, environment and health

Myriam Merad

Research Director, CNRS

For the purposes of this presentation, 'regulation' should be taken to mean the direct and indirect and formal and informal mechanisms that enable systems to arrive at a normal, sustained way of working.

In the areas of safety, security, environment and health, climate change risk regulation has increased interconnection between systems and people, particularly between systems and systems-of-systems relating to technical infrastructure and people. Population density has increased, especially in major cities, and hazardous events are more common. Systems are required to offer a high degree of availability.

Climate change risk regulation is unusual in that there is a clear connection between science and regulation. Rather than thinking of risk as the probability of consequences, it can be viewed as a combination of hazards, the vulnerability of assets and a set of regulatory measures. Many scientists focus on hazards and asset vulnerability while most regulators focus on regulatory measures. In France, regulatory responsibility for safety, security, environment and health is fragmented between different bodies. Climate change will change the impact of natural disasters as well as the probability of these events, the way that probability is calculated, and the severity of their consequences. Networks for gas, electricity, water, etc. are increasingly inter-connected and there is also a growing need to build and adapt infrastructures to cope with increasingly severe natural disasters. Climate change alters the way technological hazards are perceived and mitigated. Demographic change and increasing demand for systems is changing the vulnerability of assets by stretching systems beyond their designed limits. 'Smart' systems are being developed to respond to this challenge and increase resistance but these changes also increase vulnerability. Aging infrastructure further complicates the way public-private infrastructure investment is allocated.

Regulators have access to a limited number of formal tools to manage these hazards and vulnerabilities. Measures that have been developed, for example to manage flooding

risk, may become less effective as the relative weights of hazards and vulnerabilities shift due to climate change. The main challenges relate to balancing public and private investments in keeping systems safe. For example, the French public sector is extremely complex and extensive but responsibilities are gradually being shifted towards private companies and even individual citizens. Different communities and companies manage risks in different ways using different tools and definitions. The way risk is framed must be redefined to ensure regulatory decisions can be more broadly understood and applied. This is a significant challenge.

With regard to public policies and common goods, the main challenges are to foster expertise and decision-making by leveraging available data more effectively and to develop formal and informal tools to nudge behaviour in desired directions.

Energy: transitions and risks

Anna Creti

Professor of Economics & Scientific Director, Chaire Economie du Climat at Paris-Dauphine University – PSL

The energy sector provides an interesting way to view the interaction between climate risk and the economy and the contradictions inherent in our world. For example, a new French energy law aims to shift towards a carbon-neutral economy but, while seeking to eliminate coal from the electricity mix, allows it to be used for 'security reasons' even though France tends to generate an energy surplus. In California, Pacific Gas and Electric filed for bankruptcy in January after its distribution network and activities – aggravated by climate change – helped cause the devastating fires of November 2018. The impact of the electricity market failure and blackouts in 2000 on the company's finances was, however, overlooked. These scenarios highlight the need to identify a market failure, if it exists, and fix a price to resolve that failure.

The concept of 'unburnable carbon', first used in 2011, refers to the number of tonnes of fossil fuel that must be left in the ground if global warming is to be kept below 2°C. The latest IPCC report emphasises that carbon consumption needs to be drastically reduced to keep warming below 1.5°C and that humanity's carbon budget may already have been exceeded.

These global calculations have to be translated into usable targets and limits. This creates a transition risk based on expropriation, the idea that using natural resources is a right. Regulators must consider how the use of fossil fuels can be limited by rents that transfer the economic benefits from resource owners to those who obtain the right to exploit the remaining burnable reserves. The challenge is to put a price on this risk. When the paper introducing 'unburnable carbon' was published, the stock price of the 63 largest US oil and gas companies fell by 1.5-2%. The impact was short lived: within three years, no effect could be detected.

Climate and environmental regulations are, however, increasingly creating 'stranded assets' that suffer from unanticipated or premature write-downs, devaluations or conversion to liabilities. Asset stranding is, in fact, a necessary condition of meeting the CO₂ goals of the Paris Agreement. Existing fossil fuel plants are expected to emit around 300 billion tonnes of CO₂ while new power plants that are already underway are expected to emit a further 270 billion tonnes of CO₂. This total significantly exceeds the world's remaining carbon budget of around 240 billion tonnes of CO₂ that can be emitted if warming is to be kept below 2°C. To stay within our carbon limits, a choice will have to be made between closing existing plants, running all plants below capacity, using carbon capture, attempting other solutions, or abandoning the Paris Agreement entirely. A far more cost-effective solution would be to reallocate the funds for those new power plants into developing clean energy sources.

Encouraging investors to disinvest from fossil fuels and invest in green assets will require effective measurement of climate and transition risks. At present, suitable metrics do not exist. It is extremely difficult to calculate these risks and associated financial and sectorial exposure but this will need to be done in order to set a motivating price. Work

is being done to combine macroeconomic simulations of energy transition scenarios with industry-specific risk factors to gauge the potential losses for investment portfolios and to assess how different industries could be affected under various energy transition scenarios. In addition, researchers are gauging the potential spillover effects between financial institutions in the case of a disruptive energy transition and working to analyse the equity and bond exposure of financial institutions in industries that are particularly vulnerable. The Netherlands, a major gas producer, is working to set a carbon price based on a scenario of severe but plausible shock analysed in macro-economic terms and across the financial sector and multiple industries. This analysis argues that climate change will cause technology, confidence and policy shocks that will be even more significant when combined. Additional research comparing the impact of different climate policy instruments indicates that efficient carbon pricing would, in the long term, have the least disruptive influence, the lowest legacy cost, and the lowest technology cost. However, overlapping different instruments, such as carbon pricing, subsidies and standards, is a source of inefficiency.

From traditional to clean energy: insights from the German energy transition

Annegret Groebel

Head of Department - International Relations / Postal Regulation, German Network Agency for Electricity, Gas, Telecommunications, Post and Railway (BNetzA)

In 2010-11, Germany started an energy transition and set ambitious climate protection goals in its 'Energy Concept 2050' plan, which emphasised the importance of transforming the energy sector as part of a shift towards a 'clean' economy. The plan aimed to reduce primary energy consumption by 50% between 2008 and 2050 and reduce greenhouse gas emissions by 80% between 1990 and 2050, primarily by increasing the share of renewables in the energy mix. These targets have since been adjusted: renewables are now expected to account for 40-45% of consumption by 2025 and 65% by 2030. At the end of 2017, renewables accounted for 33% of gross electricity production. Nuclear power is due to be phased out in 2022. Coal power generation will be phased out by 2038, a decision that makes political sense due to the importance of the German coal industry but which seriously jeopardises the attainment of greenhouse gas targets due to its long phase out period. These decisions present a number of challenges in terms of grid expansion.

Due to the merit order effect, Germany's greenhouse gas emissions increased after the decision to cease nuclear generation. This was the opposite of the intended effect of the energy transition. Although it is possible to dramatically ramp up renewable energy generation, exiting two major fuel sources like nuclear and coal at the same time in a developed, industrialised country is not feasible. Successfully phasing out coal will require major structural changes in coal-mining regions to compensate for the loss of jobs and 40 billion euros has already been set aside to finance this transformation. Germany's aim is to deliver an energy supply that is secure, reasonably priced, consumer friendly, efficient and environmentally friendly. The final point is important as it justifies certain regulatory decisions relating to climate change.

Restructuring the energy system to increase the proportion of renewables requires significant alterations to the grid. Traditionally, energy generation occurs close to the load. With the shift to renewables, Germany needs to get energy generated primarily by on- and off-shore wind farms in the north to the industrial areas in the south and south-west of the country. The regulator has a responsibility for ensuring this new, expanded infrastructure is efficiently constructed and financed and for allocating permissions for the new transmission lines. At the distribution level, an increase in distributed energy resources, such as household solar panels, exacerbates both complexity and decentralisation in transmission and distribution. The extent to which the grid would need to be expanded and adjusted and the time required to approve and construct new transmission lines was initially under-estimated. Public hearings have been held in affected areas to try to shift public opinion and combat nimbyism. The reality is that, if Germany wants to exit nuclear and ramp up renewable generation, additional transmission lines are necessary and must be financed. Although there is a cost to the energy transformation, Germany will end up with a cheaper energy supply if the shift to renewables is successful.

The energy transition has a complex legislative framework based on a grid expansion act and a renewables act. Additional reforms have increased the proportion of tendering and reduced support via feed-in tariffs to increase the efficiency of pricing. As renewables become more competitive, they will not need support. Germany has decided to pursue an energy-only market to avoid distortions from capacity remuneration mechanisms as the security of supply security is not an issue and facilitate cross-border trading. On the demand side, the regulator is working to increase flexibility and improve response with smart grid and smart meters. The regulator has acquired broader responsibilities that oblige it to look beyond the grid in order to consider the interaction between the grid and energy generation, particularly of renewables, and seek to implement and optimise a more flexible, market-based approach to energy generation and transmission that delivers increased infrastructure without compromising on efficiency or the cost to the consumer and enables Germany to achieve its climate targets.

Anne Yvrande-Billon

These presentations highlight the unintended consequences of transition decisions and the fact that they can be counter-productive in the short term. It is interesting to note how regulators' powers are shifting and consider how the actions of sectoral regulators are factored into analysis of risk by financial regulators.

Debate

From the floor

Countries need to invest in new, relatively clean power plant technologies that could fill the gap when intermittent energy supplies cannot satisfy demand. Normal energy users often fail to understand the intermittent nature of renewable supplies and that investment is required in other, more reliable solutions.

The shift to renewables depends in part on the extraction of rare metals in countries that lack adequate environmental standards. The extraction process also generates CO2 and generates environmental risks. How should these emissions and risks be regulated?

Energy use is changing, for example with the rise of autonomous, electrical vehicles. How is this factored into your thinking?

Annegret Groebel

The demand side needs to be more flexible and customers need to be more engaged. I focused on the transmission level but increasing the use of renewable energies also requires restructuring and investment at the distribution level. Distribution operators must remain neutral and regulators must ensure distributors do not gain an unfair advantage due to their lower risk profile.

There is extensive competition among equipment providers. I hope this will drive a higher degree of environmental responsibility around the sourcing of materials.

Julie Ansidei

The financial services action plan of the European Commission focuses on the creation of a green taxonomy. The principle of 'do no harm' applies: generating green energy should not come at the expense of achieving other environmental and social objectives. There is a real need for discussion and definition of thresholds.

Myriam Merad

Regulators often try to manage complex systems by focusing on a single variable. For example, the current discussion highlights that CO2 is not the whole story. Regulation can give the illusion that we are moving towards a sustainable system. Using one regulatory mechanism can result in deterministic tests for the system that are based on known risks. The result is that we are unprepared for risks that are currently unknown. In addition, when transitioning from one energy generation system to another, we must remember the interdependence of energy systems and our reliance on other countries and sectors.



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