

THE JOURNEY TO NET ZERO

12 perspectives from the frontline of
the energy transition in Europe



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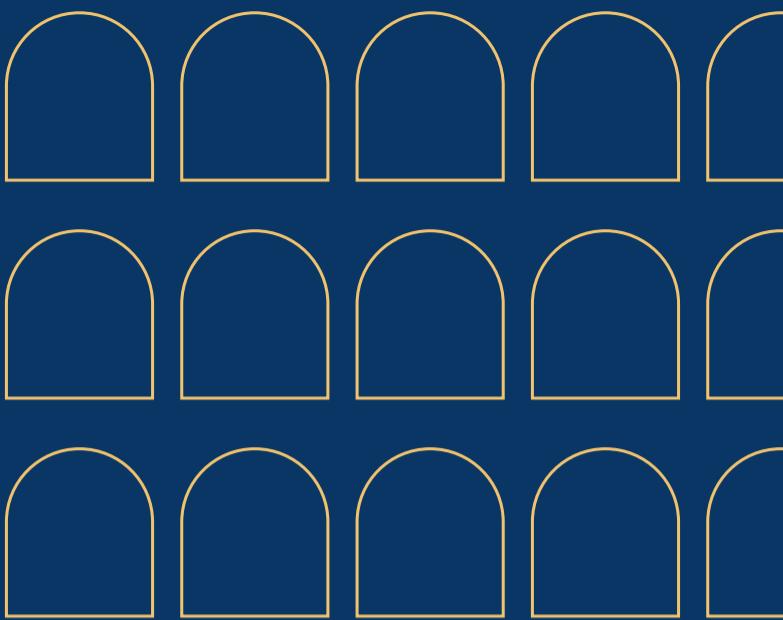
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FOREWORD: THE JOURNEY TO NET ZERO

By **Ditte Juul Jørgensen**

Director General for Energy of the
European Commission



In December 2019, European Commission President Ursula Von der Leyen presented the European Green Deal - outlining a clear objective for Europe to become carbon-neutral by 2050. Presenting a roadmap of different initiatives across all policy areas, the Green Deal is sometimes seen as the launch of **the journey to net zero**.

The concept goes beyond the fight against climate change. It is the EU's strategy for sustainable jobs and growth. It is about transforming the whole economy so that Europe can be the first continent to reach net zero emissions.

In this foreword, my aim is to provide you with an up-to-date overview of the policy context, so that you can better appreciate all of the contributions that follow.

European Green Deal

In the course of 2020, as the first steps under the European Green Deal roadmap, the Commission published a number of important strategies and plans [in the energy sector] for how we might become better placed to achieve our long-term ambition.

The Renovation Wave: which concluded that we should look to **double the rate of renovation by 2030** (including enhancing the integration of renewables).

The Energy System Integration strategy: which is aimed at making our energy system more flexible so that we can incorporate all the different new technologies in the most efficient way possible.

The Offshore Renewable Energy Strategy: which stressed the enormous potential for renewable energy production offshore.

The Hydrogen Strategy: which underlined the potential for this fuel and the importance of decarbonizing hydrogen before we expand its use.

The Methane Strategy: which highlighted the importance of monitoring this highly polluting greenhouse gas, and take steps to reduce emissions – also at international level.

The Revision of the regulation for the Trans-European Network for Energy: a legislative proposal which aims to align our investment in energy infrastructure with our decarbonisation objectives.

In more concrete terms, one highly significant development in recent months has been the agreement by the Council and the European Parliament on a **new EU Climate Law**. This writes into EU law our commitment to carbon neutrality by 2050 – and the important milestone of achieving 55% emissions reductions by 2030.

Fit for 55 package

And this is why – having discussed the concepts outlined last year with interested parties and the European Parliament and the Council - the Commission has now prepared a big package of legislative proposals called the **“Fit for 55” package**. This covers a range of different policy areas – from revising existing rules on energy taxation, transport fuels and the Emissions Trading System to proposals for a new Carbon Border Adjustment Mechanism. The key point is that we achieve a consistent approach across all areas of EU legislation that will facilitate our climate ambition – focussing on the milestone of reducing emissions by 55% by the end of this decade.

In energy policy terms, **Energy efficiency** and **renewables** are the main policy areas where we need to commit to a higher climate ambition in order to reach our 55% target by 2030. For this reason, we are revising the **Energy Efficiency and Renewables Directives**. (You will recall that the current targets, set in 2018, are 32.5% for energy efficiency and 32% for renewables.) Our aim is to write into EU law some of the key

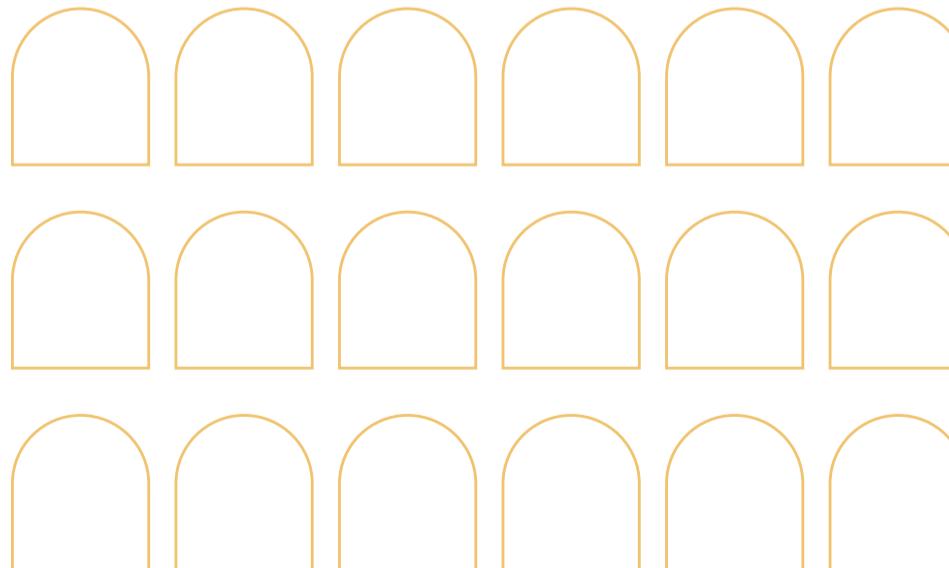
actions outlined in the different 2020 strategies in the energy sector, but also taking others into account, for example the Biodiversity 2030 Strategy.

In addition to these proposals in July, we will table further proposals before the end of the year i) to revise the **Energy Performance of Buildings Directive (EPBD)**; ii) to revise **gas market rules to promote low carbon gas (and hydrogen in particular)**; and iii) to achieve better measurement, reporting and mitigation of **methane emissions** linked to the consumption of fossil fuels in the EU.

Of course, all of these proposals are now subject to change in the course of the negotiations with MEPs in the European Parliament and Member States in the Council.

While the European Green Deal – and these Fit for 55 initiatives – were more or less foreseen at the start of this Commission's mandate, the Covid pandemic and the way it has changed our lives was not. As the Commission and EU heads of government are concentrating on how we can recover from the pandemic, establishing **national recovery and resilience plans**, one key message is already loud and clear - **economic recovery and our increased ambition in fighting climate change are two sides of the same coin.**

Before closing, let me just recall that the journey to net zero is not just about policy. It is true that policy sets the legal framework for the clean energy transition, but success will not be possible without all the different players making the commitment to this end goal. And I am pleased that this volume provides a flavour of all of these different perspectives.





INTRODUCTION

As this book ‘goes to print,’ the European Union has set a bold **goal** to get to **net zero** CO₂ emissions by 2050. More and more countries (and large corporations) are joining in with similar pledges. New Zealand has committed to having a net zero government by 2025.

Why does it matter? While we keep talking about gigatons of CO₂ and degrees (of increasing atmospheric temperatures on Earth), these are all just proxies for quality of life.^[1] Proxies for safe healthy lives, continuing livelihoods and stable, rich ecosystems.

Now, a goal without a plan is just a wish.^[2] Therefore, we analyse the path to get there, focusing on **Europe** and on the role of the **energy sector** in reducing greenhouse gas (GHG) emissions by moving from fossil fuels to renewable energy. This is known as the energy transition. Both Europe and the power sector are forerunners for climate neutrality progress – and they could serve as lighthouses for other regions and industries.

Europe has been over-delivering on its climate targets over the last twenty years^[3] (although this has been underpinned by very poor economic

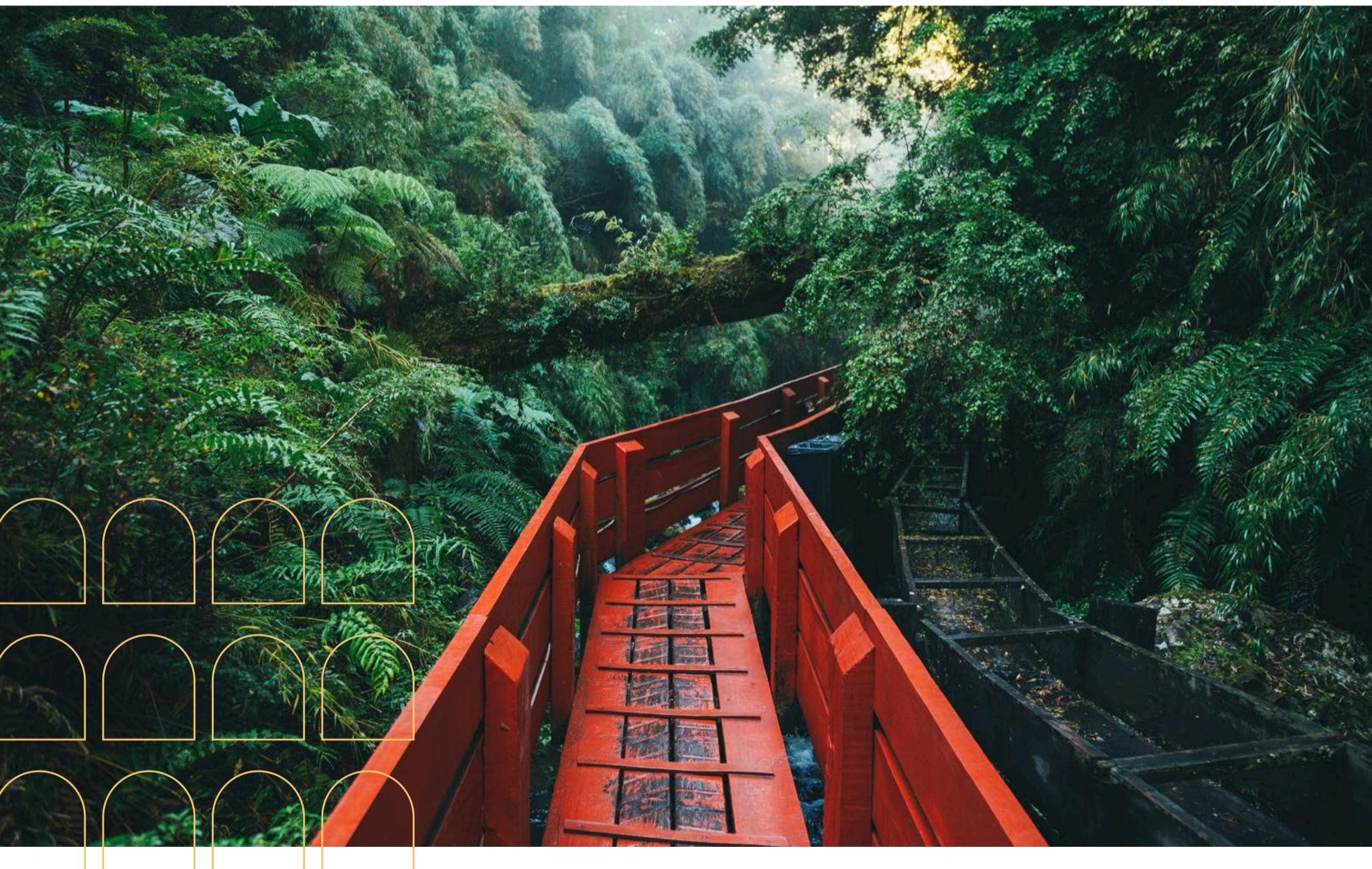
growth). After signing the Kyoto Protocol in 1997, it reduced its GHG emissions by 18 percent by 2012 when the target was 8 percent. Then, in 2007, the European Commission set a target to reduce emissions by a further 20 percent by 2020, but by 2018 it had already passed that milestone.

The continent accounts for only 7 percent of global greenhouse gas emissions, but if it were to be climate neutral it could have a ripple effect encouraging other countries along the same path, driving the accompanying changes in consumer behaviour and pushing demand up (and costs down) for the nascent technologies needed to enable the transition. Hopefully, this can also be

done in a way that does not inhibit developing nations' legitimate aspirations for prosperity by creating a new way to achieve it.

Likewise, the energy sector is leading the way in decarbonising the economy, and some analysts consider it will beat other sectors (like industry, transport and agriculture) to net zero by a full decade.^[5] It uses a larger share of mature technologies and started its journey away from carbon-emitting power sources in the 1990s.

However, this is not a textbook on the decarbonisation of the power sector in Europe. Climate change now permeates every aspect of our lives. When Justin Bieber plays an



unemployed oil-rig worker in a [music video](#)^[6] and one in four childless adults mention climate as a determinant of their family planning decisions,^[7] we know that the energy transition is no longer the strict realm of academia, business or policy.

Therefore, we climb down from our ivory tower and bring you **12 fresh perspectives** from key actors on the ground who are undertaking the transition in the first person, but with very different viewpoints. To make it more fun, we add the latest insights from the Energy and Climate researchers at the Florence School of Regulation (FSR) on critical topics. These testimonies are based on interviews recorded between 2019 and 2021 for the FSR's **Net Zero Podcast**.

We start with the **destination** – where are we going? What will the world look like when we have reached net zero? Albert Cheung from BNEF discusses the possibilities and requirements of a fully decarbonised **power sector**. Tara Connolly, formerly of Greenpeace, tells us about the complex implications of the energy transition for the **environment** and Andris Piebalgs, former European Commissioner for Energy, shares his views on the new **geopolitics** of renewables.

We then investigate who will get us there by gathering diverse perspectives from four types of **key actors: power companies** (António Mexia, former CEO of EDP); **consumers** (Monika de Volder, from BEUC – the European Consumer Organisation); **start-ups** (Elena Bou, from InnoEnergy); and **policymakers** (Kadri Simson, European Commissioner for Energy).

Finally, we ask how we will get there and bring you the latest on what we see as the main **levers** in the energy transition: the role of **digital transformation**, as seen by Chris Peeters, CEO of Elia; the impact of adequate **CO2 pricing**, according to Auke Lont, former CEO of Statnet and member of the Energy Transitions Commission; the long-term role of **green hydrogen**, in the perspective of Michele Azalbert, CEO of the Hydrogen Business Unit at Engie; the short-term importance of **carbon capture**, according to Mechthild Wörsdörfer, Director for Sustainability, Technology and Outlooks at the International Energy Agency; and the unavoidable need for a new **finance paradigm**, with Zoë Knight, Managing Director and Group Head of the HSBC Centre of Sustainable Finance.

It's an exciting journey – we hope you enjoy the ride!

[1] Cristina Figueres, Outrage and Optimism.

[2] Antoine de Saint-Exupéry.

[3] McKinsey & Company, Net Zero Europe – Decarbonization pathways and socioeconomic implications, December 2020.

[4] 2017 data, from McKinsey & Company, Net Zero Europe – Decarbonization pathways and socioeconomic implications, December 2020.

[5] McKinsey & Company, Net Zero Europe – Decarbonization pathways and socioeconomic implications, December 2020.

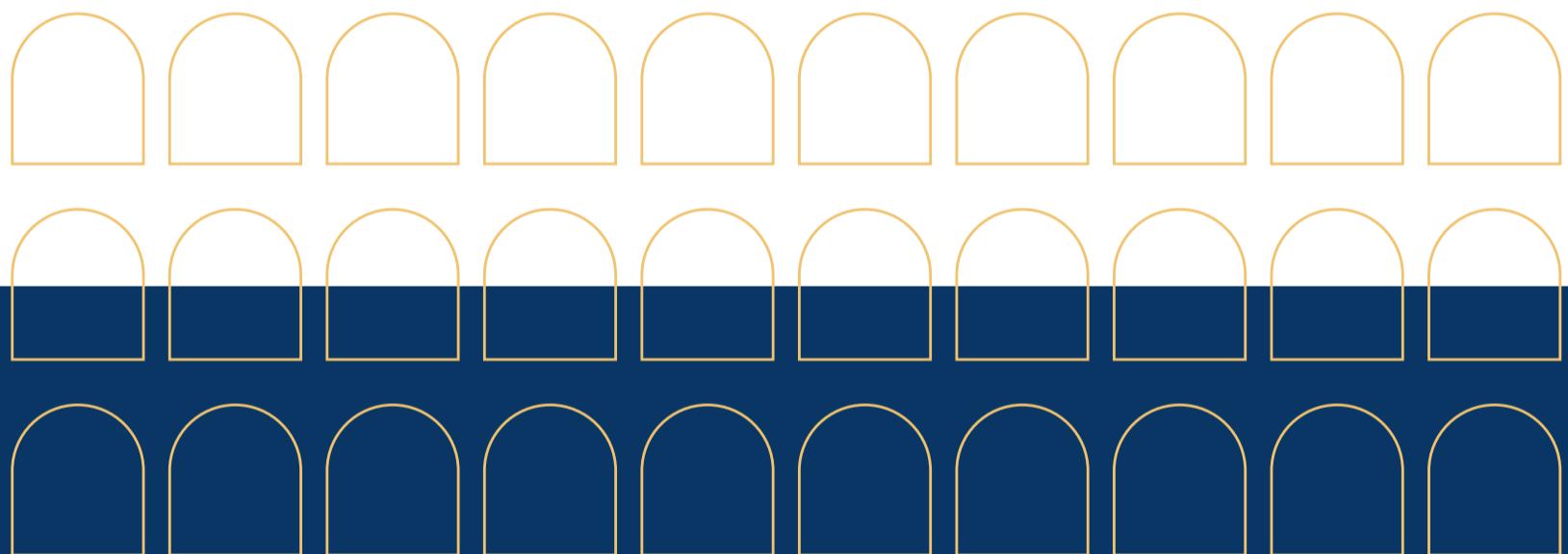
[6] <https://www.businessinsider.in/entertainment/news/justin-bieber-plays-an-oil-rig-worker-who-gets-laid-off-and-evicted-in-his-new-music-video-for-holy/articleshow/78190958.cms>

[7] Data on the USA, from Morning Consult.

PART ONE:

THE DESTINATION

Where are we going?



We start with the end in mind – what will the world, and Europe in particular, look like when we have fully transitioned from fossil fuels to renewable energy sources? We look at decarbonisation pathways in the power sector, question the true benefits of the transition for human health and the environment, and dream of a safer geopolitical balance, no longer strained over control of hydrocarbons. The journey begins.

CHAPTER 1

A FULLY DECARBONISED POWER SECTOR, WITH ALBERT CHEUNG

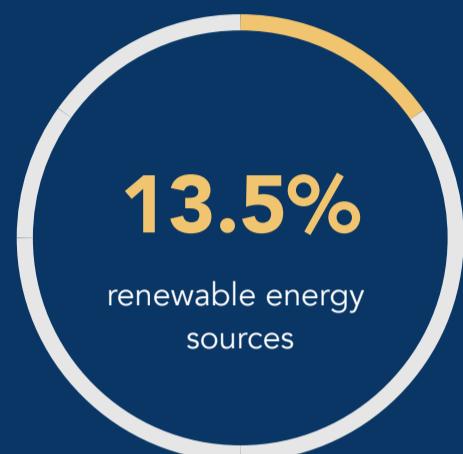
Albert Cheung
Head of Global Analysis at BNEF



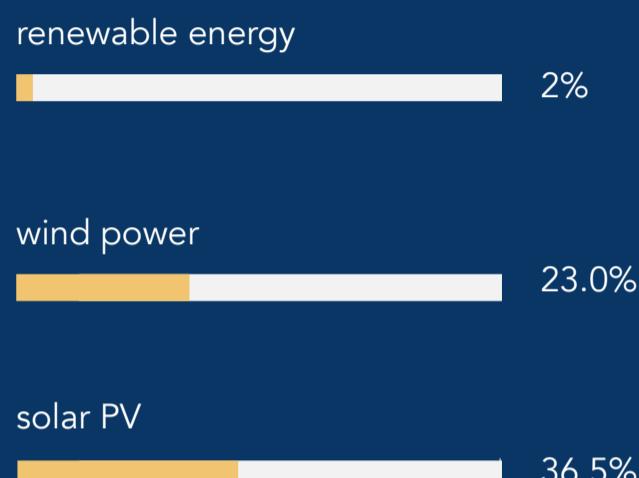
"That energy system that has 90 percent renewables in 2050 is going to operate so differently from the one that we have today."

Key facts

Total global energy supply, 2018*



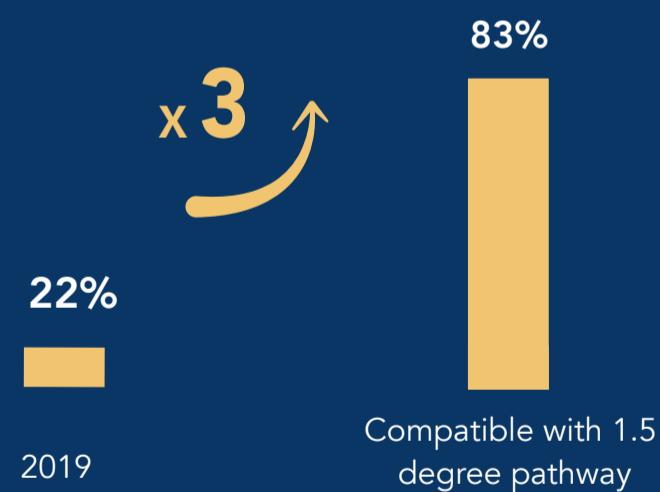
Average annual growth rate of renewable energy source, 1990-2018*



Share of renewables in final energy consumption in 2019**



Global share of renewables evolution ***



*Renewables Information Overview, IEA, 2020.

**European Union 2020: Energy Policy Review; IEA, 2020.

***McKinsey.

To start our journey, we asked Albert Cheung, Head of Global Analysis at Bloomberg NEF, if Europe will be able to achieve 100 per cent renewables by 2050. Cheung considers that it can get very close, but not quite to full carbon-free, with one exception: “*that is, in regions where there is a lot of hydro resource – hydro can be the backup for renewables to get to 100 percent.*”

As solar and wind are becoming the cheapest forms of power generation, “*we should stop talking about subsidies for renewable energy.*”



However, as wholesale electricity prices will be heavily impacted (downward) by the growing integration of wind and solar, there needs to be an adequate way to remunerate the investment in renewable capacity and flexibility solutions (like storage). On the other hand, retiring fossil fuel power sources (like coal and eventually gas) from the grid, will require attention and resources devoted to a just transition for the workers, companies and investors in these legacy sectors.

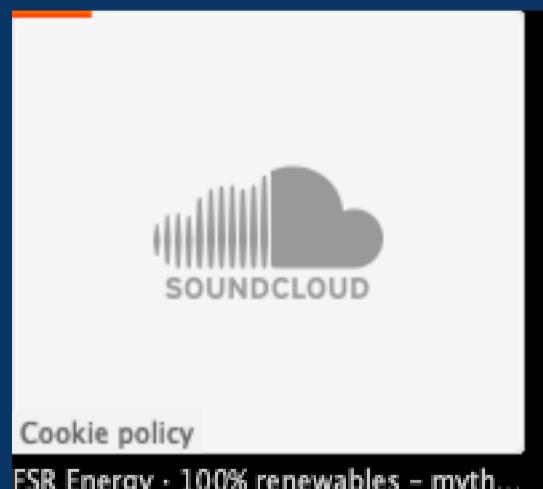
Regarding the macroeconomic implications of full decarbonisation, Cheung is heartened by the conclusions of several recent studies: the Committee on Climate Change in the UK said that getting to a net zero economy throughout the UK would cost 1 to 2 percent of GDP by 2050; the Energy Transitions Commission has published a report looking at the hard-to-abate sectors (like industry, shipping and aviation) and stating that, globally, to decarbonise these sectors would cost half a percent of GDP. “*So, these numbers are incredibly encouraging and actually energising, saying that we can get to a net zero economy really at a relatively low cost.*”

This does not mean we should underestimate the effort required to decarbonise the economy, as “*there are a lot of obstacles and it's a really long road to get to those sorts of high penetrations.*” It will require “*massive investments in new infrastructure, in renewable generation, in storage and in demand-side management*” and “*a very clear and stable regulatory framework for investments in renewables.*” There will be a need for more investment in the transmission grid both between countries and within countries to connect renewables to demand centres. And distribution grids will have to adapt to “*greater distributed energy whether it's rooftop PV, storage or electric vehicles.*”

As 100 per cent renewables also means a zero-carbon power system, it will require a “*huge collaborative effort between governments, energy companies and the investment community.*”

Despite the obstacles, several European countries are already setting ambitious targets for the next decade. By 2030, Austria expects to achieve 100% of renewables in electricity consumption, while the UK will be coal-free by 2025. Albert also notes that this change of paradigm will require “*massive amounts of flexibility*” as an “*energy system that has 90 percent renewables in 2050 is going to operate so differently from the one that we have today.*”

For more on the key obstacles and challenges of an energy system with high penetration of renewables [listen here](#)



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FSR Energy · 100% renewables – myth...

CHAPTER 2

THE ENVIRONMENT IN A NET ZERO WORLD, WITH TARA CONNOLLY

Tara Connolly

former EU Climate and Energy Policy Director at Greenpeace's European Unit and Energy Campaigner at Friends of the Earth Europe



"We cannot keep the same system that we have and just replace it; we need to significantly downsize a lot of what we are doing"

Key facts

Global CO2 emissions from fuel combustion 1971-2018*



EU GHG emissions evolution**

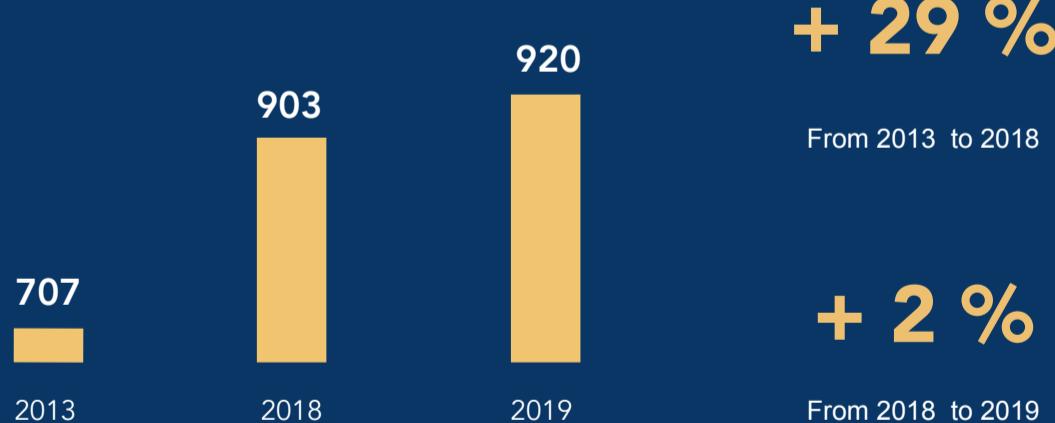
- 24 %

From 1990 to 2019

- 3.7 %

From 2018 to 2019

Global CO2 emissions from commercial aviation, millions of ton of CO2**



+ 29 %

From 2013 to 2018

+ 2 %

From 2018 to 2019

*CO2 Emissions from Fuel Combustion, IEA, 2020.

**EU Commission website.

If 100% renewables become a reality, are there hidden costs for ecosystems and human health? While today in Europe there is a big drive to switch away from fossil fuels, is the emphasis on power generation (which accounts for 25% of greenhouse emissions) enough to fight climate change? Tara Connolly, former EU Climate and Energy Policy Director for Greenpeace, reflects on the real impact of the energy transition on the environment.

Connolly started by drawing our attention to the environmental emergency we are living in:



"we're talking about a very serious situation in which we have twin crises of climate change and biodiversity. Scientists are saying that the permafrost is melting 70 years before they expected it to. And the forest in the Arctic is on fire for the second summer in a row."

According to Connolly, "*decarbonising the power sector is absolutely key*" but there needs to be more focus on other sectors, like transportation and heating and cooling. She also notes that for the most part "*the technologies are there, it's about putting in place policies that will support and accelerate their deployment.*" Another important element in decarbonisation is agriculture: "*we really, really need to move away from the intensive industrial agriculture in Europe that is contributing to both crises*" to agriculture that is, first of all, plant based. "*Greenpeace says that globally we have to cut meat and dairy consumption by 50 percent. And not only are the animals themselves contributing to climate change but they're also contributing a double load through deforestation outside Europe, when we are importing grain to feed them. So, it's especially perverse.*" In other areas, like buildings, energy efficiency will play a large role. In heavy industry, where electrification may not be possible, reducing emissions may be more challenging, but it is equally important. Finally, as we lean on nature to capture carbon and stabilise temperatures, "*we cannot keep putting our ecosystems under so much pressure and then demand that they act as a carbon sink.*"

A world with more renewables will also probably be a world with mass deployment of lithium-

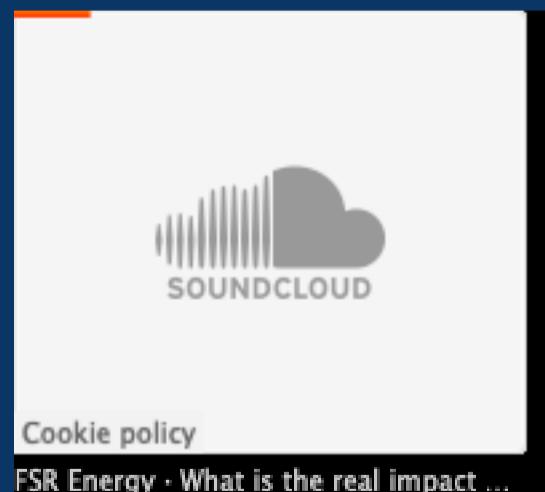
ion batteries and increased mining of cobalt. There is now even talk of drilling the seabed for cobalt reserves, which in turn raises other environmental concerns. Will the environment be better off after the energy transition or are we just changing the types of aggression we impose on the planet? Tara takes a full-system approach and believes “*the energy transition has to be seen in the context of the broader transition that has to happen in all sectors. It's also a social transition.*”

On the topic of transport, Connolly emphasises the need to internalise the costs of emissions of carbon-intensive sectors like aviation, and also to shift consumer habits. According to the European Commission, the top 10 CO2 emitters in 2018 were nine coal-fired power plants in Germany and Poland and Ryanair. Connolly points out that

“*those cheap Ryanair tickets are not as cheap as we think they are.”*

So how can we address climate change and any side-effects of the transition? According to Connolly, for there to be real improvement the transition and related technological innovation must be paired with a social transition. It is about “*understanding and accepting that we cannot keep the same system that we have and just replace it ... we need to significantly downsize a lot of what we are doing.”*

**For further discussion
on the complex issues
involving the environment
and the energy
transition listen [here](#)**



CHAPTER 3

THE NEW GEOPOLITICS, WITH ANDRIS PIEBALGS

Andris Piebalgs

Professor at the Florence School of Regulation
and former EU Commissioner for Energy



**"More renewable energy means more
energy security, particularly for Europe."**

Key facts

Percentage of the world's population living in countries that are net importers of fossil fuels*



#1

Global manufacturer of clean energy technologies: China*



#1

Country in renewable energy patents: China*

Origin of the world's cobalt supply*



*A New World: The Geopolitics of the Energy Transformation, IRENA, 2019.

Taking a step back for a more global perspective, we spoke with Andris Piebalgs, Professor at the Florence School of Regulation and former EU Commissioner for Energy, to understand how renewable energy is actively changing global geopolitics.

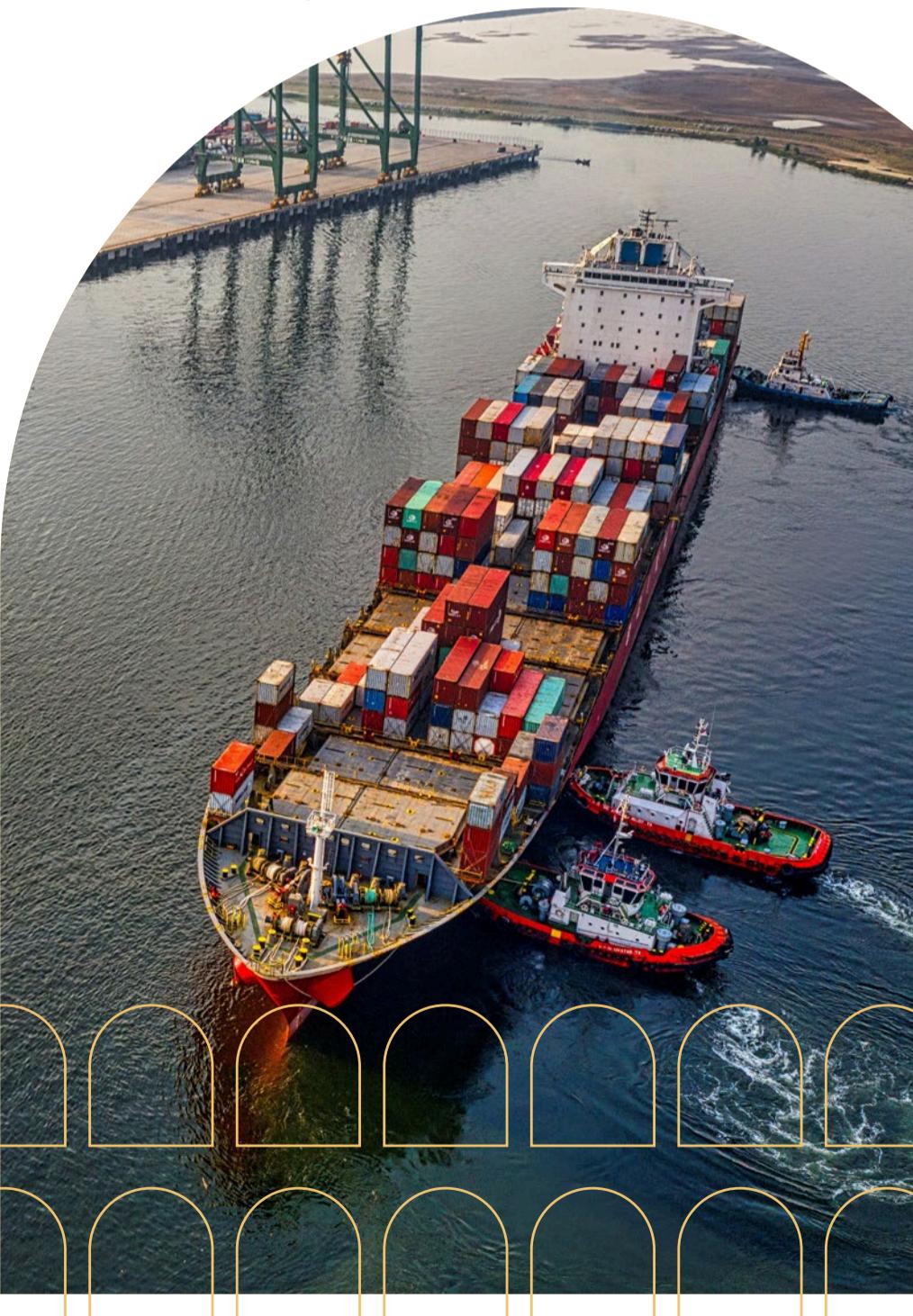
While over the last 200 years control of oil, natural gas and coal, and of bottlenecks in global sea routes (like the Strait of Hormuz), has dominated geopolitics, renewables are expected to challenge this landscape.

Piebalgs sees an opportunity for nations that have been investing in new technologies related to renewables to reinforce their global influence in the energy area. China, for example, is the world's largest producer, exporter and installer of solar panels, wind turbines, batteries and electric vehicles.

For Europe, the geopolitical landscape will change too. Europe is dependent on Russia for natural gas – as was made apparent when in 2009 Russia cut off its gas supply to the Ukraine, affecting consumers downstream in Europe. With the rise of renewable energy sources, Europe should lessen this dependency, but some may argue that it will become more dependent on imports from China. Piebalgs doesn't think so: "*with all these technologies, you can always develop*

alternatives." He stresses that "more renewable energy means more energy security, particularly for Europe" – Europe is on track with new technological innovations, a substantial green investment and a green Covid recovery plan of its own.

On the other hand, when we take a look at the Middle East, especially the Emirates, while investments in renewables are growing, "*it will be very difficult domestically to change the pricing of fossil fuels*" making the road towards energy transformation a bumpy one. In Piebalgs's perspective, a change



in consumption patterns might be a key trigger for transformation in such countries: *"If Europe goes massively for electric vehicles, then other countries will also be encouraged to make reforms."*

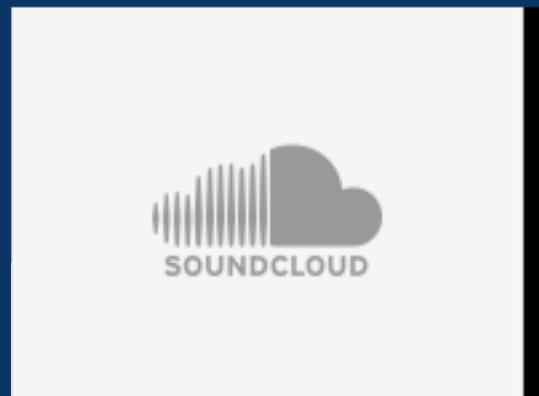
Access to materials used in renewable technologies and batteries (such as cobalt, lithium and rare earth elements) can also be argued to constitute a source of political instability and even conflict. However, the former EU Commissioner is optimistic, stressing that these materials are much less geographically concentrated than fossil fuels, and alternatives can be developed, together with recourse to recycling.

On the other hand, the role of electricity grid infrastructure in national security is coming under scrutiny. A recent IRENA report argues that just

as oil embargoes were used in the 1970s as a foreign policy instrument, perhaps interstate electricity cut offs could now be used in the same way. For Piebalgs, the advantages of further integrating national and regional electricity systems outweigh the potential risks. *"There are synergies if you combine more than one market. The EU definitely is a leader [in this field] and could export its experience to other parts of the world."*

In a world where climate change is perhaps the biggest challenge, Andris Piebalgs also believes that the energy transition *"definitely brings more peace."*

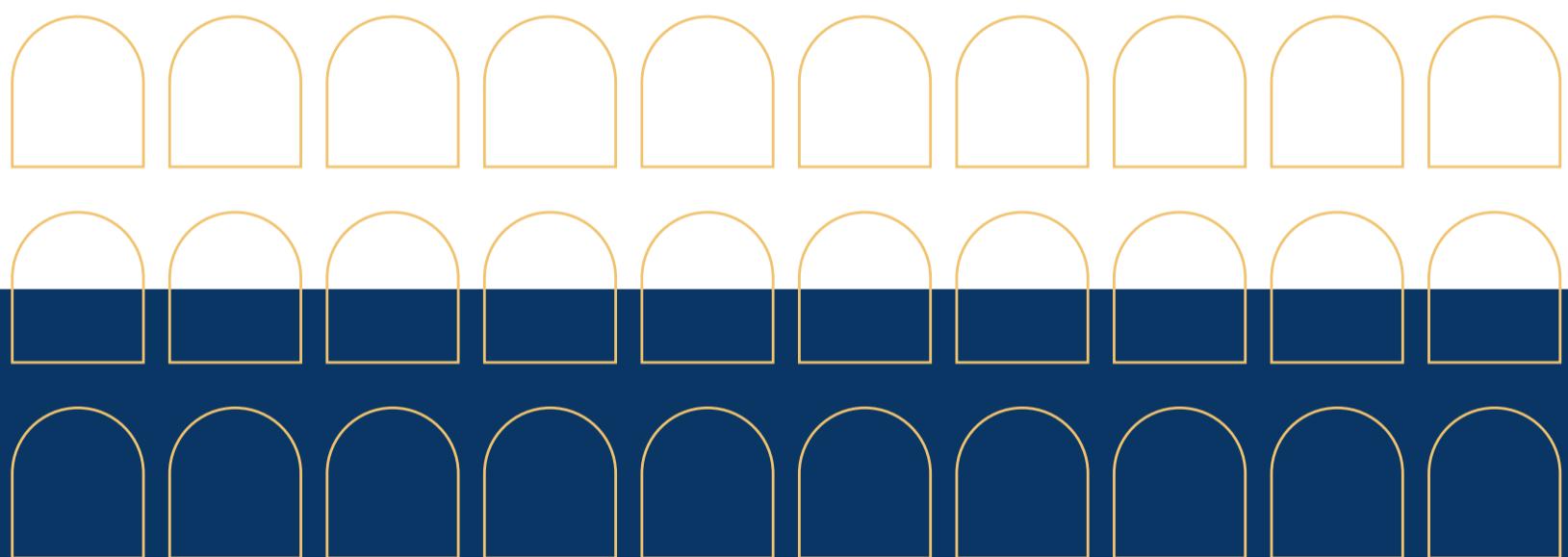
For additional insights on how the energy transition is changing global geopolitics, listen here



PART TWO:

THE ACTORS

Who will get us there?



The seismic change required to get to net zero emissions within our lifetime will need ‘all hands on deck’ to be pulling in the same direction – corporations, consumers, start-ups and policymakers. In this section, we bring you the unfiltered views of some of the protagonists making it happen on the ground today. Meet the actors in the energy transition.

CHAPTER 4

POWER COMPANIES, WITH ANTÓNIO MEXIA

António Mexia,
former CEO of EDP Group



"Open innovation is key, as most opportunities will probably come from outside our walls, from outside the company."

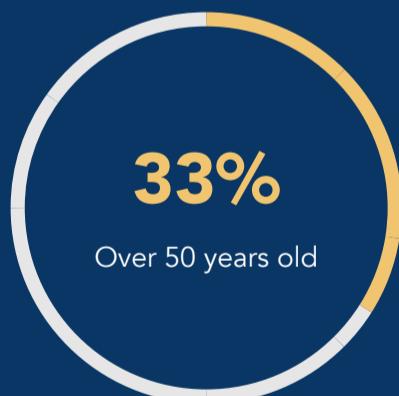
Key facts

Global installed capacity of renewable GW*



Only 10% of electricity utility companies are prioritising investment in renewable energy over fossil fuels**

Breakdown of European utilities employees by age***



Percentage of Women in the workforce****



*Renewable capacity statistics 2020, IRENA, 2020.

**ALOVA, Galina; A global analysis of the progress and failure of electric utilities to adapt their portfolios.

***Digitalization and utilities: More data, more profits, Goldman Sachs, 2018.

****Renewable energy: a gender perspective, IRENA, 2019.

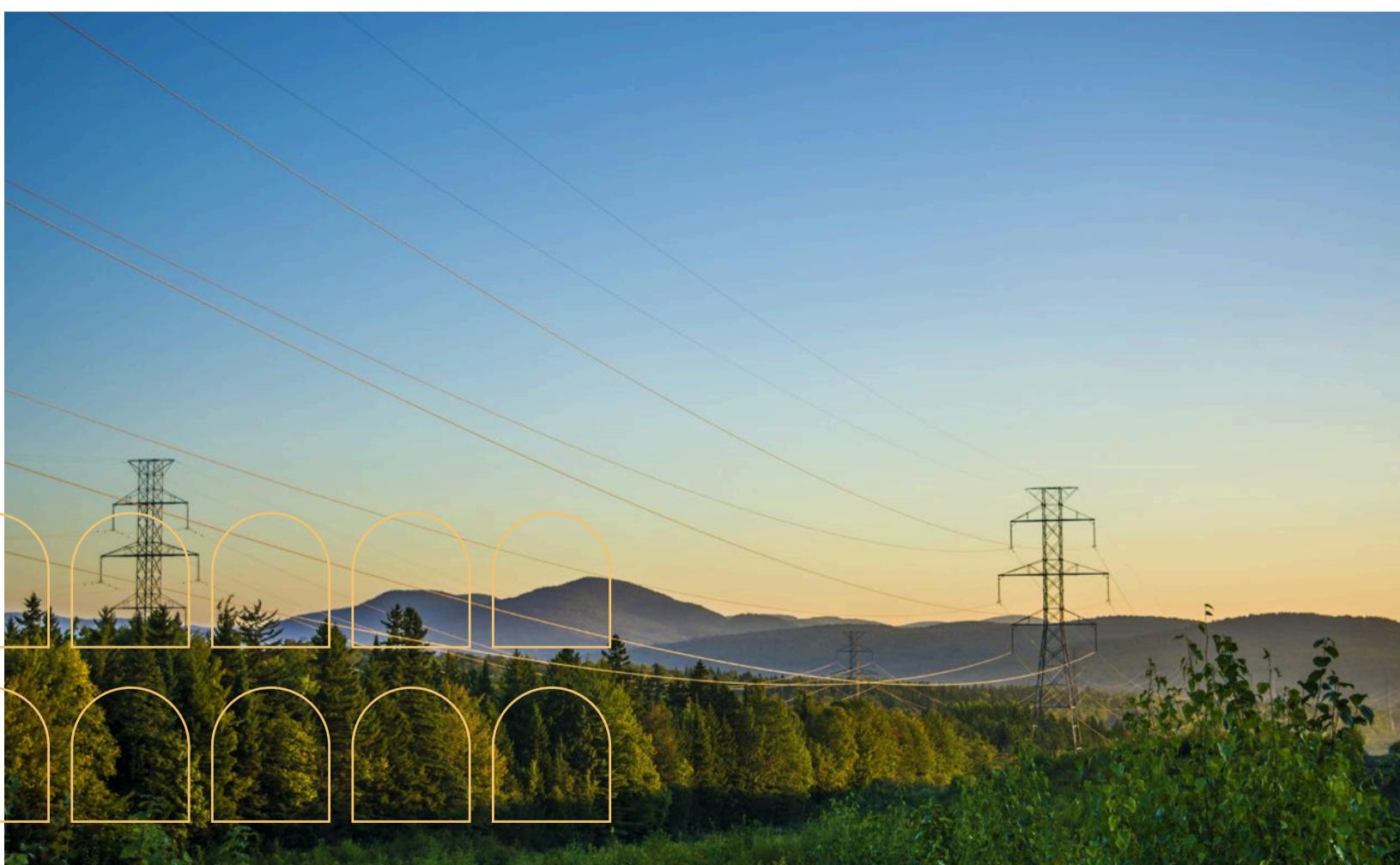
What are the challenges that utilities face in adapting their organisations, skills and culture to the energy transition environment? António Mexia, former CEO of EDP Group, gave us his take, highlighting that an open innovation approach is crucial in facing this new context. *"For decades, the energy sector was a very traditional one. Nothing happened."* But now "*we are in the middle of a revolution.*"

On the best way to foster innovation in power companies, Mexia said, *"I don't believe innovation is one department. It's the opposite. But we created this [innovation unit] to challenge and basically to tease all the organisation."* He also believes in exposing employees to innovation ecosystems (like Silicon Valley) and sending them on immersive joint projects.

Integrated utilities often have within them

multiple cultures in different business units and places, which can be difficult to bring together at the necessary speed. Mexia touched on the specific case of EDP, where the early growth in the renewables business segment was one of the drivers of the company's culture change: *"it brought us the positive virus of change. People understood that everything would be different. It brought new ways of working and spread throughout the company."*

With their incumbent past, many utilities can also struggle to win the war for talent, especially with the younger generation. On this topic, the CEO stressed the importance of purpose beyond business: *"we need to attract the best talent and for this you need to have a story to tell; not only as a business, but for society and the sustainability of the world. You need to fight for something."*



While energy companies have been mostly led by all-male executive teams with engineering backgrounds, critics argue that you cannot deliver the momentous change required with the same leadership. Mexia stated his belief in the importance of diversity (gender, background, way of thinking): “*we need leaders that want to collaborate and can create networks. That are constant learners and flexible thinkers. That have the necessary courage to face a challenge and to present their ideas.*”

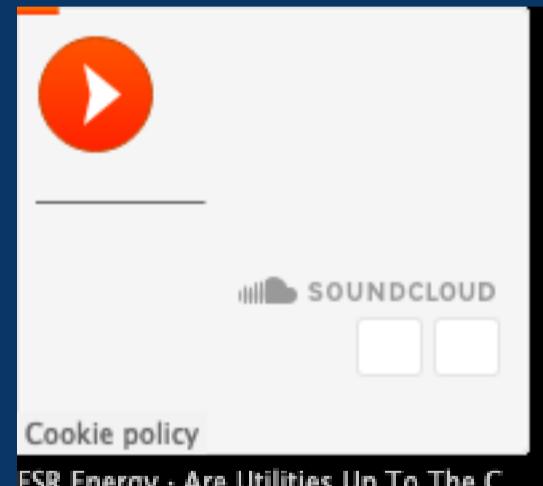
In his view, the ability to become agile and flexible is key to addressing the technological and market disruptions that are coming. Looking at the challenges facing grid operators in particular, he noted that while they have been mainly focused on security of supply, they must now also rapidly

adapt to an increasingly decentralised and decarbonised system.

While it seems that not everyone is on board in this upcoming disruptive change, Mexia noted that this is a movement “*clearly demanded by society in the streets,*” with which the companies will have to cope.

“*Being very clear about your commitment, being very clear about your goals, but being very transparent in what concerns walking the talk*” – this is what is needed from power companies.

For more on the role of power companies in the energy transition, listen here.



CHAPTER 5

CONSUMERS, WITH MONIKA DE VOLDER

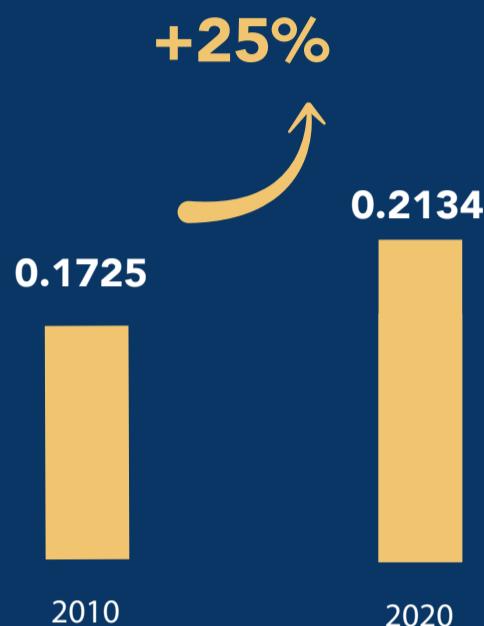
Monika de Volder
Senior Economic Officer at BEUC



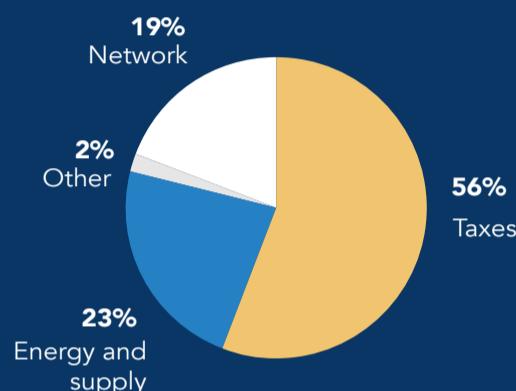
**"Consumers don't really know
what the market price is and how
to adapt their consumption."**

Key facts

Electricity price for European medium-sized households Euro/KWh*



Retail electricity price breakdown for European medium-sized households in 2019*



Number of European households reported an inability to keep their homes adequately warm***



34 million

89% of Europeans agree that the EU must ensure access to affordable energy, such as by ensuring competitive market prices**



*Eurostat.

**Special Eurobarometer 492, 2019.

***EU Commission website.

When we sat down with Monika de Volder to discuss the expected impact of increasing renewables and consumer-oriented services in retail electricity prices, she noted that, against public expectations, electricity prices for households have been increasing over the last ten years: “*we see more and more liberalisation, which we would expect to result in more competition and better services and lower prices for consumers. Yet we don't see that in every country.*” De Volder explained that in broad terms retail prices have three main components:

the price of generating
the energy itself,
network

charges and taxes. While increasing the share of renewables in the generation mix can lower wholesale prices, “*we are still paying for gas and coal because they are influencing how the marginal price is set*” and so consumers have not felt the full benefit of this trend. Then we have network charges, regulated transmission and distribution costs reflected in consumers’ bills. According to De Volder, “*what we are sometimes missing is transparency and guarantees that costs are kept to the minimum for consumers.*” And finally, there are taxes and levies, including the past subsidisation of renewables. She noted that while support for renewable technologies has often been blamed for increasing electricity prices, it is important to consider two points: first “*what are the alternatives? If we stay with fossil fuels, that means we stay dependent on external suppliers and [will] be locked in for decades in those oil fields*” and second, “*how much do we pay for nuclear, for coal, for gas in the form of subsidies for capacity mechanisms? Greenpeace found out that EU citizens have paid and will [be paying] around 58 billion euros for those subsidies for nuclear, gas and coal.*” Finally, Monika pointed out that prices for industrial consumers have in fact gone down, showing that the costs of the energy transition have not been fairly spread among all consumers: “*it has been alarming to see that, for instance, industry consumers have received exemptions or reductions or discounts from network tariffs, from renewable surcharges, from paying for capacity mechanisms.*”



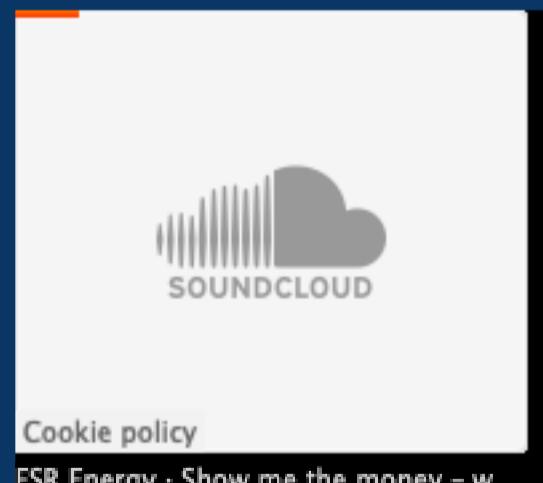
An energy market with a higher penetration of renewables will also be likely to result in greater price volatility for consumers. De Volder considers that there is an opportunity for household consumers to benefit from this through participation in demand response services. She highlighted that for these to engage consumers they need to be transparent and adequately respect consumer privacy.

De Volder also pondered the role of digitalisation for consumers: “*what we hear is that digitalisation will be a revolution in which the consumer needs to adapt to the electricity grid. But in fact, it should be the other way round. The consumer needs to be in the centre and the technology needs to [design] protocols [around it]*”. She credits smart meters, home automation, electric vehicles as decentralised storage and demand response mechanisms with the potential to “*help*”

consumers [...] and, if well-designed, to actually cut energy bills” and improve the accuracy of bills. She also highlighted that smart meters will gather much data on consumers, whose privacy needs to be safeguarded.

On the topic of vulnerable consumers, De Volder drew our attention to the fact that “*more than fifty million consumers around Europe have difficulties in keeping their homes warm in winter. More than a hundred million consumers have difficulties in keeping their homes comfortable in summer.*” This is a huge challenge and from her perspective the response is a combination of social and energy policy. As de Volder underscored the game-changing impacts and benefits of the electricity system transformation, she also stressed that there must be special efforts put in place to assist energy-poor and vulnerable consumers.

For more on how consumers can participate and benefit from the energy transition, listen [here](#)



CHAPTER 6

START-UPS, WITH ELENA BOU

Elena Bou

Executive Board Member and Innovation
Director at InnoEnergy



"Nowadays, especially in Europe, the pressure on incumbents is huge."

Key facts

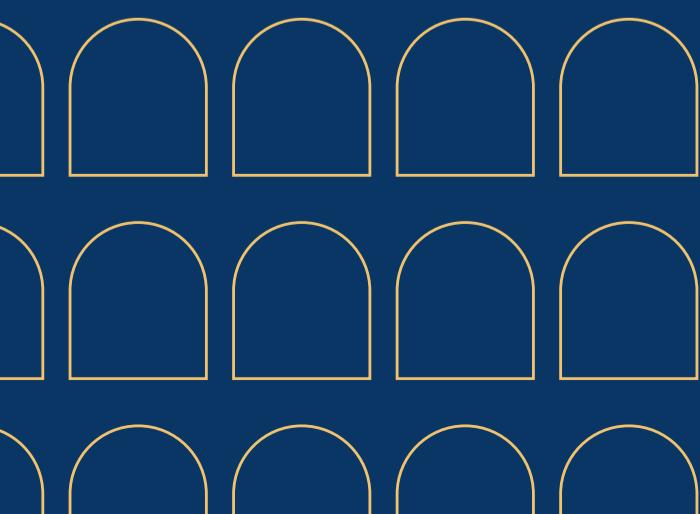
21% of all German start-ups can be classified as green given the contribution of their products and services to environmental and climate protection*



In 2018, Bill Gates, Jeff Bezos and a number of other billionaires announced investment in energy start-ups through a \$1 billion fund**



1 billion \$



*Green Startup Monitor 2020, Borderstep Institute for Innovation and Sustainability, 2020.

**Yahoo Finance.

As we dive deeper into the transformation of the energy sector, we must also examine the role of start-ups, which are taking advantage of the unprecedented opportunities for innovation and growth.

As Innovation Director at InnoEnergy, Elena Bou screens a large array of new ideas in the clean tech space- she shared some examples of the most disruptive ones closer to our everyday lives as individuals: given rising temperatures around the globe, “*what about if we have a company that can make it snow at 20 degrees? I mean green cold.*” And, as we are looking for new ways to address mobility, what about hyperloop? According to Bou, winning solutions will not only reduce carbon footprints but will do it at an accessible price and solve real consumer problems. From batteries and e-mobility to the control of heating and cooling using low-carbon solutions, the changes start-ups are driving will directly impact citizens.

Bou has seen great start-up activity in areas like batteries: “*we are talking about creating a new market of 250 billion euros per year. This is the economy of Denmark. In the year 2025.*”

While start-ups are challenging the traditional world of utilities, they are also lending them a helping hand. At InnoEnergy “*our model of supporting start-ups in renewable energy is to look for collaboration between the newcomers, the start-ups and incumbents. And so that is why 90 percent of our start-ups have collaborations.*” These collaborations help energy incumbents to accelerate their innovation processes in solving specific problems and to explore new business models. Using a start-up partnership in more exploratory matters is a way for utilities to mitigate risk. At the same time, they are exposing their employees to a new mindset and in that way infusing their own culture with more agility and open-mindedness.



On the other hand, large energy corporations are now faced with the challenge of fighting for talent in new areas like digital transformation, with a very different type of employer – a start-up: “these profiles, they don’t want to go to work [in these] companies because they prefer to work with the start-ups. It is not stability and a good salary anymore. Now they want purpose. They want a meaning in their work.”

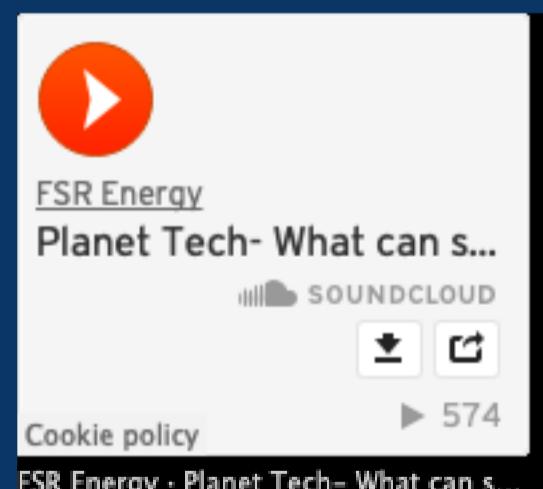
Additionally, Elena noted that, as the consumer becomes central in the energy system, innovation teams (in incumbents as in start-ups) “need to include people like social scientists, anthropologists, so they know about it [the consumer]. So, we need engineers working with other social scientists.”

For a long time, energy incumbents either owned large assets and/or they were regulated monopolies. While we have not yet seen attackers

from the tech world posing a real challenge to these incumbents, we asked Bou if she thought the threat would become real. “Nowadays, especially in Europe, the pressure on incumbents is huge.” Retail has seen some added disruption and competition but other parts of the value chain have seen less, making it hard for these companies to embrace innovation unprompted. She believes that business executives are often more focused on the short term, both because that is what their shareholder base values and because “they are probably going to retire in five years.”

As venture capitalists and asset managers take a fresh interest in impact investing, Bou sees a tremendous opportunity for funding of climate-positive businesses: “Banks are not financing coal plants anymore. These are good signs.”

For more on the role of innovation and start-ups in the energy transition, listen [here](#)



CHAPTER 7

POLICYMAKERS, WITH KADRI SIMSON

Kadri Simson
European Commissioner for Energy



"We don't know what the exact energy mix will be by 2050, but we are heavily investing in research and innovation and trying to find new solutions."

Key facts

Key targets for 2030*:

At least a 55% cut in greenhouse gas emissions (from 1990 levels)

At least a 32% share for renewable energy

At least a 32.5% improvement in energy efficiency



€50 billion

The Just Transition Mechanism is expected to mobilise at least €150 billion in public and private funds**

Covid-19 economic stimulus.***



*EU Commission website.

**Towards an inclusive energy transition in the European Union: Confronting energy poverty amidst a global crisis, European Commission, 2020.

***BNEF Tracker, November 2020.

To close our section on the actors in the energy transition, we turn to policymakers. Their role will undisputedly be critical in driving all the other agents towards a zero emissions future. We spoke with Kadri Simson, the European Energy Commissioner, to discuss her vision for energy policy in the light of the Green Deal, the untapped potential of aligning taxation with decarbonisation goals and how to best address the stark challenges behind a just transition.

"75 percent of our emissions is coming from either producing or using energy. That means that ahead of us is a significant transformation of the energy sector," Simson told us. While

Member States have been

working on their National Energy and Climate Plans to set their targets and action plans for the next decade, the Commission will add its own programme. Simson highlighted four of its key initiatives: an offshore wind initiative, to help expand renewable capacity where onshore space is limited; a sector integration initiative; the electrification of cooling and heating (representing around 40 percent of energy use) and transport; and an energy efficiency initiative, aiming to renovate Europe's building stock. To this end, Commissioner Simson works closely with Transport Commissioner Adina Ioana Vălean, Vice President Frans Timmermans and Economy Commissioner Paolo Gentiloni to create a multi-sector plan that will enable the EU to transition to sustainable energy sources while protecting jobs and spurring innovation.

Commissioner Simson expects the European Green Deal to be a critical tool in driving energy markets towards decarbonisation, but for her the Green Deal is more than a climate strategy. It is a growth strategy for Europe, based on three key pillars: innovation as a driving force, the importance of R&D in energy storage solutions, and ensuring no one is left behind.

On the innovation and R&D front, the Commission is helping to support research on climate-positive solutions such as batteries and supercapacitors but, as Commissioner Simson mentioned, "*definitely the most innovative and exciting [renewable] solution is hydrogen.*" Hydrogen is multifaceted as it can be used for energy storage and help decarbonise had-



to-abate sectors, such as heavy industry and long-haul transport.

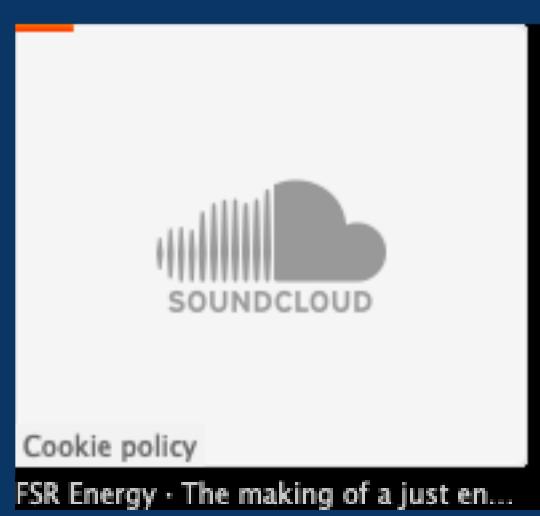
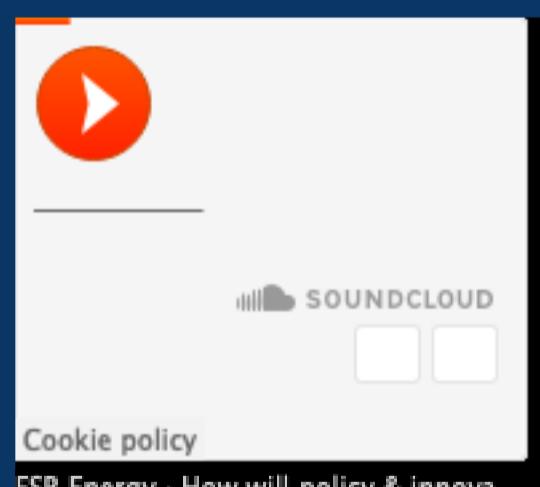
To achieve the level of ambition that is proposed in the Green Deal, according to the Commissioner, the EU needs to set an effective carbon pricing policy: “*around the European Union we have a problem: energy taxation in some parts of the EU is not treating renewables and fossil fuels equally. And in some cases, the taxation is more favourable to fossil fuels. This is not the right balance.*”

Furthermore, the Commission aims to avoid ‘carbon leakage’ by imposing a tax on imports from countries that do not follow the same emission requirements as Europe – a Carbon Border Tax. “*We want to protect the competitiveness of our industry,*” Simson states. “*Our main goal is to find like-minded partners that will also take care of their carbon footprint.*” Expectations are high to see this bold, and some say complex, proposal implemented in practice.

As for its ‘leaving no-one behind’ policy, the Commission has set up the Just Transition Mechanism, an array of funding facilities to soften the blow for fossil-fuel-reliant Member States. “*All around Europe we have factories that are losing their market share because of the technological solutions they are using.*” Simson believes Europe will make the journey to net zero in a true spirit of solidarity.

As for the challenges in implementing the European Green Deal, while Simson feels empowered by “*the schoolkids who came to the streets and asked for a less polluting way of life,*” she also knows that success will only happen if it underpins economic welfare for Europeans: “*we have to show that it is achievable, that we are still taking care of our consumers and our industry, and that Europe will stay competitive compared to other regions.*”

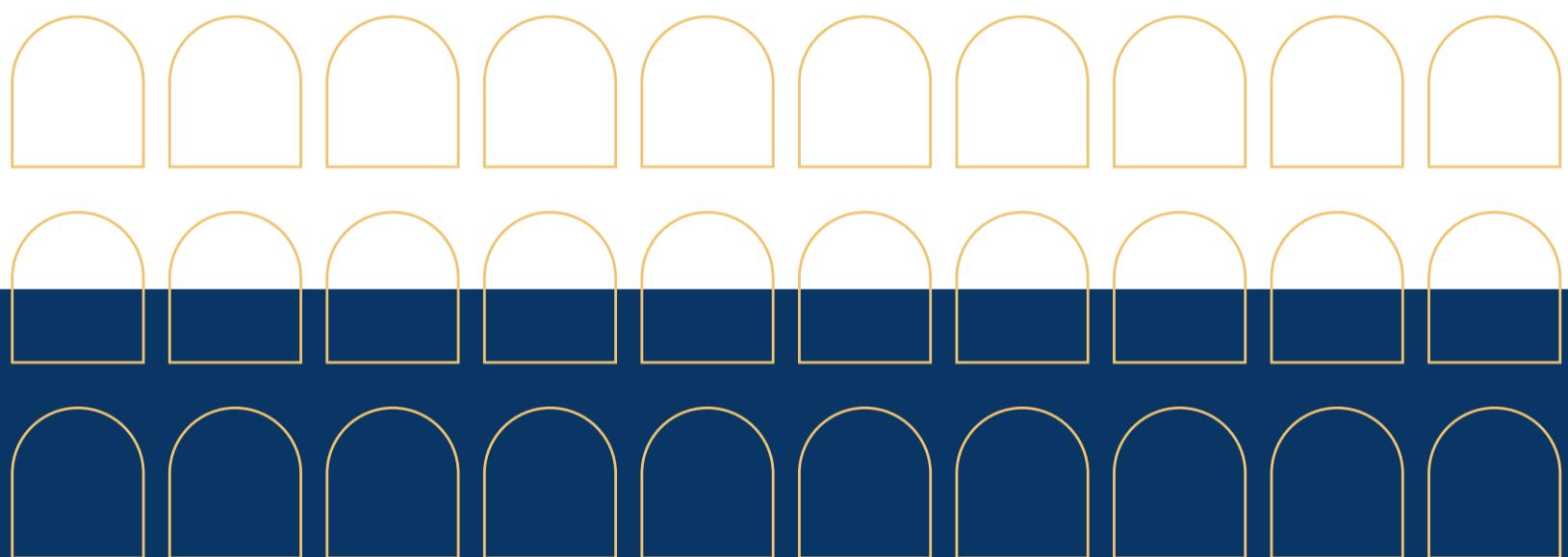
For more on the role of policy in the journey to a zero emissions Europe, listen to Part 1 of the podcast [here](#) and Part 2 [here](#)



PART THREE:

THE LEVERS

How will we get there?



While many believe that we already have the technology, the policy instruments and the capital needed to transform our power systems and economies into a net zero scenario, there is no silver bullet to get there. We will need multiple levers to be pulled in a concerted effort. In this section, we shed light on some of the key instruments which will be critical on the energy transition path. Some will steer resources to be allocated in a climate-positive way (like sustainable finance and CO₂ pricing) or create the technological conditions that allow an all-green power system (like digital transformation); others aim to bridge the gap between our current fossil fuel dependency and the speed at which we aim to decarbonise (like carbon capture); others still will play a role in the medium term in hard-to-abate sectors that cannot be electrified (like green hydrogen). Here are the levers on the journey to net zero.

CHAPTER 8

DIGITAL TRANSFORMATION, WITH CHRIS PEETERS

Chris Peeters
CEO of Elia Group



**"Digital technology will make sure that
we keep the equilibrium of the system
while the complexity will have increased."**

Key facts



€300 billion

The digitalisation of power distribution grids in Europe requires an additional €300 billion of capital expenditure in the period 2017-2050*

15%

Across the power sector, digitalisation could lead to a 15% reduction in operating costs*



Percentage of power-sector chief executives that see the digital transformation as a top strategic priority**



*Digitalisation and utilities: More data, more profits, Goldman Sachs, 2018.

**Digital innovation: Creating the utility of the future, Deloitte, 2019.

We spoke with Chris Peeters, CEO of the Elia Group, to hear his views on what digitalisation of the energy system really means and the key challenges and consequences for different market players.

In Chris Peeters's perspective, one of the immediate uses of digital technologies will be to improve the efficiency and effectiveness of day-to-day activities. *"This can be integrating satellite images, drone images, in the way we plan how we do maintenance of our assets, as an example, or introducing artificial intelligence to our control centre. Not a big step or change, but it will dramatically improve our current operations."* According to Peeters, this means improving grid and power companies' existing operating models, and *"all these technologies have somewhere their place in the system."*

Secondly, as the energy system goes *"from a quite centralised system to a distributed system, it needs to be digitalised so that it becomes more efficient in interacting with the users of the infrastructure."* In Peeters's perspective, digital

will allow the information available on all the grid injection points to be used purposefully and for sectors to converge: *"so, we see that mobility electrifies. We see that heating electrifies. We see that hydrogen is coming up. And so, each of those sectors will have to interact with the electricity system in a different way. We need to redefine how those interfaces will function. And of course, again a lot of digital technology will be needed to make this an efficient interaction."*

Thirdly, as *"flexibility will play a much more important role in the management of that system, digital technology will make sure that we keep the equilibrium of the system while the complexity will have increased."*

Will digitalisation enable such a deep change in the energy system that the roles and responsibilities of different actors will be themselves transformed?

Peeters believes so, and noted that consumers in particular will play an increasingly important role as we will be moving to *"the concept of, first of all, the consumer in the centre and, secondly, around that consumer providers of energy as a*



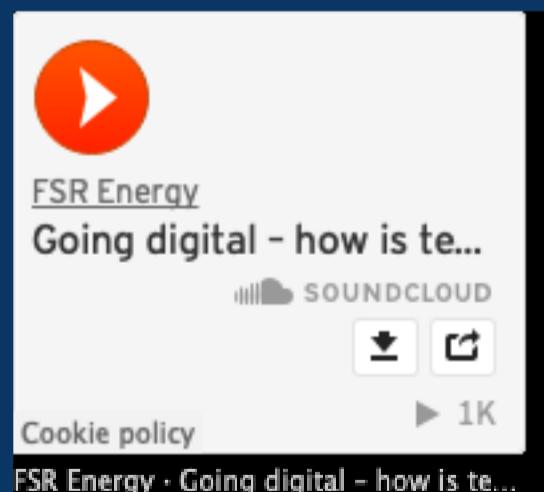
service.” He sees digital platforms disrupting the traditional vertical industrial structure of power markets. “*The link between power generation suppliers and customers is a very strong vertical one. You will see that breaking up into much more horizontal systems where you will have the specialists in the energy system managing all kinds of typical energy assets. But, on the other side, you will also have the specialist in consumer needs.*” Consumers need mobility, a comfortable house and an optimised budget, not MWh, so we should see the provision of electricity move in that direction.

Regarding electricity grid operators, Chris Peeters pointed out two lines of action for the coming years: continuing to invest in infrastructure to adjust to the new system setup and “*making sure that the system evolves in a way that is actually adapting to the new needs of the clients.*” While large investments are expected to digitise networks, Chris Peeters considers that

“*we should really limit the regulated sector to [...] a very robust, lean and mean layer, and all the other investments need to prove themselves commercially viable.*”

With growing amounts of data being collected and used by different players, fresh opportunities arise, but also new challenges for regulators and legislators: “*how can we make sure that every player can act on that data in a correct way while the consumer remains, of course, protected and cybersecurity is something that is guaranteed?*” In addition, Peeters believes that grid operators need to resist the temptation to use data for commercial purposes: “*as a regulated monopoly, it's not our role to exploit data for anything other than system operation. And further improving the service that we provide to society in general and the consumer.*”

For more on how the digital transformation is enabling the energy transition, listen [here](#)



CHAPTER 9

CO² PRICING, WITH AUKE LONT

Auke Lont

Former CEO of Statnett and Member
of the Energy Transitions Commission



**"We should indeed try to link the
fairness of the transition to the
incomes which might be generated
through the carbon tax system."**

Key facts

Percentage of EU's GHG emissions covered by the EU Emissions trading system*



Revenue from EU - ETS



€25/ton on emission currently covered by the EU ETS**

€40/ton on all emissions**

To meet the Paris Agreement temperature goals, carbon prices should reach at least US\$50-100 per ton by 2030***

EU Carbon Price

Record high of above €50/ton

**US\$ 50-100
per ton**



*EU Commission website.

**How to make the European Green Deal work, Bruegel, 2019.

***States and Trends of Carbon Pricing 2020, World Bank, 2020.

Auke Lont, former CEO of Statnett, joined us to discuss the key challenges around carbon pricing and its role in the energy transition.

The European Union currently has a mixed system to price emissions: 41% of greenhouse gas emissions fall under the Emissions Trading System (ETS), 7% are covered by carbon taxes and 4% fall under both instruments. Auke Lont considers that the EU ETS system “functions pretty well” and pointed to two improvements going forward: introducing a floor price and getting rid of free allowances. Rather than finding the perfect system, time is what matters: “*to my mind, we don't have too much time left to clean up CO2 emissions.*”

On top of that, Lont also recognises the importance of specific measures outside the ETS scheme, particularly to accelerate innovation in getting CO2 out of the system. “*In Norway many years ago, there was a CO2 tax installed in the*

offshore [oil drilling] sector. [...] And that created a boost for that industry because then it was a cost which really bit. So, there might be reasons why you would step outside a carbon trading system and instead go for a tax if you really want to get some acceleration of innovation in a specific sector.”

One of the key issues is how to address emissions from different sectors of the economy. There are still a number of sectors not subject to emissions restrictions in the EU, like agriculture and transport. For Auke Lont, the European Emissions Trading System needs to evolve to encompass all sectors so that the market mechanism pricing carbon can be a driver of climate-positive economic decisions and resource allocation: “*we need to make a path from the current emissions level to zero in 2050 and through the ETS that means that we would have allowances which would decrease every single year so that we will*



end up at zero. The market will tell us what the real cost of carbon in such a system will be. The market should help us find the most cost-efficient solutions. And I think that's extremely important, actually, that we let the market work." The other issue regarding pricing carbon is whether prices in different countries should be allowed to vary – a single price approach might have significant impacts on specific regions. Here Lont pointed to a need for European solidarity: "*What is the spirit of the EU? We are in it together and we will find solutions together.*"

Governments raised approximately 44 billion U.S. dollars in carbon pricing revenue in 2018,

with more than half generated by

carbon taxes. So how should this revenue be spent? "*We should indeed try to link the fairness of the transition to the incomes which might be generated through the carbon tax system.*" In Lont's perspective, the income from carbon taxes should be redistributed back to society: "*And that might be companies or it might be groups in society, or it might be countries so that nobody is left behind. I think it's extremely important to make that link so that we understand what we are doing and why we are doing it.*"

According to Lont, one of the most powerful measures presented by the new President of the European Commission is the creation of a Carbon Border Tax: "*I was asked during a conference what words made the most impression on me during the last half year in relationship to climate change. I answered Carbon Border Tax.*" Auke Lont noted that it will force other countries to join the EU in the climate change fight. However, the use of trade policy instruments might lead to retaliation: "*it's very brave and it might actually change the dynamics of the international climate negotiations.*"

Another important challenge will be to tax emissions in a way that does not deepen income inequalities. Lont mentioned research by the Energy Transitions Commission that looked at the effect on final consumer prices of carbon prices rising to a level where all emissions are taken out of the manufacturing of products like plastic bottles and cars: "*So even if you put a price on carbon of 50 or more euros per ton in Europe on the process of producing plastics,*



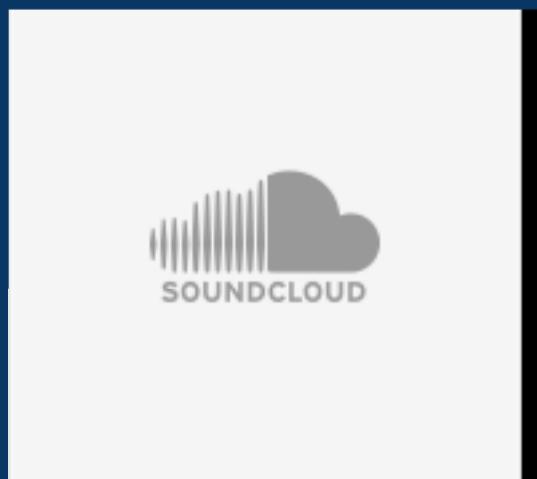
and therefore industry in the end develops a green plastic, the effect of the increased cost in producing a green plastic bottle is only 1 US dollar per bottle. That would not really affect you.”

Likewise, “the price of a car if we are going to produce green steel, which means we take coal out of the process of producing steel, we use renewable electricity to produce hydrogen and we use hydrogen in the process of producing

steel. The cost of a car will not increase very much. It will increase a bit but it’s not killing the business of buying a car.”

Consumer behaviour also plays a very significant role in the transition: *“it might be a catalyst for both industries to move faster in the green direction and for politicians to actually put more regulations or higher prices on carbon.”*

For more on how carbon prices are driving the change to a net zero society, listen [here](#)



CHAPTER 10

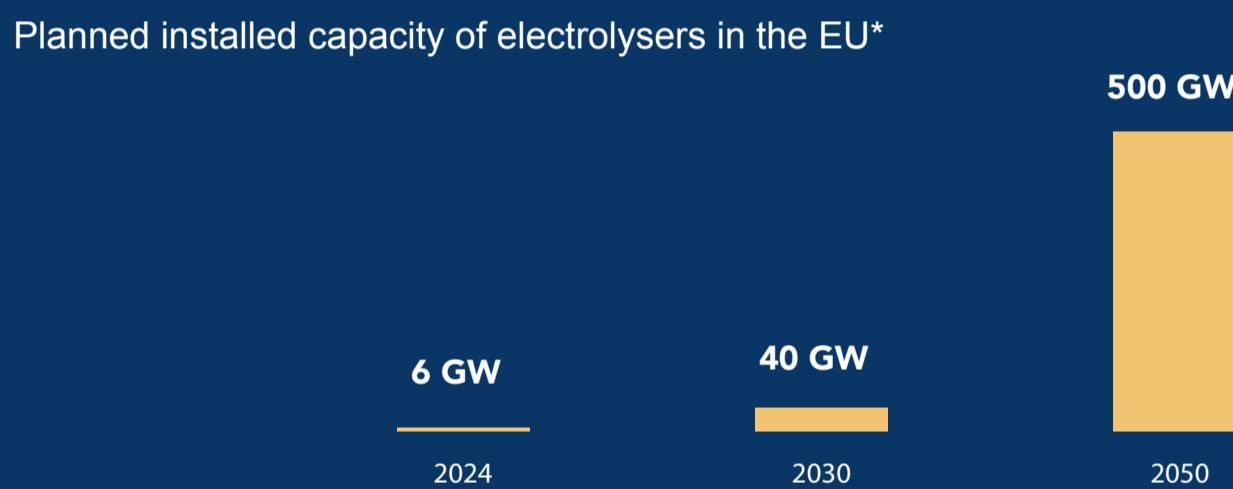
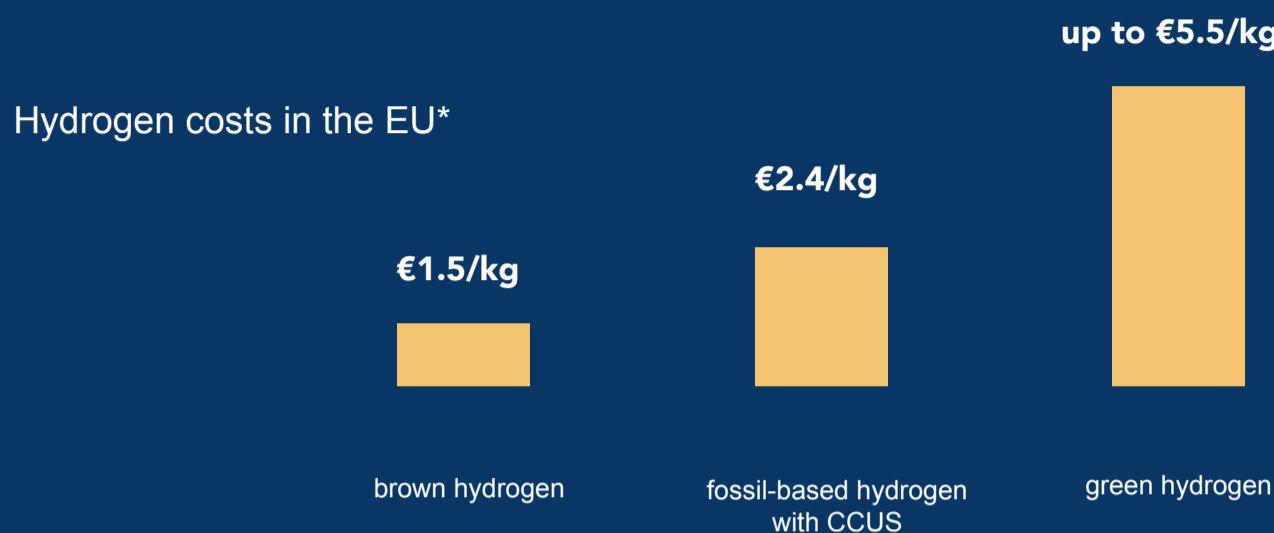
GREEN HYDROGEN, WITH MICHELE AZALBERT

Michele Azalbert
CEO of Engie Hydrogen Business Unit



"We consider renewable hydrogen the missing link in the energy transition."

Key facts



To scale up the use of hydrogen in industry, a roll-out of around \$150 billion of cumulative subsidies over the next decade would be required**



\$150 billion



*EU Commission website.

**Hydrogen Economy Outlook, BNEF, 2020.

Continuing our journey through the levers of the energy transition, we sat down with Michele Azalbert, CEO of Engie Hydrogen Business Unit, to discuss the role of green hydrogen.

Green hydrogen has often been in the news lately. The European Commission has presented an ambitious roadmap for green hydrogen until 2050. In the US, President Joe Biden has promised to use renewable energy to produce green hydrogen, costing less than using natural gas. Other countries like Chile, Japan, Saudi Arabia and Australia are also announcing major investments in green hydrogen. Michele Azalbert sees green hydrogen “*as the missing link in the energy transition*” as it would enable the storage of large quantities of renewables over a long period and decarbonise several sectors, such as industry, transport, construction and energy.

Despite several false starts in the past, hydrogen is gathering strong momentum as a key energy transition pillar. According to BNEF, in 2018-20 investment averaged about 1.5 billion US dollars

per year, while the IEA anticipates an increase to 38 billion US dollars per annum in 2019-40 and 181 billion US dollars annually in 2041-70.

“Clearly, it is not the first or the second time hydrogen has been talked about, but we think this time seems to be different. Green hydrogen is not yet competitive. Today we are in the same kind of context, with the same momentum, as we were 10 years ago with regard to solar PV.” Michele Azalbert also noted that, beyond the strategies recently announced by several governments worldwide, there are today more and more commitments from private players to improve their carbon footprints.

As Michele Azalbert observes, green hydrogen emerges as an opportunity to decarbonise hard-to-abate sectors. However, there seem to be significant hurdles doing so even using green hydrogen. Technology solutions are not mature, their existing industrial facilities have long useful lives making them hard to replace or refurbish and, in some cases, the large amount of



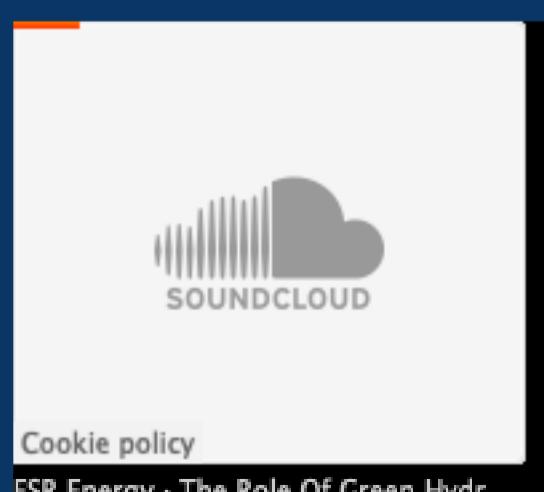
renewable energy required for the production of green hydrogen may not be available. In Michele Azalbert's perspective, "*scale and synchronisation of all efforts*" are key to overcome these hurdles in a reasonable timeframe: "*It's not only the technical suppliers but it is also for sure the customer ready to engage and to pay a premium for the product. It is also the policymakers and the public bodies on which we count for the early project, in order to breach the competitiveness gap. It is also dealing with the question of permitting. It is also finding the right investors and financial players to support the development of the project.*"

Throughout our conversation, Michele Azalbert often referred to a competitiveness gap between brown and green hydrogen. In fact, in the EU current estimated costs of brown hydrogen are around €1.5/kg, disregarding the CO2 cost, while the estimated costs of green hydrogen are around €2.5-5.5/kg. At the same time, while most experts agree that green hydrogen will be essential to meet the Paris Agreement goals, the need to build expensive electrolyzers and the additional costs of storing, transporting and

delivering it in comparison with fossil fuel based hydrogen has been raising concerns regarding its financial sustainability. Michele Azalbert reiterated "*we have to go all together at scale now*" working on both the supply and demand sides. She also highlighted the importance of putting in place market instruments that may reduce the amount of subsidies required, namely implementing a robust and sustainable CO2 price signal and defining a global classification of renewable and decarbonised gases.

Although the production of green hydrogen is still not economically viable, several energy companies are reinforcing their investment in electrolyzers and green hydrogen facilities. Michele Azalbert touched on the specific case of Engie to explain: "*The market is not yet there. Technical solutions are not yet available at scale and the customer is today maybe not willing to pay. However, at the level of Engie, we see ourselves as a hydrogen economy enabler. We need to activate the market.*"

For more on the role of hydrogen in the energy transition, listen [here](#)



CHAPTER 11

CARBON CAPTURE, UTILISATION AND STORAGE (CCUS), WITH MECHTHILD WÖRSDÖRFER

Mechthild Wörsdörfer

Director for Sustainability,
Technology and Outlooks at the
International Energy Agency



**"CCUS is the only known technology
to be able to put these sectors
[cement, steel and chemicals] on a
pathway to net zero emissions."**

Key facts

CO2 emissions



Global energy demand by sector



Tons of CO2 emissions per year by the existing large scale industrial CCUS applications*



25% of industrial emissions are non-combustion process emissions that result from chemical or physical reactions, and therefore cannot be avoided by a switch to alternative fuels*

What role might carbon capture, utilisation and storage (CCUS) technologies play in the energy transition context? Mechthild Wörsdörfer, Director for Sustainability, Technology and Outlooks at the International Energy Agency (IEA), shared her views on the opportunities and challenges arising from these technologies: “*we in the IEA see this technology as very critical for a successful energy transition. And indeed, without it we don't see that we can meet our ambition: ambitious climate goals.*”

Wörsdörfer started by explaining what is behind the acronym: carbon can be captured directly from the air or from fuel combustion and industrial processes (such as the production of fertilisers from ammonia); it can be used to create valuable products and services; and it can be stored underground in geological formations: “*the oil and gas industry has been reinjecting CO₂ into reservoirs to promote enhanced oil recovery since the 70s. And another example is Norway, which is one of the leading countries on CCUS. It started more than 20 years ago with a project to store around a million tons of CO₂ each year in*

geological formations deep under the North Sea” - the Sleipner project.

According to the IEA, CCUS can play an important role first and foremost in decarbonising heavy industry. Continued economic growth and urbanisation, particularly in developing countries, is expected to drive up the demand for cement, steel and chemicals. In Wörsdörfer’s perspective, CCUS is “*the only known technology to be able to put these sectors on a pathway to net zero emissions.*” These industries are particularly difficult to decarbonise for three main reasons: i) they require very high temperatures in their industrial processes and currently there are not any mature alternatives to the use of coal and gas to achieve them; ii) the production facilities (of a cement plant for example) have very long useful lives, up to 50 years, so they cannot be easily replaced overnight; iii) a large part of industrial emissions are process emissions, meaning that they are inherent in the production process and not the result of combustion of fossil fuels. Therefore, fuel switching is not possible (although technology switching might be). She also sees a



role for CCUS in the power generation sector, especially in countries like China and India, where most of the coal power plants are still very young and able to operate for decades: “*One of the options here is to retrofit them and also put CCUS on the existing ones to cut the emissions.*”

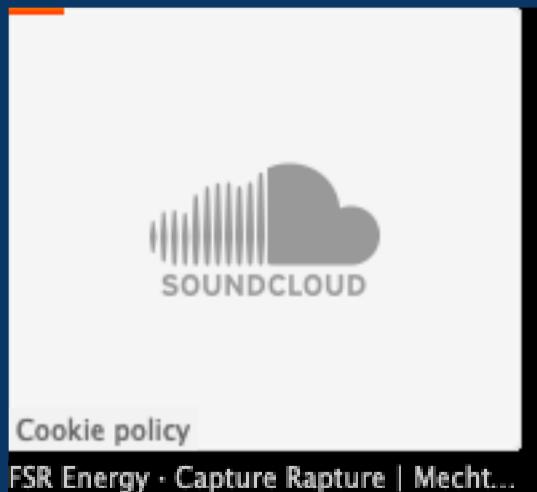
Discussion on CCUS is not new and has had some false starts. For Wörsdörfer, there are some lessons to be learned from the past: “*early programmes focused on supporting standalone fully fledged projects. But what we are seeing right now today, it's more about developing industrial hubs where there is a shared infrastructure and business model that separates the transport and storage operations from the capture facilities, and that can reduce costs and project risks.*

The other lesson is greater coordination between public and private players: “*governments can play an important role, in my view, in coordinating and encouraging CCUS developments across different applications.*” Wörsdörfer gave

the example of the Port of Rotterdam in the Netherlands, “*where industry and government are sharing the risks and money, but also investing a lot in common infrastructure for transport and storage of CO2.*”

The Paris agreement goals and the new net zero ambition for 2050 have been driving a renewed interest in CCUS, particularly in Europe. On the other hand, CCUS deployment is still facing public acceptance issues in some European countries. According to Mechthild Wörsdörfer, the use of CCUS does not mean “*business as usual for fossil fuels*” as, even considering the use of this type of technology, it is necessary to decrease the use of coal in power generation by 75% in 2040 to achieve the climate goals. CCUS technology “*provides a bridge between the reality we are still having right now and the need for urgent emissions reduction.*”

For more on the role of CCUS in the path to net zero, listen [here](#)



CHAPTER 12

SUSTAINABLE FINANCE, WITH ZOË KNIGHT

Zoë Knight

Managing Director and
Group Head of the HSBC Centre of
Sustainable Finance



"It is no longer about why we should be looking at climate change in the financial system, it is more about how to do it."

Key facts

Green bonds issuance*

€177 billion

€1 billion



2009



2018

Clean energy investment*

€300 billion

x 6
↗

€60 billion



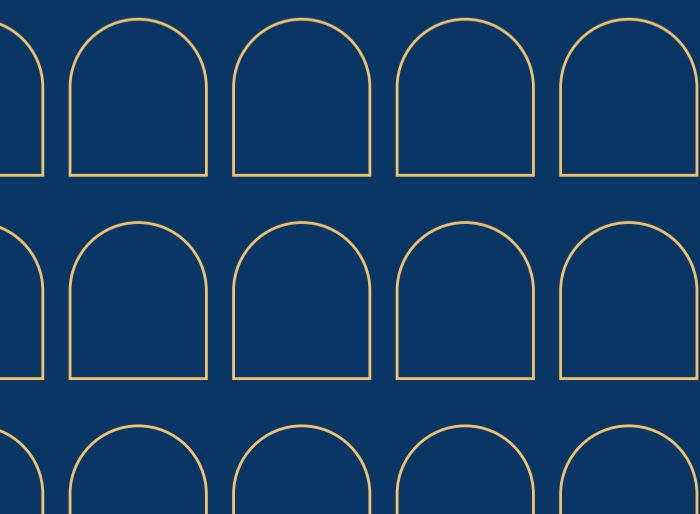
2004



2018

According to IPPC estimates, clean energy investment would need to increase by a factor of 6 by 2050 compared with 2015 to limit warming to 1.5°C**

6x



* Financing the Low-Carbon Future – A Private-Sector View on Mobilizing Climate Finance, Climate Finance Leadership Initiative, 2019.

** IPCC, Special Report: Global Warming of 1.5°C: Summary for Policymakers, 2018



To close our section on the levers in the energy transition, we spoke with Zoë Knight, Managing Director and Group Head of the HSBC Centre of Sustainable Finance, to discuss the role of the finance sector in the net zero transition.

The finance sector's role in the global response to climate change will involve not only accelerating low-carbon investments but also supporting the transition in carbon-intensive sectors.

Regarding investments in green renewable generation and electric vehicles, the appetite of investors seems to exceed the volume of

investable projects. According to Shemara Wikramanayake, the CEO of Macquarie, “*the biggest challenge to mobilising climate finance is not the availability of capital but the lack of a sufficiently strong pipeline of investable projects.*” Zoë Knight identified a variety of reasons, highlighting that the “*risk assessment of how strongly investment will contribute to solving climate goals isn't truly reflected yet.*”

On the other hand, the hard-to-abate sectors, including heavy industry, heavy-duty transport and agriculture, account for around 40% of greenhouse gas emissions but still attract limited investment: “*This is where investors are a little bit unstuck in terms of what to do.*” In Zoë’s perspective, companies need to clearly demonstrate what their climate strategy is, while governments “*can help with this by providing and supporting areas like the EU taxonomy, which sets out a classification system for activities that are related to driving down emissions and generating a circular economy.*”

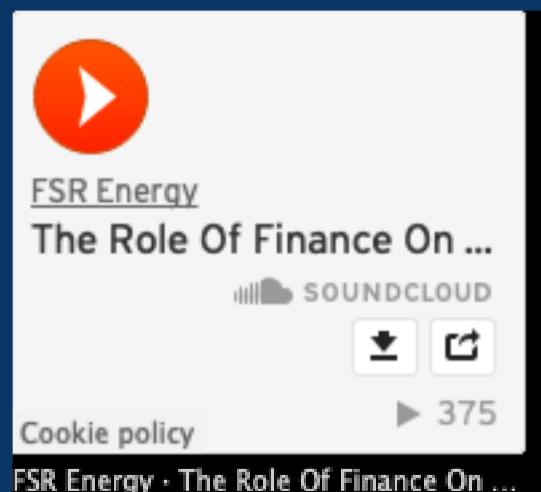
Green financial instruments, such as green bonds and sustainability-linked bonds, also have a significant role to play in decarbonisation. Although investor interest in green financial products has grown quickly in the last few years, it remains concentrated in tightly defined green bonds. In 2018, the issuance of green bonds reached 177 billion US dollars, compared with less than 1 billion US dollars in 2009, but this is still a small portion of the global corporate bond market. “*There's plenty of work to do in this labelled finance aspect because we need*

to drive so much capital towards low carbon outcomes. So, in the financial system as a whole, to get better alignment of our financing with that net zero goal, we need transparency on what the projects are going to be from those high climate impact sectors,” Zoë Knight said. Governments may also signal to investors that they are taking their climate plans seriously by issuing green financial instruments. Zoë considers that these initiatives are “*a really powerful backdrop for privately held corporations to be able to also be transparent about their financing.*”

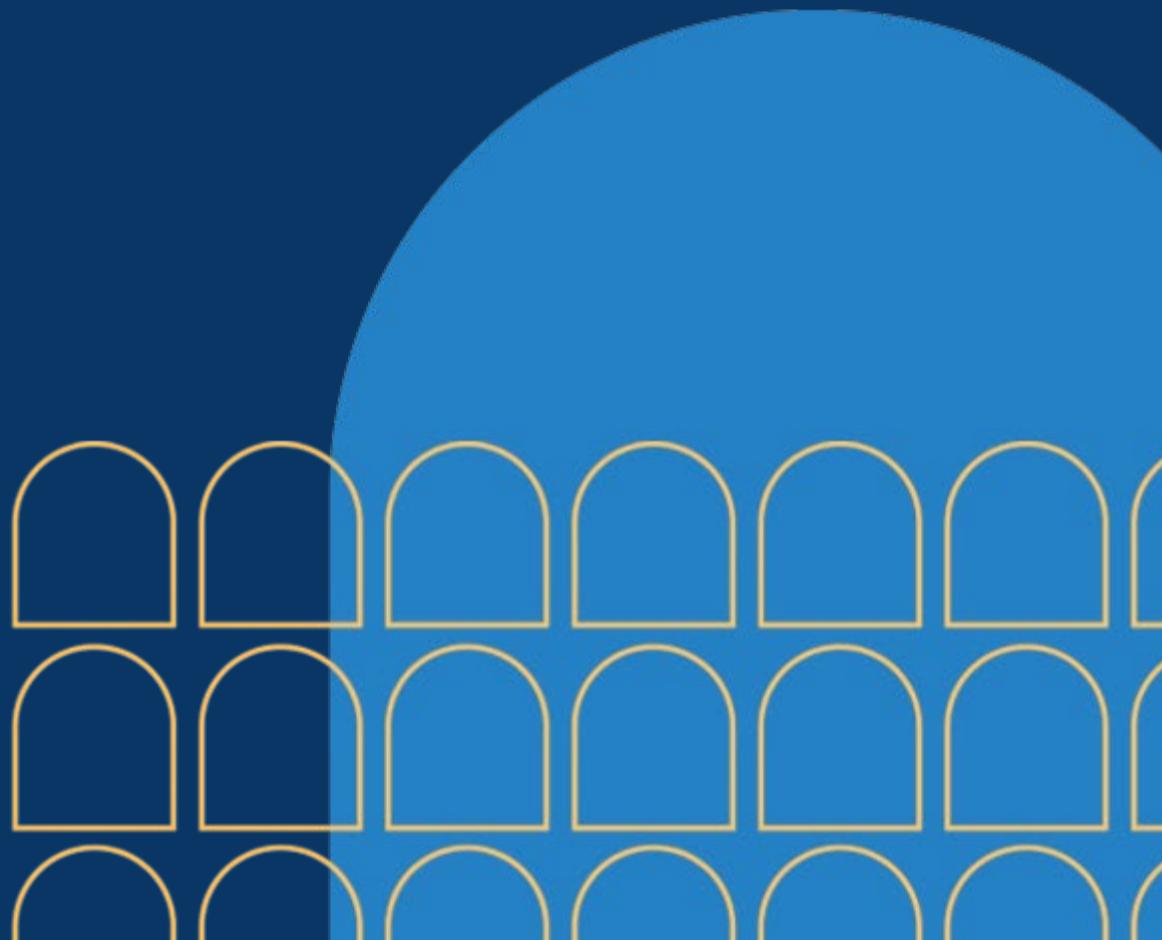
Throughout our conversation, the role of transparency and in particular the disclosure of climate-related information was mentioned

as a critical element to support better decision-making by investors. In 2017, the Financial Stability Board's Task Force on Climate-Related Financial Disclosures released a framework for organisations to develop more effective climate-related financial disclosures. In Zoë’s perspective, “*it provides us with a better toolkit to assess the risk, the reward profile and also the alignment of how we deploy capital more effectively*” as “*it is no longer about why we should be looking at climate change in the financial system, it is more about how to do it.*”

For more on the role of the finance sector in the energy transition, listen [here](#)



CONCLUSION



In addition to the first-person accounts we have seen so far, we would now like to bring to your attention some fresh ideas emerging from the Florence School of Regulation's rich dialogue with all these players over the past few years.



Piero Carlo Dos Reis,
Research Associate
primary author



Golnoush Soroush,
Research Associate



Tim Schittekatte,
Research Associate

We have started our journey by looking at the **destination** - ‘*what does the future look like, if we reach our net zero goal?*’. Although a decarbonized economy, flourishing ecosystems and more stable international relations are key elements of this brave new world, we also need to account for what is our desired destination in **social** and **economic** terms, how **citizens** will be at the core of it, and what shape will **political leadership for climate action** take in the future.

On one hand, the implementation of many of decarbonization policies relies on public acceptance (e.g. infrastructure upgrades might face objections from NIMBYs, demand side management might not be well-received, etc.). On the other hand, citizens themselves are being called upon to carry through a number of these policies (e.g. investments in buildings’ renovation, using e-mobility and electrical heat sources, etc.). Therefore, enhanced **engagement** of citizens in contributing to efforts to have a net zero world should be considered another important target.

The Florence School of Regulation has been leading fruitful debates about how citizens can engage in novel ways with power markets (i.e. Dynamic pricing in the electricity retail market), as well as how European institutions are delivering on their climate mission: in the recent working paper by Jean-Michel Glachant - La politique européenne de l’Europe, mais à ma façon - the FSR looks back at how the European Commission has been leading Europe in successfully attaining ever increasing climate goals, despite its limited

formal executive powers, and discusses the challenges ahead.

In what regards the role of different **actors** of the energy transition, while diverse and complementary, all the different perspectives portrayed here agree on a sense of **urgency** and the need for strong investment in **innovation**.

At the Florence School of Regulation, we have also been discussing the pivotal role of **innovation**, not only through the influence of start-ups and new products and technologies, but in areas such as regulation, public funding, and regulated networks.

Finally, we addressed the issue of the required **levers** for a net zero world, essentially asking the question: ‘*what do we need to complete the net-zero journey safely and successfully?*’. Here, we aim to complete the answer by leveraging the Florence School of Regulation’s expertise in analysing and challenging established policymaking institutions and other energy players’ statements and claims.

Firstly, it is important to note that the levers and actions highlighted in the interviews are not exhaustive, and could be complemented by:

1. other known technologies (such as energy efficiency, massive expansion of renewable electricity, electric vehicles, heat pumps, e-fuel production, negative emissions technologies, etc.);

2. other known policy tools (such as tools for mitigating methane leakages and other greenhouse gases, upgraded systems of guarantees of origin, removing market distortions and barriers to new business models, new regulatory models, etc.);
3. other known measures (e.g. materials efficiency, behavioural change);
4. other levers currently unknown; and so on.

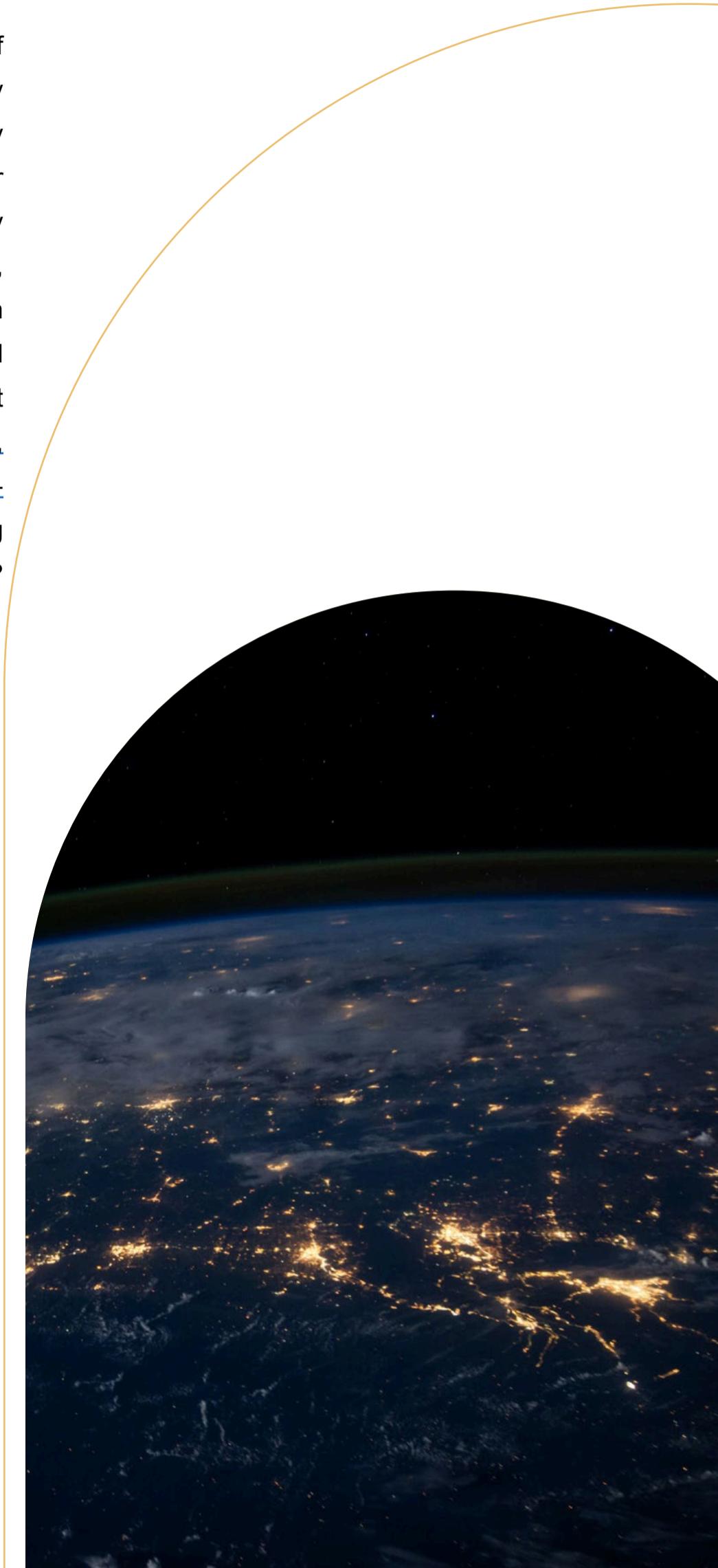
The pursuit of a net-zero scenario in the next 30 years is likely to require a combination of these different levers, although the exact mix is hard to predict. Whereas the solutions for 2030 are mostly known, those for 2050 are largely ‘known unknowns’ and ‘unknown unknowns’. In fact, the FSR “Cost-effective decarbonization study” demonstrates how sometimes the assumptions by key ‘policymaking’ sources (such as IEA, IRENA) can be contrasting depending on the methodology, or even on an undisclosed ‘black box’. Secondly, we can bring complementary insights to the question ‘*what do we need?*’ by flipping it around and asking instead: ‘*what should we avoid to complete our net zero journey?*’. Here are some key elements to consider:

- a. Repeating the mistakes and forgetting the lessons of the last couple of decades. To name a few: global warming is a global problem which must be tackled by everyone and not only by a few regions; policy tools must be coordinated keeping in mind the interactions between different parts of the system and other

world regions; citizens must be informed of the transition and be made to contribute to it to avoid a ‘not in my back yard’ (NIMBY) reaction; expensive sustainable technologies adopted by those with higher incomes must not be largely supported through additional burdens on those with lower incomes; a competitive market with correct and transparent price signals (CO2 prices, system costs) will yield the cost-optimal transition.

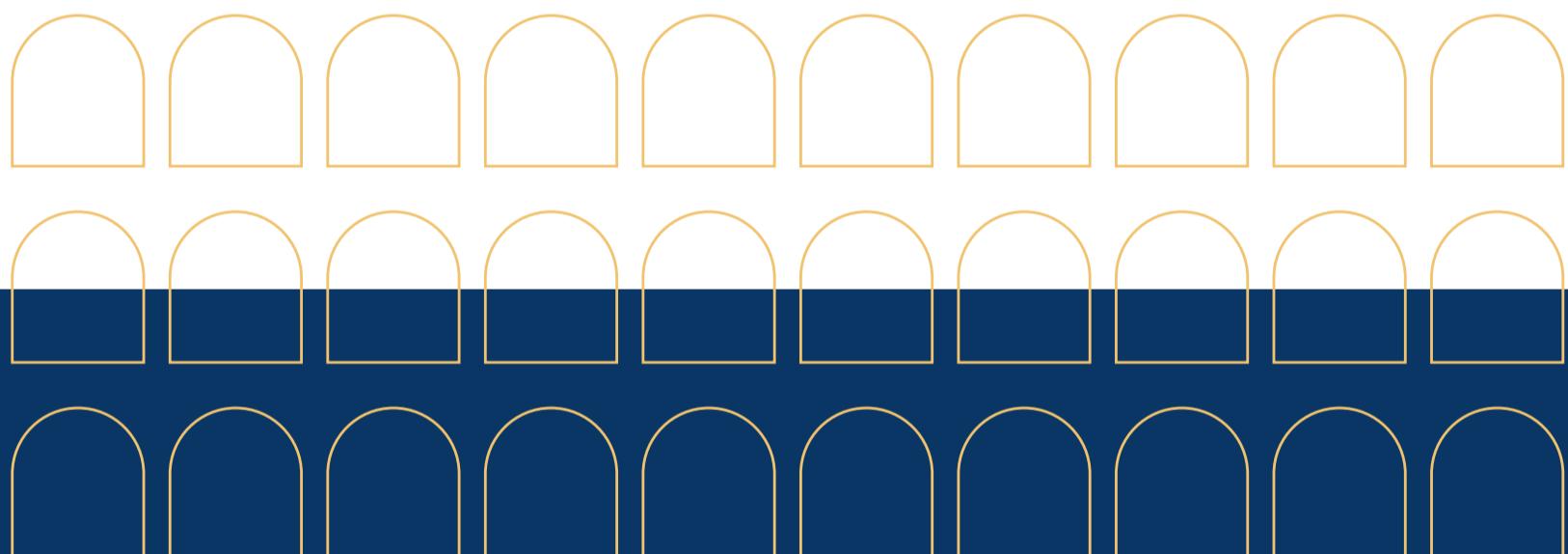
- b. A business-as-usual approach, without a decisive commitment from the different members of society (i.e. citizens, government, project developers, financial actors, system operators ...). Changes will increasingly be needed, uncertainty is large and avoiding reality will only make things worse. In the words of Giuseppe Tomaso di Lampedusa, in ‘Il Gattopardo’: “*If we want things to stay as they are, things will have to change*”.
- c. A vision that does not account for the complexity, interdependency and scale of the change required. If timing, limited natural resources, and an increasingly interconnected and complex system, are not accounted for, the journey to a net-zero vision will not pass the reality test. Experts argue that we already possess all the levers needed to complete the journey. However, not all levers are ready to be used immediately (e.g. e-fuel production, negative emissions technologies and materials efficiency). Likewise, Earth’s resources are not infinite, and its use must be well-planned. The finite nature of resources

also justifies the three pillars approach of the EU system integration: energy efficiency first, electrification and renewable electricity second, green molecules whenever electrification is not technically or economically feasible. Do we have enough water, land, metals, forests, green electricity, production facilities, project developers, infrastructure and so on, to enable this transition? Did we account for the interaction across different “sectors, services, physics rules and economic trade-offs” in the planning? Finally, are we truly putting enough effort into turning the vision into reality?



THE FUTURE OF NET ZERO IN SIX QUESTIONS

AS SEEN BY OUR PROTAGONISTS



1. Zero carbon Europe by 2050 – myth or reality?

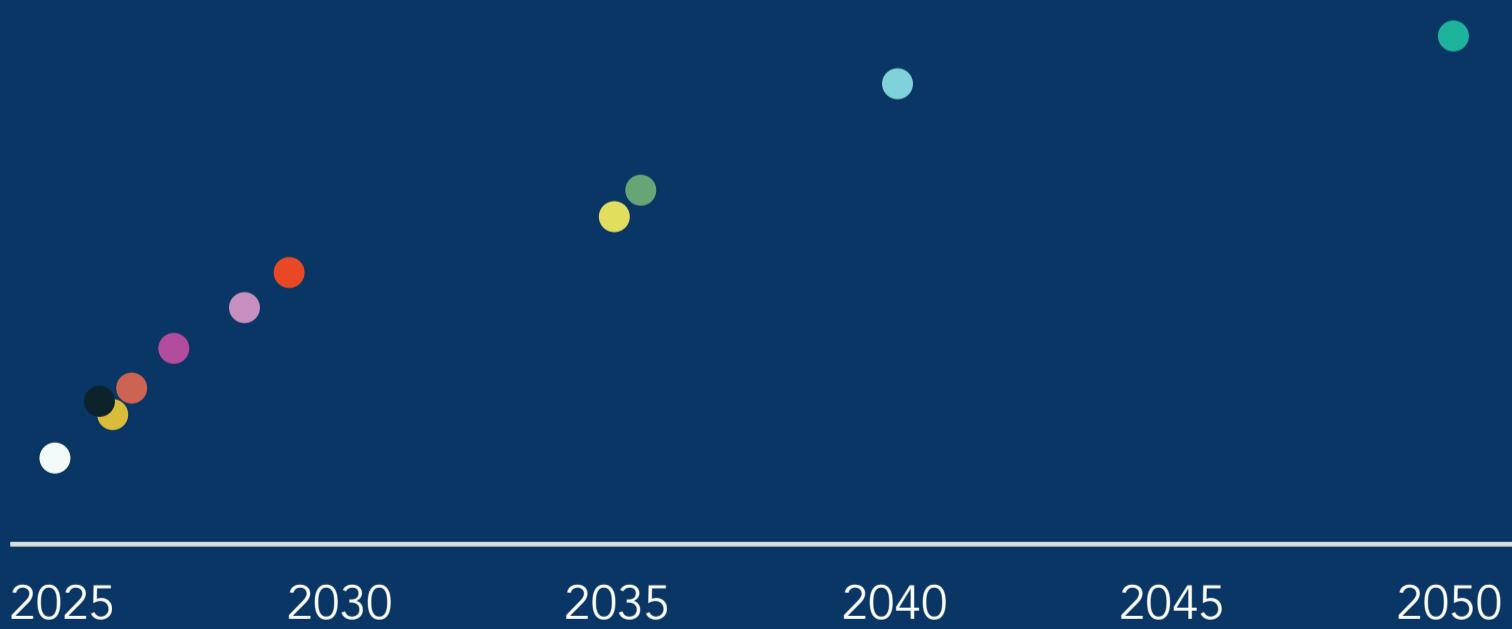
- Albert Cheung
- Monika de Volder
- Tara Connolly
- Chris Peeters
- Andris Piebalgs
- António Mexia
- Elena Bou
- Auke Lont
- Mechthild Wörsdörfer
- Zoë Knight
- Michele Azalbert



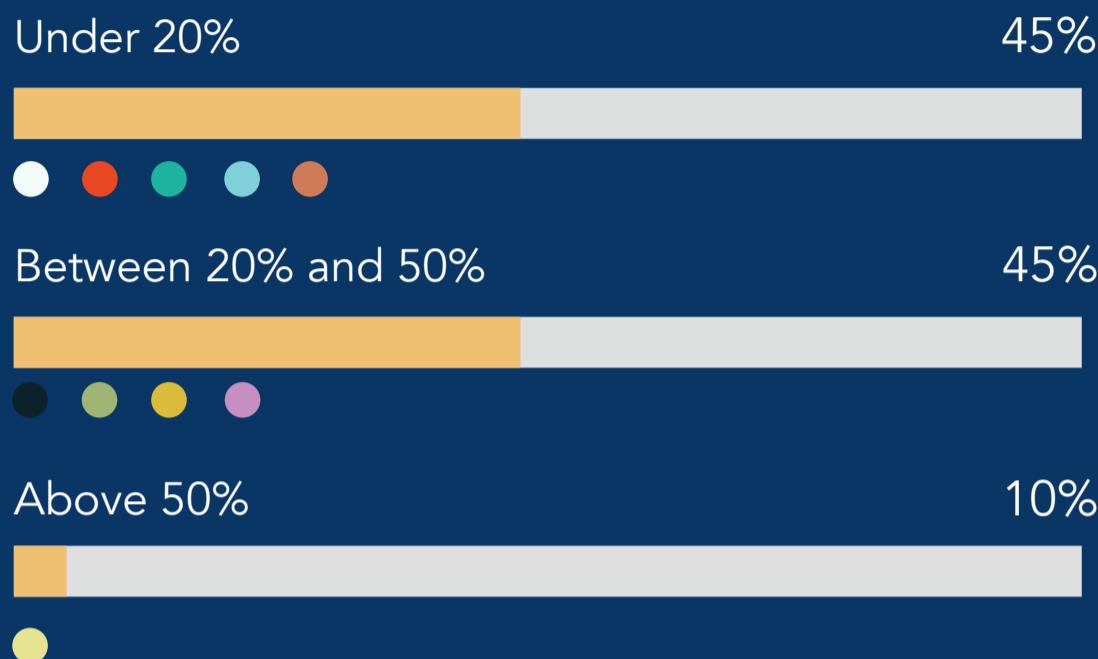
2. The future of storage: batteries or power to gas?



3. What year will see the last internal combustion-engine vehicle sold in Europe?



4. What will the percentage of power generated by prosumers be in 2050?



5. The main challenge for utilities in the next decade is _____

- Create value in a very competitive and uncertain transition and engaging customers
- Find new ways to engage with customers and meet increasing expectations from customers
- Keeping up with the transition and making it fast and fair
- Make sure that we act quickly enough to both the infrastructure challenge and the digital challenge
- To adapt the business models to provide energy services and consultancy
- Cultural change to enable the redesign of the business
- Skills
- To accelerate decarbonisation using data
- To focus more on services, system integration and another portfolio
- Transparency of climate plans
- To jointly develop very large scale projects to accelerate the transition and jointly rather than competing

6) Do you believe that the Paris Agreement goal of keeping the increase in global average temperature to well below 2 °C above pre-industrial levels will be attained? If yes, by what date?

● **Albert Cheung**

“On current trend, no. On current trend, I think most experts would say we are on track for three/more than three degrees of warming. But when we look at the tipping points that are coming in terms of the possibilities around renewables, around electric vehicles, around greater electrification of the economy and new technologies, like hydrogen that are coming down the road. It's possible and I think we have to remain optimistic that it's possible. We have to work towards it.”

● **Monika de Volder**

“We don't have any choice. There's no consumer on that planet. The science is very clear, the impact of climate change is more than clear. We have an ultimate deadline to meet that and I would hope that we can actually do it before the deadline as is in the Paris Agreement. I'm quite optimistic, so that means actually no more procrastination, and it's not only about talking the talk but also walking the walk.”

● **Tara Connolly**

“I hope we keep it at 1.5, not just well below. By what date, I don't know.”

● **Chris Peeters**

“I don't have a crystal ball on that one but I think that we need to do everything to get as close as possible to that objective.”

● **Andris Piebalgs**

“I think we should stick to this goal and we should stick to the dates that we have also committed ourselves. I know it's difficult and the progress today is not going in the right direction, but we should not abandon it. And we need to strengthen international peer review mechanisms so that countries that committed to achieve this goal also deliver.”

● **António Mexia**

“Can we bear the risk of not fulfilling the Paris agreement? The answer is no. So to your question, I say we are going to meet Paris because we don't have an alternative.”

● **Elena Bou**

“I think that we will, something good will happen but, when, that is another story”

● **Auke Lont**

“We have to make it by 2050”

● **Mechthild Wörsdörfer**

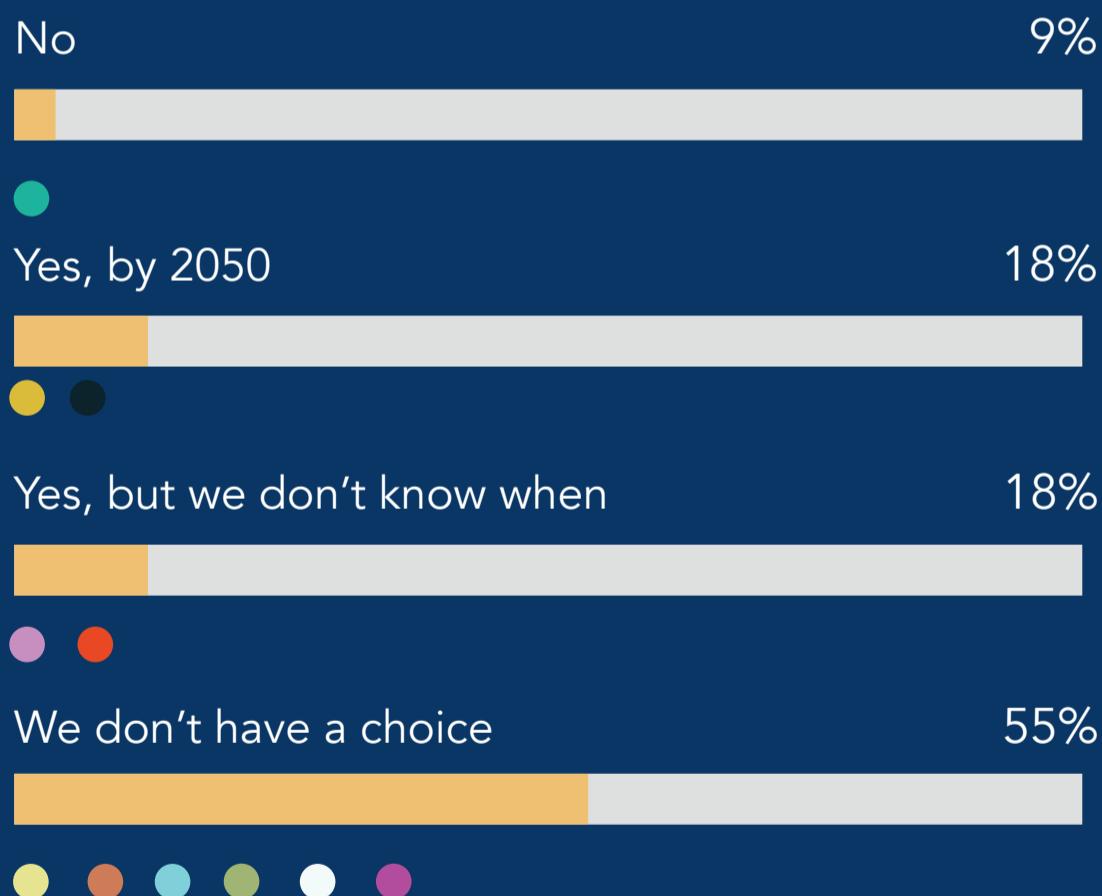
“At least for Europe, by the mid-century we can reach net zero, and hopefully, globally, soon after”

● **Zoë Knight**

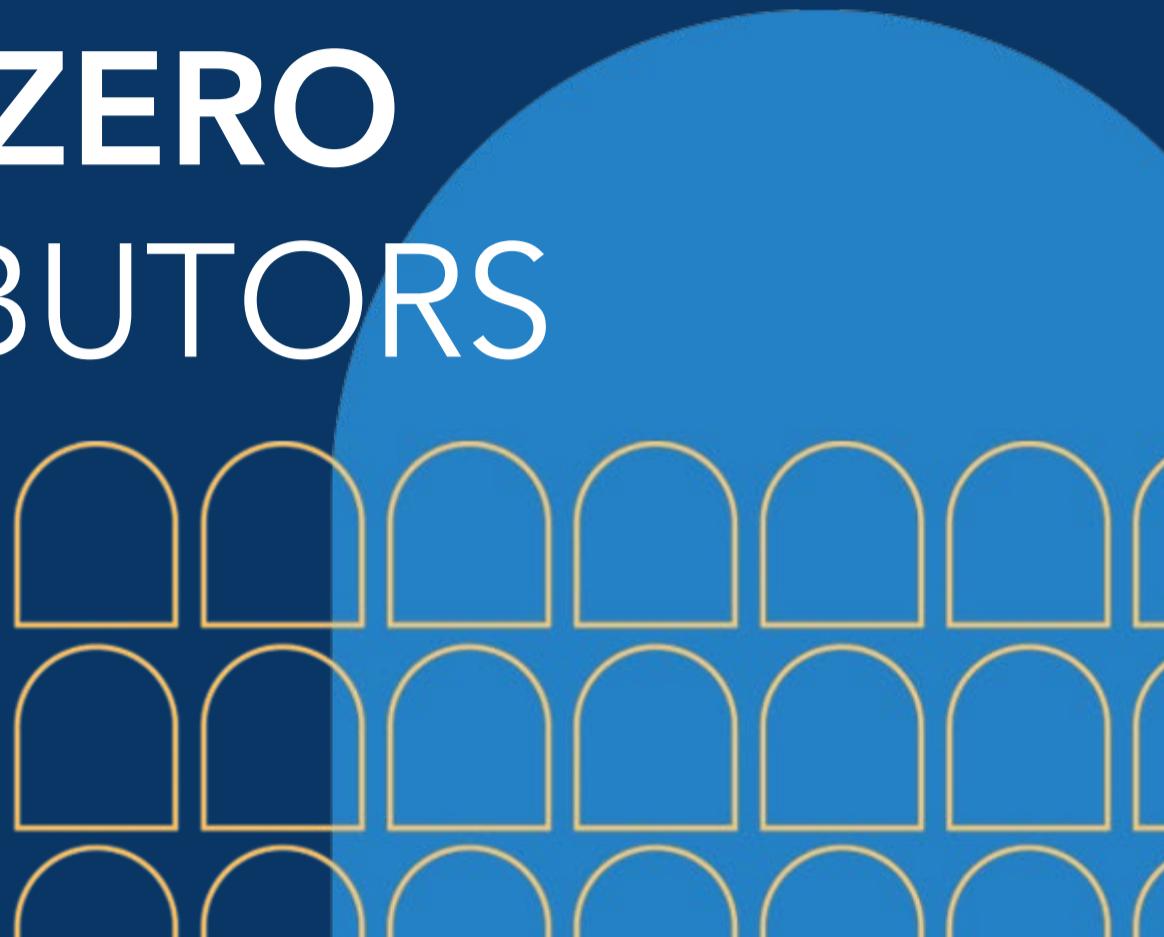
“Yes, absolutely. I think it's going to move faster than people anticipate. And I think by 2040.”

● **Michele Azalbert**

“It's our target at Engie and we have taken concrete action to date”



THE JOURNEY TO NET ZERO CONTRIBUTORS



Authors

Joana Freitas – Net Zero Host

Jessica Dabrowski – Producer and Communications Specialist

Samuel Silva – Research Analyst

Editorial team

Sara Jane Rzegocki – Communications Assistant

Gianluca Dolfi – Podcast Editor

Giorgio Giamberini – Graphic Designer

About the authors



Joana Freitas

Ambassador for the *Lights on Women* initiative of the Florence School of Regulation

Joana Freitas is an energy professional and Executive Board Member at EDP Produção. After starting her professional life as a McKinsey consultant for 7 years in London, Rio de Janeiro and Lisbon, she has had a career as an executive in infrastructure operations and finance. She went on to join the Cabinet of the Secretary of State of Treasury and Finance in Portugal. Joana holds an MSc in Economics from Porto University, an MBA from INSEAD and in 2019 completed the Future Grid Managers Programme at the Florence School of Regulation and Vlerick Business School. She is a co-founder of the Leading Together gender balance initiative.



Jessica Dabrowski

Jessica is currently the Associate Director for Communications at the Atlantic Council's Adrienne Arsht – Rockefeller Foundation Resilience Center in Washington D.C. Previously, she spent six years as a Communications Specialist at the European University Institute's Florence School of Regulation (FSR). During her time at the FSR, she co-founded Lights on Women, an initiative that promotes gender equality and inclusion in energy, climate, and sustainability. Jessica holds an M.A. in Political Science with a concentration in EU Economic and Social Policy, and a B.A. in Public Policy and Administration and Justice Studies from James Madison University.



Samuel Silva

Samuel Silva has been working as a strategy analyst in the energy sector over the last six years. His responsibilities include supporting corporate strategy, developing a long-term business plan and providing financial projections for top management, investors and rating agencies. In addition, he is also in charge of developing a yearly benchmark comparing European TSOs and analysing key industry trends. He holds an MSc in Industrial Engineering and Management from Universidade Nova de Lisboa and has completed the Master in Finance for Executives at Católica Lisbon School of Business & Economics.

**Florence School of Regulation**

Robert Schuman Centre for Advanced Studies
European University Institute (EUI)
Via dei Roccettini 9, I-50014
San Domenico di Fiesole (FI)
Italy

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