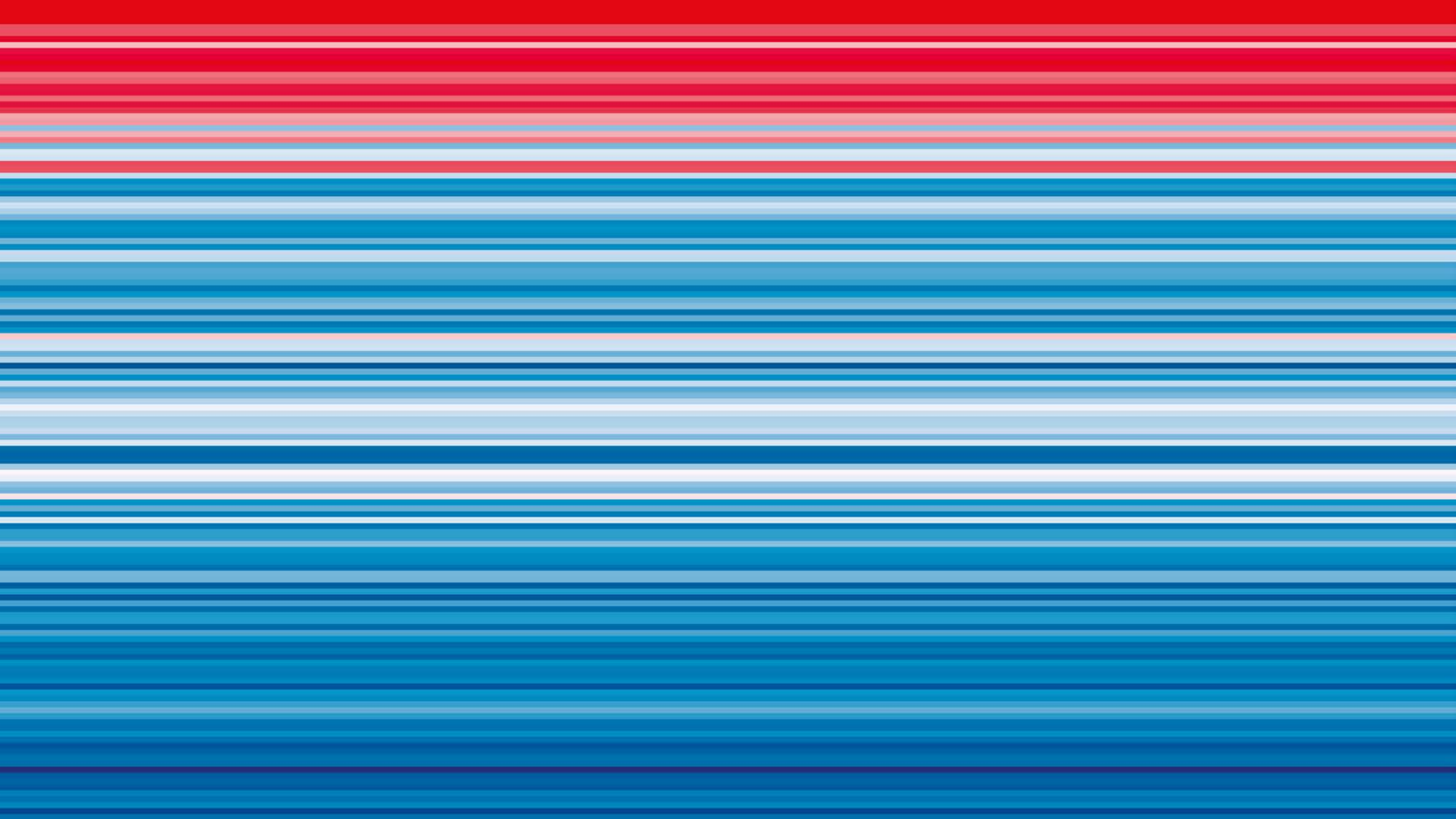


# Clean Energy Transition in Europe: The Big Picture

Matthias Buck

BERLIN, APRIL 1, 2019



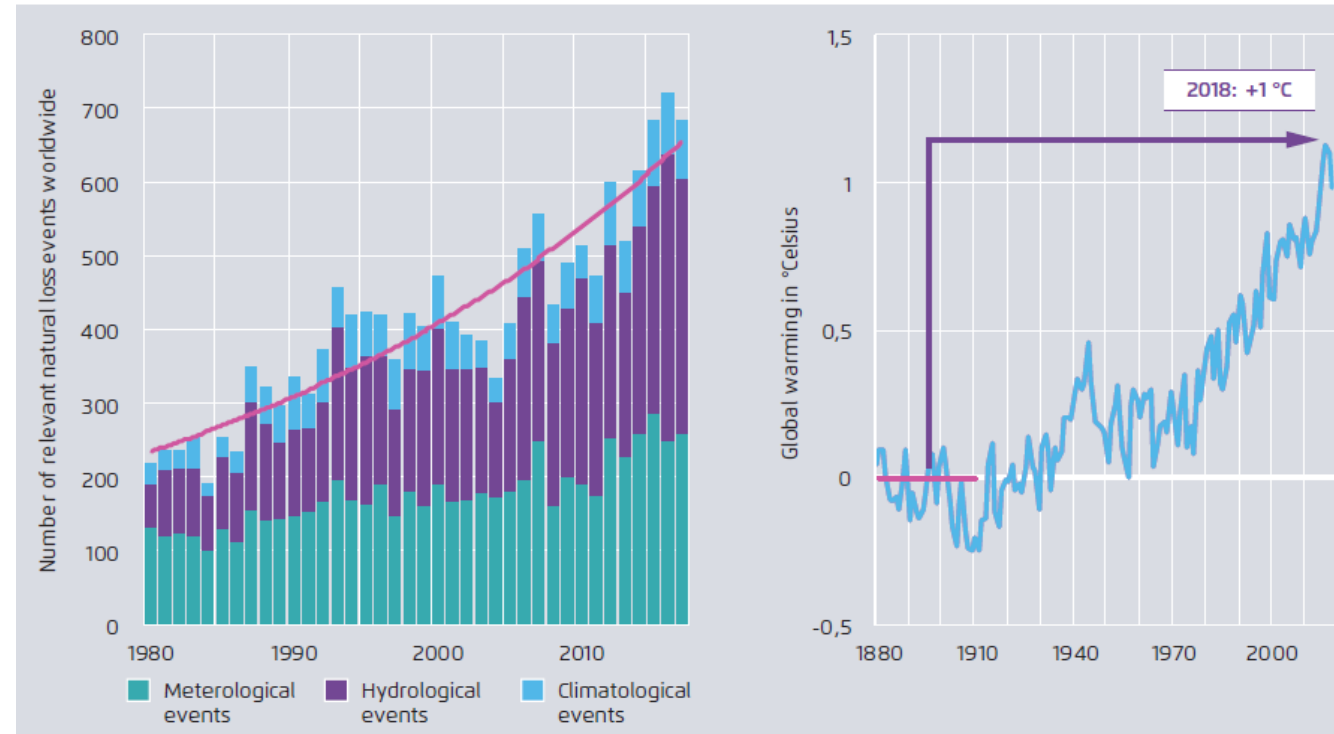
**10 Megatrends that  
will shape energy  
policy in the next  
decade**

## Megatrend #1: Decarbonisation

As climate change accelerates, societal pressure to act increases

Climate change is real: since 1970 the rate of global warming has accelerated, and since 1980 extreme weather events have tripled

Figure 1



MunichRE (2018): NatCatSERVICE

WMO (2018)

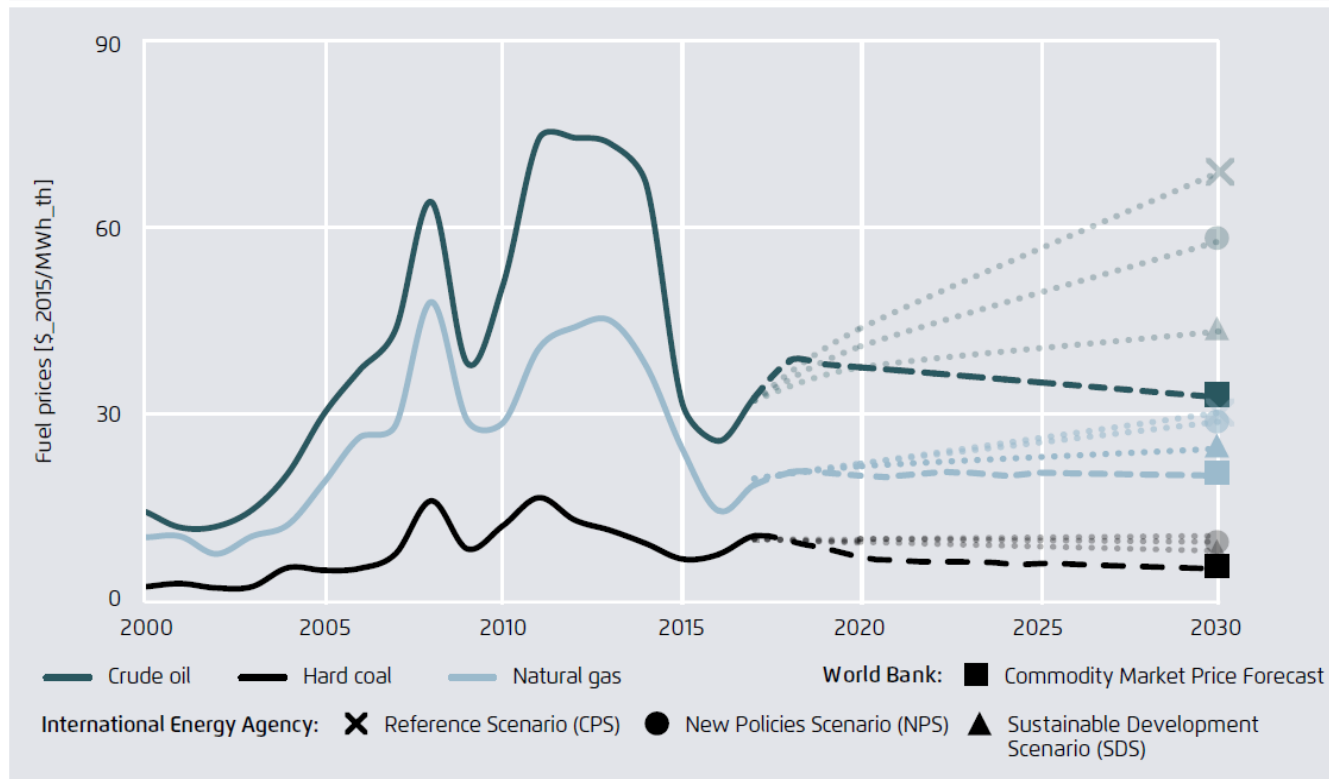
- The 2015 Paris Agreement aims to limit warming to well below 2° C
- National pledges so far are not adequate to achieve this goal
- With impacts of climate change becoming more visible, societal pressure to reduce emissions is growing
- Pressure is coming from citizens, NGOs, but also investors and businesses

## Megatrend #2: Deflation of fossil fuel prices

Coal, oil and gas prices will remain low, but become more volatile

Fossil fuel price projections forecast low to moderate price levels to 2030

Figure 2



IEA (2016), World Bank (2017a) and World Bank (2017b)

Prices for fossils are in general not going to rise, as

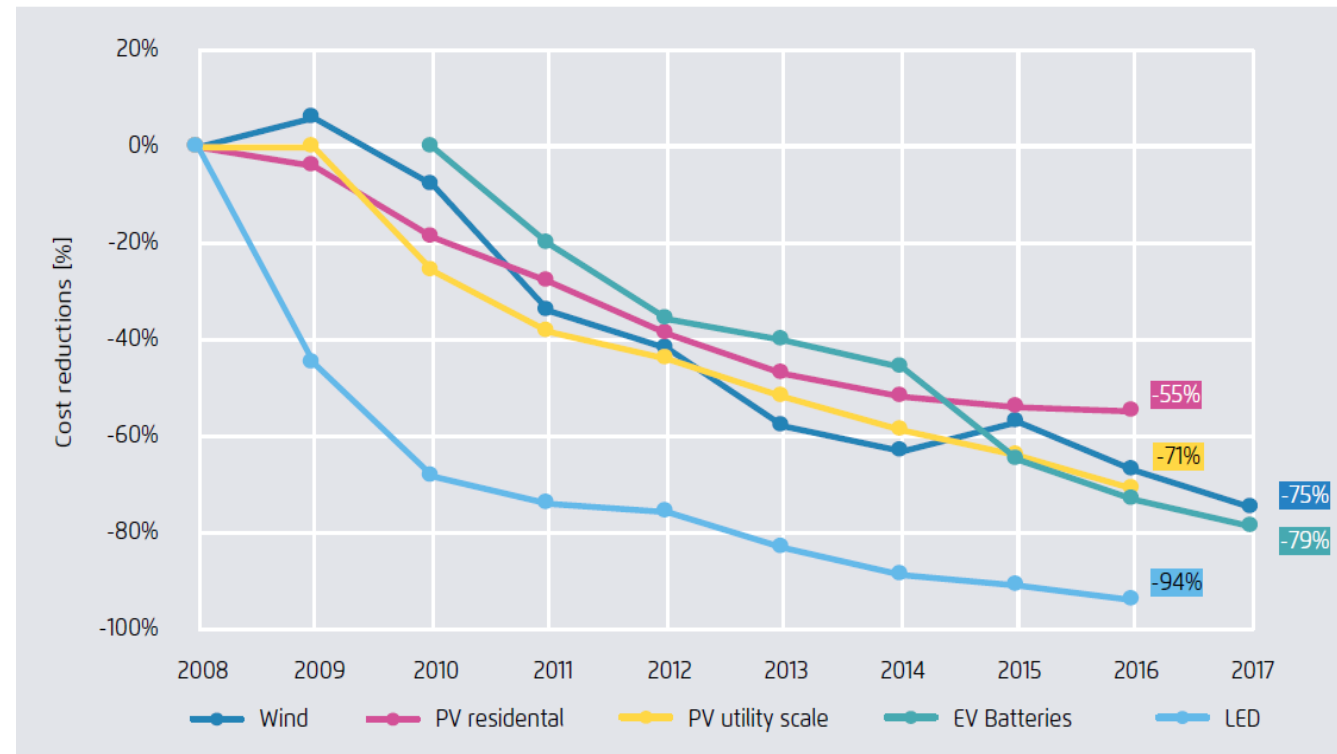
- unconventional sources of oil & gas are cheap to explore
- low-cost renewables serve as upper price limit for gas and coal
- If the world is to remain well below 2 degrees warming, there is no shortage, but an abundance of known fossil fuel reserves!

# Megatrend #3: Decrease in costs for clean energy solutions

Wind, Solar, Batteries, Efficiency technologies are now cheaper than conventional and fossil technologies

Cost reductions in major clean-energy technologies from 2008–2017

Figure 3



NRDC (2018) Revolution now

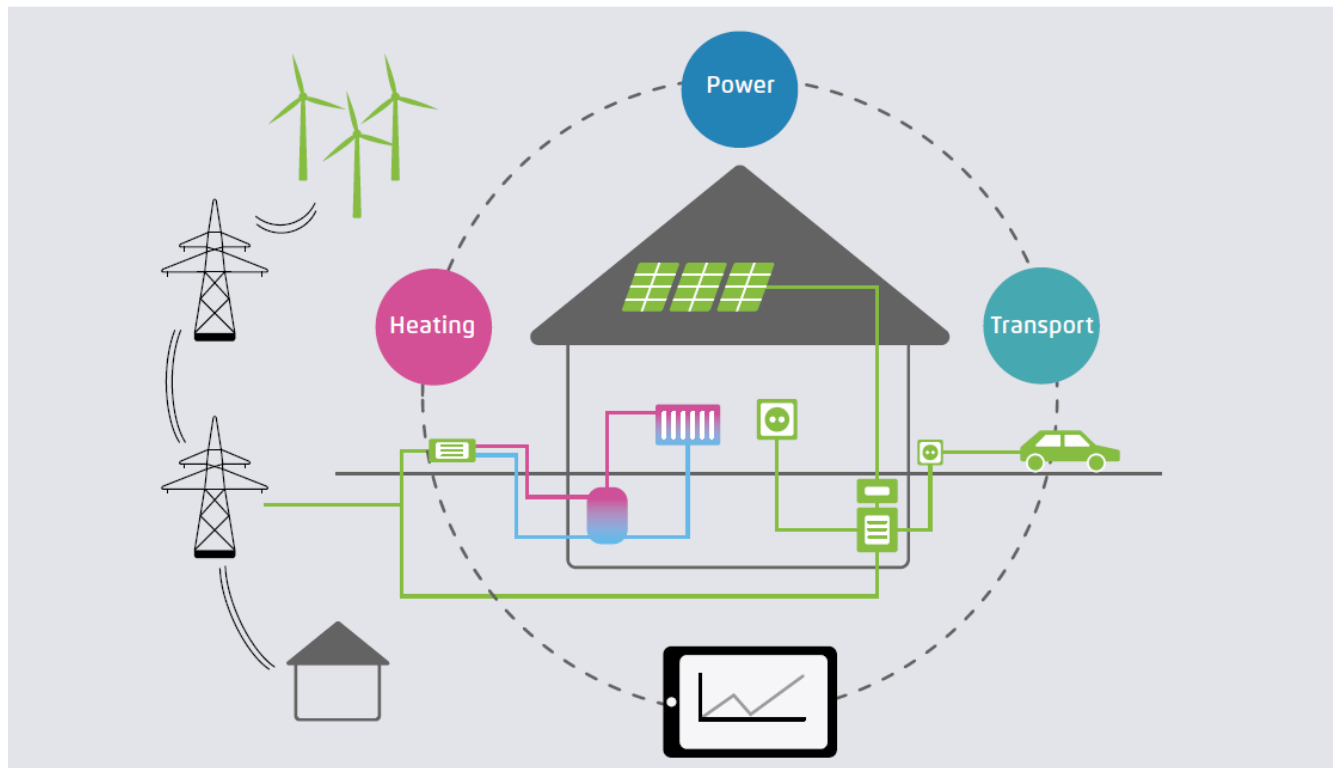
- The cost for wind and solar power has fallen dramatically over the last decade: new wind and solar plants are now cheaper than any other new built power technology
- Over the next decade, *new* wind and solar plants will become cheaper than operating *existing* coal and gas plants
- A similar drop in costs is underway for batteries and in consequence also for electric vehicles

## Megatrend #4: Digitisation

Energy and transport systems are becoming smarter and better networked

Digital technology will enable the integration of the power, heating and transport sectors

Figure 4



Agora Energiewende

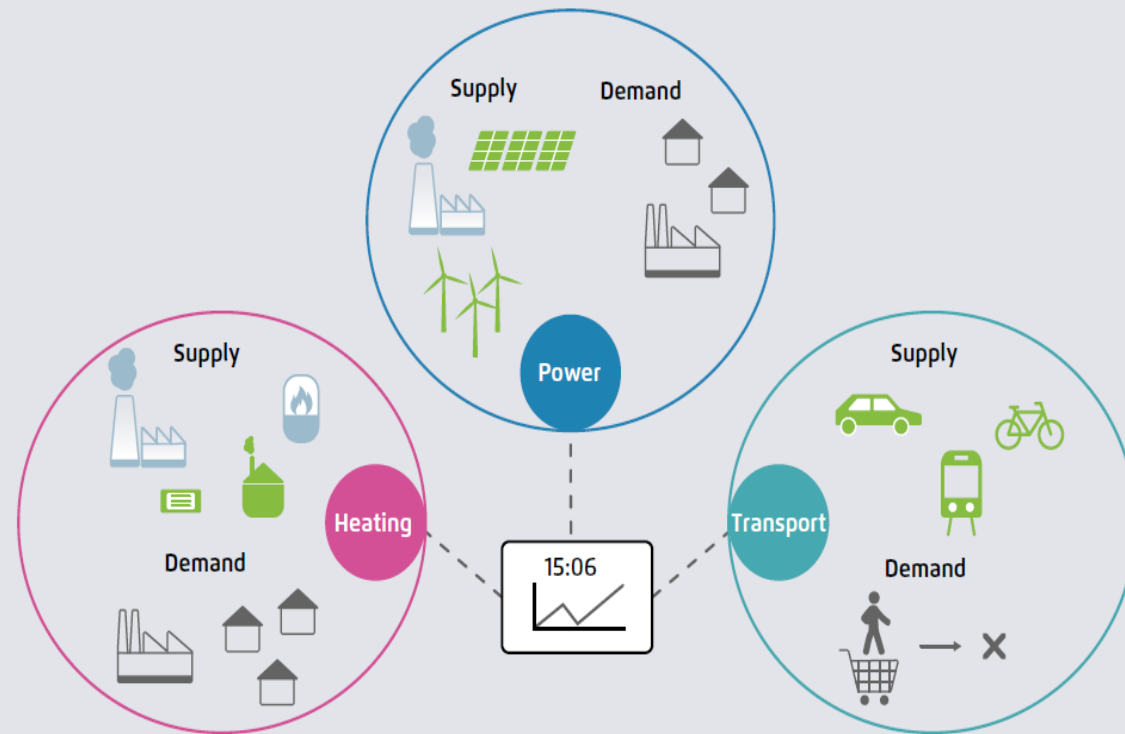
- Digitisation is a key enabler of the energy transition
- Digitisation is the backbone of new technologies and new business models from smart homes, sharing platforms, virtual power plants or autonomous cars
- Smart and interconnected devices increase power system flexibility needed to integrate high shares of variable wind and solar energy

## Megatrend #5: Electrification

The power, transport, and heating sectors are increasingly interconnected

Electrification is the key driver of a stronger coupling of power, heat and transport systems

Figure 5

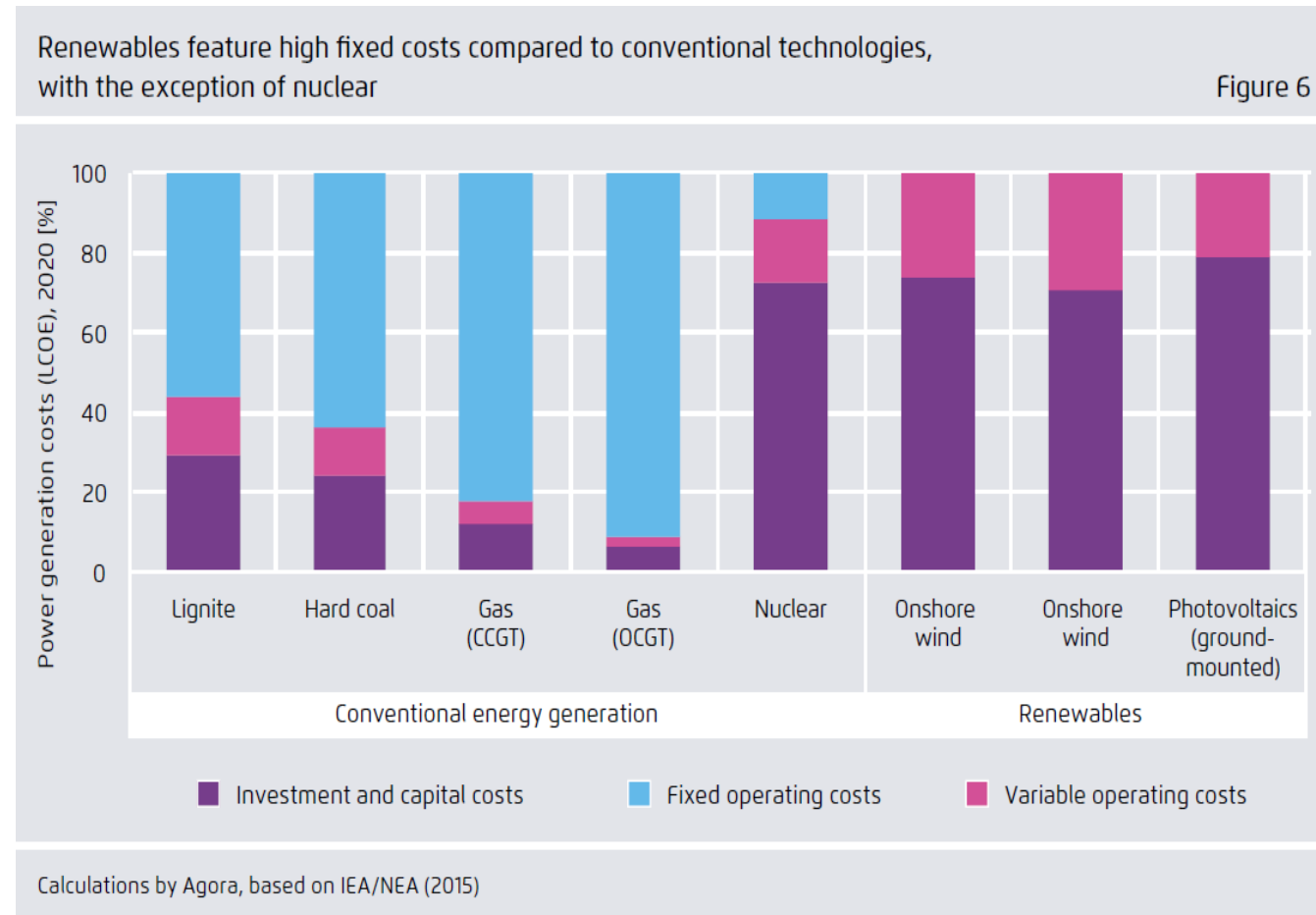


- The energy transition is tearing down the traditional separation between power, transport and heating sectors since the most promising low-carbon technologies are electric.
- Electric vehicles and heat pumps will likely push up electricity demand, increasing the need for energy efficiency and faster renewable energy deployment
- Synthetic fuels (PtG/PtL) will also be based on renewable power



## Megatrend #6: Dominance of fixed costs

Future energy systems will be dominated by investment costs



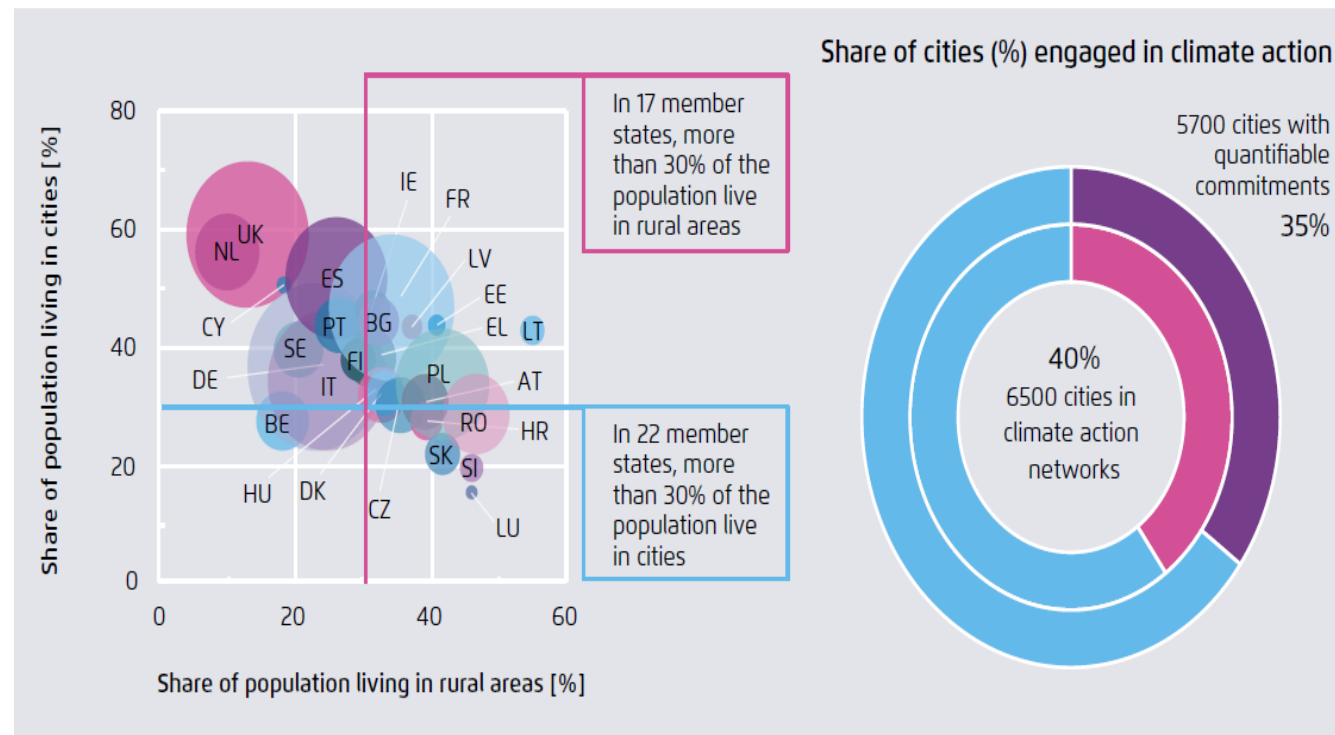
- The energy transition relies on technologies with a high share of investment costs and low share of operating costs
- That applies to wind, solar, batteries, grid infrastructure and energy efficiency measures
- This new finance structure challenges existing business models and market arrangements
- Robust and stable regulation and long-term objectives are needed to keep financing cost low

## Megatrend #7: Influential cities

More people in big cities means that urban decisions are becoming more important for enabling low-carbon lifestyles

Cities are key players in climate action and home to a large share of the EU population

Figure 7

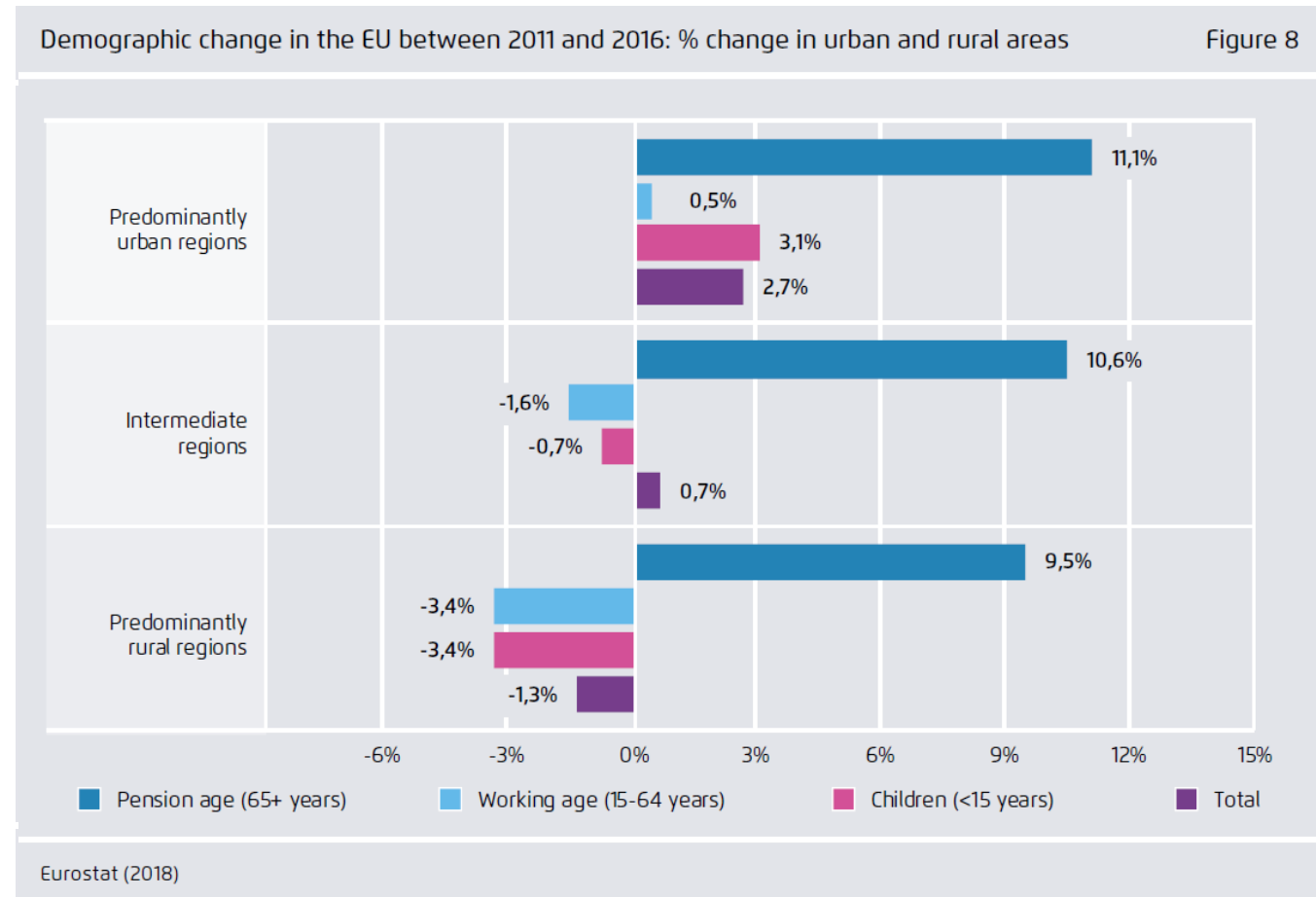


Own creation based on Data Driven Yale et al (2018) and Eurostat (2018)

- Almost three quarter of the EU's population live in urban areas.
- Densely populated cities feel the environmental pressure from transport, industrial activity and infrastructure development
- Cities governed by ambitious mayors become laboratories for low-carbon lifestyles
- New mobility solutions such as bike, ride and car sharing, cargo bikes and electric mobility are most easily implemented in cities

# Megatrend #8: Demographic and economic change in rural areas

## Energy transition chances and challenges arise in the countryside

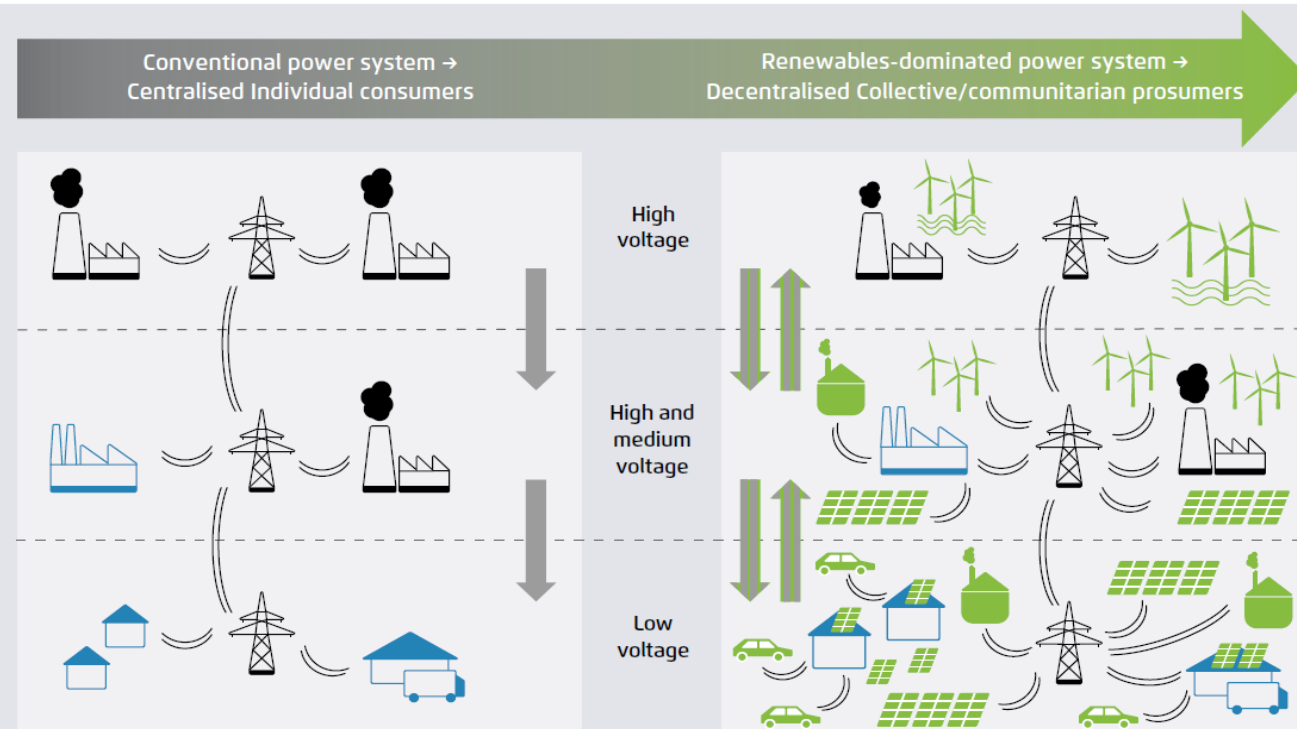


- Regions that currently live from fossil technologies (coal, gas, combustion engines) will face the challenge to re-invent themselves
- New technologies offer new job opportunities, but not necessarily where the old jobs were
- Wind, Solar and other renewables will take place in rural areas, opening up new income streams
- Especially rural areas will need a promising perspective to embrace the energy transition

# Megatrend #9: Decentralization: Small-scale solutions enable but also require pro-active energy consumers

The power system's "one-way street" is replaced by a decentralised, networked structure

Figure 9



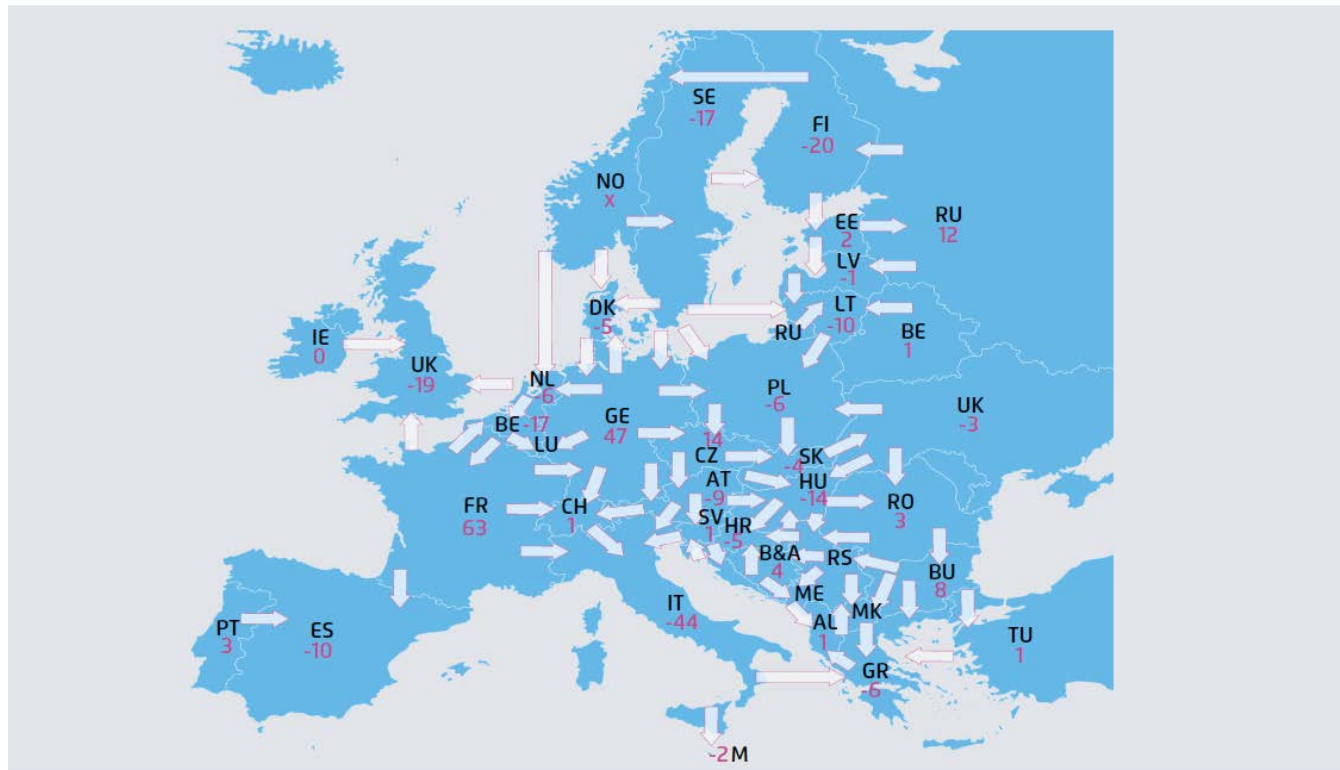
- Solar and wind are more decentralised than conventional power plants and require greater flexibility in the system
- As a consequence, the system is no longer dominated by a handful of producers, but consumers and businesses will become prosumers, generating their own heat and power at every level of the grid
- Consumerism will also be a major drive for change in the transport sector

# Megatrend #10: Interdependence

Progressive integration of European economies and energy systems is demanding more coordination between countries

Net physical electricity flows between countries (TWh) in 2018

Figure 10



ENTSO-E

Note that net exports are shown as positive, net imports as negative figures

- The EU has made tremendous progress in creating an internal market for energy. Physical infrastructure links for gas and electricity and the convergence of market rules enable market coupling and converging wholesale prices
- The internal energy market means lower costs for all, but also greater inter-dependence: national energy policy choices affect neighbours and are affected by decision-making in other Member States.

**Major importance of  
EU LAW, POLICY,  
GOVERNANCE, and  
FINANCE**



# A comprehensive EU climate and energy framework for 2030 is in place. Europe as a continent has embarked on an energy transition based on the efficient use of energy and a progressive decarbonization of the energy supply

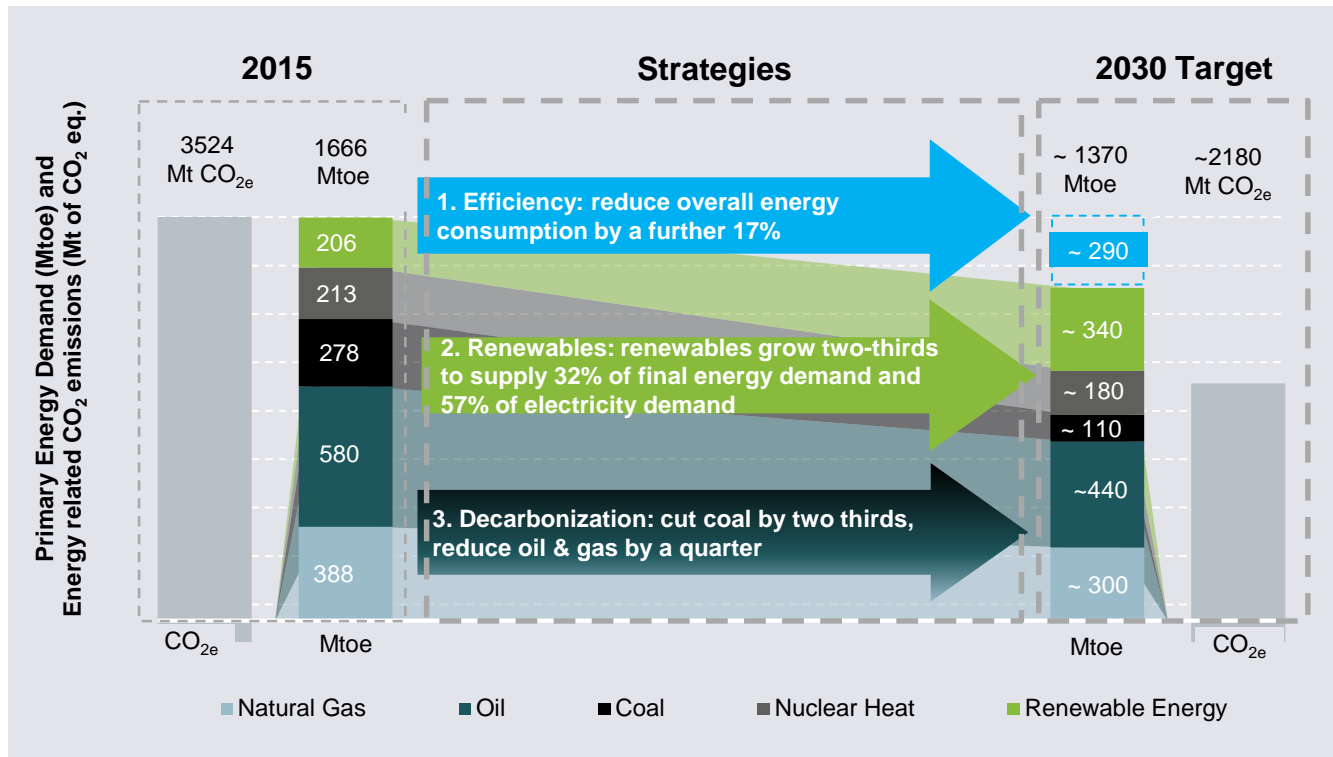


<b>Climate</b>	<b>Greenhouse Gas Emissions 2030</b> In 2030: 40 % reduction in GHG emissions compared to 1990 levels	
	<b>EU Emissions Trading System</b> In 2030: 43 % reduction compared to 2005	<b>Climate Action Regulation</b> In 2030: 30 % reduction compared to 2005
	A Europe-wide GHG emissions cap covering Large-scale facilities in power and industry, as well as domestic aviation	28 national GHG emissions reduction targets, stretching from -40 % to 0 %, covering sectors not covered by the ETS (Road & rail transport, buildings, small industrial facilities, agriculture, waste)
<b>Energy</b>	<b>Energy Efficiency 2030</b> 32.5 % decline in primary and final energy consumption compared to a 2007 Baseline	
	<b>Renewable Energy 2030</b> 32 % share of renewable energy in gross final energy consumption	
	National Energy and Climate Plans (NECPs) delivering the binding EU headline targets	

**Energy Union Governance**

# Europe's 2030 climate and energy targets and national coal phase out decisions imply: Cutting coal use by two thirds, reducing oil & gas by a quarter, increasing RES in power to 57% and significant efficiency improvements

Strategies for a cost-efficient transformation of the energy sectors by 2030



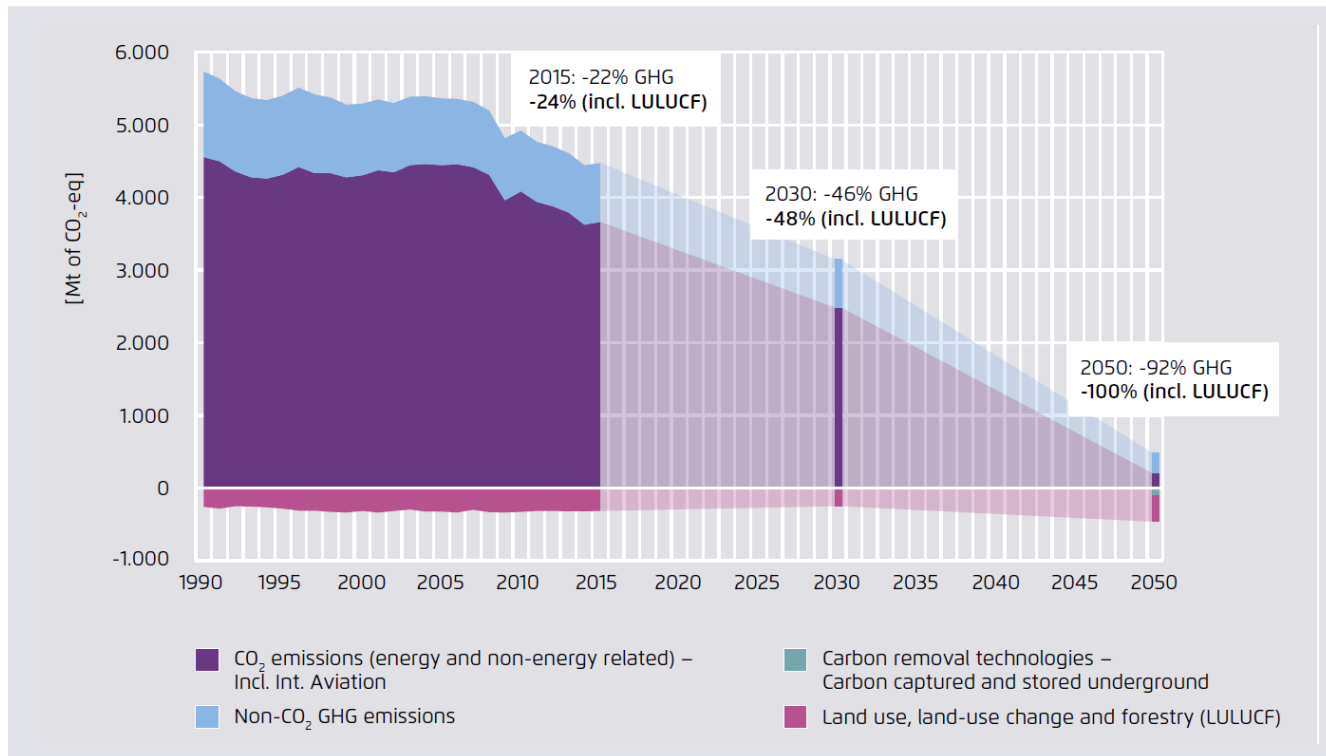
- No national energy transition will be exactly alike.
- However, the 2030 targets require countries to pursue the same set of objectives and to develop their energy systems into the same direction over the next decade.
- Effective implementation of the EU's 2030 climate and energy framework will change the way energy is produced & consumed in power, buildings, transport and industry throughout Europe.

Own calculations based on COM modelling for the Clean Energy Package and EU Long Term Strategy, and taking into account the coal phase outs announced by member states.



# Delivering the *EU energy targets* for 2030 will reduce emissions further than required by the *EU climate target*. However, additional measures are needed to get there.

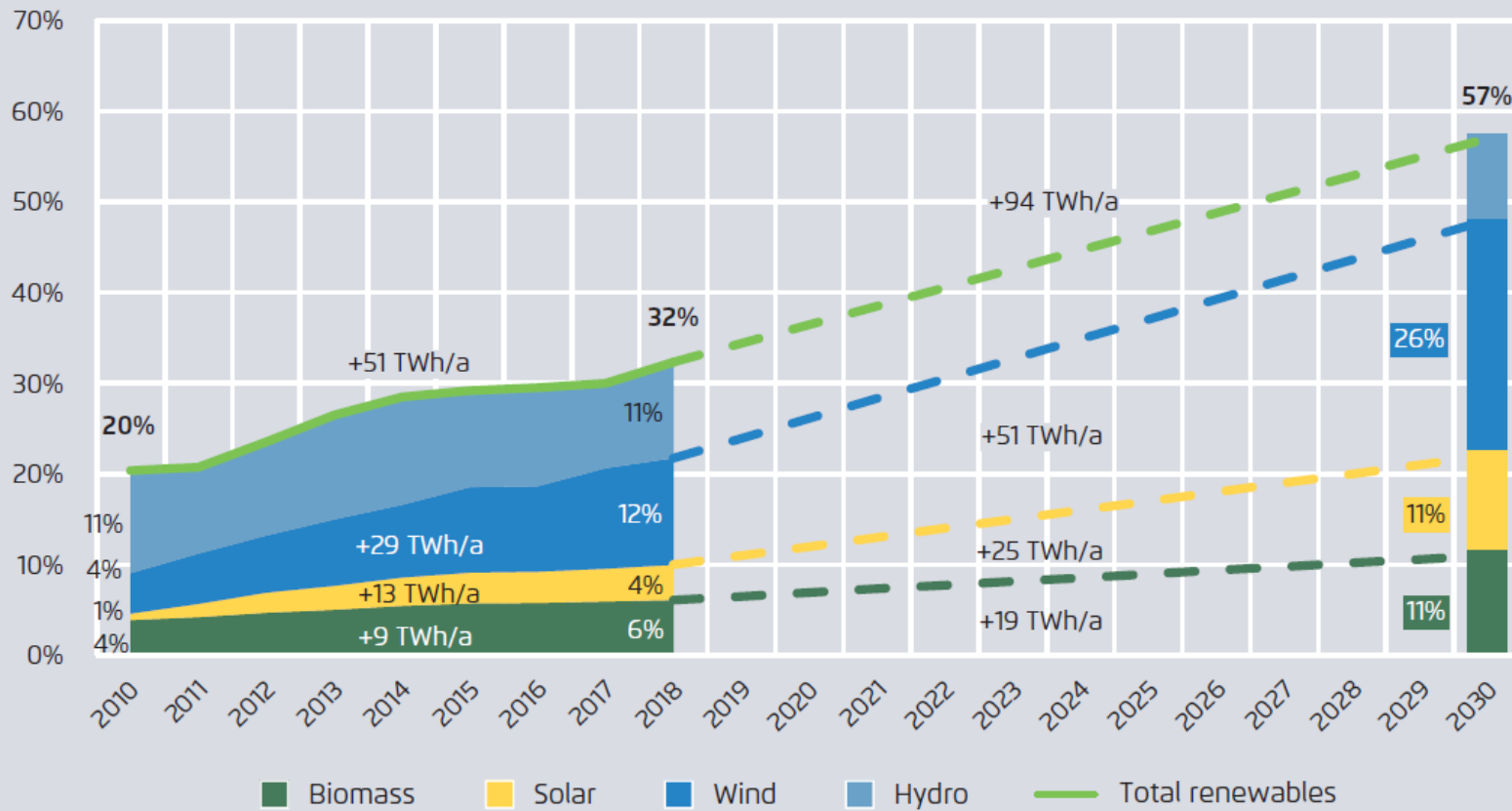
Greenhouse gas emissions from 1990-2015 and in 2030 and 2050 target scenarios



Own analysis based on EEA (2018) and EU Long Term Strategy

- The EU's energy targets would deliver 46% greenhouse gas emissions reductions compared to the EU's climate target of 40%.
- Current Member State projections of planned and existing measures will only deliver reductions of 30-32% by 2030.
- Only six Member States will meet their 2030 national reduction targets under the EU Climate Action Regulation based on current trajectories, indicating that additional efforts, particularly in the transport and buildings sectors, are needed.
- The European Commission's political vision of achieving a Net Zero economy by 2050 implies energy related greenhouse gas emissions must progressively be reduced to close to zero.

# Decarbonizing the power sector cost-efficiently implies doubling the annual increase of renewable power generation compared to 2010-2018 levels.

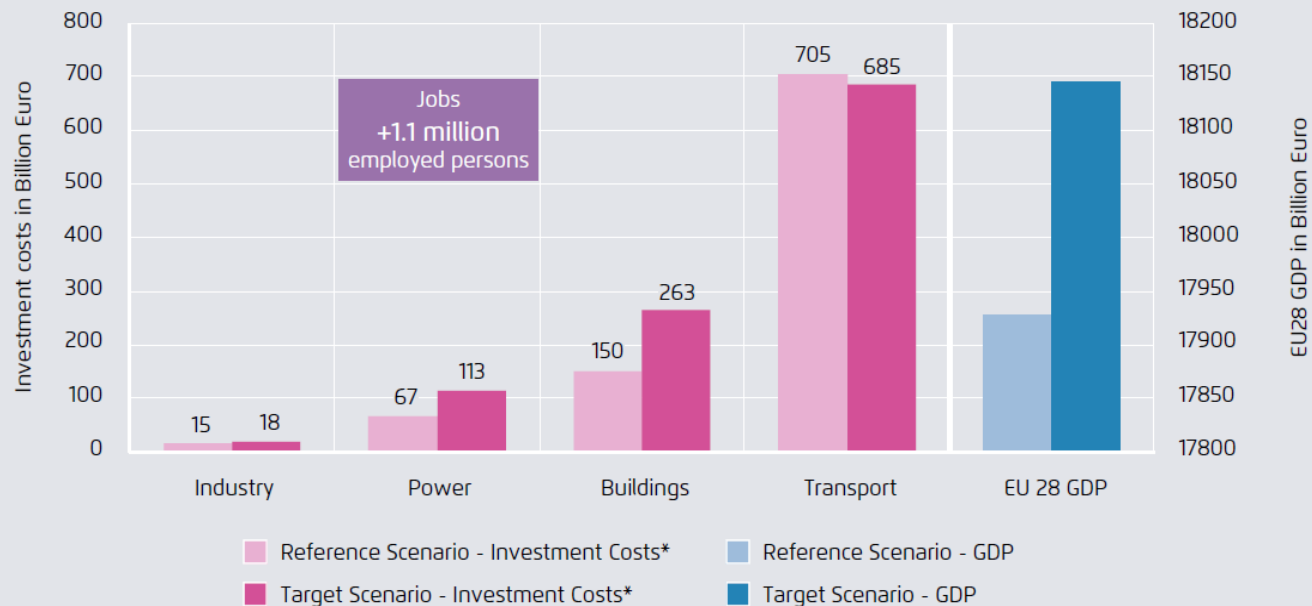


- Electrification of transport, heat and industry means electricity consumption is forecast to rise by 18% by 2030. Therefore, renewables generation must rise by 18% by 2030 just to maintain the same 32% share as now.
- To reach a share of 57% of electricity in 2030, renewables deployment needs to almost double from 51 TWh/year from 2010 to 2018 to 94 TWh/year from 2018 to 2030.

# Achieving the EU's 2030 climate and energy targets requires considerable investment, but energy system costs are comparable with current policies. The energy transition generates significantly higher benefits.

Investment costs are higher in a target scenario vs a reference scenario, but so are growth and jobs

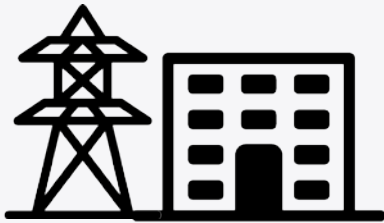
Figure 20



Own calculations based on the EU 2016 Reference Scenario and Commission modelling for the Clean Energy Package and the EU Long-term Strategy  
 \*Average annual investment expenditure (2021-2030) in Billion Euro (€'13)

- Meeting the 2030 targets will not raise household expenses relative to the reference case.
- The energy transition will increase employment and GDP compared to reference case.
- The shift to renewables and energy efficiency increases energy security.
- Avoided health costs more than outweigh the additional costs of the transition.
- Industrial competitiveness is not at risk, but energy- and trade-intensive branches need support.

# From an EU-perspective, a cost-effective transition to 2030 means different challenges in the different sectors.



For the **power sector** and the **buildings sector**, effective implementation of the agreed EU climate and energy framework is paramount.



For the **transport sector**, current EU standards are insufficient and should be raised.

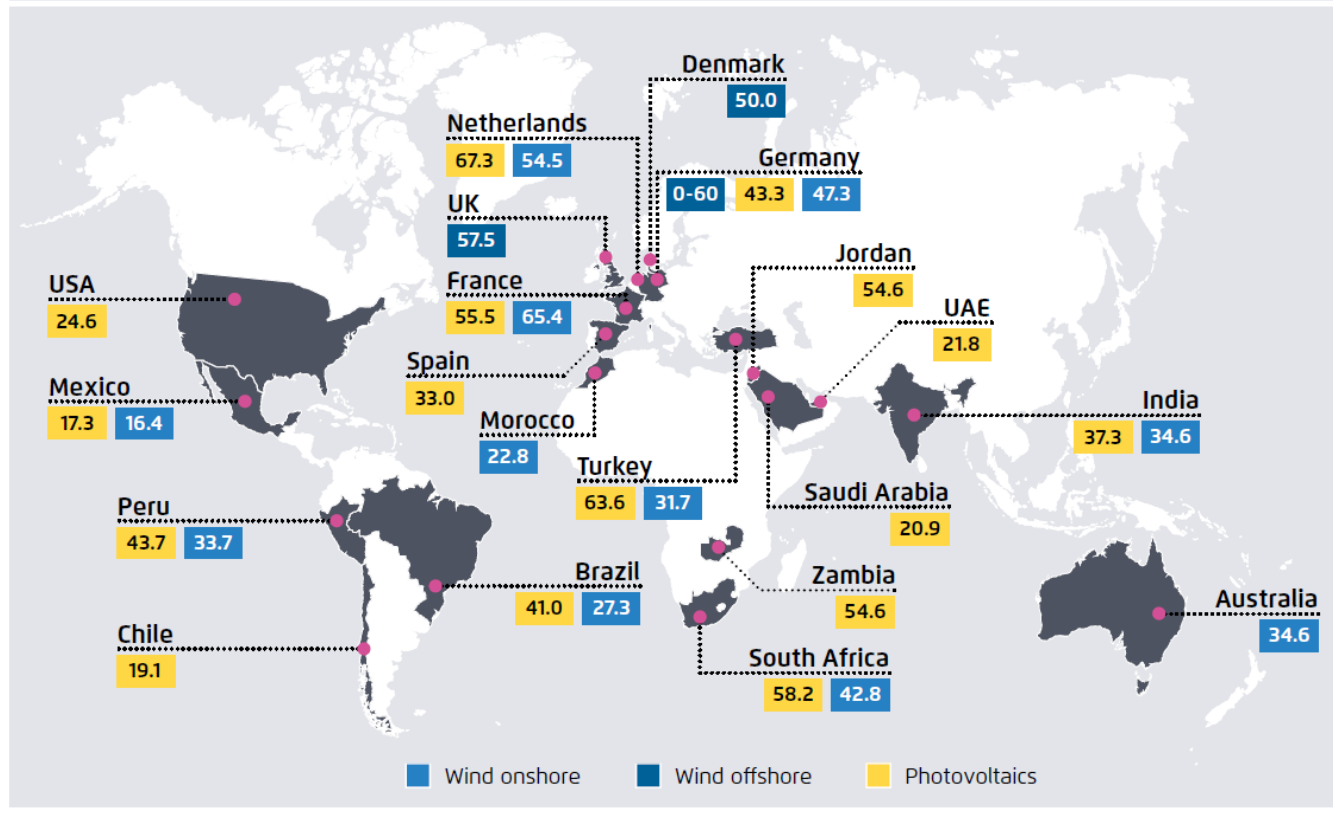


For the **industry sector**, the creation of lead markets will unlock necessary investments into low- and zero-carbon processes and technologies that are needed after 2030.

# The global energy transition is speeding up.... And Europe has the choice: to lead or to follow?

Select results of competitive auctions and power purchase agreements 2016–2018 in €/MWh

Figure 35



Own illustration based on BMWi, BNetzA, etc.; PPA or lowest/ average, volume weighted awarded bid values (Europa)

- Wind and solar are now everywhere cheap technologies and will be shaping energy systems everywhere
- Europe's 2030 targets call for riding the wave instead of a „wait-and-see“ approach
- The new European Commission and the new European Parliament will need to swiftly set out a comprehensive climate and energy work programme to make Europe fit for the challenge of a clean, safe and affordable energy future

## Recently launched major report

### ***European Energy Transition 2030: The Big Picture***

*Ten Priorities for the next European Commission to meet the EU's 2030 targets and accelerate towards 2050*





“*European Energy Transition 2030: The Big Picture*” takes the agreed EU climate and energy targets for 2030 seriously. We use best available data and analysis to explain in a concise and accessible format the following questions:

- 1) Where do we stand?** – What is the State of the European Energy Transition?
- 2) Where do we need to be?** – What would an energy system look like in 2030 that fully implements recently adopted EU legislation? What is the scope to go further?
- 3) How do we get there?** –What are concrete next steps for reaching and potentially over-shooting the EU's 2030 climate and energy targets? How should a concrete political agenda for the next phase of the European Energy Transition look like?



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# Thank you for your attention!

Questions or Comments? Feel free to contact me:

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Agora Energiewende is a joint initiative of the Mercator Foundation and the European Climate Foundation.

**Back-Up**



# The Big Picture Report includes concrete proposals for:

- 10 EU-level priority actions for the next years
- 4 „Implementation Flagship Initiatives“
- how to increase the EU’s 2030 climate target



10 EU-level priority actions that should be advanced by the incoming European Commission and the new European Parliament

### Priority 1

A vibrant action framework for 2030: Kickstarting and supporting implementation at the national level

### Priority 2

A state aid framework that enables and advances Europe’s clean-energy transition

### Priority 3

A shadow price on carbon emissions to guide infrastructure planning and investment decisions

### Priority 4

Reducing emissions from individual mobility: An early and ambitious review of CO<sub>2</sub> standards for cars

### Priority 5

Reducing emissions from heavy transport by raising ambition and increasing member state flexibility

### Priority 6

Opening up a pathway to decarbonize aviation and shipping fuels

### Priority 7

A strong, competitive, and sustainable battery industry in Europe

### Priority 8

Establish the foundation for a scalable green hydrogen economy

### Priority 9

“Buy Clean Europe”: Create lead markets for zero-carbon cement and steel

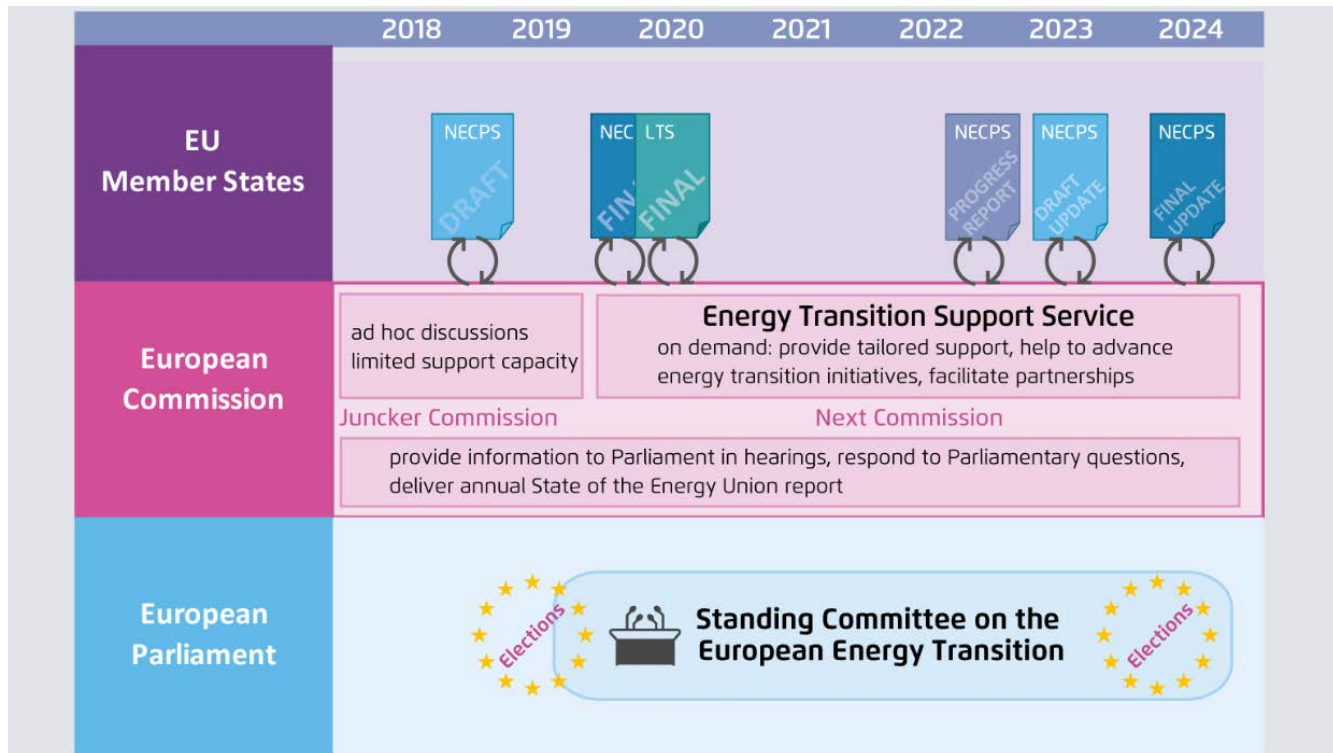
### Priority 10

Prioritize the energy transition in the new European budget for 2021–2027

Agora Energiewende (2019): European Energy Transition 2030: The Big Picture.

# Priority 1 – A vibrant action framework for 2030: Kickstarting and supporting implementation at the national level

Proposed EU-level framework to support implementation and raise ambition



Own creation

- The European Parliament that assembles after the May 2019 elections should establish a Standing Committee on the European energy transition to create a political space for dialogue between national energy transition stakeholders and EU-level decision-makers.
- In November 2019, the European Commission should launch an Energy Transition Support Service that provides member states and stakeholders with tailored support to resolve concrete implementation challenges, advance initiatives, and facilitate partnerships.
- Finally, the European Commission must also launch a series of Implementation Flagship Initiatives that address the social dimension of the energy transition and break through existing bottlenecks.

# We propose four *Implementation Flagship Initiatives* and three key budget priorities to help drive forward the European energy transition at national level

## *Implementation Flagship Initiatives*

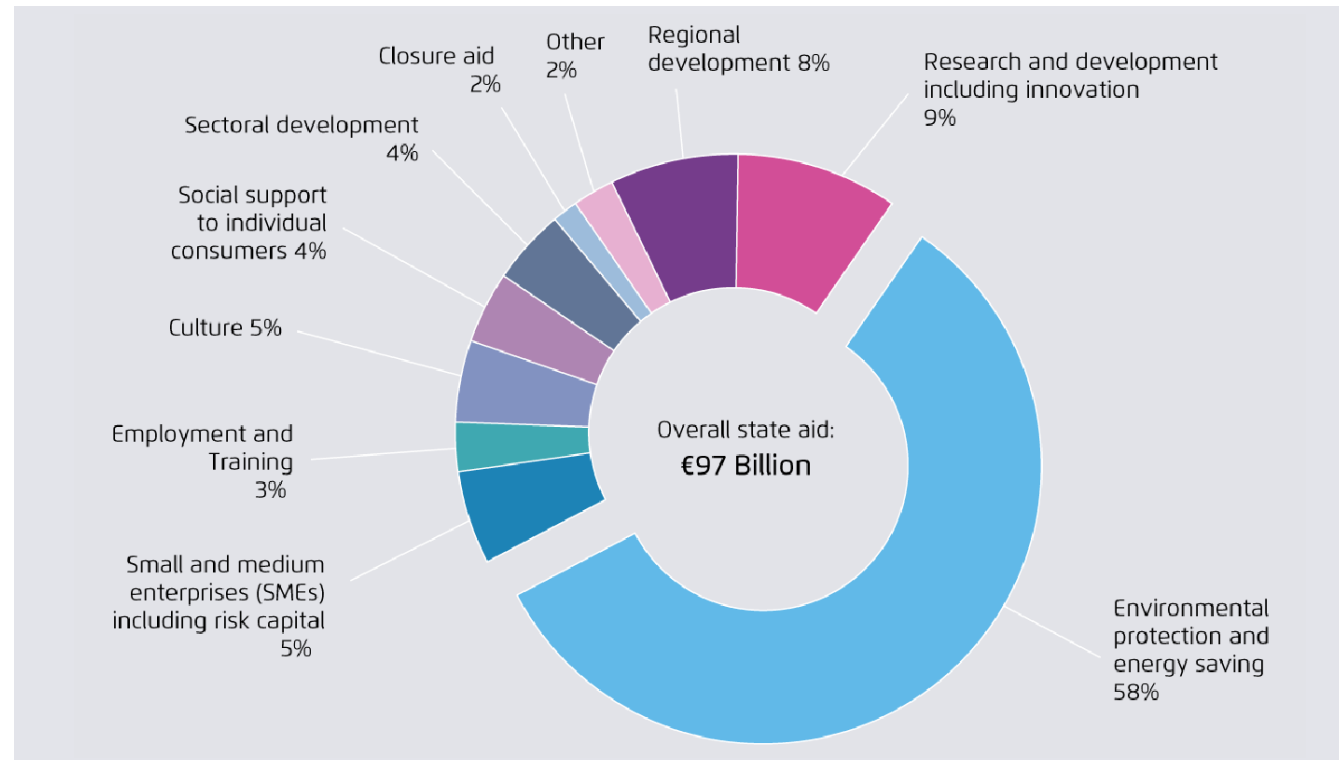
- **Initiative 1:** Renovate 1 million buildings by 2025 on an industrial scale
- **Initiative 2:** Add 10 million solar rooftops by 2025
- **Initiative 3:** Help 100 cities in Europe launch strategies for decarbonising their district heating & cooling networks by 2025
- **Initiative 4:** Support a just transition in coal regions

## *Key budget priorities*

- **Priority 1:** Support the energy transition
  - Unlocking low-cost investment in wind and solar
  - Infrastructure for e-mobility and modal-shift
- **Priority 2:** Support people and regions
  - Focus on building renovations in Central and South Eastern Europe
- **Priority 3:** Research & innovation
  - Focus on immature, early-phase technologies
  - Technology for Direct Air Capture of Carbon

# Priority 2 – A state aid framework that enables and advances Europe’s energy transition

Shares of overall state aid in the EU by category, 2018

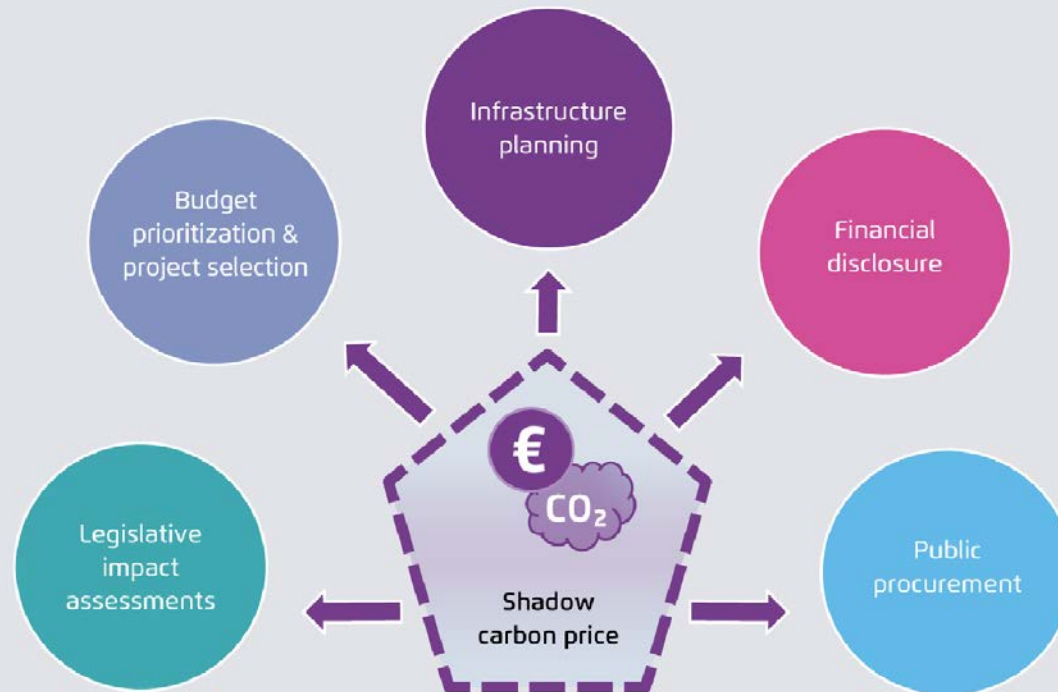


EC (2018) State Aid Scoreboard

- The next European Commission leadership should commit itself to achieve consistency of its state aid decisions with the EU’s 2030 climate and energy framework.
- Practically, the Commission should conduct internal assessments of relevant draft state aid decisions with EU climate and energy objectives and train staff of DG Competition on energy system aspects of the transition, key technologies and energy market dynamics
- The new EU Energy and Environment State Aid Guidelines should enable governments to:
  - (i) create lead markets for the low-carbon industry;
  - (ii) push for electricity-led decarbonization;
  - (iii) stabilize returns for clean-energy investors;
  - (iv) employ a shadow price for carbon emissions of €80-100 t/CO<sub>2</sub>.

# Priority 3 – A shadow price of 80 to 100 €/t on carbon emissions to guide infrastructure planning and investment decisions

Potential areas of application for a shadow carbon price



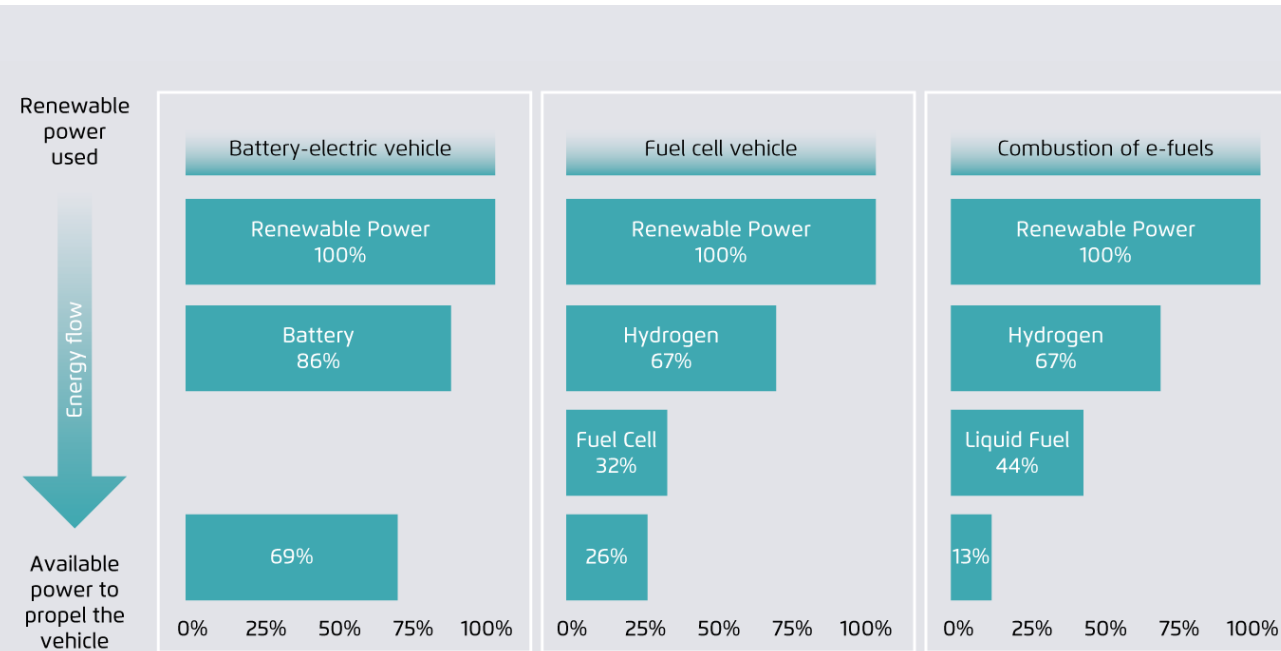
Own creation

- The High-Level Commission on Carbon Prices, co-chaired by Joseph Stiglitz and Lord Stern, recommended carbon prices of \$40–80 per tonne of CO<sub>2</sub> by 2020 and \$50–100 per tonne by 2030 to keep global warming below 2 °C.
- The new European Commission that takes office in November 2019 should prepare an ambitious proposal for an EU Regulation that sets an EU-wide minimum shadow price of €80–100 per tonne of CO<sub>2</sub> emissions and that determines how and for which specific decisions the shadow price will be applied at the EU and national levels.
- Shadow prices should be applied to legislative impact assessments, infrastructure planning, public procurement, EU project funding, and the setting of regulatory benchmarks for sustainable private-sector financing.



# Priority 4 – An early review of the new CO<sub>2</sub> emission standards for cars is needed to exploit the full technical potential and advance zero and low-emission vehicles. Ensure the efficiency of electric vehicles.

Individual and overall efficiencies for different vehicle drive technologies

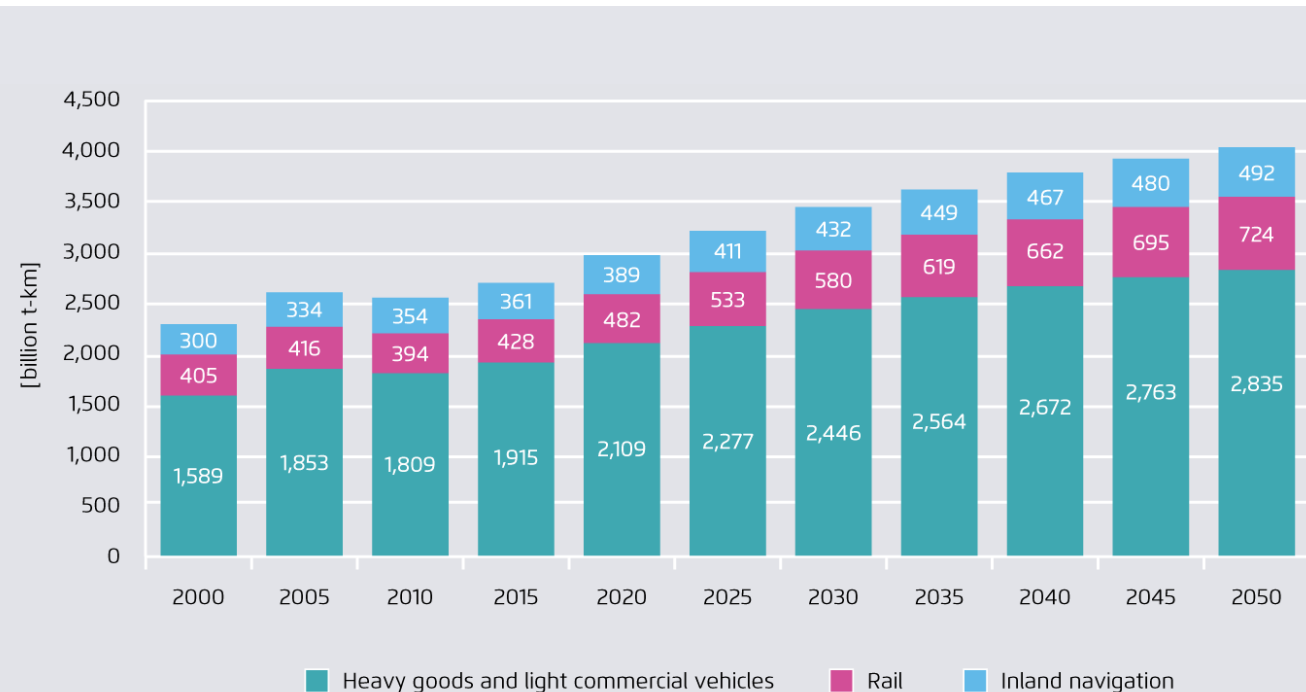


The European Commission that takes office in November 2019 should conduct an early and broad review of the effectiveness of the new CO<sub>2</sub> emission standards for cars. On that basis it should:

- Propose by 2022 a further increase in ambition to ensure that by 2030 the majority of all new passenger cars are zero- and low-emission vehicles (ZLEV); consider introducing binding ZLEV sales mandates;
- Ensure that the method used to measure the energy consumption of electric vehicles and plug-in electric vehicles under the EU's vehicle type approval system is realistic; include ZLEVs in the EU Car Labelling Directive; and propose EU legislation to safeguard and improve the energy efficiency of ZLEVs.

# Priority 5 – Strengthen the new CO<sub>2</sub> emissions standards for heavy-duty vehicles prior to 2022 and adopt a quota for ZLEVs. Enable Member States to introduce road charges that reflect the costs of CO<sub>2</sub> emissions & charging infrastructure.

Projected transport freight demand until 2050 for the EU28



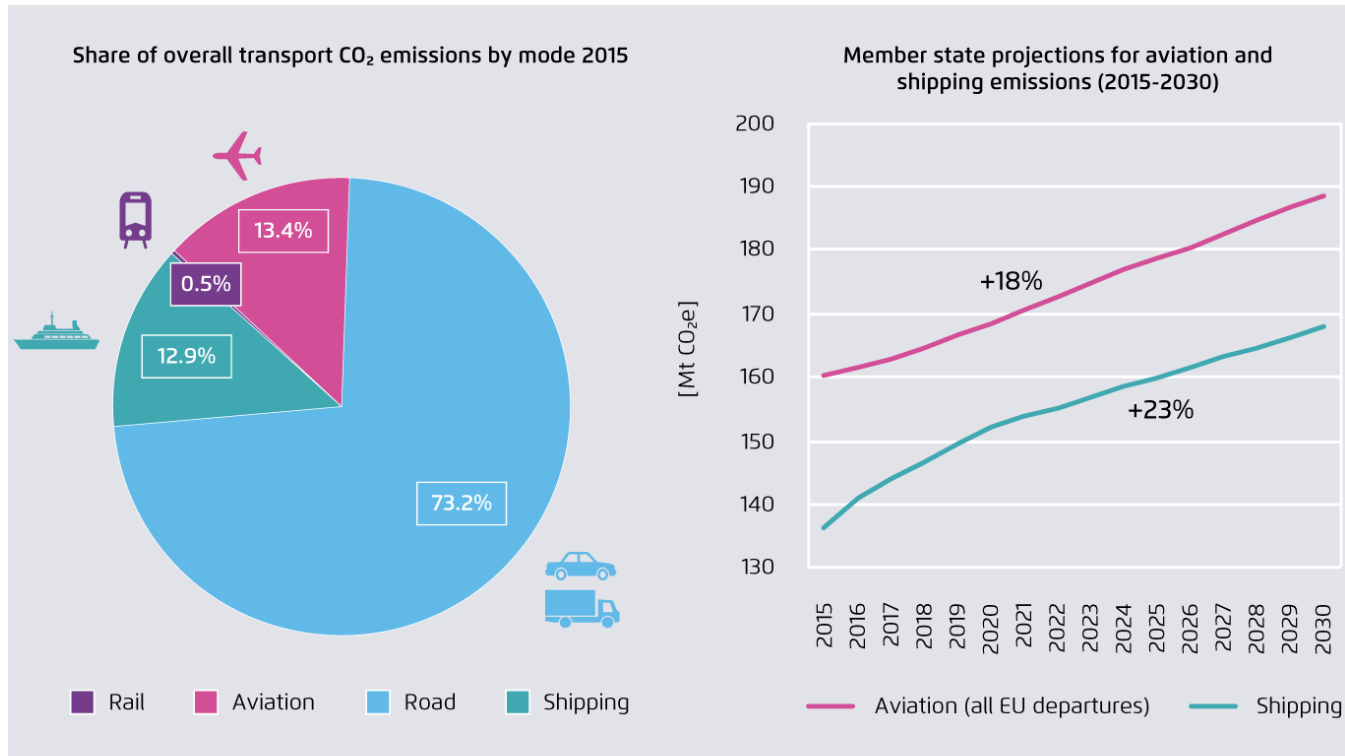
EU Commission 2016 Reference Scenario

The European Commission that takes office in November 2019 should:

- propose by 2022 legislation that requires a -40% reduction in emissions from heavy-duty vehicles as well as a binding new sales quota for zero and low-emission vehicles (ZLEV) of at least 25% in 2030.
- further develop its proposal for a revision of the Eurovignette Directive on road charging to enable member states to include into national road charging regimes CO<sub>2</sub> costs of at least at €80–100 per tonne of CO<sub>2</sub> as well as the cost of key infrastructure investment for the European energy transition in transport.

# Priority 6 – An alternative fuels quota and complementary sustainability safeguards should open a pathway for the gradual decarbonization of aviation and shipping fuels.

## Current and projected EU aviation and shipping transport emissions



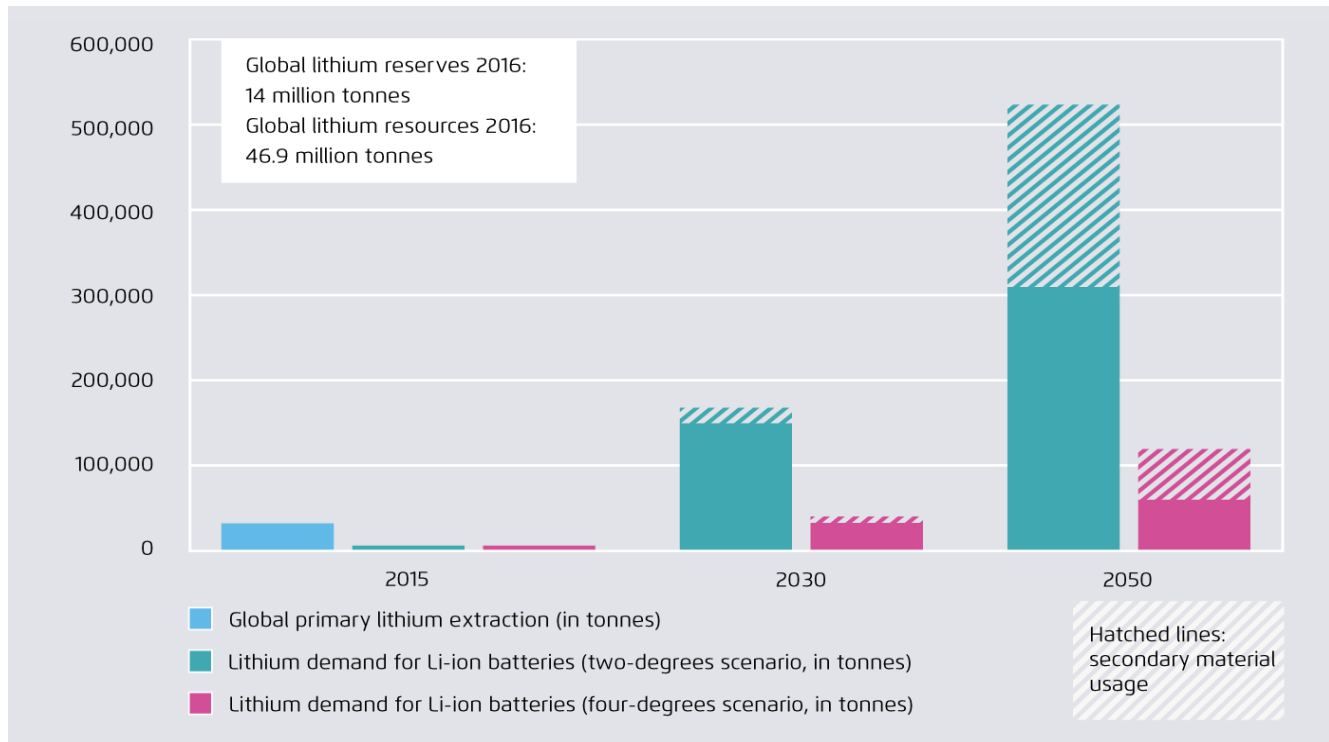
EEA (2018)

- The new European Commission should propose a legislative package on the decarbonization of aviation and shipping fuels that includes concrete arrangements for the introduction of an alternative fuels quota in EU aviation and shipping, including measures to prevent avoidance strategies among operators.
- The package should also include robust additionality and sustainability safeguards for the sourcing of CO<sub>2</sub> for electrofuels production, as a complement to the sustainability framework developed for green hydrogen (see Priority 8).



# Priority 7 – Encourage the development of a strong, competitive and environmentally sustainable European battery industry. Minimum carbon footprint standards for batteries sold in Europe must be a key feature.

Global lithium demand for EV batteries in 2015, 2030 and 2050



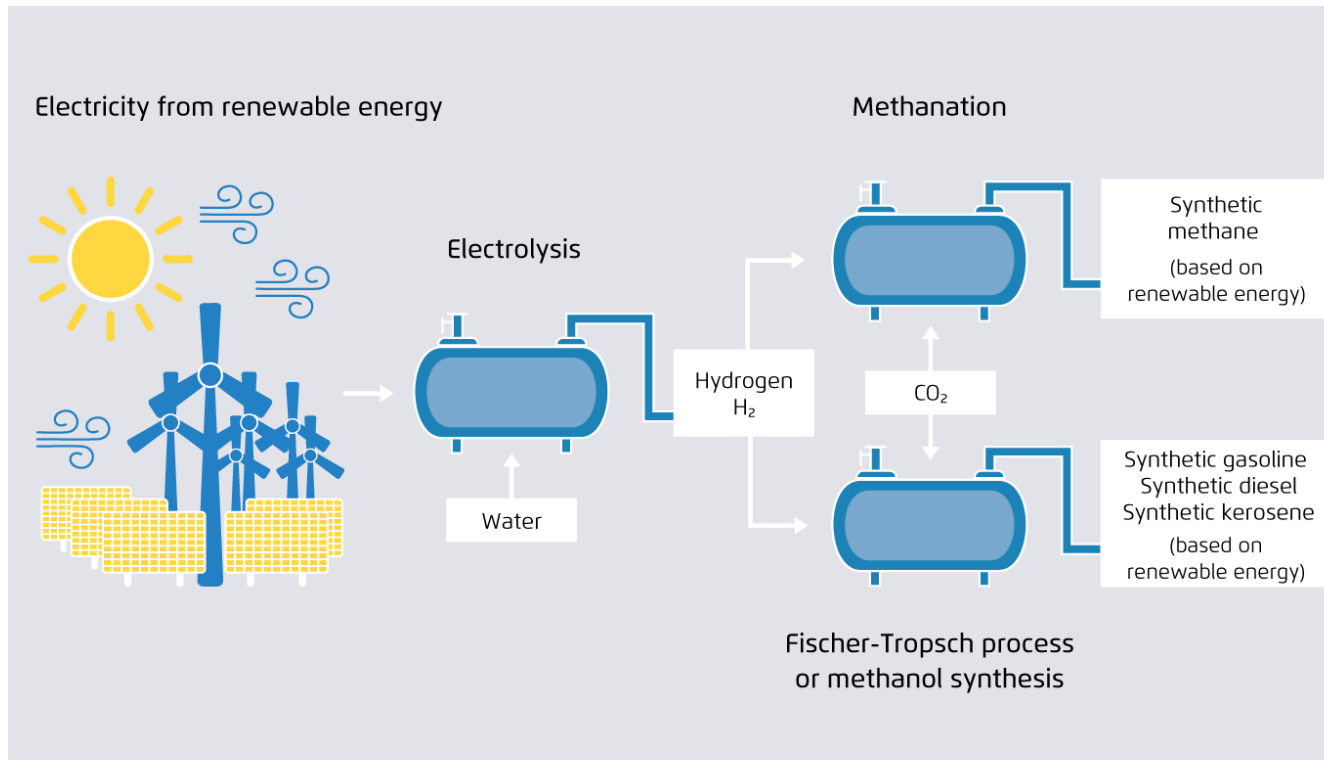
USGS\* 2017 for primary extraction levels and reserves and resources; authors' own calculations and visualisation

\* Including secondary material usage

- The new Commission should launch a broad industrial strategy that combines regulation, financing, research, and international trade to promote a strong, competitive and sustainable European battery industry.
- The Commission should propose:
  - a) EU legislation setting minimum environmental and sustainability requirements for batteries sold in Europe;
  - b) Ambitious recycling targets for strategically significant raw materials as part of a reformed EU Battery Directive;
  - c) The inclusion of cobalt in the EU Regulation on Conflict Minerals.
- Establish an EU clearing house for battery life-cycle data to improve transparency on energy & raw materials consumption in battery manufacturing.

# Priority 8 – Establish a binding and gradually increasing EU-wide renewable gas quota for natural gas suppliers in order to advance the decarbonization of industry and facilitate investment in $\geq 30$ GW of electrolysers in Europe by 2030.

Production process for electrofuels (Hydrogen, PtG, PtL) from sun and wind

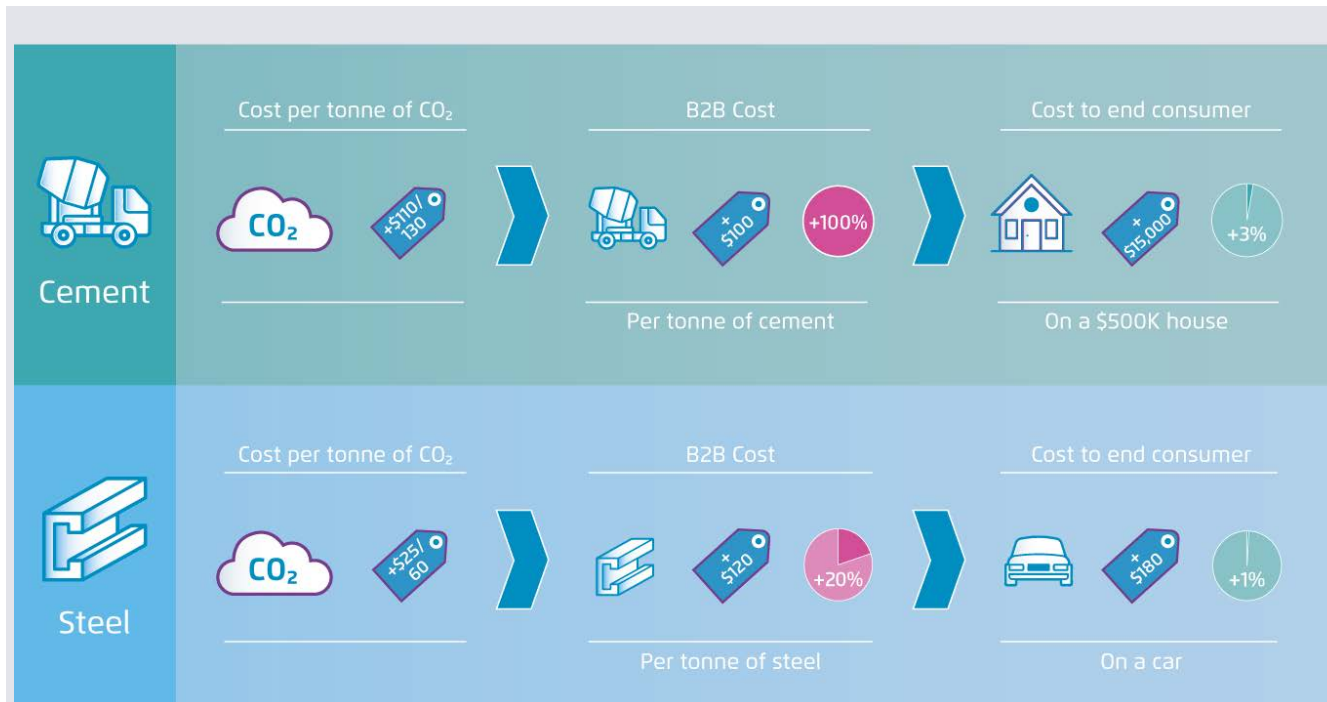


Agora Verkehrswende (2018)

- As part of its upcoming Gas Package, the Commission should propose a binding, gradually increasing EU-wide renewable gas quota for natural gas suppliers, rising from 2% of overall final gaseous fuels demand in 2022 to 10% in 2030. This is projected to equate to some 370 terawatt hours in 2030.
- A sub-quota should require at least 1/3 of the quota to be supplied by green hydrogen. This will ensure that EU green hydrogen production and electrolyzer capacity grow to at least 120-125 terawatt hours and 30 gigawatt by 2030.
- The Commission should introduce a rigorous sustainability framework for green hydrogen and CO<sub>2</sub>-based electrofuels.
- Harmonize technical rules to allow higher shares of hydrogen in existing gas grids.

# Priority 9 – A “Buy Clean Europe” initiative would oblige public authorities to purchase increasing shares of low- and zero-carbon cement and steel for infrastructure projects and public vehicle fleets with huge economic and climate benefits.

## Maximum decarbonization costs for cement and steel



Based on Energy Transition Commission (2018)

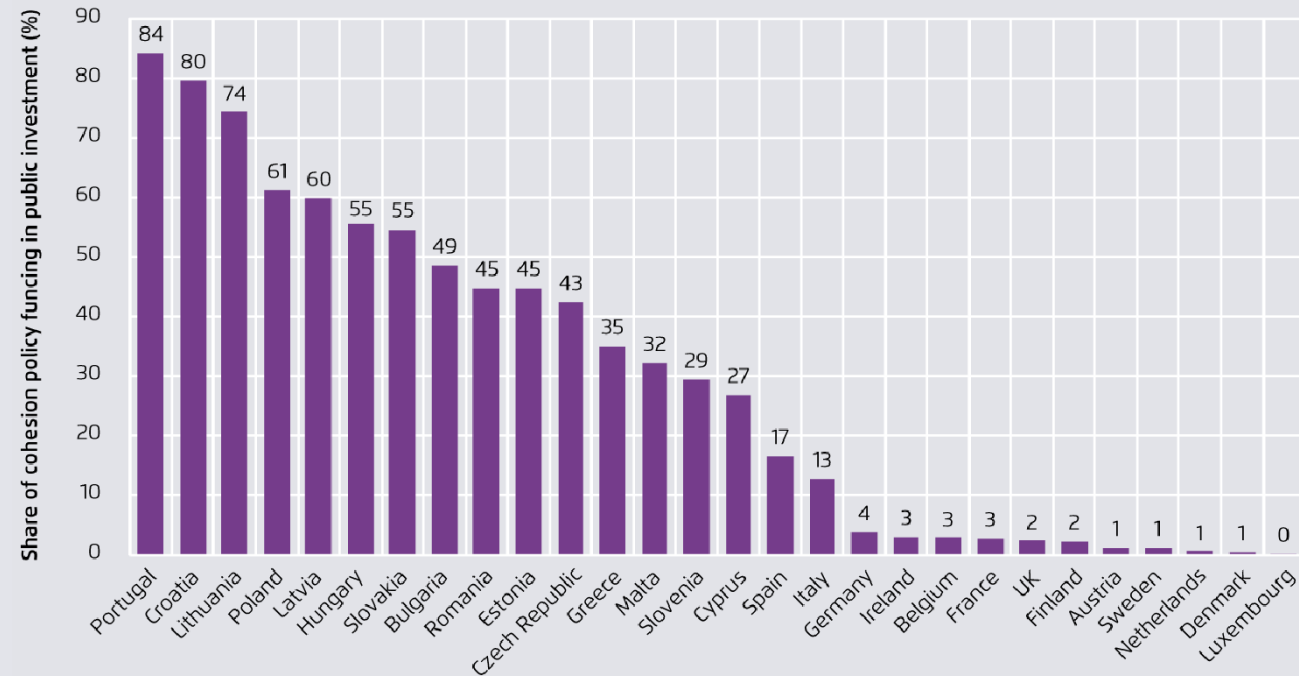
The new European Commission should launch a “Buy Clean Europe” initiative that includes:

- A proposal for an EU Directive that obliges public authorities to purchase low-carbon cement and zero-carbon steel in public infrastructure projects, as is already legally required in California.
- A proposal for an amendment to the Clean Vehicles Directive that requires vehicles purchased by public authorities to contain a minimum share of green steel.

This will provide investment security to companies that want to adopt innovative production methods while only placing minimal additional burdens on public budgets.

# Priority 10 – Prioritize energy transition in the new European budget for 2021-2027

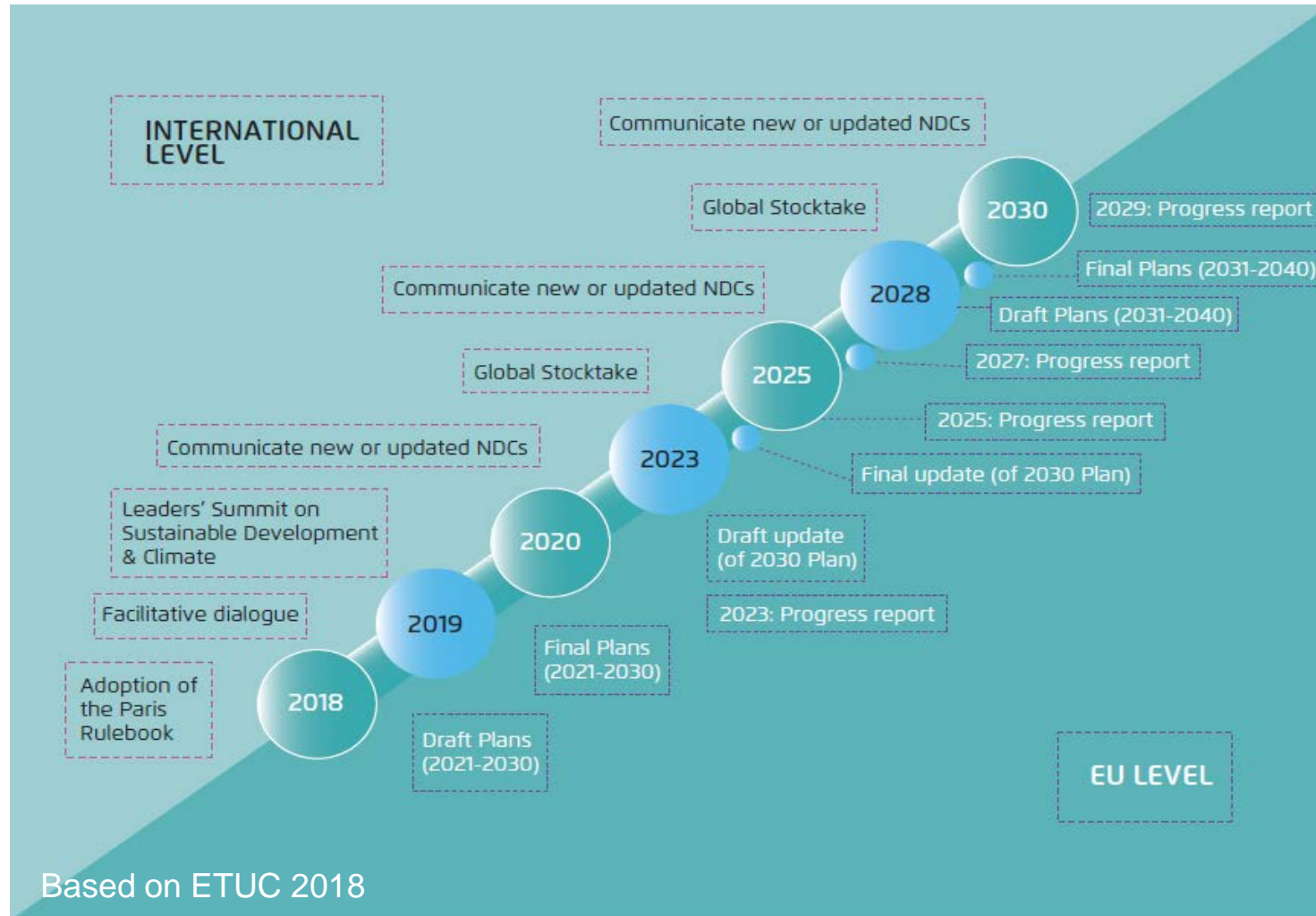
Share of cohesion policy funding in public investment per Member State (%), 2015-2017



EC (2018)

- The next EU budget should make at least 25% of non-climate-related funding under the Cohesion and Structural Funds conditional on the fulfillment of certain basic criteria related to the European energy transition.
- The new EU budget should explicitly ban funding for fossil fuels and establish a shadow carbon price of €80–100/t CO<sub>2</sub> for the prioritization of funding for infrastructure projects.
- The European Commission should insist that operational programmes negotiated with member states reflect key budget priorities in support of the European energy transition.

# Preparing for the Paris+5 Conference in 2020: Based on current policies, Europe may raise its 2030 target from -40% to -50% ghg emissions, with up to 4% through international cooperation (Article 6)



- The Paris Agreement is aiming at „well below 2 degrees“ global warming, but current targets sum up to much more than that
- The first review and ratcheting-up process under the Paris Agreement in 2020 is a crucial moment for climate diplomacy.
- The EU will be in the global spotlight. The question is not *whether* to increase 2030 climate ambition but *how much*.
- Current RES- and Efficiency-targets are to deliver -46% ghg emissions by 2030 according to EU-COM calculations