A (somewhat European) perspective on the macro impact of climate change

Pierre Wunsch | Peterson Institute

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BanqueNationaleBank
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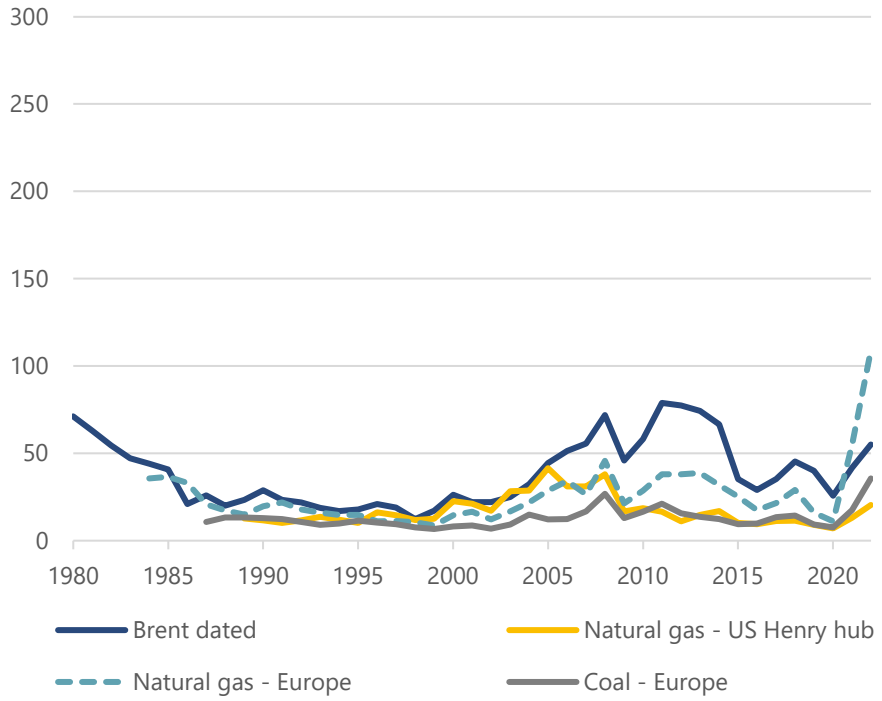
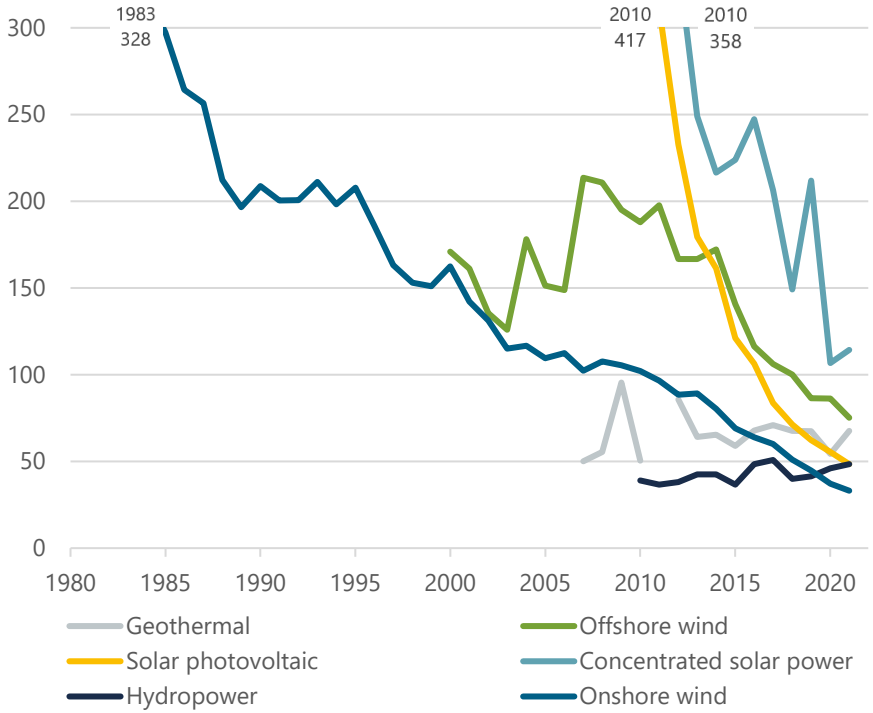
Setting the scene: A return to cheap energy?

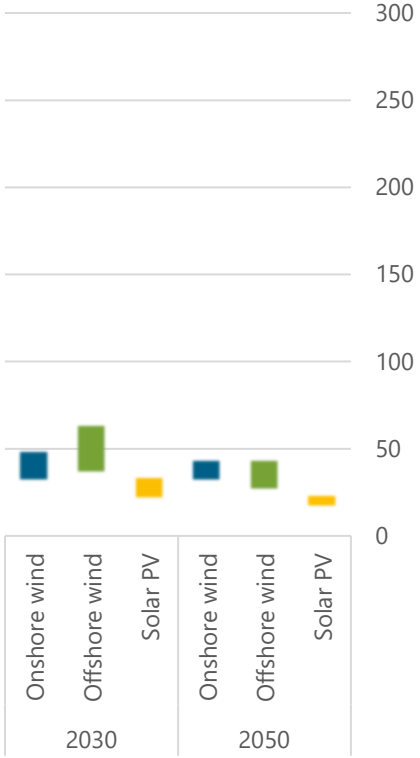
Fossil fuel prices
(in $2021/MWh)



Levelised cost of renewable generation today…
(in $2021/MWh – worldwide)



… and in 2030-2050



Min. onshore wind = US

Min. offshore wind = Europe

Min. solar PV = China

Sources: BP statistical review of world energy (June 2022) – Our world in data based on "IRENA Renewable power generation costs in 2021" – "IEA World energy outlook 2022".

Cheap fossil fuels will be replaced by cheap renewables (and some more)…
…but they are not perfect substitutes

The not so good

- (Most) rewenables are intermittent
- Electricity is not easy to store
- Batteries are heavy and bulky
- Not all industrial processes can be electrified (very high temperatures, carbon feedstocks…)
- Potential bottlenecks in the sourcing of materials

And the better

- Electric cars are 300-400% more efficient than combustion engine cars
- Heat pumps are 300-400% more efficient than gas or oil boilers
- Increasing electrification of heating and transport will increasingly allow for grid balancing via demand-side management
- Phase-out of fossil fuels leads to substantial, immediate air quality co-benefits
- Reduced fossil fuel import bill improves trade balance and allows for flexible foreign policy

Is it macro critical ? Pisany-Ferry* as a starting point

How big? "(Keynesian) new growth strategy" view vs "(large) negative supply shock" view

- Size of supply shock is essentially in line with oil shock of the 70^{ies}: 3-4% of GDP (based on a Worldwide carbon tax of 75-100€)
- …but spread over 30+ years…and not as sudden: more predictability

With, as a result:

- Need for major resource reallocations (workers and investments)
- Higher aggregate investments (~2% of GDP on a net basis)
- Higher r* (and inflation ?)
- Lower consumption

And also:

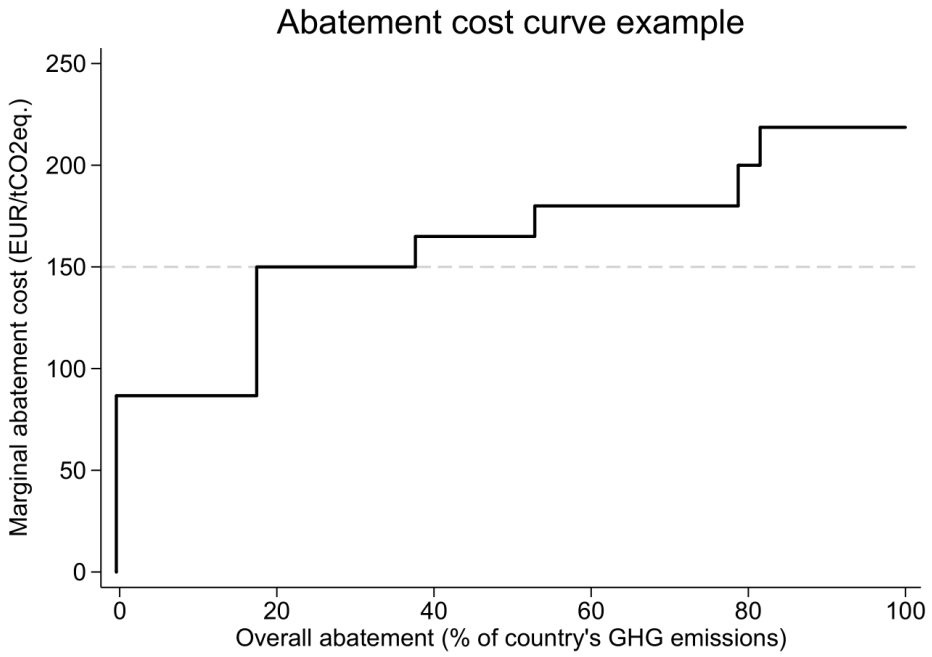
- Significant distributional - and therefore fiscal - consequences (vs. « double dividend » argument)

Source: See, e.g.,: Pisani-Ferry, Jean "Climate Policy is Macroeconomic Policy, and the Implications Will Be Significant", POLICY BRIEF 21-20, Peterson Institute, August 2021.

Is it macro critical? Some remarks

Level of CO_2 price OK as a first approximation of macro impact

- The price of carbon will have to rise to the marginal cost of the most expensive decarbonisation technology, implying a steep marginal abatement cost curve. Ultimately, probably direct air capture for negative emissions (>300€/ton CO_2)
- A better measure of the supply shock is the integral under the (increasing) carbon price. Or the *average cost of abatement per ton of CO_2eq*
- Overlapping instruments caveat: not only carbon prices will be used to get there (subsidies, standards…)



Source: National Bank of Belgium.

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My take on the average cost of abatement

- ~150€/ton $CO_{2eq.}$ = 3,5% of 2020 GDP in Belgium (high income/high emission); 2,5% of 2050 GDP
- This corresponds to ~0,1% GDP growth per year and is, indeed, comparable to the impact of an oil shock
- The cost for lower income countries could be higher but they typically have a higher growth potential → two years of growth looks like a good first approximation

Main issue on other macro impacts: additionality vs. crowding-out

- What other productive investments does climate action replace? How does it affect technological progress?

Existing technology can abate nearly all GHG emissions at reasonable cost

Mitigation technology	Competitive at a carbon price of	Remaining barriers to scale
Renewables	**~0-25** USD/$tCO_2eq.$	Seasonal storage, public acceptability
Heat pumps		Space, listed buildings, supply chain
Energy efficiency improvements		Non-monetary measures, credit constraints
Methane capture (waste & energy)		MRV & legal enforcement
Small modular nuclear reactors		Not yet commercially available
Electric vehicles	**~100-200** USD/$tCO_2eq.$	Network effects, raw materials
Land-based carbon removal		MRV & legal enforcement
Agricultural practices		Observability
Electrification in industry		Availability of renewable electricity
Lab-grown meat		Public acceptability
Light electric trucks		Battery technology
Green H_2 in industry & storage	**~200-300+** USD /$tCO_2eq.$	Availability, transport
Carbon capture & storage (CCS)		Storage, acceptability, investment
Direct air capture (DAC)		Regulatory framework, investment
Sustainable aviation fuels		Regulatory framework

Source: National Bank of Belgium.

Main issue 1 : There is little time left!

Public economics 121 on externalities

1. Set a Pigouvian price
2. Pay attention to distributional issues (of course!)
3. … enjoy your holidays

But

- The carbon price necessary to reach net zero GHG emissions is quite high (again, DAC >300€/ton) → Not politically feasible in one "jump"
- Increasing the carbon price progressively implies that there is no movement on all fronts (see previous slide) → Unless one assumes perfect markets and foresight, time is quickly running out

Therefore

- An increasing carbon price can be seen as the wave that will ultimately lift all boats in an efficient way
- But other instruments (subsidies, regulation, R&D support) will be needed to move on all fronts in time

Still

- Waiting is not always bad: one should not roll-out technologies before they are cheap enough
- A carbon price allows to focus first on the most efficient technologies, which makes sense

Main issue 2: Keeping the (voting) public on board

Do not overestimate popular support

- Many people have been told the « great economic opportunity story », not the « significant supply shock » one
- Surveys that estimate public climate policy support often fail to mention trade-offs

We need more granular data per households on energy use

- Proxy data per income categories hides important heterogeneity in exposure to carbon price:
- People have different mobility needs, level of housing insulation…
- Additionally, wealth vs income

As well as a better understanding of the costs of various technological options

- Many economic policy makers seem underinformed about abatement cost and trade-offs

Demand vs. supply destruction?

Fossil fuel prices will ultimately have to increase

- The higher price can either go to Russia, Iran and Venezuela…
- … or to governments as tax revenues

Energy demand being inelastic, a small supply destruction can have BIG price impacts

- And immediate political consequences (like officials travelling to the Middle East)

IEA (2021): Text in full

- "The trajectory of oil demand in the NZE means that no exploration for new resources is required and, other than fields already approved for development, no new oil fields are necessary. *However, continued investment in existing sources of oil production are needed.*"

Source: IEA (2021): "Net Zero by 2050 A Roadmap for the Global Energy Sector",p.101.

Carbon price vs. subsidies?

"If the problem is overfishing, subsidizing chicken will not solve it.*"

Still, well calibrated subsidies are part of the solution

- In order to support clean R&D or "learning by doing" (cf. Acemoglu et al. 2012)
- In order to deal with "political realities", myopia or network economies

But beware of the rebound effect…

- German real estate federation report: more than 340 BEUR invested in insulation from 2010 to 2022.
- No reduction in energy consumption over the period
- Compared to minus 31 % between 1990 et 2010, (*Le Monde*, 07/10/2020)

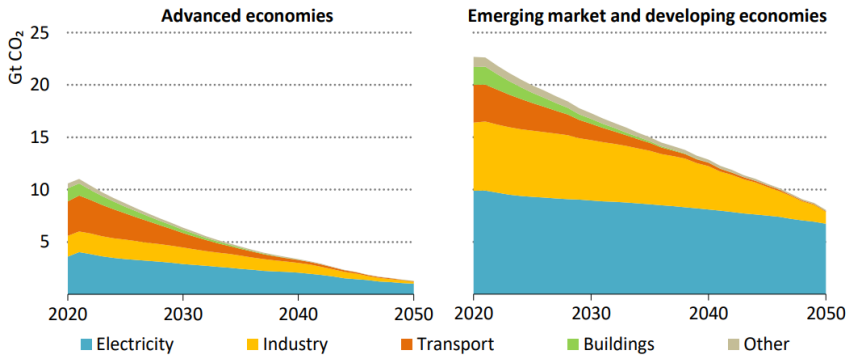
Source: *John Hassler at NBB seminar in 2023.
Acemoglu, Aghion, Bursztyn, and Hemous (2012): "The Environment and Directed Technical Change", *American Economic Review*, 102(1): 131-166.

Stranded assets likely not a first-order issue

Growing consensus that the issue may not be that big

- Stranded assets concentrated in fossil-fuel companies, and newer coal-fired power plants, many of which are developing countries– although ownership can be in in advanced economies
- Overall estimate of around 1-2 trillion USD worth of assets that could be stranded by 2050 (~1% of global GDP) – but this highly depends on how well transition is managed. Moreover, the net present value of long-lived assets is relatively low (1,05^30 = 4,3, assuming a discount rate of 5%)
- Cost depend highly on how transition is managed: sudden and unexpected, or well prepared?

Figure 1.9 ▷ Emissions from existing infrastructure by sector and region



Emerging market and developing economies account for three-quarters of cumulative emissions from existing infrastructure through to 2050

Quid higher EU ambition to 2030 ?

Risk would not result from the carbon price per se but from regulations mandating some specific investments (housing insulation, heat pumps, electric cars…) ?!

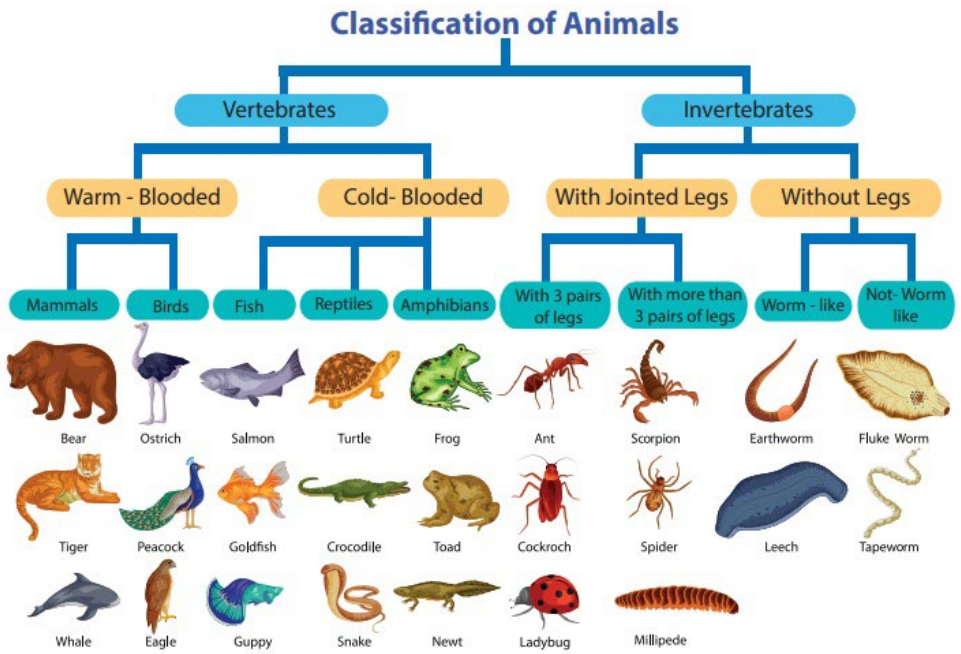
Not only impact on residential and commercial real estate prices but also risk of bottlenecks and/or inefficiencies ?!

Re-use of gas infrastructure for H2 requires significant investments

This, combined with infrastructure need for CCUS, may lead to (further) concentration of industrial activities around harbours ?!

Source: IEA (2021), op.cit., p. 40, McKinsey&Company (2022), Semieniuk et al. (2022): "Stranded fossil-fuel assets translate to major losses for investors in advanced economies", *Nature Climate Change*, 12: 532-538.

Why do we need the taxonomy in a Paris-aligned economy?



EU ETS system = Paris-aligned, and efficient → Why do we need the taxonomy ?

- To inform customers or investors: voluntary carbon markets to date mostly unregulated → financial flows might be in vain / greenwashing
- To support environmental concerns beyond climate

But there is a risk of pushing for "dark green" solutions:

- Energy performance ratings: not all houses can be insulated quickly or cheaply
- Wood pellets and/or a mix of insulation, solar panels or heat-pump could be cheaper than only insulation
- Paradoxically, electrifying heating and cars in cities might be more difficult than electrifying suburbs
- Risk of credit rationing for poor households ?
- Risk of too high an ambition for green hydrogen – might need blue or turquoise H2 to kickstart infrastructure in time

Behavior vs. Technology or Moral argument vs. Efficiency ?

The longer-term debate is not addressed here-that is, the controversy between the techno-optimists who argue that if the right investments are made in time, climate-related disasters can be prevented without much change to living standards, and the techno-pessimists who maintain that life on Earth can be preserved only if societies break away from an economic model centered on the maximization of material well-being.

Pisani-Ferry, J. (2021), p. 3

- My take: 80% technology & 20% behaviour
  - The "beauty" of net zero is that we need climate neutral technologies in all sectors of the economy
  - It took the war in Ukraine for people to reduce their gas consumption, and even then only by 20%
- Many (young) people see the climate issue as a moral issue. Is that a problem ?
  - *No* if it pushes people to adapt their behaviour and be early adopters
  - *Yes* if it leads to despair or to inefficient choices that would significantly delay the transition and increase its costs (back to "dark green")
  - NB: Most people in the EU have no clue what the EU ETS is or that the carbon price is at 100€/tCO_2. But they are convinced that we are not doing enough and they do not want you to use plastic glasses or silverware (let alone board a plane)

Impact on monetary policy?

Back to impact on r* and inflation

- "We need to invest" vs. assimilation of a carbon price to a form of oil shock (without terms of trade)
- Not even sure investments will go up

If investments do go up, r* should go up

- By how much is less than clear (as in any discussion on r*)
- The supply shock implies higher costs of ~0,1% GDP growth per year
- But, in theory, higher costs do not necessarily imply higher inflation

We start from a period of high energy prices and inflation

- Energy prices should be lower in 2050 than in 2022, at least in Europe
- Volatility will come less and less from fossil fuels and more and more from bottlenecks in materials or expert skills

Some measurement issues may blur the picture at the margin

- Electric vehicles are more expensive than internal combustion cars but their price is dropping faster
- This will have a *negative* impact on inflation as the share of electric cars in consumption goes up
- This is because new goods, even though close substitutes, typically enter the price index as different items, and the chain-linked methodology of price indices removes any level effects (NB: solar panels and batteries for domestic use are considered investment goods, however)

Role for monetary policy in the transition?

Mainly a question of principles and symbols

Fed will not become a 'climate policymaker', says Jay Powell

US central bank chair underscores importance of maintaining focus on inflation and labour market

Jay Powell says it is important that the Fed resists the 'temptation to broaden our scope to address other important social issues of the day' © TT News Agency/Claudio Bresciani via Reuters

Schnabel said the ECB needed to act faster to bring its own investments and lending operations in line with the objectives of the Paris agreement and achieve carbon neutrality by 2050.

Financial Times, January 10, 2023

Central banks will NOT make the difference but have a part to play

- The no brainer: study the impact of climate change on the macroeconomy
  - But should we also "open the black box of the proprietory models" on abatement cost?

    → Get a detailed understanding of the abatement cost per technology
  - I believe it is an investment worth making to inform policy: climate policy is now core economic policy, and central bank expertise on estimating the macroeconomic cost of climate neutrality is sorely needed

- The conceptually clear but maybe overblown: understand the impact on risks (of default)
  - Climate change implies risks… like fossil fuel price volatility, wars, innovation…
  - Not clear that the markets/rating agencies would not be able to quantify this risk
  - In any case, avoid double counting and focus on long duration asset. Stop assuming static portfolios to 2050. Need for more realistic assumptions

- The controversial: act on relative prices
  - Tilting of monetary policy portfolio; green supporting factors in capital regulation
  - Here, the Atlantic divide is HUGE, which is a first indication that the issue has a political dimension

What falls under ECB's remit? Article 3

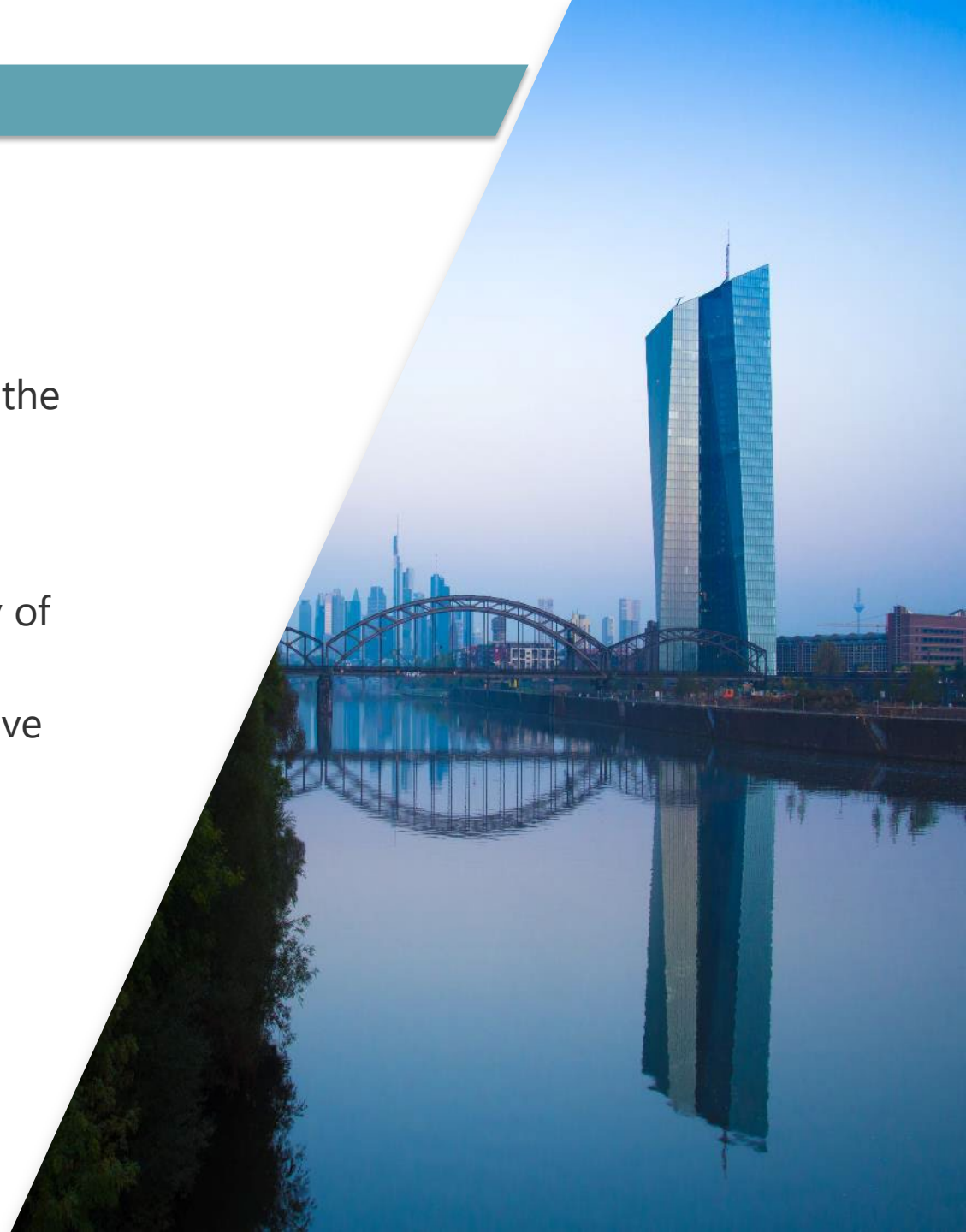
ECB mandate is anchored in the EU Treaty:

- price stability is the primary objective
- without prejudice to that objective, support the general economic policies in the EU with reference to Article 3 of the Treaty

Article 3 lists many objectives:

- a high level of protection and improvement of the quality of the environment …
- … but also balanced economic growth, a highly competitive social market economy, full employment, social progress, scientific and technologic advance, social exclusion and discrimination, equality of women and men, …

→ Risk of cherry picking : "Animal Farm" reading of the Treaty ("All animals are equal but some are more equal than others")



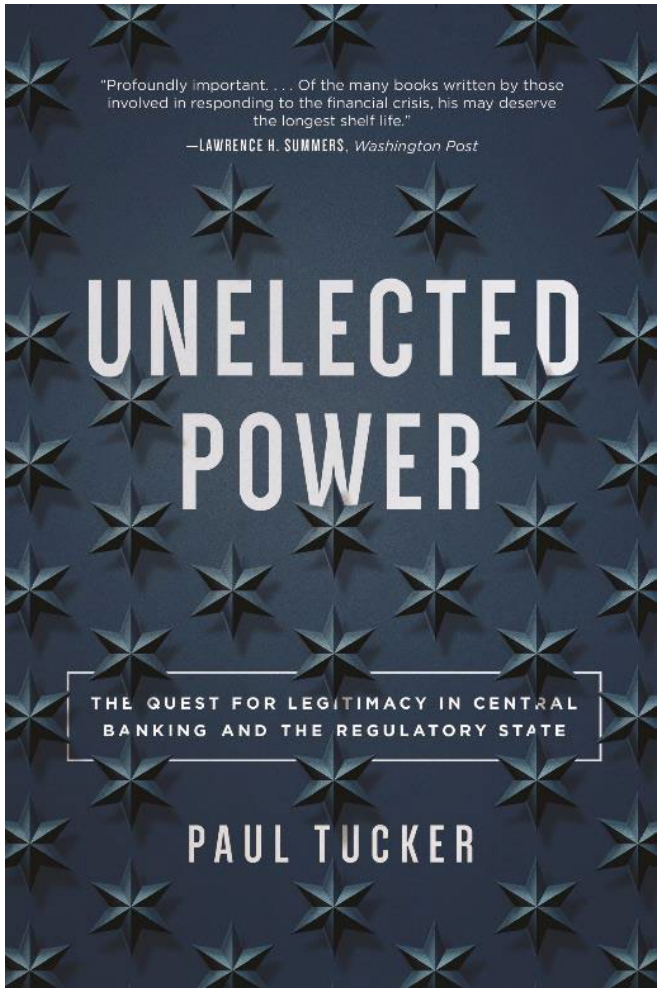
Broader issue of mission creep?

- Mervyn King (former Bank of England Governor):

"The Federal Reserve, European Central Bank and Bank of England all seem willing to take on vexing social challenges. If they aren't careful, they may end up losing their autonomy."

- Lawrence Summers (former US Treasury Secretary):

"Central banks have, in order to be relevant to something that's on political leaders' and citizenry's mind, rather stretched things in the degree of emphasis they place."



My take on it

Is central bank's involvement in climate policy about supporting policy or correcting policy failures?

- The second one would clearly be problematic
- At the end of the day, the question is whether central banks have an instrument that is not available to policy makers and that is part of the first or second best solution
- Textbooks: generally no role for central banks in allocative efficiency

In Europe, the EU Emissions Trading System (EU ETS) is close to a first best solution

- What is the point of asking which firms are (more or less) "Paris-aligned" when all firms in the EU will be forced to be ?
- Discrimination between firms that fall under the EU ETS (tilting against some of them) is against the objective of an efficient allocation of the effort → flirting with autonomous policy making
- Discrimination against firms that operate in jurisdictions that are not « Paris compatible » may be closer to supporting EU policy → Depends on the efficiency of the Carbon Adjustment Mechanism (CBAM), and on whether firms operate in sectors covered by CBAM

Communication issue : Dealing with symbols

"Tinbergen's rule" vs. "We all need to do our part to save the planet"

Many people believe central banks are just… another kind of banks

- Tilting for climate contributes to the communication challenge that, no, we cannot save the planet and finance the transition

Admittedly, just saying that the EU ETS will take care of it all is… a bit boring. Still, one needs to choose (in)-between:

- "The great opportunity / party time" narrative…
- … and the "Risks are huge, and banks do not get it" one

Thank you for your attention

Pierre Wunsch | 5 June 2023

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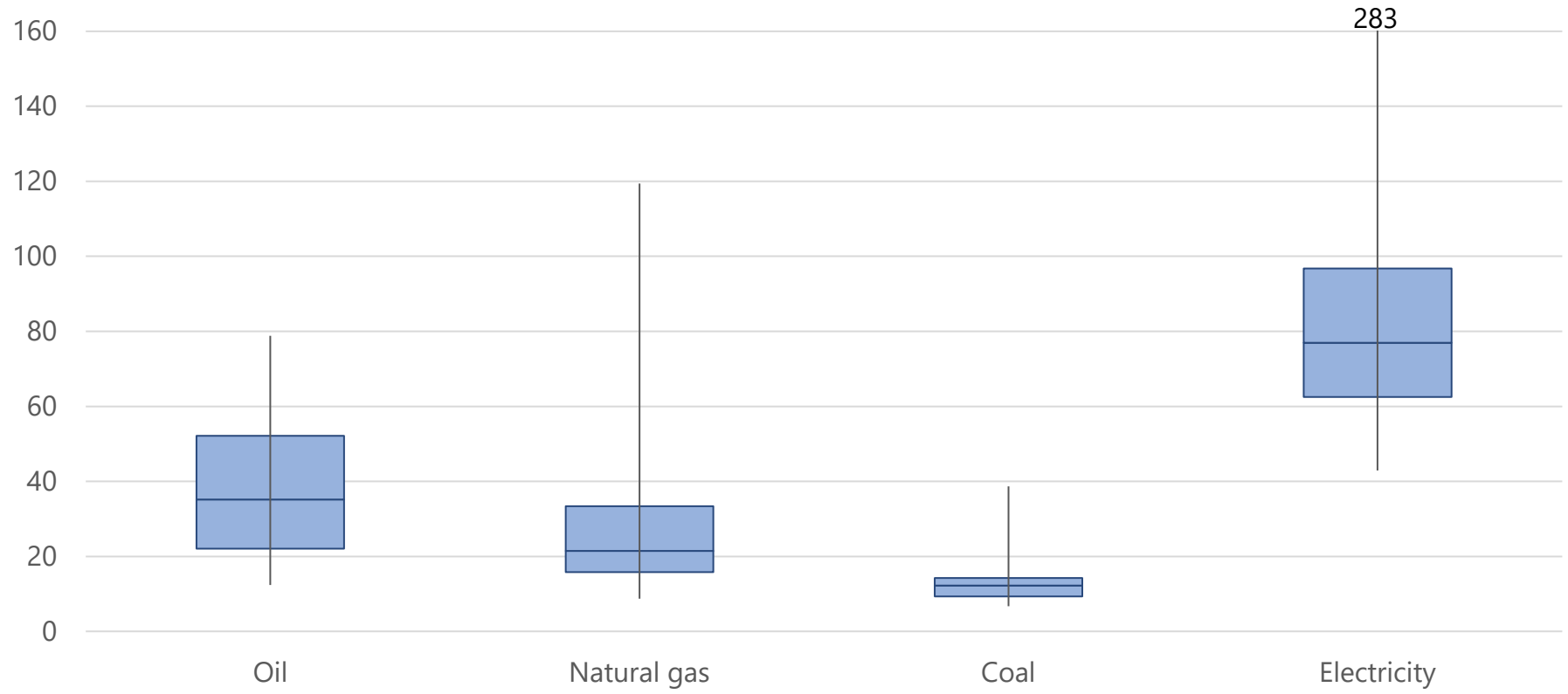
Backup slides

Looking back: electricity prices were clearly higher than fossil fuel prices

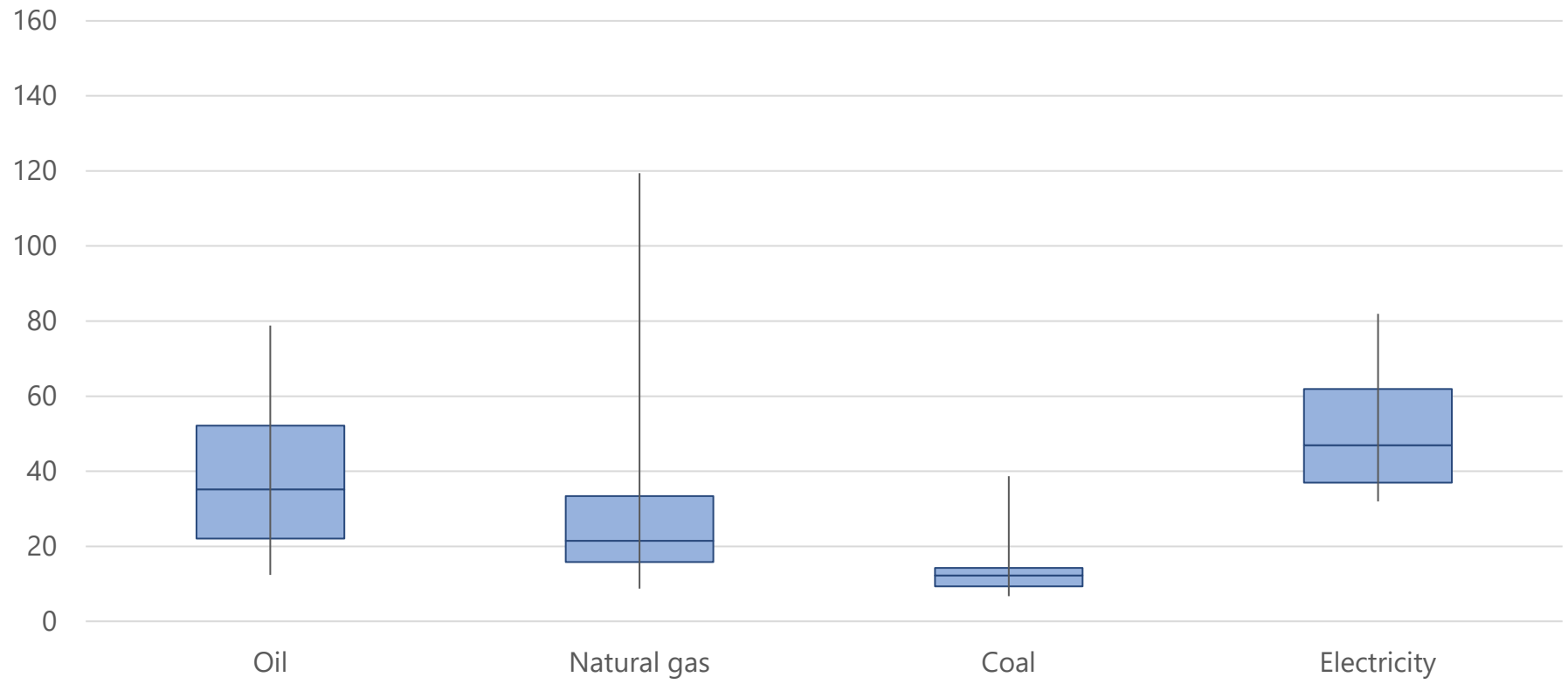
Fossil fuel prices vs electricity prices in the past
(in $2021/MWh)



Source: NBB analysis. Fossil fuel prices: 1980-2023, electricity prices: 2005-2023. Prices for European markets.

Looking ahead: electricity prices (electrification) should become cheaper

Fossil fuel prices until now vs electricity going forward
(in $2021/MWh)



Source: NBB analysis. Fossil fuel prices: 1980-2023. Prices for European markets Electricity includes recent LCOE estimates plus illustrative cost of grid balancing and storage.

Electrification is the key question for decarbonisation

Already electric?

Yes
- Electrified buildings
- Appliances
- Industry

No. Electrify?

Efficiency gains?

Yes
- Electric vehicles
- Heat pumps

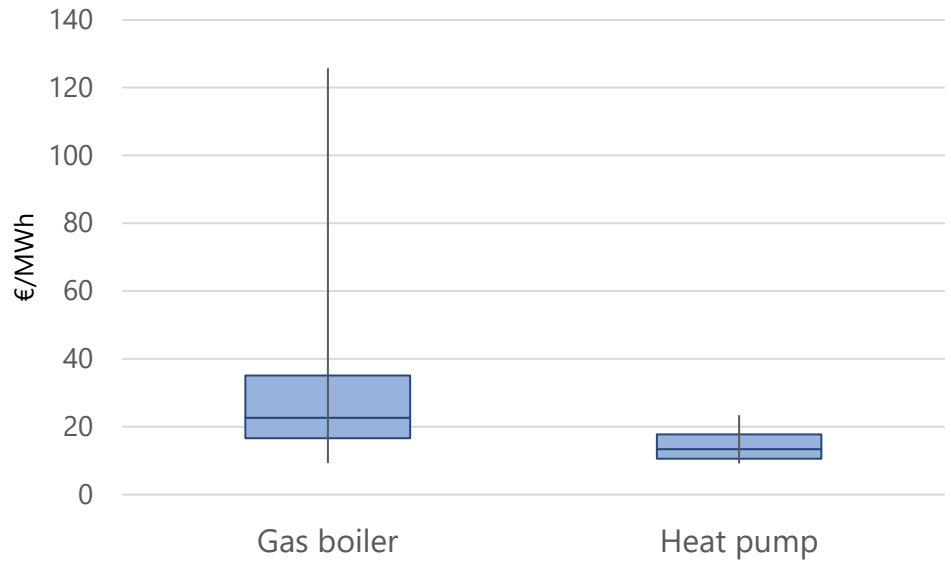
No
- High-heat applications

Decarbonised fuels
- Sustainable aviation fuels, natural gas with CCS, green and blue hydrogen

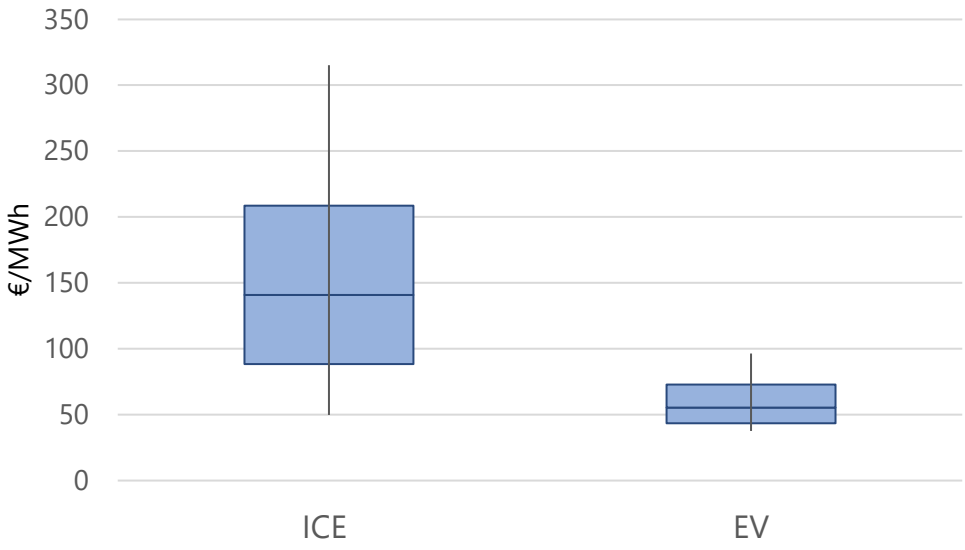
Source: NBB analysis..

Efficiency gains from electrification

Residential heating



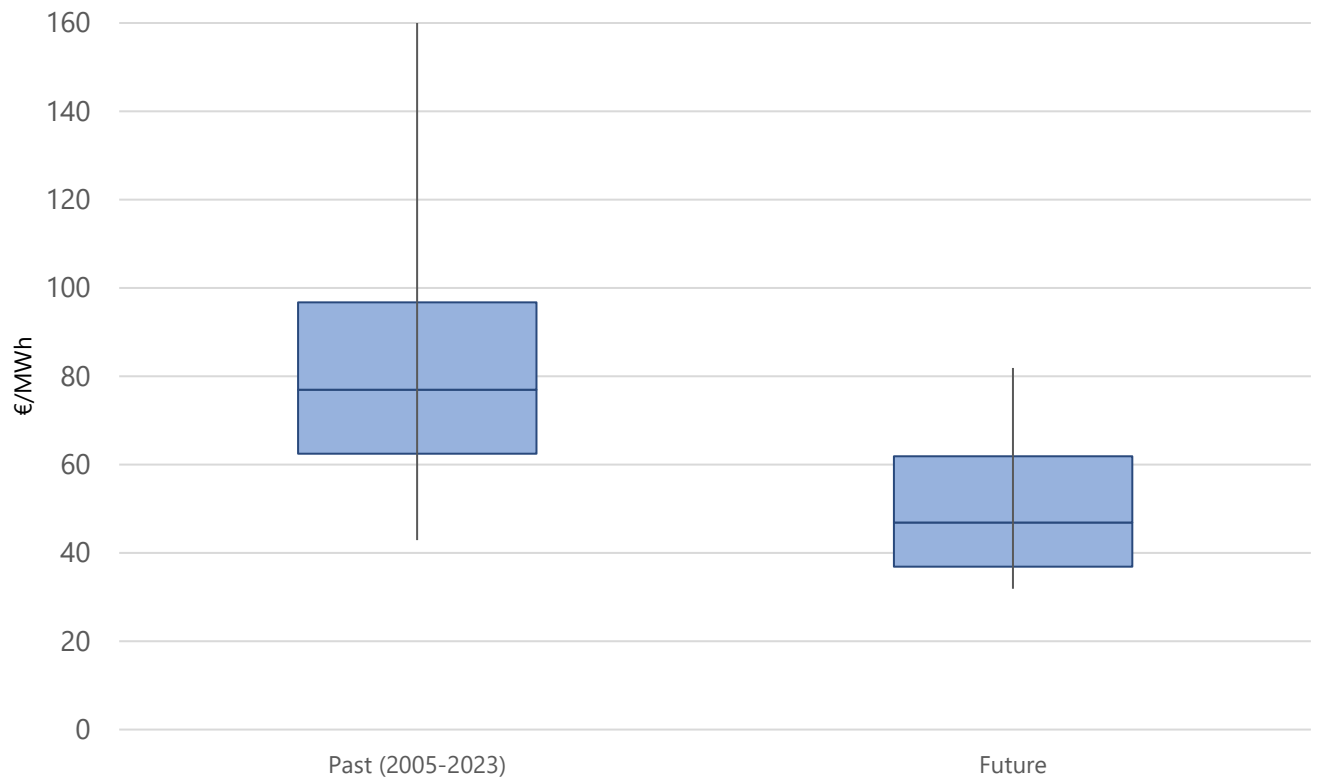
Road transport



Source: NBB analysis based on energy costs presented in earlier slides. Assumes efficiencies as follows: gas boiler - 95%, heat pump – 350%, ICE - 25% and EV - 85%. Cost of oil and gas based on wholesale prices, and cost of electricity based on recent LCOE plus illustrative balancing and storage cost.

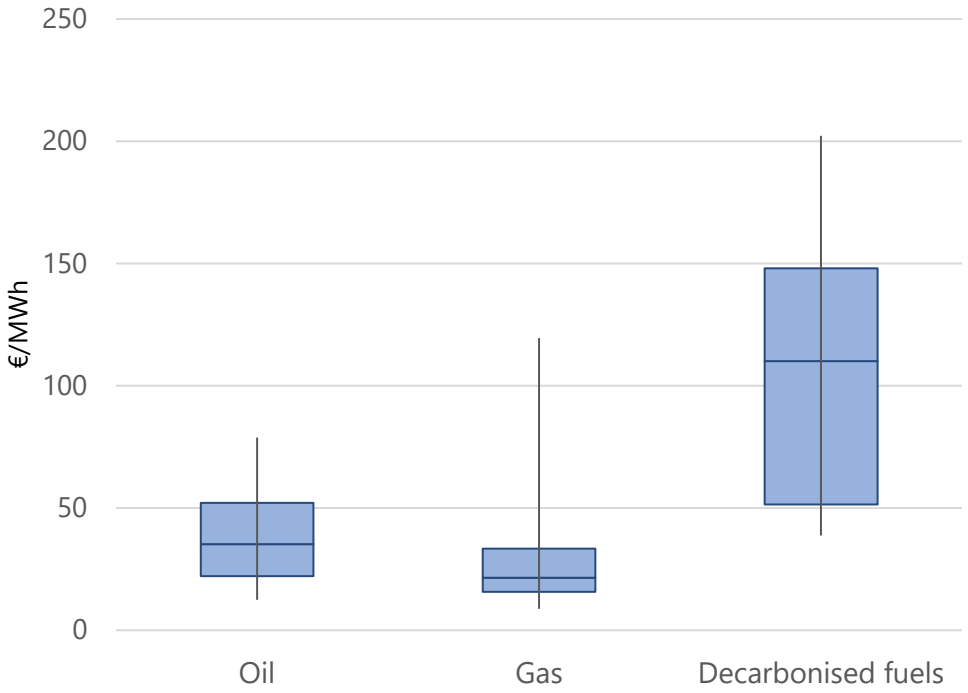
Gains from cheaper electricity despite lack of efficiency gains

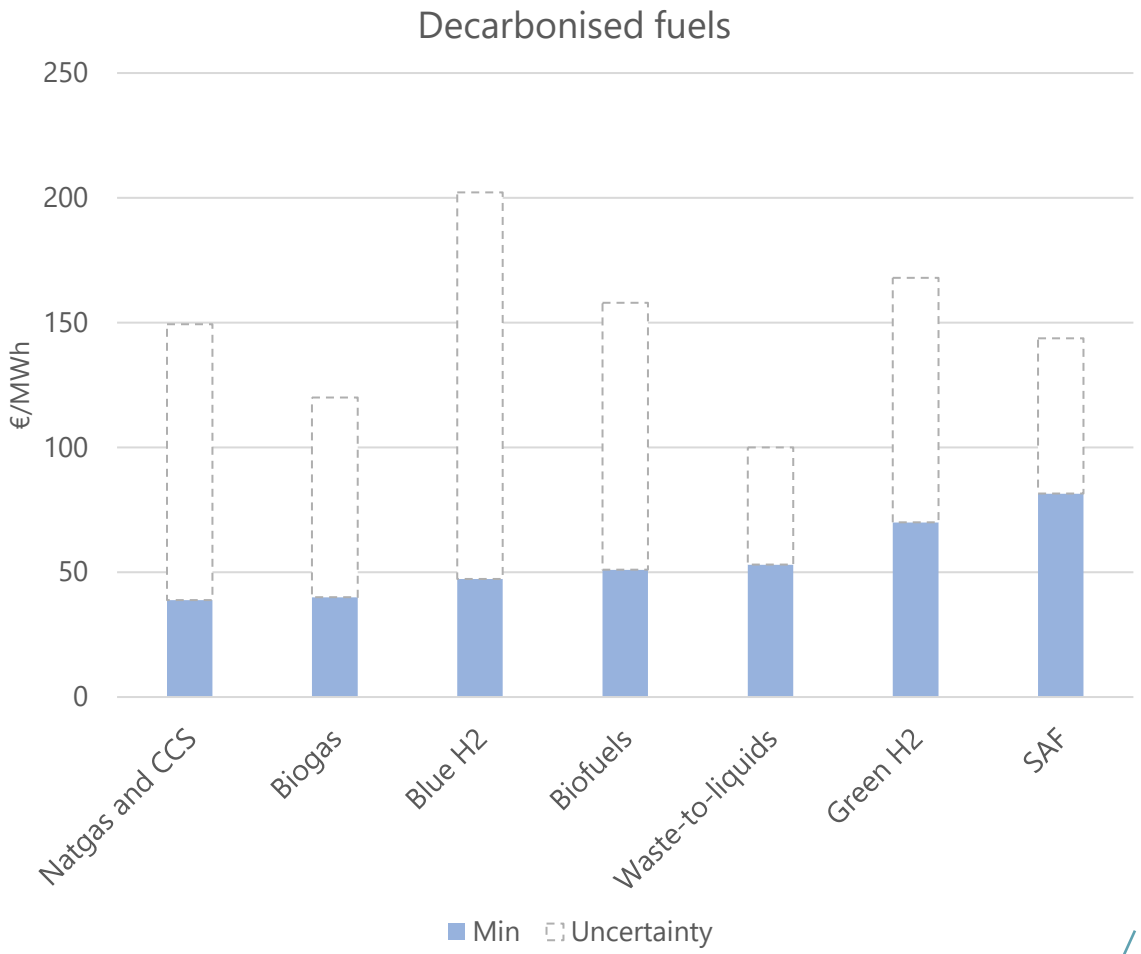
Historic vs future electricity costs



Source: NBB analysis based on energy costs presented in earlier slides. Future cost of electricity based on projected LCOE plus illustrative balancing and storage cost.

Fuel use where electrification is not economical/possible





Source: NBB analysis.

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