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

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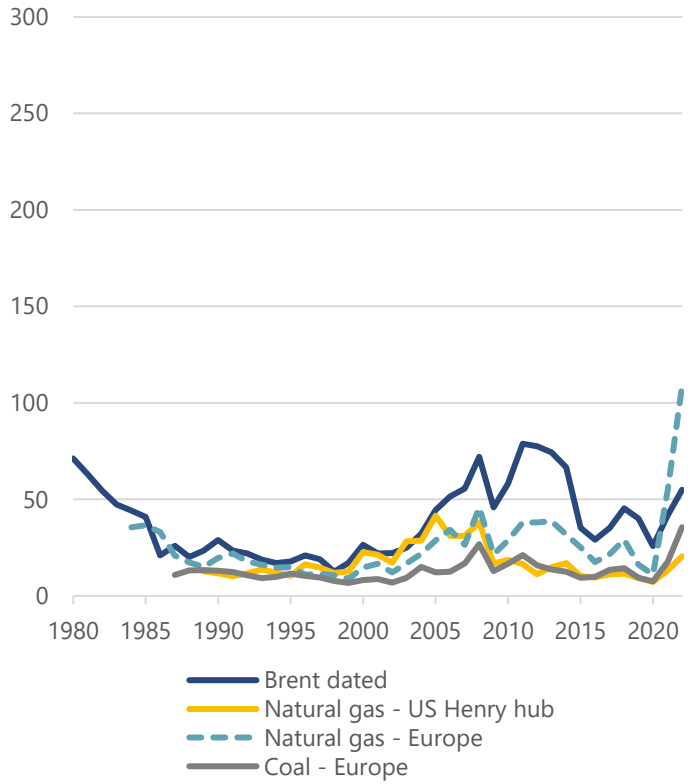
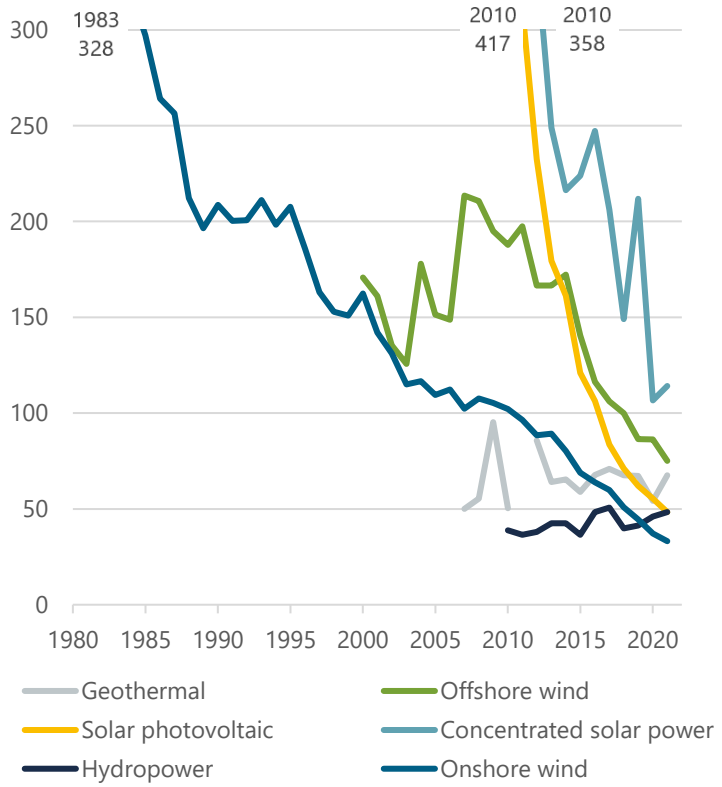
Setting the scene: A return to cheap energy?

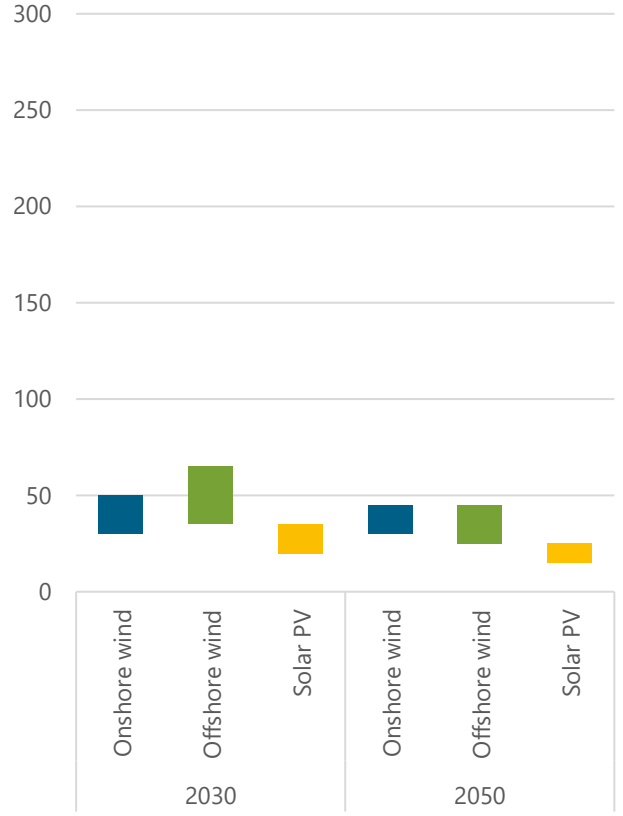
Fossil fuel prices
(in $2021/MWh)



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

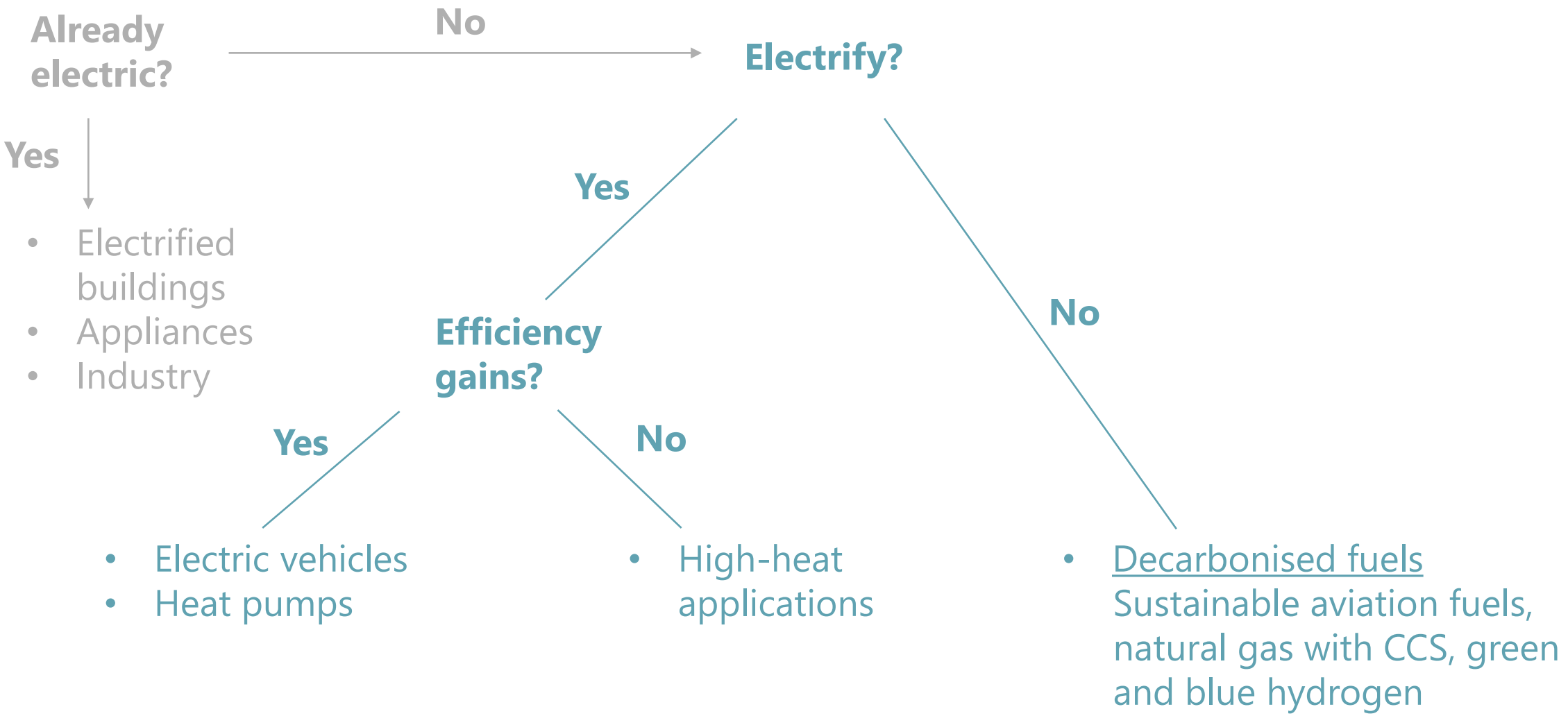
The not so good

- (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

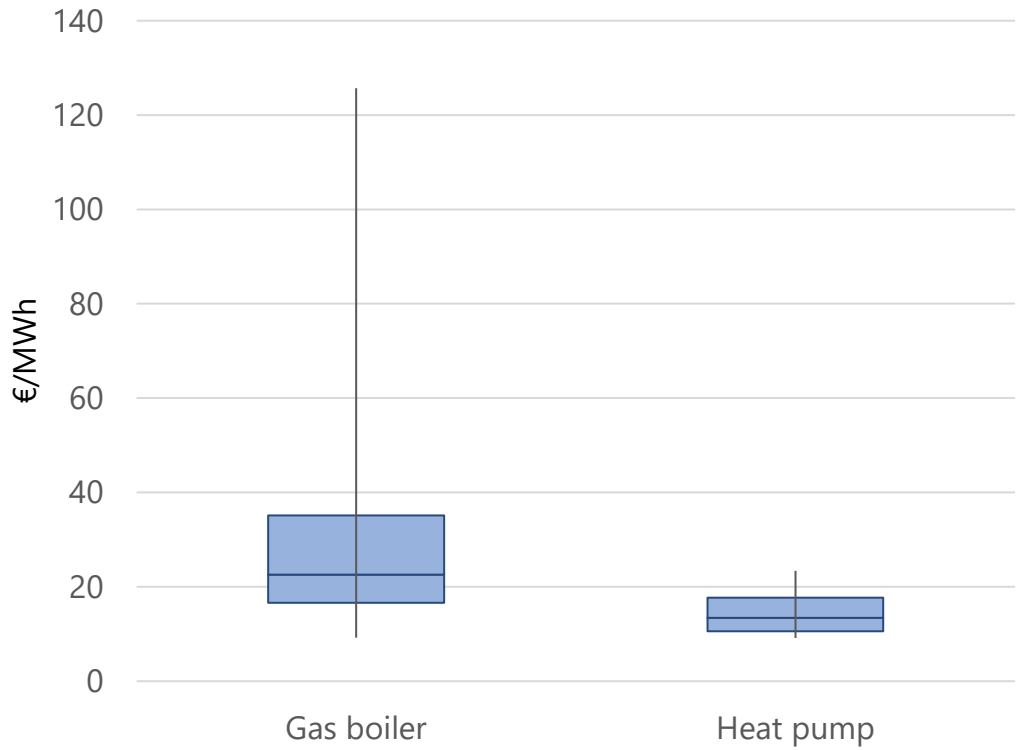
Electrification is the key question for decarbonisation



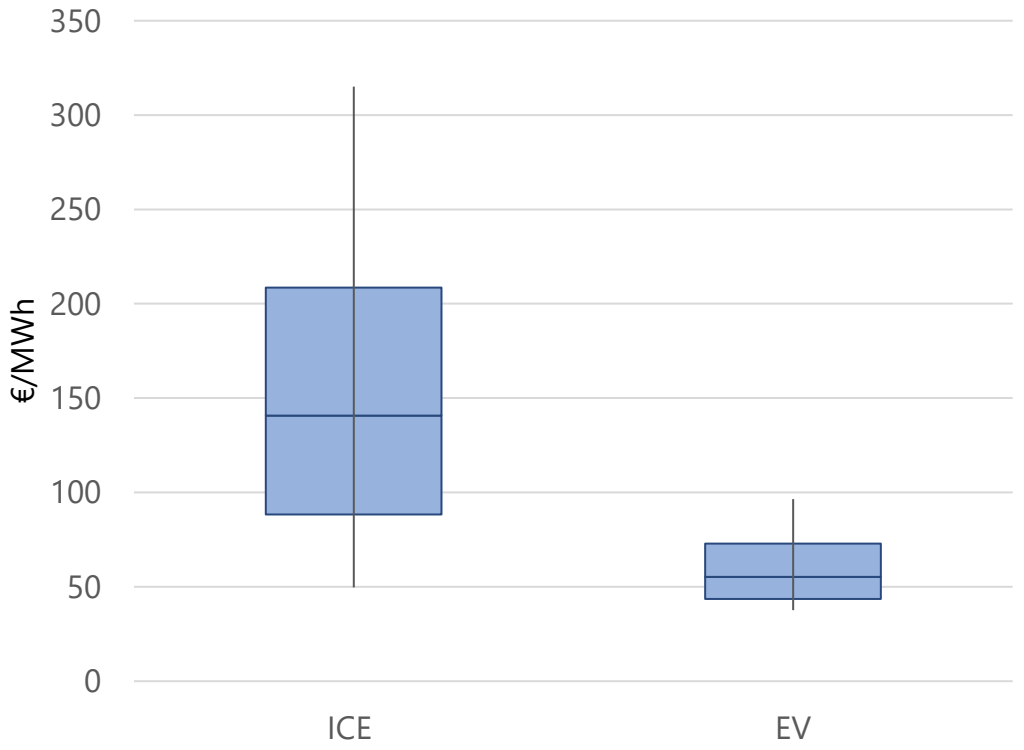
Source: NBB analysis.

Efficiency gains from electrification

Residential heating



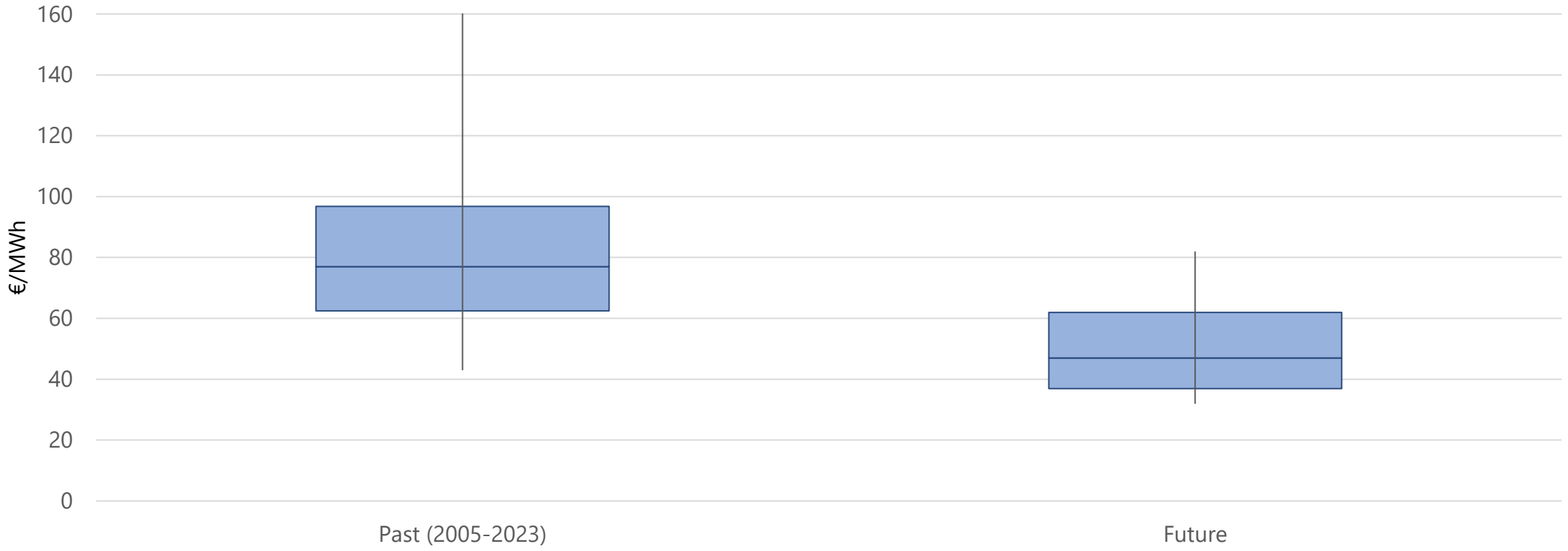
Road transport



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.

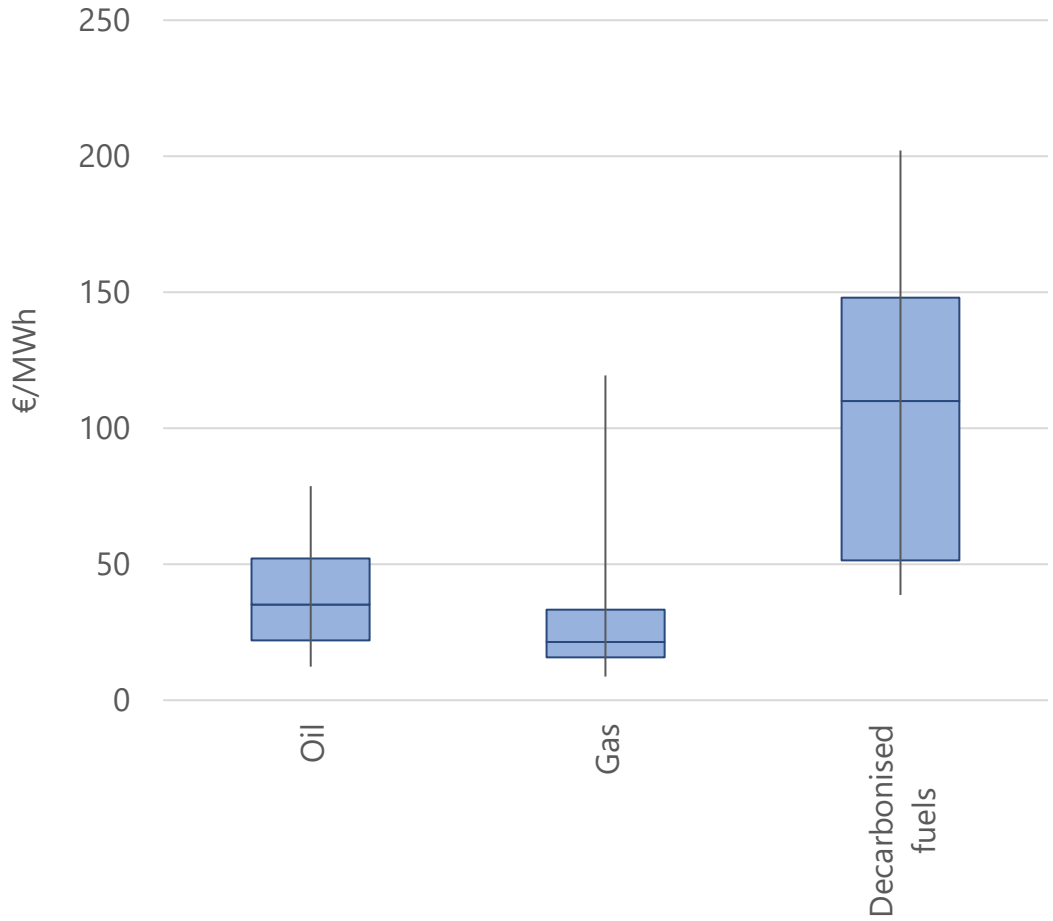
Gains from cheaper electricity despite lack of efficiency gains

Historic vs future electricity costs

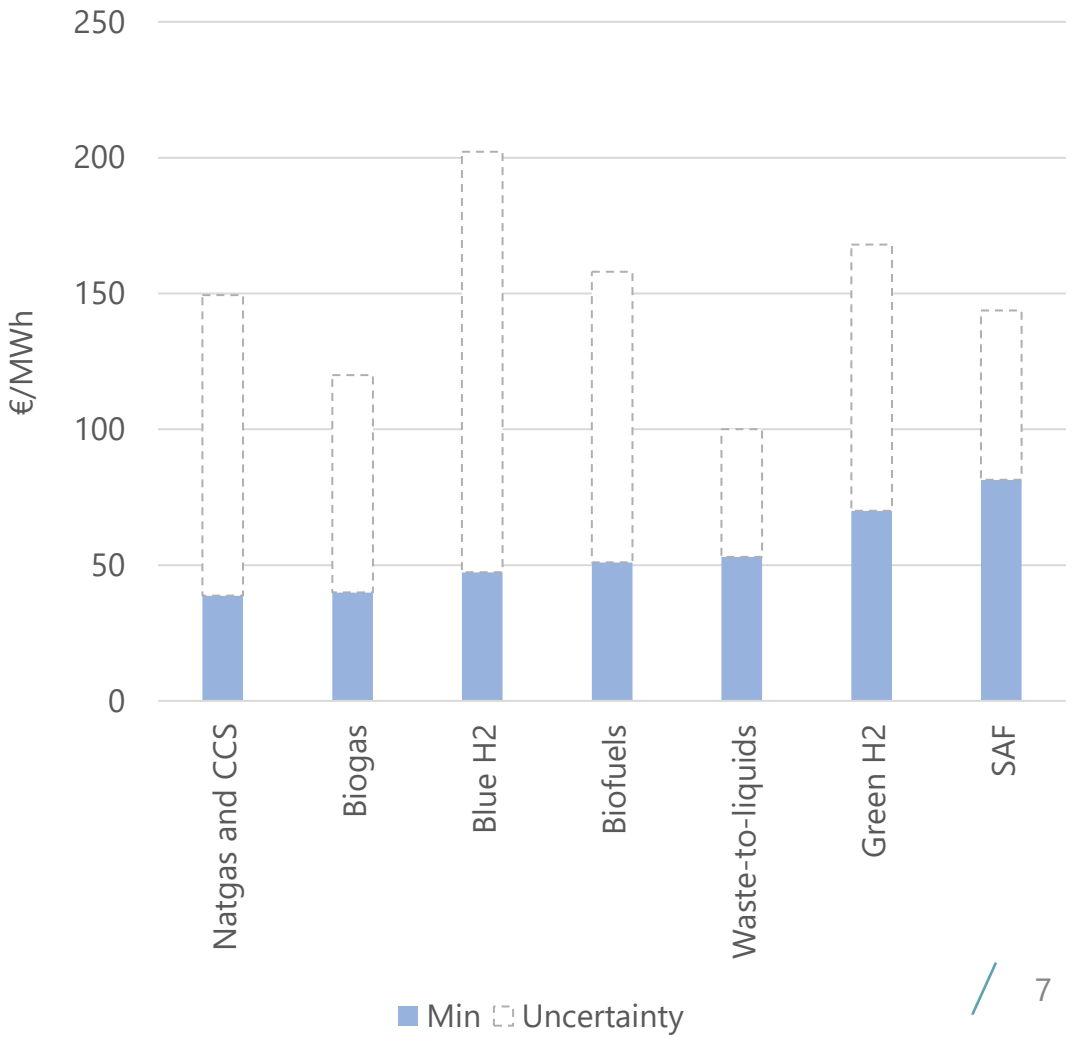


Source: NBB analysis based on energy costs presented in earlier slides. Future cost of electricity based on projected LCOE plus illustrative balancing and storage cost.

Fuel use where electrification is not economical/possible



Decarbonised fuels



Source: NBB analysis.

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…)

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

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. Feedstocks

Source: National Bank of Belgium.

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: risks of mission creep even under the ECB's secondary remit

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

Thank you for your attention

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Climate neutrality is macrocritical, and it is possible. How to get it done?

Main issue 1: there is little time left!

- 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
  → Unless one assumes perfect markets and foresight, time is quickly running out

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
- Need for clearer data on distributional impact of mitigation cost on households (by income and wealth)

Main issue 3: Demand vs. supply destruction?

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

Main issue 4: Carbon prices vs. subsidies for decarbonized technologies?

- Relative price shifts key. However: "If the problem is overfishing, subsidizing chicken will not solve it."
- In presence of additional externalities, subsidies can play a key role but beware of the rebound effect.

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.

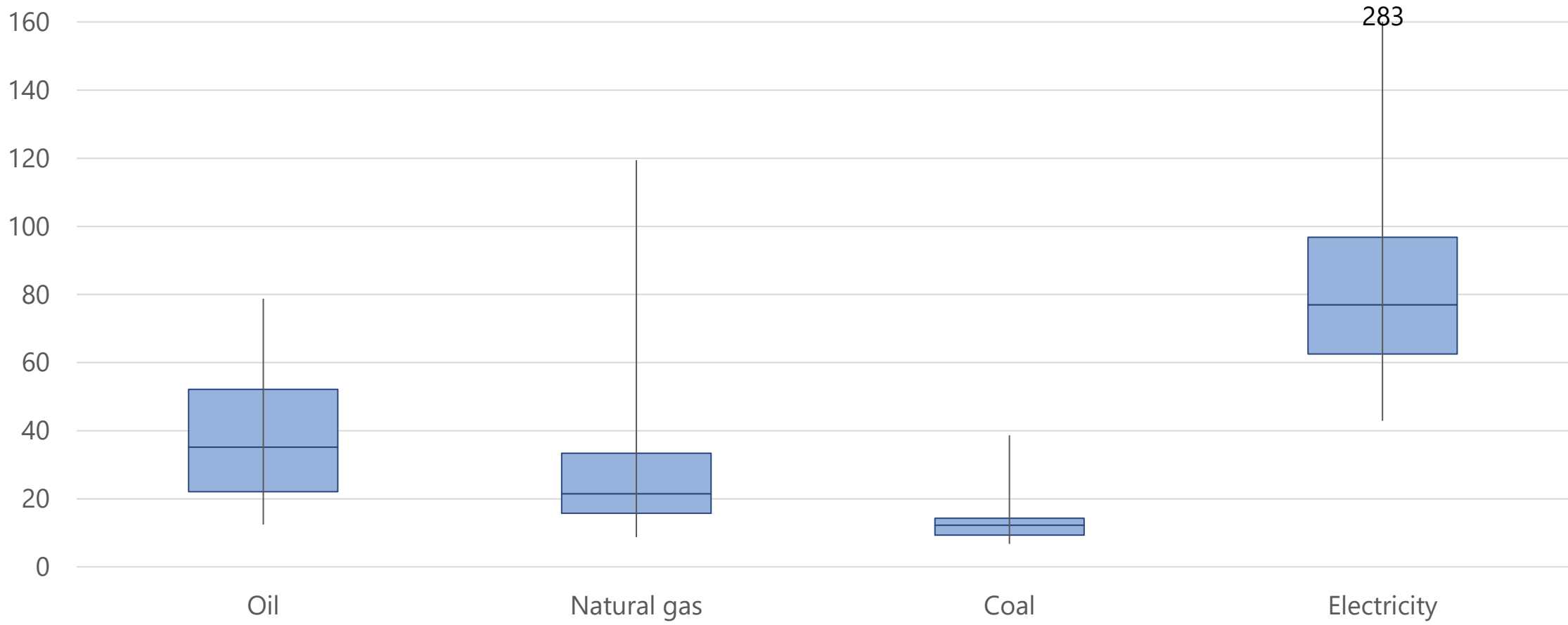
Pisani-Ferry, J. (2021), p. 3

- 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)

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

Fossil fuel prices vs electricity prices in the past

(in $2021/MWh)

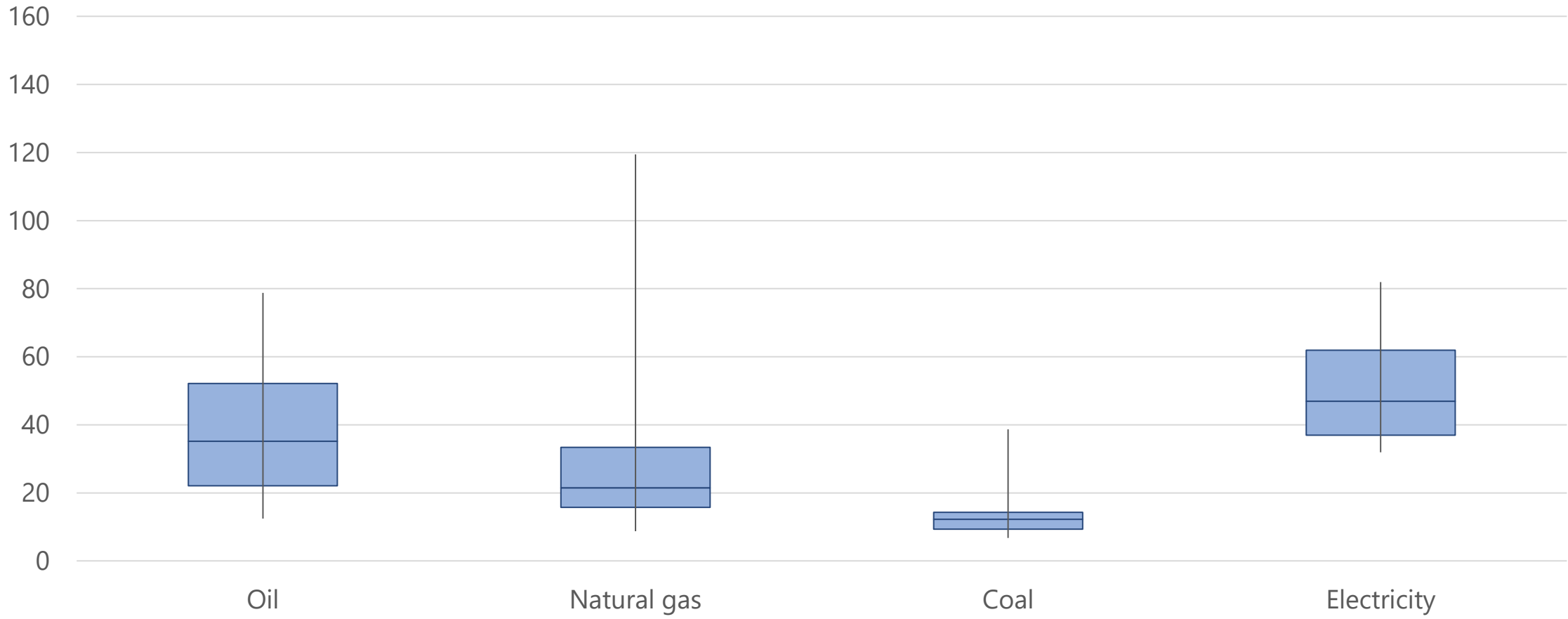


Source: NBB analysis. Fossil fuel prices: 1980-2023, electricity prices: 2005-2023. Prices for European markets.

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.

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