Pantelis Capros - IENE
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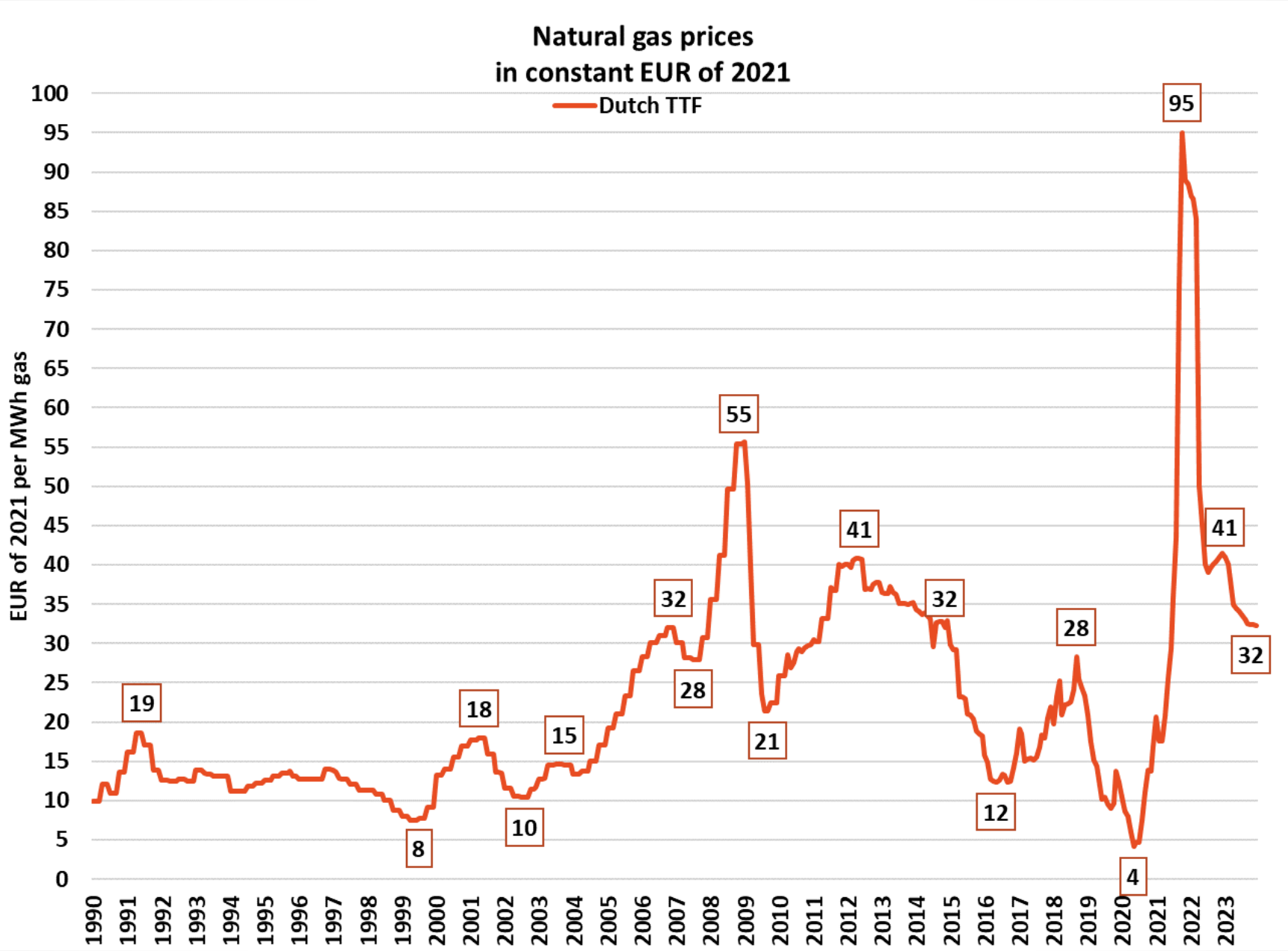
Lessons from the energy price crisis



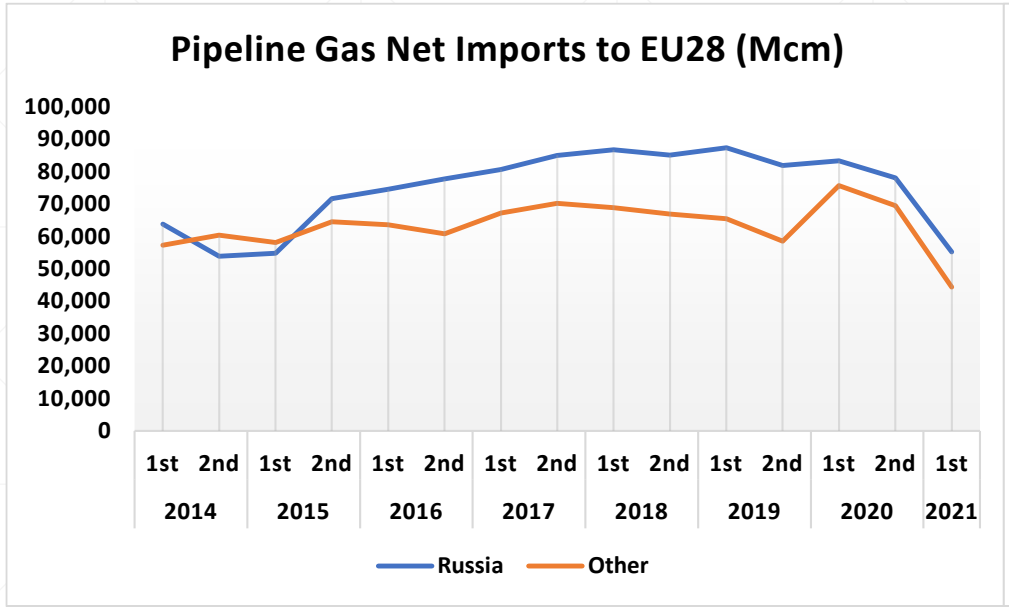
Long history of natural gas price fluctuations

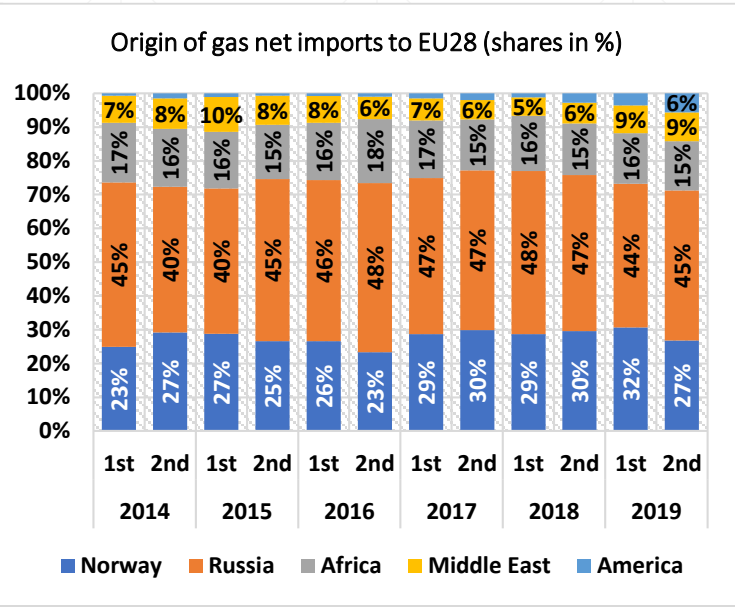
Remarkable gas price cycles

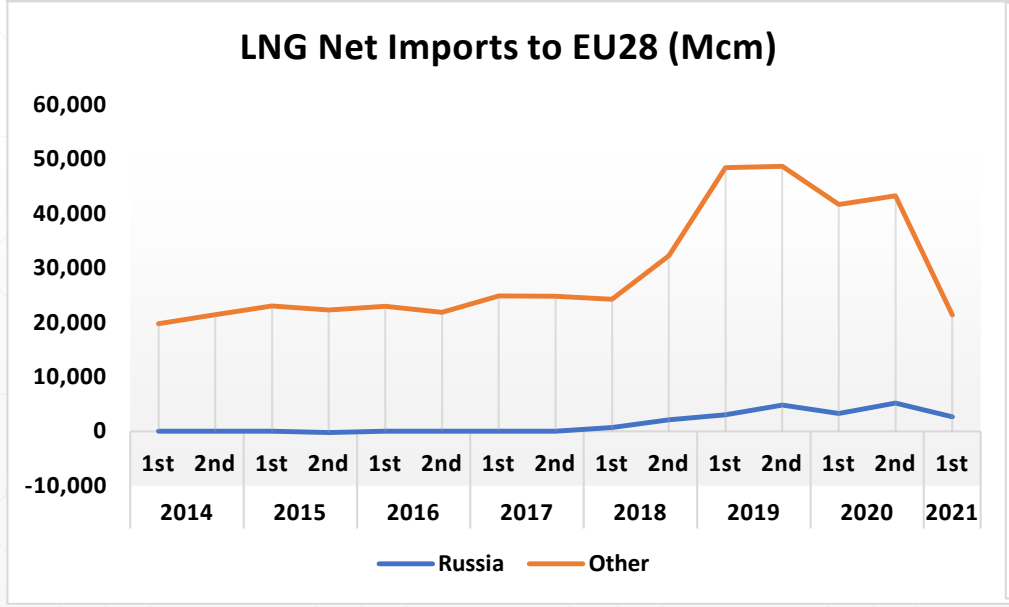
- High gas prices as the economy was recovering from the global financial crisis of 2007-2008
- Then, again high gas prices when recovering from the (smaller) economic crisis of 2010-2011
- Significant drop of gas prices driven by the US-produced LNG becoming a global commodity, gradually after 2015-17
- Collapse of gas prices during the COVID crisis
- However, and unexpectedly huge increase in gas prices amid the economc recovery from the COVID downturn

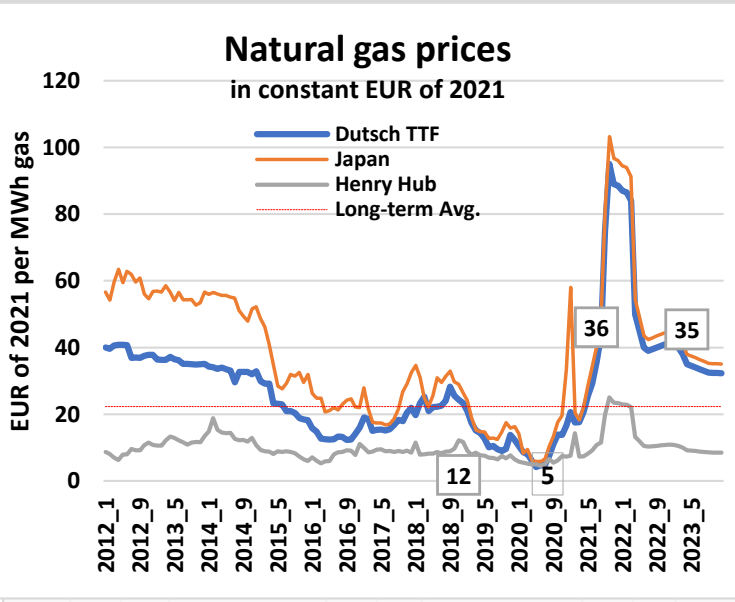
Extraordinary circumstances

- Slow down of upstream investment driven by negative expectations and poor financing; adverse effects of COVID on US LNG capacities
- Meteorological conditions driving higher demand for gas in Asia adding to strong economic recovery driving an increase in demand for gas
- Geopolitical reasons, such as the issue of Nord Stream 2 and the bypassing of Ukraine
- Decline of long-term gas contracts of EU purchasers, as a result of gas-hubs and the impact of cheap US LNG on Russian contracts, having used gas prices indexed to oil



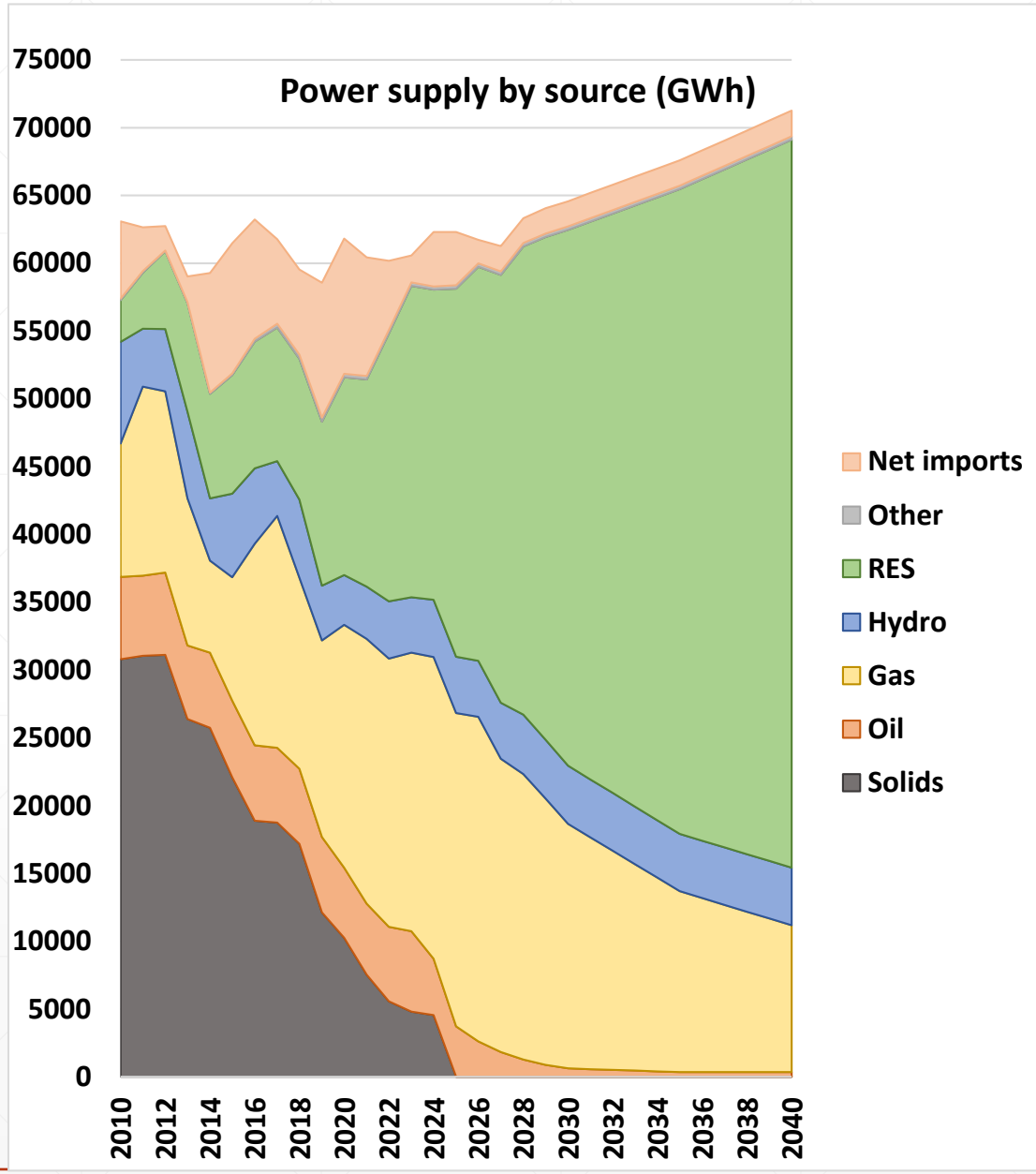


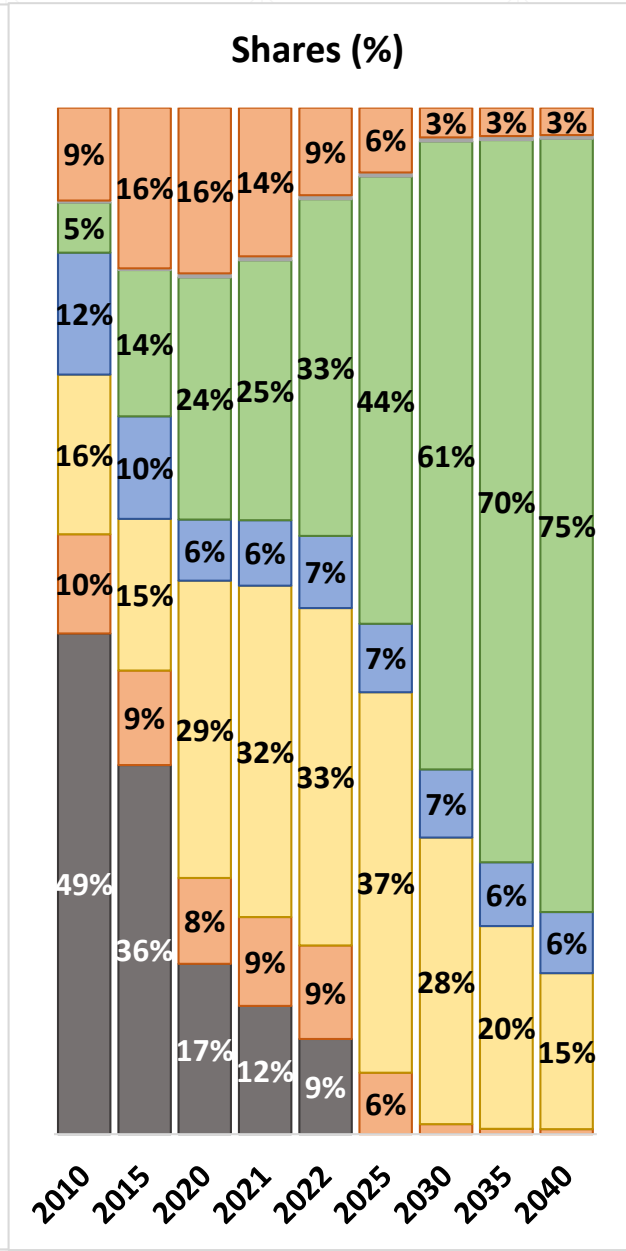




Greece: Power mix restructuring trend

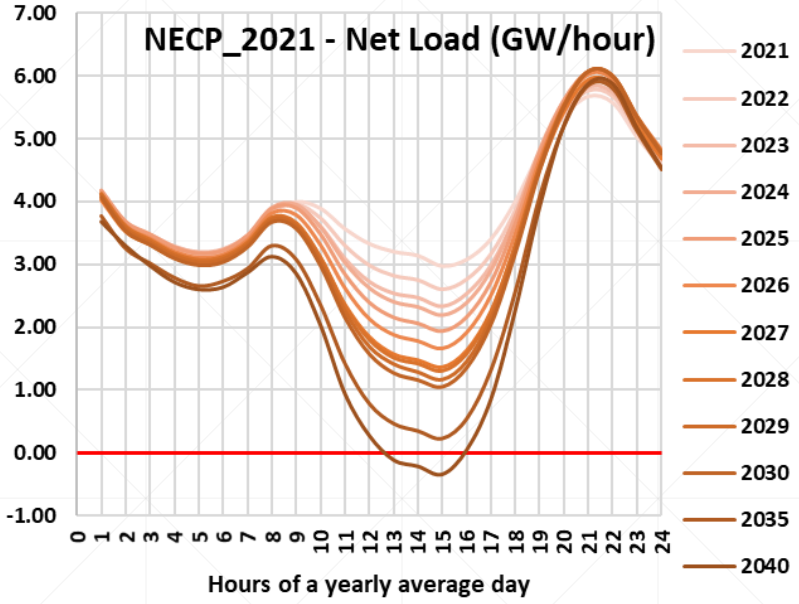
- The decline of lignite has started post-2012, driven by increasing mining costs and escalated after 2018 due to high ETS prices.
- Delaying lignite phase-out has no technical and economic logic
- Natural gas as a bridge is peaking in the mix during the first stages of the green transition but declines later
- The RES dominate the mix, but the development pace is slower than needed to reduce natural gas; however, gas independence takes place close to 2030 and onwards

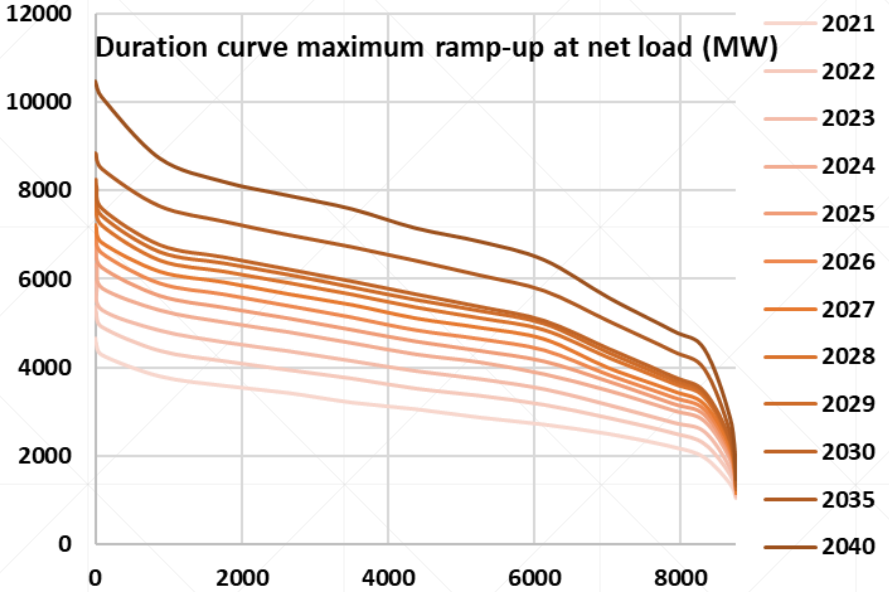


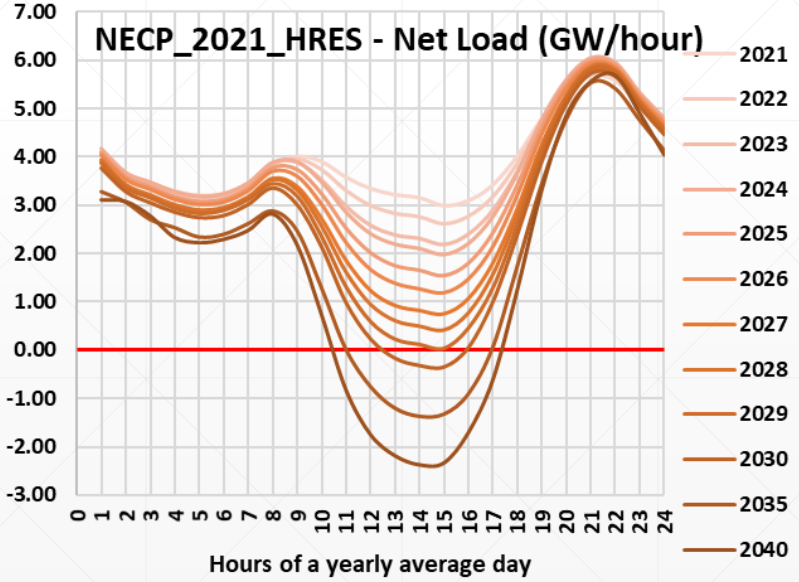


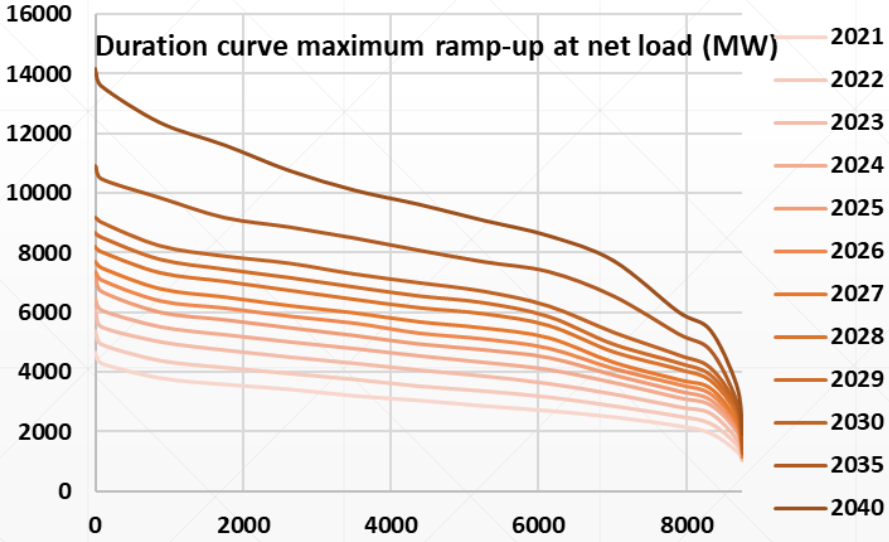
Net Load Projection

- Net load is load and losses minus generation by variable RES – it is then the load that dispatchable units and storage has to serve
- The deployment of RES, and particularly the solar PV, modifies the shape of net load by increasing the gap between the valleys and the peak, the latter occurring in the evening.
- The high RES scenarios induce higher gaps between valleys and peak net-load. Already in 2030 and much more after 2030, net load becomes negative during daylight and thus load shifting enabled by storage is essential
- RES deployment also drives ramping requirements upwards. Ramping of typical duration of 3-4 hours occurs daily at an increasing magnitude over the years, attaining above 10TW after 2030 in the base-RES case and almost 14TW in the high-RES cases.
- The stress on system balancing is considerable in the high-RES scenarios



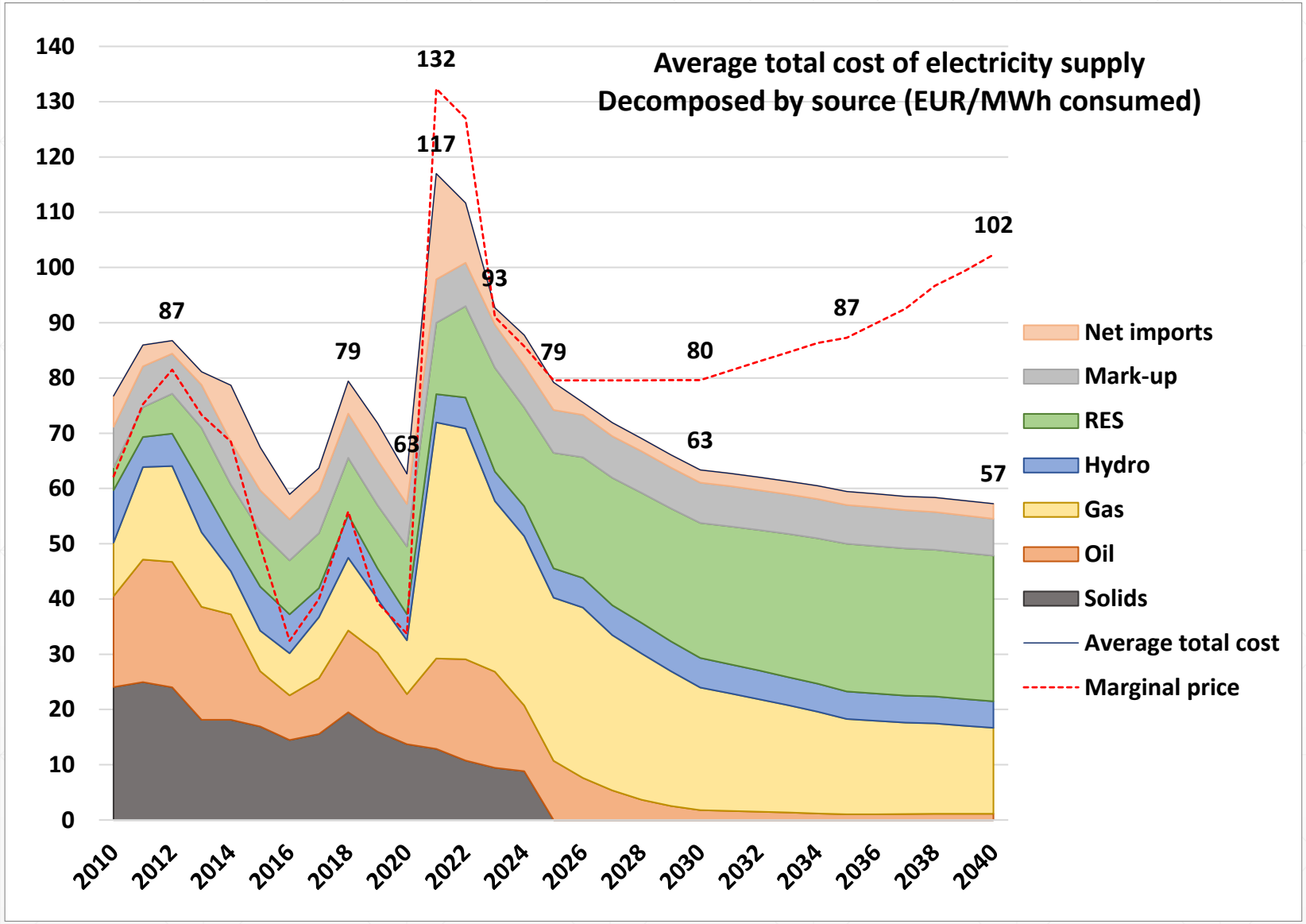






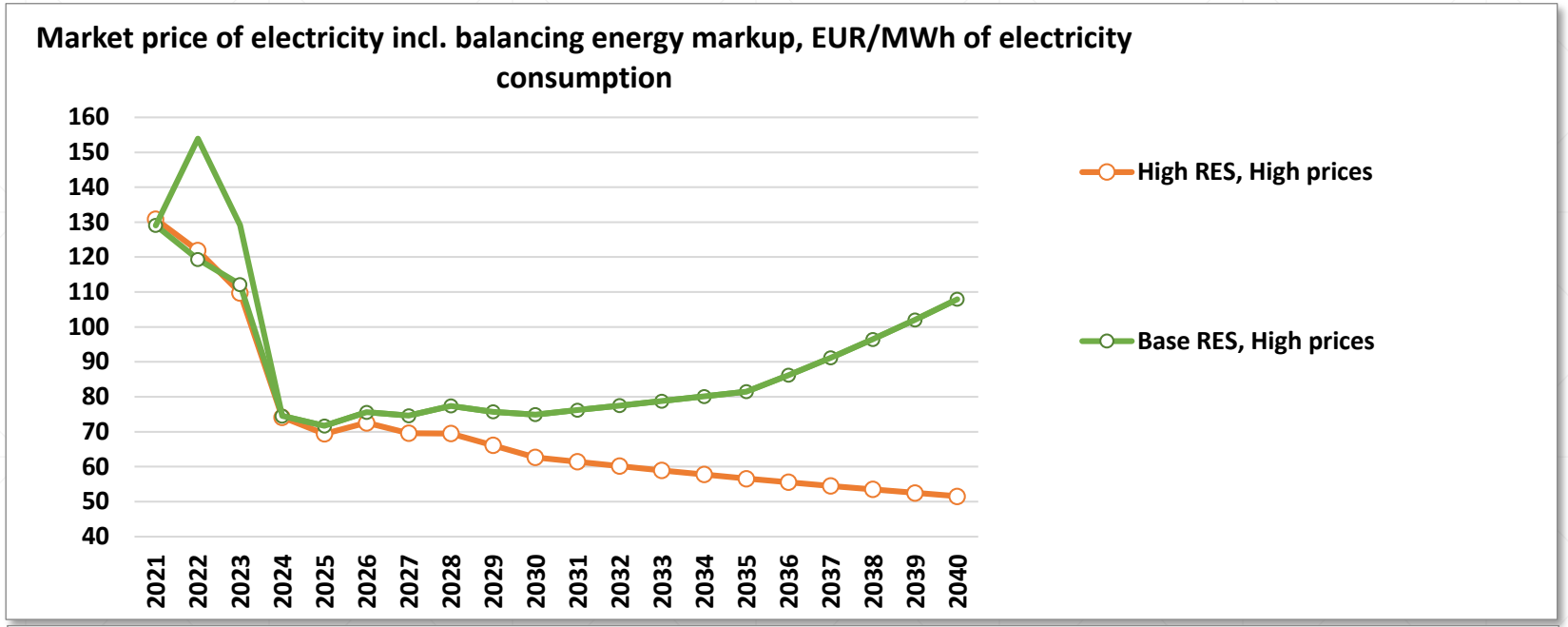
Average vs. Marginal total costs

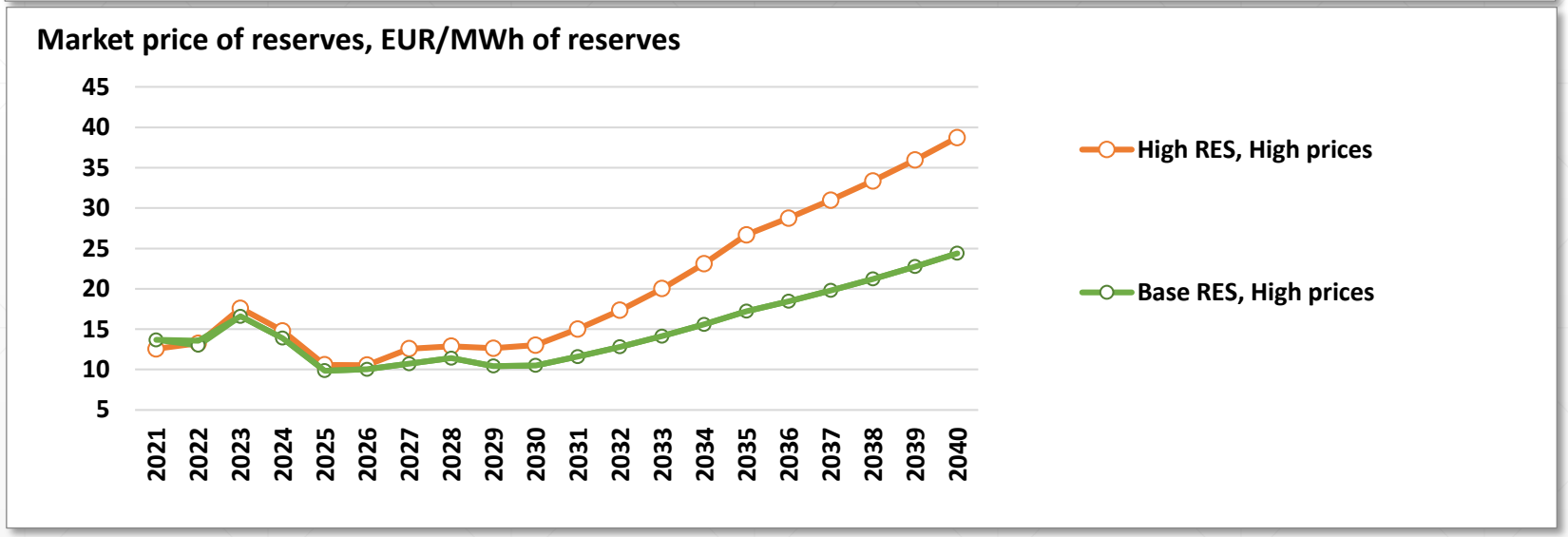
- In a welfare-maximizing market, consumer tariffs exactly recoup the average total costs of the power system
- Average costs reflect the unit cost of each power source weighted by its share in the mix
- This is different from spot market marginal prices
- During the crisis, marginal prices exceed average costs (windfall profits)
- Marginal prices can be lower than average costs in periods of excess capacity (as in the past, when CRM emerged)
- In the RES-dominant system of the future, marginal prices will certainly be higher than average costs
- Therefore, consumer pricing deserves a policy focus



Wholesale market price of Electricity

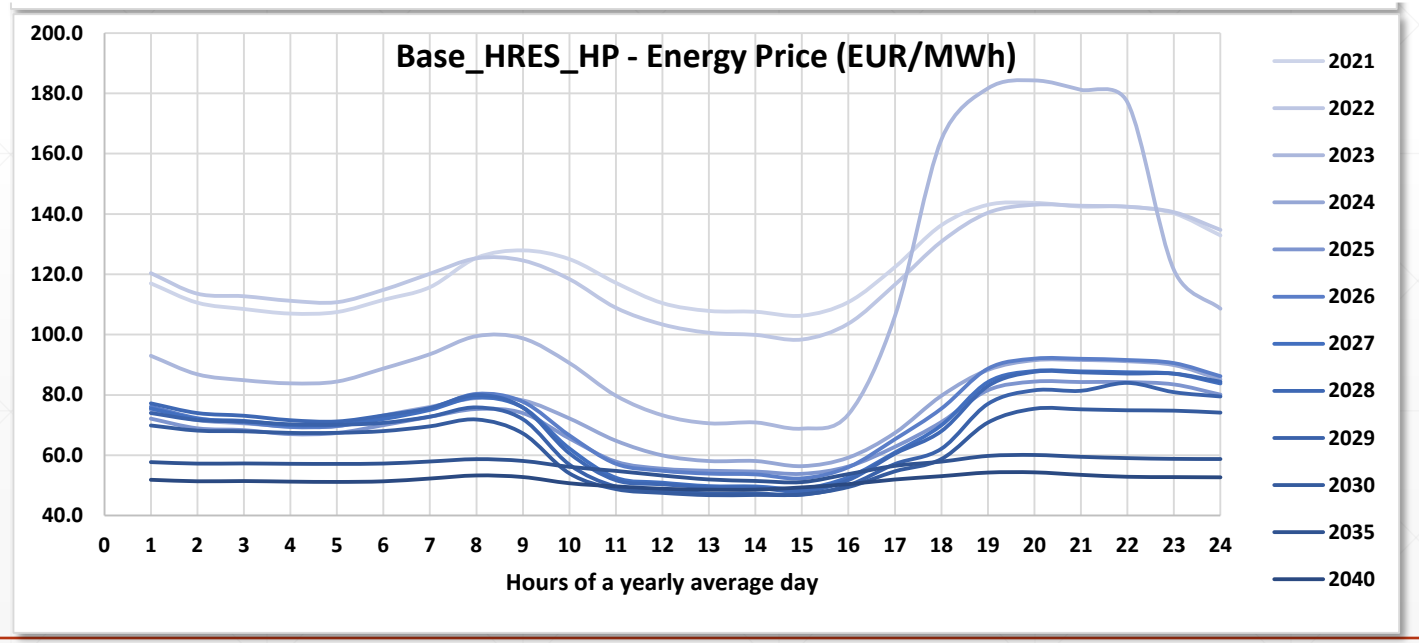
- Includes marginal price of Day-Ahead and Balancing Energy
- Gas is a strong price setter in the short-term
- RES deployment reduces market prices in the medium and long term
- However, high RES drives an increase in market prices in the long term, due to scarcity and cost of balancing
- High-RES also drive reserve prices upwards, much above Base-RES





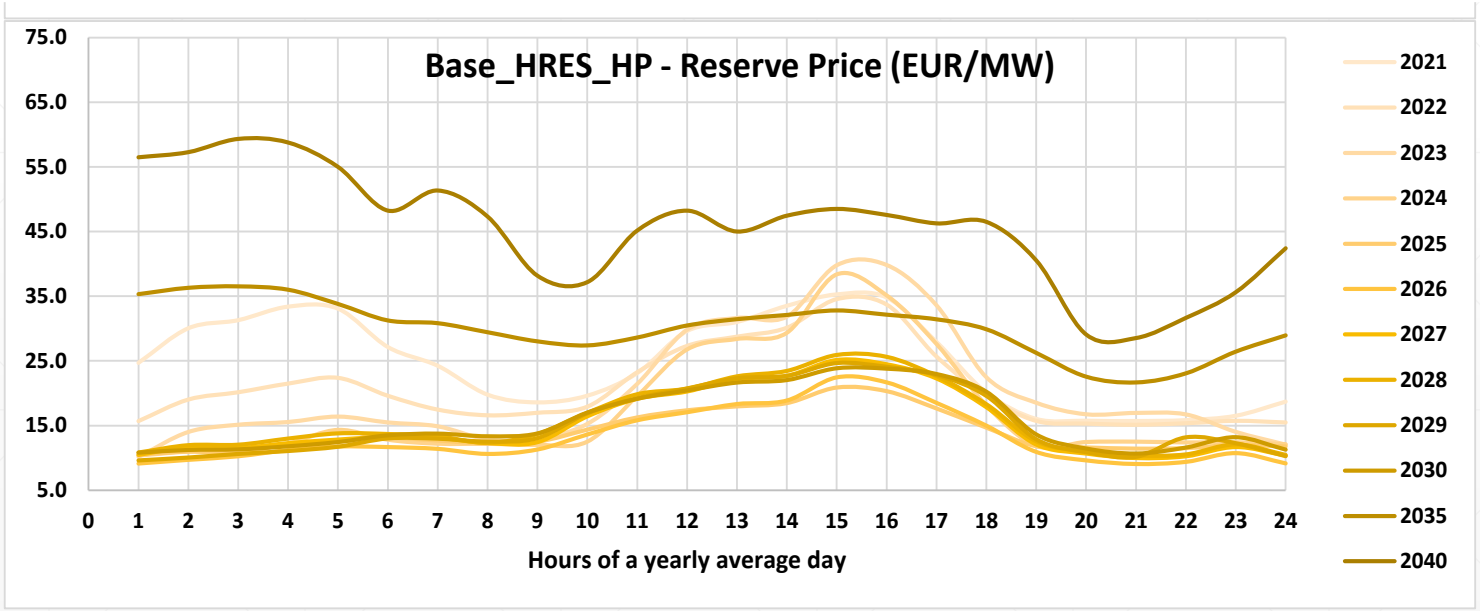
Average daily variation of electricity market prices

- Large price variation (high in the evening, low at noon) in the short term
- In the longer-term, storage smooths out price variability
- Under high-RES, energy prices are smoother and lower, compared to the base-RES cases
- Obviously, the increase in storage implies a reduction of storage's net market revenues



Average daily variation of reserve prices

- The increase in RES drives over time an increase in reserve prices
- High-RES implies much higher reserve prices than Base-RES
- The variability of reserve prices is high in the short-term and reduces significantly in the long-term due to storage
- Down reserve is found to be more expensive than up reserve



RES-PPA (+storage) must be the basis for consumer tariffs

- Why?
  - RES-E share will exceed 60-65% by 2030, according to the NECP (even above under fit-for-55)
  - The levelized cost of energy of RES is the cheapest among all possible sources
  - State supported PPAs for RES are gradually reducing
  - Thus, part of new RES, 8-10 GW until 2030, need private revenue streams (merchant PPAs)
  - Weak credit worthiness of private off-takers increases capital costs of RES investment
  - The consumers wish stable volumes and stable/affordable prices of electricity; cannot continue enjoying low energy prices based on fossils

➢ But, the private RES-PPA market is still immature and illiquid.

➢ Therefore, state intervention is needed to facilitate the matching between RES private financing and the affordable and stable supply of industry and consumers

➔ RES-PPA organised market

The French proposal

Apply a collective contract for economic differences between the nuclear and RES generators and the load serving suppliers during the settlement of the Day Ahead market, with strike prices defined by regulation reflecting LCOEs

The Day-Ahead market does not change (i.e., prices clear at most expensive marginal cost bid, the merit order follows the order of bids, cross-border flows continue to depend on marginal prices)

But when it comes to payments by load serving suppliers (for every hour of the Day-Ahead market), they will have to pay the regulated strike prices and not the marginal market prices

Therefore, load serving suppliers pay less and pass through to consumer prices lower costs; hence consumers see RS benefits directly and immediately.

Market Trading Platform
Multi-Seller/Multi-Buyer facility for RES-PPAs

Sellers	Clearing price per specific tender	Buyers
• Suppliers • Traders • Aggregators • (they represent RES and storage without direct representation of RES project developers)	• Product to trade: specific volume, tenor, time profile, firmness • Tender initiator (any seller or buyer or the market operator) • Price from demand-supply interaction • State guarantee if buyer is energy-intensive industry	• Suppliers • Customers • Energy Intensive industries (quota based on tender initiation by the market operator)

Future market design

- Fundamentals
  - Spot market volatility is a source of uncertainty which cannot sustain capital-intensive investment
  - Suppliers' and customers; utility match together when tariffs reflect cost-reflective prices for supplier while affordable and stable for consumers
  - Therefore, spot markets only to manage short-term deviations and fluctuations, while, the bulk of competition is among forward looking bilateral contracts
- Radical changes – challenges
  - Marginal cost – based supply curves disappear
    - No earnings due to high marginal cost market maker
  - Costs are CAPEX, requiring high cost recovering assurance
  - Stochasticity increases and storage is not economically viable within wholesale markets
- Two contrasting views
  - **State-driven markets**: competition to obtain long-term state guarantees and exclusive rights, competition between pure retailers-arbitragers
  - **Free-market for portfolio-based contracts**: Bundles (portfolios) support firm supply options at stable prices reflecting service subscription

Conclusions about the energy price crisis

- The impacts of the current price crisis are considerable because the market does not protect consumer price stability, via for example forward and bilateral contracts
- The temporary exposure to gas dependence was known in the European Union policy-making; however, the EU policy failed to include price and supply hedging mechanisms
- The stable response to surging gas prices is to accelerate RES and storage – No option to return to coal
- RES and potentially storage are able to form portfolios that ensure low and stable prices to consumers

- Blame the structure of competition not the green transition
- Way forward based on RES-PPAs