SICEM 2022

A Discussion on the Evolution of Electricity Markets in Response to Changing Energy Mix and Soaring Prices

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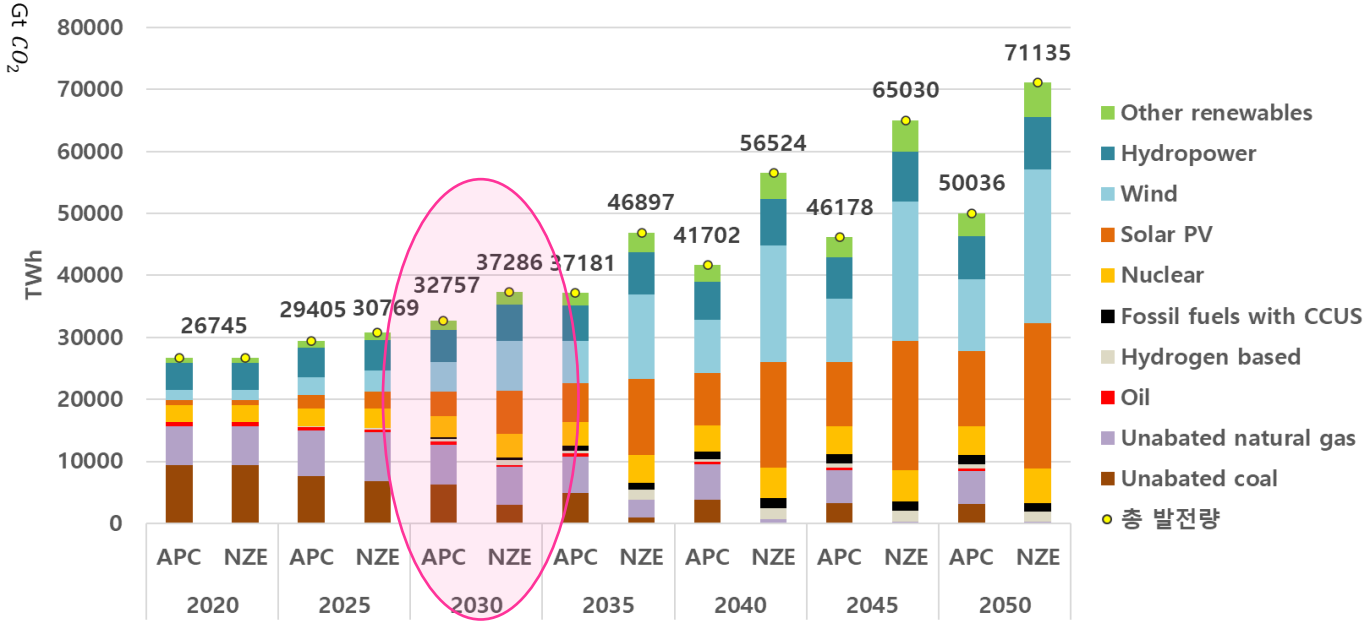
Today's discussion

- Will the current electricity market structure address the following issues?
  - › Long-term challenges : power system dominated by high renewables and nuclear
  - › Near-term challenges : soaring energy prices

- Not limited to Korean electricity market but include a more general discussion

Background: VRE to dominate future electricity markets

- Global temperature increase needs to be limited to 1.5°C above pre-industrial levels
- Emissions need to be reduced by 45% by 2030 and reach net zero by 2050
- According to IEA, in the net zero pathway, the energy sector is based largely on renewable energy
  - › By 2050, almost 90% of electricity generation comes from renewable sources (VER 70%)
  - › By 2030, almost xx% and xx% comes from low emission energy sources in NZE and APC scenarios

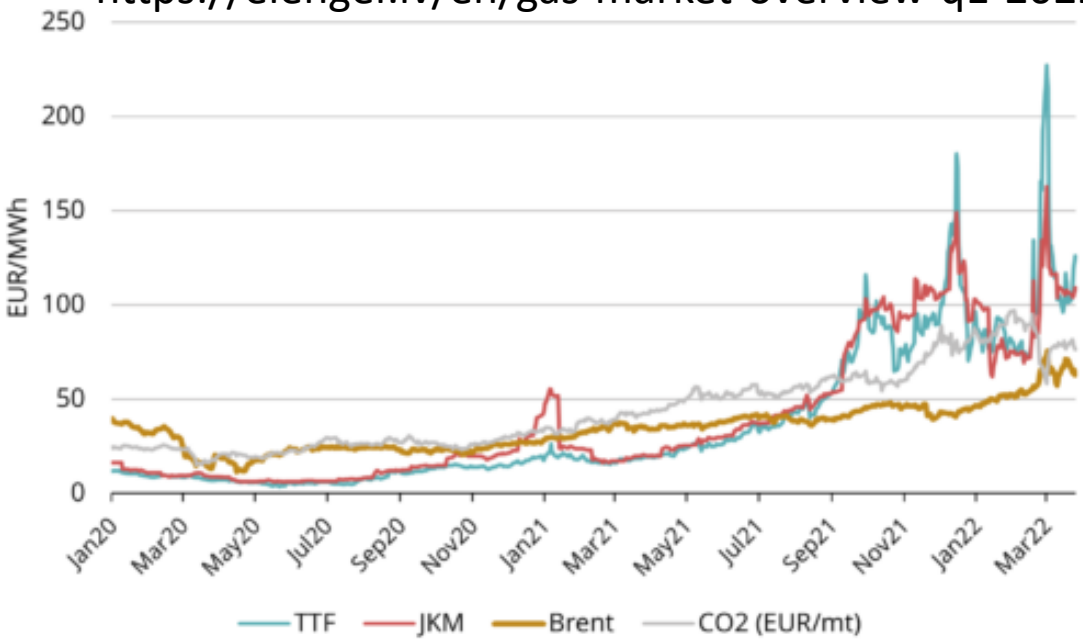


WEO 2021, IEA

Background: risky energy markets

- World energy security concerns
  - › Russian's invasion of Ukraine
  - › High prices, rising costs, economic uncertainty

https://elenger.lv/en/gas-market-overview-q1-2022/



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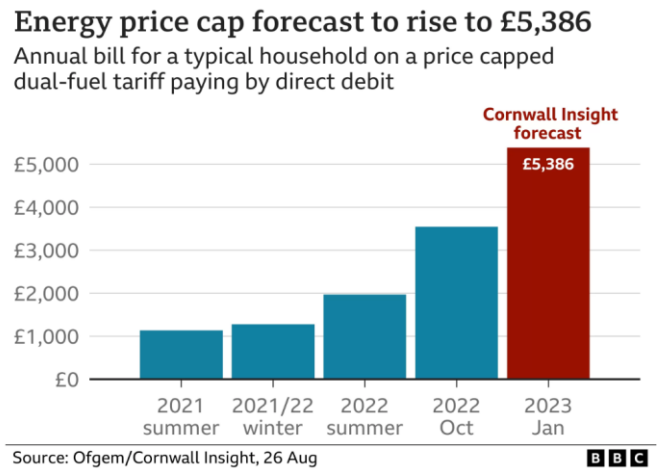
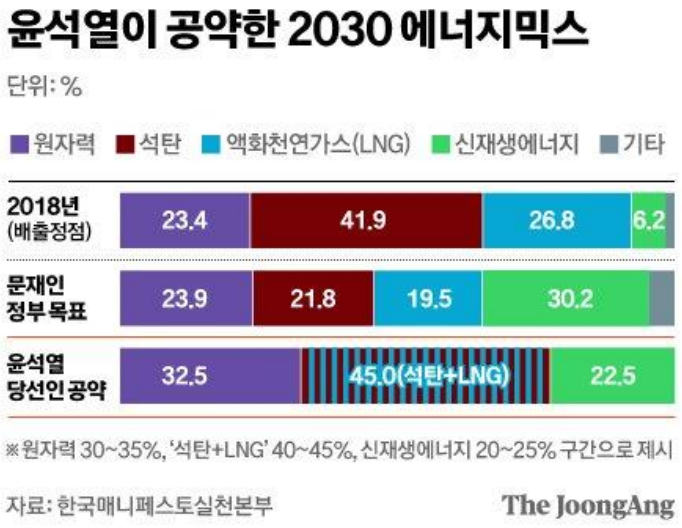
News website of the year

EU must act now on 'catastrophic' energy price spike, says European Council chief

Charles Michel says bloc must address price caps and has been too late in putting 'concrete proposals on the table'

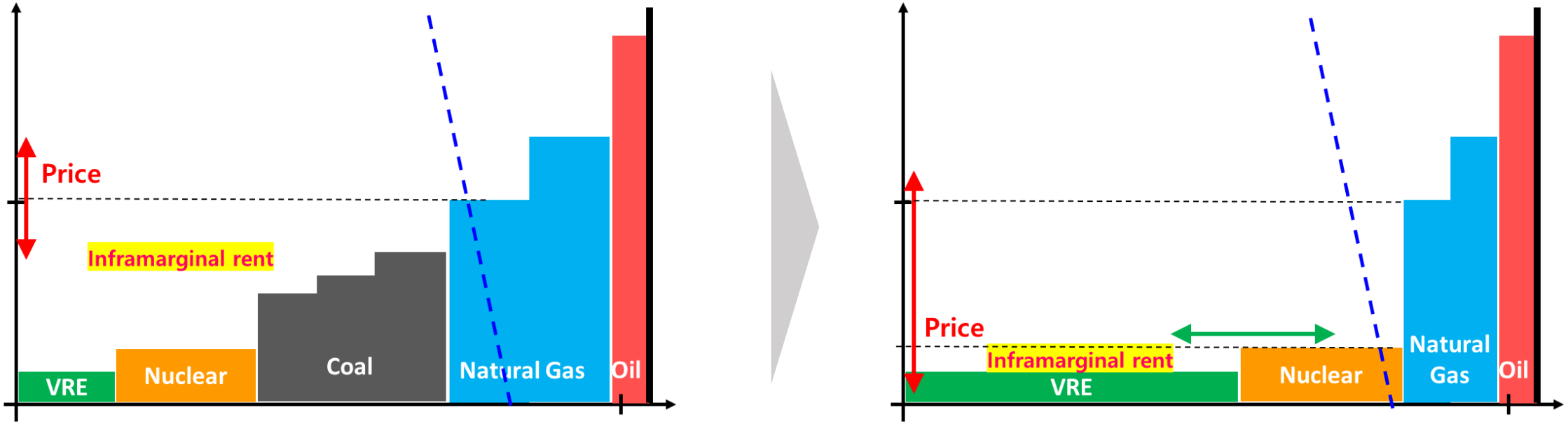




WEO 2021, IEA

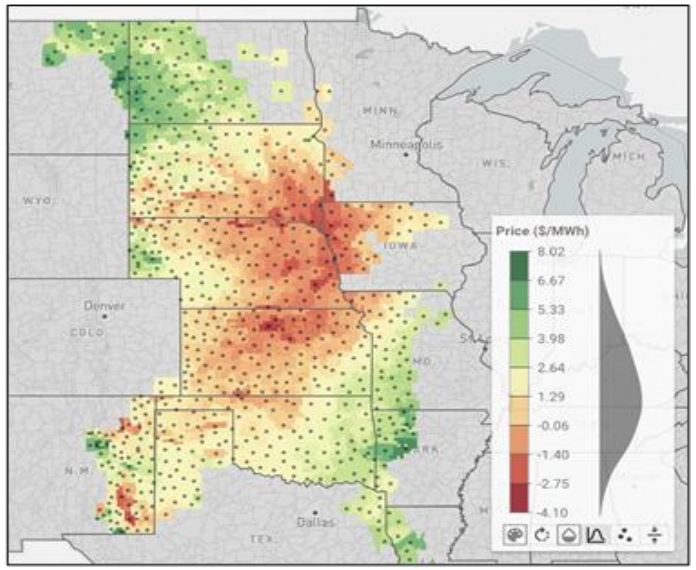
Electricity market dominated by VRE (relevant to the long-term challenge)

- Under the marginal cost pricing and uniform price rule
  - › The merit order effect incurs decrease in average wholesale electricity prices
  - › Fluctuating outputs of VRE causes increase in price volatility



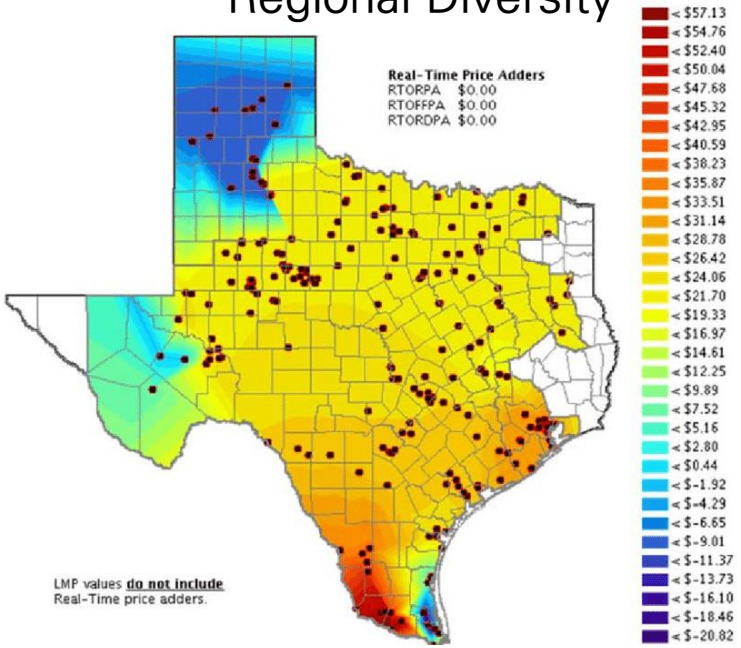
IEA, "Net Zero by 2050: A Roadmap for the Global Energy Sector," 2021. 05

Data shows that market prices are being affected by VRE

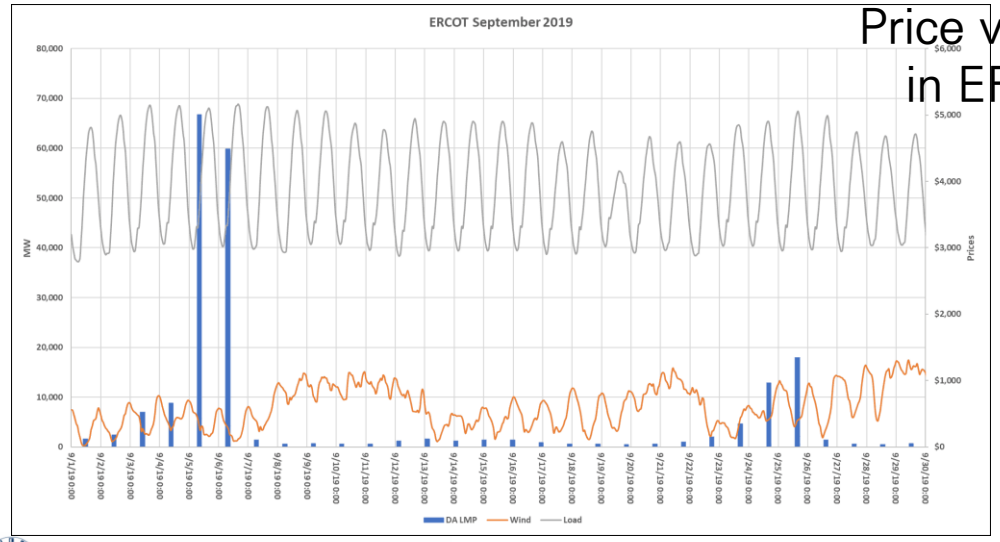


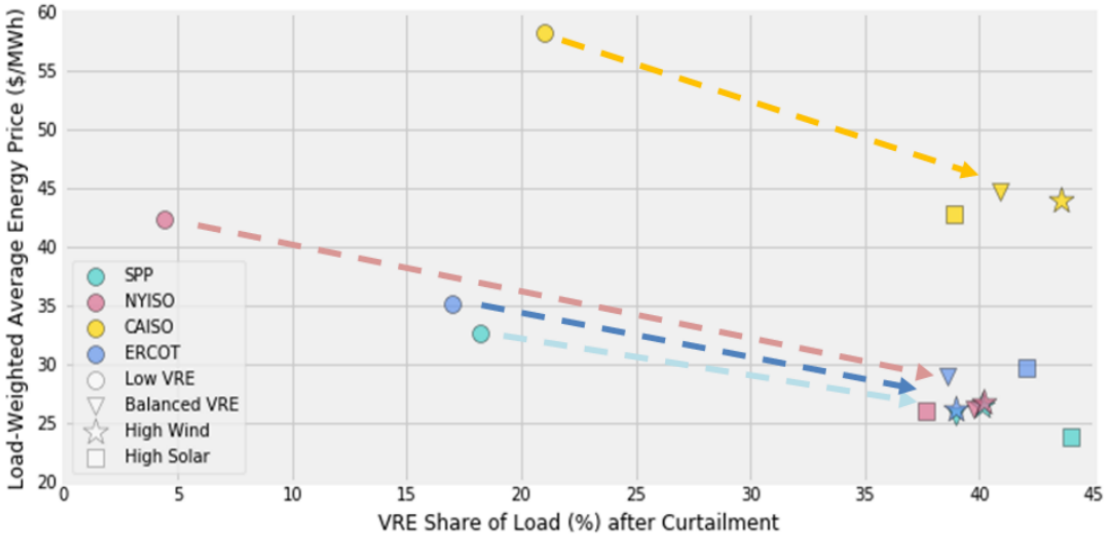
The average real-time value of wind generation at SPP North was worth $1/MWh over the entire month of November 2020

Regional Diversity



Price volatility in ERCOT





[VRE share of load vs average prices by region in the US]

Case study

- Simulation results for the Korean market

Current market structure and high VRE

- Worsening missing money problem
  - › "There is growing world-wide concern over depressed energy prices and need for capacity adequacy…" Charlie Smith, UVIG
  - › This impacts long-term reliability or resource adequacy
    - › This results in premature plant retirements and/or a lack of new resources for capacity and/or flexibility

- Ironically, the more renewable energy increases, the worse the business of gas generators that are needed to provide flexibility

Lesson 1. Under the current MCP rule, energy alone does not sufficiently reflect the value of resource

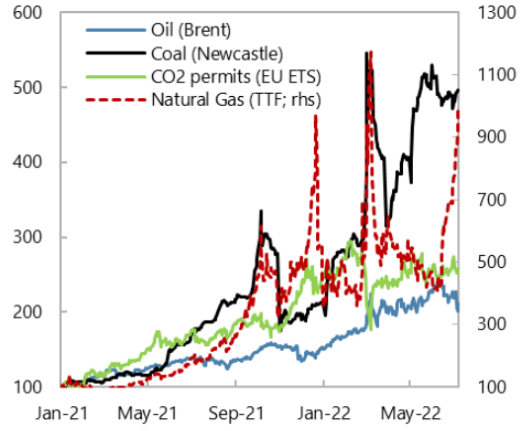
› *Scarcity of resources cannot be appropriately evaluated*

Electricity market change with high energy costs

- Surging energy prices globally in the aftermath of Russian's invasion of Ukraine
- Russia's weaponization of natural gas

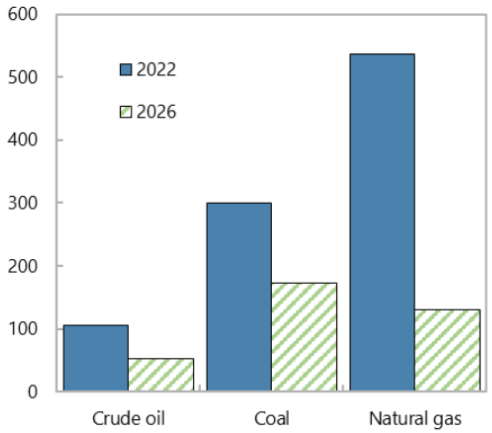
Figure 1. International Fossil Fuel Prices

1-a. Primary Energy Commodity Prices (Index 01/01/2021=100)



Sources: Bloomberg Finance L.P., and IMF staff calculations. Data as of July 7, 2022.

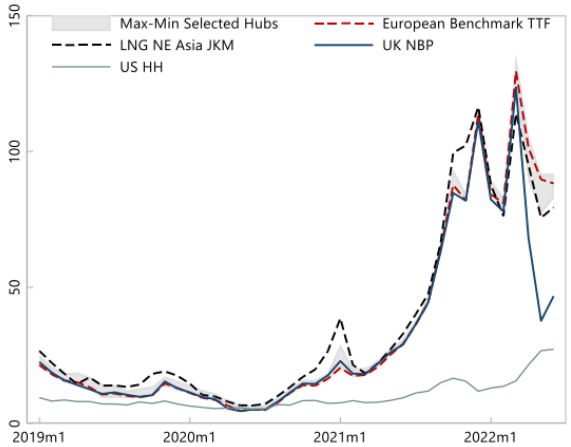
1-b. Difference in Prices Projected for 2022 and 2026 in June 2022 vs. January 2021 (Percent)



Sources: Bloomberg Finance L.P.; and IMF staff calculations.
Notes: Oil prices correspond to the Brent Crude Oil index, coal prices to the simple average of the Newcastle and Richard Bay indexes, and natural gas prices to the Netherlands TTF index. The calculations are based on annual averages of futures prices as of June 20-24, 2022.

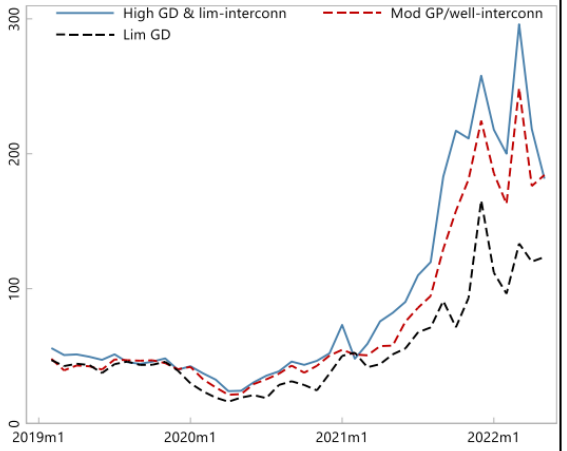
Figure 3. European Wholesale Natural Gas and Electricity Prices

3-a. Wholesale Natural Gas Prices (€ per MWh)



Note: European gas hubs include NLD, DEU, AUT, FRA, POL, ESP, ITA.

3-b. Wholesale Electricity Prices (€ per MWh)



Note: GD=Gas dependency. Country grouping, based on ACER (2021), reflects the degree of gas dependency in electricity generation (high/moderate/limited) and grid interconnectedness (limited/well).

Sources: Bloomberg Finance L.P., European Association for The Cooperation of Transmission System Operators for Electricity (ENTSOE), and IMF staff calculations.

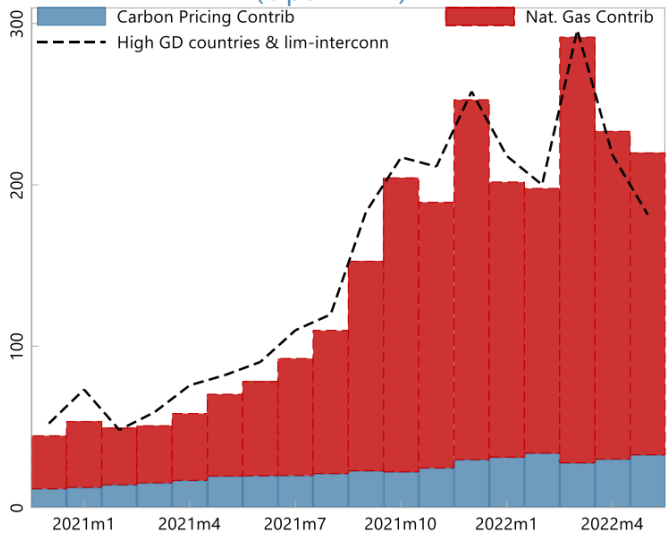
https://www.imf.org/en/Publications/WP/Issues/2022/07/28/Surging-Energy-Prices-in-Europe-in-the-Aftermath-of-the-War-How-to-Support-the-Vulnerable-521457

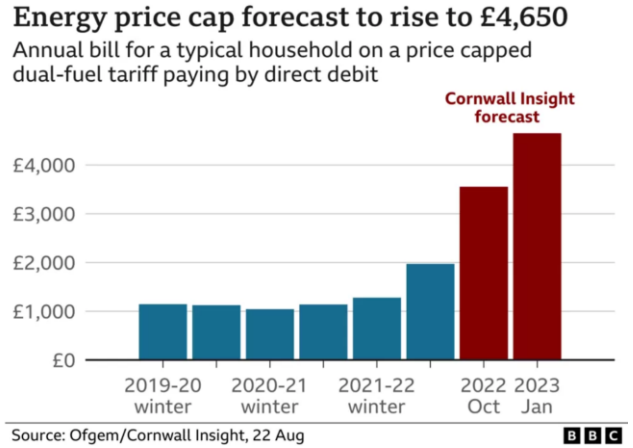
Electricity market change with high energy costs

- European wholesale electricity prices have increased significantly as well
  - › The rise in natural gas prices accounts for about 90% of the increase in wholesale electricity prices since 2021Q1, with higher carbon prices in the EU ETS accounting for about 10%
  - › The reason for the tight relationship between natural gas and electricity prices is that wholesale electricity markets in the EU follow a "marginal" pricing system

Figure 4. Wholesale Electricity Price Decomposition

(€ per MWh)





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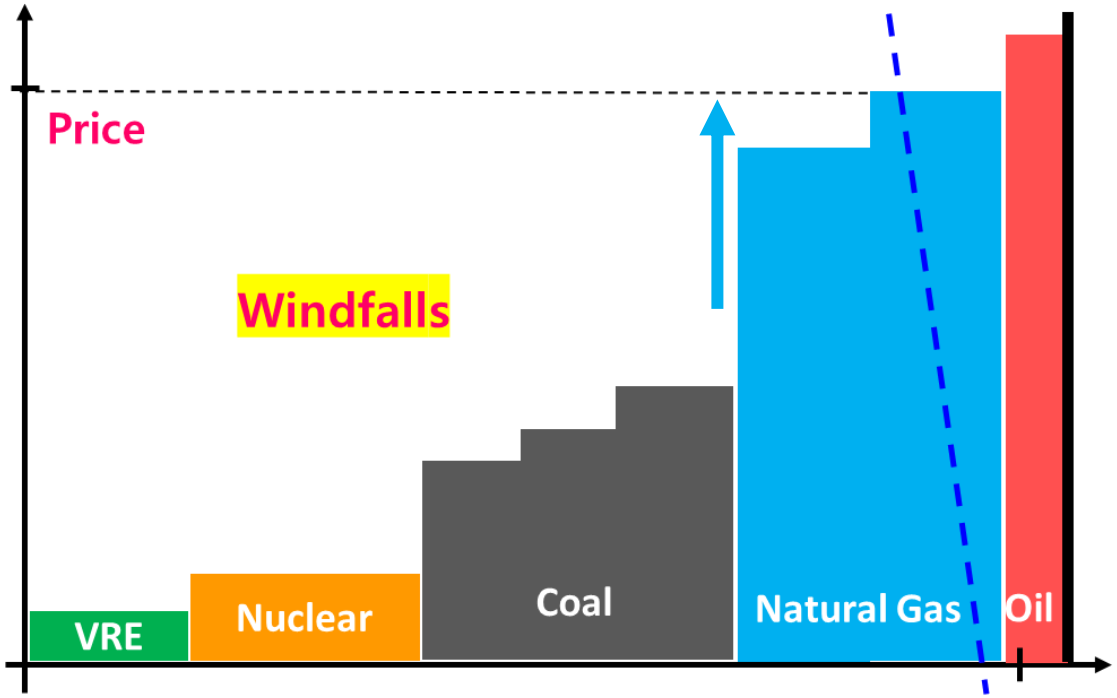
Soaring retail prices and the question of marginal pricing

- Uniform price under marginal
  - › Windfall profit of non-gas generators
  - › Electricity is not a common commodity

- Discussion on other schemes
  - › Pay-as-bid
  - › Windfall tax or payment adjustment factor
  - › Price caps (electricity, gas)



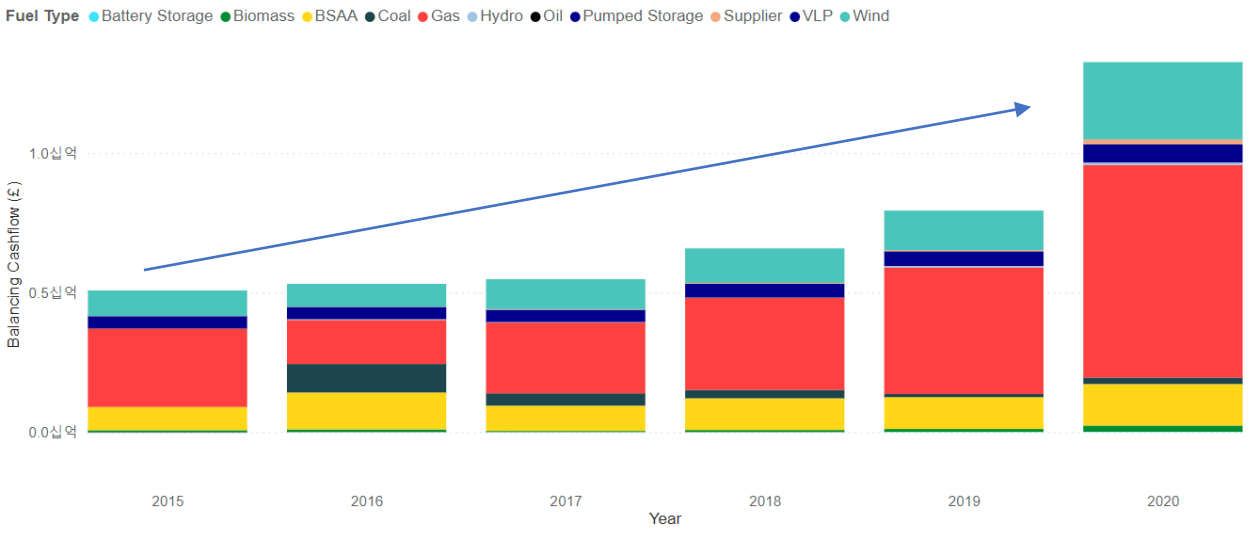
- Not similar to California outage in 2020. We still have a sufficient capacity but suffer from scares fuel

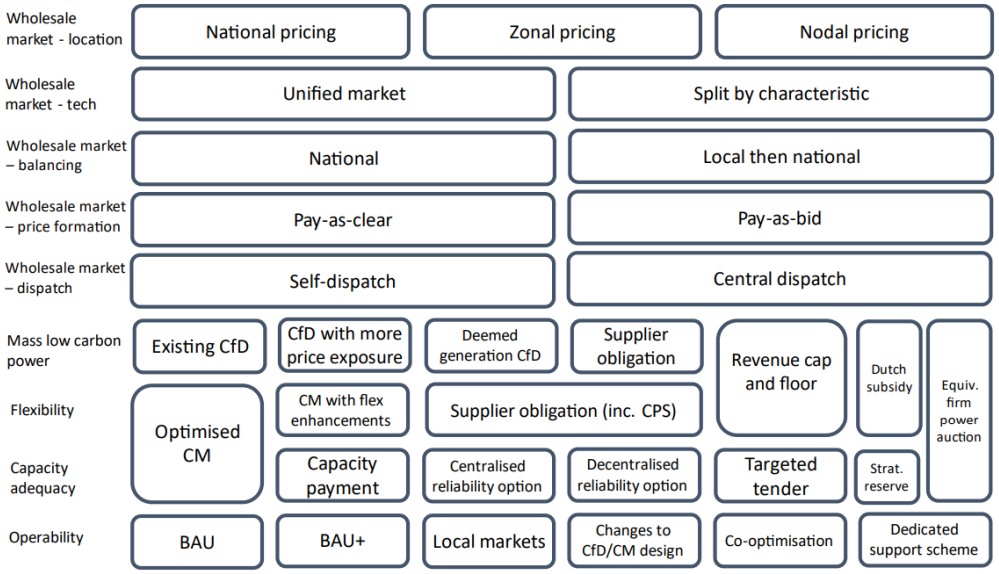
Lesson 2. MCP might not work well during energy crisis

› *Any modification may be needed*

Electricity market structures for the future

- There is no single perfect market design, but various options can be chosen by each region
  - › [US] Centralized dispatch + pay-as-clear + nodal pricing
  - › [UK] Self-dispatch + pay-as-clear + national pricing





- Balancing cost is soaring in UK partially due to its market designs
  - › Congestion increase as RE grows

- Which options do we need to chose for dealing with short- and long-term issues?

ELEXON, ofgem

Advanced market design for the long-term issue

- Market value, energy → ancillary services
  - New products
  - Pricing mechanism
- Improvements in scarcity pricing (ex. ORDC in ERCOT)
- Multi-period dispatch and pricing
- Unit commitment, dispatch and pricing
- Nodal pricing

- William Hogan "in a competitive market operating under principles of open access and non-discrimination, good design begins with the real-time market and works backward."

Temporary modifications may be required

- Energy security, short-term energy crisis
- Since electricity is an essential element of the country, it needs to be differentiated from other commodities
- Therefore, in times of crisis, it is necessary for the government to intervene and take short-term actions
  - › Gas price cap
  - › Spot market price cap
  - › Pay-as-bid or payment adjustment factor
- Allowing bilateral long-term contract for risk hedging is a precondition.

Temporary modifications may be required

- But how do we detect the times of crisis out of normal times?

- Ukraine–Russian war is a crisis? What about COVID–19?

Trading economics

Discussion and Conclusion

- The need for a fundamental change in market design in the current path is questionable
  - the principles of open access and non-discrimination
  - centralized dispatch, uniform pricing

- Of course, the evolution of market design, especially spot market, must continue

- However, in times of crisis, the market mechanism can temporality deviate from the market principle by the intervene of the government

- However, the assessment of the crisis should be objective and relevant actions must be utilized in a limited way

Deloitte insights, 2021

Thank You