



# The incremental price paradox

**APEX 2022**

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# “4D” Megatrends Are Driving Change And Disruption In The Utility Sector



## Decarbonization

more variability requiring full awareness and encouraging exchanges



## Digitalization

enables creation of new transformative energy provisioning business models



## Decentralization

introduces the need for new network operating model



## Democratization

more parties in the energy value proposition and involvement of prosumers

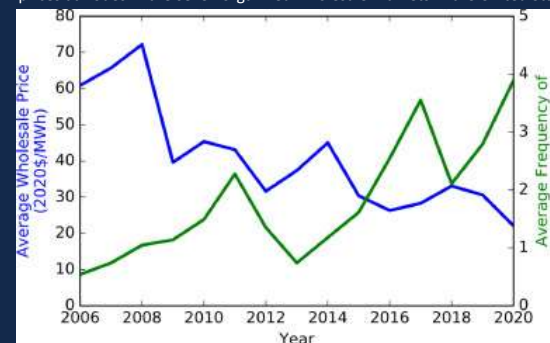


# A 5<sup>th</sup> Demarginalization ? ..

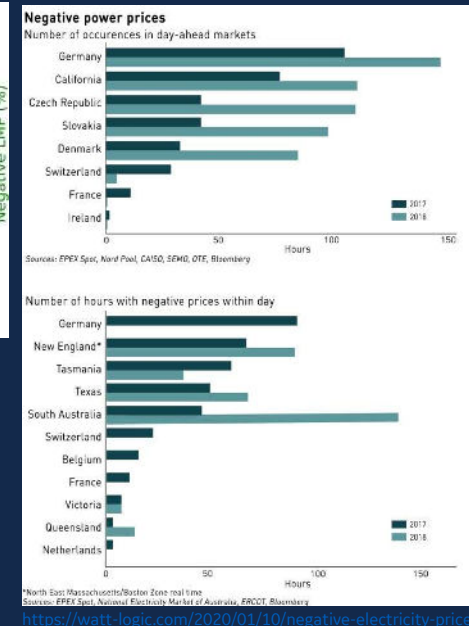
Fundamental questions MISO asks:

- How to run a market when marginal cost for main commodity is lower than average cost?
- If energy is cheap, what other services should resources be paid for?

Average wholesale prices and average frequency of negative locational marginal prices at nodes in the seven organized wholesale markets in the United States.



<https://www.sciencedirect.com/science/article/pii/S2666792421000652#fig0001>



Designing the electricity market of the future – MISO, 2019

<https://www.cmu.edu/ceic/assets/docs/seminar-files/2018-2019/rose---cmu-epp-seminar---2019-june-07-v1.pdf>

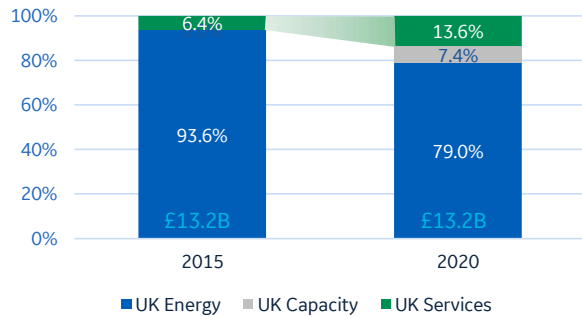


# Energy Markets Are Changing To Satisfy Flexibility Needs



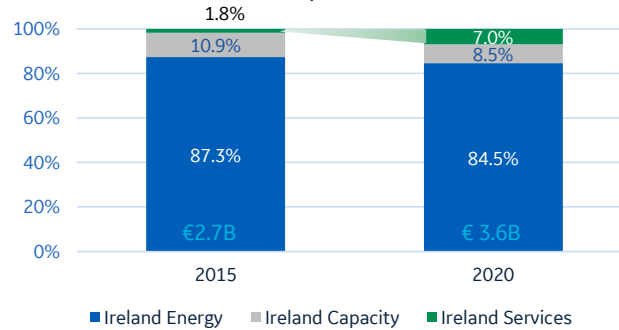
VRE penetration 24% → 43%  
(Variable Renewable Energy)

**UK Electricity Market 2015-2020**



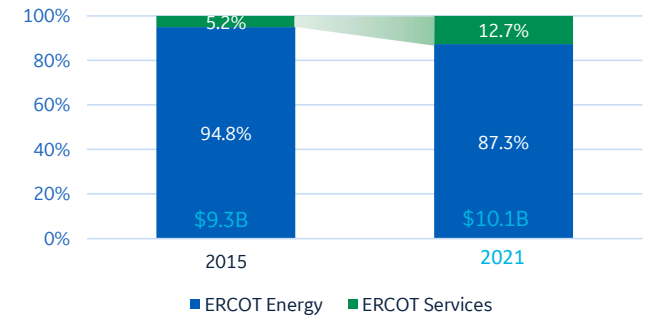
VRE penetration 27% → 42%

**Ireland Electricity Market 2015-2020**



VRE penetration 12% → 25%

**ERCOT Electricity Market 2015-2021**



Reduced energy percentage in the clearing mix



... but at same time, wholesale prices ...

### Prepare For Even More Electricity Price Hikes

October 4, 2022 by [Ronald Drakels](#) - 26 Comments

SHARE NEWSLETTER



It's October and Australia's wholesale electricity price crisis has entered its sixth month. Massive retail electricity price hikes in the eastern states are becoming more likely (from July 2023). These could exceed 10 cents per kilowatt-hour.

This post is a quick update on the current situation, followed by a short warning.

Here's a six-point summary to bring you up-to-date on the current crisis:

1. Putin decided to put an end to the threat of Russia not invading Ukraine by invading Ukraine on February 20th.
2. Because east coast natural gas is sold on the international market, its price soared.
3. Even though Australia only generated 5-6% of its electricity from natural gas last financial year, wholesale electricity prices soared because gas is a 'price setter' in our electricity market.
4. The cost of black coal also increased, but despite supplying 43.8% of Australia's electricity,<sup>1</sup> due to its inelasticity this has had a much smaller effect on wholesale prices than the gas price rise.
5. Behind-the-scenes arm twisting pushed down the price of east coast natural gas from extreme levels at the end of July, but they are still well above normal.
6. The situation should improve as we head into warmer spring weather and solar energy output increases, but the crisis may not end until after the war in Europe ends.

<https://www.solarquotes.com.au/blog/more-electricity-price-hikes/>

### U.S. should pump more oil to avert war-level energy crisis, says JPMorgan's Jamie Dimon

PUBLISHED MON, OCT 10 2022, 7:16 PM EDT | UPDATED 4 HOURS AGO

By [Kareo Gichras](#)  
@KAREOGICHRAS

- KEY POINTS**
- JPMorgan Chase CEO Jamie Dimon told CNBC Monday that the U.S. should forge ahead in pumping more oil and gas to help alleviate the global energy crisis.
  - Likening the situation to a national security risk of war-level proportions, Dimon said Western allies should support the U.S. in sharing up supply.
  - "America needs to play a real leadership role. America is the swing producer, not Saudi Arabia," Dimon told CNBC's Julia Hirschman.

<https://www.cnbc.com/2022/10/11/us-should-pump-more-oil-to-avert-war-level-energy-crisis-jpmorgans-jamie-dimon.html>

### Europe's Energy Crisis Could Last for Years

This winter will be bad, but next year's could be worse.

By [Gordon Smart](#), a deputy editor at Foreign Policy



A burner turns the kinds of gas burner in Düsseldorf, western Germany, on April 4, 2014. (AP/Wide World Photos)

October 10, 2022, 11:10 AM

Europe is facing a generational energy crisis as it heads into winter. A shortfall of 150 billion cubic meters of gas—gas that Russia won't be delivering to Europe this year because of its war in Ukraine—has left Europe scrambling to find alternatives and contain the fallout. Gas prices in Europe are now about eight times the average of the past 10 years—and about eight times more expensive than prices in the United States. Governments are appealing to the public to reduce their gas usage while also trying to ensure consumers and businesses can afford to pay their gas and electricity bills at all—the while preparing for the worst-case scenario, ranging from periodic blackouts to cascades of industrial bankruptcies.

<https://forumpolicy.com/2022/10/10/europe-energy-crisis-russia-ukraine-war-ones-and-twos/>

### Britain's grid warns of winter blackouts if Europe energy crisis escalates

By [Gordon Smart](#)



The power is out in a residential area in London, England, on September 28, 2022. (AP/Wide World Photos)

Britain's electricity operator said it faces real business could face severe blackouts this winter if supplies are too low, preparing for a winter now considered of Europe's energy crisis.

The company described it as "unfathomable" that the lights would go out but still retained the prospect of a "mass extreme scenario" in its winter forecast.

<https://www.washingtonpost.com/world/2022/10/07/uk-energy-blackouts-warning-russia/>

### Energy crisis: how the EU hopes to tackle high power prices while protecting its cross-border electricity market

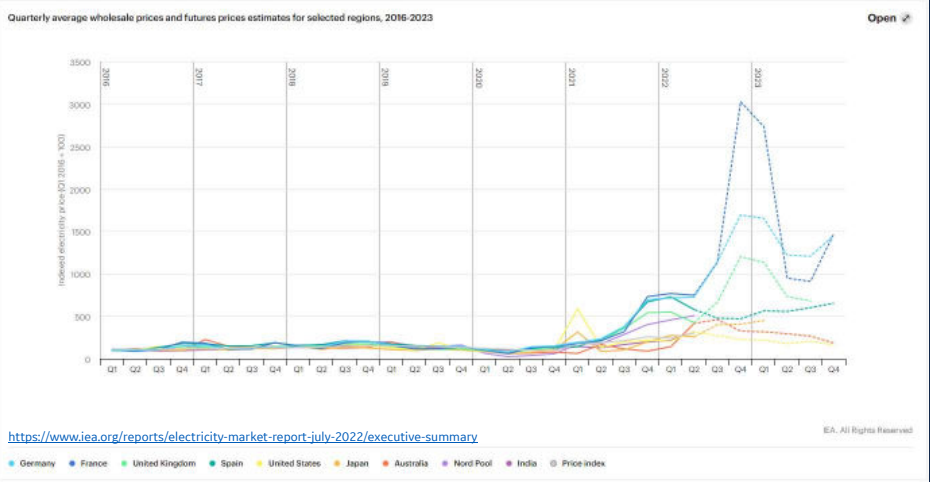
10th October 2022, 10:52:07



Europe is fighting more of its energy from [renewable sources](#) every year but as the current crisis has shown, power markets remain at the mercy of increasingly volatile gas prices. The EU Commission has recently proposed a plan to reduce the risk of escalating electricity and gas prices. But the plan must strike a balance between softening sky-rocketing prices and protecting the cross-border power market the EU has been rolling out across its member states [national states](#).

Key feature of liberalised power market is marginal cost pricing. Gas fired power is often the most expensive source of electricity, and if this kind of plant is required to balance supply and demand it becomes what's called the marginal plant, which reflects its cost to the price in the energy market.

<https://theconversation.com/confidential-2022-general-electric-company-all-rights-reserved-tackle-high-power-prices-while-protecting-its-cross-border-electricity-market-191015>



<https://www.iea.org/reports/electricity-market-report-july-2022/executive-summary>

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APEX 2022, October 20<sup>th</sup>, Dubrovnik

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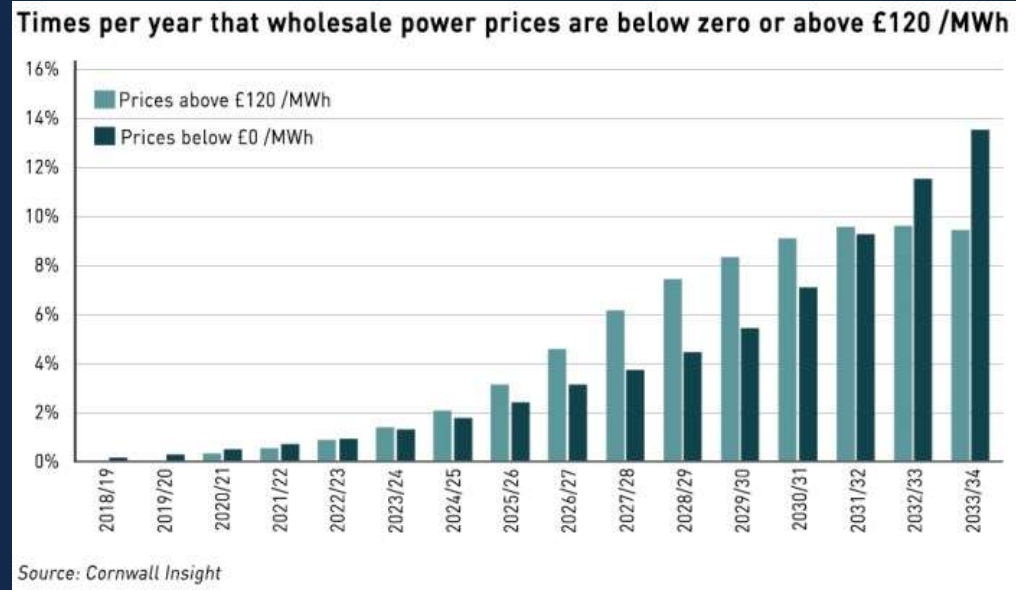
# Is Electricity cheap or expensive ?

Raising some open questions:

- Cap on prices?
- Separate fuel-based markets?
- Co-optimize Energy and Ancillary services?
- Redesign?
- ...

**Will price volatility increase over time?**

Analysis by Cornwall Insight in the UK





**Existing Markets**

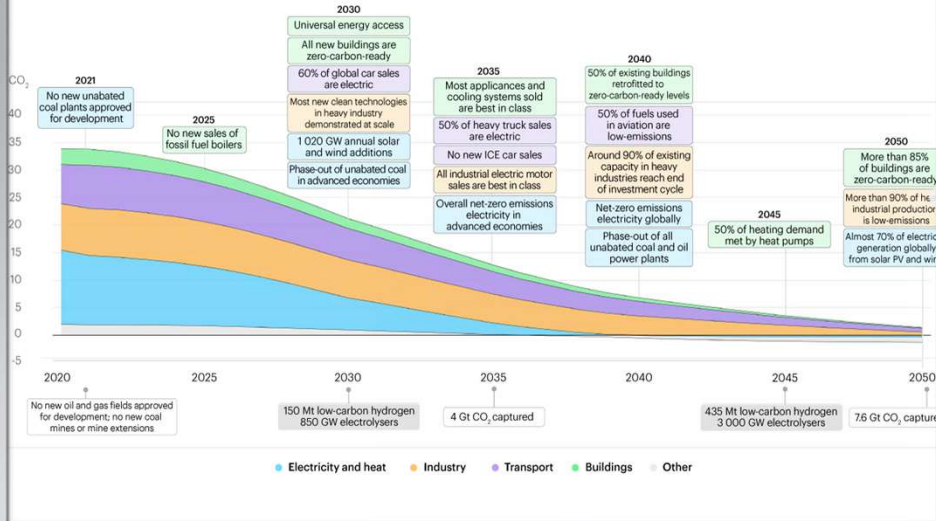
**Today**

**Next Gen Carbon Free Markets**

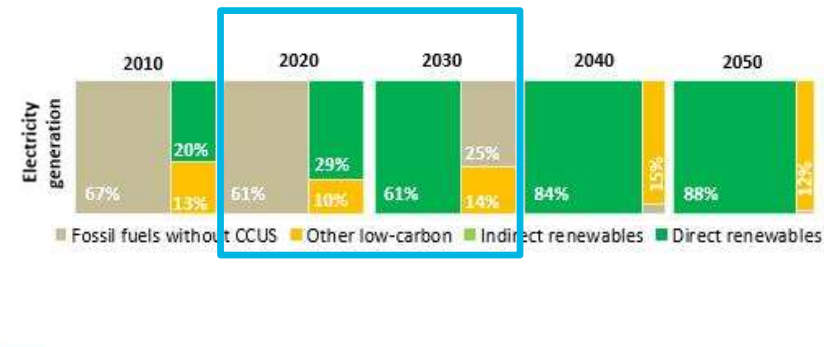


# IEA Net zero by 2050 <https://www.iea.org/reports/net-zero-by-2050> – May 2021)

## Twin transformation



Doing more in 10 years than what we ever have done



**88%** **2050** **70%**

of Electricity produced from renewable energy from Variable Renewable Energy (VRE)

Renewable penetration combined with Electrification of sectors to drive emission reduction



# New Services are being created!

## Observations:

- UK, Spain, France, Italy and US already have ancillary services markets >\$1B
- Global market is expected to more than double over the next 5 years

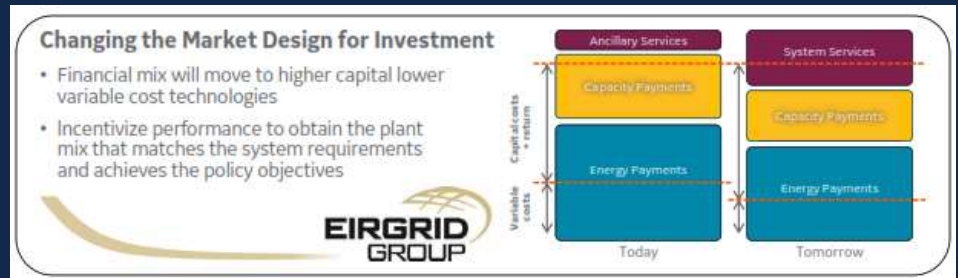
## With new products

- Fast frequency response, Ramping products, flexibility, inertia, restoration, reactive P...

Are these services enough?

National Grid ESO claims world first approach to inertia, awarding £328m in contracts

<https://agileenergy.net/national-grid-eso-claims-world-first-approach-to-inertia-awarding-328m-in-contracts/>



A Wood Mackenzie Business news research squared events

**gtm:** Solar Grid Edge Storage Wind Podcasts White Papers Webinars

## Electric Trucks Provide Frequency Regulation in ERCOT

<https://www.greentechmedia.com/articles/read/Electric-Trucks-Provide-Frequency-Regulation-in-ERCOT>



# Effective Inertia

Area  
Effective  
Inertia

The **Inertia Challenges**

**Measuring** Effective Area-Inertia  
with WAMS

**Forecasting** area-inertia by  
machine learning



Inertia Measurement and Forecast

## Effective Inertia as a valuable service

- Enable higher penetration of low inertia renewable generation.
- Reduce curtailment fees and penalties.
- Lower frequency response services.
- Increase network resilience; minimize risk of system separation.



# Grid Forming

TODAY

## Grid Following

- Locks to the voltage waveform
- Acts like an AC **current source**
- Regulates power slowly to meet device needs

TOMORROW

## Grid Forming Base

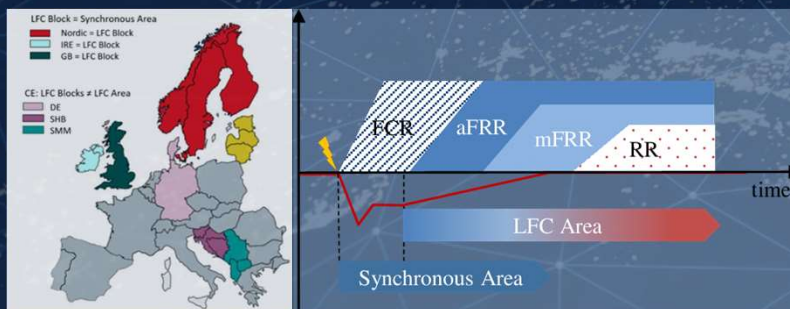
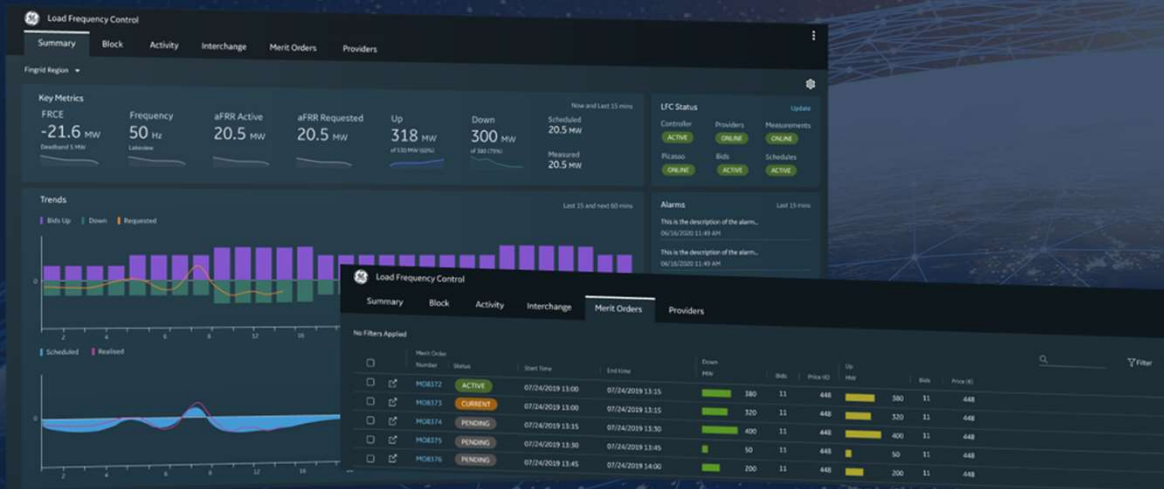
- Control SW only modifications
- Acts as an AC **voltage source**
- Fast provision of power & current to help stabilize the grid
- Can potentially be retrofitted

## Grid Forming +

- Add Energy Storage
- Acts as an AC **voltage source**
- Fast provision of power & current to help stabilize the grid
- Additional fault support capability
- Can expand to Islanding & Black Start



# Load Frequency Control



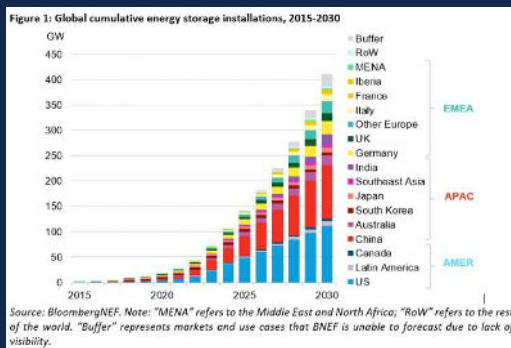
## ENTSO-E EBGL driving the regional harmonization and optimization in reserves activation

- Interchange schedules processing
- Realtime multi-sources measurements ingestion
- **Regional optimization in aFRR signal calculation (AOF/PICASSO)**
- **Market bids processing for BSPs activation - Merit Order List based**
- Open loop (study) or closed loop, configurable periodicity & time cycles (e.g. 1-4sec)
- Modular, IEC CIM based, state of the art UI/UX, cybersecure, HA, interoperable



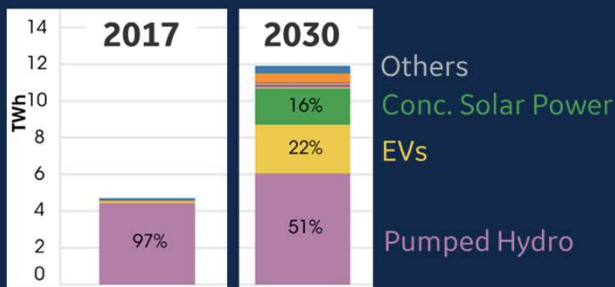
# Storage

## CAPACITY



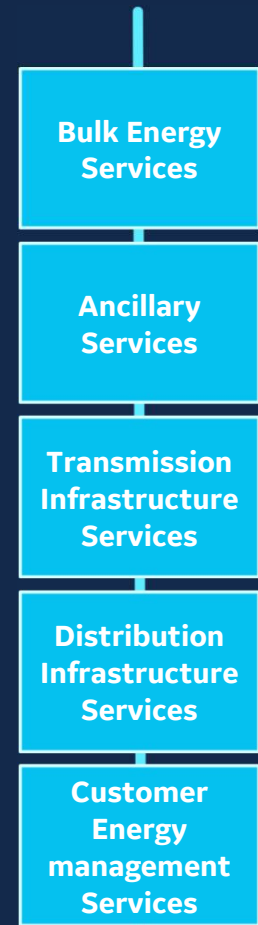
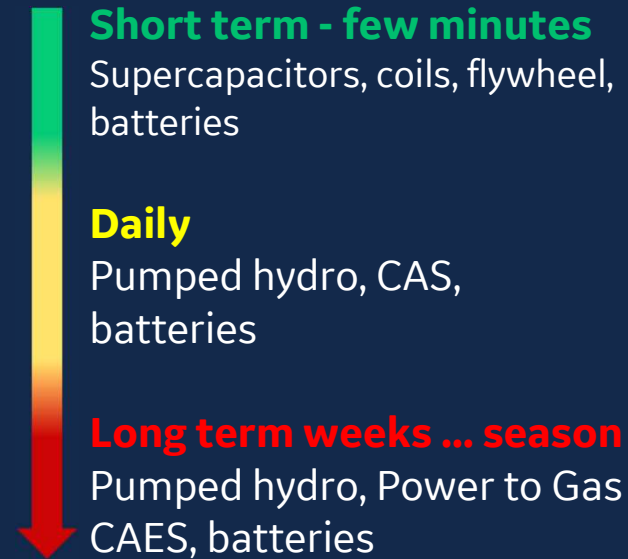
BloombergNEF (Oct. 2022) :  
Global Energy Storage Market to  
Grow 15-Fold by 2030

BNEF's definition of energy storage excludes pumped hydro  
storage.



# GRID SERVICES

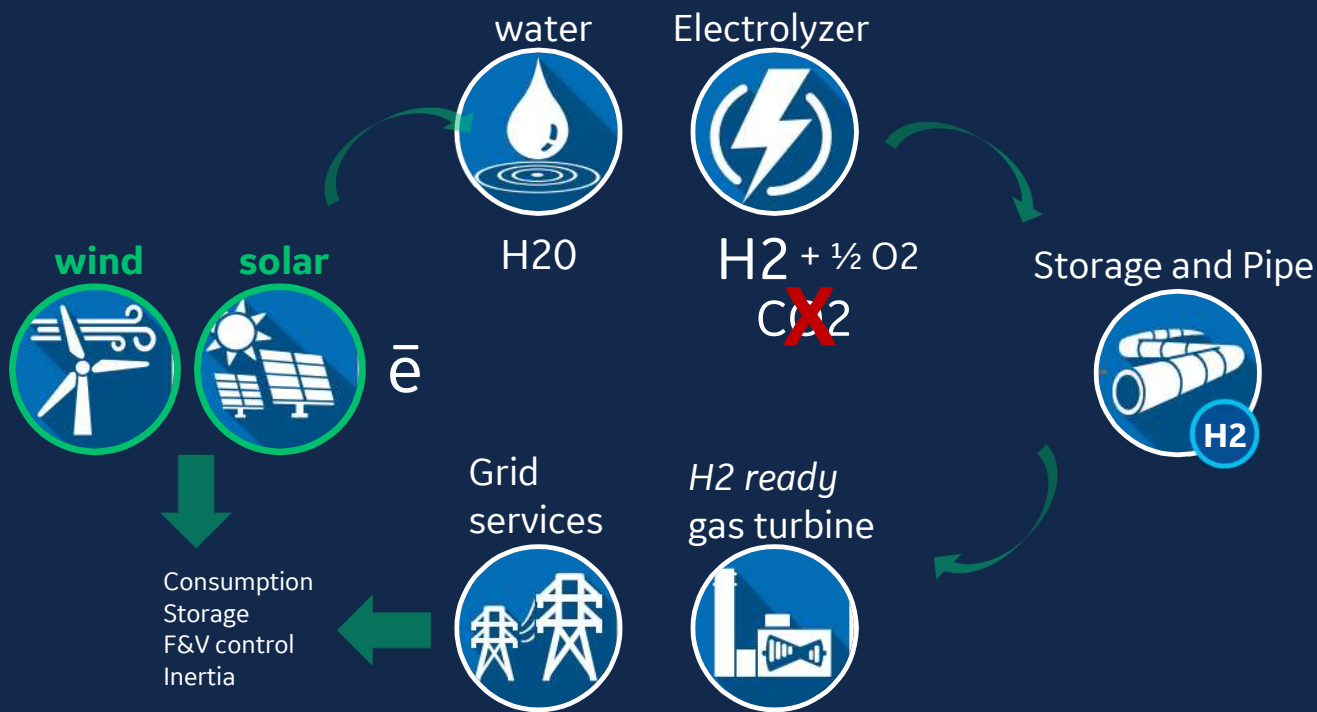
## STORAGE APPLICATIONS



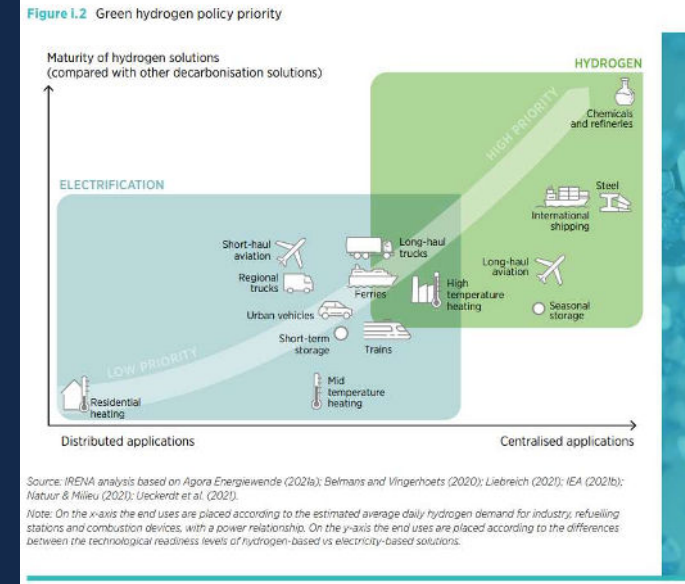
# Power to Gas – Circular energy

## Why curtailing VRE sources while you use gas at the same time?

Curtailment: 2% of total VRE (av 2018)



[https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Mar/IRENA\\_Green\\_Hydrogen\\_Industry\\_2022.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Mar/IRENA_Green_Hydrogen_Industry_2022.pdf)



The total hydrogen production is expected to **expand by almost five times**, to 614 MtH<sub>2</sub>/year, to satisfy 12% of the final energy demand by 2050 in a 1.5°C scenario.

This is driven by growth in the industrial and transport sectors, where hydrogen mitigates close to 12% and 26% of the CO<sub>2</sub> emissions, respectively (IRENA, 2022a)



# A geographical paradox ?

**More Regional coordination**



**More Local consideration**



[https://www.entsoe.eu/network\\_codes/bzr/](https://www.entsoe.eu/network_codes/bzr/)





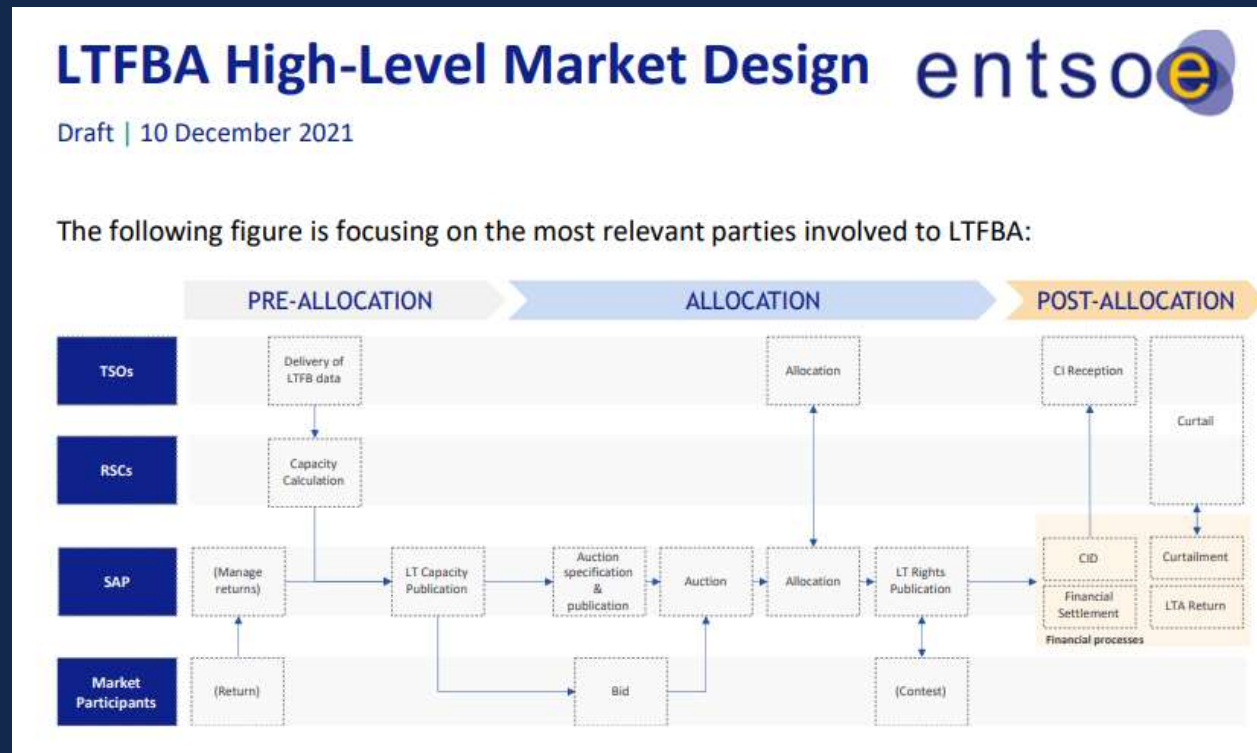
# Extending **Flow Based** methodology to Long Term Allocation

Important milestones are passed:

- ✓ March 2022, The Nordic TSOs and the Nordic RSC jointly decided to start the external parallel run (EPR) of the Nordic flow-based methodology – [news](#)
- ✓ June 2022, Day-Ahead Flow-Based Market Coupling project is **live in the Core CCR** – [press](#)

*And as a next step,*

Core and Nordic CCRs to implement **LTFA** with JAO by the end of 2024 – [JAO.eu/news](#)

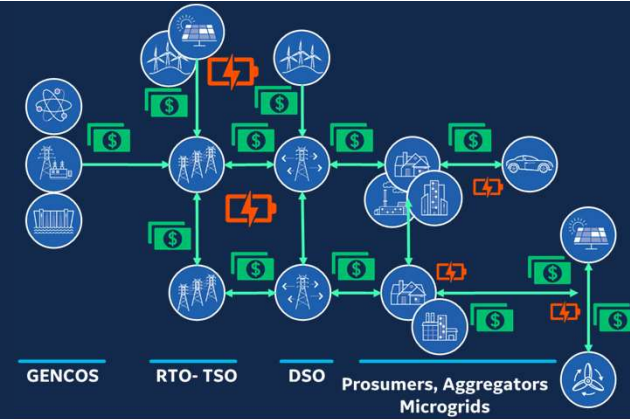


[https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20FCA/publications/220330\\_ALL\\_TSOs\\_TOP\\_3.5.1\\_b\\_LTFBA\\_High\\_Level\\_Market\\_Design\\_Document.pdf](https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20FCA/publications/220330_ALL_TSOs_TOP_3.5.1_b_LTFBA_High_Level_Market_Design_Document.pdf)



# Value emerging all along the Chain

## Flexibility



Together, we offer a suite of natively interoperable software solutions purpose built for Transmission, Distribution, and **Market Operators** to plan, manage, optimize and **trade renewables and DERs** across the energy network.



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### Sample Partners



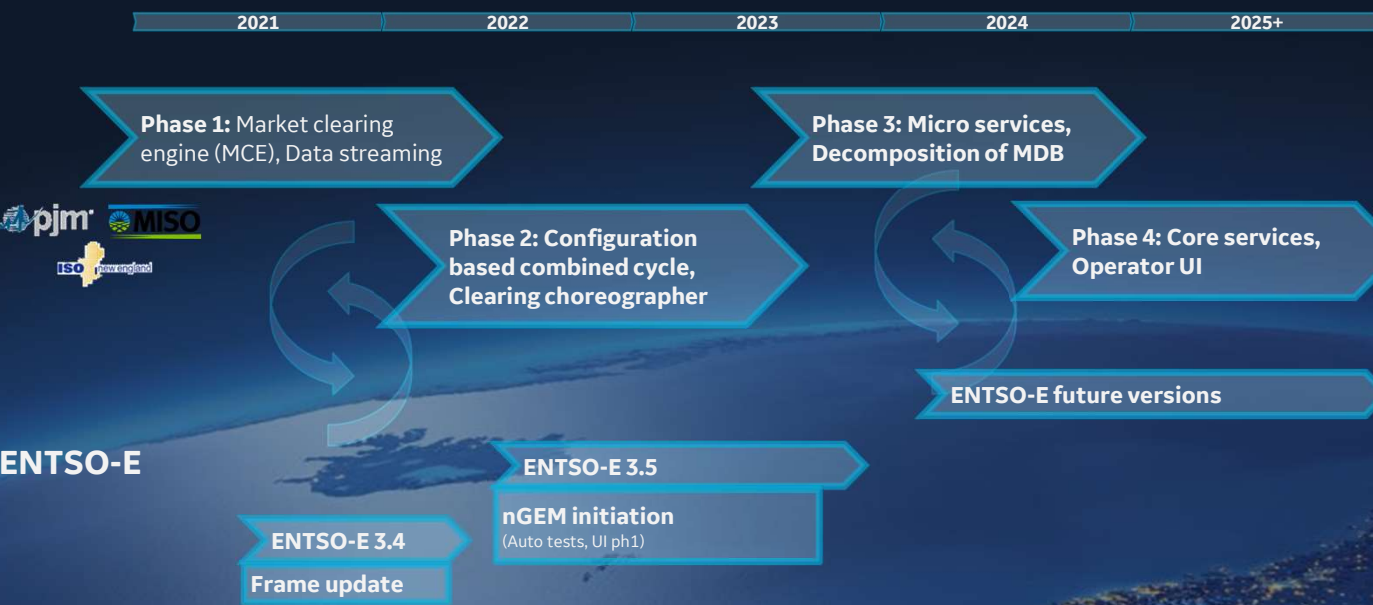
### Challenges

- Flexibility markets are increasingly important and economic in the management of congestion, especially at LV.
- However, current approaches to zonal flexibility markets through contracts may not identify the most efficient and effective use of DERs, and lock aggregators out of other markets where constraints are not expected.
- GE and Opus One support day-ahead optimisation of flexibility markets, down to the lowest visible voltage level.



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# Learning together to overpass a common **Challenge**



## The opportunity to leverage several region's experience

- **Locational price** in North America
- **Renewable** penetration in Europe

## And be growingly flexible

- Composability
- Modularity
- Scalability
- Deployable at the point of impact.. Cloud.. Prem.. Edge



# How Energy Market Success Will Look Like?

Fair Energy prices

Green energy

Flexibility rewarded

Consumers

100% of Capacity rewarded

Flexibility and Capacity Rewarded

Minimum Renewable Energy Lost

Minimum Deviation from scheduled power balance traded

Maximum of lines capacities used



Business 100% participants

Business Flexibility

Fair Market with liquidity

Multiple Energy Exchange Relations

Interoperability with all Nodes

Security: Zero Failure

**Grid:** quality of supply, no blackout

**Privacy:** Respect privacy sensitive data

**Cyber:** Strong protection, no intrusion



Thank you



# Wrap-up & Q&A

Jean-Marc Moulin [VP, Product Management, GE Digital](#)





GE Digital