Gas + RES Integration: Enhancing Energy Security Resilience and Accelerating Decarbonization

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Trends for Variable Renewable Energy (VRE)

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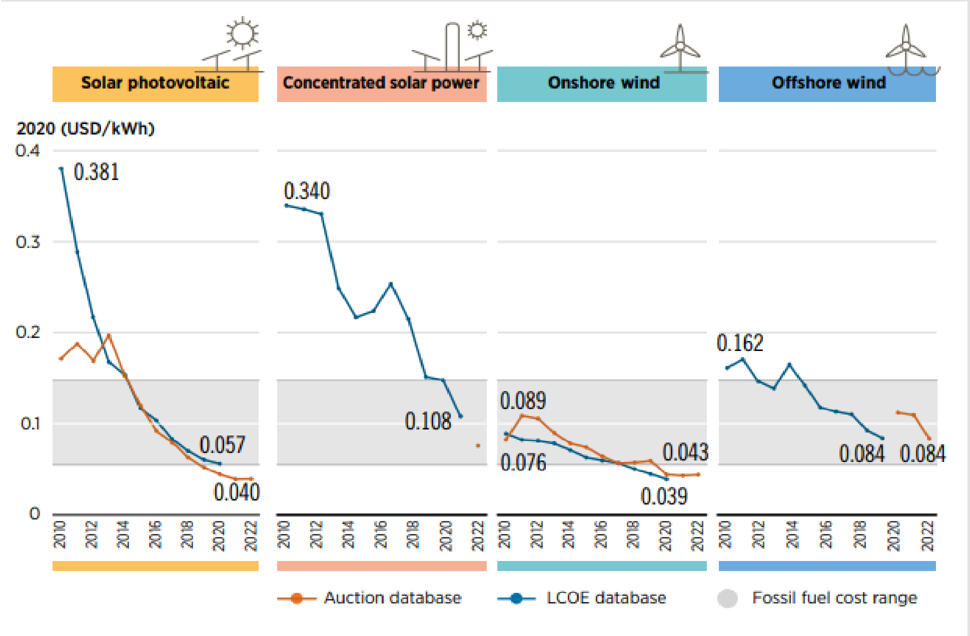
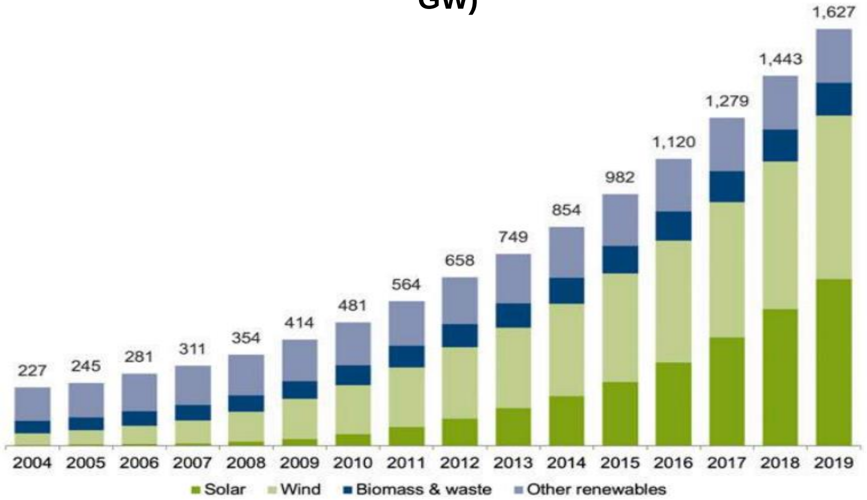
- Strong political commitments
- Decreasing costs
- Cheaper than marginal costs of existing coal-fired capacity
- Increasing installed capacity



Global weighted average LCOE from utility-scale renewable power generation technologies (2010 and 2023);

Source: IRENA World Energy Transitions Outlook 2022

GLOBAL CAPACITY IN RENEWABLE POWER (2004-2019, GW)



Source: UNEP

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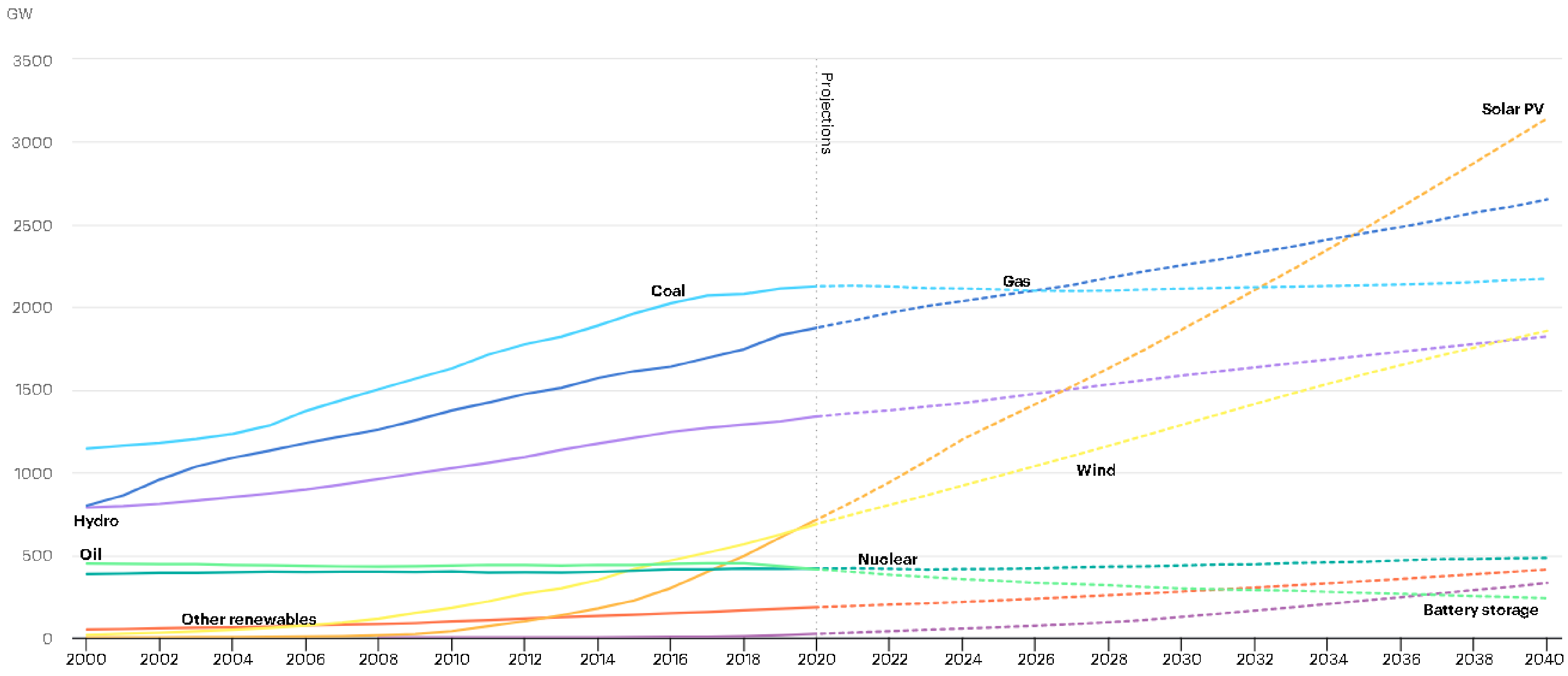
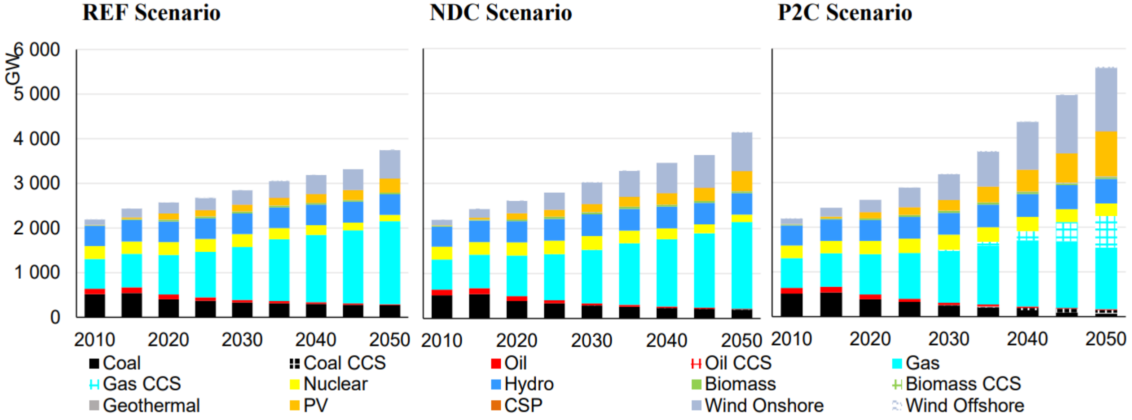
Installed Power Generation Capacity by Source in the New Policies Scenario (2000-2040)



Source: IEA WEO 2019

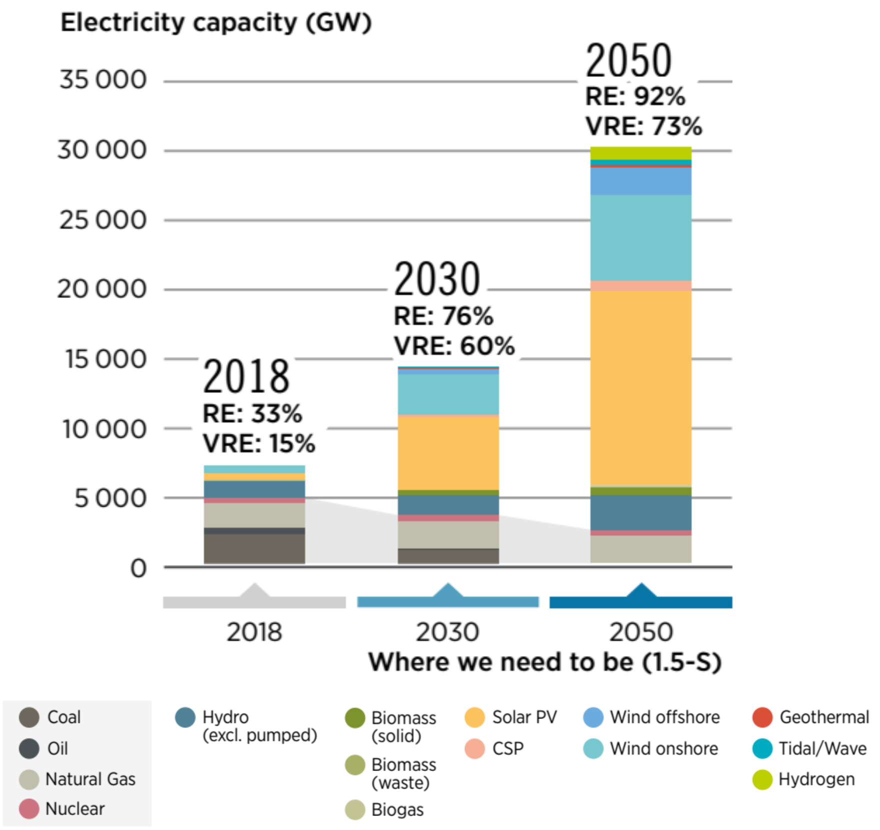
Trends for Variable Renewable Energy (VRE)

Electricity Generation Capacity in the UNECE Region by Policy Scenario



Source: UNECE – Pathways to Sustainable Energy, 2020

Global Electricity - Total Installed Capacity



Source: IRENA – World Energy Transitions Outlook 2022

Integration of VRE into the Energy System

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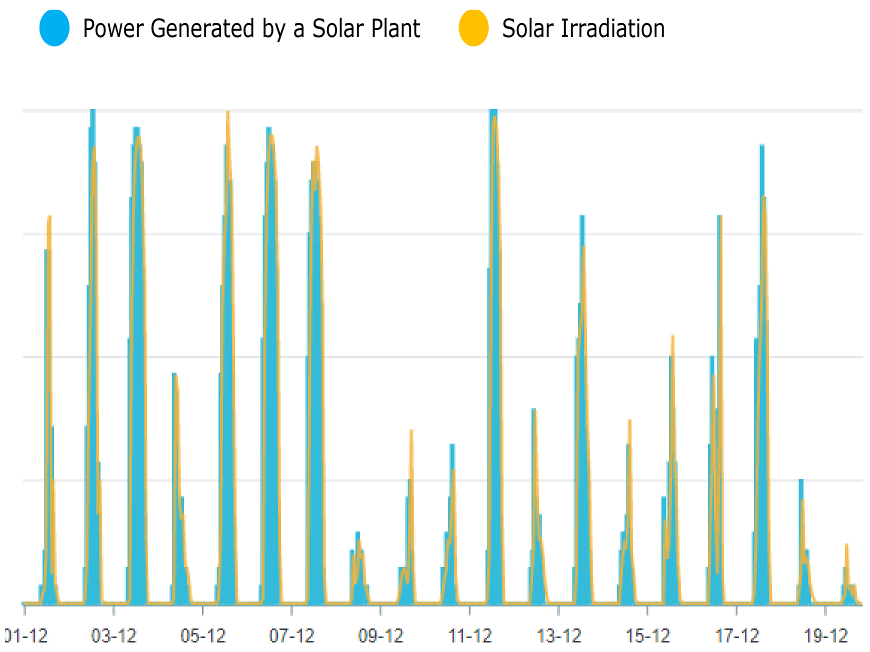
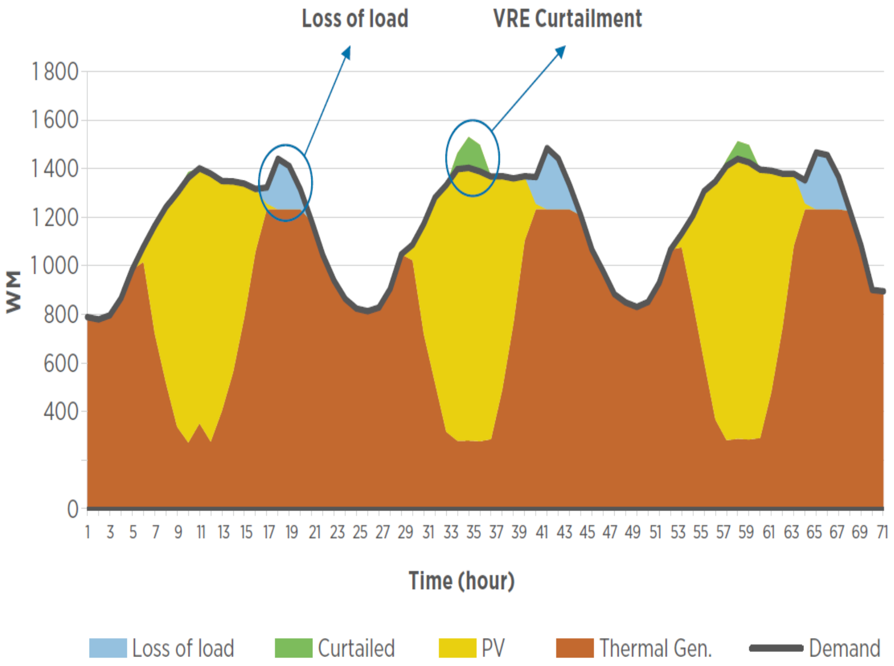


Variability of a typical solar power plant in Spain during different days of a given month (December)



Example of energy system with high PV penetration

Source: Sample - Actual Case – Small Solar Operator in Spain

Source: IRENA

Integration of VRE into the Energy System

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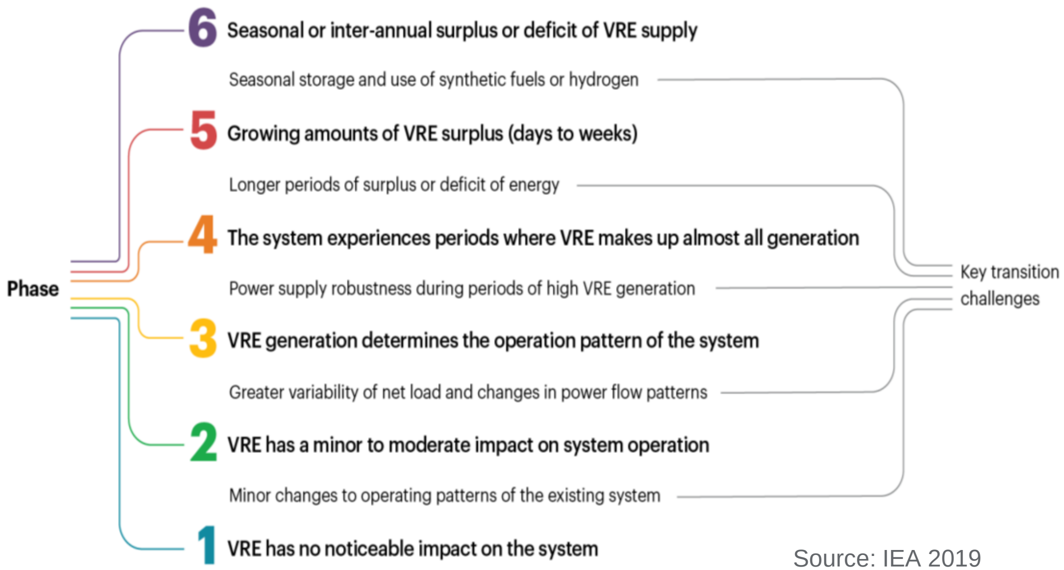
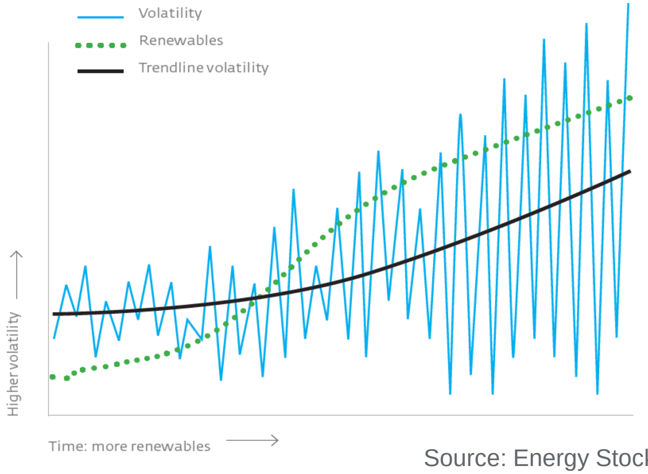
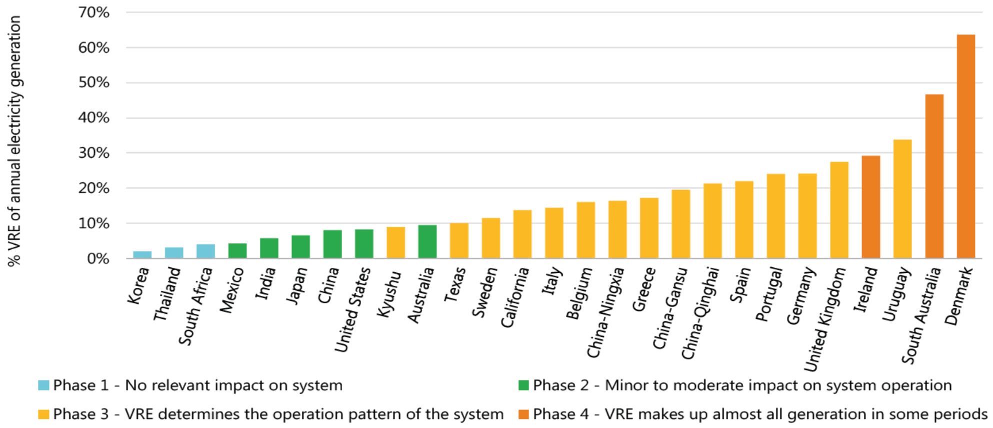


Source: IEA 2019



Source: Energy Stock



Source: IEA 2019

Image: Pixabay - adege

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Options to Integrate VRE

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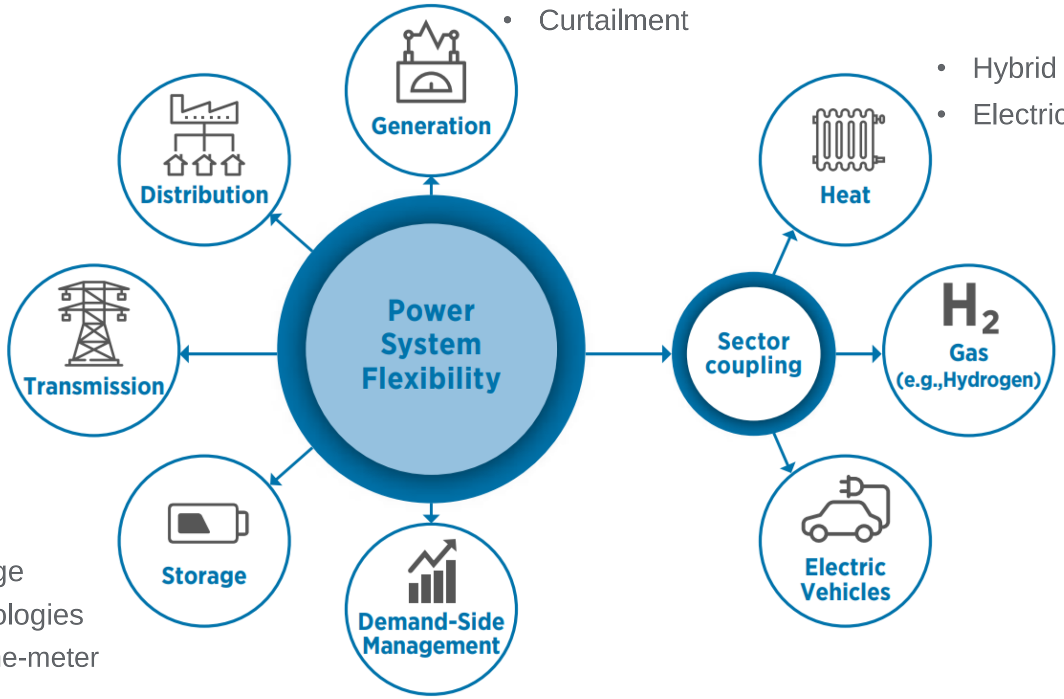
- Flexible generation (local and centralised)
- Advanced VRE forecasting
- Curtailment

- Hybrid heat pumps
- Electric water heaters

- Interconnections
- Supergrids
- Regional Markets



- Transport (HDV, ,)
- Thermal power
- E-fuels
- Feedstock

- Pumped Hydro Storage
- Other Storage Technologies
- Utility-scale / behind-the-meter battery solutions

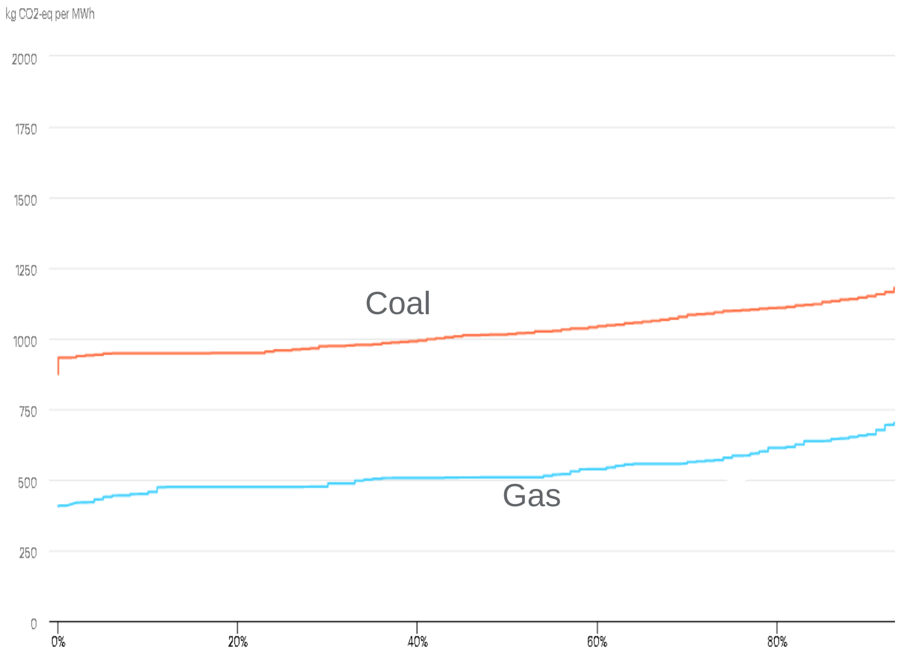
- Demand-Side Management
- Aggregating Distributed Energy Reosources (DER)
- Renewable mini-grids services to the main grid
- Optimisation of energy networks with DER

Source: IRENA and others

Options to Integrate VRE

Property	Open cycle gas turbines (OCGT)	Combined cycle gas turbines (CCGT)	Hard coal-fired power plant	Lignite-fired power plant
Most commonly used power plants				
Minimum load (% P_{Nom})	40-50 %	40-50 %	25-40 %[a]	50-60 %
Average ramp rate (% P_{Nom} per min)	8-12 %	2-4 %	1.5-40 %	1-2 %
Hot start-up time (min) or (h)	5-11 min[b]	60-90 min	2.5-3 h	4-6 h
Cold start-up time (min) or (h)	5-11 min[c]	3-4 h	5-10 h	8-10 h
State-of-the-art power plants				
Minimum load (% P_{Nom})	20-50 %	30-40 % (20 % with SC[d])	25[e]-40 %[f]	35[g]-50 %
Average ramp rate (% P_{Nom} per min)	10-15 %	4-8 %	3-6 %	2-6[h] %
Hot start-up time (min) or (h)	5-10 min[i]	30-40 min	80 min-2.5 h	1.25[j]-4h
Cold start-up time (min) or (h)	5-10 min[i]	2-3 h	3-6 h	5[k]-8 h

Comparison of technical characteristics between coal-fired and gas-fired power generation technologies



Full lifecycle emissions intensity of global coal and gas supply for power generation, 2018

Source: IRENA

Source: IEA Methane Tracker (2019)

Gas as Enabler of VRE Integration: Case Studies

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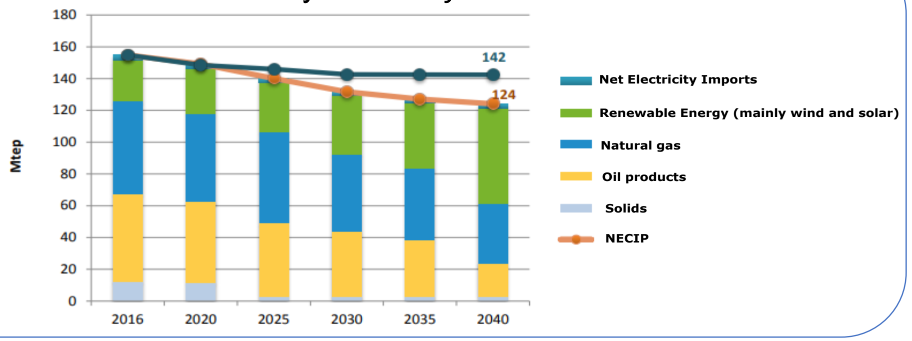
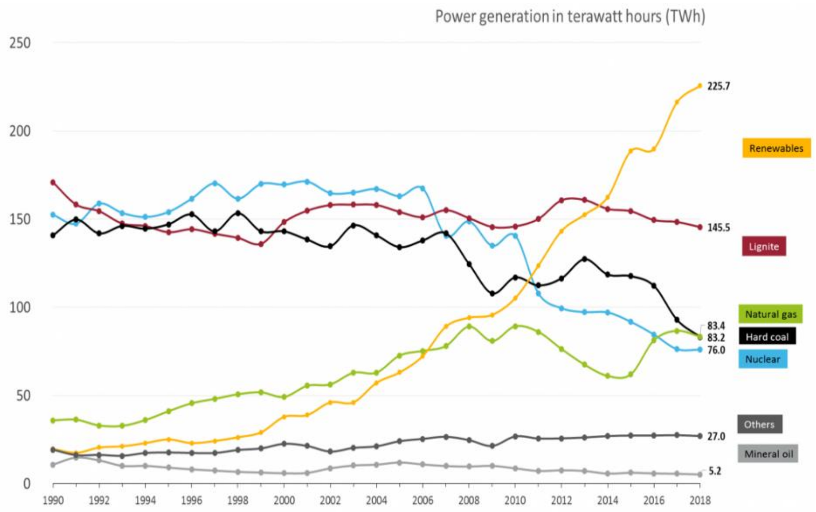
Evolution Italy's Primary Mix [1]



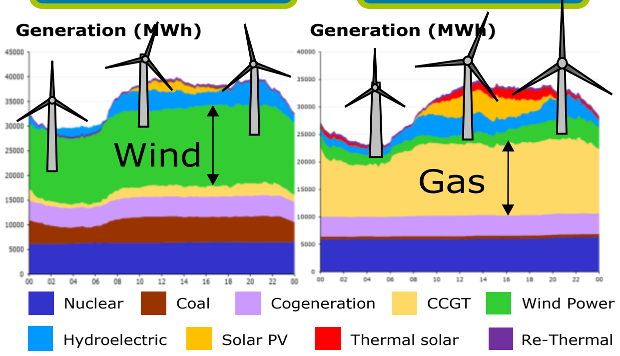
Gross power production 1990 -2018 (TWh) [2]

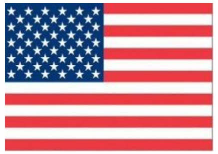


Power Generation Mix in two different days in Spain [3]

23/01/2019

29/08/2019

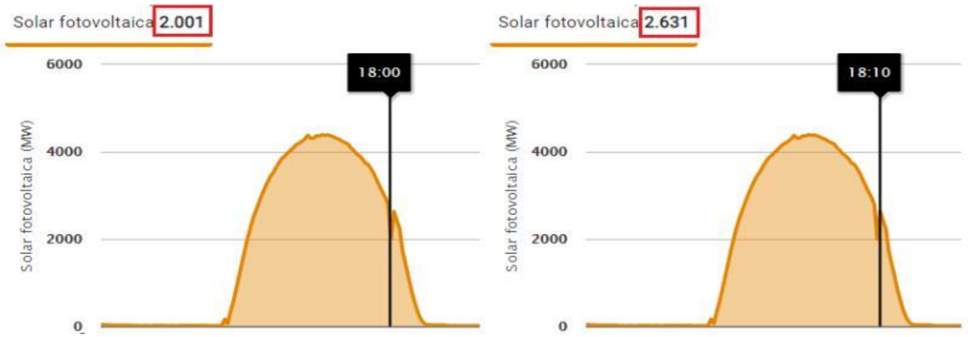




(etc.)

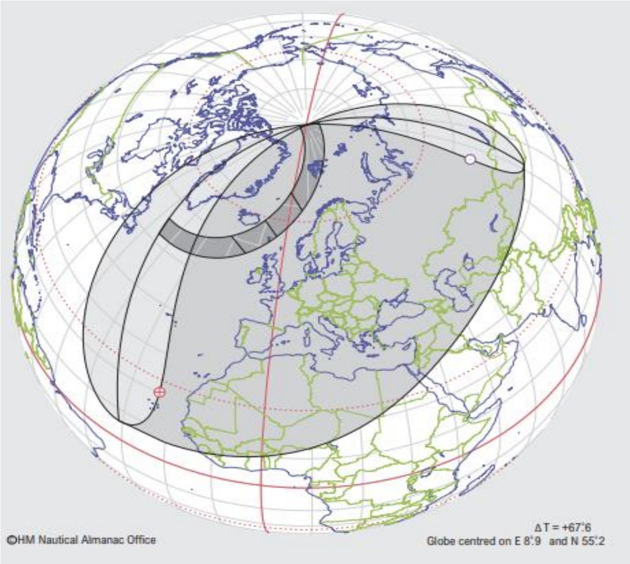
Source (1) : Italy' National Energy and Climate Plan (Dec 2019); Source (2): Clean Energy Wire; Source (3): Enagas – based on data published by REE

Gas-fired power generation role to integrate Solar PV in all cases



Power production (MWh) from a solar power plants in Spain in two different moments of the same day(MW)

Source: REE



Solar Eclipse trajectory 20 March 2015;

Source: ENTSOE

- Solar eclipses similar to that one of 20 March 2015 will occur again. In 2026 there will be a total eclipse in Europe.
- Regarding installed PV, Solar Power Europe foresees 250 GW PV in 2026
- At that point in time, the flexibility provided by gas-fired power plants will be critical to maintain the energy system operation

Gas-fired power generation role to integrate Solar PV in all cases

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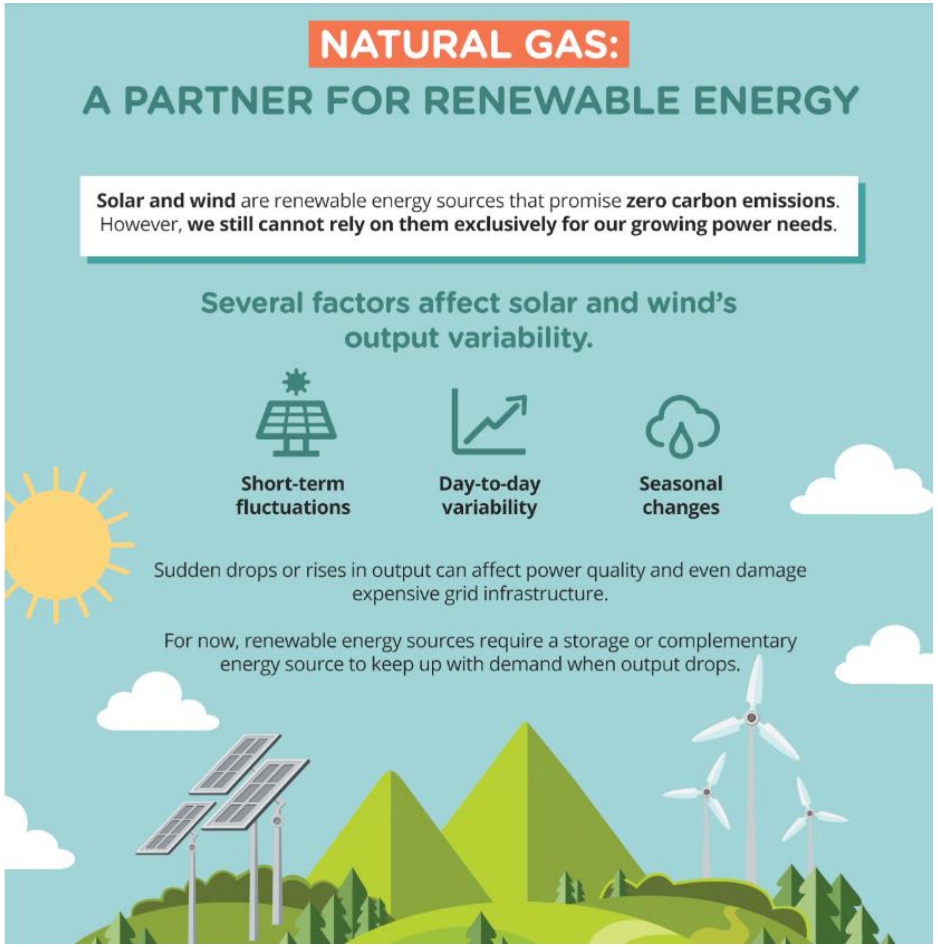

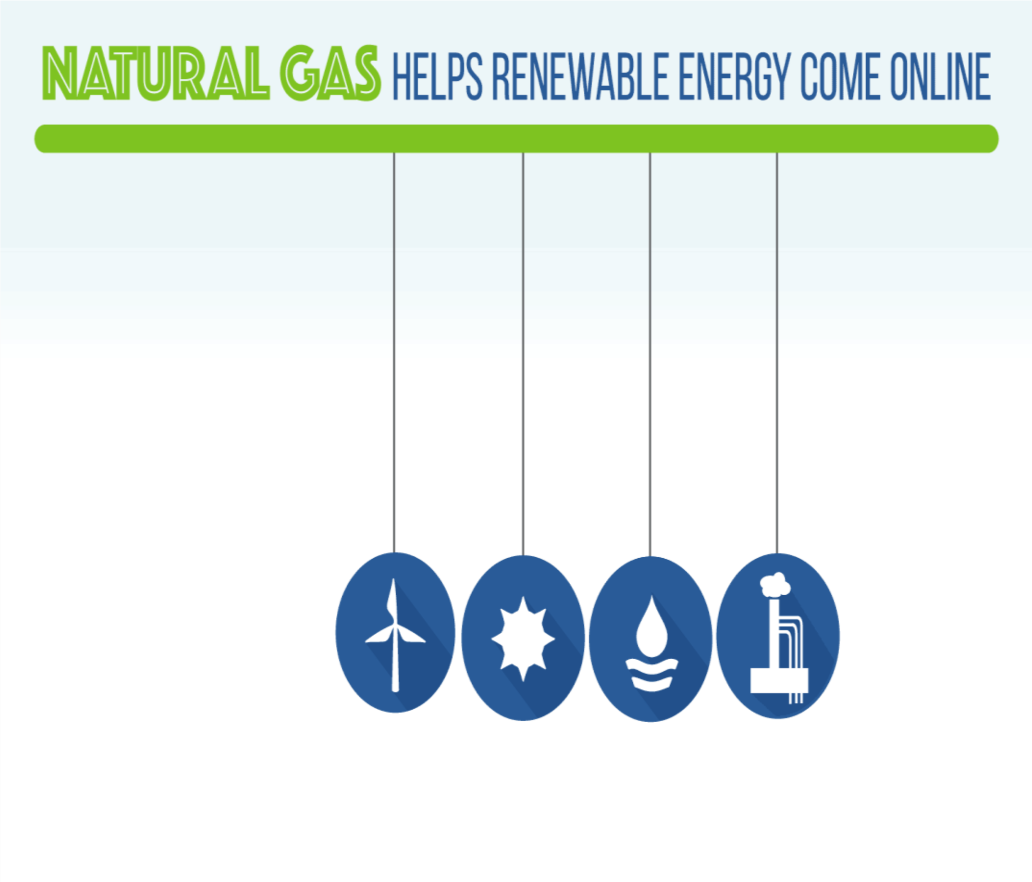

Source: http://www.nber.org/papers/w22454?utm_campaign=ntw&utm_medium=email&utm_source=ntw

...and 100% Electrification is Not Possible

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Source: Eurelectric; “Decarbonisation Pathways” (2018)

Efficient Energy Transition: Efficient Transport of Energy

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The transmission of energy in a well developed gas infrastructure offers a more efficient solution in terms of volumes, costs and visual impact

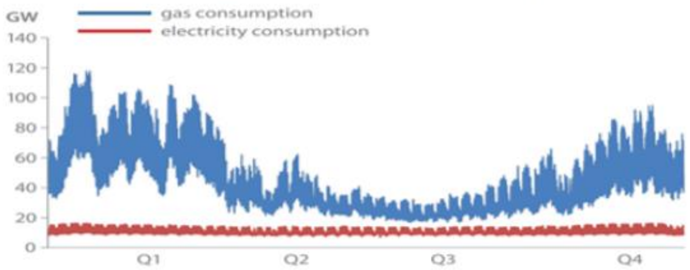
1 pipeline of 48” is able to pass on the same energy as 8 high power lines

	Britned (NL-UK) Power wire - cable	BBL (NL – UK) Gas pipeline
Length	235 km	260 km
Budget	600 M€	550 M€
Capacity (NL→UK)	1 GW	20 GW

The gas system:

- transports “x” times more energy than the power system.
- deals with strong seasonality and demand variability.

Example: Annual gas and electricity consumption in NL



Source: IGU, GIE, ENTSOG

Gas Storage: Large Capacity, also for seasonal use

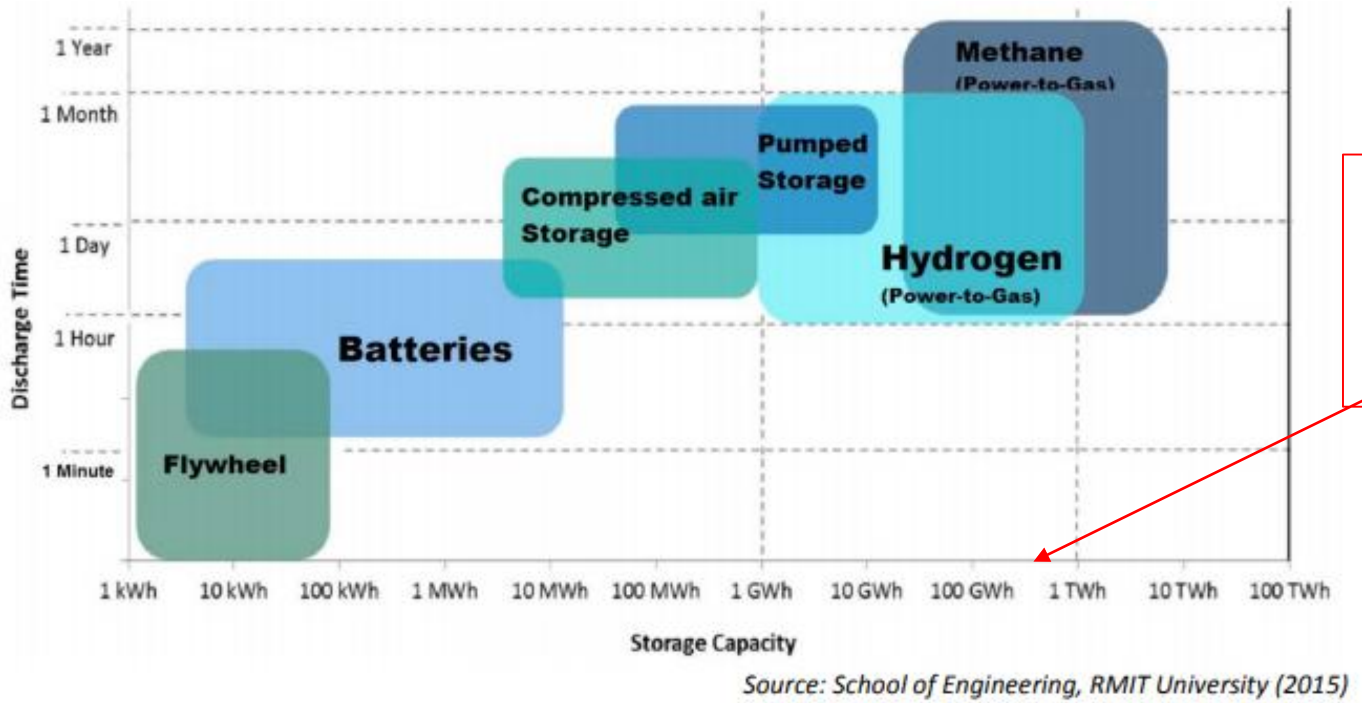


Figure 3. Available storage technologies, their capacity and discharge time.

Please note it is a logarithmic scale

Electricity storage in the EU: ≈30 TWh (almost all is hydro pump storage)

Gas storage in the EU: 1131 TWh, represents 21% of annual gas consumption in EU;
Flexibility: 22 TWh of withdrawal capacity

Renewable and Low-Carbon Gases: backbone for the future Energy System

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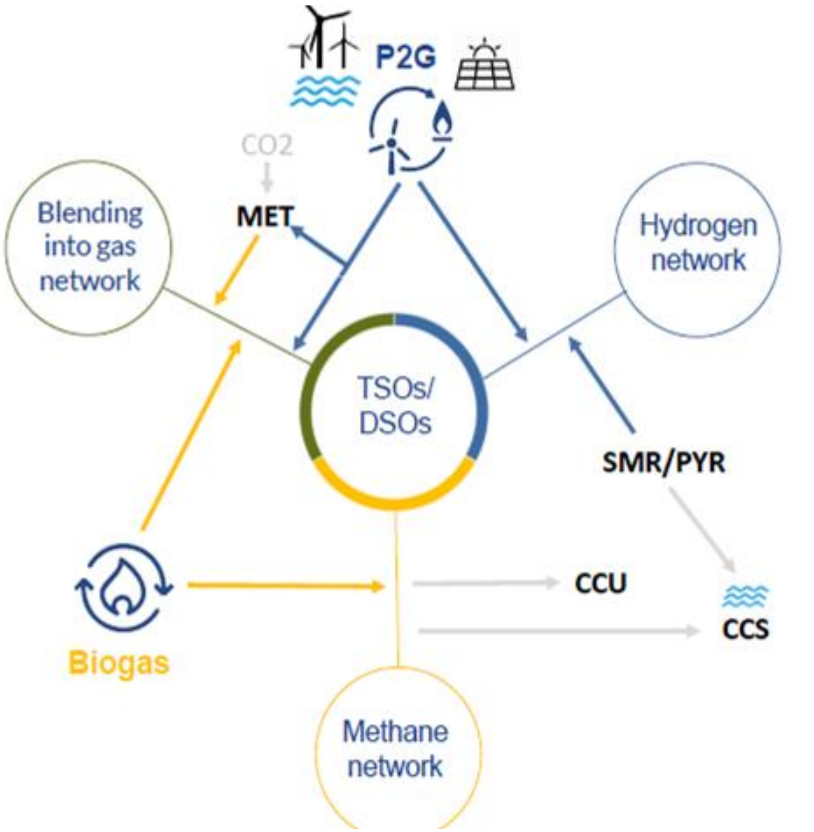
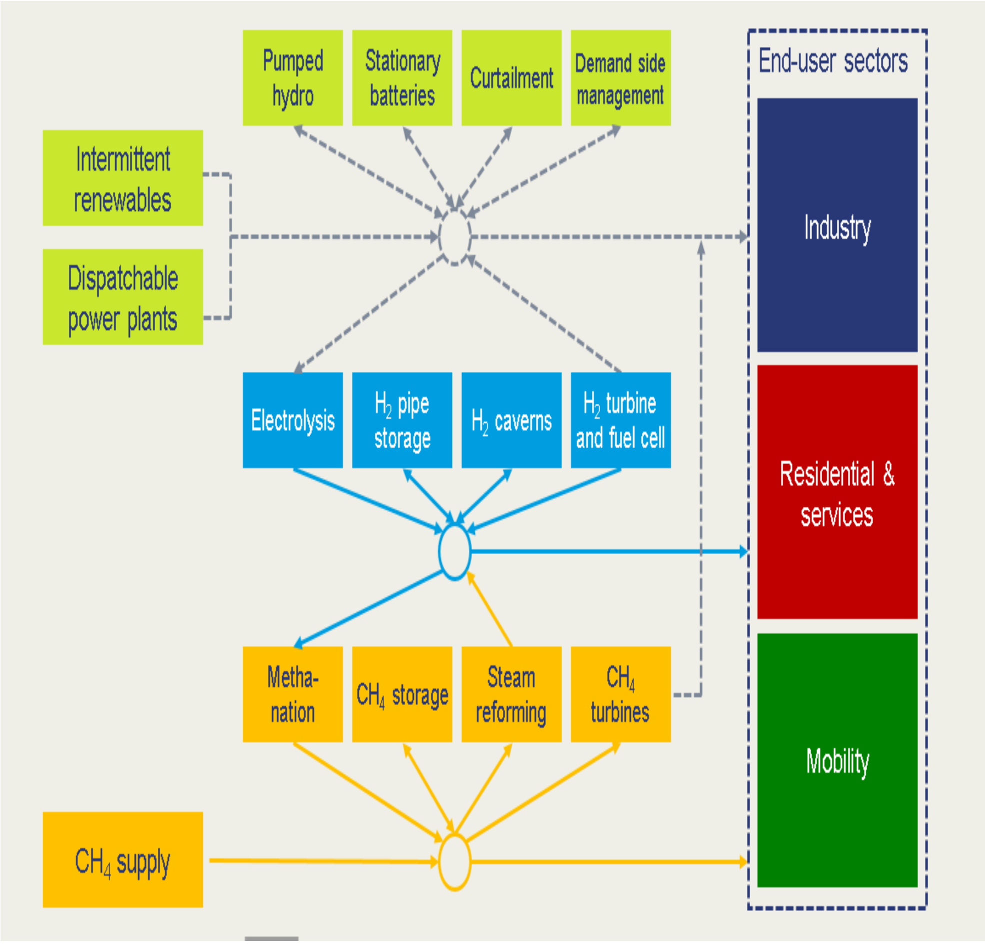


Legend:
MET = Methanisation; P2G = Power to Gas; SMR = Steam Methane Reforming, PYR = Pyrolisis; CCS = Carbon Capture and Storage; CCU = Carbon Capture and Utilisation



Source: ENTSOG

Source: Trinomics - 2019 (Study for European Commission)

Renewable and Low-Carbon Gases: backbone for the future Energy System

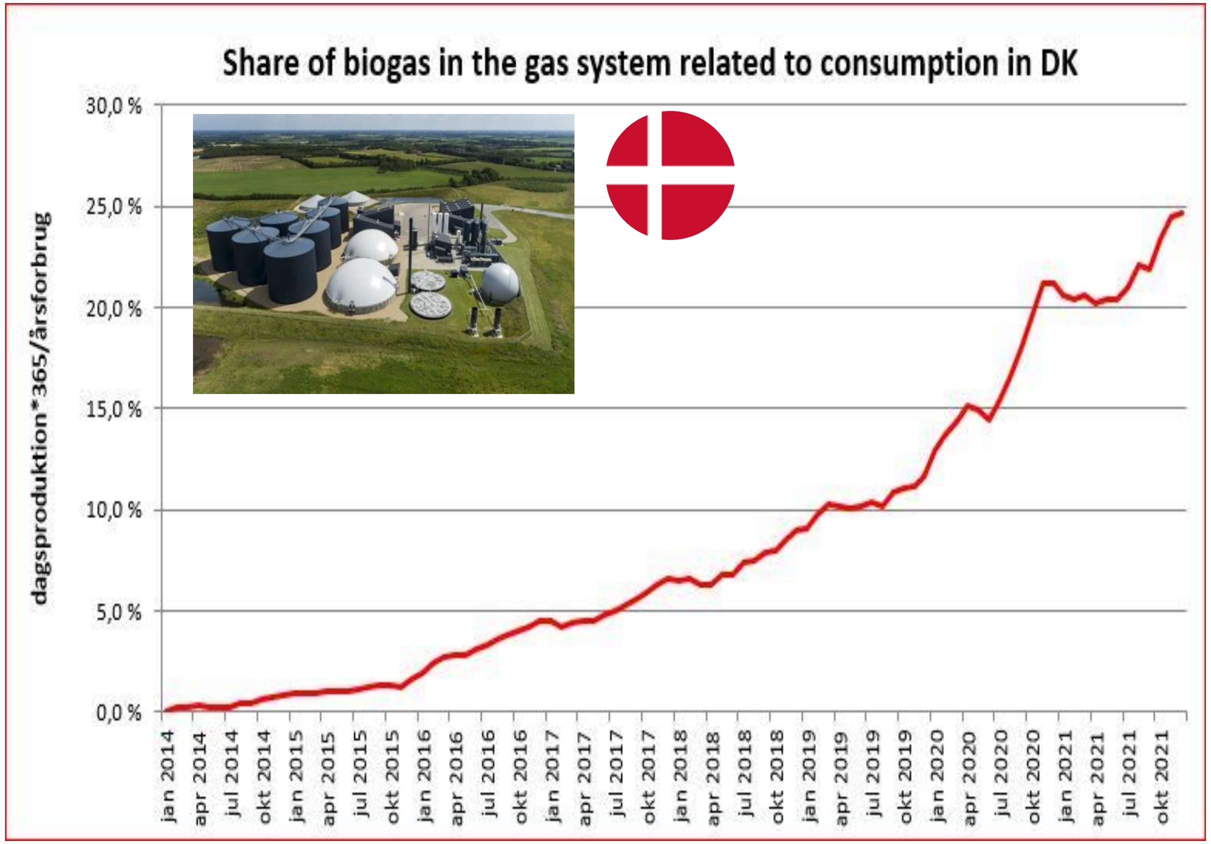
REPowerEU Key Targets for 2030

Energy Efficiency Directive: increased from 9% to 13%

Renewable Energy: increased from 40% to 45%, or approximately 1,236 GW by 2030

- Solar Energy: bring online more than 320 GW of solar by 2025 and 600 GW by 2030
- Green Hydrogen: 10 million tonnes of domestic production and 10 million tonnes of renewable hydrogen imports, up from 4 million tonnes
- Biomethane: 35 billion cubic meters of production

To increase EU's Energy resilience and security of supply, EU will speed up development of renewable energy electricity & renewable gases, developing an EU Integrated Energy System.



- Biogas will be able to cover 75% of Danish gas consumption in 2030.
- In 2034, biogas production is expected to be able to fully meet Danish gas demand on an annual basis.

Recommendations (1/2)

- **Recognise the value of the flexibility provided by gas-fired power plants**
    - Take advantage of the existing gas flexibility: substantial amounts of VRE can be integrated by unlocking existing flexibility rather than by investing in new costly assets

- **Take into account the future impact of VRE**
    - Implement an adequate regulatory framework for VRE integration
    - Be flexible in the planning process
    - Get ready in advance for short-term imbalances

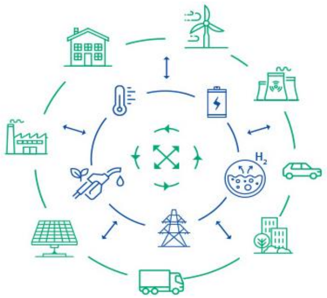


Image: European Commission

- **Promote sectoral integration**
    - Set up a policy and regulatory framework to enable a Hybrid Energy System
    - Foster research, development and innovation

Recommendations (2/2)

- **Clarify the regulatory framework for renewable and low-carbon gases**
    - Widen the concept of “renewable energy” and introduce a “new gases” terminology
    - Establish principles for
        - transporting new gases (hydrogen, biomethane and others) whilst maintaining a non-fragmented market where all gases can be traded
        - managing gas quality in a proper way
    - Implement standardised GOs/certificate frameworks across the UNECE region
    - Support the development of a hydrogen market
- **Deploy a digitalization environment**
- **Share knowledge and experiences across the UNECE region**

THANK YOU

For your attention

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