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Group of Experts on Gas
Group of Experts on Renewable Energy

GEG Item 6 and GERE Item 7: Workshop: Decarbonization through synergies between electricity and gas

23 September 2020 14:00 CET

Moderators and documentation

ENERGY

Moderators:

Mr Francisco de la Flor Garcia, Chair, Group of Experts on Gas

Mr Kostiantyn Gura, Chair, Group of Experts on RE

Documentation (to be published for CSE November 2020 session):

ECE/ENERGY/2020/8:
"Hydrogen – an innovative solution to carbon neutrality"

ECE/ENERGY/2020/9
"Carbon neutrality through synergies between gas and renewable energy"

Presenters

Keynote speaker:

Ms Yolanda Garcia Mezquita, Deputy Head, Strategy and Policy Coordination Unit, DG Energy, European Commission

Panelists:

Mr Abel Enriquez, EU Regulatory Affairs Manager, Enagas, Spain

Mr Constantine Levoyannis, Hydrogen Europe

Mr Florian Marko, Vice-chair of GEG, Austria

Mr Bjørn Simonsen, Nel Hydrogen, Norway

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Powering a climate-neutral economy

The Energy System Integration and Hydrogen Strategies in the context of the European Green Deal

UNECE Workshop
Decarbonisation through synergies between electricity and gas
23 September 2020

Yolanda Garcia Mezquita
Dep. Head of Unit Strategy and Policy Coordination
Directorate-General for Energy
European Commission

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The European Green Deal

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The 2030 Climate Target Plan

1. EU-wide, economy-wide greenhouse gas emissions reduction target of at least 55%, including emissions and removals, by 2030 compared to 1990

2. Actions required across all sectors of the economy and launch of revisions of the key legislative instruments

3. Public debate in autumn 2020 to increase the EU's contribution to the Paris Agreement before the end of the year and set the stage for the Commission to make detailed legislative proposals by June 2021

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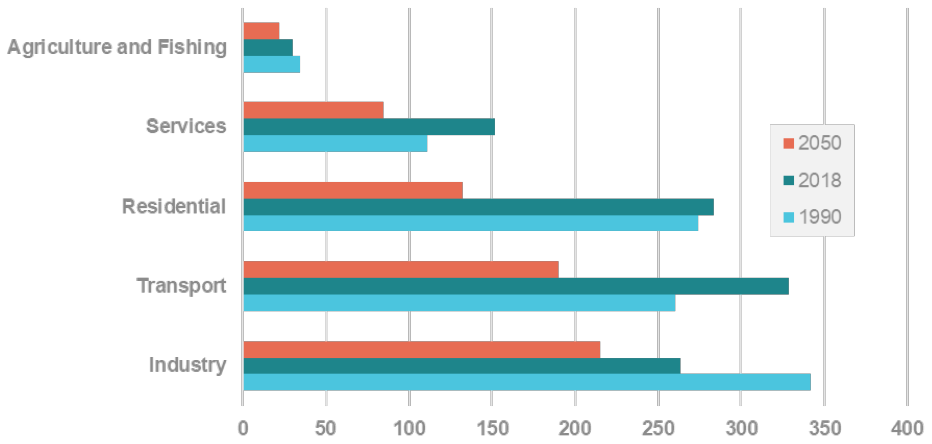
Energy contribution to the Climate Target Plan

- 60% emission reductions by 2030 or more compared to 2015 in buildings and power sector from rapid penetration of renewable energy, use of the energy efficiency first principle, electrification and energy system integration.
- Use of fossil fuels will fall substantially. Coal for instance decreases by more than 70% compared to 2015.
- By 2030, the share of renewable electricity production will double to 65% or more.
- Industry and buildings can subsequently decarbonise, with heating and cooling reaching a 40% renewable share by 2030.
- Projections include increase in transport renewables to 24% by 2030.
- Clean hydrogen crucial for decarbonising heavy-duty transport and, through its derivatives, the aviation and maritime sector.
- Projected increases in bioenergy use by 2030 are limited. Bioenergy production best to come from better use of biomass wastes and residues, sustainable cultivation of energy crops, replacing the production of first generation food-crop-based biofuels.

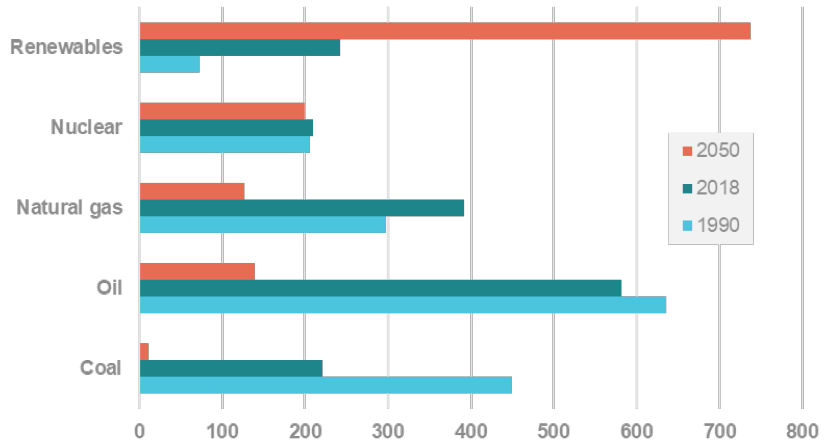
Changing consumption and production patterns towards 2050

ENERGY

Final energy demand per sector



Consumption per energy supply source



Source: Mtoe, based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios

Changing energy carriers

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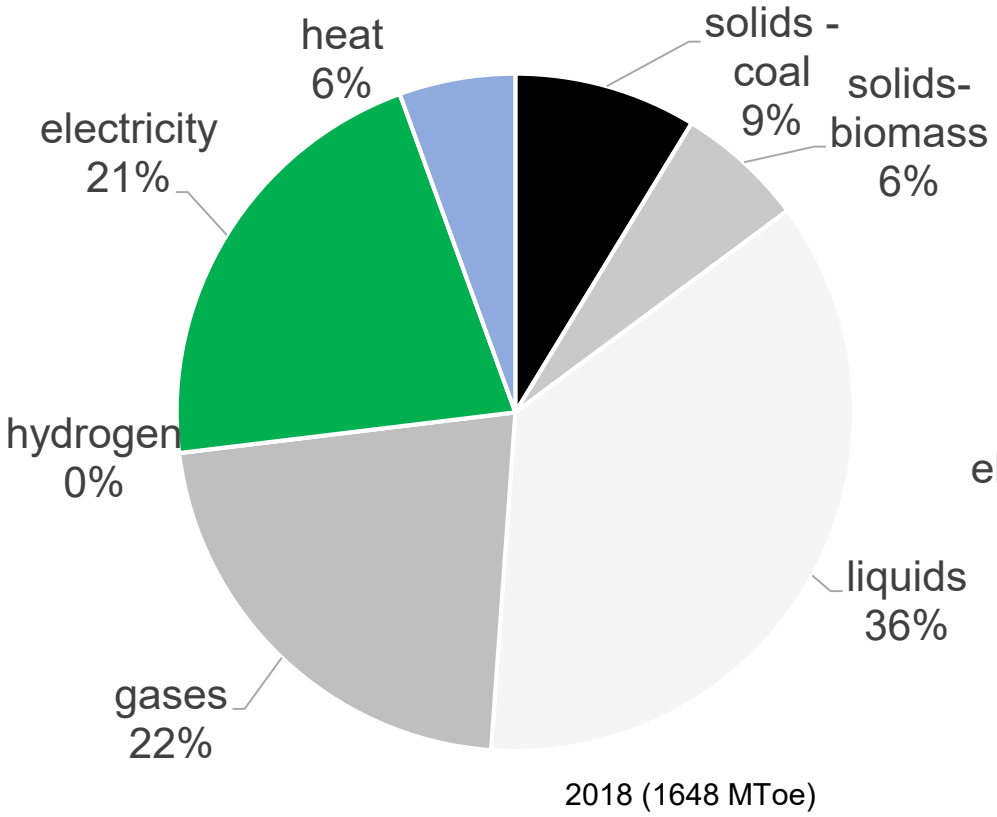
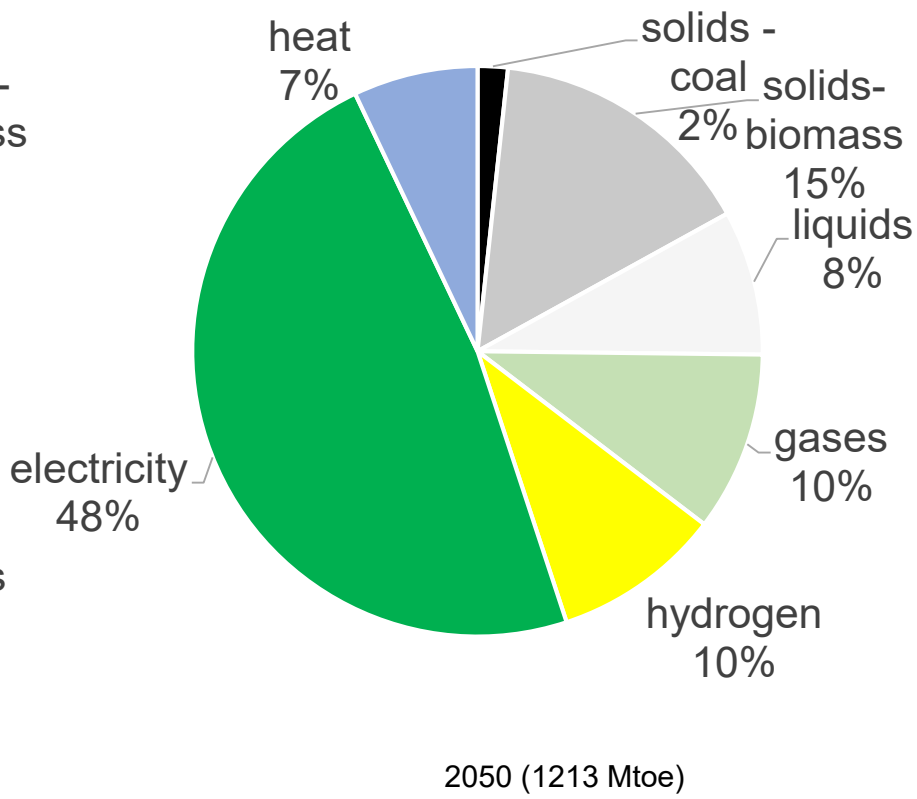


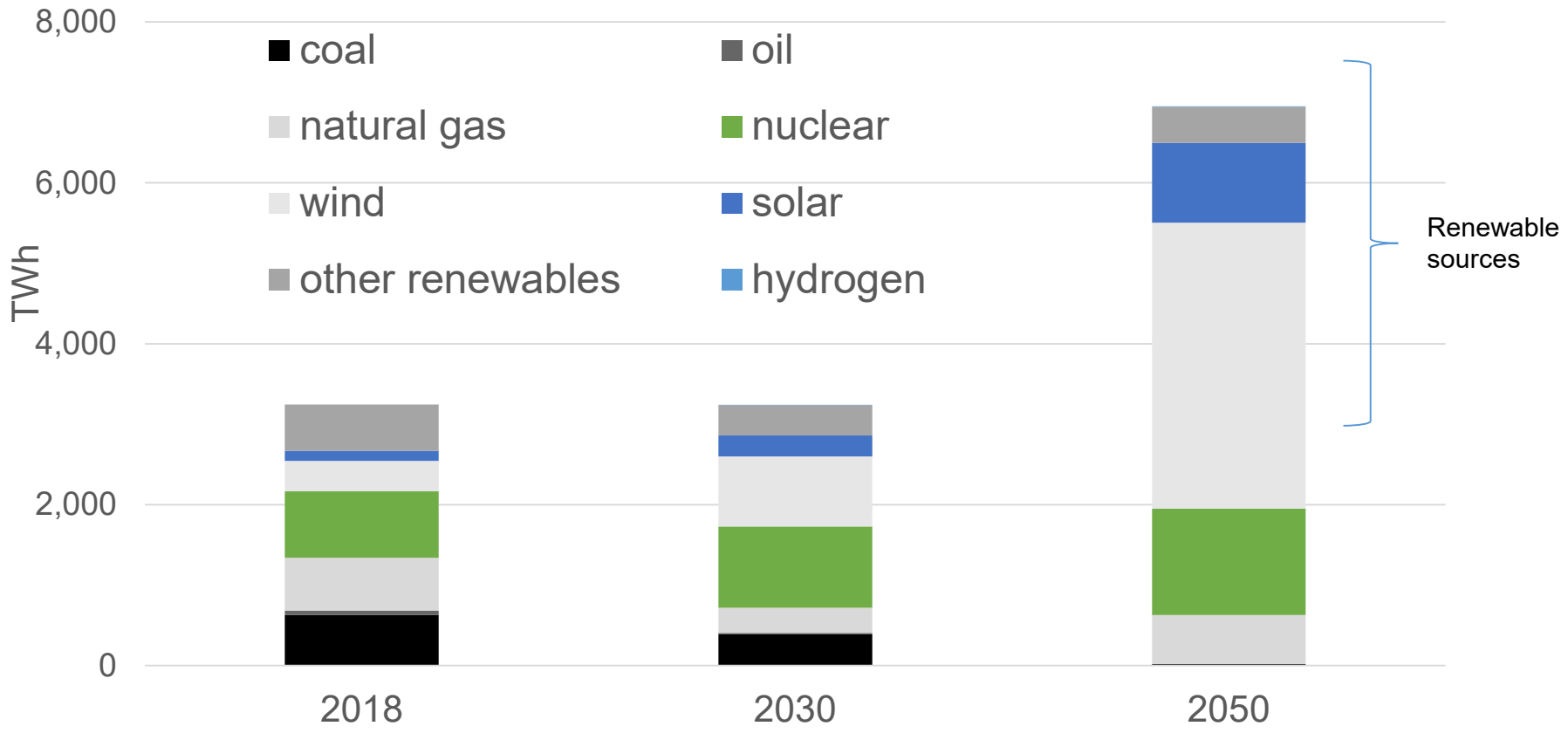
2018 (1648 MToe)



2050 (1213 Mtoe)

Source: Based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios

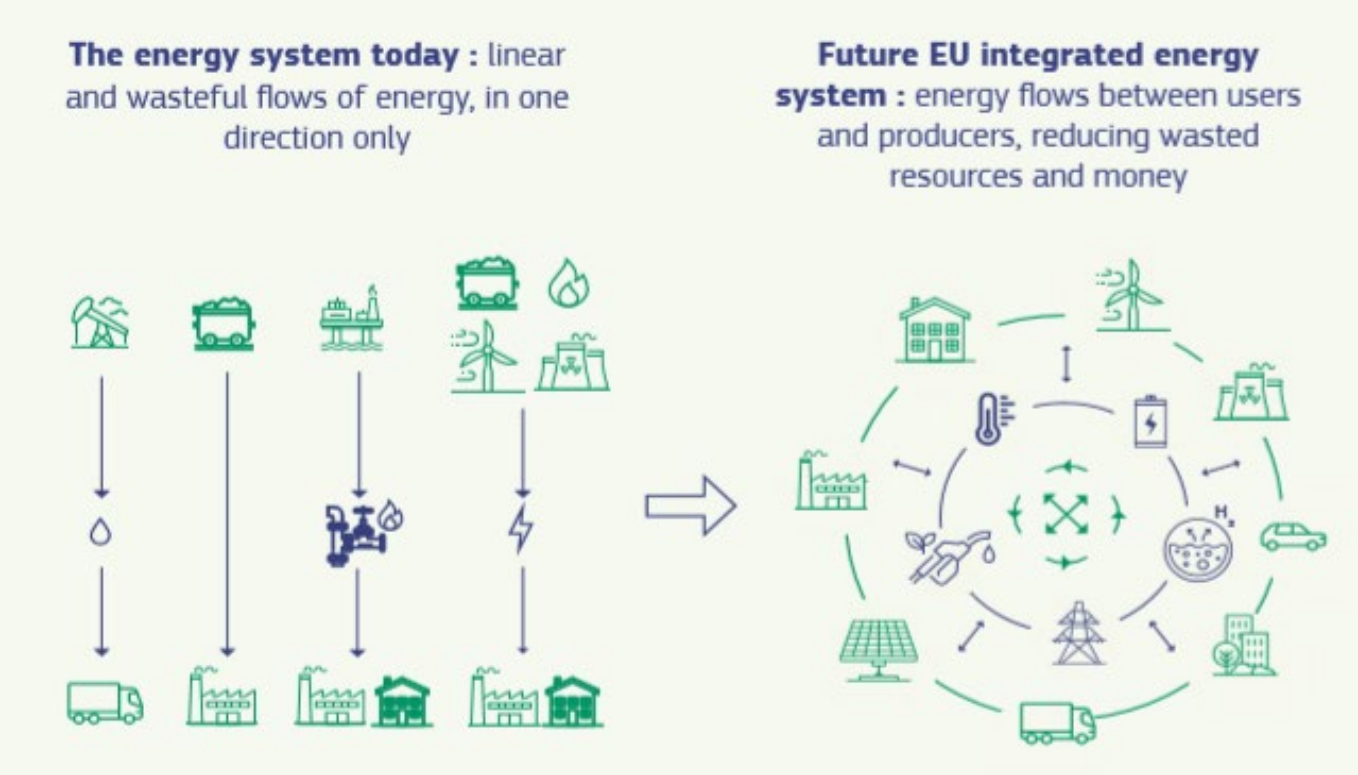
Power system is most rapid to decarbonise



Source: Based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios

Why a Strategy for Energy System Integration? Why now?

What is energy system integration?



Energy System Integration (ESI) is the integrated planning and operation of the energy system 'as a whole', across multiple carriers, infrastructures and consumption sectors

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Laying the foundation for a climate-neutral energy system

1. A more circular and energy efficient energy system
2. A deep electrification of consumption, based on renewable electricity
3. The use of renewable and low carbon fuels (incl. hydrogen) in hard-to-abate sectors

Hydrogen Strategy

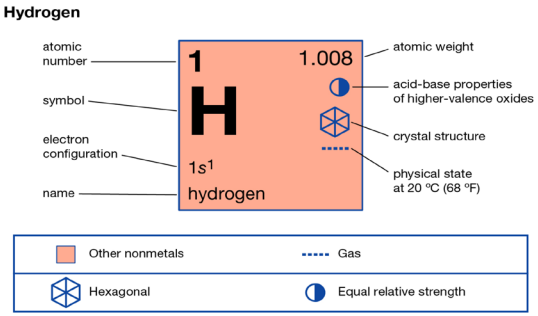
A full value chain approach to upscale hydrogen

+

Clean Hydrogen Alliance

ENERGY

Hydrogen – What and Why?



Hydrogen:

- Feedstock, fuel, energy carrier / storage, many applications
- Does not emit C02, no air pollution
- Essential to reach our climate ambition (hard-to-abate sectors)
- Europe is highly competitive in clean hydrogen technologies manufacturing

Which hydrogen:

Currently: fossil- based hydrogen

Our vision: Renewable (clean), and in a transitional period **low-carbon hydrogen** (fossil-based hydrogen with carbon capture and electricity based) for:

- Replacing **existing hydrogen** production
- **Industry** (fertilisers and green steel) **and transport**
  (Local buses, parts of rail, heavy duty road vehicles; in the longer term: maritime and aviation)

Issues:

- **Cost-competitivess**
- **Technological maturity (cost-effective electrolysers)**
- **Renewable energy & scale**

The Hydrogen Strategy – a roadmap to 2050

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2024

- 6 **GW** of renewable hydrogen electrolysers
- Replace **existing hydrogen production**
- Regulation for liquid hydrogen markets
- Start planning of hydrogen infrastructure

2030

- **40 GW** of renewable hydrogen electrolysers
- New applications in **steel and transport**
- Hydrogen for electricity balancing purposes
- Creation of “Hydrogen Valleys”
- Cross-border logistical infrastructure

2050

- Scale-up to **all hard-to-decarbonise sectors**
- Expansion of hydrogen-derived **synthetic fuels**
- EU-wide infrastructure network
- An open intl market with € as benchmark

Financing energy priorities

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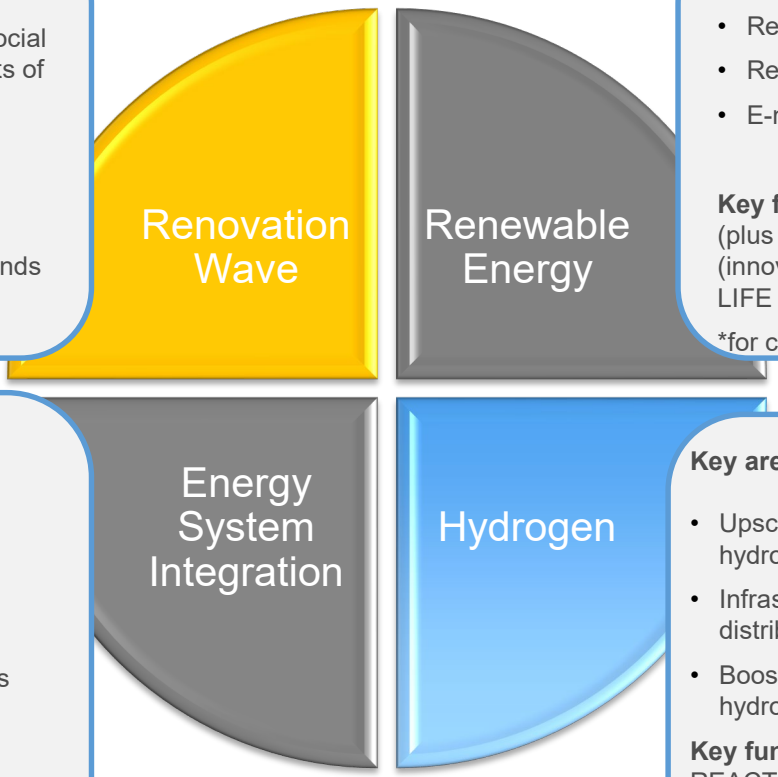
Key areas:

- Energy renovations in public buildings and social infrastructure, including through engagements of Energy Service Companies (ESCOs)
- Energy renovations of residential buildings
- Energy efficiency in SMEs (buildings)

Key funds: RRF, InvestEU, JTM, Cohesion Funds (plus REACT-EU), Horizon Europe (R&I) Modernisation Fund, LIFE



Key areas:

- Renewable Power Generation
- Renewable-based heating and cooling
- E-mobility based on renewables

Key funds: RRF, InvestEU, JTM, Cohesion Funds (plus REACT-EU), CEF*, Horizon Europe (innovation), Modernisation Fund, Innovation Fund, LIFE

*for cross border RES projects

Key areas:

- Transmission and distribution infrastructure
- Smart grids
- Storage infrastructure
- District heating and cooling
- Direct electrification in end-use sectors
- Industrial energy efficiency and EE by SMEs
- Infrastructure for CO2 transport

Key Funds: RRF, CEF [T], Cohesion Funds [D] (plus REACT-EU), InvestEU, JTM, Modernisation Fund, Horizon Europe (R&I), LIFE

Key areas:

- Upscaling electrolyser capacity for green hydrogen production
- Infrastructure for the transmission and distribution of hydrogen
- Boosting the use of green or low carbon hydrogen in end-use sectors [transport, industry]

Key funds: RRF, InvestEU, Cohesion Funds (plus REACT-EU), JTM, CEF, Horizon Europe (R&I), Innovation Fund, Modernisation Fund, LIFE


Thank you for your attention!

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GEG & GERE Workshop

Decarbonisation through Synergies Between Electricity and Gas

Abel Enríquez
Enagás

Geneva & Virtual, 23 September 2020

Index

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1. Trends for Variable Renewable Energy (VRE) and Gas

2. Integration of VRE into the Energy System

3. Options to Integrate VRE

    Gas as Enabler of VRE

4. What's next:

    Hybrid System / Sector Integration

    Renewable and Low Carbon Gases

5. Recommendations

Trends for Variable Renewable Energy (VRE)

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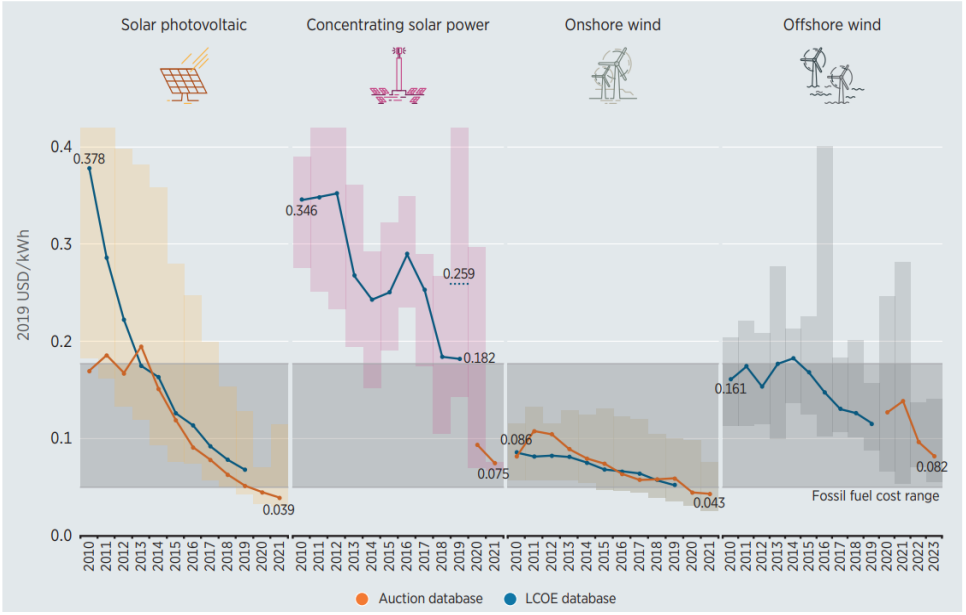
PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

SUSTAINABLE DEVELOPMENT GOALS

Going CLIMATE-NEUTRAL by 2050

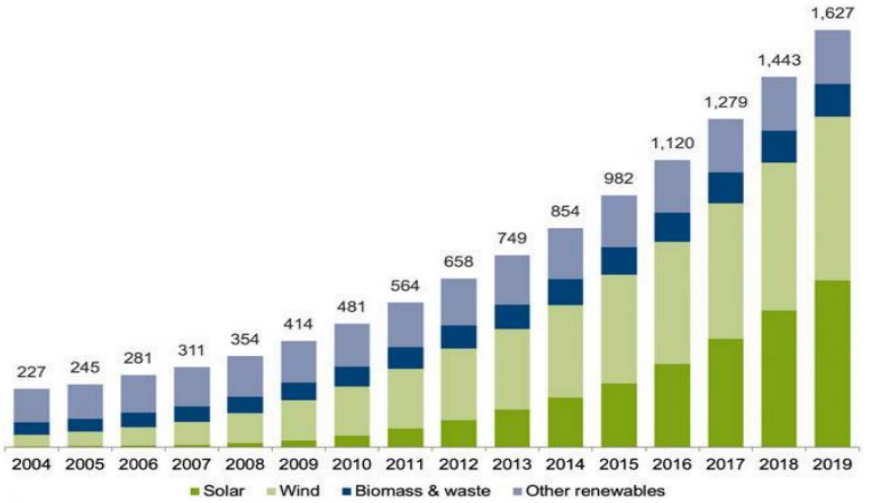


Global weighted average LCOE from utility-scale renewable power generation technologies (2010 and 2019);

Source: IRENA Power Generation Costs in 2019

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

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



Source: UNEP

Trends for Variable Renewable Energy (VRE)

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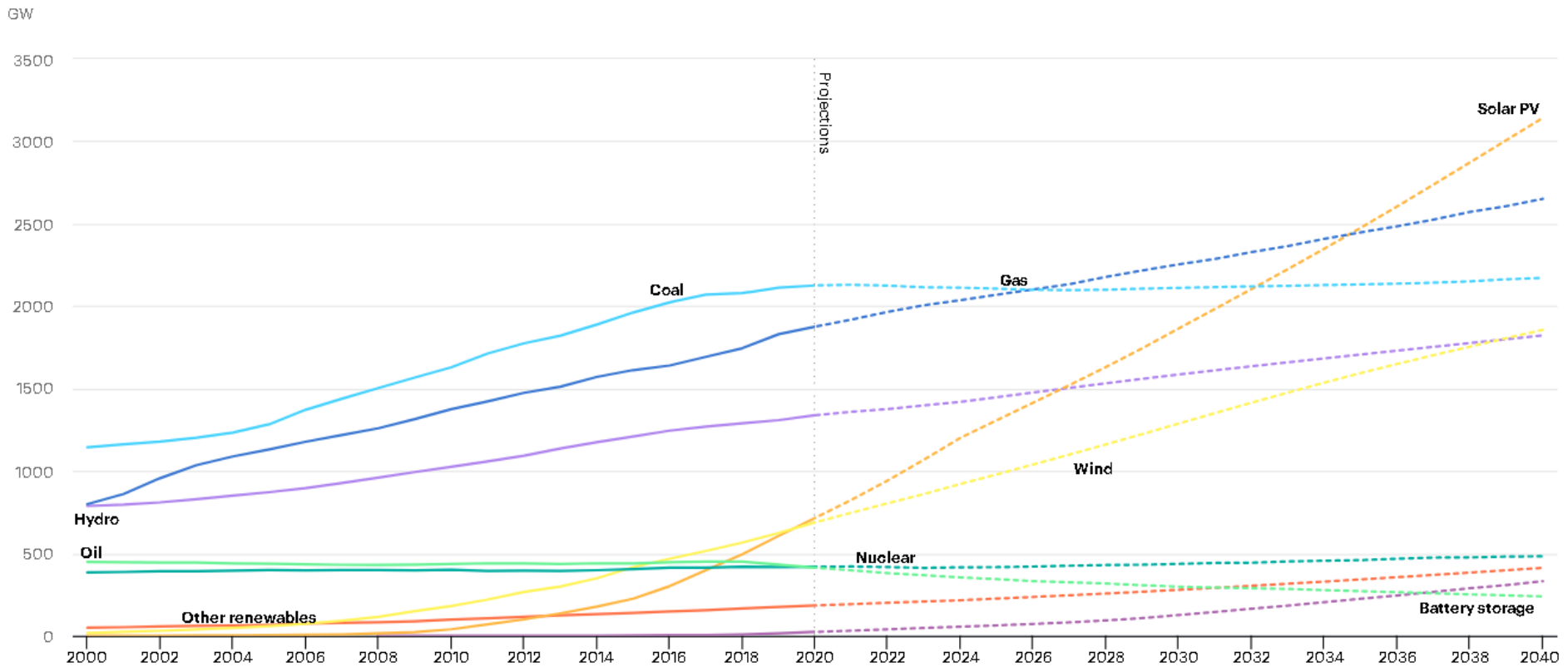
Installed Power Generation Capacity by Source in the New Policies Scenario (2000-2040)



Source: IEA WEO 2019

Trends for Variable Renewable Energy (VRE)

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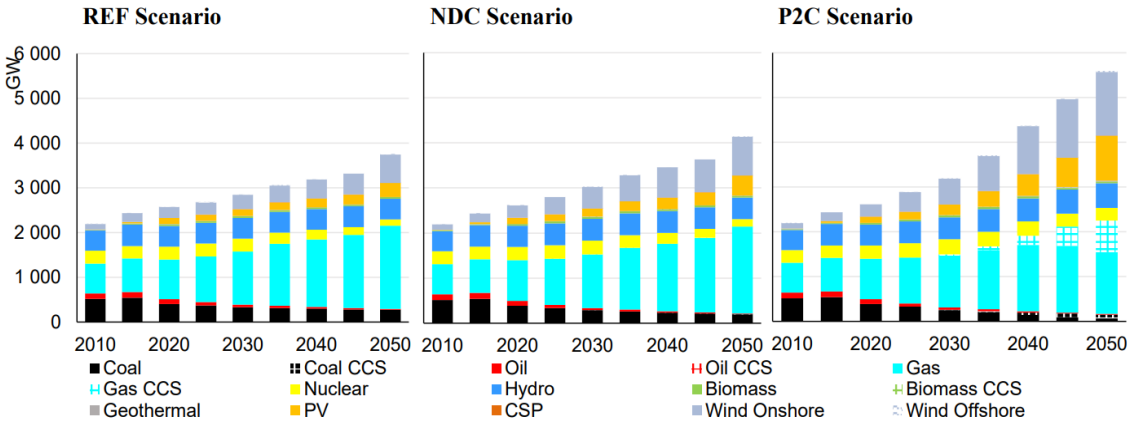
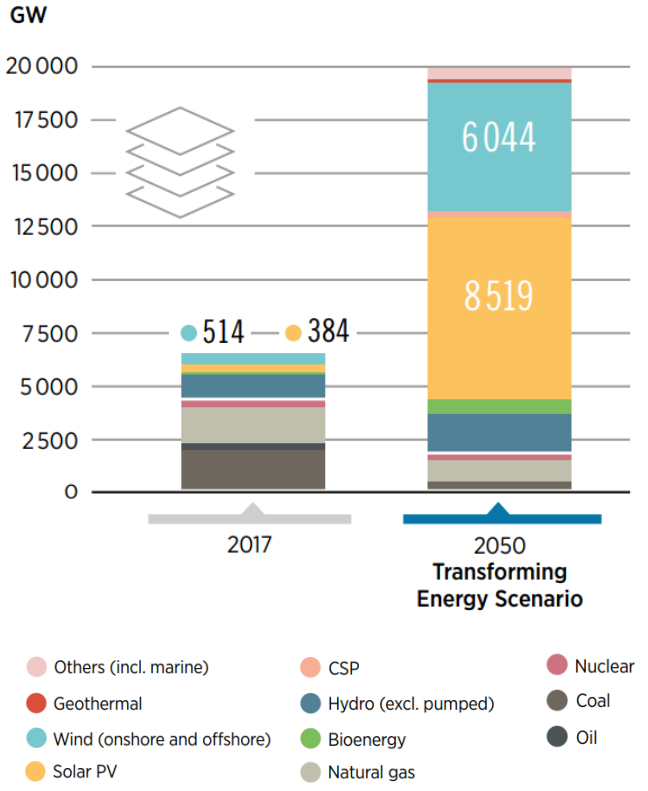
Electricity Generation Capacity in the UNECE Region by Policy Scenario



Source: UNECE – Pathways to Sustainable Energy, 2020

Global Electricity Generation and Total Installed Capacity



Source: IRENA – Global Renewables Outlook 2020

Integration of VRE into the Energy System

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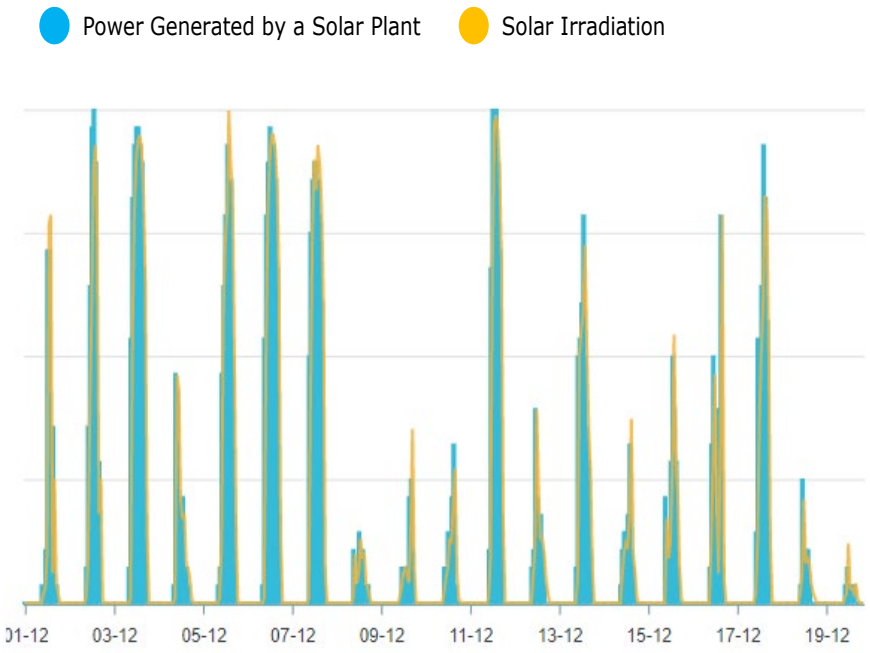
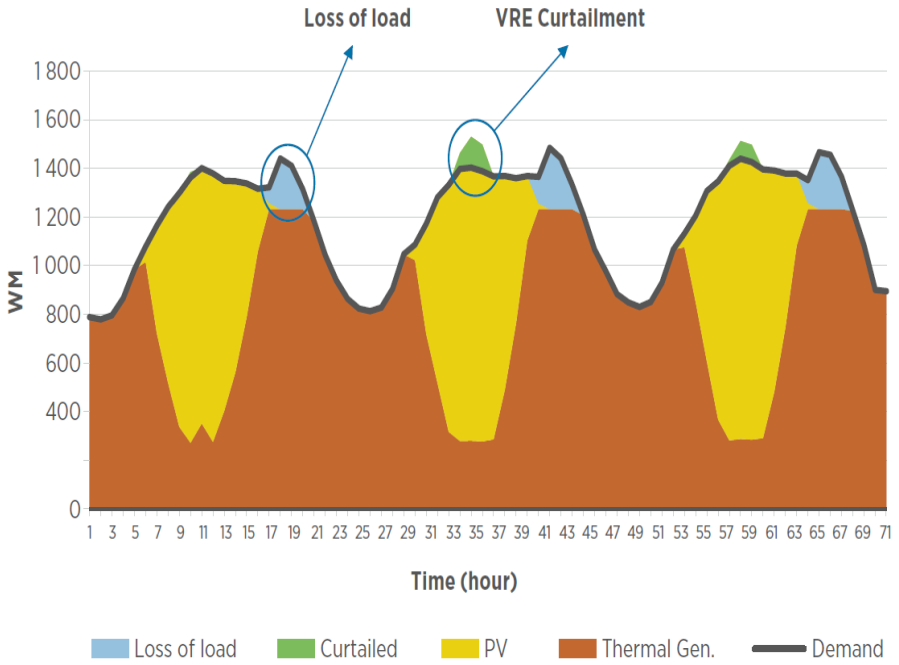


Variability of a typical solar power plant in Spain during different days of a given month (December)

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



Example of energy system with high PV penetration

Source: IRENA

Integration of VRE into the Energy System

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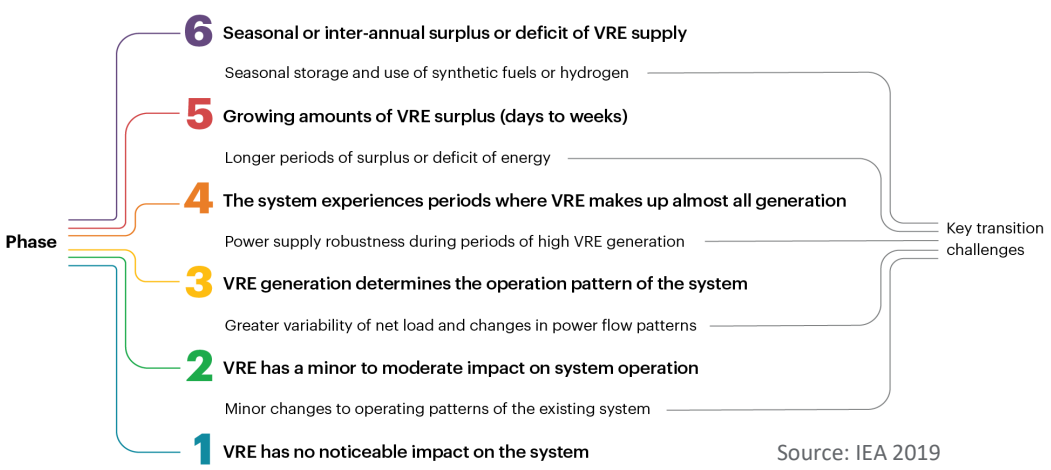
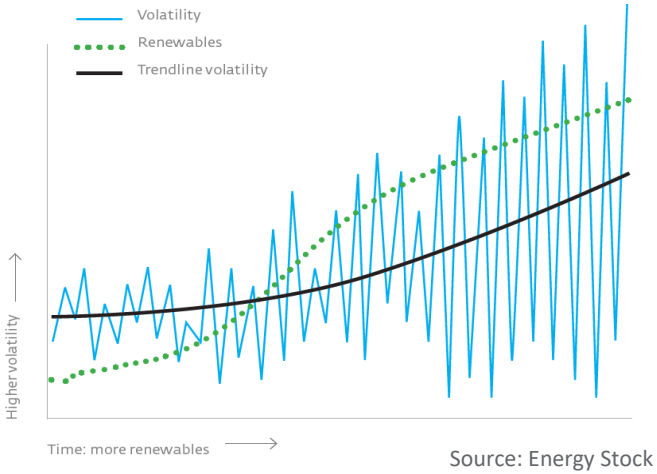
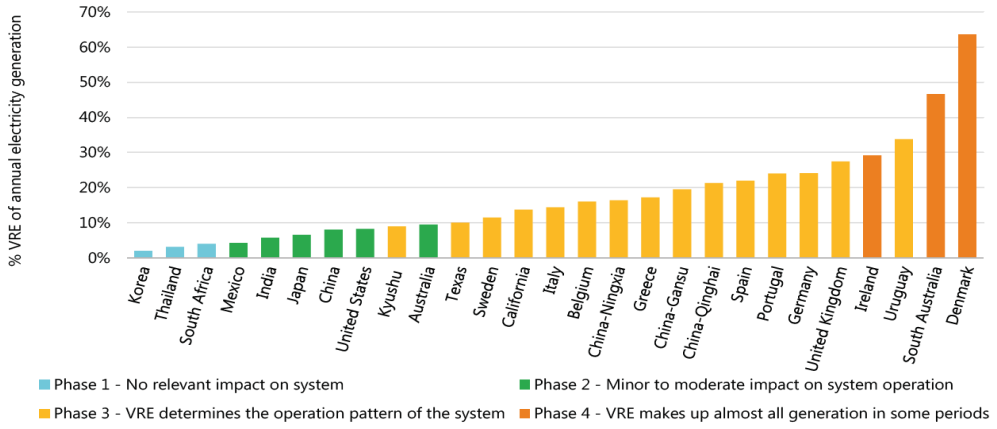


Source: IEA 2019



Source: Energy Stock



Source: IEA 2019

Image: Pixabay - adege

Options to Integrate VRE

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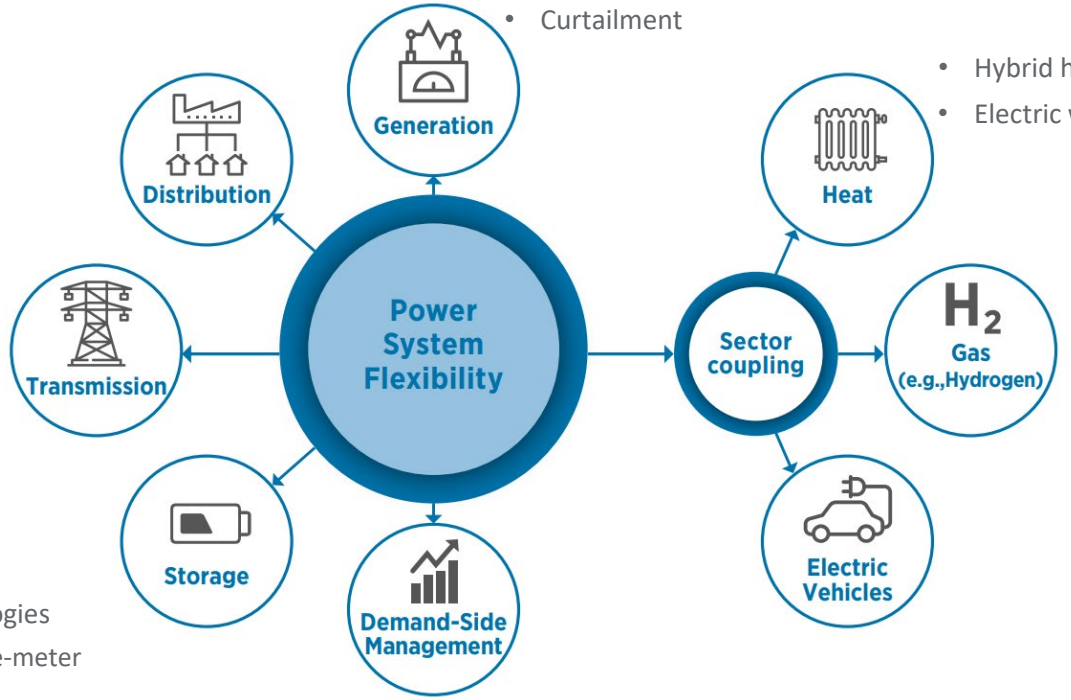
- Flexible generation (local and centralised)
- Advanced VRE forecasting
- Curtailment



- 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 Reosurces (DER)
- Renewable mini-grids services to the main grid
- Optimisation of energy networks with DER

Source: IRENA and others

Options to Integrate VRE

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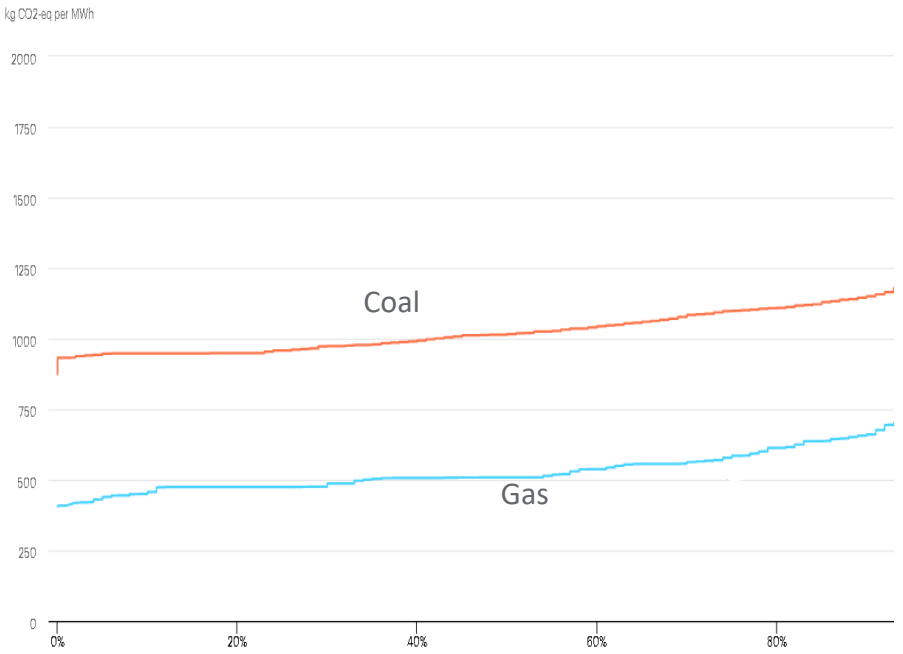
Property	Open cycle gas turbines (OCGT)	Combined cycle gas turbines (CCGT)	Hard coal-fired power plant	Lignite-fired power plant
Most commonly used power plants				
Minimum load (% P_{Nom})	40–50 %	40–50 %	25–40 %[a]	50–60 %
Average ramp rate (% P_{Nom} per min)	8–12 %	2–4 %	1.5–40 %	1–2 %
Hot start-up 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

Source: IRENA



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

Source: IEA Methane Tracker (2019)

Gas as Enabler of VRE Integration: Case Studies

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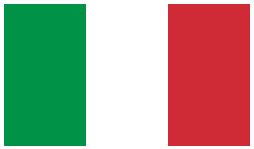
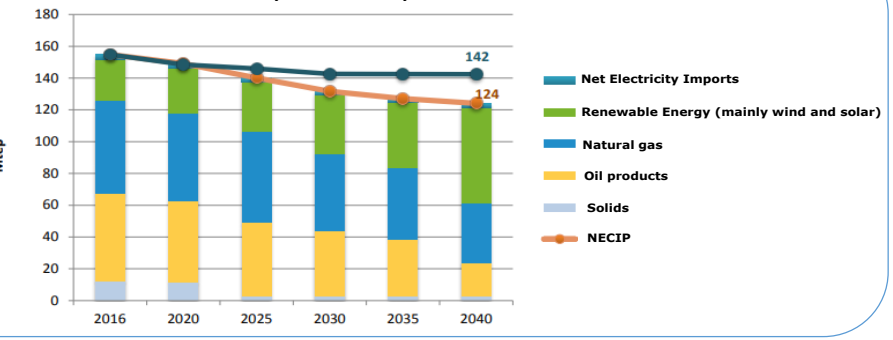
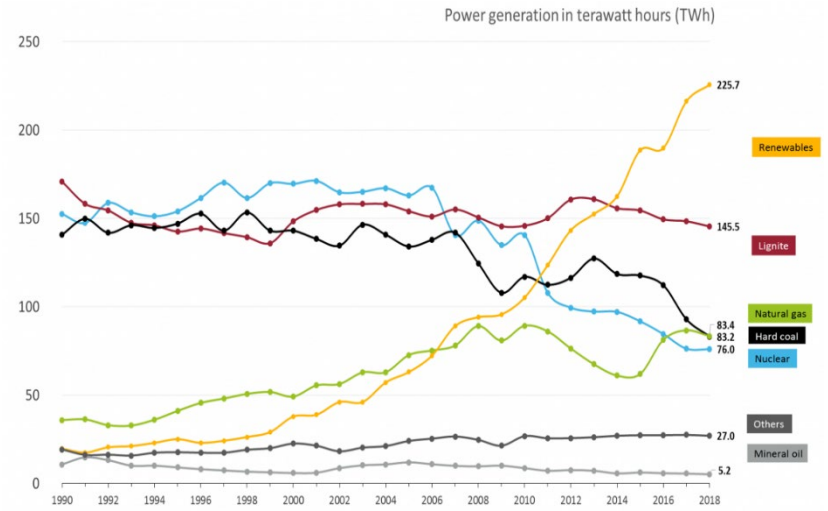


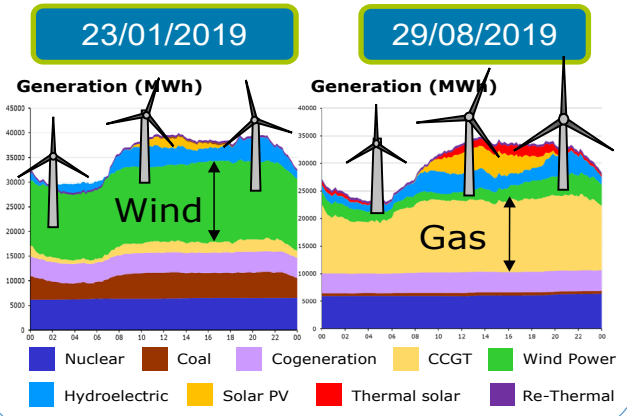
Evolution Italy's Primary Mix (1)

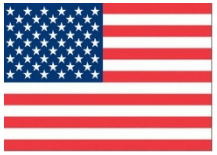


Gross power production 1990 -2018 (TWh) (2)



Power Generation Mix in two different days in Spain (3)

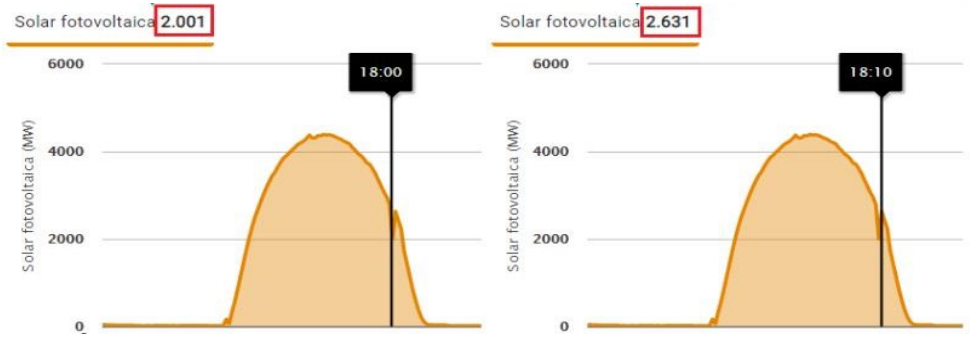




(etc.)

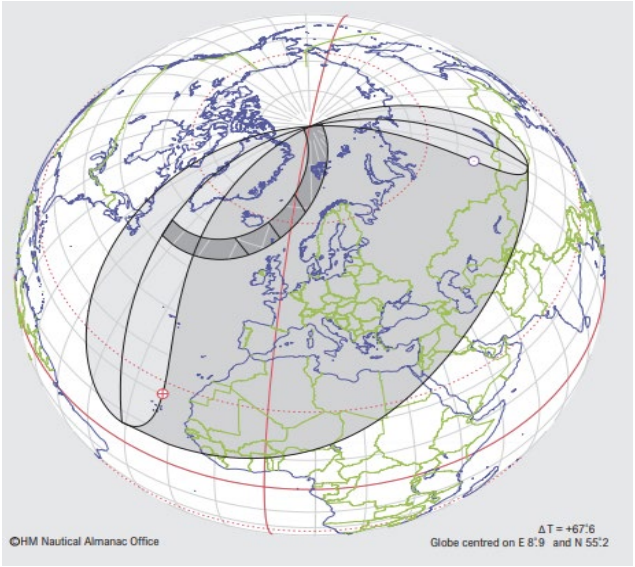
Source (1) : Italy' National Energy and Climate Plan (Dec 2019); Source (2): Clean Energy Wire; Source (3): Enagas – based on data published by REE

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

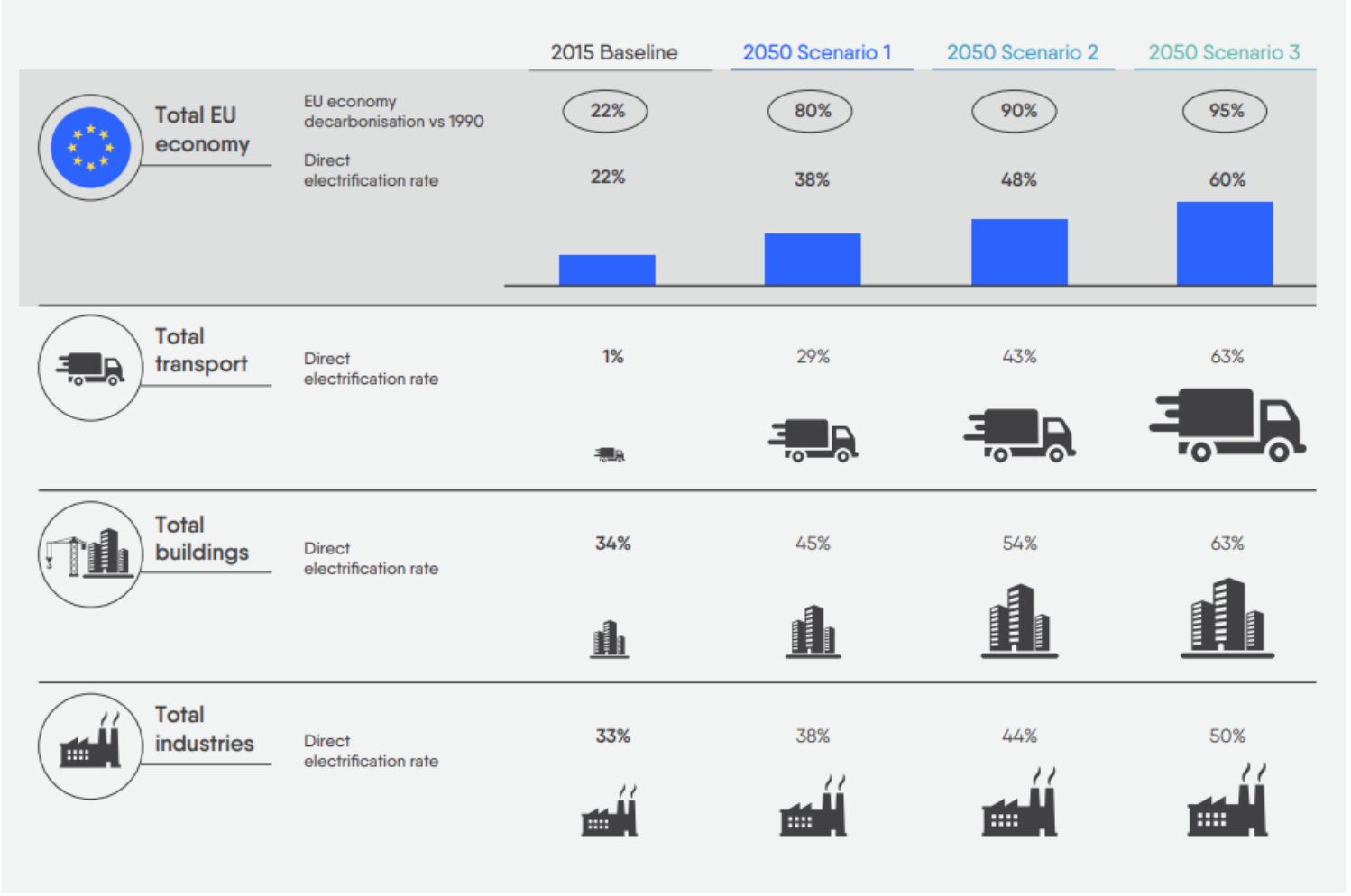


Solar Eclipse trajectory 20 March 2015;

Source: ENTSOE

- Solar eclipses similar to that one of 20 March 2015 will occur again in 2021 and 2026.
- Regarding installed PV, Solar Power Europe foresees
  - 170 GW PV in 2021
  - 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

…and 100% Electrification is Not Possible



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

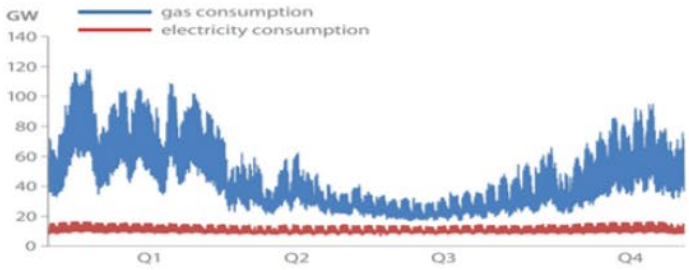
1 pipeline of 48" is able to pass on the same energy as 8 high power lines

	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

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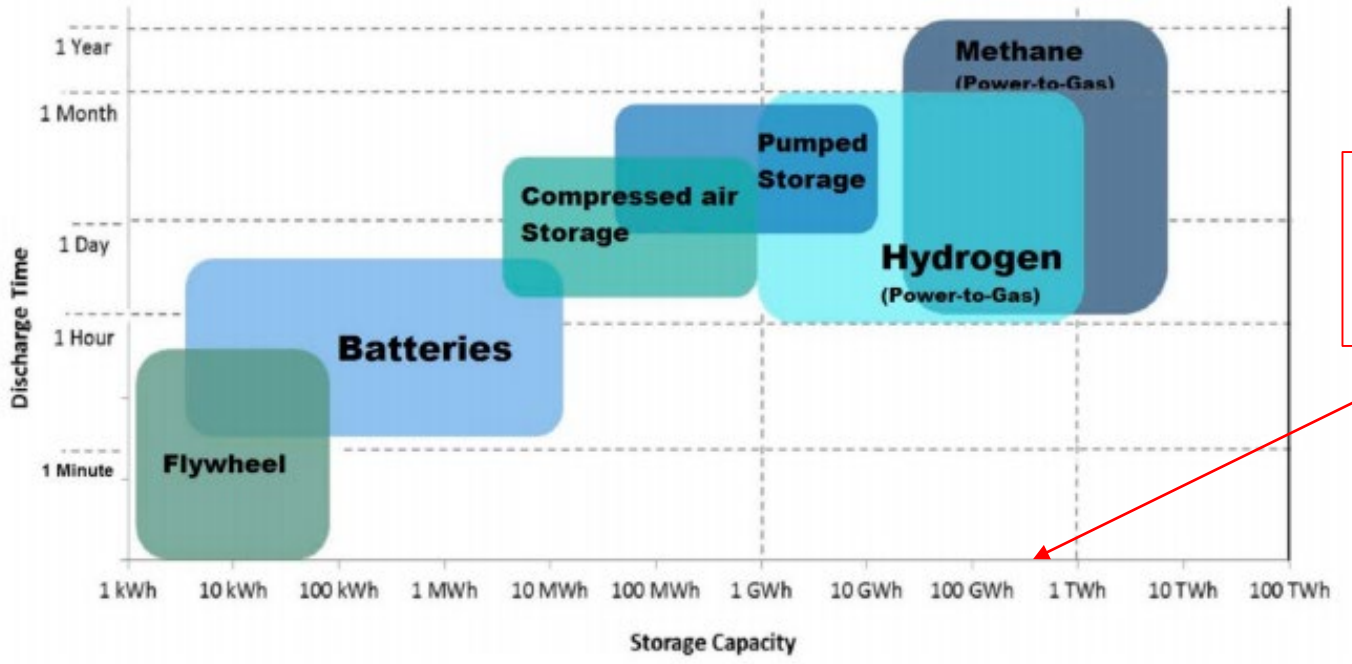

Please note it is a logarithmic scale

Source: School of Engineering, RMIT University (2015)

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

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

Hybrid System – Sector Integration

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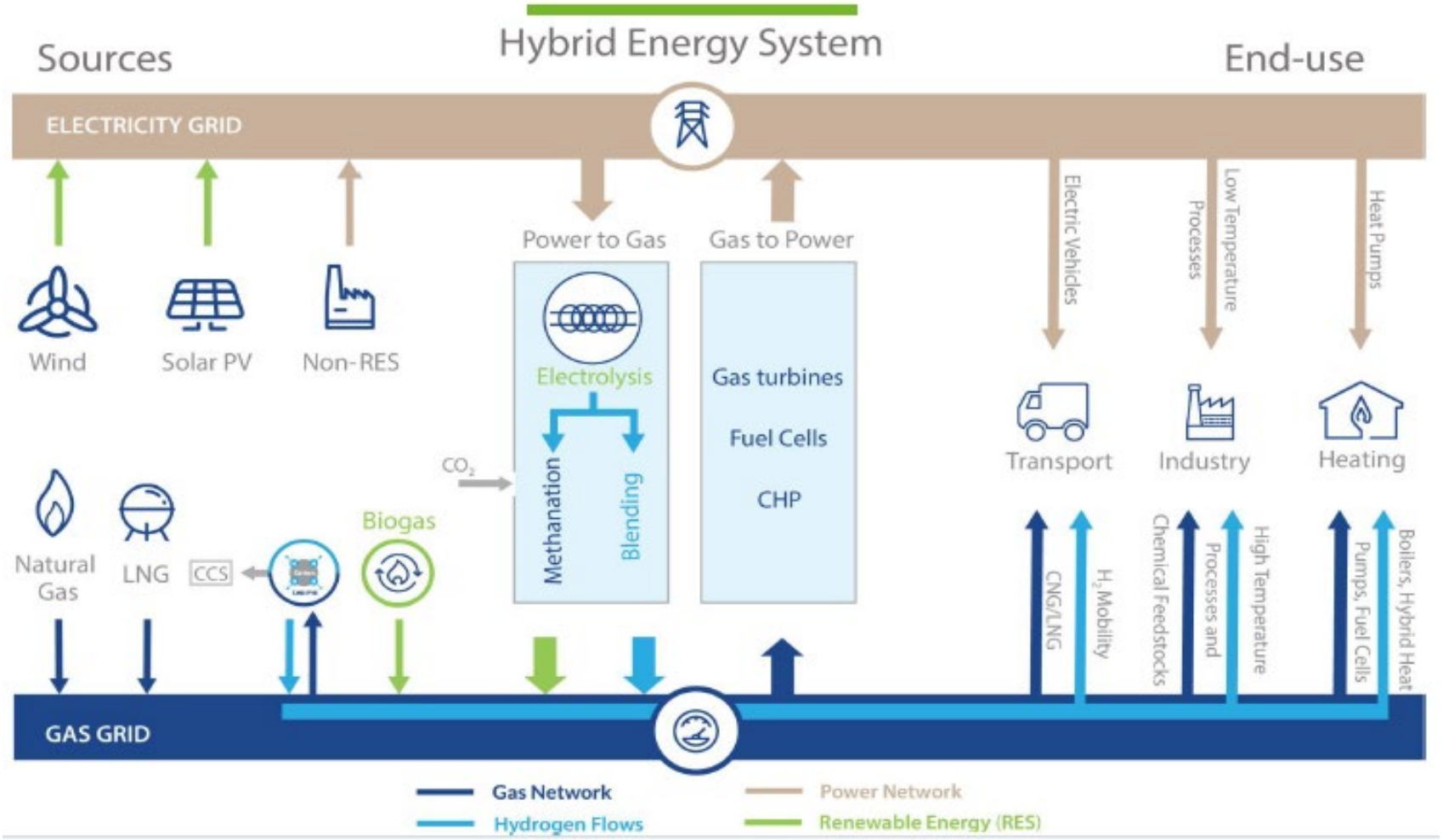

Source: ENTSOG

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

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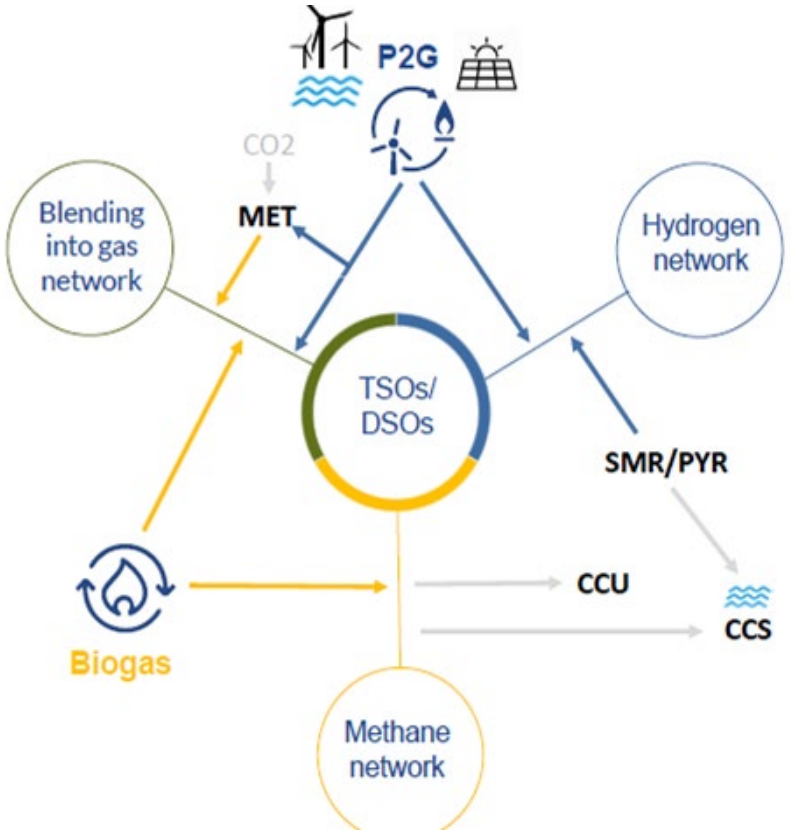
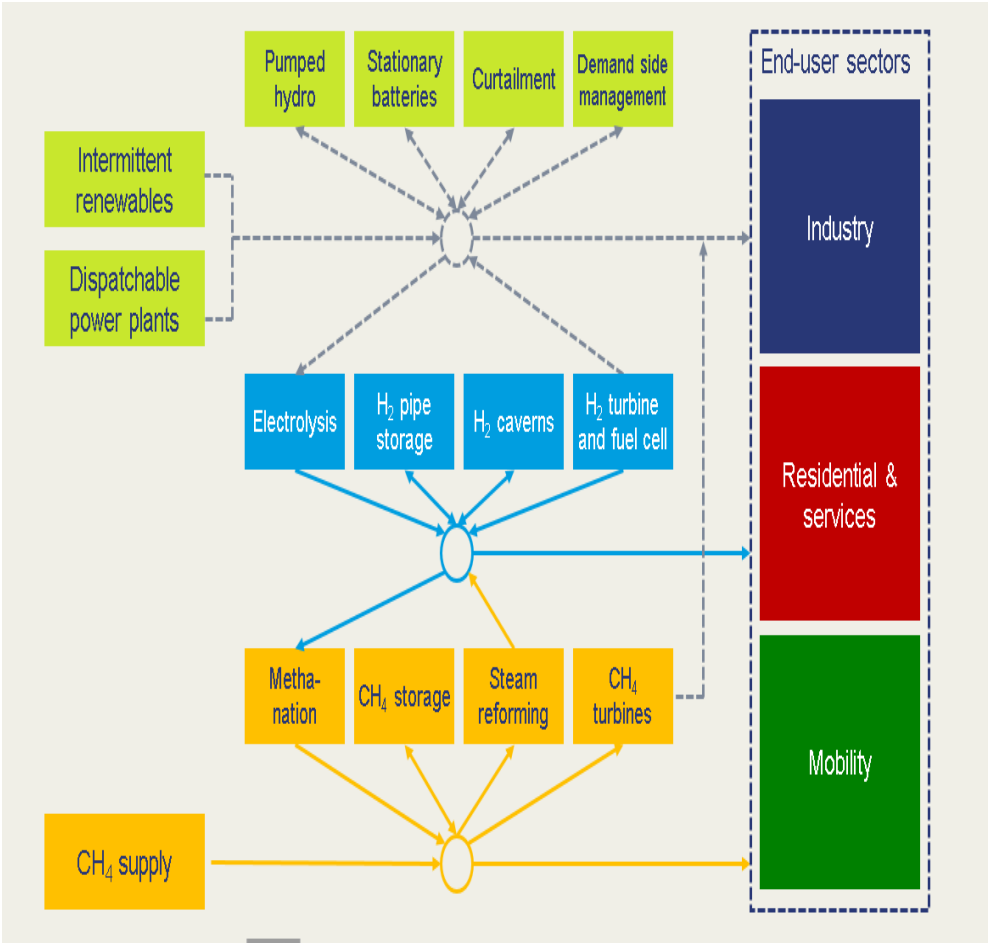


Legend:
MET = Methanisation; P2G = Power to Gas; SMR = Steam Methane Reforming, PYR = Pyrolisis; CCS = Carbon Capture and Storage; CCU = Carbon Capture and Utilisation

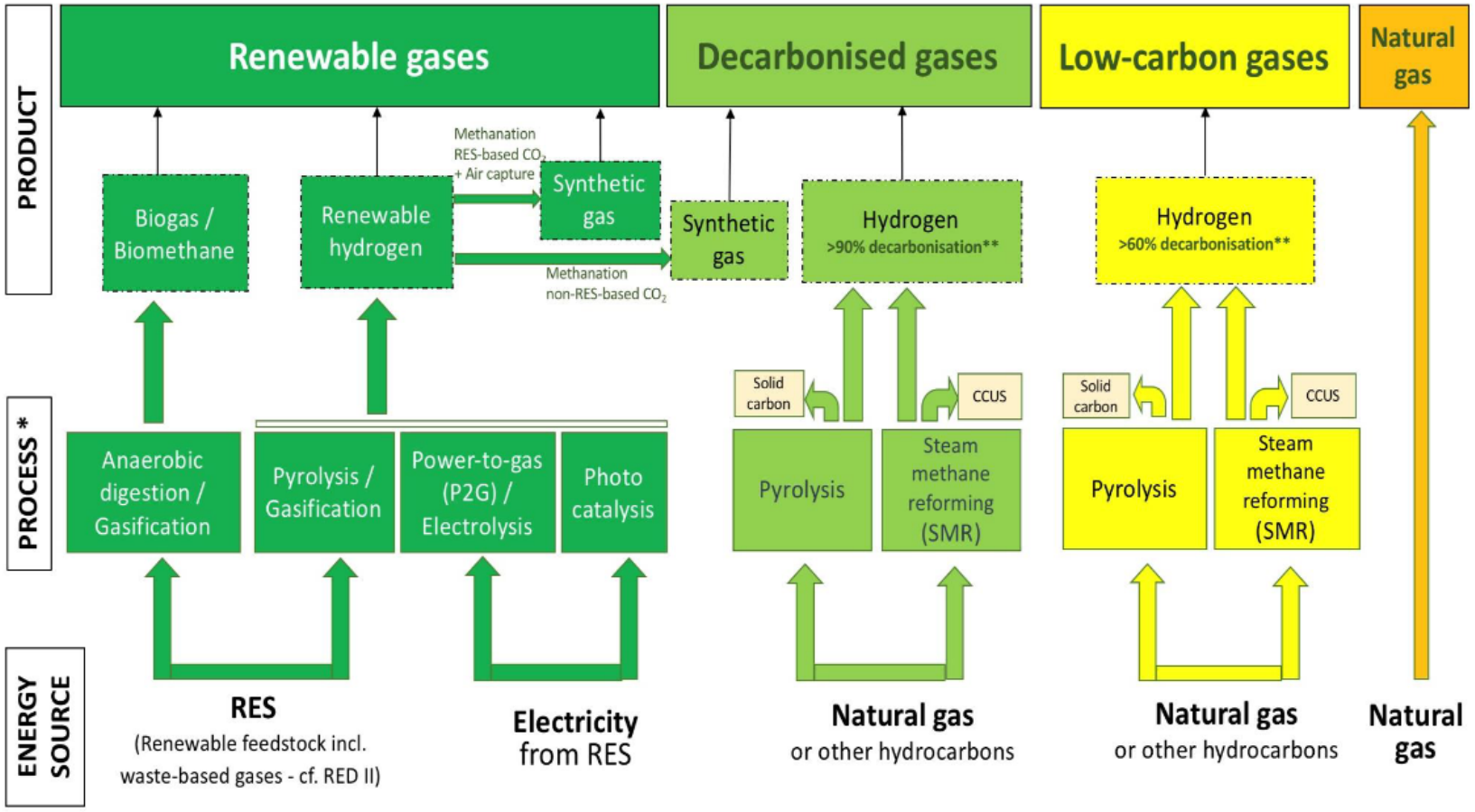
Source: ENTSOG



Source: Trinomics - 2019 (Study for European Commission)

Terminology for New Gases

UNECE



Source: New Gases Network

Recommendations (1/2)

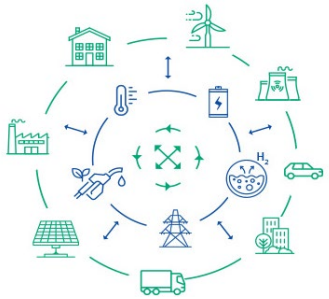


Image: European Commission

- **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
- **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**

UNECE

Thank you

Decarbonisation through Synergies Between Electricity and Gas

Geneva & Virtual, 22-25 September 2020

Presenters

ENERGY

Keynote speaker:

Ms Yolanda Garcia Mezquita, Deputy Head, Strategy and Policy Coordination Unit, DG Energy, European Commission

Panelists:

Mr Abel Enriquez, EU Regulatory Affairs Manager, Enagas, Spain

Mr Constantine Levoyannis, Hydrogen Europe

Mr Florian Marko, Vice-chair of GEG, Austria

Mr Bjørn Simonsen, Nel Hydrogen, Norway

UNECE Workshop: Decarbonization through synergies between electricity and gas

Constantine Levoyannis, Head of Policy

23.09.20

The Advent of the Green Deal

93% of the EU population seeing climate change as a serious problem

72% agreeing that reducing fossil fuel imports can increase energy security and benefit the EU economically

"A different growth model is possible. I see the climate transition as a huge opportunity for the European economy...we have the technologies...just think of hydrogen..."

"Never before in Europe have we seen such a level of interest about hydrogen as we have today. The reason is twofold: we need hydrogen to achieve climate-neutrality and we should use this opportunity to invest in the clean energy technologies, to restart the economy and promote innovation after the devastating economic effects of the COVID crisis."

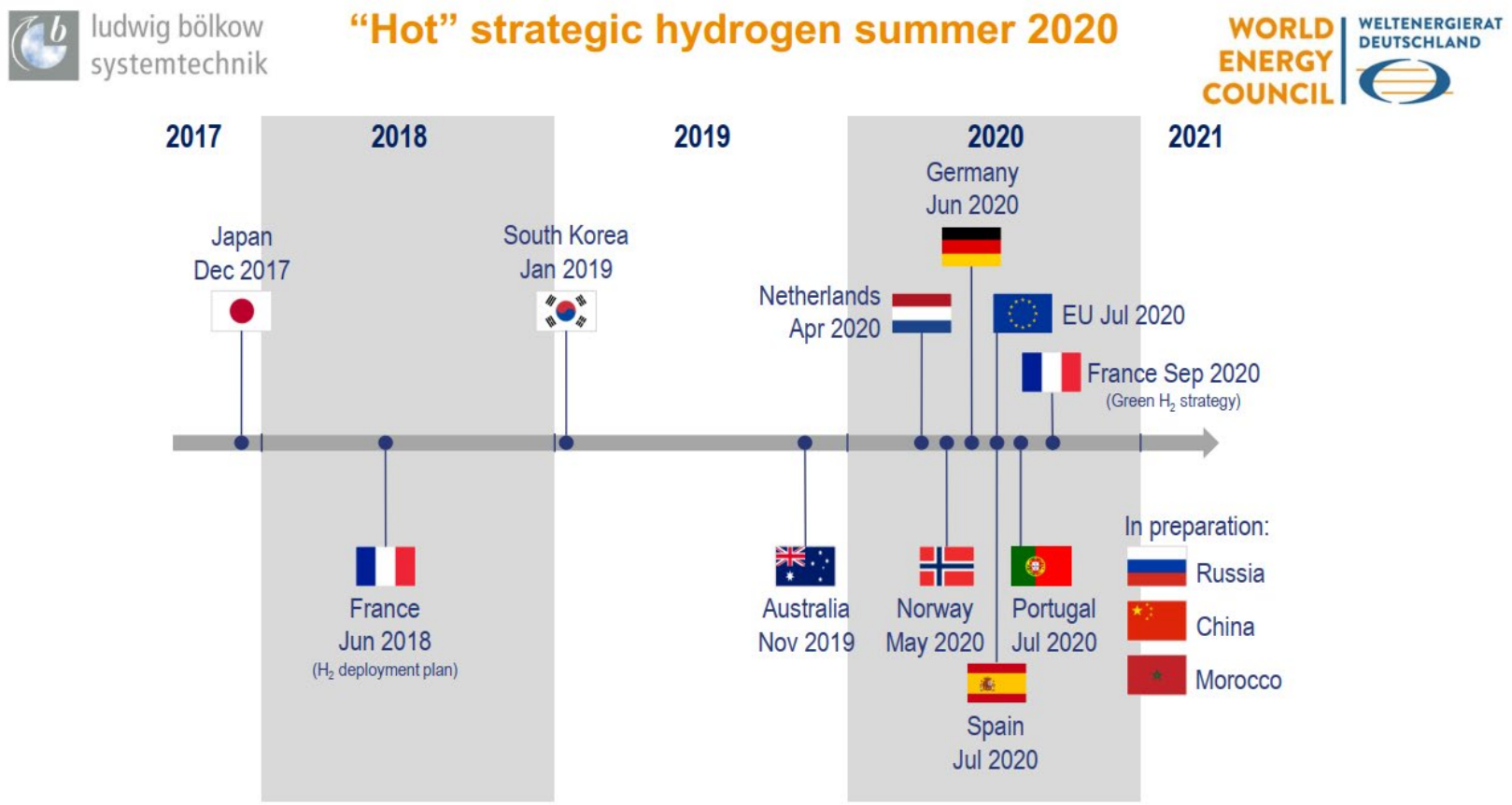
@Global Hydrogen Forum 2020, June

Hydrogen Europe

“HydroGenewables”

Hydrogen Europe

Global Hydrogen Developments



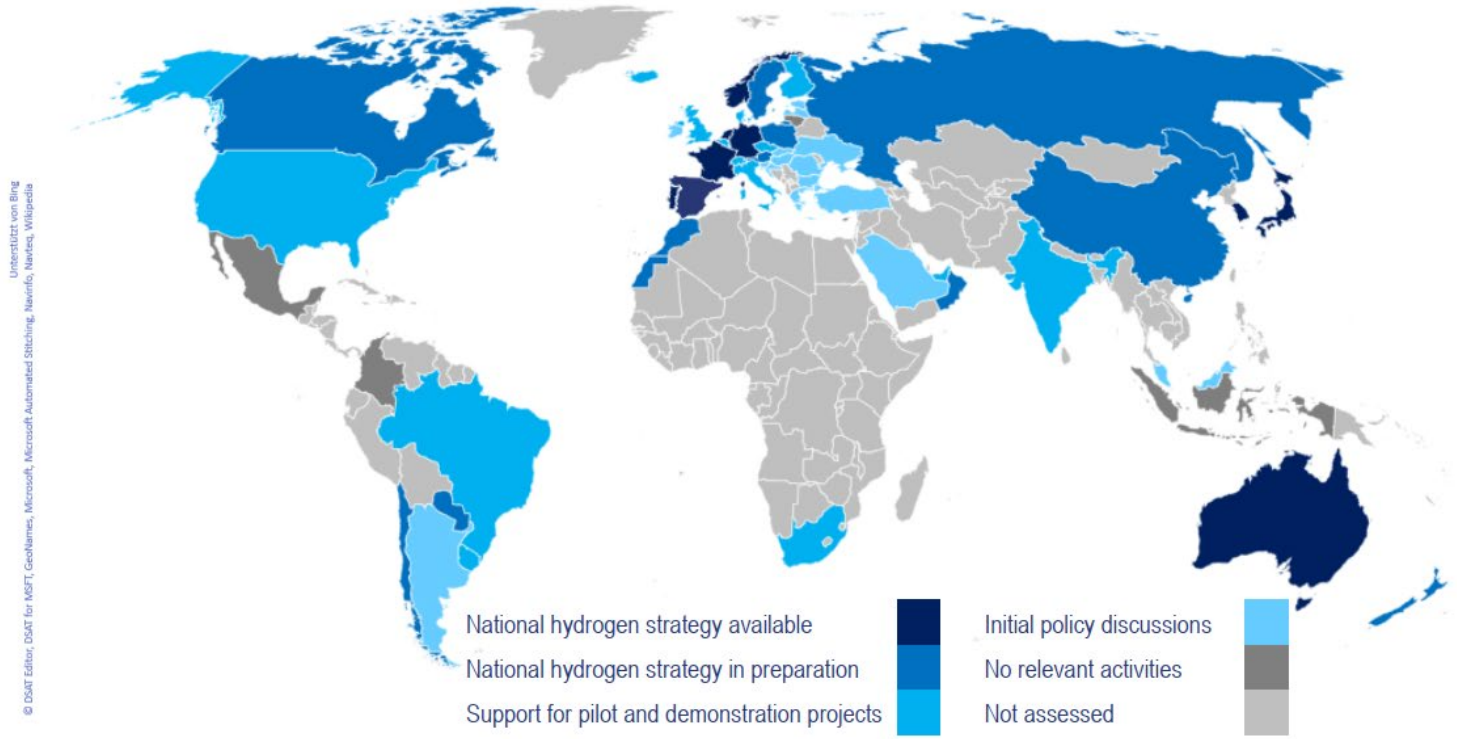
Hydrogen Europe

Global Hydrogen Developments

ludwig bölkow systemtechnik

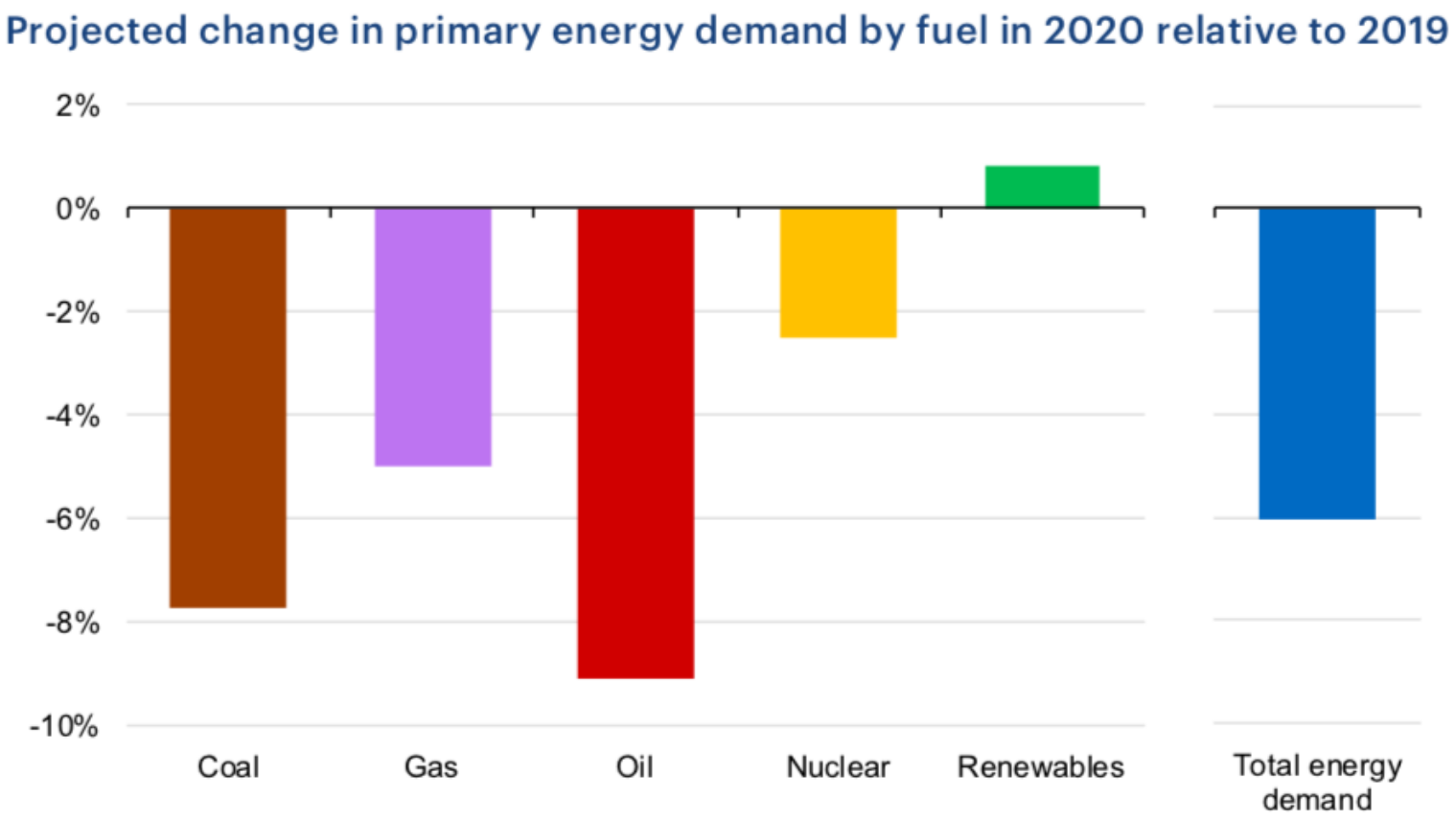
Overview H_2-strategies and activities (Status: August 2020)

WORLD ENERGY COUNCIL | WELTENERGIERAT DEUTSCHLAND



Hydrogen Europe

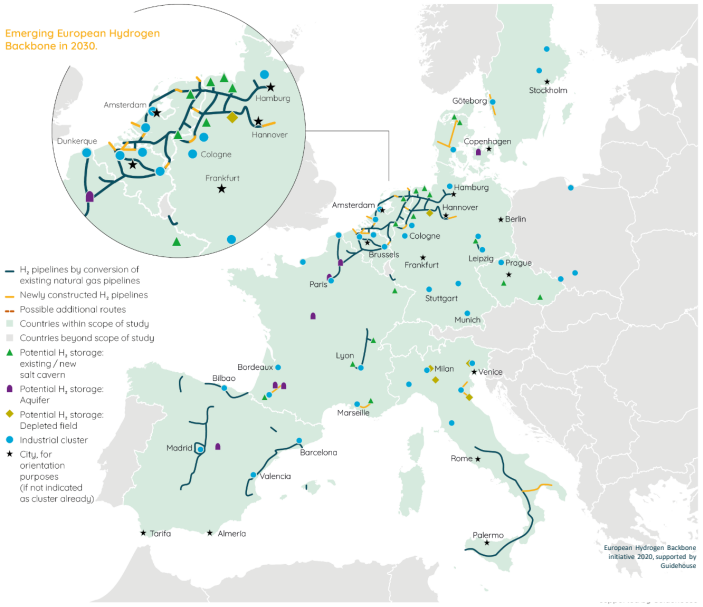
Global Hydrogen Developments

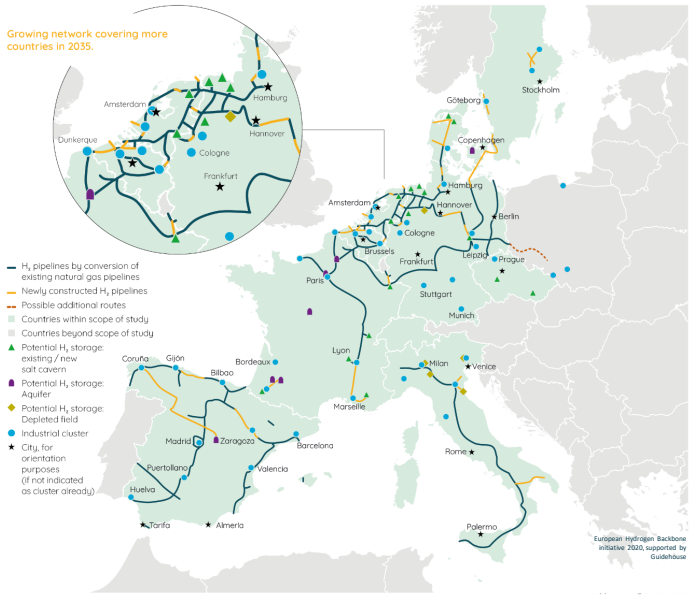


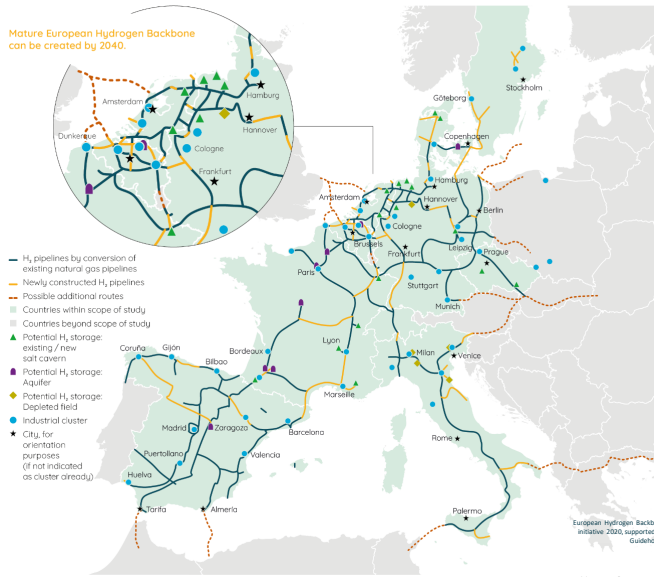
Source: *IEA, April 2020*

Hydrogen Europe

Hydrogen Infrastructure Development







Source: *Gas for Climate: European Hydrogen Backbone Study, Guidehouse, July 2020*

Hydrogen Europe

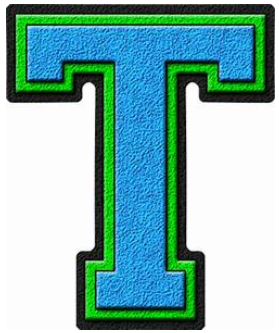
The value of gas infrastructure

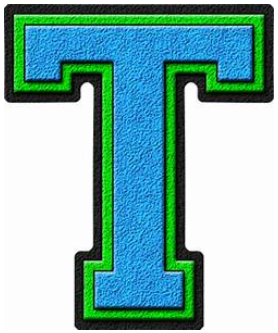
	Cable (BritNed)	Pipeline (BBL)
Capacity	1 GW	15 GW
Cost of construction	€ 500 mln	€ 500 mln
Volume (year)	8 TWh	120 TWh

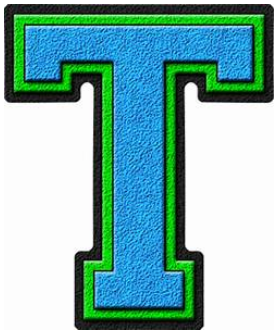
Hydrogen Europe

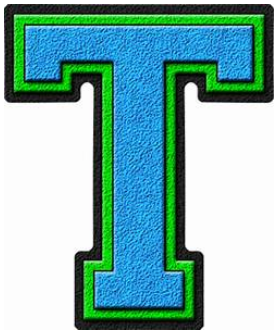
Recommendations

ADOPT A UNIFORM METHODOLOGY FOR CALCULATING THE LIFE CYCLE GREEN HOUSE GAS EMISSIONS FROM RENEWABLE AND LOW-CARBON HYDROGEN









- **Establish the principle of CARBON CONTENT as the new CURRENCY of the future energy system**

- **Guarantees of origin that are TRACKABLE, TRACEABLE, TRANSPARENT and TRADEABLE**

Hydrogen Europe

Thank you for your attention!

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Hydrogen Europe

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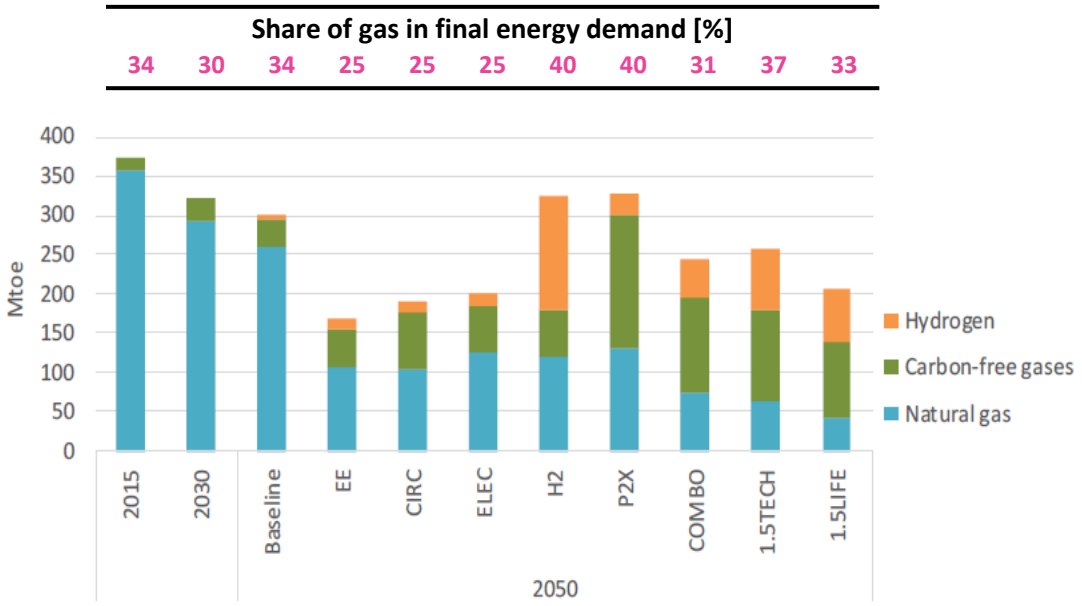
Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Renewable gases in the era of decarbonisation: Strategic and regulatory approaches

Florian Marko
Directorate for Energy Policy
DG Energy
23 September 2020

The Green Deal – Carbon Neutrality 2050

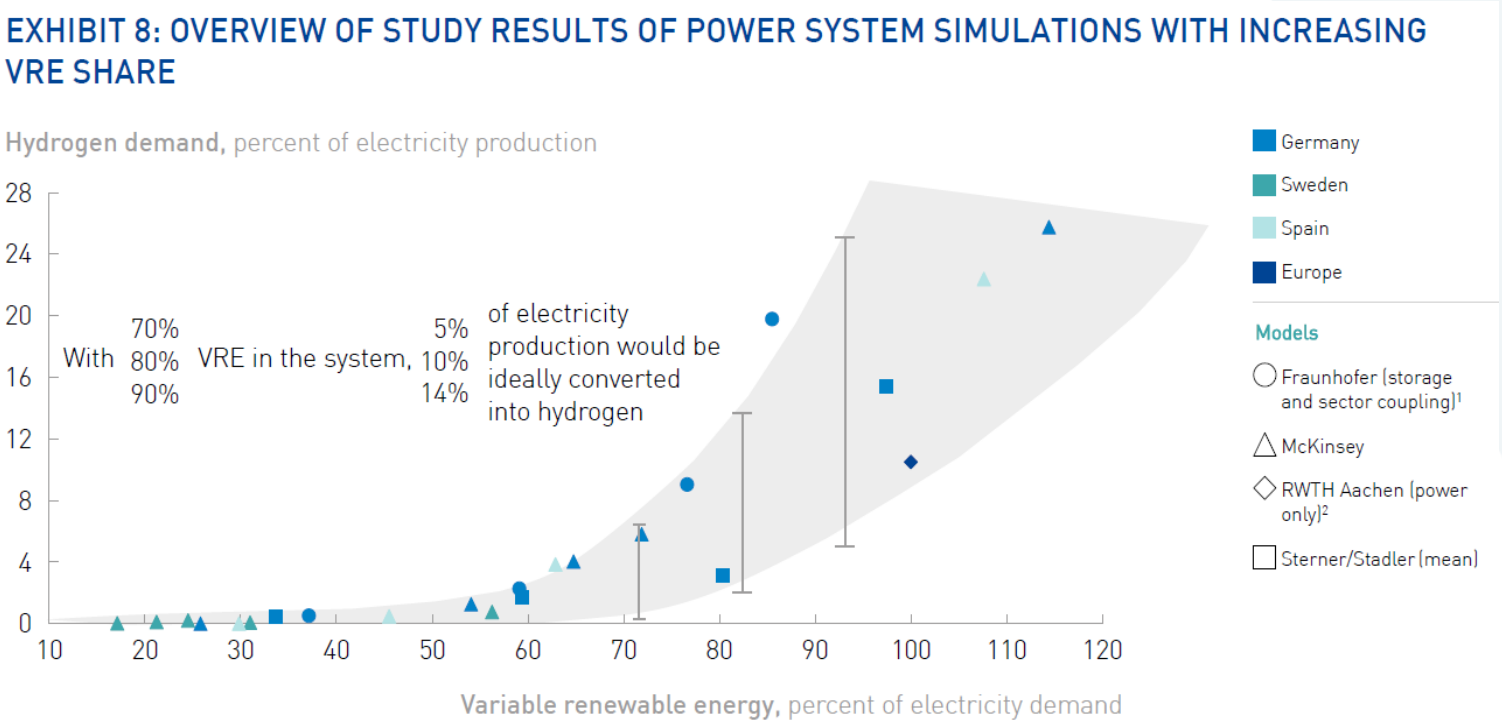


Note: "carbon-free" gases refer to e-gas, biogas and waste-gas.

Source: Long-Term Strategy 2050 of the EC, 2018; PRIMES

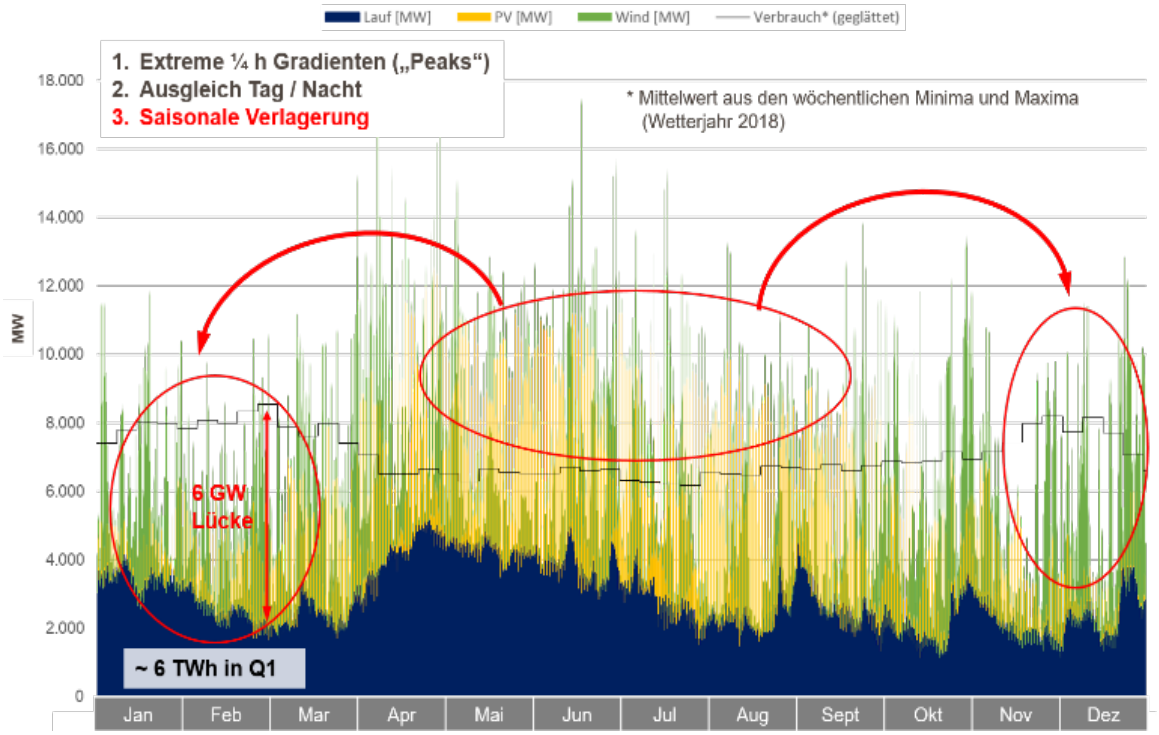
- **Renewable molecules like hydrogen have an essential role for the deep decarbonisation until 2050**
- Even in the electrification scenario (ELEC) gas represents 25 % of the final energy demand
  - **on average: 35 %**
- in addition: 3 – 8 % renewable liquids (depending on scenario)

Demand for Power-to-Gas



Source: FCH JU „Hydrogen Roadmap Europe", 2019

AT: 100 % renewable electricity in 2030, carbon neutrality 2040



Systemic needs

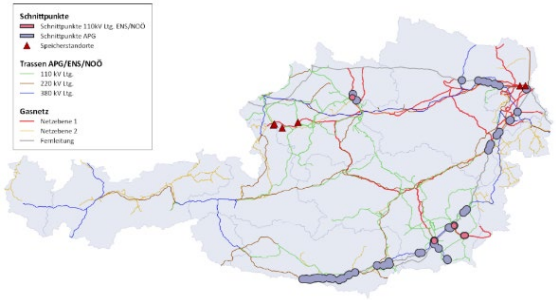
- Flexible Loads
- Flexible renewable production capacities

Source and Model: Austrian Power Grid, 2019

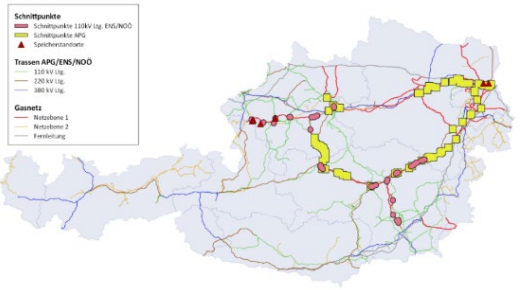
Gas Grid: Network for Decarbonisation

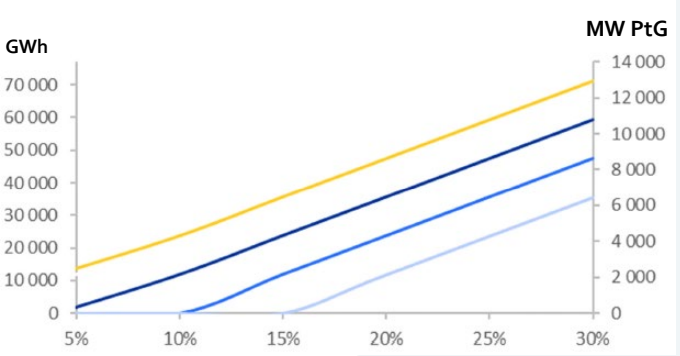
Potential Locations for Sector Coupling and Integration

Permanent locations



Seasonal locations (June – September)





Amount of hydrogen in the gas grid

Model and Graphics: Austrian Gas Grid Management (AGGM), 2019

Regulatory Aspects

Ensuring legal certainty

- Definitions
- System of guarantees of origin

Fair levies und network charges

- Avoiding double tariffs
- Superposing network charges
- Grid-supportive behaviour
- Taxation

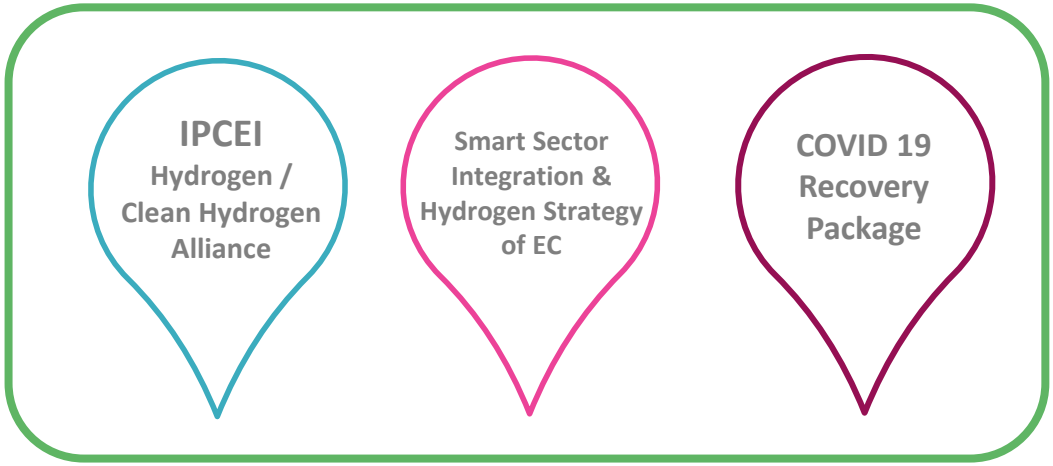
Strengthening market players

- Incentiving schemes (CAPEX & OPEX)
- Role of TSOs and DSOs

Overcoming technical barriers

- H_2-Fitness in the gasgrid
- Quality standards
- Customer billing
- End-user units

Current Hydrogen Focal Points for the Green Deal



Federal Ministry
Republic of Austria
Climate Action, Environment,
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Thank you for your attention!

Florian Marko
Directorate for Energy Policy
DG Energy
florian.marko@bmk.gv.at

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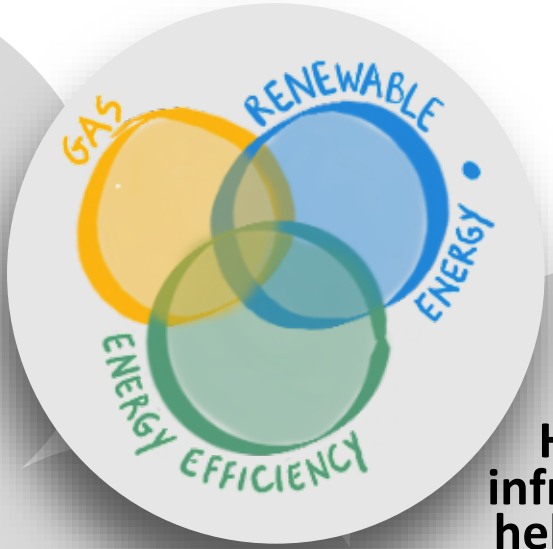
Q & A

ENERGY

How can UNECE accelerate the transition to a hydrogen economy?



What is the role of renewable/ low-carbon/ decarbonized gases in the transition?

How can gas infrastructure help increase the share of variable RE in the energy mix?

The key recommendations to UNECE member States on decarbonization through gas-RE synergies?

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GEG Item 6 and GERE Item 7:
Workshop: Decarbonization through synergies between electricity and gas

Thank you!