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EU4ENERGY PHASE II

Regulation of Energy Infrastructure to support the Energy Transition

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Introduction

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- Decarbonisation is one of the core priorities of Europe's energy sector, and the EU Green Deal sets ambitious targets that require significant developments in energy infrastructure

- With the aim of supporting the energy transition, regulators face **several challenges**, and will have to make a broad range of choices in relation to different aspects of **infrastructure regulation**

ACCESS RULES

ACCESS PRICE

- CONNECTION TO THE NETWORK
- USE OF THE NETWORK

QUALITY OF SERVICE

UNBUNDLING

PLANNING

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Agenda

REGULATION OF GAS NETWORKS

- **FUTURE REGULATORY DECISIONS**
  ON REPURPOSING, DECOMMISSIONING AND REINVESTMENT
- **ADDRESSING BIOMETHANE DEVELOPMENT**

REGULATION OF ELECTRICITY NETWORKS

- **TARIFF DESIGN FOR END USE**
- **TARIFF DESIGN FOR GENERATION**
- **PLANNING AND MANAGING GRID INVESTMENTS**

EU DEVELOPMENTS

- **HYDROGEN STRATEGY**
- **GAS DECARBONISATION PACKAGE**
- **METHANE EMISSIONS**
- **TRANS-EUROPEAN ENERGY NETWORKS AND PROJECTS OF COMMON INTEREST**

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REGULATION OF GAS NETWORKS

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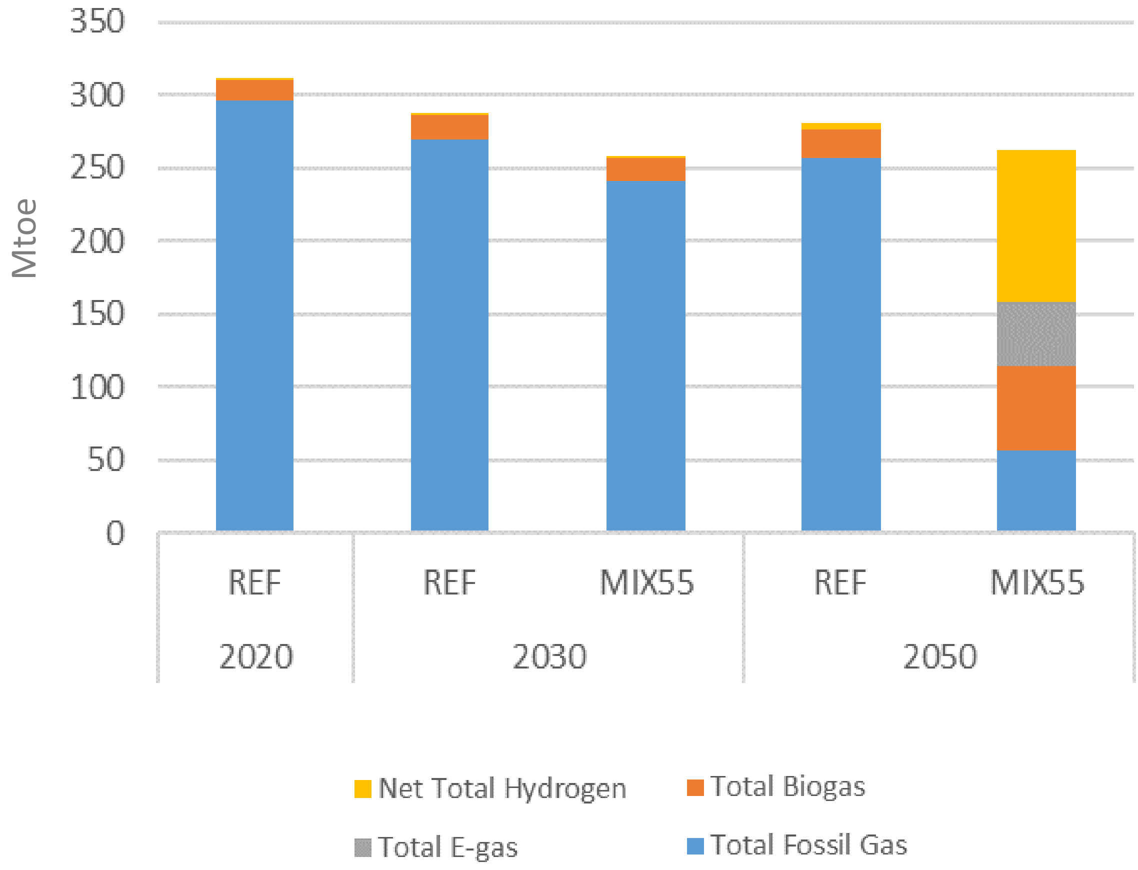
Gas networks



Source: PRIMES, MIX scenario

- Gaseous fuels account for roughly 25% of total EU energy consumption, used for 20% of EU electricity production, and 40% of heat production
- In case direct electrification is technically or economically not viable, gaseous fuels are likely to remain present in the EU's energy system
- Biogas and biomethane, renewable and low-carbon hydrogen and synthetic fuels will gradually replace fossil gases

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Gas networks | Challenges

- How to adapt regulation of gas networks to an **uncertain future** with lower levels of (natural) gas
  - Declining amount of required network capacity, risk of spiralling costs effects
  - Risk of stranded assets (i.e. assets no longer used and potentially costs not recovered)
  - Costs for removing gas connections and parts of the gas network (especially DSO's)

- How to deal with the increased **local production** of renewable and low-carbon gases (e.g. biomethane), generally occurring at DSO level
  - Investments required
  - Optimal use of existing capacity

- How to optimally manage the transition to **hydrogen**
  - Manage H2 injections into gas grid
  - Plan repurposing investments and allocate respective costs

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REGULATION OF GAS NETWORKS

FUTURE REGULATORY DECISIONS

ON REPURPOSING, DECOMMISSIONING AND REINVESTMENT

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Gas networks | Future regulatory decisions

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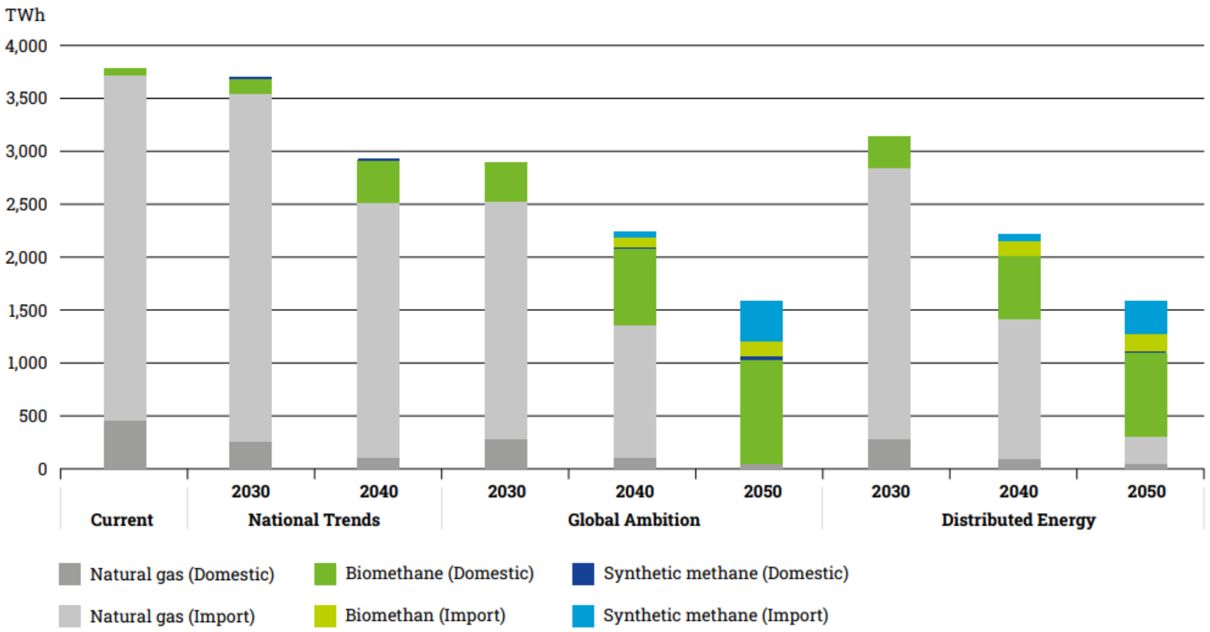
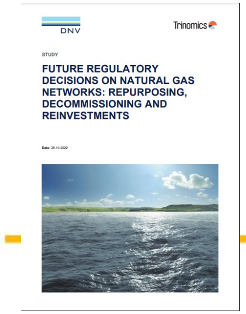
Methane supply to EU27. Source: ENTSOG/ENTSOE, TYNDP 2022, Scenario Report.




DNV
Trinomics
STUDY
FUTURE REGULATORY DECISIONS ON NATURAL GAS NETWORKS: REPURPOSING, DECOMMISSIONING AND REINVESTMENTS

2022 ACER study

Future Regulatory Decisions on Natural Gas Networks: Repurposing, Decommissioning and Reinvestments (DNV)

Decreasing demand forecast

- European and national decarbonisation targets indicate a permanent decline of natural gas demand → decline in transported gas volumes

Future use of natural gas transmission assets

- Current natural gas infrastructure will be used to transport RES gases (biomethane, hydrogen)
- Uncertainty about future utilisation rates

Risks

- Tariff increases (cost spiralling effect)
- Risk of stranded assets (not utilised and/or paid for)

Regulatory challenges

- Identify and quantify
- Maximise the utilisation of existing infrastructure
- Rules and regulation on stranded assets
- TSO revenue in the context of decreasing network use

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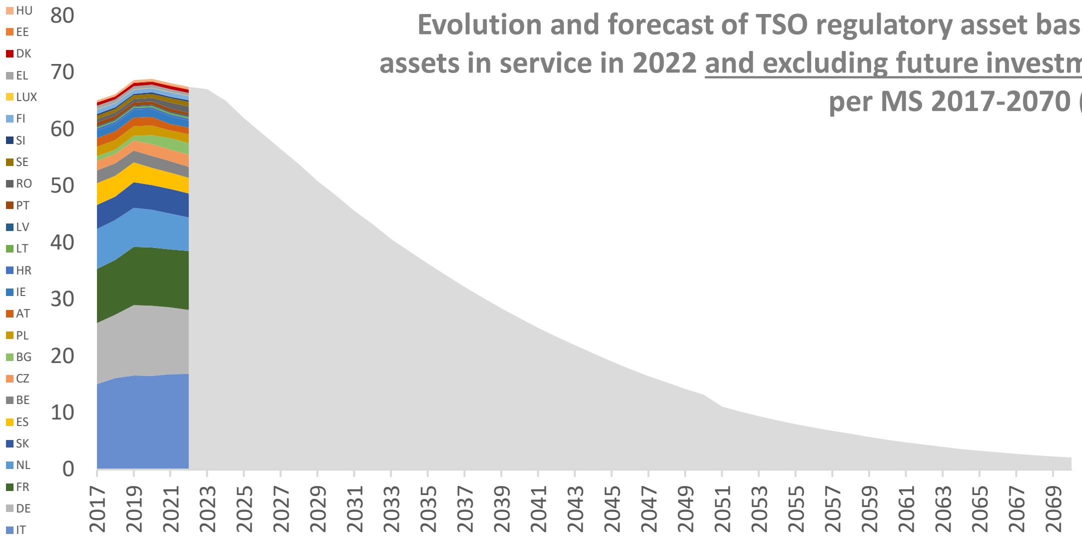
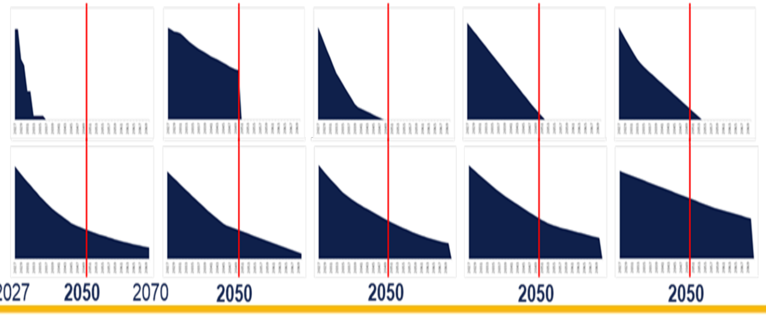
Gas networks | Future regulatory decisions
Decommissioning and reinvestments

DEPRECIATION

Evolution and forecast of TSO regulatory asset based on assets in service in 2022 and excluding future investments, per MS 2017-2070 (€ bn)

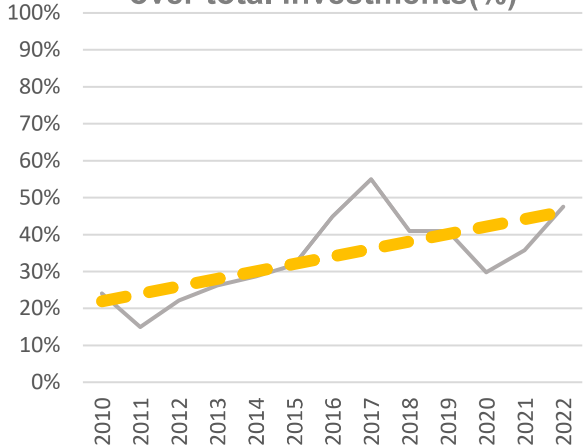


Selected TSOs RAB per Member State (without future investments) – anonymized. Units on the vertical axis (€) differ across graphs



REINVESTMENTS

Share of infrastructure replacements over total investments(%)



- EU aggregate TSO RAB costs are consistent with 2050 objectives → but depreciation profiles vary greatly across the networks
- Asset replacements will influence future network investments
- Allowed revenue methodologies key for ensuring the consistency of TSO costs with EU decarbonisation targets

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Gas networks | Future regulatory decisions

Repurposing of gas assets

An emerging topic is also the adaptation or conversion of existing natural gas infrastructures to become able to transport H2.

- **Adaptation** → Blending H2 into current grid
  - In principle, H2 and CH4 in the same market → Costs borne CH4+H2 users

- **Conversion** → Dedicated H2 pipeline
  - H2 and CH4 into different markets → Future H2 users would have to pay for the net value of pipeline + conversion costs // No cost on CH4 users

Gas networks | Future regulatory decisions
Regulatory challenges

- How to identify potential stranded assets → NRA faces information asymmetry with TSO
- How to deal with stranded costs, and who should bear the associated risk
- How to ensure decommissioning does not pose threats in terms of reduced security and reliability of supply, and reduced potential competition

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Gas networks | Future regulatory decisions
Regulatory options

- **Improve information quality and network planning**
  - Establish network utilisation targets and trajectories based on decarbonisation policies
  - Identify and quantify stranded asset risks based on joint scenarios

- **Avoid the risk of stranded assets and spiralling costs effects**
  - Adapting asset depreciation (non-linear): Future demand will be based on a smaller consumer base → Depreciation can be accelerated or shortened to frontload cost recovery
  - Non-indexation of the RAB / Nominal WACC

- **Maximise infrastructure utilisation**
  - Regulatory mechanisms to extend the operation of fully depreciated assets

- **Introduce rules and criteria for decommissioning**
  - Quantify decommissioning costs and design rules to allocate them

Regulation needs to be dynamic

Assumptions underlying regulation need to be periodically revisited

Different regulatory principles need to be addressed and balanced

Cost-reflectivity – cost-recovery – 'fairness' – stability / predictability – transparency

Gas networks | Future regulatory decisions

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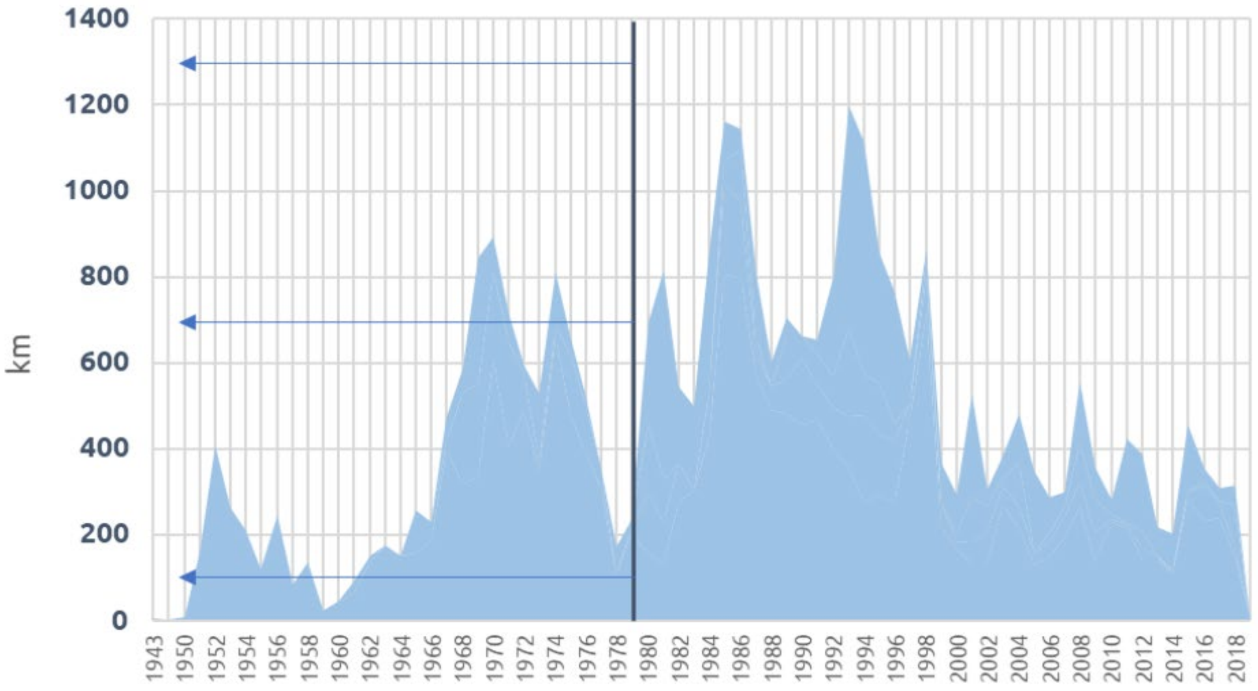
ITALIAN CASE STUDY

MAINTAINING FULLY DEPRECIATED ASSETS INTO OPERATION

ARERA’s objectives

- Extracting information from the TSO about the extent of assets’ possible life extension
- Inducing TSO to keep in exercise fully depreciated assets when technically feasible, and postponing/avoiding their substitution
- In the context of decarbonisation, lessening the risk of assets no longer being needed before the end of their technical life

Dynamic evolution of the Italian gas transmission network (Source: Snam Rete Gas)



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Gas networks | Future regulatory decisions

ITALIAN CASE STUDY

MAINTAINING FULLY DEPRECIATED ASSETS INTO OPERATION

- **Increased oversight on TSO investments**
  - ➢Asset Health Methodology to evaluate the need for substitution or the possibility of reinvestment (and obtain info on status of the network) → Measure safety, H-readiness and emissions

- **Incentive to postpone a substitution investment**
  - ➢Based on the benefit for the system of avoided remuneration
  - ➢Simulations show that postponing investment, in general, brings a benefit to the system (decreasing with the years of postponement)

- **Possibility to capitalise extraordinary maintenance expenses**

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Gas networks | Future regulatory decisions

DUTCH CASE STUDY MANAGING THE GAS SECTOR TRANSITION

- **Move from real to nominal rate of return (WACC), no longer indexing the Regulatory Asset Base (RAB)**
  - Inflation is immediately paid by users instead of during investments' lifetime

- **Divestments are immediately removed from asset base**
  - Costs are no longer remunerated by future users

- **Move from linear depreciation to degressive depreciation method**
  - Degree of 'acceleration' based on average expected decline in network use in the three scenarios
  - Degree of acceleration can be adjusted in next regulatory period. Important to start early (now), as there are not yet too many gas network 'leavers' → accelerated depreciation share by many consumers
  - In case of the TSO, assets that may be re-used for hydrogen are excluded from degressive depreciation

- **Operational costs of removing connections and parts of the network**
  - Need to move costs forward in time, for example via 'removal fee' and installation of separate fund (similar to design of fund for cross border auction rents)

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REGULATION OF GAS NETWORKS

ADDRESSING BIOMETHANE DEVELOPMENT

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Gas networks | Biomethane

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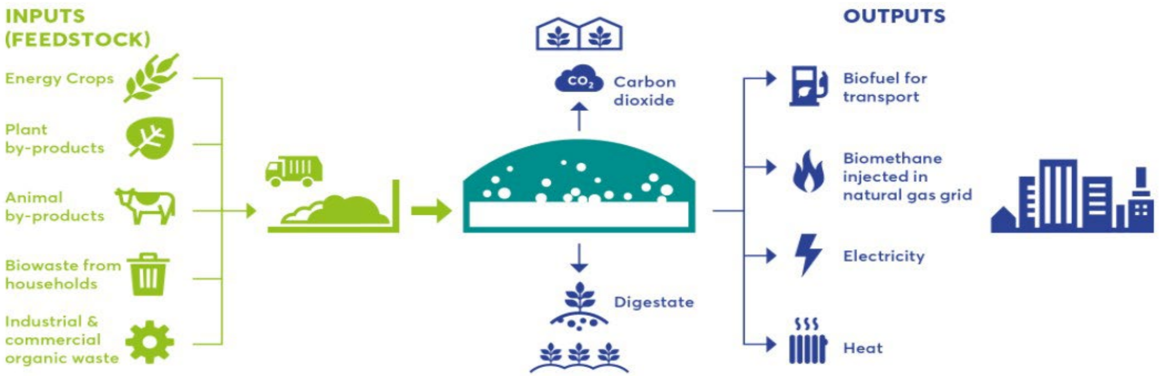
BIOGAS

- Produced through degradation of organic matter (effluents, intermediate crops, waste) in an oxygen-free environment ('anaerobic digestion')
- Mixture of methane (CH4), carbon dioxide (CO2) and small quantities of other elements
- Used to produce electricity and heat, energy source for cooking, converted in biofuel for transport ('bio-CNG'), or upgraded to biomethane and injected in natural gas networks

BIOMETHANE

- Mainly produced through upgrading biogas, but also via alternative technologies
- Prevents GHG emissions across the whole value chain
- Well-mature sector (contrary to other new gaseous alternatives, i.e H2)
- Perfectly substitutable to fossil methane



CHALLENGES OF NETWORK INTEGRATION

NATURAL GAS SYSTEMS DESIGNED TO DELIVER IMPORTED GAS FROM A LIMITED NUMBER OF INTERCONNECTION POINTS AND LNG TERMINALS TO CONSUMPTION SITES

→ NOT TO COPE WITH MULTIPLE DECENTRALISED INJECTION SITES

ADOPT A CONSISTENT APPROACH TO CONNECTION CHARGES

ADEQUATELY PLAN REINFORCEMENT AND ADAPTATION INVESTMENTS

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Gas networks | Biomethane
Connection charges

- Rapid growth of the sector can be fostered by solid incentive framework. Biomethane production facilities need to:
  - be economically viable → e.g. feed in tariff systems
  - access the market → e.g. purchase obligation for gas suppliers, with a system of guarantees of origin
  - **have equal and fair access to the network → e.g. right to injection**

- In terms of network management, important that the costs incurred for the access to the network (reinforcements, connection) of biomethane production plants are not entirely paid by the producer.
  - Avoid a system of 'first come, first pay': some producers would benefit from the network reinforcements which were financed by first-movers
  - The right for getting connected to the network (either distribution or transmission) should follow technical-economic criteria

Gas networks | Biomethane
Network adaptations

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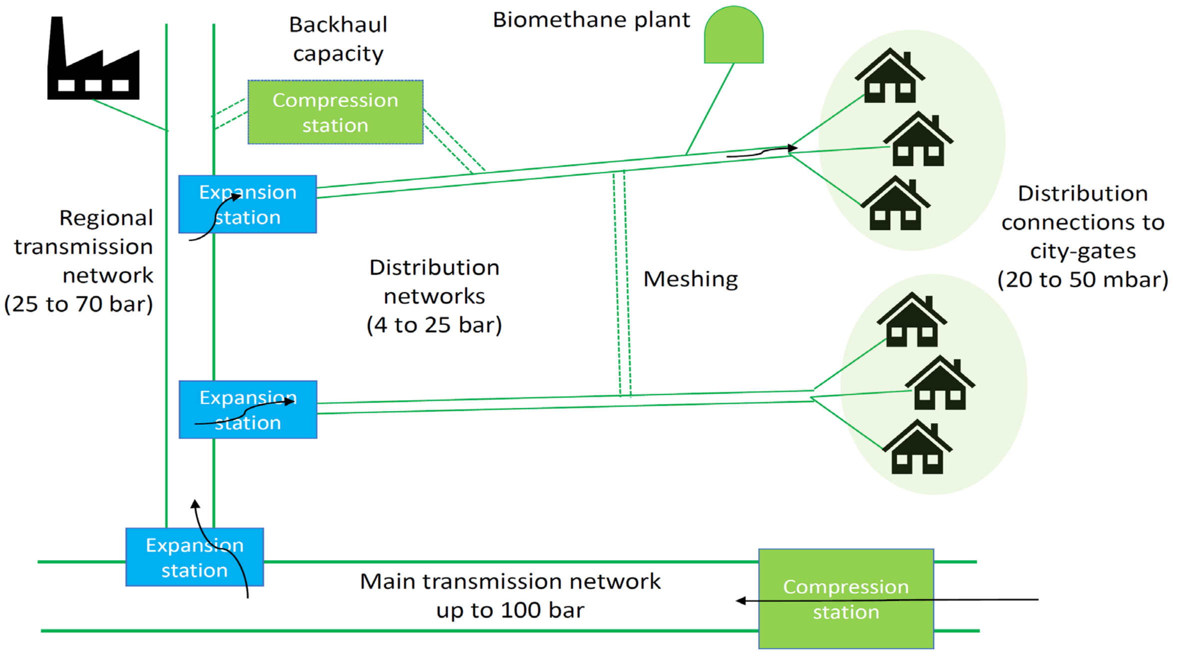
- **Backhaul installations (allowing reverse flows from distribution to transmission level)** are key to widening biomethane injection capacities → but are expensive. Who should operate them (DSO or TSO)?
- **DSOs play the role of forecasting** party and make sure the portfolio of each supplier in each distribution zone is balanced. Share injection/withdrawal info with TSOs
- Network constraints can also be addressed by offering **conditional capacity**
  - access to capacity can be clipped off ("**load shedding**") if gas consumption not sufficient to absorb all produced volumes
  - define rules and procedures for load shedding
- Network operators shall explore flexibility solutions to avoid load shedding



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Gas networks | Biomethane
The need for optimal planning

- At system level, there could be places to optimally locate decentralised gas production and injection → Points on the networks where injection of additional gas volumes do not require, in the short term, network adaptations or reinforcements (e.g., because demand is high, or network is meshed)
    - ➢ But leaving too much room for choice to producers could lead to sub-optimal results

- Possible regulatory solutions
    - ➢ TSOs and DSOs to be obliged to provide **information** on optimal locations
    - ➢ Connection charges or access charges differentiated according to the cost generated to the system (**locational signals**)

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Gas networks | Biomethane
Gas quality issues

- Biogas is a mixture of methane (CH_4), carbon dioxide (CO_2) and small quantities of other elements (water, oxygen, hydrogen sulphide)

- Typically, it is the producer who has the responsibility of upgrading the biogas to biomethane (by injecting oxygen) and purifying biomethane before injecting it into networks

- The decentralised injection of growing volumes of biomethane can lead to issues in terms of gas quality, which will need to be addressed

Gas networks | Biomethane

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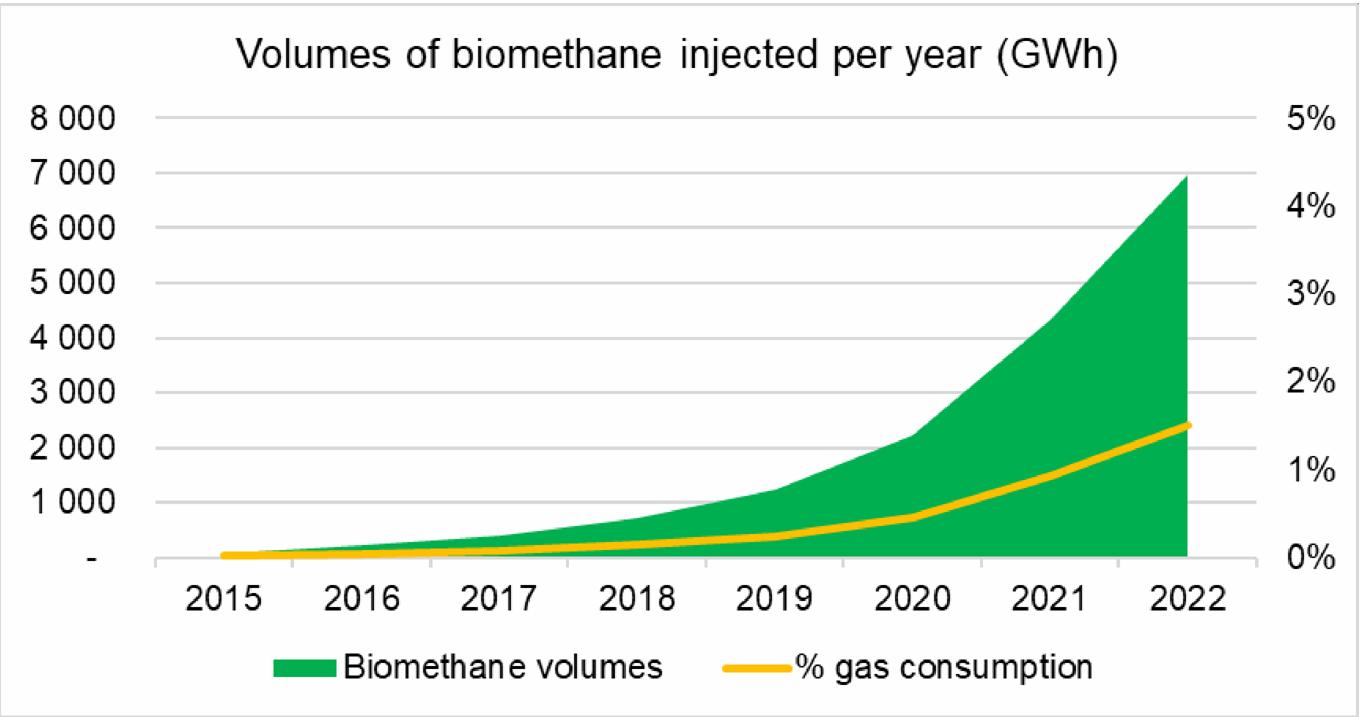
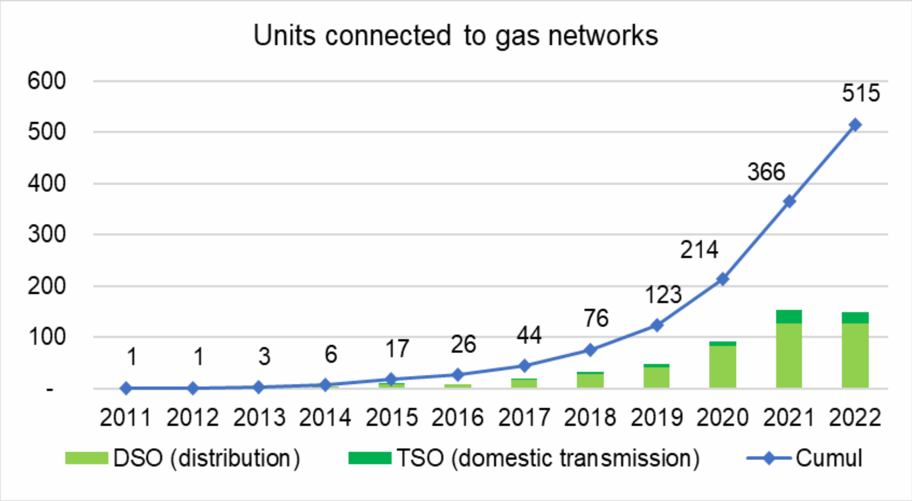
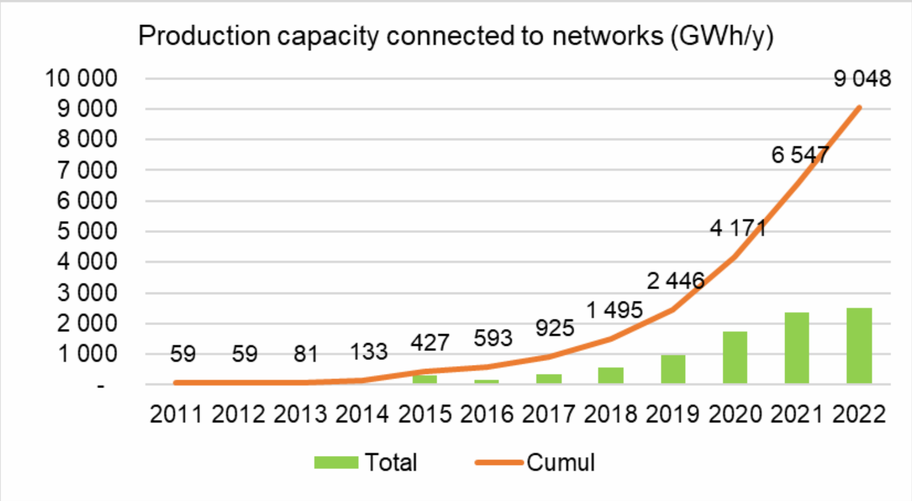
FRENCH CASE STUDY ADDRESSING BIOMETHANE DEVELOPMENT







Source: *Open Data Gaz* https://opendata.reseaux-energies.fr

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Gas networks | Biomethane

FRENCH CASE STUDY ADDRESSING BIOMETHANE DEVELOPMENT

- DSOs & TSOs establish a prescriptive connection zoning according to the level of a technical-economic criterion:
  - indication of best areas to build new biomethane capacity in terms of investment costs
  - indication of areas where reinforcements are technically feasible and economically suitable
  - threshold (4.700 €/Nm^3/h) for a passthrough of network reinforcement

- TSOs manage a national register for injection capacity development and booking

- Principles for cost-sharing and tariff passthrough to move away from the previous "first come, first pay" issue

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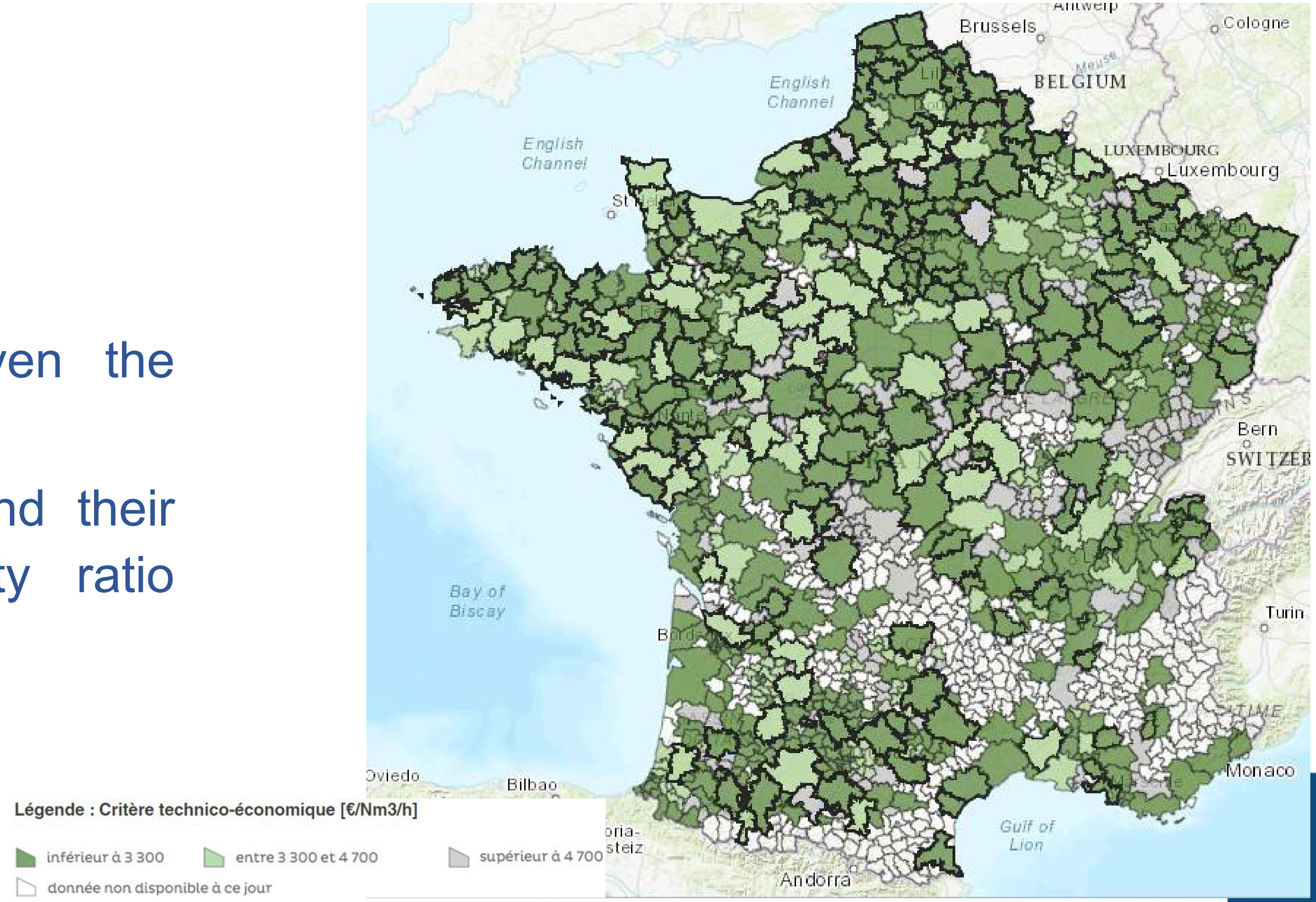
FRENCH CASE STUDY ADDRESSING BIOMETHANE DEVELOPMENT

Main steps of zone design

- Definition of zone boundaries
- Evaluation of connection capacity given the consumption level
- Identify known projects in the zone and their production capacity, with a probability ratio attributed to each project
- Establish **best connection solutions**



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REGULATION OF ELECTRICITY NETWORKS

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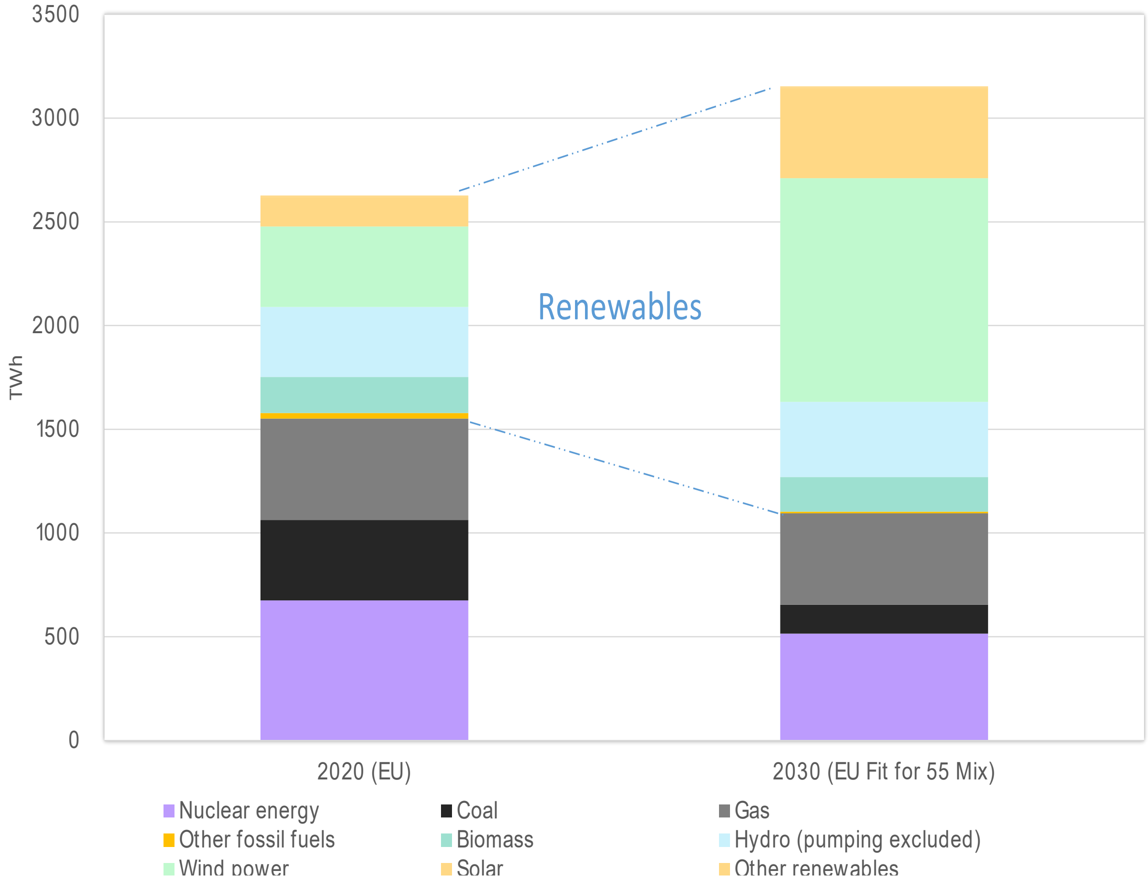
Electricity networks



- Energy production and use accounts for 75% of EU emissions, so accelerating the transition to a greener energy system is crucial
- Reducing greenhouse gas emissions by at least 55% by 2030 requires
  - higher shares of RES (20% in 2019 → 40% in 2030)
  - greater energy efficiency (17% in 2019 → 36% in 2030)
  - in an integrated energy system

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Electricity networks | Challenges

- **Electrification of end uses** requires significant amounts of capacity made available to users. How to reduce the amount of investment needed, and better exploit existing infrastructure? Regulators shall find the **optimal tariff design** for consumers to adapt their consumption, e.g. by relying on <u>Power-based tariffs</u>, or <u>Time-of-use signals</u>

- A similar issue arises with regards to **generation**: how to drive investments towards the most cost-efficient solutions from a network perspective? Are <u>locational signals</u> suited in a context of increasing generation from Renewable Energy Sources (RES)?

- Where investments cannot be avoided, how to achieve proper **network planning** to ensure the most cost-efficient solutions are adopted. The regulatory framework should be consistent in providing the right <u>incentives</u> and mitigating <u>risks</u>

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REGULATION OF electricity NETWORKS

TARIFF DESIGN FOR END USES

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Electricity networks | Tariff design for end uses

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- Electrification means replacing technologies or processes that use fossil fuels, like internal combustion engines and gas boilers, with electrically-powered equivalents, such as **electric vehicles** or **heat pumps**

- Power grids will also need to expand their capacity and flexibility to accommodate the growing demand for electricity. The increase in demand for capacity is not necessarily proportional to the increase in demand for energy

- **Regulatory tools**:
  - ➢ Shift towards more power-based tariffs
  - ➢ Introduce time of use signals

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Electricity networks | Tariff design for end uses
Power vs Energy-based

- **Energy-based (EUR/kWh)** tariffs have often been preferred as a tool to promote electricity savings, at the expenses of cost-reflectivity (i.e. cost caused by a network user being properly reflected in the amount paid)

- With increased electrification, higher electricity consumption does not necessarily mean energy inefficiency → **Power-based (EUR/kW)** tariffs can be less distortive
- But power-based tariffs, especially when referred to actual maximum power during peak load periods, may feature a higher complexity than energy-based charging and can have a negative impact on some tariff principles, such as simplicity, predictability and transparency

Electricity networks | Tariff design for end uses
Power vs Energy-based

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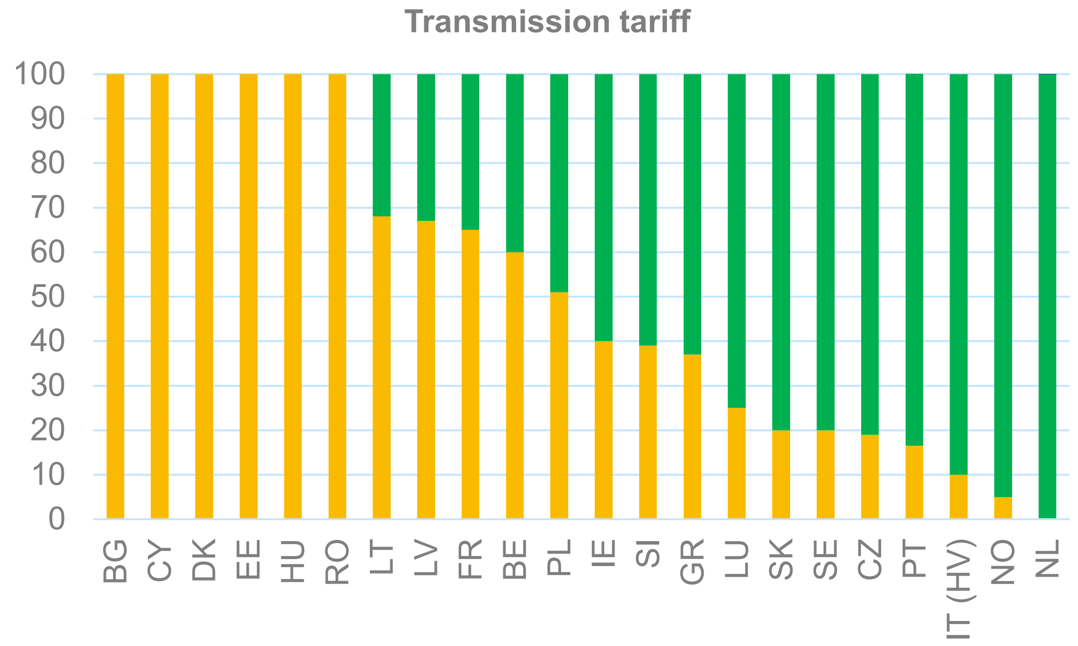
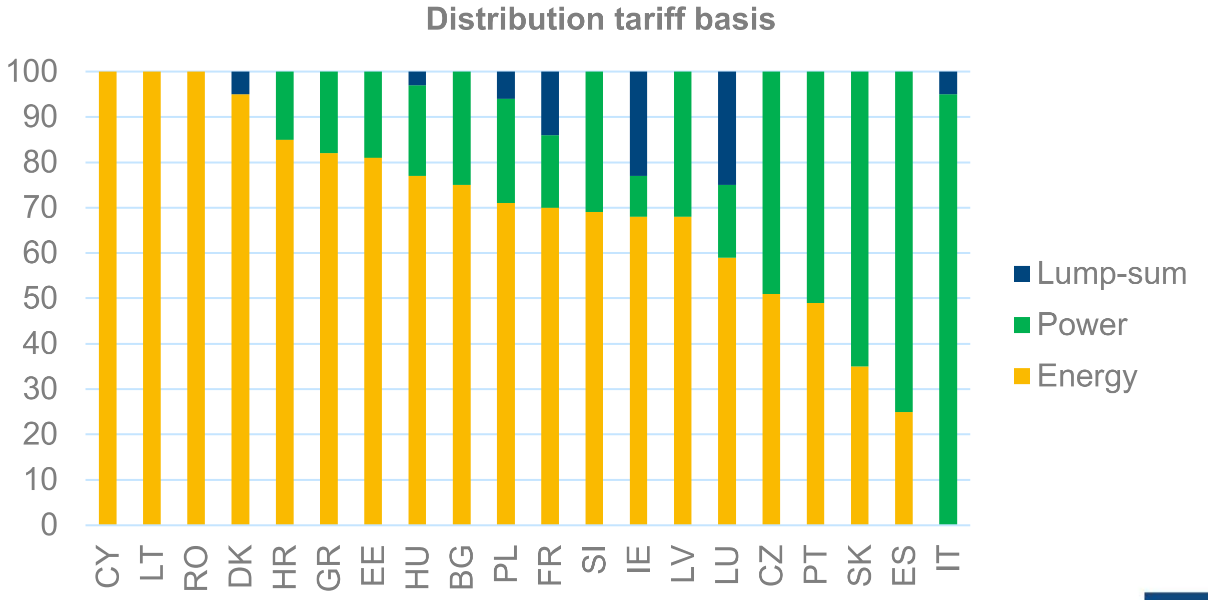
FOR WITHDRAWAL CHARGES, THE MAJORITY OF MS APPLIES A COMBINED TARIFF BASIS (ENERGY BASED AND POWER-BASED)





Source: ACER 2019 and 2021 Report on Electricity Transmission and Distribution Tariff Methodologies in Europe

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Electricity networks | Tariff design for end uses
Time of use signals

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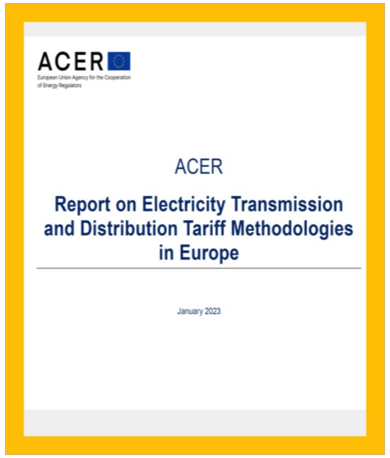
- **Time-of-use (ToU) network tariffs are charges that vary according to when the service is used** (e.g. by peak/off-peak, season, month, weekdays/weekends, hour).
- ToU give signals to network users on when to best use the network
  - Higher charges when network utilisation is closer to technical limits → Also: the coincident and rising use of the network during peak periods may induce the need for network reinforcement, thus justifying a higher network charge.
  - Use of the network in off-peak periods, on the other hand, does not lead to additional costs and thus a lower charge is justified to encourage the use in those time windows.
- ToU charges can be **static** (time periods defined in advance) or **dynamic** (peak period set at short notice, close to real time). Dynamic ToU charges better reflect actual system conditions, but are less predictable for network users
- ToU **effectiveness depends on multiple factors**
  - weight of infrastructure costs in the final electricity bill
  - the more refined the signals (e.g. dynamic network tariffs), the more complex the system is, requiring a sufficient level of automation
  - potentially conflicting time signals coming from dynamic wholesale energy prices

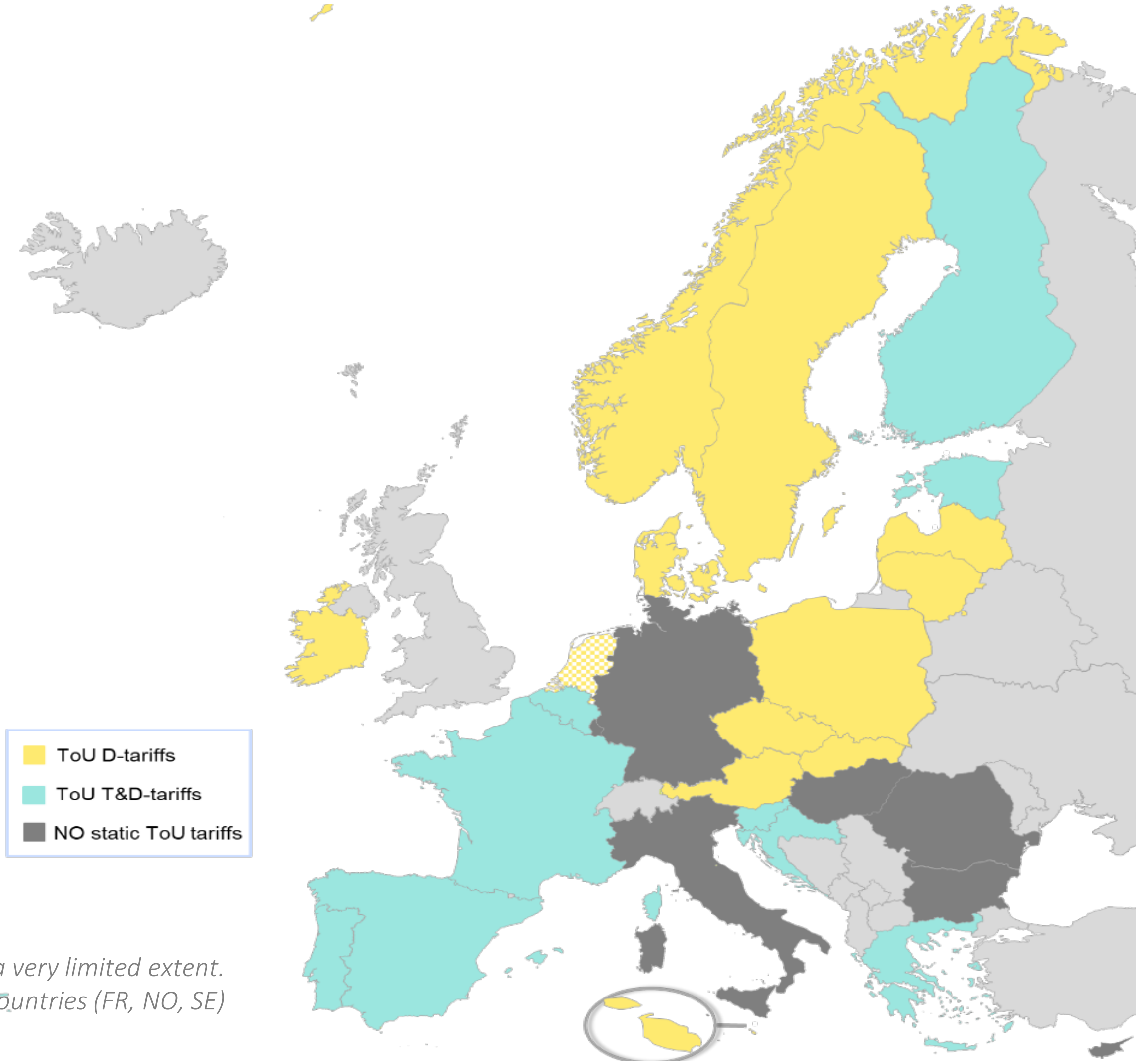
Electricity networks | Tariff design for end uses

Time of use signals

2023 ACER Report

Electricity Transmission and Distribution Tariff Methodologies in Europe





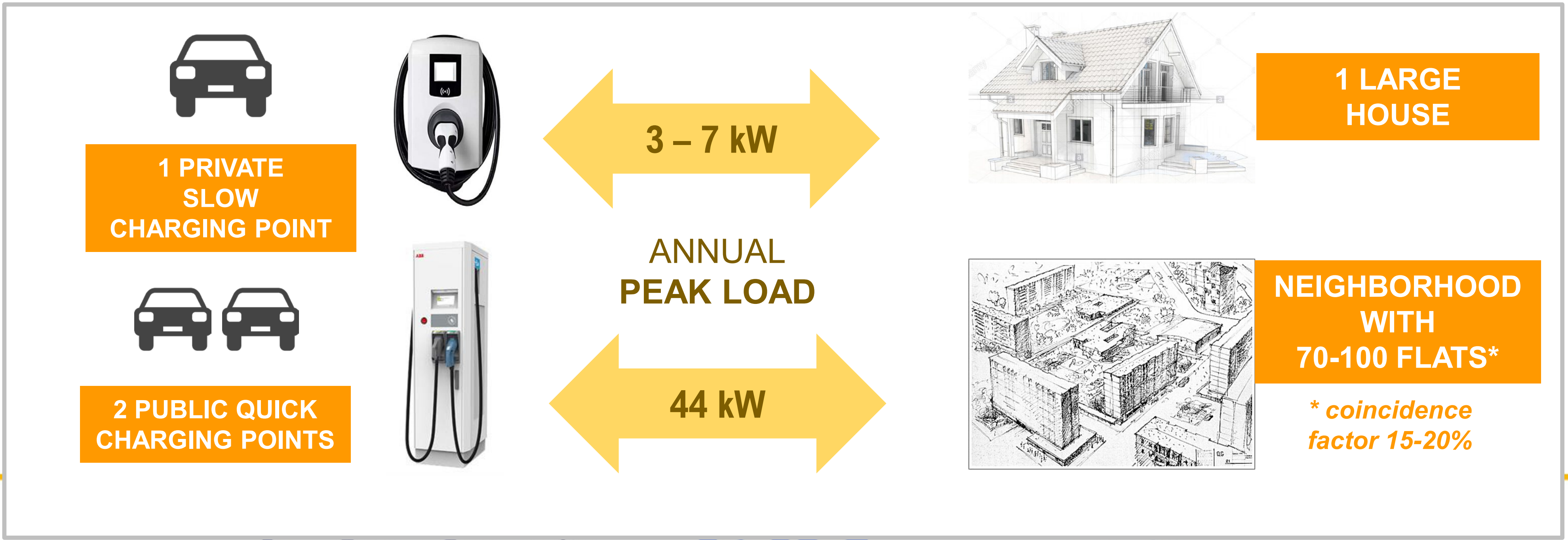
In the Netherlands (NL), time-of-use distribution tariffs apply, but to a very limited extent.
Dynamic tariffs or market-based elements in network charging have been reported for three countries (FR, NO, SE)

Electricity networks | Tariff design for end uses

Time of use signals – The case of EVs

Charging at	Battery filled in	Mileage available after 8 hrs
2 kW	20 - 25 hrs	~100 km
3 kW	13 - 17 hrs	~150 km
6 kW	7 - 8 hrs	~300 km

- Specific time of use signals are sometimes introduced for EV charging solutions
- The rapid growth of EVs significantly changes the way in which electricity is consumed → EV charging demands high capacity in relation to the demand for energy



Electricity networks | Tariff design for end uses
Time of use signals – The case of EVs

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- Ensuring **adequate network capacity** will be crucial → but the need for investments in the grid can be reduced by **better exploiting existing resources**
- To prevent the risk of an increasing weight of network tariffs on the electricity bills, need to invest on **smart charging** solutions
- Examples of approaches to EV charging
  - Specific tariff for publicly accessible EV recharging points (SK)
  - Different tariff structure (i.e. energy-based vs. mixed) or similar structure with a greater weight of the energy component (IT, PT, ES)
  - Off-peak withdrawal charge for EV recharging (CZ, MT)
  - DSO right, under conditions, to interrupt EV charging in case of network congestion (CZ)
  - Special increase of “technically available capacity” for private EV charging (IT-experimental initiative)
  - Vehicle-to-grid (V2G) (PT - pilot project in Azores)

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Electricity networks | Tariff design for end uses

Time of use signals – The case of EVs

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ITALIAN CASE STUDY **FACILITATE EV CHARGING DURING NON-PEAK HOURS**

EXPERIMENTAL INITIATIVE

LV clients (households or small businesses) with CCL ≤ 4,5 kW can ask to increase FOR FREE their available capacity to 6 kW but ONLY during night hours, Sunday and holidays as far as such capacity is used for EV charging. Conditions:

- to be equipped with a working smart meter (in case of 2G, customized time-bands should be compatible with identification of power withdrawn during F3 hours).
- having installed a **«smart» charging point**
- Granting explicit permission to perform on-site verifications

Installed permanently (mode 3 defined by standard EN 61851-1 → no portable devices) to the electrical system with a certification guaranteeing compliance to all safety regulations.

Able to offer V1G functionalities

- Monitor, record and transmit energy consumption
- Receive and process information and adjust charging or discharging rate
- Local load management features not required

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Electricity networks | Tariff design for end uses
Time of use signals – The case of EVs

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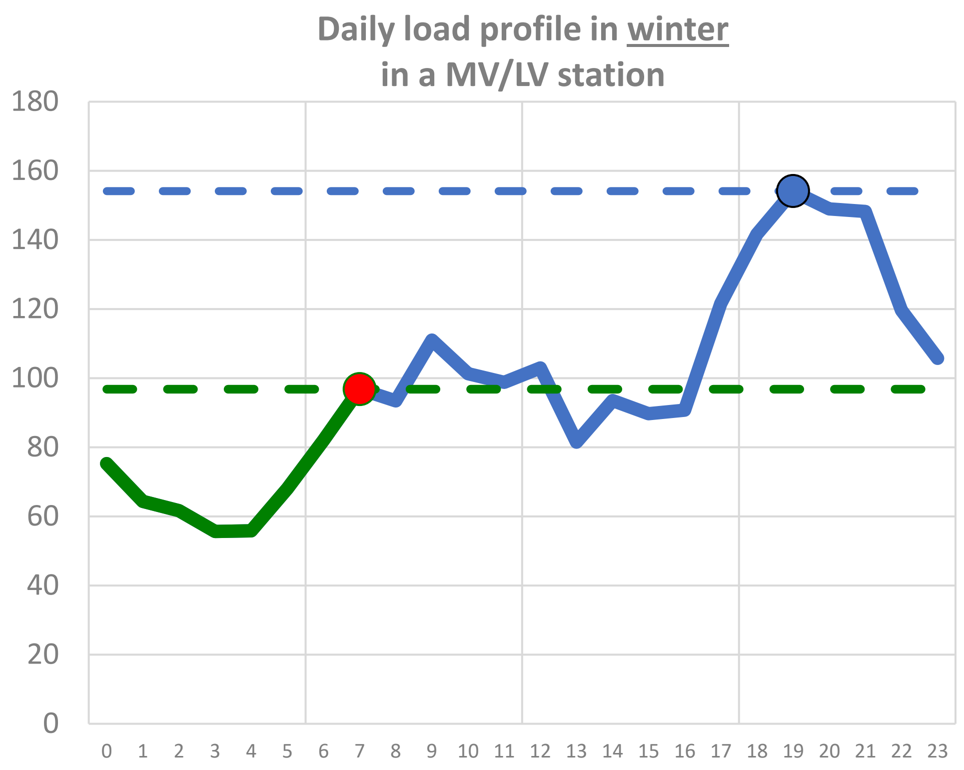
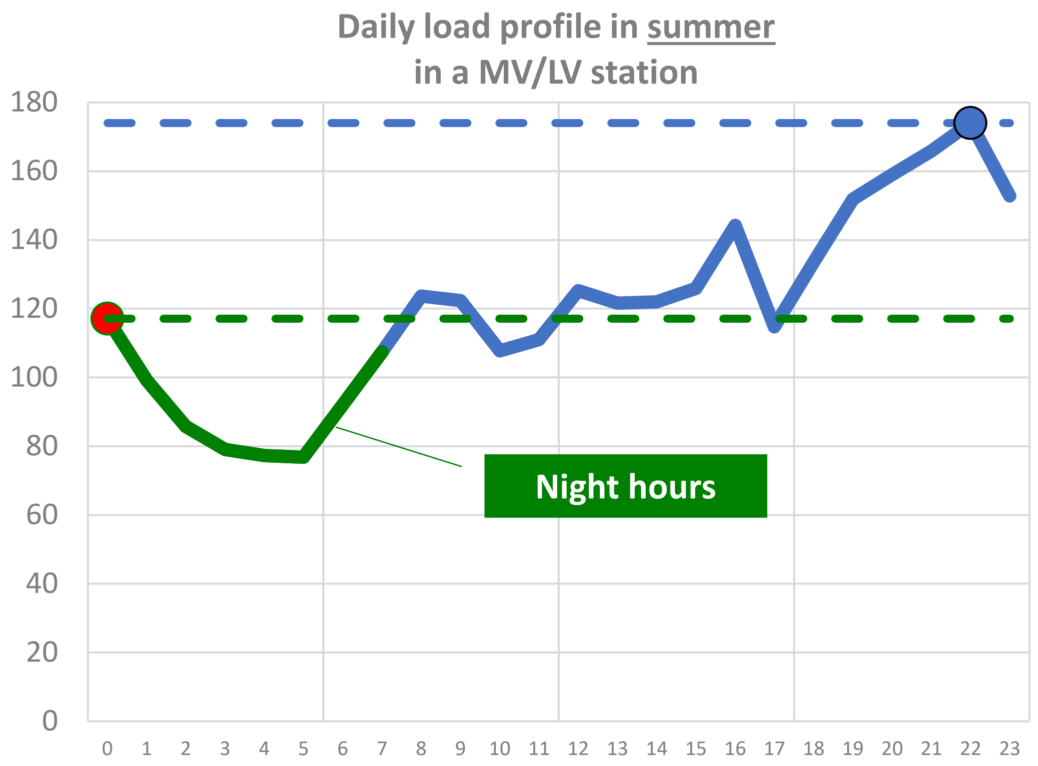
ITALIAN CASE STUDY **FACILITATE EV CHARGING DURING NON-PEAK HOURS**

EXAMPLES OF MV/LV STATIONS DEVOTED TO TWO NEIGHBORHOODS WITH 380-400 HOUSEHOULDS EACH





OFF-PEAK (F3) TIME-BAND REPRESENTS THE LONGEST CONTINUOUS PERIOD WITH LOWEST LOADS IN A DAY

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Electricity networks | Tariff design for end uses
Time of use signals – The case of EVs

ITALIAN CASE STUDY

FACILITATE EV CHARGING DURING NON-PEAK HOURS

OBJECTIVES

- Valuing **flexibility features** provided by smart meters, both first and second generation (1G and 2G)
- Gently pushing the newborn consumer wallbox market towards **smart devices**, so that we can empower clients, making them ready to offer vehicle-to-grid services to a BSP (balancing service provider) or emergency services to the DSO
- Offering a "smart" **saving opportunity** on private charging expenses: this is not to be considered as a public incentive, as the saving is "cost reflective"
- **Collecting useful information** to help studying private charging behaviours and evaluating whether to extend application in the future or to other technologies (e.g. home storage systems)

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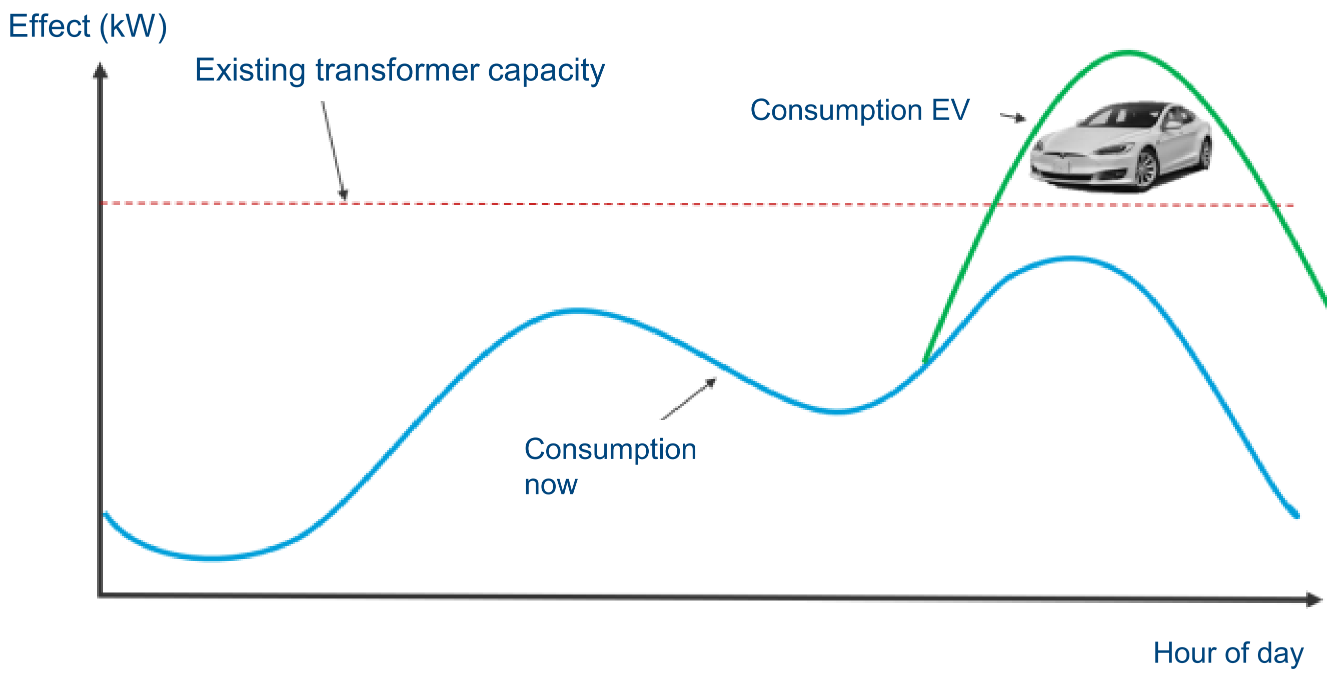
Time of use signals – The case of EVs

NORWEGIAN CASE STUDY



THE STARTING POINT, AND THE DESIRED TRAJECTORY, DEPENDS ON THE FEATURES OF THE SYSTEM CONSIDERED!

IN NORWAY, A TARIFF REFORM WITH TIME OF USE SIGNALS HAS BEEN INTRODUCED TO AVOID EXCESSIVE LOAD DURING THE NIGHT

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REGULATION OF ELECTRICITY NETWORKS

TARIFF DESIGN FOR GENERATORS

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Electricity networks | Tariff design for generation

- The transition to low-carbon forms of generation changes the way in which the network is planned, built and used. Providing **locationally-driven charges** (either embedded into connection or use of system charges) to producers should prove efficient, because:
  - Much network build is now driven by production (not consumption) and charging signals can indicate to producers the likely effect they will have on the network by choosing to locate in one place over another
  - Internalising those signals and using them to make siting decisions requires those producers to actively consider where to locate: they can locate in areas where they will exacerbate dominant flows and face a higher charge (reflecting the network build they may cause) than if they located somewhere with spare capacity, or where they will offset dominant flows and reduce the need for new network
- Locational charges reflect the **marginal costs** (usually the long-run marginal cost, LRMC) that the user places on the transmission system → assessing the impact on the overall cost of the system of an increment of demand at a reference node being met by an increment of generation at each of the system nodes
- Since it may not be possible for a producer to move their facility to an entirely different region, it is important that signals have a sufficient level of **granularity**

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Electricity networks | Tariff design for generation

- Producers have limited choice over where they can locate at a broad/regional level
- Existing sites cannot respond to a locational signal until they come to make their repowering decision
- There is a centralised planning and dispatch regime

LOCATIONAL TARIFFS MAIN PURPOSE IS TO ENSURE ALL USERS FACE "FAIR" CHARGES, REFLECTING LOCALISED COSTS

- Producers can choose – at a highly specific level – where to locate
- Consideration is given to how to provide certainty to existing users, for instance through connection contracts that 'lock in' transmission charges at the point of connection
- The network is planned in advance, but the TSO is responsive to users' locational decisions

SITES FACE CHARGES BASED ON THE EFFECT THEY HAVE, AND COMPETE ON THE BASIS OF ALL THEIR COMMERCIAL DECISIONS INCLUDING THEIR TRANSMISSION CHARGE LIABILITY

→ CLEAR CASE FOR LOCATIONAL SIGNALS

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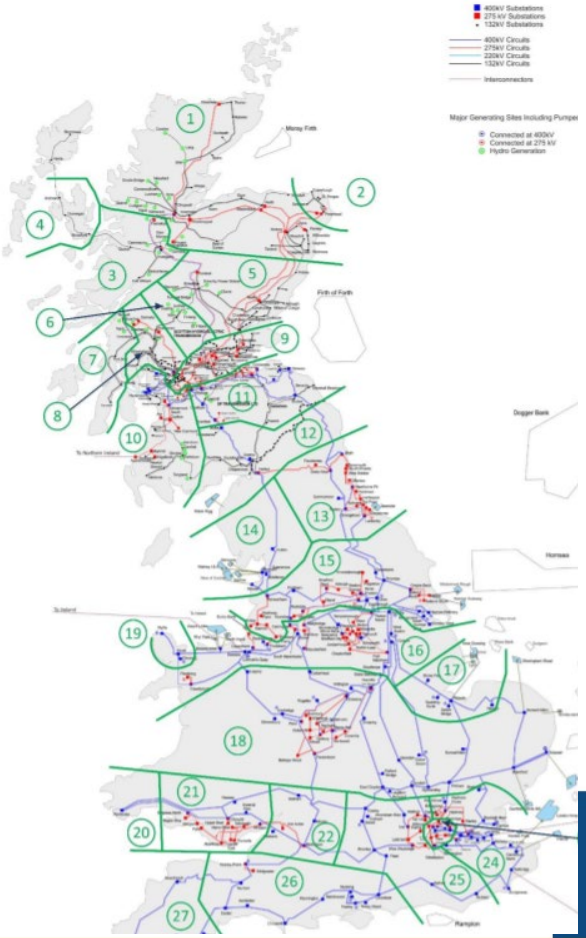
UK CASE STUDY LOCATIONAL SIGNALS IN TRANSMISSION CHARGING

- A representative model (the “Transport Model”) of the GB network is maintained by TSO, for charge calculation → creates the incremental cost of increasing production at each ‘node’ (substation).
- GB is then split into ‘zones’ for the purposes of levying transmission charges.
- Charges paid by generators include a Locational Charge, reflecting the incremental cost of power being added to the system at different geographical points



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REGULATION OF ELECTRICITY NETWORKS

PLANNING AND MANAGING GRID INVESTMENTS

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Electricity networks | Grid investments

- A high value investment may not happen due to various reasons
  - Insufficient **mitigation or reward of TSOs' risk**
  - Inadequate **infrastructure planning**: a high value project may not be identified or not given the right priority
  - Ineffective or perverse **regulatory incentives**: financial interests by TSOs in an alternative (socially less beneficial or less cost efficient) solution (e.g. CAPEX or technology bias)

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Electricity networks | Grid investments

RISK MITIGATING MEASURES

- Risk of **cost overrun** → Adjustments to OPEX for innovative technology or in cases of unforeseen events
- Risk of **time overrun** → Recognition of efficient costs from time overruns beyond promoter's control
- **Volume risk** → Regulatory account
- Risk of costs being considered **inefficient** → Ex ante approval of investments based on benchmarking or standard costs
- **Liquidity** risk → Allowing revenues based on planned (stages of) expenditure

INVESTMENT PLANNING

- Needs and infrastructure **gap identification** should be the priority.
- **Project assessment** (CBA) should be designed to allow proper **prioritisation** between proposed projects and among alternatives that could address the same need).
- **Monetisation** of costs and benefits should be consistently pursued

CONSISTENT REGULATORY FRAMEWORK

- Ensure fair remuneration on investments
- Avoid CAPEX-bias (same incentive for OPEX, TOTEX solutions)
- Apply benefit-based incentives linked to the measurable project benefits or major performance targets
- implement performance indicators for monitoring efficient use of existing infrastructure

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Electricity networks | Grid investments
The case of offshore transmission

- Given the rapid acceleration of offshore wind (OSW) generation, **proactive planning** of both near-term and long-term transmission needs is essential to create cost-effective solutions
    - reduce overall transmission costs
    - reduce the miles of transmission cables installed in the sea floor
    - reduce onshore transmission line miles
    - reduce the number of beach crossings
- Integrated planning and consistent technological approaches are even more relevant as OWF become **hybrid** (as opposed to radial), i.e. connected with other OWF as well as with more than one onshore bidding zone (also serving as interconnectors)

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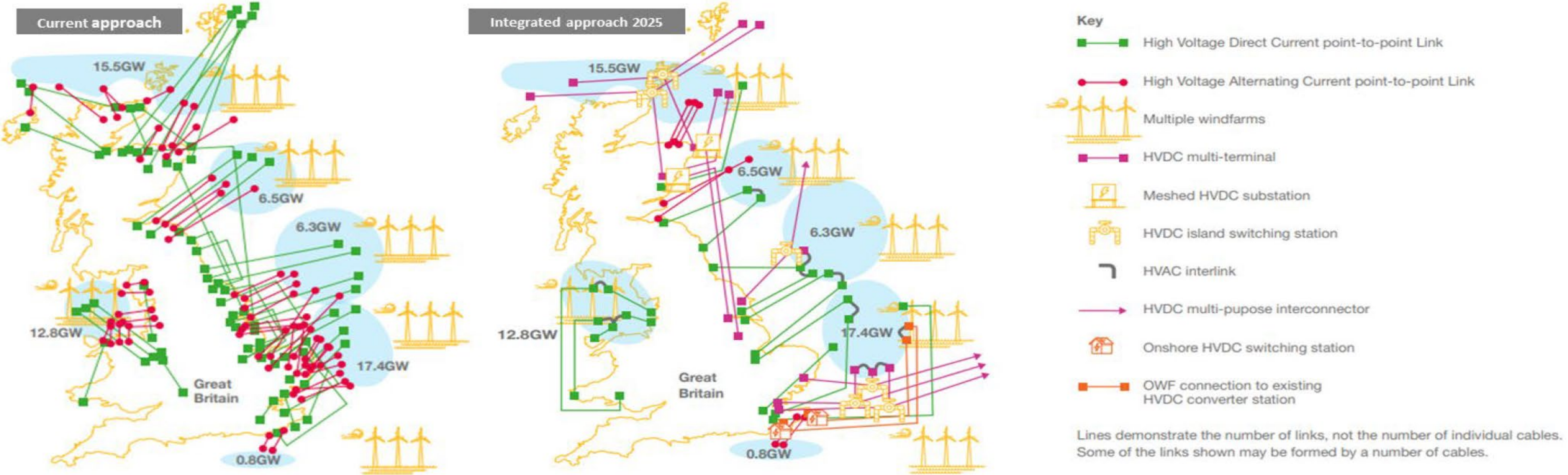
Electricity networks | Grid investments
The case of offshore transmission

FIGURE ES-2: UNPLANNED VS. PLANNED TRANSMISSION FOR U.K. OFFSHORE WIND IN 2050
(Assuming planning efforts start to be effective by 2025)



Source: National Grid ESO, *Offshore Coordination Phase 1 Report*, December 2020.

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Energy Transition and infrastructures in the EU Green Deal

- The European Green Deal sets out a roadmap for cutting greenhouse gas emissions, while also boosting a modern and resource-efficient economy

- The most relevant initiatives with regards to energy infrastructures are:
  - The revision of the **TEN-E Regulation**
  - A new **Regulation on methane emissions reduction**
  - The review and revision of the Gas Package, now referred to as the **Hydrogen and gas markets decarbonisation package**

- Furthermore, the **Hydrogen strategy** sets out how to update the energy markets, including the decarbonisation of the production and consumption of hydrogen and methane

GREEN DEAL

- ENERGY EFFICIENCY
- ETS SYSTEM
- RENEWABLE ENERGY
- TRANS-EUROPEAN ENERGY NETWORKS
- METHANE EMISSIONS
- HYDROGEN STRATEGY
- DECARBONISATION PACKAGE

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HYDROGEN STRATEGY

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Hydrogen strategy

- The EC sees hydrogen as a cornerstone of its clean energy policy.
  - ➢ Hydrogen currently accounts for around **2% of the EU energy mix**. **96%** of this hydrogen is **produced with natural gas**
  - ➢ The EC has proposed to produce **10 Mt of renewable hydrogen by 2030** and to import 10 Mt by 2030
- Why developing hydrogen? Using renewable or low-carbon hydrogen as energy vector:
  - ➢ Helps decarbonising «hard to abate» sectors (steel, refineries, heavy transport)
  - ➢ Allows energy storage by absorbing excess production of RES
  - ➢ Represents an alternative to electricity grid reinforcements

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Hydrogen strategy

The EU **Strategy on hydrogen** (COM/2020/301) was adopted in 2020. It foresees 2 phases:

- Transitional phase
  - 2020-2024: decarbonise existing H2 production: local H2 infrastructures
  - 2025-2030: target of 40 GW of electrolysers for 2030 and 10 Mt of H2: starting developing an EU-wide infrastructure
- Maturity phase
  - 2030-2050: renewable H2 technologies expected to reach maturity and be implemented on a large scale: EU-wide infrastructure

SUPPORT INVESTMENTS	SUPPORT PRODUCTION AND DEMAND	CREATE H2 MARKET AND INFRASTRUCTURE	RESEARCH	INTERNATIONAL COOPERATION

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Hydrogen strategy

Need for **large investments** for 2030:

- 24 - 42 b€ in electrolysers
- 220 - 340 b€ to build and connect 80 - 120 GW of solar and wind power generation
- **65 b€ for the transport, distribution and storage of H2**

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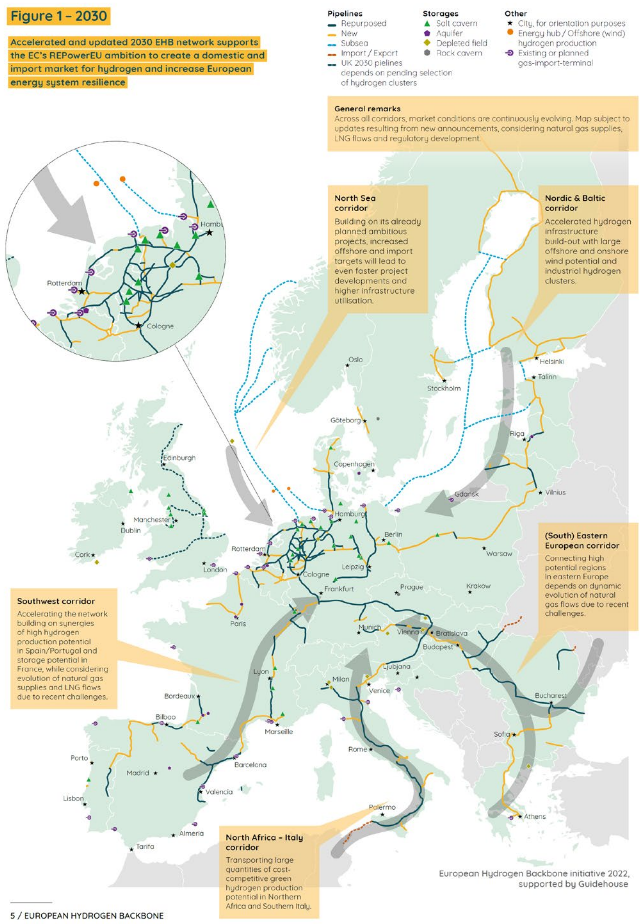
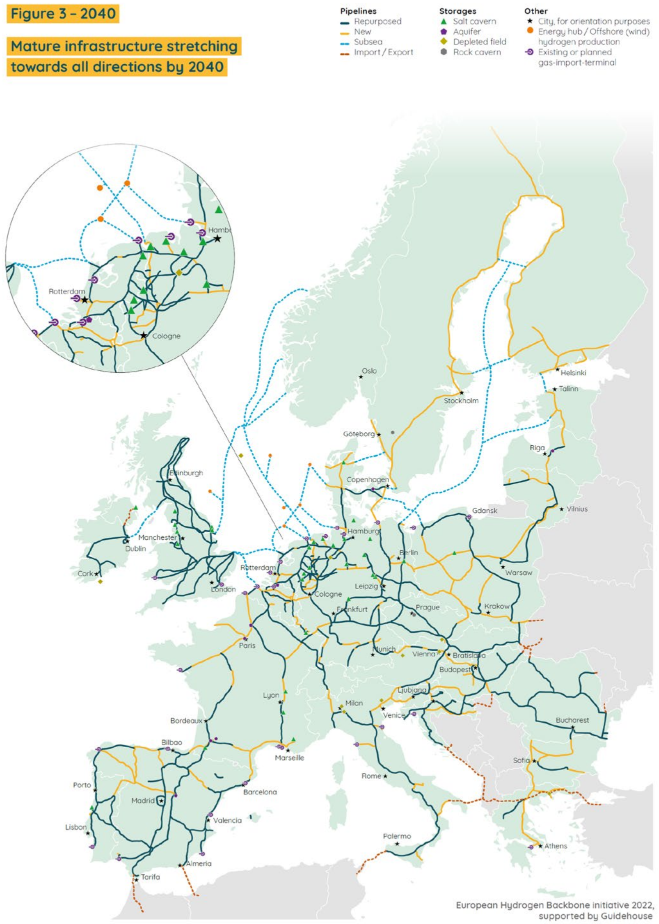
Hydrogen strategy





By 2040, the proposed backbone can have a total length of almost 53,000 kilometers
60% repurposed
40% new

TOT INVESTMENT COST ENVISAGED (2040)

80 – 143 b€

Source: European Hydrogen Backbone (EHB) initiative. Report April 2022

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EU DEVELOPMENTS

DECARBONISATION PACKAGE

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Decarbonisation Package | Legislative process

- On 15 December 2021, the European Commission published the **Hydrogen and gas markets decarbonisation package**, to revise Gas Directive 2009/73/EC and Gas Regulation (EC) No 715/200

- The Package is currently in trilogue phase, i.e. discussions between European Parliament, Council, and European Commission. Adoption is expected end of 2023

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Decarbonisation Package | Main new topics

REGULATORY FRAMEWORK FOR HYDROGEN

RENEWABLE AND LOW-CARBON GASES

INFRASTRUCTURE PLANNING

CONSUMER PROTECTION

SECURITY OF SUPPLY

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Decarbonisation Package | Main new topics
Regulatory framework for hydrogen

Extension of the Gas Package to hydrogen. Regulatory authorities to become responsible for hydrogen sector. Target model from 2030 (before 2030: flexibility phase).

- **Unbundling**
  - **Ownership unbundling** of hydrogen network operators, but ISO for existing operators possible and ITO until 2030
  - At least legal unbundling from transmission or distribution of natural gas or electricity
- **Third-Party Access**
  - **Regulated TPA** for hydrogen networks (including storage and LNG) from 2031 onwards. Before 2031: at least negotiated TPA
  - H2 networks to be organised as **E/E systems**, tariffs article to apply to H2 tariffs
  - **No cross-border tariffs** for hydrogen networks but an ITC mechanism after 2030
- **Derogations**
  - For **existing** H2 networks: from unbundling and TPA provisions, not beyond 2030
  - For **geographically confined** H2 networks: from vertical unbundling. Can be beyond 2030 but will expire if a competing renewable H2 producer wants access to the network, or if the exempted H2 network becomes connected to another H2 network

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Decarbonisation Package | Main new topics
Regulatory framework for hydrogen

- **Cross-subsidies and financing**
  - When assets are transferred to different RAB: no cross-subsidies
  - Conditions for **financial transfer**: dedicated charge, collected only from exit points to final customers located within the same Member States as the beneficiary of the financial transfer, subject to NRA approval

- **Planning**
  - Hydrogen **network development** reporting to NRAs. Operators shall publish an "overview" of the H2 network infrastructure in line with the NECPs. NRA shall examine the overview
  - Creation of European Network of Network Operators for Hydrogen (**ENNOH**) with tasks comparable to ENTSOG. Until ENNOH is established, ENTSOG is responsible for the TYNDP for hydrogen networks
  - ENNOH shall publish biannually a non-binding EU-wide **TYNDP** for H2 built on the national hydrogen network development reporting. ACER can provide an opinion on the national H2 network development reports, and assess their consistency with the TYNDP

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Decarbonisation Package | Main new topics
Renewable and low-carbon gases

- **Certification of renewable and low carbon gases**
  - ► Mass balance system to ensure that GHG emissions savings from use of low carbon gases are at least 70%. Apply life cycle assessment of the total GHG emissions of low carbon gases

- **Definition of entry-exit and firm capacity**
  - ► Definition of entry-exit system to include transmission and distribution
  - ► TSOs/DSOs ensure firm capacity for RES and low carbon gases and reverse flow from DSO to TSO level

- **Tariff discounts**
  - ► Entry points from RES and low carbon production facilities: 75% discount
  - ► Storage: 75% discount for RES and low carbon gases
  - ► IP and LNG entry: 100% discount for RES and low carbon gases. Once revenue of TSO is reduced by 10% as result of applying discount, affected and all neighboring TSOs are required to negotiate ITC. Agreement within 3 years, if not, the involved NRAs to decide jointly within 2 years.

- **Blending**
  - ► Cross-border coordination on gas quality and on hydrogen quality. TSOs to cooperate to avoid restrictions to cross-border flows due to gas quality differences. Defined process for cooperation and dispute settlement, with roles for NRAs (have to agree on recognising/removing restrictions) and ACER (last resort)
  - ► Blending: gas TSOs to accept hydrogen content of up to 5% in cross border flows from 1 October 2035

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Decarbonisation Package | Main new topics
Gas infrastructure planning

- **Process**
  - ► Mandatory NDP every 2 years
  - ► Single plan per Member State
  - ► NRA approval

- **Scenarios**
  - ► Joint scenario framework developed by infrastructure operators (gas, electricity, hydrogen, district heating)
  - ► In line with NECPs and support climate-neutrality objective, to be examined by NRA

- **Integration**
  - ► Information exchange between infrastructure operators
  - ► LNG terminal, SSOs, DSOs, hydrogen, district heating and electricity network operators to provide all relevant info to TSO required for developing the plan

- **Decommissioning**: NDP to also include decommissioning projects

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Decarbonisation Package | NRAs reaction

GRADUAL AND FLEXIBLE APPROACH

Find the right balance between a hard deadline approach and leaving sufficient **flexibility** for the implementation of the rules depending on the maturity of the market

Ensure flexibility to phase in regulation of hydrogen networks by allowing **derogations and exemptions** even beyond 2030

INVESTMENT PLANNING

Prudent approach

- Regulatory oversight is crucial to ensure a prudent and no-regrets approach (avoid over-investment)
- Development of H2 assets should be based on proven needs and chosen among most cost-efficient solutions

Integrated approach

- Involvement and exchange of information both vertically (levels of supply chain) and horizontally (energy carriers)
- Gas NDPs should include info on repurposing
- Further integrating project assessment

FINANCING

- Support the **cost reflectivity** and beneficiary-pays principles to hydrogen networks, avoiding cross-subsidies
- Forms of **support** might be needed in the early phase of sector development (preference for inter-temporal cross-subsidies and instruments funded by general taxation)
- Any deviation from such principles should be limited in both scope and time, and subject to an appropriate regulatory framework including NRA oversight

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EU DEVELOPMENTS

METHANE EMISSIONS

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EU developments | Methane emissions Regulation

The importance of addressing methane emissions

CLIMATE CHANGE AND AIR QUALITY

- Methane is a **potent but short-lived** GHG causing >25% of today's warming
- Achieving the Paris Agreement 1.5°C target is impossible without reducing the **growing methane atmospheric concentration** by 40-45% by 2030 (=0.25°C of warming by 2050)
- **Air quality** is also an issue

SAFETY

- Traditionally: key motivation to reduce methane emissions
- Companies follow safety regulations and industry standards and conduct regular surveys on their gas network
- Safety monitoring ≠ environmental monitoring

ENERGY CONSERVATION

- In times of high energy prices, the loss of commodity has to be minimised
- No harmonised definitions of network losses and responsibility for the lost gas
- No harmonised approach to how to incentivise the merit investment/mitigation measures

also: SOCIAL LICENSE TO OPERATE

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EU developments | Methane emissions Regulation

- In the context of the Decarbonisation Package (December 2021), the EC published a proposal for a Regulation on Methane emissions in the energy sector. The approach is to set **mandatory requirements based on best practices.** It includes provisions on
  - Measurement, Reporting, Verification (**MRV**)
  - Mitigation: mandatory **leak detection and repair** (**LDAR**) obligations, and a ban on routine **venting** and **flaring** practices, which involve the release of methane directly into the atmosphere
  - Emissions associated with **EU fossil energy imports**: methane transparency database, methane emissions global monitoring tool → Collect info on whether and how exporter countries/companies are measuring, reporting and abating methane emissions, with a view to establish their methane intensity profile

- Trilogues started on 30 Aug, limited chances the Regulation will be adopted by the end of 2023

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EU developments | Methane emissions Regulation

- Obligations for gas infrastructure operators:
  - ► Monitoring:

OGMP

TIER 3 • Within 1 year: *Source-level methane emissions estimated using generic but source-specific emission factors for all sources*

TIER 4 • Within 2 years: *Direct measurements of source-level methane emissions (…) May involve the use of source-level measurement and sampling as basis for establishing specific emission factors*

TIER 5 • Within 3 years: *Direct measurements of source-level methane emissions (…) complemented by measurements of site-level methane emissions* + **INDEPENDENT VERIFICATION**

  - ► Take all measures available to them to prevent and minimise methane emissions in their operations. LDAR surveys to be performed every 3 months.
  - ► Use devices that allow detection of loss of methane from components of 500 ppm
  - ► Repair or replace components emitting > 500 ppm no later than 5 days after detection (delays only in duly justified cases of safety or technical considerations not allowing immediate action)

- Ban on *venting*, except proven emergency or maintenance cases. *Flaring* only allowed if re-injection, utilisation on-site or dispatch to a market not technically feasible

Oil and Gas Methane Partnership (OGMP)

Founded in 2014 by Climate and Clean Air Coalition (CCAC) and United Nations Environmental Programme (UNEP) as voluntary initiative to support companies in measuring methane emissions

Main aim is to establish *best practice* e make info available.

Currently participated by approx. 60 companies (30% of global oil and gas assets)

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EU developments | Methane emissions Regulation
The role of regulators

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- Member States shall:
  - ► designate one or more **competent authorities** responsible for monitoring and enforcing the application of this Regulation, who can carry out periodic inspections and issue a notice of remedial actions to be undertaken by the operator
  - ► lay down the rules on **penalties** applicable to infringements (can also be fines proportionate to the environmental damage)

- Role of NRAs: when fixing or approving transmission/ distribution/LNG/storage tariffs shall **take into account the costs incurred** and investments made to comply with the obligations under the Regulation, insofar as they correspond to those of an efficient and structurally comparable regulated operator

- ACER shall establish and make publicly available a set of indicators and corresponding reference values for the **comparison of unit investment costs** linked to measurement, reporting and abatement of methane emissions for comparable projects

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EU DEVELOPMENTS

TEN-E REGULATION AND PROJECTS OF COMMON INTEREST

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EU developments | PCI and TEN-E

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- **Regulation (EU) n. 347/2013** of the European Parliament and the Council (TEN-E Regulation) lays down guidelines for the timely development and interoperability of priority corridors and areas of trans-European energy infrastructure
  - Sets rules for identification of Projects of Common Interest (PCI)
  - Facilitates their timely implementation by streamlining, coordinating more closely, and accelerating permit granting processes and by enhancing public participation
  - Provides rules and guidance for the cross-border allocation of costs (CBCA) and risk-related incentives
  - Determines the conditions for financial assistance eligibility

- On 15 December 2020, the EC adopted a proposal to revise the 2013 TEN-E Regulation, to align with the climate neutrality objectives of the European Green Deal. **New TEN-E Regulation (2022/869)**:
  - Introduction of environmental and decarbonisation objectives, greater weight of sustainability
  - New project categories (e.g. hydrogen networks and electrolysers)
  - New status of «Projects of Mutual Interest» for projects with third countries

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EU developments | PCI and TEN-E
The process

Benefits of becoming PCI

ACCELERATED PERMITTING
(MAX 3,5 YRS, «ONE STOP SHOP»)

REGULATORY MEASURES
(CROSS-BORDER COST ALLOCATION, INCENTIVES)

FINANCIAL SUPPORT
(FUNDS FOR WORKS AND STUDIES FROM CONNECTING EUROPE FACILITY)

Selection criteria

- EUROPEAN RELEVANCE
- BENEFITS OUTWEIGHT COSTS
- SPECIFIC CRITERIA DEPENDING ON THE PROJECT CATEGORY

Process

NATIONAL DEVELOPMENT PLAN
- PROJECT PROMOTER
- PLAN APPROVED BY NRA

SCENARIOS

CBA

EU TYNDP
- PROJECT PROMOTER
- PUBLISHED BY ENTSO
- ACER OPINION

PCI SELECTION
- CHOICE BY MEMBER STATES AND EUROPEAN COMMISSION
- ACER OPINION
- NRA OVERSIGHT

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EU developments | PCI and TEN-E
The new TEN-E

Introduce mandatory sustainability assessment and increase scrutiny from the Commission

Facilitate rapid electrification (double the share of renewable electricity production)

Support decarbonising the gas sector (e.g. through the development of hydrogen infrastructure)

Scale up offshore renewables grids across European seas

Update infrastructure categories ending support for oil and natural gas infrastructure

Accelerate the take-up of innovative solutions such as smart grids

Speed up planning and improve rules for obtaining permits, including for offshore grids (e.g. a single national authority)

Enable a more integrated energy system

Increase transparency and public participation via consultation

Create growth and jobs, supporting the economic recovery

Categories no longer included

- OIL PIPELINES
- NATURAL GAS INFRASTRUCTURE
- Transitional period until 2030 for assets converted from natural gas to H2: can be used for blending
- Derogations for Cyprus and Malta

New categories

- OFFSHORE ELECTRICITY GRIDS
- HYDROGEN NETWORKS
- SMART GAS GRIDS
- ELECTROLYSERS ABOVE 50 MW

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EU developments | PCI and TEN-E
Sustainability evaluation

HYDROGEN NETWORKS

- CONTRIBUTION OF A PROJECT TO GREENHOUSE GAS EMISSION REDUCTIONS IN VARIOUS END-USE APPLICATIONS IN HARD-TO-ABATE SECTORS, SUCH AS INDUSTRY OR TRANSPORT
- FLEXIBILITY AND SEASONAL STORAGE OPTIONS FOR RENEWABLE ELECTRICITY GENERATION
- INTEGRATION OF RENEWABLE AND LOW-CARBON HYDROGEN WITH A VIEW TO CONSIDER MARKET NEEDS AND PROMOTE RENEWABLE HYDROGEN

SMART GRID GAS

SHARE OF RENEWABLE AND LOW-CARBON GASES INTEGRATED INTO THE GAS NETWORK, THE RELATED GREENHOUSE GAS EMISSION SAVINGS TOWARDS TOTAL SYSTEM DECARBONISATION AND THE ADEQUATE DETECTION OF LEAKAGE

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CONCLUSIONS

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Conclusions

- Decarbonisation policies require significant infrastructure investments, but appropriate tariff designs can help optimising the use of existing infrastructure
- Where gas demand is expected to decline, regulators face decisions over repurposing, decommissioning, reinvestment and asset lifetime extensions on existing gas networks
- Renewable and low-carbon gases blended into the existing gas grid need access to the market while maintaining secure system operations. The development of the hydrogen sector needs a consistent and flexible regulatory framework
- An integrated approach to investment planning is needed to ensure system adequacy while delivering the most cost-efficient solutions

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EU4ENERGY PHASE II

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