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EU HYDROGEN STRATEGY: HARNESSING MOMENTUM FOR A NEW REGULATORY APPROACH

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The journey to climate neutrality will not be easy and the ability to produce zero emissions gases (largely 'green' hydrogen[1]) is an important part of the decarbonisation toolbox. The European Commission aims to address the future of hydrogen in an 'EU Hydrogen Strategy'. Current policy and regulatory processes are not well suited to making meaningful decisions on this issue. The hydrogen strategy should be seen as an opportunity for a new regulatory and planning approach.

Significant uncertainty over future cost, availability of and need for hydrogen makes it difficult to take planning and market regulation decisions. Many studies published cloud this uncertainty by presenting single point estimates for costs and volumes or omitting crucial factors (e.g. methane emissions or CCS infrastructure costs). [2]

The prospect of risky binary decisions means there is often a focus on "wait and see" and "pilot projects" which is not sufficient for the scale and speed of the transition needed.

[1] Produced through water electrolysis using renewable electricity.

[2] E.g. the **ENTSOG Roadmap 2050** storylines do not include pathways where gas consumption may reduce, the most recent **Gas4Climate study** does not present sensitivities to significant assumptions such as CCS costs or the inclusion of methane emissions.

Strengthening Europe's ability to carry out evidence-based whole energy system analysis, accelerate learning and manage risks is required to enable climate neutrality and the deployment of hydrogen.

The need for a transition at scale and speed

The EU has yet to define a pathway to achieve climate neutrality by 2050, both in terms of overall emissions trajectory and how this might be divided between sectors and member states. However, most commentators agree that the power system must be rapidly decarbonised, and action taken to improve overall efficiency and to electrify other sectors where there is no viable alternative means of decarbonisation at scale.

The defining features of this new paradigm are not only the extent of the changes required but **the rate at which they must happen**. **We have neither the time nor the money to keep the option of all potential pathways open.** Some choices about the future need to be made now to allow deployment to move forward at pace. Other choices can be left open on the basis that the risks are too great and we will be in a better position to decide later.

The future of gas in the EU

The future of gas represents a key case in point.

> The current best view of the future suggests that to achieve climate neutrality there will need to be a stark reduction in the use of molecules, abated and unabated, starting before 2030 and continuing out to 2050 (Figure 1). This suggests the need for fundamental changes to our gas network. What we do not know is the full extent of the reduction, how this reduction will be geographically distributed and what that means for individual parts of our gas network.

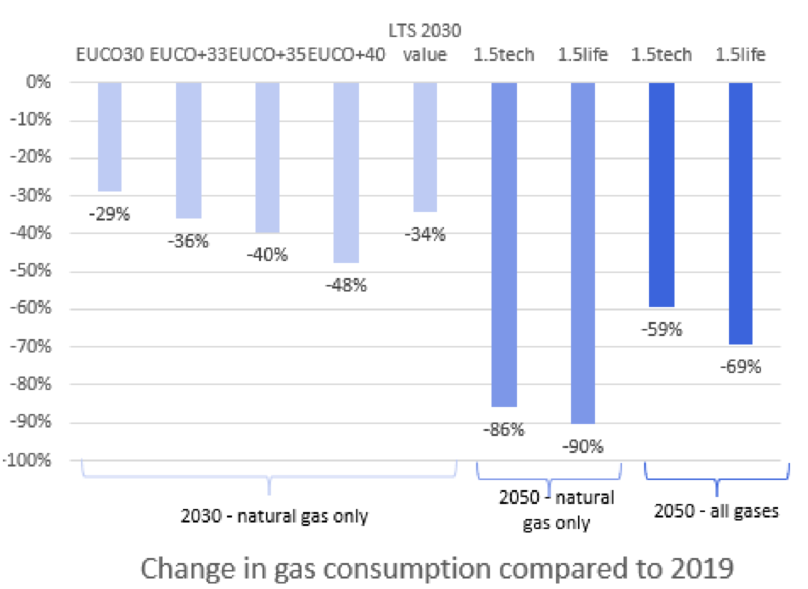

Figure 1 Change in gas consumption compared to 2019[3]

> 'Green' hydrogen produced via electrolysis using renewable electricity and some forms of biogas are - currently - our best solution available to replace fossil gas or "grey hydrogen"[4] in hard-to-abate sectors.

> The extent to which hydrogen is a cost-effective solution in other sectors is strongly debated and significantly depends on assumptions such as technology costs, ability to roll out energy efficiency and electrification measures, carbon prices.

> Based on current best knowledge, it appears likely that zero-emissions gases will represent a high value and scarce resource.[5]

> A source of controversy is the extent to which hydrogen produced from fossil gas using CCS (so-called 'blue' hydrogen) can play an important role on the pathway to climate neutrality (*see box*).

What follows from this is that, first, developing hydrogen resources must proceed alongside efforts to promote efficiency and electrification and to phase out fossil gas. Second, phasing in hydrogen without a clear strategy for phasing

[3] E3G analysis based on European Commission numbers in the 2016 Clean Energy Package Impact Assessment and from the 2018 Long Term Strategy. 2019 consumption was 482bcm (**EC Gas Market Update Q4**)

[4] Produced from fossil gas without using CCS.

[5] Gas4Cilmate (as above) and ICCT (2018), What is the role for renewable methane in European decarbonisation

out unabated fossil gas – responsible for more emissions than coal[6] - would undermine the legitimacy of the transition: increasing costs without climate benefits.

This does, however, not provide a sufficient basis for making decisions on individual infrastructure projects, e.g. to decide which parts of the network to downsize or adapt, or for a foreign policy strategy on hydrogen development abroad, as demand volumes in Europe are uncertain. **This may result in paralysis on our route to 2050 because of risk averse decision makers or, alternatively, stranded investments because of a failure to manage risks.**

Box: Blue hydrogen paving the way for green hydrogen?

A source of controversy is the extent to which hydrogen produced from fossil gas using CCS (so-called 'blue' hydrogen) can play an important role on the pathway to climate neutrality. In the long term, it cannot have a significant role due to residual emissions. First, permanence of carbon storage is still an issue and varies by technology[7]. Second, recent EU satellite data highlights that 50 out of 100 methane hotspots globally are associated with oil and gas production (*Figure 2*) with the true extent of leakage for all sources of EU gas and transport routes still to be determined.

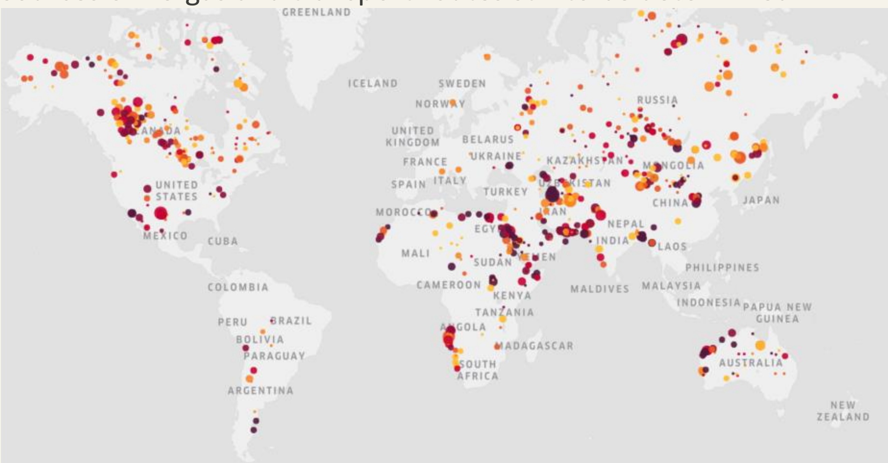

Figure 2 European Space Agency 2020[8]

[6] 878mt CO2e (gas) vs 874mt CO2 (coal) as of 2018, IEA WEO 2019

[7] https://energypost.eu/10-carbon-capture-methods-compared-costs-scalability-permanence-cleanness/

[8] http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Mapping_methane_emissions_on_a_global_scale

With well over 1 million km of gas pipelines in Europe alone, not counting import routes outside the EU, reducing methane leakage to near zero will be a massive challenge.[9] Even more so if this needs to be done quickly to avoid climate tipping points and to pave the way for green hydrogen.

The EU is in an advantageous position for fast learning on methane. Data from its Copernicus satellite will soon deliver better information at global scale. It is important to make sure this learning can directly inform our decisions over whether to rely on hydrogen from fossil gas.

Investments in blue hydrogen production could encourage investments in infrastructure and appliances that would ultimately be required for green hydrogen usage. This would involve a huge and fast transformation of the energy system underpinned by significant innovation in gas production and CO_2 capture, their transport as well as end consumption and reduction of methane leaks *within around a decade*. This needs to be weighed against the likelihood that costs of green hydrogen will have reduced by the early 2030s,[10] and low-cost potential exists from other solutions in easier-to-abate sectors.[11]

Instead, we need a way to manage the complexity and scale of decisions on the way to climate neutrality, and understand the related policy and regulatory questions. The optimal investment (infrastructure and innovation) requirements for long-term futures involving scarce or plentiful green gases will be very different and are likely to diverge significantly over the coming decade (see schematic representation in *Figure 3).*

A critical energy policy question facing the EU is to decide whether to bear the cost of preparing for both potential futures or to focus efforts on delivering one of them.

[9] **https://www.ceer.eu/documents/104400/-/-/0261ad33-6b06-f708-354b-5adf04683129**

[10] Some studies suggest that "*Clean hydrogen derived from renewable energy will be cost-competitive with grey hydrogen within 5-10 years.*"(**McKinsey**) This study also relies on significant assumptions, but illustrates the boundaries of possibilities to plan for.

[11] In 2019 alone, there was an 8% reduction registered for grid-scale battery storage and a nearly 15% drop for behind-the-meter applications, making for example renewables + storage projects increasingly attractive for short term flexibility (**IEA World Energy Investment report 2020**, p. 106)

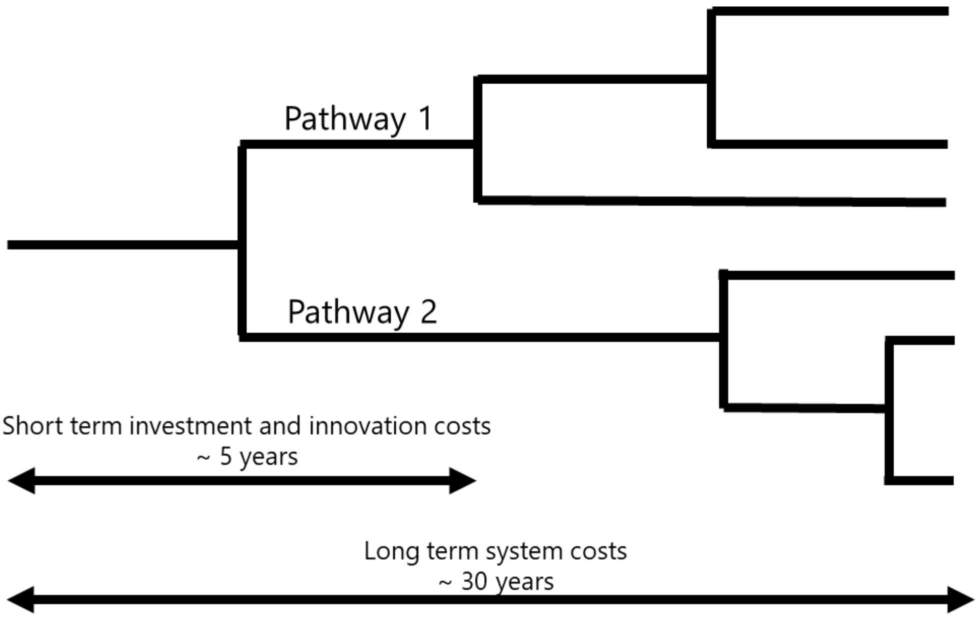

Figure 3: Pathways to net zero

Whilst there are risks associated with making choices, the risks of failing to do so are likely to be greater. The status quo would undermine efforts to deliver emissions reductions in line with the Paris climate agreement and the climate neutrality target and fail to address other emerging energy system challenges[12]. Also, there is the threat that increasingly low-cost solutions such as efficiency and renewable energy will remain untapped, leading to a higher cost energy system.

The need for regulatory reform

The nature of the energy system is changing and will continue to do so in the coming years. Increased interactions between sectors is creating scope for competition where this was previously impossible, such as between infrastructures supporting different energy carriers or between supply and demand side technologies. Also, energy costs are increasingly driven by investment rather than operational costs and the need to ensure efficient financing is becoming a more important factor in keeping energy prices low.

The current regulatory and market paradigm is not well-suited to dealing with the emerging situation. **Critical choices, such as the infrastructure and investment needs related to the future of gas, cannot be made through market**

[12] Already, energy system needs are changing because of climate change, e.g. the number of heating degree days is steadily declining, while the number of cooling degree days rising, shifting strain from gas and heat networks to electricity. (**EEA 2019**).

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processes. The consumer is unable to express their long-term energy needs given the extent of the infrastructure transformation required. Also, current regulatory structures and objectives are suited for securing benefits through short-term, gradual change, but poorly suited to making important long-term strategic decisions associated with network transformation.

Enabling hydrogen to become a part of the EU's future energy system should be part of a more substantial review of desired energy transition outcomes and how to achieve them. We need to distinguish between two types of outcomes:

> Those where multiple solutions and technologies for decarbonisation already exist. Here the focus is on enabling fair competition as far as possible, e.g. by reviewing fiscal and regulatory structures. An example is to ensure green hydrogen is not disadvantaged compared to fossil gas or blue hydrogen because of indirect fossil fuel subsidies or higher electricity taxation.

> Those where few solutions exist and where the development and maturing of a specific technology is critical to delivering climate neutrality. The development of green hydrogen for high temperature heat processes in industry may be an example for that criticality.

This issue is considered at length in a separate E3G briefing paper[13]. It concludes that there are 4 key challenges which can only be addressed by changing the approach to regulation. The challenges are:

> Making choices about the pathway to climate neutrality.

> Making the most of new sources of competition between infrastructures.

> Defining future need in administered markets, especially where this involves consumer purchasing decisions.

> Ensuring equitable distribution of costs and benefits, given the threats to vulnerable consumers.

It identifies that establishing an independent technical expert body at EU level – the Clean Economy Observatory – would be a crucial building block to respond to these challenges. Apart from helping regulators to manage the difficult trade-offs that they face relating to infrastructure choices and market definition, it would

[13] Upcoming E3G paper, "A new regulatory paradigm".

help drive consistency, innovation and efficiency across the EU. Other proposed solutions to these challenges are set out in Table 1 below.

Challenge	Solution
Choosing between different pathways to net zero where the costs of maintaining the options open is high.	Independent technical expert – the Clean Economy Observatory – to provide guidance.
Defining market scope and rules that allow fair competition.	Use Clean Economy Observatory to clarify outcomes and design markets to achieve these outcomes in the most efficient manner possible.
Defining future market need in consumer facing markets.	Consider new choice mechanisms that enable consumers to realise benefits and operate markets locally to take advantage of different local circumstances.
Equitable sharing of costs and benefits	Guidance provided by governments on balancing the interests of member states, rate payers versus taxpayers, and wealthy versus vulnerable.

Table 1: Key regulatory challenges and solutions

Implications for the future of gas

Zero emissions gases have the potential to meet a variety of needs: fuel for flexible power generators, high-grade industrial heat, low-grade heat for buildings, and fuel for certain forms of heavy transport such as shipping and aviation. Meeting all these needs would require a massive production capacity and extensive transportation network which raises questions over sustainability at systems level[14]. But the risk is not limited to the potential supply of gases. Alternative solutions either already exist (e.g. electric heat pumps) or might emerge (e.g. advanced battery and other storage technologies). This creates huge uncertainty over the future role that these gases might play.

Questions are being raised about the ability of sources of zero emissions gases to feed into the existing network, how to promote competition with heat networks and demand reduction, and the nature of the market arrangements that will promote efficient trading.

[14] E3G (2018), Renewable and decarbonized gases – options for a net-zero emissions society.

One unresolved issue is the extent to which the existing network of gas pipelines and the appliances that burn the gas should be converted to transport the new gases or whether they should be progressively phased-out and decommissioned. In the latter case, production and usage of zero emissions gases would be concentrated in local hubs and focused on high value uses where there are no ready decarbonisation alternatives. These two scenarios – maintaining an interconnected gas network and developing local zero carbon gas hubs - could lead to very different futures with different regulatory challenges – see Table 2.

<table>
<tr><th>Interconnected gas network</th><th>Local gas hubs</th></tr>
<tr><td colspan="2">Choosing a pathway</td></tr>
<tr><td colspan="2">• Critical assumptions: the potential future volume and cost of gas production compared with alternatives.
• Innovation investment key in either scenario.
• Investment in gas network and appliances will differ significantly and will determine when the choice must be made.</td></tr>
<tr><td colspan="2">Market scope and competition</td></tr>
<tr><td>• Competition exists between gases and with alternatives, but it will be very complicated to resolve this through a single market framework whilst overcoming inherent technology biases.
• Critical decision: where to resolve competition through markets and where through administered mechanisms.</td><td>• Competition will occur primarily at the investment stage between locations seeking to act as hubs.
• Key assumption will be the ability to meet high value demand.
• Will, at least initially, involve the allocation of public funds.</td></tr>
<tr><td colspan="2">Defining future need</td></tr>
<tr><td>• Can be administered at wholesale level through progressively reducing the volume of fossil gas allowed to feed into the network.
• Introduce competition between various solutions, including between gases.</td><td>• Public funds allocated based on forecasts of local demand.
• Risk managed by ensuring capacity can be scaled to adapt to future requirements.</td></tr>
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• New appliance standards required to drive upgrading of consumption equipment.	
Equitable sharing of costs and benefits	
• Costs of upgrading and maintaining the whole network can be shared by all network users. • The disproportionate impact on vulnerable consumers might require a redistribution of the cost burden.	• Costs primarily funded by local consumers although grants and other revenue guarantees likely to be required from public funds. • Consumers will not have to directly bear infrastructure costs unless hydrogen is used for domestic purposes. In this case, local authorities may implement schemes to support vulnerable consumers.

Table 2: Regulatory issues for future gas scenarios

Table 2 illustrates the importance of a pathway choice mechanism in helping regulators to focus on the priority questions that need to be addressed such as distributional effects and how to maintain system reliability. This is in addition to the significant savings available on infrastructure and innovation spend.

Recommendations

This analysis highlights that

- Current best evidence suggests that **the success of zero emissions hydrogen is dependent on delivering efficiency, renewables and electrification**.
- The legitimacy of a hydrogen strategy and the associated costs and investments hinges on **its ability to contribute to emissions reductions through a simultaneous phaseout of unabated fossil gas.** A successful hydrogen strategy thus is accompanied by clear measures and milestones towards a phaseout of unabated fossil gas.
- **The EU Hydrogen Strategy must recognise the foundational role that an evidence-based pathway choice mechanism plays** in allowing other players – regulators, investors, consumers – to implement a smooth and efficient transition. If needed, to expedite the process until a proper whole systems independent governance structure is in place, an

independent expert group on hydrogen should advise on core interventions in line with the EU's climate objectives. Decisions of this strategic importance need to be based on best evidence and high transparency and be free from vested interests.

- **For hydrogen to play a role, energy markets need to be reformed and framed around outcomes**. These markets must ensure key outcomes are delivered efficiently, promoting fair competition between different technologies where delivery of the outcomes does not depend on the deployment of one technology. Obstacles to fair competition between unabated fossil gas and all its alternatives, including hydrogen, need to be removed. This includes fossil fuel subsidies (e.g. exemptions from VAT).
- There are many **system-level risks** that would need to be managed if hydrogen is to be developed at scale:
  - A certificate system to trace the origin and greenhouse gas content of new gases is necessary and should include scope 3 emissions from methane. But this will not ensure sustainability by itself. The overall sustainable potential of new gases is limited and certain resources, may yield higher societal value if used in specific parts of the energy system (e.g. hard-to-abate sectors). If new gases are developed, the total volumes must be capped at the volume of the sustainably available potential.
  - Distribution-level network utilisation may reduce as users electrify and reduce energy demands. The social impact on remaining users will need to be managed, in particular if new investments into hydrogen use are made and the cost of hydrogen continues to be higher than those of fossil gas.

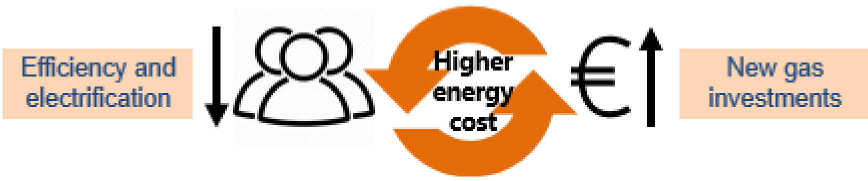

Figure 3 Illustration of consumer costs on the gas grid with new gas investments and increasing efficiency and electrification

- Hydrogen imports for blue hydrogen need to be contingent on measures to drastically and speedily reduce methane emissions. For green hydrogen, the picture is complex. Evidence suggests that the cost differentials on renewables costs are eliminated by shipping costs[15], imports from renewables rich but water scarce regions need careful management of the impact on water use[16], and for many of EU neighbours the development of renewable electricity for domestic use is a more effective contribution towards combatting climate change for at least another couple of decades.[17] In the context of an economic recovery towards more regional resilience and stability, EU engagement in its neighbourhood should support a growth strategy that reduces dependence on the export of a single commodity the price of which is determined on global markets.

List of evidence:

- E3G (2018), **Renewable and decarbonised gas renewable gas – options for a zero emissions society**.
- ICCT (2018), **What is the role for renewable methane in European decarbonisation**
- Fraunhofer IEE (2020), **Wasserstoff im zukünftigen Energiesystem**
- ECF (2019), **Towards fossil-free energy in 2050**

[15] BloombergNEF research suggests that shipping hydrogen 5,000km would cost around $2 per kilogram if costs reach their lowest potential, compared to an expected $0.52 regional cost difference in production (BNEF Hydrogen Economy Outlook).

[16] Estimates vary, PEM electrolysers currently use about 0.5l potable water per kwh according to **Element Energy Ltd 2018**.

[17] Algeria, currently major trading partner for the EU on fossil fuels, is only **starting to deploy renewable electricity** now. Due to population growth and water desalination needs, electricity production needs may **double by 2030**. Ensuring this will be covered through renewables rather than new gas fired capacity is the most effective decarbonization strategy from a systemic perspective for at least another couple of decades.