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Gas in decline – what to do with the gas grid when we no longer need it?

Energy Seminar

Dr Jan Rosenow
jrosenow@raponline.org
RAP

Commentary

The elephant in the room: How do we regulate gas transportation infrastructure as gas demand declines?

Jan Rosenow,^{1,2,*} Richard Lowes,^{1,3} and Claudia Kemfert^{4,5}¹Regulatory Assistance Project, Rue de la Science 23, 1040 Brussels, Belgium²University of Oxford, Environmental Change Institute, 3 South Parks Road, Oxford OX1 3QY, UK³University of Exeter, Energy Policy Group, Penryn Campus, Treleaver Road, Penryn, Cornwall TR10 9FE, UK⁴Leuphana University Lüneburg, Institute of Sustainability Governance, Universitätsallee 1, C11.221, 21335 Lüneburg, Germany⁵German Institute for Economic Research, Mohrenstraße 58, 10117 Berlin, Germany*Correspondence: jrosenow@raponline.org<https://doi.org/10.1016/j.oneear.2024.05.022>

The use of gas will decline dramatically as part of the transition to net zero. Modeling at European levels shows that by 2050 about 70% less gaseous fuels will be used. Significant regulatory reform is needed to deal with the impacts of this decline on the gas grid.

Fossil gas today serves many end uses, from power generation to residential cooking. In order to transport gas, vast gas grids have been built over the past decades. In Europe, there are now over 130,000 km of gas transmission pipelines—a distance of more than three times the circumference of the Earth. At the more local distribution level, there are another 1,800,000 km of pipeline.¹ At the moment, regulation in most European countries treats gas distribution networks broadly as if they are expected to operate in perpetuity, though there are some exceptions. But the era of widespread fossil gas consumption will come to an end as the world decarbonizes its energy use. This poses a significant challenge for policymakers: if fewer and fewer people use gas, how is the decline of the system managed, who pays for it, and how does this work support a rapid energy transition?

Gas in decline

Globally, unabated fossil gas consumption will need to decline by around 80% by 2050 if the goals of the Paris Agreement on climate change are to be met.² In Europe, fossil gas makes up 95% of gaseous fuels consumption as of today. Driven by a number of developments, including climate targets at the European Union (EU) and national level, energy security concerns after the invasion of Ukraine by Russia, and gas price volatility,³ a steep decline in the use of fossil

gas is expected over the next two decades.

A recent impact assessment by the European Commission⁴ of the proposed 2040 90% greenhouse gas reduction target (relative to 1990 levels) indicates that total demand for gaseous fuels, including gases such as hydrogen, will fall between 71% and 73% between 2019 and 2050 (Figure 1).

Impact of declining gas demand on final customers

Fuel switching away from gas means that the costs of running gas infrastructure and the amortization of the sunk network costs will be paid by fewer and fewer customers. Typically, tightly regulated grid fees for remaining gas customers would rise as more consumers decouple from gas grids, for example by switching to a heat pump or district heating.

Analyses of the effects of declining gas consumption on network costs by the British energy regulator Ofgem show that network charges could rise by a factor of 10 within 20 years.⁵ Gas grid tariffs in Austria could increase up to 4-fold by 2040 under decarbonization scenarios.⁶ Projections for Germany and France indicate a 5-fold and 3-fold increase, respectively.⁷ Figure 2 shows the projections for all four countries.

The longer regulation allows for the continued investment into the gas grid without a credible plan for decommissioning, the bigger the problem becomes. Ris-

ing gas network fees result in an increased incentive to switch away from the gas grid, resulting in more customer switching and even higher network fees. Low-income households, in particular, are exposed to a considerable risk here, as they may not have the means to easily switch away from the gas grid to other alternatives such as heat pumps.

Alternatives to gas grid decommissioning

Gas network operators have promoted the replacement of fossil gas with hydrogen and other low carbon gases as an alternative to grid decommissioning.⁸ At first glance, this may seem like an attractive option to policymakers who want to minimize impacts of the energy transition on customers and gas industry stakeholders. Using the existing gas grid for hydrogen transportation is both technically challenging and economically irrational, however.

From a purely technical point of view, an existing natural gas infrastructure cannot simply be used with hydrogen. This is due to the lower energy density and higher flow resistance, making it harder to transport the same energy content, and the corrosive effect of hydrogen. In some countries the gas grid has been upgraded. For example, in the UK, old metal gas pipes have been replaced with polyethylene pipes through the iron mains risk reduction program. However, the UK gas infrastructure would still require

Planning and regulating Europe's gas networks: breaking up with fossil gas

Final report



The clash with gas: Should it stay or should it go?

Principles to address the changing role of gas in a decarbonised energy system

Megan Anderson, Jan Rosenow, Richard Cowart

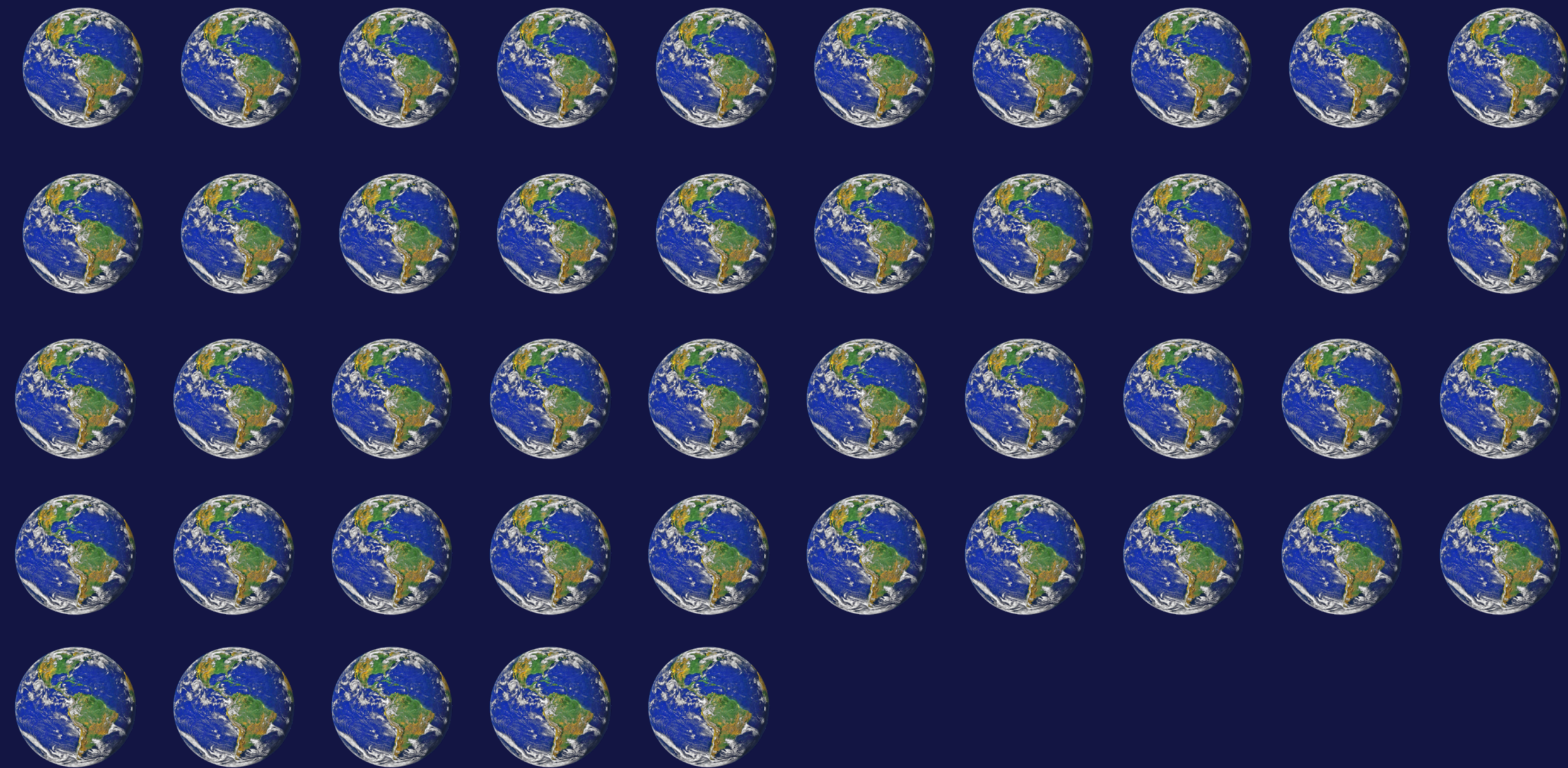




1

Gas grids today







2

Gas demand projections


Evidence suggests role for hydrogen in replacing fossil gas is limited

Joule

Commentary

Is heating homes with hydrogen all but a pipe dream? An evidence review

Jan Roseme^{1,2,4}



Dr Jan Roseme is a principal and director of European programs at the Regulatory Assistance Project (RAP), a global team of highly skilled energy experts. Jan has several board appointments, including the European Council for an Energy Efficient Economy and the Coalition for Energy Savings. Jan also has a passion for energy research. He is an honorary research associate at Oxford University's Environmental Change Institute. In recognition of his work within the field, Jan was named one of the world's top 25 energy influencers and has been appointed special advisor to the House of Commons leading into decarbonising heating.

Jackie K. 1-4, October 18, 2023. © 2023 Elsevier Inc.

CellPress

An important question is whether the available evidence supports a case for heating homes with hydrogen. This paper reviews independent analyses on the use of hydrogen for space and hot water heating. "Independent" in this context is defined as "not carried out by or on behalf of a specific industry (e.g. gas, oil, electricity, heat and boiler manufacturers)". The review studies a total of 52 studies carried out at international, regional, national, and city level by a wide range of different organizations, including universities, research institutes, international organizations such as IPCC and the IEA, and commercial, industry-funded studies. Some studies have been excluded because such are often carried out on behalf of industry groups in order to support a case that suits their vested interests. To not say that there are no relevant types funded by industry, but the purpose of this review of independent evidence, they have been excluded.

It is therefore clear that without fully decarbonising space and hot water heating, net zero greenhouse gas emissions goals are not attainable. Most analyses agree that regardless of the fuel used, one important lever to reduce emissions from buildings is improving the building fabric through energy efficiency measures.^{1,2} But there is still a sizable residual energy demand for heating even after energy efficiency improvements,³ and the question is which technologies can deliver zero- or very-low-carbon heating.

Low-carbon and zero-carbon hydrogen has been promoted by gas and heating industry representatives as a key solution to replace especially fossil gas in the distribution grid.^{4,5} It has received significant media attention over the last 2-3 years and featured in some of the many national hydrogen strategies launched recently.^{6,7}

It is important to point out that there are many legitimate current and potential end-uses for green hydrogen from renewable electricity, for example as a feedstock in industry, for high-temperature processes, in shipping, and for long-term energy storage for electricity production.^{8,9}

Background: More than 95% of global hydrogen demand is currently based on fossil fuels and coal with no carbon abatement. Because it is energy-intensive, hydrogen is a major contributor to greenhouse gas emissions. The International Council on Clean Transportation (ICCT) has published a report on the environmental impacts of hydrogen production and use. The report states that hydrogen production from fossil fuels is currently the most common method, but it is energy-intensive and produces significant greenhouse gas emissions. The report also states that hydrogen production from renewable electricity is a more sustainable option, but it is currently more expensive. The report concludes that hydrogen production from renewable electricity is a key solution to reduce greenhouse gas emissions from buildings, but it is currently more expensive than fossil gas. The report also states that hydrogen production from fossil fuels is currently the most common method, but it is energy-intensive and produces significant greenhouse gas emissions. The report also states that hydrogen production from renewable electricity is a more sustainable option, but it is currently more expensive. The report concludes that hydrogen production from renewable electricity is a key solution to reduce greenhouse gas emissions from buildings, but it is currently more expensive than fossil gas.

Cell Reports Sustainability

Article

A meta-review of 54 studies on hydrogen heating

Jan Roseme^{1,2,4}

¹University of Oxford, Environmental Change Institute, South Parks Road, Oxford OX1 3QY, UK
²Lead contact
³Correspondence: jan.roseme@ouce.ox.ac.uk
⁴<https://doi.org/10.1016/j.crsus.2023.100010>

SCIENCE FOR SOCIETY Decarbonizing buildings, heating in particular, is one of the major challenges society needs to address in order to meet the climate targets. Policy makers are tasked with developing a framework to facilitate decarbonization of buildings and require evidence to inform what this should look like. There are several potential technologies available to replace fossil-fuel heating systems, one of which is hydrogen. This meta-review assesses the independent scientific evidence on the viability of heating with hydrogen and concludes that at best hydrogen will play a niche role for heating buildings. The findings suggest that future policies should focus primarily on tried and tested technologies such as heat pumps and district heating while maintaining a focus on improving energy efficiency of buildings.

SUMMARY

In the context of achieving net zero climate targets, heating poses a significant decarbonization challenge, with buildings contributing substantially to global energy consumption and carbon emissions. While enhancing energy efficiency in building fabric can reduce emissions, complete elimination is not feasible while relying on fossil-fuel-based heating systems. Hydrogen has been suggested for decarbonizing buildings in recent years as a potential solution for replacing fossil-fuel heating. This paper carries out a meta-review of 54 independent studies to assess the scientific evidence for using hydrogen for heating buildings. The analysis concludes that the scientific evidence does not support a major role for hydrogen in cost-optimal decarbonization pathways being associated with higher energy system and consumer costs. Electrification and district heating are deemed preferable due to higher efficiency and lower costs in the majority of analyzed studies.

INTRODUCTION

Heating remains one of the most critical decarbonization challenges in the context of net zero climate targets. Buildings contribute 30% of total global final energy consumption and 26% of global carbon emissions related to energy.¹ The initial and apparent strategy to reduce carbon emissions from buildings involves reducing the heating demand of buildings, primarily accomplished through energy efficiency measures, such as enhancing insulation in building fabric. While this can decrease emissions associated with heating, complete elimination is not attainable as long as the heating system relies on fossil fuels.^{2,3}

This is why net zero scenarios also involve the decarbonization of the heat supply to buildings, such as transitioning from a fossil gas boiler to a heat pump powered by zero carbon electricity, low carbon district heating, or using low or zero carbon gases. This approach allows for the complete elimination of heating-related emissions, irrespective of whether a building has significantly reduced its heat demand through fabric insulation measures, although more efficient buildings have multiple energy system benefits especially in pathways with a large share of electrification.^{4,5}

In this context, green hydrogen produced from electrolysis using renewable electricity as well as blue hydrogen from steam methane reforming with carbon capture and storage has been proposed as a drop-in solution for decarbonizing buildings currently using fossil gas,^{6,7} often by gas network operators and heating system manufacturers.

In order to assess the scientific evidence base regarding the use of hydrogen for heating buildings at scale, a meta-review of existing studies was carried out in 2022 showing that all 52 independent studies identified concluded that the future role for hydrogen would be limited given the lower efficiency, higher costs and larger environmental impacts.

Since then, an additional 25 studies have been published. This updated meta-review includes those new studies and also provides more detailed analysis of studies carried out. Similar to the first meta-review "Independent" was defined as analysis "not carried out by or on behalf of a specific

iea
International
Energy Agency

IRENA
International Renewable Energy Agency

ipcc
INTERGOVERNMENTAL PANEL ON
climate change

McKinsey
& Company

icct
THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

C R E D S
CENTRE FOR RESEARCH INTO
ENERGY DEMAND SOLUTIONS

PIK

POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

Agora
energiewende

Öko-Institut e.V.
Institut für angewandte Ökologie
Institut für Applied Ecology

UKERC
UK Energy Research Centre

Energy
Transitions
Commission

Fraunhofer

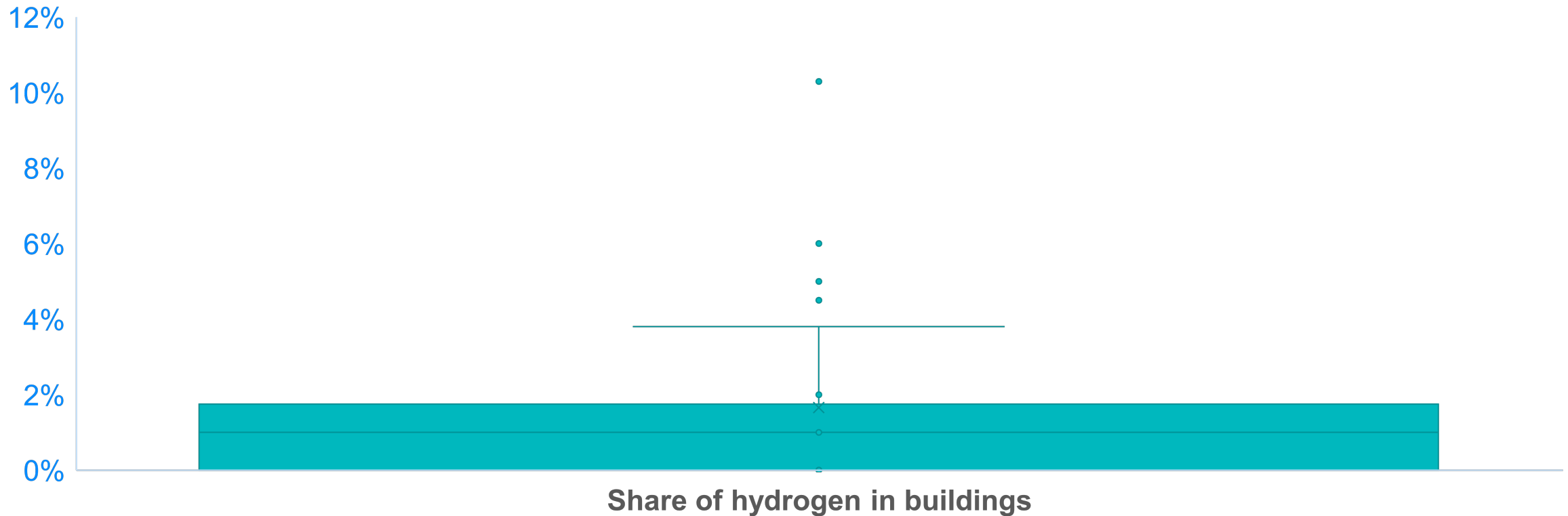
**Imperial College
London**

**Wuppertal
Institut**

UCL

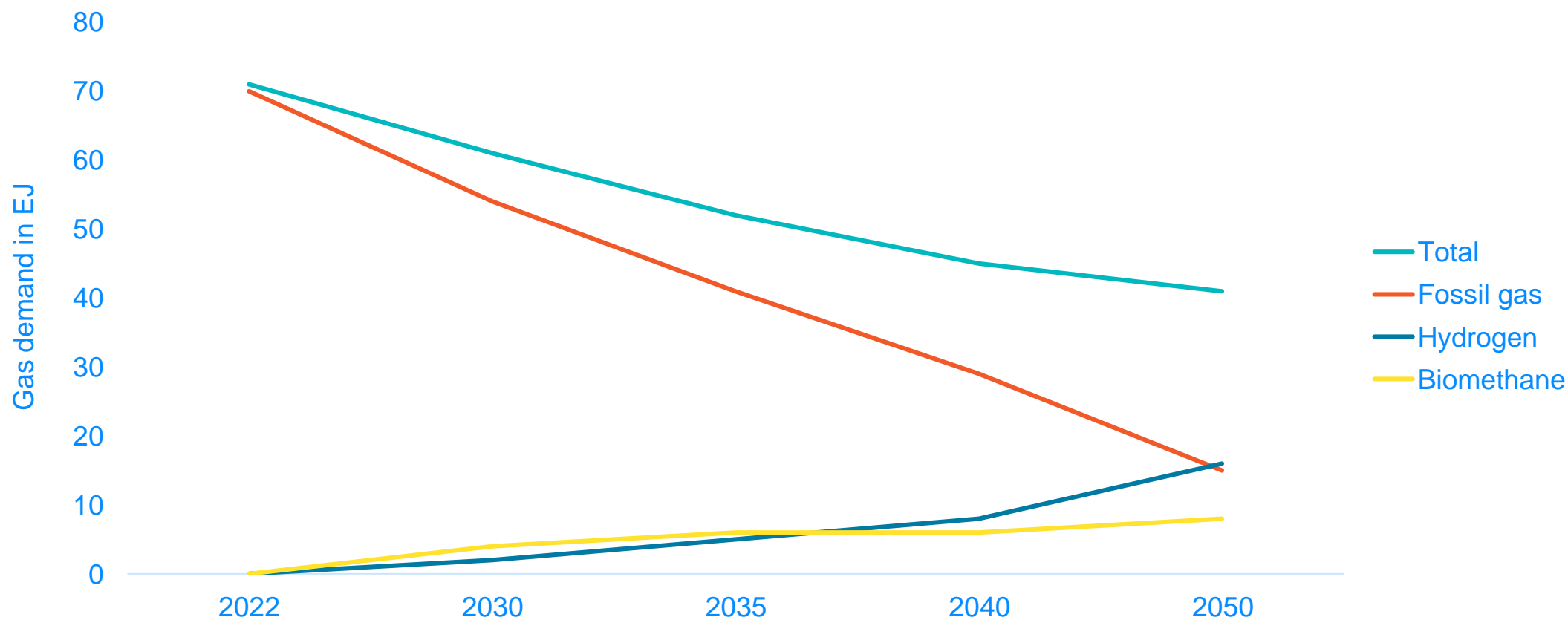
BEUC
The European
Consumer
Organisation

Median share of hydrogen in heating buildings in independent decarbonisation scenarios: 1%



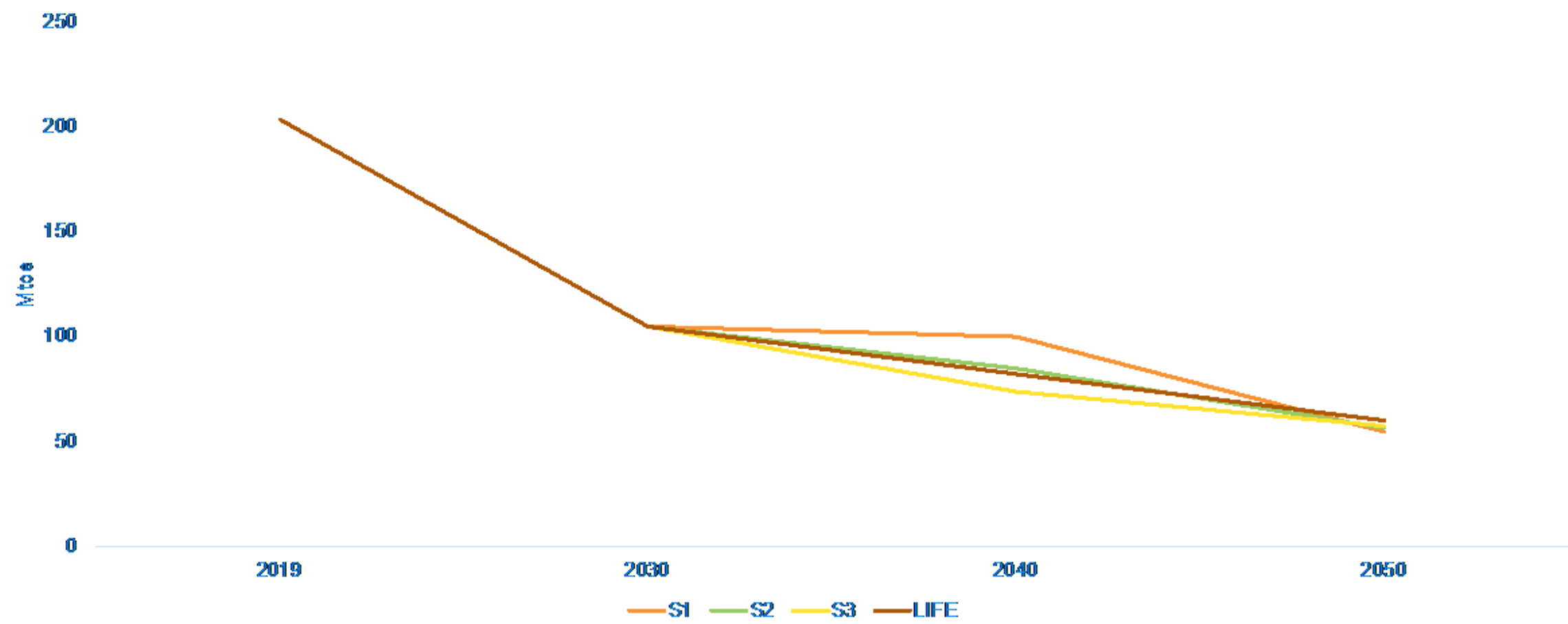
Source: Rosenow 2023

IEA Net Zero 2050 roadmap



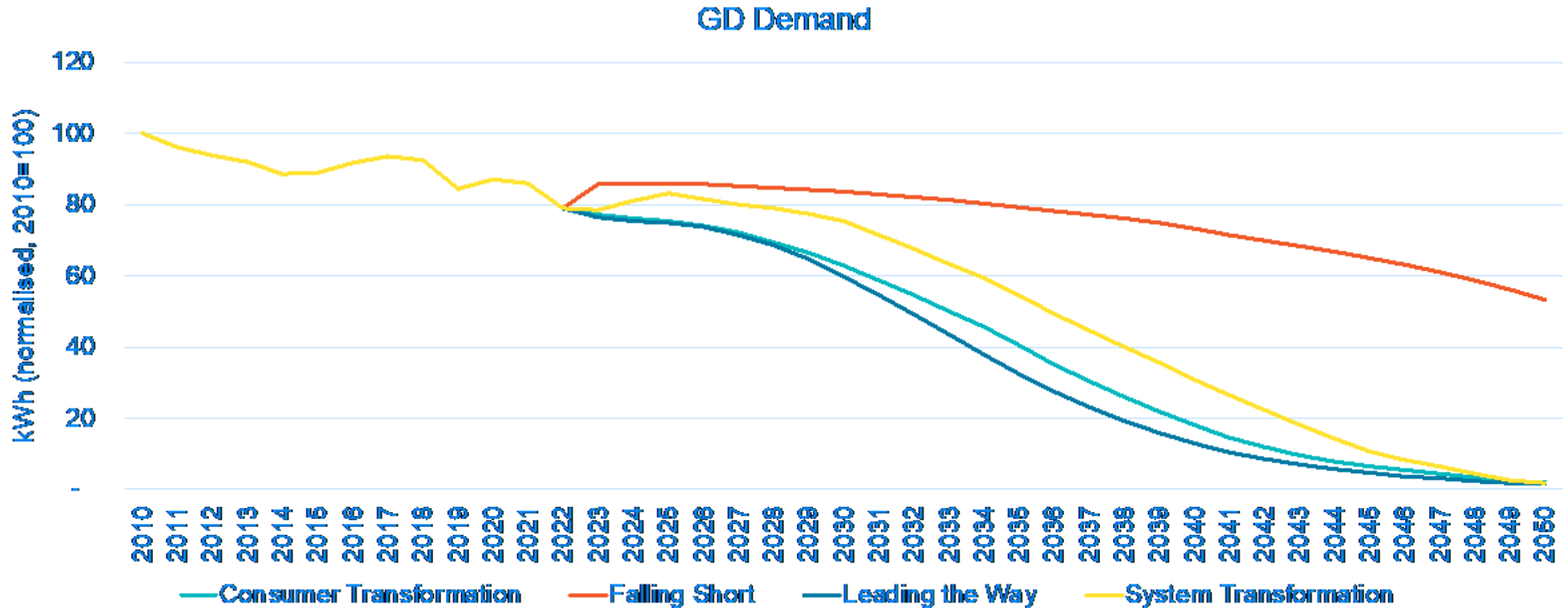
Source: based on IEA 2023

Gas demand decline in EU scenarios



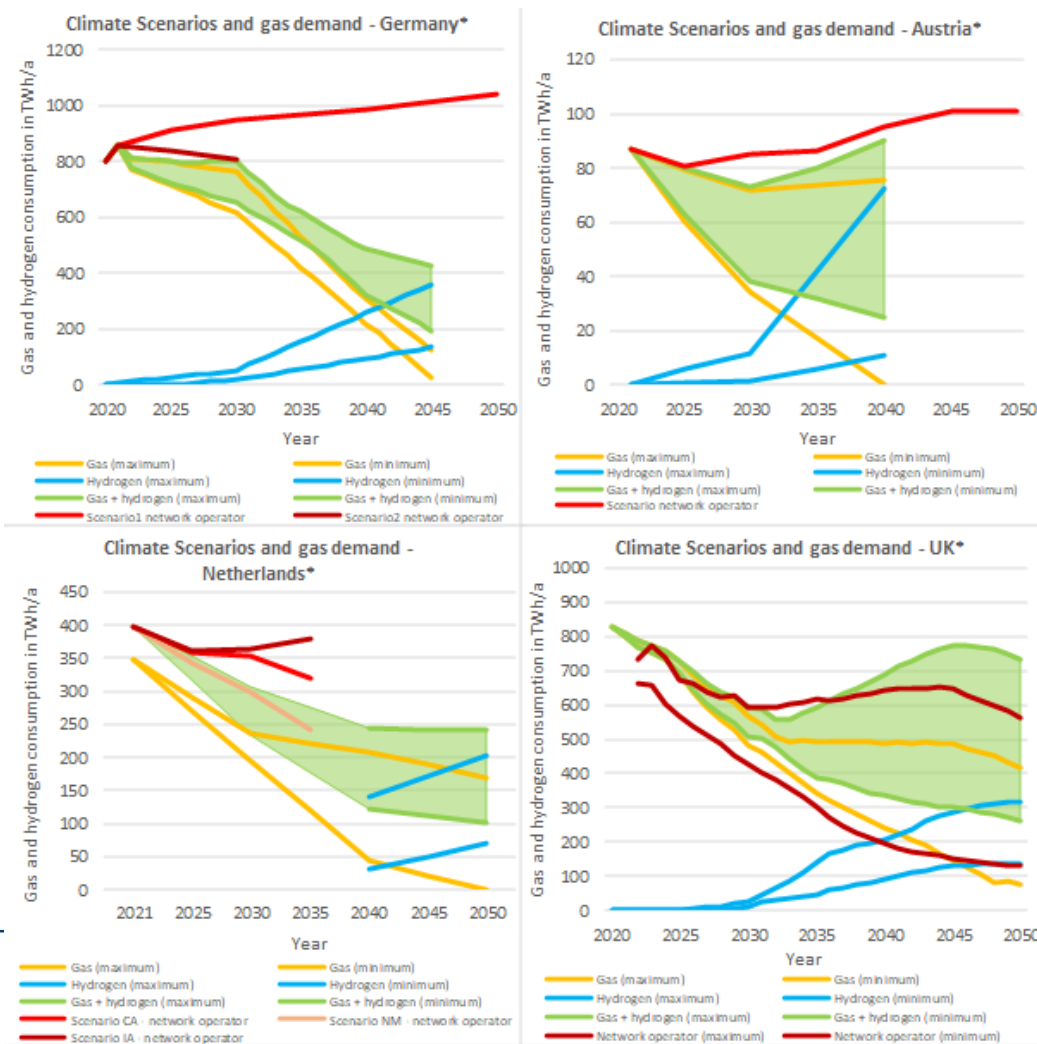
Sources: based on European Commission (2024)

Gas demand decline in UK scenarios

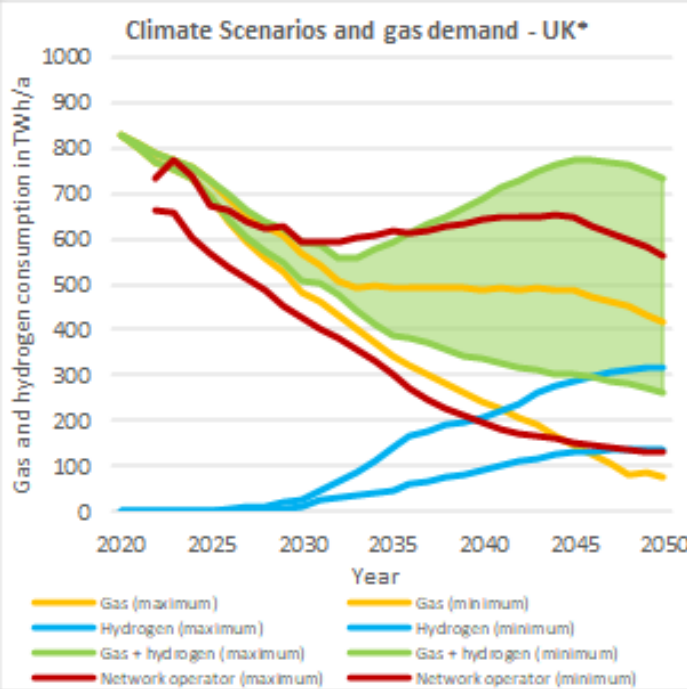
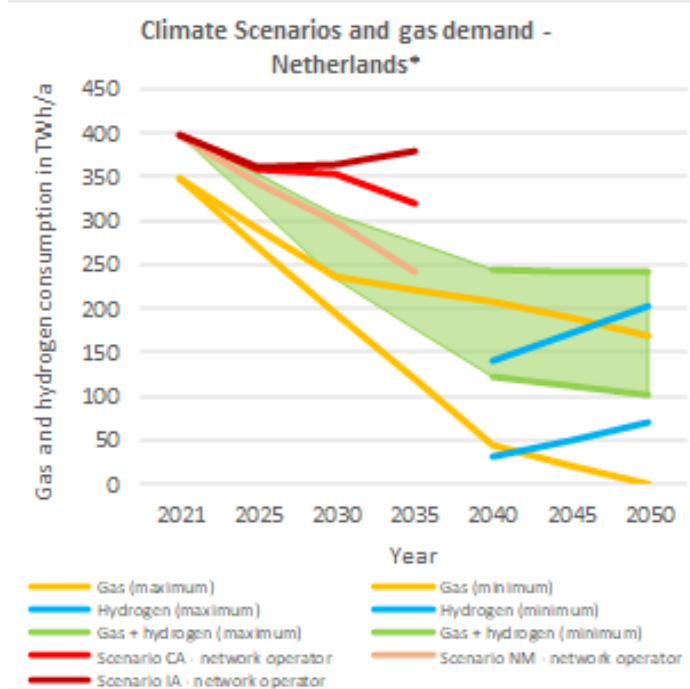
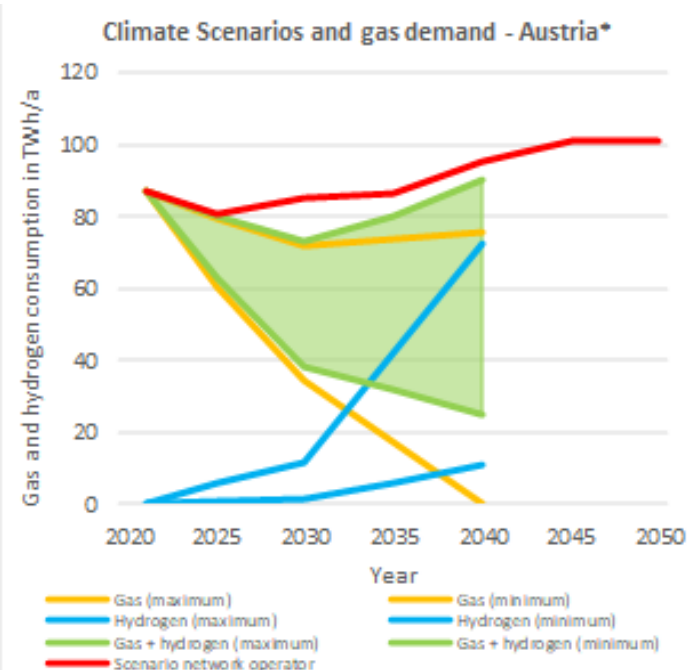
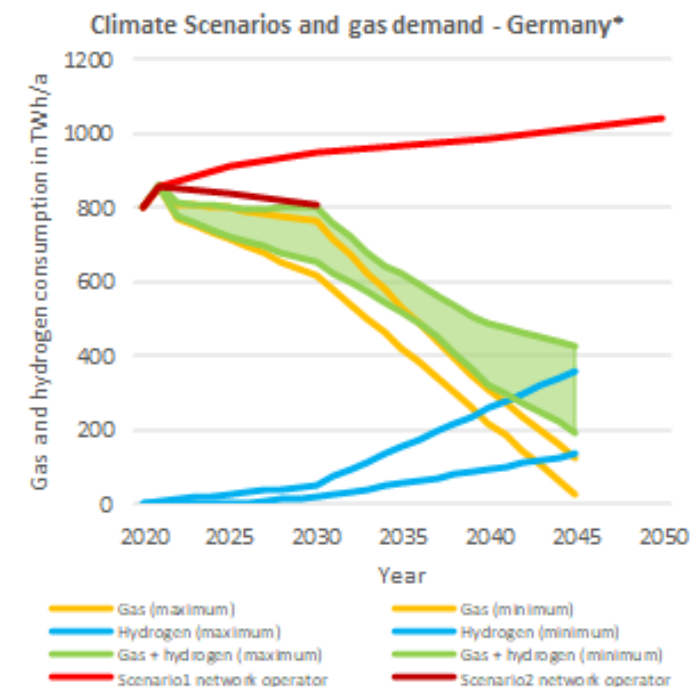


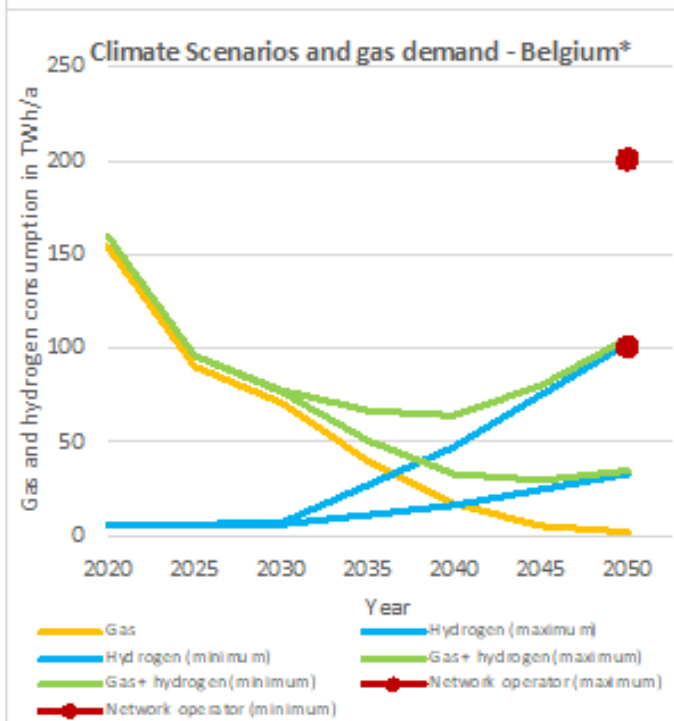
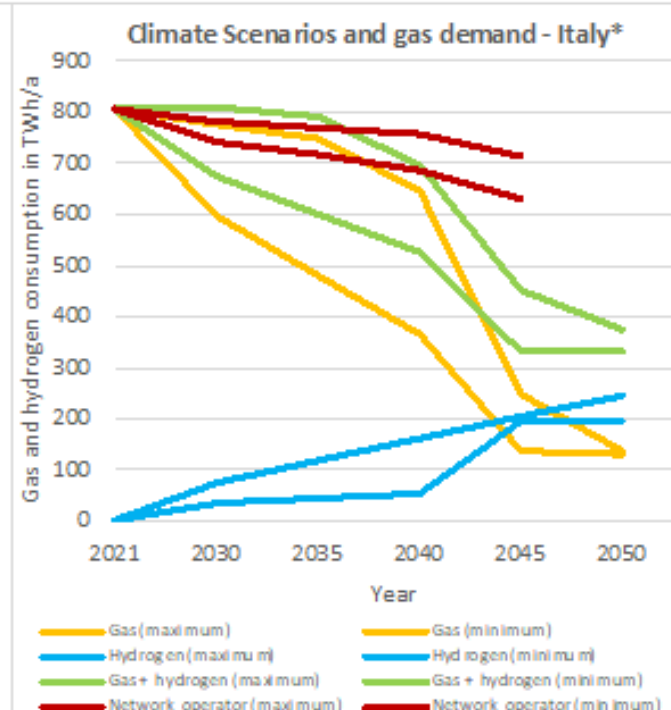
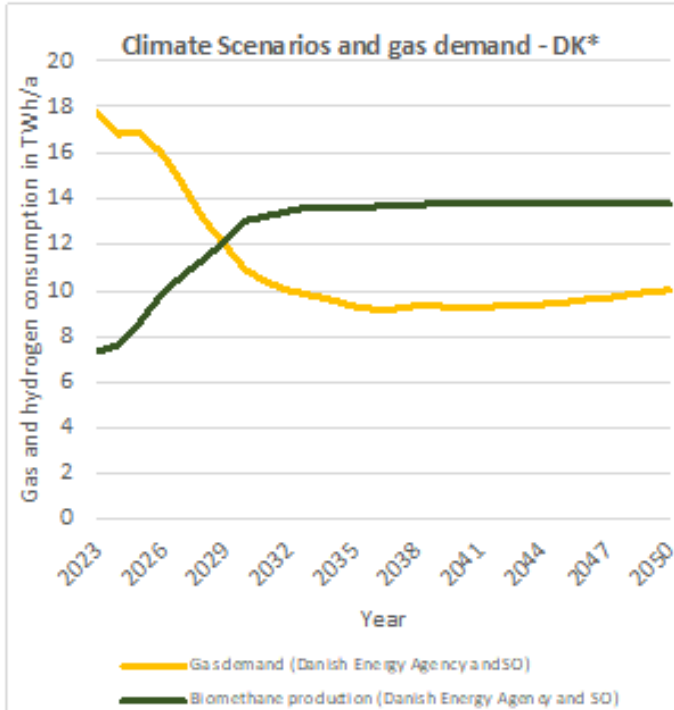
Sources: Ofgem (2023)

Gas grid operators often assume more gas demand than compatible with climate targets



Source: RAP/Oeko-Institut forthcoming



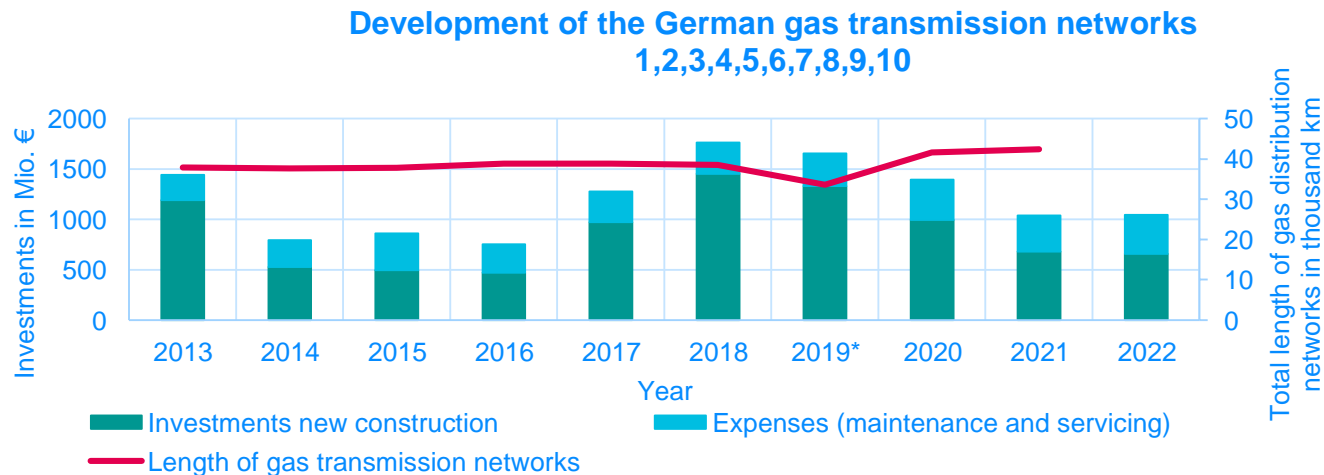
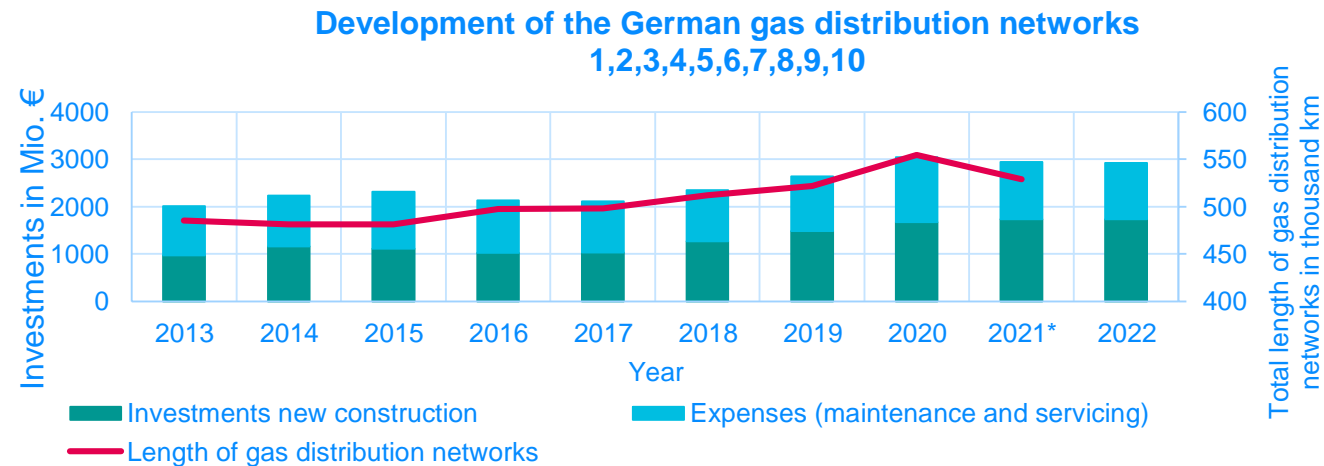




3

Gas grid decommissioning at local level

No signs of decommissioning until recently – example Germany



Sources: ¹Federal Network Agency (BNetzA) (2023); ²Federal Network Agency (BNetzA) (2022a); ³Federal Network Agency (BNetzA) (2021); ⁴Federal Network Agency (BNetzA) (2020); ⁵Federal Network Agency (BNetzA) (2019); ⁶Federal Network Agency (BNetzA) (2018); ⁷Federal Network Agency (BNetzA) (2017); ⁸Federal Network Agency (BNetzA) (2016); ⁹Federal Network Agency (BNetzA) (2015); ¹⁰Federal Network Agency (BNetzA) (2014)



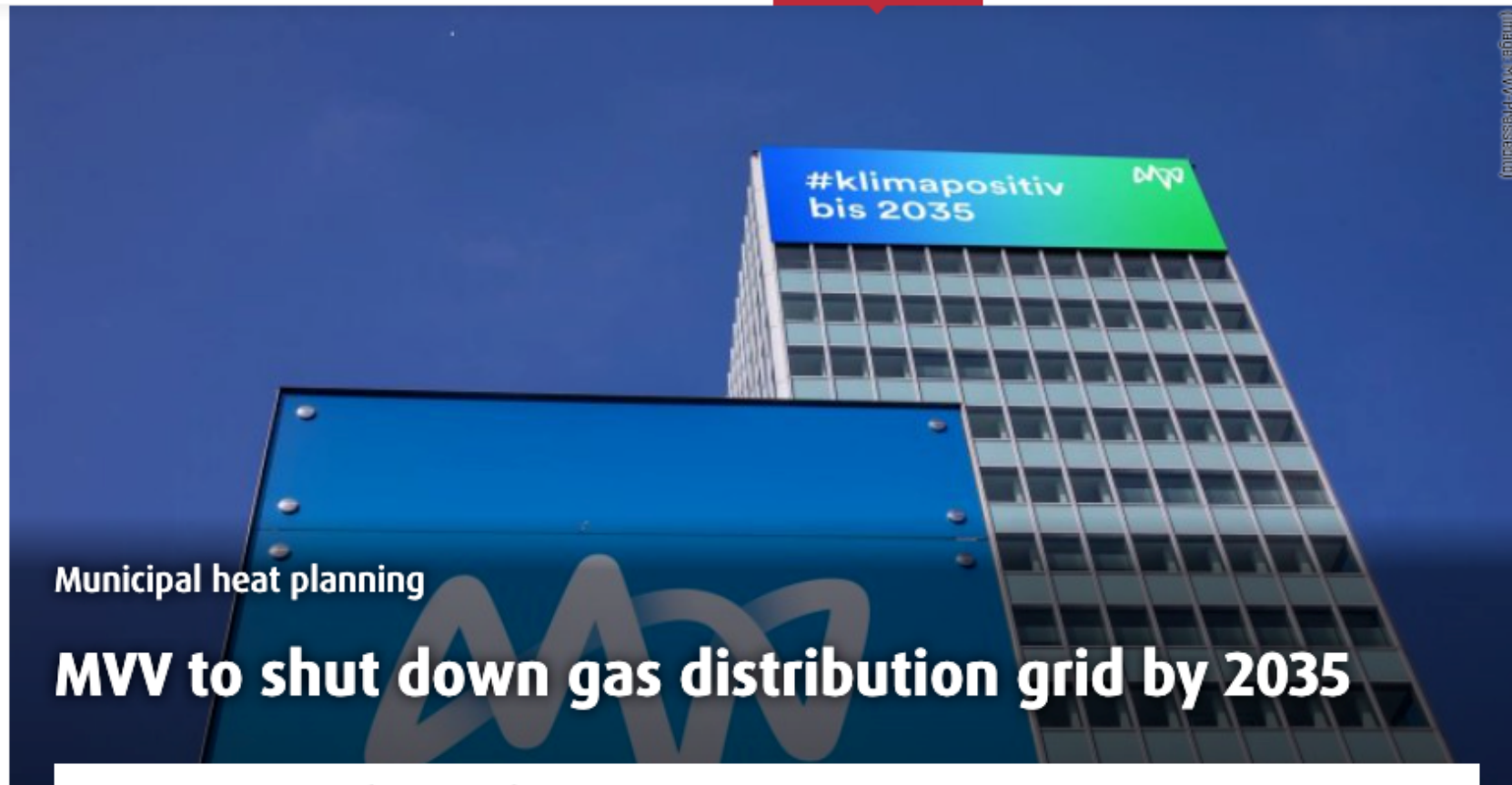
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(Image: MVV-Pressfoto)

Municipal heat planning

MVV to shut down gas distribution grid by 2035

MVV Energie has set itself the target of being "climate-positive" by 2035.


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Summer interview

Augsburg plans gas grid decommissioning with foresight

Basel-Stadt plant Schritte für den Gas-Ausstieg bis 2037

Bis im Jahr 2037 wird im Kanton Basel-Stadt das Gasnetz stillgelegt. Die ersten Stilllegungen sollen im Jahr 2026 stattfinden. Ab 2028 wird der Energieversorger IWB jährlich etwa 1000 Gasanschlüsse vom Netz nehmen, wie der Kanton am Donnerstag mitteilte.

Publiziert: 26.10.2023 um 10:32 Uhr | Aktualisiert: 26.10.2023 um 16:27 Uhr

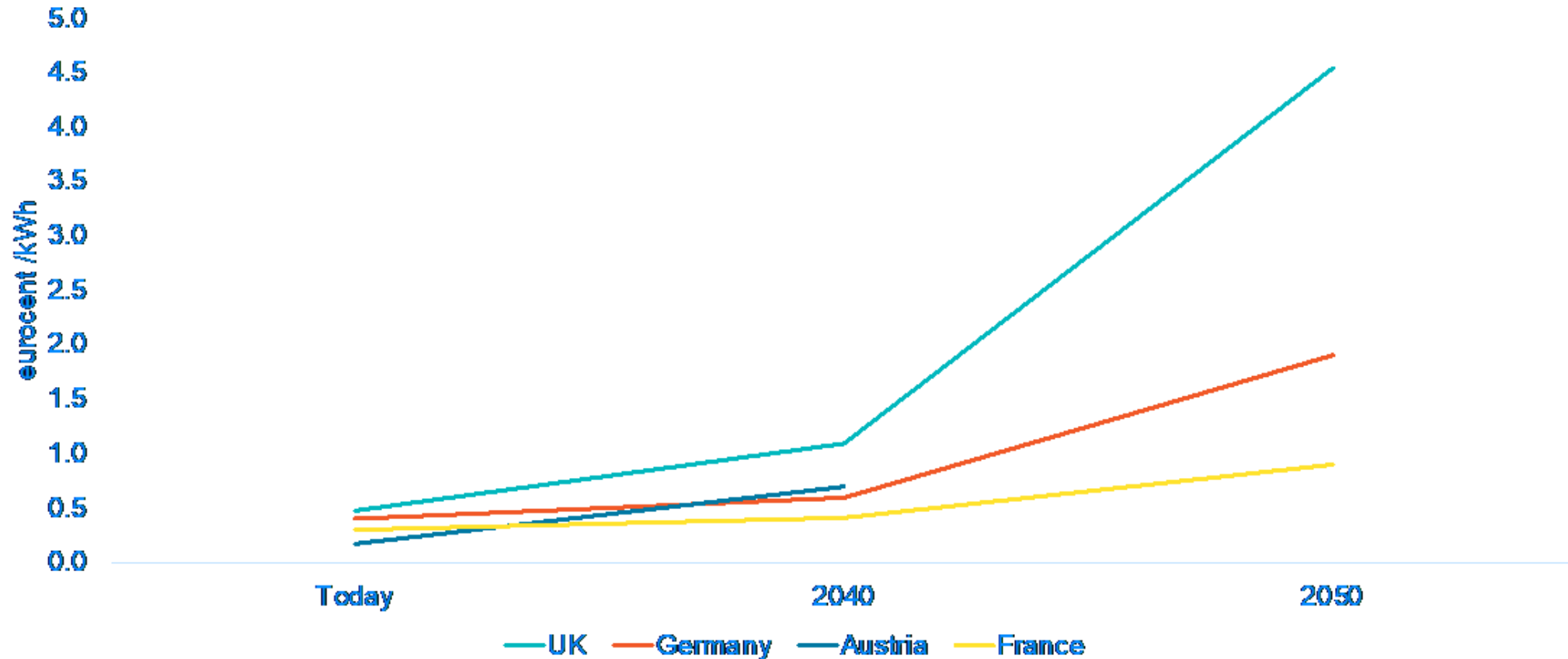


An aerial photograph of a solar farm, showing numerous rows of blue photovoltaic panels installed in a field. The panels are arranged in a grid-like pattern, and some greenery is visible between the rows. The image is used as a background for the slide.

4

Impact on gas grid fees

Rising gas grid fees projected across Europe



Sources: based on Ofgem (2023) from three decarbonisation scenarios (Consumer Transformation, Leading the Way, System Transformation); Germany and France: based on Bouacida et al. (2022); Austria: based on Zwickl-Bernhard et al. (2024)

Money

Gas bills to increase in France this summer



The Local France - news@thelocal.fr

Published: 5 Feb, 2024 CET. Updated: Mon 5 Feb 2024 11:08 CET

💬 1 comment   



“If we spread the cost of using the network amongst a smaller group, inevitably each consumer ends up paying a little bit more.”

Emmanuelle Wargon, President of the French Energy Regulatory Commission (CRE)





Louise Sunderland

Managing Principal, The
Regulatory Assistance Project
(RAP)

Getting off gas: future risks for energy poor households

The gas package and renovation wave in the European Green Deal raise new opportunities for ending Europe's dependence on gas. We need to think about what this means for energy poor households, writes Louise Sunderland from the Regulatory Assistance Project

15 July 2020 6 min. 2 shares

The views expressed are those of the author and do not necessarily reflect the position of *FORESIGHT Climate & Energy*

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Enet evaluation

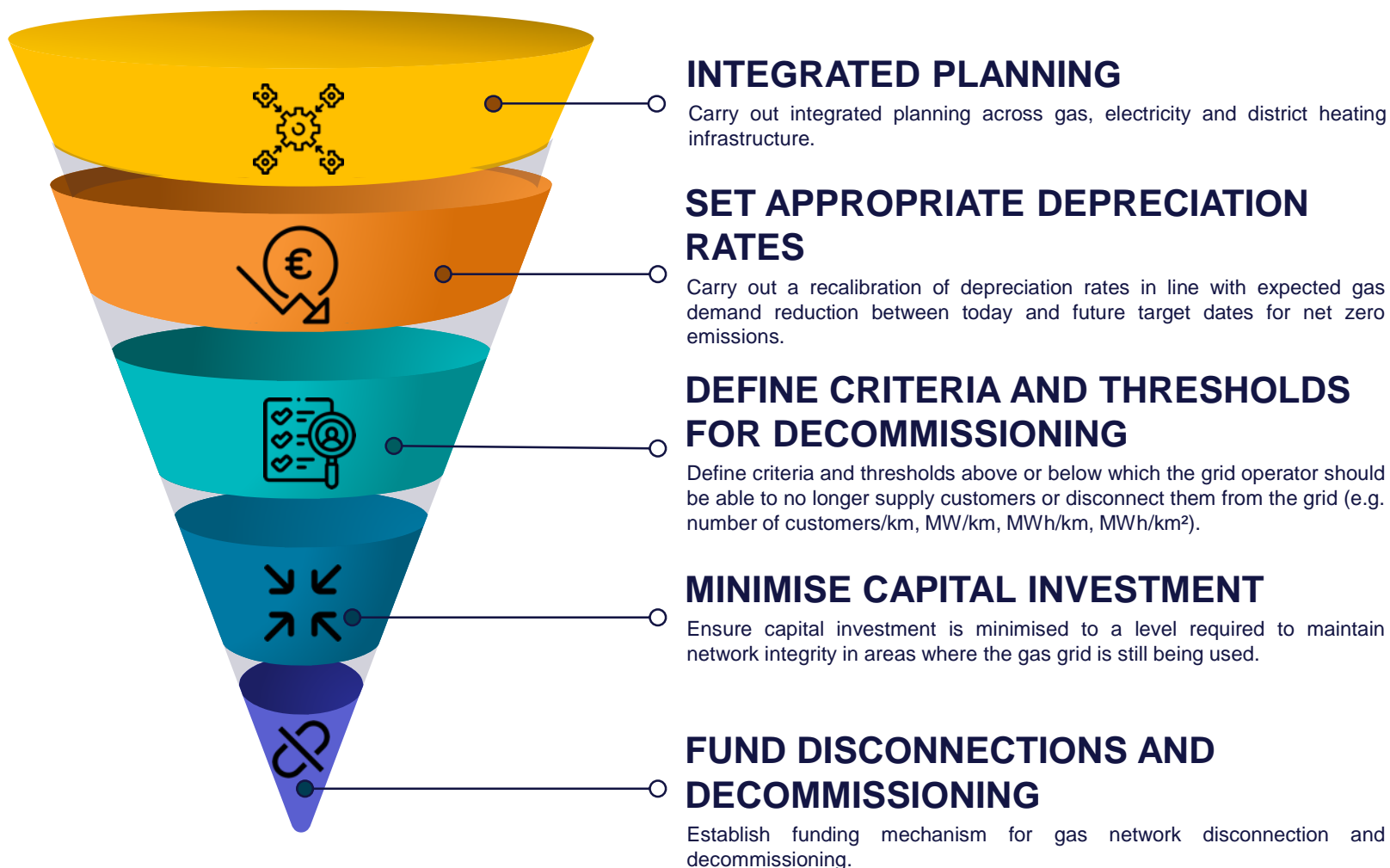
Electricity grid fees surprise, gas grid fees explode



5

A way out

Regulation to deal with gas grid decline



Source: Rosenow et al. 2024

Heat planning

EU Energy Efficiency Directive: mandatory heat planning for towns >45.000

UK moving to heat zoning

But, this will require:

- National level support
- Standardisation and monitoring
- New legal powers for local authorities
- Capacity building

UK

- ✓ Performance-based regulation allowing regulator to set specific targets
- ✓ Accelerated depreciation for new gas grid investments
- ✓ No gas grid connections for new buildings from 2025
- ✓ Heat zoning planned
- ⊗ High depreciation rate for existing gas network
- ⊗ Lack of clarity on hydrogen

Denmark

- ✓ Heat planning since 1979
- ✓ Organised phase-out of the use of gas in buildings by 2030
- ✓ No natural gas use by 2030, demand covered entirely by biomethane
- ⊗ Grid operators cannot disconnect households if the local grid is no longer economically viable

Germany

- ✓ Heat planning without decommissioning areas for gas grids
- ✓ A ban on newly installed gas boilers
- ✓ Appropriate depreciation period for the gas network
- ⊗ Grid planning not aligned with climate scenarios
- ⊗ Regulatory barriers for/while decommissioning

Austria

- ✓ Heat planning without decommissioning areas for gas grids
- ✓ Ban of gas boilers in new buildings
- ⊗ Grid planning not aligned with climate scenarios
- ⊗ The regulatory framework is not fit for the gas phase-out

Netherlands

- ✓ Heat planning
- ✓ Accelerated depreciation
- ✓ Ban for connection of new buildings
- ✓ Accelerated depreciation for the gas network
- ✓ Legislative framework for disconnection
- ⊗ Previously foreseen legislation to bans stand-alone fossil boilers not implemented

Belgium

- ✓ Connection ban for new buildings from 2025 (except WA)
- ✓ Transmission depreciation by 2050 (except if repurposed).
- ✓ H2 for industry, not heating.
- ⊗ Electricity/gas price ratio
- ⊗ Distribution grid depreciation past 2050

Italy

- ✓ Heat planning without decommissioning areas for gas grids
- ⊗ Grid planning not aligned with climate scenarios
- ⊗ Subsidy for fossil heating
- ⊗ Regulatory barriers for/while decommissioning.
- ⊗ High depreciation rate for gas network



6

Wrap up



Wrap up

1. Under-researched topic
2. Complex as part of wider energy systems analysis
3. Lack of understanding amongst stakeholders
4. Fast moving policy landscape



About RAP

Regulatory Assistance Project (RAP)[®] is an independent, global NGO advancing policy innovation and thought leadership within the energy community.

Learn more about our work at raponline.org

Dr Jan Rosenow

jrosenow@raponline.org

Posterchild Denmark

- heat planning and zoning since 1979 through Heat Supply Act
- Danish government set up a decommissioning fund to cover costs associated with removing gas supplies from homes, anticipating all homes switching to heat pumps or heat networks by 2030
- Danish government bought back the gas grid now owned by ministry of finance

In second place: Netherlands

- distribution system operators are permitted to depreciate investments in their grids on a degressive basis (paying off early) recognising a shrinking grid
- gas distribution system operators receive compensation for the costs of dismantling the gas distribution networks and for removing connection points
- mandatory local heat planning at municipality level

Early beginnings: Germany

- mandatory heat planning at municipal level from 2026
- where no future gas grid is foreseen households will no longer be able to connect new or replacement heating systems to the grid (applies to new and existing buildings)
- Energy regulator consulted on gas use decline and potential regulations for dealing with the impacts this has

Better late than never: UK

- Ofgem decided to follow accelerated depreciation for new gas grid investments in line with net zero 2050 target
- this might be applied also to the existing distribution grid but transmission may be exempt as Ofgem sees need for future use
- to address uncertainty about hydrogen and the gas grid in particular so-called “re-openers” provide the option to modify the price control framework during the next period in case of major events (e.g. decision on hydrogen)