A Pathway to a Carbon Neutral 2050: The role of gas

June 2020

What we have set out to achieve

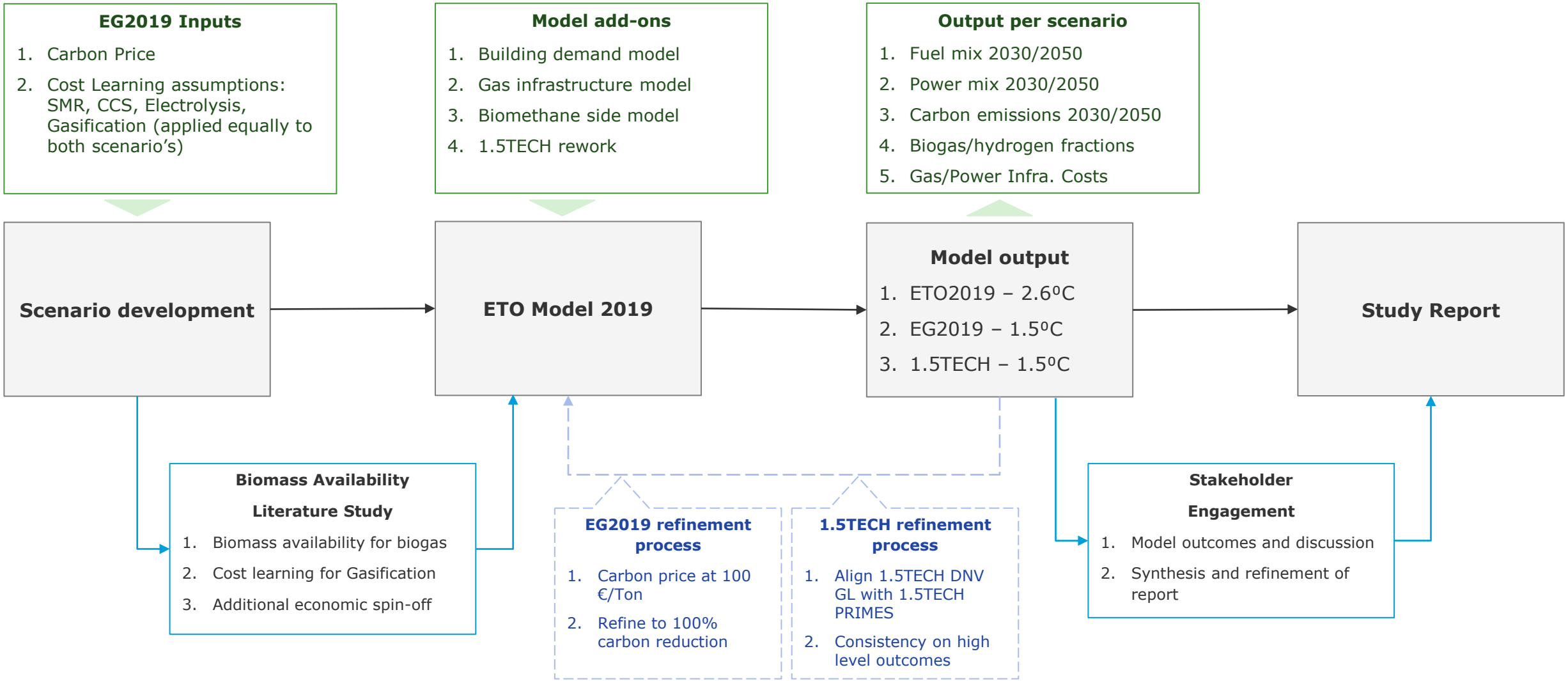
To assess a pathway to a carbon neutral future, comparing it to the European Commission's 1.5TECH

Commissioned DNV GL to carry out the study

To provide estimates of cost savings associated with a transition utilising a multi-vector approach

To outline at what point, and under which conditions, renewable and decarbonised gases will be available in Europe

Study methodology and project approach



What could a cost-effective transition look like

A multi-vector transition is more realistic and more cost-effective

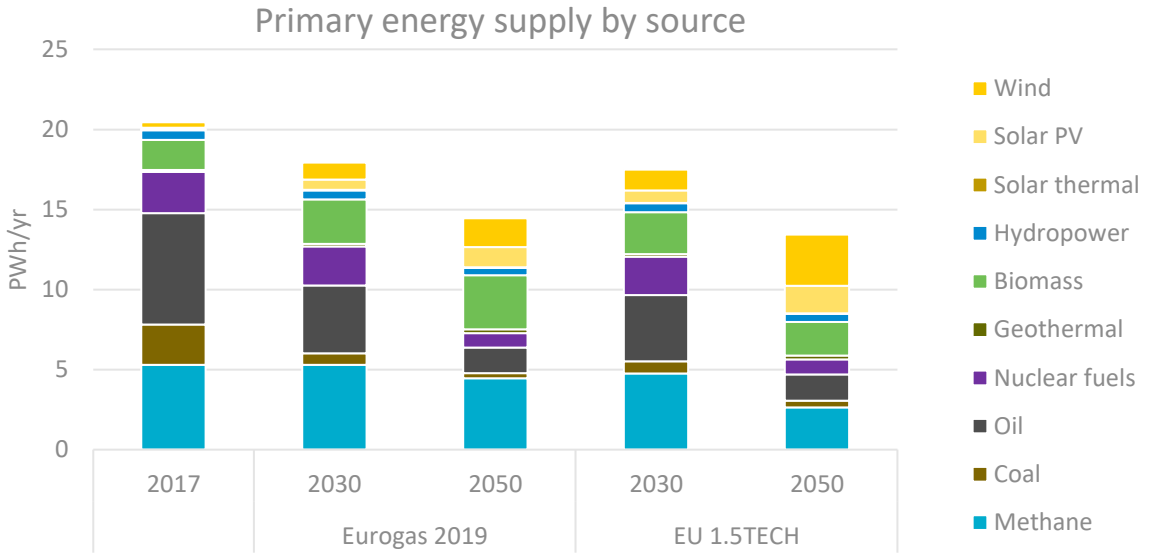
Primary energy use declines in both scenarios, 29% under Eurogas, 34% under 1.5TECH

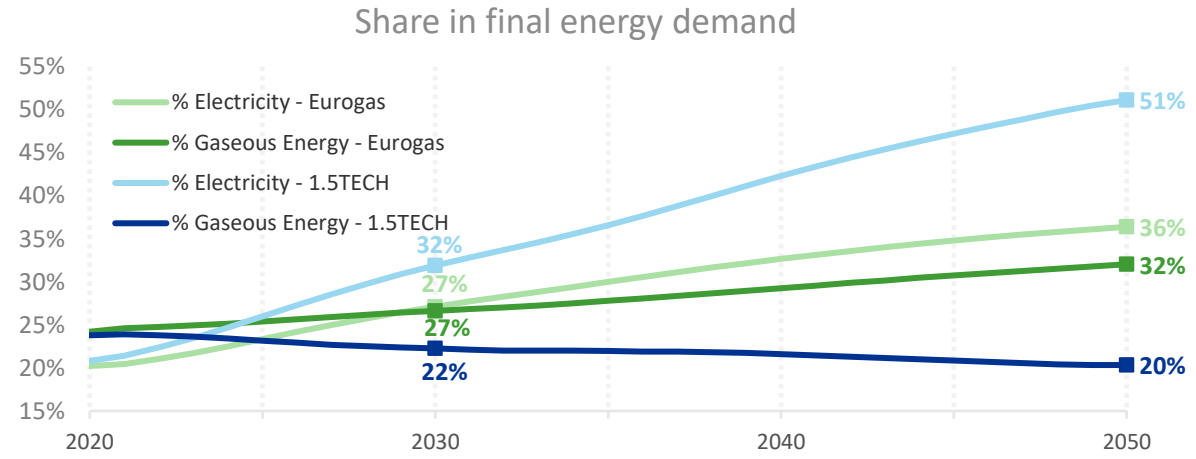
Electrification makes sense, but only up to a point – and provided the power sector decarbonises

All cost-effective decarbonisation solutions must be used across all sectors

Economy wide savings under the more balanced Eurogas scenario reach €4.1 trillion until 2050 compared to 1.5TECH

Gas enables cost-efficient decarbonisation of the building sector





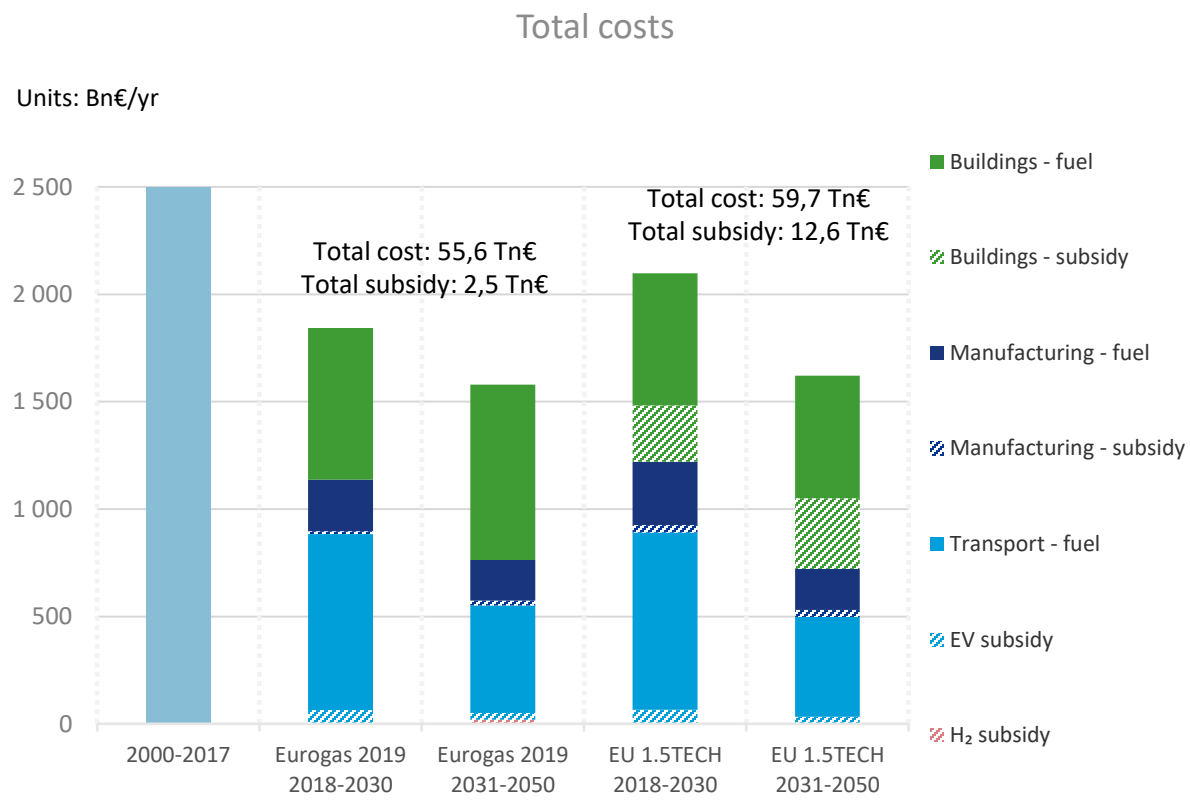
Eurogas scenario delivers carbon neutrality at considerably lower cost

A holistic energy system approach to the transition is more cost-effective

Rolling out gaseous solutions across all sectors, using existing infrastructure, saves €130 billion per year until 2050

Main cost driver of the 1.5TECH scenario is the electrification of heating

- Over €10 trillion in subsidies needed to retrofit buildings
- Over €1 trillion needed to match electricity infrastructure to meet peak demand

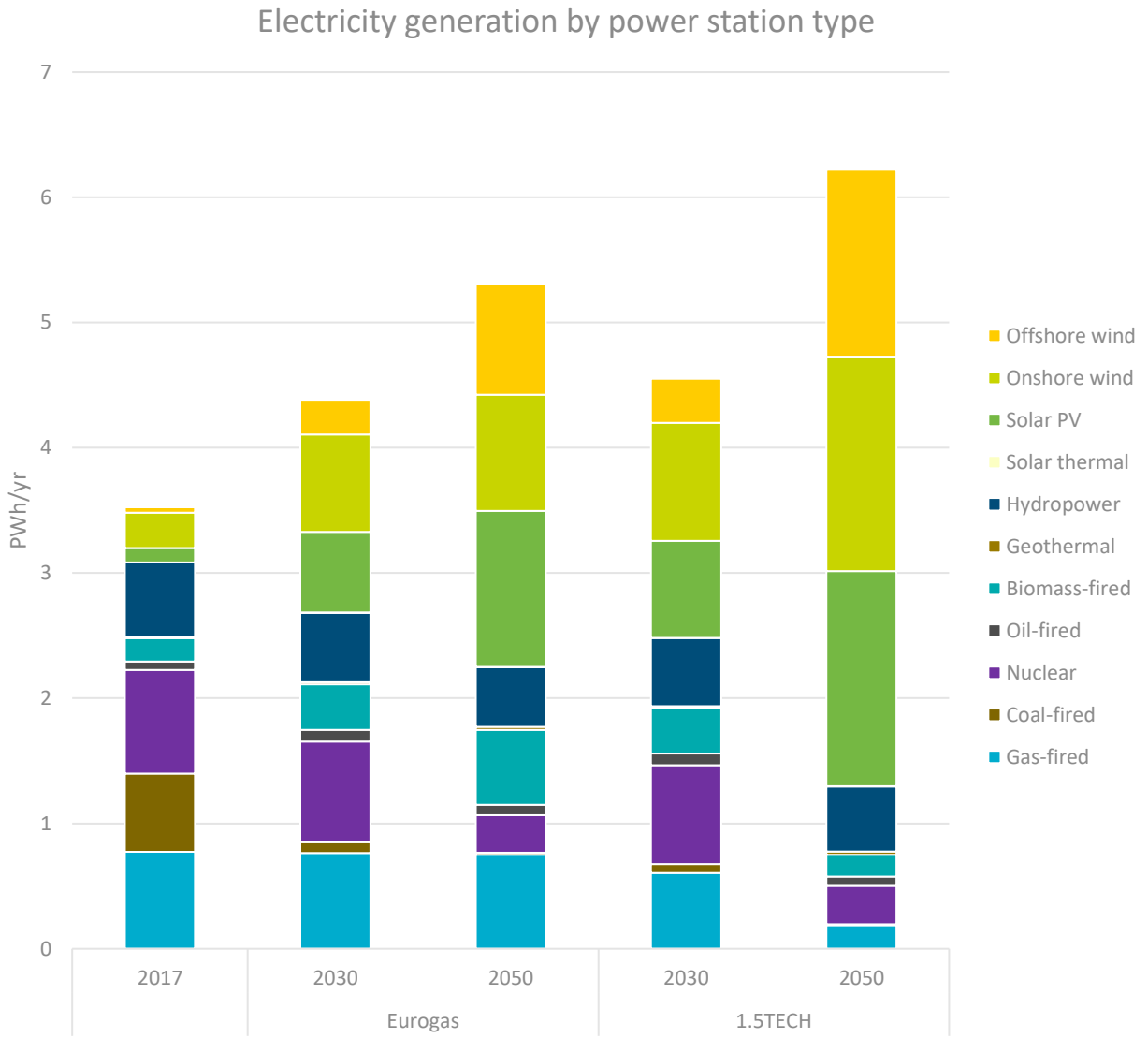


Fuel costs are after taxes and subsidies

What we need for a cost-effective transition

Significant efforts needed to make electricity green

- Massive expansion of renewable electricity generation needed from 35% in 2017 to 78% in Eurogas and 91% in 1.5TECH
- The more you electrify end uses, the bigger the challenge to deploy and integrate variable renewable power
- Coal is progressively driven out by 2050 and nuclear is reduced – this is happening faster under Eurogas
- Energy system integration facilitates the deployment of variable renewable power and delivers it through the gas network
- Gas provides system flexibility, back up and security of supply
- Net negative emissions are achieved through biomass and biogas coupled with CCS



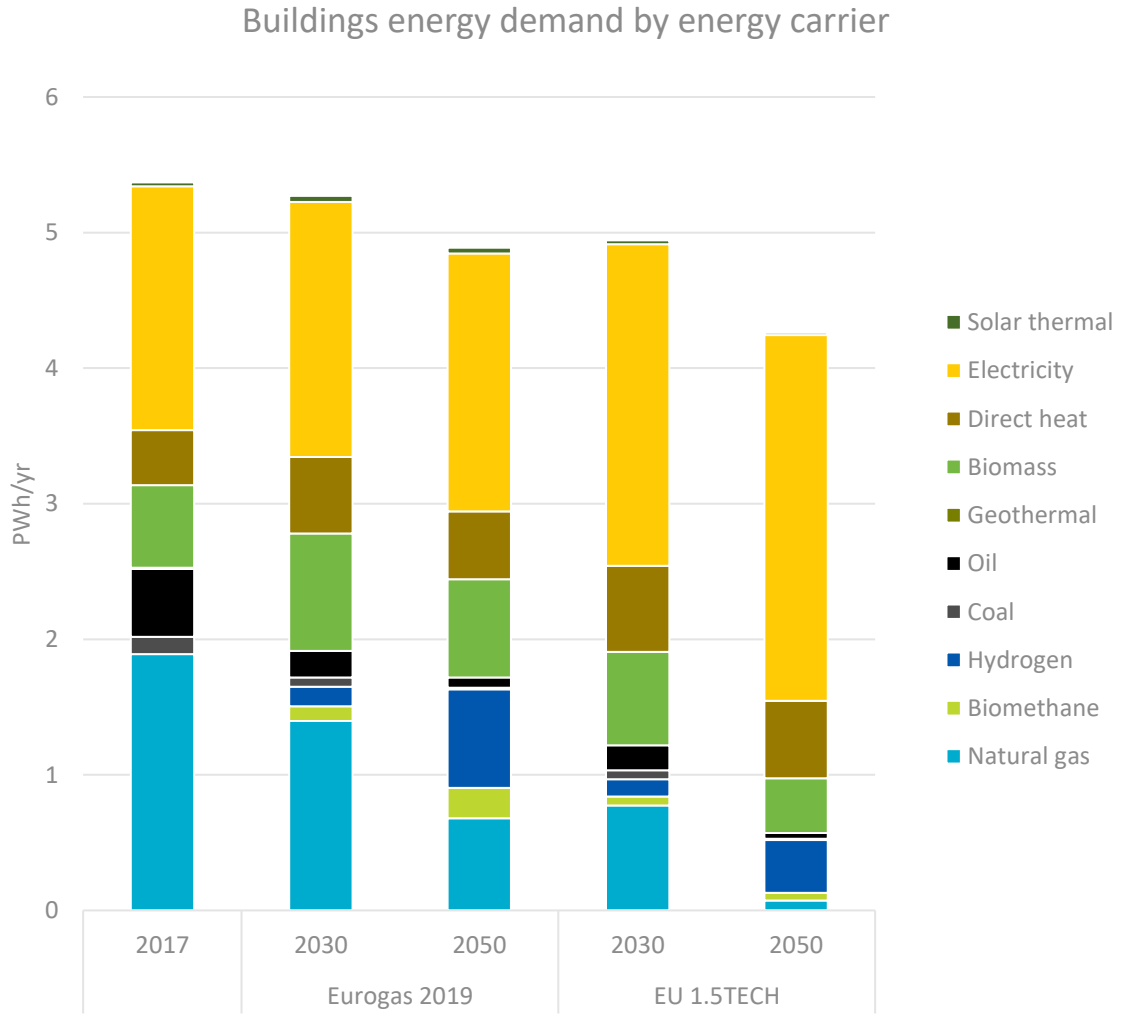
Cost-efficient decarbonisation solutions matter most in the building sector

Gaseous energy, decarbonised over time delivers a more cost-effective and realistic pathway

True: Electrification of heating can reduce energy demand compared to gaseous solutions

Also true: over €10 trillion in subsidies needed to transform Europe's buildings stock and replace appliances in 1,5 TECH

Social acceptance is a barrier that should not be underestimated – gaseous solutions are easy to implement and affordable for households across Europe



Manufacturing leads the uptake of hydrogen until 2030

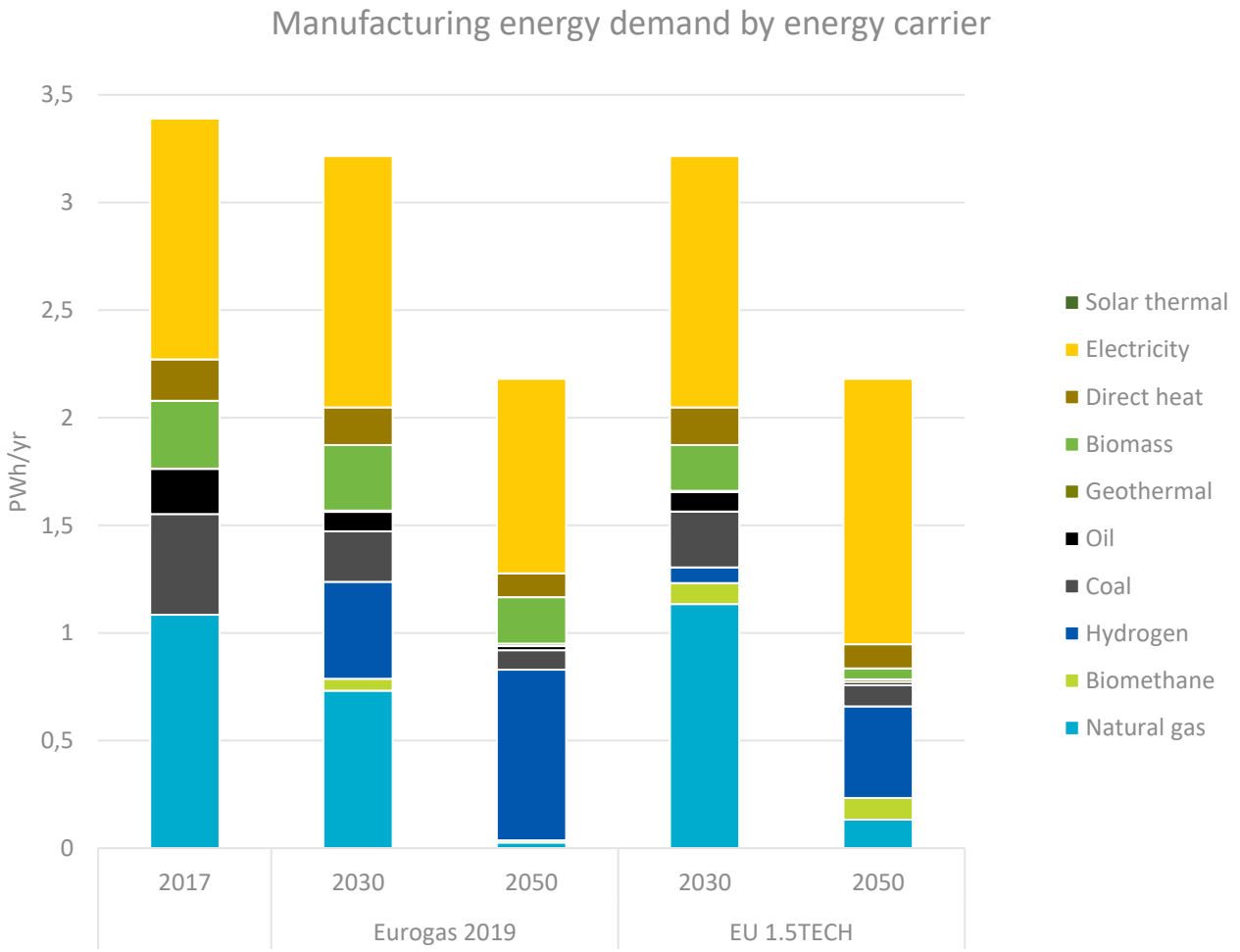
Manufacturing sector is the main driver for initial large-scale hydrogen demand

These volumes lead manufacturing to trigger the necessary infrastructure investments

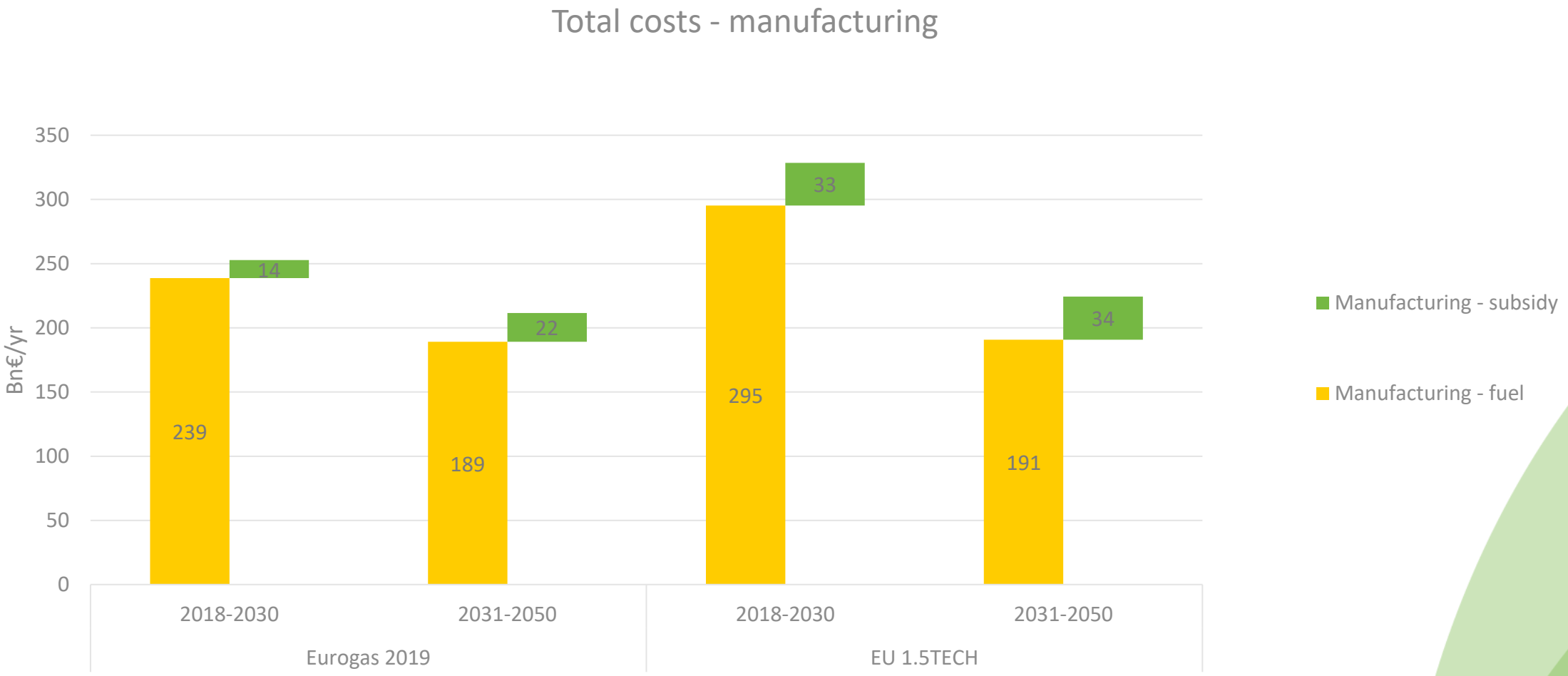
CCS is a pre-requisite for deep decarbonization

Using hydrogen in manufacturing requires less subsidies and has lower energy costs than the strong electrification seen in 1.5TECH

The cost advantage is particularly apparent in the period to 2030



Total costs – manufacturing sector



Efficiency gains in transport halve energy demand by 2050

Energy efficiency gains by using hydrogen and electrifying road transport

Doubling the share of natural gas use to 2030 reduces emissions

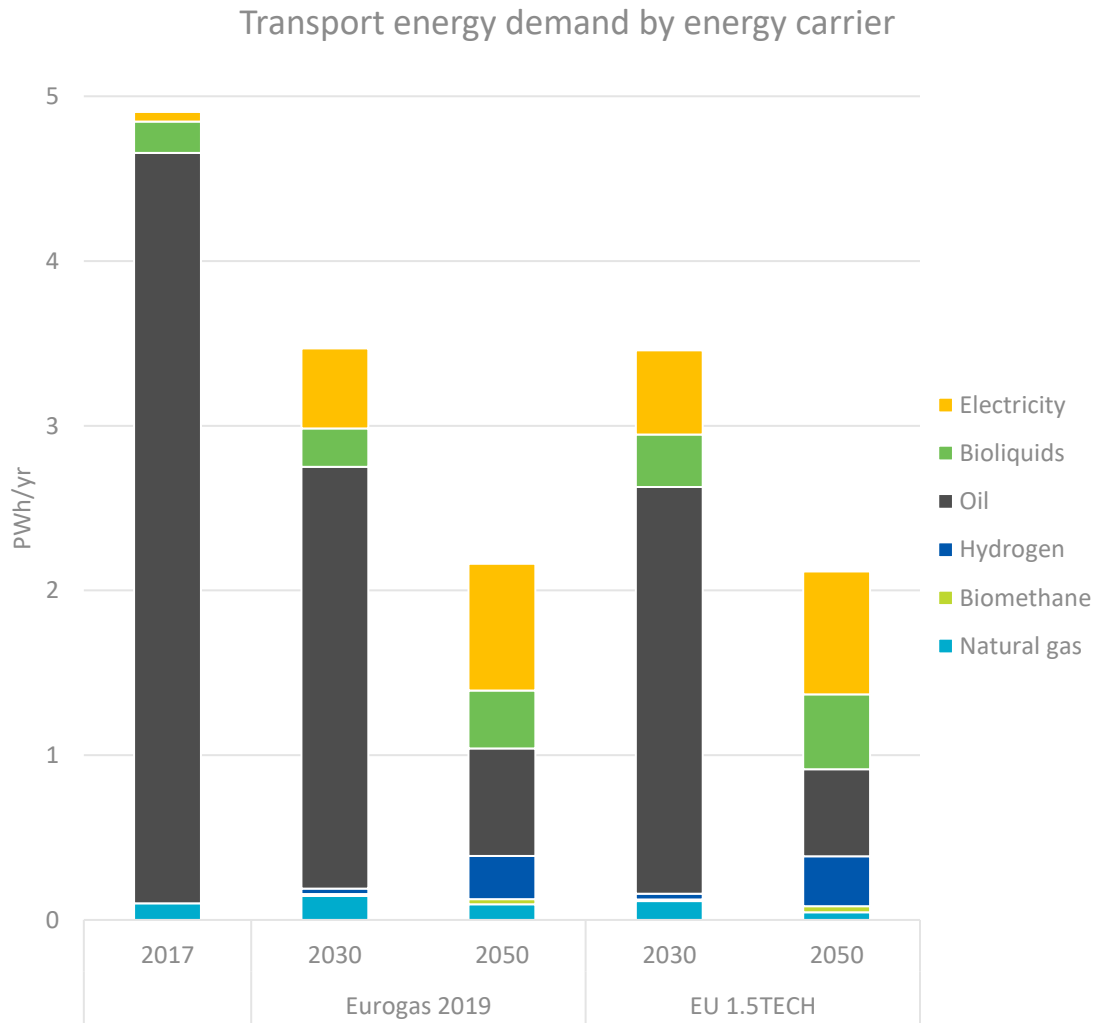
Hydrogen becomes the dominant gaseous energy carrier in transport towards 2050

Biogas, natural gas and hydrogen increase from 2% in 2017 to 18% of energy demand in transport by 2050 under both scenarios

Battery electric vehicles dominate drive trains for both commercial and passenger vehicles by 2050

Electricity a marginal energy carrier in the Maritime and Aviation sectors

Decarbonisation of the maritime sector in the Eurogas scenario through hydrogen – 31% of total maritime demand



How we will decarbonise the gas sector

eurogas 30 years

Demand for hydrogen *as an energy carrier* increases in both scenarios

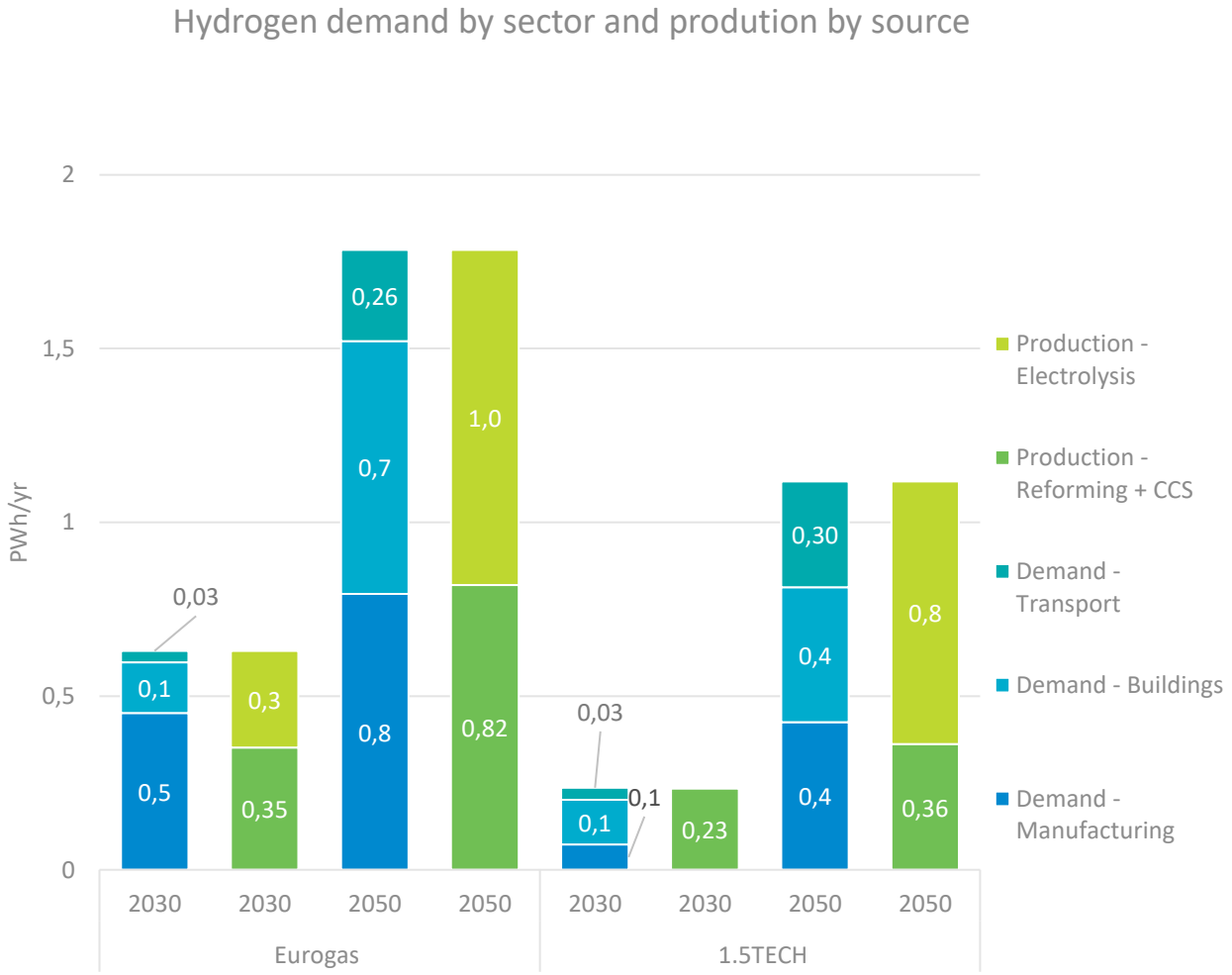
Eurogas scenario sees manufacturing lead hydrogen uptake until 2030

Hydrogen *(together with biomethane)* displaces natural gas in heating after 2030 towards 2050 – in the beginning blending will be especially important for this sector

The transition is gradual and requires appropriate framework conditions are set in 2020s

Both scenarios show an important role for hydrogen from reformed natural gas as an early driver to provide scale by 2030

The share of hydrogen from electrolysis overtakes hydrogen from reformed natural gas by 2050

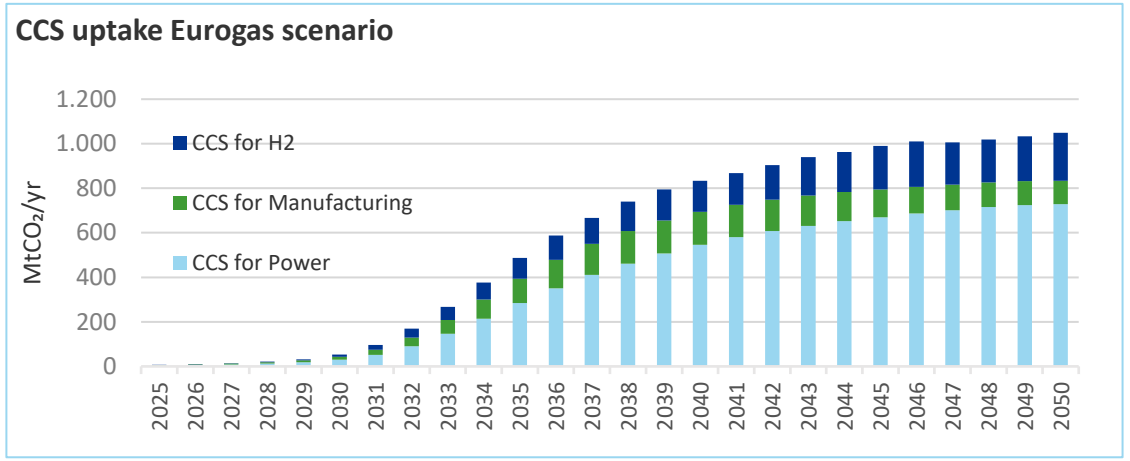


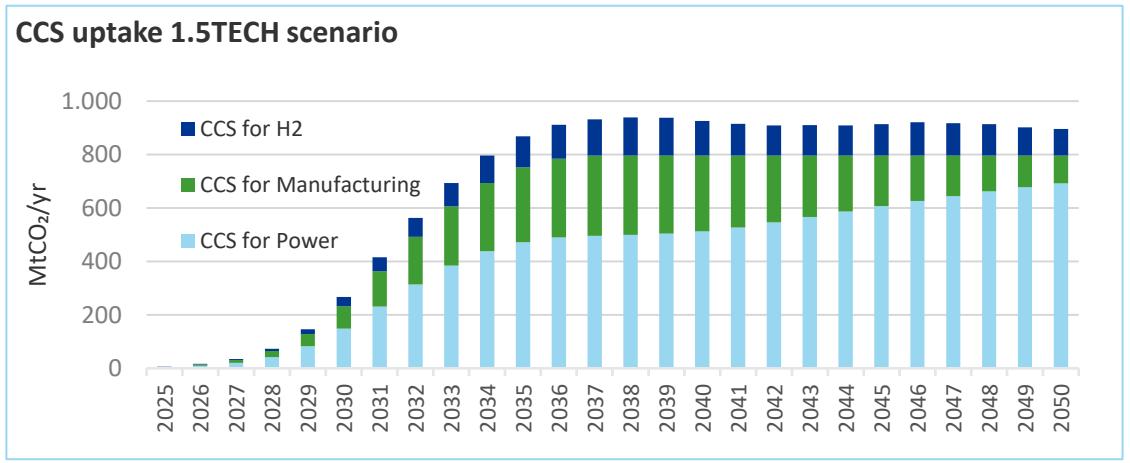
Whatever scenario we choose. CCS is not an option. It is a necessity.

Both scenarios rely on CCS, especially to decarbonize the power and manufacturing sector

Although the Eurogas scenario has a higher share of natural gas, it decarbonizes the energy system with 15% lower cumulative CCS deployment towards 2050 than 1.5TECH

Under conservative assumptions and restrictive policies, both scenario's use 11-13% of available storage capacity, and have between 114-130 years of storage left in 2050





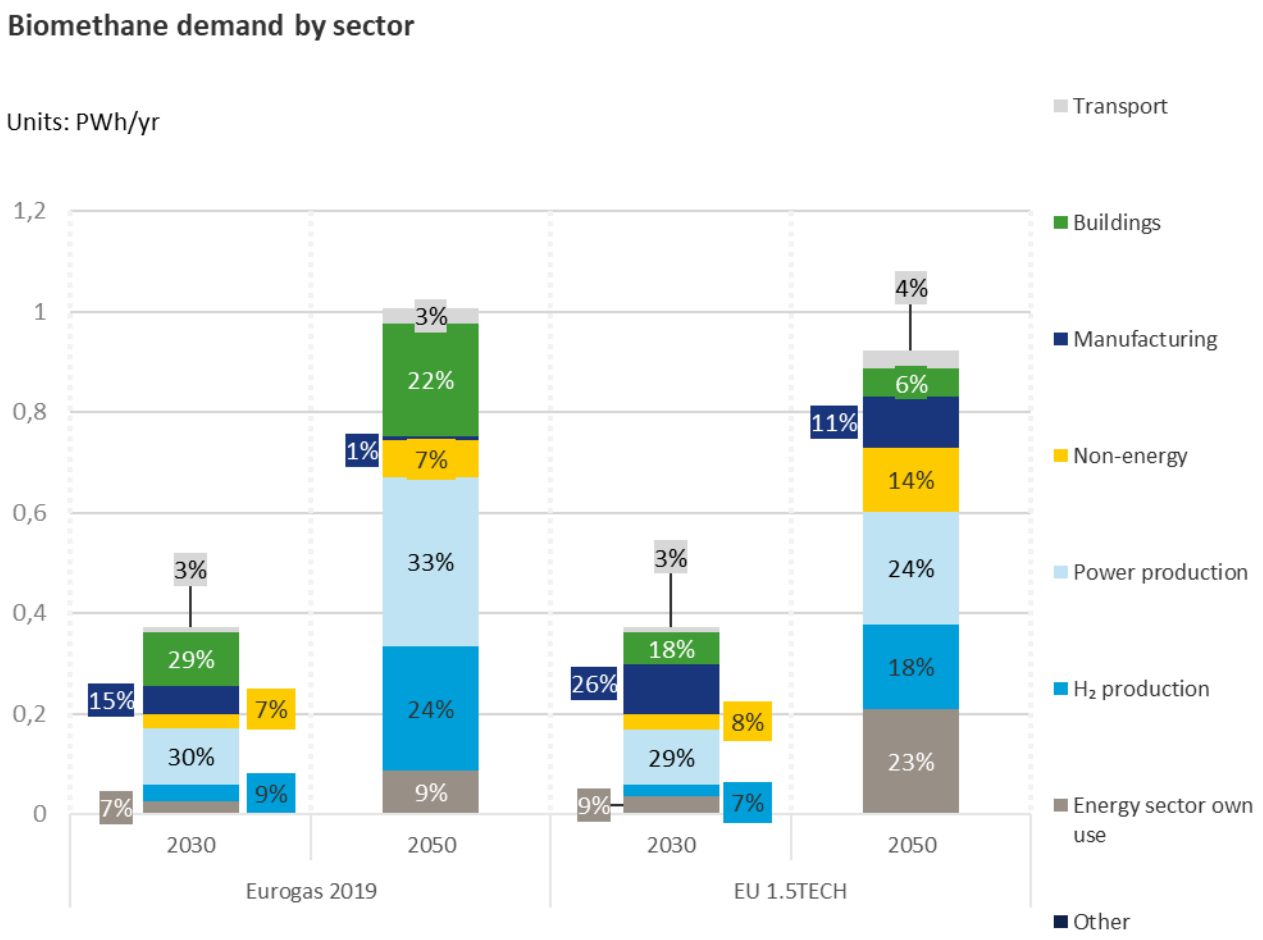
Biomethane is a no-regret option that enables substantial negative emissions

Biomethane is used in all sectors in the EU as delivered through the natural gas networks

Biomethane demand in Eurogas and 1.5TECH are similar for 2030 and diverge slightly in 2050 (~900/1000 TWh)

Largest sector in terms of biomethane demand is power generation in both Eurogas (33%) and 1.5TECH (24%) in 2050

Enables net negative CO2-emissions in power and manufacturing, offsetting >100% of unabated emissions in the Eurogas scenario and ~95% in the 1.5TECH scenario



What it means for energy infrastructure

Hydrogen will be supplied blended and unblended

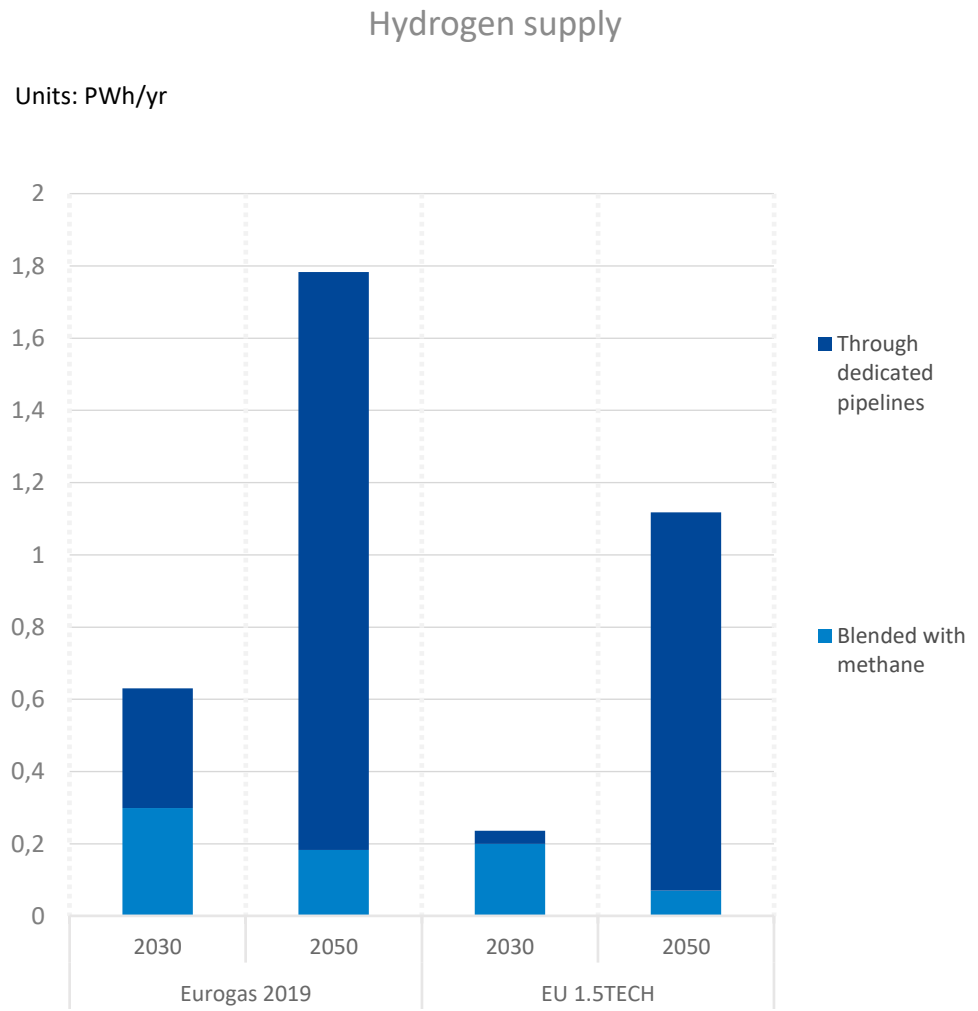
Pure hydrogen networks develop in specific demand sectors (e.g. manufacturing) already in the 2020s and become the norm by 2050

Initially blending will also play an important role to start scaling the hydrogen market without delay and optimise the use of existing infrastructure

In the Eurogas scenario, half of the hydrogen supply is delivered through blending in 2030

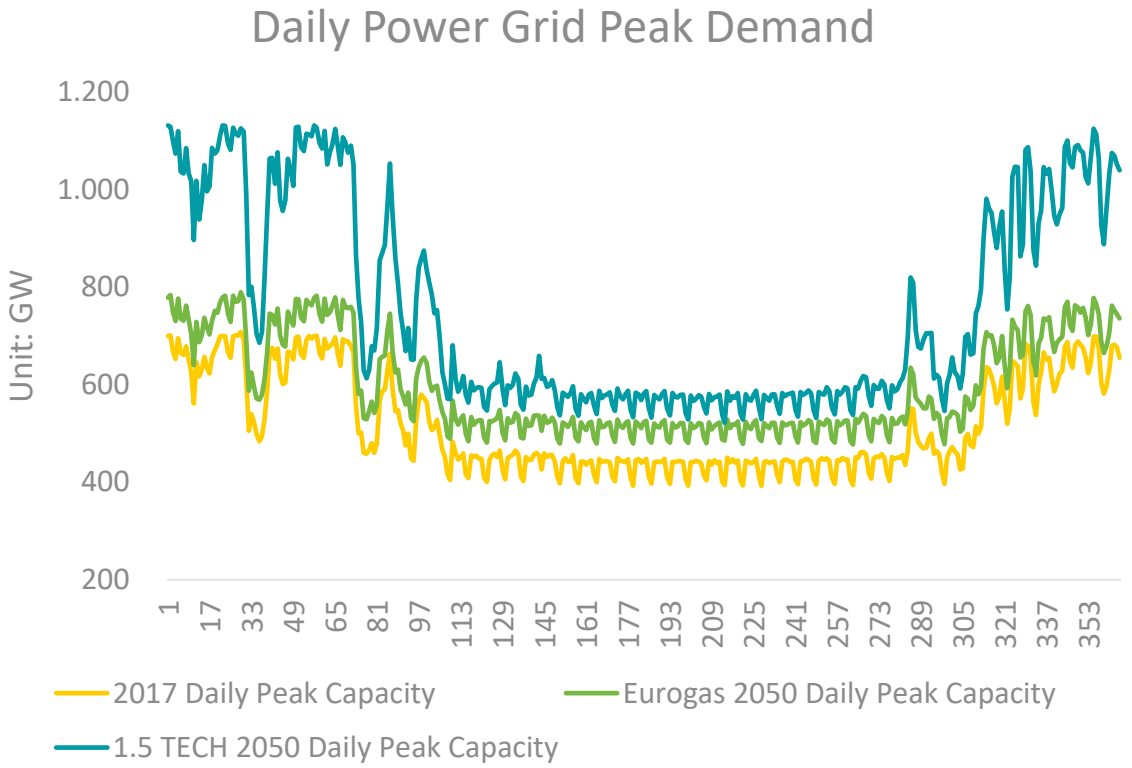
As there are technical limits that making continuously increased blending levels uneconomical, the share of dedicated infrastructure jumps to 90% by 2050

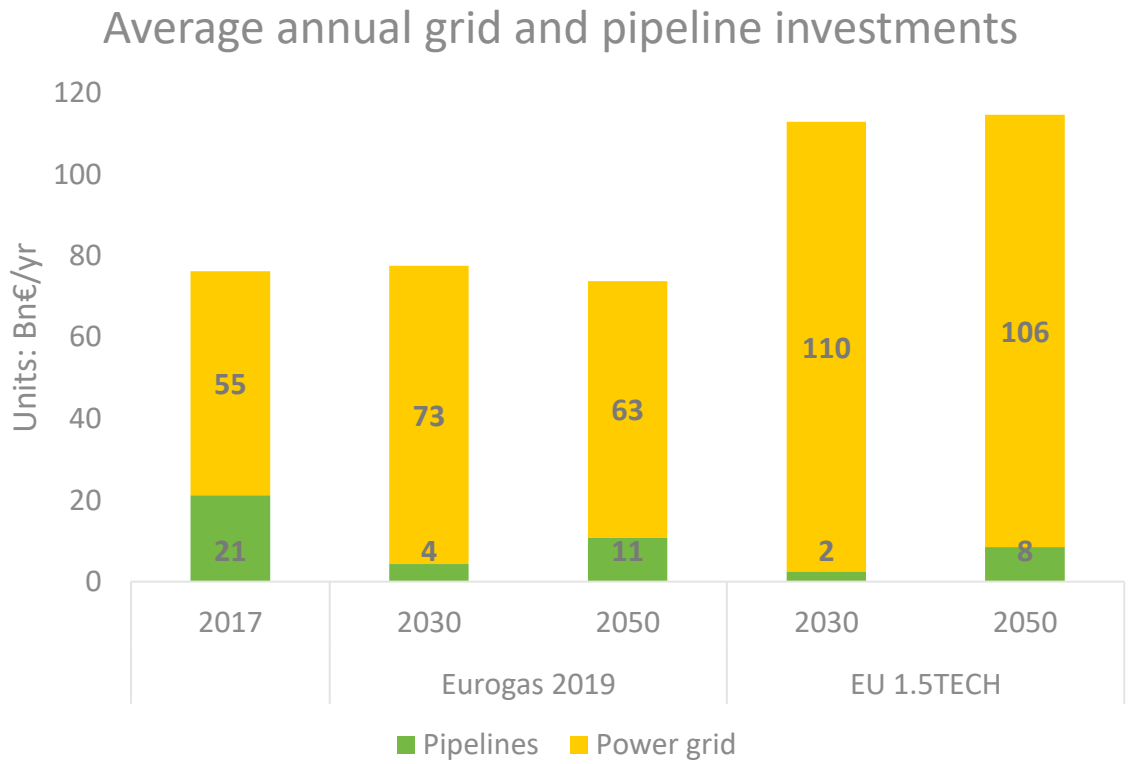
CAPEX in gas infrastructure to 2050 mainly required for decarbonised hydrogen supply



Electrifying heat drives peak power demand

Decarbonising heating with gas saves €1.3 trillion - otherwise needed to expand power networks that would be underutilised most of the time while increasing the risks of blackouts





Which pathway should we chose?

Eurogas is the more cost-effective 2050 pathway and inline with the Green Deal objective to 2030

Total costs for the Eurogas scenario are 4.1 trillion euro lower - equivalent to saving 130 billion euro per year

Subsidies to incentivise consumers to opt for decarbonised energy solutions are 80% lower

1.5TECH has a steeper emissions reduction curve due to a sharper increase in carbon price and faster uptake of CCS already by 2030

Eurogas shows that climate objectives can be met more cost-effectively, using existing assets, limiting subsidy schemes and leaving market fundamentals in place