Role of gas infrastructure in a decarbonised economy

ENTSO's Scenario Storylines workshop for TYNDP 2020

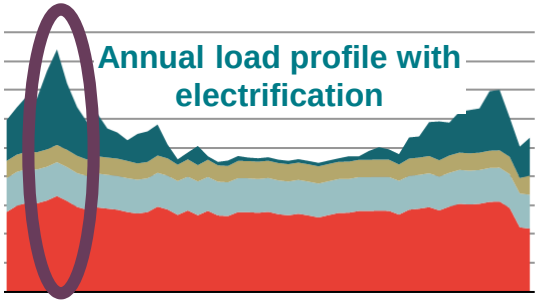
May 2018

Frontier study highlights benefits of a joint view on electricity and gas infrastructure

Context – RES replace fossils, also in transport, heating and industry

Challenge – storing and transporting unprecedented volumes of electricity

Direct electrification of heat implies substantial increase in peak electricity in winter!



Requires **seasonal storage** and **new** peak **transport capacity**

Solution – continue using gaseous (and liquid) fuels for stoarge and transport

Tranform (some) RES to gas („**Power-to-Gas**“) and use existing gas storages and networks

Benefits	DE Case study
Acceptance – Less need for power grid expansions	**TSO: 40% less** expansion **DSO: 60% less** expansion
Increased supply security (fuel mix)	Gas storage volume **6,000 times** higher than electricity storage
Substantial cost savings	**€12 bn** p.a. in 2050

Policy implications

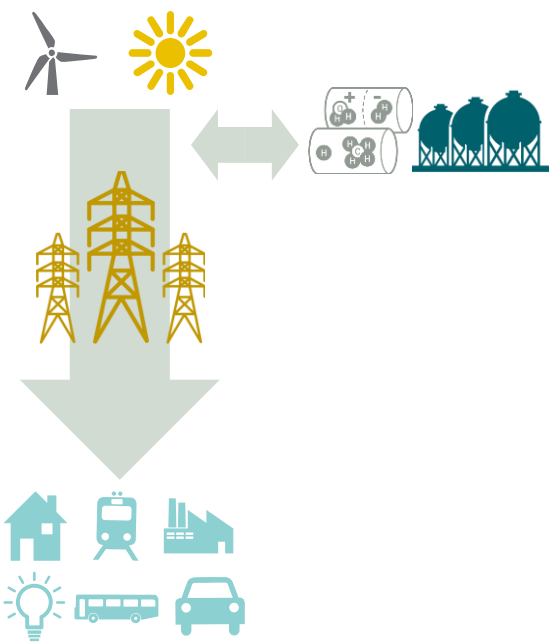
- Systemic comparion of energy carriers!
- Integrated infrastructure planning!
- Creating level playing field!

We consider 3 scenarios with varying degrees of use of gas infrastructure. 95% emissions reduction target for 2050 will be achieved in all of them

Electricity only

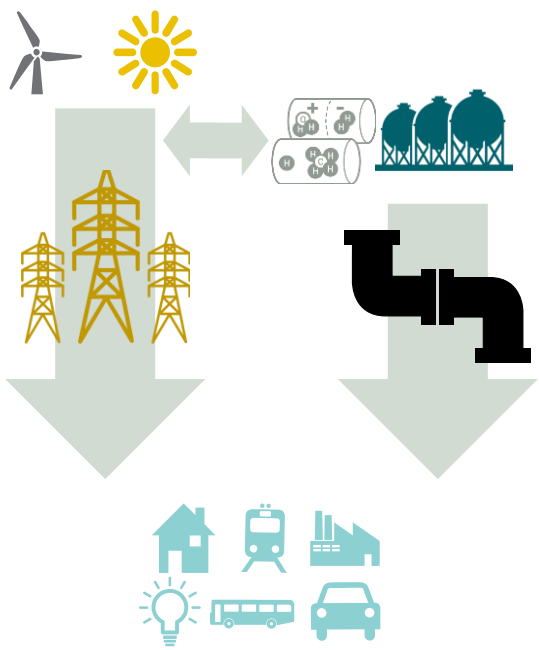
- End applications primarily directly electrified (e.g. electric vehicles, HP, direct heating)
- No gas-based end applications
- No Power-to-Gas
- Electricity networks alone combine power generation and end energy use

Electricity and gas storage



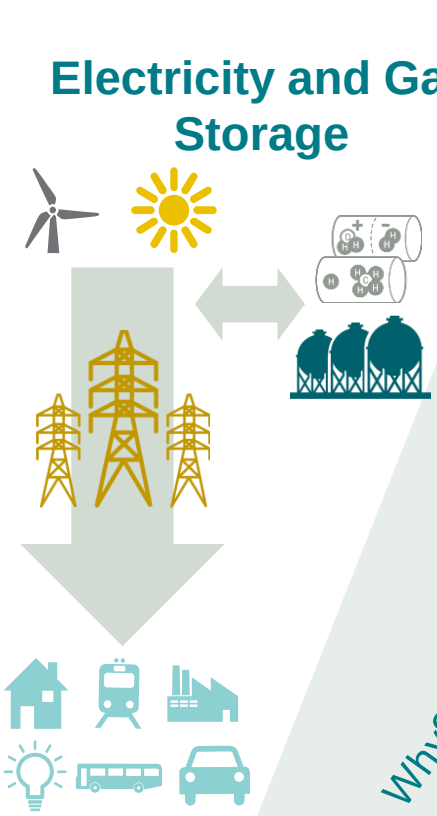
- End applications primarily directly electrified (e.g. electric vehicles, HP, direct heating)
- No gas-based end applications
- Possibility of "Power-to-Gas-to-Power" for seasonal storage
- Electricity networks alone combine power generation and end energy use

Electricity and green gas



- End applications partly directly electrified, partly based on green gas
- "Power-to-Gas " in Germany for the production of green gas
- (Existing) gas infrastructure parallel to the power grid

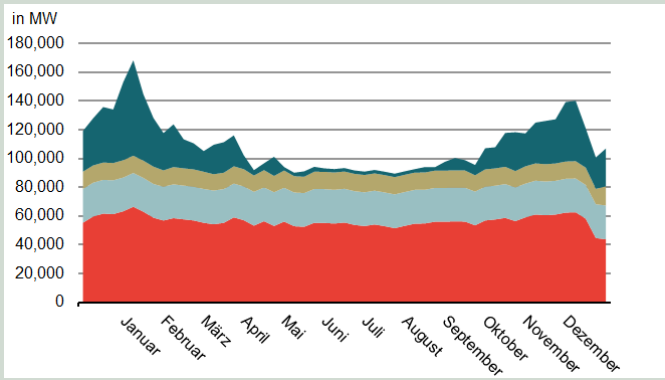
Result 1: Power-to-Gas for seasonal storage is essential for future energy system



Unrealistic & prohibitively expensive

Why?

Sysetm with 100% RES-E needs large seasonal storage…

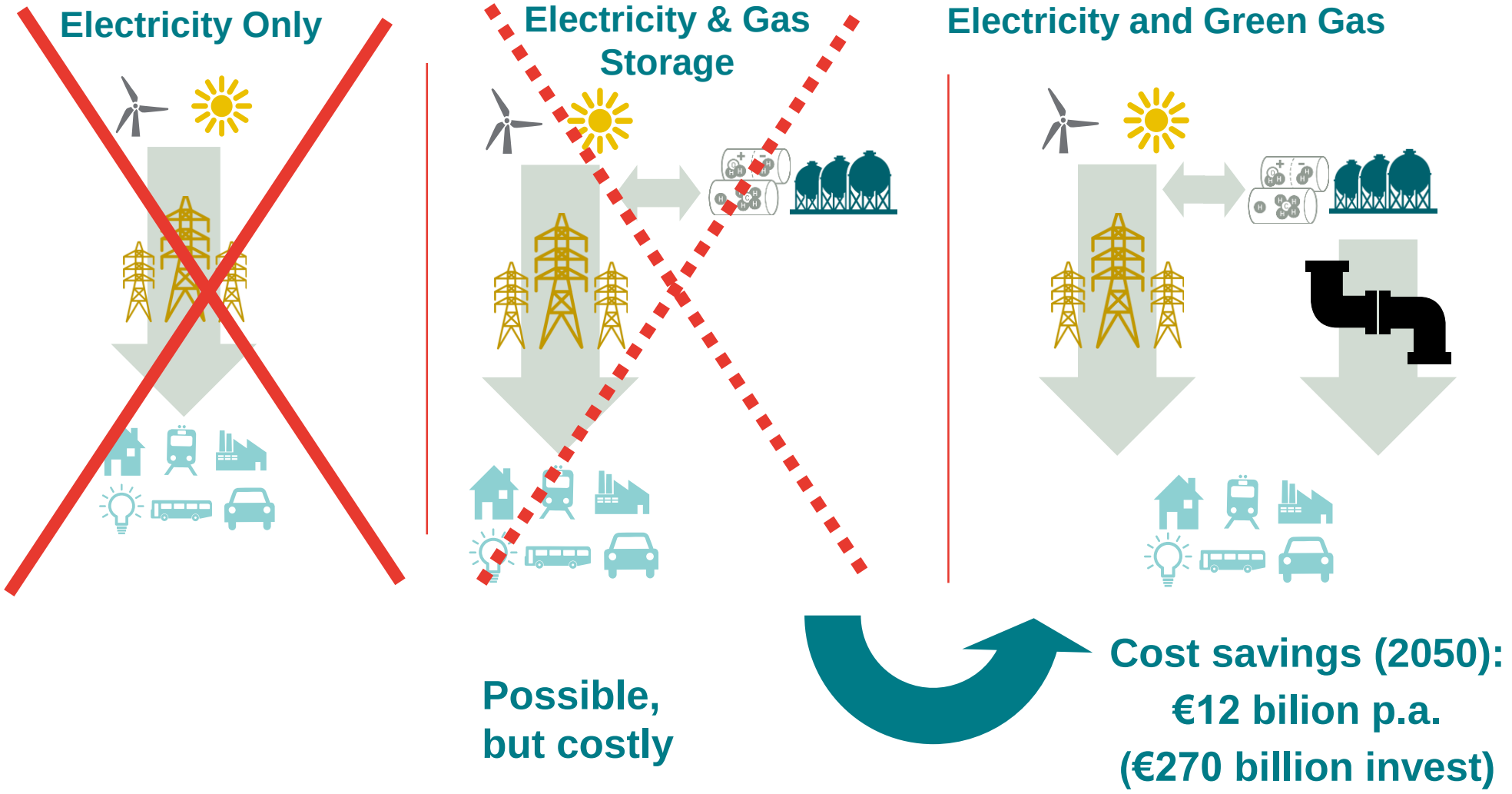


… which requires gas storage

Gas-Storage in Germany >260 TWh

Power storage 0.04TWh$_{el}$

Result 2: Use of green gas by end-consumers significantly reduces system costs and enhances SoS & public acceptance



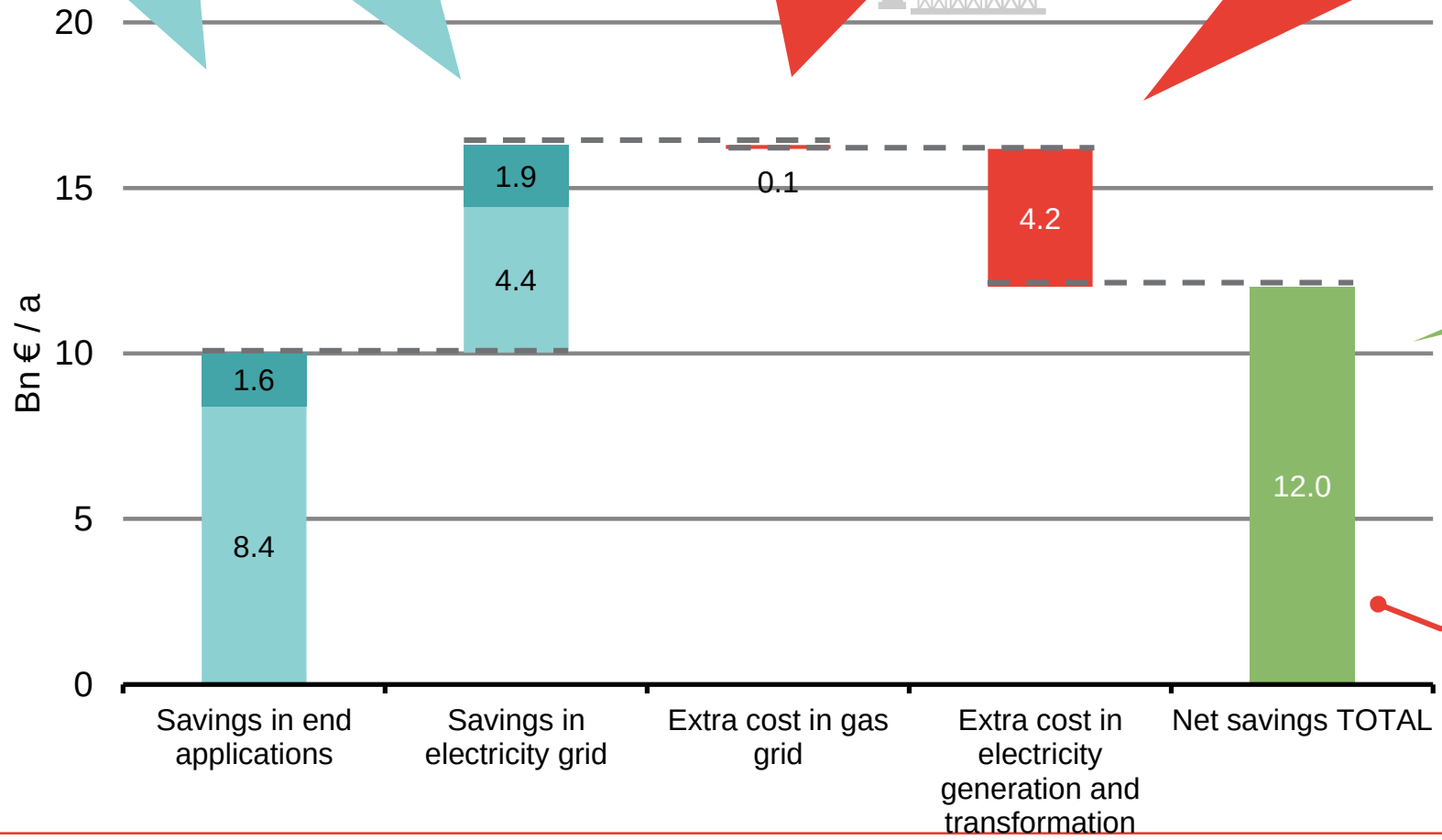
Overview: Use of gas grids saves **€ 12 billion per year (in 2050)** through cheaper end applications and avoided power grid expansion

1 P2G can avoid major end-user adjustments and save costs

2 Utilization of existing pipelines saves costs for power grid expansion in transmission and distribution grids

3 Costs for maintenance of gas grids only slightly higher than costs for decommiss-ioning in case of exit from gas grids

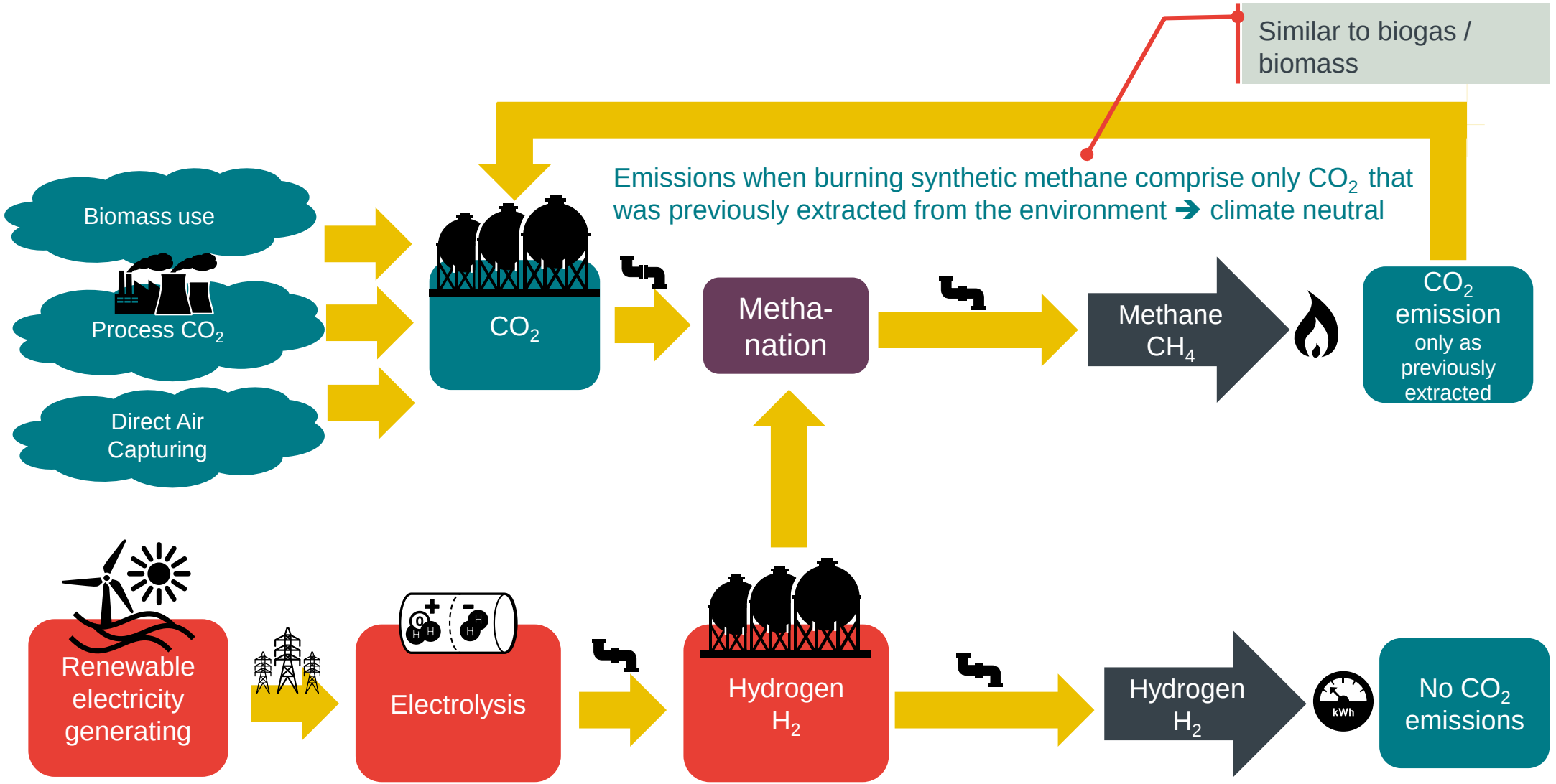
4 Slightly higher electricity generation costs due to PtG conversion losses & PtG-CAPEX, but partially compensated by better utilisation of renewables



In total, the continued use of gas infrastructure (via PtG) leads to lower system costs!

As component lifetimes vary widely across the system, we consider total annual costs based on annuities

Background - Biogas and green gas from synthetic sources is climate neutral fuel that can be transported and stored in large volumes



Dr Christoph Riechmann

+49 221 337 13 102

+49 170 526 7339

christoph.riechmann@frontier-economics.com

Dr Matthias Janssen

+49 221 3371 3117

matthias.janssen@frontier-economics.com