

Synthetic Methane

as a Key Component for Flexibility
and System Balancing

Enabling Seasonal Storage through Power-to-Gas
Lessons from the GreenGas Project — Gaznat SA

EPFL 15.06.2026

CCUS Stakeholder Dialogue



Presentation Overview

01 The Challenge: Seasonal Energy Imbalance

02 Why Molecules Matter: Gas as System Backbone

03 Syngas vs Hydrogen: The Case for eCH₄

04 P2G Fundamentals & Methanation Pathways

05 GreenGas: Swiss P2G Demonstrator

06 Technical & Economic Barriers

07 Regulatory & Social Dimensions

08 Conclusions & Policy Recommendations

09 Tomorrow

The Core Challenge: Seasonal Energy Imbalance

Europe & Switzerland

Summer surplus, winter deficit

Solar PV peaks in summer; heating demand peaks in winter — creating a structural mismatch that short-term storage cannot bridge.

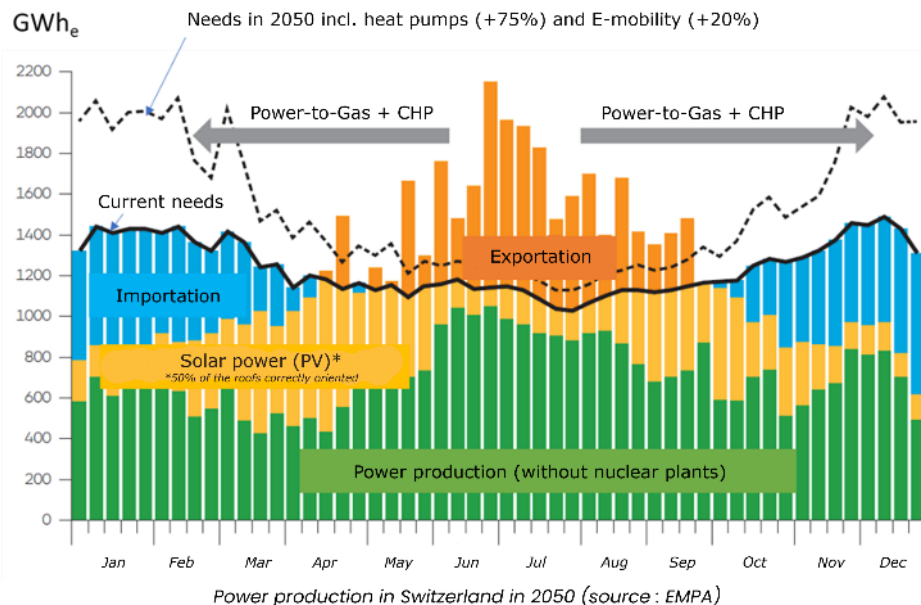
Switzerland's specific constraints

- ✗ No offshore wind
- ✗ Nuclear phase-out (Energy Strategy 2050)
- ✗ Hydropower >90% exploited

Global constraints

- ✗ Batteries: daily storage only

Result: a growing winter electricity gap that electrons alone cannot fill.



Why Molecules Matter: Gas Infrastructure as System Asset

Existing gas infrastructure

Pipelines, compressors and underground storage = terawatt-hours of capacity, already amortised

Scale without parallel investment

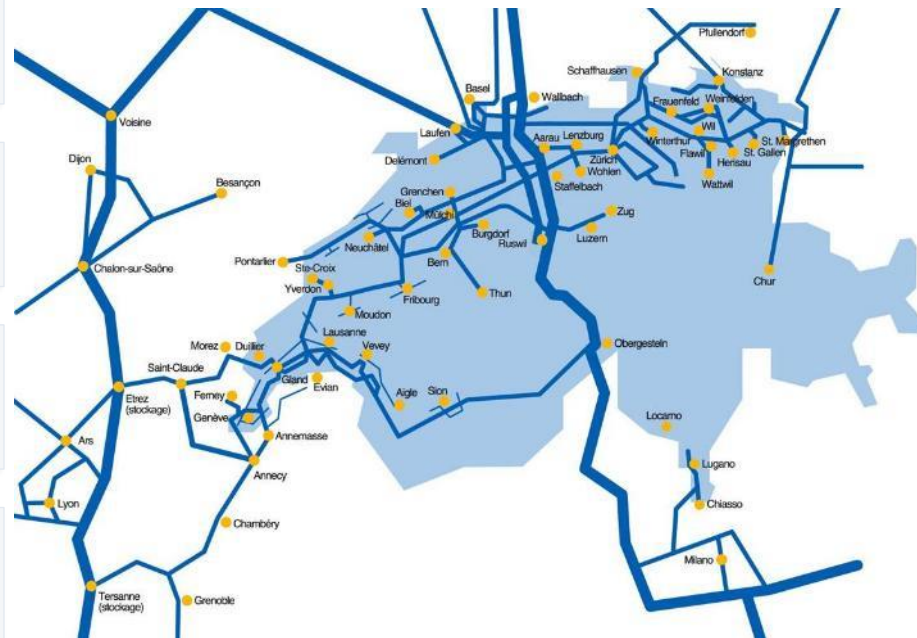
Gas networks store energy at densities impossible for batteries or pumped hydro

Seasonal storage by design

Underground caverns can store gas for weeks or months — exactly matching the seasonal gap

Sector coupling enabler

Connecting electricity grids, gas networks and heat supply into one optimised system



The Comparative Argument: eCH₄ vs Pure Hydrogen

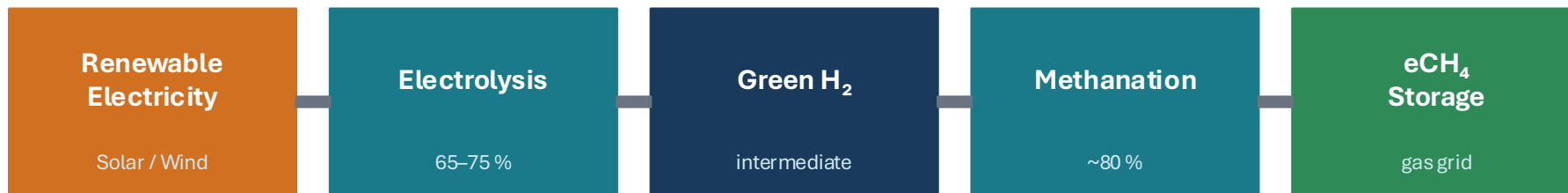


Why go one step further than hydrogen?

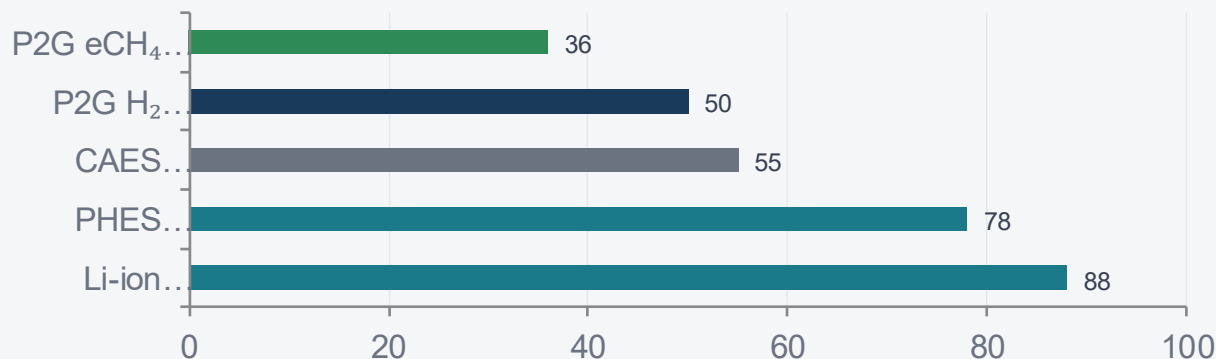
Criterion	Pure Hydrogen	Synthetic Methane (eCH ₄)
Infrastructure compatibility	Requires new H ₂ pipelines	Uses existing gas grid ✓
Storage	Salt caverns / liquid H ₂ (complex)	Underground storage (mature) ✓
End-use readiness	Fuel cells (limited scale)	Gas turbines & boilers (existing) ✓
Round-trip efficiency	~45–55 % ✓	~30–40 % (accepted for seasonal)
Negative emissions potential	None without CCS	Yes — via DAC + renewables ✓
Deployment timeline	Medium-term (infra gap)	Near-term (drop-in) ✓

Key insight: eCH₄ can be seen as a 'hydrogen carrier' — monetising green H₂ via existing infrastructure at lower system transformation cost.
Sources: Imre (2022); IEA (2019); Thurber (2020)

Power-to-Gas: Technology & Efficiency Chain



Round-trip Efficiency by Technology (%)

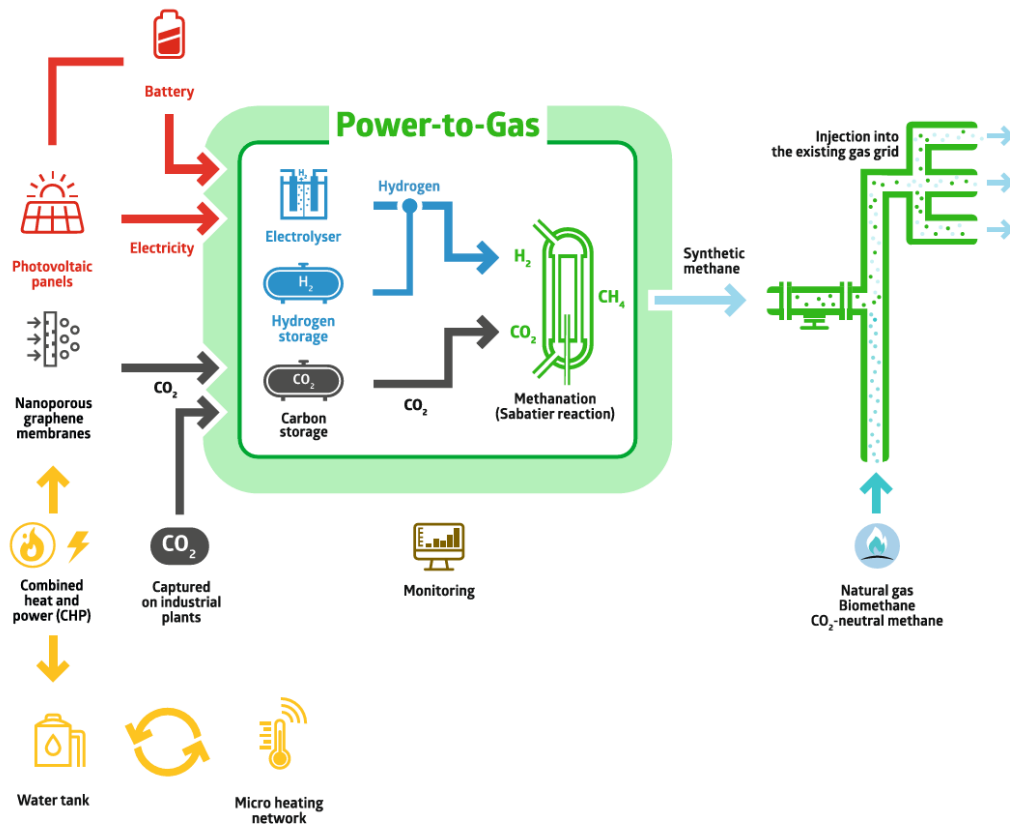


⚡ Key trade-off

P2G efficiency (~36 %) is lower than batteries — but it is the only technology capable of seasonal storage at grid scale.

For Switzerland, system value > round-trip efficiency.

The GreenGas Project: Swiss P2G Demonstrator



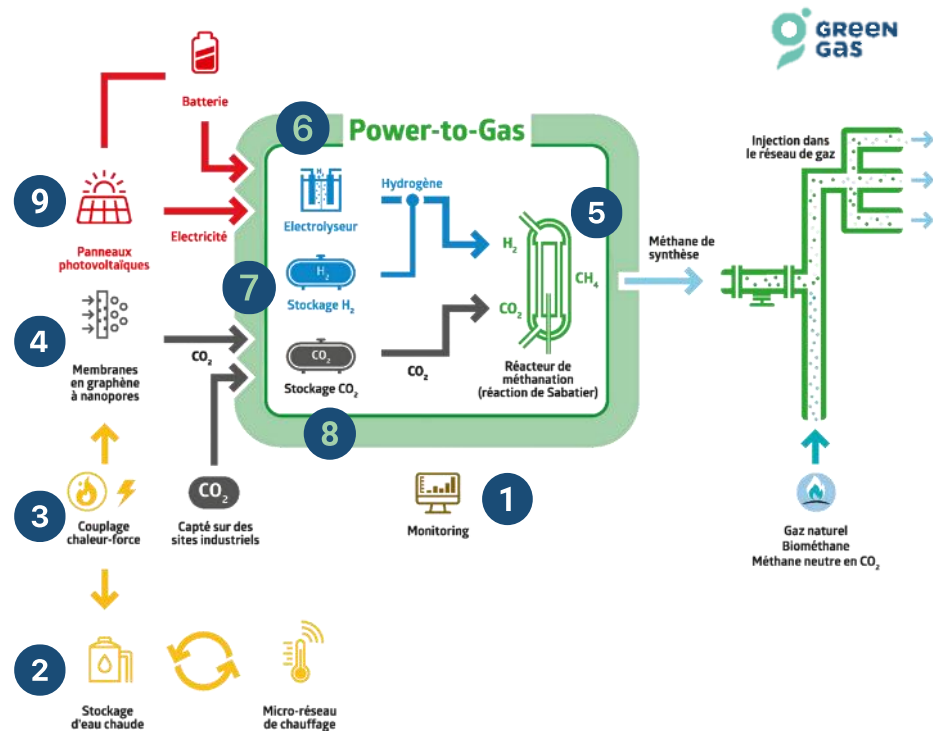
The GreenGas Project: Swiss P2G Demonstrator



The GreenGas Project: Swiss P2G Demonstrator



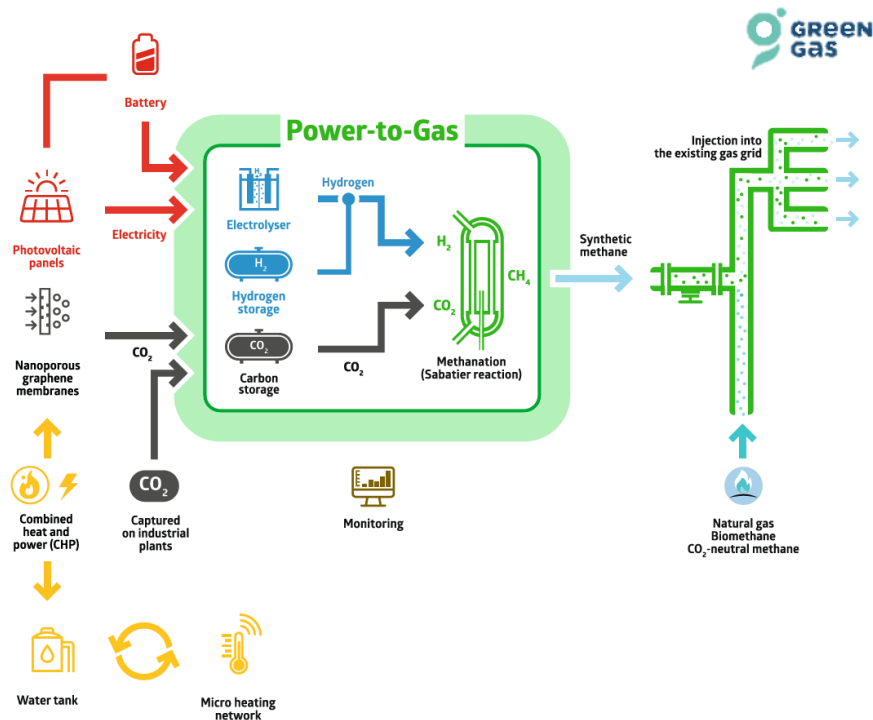
The GreenGas Project: Swiss P2G Demonstrator



The GreenGas Project: Swiss P2G Demonstrator

Gaznat Innovation Lab, Aigle (VD) — one of Europe's most integrated P2G sites

PV Array:	1,200 panels — 487 kWe
Electrolyser:	450 kWe — up to 8.1 kg H ₂ /h @ 30 bar
Methanation:	550 kWth catalytic reactor
CO₂ Capture:	Graphene membranes — 10 kg/day → 1 T/day (2026)
H₂ Storage:	30 kg — 1 MWh
CO₂ Storage:	22,000 L
Grid injection:	High- & low-pressure gas infrastructure



Barriers to Deployment: Technical & Economic

The 'valley of death' between feasibility and market competitiveness



Electrolysis losses

65–75 % efficiency; degrades at partial load.
Ongoing R&D on PEM & alkaline.



Methanation flexibility

Exothermic reaction; thermal inertia limits rapid
ramping to variable renewables.



CO₂ capture cost

DAC energy-intensive; membrane selectivity
limited. Graphene membranes under R&D
(EPFL/Gaznat).



High production cost

eCH₄ more expensive than fossil CH₄. Limited
operating hours restrict economies of scale.



Electricity price

Swiss grid fees and high electricity costs penalise
electrolyser economics. Policy bridge needed.

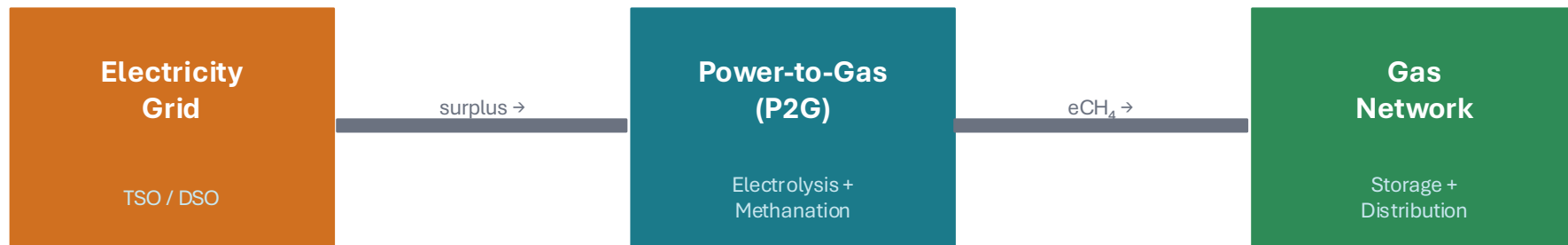


Market value gap

Seasonal resilience value not monetised.
Contracts-for-difference and carbon pricing
essential.

The Bigger Picture: Sector Coupling & System Integration

Power-to-Gas is not just a storage technology — it is the physical bridge linking electricity, gas and heat into a single optimised energy system.



Grid balancing

Absorbs renewable curtailment

Seasonal storage

Months of energy buffer

Infrastructure reuse

Existing gas grid leveraged

Climate neutrality

Zero-carbon molecule loop

Conclusions & Policy Recommendations

1

System necessity, not an option

In constrained systems like Switzerland (no offshore wind, nuclear phase-out, limited hydro), synthetic methane via P2G is not optional—it is critical for seasonal resilience.

2

The 'hydrogen carrier' argument

eCH₄ offers a pragmatic route: lower round-trip efficiency than H₂, but immediate deployability on existing infrastructure, with negative-emission potential via DAC or CO₂ capture membranes.

3

Integrated sociotechnical approach

Success requires coordinated progress across technology (GreenGas), policy (carbon pricing).

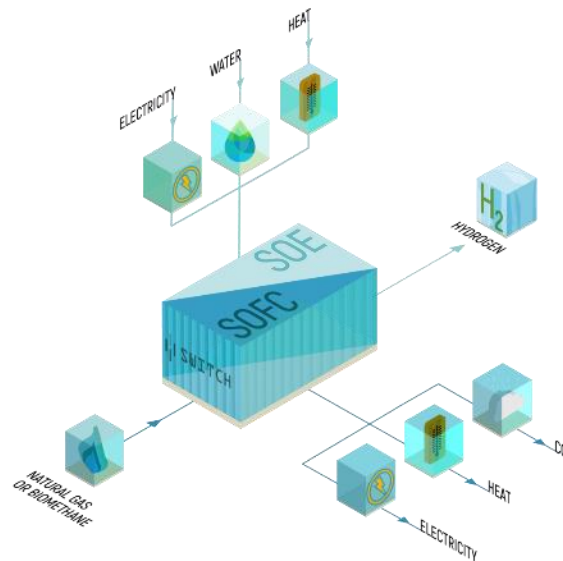
Policy levers needed

- Carbon pricing reflecting system resilience
- Renewable gas quotas & certification (RED II+)
- Contracts-for-difference for seasonal storage
- Harmonised electricity tariffs for P2G electrolyzers
- Stable long-term frameworks (10–20 yr horizons)



New equipment installed on Gaznat Innovation Lab facility: SWITCH

SWITCH is a Horizon 2020 European Project that aims to design, build and test an in-situ fully integrated and continuous multisource hydrogen production system, based on solid oxide cell technology.





2nd call of projects Gaznat – EPFL

After a 1st call of projects launched in 2025 and the reception of 33 projects (from which 7 have been selected) a new call of projects is now open (until end of August 2026).

5.- MCHF for the 3 calls of projects,

SEED projects: TRL < 4: early-stage projects with the potential to advance to higher TRLs

- Project duration: 6-12 months.
- Expected funding: CHF 50-100k (maximum) per project.

EXPLORE projects: TRL ≥ 4: Lab-scale prototypes with the potential to progress towards TRL 6-9

- Project duration: Up to 4 years.
- Expected funding: CHF 300-500k (maximum) per project.

- Advanced separation technologies,
- Synthetic fuels,
- Energy storage & transport,
- CCUS,
- Material impacts,
- Systemic gas transformation,
- AI applications,
- and more...

"Synthetic methane is not a silver bullet, but it is a critical enabler of high-renewables energy systems."

EPFL 15.06.2026
CCUS Stakeholder Dialogue

