

Hydrogen and hydrogen derivatives

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Content

- **SWEET consortia “reFuel.ch”**
- **Electricity system transformation and hydrogen production**
- **Hydrogen with negative CO₂ emissions**

SWEET consortium “reFuel.ch”

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USI



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WP2
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Prof. Dr. Lino Guzzella
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NGO / Climate
WWF



**Antoinette Hunziker-
Ebneter**
Sustainable Financing
Forma Futura



Dr. Brigitta Kratz
Energy laws
Badertscher
Rechtsanwälte

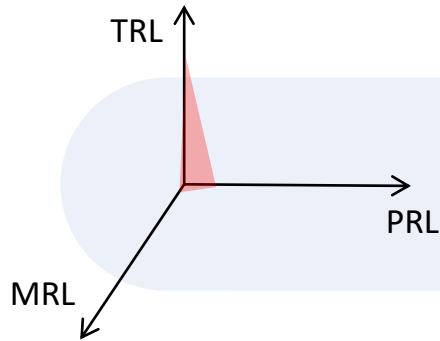


Roger Sonderegger
Industry
Swissmem

Implementation oriented research

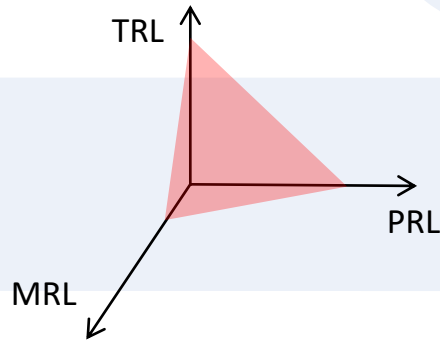
High TRL part

**High
Technology Readiness Level**



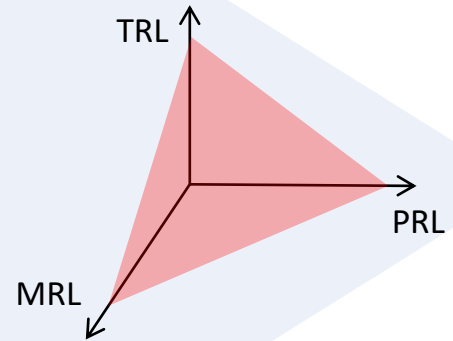
End-product is producible

**Increase
Policy Readiness Level**



End-product *could* be brought
to markets

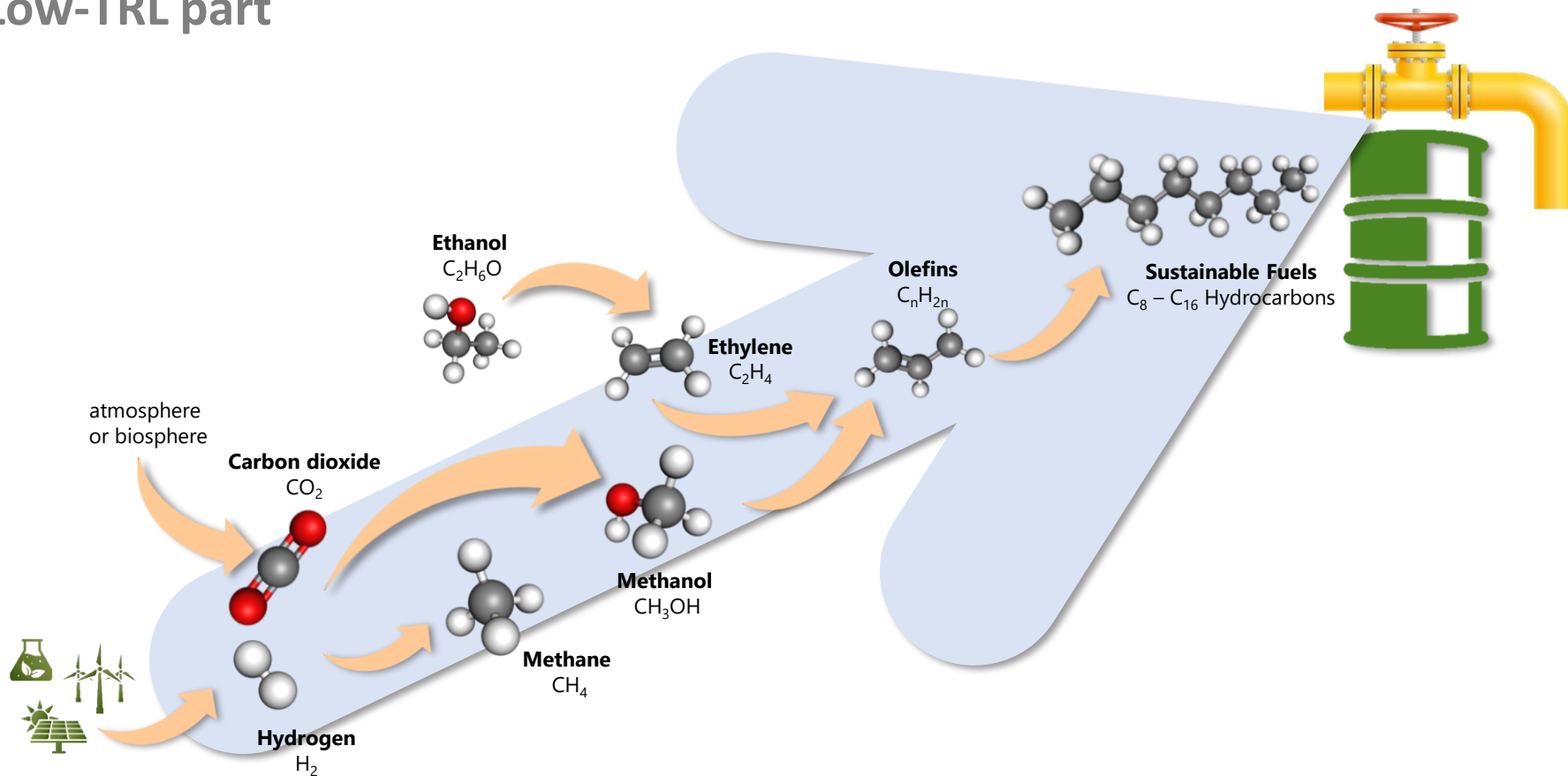
**Increase
Market Readiness Level**



End-product *can* be brought
to markets

Technology oriented research

Low-TRL part

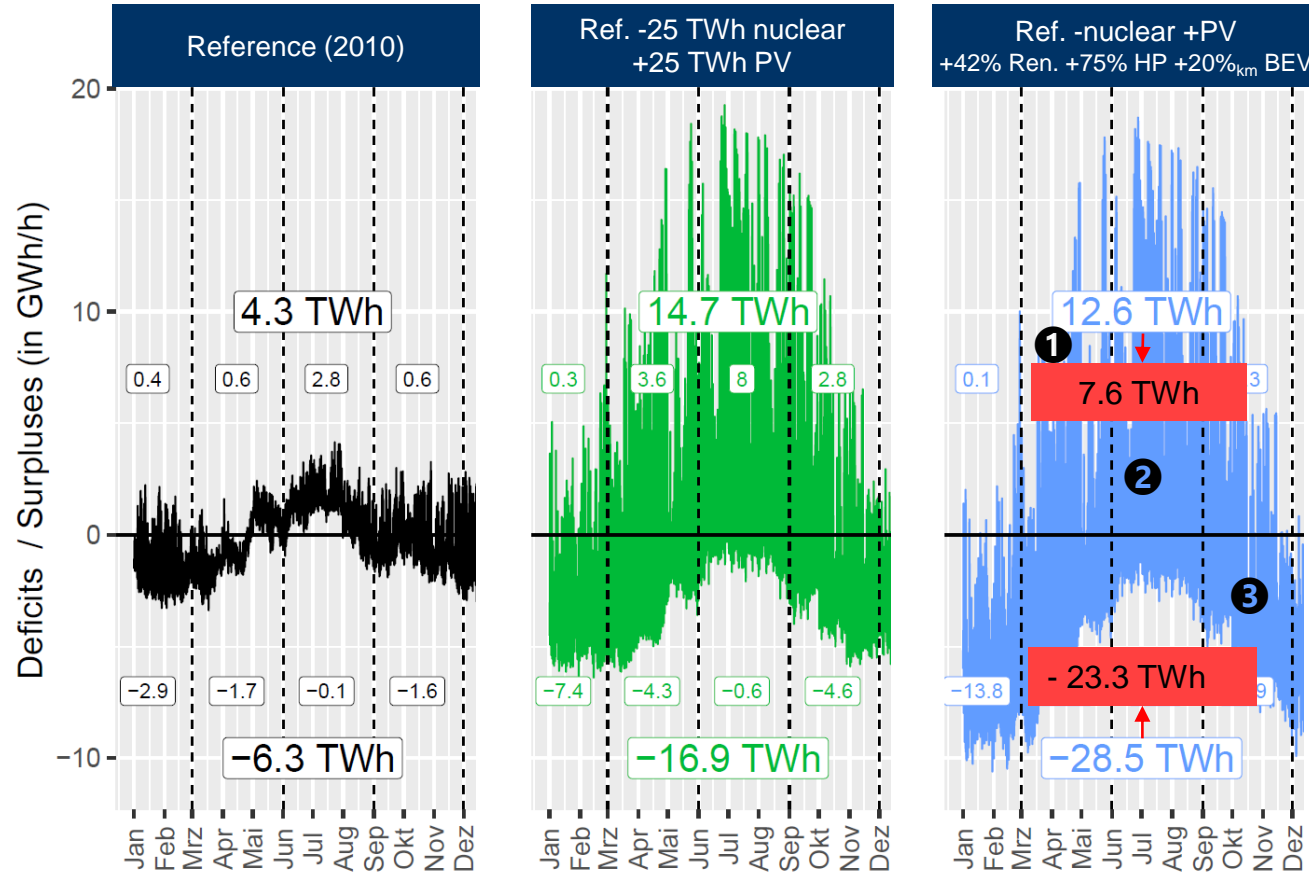


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Swiss electricity market transformation

Strong increase of fluctuations and seasonally unbalanced production profile



1 Electric vehicles for day-night balance

Requested storage cap: 80 – 140 GWh

Use of parked electric cars

3 Mio BEV → z.B. 60 GWh storage cap.

2 Hydrogen vehicles for the use of surplus electricity

Remaining excess: 7 – 8 TWh/a

Hydrogen production for trucks

20'000 FC-trucks → 5.0 TWh_{H₂}, (8 TWh_{el})

3 Synth. energy sources for long-dist. trucks and winter electr.

Import demand: 10 - 20 TWh_{el}

Synthetic energy carrier & CHP

5 GW_{el} CHP @ 4'000 FL-h/a

Renewable Energy Directives III (RED-III)

Main requirements

- **Additionality of renewable energy**

The electricity must be generated by new power production systems (max. 3 years old)

- **Direct coupling with renewable electricity production**

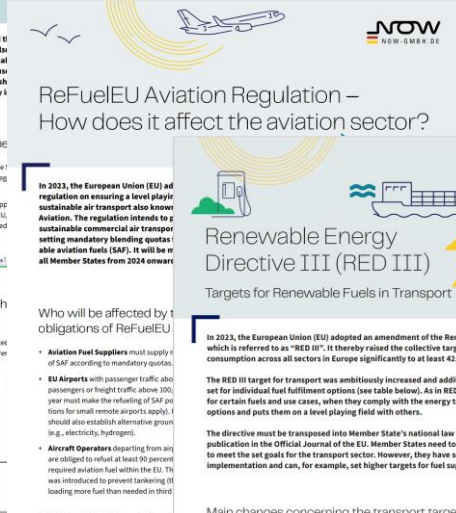
The PtX plant has to be directly coupled to the renewable electricity power plant or – in case of grid supply – has to follow the electricity production profile.

- **CO₂ supply after 2035 by Direct Air Capture**

Permitted carbon sources for the production of synthetic fuels

- Direct air capture
- Biogenic CO₂

- **70% of CO₂ reduction in whole path**



Main changes concerning the transport targets

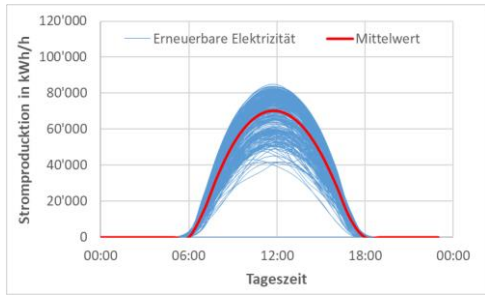
Targets 2030	Targets in RED II (2018)	Targets in RED III (2023)
Renewable energy in transport	At least 14 % share of renewable energy in final consumption of all energy used in transport	At least 29% share of renewable energy in final consumption of all energy used in transport - Or a minimum of 14.5 % reduction in greenhouse gas (GHG) compared to emissions that would have been created by fossil fuel use instead
Fossil fuel comparator (reference value to calculate baseline for GHG reduction target)	94 gCO ₂ eq/MJ for all energy used in transport	183 gCO ₂ eq/MJ for electricity used in transport - 94 gCO ₂ eq/MJ for all other energy used in transport
Electricity used in transport	No sub-target	No sub-target Multiplier of 4 for renewable electricity used in road vehicles and of 1.5 for renewable electricity in rail

Factsheets for Download:
[NOW factsheets on EU legislation for renewable fuels - NOW GmbH \(now-gmbh.de\)](#)

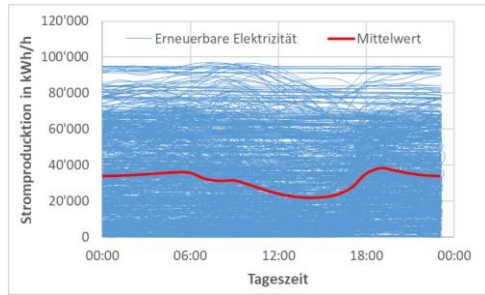
Renewable Energy Directives III (RED-III)

High load flexibility demand

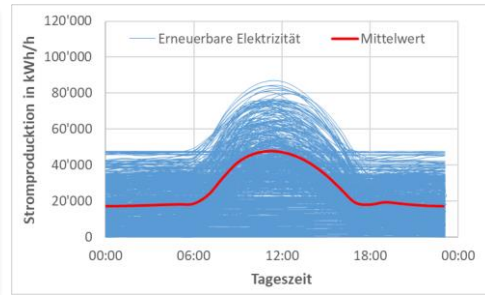
Direct coupling of PtX plant with PV, wind or PV/wind is demanding a high load flexibility of the entire PtX system (PV only: 100 – 0%; Wind only: 100 – 10%; PV/wind combined: 100-20%)



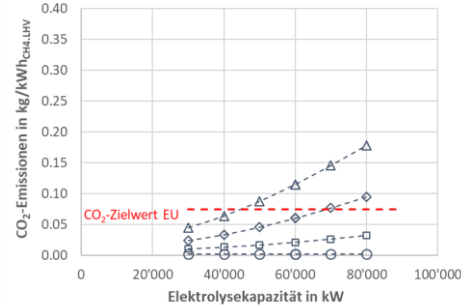
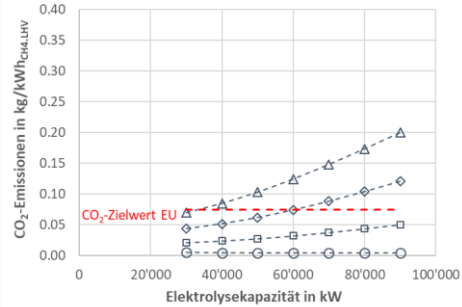
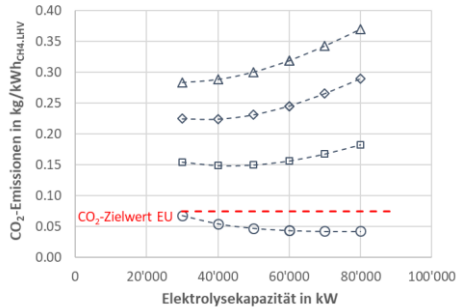
100 MW_p PV



100 MW_p wind



50 MW_p PV and wind each



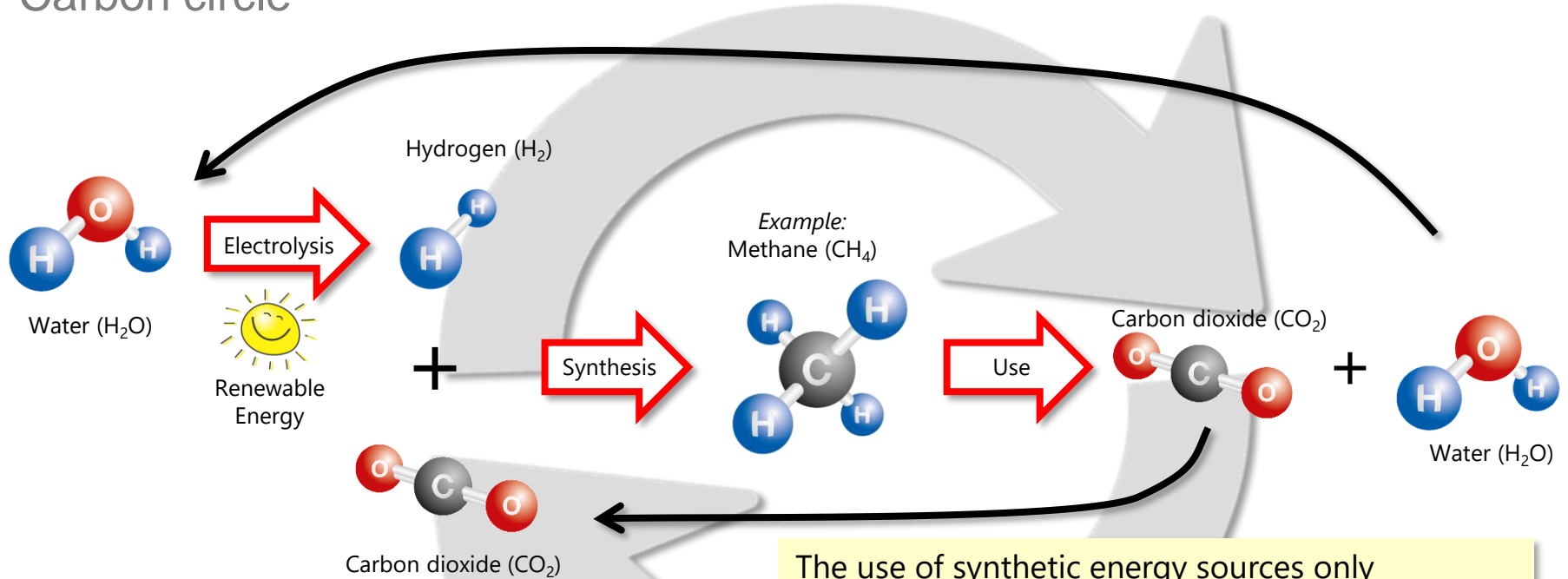
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Synthetic methane production

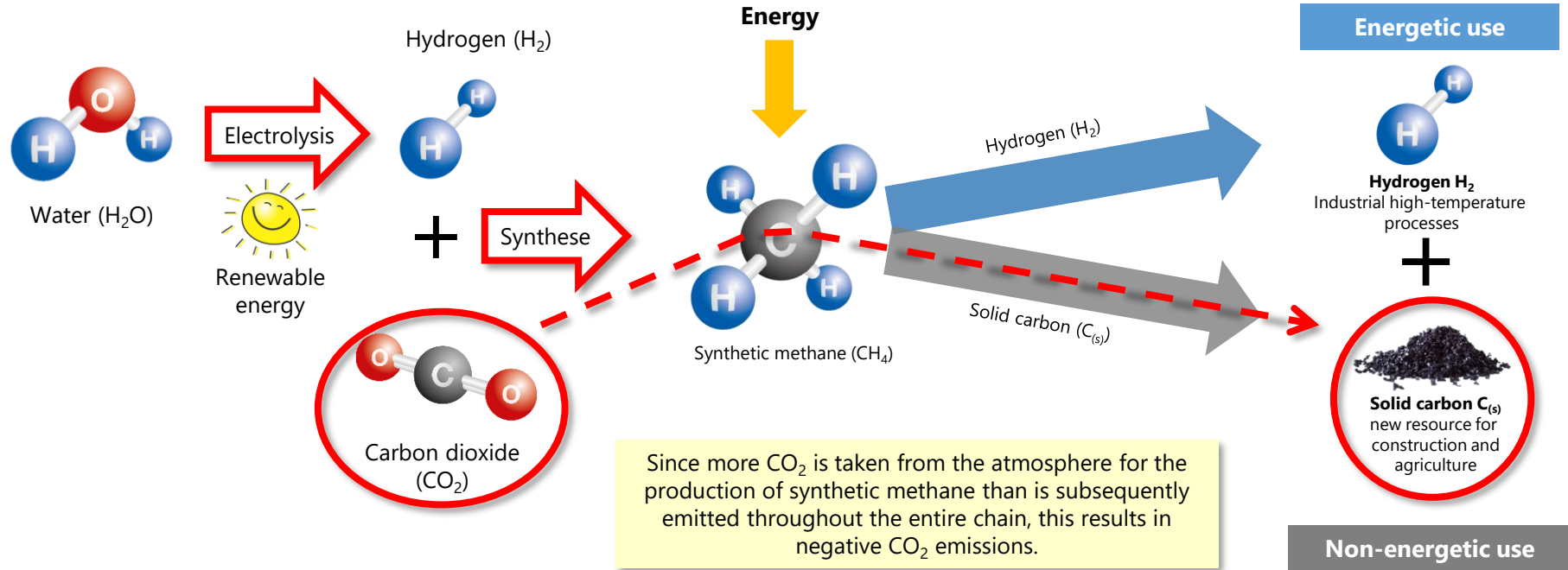
Carbon circle



The use of synthetic energy sources only generates as much CO₂ as was previously removed from the atmosphere for their production.

Pyrolysis of (renewable) synthetic methane

Hydrogen production with negative CO₂ emissions



Thank you for your attention!

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