Renewable **Fuel**s and **Ch**emicals for Switzerland*

*reFuel.ch is a consortium sponsored by the Swiss Federal Office of Energy's SWEET programme and coordinated by Empa.

Empa PSI EPFL Fachhochschule Nordwestschweiz
zh aw Universität Basel ETH zürich SUPSI CASALE

Agenda

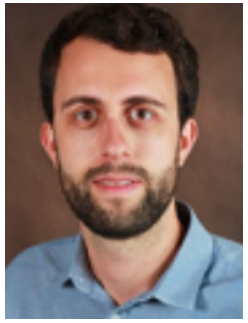
2:00 pm	**Introduction people & project**
2:10 pm	Participant mapping & check-in questions
2:30 pm	The need for SWEET-refuel.ch partners
2:40 pm	Short introduction of each round table & methodology
2:55 pm	**Networking & break**
3:15 pm	Group sessions
4:05 pm	Plenary reflection & outlook
4:45 pm	**Apéro**

reFuel.ch - Management Team

Christian Bach

Empa

Head of APTL
Co-Coordinator
Leading House



Florian Kiefer

Empa

Deputy Head of
Leading House

Regina Betz

ZHAW

Head of CEE
Co-Coordinator

Jörg Roth

PSI

Research
Exchange
Manager

Karin Lacher

Empa

Financial
administrative
support

Bettina Schwarzen

ZHAW/CEE

Administrative
support

reFuel.ch - Executive Committee

New Members will be added when P&D or SFLV projects are approved

WP1	WP2	WP3	WP4	WP5	WP6	WP7
Social, Economic, and Policy Assessment on **National** Level	Social, Economic, and Policy Assessment on **International** Level	Energy System and Life Cycle Assessment for Robust Pathways	Co-Electrolysis for Synthesis Gas Production	High-Conv. and Load-Flexible Methanol Synthesis	Manure to Sustainable Fuels	Methanol to Sustainable Fuels and Chemicals
ILARIA ESPA SUPSI	RUTH DELZEIT UNI BASEL	ROBIN MUTSCHLER EMPA	JUAN H. SALANER PSI	FLORIAN KIEFER EMPA	VANESSA BURG ETHZ	OLIVER KRÖCHER PSI







reFuel.ch - Advisory Committee

Daniela Decurtins

Antionette Hunziker-Ebneter

Brigitta Kratz

Lino Guzzella

Thomas Häusler

Roger Sonderegger

Conceptual & Organizational Support

Dr. Barbara Dubach

Founder and CEO
engageability

Hellen Hohoff

Consultant
engageability

reFuel.ch – **Re**newable **Fuel**s and **Ch**emicals for Switzerland

Our objectives:

⇨ Develop an **interdisciplinary understanding of robust and sustainable pathways** for fuels and chemicals supply.

⇨ Provide the scientific basics for a **robust strategy to meet the Swiss demand on sustainable fuels and chemicals** according to the timeline prescribed by the 2050+ perspectives including mainly foreign resources.

⇨ Develop a **roadmap for optimal integration of unused domestic resources** […] by considering sector coupling, seasonal storage, as well as biodiversity and resource challenges.

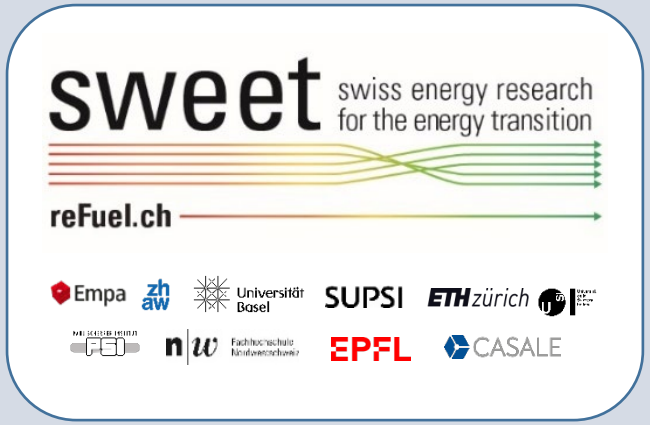
⇨ **Strengthen the role of Switzerland as technology and knowledge supplier** […].

⇨ **Act as an aggregator** for developments and projects between the different stakeholders in the field of sustainable fuels and chemicals.

Social, economic, and policy assessment

Regulations and policies for:

- System transition
- Market integration
- Social acceptance



Technology development

High potential technologies for

- Efficiency increase
- Cost reduction
- Energy system transition

Round Tables

- **RT1: Industrial Power-to-X plants**
- **RT2: Manure and biomass as resource**
- **RT3: Energy sector, platform chemicals, and industrial applications**
- **RT4: Transport and logistics**

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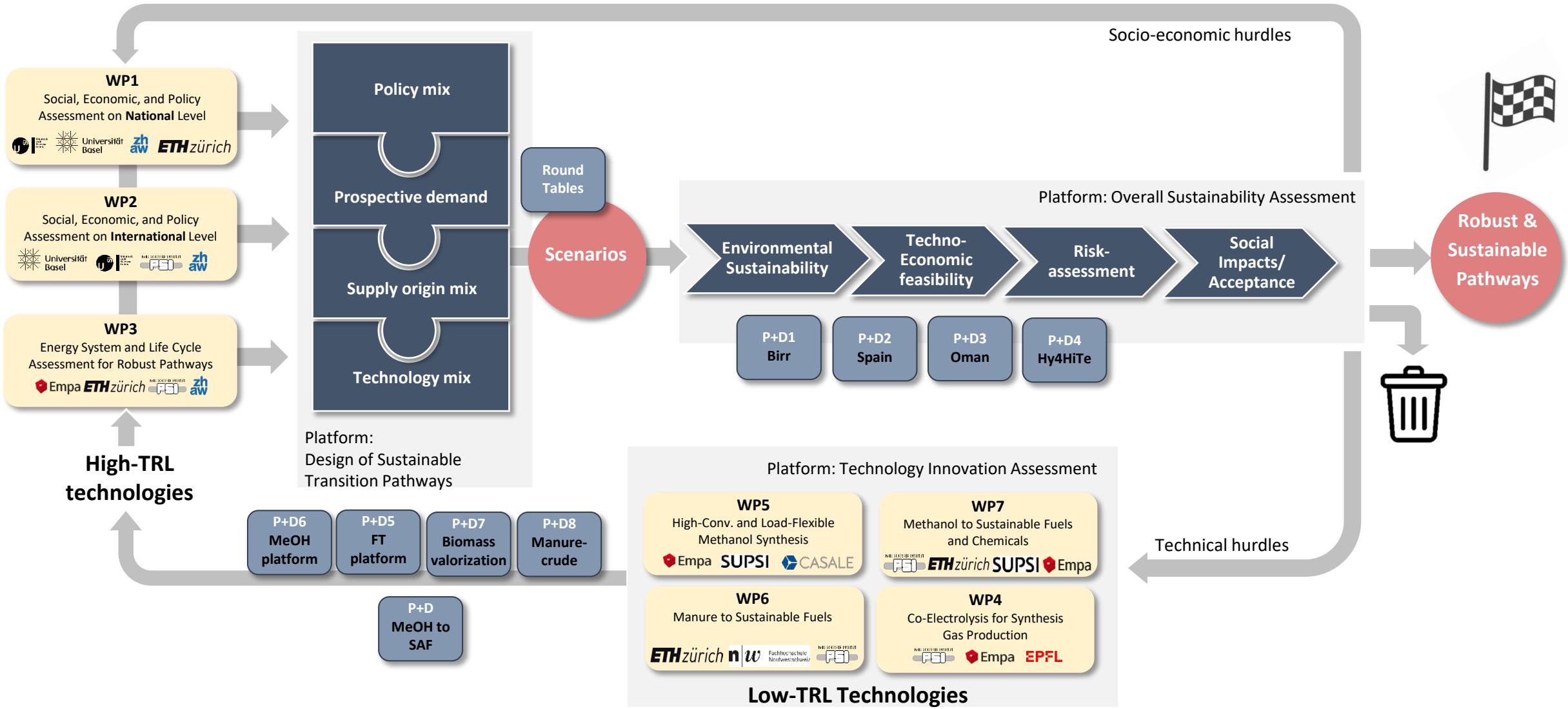
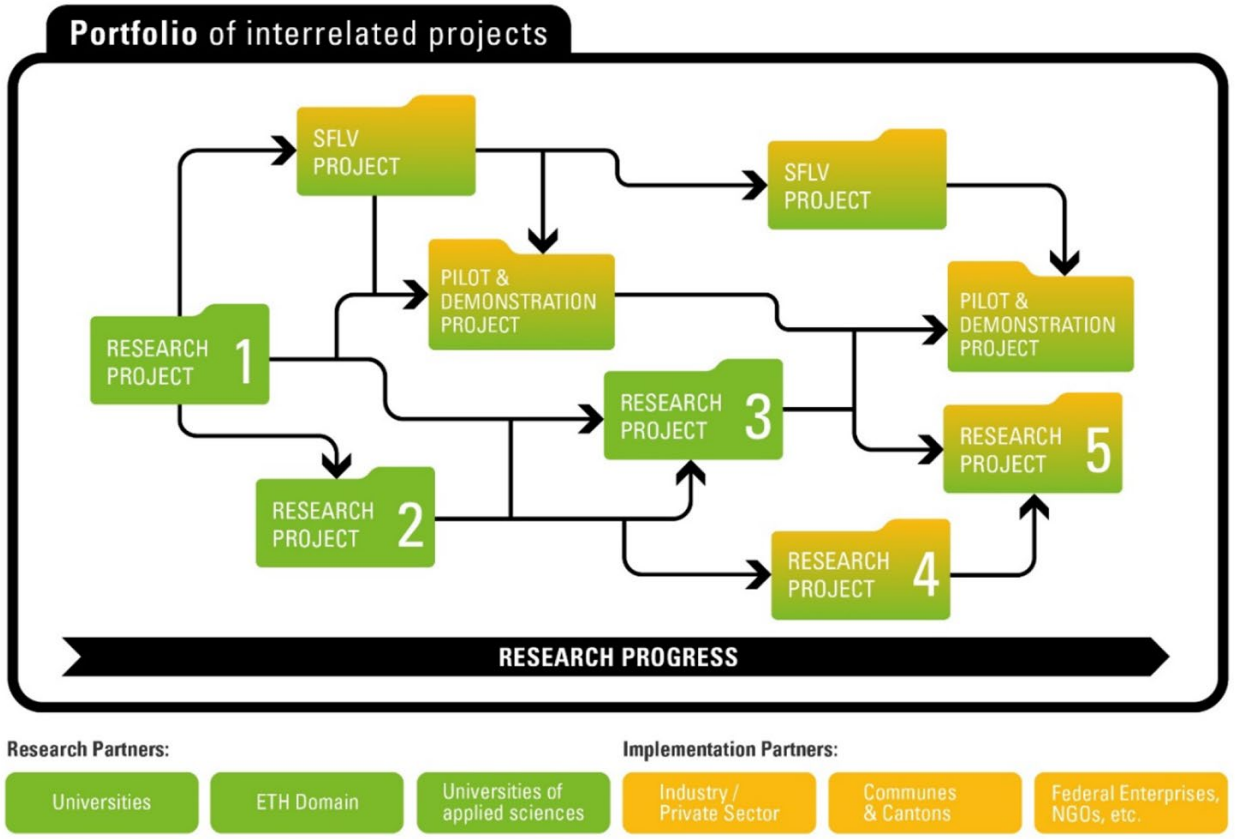


What do we not do?

We should not:

- ... create an own energy strategy regarding sustainable fuels (but rely on the SFOE scenarios)
- … develop an own quantity framework (but start with SFOE data)
- … push market actors towards whatever decisions (but serve them with scientific results)
- … fight for or against one or the other solution (but elaborate scientific results for different solutions)

P&D and SFLV Projects



P&D: https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/pilot-and-demonstration-programme.html/

SFLV: https://www.bazl.admin.ch/bazl/de/home/themen/finanzhilfen-luftverkehr/spezialfinanzierung.html/

Funding rules for P&D (1.1.2024)
Funding rate:
Max. 50% of eligible project costs

Max. 70% in exceptional cases (TRL 4-7, generated output not utilised in commercial context, maximum score for criteria «Energy and climate policy» and «Costs/benefit», high strategic relevance for the SFOE, reasonable and relevant size.

Eligible project costs:
represent the non-amortisable portions of the costs (NAC) that are directly related to the development and testing of the innovative aspects of the project.

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Research Group		Special roles		
Empa	APTL MEC UES	Electrochemical & thermochemical processes Energy system modeling	Leading house, Co-Lead Christian Bach	APTL Florian Kiefer MEC: Corsin Battaglia UES Robin Mutschler
zh aw	CEE ZAV	Climate policy and electricity market design Aviation operations and the environment; Sustainable logistics	Co-lead Regina Betz	CEE Paula Castro ZAV Thomas Rötger
PSI	LBK LEA LEC	Thermochemical processes Energy modeling and Life Cycle Assessment Electrochemistry	Research Exchange Management, Jörg Roth	LBK Oliver Kröcher LEA Panos Vangelis LEC Jörg Roth
Universität Basel	LUC	Social acceptance • Land use change		Basel LUC Ruth Delzeit
EPFL	INE	Material electron characterization for electrochemical processes		EPFL INE Vasiliki Tileli
ETH zürich	EPSE ESD	Sustainable chemicals supply Techno-economic and life cycle assessment of manure to fuels		EPSE Florian Baader ESD Vanessa Burg
n|w Fachhochschule Nordwestschweiz	IBRE	Exploitation of manure for fuels production by hydrothermal processing		FHNW: Frederic Vogel
SUPSI	MEMTI	Computational reaction and reactor modeling		SUPSI: Maurizio Barbato
USI	IDUSI	Policy and legal assessment		UDUSI: Illaria Espa
CASALE	R&D	Process and reaction engineering	Industry partner	Casale: Pierdomenico Biasi

Who is Who?

You belong to which sector / stakeholder group?

Academia

Industry

NGO

Politics

Authority

Association

Check-in Questions

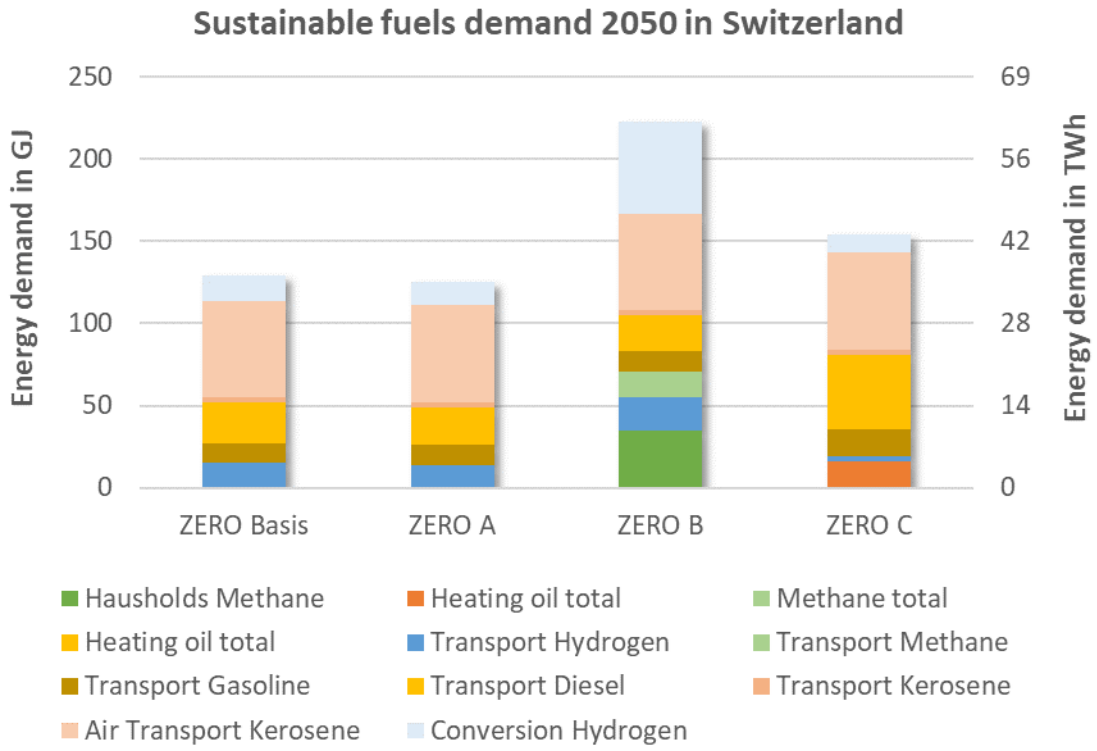
Please use your phone to open Slido

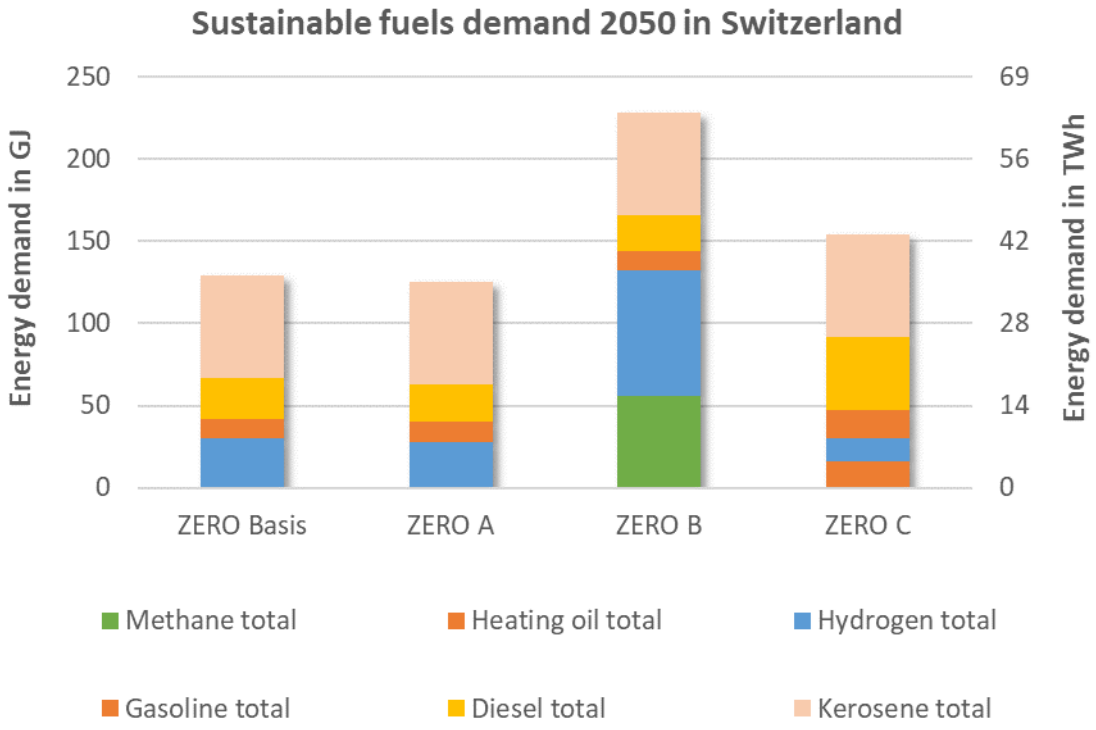
Why are cooperation partner essential for the SWEET-reFuel.ch consortium

Because the implementation of sustainable fuels and Platform chemicals is a task for market actors!

Sustainable energy demand of Switzerland

30 – 60 TWh of sustainable fuels are needed by 2050 to comply with climate targets

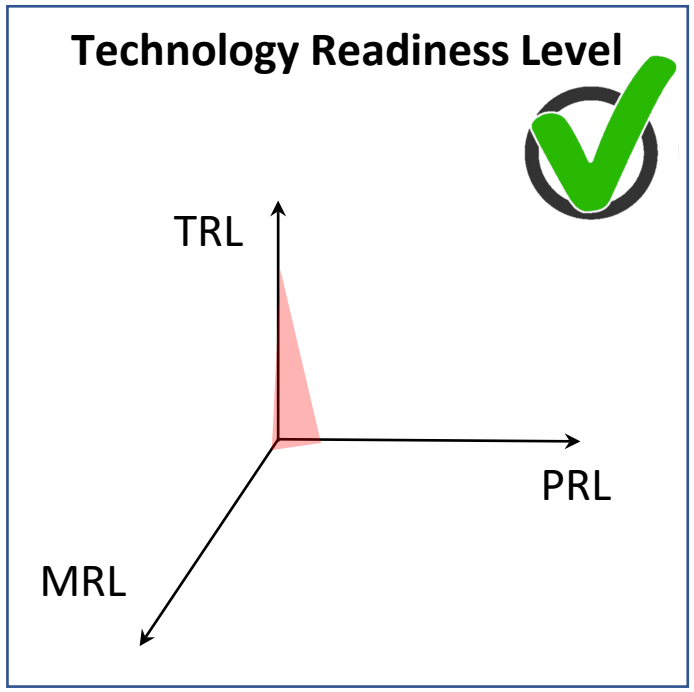




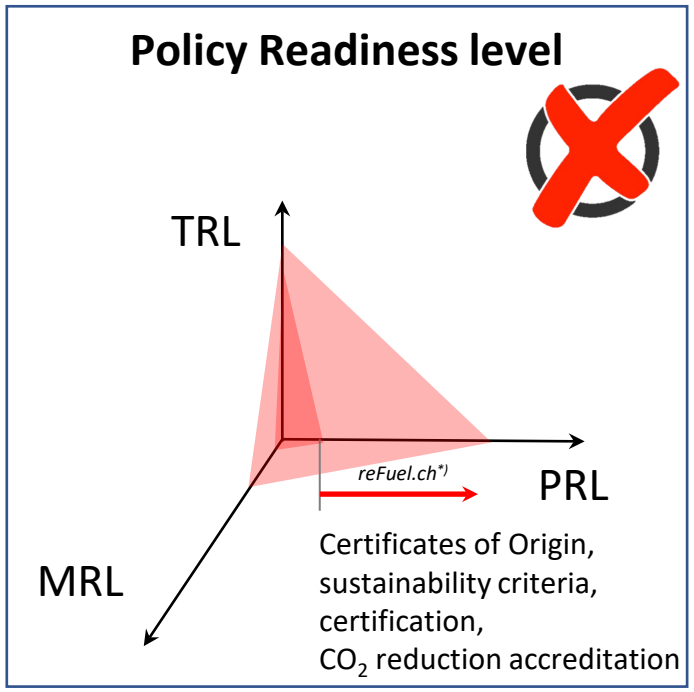
Source: SWEET Call 2-2022 (Sustainable Fuels)

How reFuel.ch may support implementation

Increase of PRL and MRL (increasing investment security)

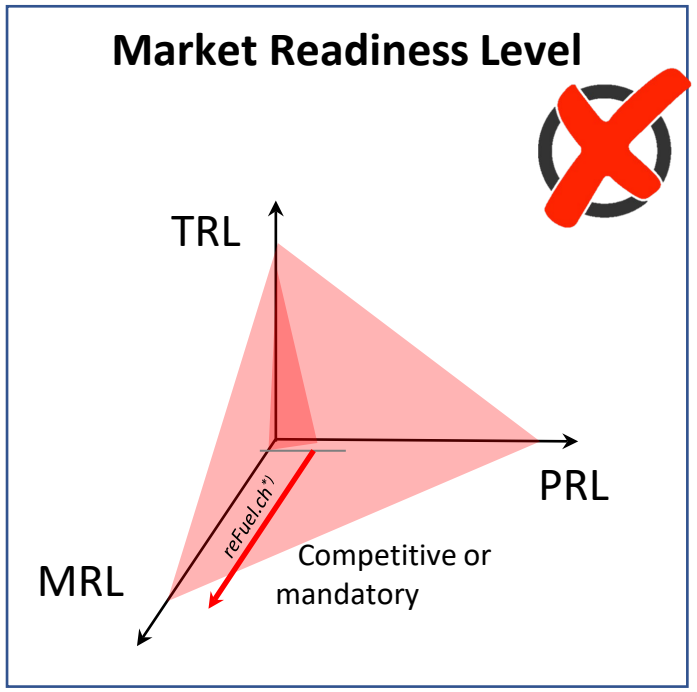


End-product is producible



End-product *could* be brought to markets

*) including cooperation partner in discussion with policy maker



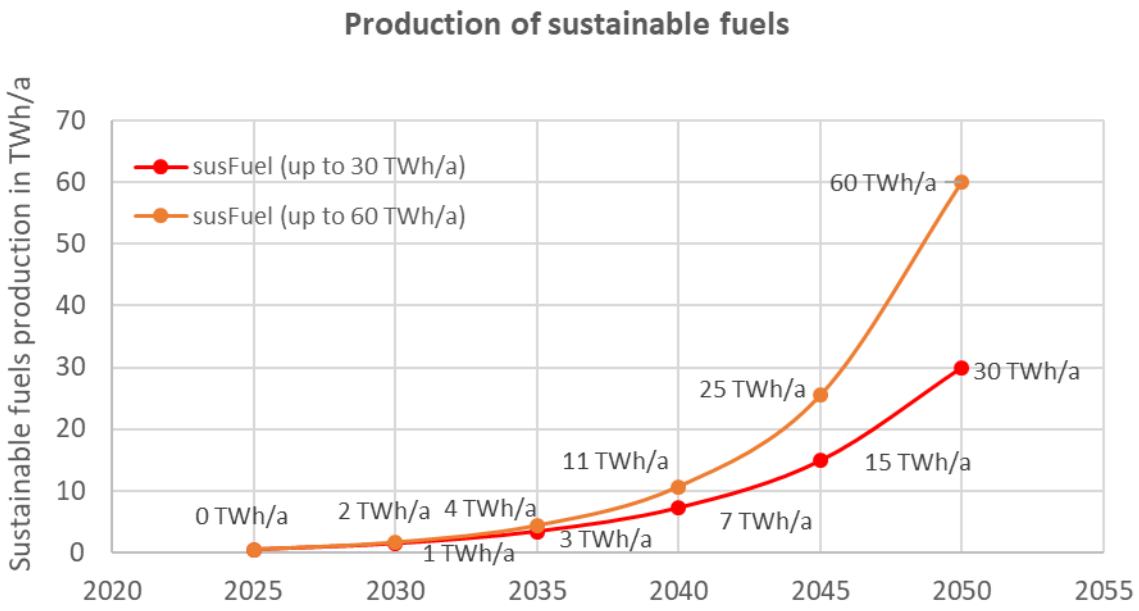
End-product *can* be brought to markets

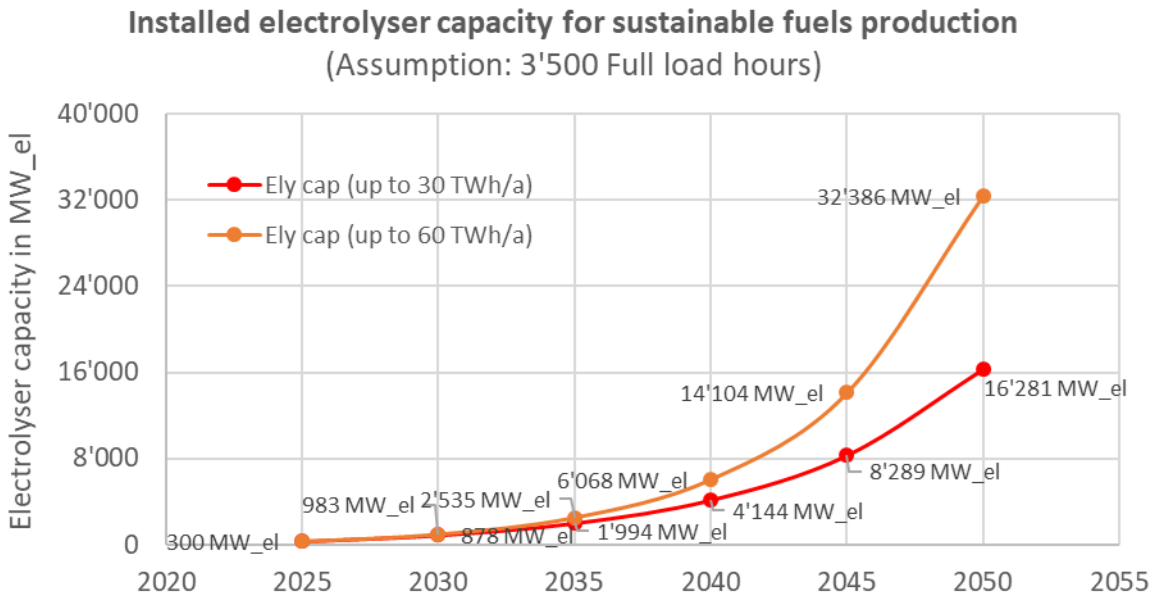
*) including cooperation partner in discussion with policy maker

TRL = Technology Readiness Level
PRL = Policy Readiness Level
MRL = Market Readiness Level

Focus

Large scale plants and innovations in technologies and applications





- Large scale implementation has to be fast, if the supply targets in 2050 shall remain.
- It is a least unclear, if a «market» for sustainable fuels will be developed or if own investments have to be made.

Two types of Cooperation Partners

Round Table-cooperation partner (RT-cooperation partner):
The RT-cooperation partnership doesn't include any legal commitment or duties. We envisage that only public information will be shared in Round Tables, this is why **no Non-Disclosure Agreement (NDA)** will be signed. All cooperation partners are listed as RT-cooperation partner so far.

Research Group-cooperation partner (RG-cooperation partner)*:*
RG-cooperation partners are collaborating closely with a specific research group of the reFuel.ch-consortium. This cooperation is defined in bilateral contracts between the corresponding research group and the cooperation partner and **may include an NDA**. In case, you are interested in a direct cooperation with a specific research group, please contact the research group.

It is still possible to **become** a Cooperation Partner for interested parties by signing an LoI as well as it is possible to be **deleted** from the list of Cooperation Partners by sending an to Christian Bach (christian.bach@empa.ch) and Karin Lacher (Karin.Lacher@empa.ch)

Exclusion from Round Table discussions and annual conferences with a 2/3 majority decision from the Executive Committee and possibility of hearing by Arbitration Commission.

Focus on
(swiss) market actors

Focus on
real sustainable fuel production

Difference between the "Round Tables" and the 3 "Cases"

Swiss sustainable fuels case in **Ticino** (lead: Florian Kiefer)
European sustainable fuel case in **Iberian Peninsula** (lead: Jörg Roth)
Extra-European sustainable fuel case in **Oman** (lead: Christian Bach)

Oman Case Strategy

From Ideas -> Implementation

reFuel.ch project (scientific topics)

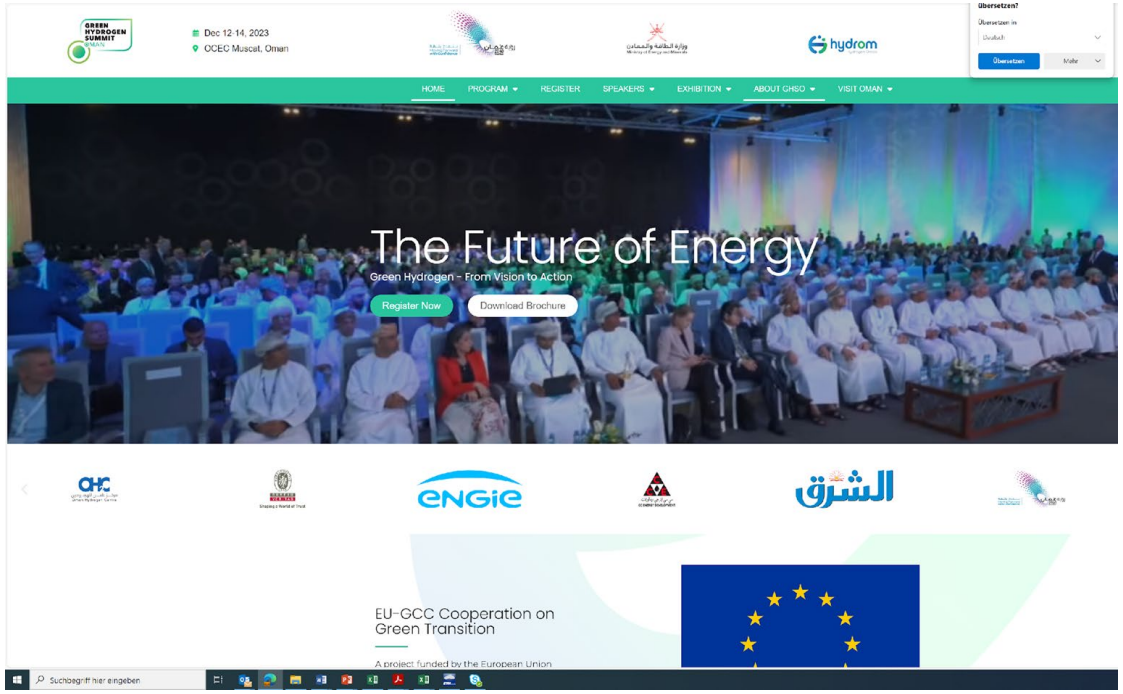
Round Tables (exchange with market actors and policy maker)

Idea consortium	*Concept* consortium	*Pre-feasibility study* consortium	*Full feasibility study* consortium
Development of a common idea (no NDA)	Development of a concept (e.g. 1 – 2 energy carrier, plant concept, off-taker, …)	Identification of supplier, locations, legal and regulatory details	Answer investor questions

The roles:

Oman Case “Idea Consortium”

reFuel.ch delegation at the Green Hydrogen Summit in Oman (12.-14.12.2023)



reFuel.ch - Idea Consortium Oman

Name	Affiliation
Dr. Walter Steinmann	Steinmann Consulting
Heinz Buhofer	44.01.earth / Tech Cluster Zug / Metall Zug
Dr. Thomas Oertle	Embassy of Switzerland in Oman
Dr. Anka Käster	OSFA
Christian Bach	Empa APTL
Dr. Robin Mutschler	Empa UES
Prof. Matthias Sulzer	Empa UES
Dr. Gurdial Blugan	Empa Ceramics
Gilles Hardy	Accelleron
Antoine Parrella	Groupe Curie AG
Christian Bersier	Ineratec Schweiz AG
Ralph Dassonville	Alpiq AG
Dr. Boris Krey	gazenergy
Luca Motta	Burckhardt Compression
Nazir Shahin	Ara Petroleum (Oman)
Mark Geilenkirchen	Amnah Consortium
Shady Taha	ABB (United Arab Emirates)

Exchange with Ministry of Energy and Minerals and roughly 20 more entities.

The Round Tables

Round Tables in brief

Round Table 1: **Industrial Power-to-X Plants**

Round Table 2: **Manure and Biomass as Resource**

Round Table 3: **Energy Sector, Platform Chemicals & Industrial Applications**

Round Table 4: **Transport & Logistics**

RT1: Industrial Power-to-X Plants

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RT2: Manure and Biomass as Resource

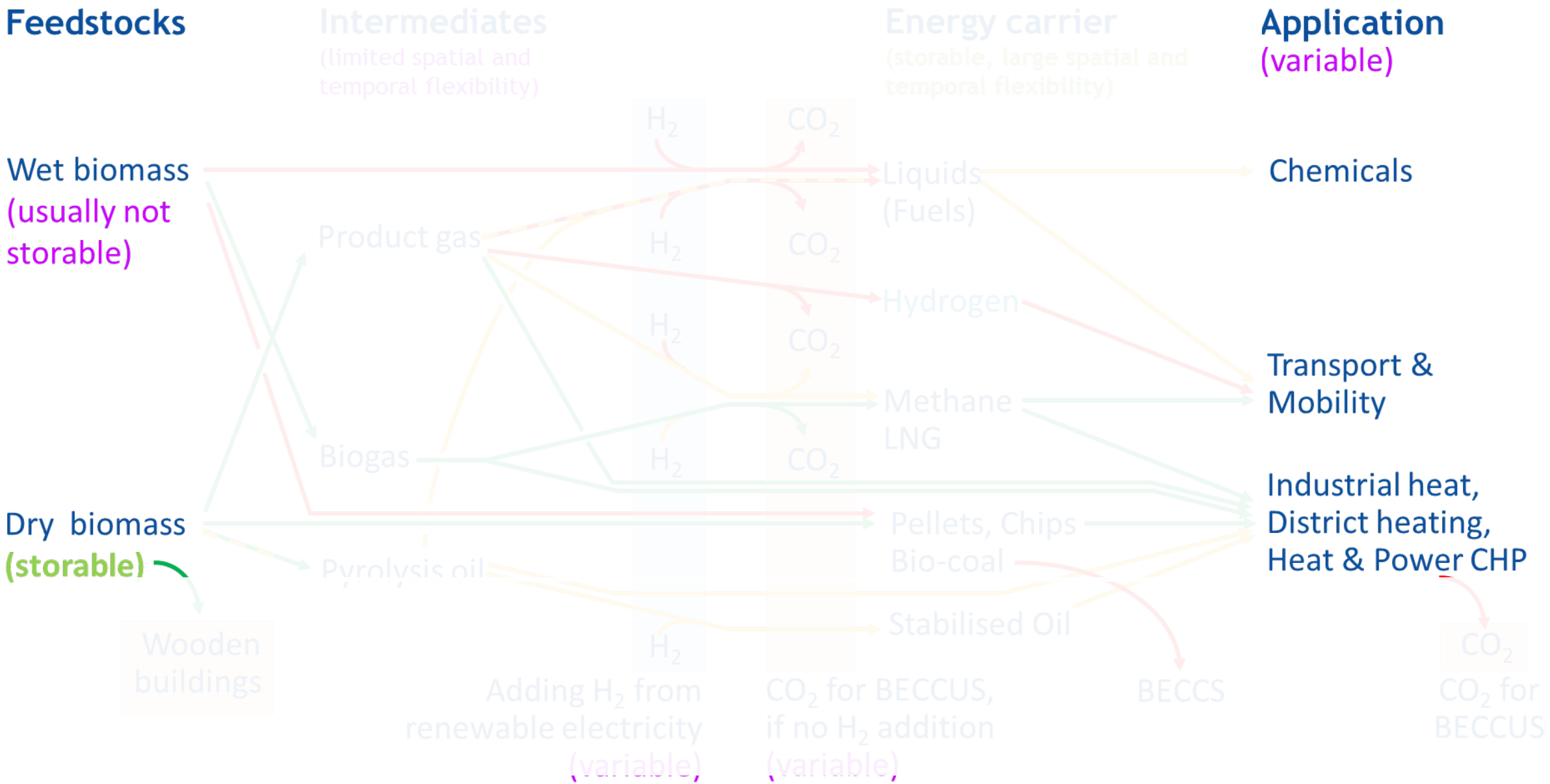
Background

- Manure holds significant untapped energy potential: 25 PJ/a.
- Challenges include low energy density and structural aspects unique to Swiss agriculture.
- Similar issues (logistics, costs, owner structure, social acceptance, …) can be found for most biomass incl. wood.

Goal:

- Discuss efficient and environmentally sustainable pathways to exploit this potential
- Is sustainable aviation fuels and platform chemicals the best/only option? What should be used what for?
- How to realise the options of flexible biomass use to increase resilience of the energy system and connected material flows?

Flexible biomass: **What to use when what for?**



RT3: Energy sector, platform chemicals and industrial applications

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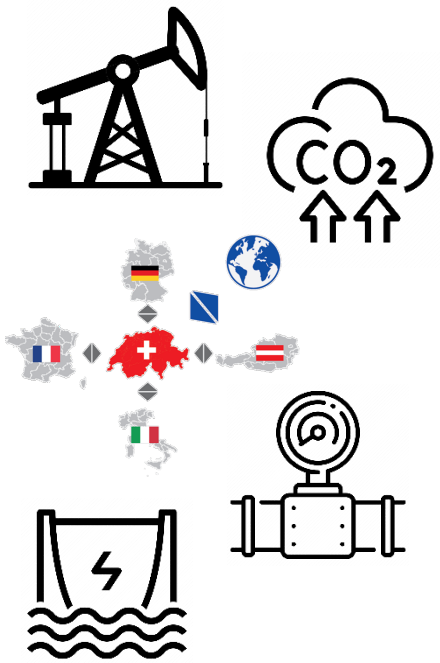
Current Swiss energy system



Transition paths

Swiss energy system model(s)

- Mathematical equations
- Only as good as the inputs
- Can't see the future. Tools to evaluate paths holistically.

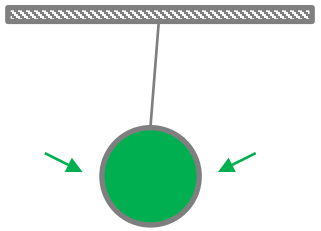
Social | ***Boundary conditions*** | **Market**

Policy | **Tech-nology**

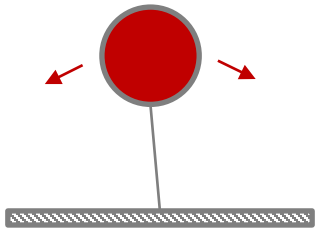
Round table inputs
Stakeholder, expert and industry inputs

Future Swiss energy system

Robust system



Sustainable and robust!



Instable system

RT3: Energy sector, platform chemicals and industrial applications

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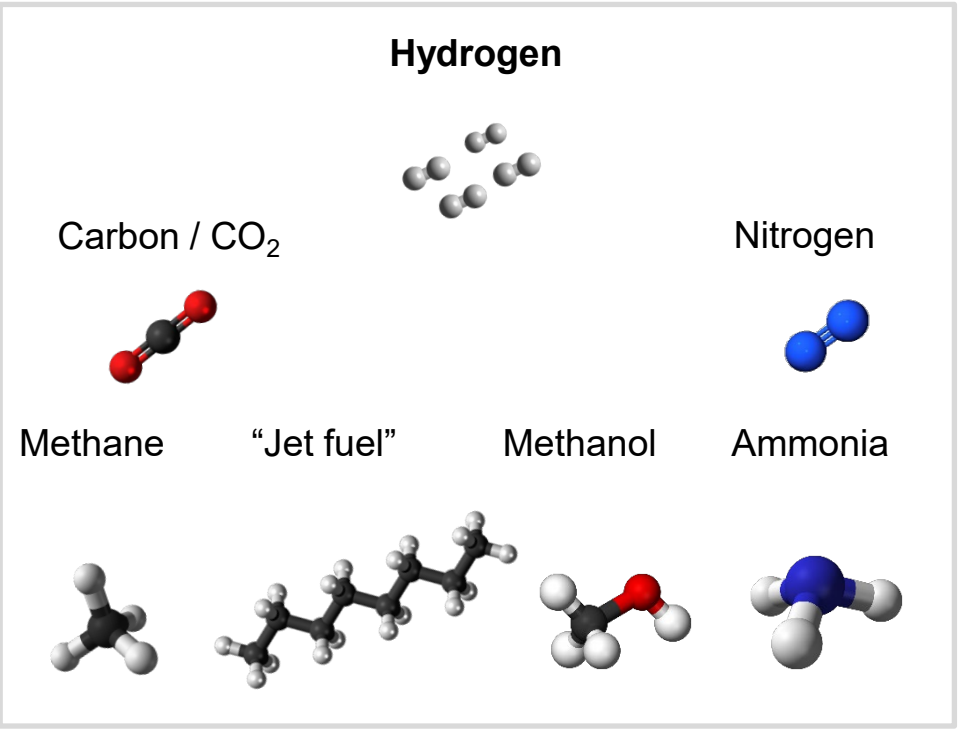
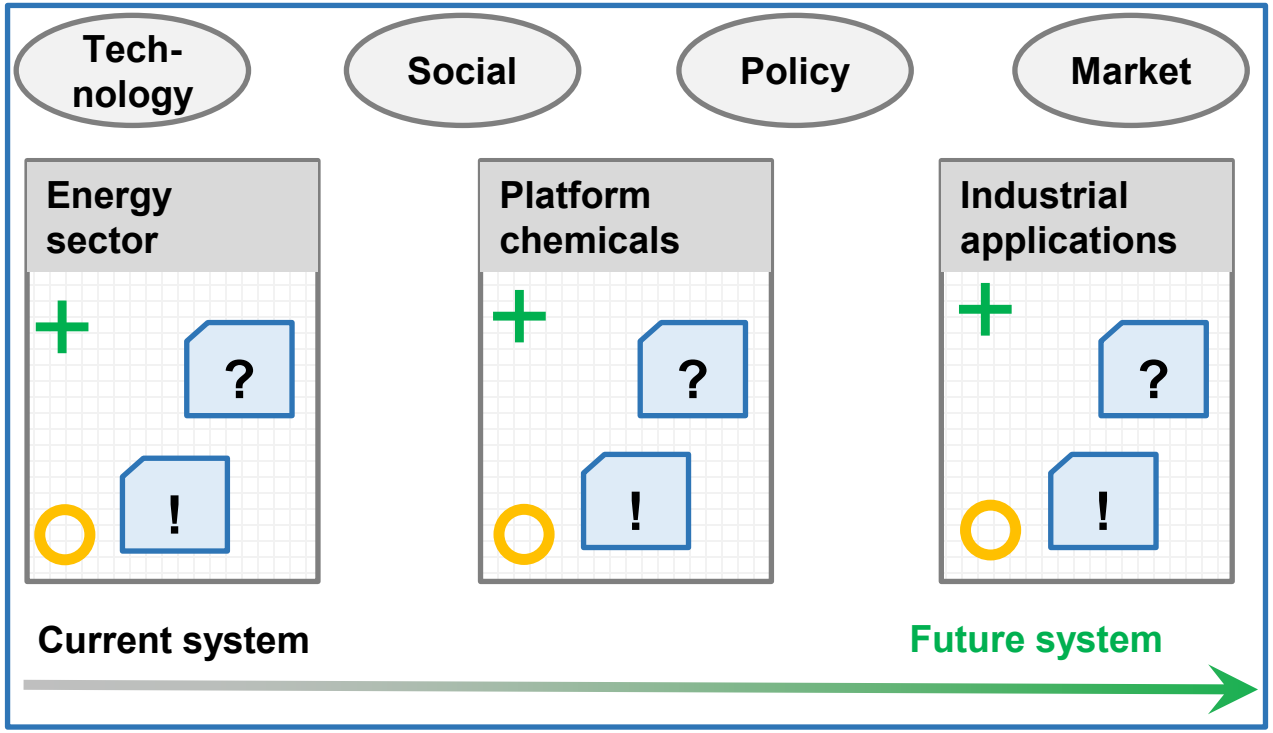
Thematic focus: Hydrogen and its derivatives



Round table inputs
Stakeholder, expert and industry inputs



RT3: Energy sector, platform chemicals and industrial applications

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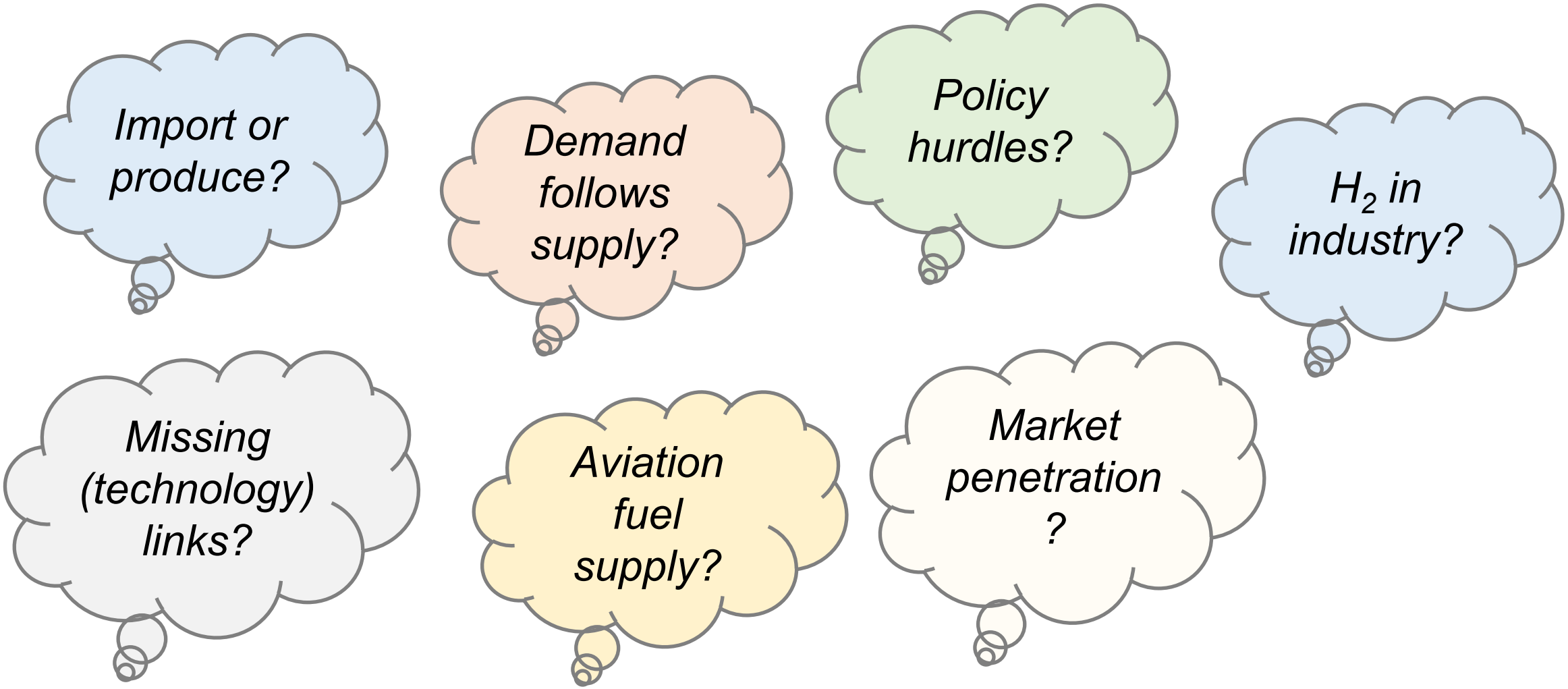
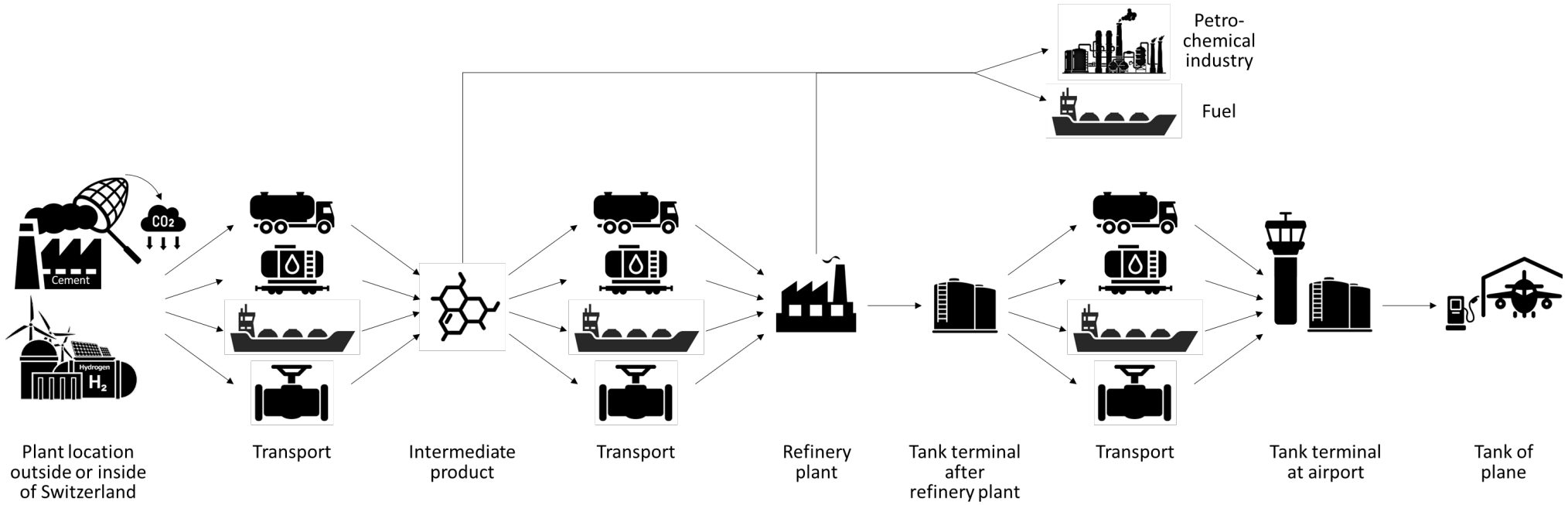


RT4: Transport and Logistics



Group Sessions

How it works

After the break…

1. participants choose their Round Table *(3:15 pm)*
2. participants proceed to the appropriate group session room
3. one expert and one facilitator will guide the discussion with questions about market readiness, policy framework, investment security and technology
4. there will be group work & discussions

After the group discussions…

➢ the participants return to the plenary for a last reflection *(4:05 pm)*

Round Table 1:
Industrial Power-to-X Plants

Round Table 2:
Manure and Biomass as Resource

Round Table 3:
Energy Sector, Platform Chemicals and Industrial Applications

Round Table 4:
Transport and Logistics

Group Sessions

How it works

RT1: Industrial PtX plants	C. Bach, I. Espa	**E 33.3**
RT2: Manure and biomass as resource	T. Schildhauer, J. Roth	**G 26.3**
RT3: Energy sector, platform chemicals and industrial applications	R. Mutschler, H. Hohoff	**F 26.3**
RT4: Transport and logistics	P. Doege, R. Betz	**G 26.5**

Group Sessions

Methodology in each room

Brainstorming

A) Each participant answers the questions individually for his/her organization & from his/her perspective (via post-it note) and discuss it with a neighbor.

B) He/She puts the post-it notes on the flipchart with the questions and include his/her organization's name/acronym. (15 min)

Analysis

The participants split into small groups of similar size. Each group reviews the post-its and prepare a summary to present in the plenary. (15 min)

Rapid Highlights

Each group should give a high-level summary of their question in the breakout room. (15 min)

Short final reflection in the room

The Key take aways shall include suggestions to overcome the biggest challenges.

Networking & Break

Please reconvene in your Round Table room at *3:15 pm*

Plenary reflection

Please use your phone to open Slido

Outlook

Next steps:

- Cooperation partners contact WP and P&D/ SFLV leads to become a Research Group-cooperation partner
- Use of knowledge transfer tool to update profiles and to share information
- Develop the best working process based on 1st metting (e.g. idea consortium or split into working groups for specific subtopics)
- Develop a common view on priorities as well as identify common gaps among cooperation partners
- Understand the heterogeneity of cooperation partners (e.g. mapping)

Next Annual Conference: September 2024

Next Round tables: 21.10.2024

Online, two Round Tables in parallel each 90 min