



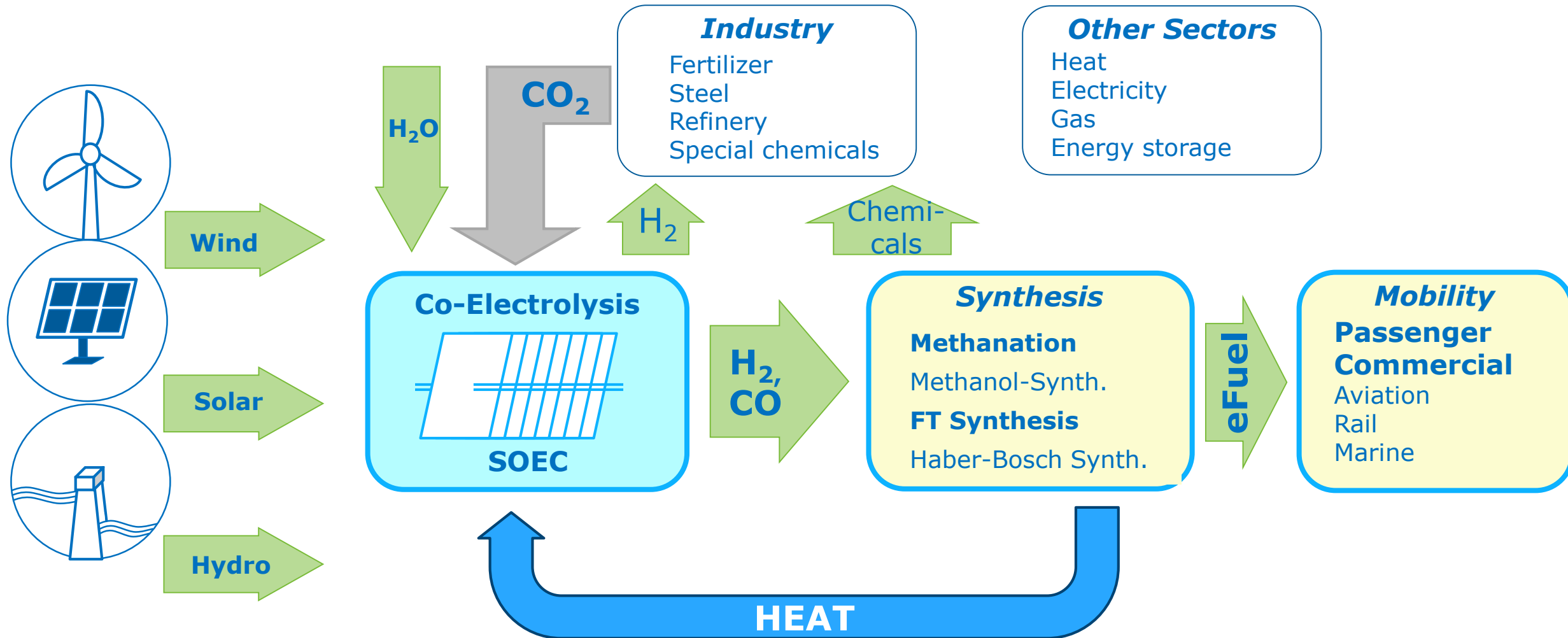
# Power to X with High Temperature Electrolysis

Eco-Mobility 2020 - Session 3: Hybrids and Fuels

**Richard Schauperl**

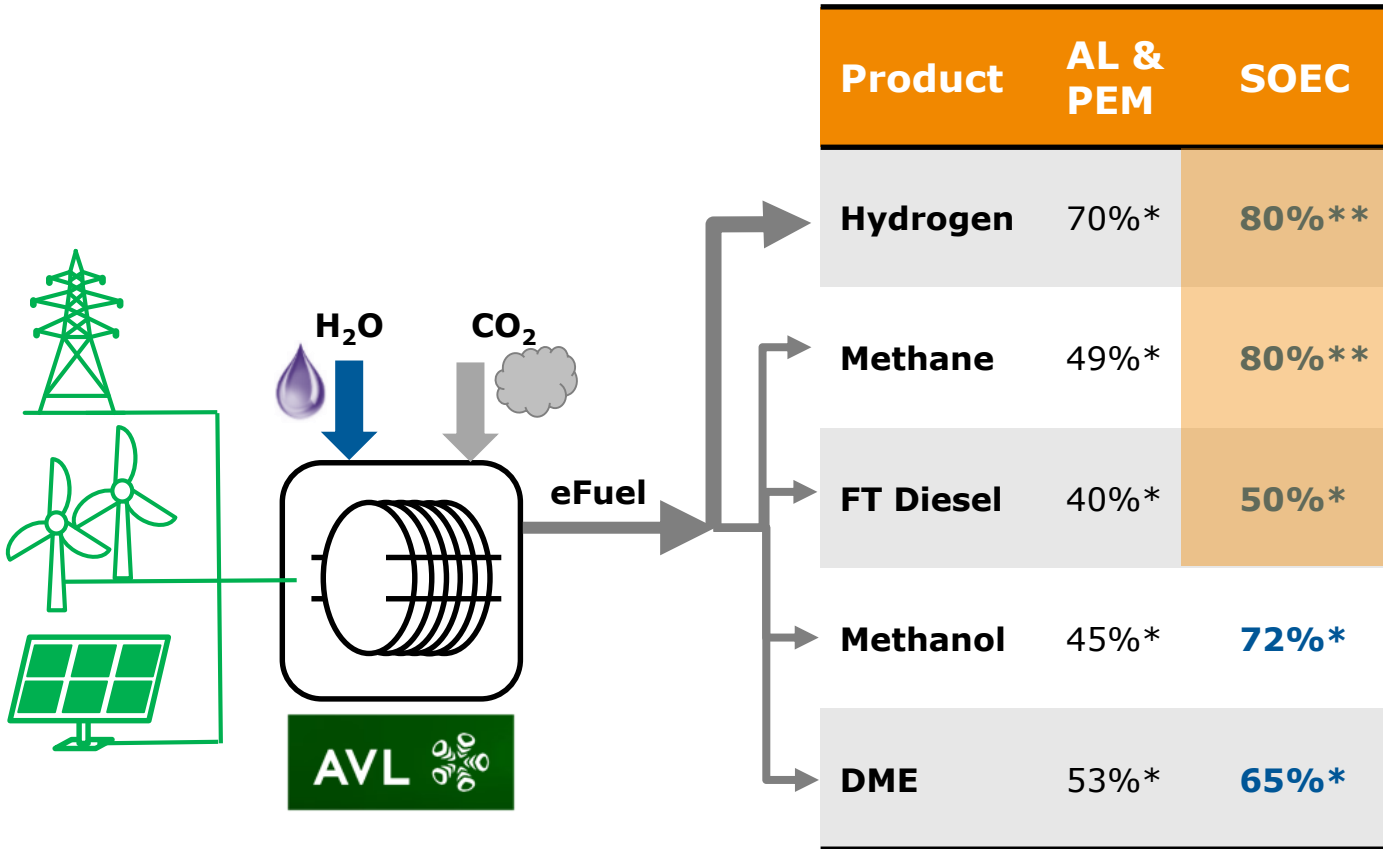
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# High temperature electrolysis as Enabler of Sectorial Integration



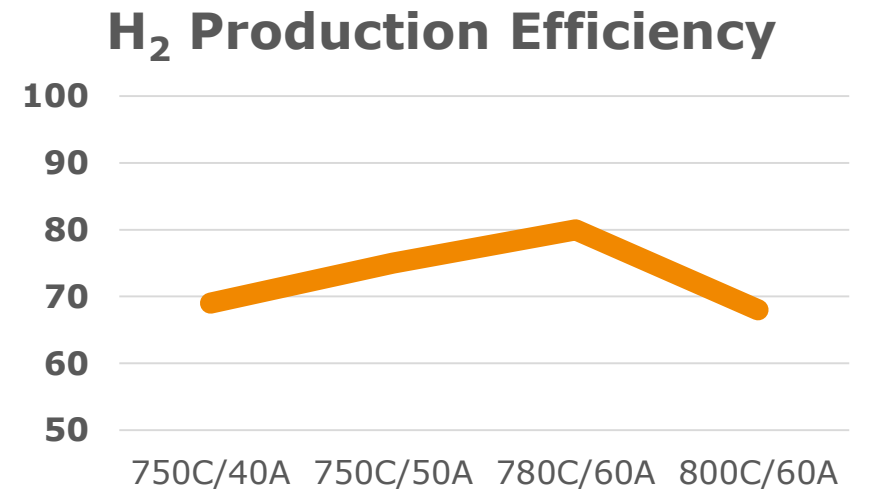
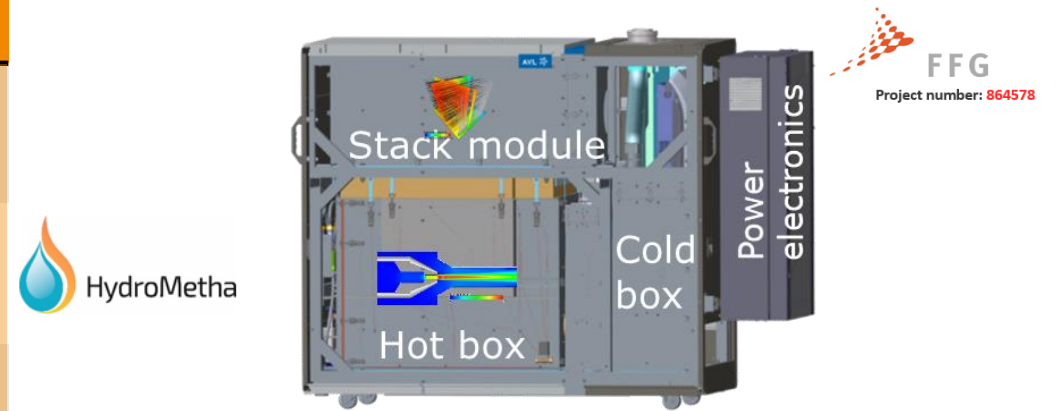
SOEC links electricity,  $CO_2$  and heat and converts it to synthetic fuels for mobility

# Hydrogen & eFuel Production with SOEC

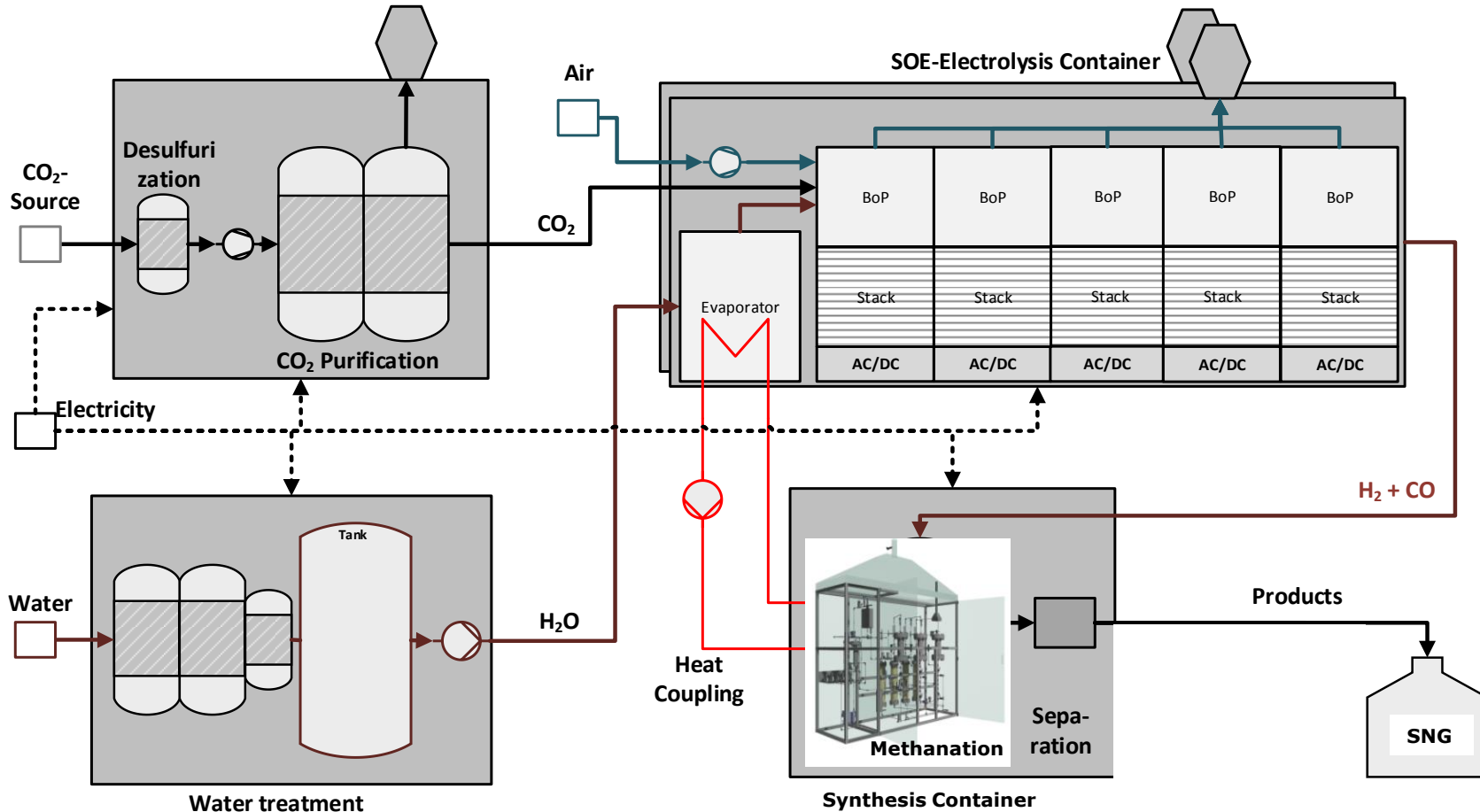


Sources:  
 \* Based on Literature:  
 - Tremel, 2017  
 - Becker, 2012  
 \*\* based on AVL project results

## AVL SOEC Demonstrator



# Decentralized SOEC-FT Plant Layout



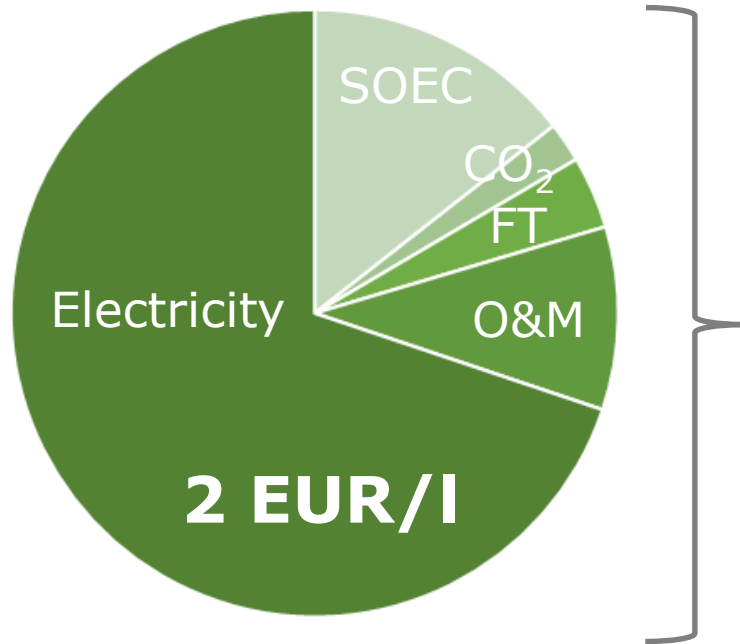
- Local requirements**
- Renewable electricity source
  - CO<sub>2</sub> source
  - Water source
  - Product storage and distribution logistics



SOEC needs to be upscaled. All other PtL plant sections are available on industrial scale.

# Key Economic Boundary Conditions SOFC-FT

## Total cost of ownership



@ 8 ct/kWh and 8000 h/year

		Electricity price [EUR cent/kWh]												
		2	3	4	5	6	7	8	9	10	11	12	13	14
Full load hours [h/year]	500	4.26	4.43	4.60	4.77	4.94	5.11	5.28	5.44	5.61	5.78	5.95	6.12	6.29
		3.50	3.67	3.84	4.01									
		3.00	3.16	3.33	3.50									
		2.63	2.80	2.97	3.14									
		2.36	2.53	2.70	2.87									
	2500	2.15	2.32	2.49	2.66									
		1.98	2.15	2.32	2.49									
		1.84	2.01	2.18	2.35									
		1.73	1.90	2.07	2.23									
		1.63	1.80	1.97	2.14									
	4500	1.55	1.72	1.88	2.05									
		1.47	1.64	1.81	1.98	1.98	2.15	2.32	2.49	2.65	2.82	2.99	3.16	3.33
		1.41	1.58	1.75	1.92	1.94	2.10	2.27	2.44	2.61	2.78	2.95	3.12	3.28
		1.35	1.52	1.69	1.86	1.90	2.06	2.23	2.40	2.57	2.74	2.91	3.08	3.24
		1.31	1.47	1.64	1.81	1.86	2.03	2.20	2.37	2.53	2.70	2.87	3.04	3.21
	6500	1.26	1.43	1.60	1.77	1.83	1.99	2.16	2.33	2.50	2.67	2.84	3.01	3.18
		1.22	1.39	1.56	1.73	1.80	1.96	2.13	2.30	2.47	2.64	2.81	2.98	3.15
		1.18	1.35	1.52	1.69	1.77	1.94	2.11	2.27	2.44	2.61	2.78	2.95	3.12
		1.15	1.32	1.49	1.66	1.74	1.91	2.08	2.25	2.42	2.59	2.76	2.92	3.09
		1.12	1.29	1.46	1.63	1.72	1.89	2.06	2.23	2.39	2.56	2.73	2.90	3.07
8500	1.09	1.26	1.43	1.60	1.68	1.85	2.02	2.18	2.35	2.52	2.69	2.86	3.03	
	1.07	1.24	1.41	1.57	1.66	1.83	1.99	2.15	2.32	2.49	2.65	2.82	2.99	
	1.04	1.21	1.38	1.55	1.64	1.81	1.98	2.15	2.32	2.49	2.65	2.82	2.99	
	1.02	1.19	1.36	1.53	1.62	1.79	1.96	2.13	2.30	2.47	2.64	2.81	2.97	
	1.00	1.17	1.34	1.51	1.60	1.77	1.94	2.11	2.28	2.45	2.62	2.79	2.96	
		0.98	1.15	1.32	1.49	1.66	1.83	1.99	2.16	2.33	2.50	2.67	2.84	3.01
		0.97	1.14	1.30	1.47	1.64	1.81	1.98	2.15	2.32	2.49	2.65	2.82	2.99
		0.95	1.12	1.29	1.46	1.63	1.80	1.96	2.13	2.30	2.47	2.64	2.81	2.97
		0.94	1.10	1.27	1.44	1.61	1.78	1.95	2.12	2.28	2.45	2.62	2.79	2.96
		0.92	1.09	1.26	1.43	1.60	1.76	1.93	2.10	2.27	2.44	2.61	2.78	2.95
		0.91	1.08	1.24	1.41	1.58	1.75	1.92	2.09	2.26	2.43	2.59	2.76	2.93
		<1.5 EUR/l			<2 EUR/l			2-3 EUR/l			>3 EUR/l			

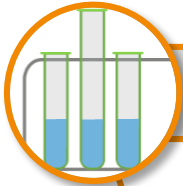
**Key drivers for economics**

- 1) Overall efficiency
- 2) Low electricity price
- 3) High full load hours
- 4) Low CAPEX

**Realistic range for decentralized production in Europe**

Decentralized SOEC-FT plants in the range of 10-50 MW meet economic key drivers and technical requirements → key to enable a region-wide implementation for a fast CO<sub>2</sub> reduction impact

# Summary



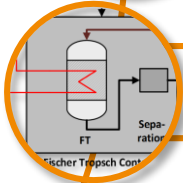
Synthetic fuel provides an effective solution for large scale CO<sub>2</sub> emission reduction



Synthetic fuel can be produced via a combination of electrolysis and e.g. catalytic methanation and Fischer-Tropsch process



SOEC technology provides highest efficiency potential for electrolysis and enables sectorial integration by linking electricity, CO<sub>2</sub> and heat



Decentralized production useful for region-wide implementation



Locations with low electricity price and high full load hours are required to meet synthetic diesel production price in the range of approx. 2 EUR/liter