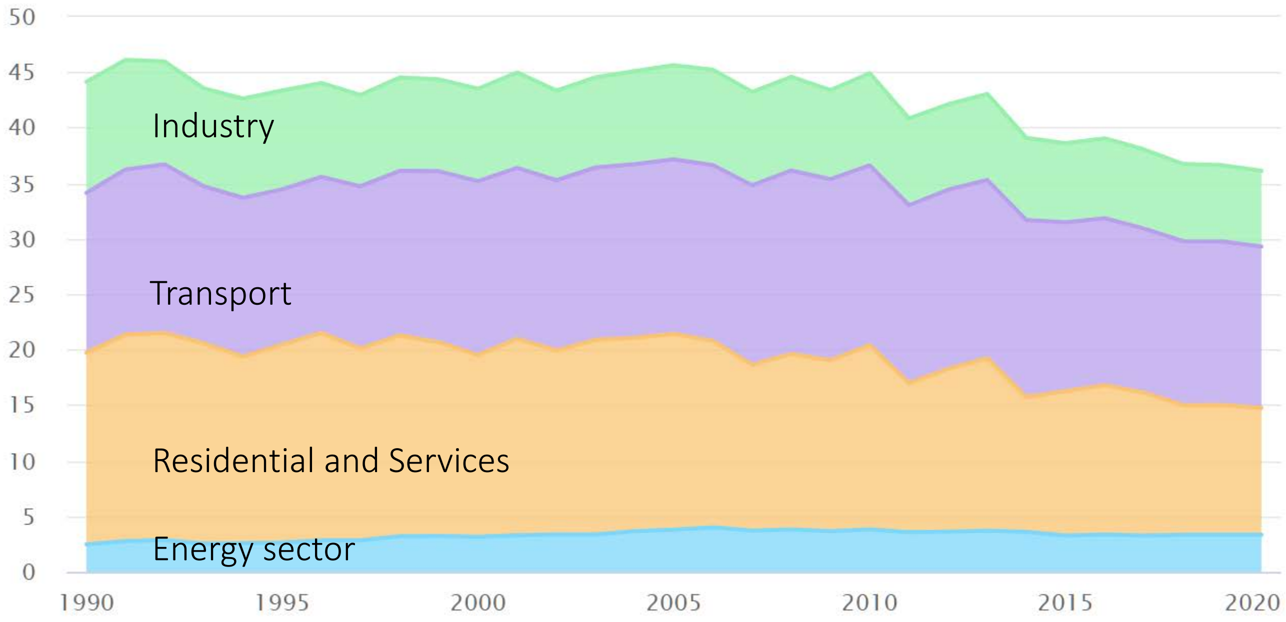
Evangelos Panos :: Energy Economics Group :: Paul Scherrer Institute

Switzerland's national mitigation pathways: towards net-zero emissions in 2050

Fourteenth IAMC Annual Meeting, 1st December 2021, Online

Evolution of CO2 emissions in Switzerland, Mt/yr.

(from fuel combustion and industrial processes, excluding international aviation)



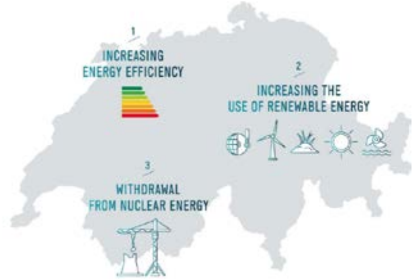
2008: ETS in Switzerland and CO2 levy on thermal fuels of 12 CHF/tCO2
2011: Negotiations for linking Swiss-EU ETS
2010: CO2 levy to 36 CHF/tCO2
2014: CO2 levy to 60 CHF/tCO2
2016: CO2 levy to 84 CHF/tCO2
2018: CO2 levy to 96 CHF/tCO2
2020: Link Swiss-EU ETS

- Key challenges in Swiss transition to low carbon energy system:
  - Limited renewables resources
  - Seasonal balancing issues in electricity supply
  - Domestic CO2 storage uncertainties
  - Maintaining energy security
  - Maintaining a carbon-free electricity

Milestones in the Swiss long-term energy and climate policy

2015

Switzerland is the first country submitting its climate action plan ahead of Paris Agreement
(Feb 2015)



2018

The new Energy Act comes into force
(Jan 2018)

2019

The Swiss Federal Council commits to Net-Zero for 2050
(Sep 2019)

2020

The Swiss Parliament votes the revision of the CO2 Law to meet 2030 targets
(Sep 2020)

2021

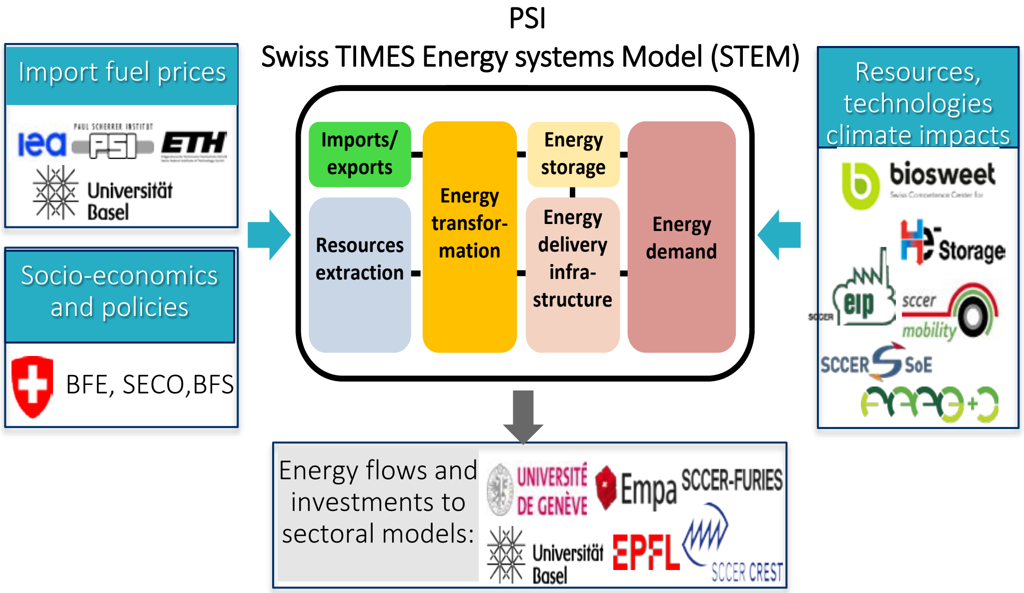
The Swiss Federal Council adopts the long-term climate strategy,
(Jan 2021),
the Swiss population rejects the revision of the CO2 law
(Jun 2021)

Asessing the Swiss transition (SCCER JASM project, 2017-2020)

The Swiss Competence Centres for Energy Research (SCCERs) programme:

- 250 MCHF for 2013-2020 to 8 challenges related to the Swiss energy transition :
  buildings, industry, mobility, grids, electricity, bioenergy, storage, society

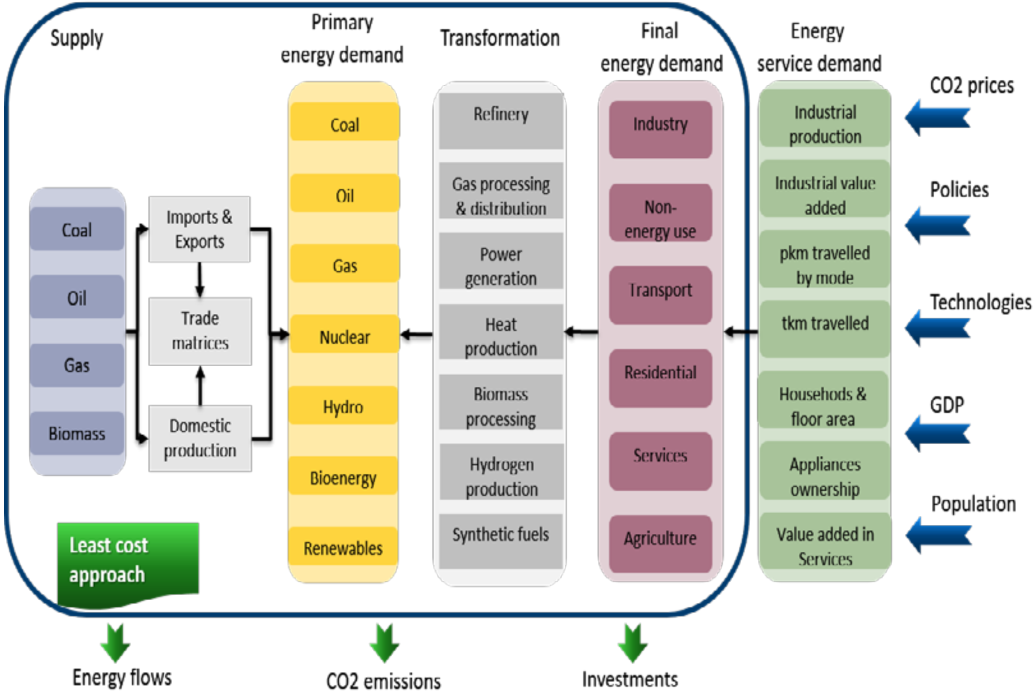
SCCER Joint Activity Scenarios and Modelling (~5.6 MCHF) is a cross-SCCER activity to assess net-zero pathways



Buildings, industry, mobility, grids

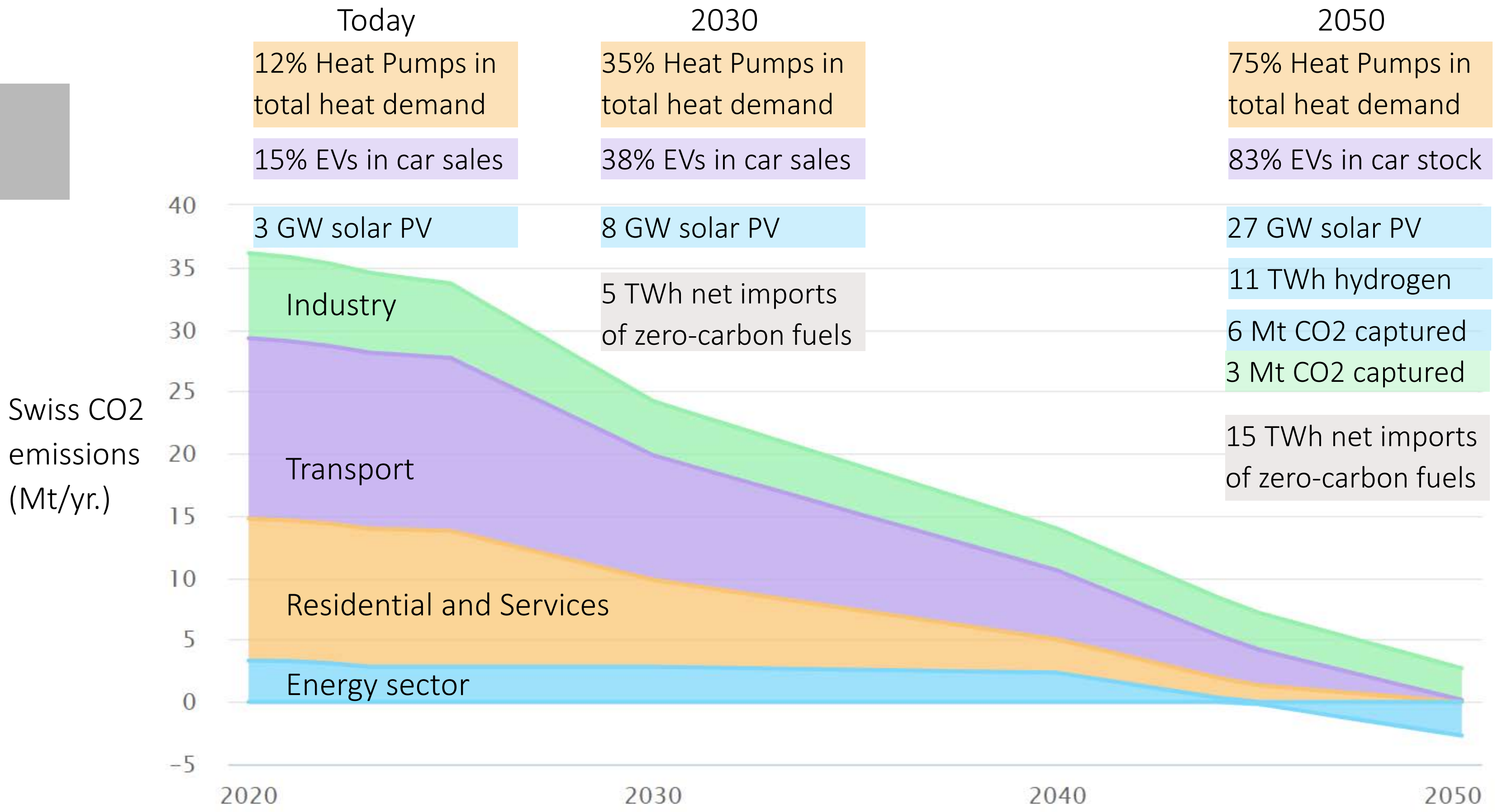
The Swiss TIMES Energy systems Model (STEM)

- Long term horizon (2050+)
- High temporal resolution (288 timeslices)
- More than 90 energy end-uses
- Electricity grid topology with voltage levels
- Computationally efficient unit commitment algorithm
- Technical and market flexibility mechanisms (incl. ancillary services markets and DSM)



Net-zero CO2 emissions in 2050 is technically feasible for Switzerland

(results from the net-zero core scenario in JASM with STEM)



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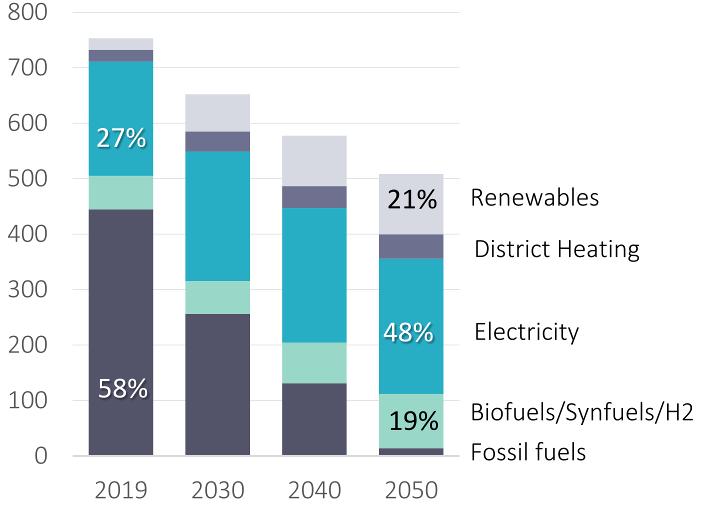
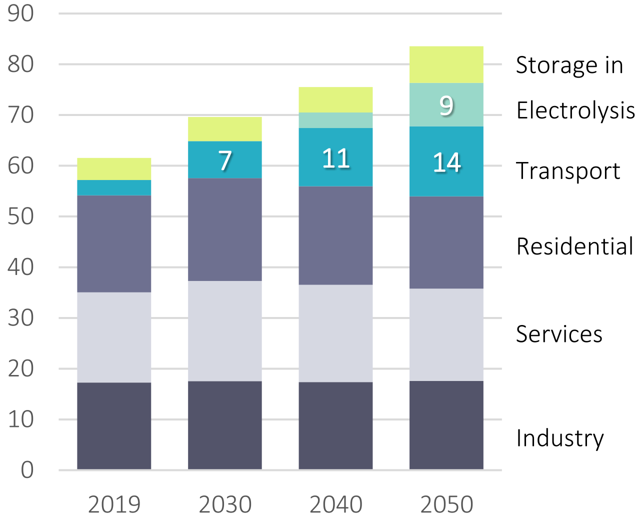
Towards a 2000 Watt society, powered by electricity

Final energy consumption, PJ/yr
(excl. international aviation)



Electricity demand by sector, TWh/yr.



Per capita consumption in 2050 -55% from 2000

Electric cars alone need 7.5 TWh electricity in 2050

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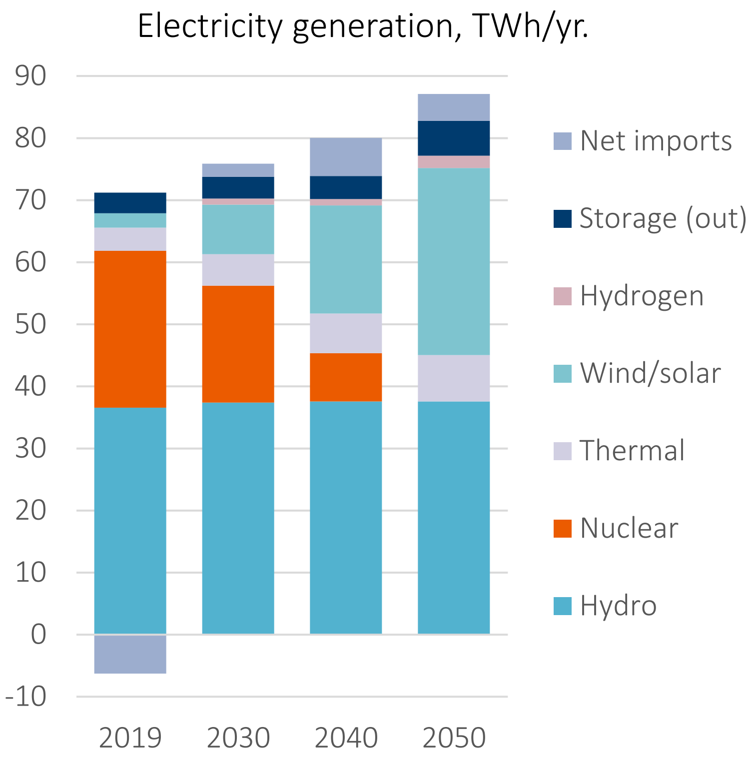
Electricity generation becomes more weather-dependent



- Production shifts towards lower grid levels
- CC(U)S to waste incineration installations
- Avoidance of substantial electricity imports
- Flexibility through electricity trade
- System flexibility is also provided by coordinated deployment of several options, beyond electricity sector

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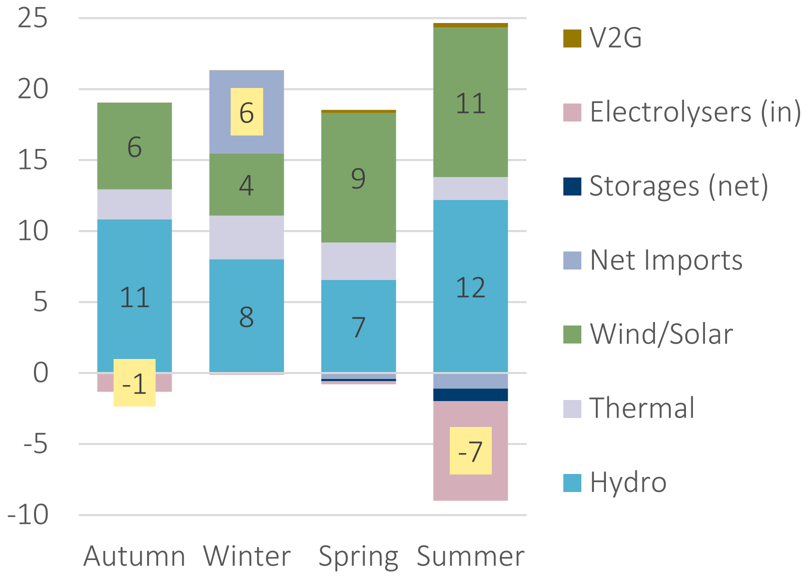
Seasonal and intraday imbalances call for flexibility options

Electricity balance per season in 2050, TWh



Deployment of energy system flexibility options in 2050:

Flexibility option	Deployment (capacity)
Pump storage	3.5 GW , 240 GWh
Stationary batteries	2.1 GW , 11.5 GWh
Thermal storage	5.8 GW , 35 GWh
Thermal storage (seasonal)	1.4 TWh
H2 storage (seasonal)	1.6 TWh
Vehicle-to-Grid (V2G)	output 0.5 TWh (from 13% of the electric cars)
FCR+ reserve demand	+ 45% from 2020 (624 MW)
Electricity shifts (DSM) in industry, services, residential	10% of demand (5.5 TWh)

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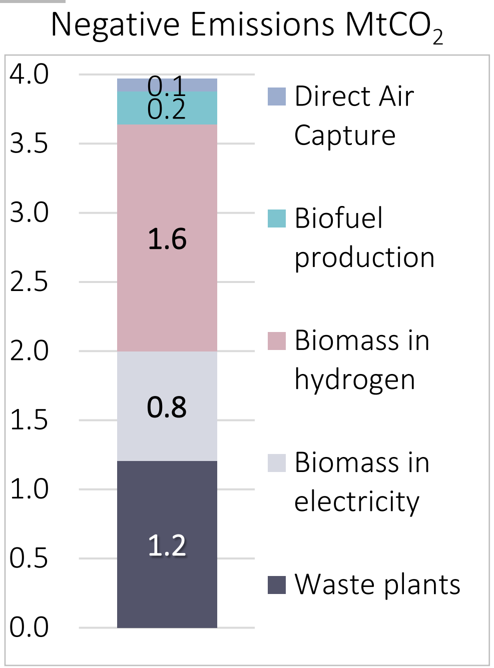
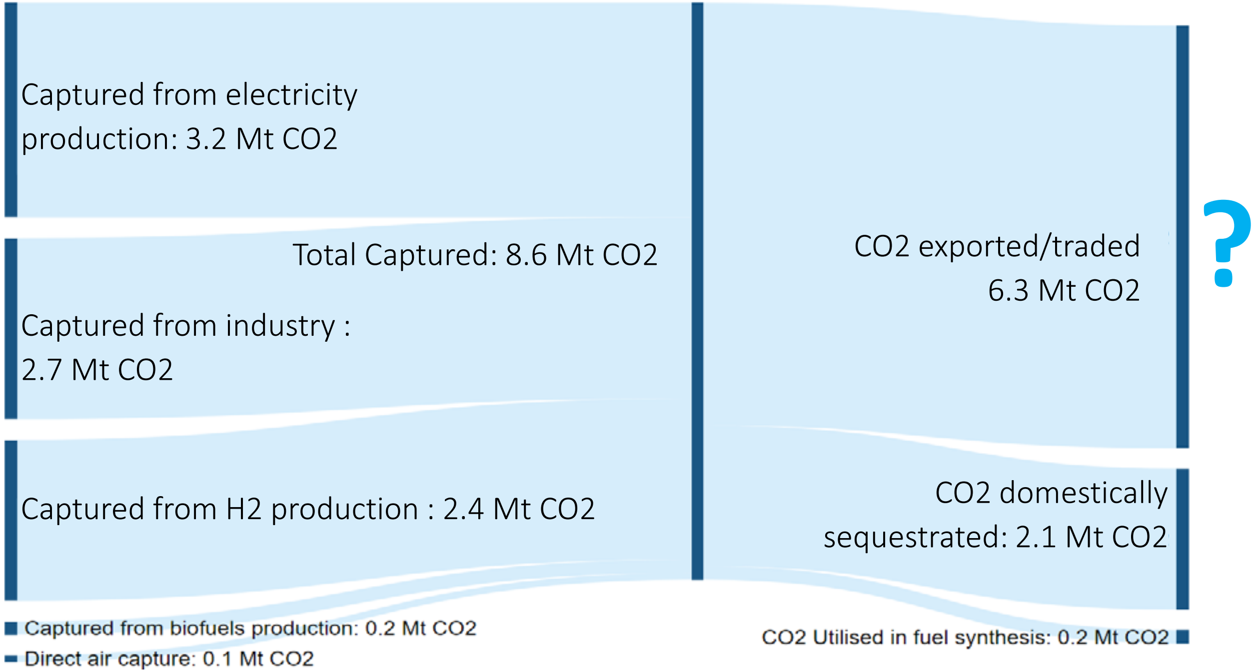
CC(U)S and negative emissions essential to net-zero for CH





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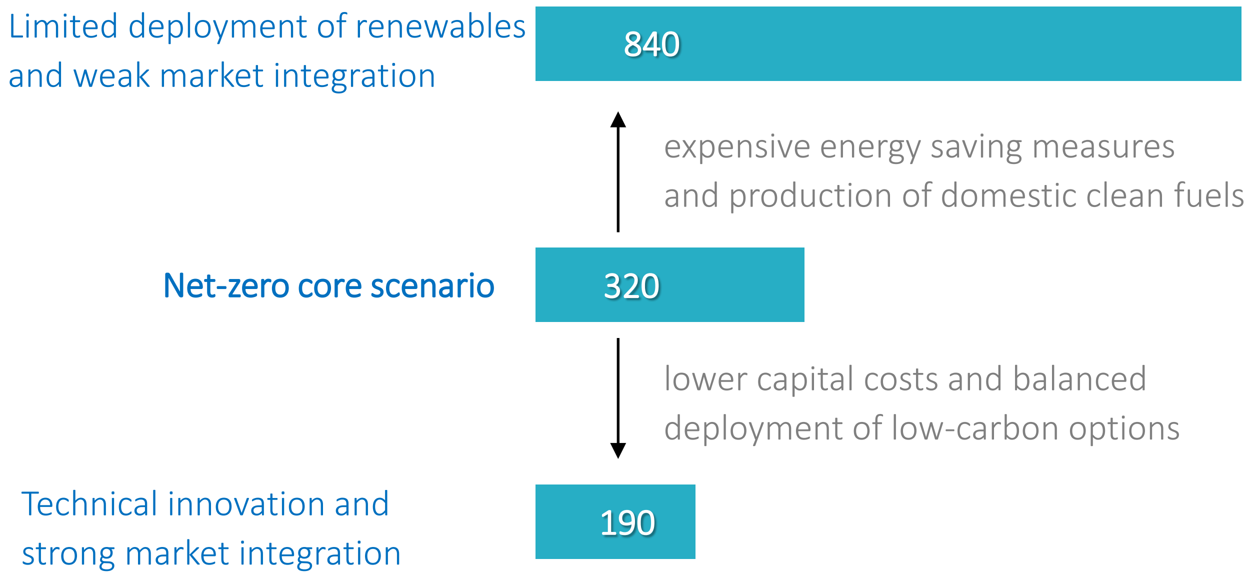
«Price tags» of the Swiss energy transition to net-zero in 2050

Average annual per-capita energy system cost 2020-2050
to achieve net-zero emissions (CHF/yr)



07.03.21

01.09.21


Tages-Anzeiger

Das braucht es für eine klimaneutrale Schweiz ohne AKW

Bis 2050 sollen nur noch E-Autos fahren und alle Kernkraftwerke abgeschaltet sein. Das bedeutet vor allem eines: Wir brauchen mehr Strom. Woher soll der kommen?

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Conclusions

Achieving the net-zero ambition is technically feasible, but requires coordinated efforts across all sectors and access to international energy markets in order to limit the associated costs

- Requires scaling up clean energy technologies
- Electricity is a key energy carrier but alone cannot decarbonize the entire energy system
- Fostering innovation in electrification, hydrogen, bioenergy and CCS is essential

When it comes to national analyses:

- improve the “realism” of the modelled pathways, especially at national scales
- scale down pathways to identify local constraints and best-fit local decarbonisation solutions

My thanks go to:

- Stefan Hirschberg
- Tom Kober
- Kannan Ramachandran
- … and to the SCCER JASM team

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