

CROSS FINAL EVENT

CROSS achievements and results

Adriana Marcucci

SWEET CROSS (2021-2022)

PATHFNDR

Pathways to an efficient future energy system through flexibility and sector coupling

Host Institution:
ETH Zurich

EDGE

Enabling decentralized renewable generation in the Swiss cities, midlands, and the alps

Host Institution:
EPFL and UNIGE

DeCarbCH

Decarbonisation of cooling and heating in Switzerland

Host Institution:
UNIGE

SURE

Sustainable and resilient energy for Switzerland

Host Institution:
PSI

All projects include: data handling (inputs, results, etc.), scenario analyses, simulation models

CROSS (CooRdination of Scenarios and Data in SWEET)

To ensure **comparability** of results and **credibility** of the conclusions
and for an **efficient** way of **sharing data**

Main objectives



1. Data platform

Establish a hub of data to store input parameters and model results



2. CROSS catalog

Create a catalog with information about inputs, outputs, capabilities and expected outcomes.



3. Harmonized assumptions

Harmonize a basic set of input parameters across consortia to improve the relevancy and comparability of the results.



4. Scenarios

Define CROSS-scenarios to be analyzed (if possible) by all SWEET-consortia



5. Communication platform

Platform for communication of data and results within the SWEET consortia, to the scientific and public domain.

Results



1. Data platform

Establish a hub of data to store input parameters and model results

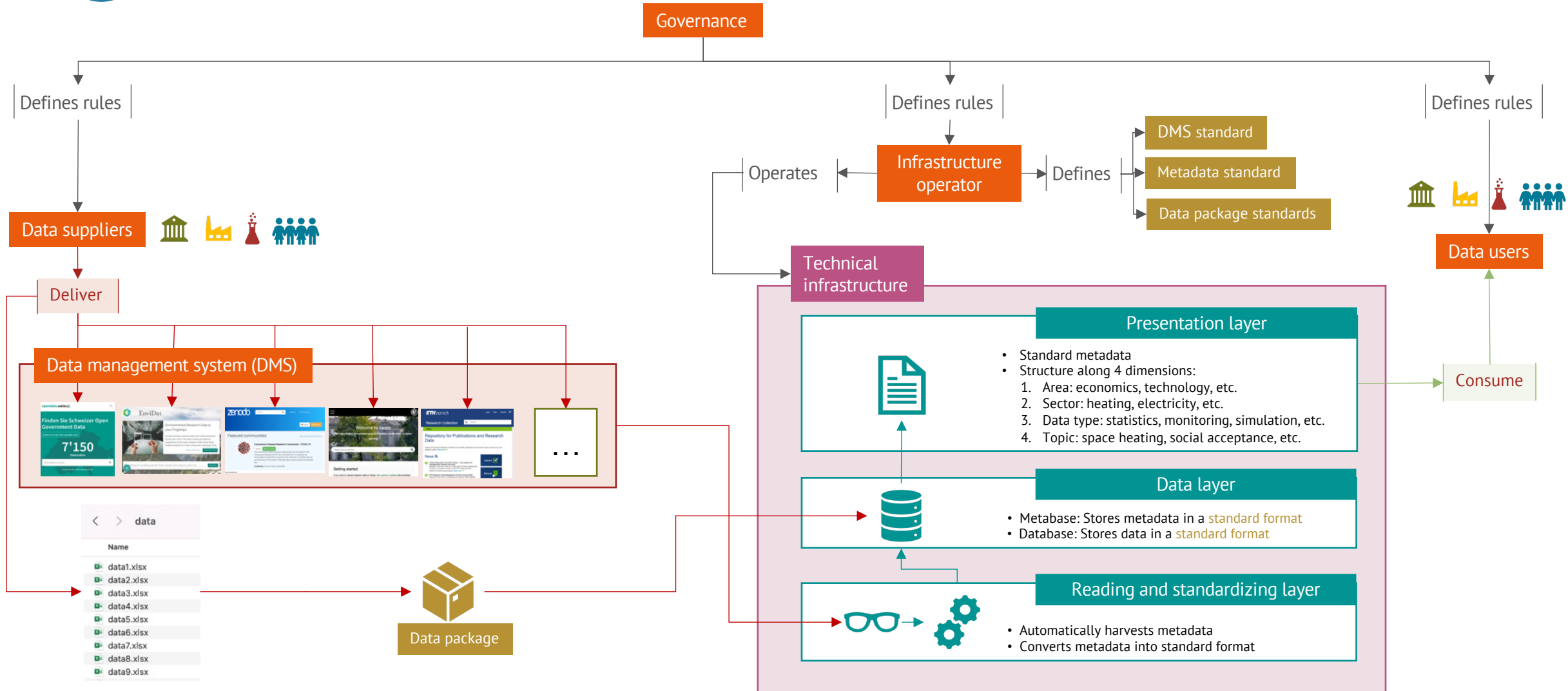


CROSSDat: A data space for aggregation

- CROSSDat is the first-stop point to find and publish research data in the energy field
- CROSSdat is a platform with unified access to SWEET and **energy** related (research) data, **irrespective of where it is stored and curated.**
- Features:
 1. It is both a metabase and a database
 2. CROSSDat uses Frictionless **standards** for data packages and metadata
 3. CROSSDat has clearly defined **principles**: Unified data access, Distributed research data management, Findable, Accessible, Interoperable, Reusable



CROSSDat: Structure





CROSSDat

<https://sweet-cross.ch/data>



CROSS ▼ CATALOG ▼ CROSSDAT ▼ RESULTS ▼

≡ MENU

CROSS Data platform - CROSSDat

Categories	Data package	Description	Institution/Project	Latest version
Clear ▼			Clear ▼	
Biomass Resources	Biomass and waste potentials in CROSS	Biomass and waste potentials for energy use including wood, manure, green and fossil waste and sewage sludge, 2015-2060. JASM-Biosweet estimation. Potentials in mass and energy units	CROSS	2022-04-05
Biomass Resources	Biomass and waste potentials in JASM	Biomass and waste potentials for energy use including wood, manure, green and fossil waste and sewage sludge, 2015-2060. JASM-Biosweet estimation. Potentials in mass and energy units	JASM	2020-08-19
Demand	End-use energy demands in CROSS	End-use energy demand for Switzerland in 2000-2050 in CROSS- Space heat, process heat, warm water, electricity appliances, passenger and freight transport	CROSS	2022-04-03
Demand Buildings	Energy reference area (ERA) in CROSS: Reference, High and low variants	Energy reference area (ERA) for residential, commercial and industrial sectors in CROSS (reference, high and low variants)	CROSS	2022-04-03
Efficiency Heating Buildings Demand	Swiss building stock heat demand data by typology, raster summary	Swiss building stock physical characteristics and heat demands data disaggregated by building typology. The values are summarised on a raster grid of 200m x 200m pixels.	UNIGE	2021-06-01
Efficiency Industry Demand	Industry - Chemical & Pharma., Cement, Motor systems, Excess heat recovery systems	<ul style="list-style-type: none"> This file provides techno-economic data for energy efficiency measures applicable in Swiss industrial systems. Generalized indicators for measure-specific potential energy savings are not developed (except for cement industry) due to the unavail... 	UNIGE	2018-10-25
Electricity statistics	Wochenstatistik Elektrizitätsbilanz - Erzeugung und Abgabe elektrischer Energie in der Schweiz	Die Wochenstatistik Elektrizitätsbilanz - Erzeugung und Abgabe elektrischer Energie in der Schweiz gibt Auskunft über Produktion, Import / Export und Verbrauch von Elektrizität in der Schweiz jeweils am Mittwoch auf wöchentlicher Basis. Bei der Produktion werden die...	Swiss Federal Office of Energy SFOE	2022-02-03

CROSS / CROSSDat / [Swiss building stock heat demand data by typology, raster summary](#)

Swiss building stock heat demand data by typology, raster summary

Package version	2021-06-01 (latest) ▼	"latest" URL
Description	Swiss building stock physical characteristics and heat demands data disaggregated by building typology. The values are summarised on a raster grid of 200m x 200m pixels.	
Last changes	Not documented	
Download	Individual data files (from external source: yareta) Zip file (7 files, 211 MB) datapackage.json (14 kB) README.txt (5 kB) /data/building_areas_per_pixel.csv (73 MB) logo.png (198 kB) /data/building_energy_per_pixel.csv (315 MB) /data/swissres_energy_and_savings_per_pixel.csv (111 MB)	
Meta data	README.md datapackage.json	
External source	Datapackage from yareta . DOI: 10.26037/yareta:sluzlbggmjfxj7qmyptxs7zoa	
Data licenses	PUBLIC Creative Commons Attribution-NonCommercial 4.0 International	
Contact	Jonathan Chambers, Université de Genève	
Institution/Project	UNIGE	
Cite as	Chambers, J.(2021). Swiss building stock heat demand data by typology, raster summary. DOI: 10.26037/yareta:sluzlbggmjfxj7qmyptxs7zoa	



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CROSS catalog

- CROSS catalog contributes to exchange and networking development. It includes information on:
 - Simulation models
 - Research groups
- Contains information:
 1. Inputs and outputs
 2. Capabilities of the model or group
 3. Relevant facts: geographical, time resolution, sectors
 4. Contact



CROSS catalog

<https://sweet-cross.ch/catalog/>

CROSS Catalog

Group	Model	Spatial coverage	Spatial resolution	Temporal coverage	Temporal resolution	Sectoral coverage	Sweet
Clear	Clear						DeCarbCH
Creem		Cantonal	City	Single year 2050	Hourly	all	DeCarbCH
Earth Science Department (Guglielmetti), U. Geneva							DeCarbCH
Energy Group, U. Geneva	TRNSYS	Geneva	300 substations of the main DH network	10 years	10 min time step	Residential	DeCarbCH
Energy Science Center, ETH Zurich	SES-ETH	Switzerland	National	Single year (for multiple years possible)	Hourly	Residential, industrial, commercial, transport, energy supply (electricity, heat and fuels)	DeCarbCH
HEIG-VD (Krummenacher)		Switzerland	Industrial site	Today			DeCarbCH
IES Institute for Energy Systems (Bertsch), OST							DeCarbCH
Institute for Solar Technology (Haeberle), OST							DeCarbCH
Institute for Solar Technology, OST	Polysun simulation	Switzerland	Cantonal	Average year 2016-Today	Yearly, monthly, weekly	Residential, Industrial	DeCarbCH
Institute of Applied Sustainability to the Built Environment, SUPSI	PILEDHC	Switzerland	Single building, district, cantonal		Yearly, Monthly, Hourly	Residential, administrative, industry, commercial	DeCarbCH
Institute of Energy and Electric System (Capezzali), HEIG-VD		Territorial	Building	Today-2060	Hourly and yearly	Residential and industrial	DeCarbCH
Institute of Mechanical Engineering and Energy Technology (Barahona Garzon), HSLU		Switzerland	Cantonal	Present time	12 Hz	Industrial	DeCarbCH

CROSS / CROSS catalog / Swiss Energy Scope - ETH (SES-ETH)

Swiss Energy Scope - ETH (SES-ETH)

Developers
EPFL, ETHZ

Contact
Gianfranco Guidati, ETHZ
Adriana Marcucci, ETHZ

License
Open Source

SWEET project
DeCarbCH - WP 1

SES-ETH is a linear optimization model of the energy system. It determines the investment and operation strategies that minimize the total annual cost, given the end-use energy demand; the efficiency and costs of the conversion technologies; and the availability and costs of the energy resources. SES represents the main energy demands: electricity, heating and mobility. SES-ETH is a snapshot model, that is, it models the energy system in a target year and it does not make any statements on the trajectory to reach this future state. The target year is modelled with an hourly resolution that allows us to represent the intra-day variations of the energy demand and resource availability.

Features

- ✓ Cost-optimisation of future energy system
- ✓ Snapshot model
- ✓ Hourly resolution
- ✓ Probabilistic analysis using Sobol distributions

Facts

Class	Energy production potential
Type	Deterministic
Spatial regions	Switzerland
Spatial resolution	National
Time coverage	Single year (for multiple years possible)
Time resolution	Hourly
Sectors	Residential, industrial, commercial, transport, energy supply (electricity, heat and fuels)

Category	Inputs	Outputs
Socioeconomy	GDP	
Infrastructure		
Environment		Total CO2 emissions CO2 emissions from energy system CO2 emissions from electricity production Captured CO2 emissions
Energy demand	Space heating Space Cooling Industrial heating Hot water Electricity - appliances Passenger mobility	Total electricity

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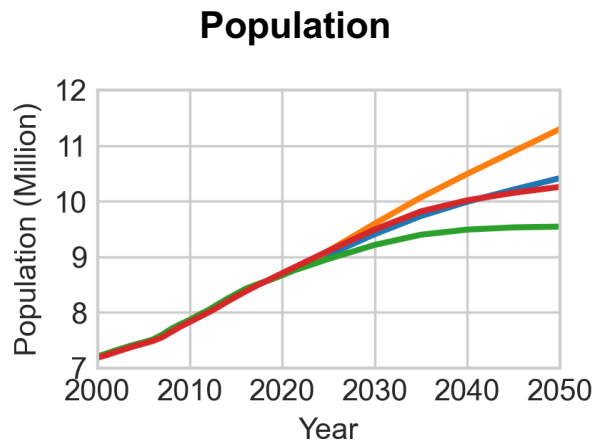
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Harmonize a basic set of input parameters across consortia to improve the relevancy and comparability of the results.

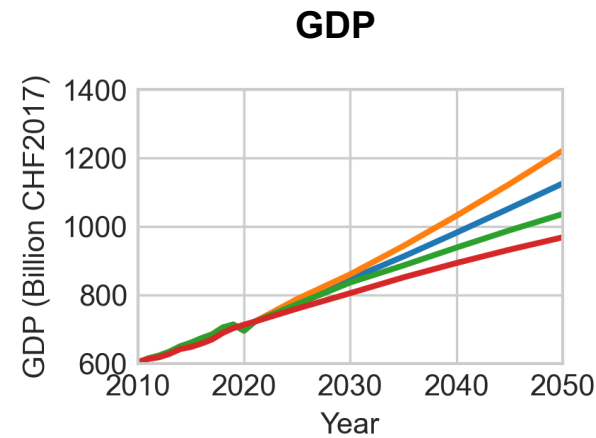


Harmonized assumptions: References values and ranges

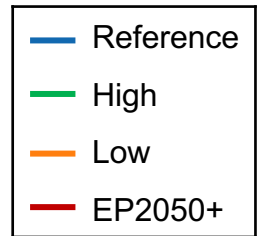
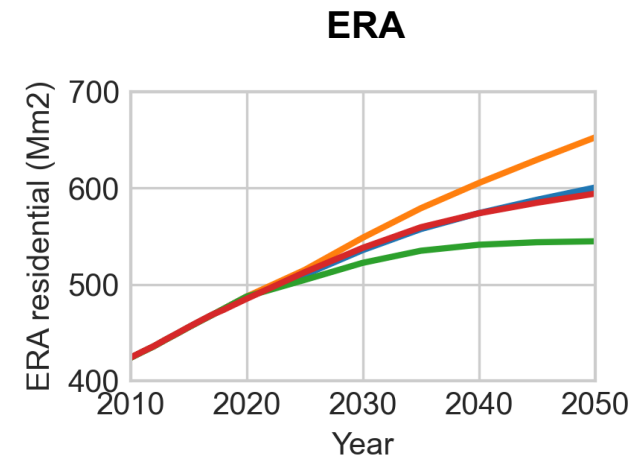
- Population, GDP, energy reference area (<https://sweet-cross.ch/data/macroeconomic-drivers-cross/>)



BFS (2020). Szenarien zur Bevölkerungsentwicklung der Schweiz und der Kantone 2020-2050



SECO, 2022. Szenarien zur BIP-Entwicklung der Schweiz



- Demands: Space heat, warm water, process heat, transport (<https://sweet-cross.ch/data/end-use-energy-demand-cross>)
- Resources: Solar PV (rooftop, mountains, facades), wind, hydropower and biomass
- Fuel prices (<https://sweet-cross.ch/data/import-prices-cross/>)



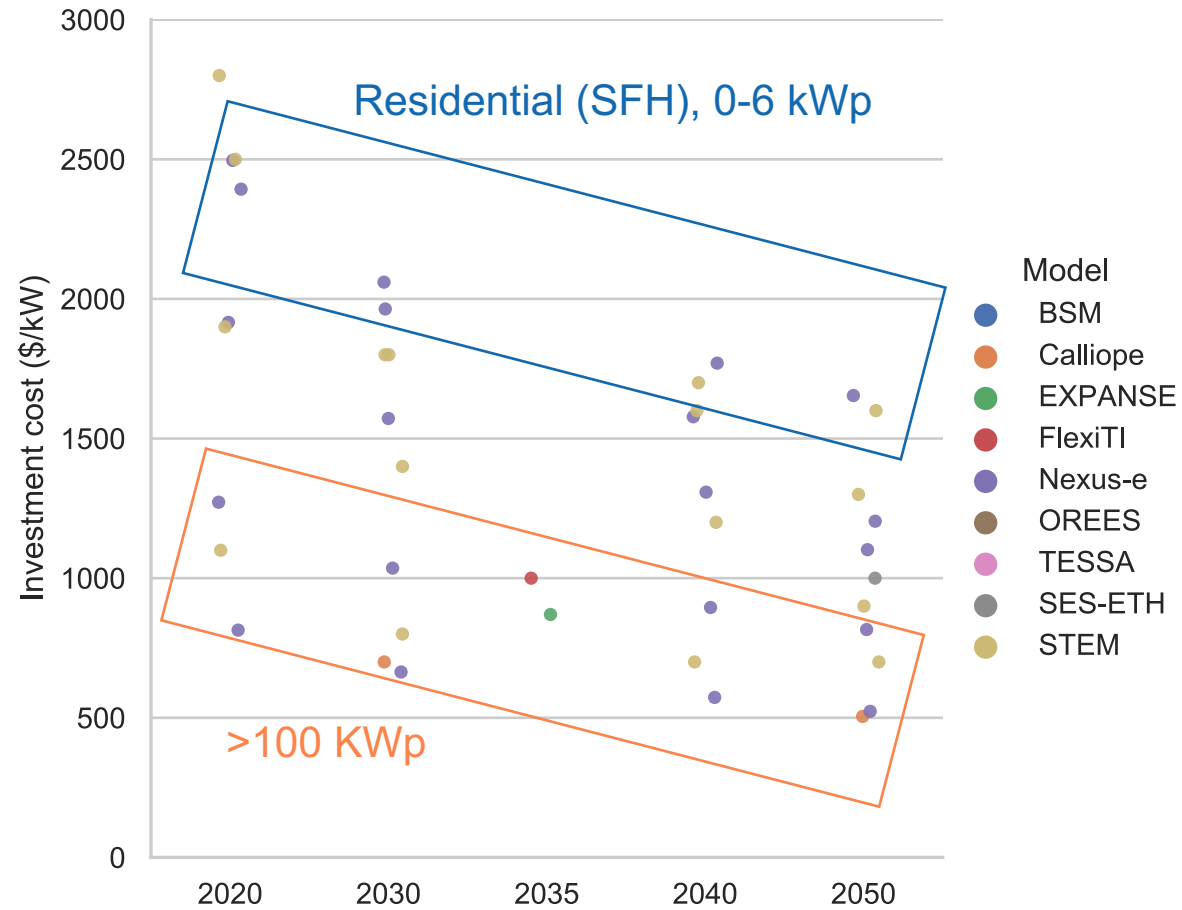
Technology assumptions: Comparison

- Collected information about:
 1. Technologies: Investment costs (scale/size), efficiencies
 2. Fuel prices
 3. Potentials
 - Including references and as many comments as possible
- Models:

DeCarbCH	PATHFNDR	EDGE	SURE
SES-ETH	EXPANSE		
TESSA	Nexus-e		STEM
	Calliope	OREES	FlexiTI
			BSM



Rooftop PV

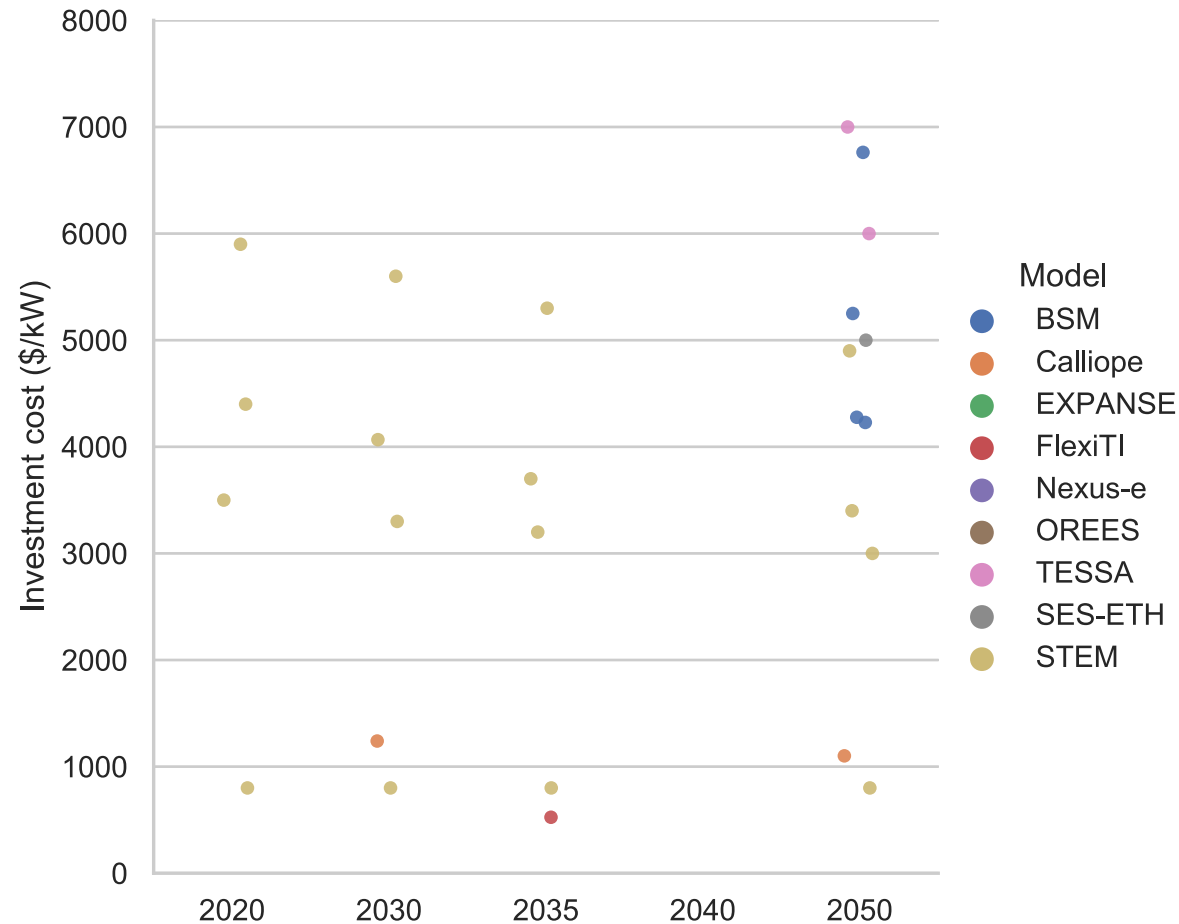


Consideration of different costs

- Scale



Ground source heat pumps

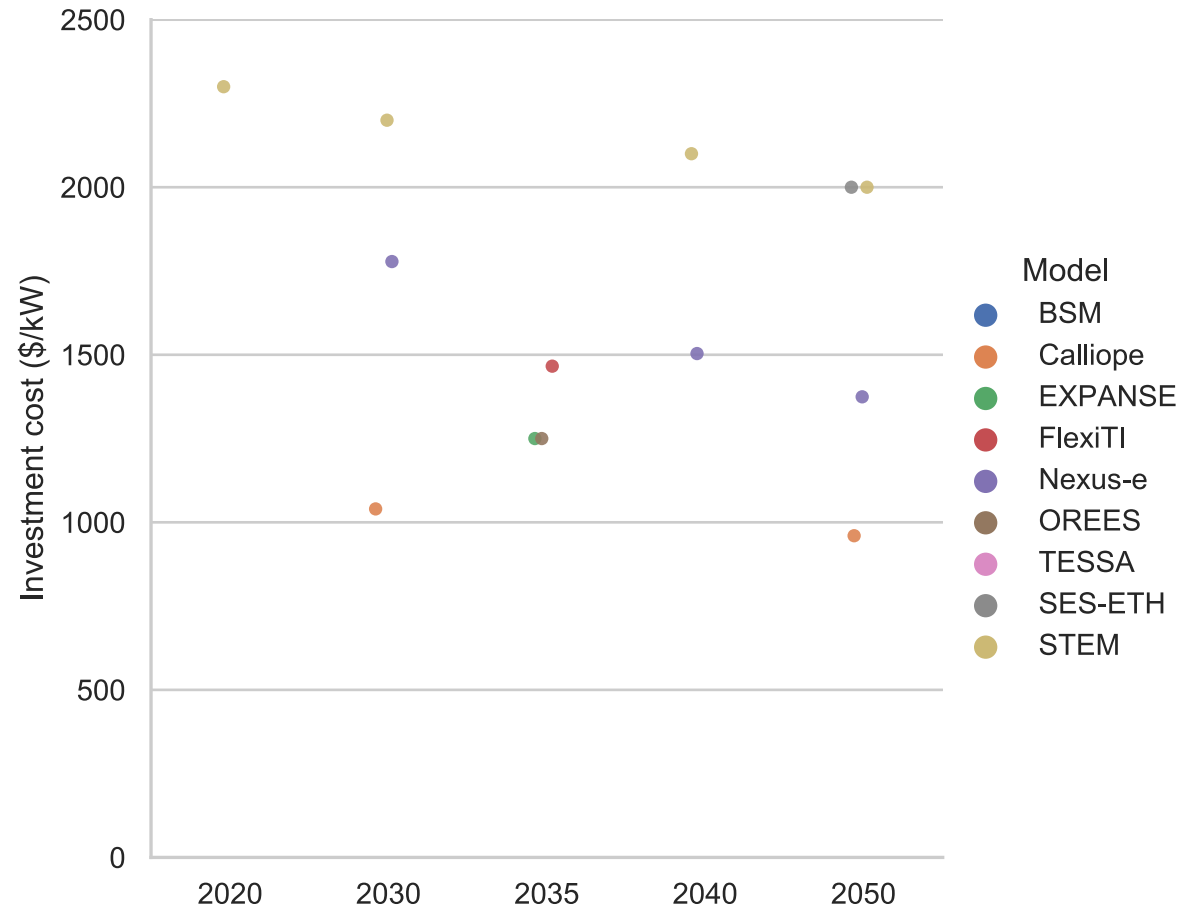


Consideration of different costs

- Scale
- Cost included:
 - Connections and pipes
 - Turnkey cost
 - Montage
 - Demontage
 - Replacement cost
 - Boreholes



Wind



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CROSS scenarios

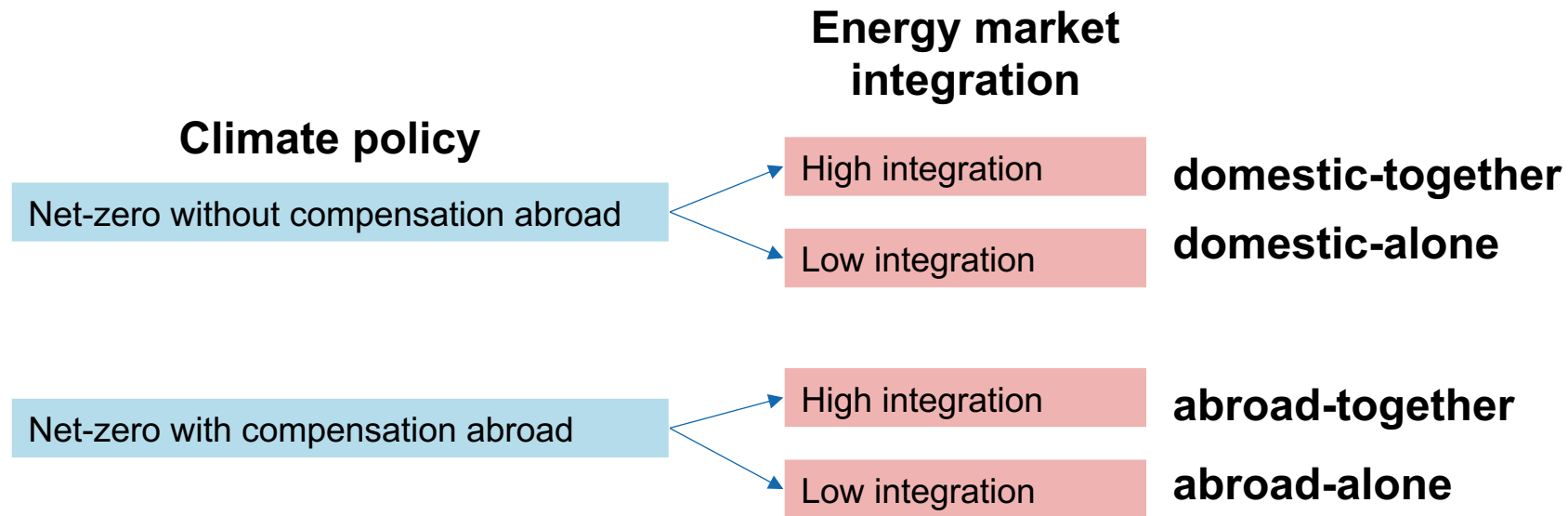
- Having harmonized narratives helps us giving relevant and useful insights to the energy policy discussion from complementary perspectives.
 - Different models give complementary results
 - Results are relevant if all models answer to the same question: e.g. *What exactly is net zero?*

Definition process:

- Defining dimensions (variables that affect energy system and that are levers on which citizens or policy makers can act)
- Prioritize dimensions
- Quantify dimensions
- “Thin storylines” so that the different consortia can add their own flavor (efficiency, resilience, etc.)



CROSS scenarios v2022-09



Complete documentation and data: <https://sweet-cross.ch/scenarios/>



Climate policy dimension

Climate policy

Net-zero without compensation abroad

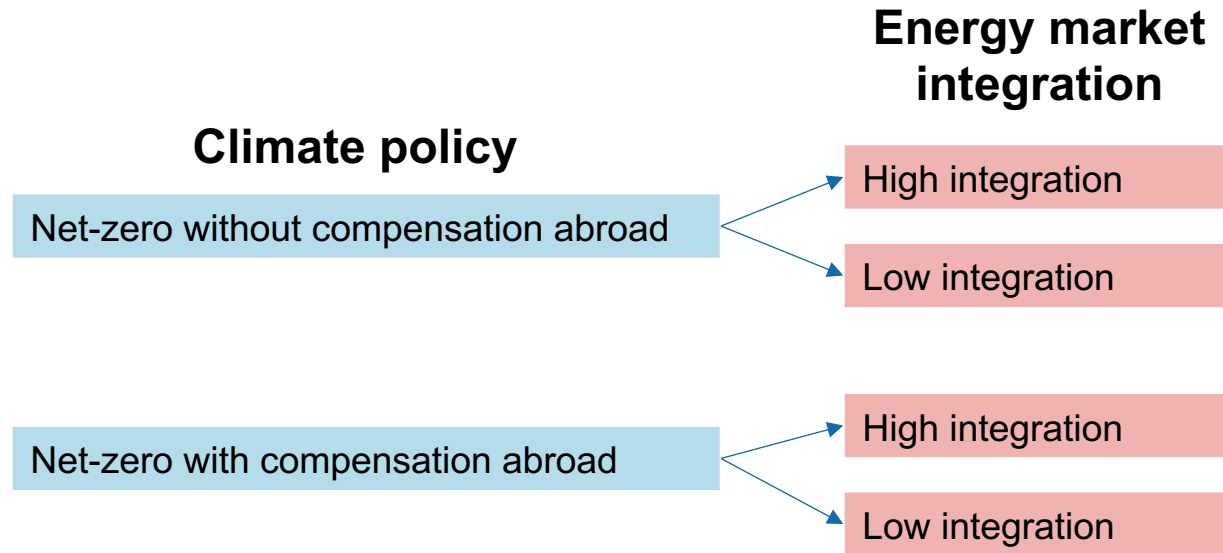
Net-zero with compensation abroad

- Goal of the Swiss Federal Council to reduce the GHG emissions to **net-zero by 2050**.
 - Covering emissions in **all sectors** and all GHG's
- **Energy sector compensates** for emissions difficult to avoid **outside** the energy sector (**5.7 MtCO₂**)
 - Industry: Cement and chemicals: 3.6 MtCO₂e - 3 MtCO₂e (CCS) = 0.6 MtCO₂e
 - Agriculture: 4.6 MtCO₂e
 - Waste disposal and waste: 0.5 MtCO₂e
- Domestically or abroad:

Variant	Domestic	Abroad	Total
Domestic	-5.7 MtCO ₂	0 Mt CO ₂	-5.7 MtCO ₂
Abroad	0 MtCO ₂ to -5.7 MtCO ₂	Up to -5.7 MtCO ₂	-5.7 MtCO ₂



Energy market integration dimension



Commodity	Low	High
Electricity	30% NTC	100% NTC
Biofuels and biomass	No imports	56 PJ in 2050
Synthetic e-fuels	No imports	64 PJ in 2050
Hydrogen	No imports	40 PJ in 2050

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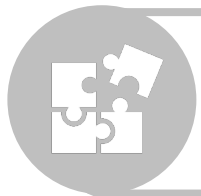
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Thank you for your attention!



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Acknowledgment

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