HELMHOLTZ
CLIMATE INITIATIVE

PROJECT BRIEFING #5

OVERVIEW OF DATA SETS
PART 1 // HOW-TO

VERSION #2 | OCTOBER 2021

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AUTHORS

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GERICS Climate Service Center Germany
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AIM

The aims of this project briefing are to get an overview on the data sets used in the cluster Net-Zero-2050, to harmonise data sources as best as possible, and finally to provide the colleagues a recommendation for data sets, in order to use as consistent and coherent data sets as possible throughout the various work packages and projects.

STRUCTURE

The project briefing #5 “Overview on Data Sets” is composed of two documents:

- Part 1: How-To (this document)
- Part 2: Excel-Spreadsheet that contains the data sets, divided into
  - Overview table with the most important data sets (one page)
  - Technology table with details about DAC_CCS as well as PtX and PtL(two pages)

HOW-TO

If you need data sets during the project Net-Zero-2050, you can use this table to check if a team member is already working with similar data. Please, if possible, work with the same data set in order to support a consistent and coherent data usage throughout the various work packages and projects.

All data sets that are listed in the overview table have been divided into four categories, so that individual records can be found easily:

1. Economic
2. Social
3. Ecological
4. Technological

These four categories are based on the categorisation of indicators that are used in project 1.1 “National Roadmap Net Zero” for the technological assessment matrix and project 1.2 “Integrated Scenario Analyses”.

Please note: this categorisation followed a rather pragmatic approach and only serves to make it easier to find specific data records (see *Table 1*). For some data records, the assignment to a single category is not clear, so please also note the other categories if you cannot find the data record you are looking for.

Table 1 Categorisation of data sets.

ECONOMIC	SOCIAL	ECOLOGICAL	TECHNOLOGICAL
GDP	population	GHG emissions	energy efficiency
employment	non-financial benefits	other emissions	resource efficiency
price per t CO2 emitted	risk assessment	global carbon budget	energy input
running costs	(climate) vulnerability	climate data	installed capacity
investment costs	acceptance	land cover & use	…
fuel & raw material costs	socio-economic develop.	soil organic carbon	
taxes & subsidies		biodiversity	
income		…	
…			

OVERVIEW TABLE

Over the last months, an overview of the most important data sets has been compiled (see *Part 2, saved here: https://bit.ly/34cIOOQ // only for project partners)*. To date, it contains about 60 data sets that are specified with the aid of different parameters – ranging from data resolution and unit to data quality and access (see *Fehler! Verweisquelle konnte nicht gefunden werden (Figure 1).*).

Please note: The overview table can be found on the excel-spreadsheet's page 1 "Overview | Data Sets" (see highlighted green area in *Fehler! Verweisquelle konnte nicht gefunden werden (Figure 1).*).

Nr.	Data Group (overarching	Scope	Data Category (part of group)	Data Unit	Data Resolution (if applicable)		Point Source	Data type
30	Land	ecological	Soil organic carbon in top 100 cm	g/kg	8x8 km	1 year	yes	observation
36	Biomass supply	economic	Lignocellulosic biomass cost	EUR/ton dm	Simulation: 2012, 2020, 2030	-	no	simulation
37	Carbon pricing	economic	Price per tonne CO2 emitted	Money unit per tonne CO2 emitted	-	-	no	other (please specify)
48	Countries' pathways to net-zero/low-emissions	social	Long-Term Low Emission Development Strategies	K	national	5 years' cycle	no	qualitiative and quantitative data, national strategies
51	Biomass supply	technological	Lignocellulosic biomass potential	ton dm or TJ	Simulation: 2012, 2020, 2030	-	no	simulation
52	Industry carbon sources	technological	Location and emission quantity of industry sources in the ETS trading scheme	Tonnes/year	1 ton	-	yes	observation
53	Underground CO2 storage potential	technological	Distribution of zones for undergound gas storage potential	-	Limited by data extraction from publication	-	yes	observation

Overview | Data Sets | Technology | DAC_CCS | Technology | PtX & PtL

Figure 1 Exemplary screenshot of the overview table, which can be found on page 1 "Overview | Data Sets" of the spreadsheet (highlighted in green).

TECHNOLOGY TABLE

Some datasets are based on literature data and are too detailed to be displayed in the overview table. Therefore, the entry in the overview table displays the general range of numbers as well as a link to an additional, more detailed technology table (see highlighted green area in *Figure 2*). By clicking on this link, the technology table will open and the user can access the information as well as the references (see *Figure 3*).

Nr.	Data Group (overarching	Scope	Data Category (part of group)	Data Unit	Data quality #1	Region of inte	Data access	Link to Source
57	Direct air capture (DAC)	technological	economic data (DAC) (15-600$/t)	$/t	quality checked	global	open access	Technology | DAC_CCS'ID9
58	Direct air capture (DAC)	technological	energy demand (DAC) (1.14-27 GJ/t)	J/t	quality checked	global	open access	Technology | DAC_CCS'IE9
59	Direct air capture (DAC)	technological	regeneration temperature (DAC) (45-900°C)	°C	quality checked	global	open access	Technology | DAC_CCS'IF9
60	Power to X (PtX)	technological	technological overview (PtX)	-	quality checked	global	open access	Technology | PtX & PtL'IA9
61	Power to X (PtX)	technological	synthesis conditions (PtX)	-	quality checked	global	open access	Technology | PtX & PtL'ID9

Overview | Data Sets | Technology | DAC_CCS | Technology | PtX & PtL

Figure 2 Detailed table for the literature-based data sets, whereby one page is focusing on DAC_CCS and a second page on PtX and PtL (both highlighted in green).

Direct Air Capture (DAC)						
Technology		Description	Cost Range	Energy Consumption	Regeneration Temperature	Development Status
Liquid Absorption	KOH (kalium hydroxide)	CO2 reacts with potassium hydroxate (KOH) to form potassium carbonate. In a 2nd stage calcium carbonate is formed, and KOH restored. The calcium carbonate is then regenerated at high temperatures, where CO2 is released with high purity.	600$/t currently future estimation: 94-232 $/t	8.81 GJ/t nat. gas 5.52GJ/t nat. gas+366kWH/t electric	900°C	pilot plant (by carbon engineering)
Solid Adsorption	TSA (temperature swing adsorption)	The CO2 is adsorbed (bonded to the surface) of specical adsorbent materials, at ambient conitions. For regeneration the adsorbent ist heated and potentially set under vacuum to further increase the desoption. (release of bonded CO2).	100$/t	6.8 GJ/t	105-120°C	laboratory/ theoretical
	TVSA (temperature vacuum swing adsorption)		targeted: 60-190$/t	2.6 GJ/t - 3.3 GJ/t	100°C	pilot plant and first commercial products (by climeworks)
	MSA (moisture swing adsorption)	Very similar approach to TSA, but in this process steam ist used to regenerate the adsorber. The water vapor lowers the capacity of the adsorber and therefore releasing the CO2.	200$/t (first prototypes) 15-50$/t (target)	1.14 GJ/t (low estimate)	45°C (Lackner 2009)	pilot plant (by Global Thermostat)
					85-100 °C (Global Thermostat 2018)	
		Special approach by Skytree to use electrostatic adsorption with moisture- driven regeneration at moderate temperatures. Skytree publishes only scarce information.	-	-	80-90°C	pilot plants and first commercial prodcts
		Infinitree uses Moisture swing adsorption but also reveals no data to current research.	-	-	-	research
	ESA (electro swing adsorption)	ESA is a process, in which CO2 is chemically bound in an reversable electrochemical reaction. While "charging" the CO2 reacts with a quinone- electrode. When reversing the process the CO2 is released.	50-100 $/t	8GJ/t	room temperature	laboratory/ theoretical

Overview | Data Sets | Technology | DAC_CCS | Technology | PtX & PtL

Figure 3 Screenshot of a literature-based entry in the overview table (page 1 in the excel-spreadsheet).

NEXT STEPS

In case you are using a data set that is relevant for the project Net-Zero-2050 and it is not yet in either the overview or the technology table, please inform the respective contact persons (see below). The data sets will then be added and an updated version will be sent to the entire team. Also, if you have improvement suggestions or need assistance, please do not hesitate to contact us.

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More results from the project Net-Zero-2050 are available here:

www.netto-null.org
www.helmholtz-klima.de/en/press/media-library

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