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SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

SCCER-Supply of Electricity

Data Management Workshop

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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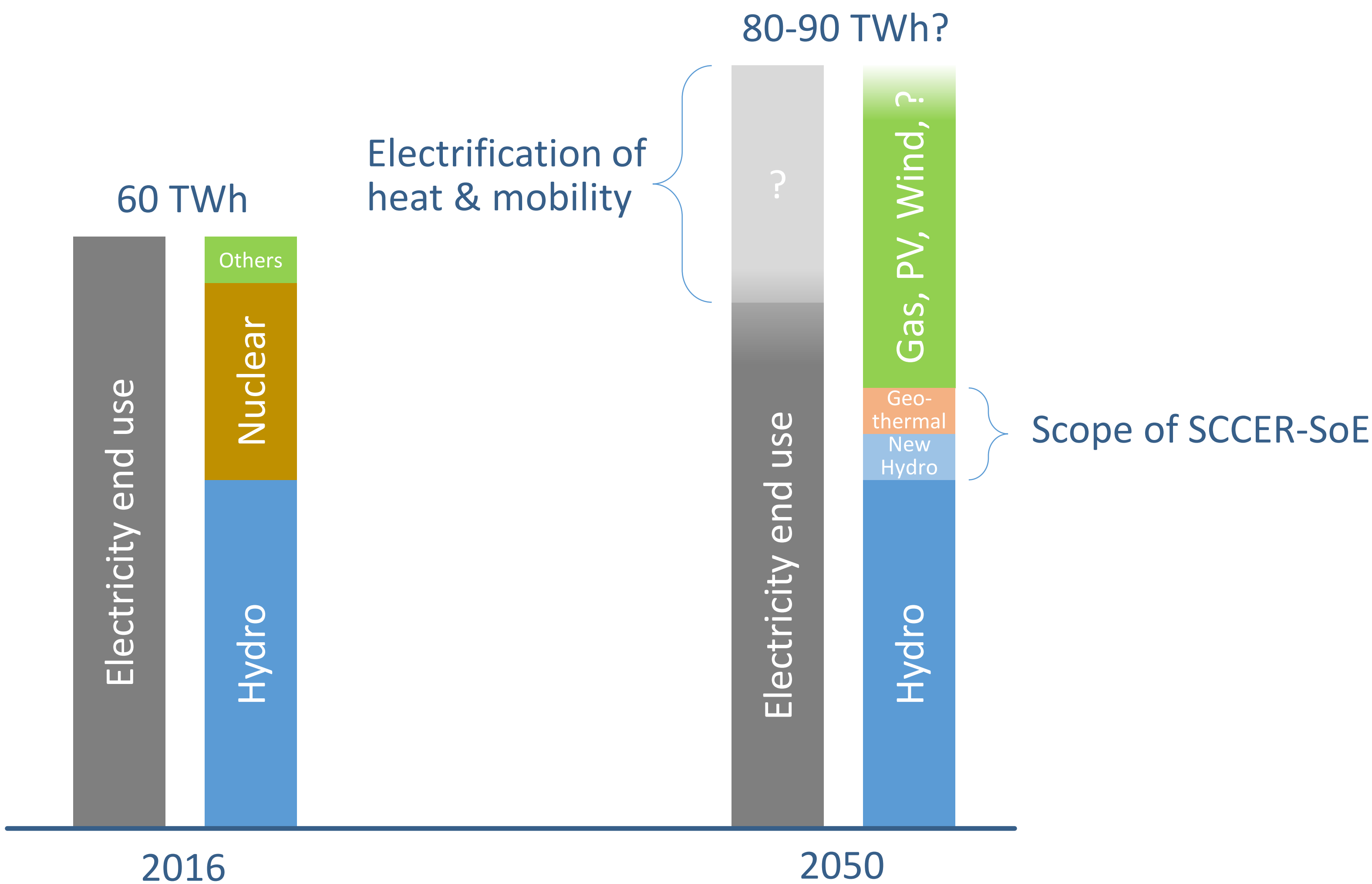
Swiss Confederation

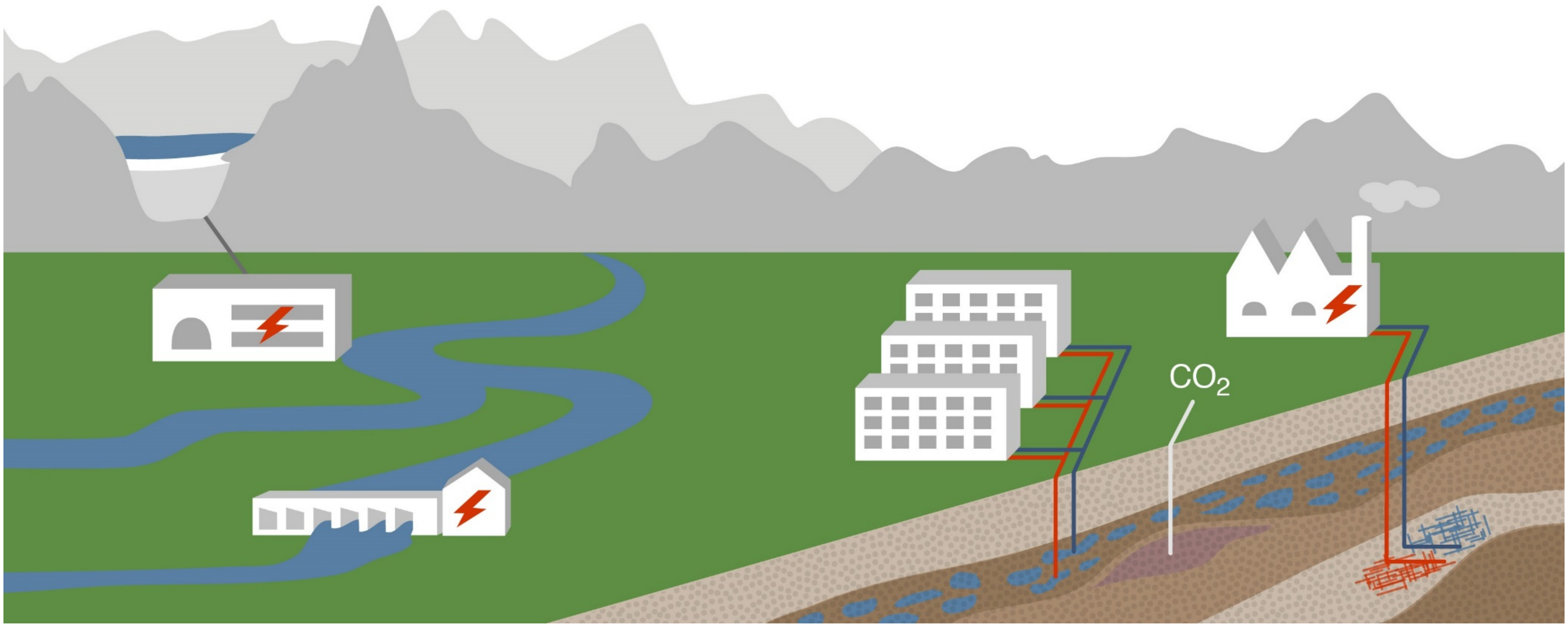
Innosuisse – Swiss Innovation Agency

The context: Energy Strategy 2050



Mission

Innovative technologies to supply energy in 2050



Enable extra 4.6 TWh_{el}/y of hydro power through new large & small plants and retrofits

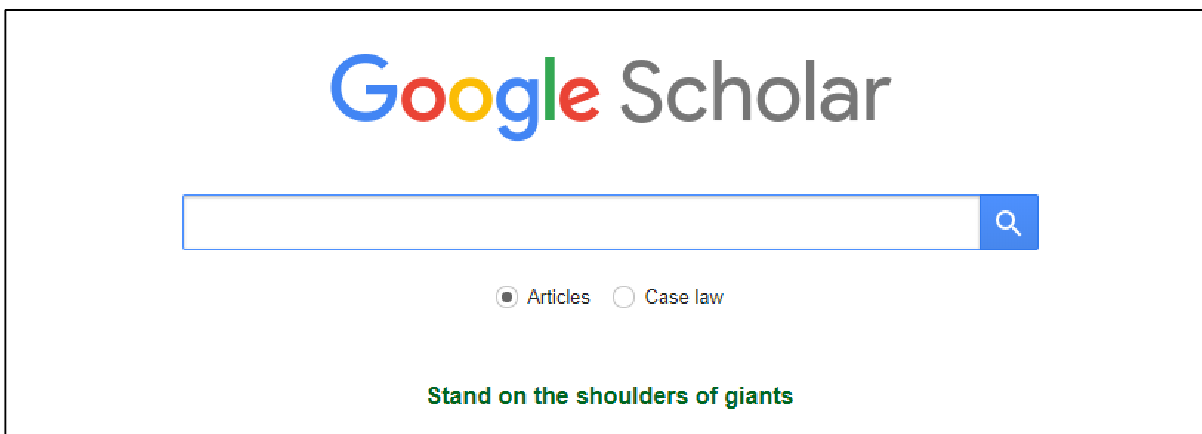
Use medium depths for heat extraction & storage and CO_2 sequestration

Access the deep underground for electricity generation (4.4 TWh_{el}/y in 2050)

If I have seen further it is
by standing on the shoulders of Giants.

Sir Isaac Newton, 1675

Discover truth by building on previous discoveries



Terabyte

Kilobyte

Distill the essence of the data

Process is irreversible

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Terabyte

Kilobyte

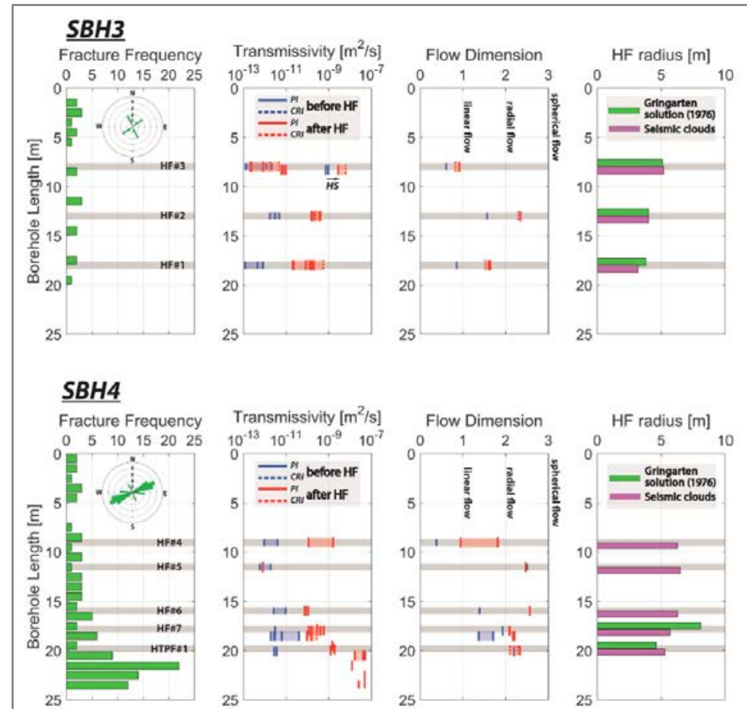
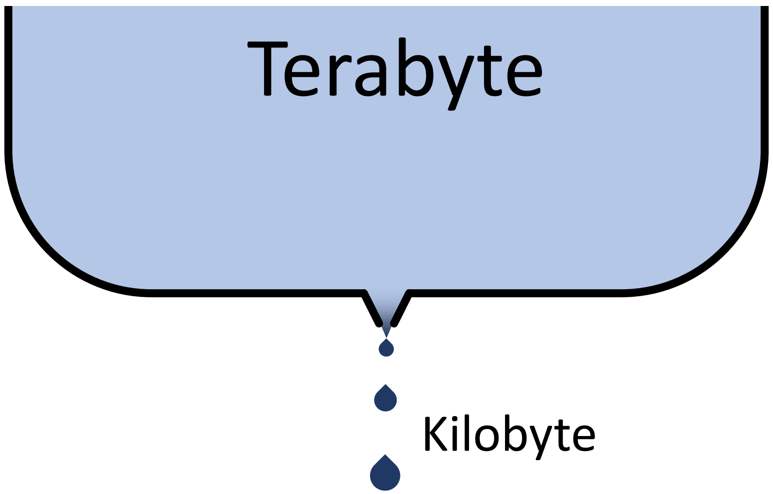


Figure 2. Profiles of fracture frequency, transmissivity, flow dimension, and the estimated radius of hydraulic fractures along the SBH3 (top) and SBH4 (bottom) boreholes. The location of each HF test is shown using the gray bands. Blue and red lines represent the value of hydraulic parameters before and after each HF test, respectively.



Required if somebody wants to **continue** your work

Ok if somebody wants to **know** what you did

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SUPPLY of ELECTRICITY

Energy scenarios for CH 2050

Sharing and preserving knowledge

Gianfranco Guidati – ETH Zurich

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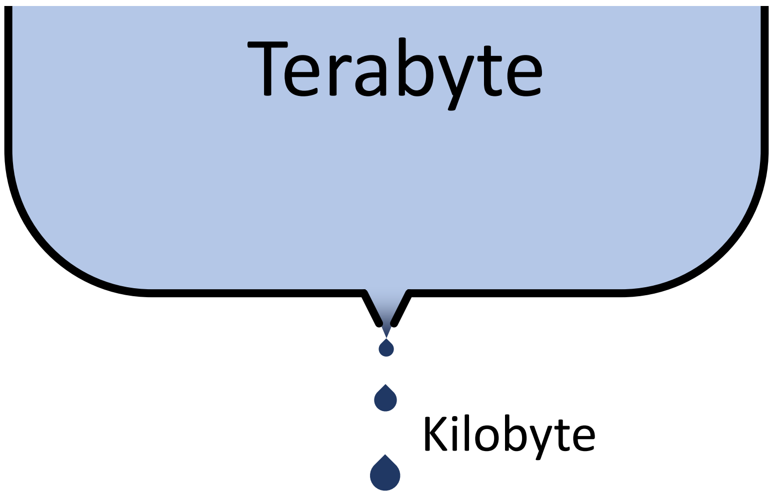

Required if somebody wants to **continue** your work

Ok if somebody wants to **know** what you did

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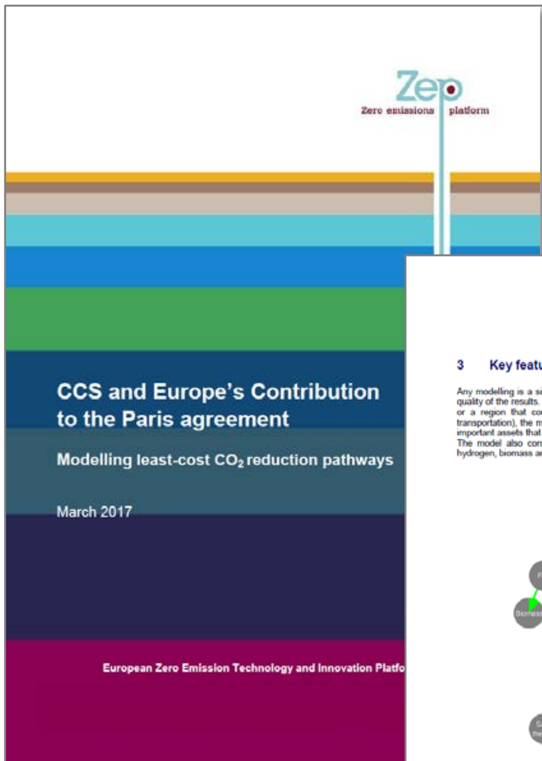
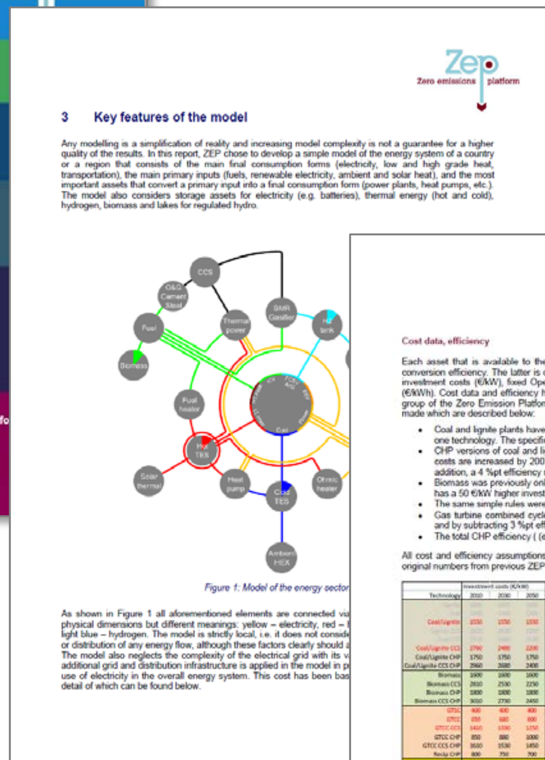
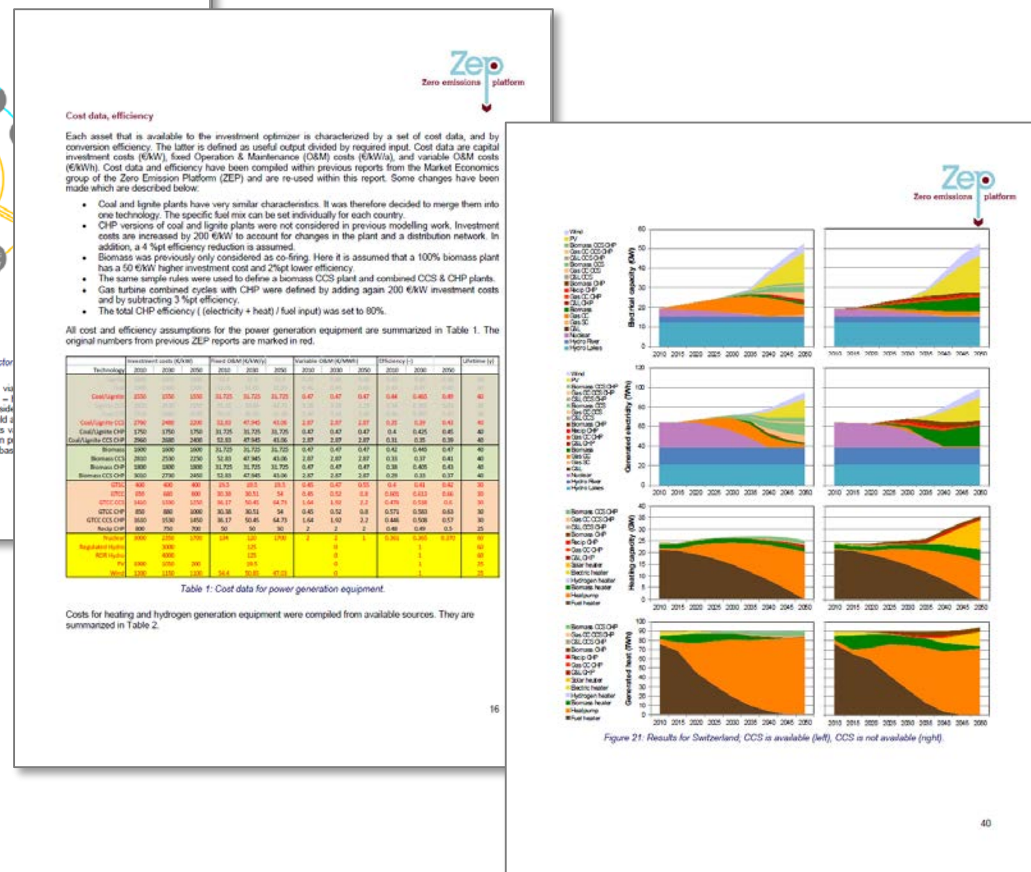
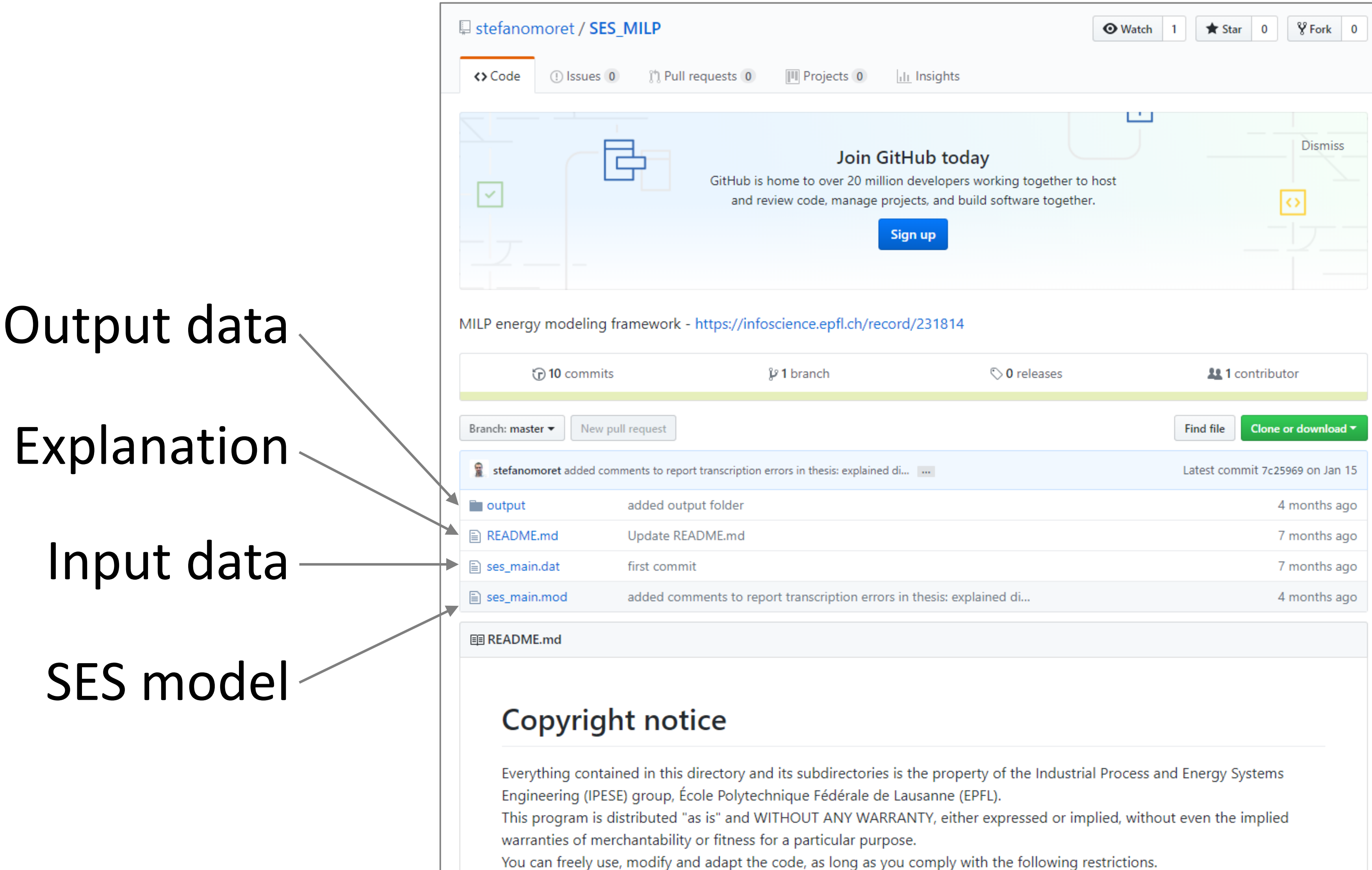
Great work!
And now what...?








Output data
Explanation
Input data
SES model
stefanomoret / SES_MILP
Watch 1
Star 0
Fork 0
Code
Issues 0
Pull requests 0
Projects 0
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10 commits
1 branch
0 releases
1 contributor
Branch: master
New pull request
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stefanomoret added comments to report transcription errors in thesis: explained di...
Latest commit 7c25969 on Jan 15
output
added output folder
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7 months ago
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added comments to report transcription errors in thesis: explained di...
4 months ago
README.md
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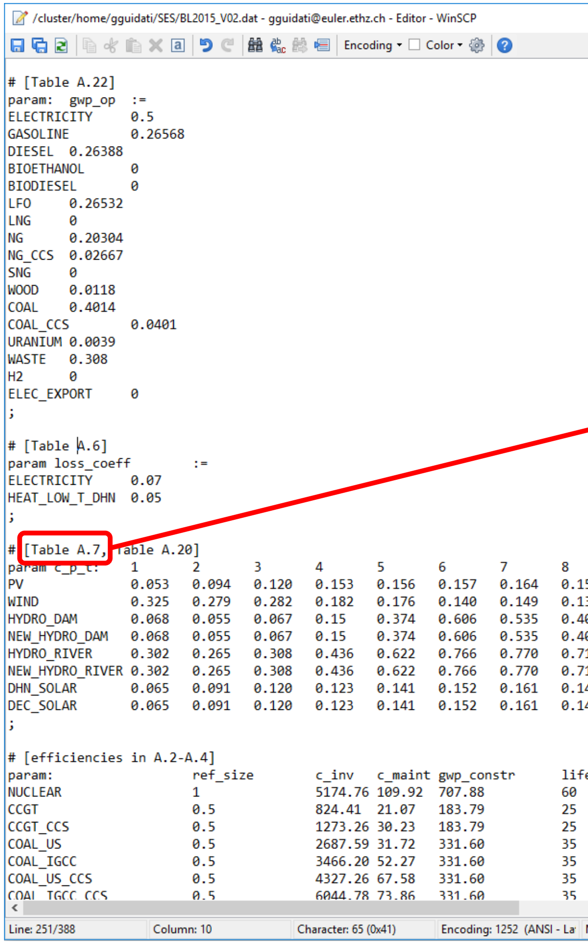
You can freely use, modify and adapt the code, as long as you comply with the following restrictions.

Input data



/cluster/home/gguidati/SES/BL2015_V02.dat - gguidati@euler.ethz.ch - Editor - WinSCP

Encoding Color

```
# [Table A.22]
param:  gwp_op  :=
ELECTRICITY     0.5
GASOLINE        0.26568
DIESEL  0.26388
BIOETHANOL      0
BIODIESEL       0
LFO     0.26532
LNG     0
NG      0.20304
NG_CCS  0.02667
SNG     0
WOOD    0.0118
COAL    0.4014
COAL_CCS        0.0401
URANIUM 0.0039
WASTE   0.308
H2      0
ELEC_EXPORT     0
;

# [Table A.6]
param loss_coeff        :=
ELECTRICITY     0.07
HEAT_LOW_T_DHN  0.05
;

# [Table A.7, Table A.20]
param c_p_t:    1       2       3       4       5       6       7       8
PV              0.053   0.094   0.120   0.153   0.156   0.157   0.164   0.15
WIND            0.325   0.279   0.282   0.182   0.176   0.140   0.149   0.13
HYDRO_DAM       0.068   0.055   0.067   0.15    0.374   0.606   0.535   0.40
NEW_HYDRO_DAM   0.068   0.055   0.067   0.15    0.374   0.606   0.535   0.40
HYDRO_RIVER     0.302   0.265   0.308   0.436   0.622   0.766   0.770   0.71
NEW_HYDRO_RIVER 0.302   0.265   0.308   0.436   0.622   0.766   0.770   0.71
DHN_SOLAR       0.065   0.091   0.120   0.123   0.141   0.152   0.161   0.14
DEC_SOLAR       0.065   0.091   0.120   0.123   0.141   0.152   0.161   0.14
;

# [efficiencies in A.2-A.4]
param:                  ref_size        c_inv   c_maint gwp_constr      life
NUCLEAR                 1               5174.76 109.92  707.88          60
CCGT                    0.5             824.41  21.07   183.79          25
CCGT_CCS                0.5             1273.26 30.23   183.79          25
COAL_US                 0.5             2687.59 31.72   331.60          35
COAL_IGCC               0.5             3466.20 52.27   331.60          35
COAL_US_CCS             0.5             4327.26 67.58   331.60          35
COAL_IGCC_CCS           0.5             6044.78 73.86   331.60          35
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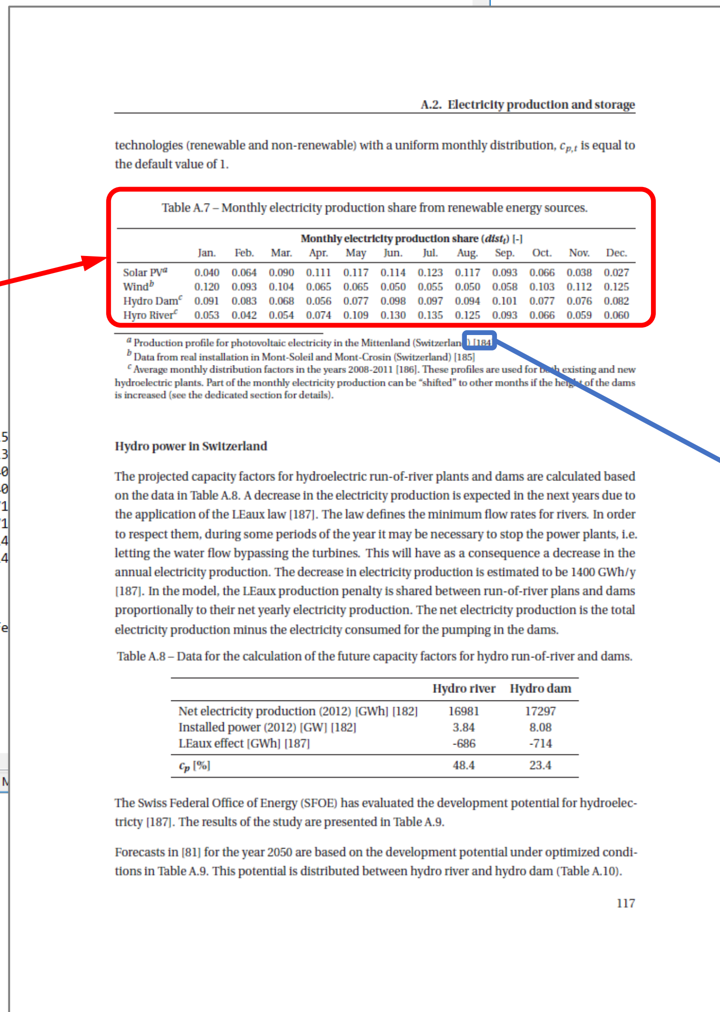

A.2. Electricity production and storage

technologies (renewable and non-renewable) with a uniform monthly distribution, $c_{p,t}$ is equal to the default value of 1.

Table A.7 – Monthly electricity production share from renewable energy sources.

	Monthly electricity production share ($dist_t$) [-]											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Solar PV[a]	0.040	0.064	0.090	0.111	0.117	0.114	0.123	0.117	0.093	0.066	0.038	0.027
Wind[b]	0.120	0.093	0.104	0.065	0.065	0.050	0.055	0.050	0.058	0.103	0.112	0.125
Hydro Dam[c]	0.091	0.083	0.068	0.056	0.077	0.098	0.097	0.094	0.101	0.077	0.076	0.082
Hyro River[c]	0.053	0.042	0.054	0.074	0.109	0.130	0.135	0.125	0.093	0.066	0.059	0.060

[a] Production profile for photovoltaic electricity in the Mittenland (Switzerland) [184]
[b] Data from real installation in Mont-Soleil and Mont-Crosin (Switzerland) [185]
[c] Average monthly distribution factors in the years 2008-2011 [186]. These profiles are used for both existing and new hydroelectric plants. Part of the monthly electricity production can be "shifted" to other months if the height of the dams is increased (see the dedicated section for details).

Hydro power in Switzerland

The projected capacity factors for hydroelectric run-of-river plants and dams are calculated based on the data in Table A.8. A decrease in the electricity production is expected in the next years due to the application of the LEaux law [187]. The law defines the minimum flow rates for rivers. In order to respect them, during some periods of the year it may be necessary to stop the power plants, i.e. letting the water flow bypassing the turbines. This will have as a consequence a decrease in the annual electricity production. The decrease in electricity production is estimated to be 1400 GWh/y [187]. In the model, the LEaux production penalty is shared between run-of-river plans and dams proportionally to their net yearly electricity production. The net electricity production is the total electricity production minus the electricity consumed for the pumping in the dams.

Table A.8 – Data for the calculation of the future capacity factors for hydro run-of-river and dams.

	Hydro river	Hydro dam
Net electricity production (2012) [GWh] [182]	16981	17297
Installed power (2012) [GW] [182]	3.84	8.08
LEaux effect [GWh] [187]	-686	-714
c_p [%]	48.4	23.4

The Swiss Federal Office of Energy (SFOE) has evaluated the development potential for hydroelectricity [187]. The results of the study are presented in Table A.9.

Forecasts in [81] for the year 2050 are based on the development potential under optimized conditions in Table A.9. This potential is distributed between hydro river and hydro dam (Table A.10).

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Bibliography

[184] R. Nordmann and J. Remund. L'évolution Des Besoins de Stockage Au Fur et à Mesure de La Sortie Du Nucléaire, Dans l'hypothèse Où l'on Remplace 70 % Du Nucléaire Par Du Photovoltaïque. 2012.
[185] Juvent AG. Centrale Éolienne Juvent. http://www.juvent.ch/accueil.html
[186] Swiss Federal Office of Energy (SFOE). Production et Consommation Totales d'énergie Électrique En Suisse 2008. Tech. rep. 2009.
[187] Swiss Federal Office of Energy (SFOE). Le Potentiel Hydroélectrique de La Suisse. Potentiel de Développement de La Force Hydraulique Au Titre de La Stratégie Énergétique 2050. Tech. rep. Bern, Switzerland, June 2012.
[188] A. Schleiss. "Talsperrenerhöhungen in Der Schweiz : Energiewirtschaftliche Bedeutung Und Randbedingungen". In: Wasser Energie Luft 104.3 (2012), pp. 199–203. (Visited on 02/10/2017).
[189] V. Rits and A. Kirchner. Die Energieperspektiven 2035 - Band 5 Analyse und Bewertung des Elektrizitätsangebotes. German. Tech. rep. Basel: Prognos AG, June 2007, p. 607.
[190] Swissnuclear. Financement - Energienucleaire.Ch. https://www.kernenergie.ch/fr/financement-_content---1--1306.html. (Visited on 02/10/2017).
[191] Association des enterprises électriques suisses. Energie Nucléaire. Mar. 2014.
[192] C. Bauer et al. New Energy Externalities Developments for Sustainability (NEEDS) - Deliverable N° 7.2 - RS 1a: Final Report on Technical Data, Costs, and Life Cycle Inventories of Advanced Fossil Power Generation Systems. English. Tech. rep. Mar. 2008.
[193] U.S. EIA - Energy Information Administration. Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants. English. Tech. rep. Washington, Apr. 2013.
[194] K. Hjorteset et al. "Development of Large-Scale Precast, Prestressed Concrete Liquefied Natural Gas Storage Tanks". In: (2013).
[195] B. Songhurst. LNG Plant Cost Escalation. Tech. rep. Oxford, UK: The Oxford Institute for Energy Studies, Feb. 2014.
[196] Association des entreprises électriques suisses (AES). Scénarios Pour l'approvisionnement Électrique Du Futur. Rapport Global. Tech. rep. 2012.
[197] D. Stump. Swiss parliament - 10.3348 - Sécuriser notre réseau de transmission et de distribution d'électricité. French. 2010. (Visited on 02/10/2017).
[198] Ove Arup and Partners Ltd. Review of the Generation Costs and Deployment Potential of Renewable Electricity Technologies in the UK. Study Report. London: Department of Energy and Climate Change, Oct. 2011.
[199] European Commission. Energy Sources, Production Costs and Performance of Technologies for Power Generation, Heating and Transport. 2008.

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Two hours to reproduce the results…

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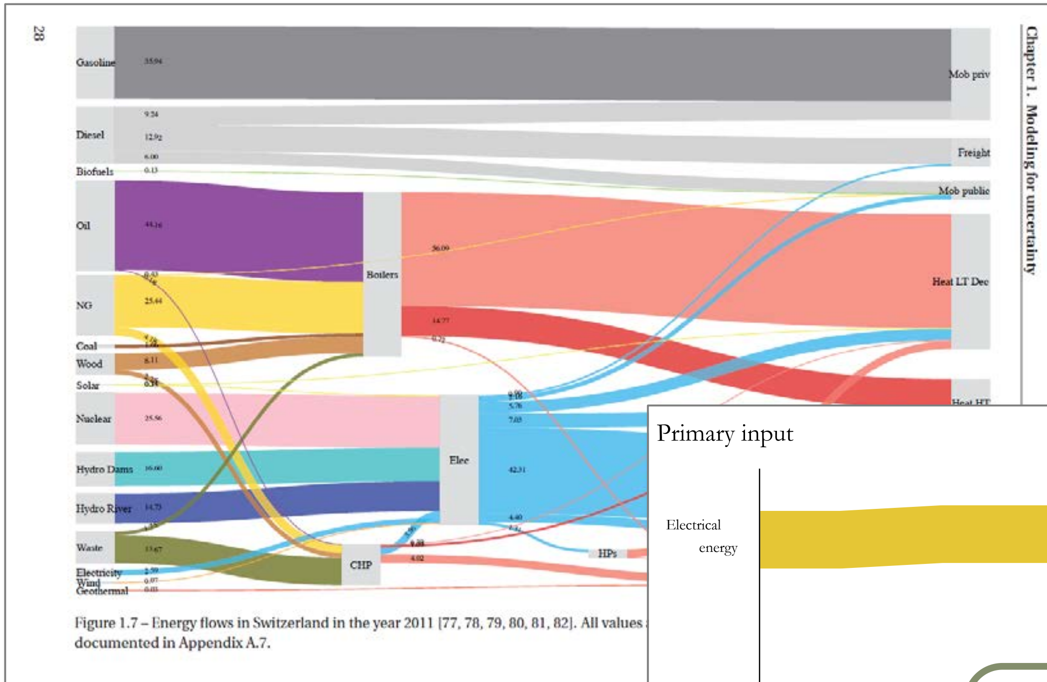
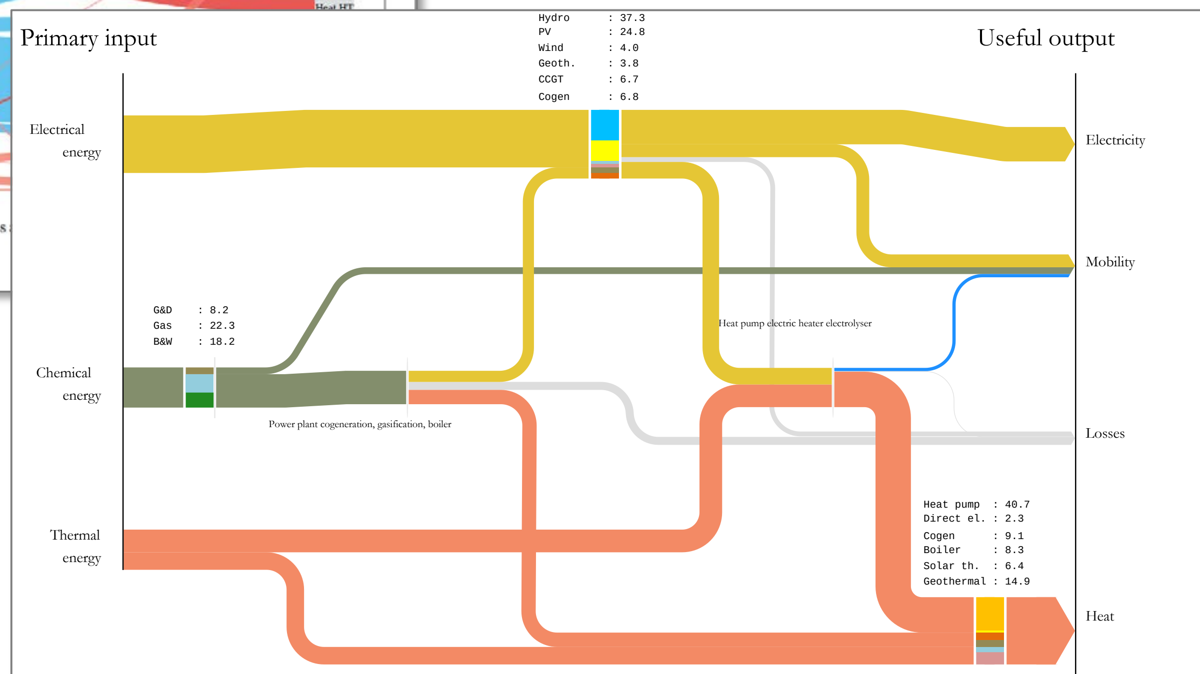
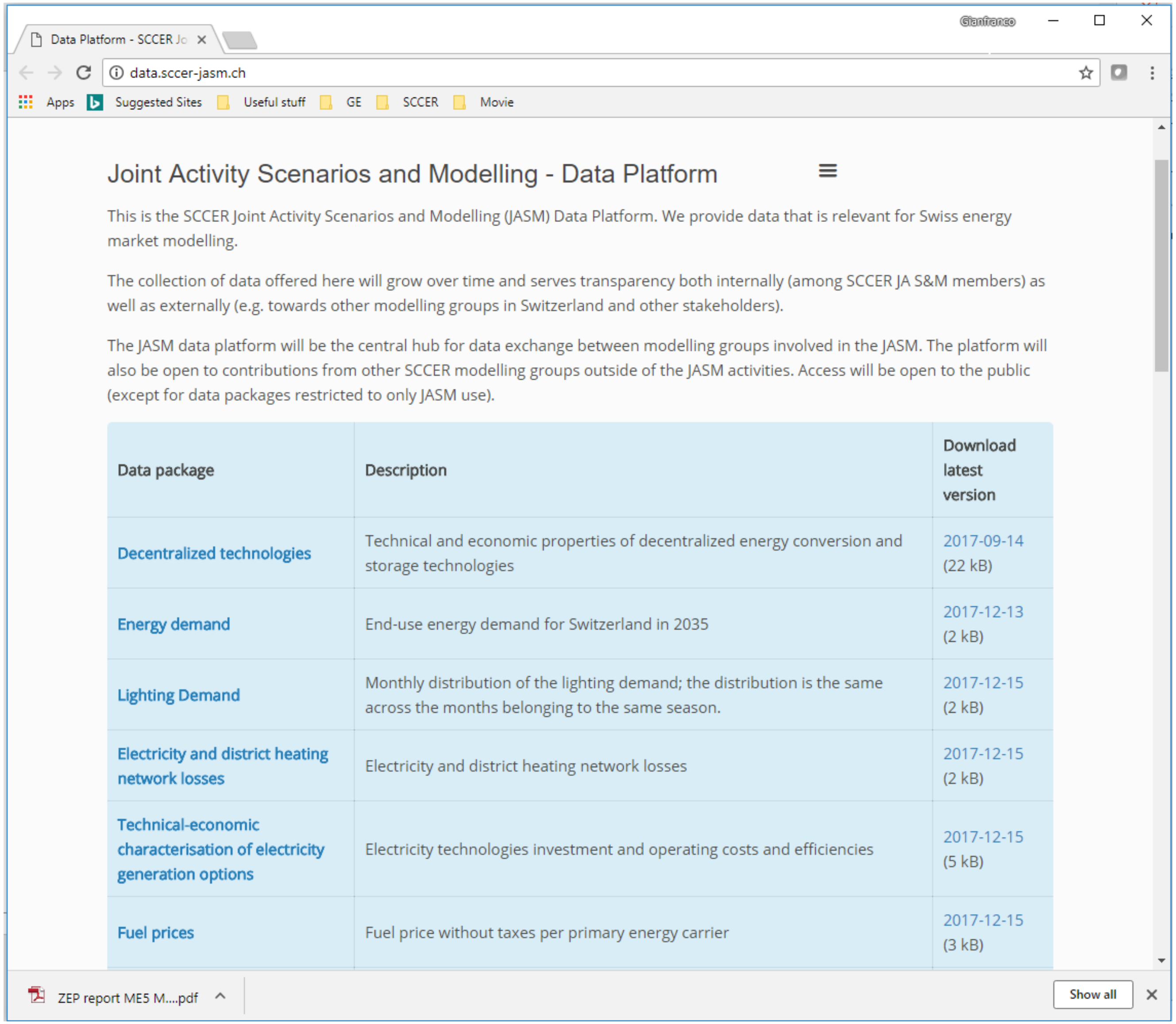


Figure 1.7 – Energy flows in Switzerland in the year 2011 [77, 78, 79, 80, 81, 82]. All values …
documented in Appendix A.7.



… two days to continue his work.



Joint Activity Scenarios and Modelling - Data Platform

This is the SCCER Joint Activity Scenarios and Modelling (JASM) Data Platform. We provide data that is relevant for Swiss energy market modelling.

The collection of data offered here will grow over time and serves transparency both internally (among SCCER JA S&M members) as well as externally (e.g. towards other modelling groups in Switzerland and other stakeholders).

The JASM data platform will be the central hub for data exchange between modelling groups involved in the JASM. The platform will also be open to contributions from other SCCER modelling groups outside of the JASM activities. Access will be open to the public (except for data packages restricted to only JASM use).

Data package	Description	Download latest version
Decentralized technologies	Technical and economic properties of decentralized energy conversion and storage technologies	2017-09-14 (22 kB)
Energy demand	End-use energy demand for Switzerland in 2035	2017-12-13 (2 kB)
Lighting Demand	Monthly distribution of the lighting demand; the distribution is the same across the months belonging to the same season.	2017-12-15 (2 kB)
Electricity and district heating network losses	Electricity and district heating network losses	2017-12-15 (2 kB)
Technical-economic characterisation of electricity generation options	Electricity technologies investment and operating costs and efficiencies	2017-12-15 (5 kB)
Fuel prices	Fuel price without taxes per primary energy carrier	2017-12-15 (3 kB)

Store all inputs, models and outputs at one locations


That's cool stuff!
What models did you use?
What were your assumptions?
Did you consider cold fusion?
What's your PV price in 2050?
Can you give me a few papers?
What does all this cost?
COMICS!
http://data-jasm-sccer.ch

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