The one that could have been!

The Swiss Supply Security in Winter 2022-2023 Under Alternative Weather Realizations

Disentis 2024

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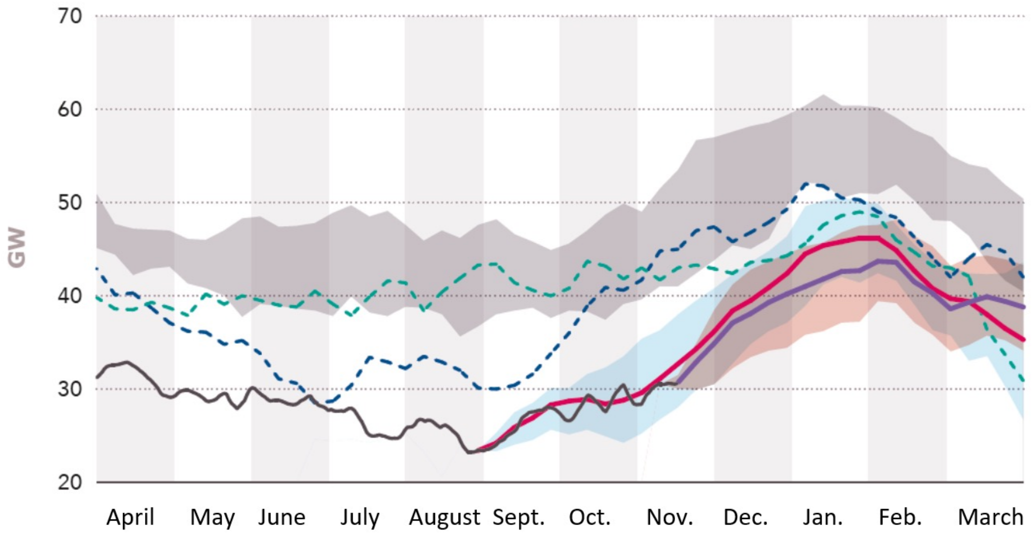
ZHAW

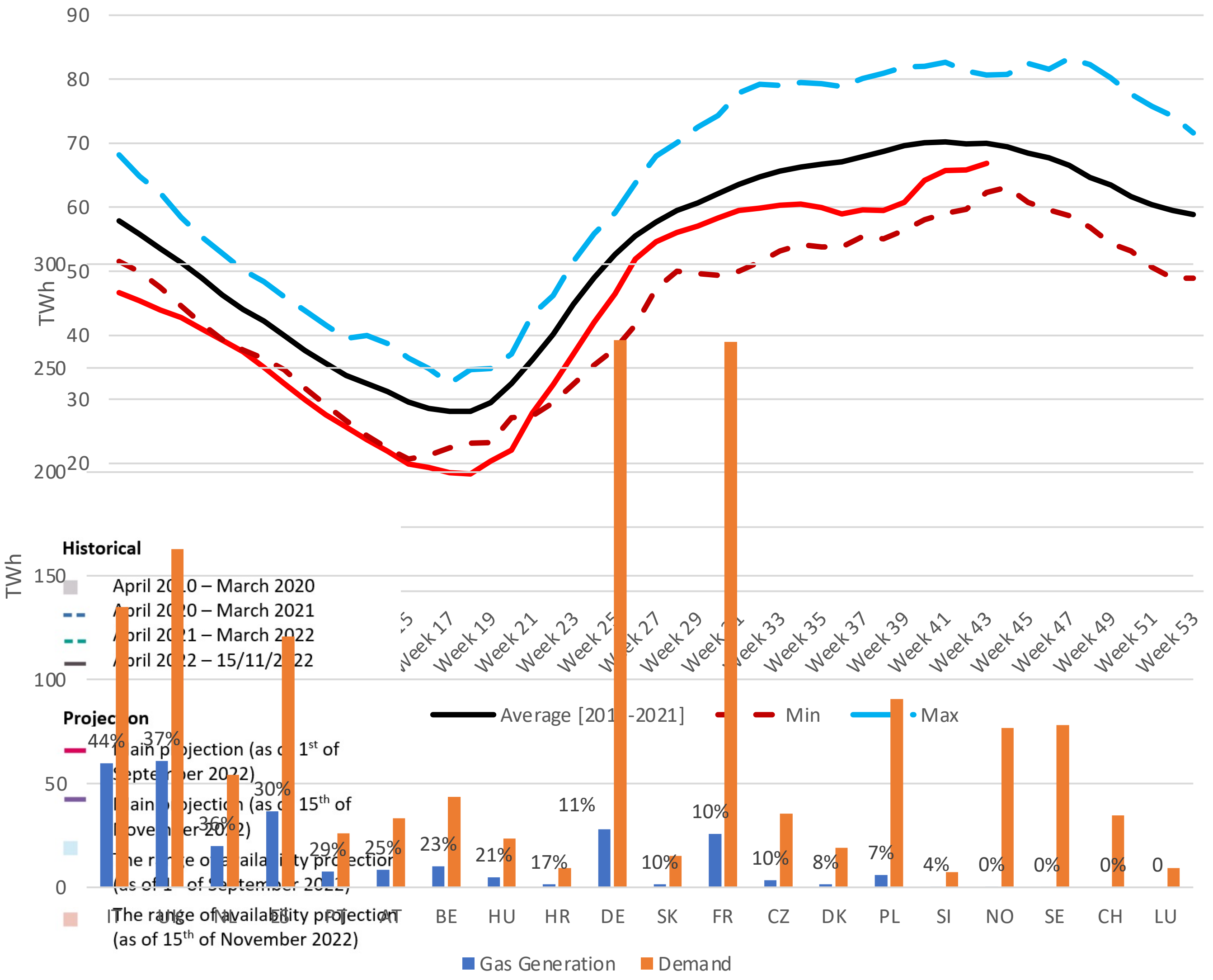
SWEET EDGE

What did happen!

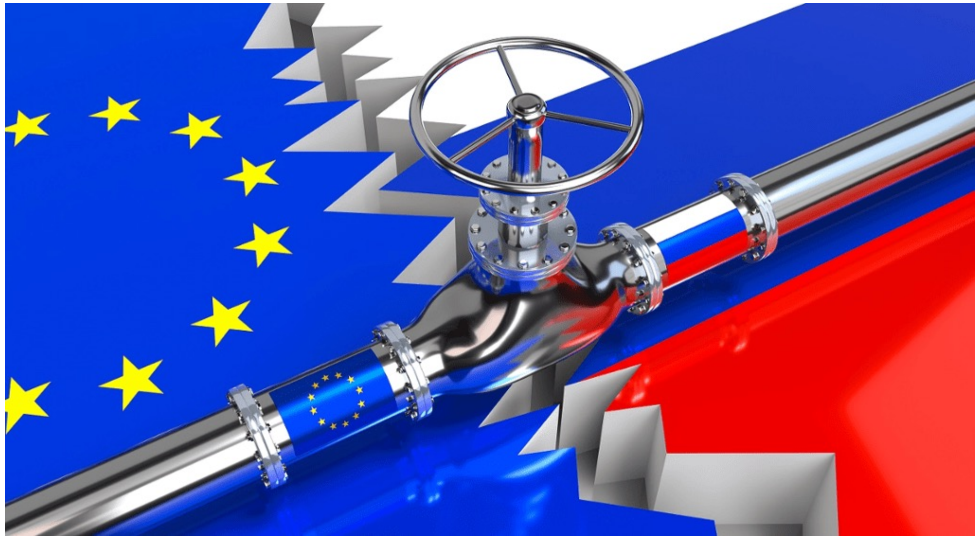
Challenges of the winter of 2022-2023

- Low hydro storage
- Outages of the French nuclear fleet
- Gas shortage risks
  - Russia’s 45% in gas market





What did happen!



European Policies

- Gas storage regulation
  - 80% capacity by November
- Coordinated demand-reduction measures for Gas
  - voluntary 15% reduction of gas consumption
- Emergency interventions to address high prices
  - Mandatory 5% reduction of peak electricity consumption
  - Voluntary 10% reduction of total consumption

Swiss Policies

- Winter hydro reserve
  - 400 GWh (1.20 Ct./kWh)
- Temporary reserve fleet
  - 326 MW of thermal plants

What did happen!

Success*

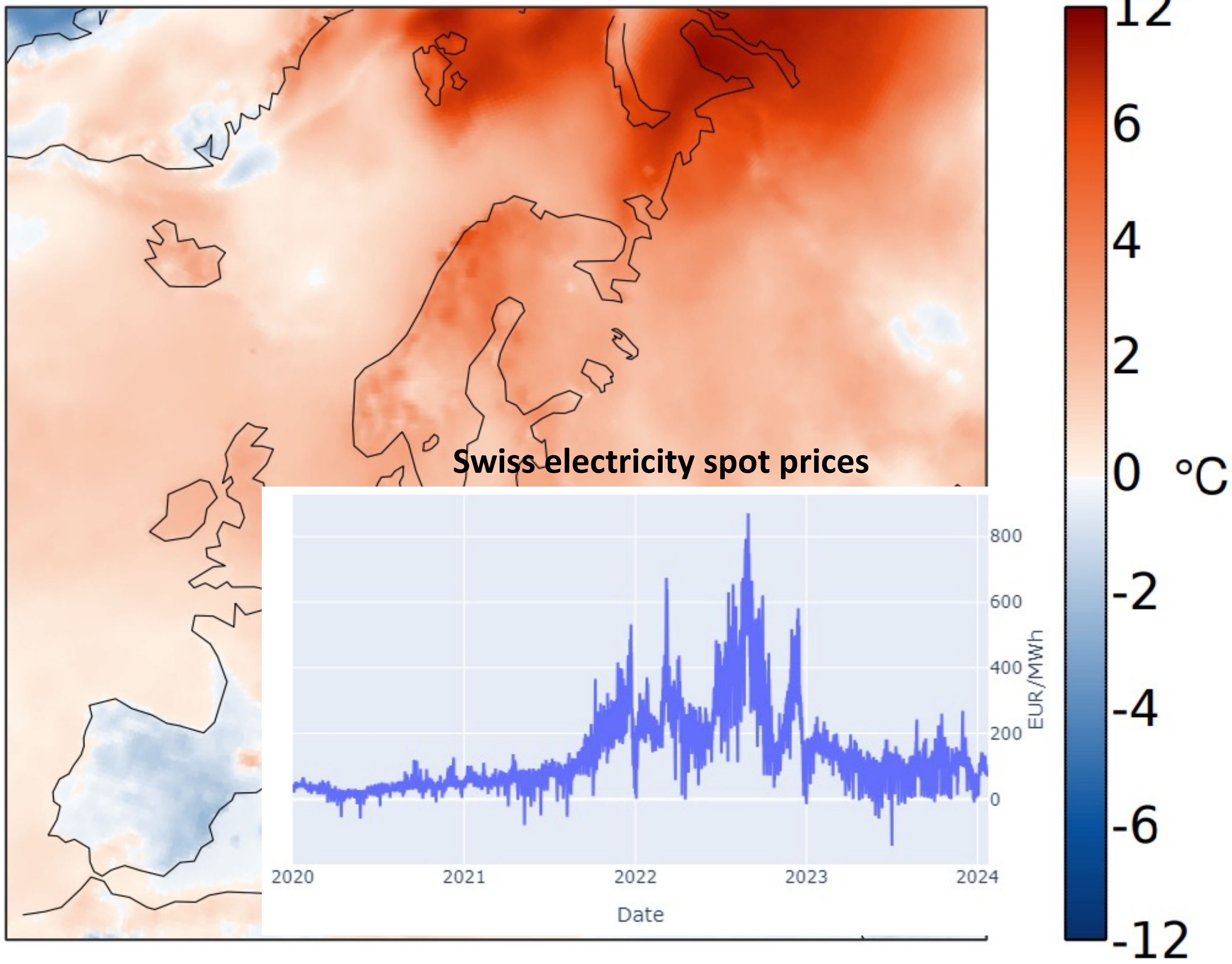
- No lost load

* Unprecedently high prices in gas and electricity

- Policy effects but also favourable winter weather realization
  - was 1.13 °C warmer than the 1991-2020 average

Surface air temperature anomaly for February 2023 relative to the February average for the period 1991-2020.

Europe's Gas Prices Are Far Below Their Crisis Peaks



Research question: What could have happened!

- Analyse the Swiss and European security of supply in winter 2022-2023
  - Several alternative
    - Weather realization
    - Conventional fleet availability

Overview

Model

Results

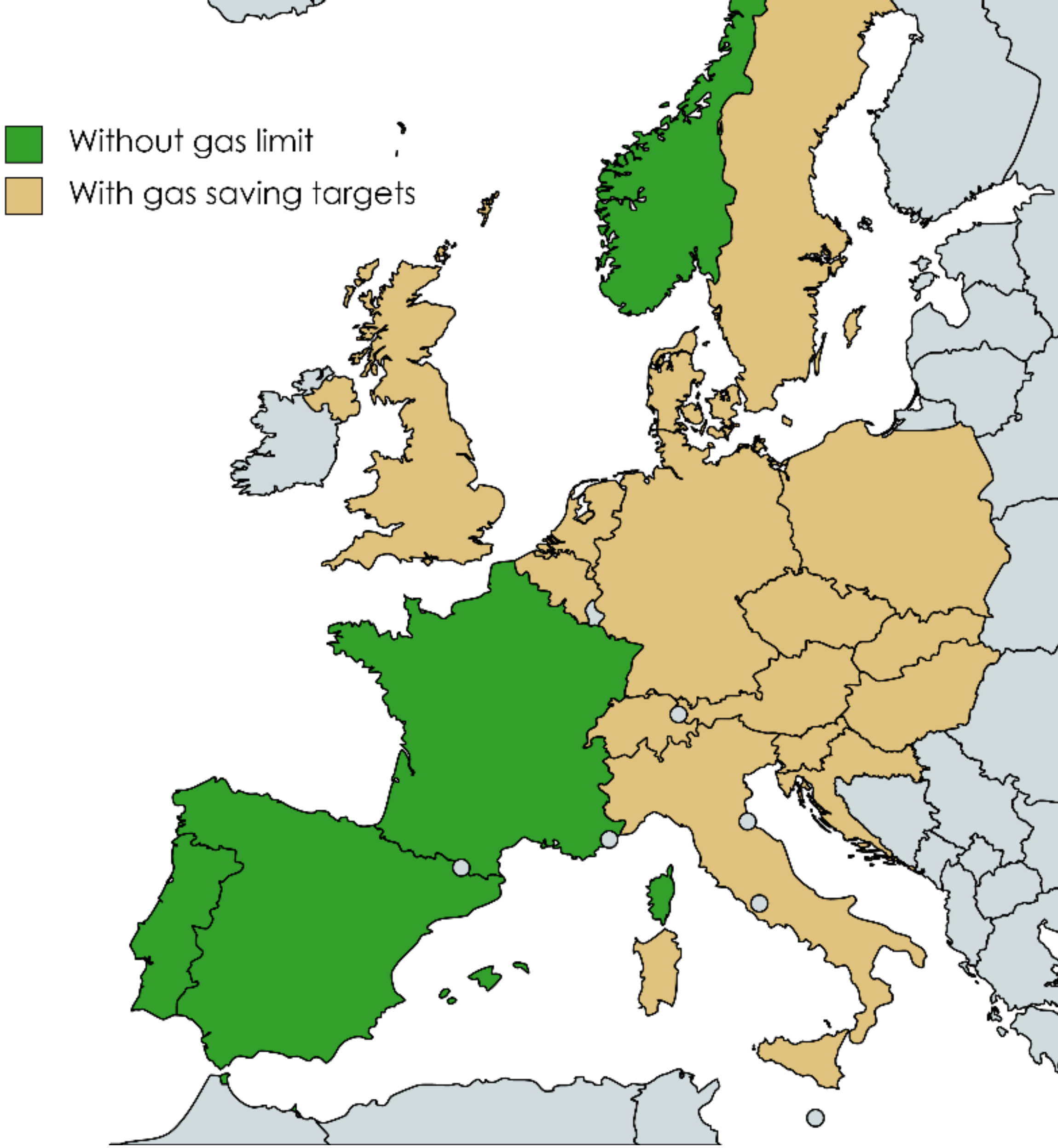
- Europe
- Switzerland

Conclusion

Model

Model – SA 22

- Dispatch
- Zonal structure
- Market coupling approach
  - ATC: Switzerland and its neighbors
  - Flow-based coupling
    - based on a nodal model
- Hourly resolution
- November to April
- Detailed Swiss hydro
- System cost minimization



Model characteristics

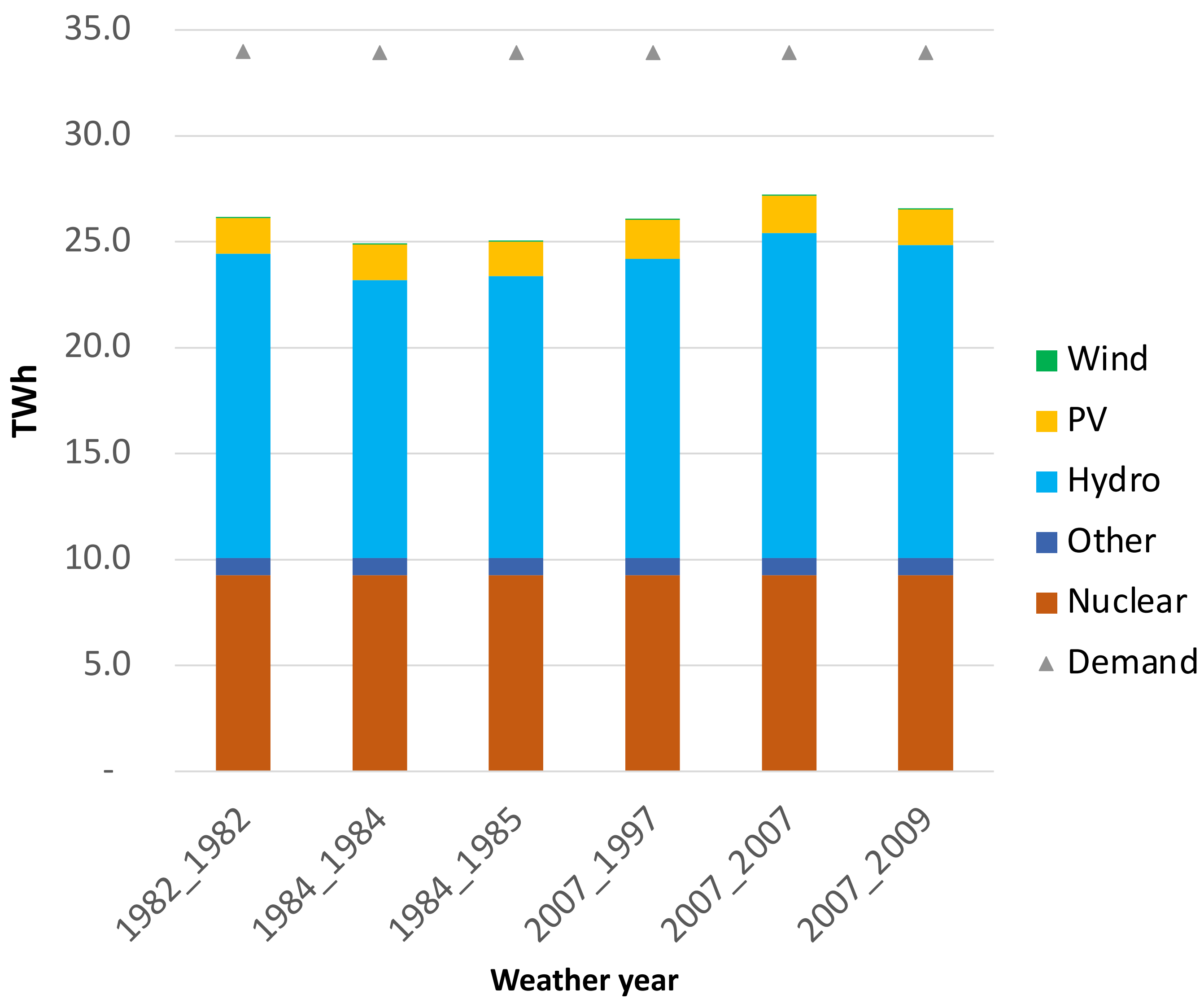
- System cost minimization
- Deterministic
- Perfect foresight

Scenarios – Gas and Nuclear

- Benchmark
- Reduced availability of the French Nuclear
- Limit availability of gas availability to previous winter values
- Combinatory scenarios
  - Reduced availability of French nuclear + 0% gas-saving target
  - Reduced availability of French nuclear + 10% gas-saving target
  - Reduced availability of French nuclear + 20% gas-saving target
  - Reduced availability of French nuclear + 30% gas-saving target

Scenarios - Weather

Criteria	Demand profile year_weather profile year
Consistency (in TYNDP as a representative year)	1982_1982
Consistency (in TYNDP as a representative year)	1984_1984
Consistency (in TYNDP as a representative year)	2007_2007
Highest daily residual load	2007_1997
Dunkelfalute	2007_2009
Highest residual winter load	1984_1985

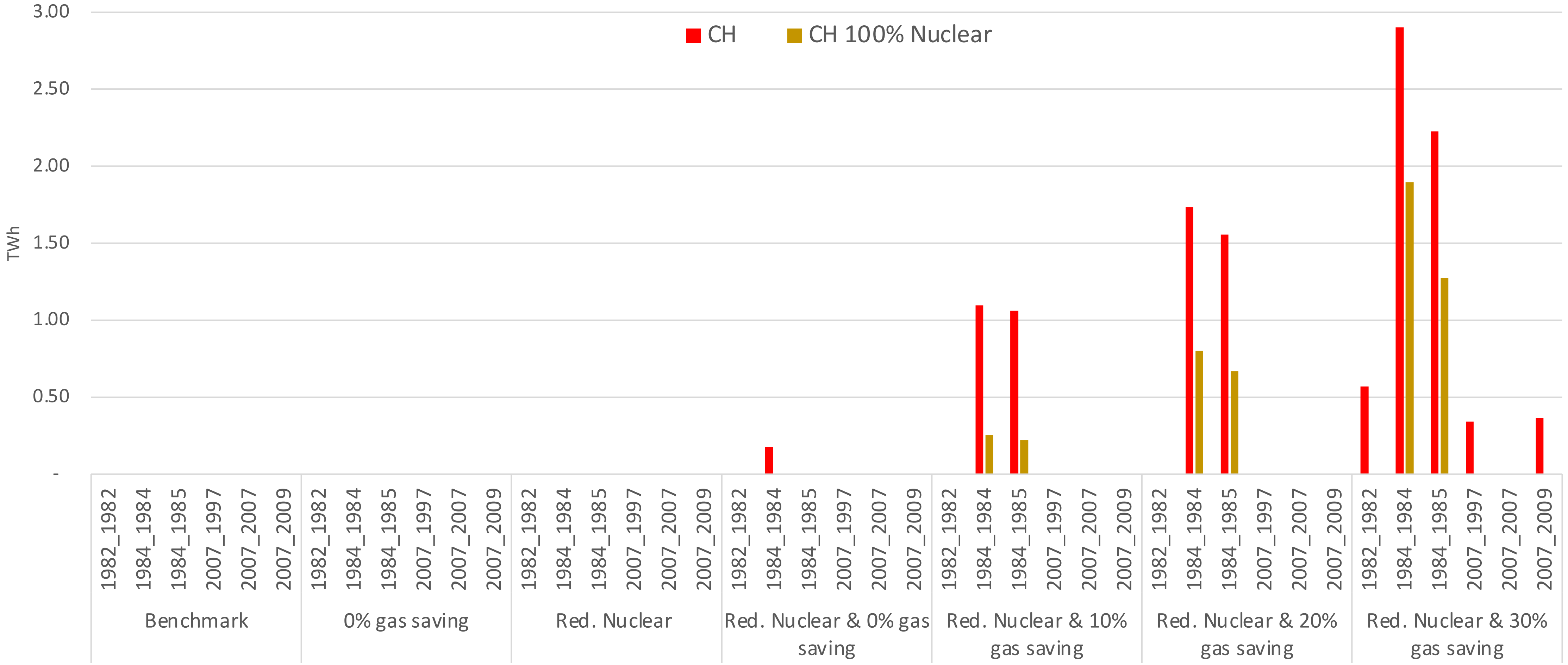


Scenarios

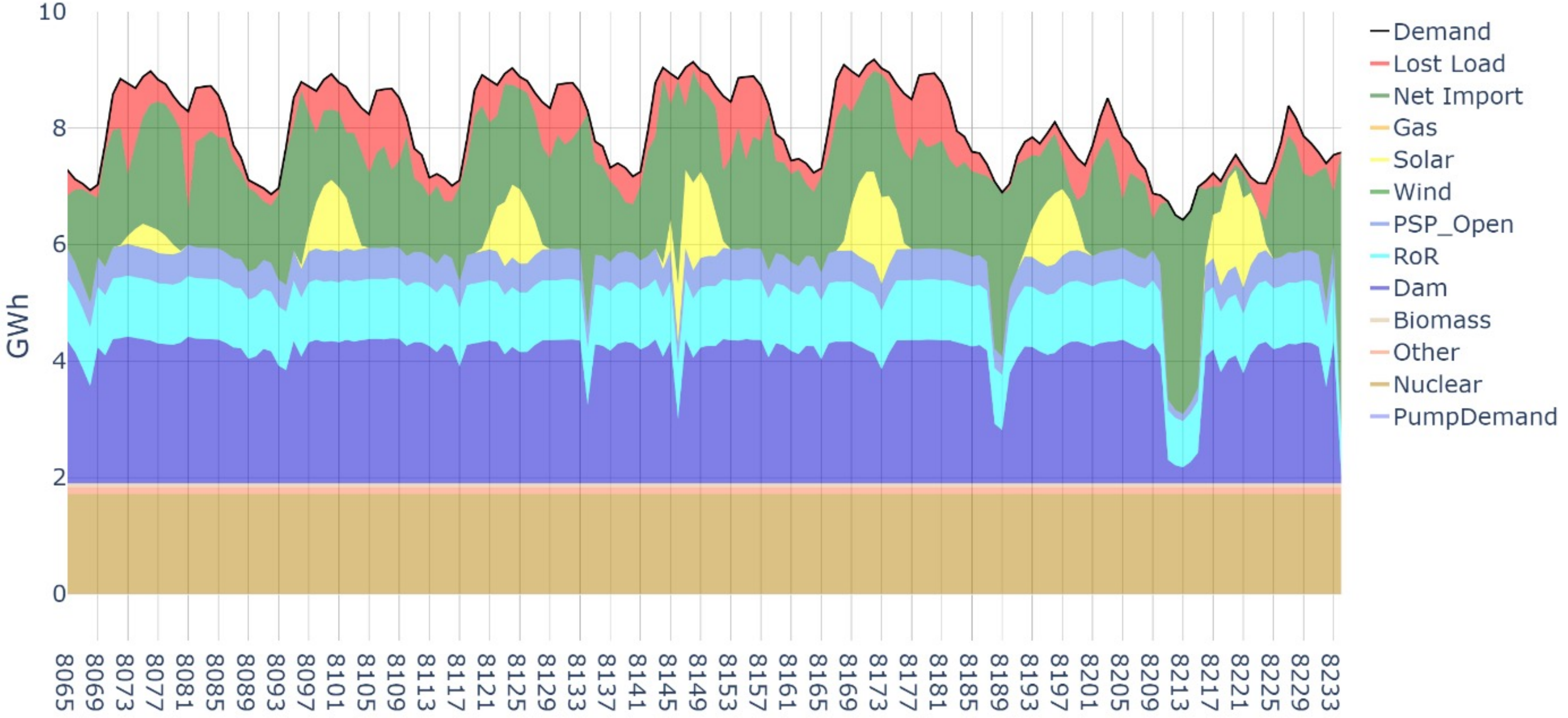
Generation and demand of Switzerland for the benchmark scenario

Results

Switzerland – ENS

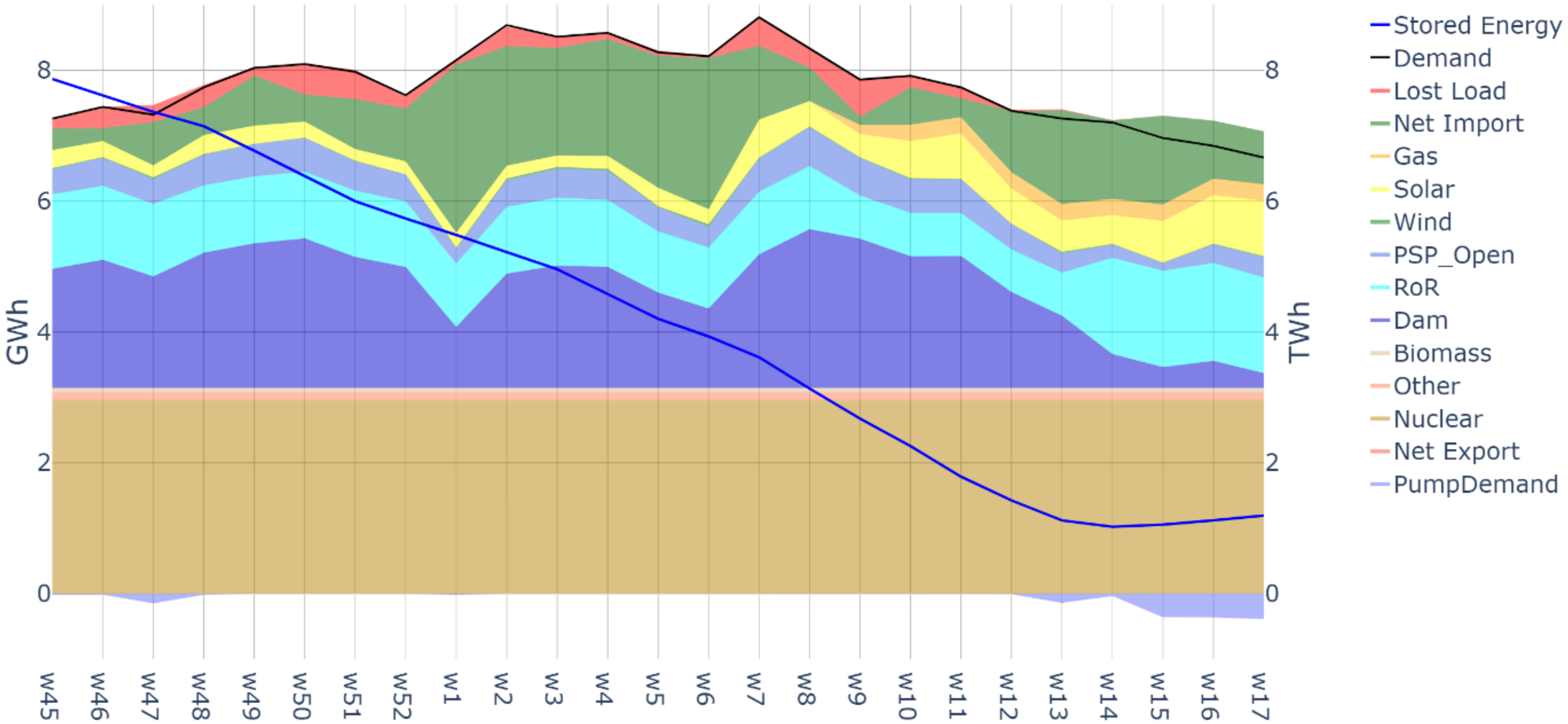


Switzerland – Hourly dispatch



Reduced Nuclear, 20% gas-saving target, weather 1984_1984

Switzerland – Weekly dispatch



Reduced Nuclear, 20% gas-saving target, weather 1984_1984

Conclusion

Conclusion

- Perfect storm for the “conventional” energy system in Europe
- CH
  - Importance of international cooperation
  - hydro flexibility and import capacity helps avoid ENS
  - CH starts having problems mostly when neighbours start having “energy” problems

Thank you for your attention!

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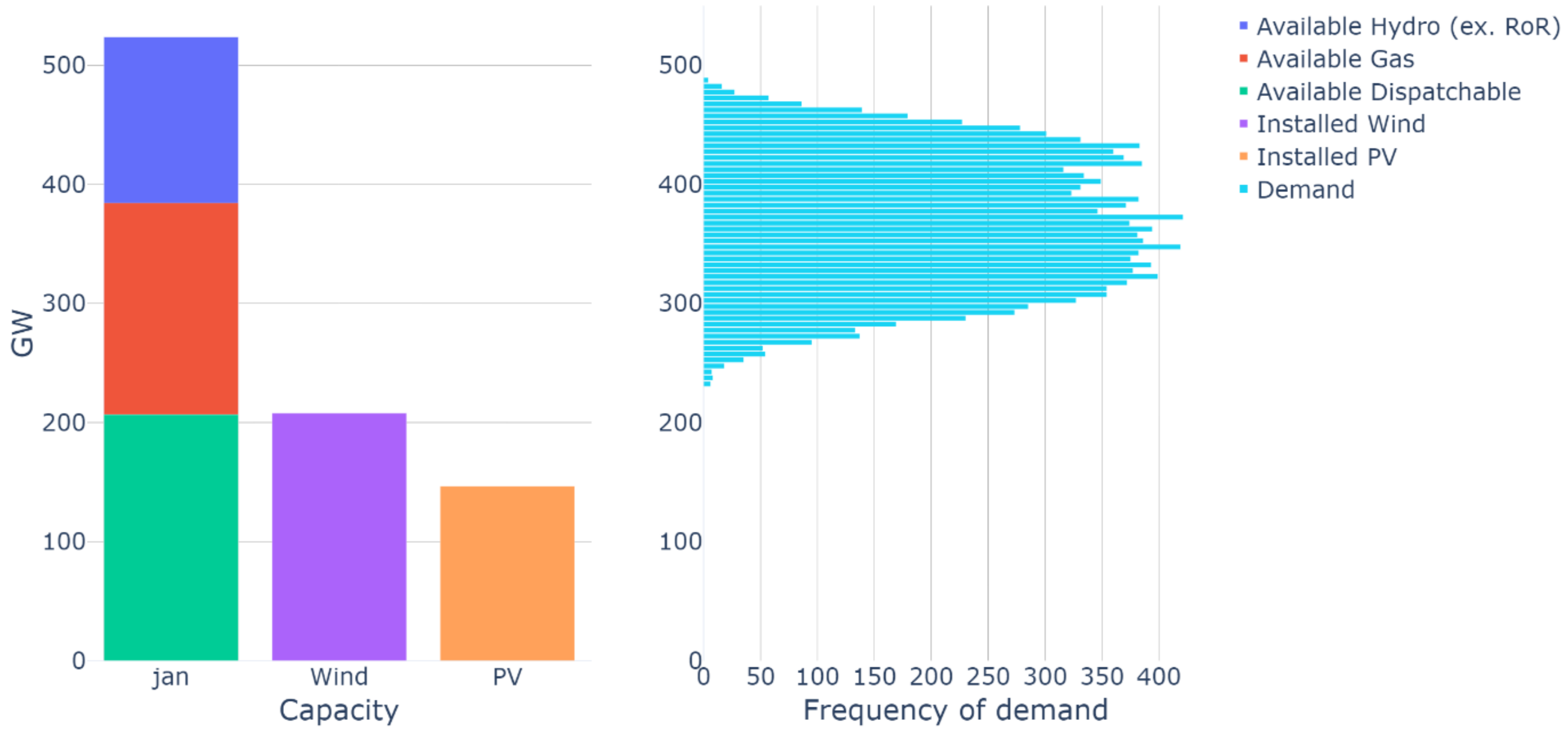
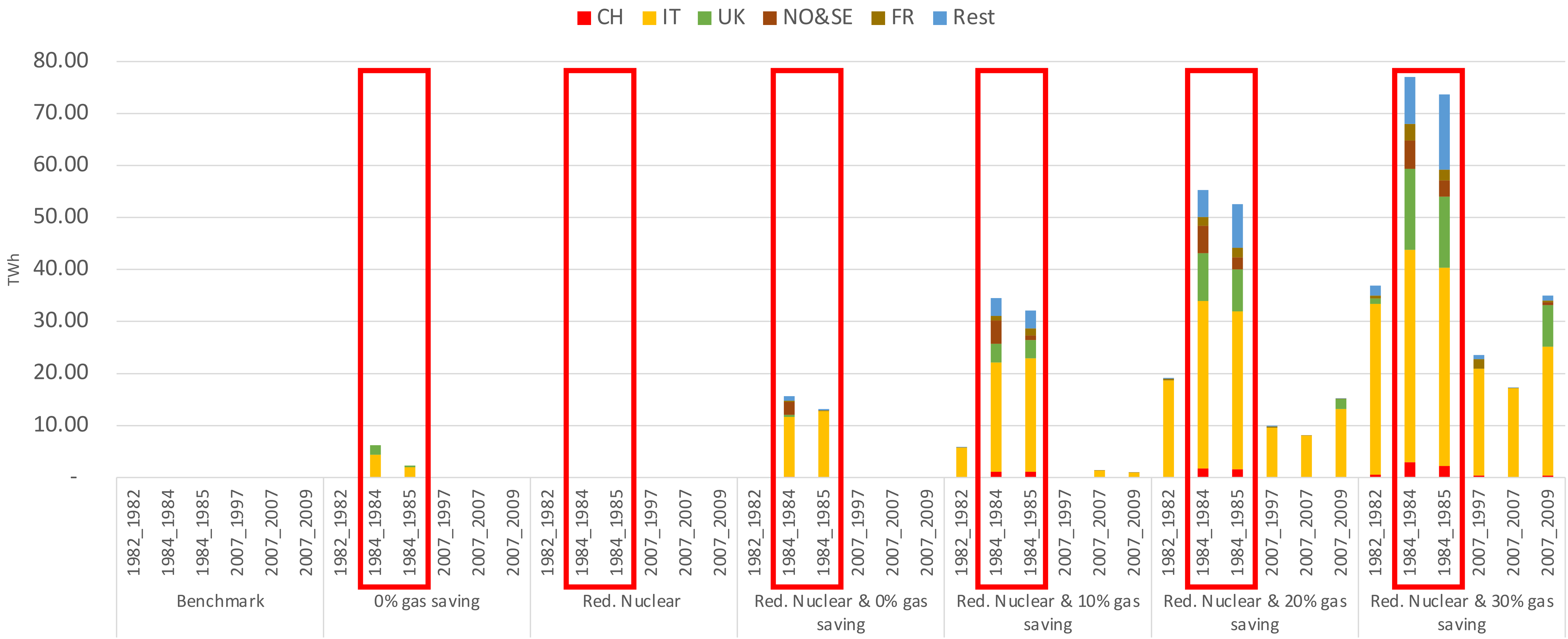
Europe

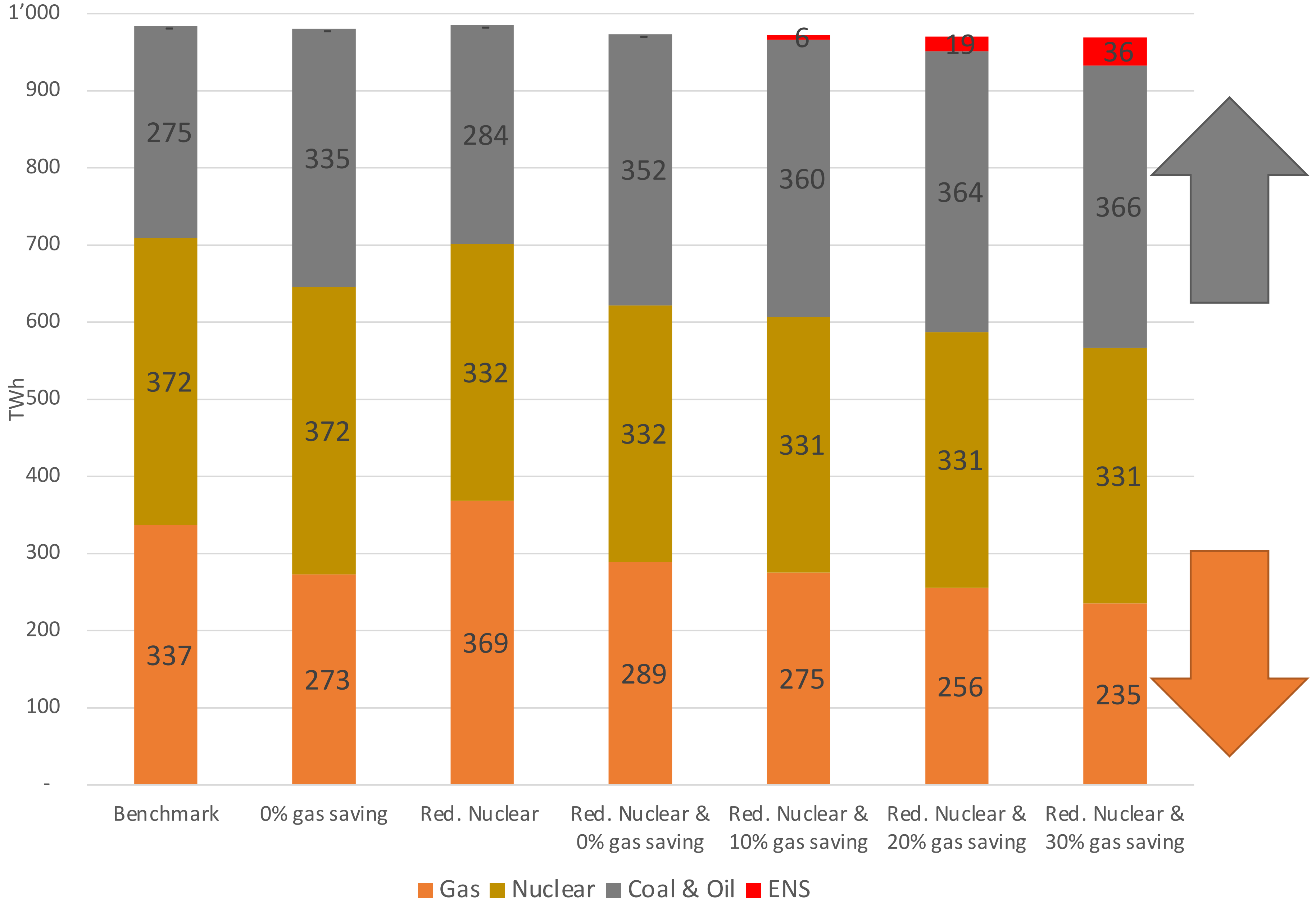


GW
500
400
300
200
100
0
jan
Wind
PV
Capacity
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
Frequency of demand
Available Hydro (ex. RoR)
Available Gas
Available Dispatchable
Installed Wind
Installed PV
Demand

Europe



CH
IT
UK
NO&SE
FR
Rest
TWh
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
1982_1982
1984_1984
1984_1985
2007_1997
2007_2007
2007_2009
Benchmark
0% gas saving
Red. Nuclear
Red. Nuclear & 0% gas saving
Red. Nuclear & 10% gas saving
Red. Nuclear & 20% gas saving
Red. Nuclear & 30% gas saving



Europe

avert ENS by dirty generation

Weather 1982_1982

Generation per type (excluding renewable and hydro)

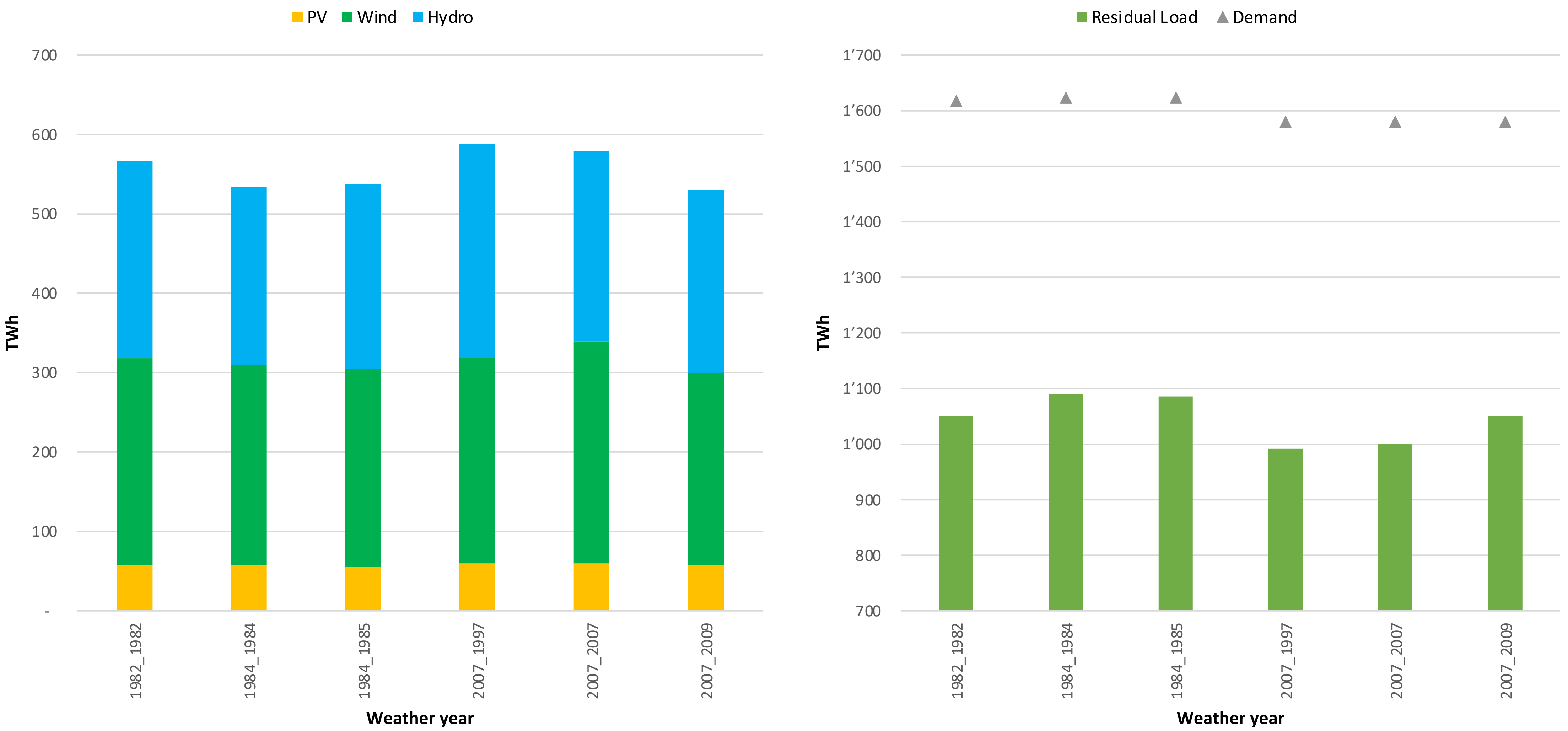


Figure 6 Total renewable generation and residual load of the whole system for the benchmark scenario per weather pairings. On the x-axis, the first and second value denotes the climate year corresponding to the demand and weather-dependant time series, respectively. For instance, 1984_1985 signifies a simulation with 1984 demand time series and PV/wind availability factor and hydro inflow of 1985.

Swissgrid comparison