

Capacity Credit – Contribution of Renewable Energies to Reliability in the Power System of the Future

Konferenz „Sektorenkopplung –
Erfahrungsaustausch und Perspektiven“

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Capacity Credit

What is “Capacity Credit”?

Why do we need it?

How is it calculated?

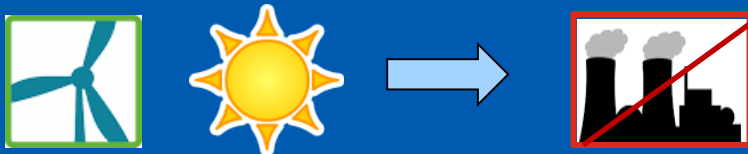
What is “Capacity Credit”?

Capacity Credit Assessment - Definitions

Capacity Credit = **Capacity Value** $\neq$ **Capacity Factor**

Capacity Credit (or Capacity Value) of a generation unit (e. g. PV) represents the contribution of the unit to power system reliability

Amount of conventional power that can be removed or avoided by adding REN to the system*



Measure of how much energy is produced by a plant in a time period compared to its maximum output

Why do we need it?

Introduction

Key question to be answered:

- “How beneficial is the contribution of renewable energies to reliability?”
- “How many conventional power plants can be replaced by renewable energies?”



Important for expansion planning

Capacity Credit is an important measure for expansion planning as it seizes the contribution of renewable energies in terms of reliability

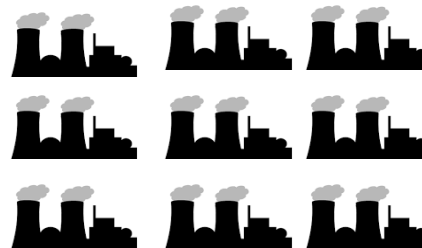
Today



Future



Without RE



With RE



Removed or
avoided by
adding RE

How is it calculated?

Fichtner “Capacity Credit Tool”



Methods to assess Capacity Credit

1. Approximation methods

- a) Highest-Load Hours Approximation Method
- b) Loss-of-Load-Probability-Weighted Highest-Load Hours Approximation Method
- c) Garver-Method etc.

+ easy to use
- perform poorly/
not accurate
(variance up
to 100%)



2. Reliability methods

- a) **Effective Load Carrying Capability (ELCC):**
Additional amount of demand that the system can cover through RE capacity
- b) **Equivalent Conventional Power (ECP):**
Conventional capacity that RE capacity can replace
- c) **Equivalent Firm Capacity (EFC):**
Ideal capacity that RE capacity can replace

- complex
- computationally
intensive calculations
+ accurate
+ state of the art and
globally accepted



used by Fichtner

Methodology to assess Capacity Credit

Input Data Requirements

1. Conventional Generation

- installed capacities (MW)
- forced outage rates (%)

for each
generating unit

2. Hourly Load Data

from hour
1 to hour 8760

3. Generation Profile of Renewable Energy Sources

from hour
1 to hour 8760

Methodology to assess Capacity Credit

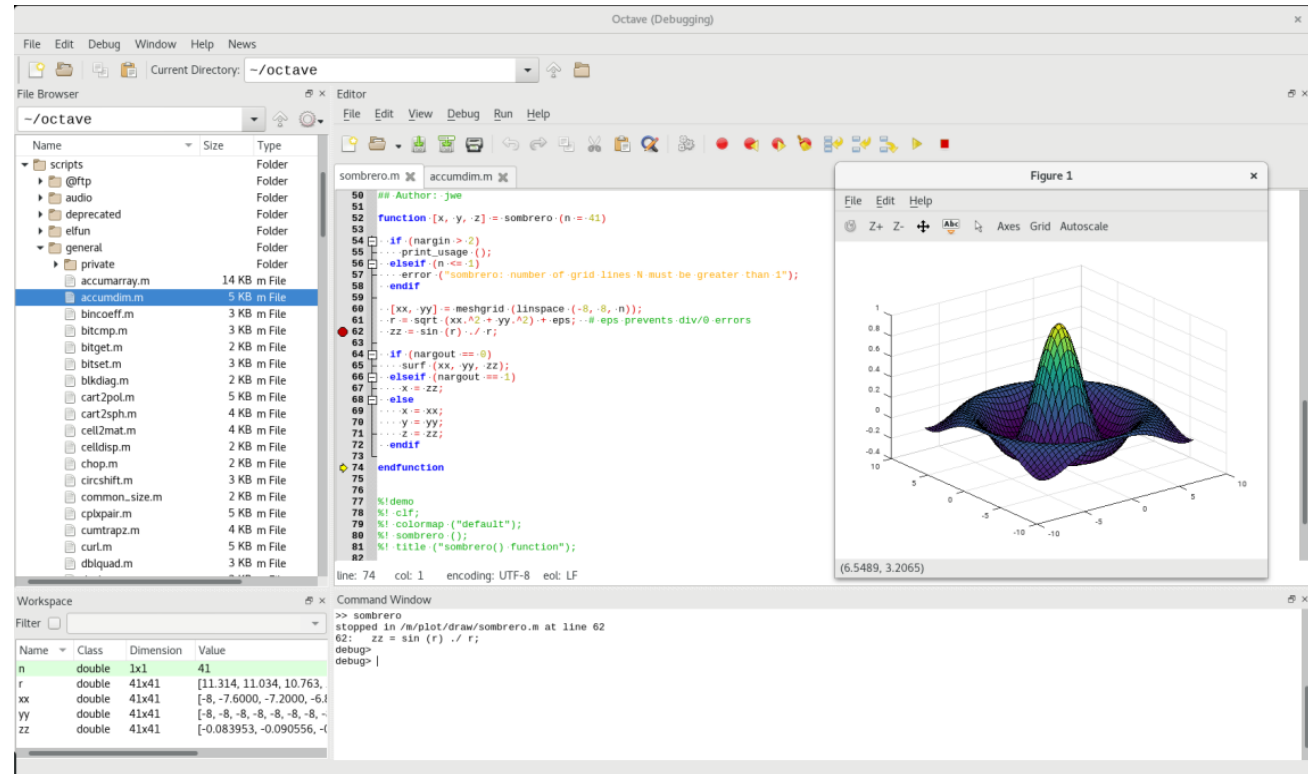
Fichtner Capacity Credit Tool

Challenges:

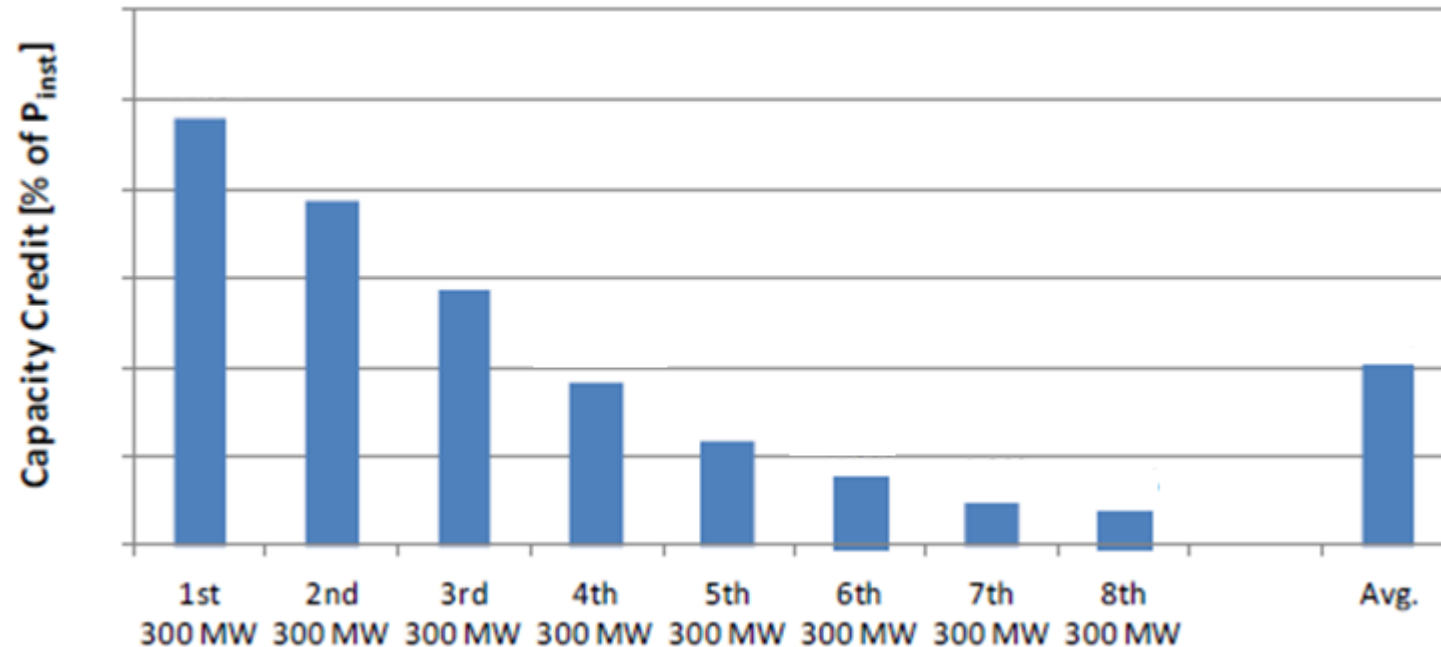
- For the reliability methods: Excel not suitable

Software used by Fichtner:

- GNU Octave free software
- Mostly comparable with MATLAB



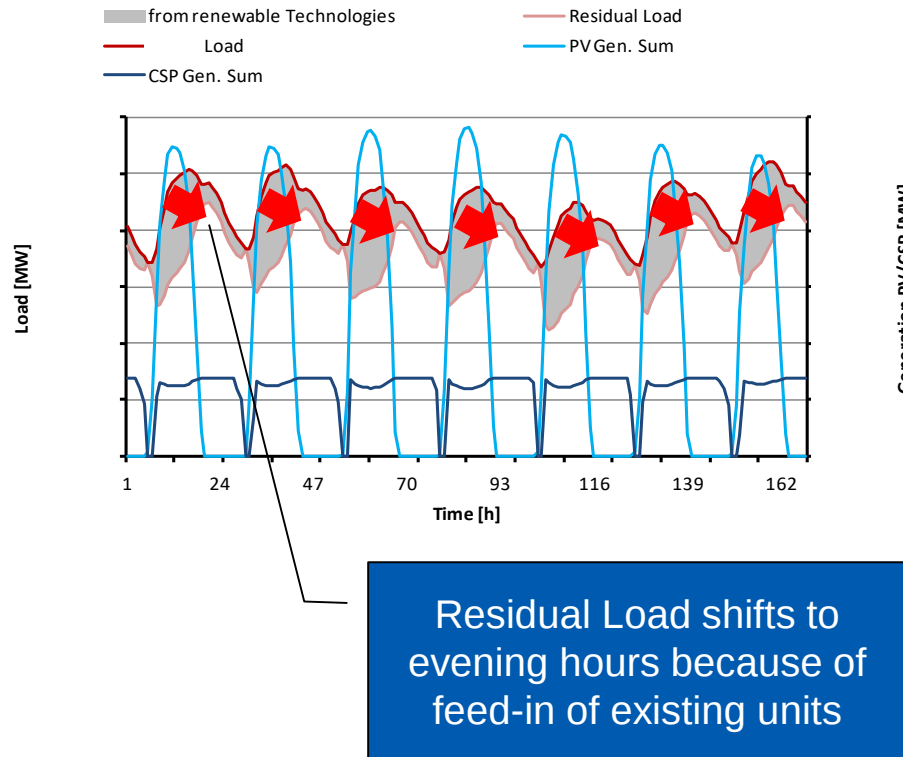
Exemplary results of the Fichtner Capacity Credit Tool



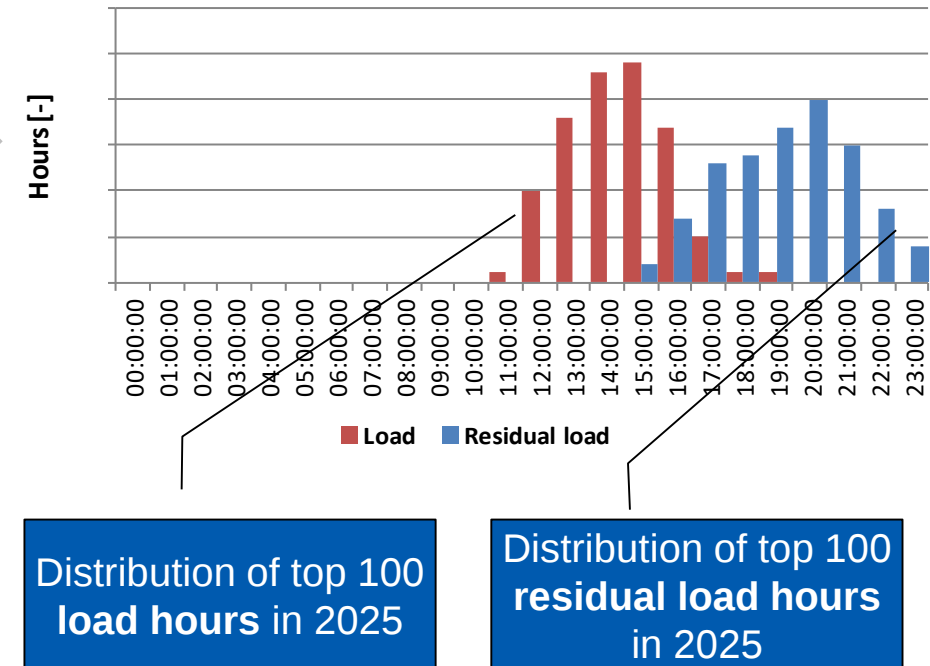
- Significant decrease of Capacity Credit of PV
- Specification/tendering and bid evaluation will not only be focused on feed-in tariff (USDcent/kWh) in future
- Capacity Credit needs to be considered as one factor

Exemplary results of the Fichtner Capacity Credit Tool

Residual Load Curve



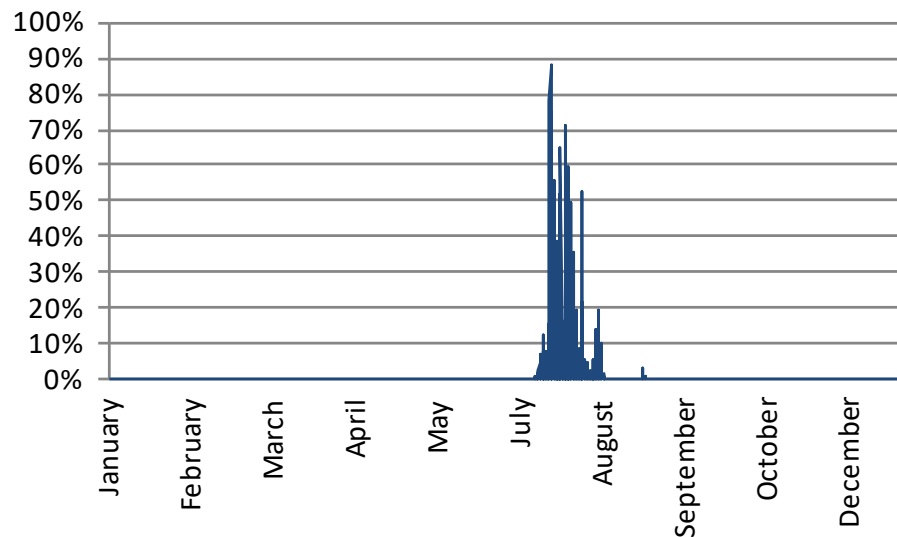
Top 100 hours 2025



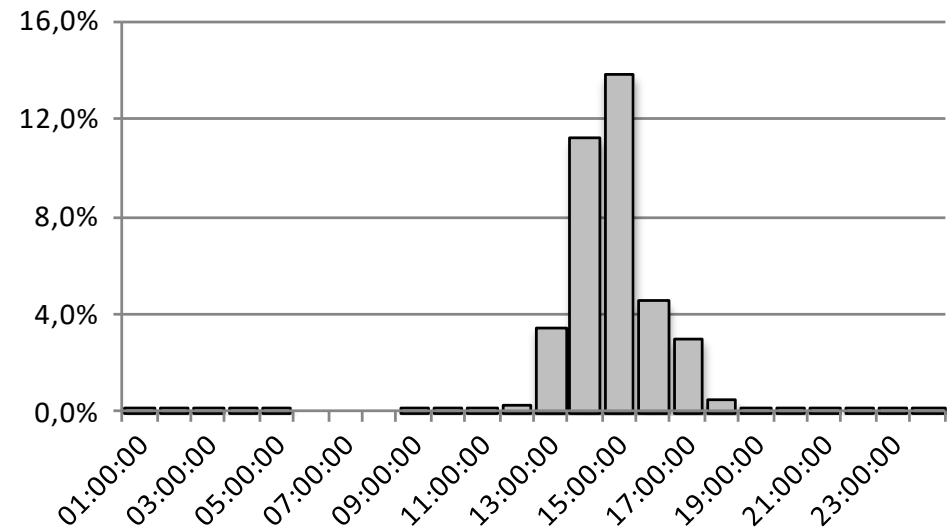
- Existing REN feed-in in 2025 shifts top load hours from approx. 14:00 to 20:00
- Capacity Credit of new REN depends on how well peak hours are covered

Results: Reliability of the conventional system

Hourly LOLP 1



Hourly averaged LOLP 1 - July and August



KEY FACTOR : Peak loads → higher risk of outage clustered in July and August due to massive use of air conditioners

What questions can be answered?

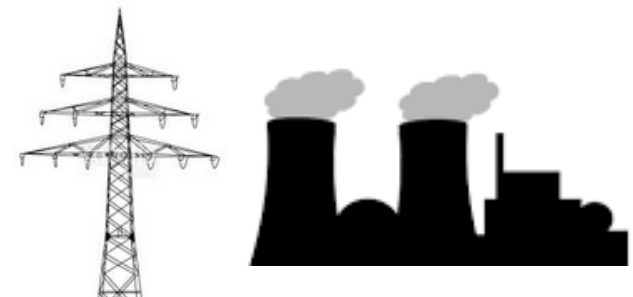
Answers provided by the Fichtner ELCC Tool to:

- RE contribution to system stability in general
“What contribution can RE make in future?”
- Ascertaining the optimum RE share in the overall system
“What share of RE makes sense?”
- Comparison of different RE combinations
“PV and wind - What ratio is ideal?”
- Expansion planning
“How much conventional capacity can be replaced by RE?
What load can RE cover?”
- Evaluating individual RE projects
“What is the capacity credit of precisely this RE project?”



Potential contracting authorities

- **Political entities / ministries (regional, national and international)**
 - Political consulting
 - Master plans (expansion planning, electrification, energy transition)
 - Evaluating system stability
- **Think tanks, NGOs and associations**
 - Master plans
 - Studies
 - Arguments for lobbying
- **Utilities (producers, grid operators), investors, manufacturers, etc.**
 - Expansion planning for the grid
 - Expansion planning for the power plant fleet
 - Due diligence reviews and economic assessments
 - Arguments in favor of one's own technology (i.e. for manufacturers)



Thank you for your attention!



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