

Renewable energy development scenarios

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<https://pii.dei.polimi.it/renewable-energy-development-scenarios/>

Schema

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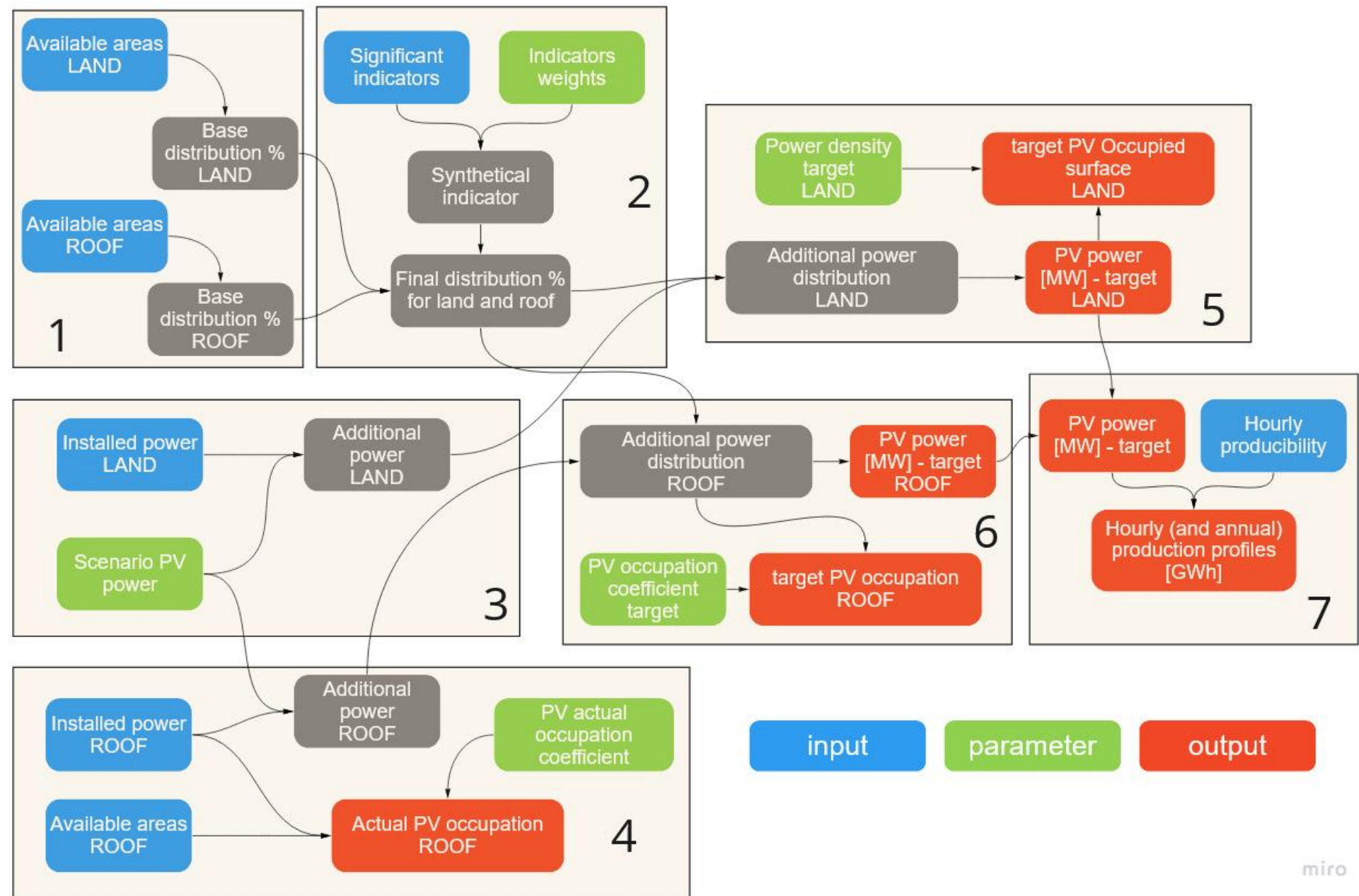


Introduction

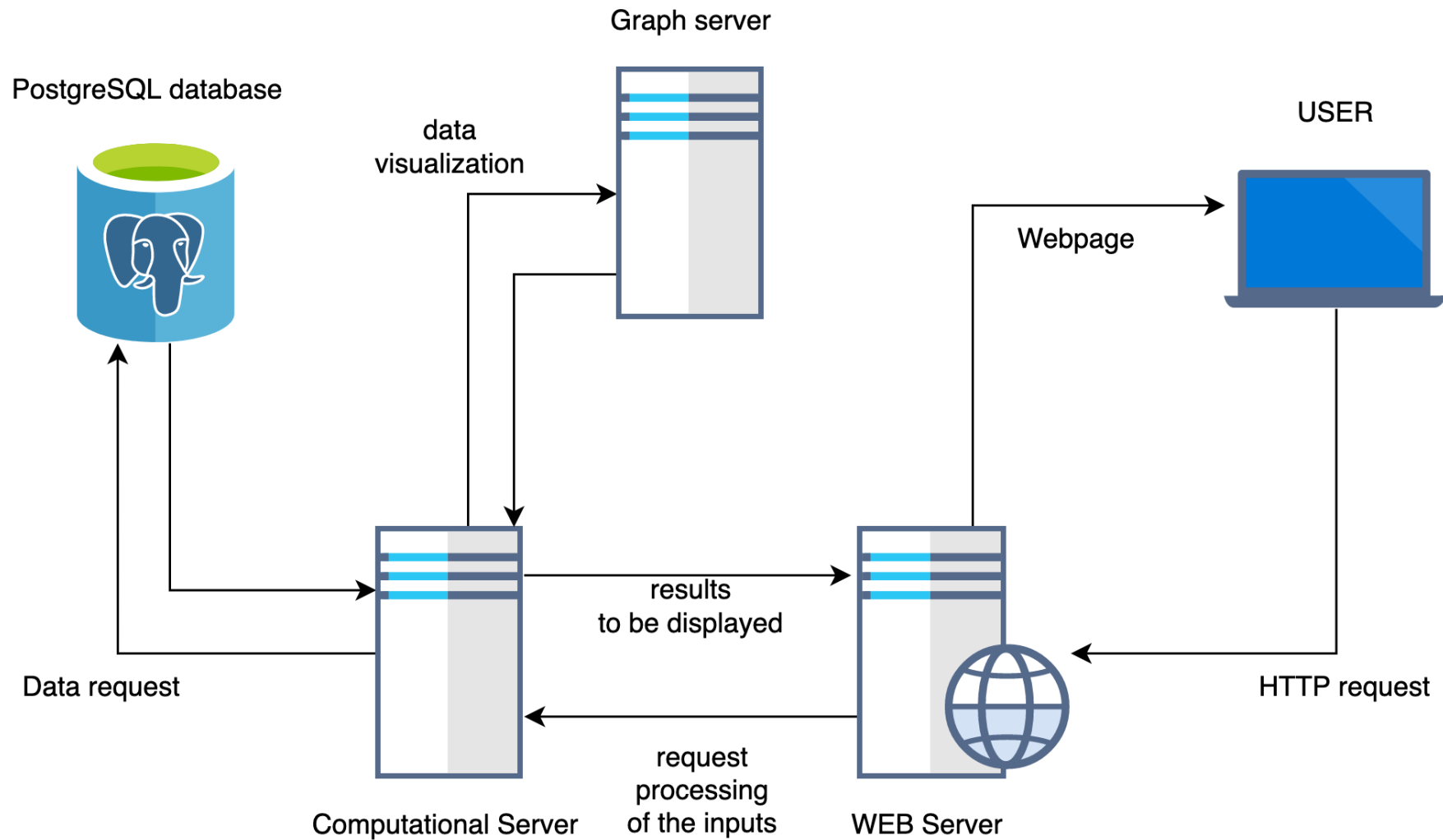
The proposed project aims to create an interactive web interface which will be integrated in the RSE S.p.A. dissemination platforms, for supporting future renewable energy development scenarios, which constitutes one of the core activities in RSE.

Objective: the web tool should compute of the photovoltaic capacity distribution and the expected production in Italy at a province scale for the achievement of the target renewable energy goals. Starting from variable input parameters and spatialized indicators, the interface should also allow the spatial and graphical representation of the intermediate and final outputs.

Flowchart



Code schema



Suggested tools

Languages:

- Python
- SQL

Suggested Software and libraries:

- PostgreSQL (<https://www.postgresql.org>) for the database
- Pandas (<https://pandas.pydata.org>) for the management of CSV files
- Bokeh (<https://bokeh.org>) for the plots and maps
- Flask (<https://flask.palletsprojects.com>) for the web server
- Psycpg2 (<https://www.psycpg.org/docs/>) for the communication with the PostgreSQL database
- Bootstrap (<https://getbootstrap.com/>) for the template of the web interface

Equation – Legend

Array of values for each province

Single number

Input (CSV) – unit of measure MW or km²

Parameters (inserted by the user from the web interface)

Output

Intermediate product

Equation – Input

Input (CSV) – unit of measure MW or km2

- Photovoltaic installed (installed.csv)
 - [Installed power LAND](#)
 - [Installed power ROOF](#)
- Variables (variables.csv)
 - [Built surface](#)
 - [Domestic consumption](#)
 - [Province population](#)
 - [Taxable income per capita](#)
 - [Arable land area](#)
 - [Agricultural added value](#)
- Hourly Producibility (hourly_producibility.csv)
 - [Hourly producibility](#)

Equation – Parameters

Parameters (inserted by the user from the web interface)

- Goals
 - Scenario PV power [52000 MV]
 - Percentage PV target ROOF [40%]
- Coefficients
 - PV occupation coefficient target ROOF [km²/MW] [0,005]
 - PV occupation coefficient base ROOF [km²/MW] [0,008]
 - PV density target LAND [MW/km²] [90,9]
- Advance Weight [0]
 - weight equivalent hours PV
 - weight domestic consumption per capita
 - weight taxable income per capita
 - weight Agricultural added value

Equation – Output

Output

- Actual PV occupation ROOF
- target PV Occupied surface LAND
- target PV occupation ROOF
- PV power target LAND
- PV power target ROOF
- PV power target
- Production profiles

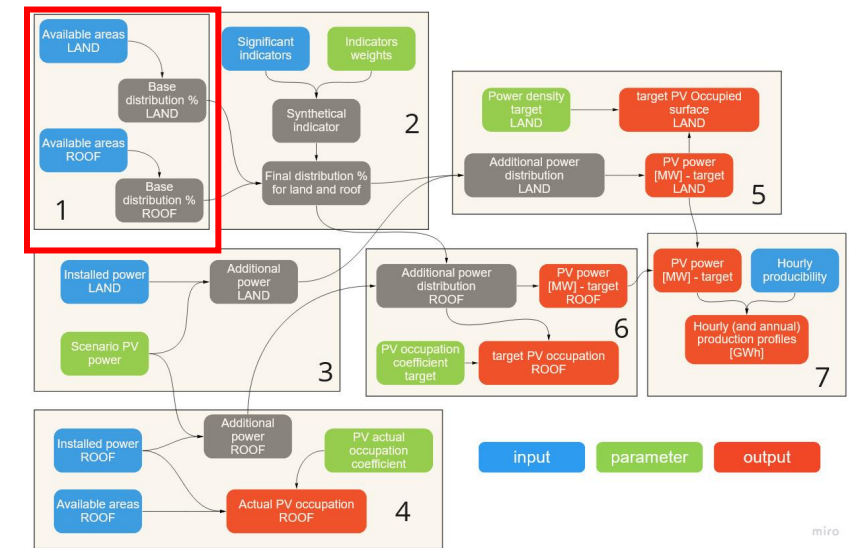
Equation – Block 1

Sum Built surface = sum values of Built surface

Base distribution ROOF = Built surface / sum Built surface

sum Arable land area = sum values of Arable land area

Base distribution LAND = Arable land area / sum Arable land area



Equation – Block 2a

Annual sum equivalent hours PV = sum values of Hourly producibility for each province

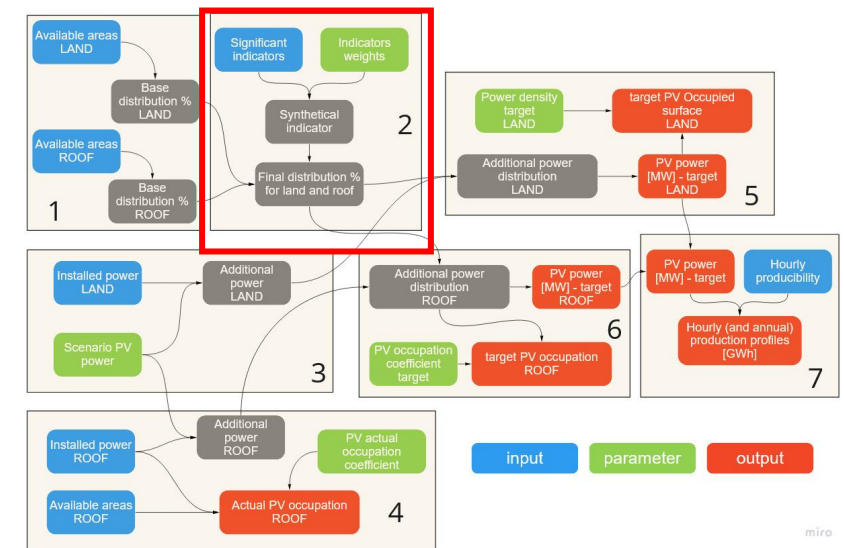
mean sum annual equivalent hours PV = mean values of Annual sum equivalent hours PV

Indicator equivalent hours PV = Annual sum equivalent hours PV / mean sum annual equivalent hours PV

Domestic consumption per capita = Domestic consumption / Province population

Mean Domestic consumption per capita = mean values of Domestic consumption per capita

Indicator domestic consumption per capita = Domestic consumption per capita / Mean Domestic consumption per capita



Equation – Block 2b

mean Agricultural added value = mean values of Agricultural added value

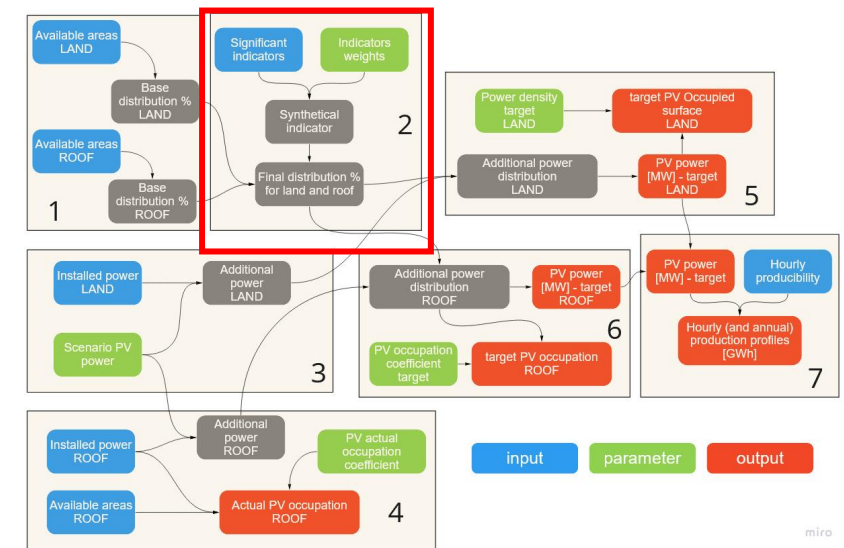
Indicator agricultural added value = Agricultural added value / mean Agricultural added value

Synthetical indicator ROOF = EXP (weight equivalent hours PV * LN(Indicator equivalent hours PV) + weight domestic consumption per capita * LN(Indicator domestic consumption per capita) + weight taxable income per capita * LN (Taxable income per capita))

Synthetical coefficient ROOF = Synthetical indicator ROOF * Base distribution ROOF

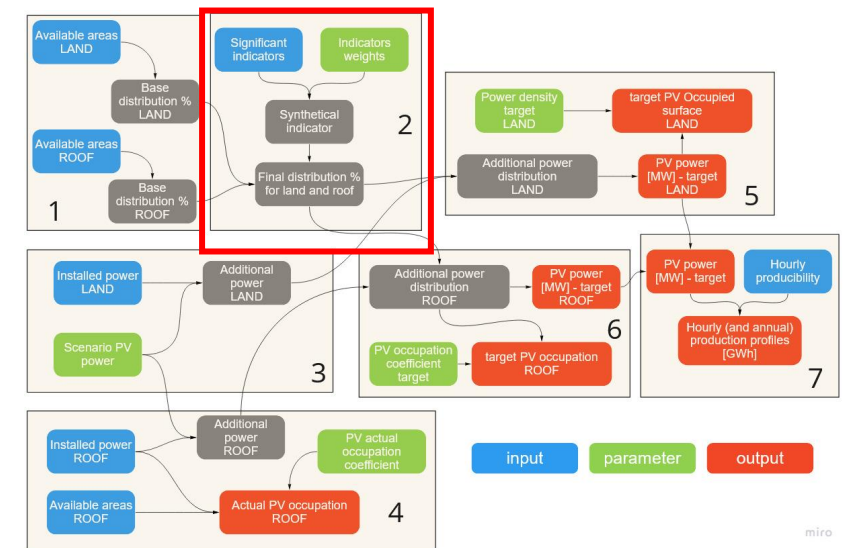
sum Synthetical coefficient ROOF = sum di values of Synthetical coefficient ROOF

Final distribution for ROOF = Synthetical coefficient ROOF / sum Synthetical coefficient ROOF



Equation – Block 2c

Synthetical indicator LAND = EXP (Weight equivalent hours PV * LN(Indicator equivalent hours PV) - weight Agricultural added value * LN(Indicator agricultural added value))



Synthetical coefficient LAND = Synthetical indicator LAND * Base distribution LAND

sum Synthetical coefficient LAND = sum di values of Synthetical coefficient LAND

Final distribution for LAND = Synthetical coefficient LAND / sum Synthetical coefficient LAND

Equation – Block 3

sum other areas LAND = sum values of other areas LAND

Percentage PV additional LAND = sum other areas LAND / Scenario PV power

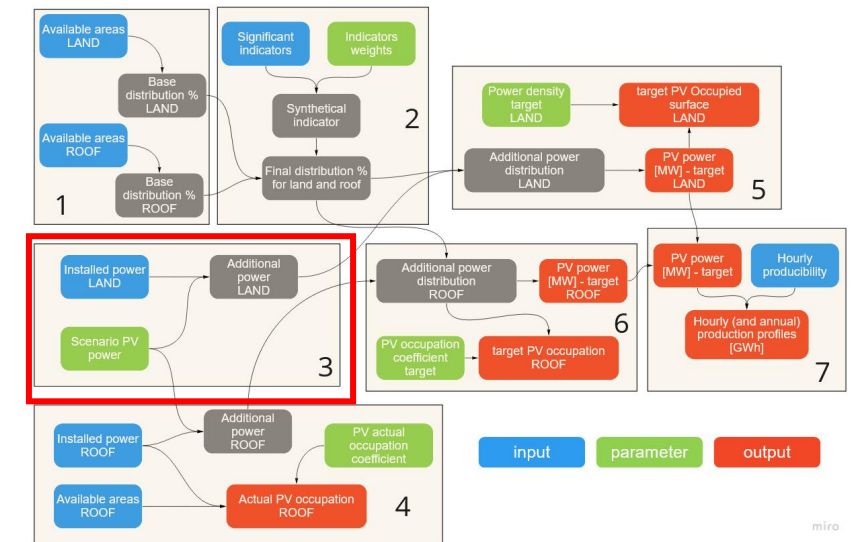
sum installed power LAND = sum values of Installed power LAND

Percentage PV installed LAND = sum installed power LAND / Scenario PV power

Percentage PV target LAND = 1 - Percentage PV target ROOF

Percentage additional LAND = Percentage PV target LAND – Percentage PV installed LAND – Percentage PV additional LAND

Percentage additional power LAND = Scenario PV power * Percentage additional LAND



Equation – Block 4

Actual PV occupation ROOF = Installed power ROOF * PV occupation coefficient base ROOF / Built surface

sum other areas ROOF = sum values of other areas ROOF

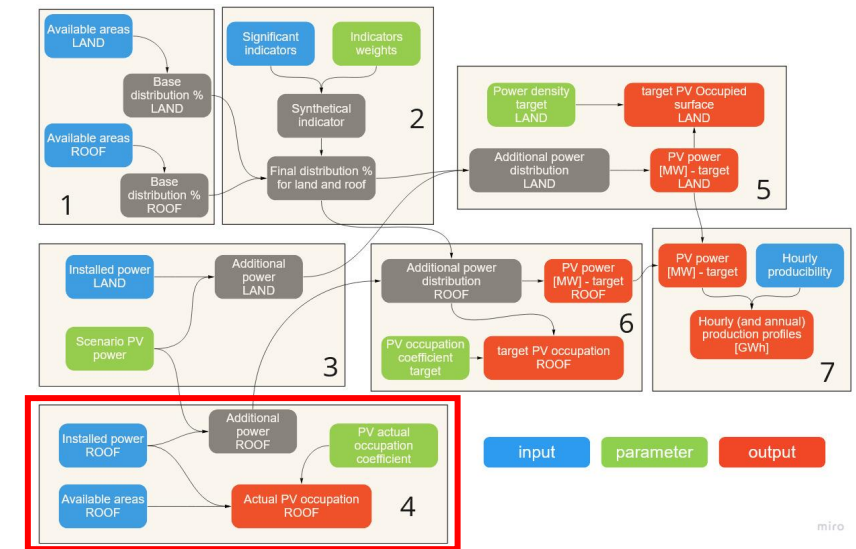
Percentage PV additional ROOF = sum other areas ROOF / Scenario PV power

sum installed power ROOF = sum values of Installed power ROOF

Percentage PV installed ROOF = sum installed power ROOF / Scenario PV power

Percentage additional ROOF = Percentage PV target ROOF – Percentage PV installed ROOF – Percentage PV additional ROOF

Percentage additional power ROOF = Scenario PV power * Percentage additional ROOF

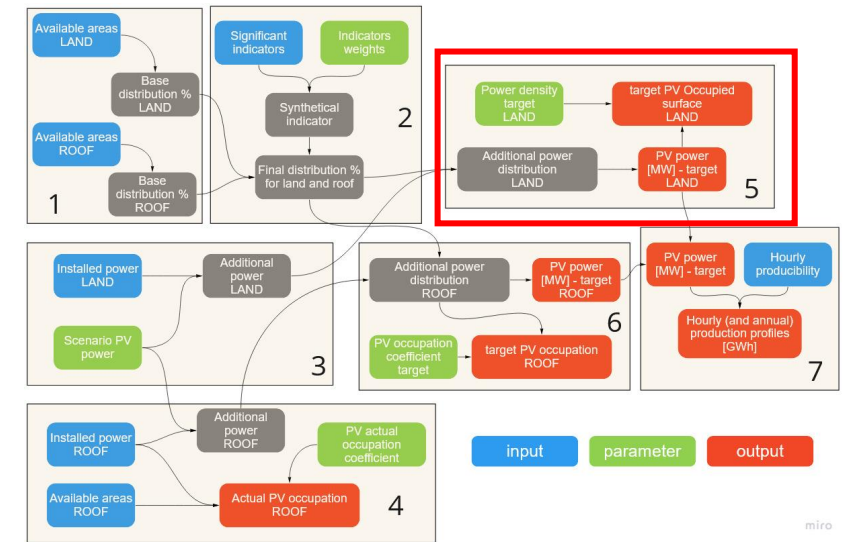


Equation – Block 5

Additional power distribution LAND = Final distribution for LAND * Percentage additional power LAND

target PV Occupied surface LAND = Additional power distribution LAND / PV density target LAND

PV power target LAND = Installed power LAND + Additional power distribution LAND



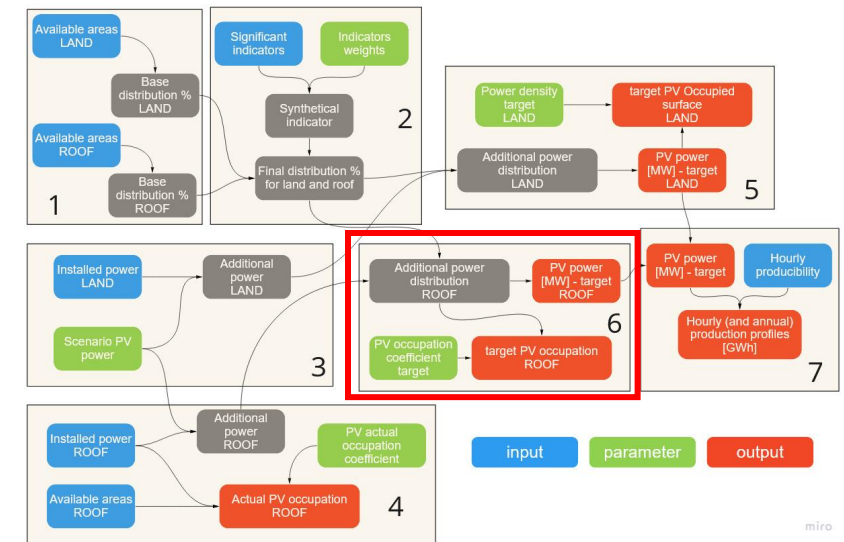
Equation – Block 6

Additional power distribution ROOF = Final distribution for ROOF * Percentage additional power ROOF

PV power target ROOF = Installed power ROOF + Additional power distribution ROOF + other areas ROOF

Additional PV occupation ROOF = (Additional power distribution ROOF * PV occupation coefficient target ROOF) / Built surface

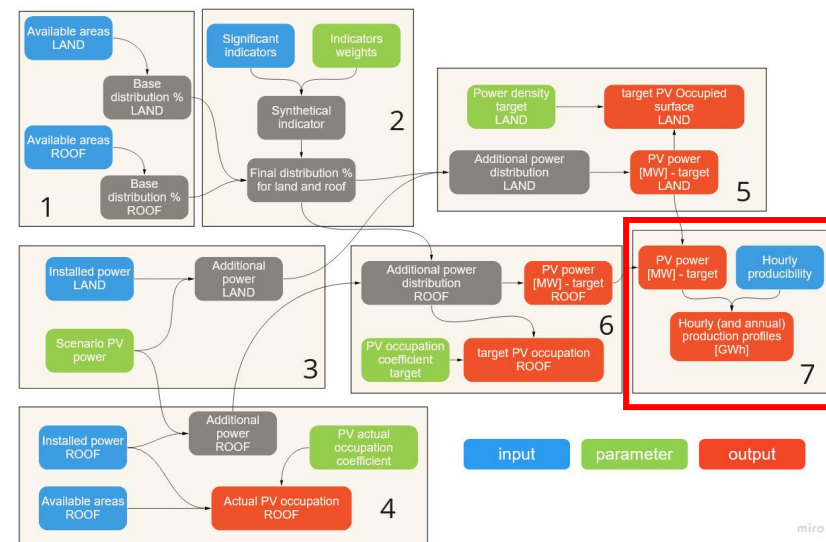
target PV occupation ROOF = (Installed power ROOF * PV occupation coefficient base ROOF + Additional power distribution ROOF * PV occupation coefficient target ROOF) / Built surface



Equation – Block 7

PV power target = PV power target ROOF + PV power target LAND

Production profiles = PV power target * Hourly producibility



Deadline and intermediate revision

Deadline: Mid-June

Revision: 25-30 April

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