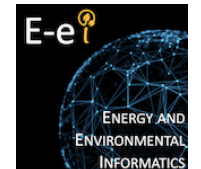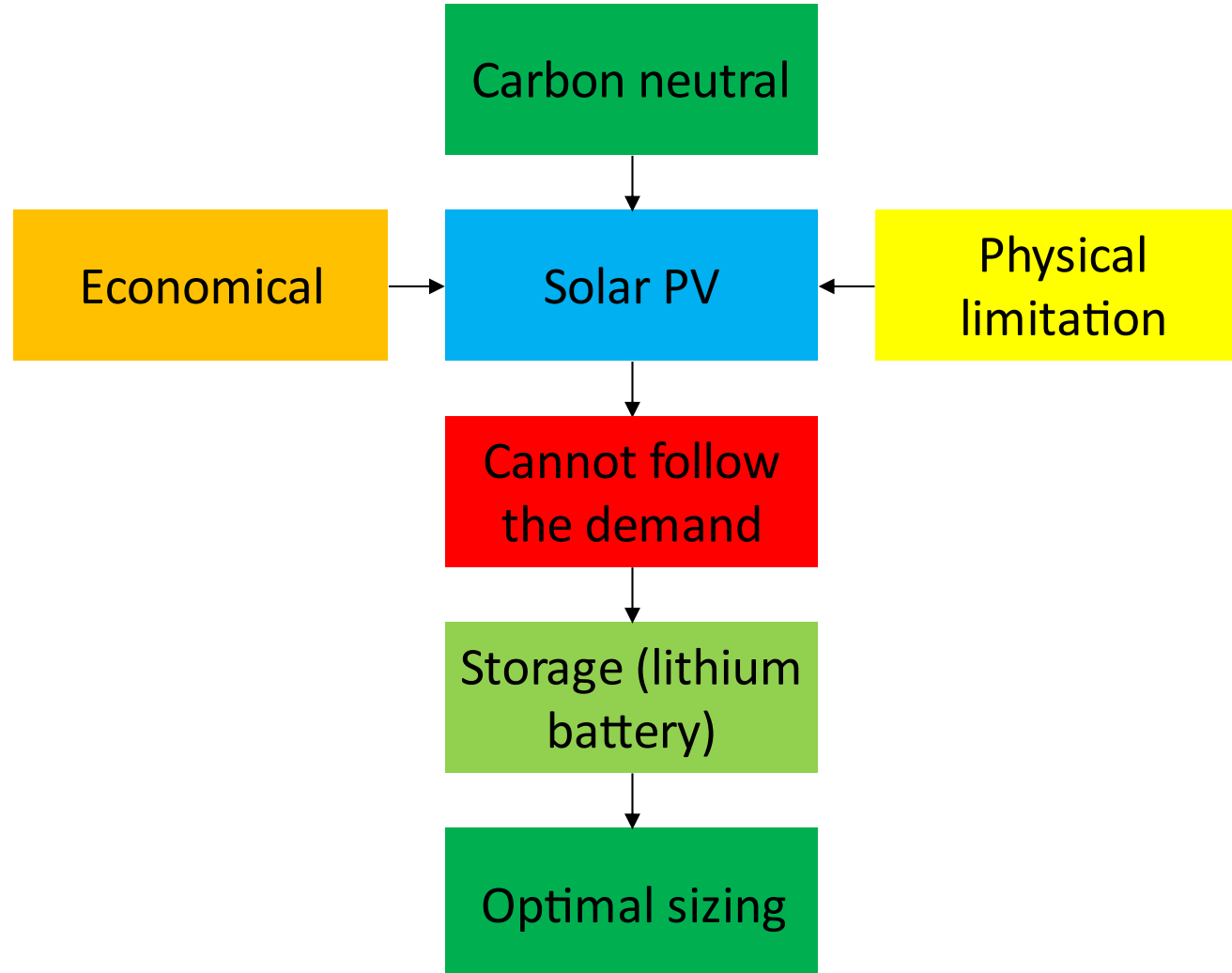# Optimal sizing of solar photovoltaic and lithium battery storage to reduce grid electricity reliance in buildings
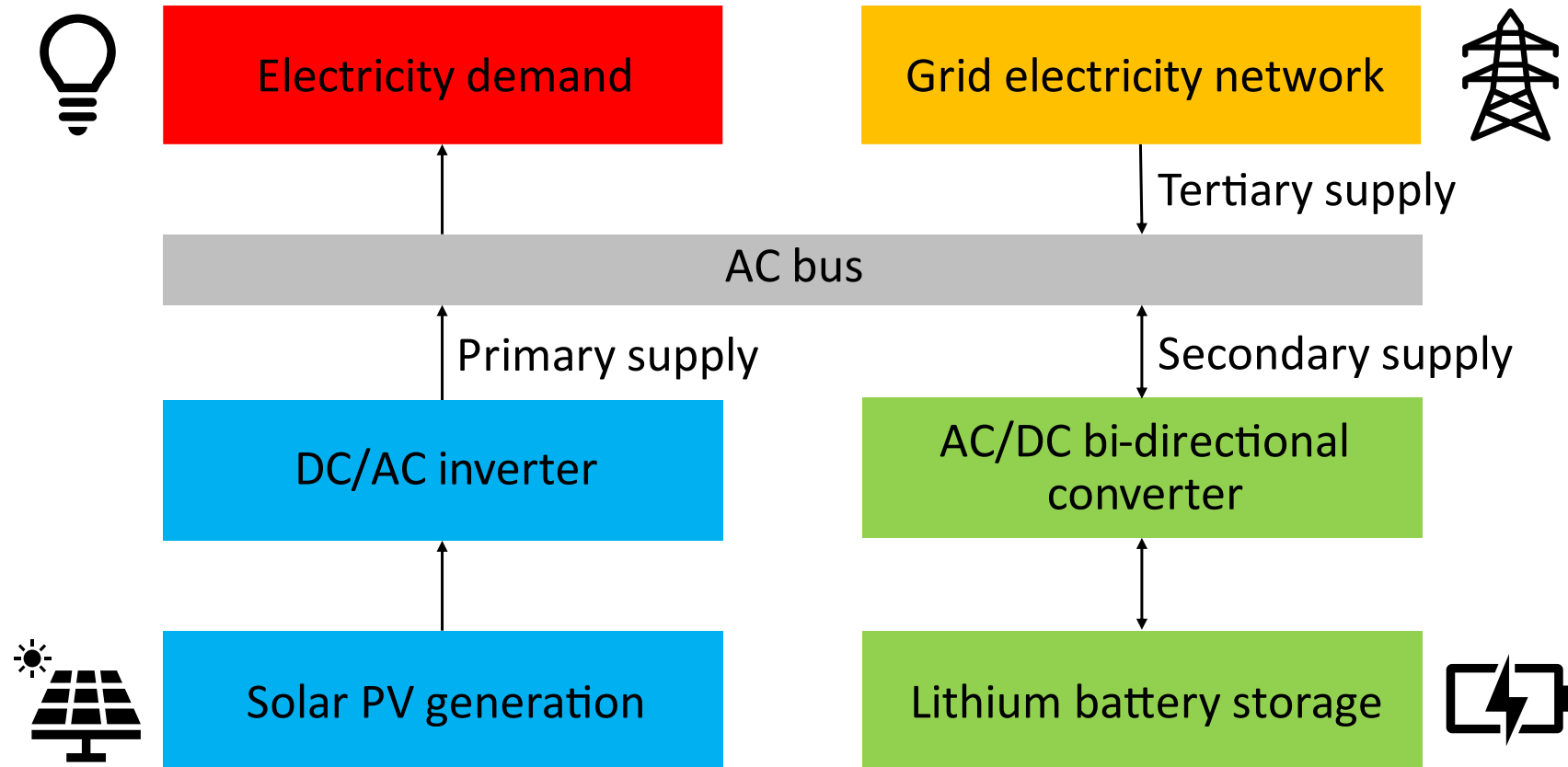
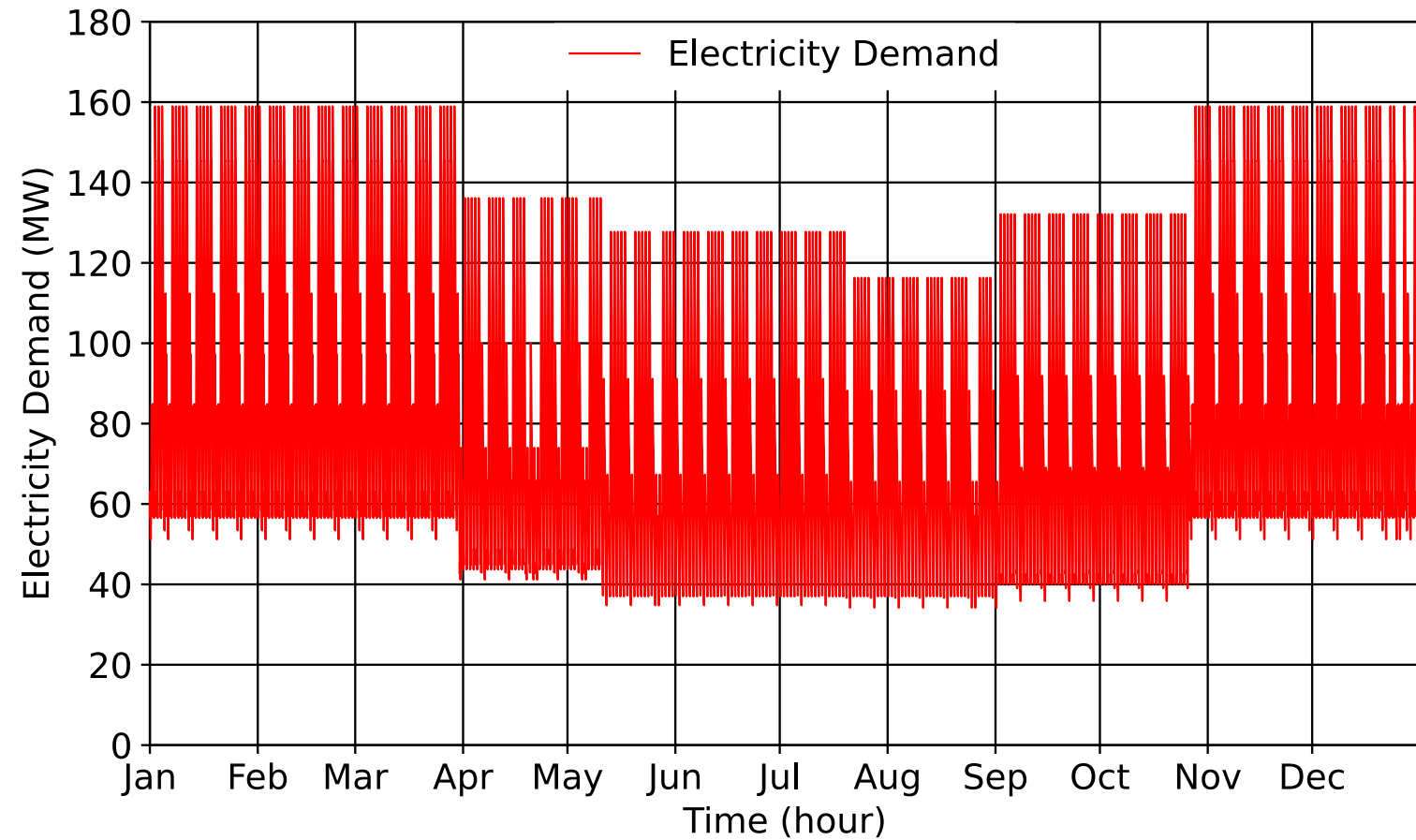Han Kun Ren, Malcolm D. McCulloch, David C.H. Wallom
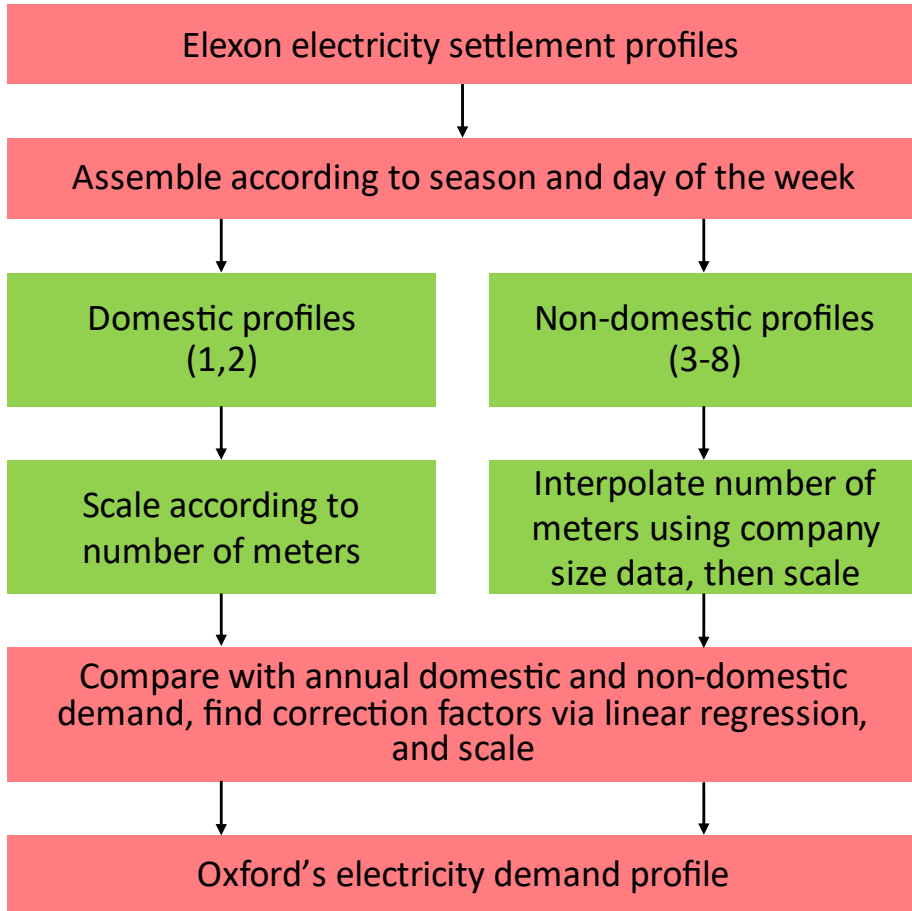
Motivation

System Setup and Operation Strategy

Demand Model

Elexon electricity settlement profiles

Assemble according to season and day of the week

Domestic profiles (1,2)

Non-domestic profiles (3-8)

Scale according to number of meters

Interpolate number of meters using company size data, then scale

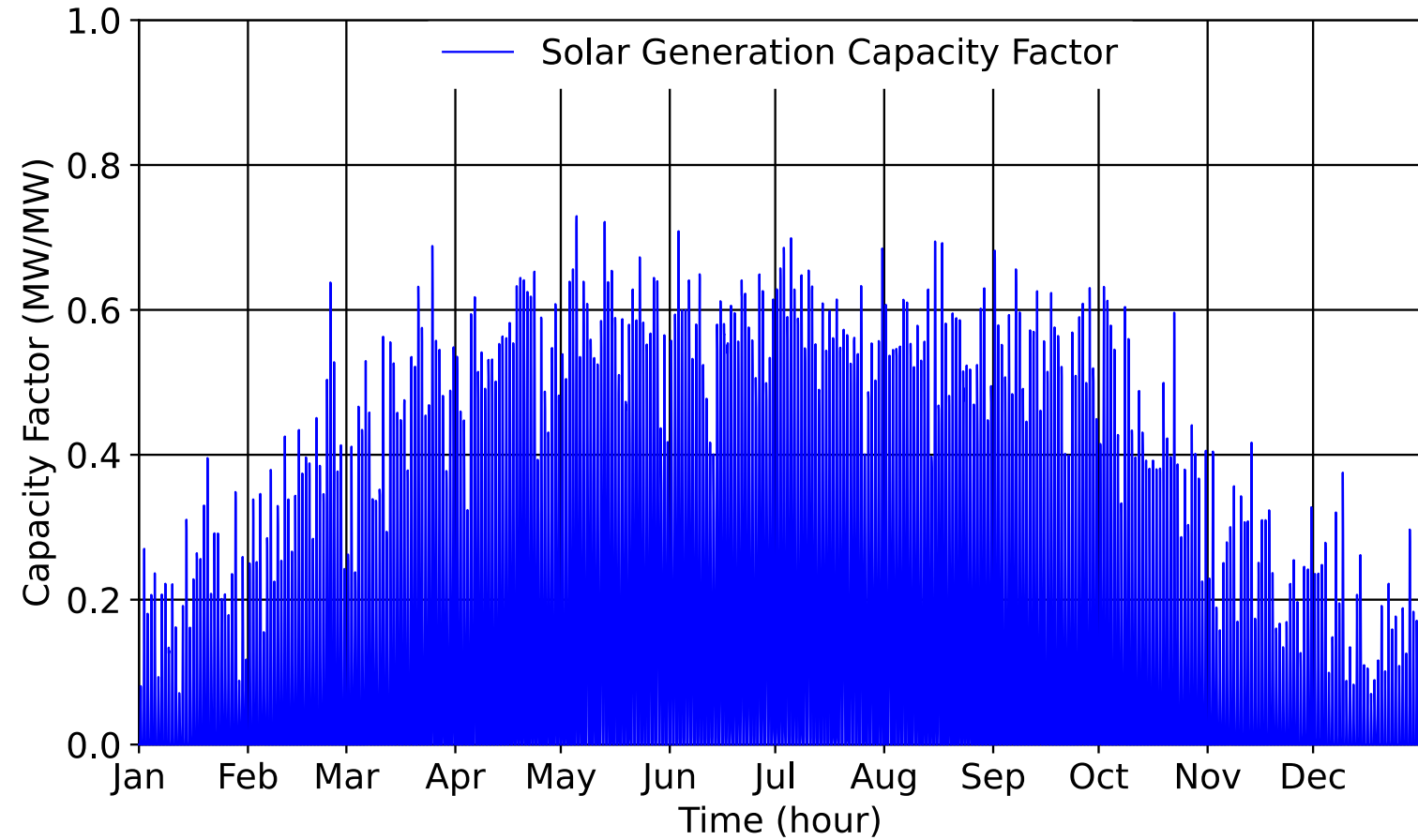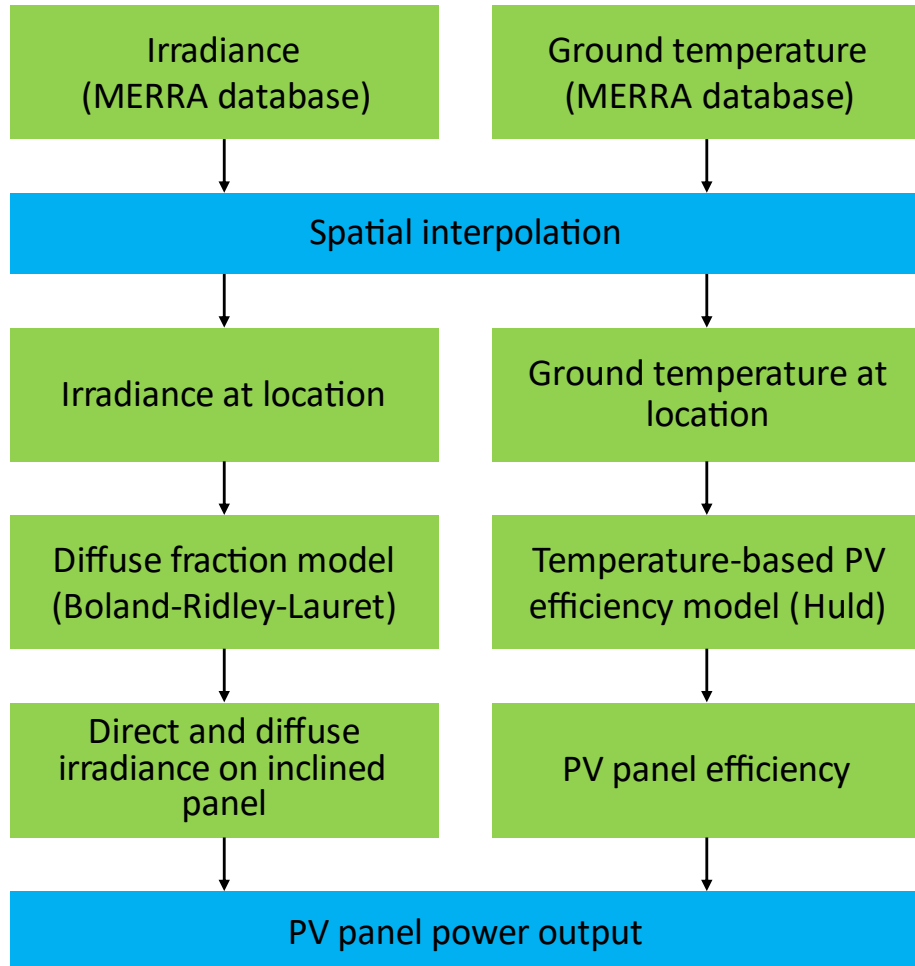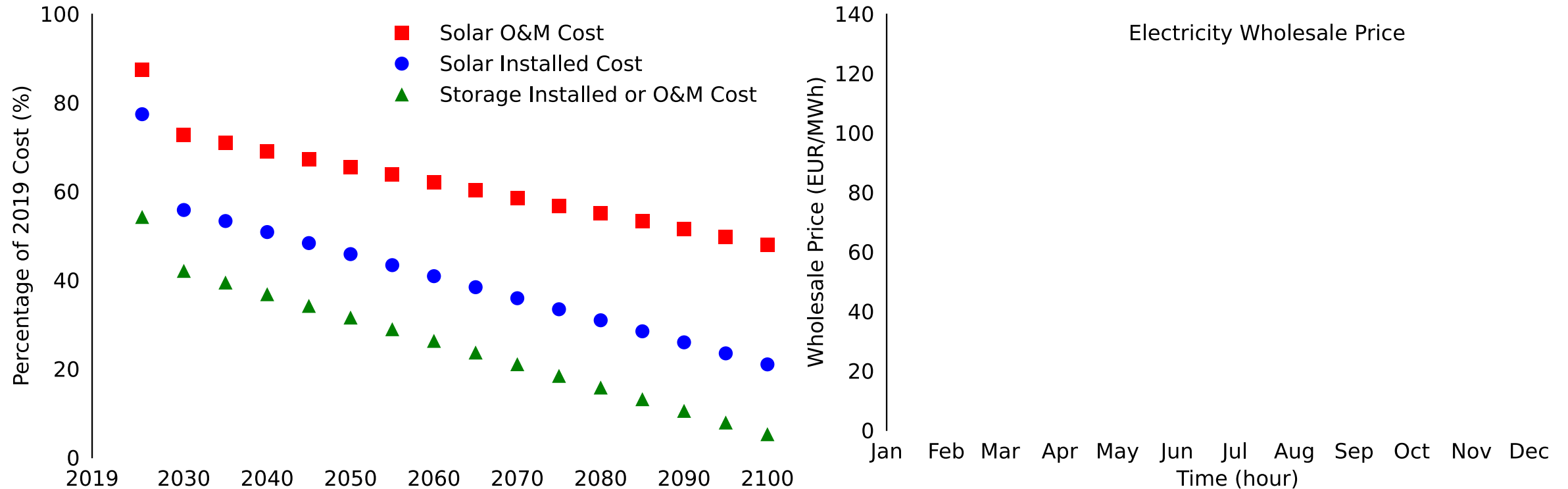Compare with annual domestic and non-domestic demand, find correction factors via linear regression, and scale

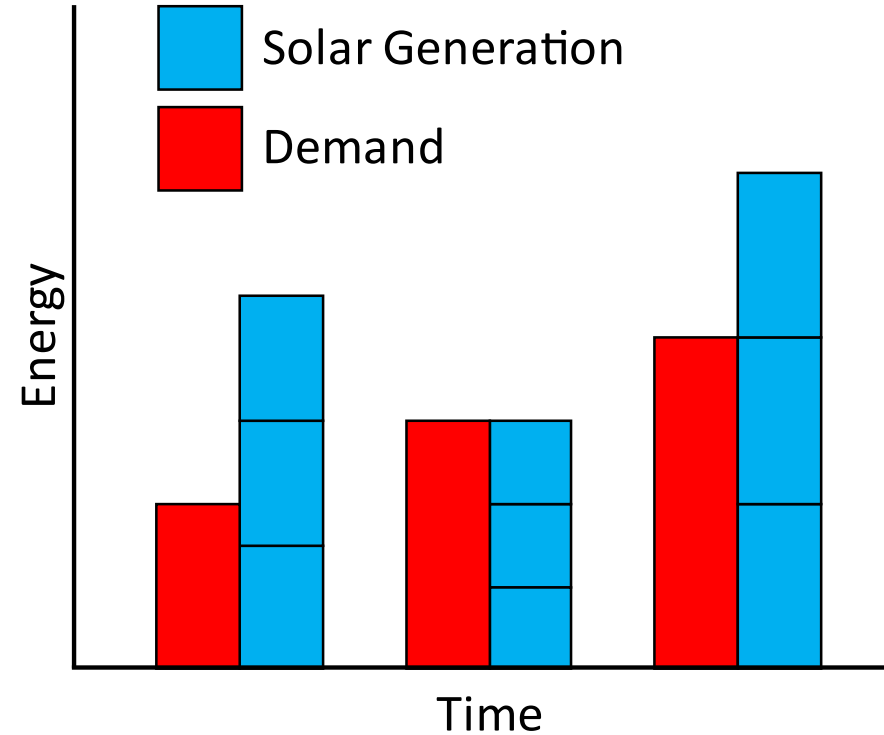Oxford's electricity demand profile
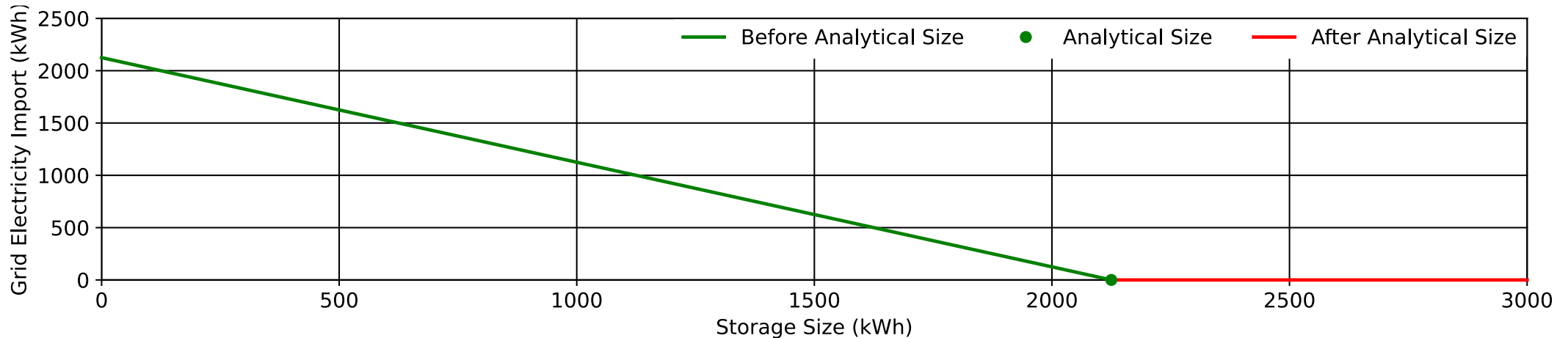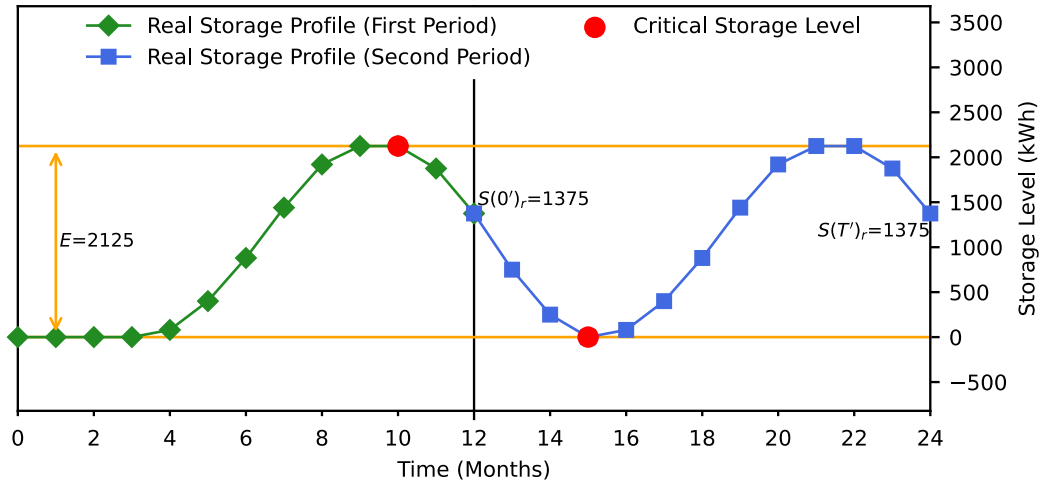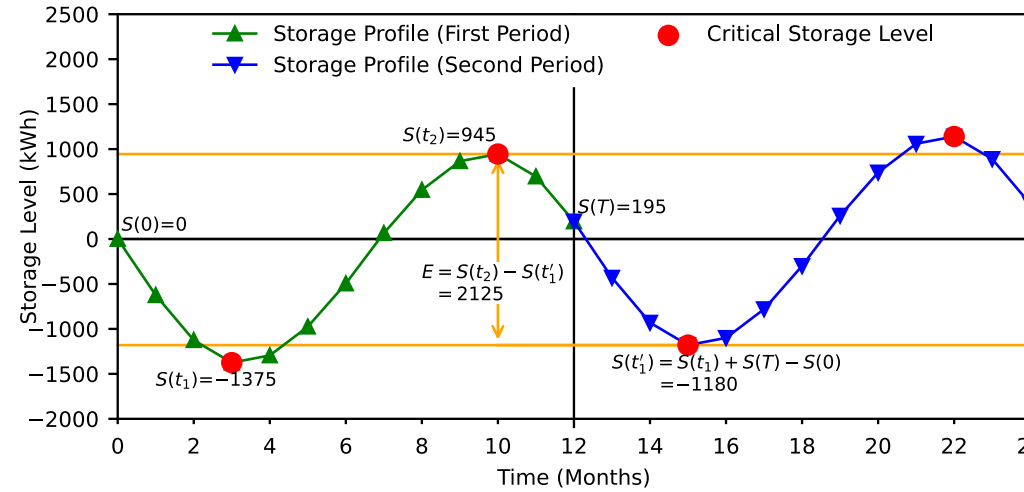
Generation Model

Cost Model

$$\text{LCOE} = \frac{\text{Solar Cost} + \text{Storage Cost} + \text{Electricity Import Cost}}{\text{Demand}}$$
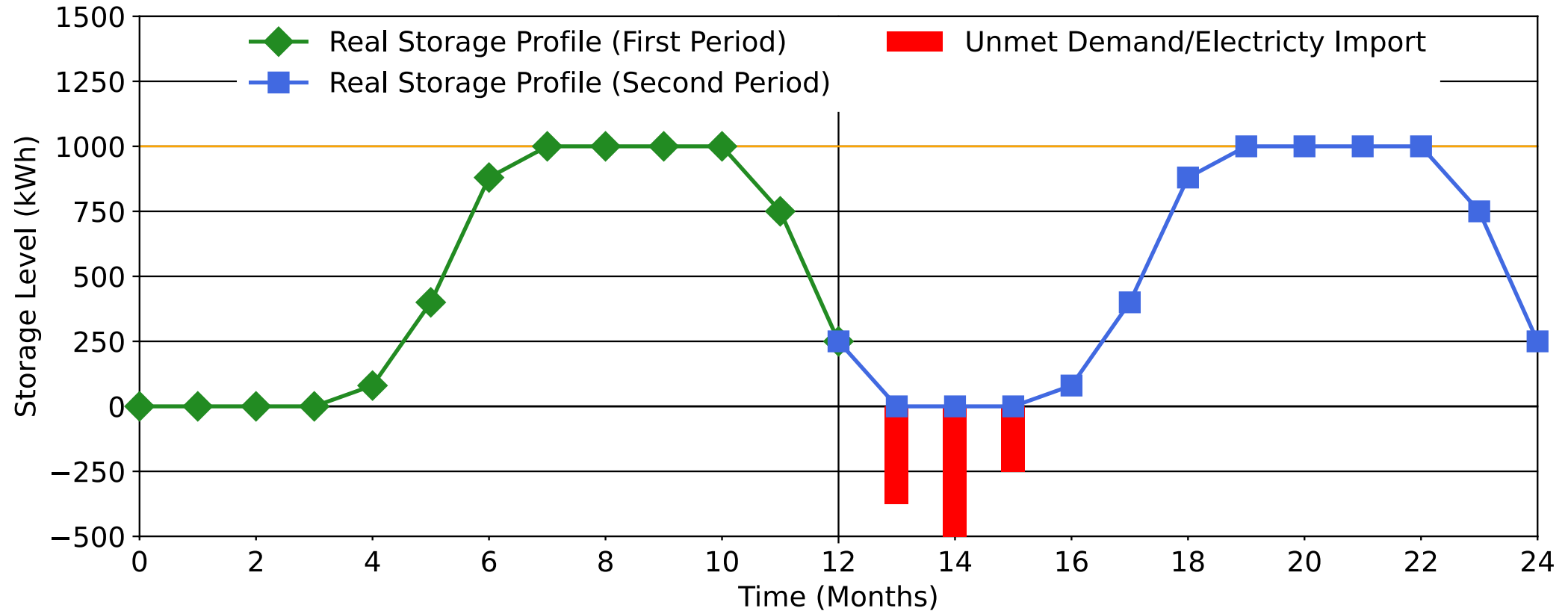
Sizing Method: Solar Size Range

$$\text{Max Solar PV Capacity} = \text{Max}\left(\frac{\text{Demand}}{\text{Capacity Factor}}\right)$$
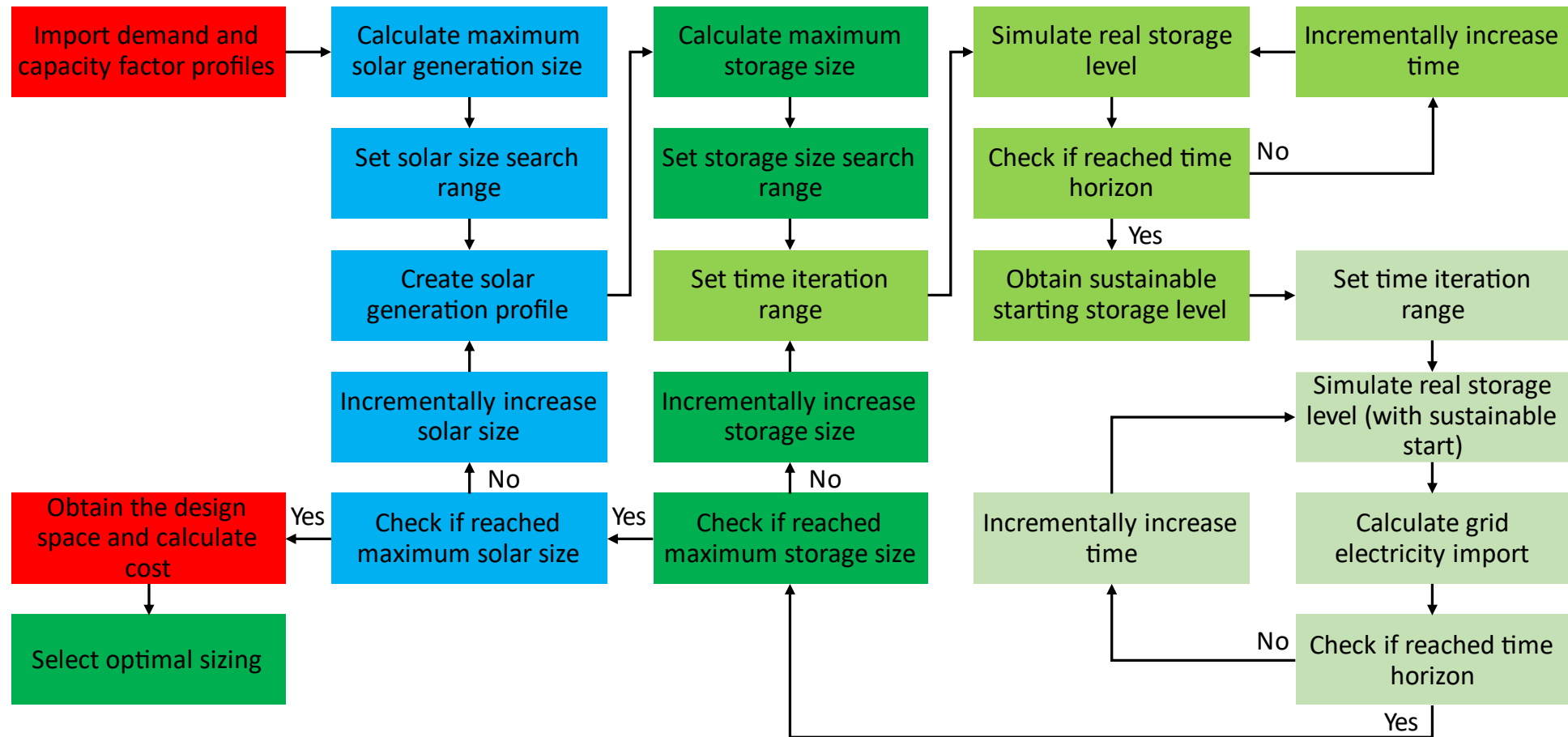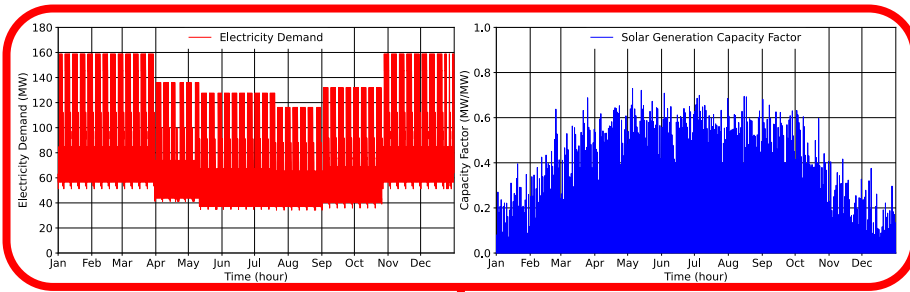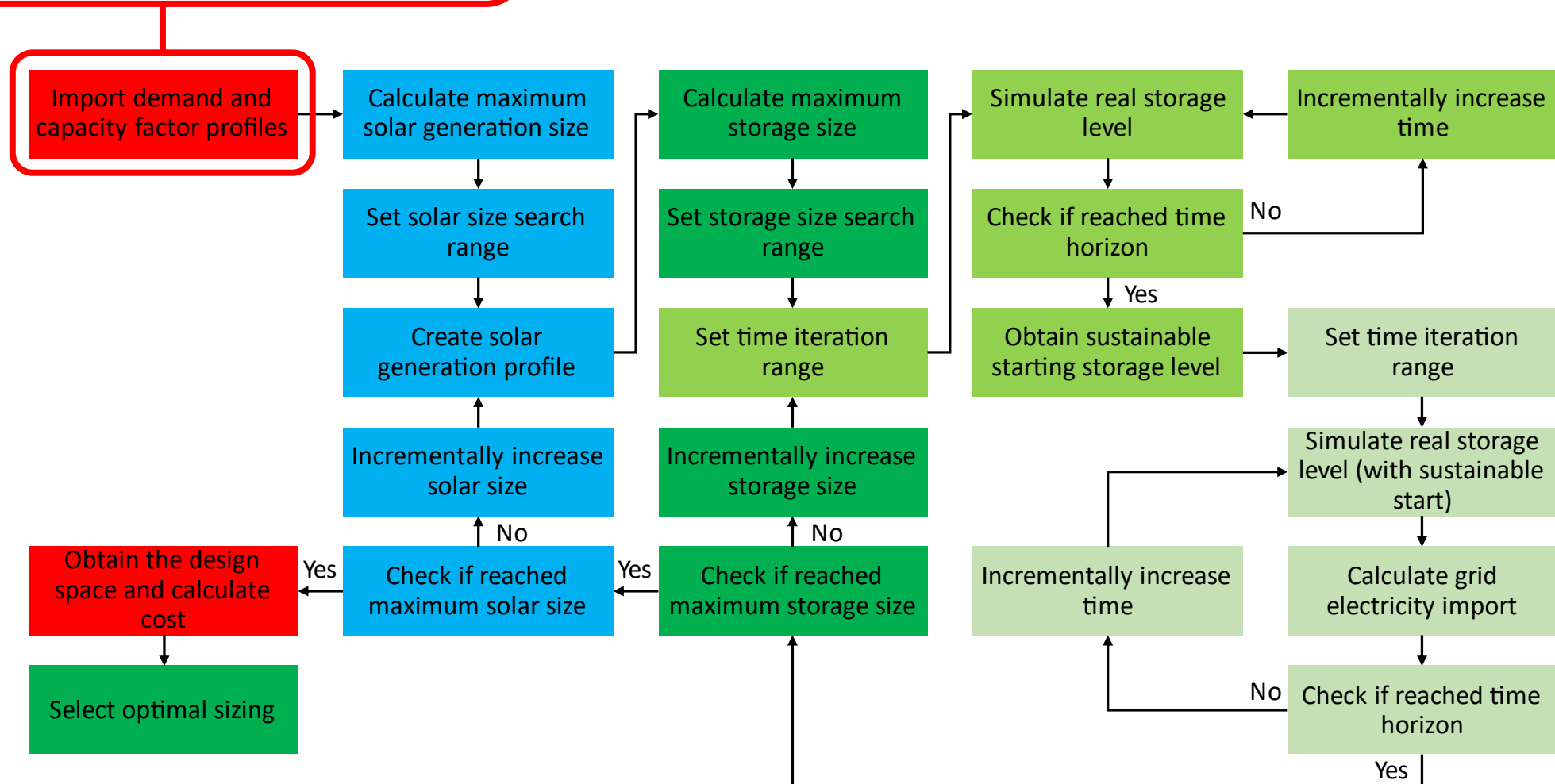
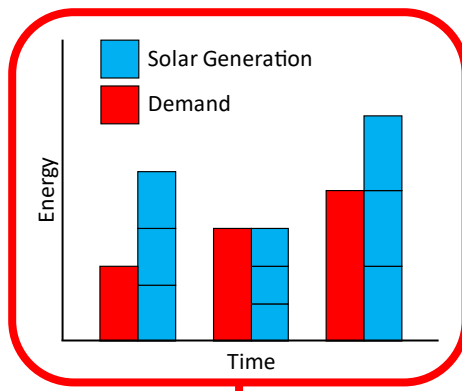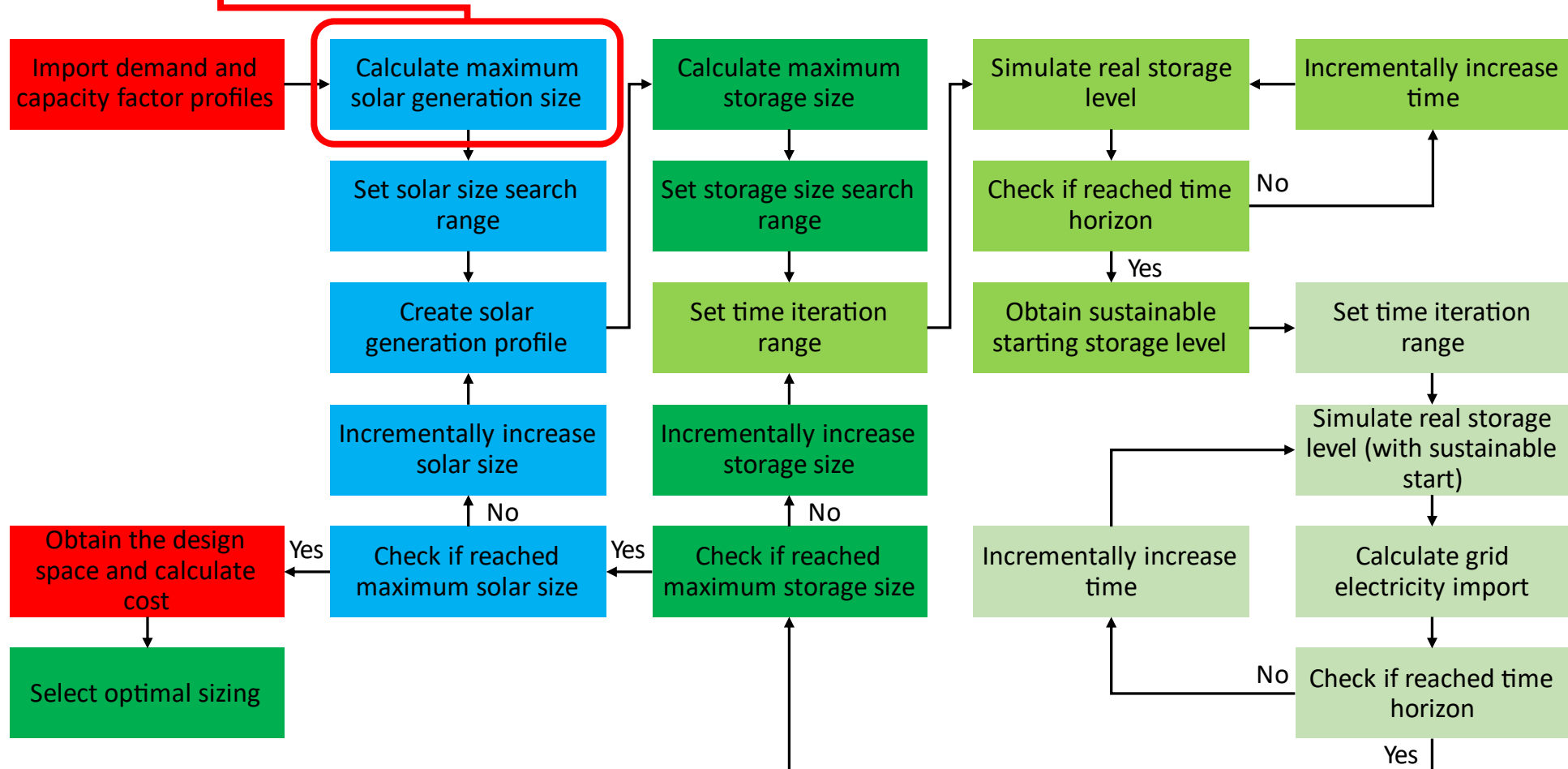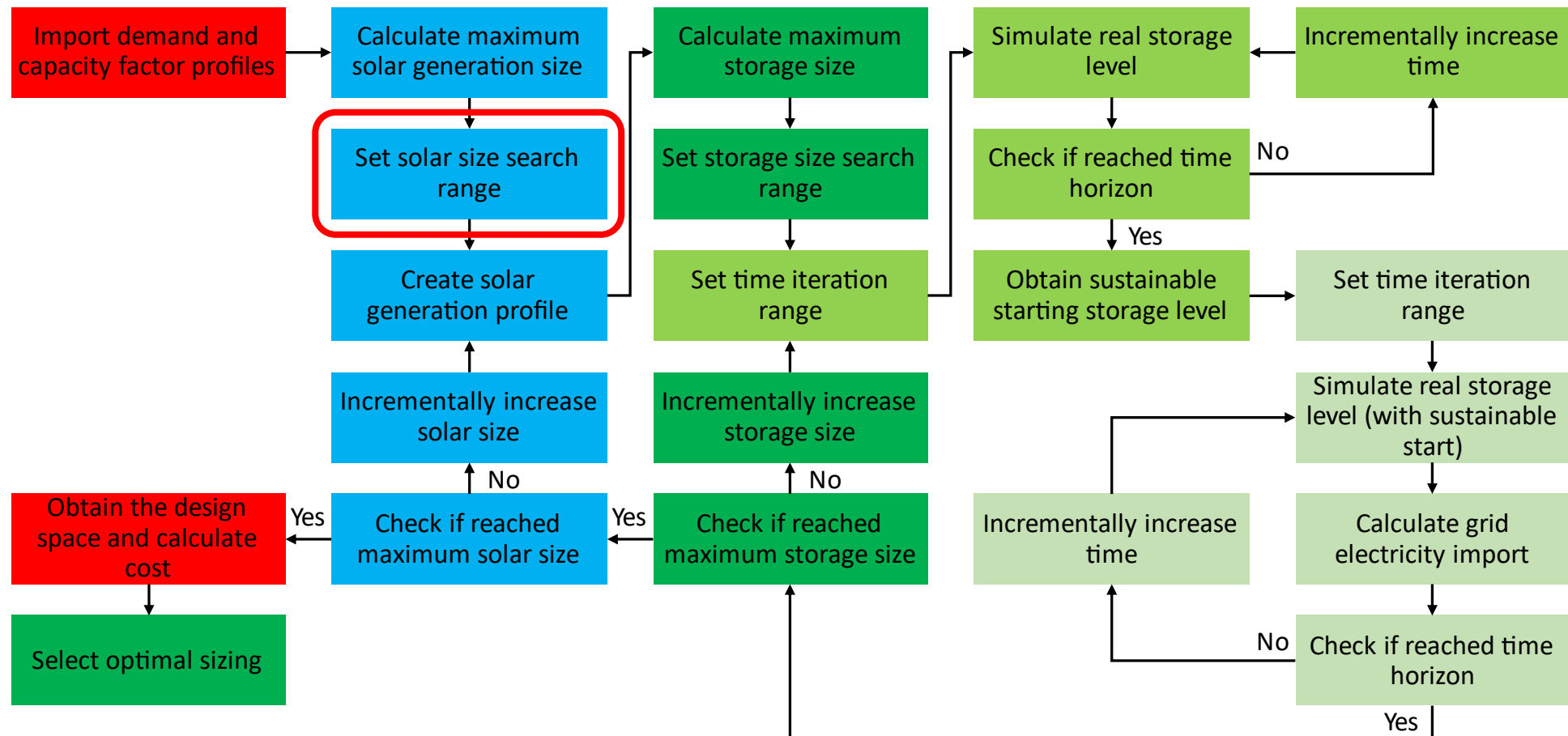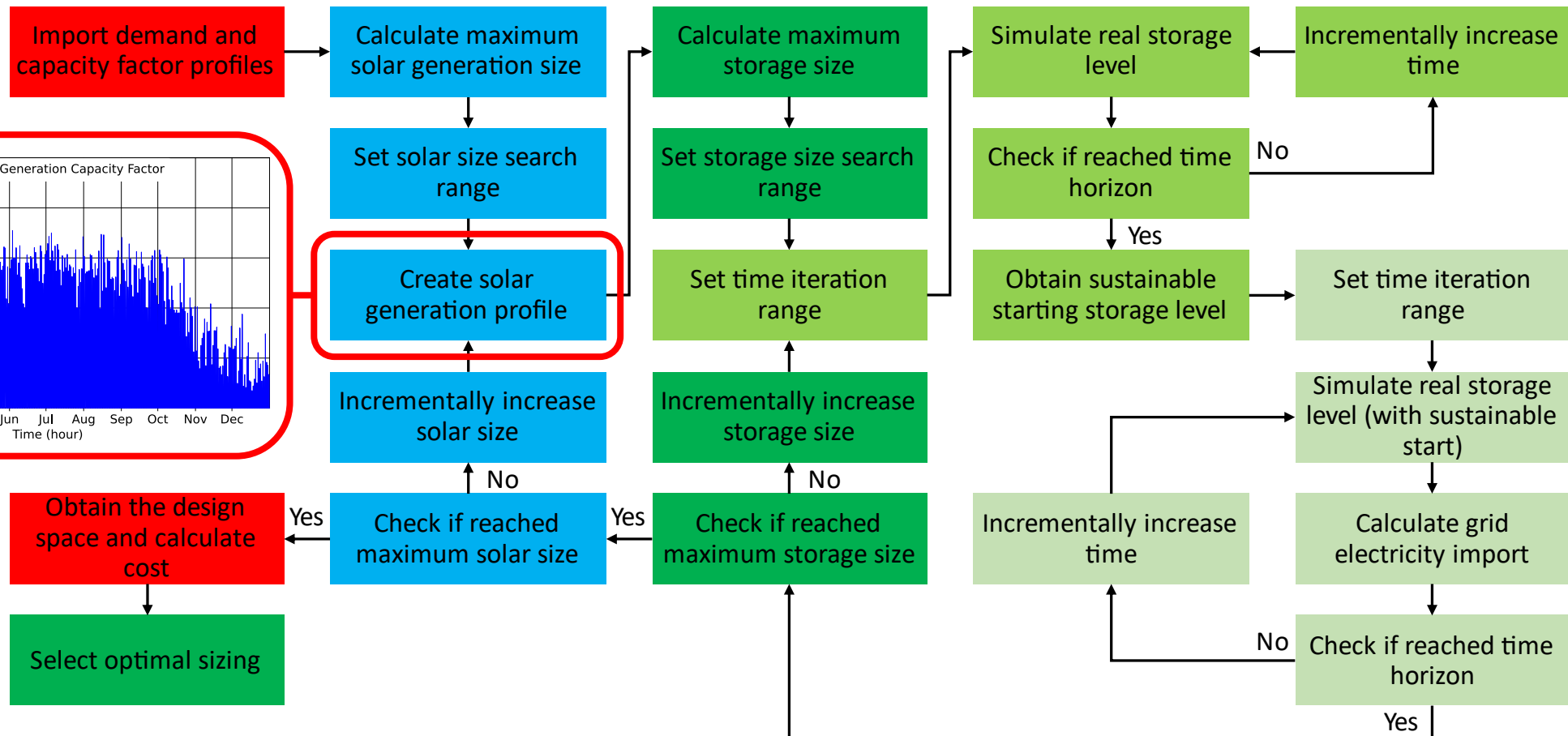# Sizing Method: Storage Size Range

Sizing Method: Electricity Import

Sizing Method

Sizing Method

Sizing Method

Sizing Method
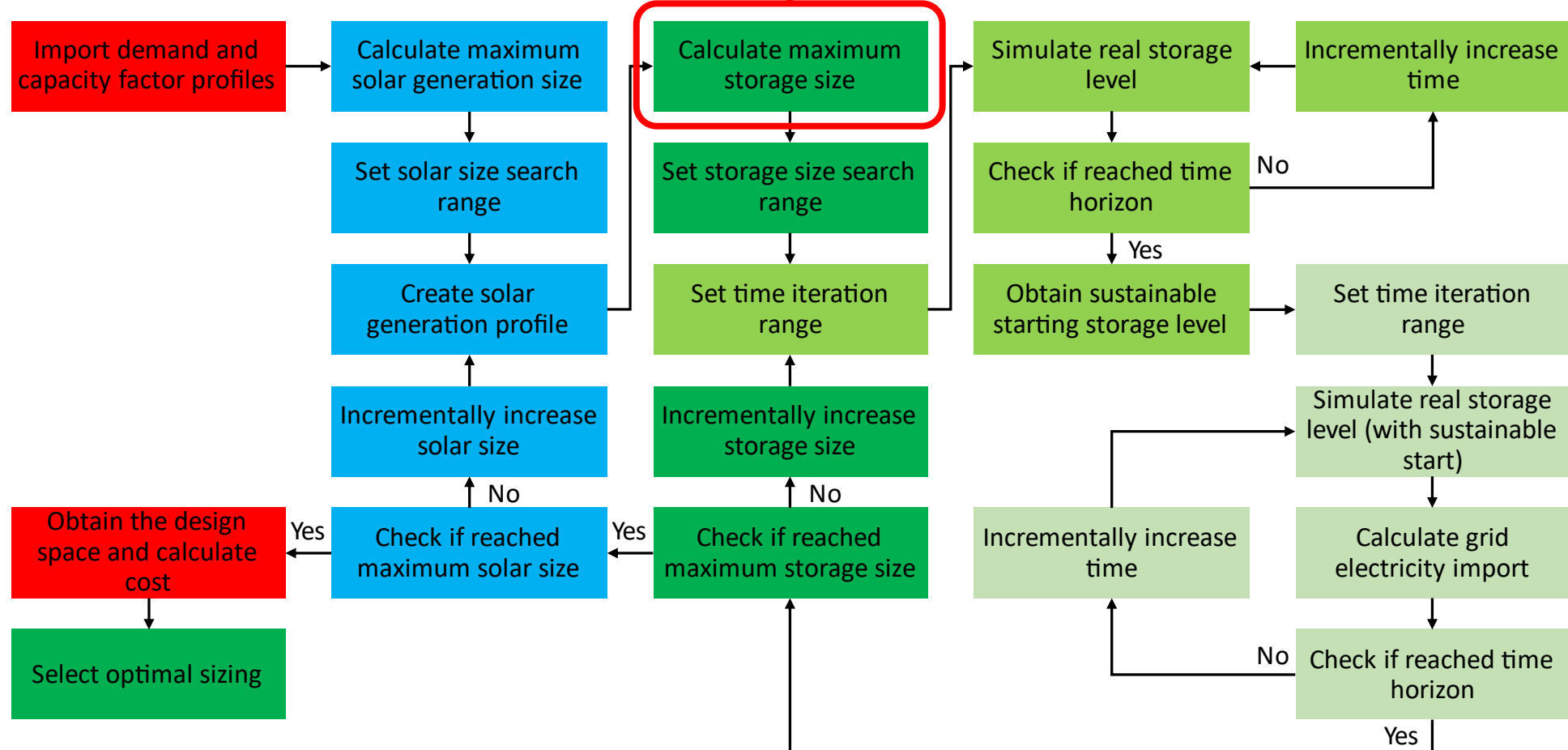
Sizing Method

Sizing Method

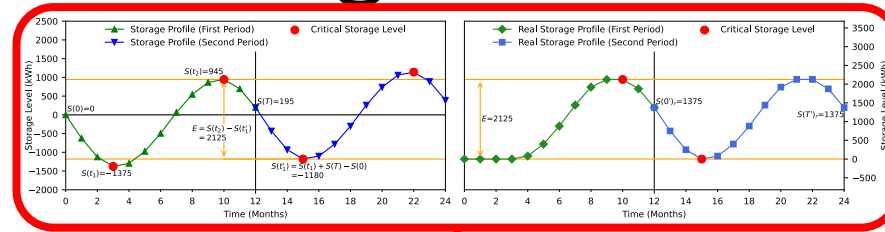# Sizing Method

Sizing Method

Sizing Method

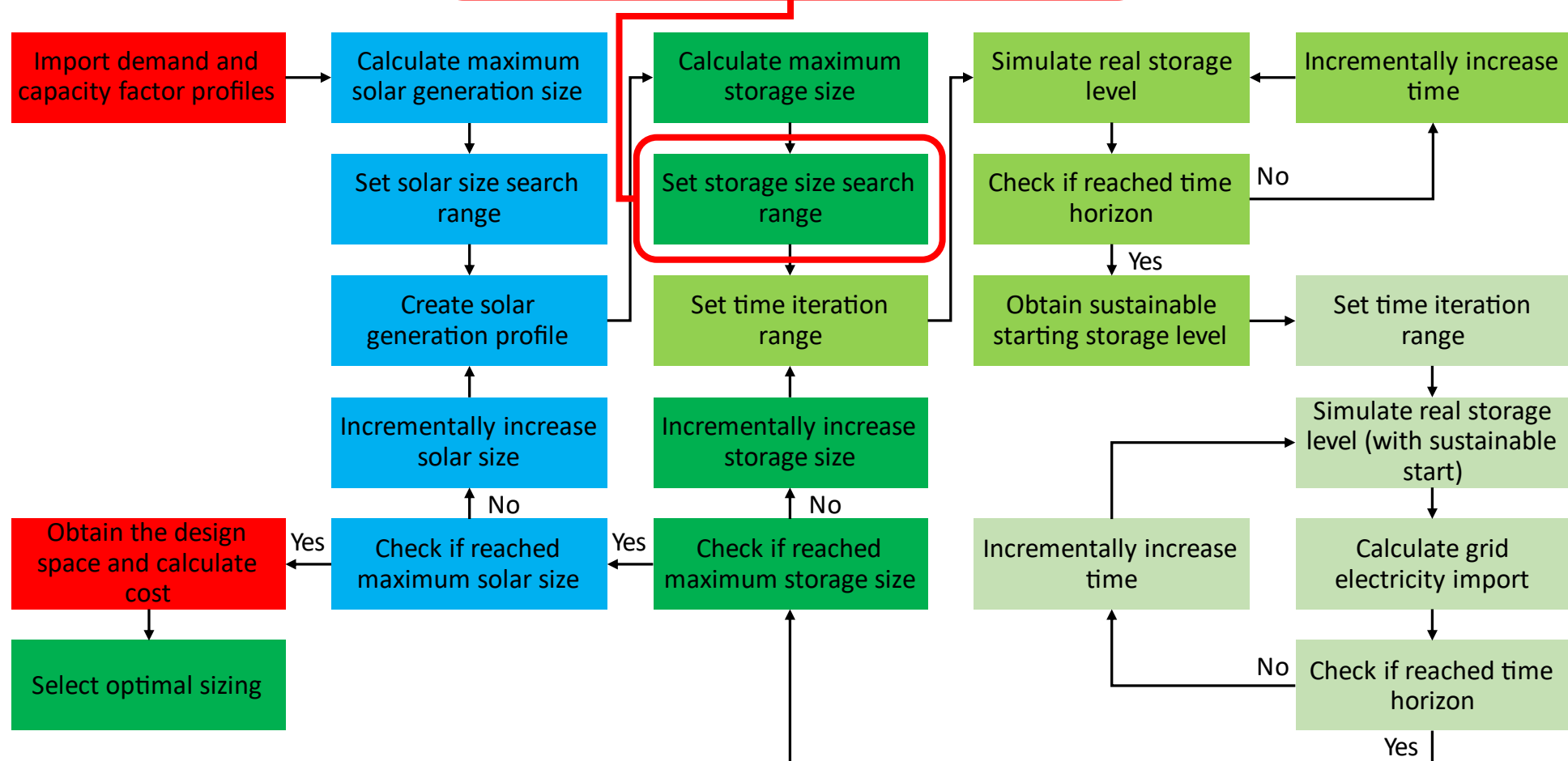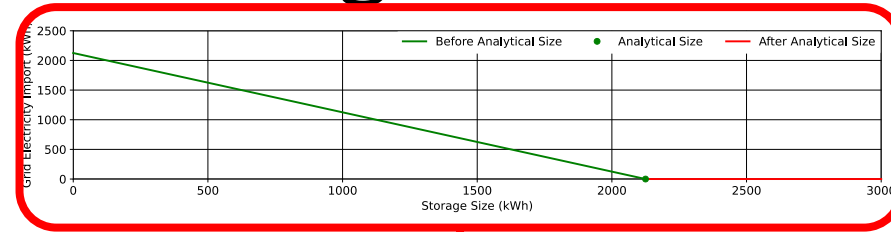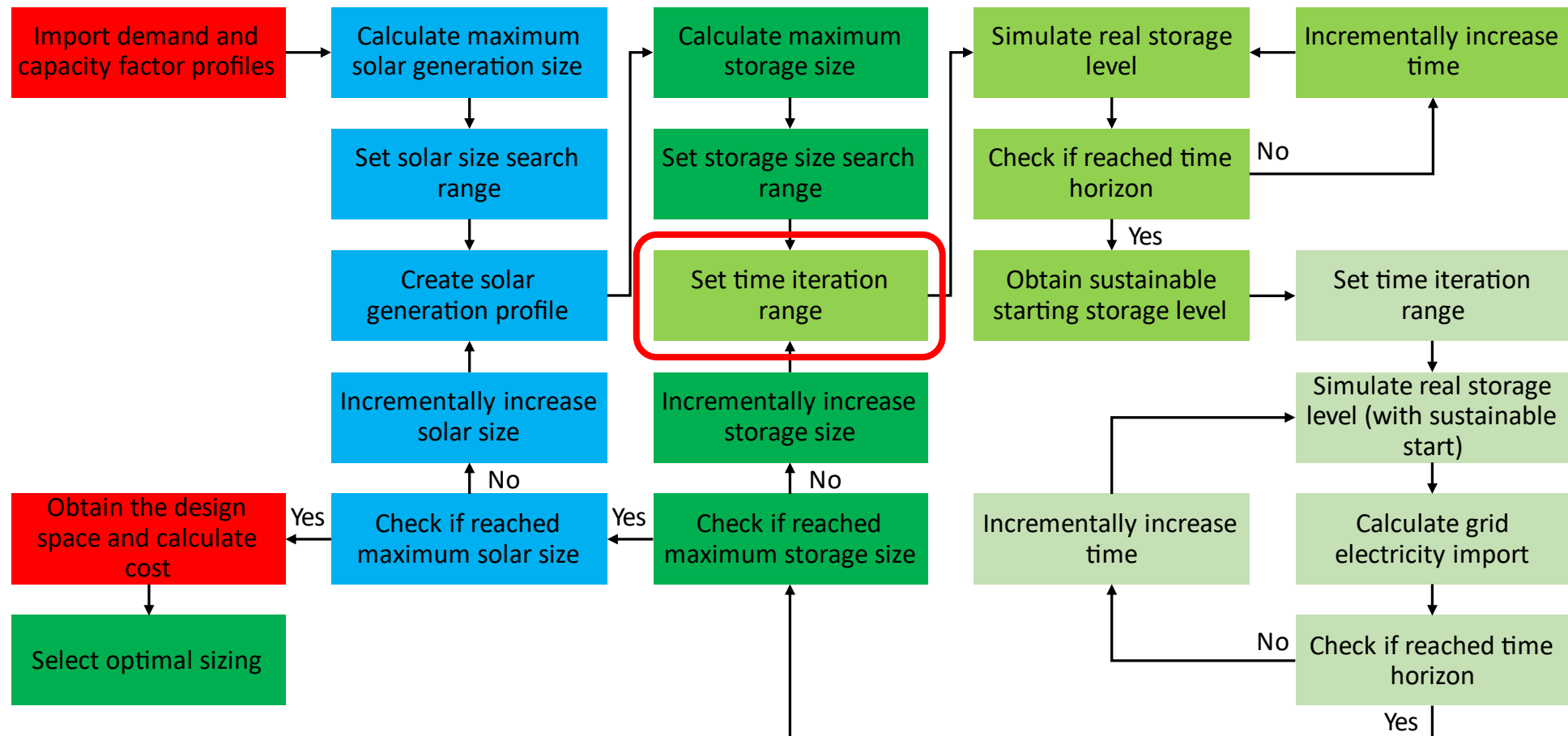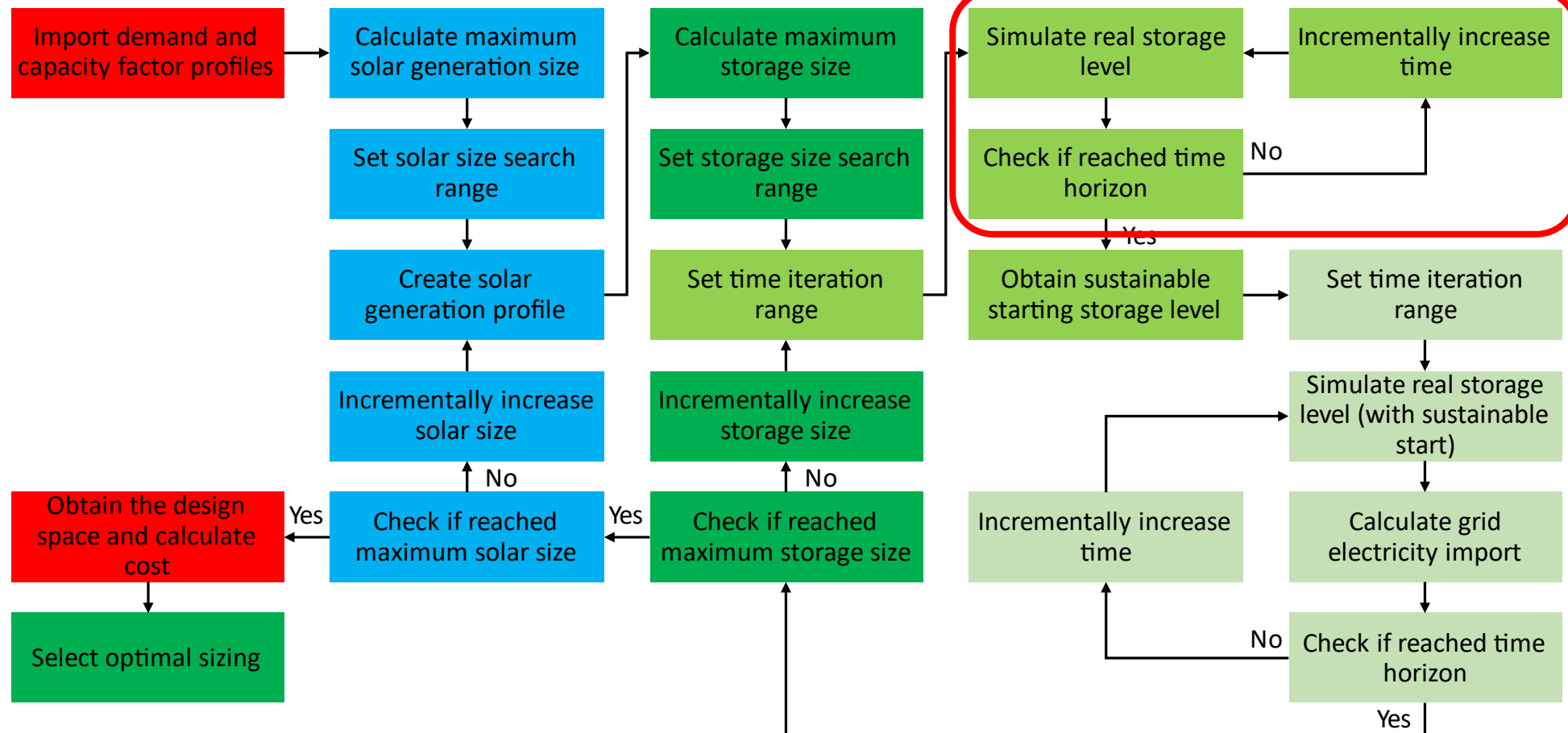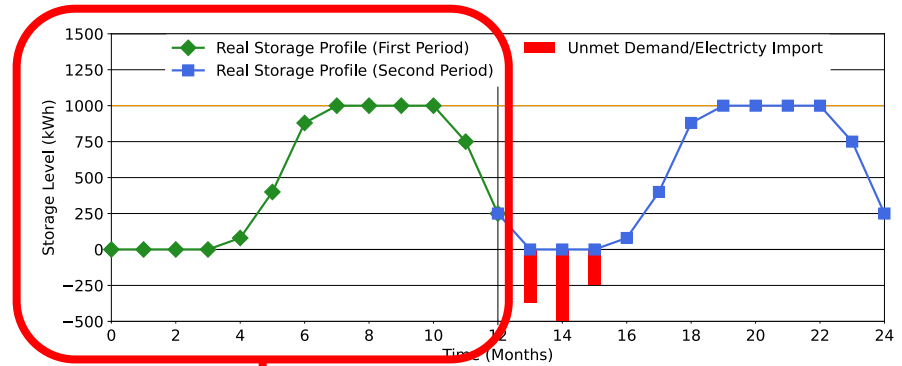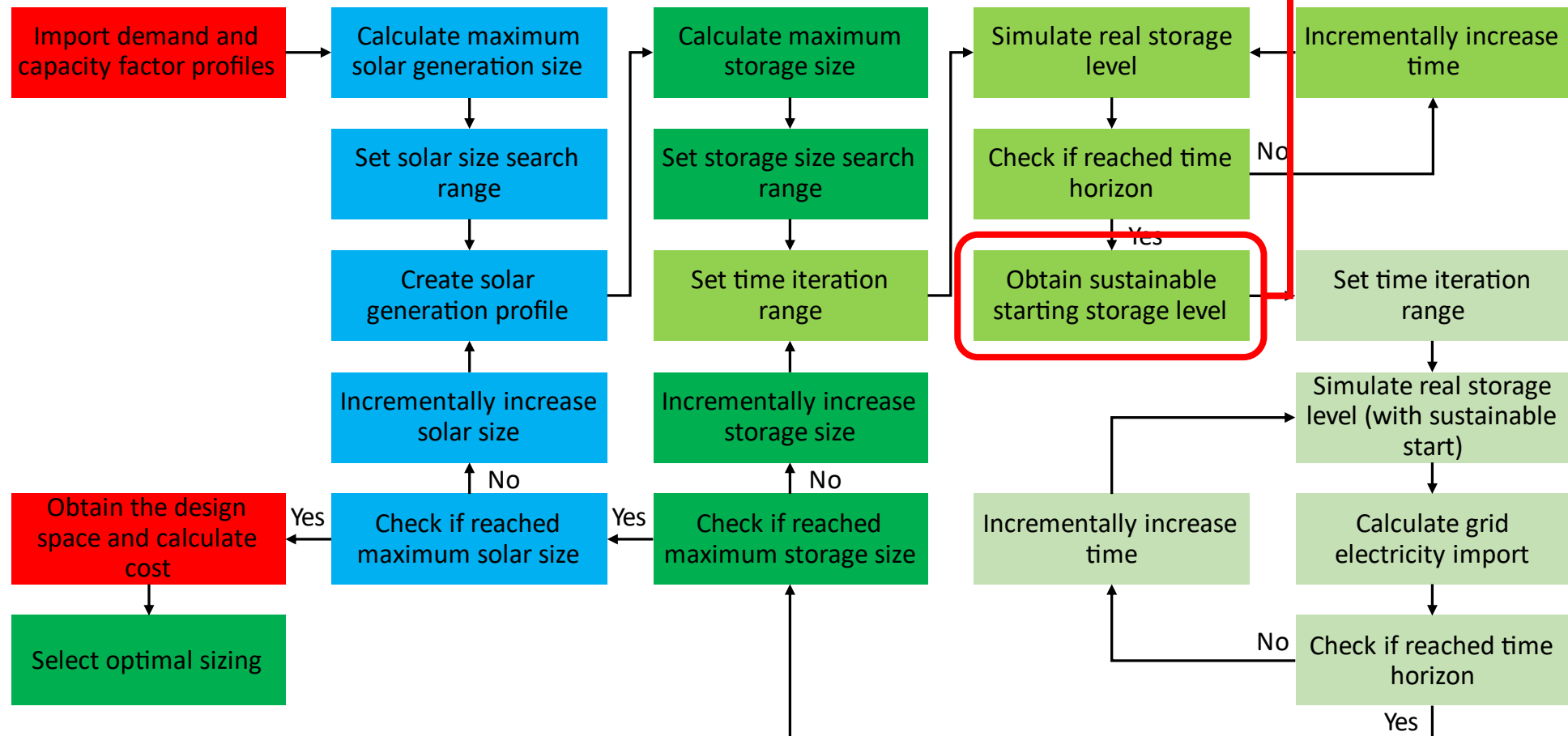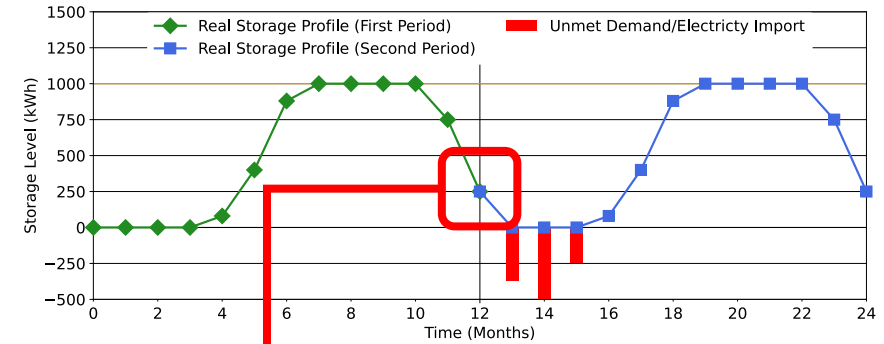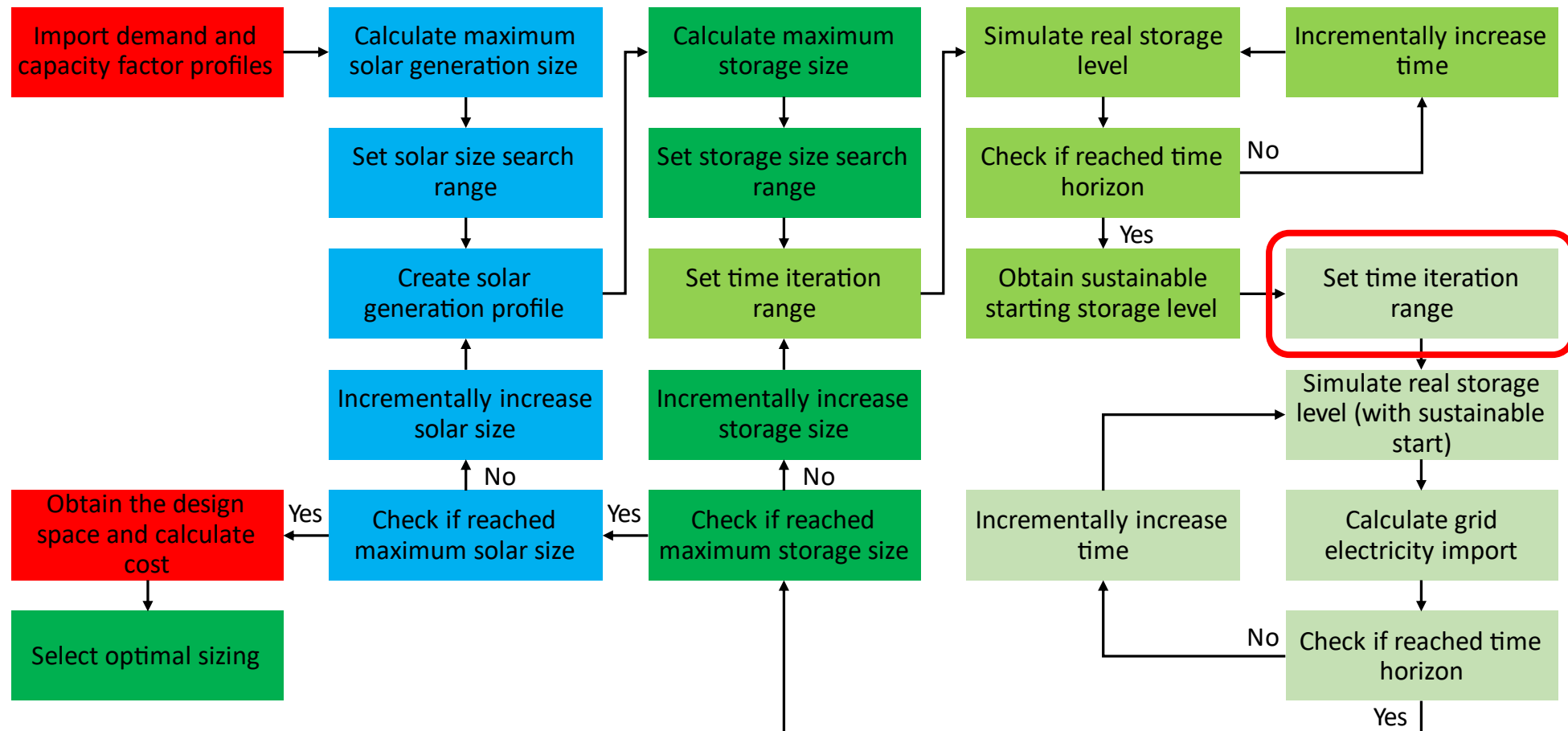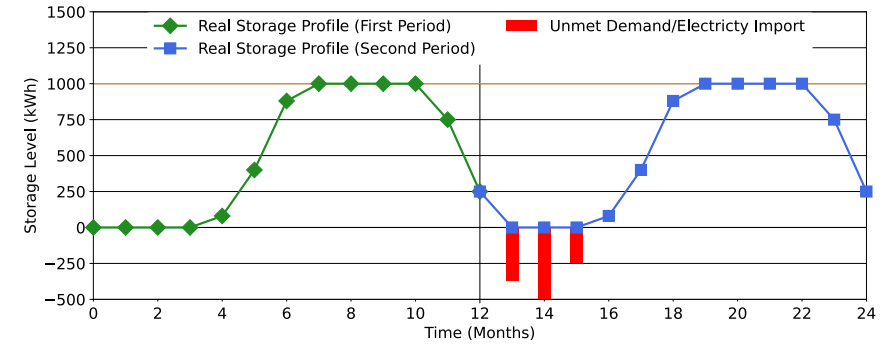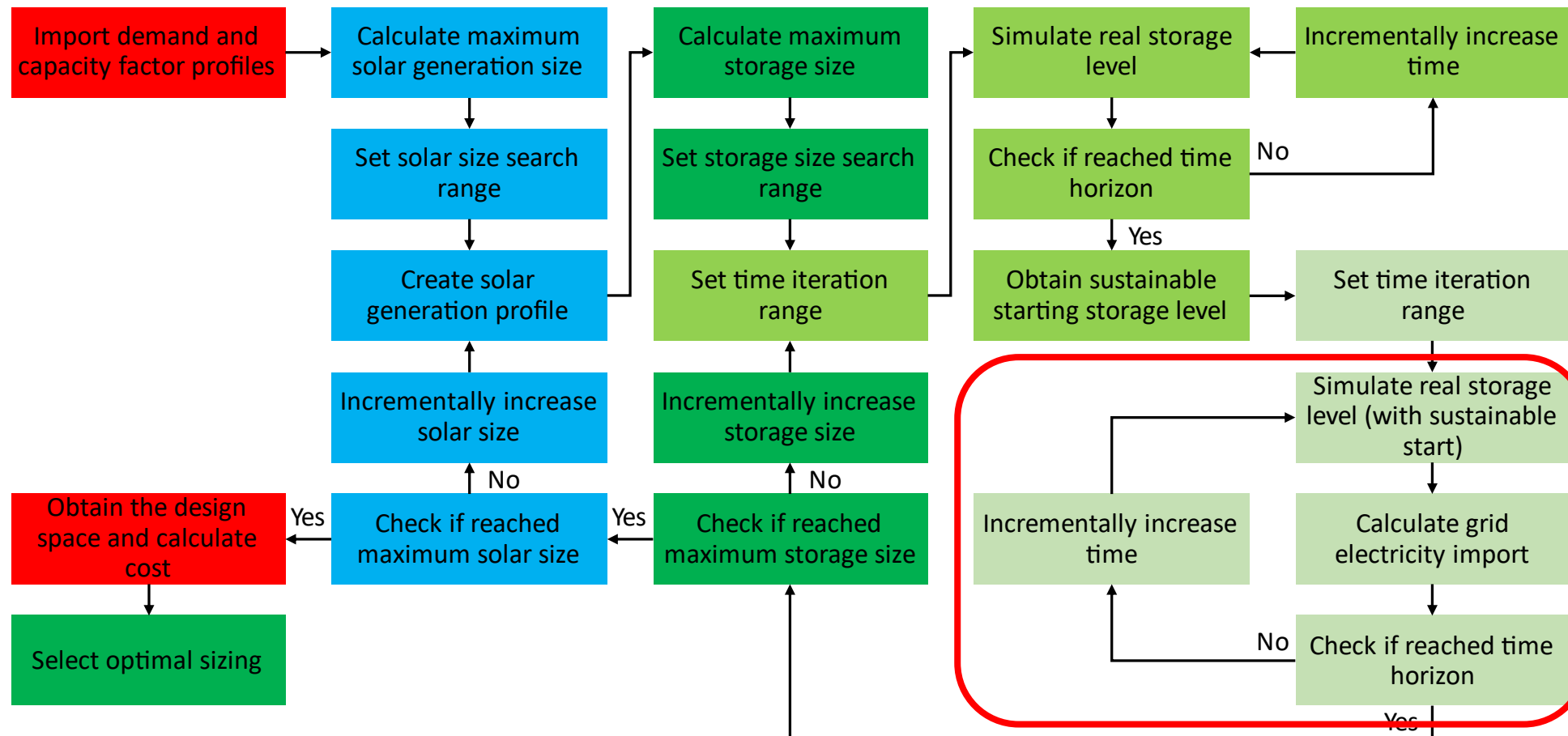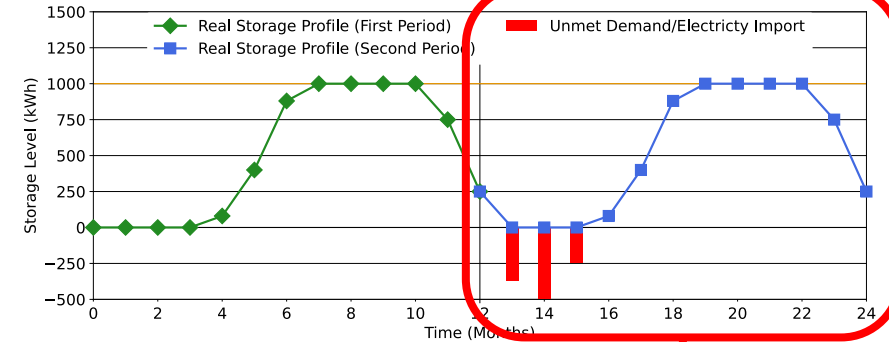# Sizing Method

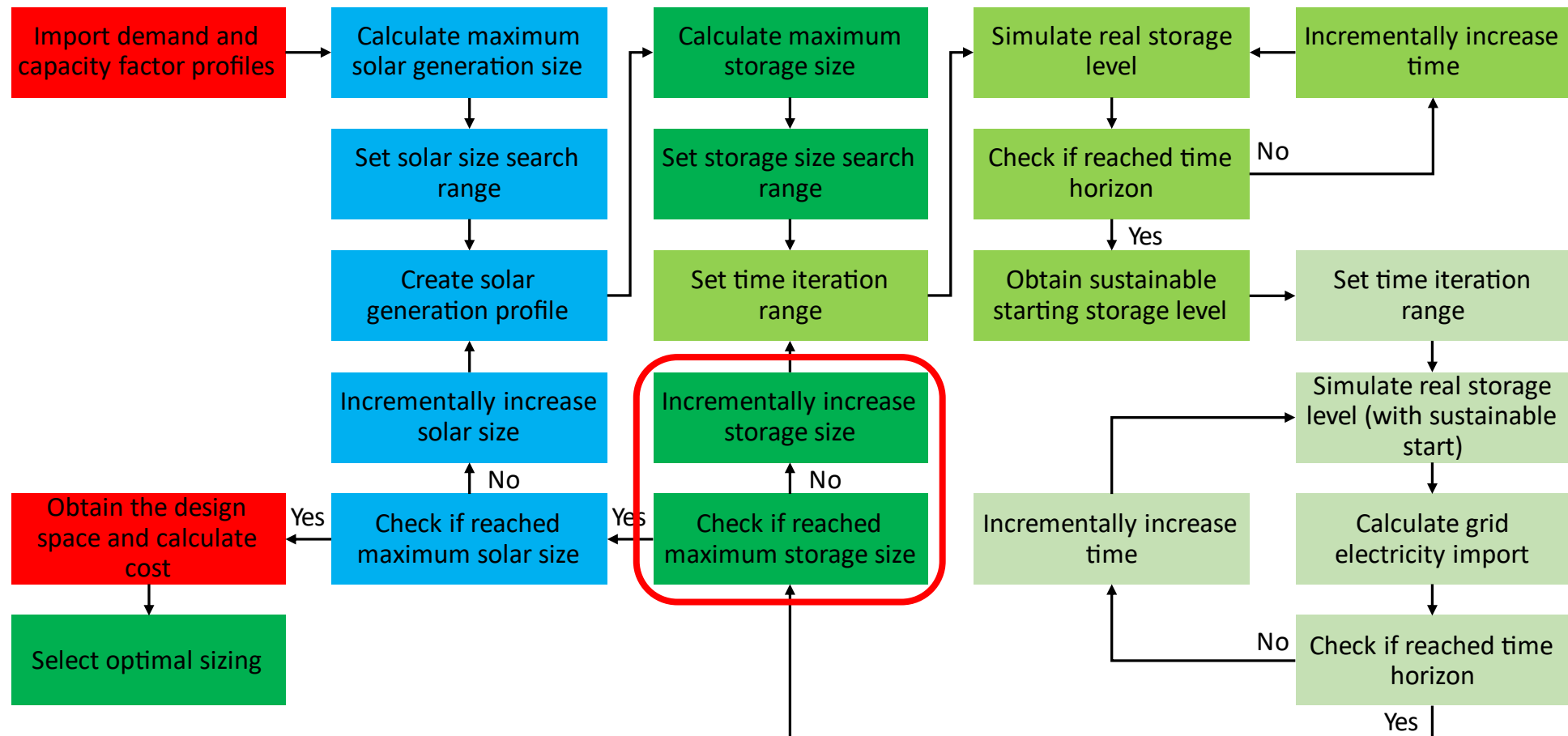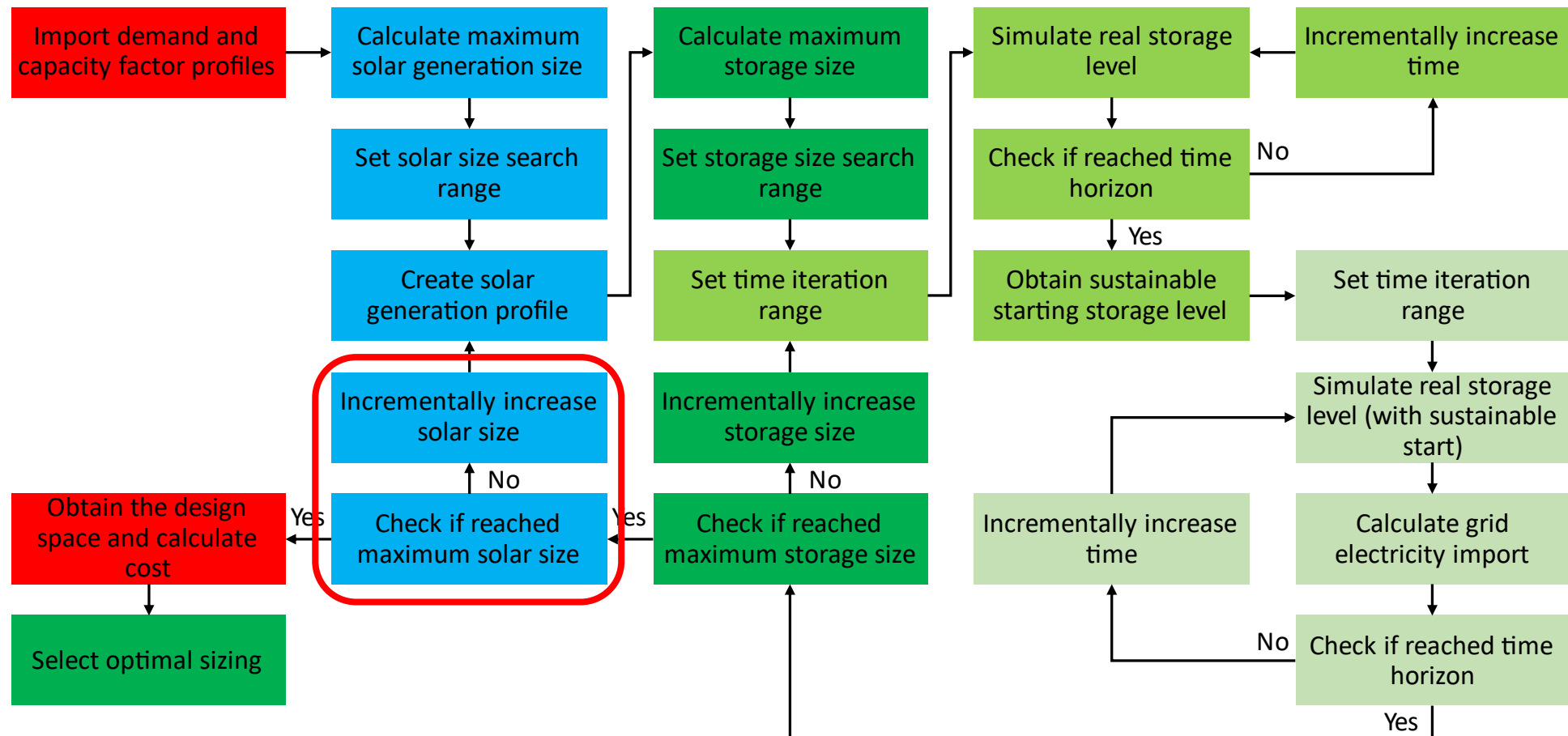# Sizing Method

Sizing Method

Sizing Method

Sizing Method
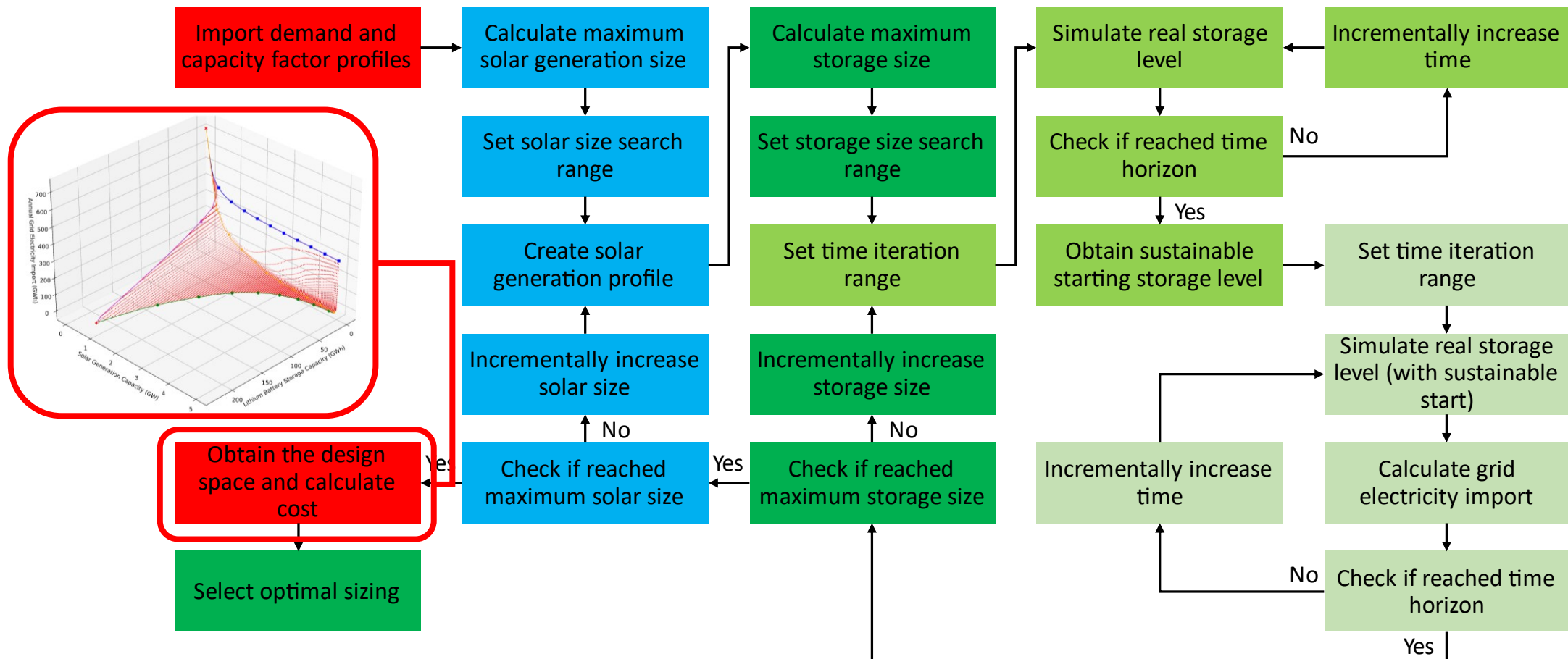
Sizing Method

Sizing Method
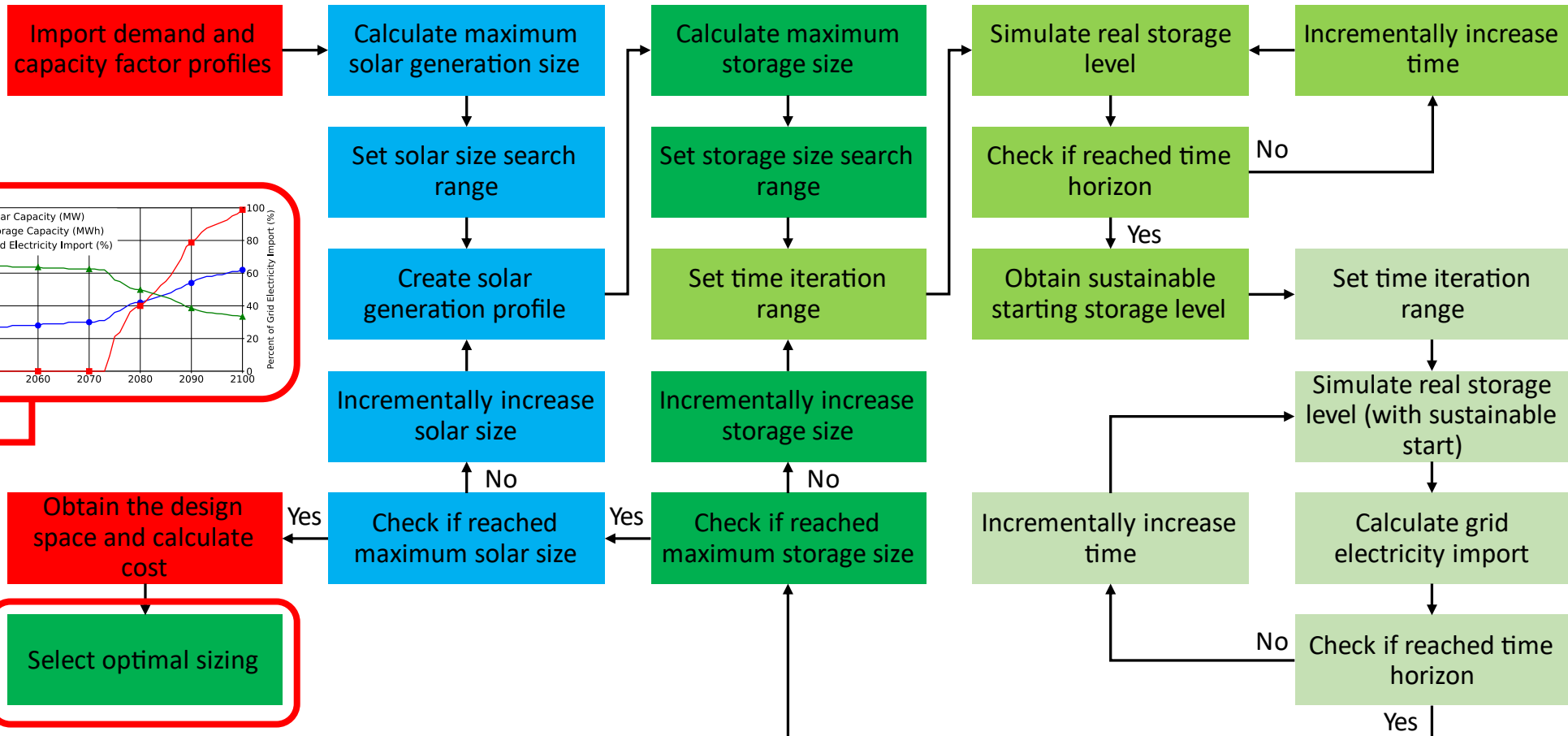
Design Space

Increasing solar size reduces grid electricity import. However, the reduction has a limit, as solar do not generate energy at night

For a particular solar size, increasing storage reduces grid electricity import. The initial reduction is large, but later reduction shows diminishing return

Small solar size cannot support independent energy system, the first solar size that can support the system also requires the largest storage
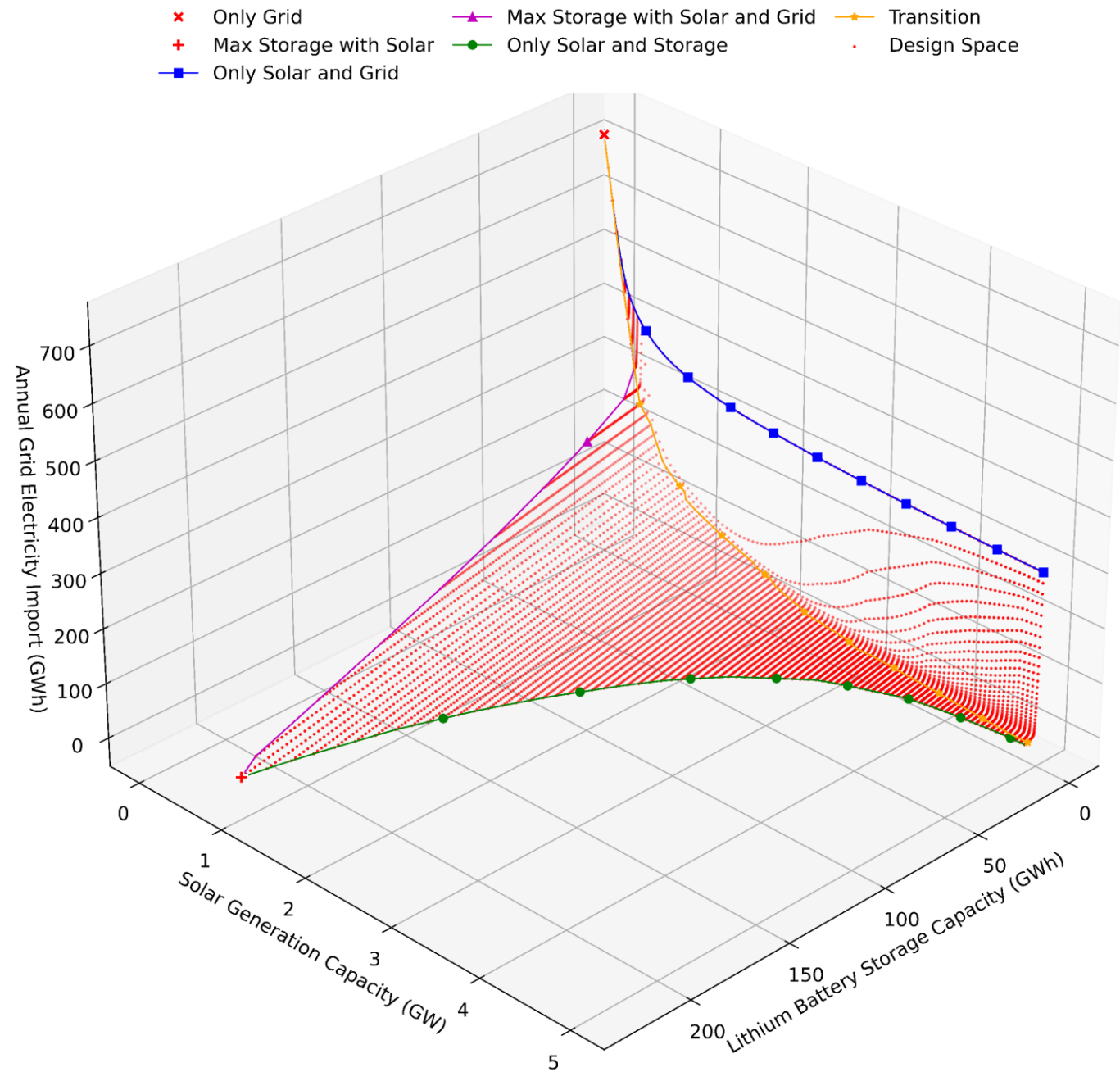
Future Trend

Conclusion

Currently

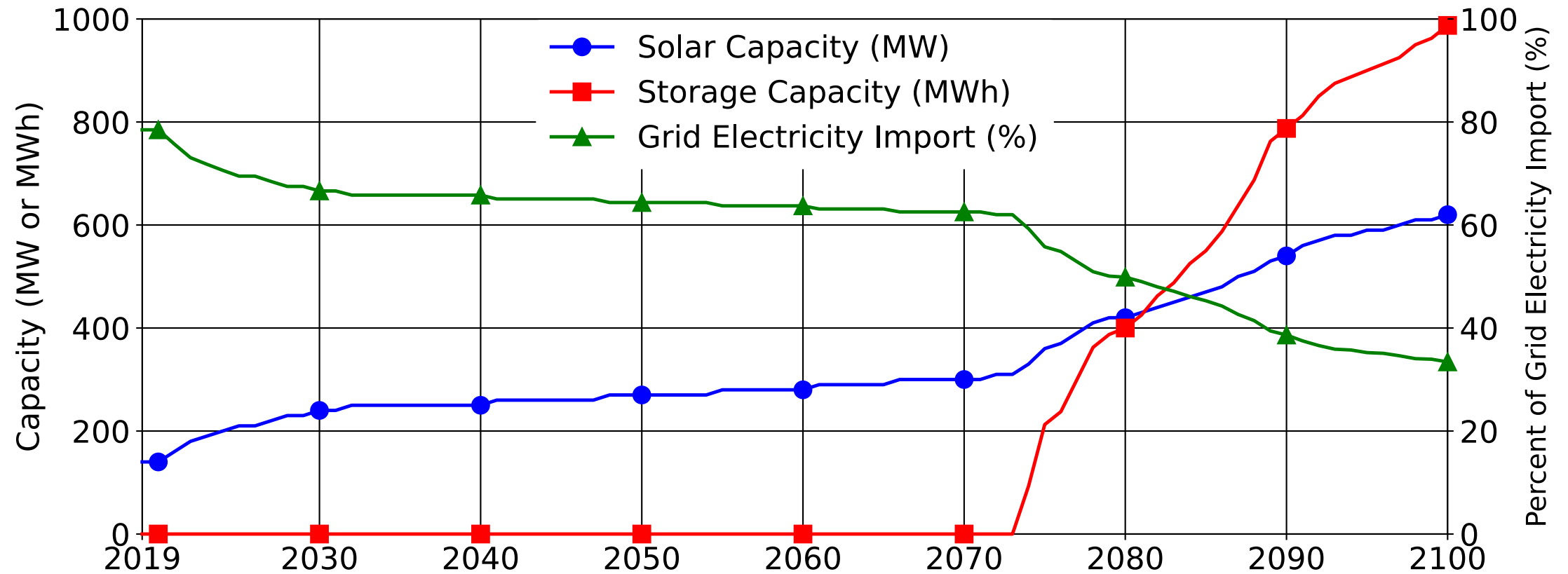Solar PV is economically competitive, but lithium battery storage is still too expensive.

Future

Solar and storage will take up greater portion of the energy system, as their prices continue to drop.

However

Flexible grid electricity is needed, to meet some demands too costly for solar and storage.

Question and Contact

Contact

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