Long Term Modelling

Capacity Expansion and NPV

Capacity expansion considers the:

- cost of retirements
- cost of new builds
- fixed operating costs and,
- variable operating costs

to:

- Maximise the NPV (Net Present Value) of the total costs of the system over a long-term planning horizon.

$$NPV = \frac{R_t}{(1+i)^t}$$

where:

- $R_t =$ net cash flow
- $i =$ discount rate
- $t =$ time of cash flow

NPV is used to determine the profitability of a certain project.

Capacity Expansion allows us to find out:

- How much to invest?
- What technologies to build?
- How many units to build?
- Where to build?
- When to build?

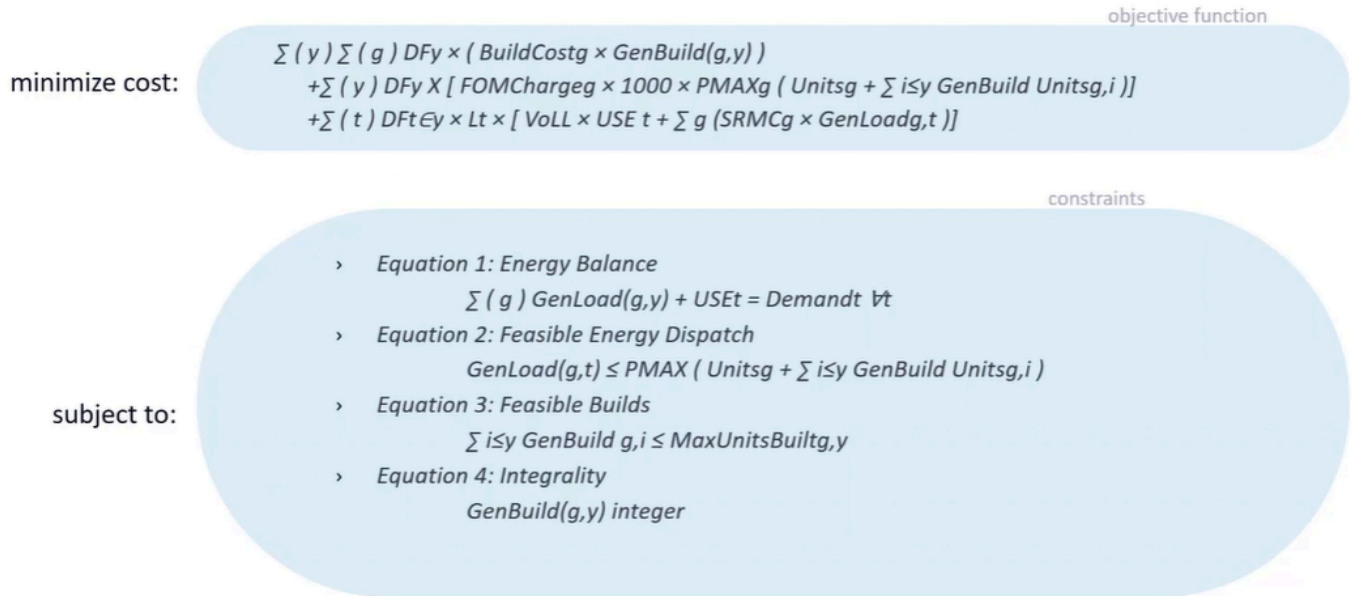
Within the LT object there are 2 components:

- Capital Costs $C(x)$ and,
  - One off fees i.e. new generators, transmission expansion, generator retirements
- Production costs $P(x)$
  - Operational costs i.e. operating existing and new builds of transmission network, notional cost of unserved energy.

The goal is to minimise NPV by formulating it as a Mixed-Integer Problem:

$$C(x) + P(x) = \text{Total Cost}$$

To formulate this you usually have an objective function: in this case to minimise costs and constraints that the equation is subject to. i.e.



Application in PLEXOS

In PLEXOS, there is an LT PLan Object where you can consider:

- Step Size: in years, can also consider overlap
- Chronology: Partial, Fitted Sampled
- Discount Rate: %, End Effects Method (Perpetuity, None), Discount/Expansion Period (Month, Quarter, Year)
- Transmission: Regional, Zonal, Nodal
- Expansion Algorithm: Linear Programming, Mixed Integer Programming