For each time , a demand of and a ‘*per unit’* availability for wind and for solar, we have of wind and , the effective residual load or mismatch is

Let be the balance of power at all times. because we cannot create or destroy energy.

If , we need backup power to cover the loads so that

If , we need curtailment to reduce the excess feed-in so that

KVL

Where:

* = Voltage difference across the component in a closed loop
* = Number of components in the loop

KCL

Where:

* = Power flow from node to node
* The sum is taken over all neighbouring nodes connected to node

Where:

* = Voltage (Volts)
* = Current (Amperes)
* = Resistance (Ohm)

Levelized Cost of Energy :

Where:

* ​ = Cost in year
* ​ = Energy generated in year
* = Discount rate
* = Project lifetime

Cost-optimal energy system

Subject to: meeting demand at each node, at time, ; availability time series; transmission constraints; capacity geographical potentials; and emissions (