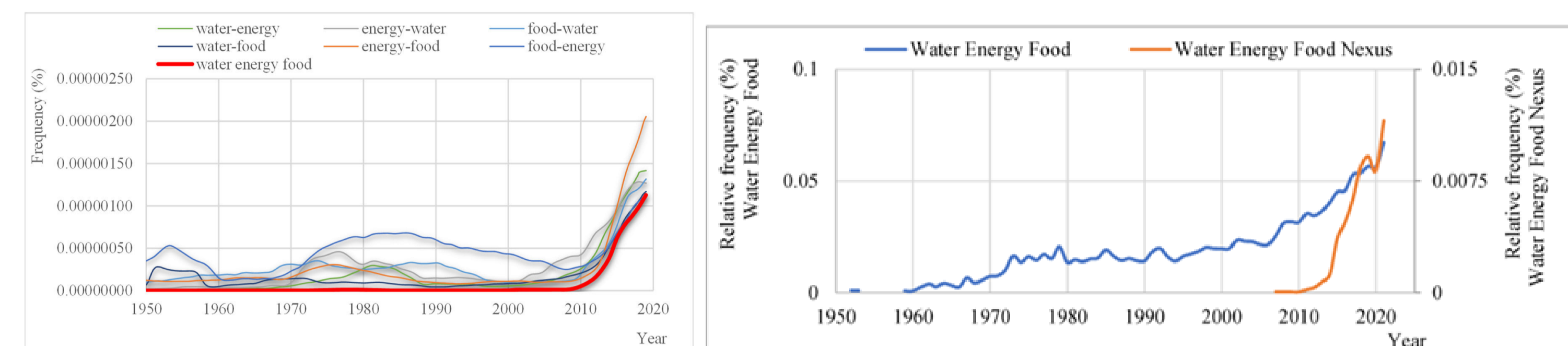
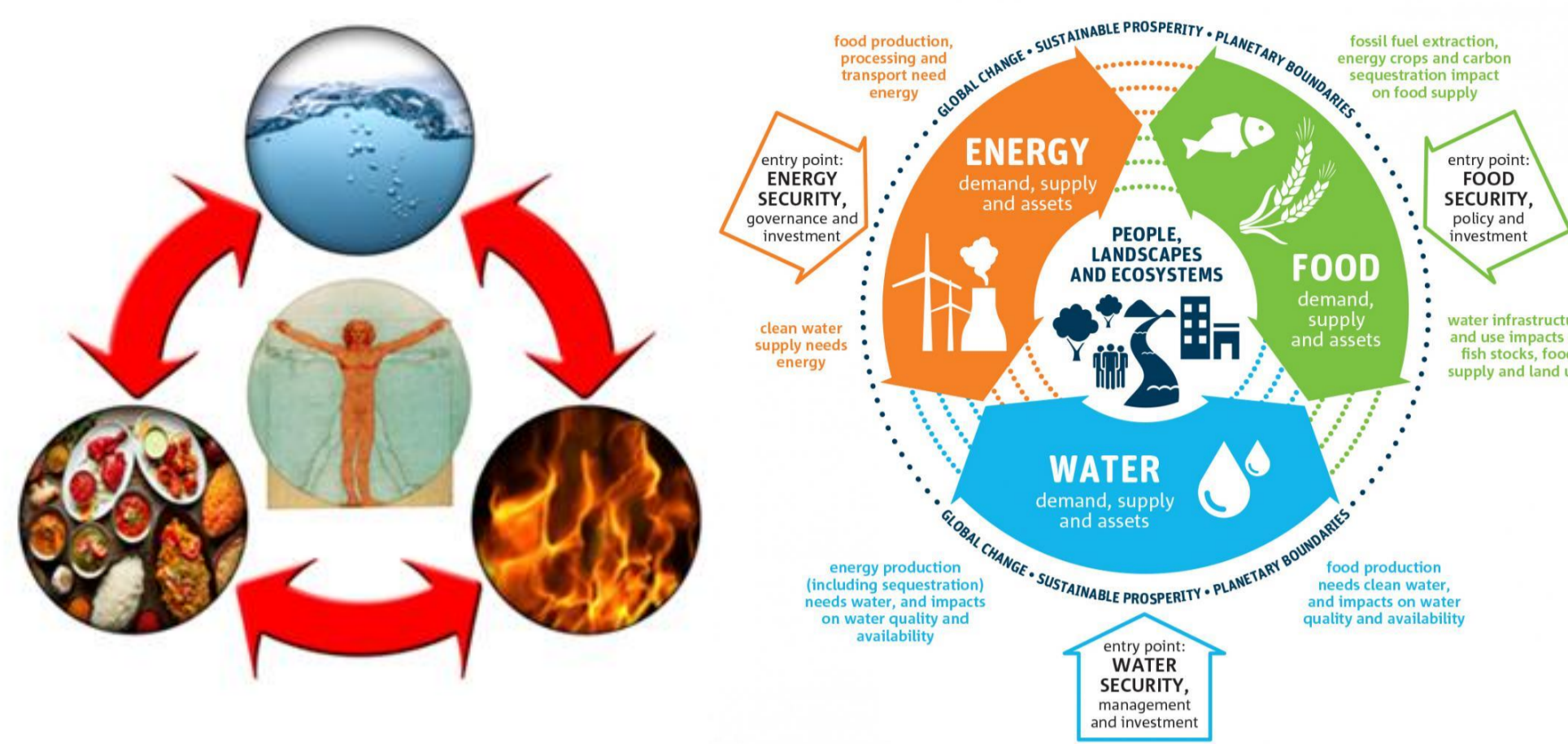


1. Introduction

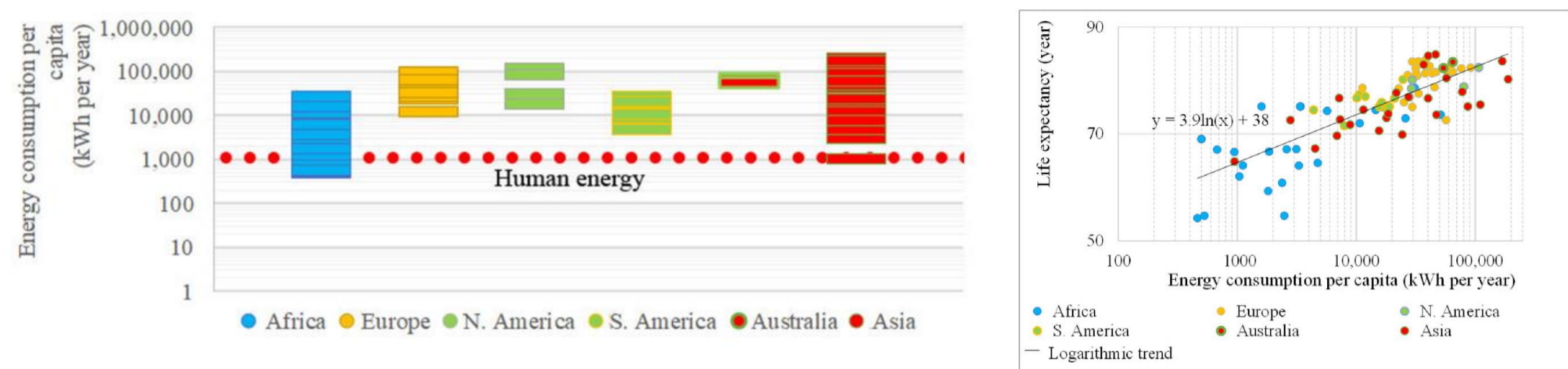
The basic human needs related to water, energy and food (WEF) compose a nexus that is not only necessary for the survival of humans, but is able to explain their prosperity as well. This nexus is extended by the addition of land, as land is a fundamental source for the support of water-energy and food.

It is important to note the interactions inside the water-energy-food nexus: water can give energy (hydropower) and multiply the production of food (irrigation), energy inputs produce food but also could pump underground water, food can be assumed as an energy source (for livestock and humans) and contains water.

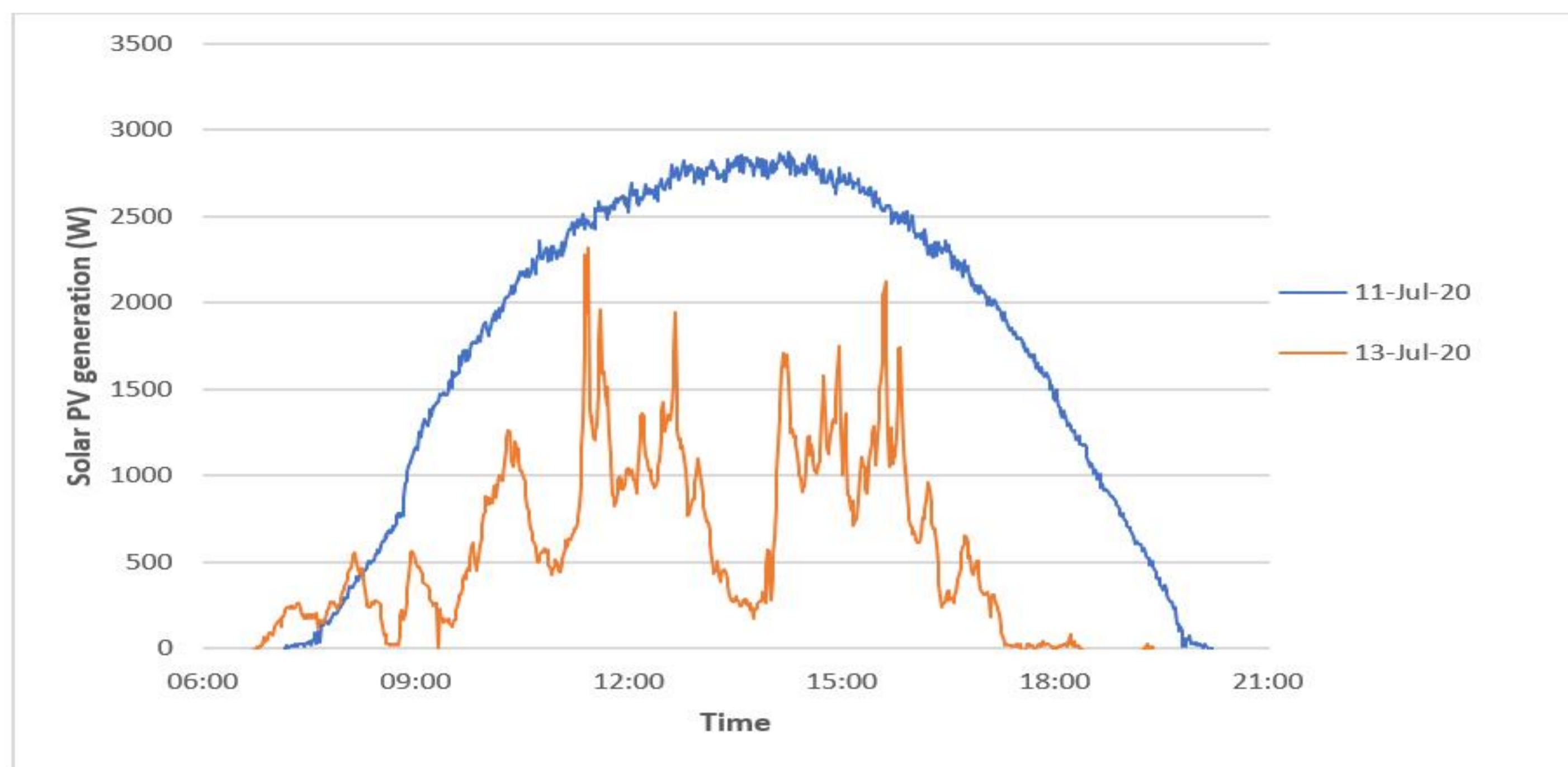
Half of the energy provided by the sun is being consumed in the water cycle, and its consumption is a necessary condition for human life. A small part of the other half is being used to convert inorganic matter to organic matter. Humans consume a small part of the organic matter as food (animals, plants) and another part as energy (wood, oil, etc.), which is essential for prosperity.



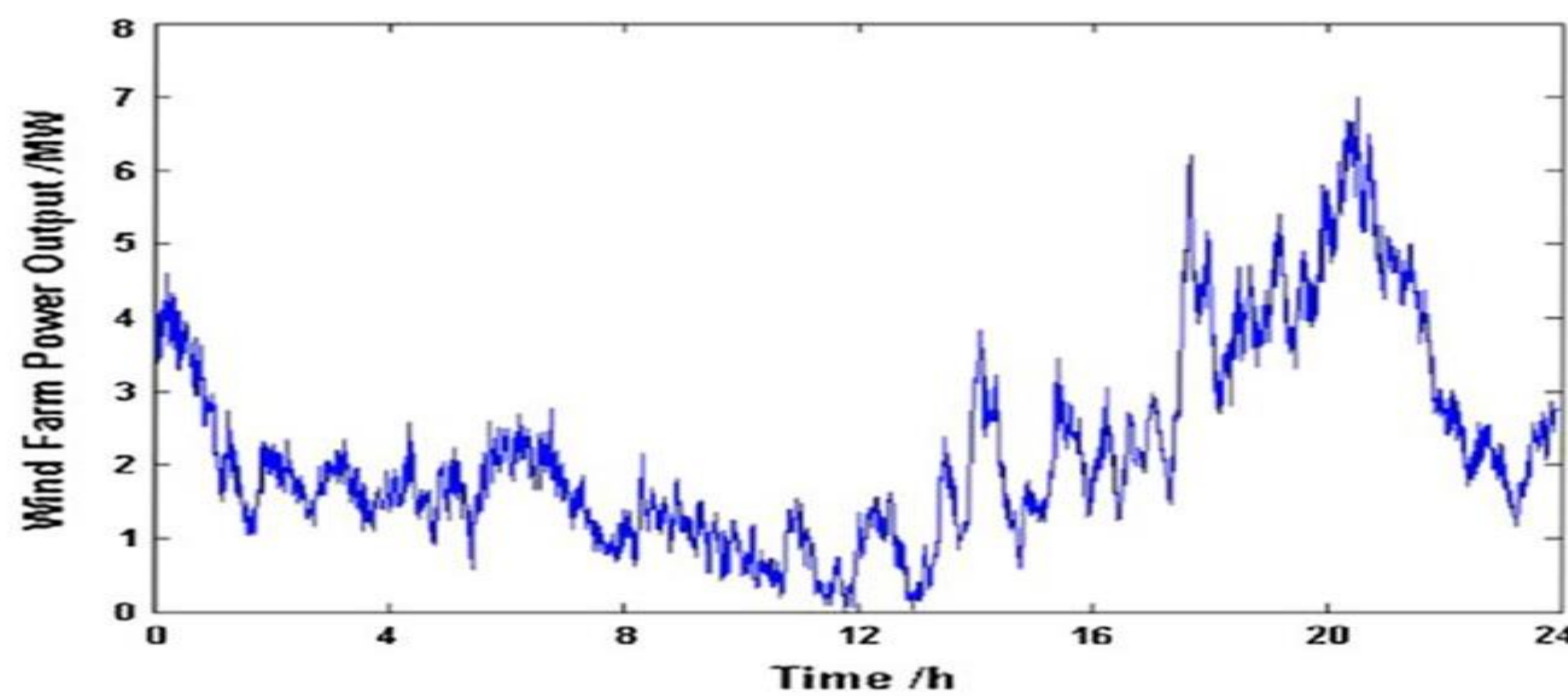
Even if the causal link of energy consumption to GDP and life expectancy is questionable according to some researchers, by correlating recent global data on the current energy consumption with GDP per capita and life expectancy, we identify interesting trends



3. Power outputs by renewable energy installations

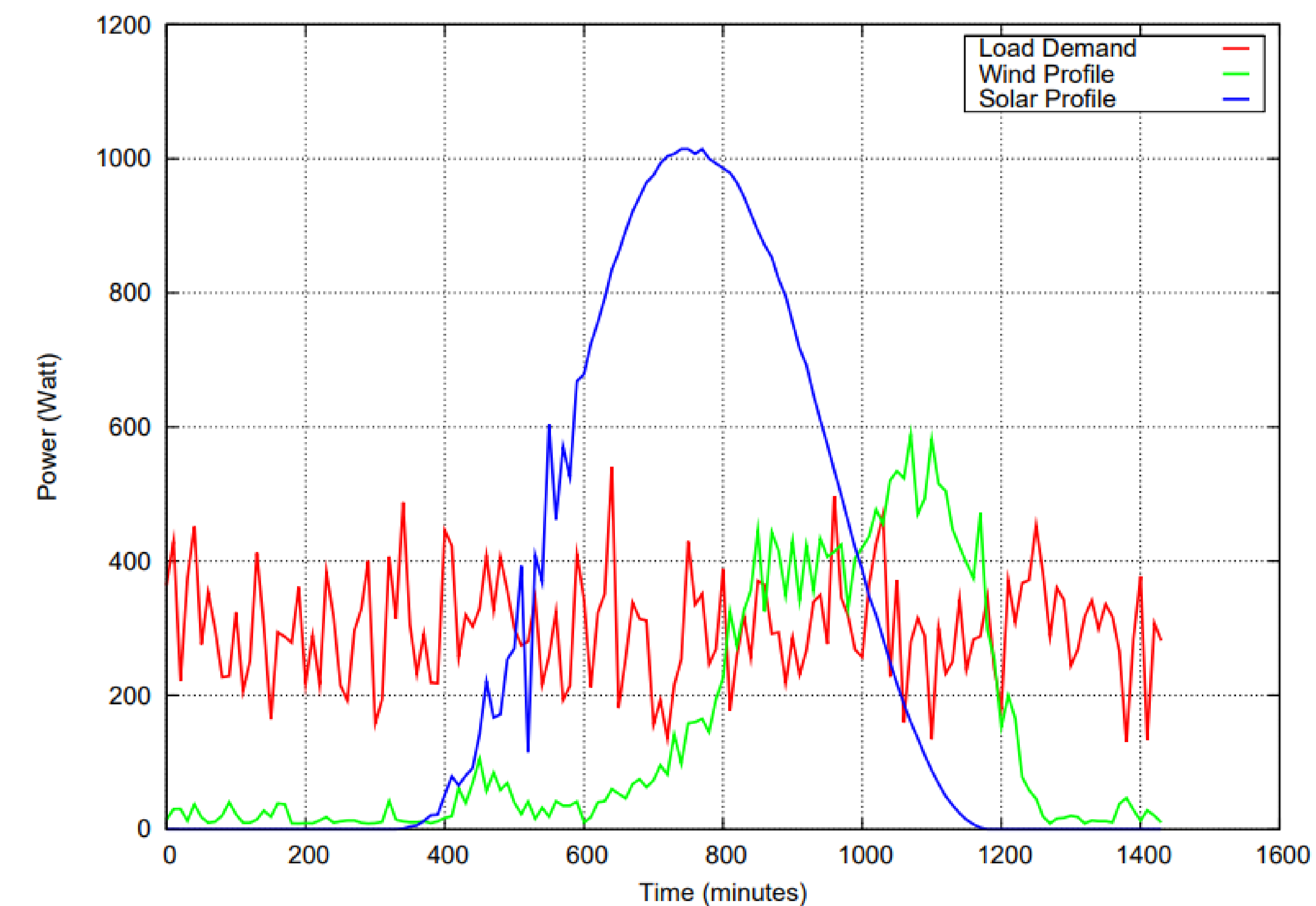
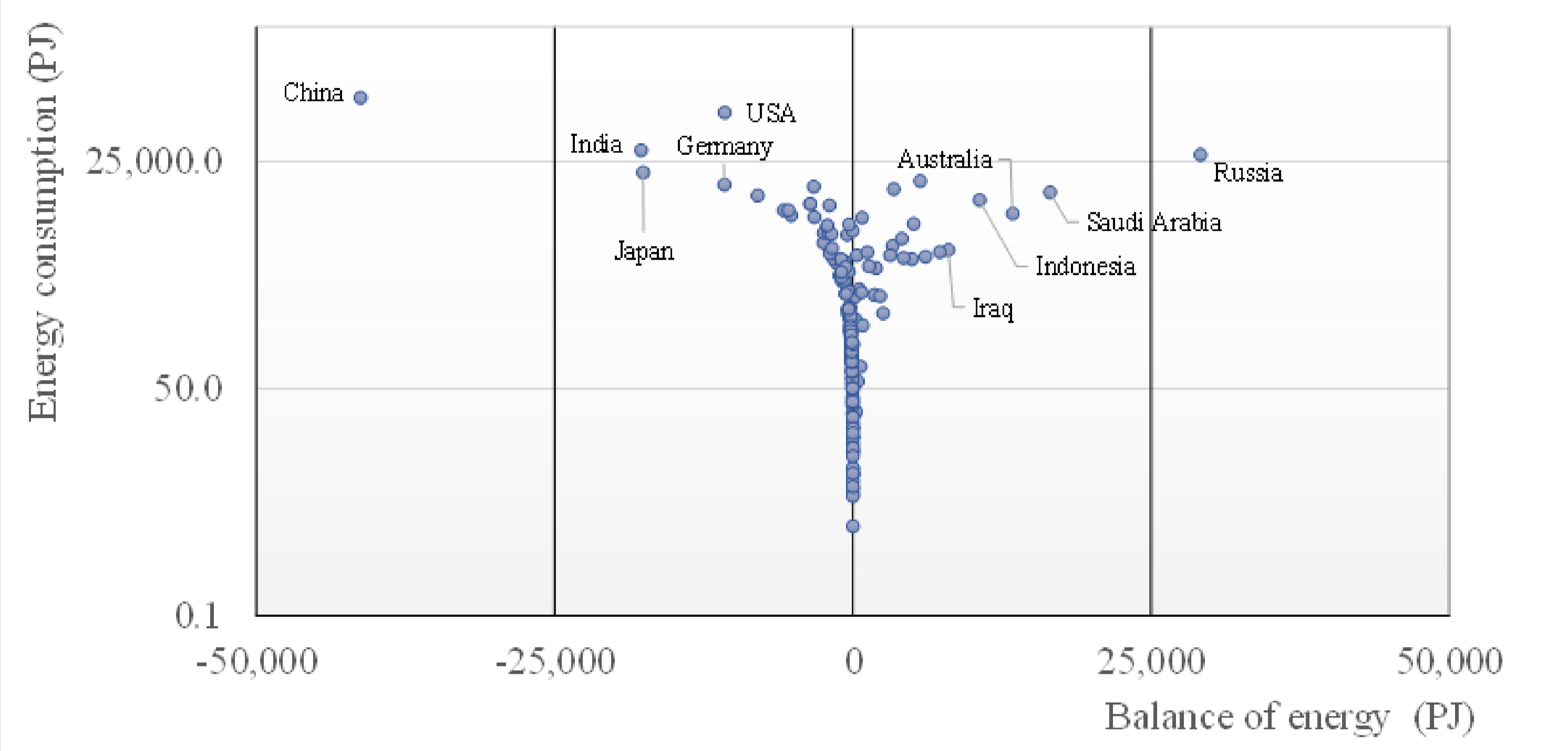


PV generation in watts for a solar PV system on 11 July 2020, when it was sunny throughout the day and on 13 July when there was a mixture of sun and cloud.



Daily wind power output profile of one wind farm in China.

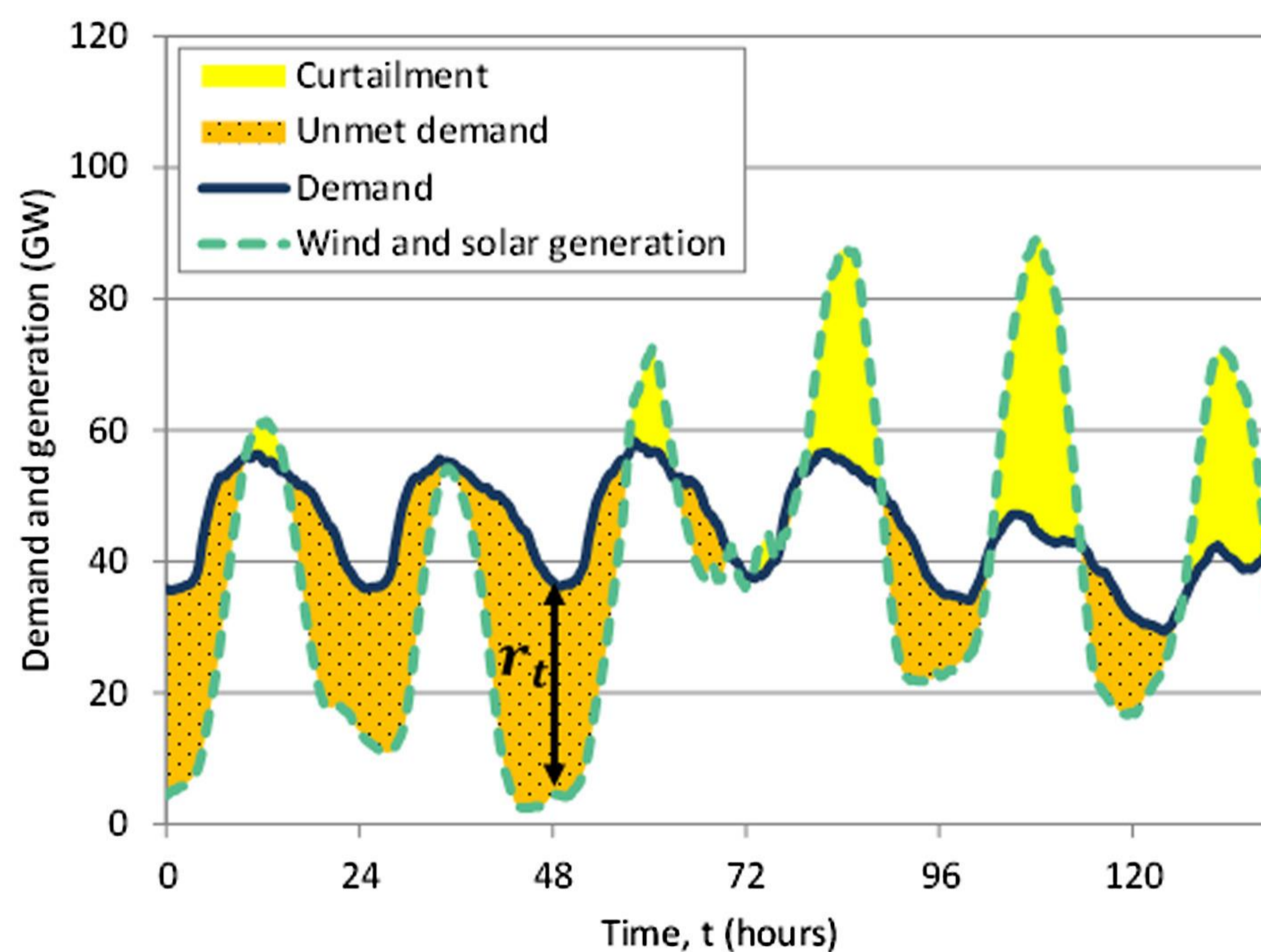
2. Energy production and consumption



Profiles of load demand, wind, and solar power during one day

- System collapses if the demand is higher than production
- The examples shows that in some periods, system works with energy surplus.

4. Modeling energy needs



Whereas variations in the dynamics of renewable energy generation are reasonably well studied, a deeper understanding of the variations in consumption dynamics is still missing.

