

Smart energy systems

„(...) A smart energy system² consists of new technologies and infrastructures which create new forms of flexibility, primarily in the ‘conversion’ stage of the energy system. This is achieved by transforming from a simple linear approach in today’s energy systems (i.e. fuel to conversion to end-use), to a more interconnected approach. In simple terms, this means combining the electricity, thermal, and transport sectors so that the flexibility across these different areas can compensate for the lack of flexibility from renewable resources such as wind and solar. The smart energy system uses technologies such as:

- Smart Electricity Grids to connect flexible electricity demands such as heat pumps and electric vehicles to the intermittent renewable resources such as wind and solar power.
- Smart Thermal Grids (District Heating and Cooling) to connect the electricity and heating sectors. This enables thermal storage to be utilised for creating additional flexibility and heat losses in the energy system to be recycled.
- Smart Gas Grids to connect the electricity, heating, and transport sectors. This enables gas storage to be utilised for creating additional flexibility. If the gas is refined to a liquid fuel, then liquid fuel storages can also be utilised.

In a stricter sense, these infrastructures can be defined as:

- Smart Electricity Grids are electricity infrastructures that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.
- Smart Thermal Grids are a network of pipes connecting the buildings in a neighbourhood, town centre or whole city, so that they can be served from centralised plants as well as from a number of distributed heating or cooling production units including individual contributions from the connected buildings.
- Smart Gas Grids are gas infrastructures that can intelligently integrate the actions of all users connected to it – supplies, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure gas supplies and storage.

Based on these fundamental infrastructures, a Smart Energy System is defined as an

approach in which smart Electricity, Thermal and Gas Grids are combined and coordinated to identify synergies between them in order to achieve an optimal solution for each individual sector as well as for the overall energy system."