PER - The assessment for a sustainable energy supply

International PASSIVE HOUSE Association iPHA

1. What is PER and what is it good for?

- PER (**P**rimary **E**nergy **R**enewable) provides an appropriate measure of how much energy needs to be generated sustainably from renewable energy sources in order to provide a given amount of energy to the end user.
- PER thus shows just how efficient different application technologies are in the context of a sustainable renewable energy supply.

2. What can we learn from PER?

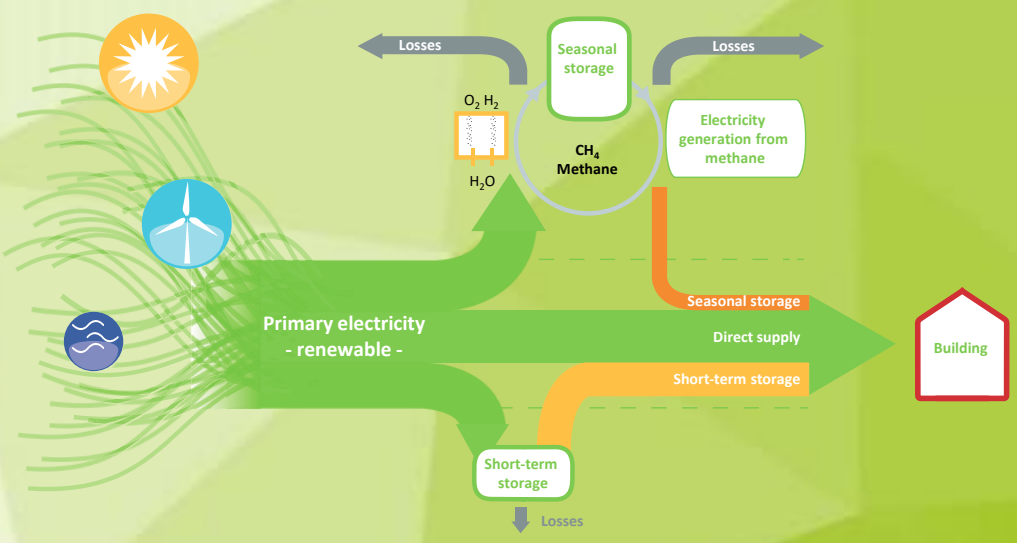
- Today, space heating is mostly provided by natural gas systems. To deliver one kilowatt hour (kWh) of final energy to the consumer, about 1.1 kWh of primary energy is needed (the PE factor is therefore 1.1). In the future, however, this gas would have to be produced with high conversion losses from renewable surplus electricity with an equivalent PER factor of 1.75. Heating with gas is therefore inefficient and expensive.
- It is much better to heat with an electric heat pump. Since the energy supply in winter is not high enough to meet the energy demand, part of the required energy must be stored in summer and converted back into electricity in winter. Because of the losses that occur in this process, the PER factor of "heating electricity" is quite high, at around 1.8. A good heat pump, however, uses environmental heat to turn one part of electricity into more than three parts of heating energy, which makes the system very efficient.
- For energy applications that are evenly distributed throughout the year, such as electric mobility or water heating, the PER factors are lower because less seasonal storage is needed for the renewable electricity. The PER factor for household electricity, for example, is around 1.4.
- These figures show that it is particularly important to use as little energy as possible, especially in winter. This is best achieved by buildings with optimised efficiency and requiring little heating. Such buildings make the energy transition possible and ensure that heating will remain affordable in the future.

3. How do I determine PER for an application?

- As with the traditional primary energy PE, the PER demand of a building is determined by multiplying the respective final energy with a PER primary energy factor. This makes sure that the losses of the full supply chain are taken into account.
- The PER factors depend on the energy carrier, as well as on the respective energy application.
- They are calculated via a dynamic model of the entire energy system (supply, distribution and end-use) and are then published for further use.
- Using PER factors is just as simple as using PE factors.

With the Passive House and the EnerPHit retrofit standard, tried and tested solutions for optimised energy efficiency have been available for 30 years. As part of this concept PER has proven itself as an easy-to-use concept for a sustainable assessment of energy demand and energy supply.

Please do not hesitate to contact us if you have any questions.



What can a sustainable energy supply system look like?

A sustainable energy supply can be achieved with renewable energy generation, coupled with energy storage, an expanded distribution system, as well as consumer loads matched to the volatile energy availability.

Such a sustainable renewable energy supply is based predominantly on electricity, which is generated by wind and solar power plants. It therefore makes sense to predominantly have electrical consumers.

Since wind and solar supply fluctuate with time, some flexibility in the electricity demand of consumers is very beneficial. In addition, energy storage is needed. Short-term storage, such as batteries and pumped storage power plants, can cover for differences in demand and generation for a few days. Bioenergy can be used for seasonal compensation – but only to a limited extent. Furthermore, surplus electricity from summer can be converted into storable energy carriers, for example hydrogen or methane.

If too little electricity is available at any time, mostly in winter, it can be generated from these stored carriers. Some of the resulting heat of this conversion process can be used in district heating. Nevertheless, such storage causes high energy losses and high costs.

The best way to keep costs low is to permanently reduce the energy consumption through improved energy efficiency, especially during the period when solar energy is rare, i.e. in the heating season. Proven energy-efficient building standards, such as Passive Houses and EnerPHit retrofits, offer optimal concepts for such savings.

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