Combined heat and power generation – the backbone of the global energy mix

In recent years, the effects of climate change have become visible in many places around the world. The global community has recognized that things can't go on like this and has created a global guideline in the form of the Paris climate protection agreement to put an end to further global warming. The central element of this project is the complete decarbonization of the global economy over the next few decades.

This document specifically describes the current challenges of energy systems and shows that intelligent sector coupling, including gas infrastructure as a seasonal and renewable storage solution, enables the climate targets to be achieved. At the same time, this approach realistically reconciles the long-term prospects of climate neutrality with the opportunities available. Against this background, the installation of decentralized combined heat and power plants (CHP systems) can provide a triple benefit.

CHP systems are:

1. part of the renewable energy storage solution in order to re-electrify the wind and solar energy stored in the gas system in a highly efficient manner,

2. due to the complementary mode of operation, the natural partner technology for PV systems – in contrast to the combination of heat pump and PV system, which has a counter-cyclical mode of operation,

3. system-relevant and can cover the residual load highly efficiently as required.

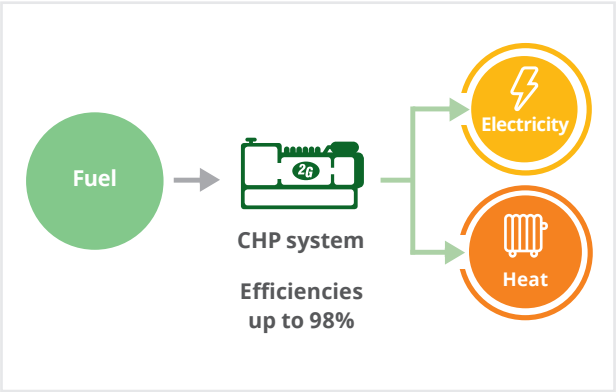


Fig. 1: Combined heat & power generation

Challenges of energy systems on the road to climate neutrality

Fossil fuels are still making a major contribution to global energy supply and are increasingly being phased out as the global economy decarbonizes.

This loss of conventional power plant capacities has a negative effect on grid stability in terms of voltage and frequency stability.

The globally advancing digitalization, the electrification of the heating sector (e.g. through heat pumps), the increase in electromobility, etc., will further increase the global demand for electricity in the coming years – although the capacity utilization of many electricity networks in the world is already at the limit today. The risk of blackouts is growing.

Wind energy and solar energy are the central cornerstones of the global energy supply of the future, but they are only available in a naturally fluctuating supply.

Energy storage is needed in order to reconcile the aforementioned energy production and its use.

Electric battery storage systems can be used as excellent short-term storage systems, which can compensate for the volatility of electricity production in wind and solar power plants over hours or over days as a maximum. However, the question of the degree of recycling or the disposal of batteries often remains open.

Energy revolution does not mean an electricity revolution, but must be implemented in an integral manner, including in the areas of heat and mobility, in order to achieve climate neutrality.

Sector coupling is the basis for a real solution

When it comes to finding a global solution, the sectors of electricity, heat and mobility must always be considered as a whole. These have a different share of the total energy requirements depending on the country, climatic conditions, infrastructure, etc. In Germany, for example, only around 20% is accounted for by the electricity sector, while the mobility sector accounts for just under 30% and the heating sector for around 50% of the final energy demand.

In future, a 100% renewable energy system will be an efficient mix of different energy sources and energy carriers – enabled by intelligent digitization solutions. Figure 2 shows the interaction between different energy sources, energy producers and energy users.

The expansion of wind and solar energy is a top priority worldwide in meeting energy needs.

Decentralized batteries act as short-term storage devices – e.g. in the mobility sector – and store the solar power harvested over the day, for example, in order to make it available for charging an electric vehicle in the evening.

The scale of the general supply requires other storage capacities that reconcile the temporal offset of renewable electricity production – for example from offshore wind farms – and their use, months later.

As a storage medium, hydrogen has become the key to ensuring a secure climate neutrality of the energy

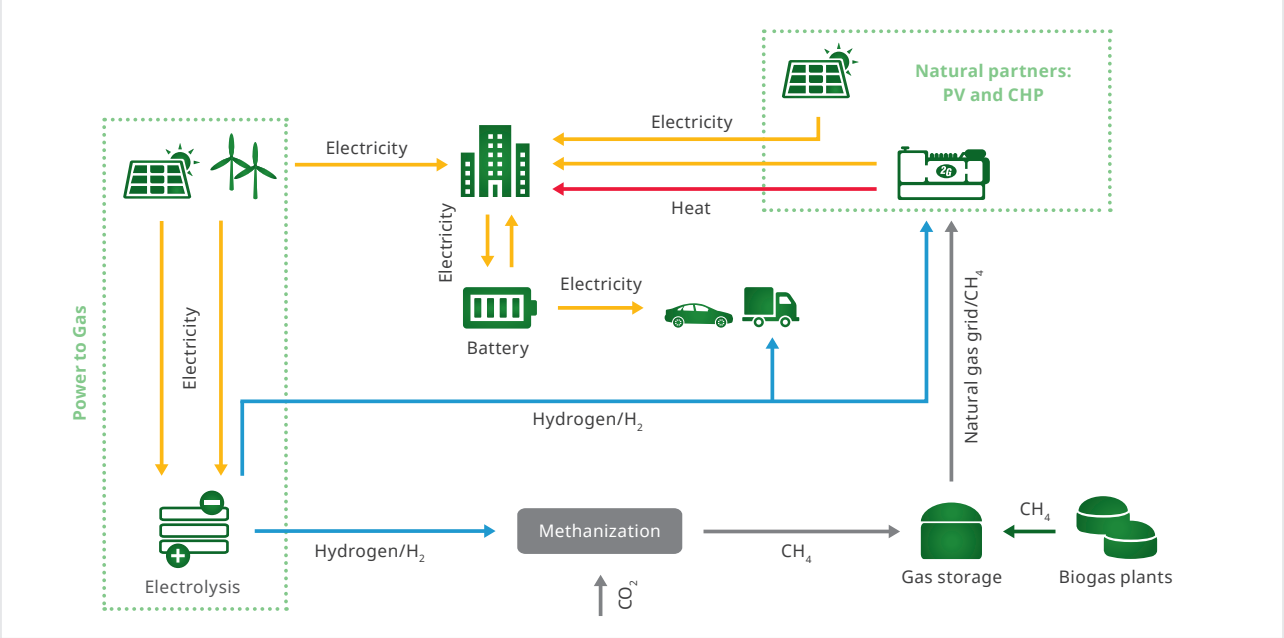


Fig. 2: A functioning energy system of the future requires efficient sector coupling of different systems.

system. The gas network in Germany has a storage capacity of 220 TWh; the hydrogen can therefore be stored in large quantities in the existing gas network and removed seasonally as required. Due to its high value, the conversion losses when using hydrogen should be minimized. Decentralized electrolyzers with waste heat utilization with efficiencies of up to 90%, combined with high-efficiency CHP systems with efficiencies of up to 98% at the location of the actual energy demand, are an option.

Hydrogen is already added to the natural gas network in many places today and component manufacturers in all sectors are taking into account an increasing mixture ratio when developing new products.

Many natural gas pipelines are suitable for conversion to 100% hydrogen, so that a slow and socially responsible transition to the renewable age can be achieved on the basis of an existing infrastructure.

By 2050, around half of Europe's energy needs are expected to be directly met by electricity and the other half by renewable gases of different origins (see Figure 3).

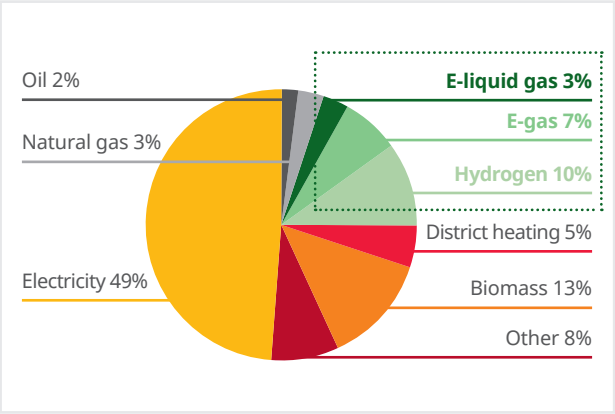


Fig. 3: Expected energy sources to meet European energy demand 2050

Source: Windeurope, based on the 2030 impact assessment and the EU Commission's 2050 mix scenario. Energy requirement: 615 Mtoe corresponds to 7,152 TWh.

Decentralized CHP as flexible backbone technology

Thanks to the simultaneous and highly efficient production of electricity and heat, every natural gas-operated CHP system is already helping to reduce greenhouse gas emissions around the world.

A 2G natural gas CHP system installed today can be converted to hydrogen operation at any time so that “stranded investments” are avoided. As things stand today, only about 15% of the initial investment sum is to be calculated for this, thus creating a solution that is both economical and future-oriented. 2G CHP systems operated with natural gas are therefore not a bridge technology that paves the way to a purely renewable energy supply and then becomes obsolete. 2G CHP systems with hydrogen can be the climate-neutral backbone power plant capacity, which compensates for the fluctuating electricity production from wind and solar power plants.

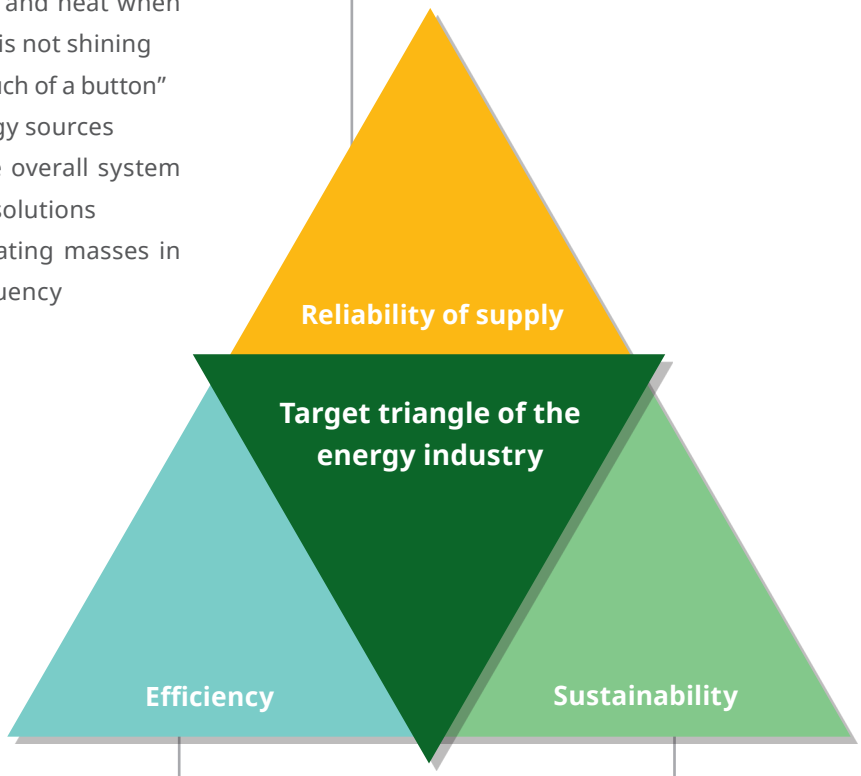
Hydrocarbon-compatible CHP systems enable a gradual, granular entry into the hydrogen economy. The existing infrastructure can be converted in parallel and synchronous with the growing supply of hydrogen. A sudden decommissioning or start-up of large infrastructure projects is not necessary.

A CHP system is the natural partner of PV systems. Unlike the heat pump, for example, which relies on the availability of renewable electricity at times when PV systems often do not produce, a CHP system delivers electricity and heat reliably when the sun is not shining.

In summary, it can be stated that decentrally installed CHP systems solve the challenges of the energy systems described above as follows:

Reliability of supply

- Demand-based supply of electricity and heat when the wind is not blowing and the sun is not shining
- Direct availability of energy "at the touch of a button"
- No dependence on fluctuating energy sources
- Digital integration into a renewable overall system via intelligent software and control solutions
- Decentralized CHP systems are rotating masses in the system and secure the grid frequency



Efficiency

- High total efficiency makes CHP a worthwhile investment regardless of gas type – both for the individual operator and for the economy
- All CHP systems installed today can be retrofitted for use with renewable gases at a later date
- Business models exist and are emerging worldwide that make the demand-based provision of energy interesting for operators and thus offer investment incentives

Sustainability

- A large number of CHP systems installed worldwide are already operated with renewable gases
- Highly efficient and resource-efficient use of natural gas to ensure security of supply during the transition to complete climate neutrality
- By using hydrogen, the CHP becomes a climate-neutral and at the same time demand-oriented energy supplier

Combined heat and power generation is THE backbone technology of a 100% renewable energy world of the future.

2G Energy AG | Benzstraße 3 | 48619 Heek | Germany | www.2-g.com
Stefan Liesner | Head of Public Affairs and Public Relations | Phone +49 (0) 2568 9347-2135 | s.liesner@2-g.de