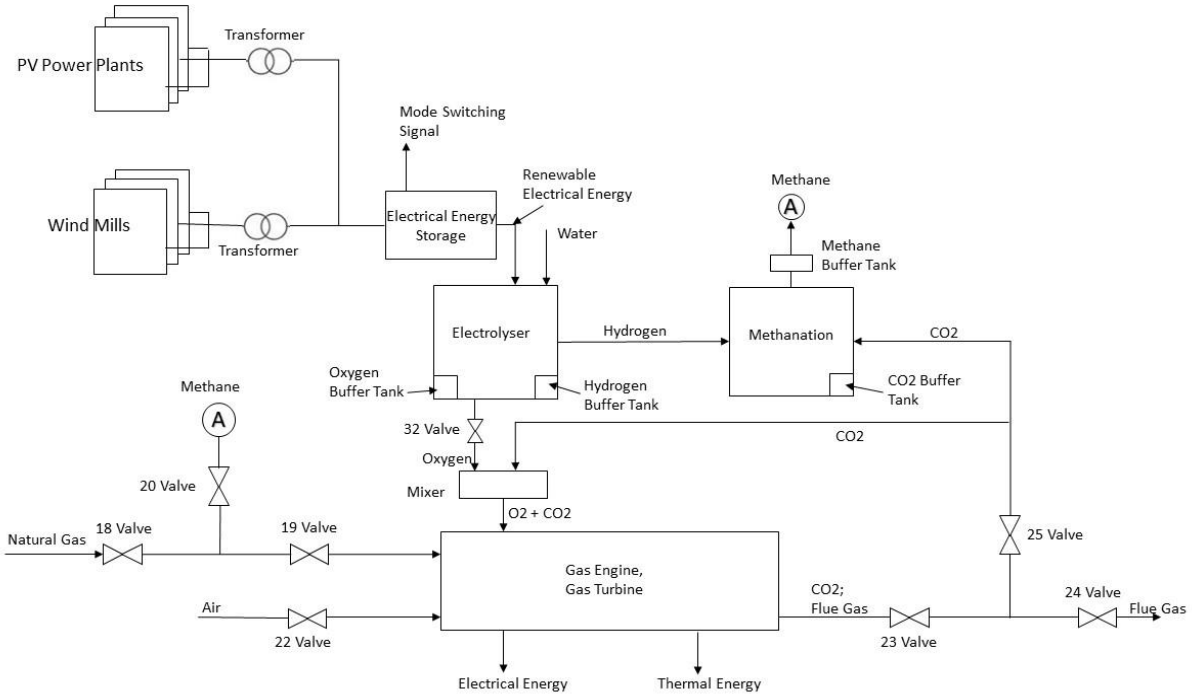
Solar and Wind Powered Natural Gas Power Plants

Gas engine and gas turbine based, synthetic natural gas producer,
new P2G technology, which is the aFRR capacity itself.

There are two main problems related to the planning of solar and wind energy and the direct use of weather-dependent energies in the electricity grid: on the one hand, when they are fully available, their inclusion is conditional on the fact that other power plants are adjusted back or shut down. On the other hand, when, contrary to the planned schedule, the sun does not shine and/or the wind does not blow, then the reserve power plants must be put into operation in order to replacing the missing renewable energy. Both cases require keeping in reserve and operating of a significant amount of low-utilized back-up power plants.
Another and fundamental problem, that there are gas-fired power plants that cannot be adjusted back or cannot be indefinitely decreased of their operation, e.g. the cogeneration power plants, where electricity is only a by-product. The same is the situation with the newly built CCGT power plants, which have a guaranteed energy production volume to justify their investment.
These problems are helped by the new P2G technology, the essence of which is that the weather-dependent energy is first converted into synthetic natural gas, which is then used by operating natural gas power plants.

This technical solution is the missing technological link: it is the possibility of receiving weather-dependent renewable energies in the electricity network without practical quantitative limits, without the use of low-utilized back-up power plants. This is a solution that does not limit the operation of gas engine and gas turbine power plants, the inclusion of renewable energies in the electricity network is not at their expense, since they themselves consume the synthetic natural gas produced from solar and wind energy. This solution also provides 100% aFRR capacity for the electricity network, with automatic transition from renewable-energy-based operation to traditional natural gas operation, when is necessary.

The structure and operation of this technology can be seen in the flowchart below.
The wind and solar power plants charge the electrical energy storage via transformer and at the same time supply the water electrolyser equipment with renewable electricity.
The electrolyser produces hydrogen and oxygen from water. Using the oxy-fuel process, the natural gas consuming equipment (gas engine or gas turbine) produces pure carbon dioxide from the oxygen which is the byproduct of the electrolyser. The methanizer produces methane from hydrogen and carbon dioxide. This methane is consumed by the natural gas consuming equipment of the power plant. The hydrogen and oxygen buffer tank, the mixing element, the carbon dioxide buffer tank and the methane buffer tank ensure flexible and expedient use of the generated gases. In the case when the valves 19, 20, 23, 25 and 32 are open, and valves 18, 22, 24 are closed, the valve combination ensures the operation of the gas engine with renewable methane. In case of insufficient renewable energy, as soon as the status signal switching the operating mode gives an instruction through the central control unit, valves 19, 20, 23, 25, 32 will be closed, and valves 18, 19, 22, 23, 24 will be open so, with this the gas engine switches to traditional operation with air plus natural gas.
The proper operation of the technology is ensured by the central control unit: it ensures the coordinated, "running together", efficient operation of the water electrolyser, the methanizer, and the gas engine, gas turbine.



The main task of the central controller is to monitor the operation of windmills and solar power plants, as well as the amount of electricity produced by them, the charge level of the electrical energy Storage in coordination with the operation of the hydrogen buffer tank, oxygen buffer tank, mixing element, carbon dioxide buffer tank and methane buffer tank, and their level of filling.

If there is not enough renewable energy, the central control unit automatically switches from renewable methane operation to conventional natural gas operation using a status signal that switches the operating mode, providing 100 % aFRR back-up capacity for the used solar and wind energy.
This new P2G technology also enables the utilization of solar energy on a social scale by being able to collect the part of the solar energy not used by the owners of residential solar panels and convert it into synthetic natural gas at a dedicated location, with the help of a "virtual power plant" type of software.
This technology makes it possible to implement solar and wind-powered operation of the existing cogeneration units and combined cycle power plants, i.e. to replace their current natural gas use with synthetic natural gas produced from weather-dependent renewable energy. This can save about three billion m3/year of natural gas imports in Hungary (**about 30% of the natural gas import**).

Our technology is closed cycled and circular – the input element is renewable electricity, and the output element is synthetic natural gas, which is consumed by the gas engine or gas turbine itself. Our procedure is an example of a circular economy: the carbon dioxide and the water only participate in the process in a circular way, as intermediary elements of the technology.

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