

## THE HIBRID AND THE SMART GRID: MORE EFFICIENCY FOR LESS GREENHOUSE EFFECT

Emulating a high risk financial operation, the incursion of politics in science, concerning the role of fossil fuels in climate change, has turned this scientific issue into an emotional topic of public opinion, accentuating the dilemma of whether to start with (or not) measures that could result unnecessary. The verdict of alleged human guilt in global warming implies the reduction of greenhouse effect gases (GHG), which coincides with the need to spare the fossil fuel reserves, in particular those of oil, which in contrast with the carbon that abounds in terrestrial quarries, presents the difficulty of being mostly offshore.

To increase the efficiency of combustion processes will reduce the GHG emission rate, giving the biosphere a better chance to equilibrate with the atmosphere. The efficiency of present thermal power plants and transportation vehicle motors is ~30%, which means that a great part of the energy is dissipated by heat transfer to the environment.

Excluding biofuels that, thanks to photosynthesis, have a smaller greenhouse effect than fossil fuels, the boom of other energy sources that are called clean for their null GHG emission, such as solar, eolic, hydraulic and geothermal energies, leads to perceive a future where most of the energy offered will be in the form of electricity instead of fuels. More so if the current problems of nuclear energy, as disposal of used materials and terrorism, are solved. Nuclear energy would open ample access to the only clean fuel: hydrogen produced by electrolysis. The possibility of storing hydrogen at very high pressures (12000psi) or adsorbed in carbon nanotubes, foreseeing its use in vehicles, is being studied. It is worth mentioning that, different to the nuclear fission used nowadays, nuclear fusion, currently in an initial stage of research and development, is considered as clean energy as it does not produce radioactive refuse.

The relatively small power of the renewable energy technologies (eolic and solar), require the decentralization of electricity supply. It would be impossible to establish powerhouses with similar capacity to the present large thermal

plants and, furthermore, fluctuations in the primary energy source (wind, sun) create the need to store electricity in rechargeable batteries or heat in appropriate media (oil or fused salt). In contrast to solar energy, in the case of eolic parks the need of enormous extensions of land is compensated by their usage in agriculture. With small powerhouses, buildings can partially supply themselves with electricity by means of solar panels or wind turbines.

A promising technology is that of fuel cells, which work with hydrogen and offer larger efficiency than current motors, as the mechanical transmission of combustion heat to obtain electricity is avoided.

Such a diverse scenario of energetic technologies promotes the concept of a smart grid for electrical distribution, integrating small combined heat and power sources (known as CHP) for the provision of heat and electricity to a building. Connected to a local network, it serves to credit it with any surplus or to debit it in case of failures in primary energy due to insufficient wind, cloudiness or lack of fuel.

The large power plants dissipate large part of the combustion heat to the air or to the sea, according to their location, while in CHPs heat is utilized to heat water, or the air in temperate climates. CHP systems can employ different combinations, such as fuel and photovoltaic cells, where the required hydrogen is obtained by water electrolysis using solar energy during the day, in order to turn on the hydrogen cell during the night.

The plugs of the future will contribute to diminish CHC emissions. This, thanks to hybrid vehicles moved by electric motors provided with rechargeable batteries for most of the travel, and with combustion motors to complete the trip before the slow recharge process. The latter could be obviated by a fast battery exchange in service stations. Completely "clean" hybrid vehicles are being developed in which there is a hydrogen cell instead of a combustion motor. Global evolution is beginning the end of the fossil fuel combustion era, and starting the new era of clean energy.

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