

PhD Offer: Study of an hybrid Diesel-renewable power plant for electricity production on isolated sites

Location: LHEEA, Nantes, France

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Subject:

The energy transition consists of an increase of the renewable sources in the electric energy production share (for instance photovoltaic power plants and wind turbines). One drawback is that these energy sources are intermittent by nature. One solution is to couple them with conventional power sources. For isolated sites, such as islands, one possible configuration that allows reducing CO₂ emissions is to mix renewable sources with internal combustion engines. The Phd candidate will have to study the coupling of a renewable power plant with a Diesel engine, with the aim at minimizing CO₂ emissions.

Some scientific and technical issues are:

- When the renewable coverage rate is high, the Diesel engine is regularly stopped and is used:
 - To help producing electricity when renewables are insufficient, the Diesel engine is running under low load conditions; the improvement of its efficiency at low load is thus necessary to further reduce CO₂ emissions. The increase of the efficiency at low loads can be obtained by: improving injection phasing, modifying the cooling strategy to reduce heat losses.
 - To produce 100% of the electricity when renewables are not producing.

Furthermore, in some cases, in particular when the Diesel is coupled with a PV power plant, the Diesel engine has to vary suddenly its production because of the sudden change in the PV production. Thus, some improvements of the engine running under transients are necessary (thermal transient after an engine stop, load and speed transients)

For the whole hybrid Diesel-renewable power plant, further issues are:

- The taking into account of the weather forecast for the anticipation of the engine start or its load variation.
- The response times of wind turbine and photovoltaic power plants being different, the coupling of the Diesel engine with wind turbine or a photovoltaic power plant should be studied separately.
- Using some storage capacities (batteries or thermal storage for instance) could help to improve the whole power plant control.

Two approaches should be developed:

- Macroscopic approach : study of the whole hybrid Diesel-renewable power plant
- Local approach: study focus on the Diesel engine and its adaptation to the hybrid power plant.

Skills:

- Energetic systems / energy conversion
- System approach, modeling of complex energetic systems and their coupling
- Thermal machines / Internal Combustion Engines (Diesel)