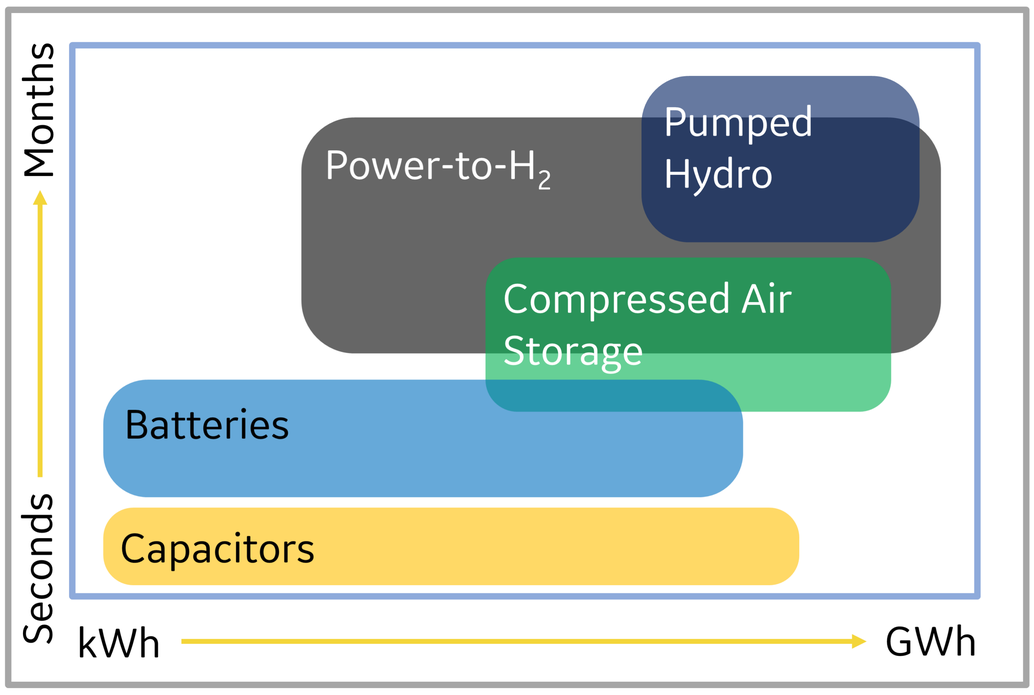
Study of an integrated and replicable green hydrogen-based system with a gas turbine for large-scale dispatchable power generation

10th GERG Young Researchers' Awards – EGATEC 2022



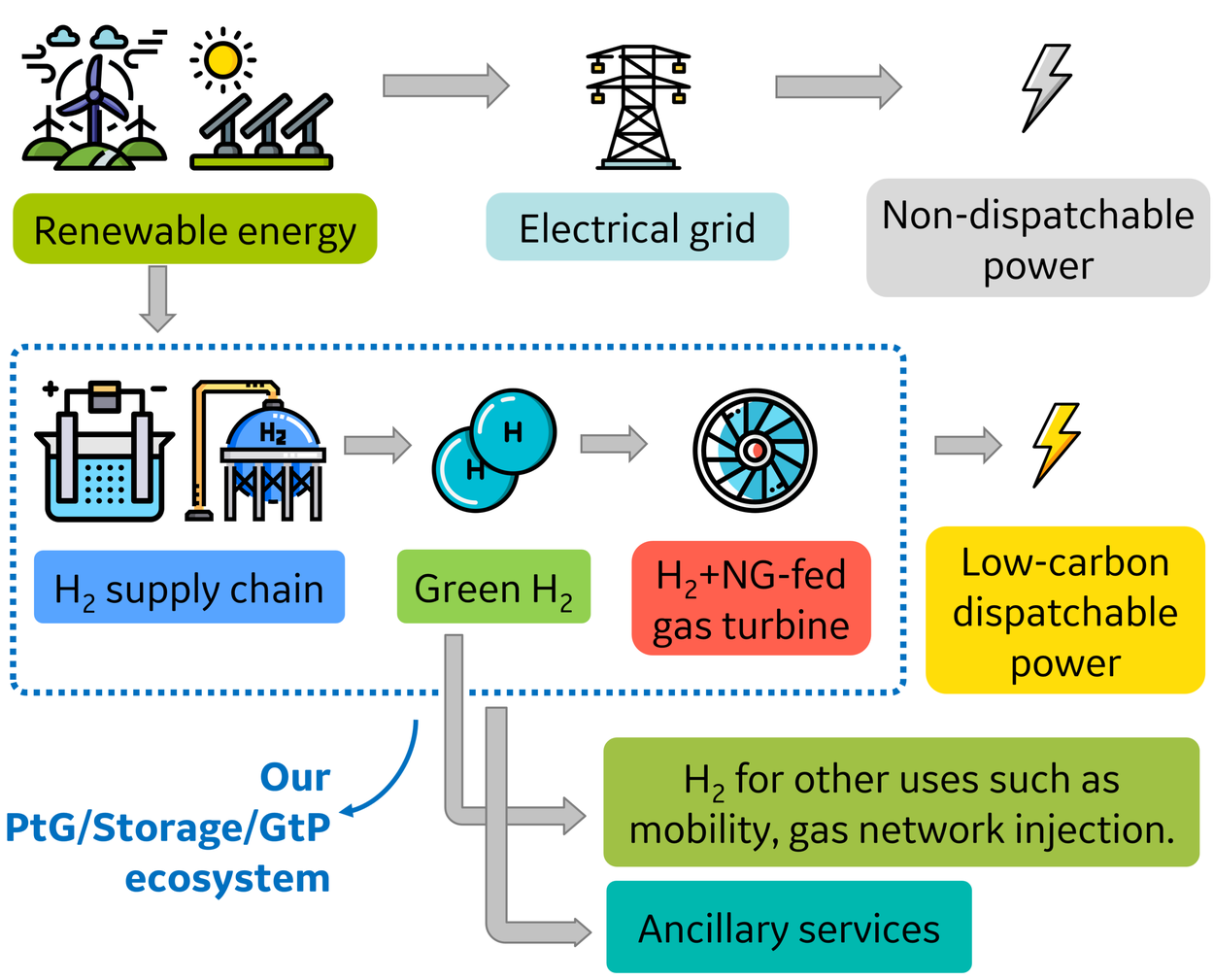
Power-to-H_2 and the challenge of long-term energy storage with sector coupling

- Development of RES: Greater need for storage and back-up facilities.
- Sector coupling: Can improve efficiency and reliability of energy systems, while reducing costs of decarbonization.
- Power-to-H_2: Prominent lever for VRE supply management coupled with grid balancing services.

Aim: Evaluate Power-to-H_2-to-Power benefits when co-locating green H_2 production with a gas turbine power plant to produce low-carbon, on-demand power.

Method: Design a "Hydrogen Hub"

- Integrated cluster on which hydrogen is produced, part of it used for power generation instead of fossil fuels, and the rest sold for increased profitability.
- Power plant participates in ancillary services.
- Define optimal sizing for all components: RES unit, electrolyzer, compressor, storage tank and gas turbine.
- Insular and continental case studies: Identify configurations where the "Hydrogen Hub" solution could be economically and environmentally viable.
- Validation: Test of our models on existing plants.



Economic and environmental considerations

- **Economic study**: Compute economic decisions indicators (such as LCOE and NPV) with policy incentives (subsidies, flexible electricity and reserves, carbon abatements).
- **Life-cycle assessment**: Evaluate our systems' environmental sustainability (direct and indirect GHG emissions) from cradle to grave through the lens of potential impacts.

Expected outcomes

Define an integrated model to produce low-carbon on-demand power.	Identify and enhance the synergies created by coupling H_2 production and a power plant on a single site.	Provide hints on the replicability of such systems to allow deployment on existing fleets.

References

Götz, Manuel et al. *Renewable Power-to-Gas: A technological and economic review*. Renewable Energy. 2016.

Maroufmashat, Azadeh and Fowler, Michael. *Transition of future energy system infrastructure through PtG pathways*. 2017.

IRENA. *Innovation landscape brief: Renewable Power-to-Hydrogen*. 2019.

Contact: Fatimatou WADE, fatimatou.wade@ge.com