Nuclear generation and flexibility modelling in renewables-driven electric systems

In the context of a diminishing and fickle residual demand, the operational flexibility of each generating technology will partly determine whether they shall participate in future de-carbonized electricity systems or not, and nuclear technology is no exception. Hence, prospective capacity expansion models and simulation models focusing on renewable-driven electricity systems while including nuclear technology should appropriately define and model its operational flexibility.

The goal of this poster is to highlight the underlying physical mechanisms that frame this technology's flexibility and its operations. It is necessary to compare this "physics-induced" flexibility to the modelling practices found in the literature and discuss how neglecting some aspects of nuclear flexibility may lead to misestimation in the models' results.

In our preprint submitted to *Renewables and Substainable Energy Reviews* in 2020, we found that crucial aspects such as the impact of Xenon transients on reactors' flexibility and the fleet's operational schedule are not considered in the literature, even though these significantly impact actual nuclear operations. Other aspects like ramping constraints are often implemented into models, but we argue that the models' insufficient time resolution may undermine their impacts. Ultimately, this preprint aims to highlight the potential benefits of a "physics-induced" nuclear modeling in renewable-driven prospective models and the advantage to adopt a fleet perspective when considering nuclear technology.

Enhancing nuclear modeling would potentially better renewables-driven models' evaluation of overall costs, carbon footprint, and security of supply at first, but also regarding the need for new development in electricity systems such as storage facilities, sector-coupling, and even demand-side response.