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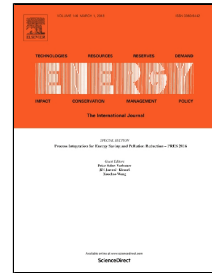
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Nuclear power supply: going against the misconceptions. Evidence of nuclear flexibility from the French experience

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Abstract

In the context of power system decarbonisation, higher shares of variable renewables are usually promoted inducing higher flexibility needs. Worthwhile flexibility can be provided by a number of solutions, including baseload power modulation. Nuclear power is usually presented as poorly-flexible, and, as such, a brake to renewable development. This article aims at providing an assessment of nuclear flexibility from a technical viewpoint, based on both a literature review (theory) and industrial feedback of the French nuclear operator (practice). From the confrontation of theory and practice, the actual potential of nuclear power is analysed, both at the reactor scale and the fleet scale. The data shows that, today, nuclear reactors are flexible, and are currently operated in France as such (approximately 40% of the fleet is currently involved in load-following). They also demonstrate that there is a margin to further take advantage of this potential, by increasing the number of reactors involved in load-following operations and the number of operations realised by each reactor.

Keywords

flexibility; nuclear power plant; load-following; ancillary services; power system

1. Introduction

The current global trend is a common willingness to switch to low-carbon energy mixes, with country-specific energy transition pathways. Energy production is the first contributor to greenhouse gases worldwide, being the source of more than two-thirds of greenhouse-gas emissions [1]. In such a context, electricity production appears to be a key parameter in working towards lower carbon contents. As stated in the SET Plan Integrated Roadmap of the European Commission: “*The decarbonisation of electricity production is the centre-piece of the Energy Roadmap 2050. All scenarios studied in the Roadmap show that electricity will have to play a much greater role than now*” [2]. Thus designing sustainable power mixes is becoming a key issue of the energy transition: significant decarbonisation of the energy system will be driven by both decarbonising the power sector and enlarging the role of electricity, especially through sector coupling (e.g. power-to-heat or power-to-mobility).

The decarbonisation of the power system is promoted by the general 3X20 European directive, with specific renewable penetration targets [3]. A binding target of at least 27% of

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