Contribution ID: **329** Type: **not specified**

Analysis of technical and economic parameters of fusion power plants in future power systems

Monday, 17 September 2018 11:00 (2 hours)

To restrict climate change, it is highly desirable to replace conventional power plants by emission free technologies like solar and wind power. This leads to increased shares of fluctuating sources in the power system challenging the balance between generation and demand. Moreover, as the transportation and heating sectors are expected to shift towards using more electricity the projected demand rises strongly. To ensure both sufficient supply and long-term stability of power systems, fusion power may play an important role in the future due to its advantageous properties. Fusion energy is emission free, controllable and inherently safe.

In recent years a lot of research has been conducted focusing on the technical principles of commercial fusion power. However, less investigation has been done regarding the interaction of different future power plants with the power system.

This paper provides a detailed analysis of technical and economic parameters of fusion power plants which are relevant in context of power system such as efficiency, heat losses, investment costs and startup costs. Therefore, two linear optimization models – urbs and evrys – are applied which both represent the European power system by including power plants, storages, transmission lines and loads of 34 countries. Both models optimize the total system costs. urbs is applied for expansion planning whereas evrys present a detailed dispatch in hourly resolution. As a result, clear statements about system costs, system configuration and system operation are made based on a comprehensive scenario framework.

First results indicate, that investment costs and fixed costs of fusion power plants as well as emission restriction highly affect investment decisions. The more flexible a fusion plant can operate, the more fusion power will be installed. The operation of fusion power plants is more dependent on efficiency rates and startup costs than on thermal properties like cooling and heating.

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Session Classification: P1