Book of Abstracts

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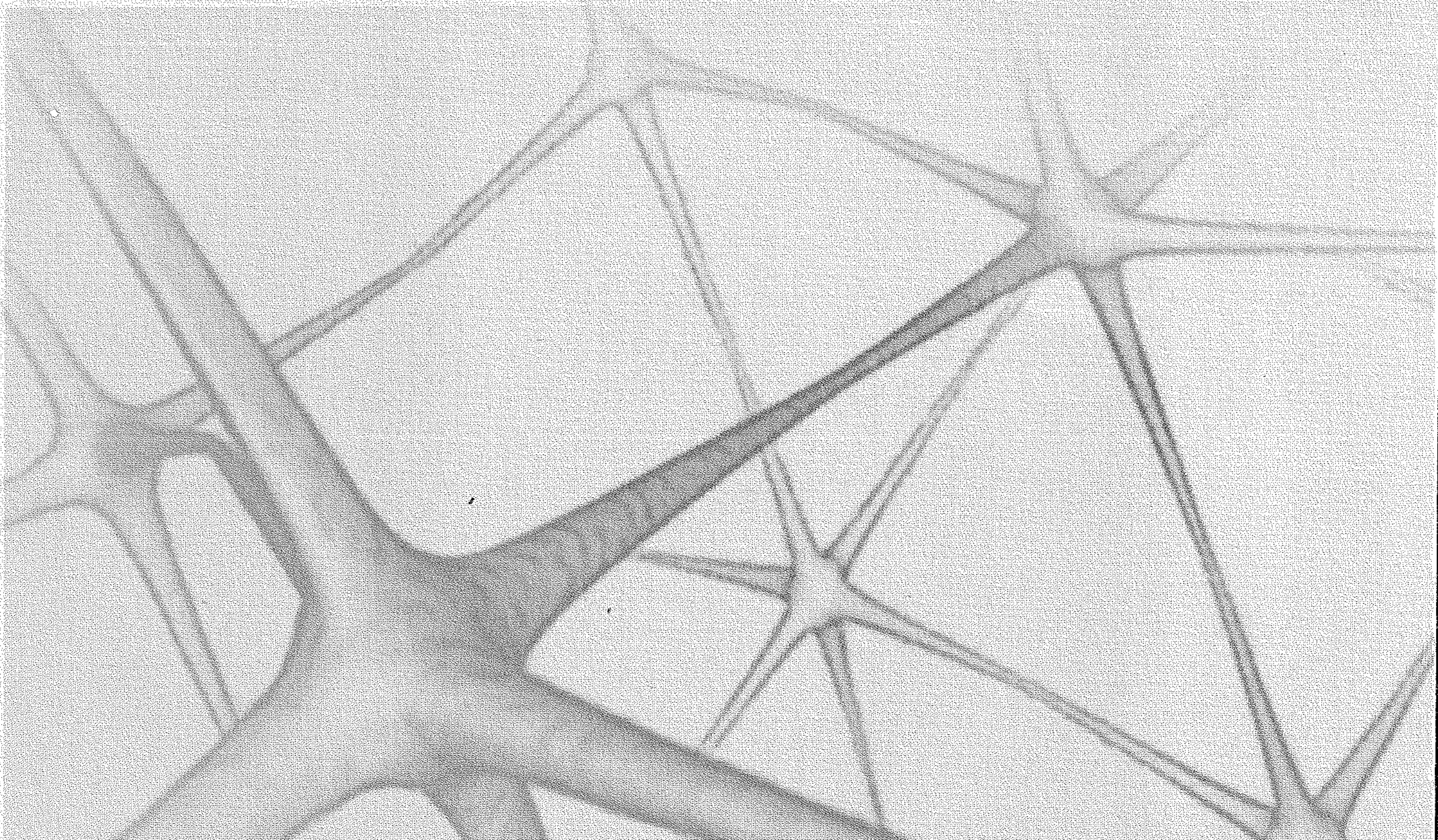

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Editors • S. Thurner and M. Szell

Complexity in Energy Infrastructures: Models, Metrics and Metaphors

Organizers: M. Zanin, F. Lillo

A framework for development of energy security indicators

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This paper presents a framework for the development of a composite energy security indicator in the European Union. Various energy supply sources are analyzed: oil, gas, coal, nuclear, renewables, each providing a number of individual indicators that are combined into a uniform metrics of energy security level for each EU member state. Having a framework for quantification of energy security, the effect on energy security of different policy options, infrastructure changes or supply diversification can be analyzed. Although analysis performed by indicators cannot substitute a detailed system level analysis, it can provide an overview of the current energy security situation and highlight strength and weaknesses of the energy infrastructure in the EU. The framework can also be used for determining the needs for a detailed system level analysis of a particular energy infrastructure network and its interdependency study with other energy infrastructures (e.g. gas pipeline network dependence on electricity grid reliability).

Assessing the reliability of the European power grid using load curve indicators and topological characteristics

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The European power grid is the largest complex physical network ever made by human kind.The assessment of its reliability has been an ambitious and attractive as well as necessary research field over the past decades. In particular, the assessment of the European power grid by means of topological measures has garnered a great deal of interest among the scientific community.The extension of its analysis and the correlation between load curve indicators and fault events in the European power grid are the main goals of this paper. The mission of a power grid is to transmit and distribute electricity in order to reliably serve the load. This objective is, inter alia, challenged by the variations of electricity demand over time. In other words, the load curve shape, featuring large fluctuations over a 24 hour period, determines the amount of energy which must be delivered. Two very important measures for power system reliability are the energy not supplied and the restoration time after.a fault event. Both values affect electricity consumers who at the same time drive the dynamics of the balance between generation and demand. Therefore, the comparison and analysis of load curve shapes throughout Europe can contribute to explanations of complex and variable fault events in the power grid. The paper intends to expand previous work assessing the European power grid reliability in terms of topological measures by extending the time frame of events and taking into account the effect of a large blackout. Moreover, load curve indicators throughout several European countries, derived from load curve characteristics such as peak and valley power levels or power over energy ratio, are described and used as additional factors to assess European power grid reliability. Considering these attributes, the central question arises, is there any correlation between load curve indicators and occurrence of power disruptions in the European power grid? The approach used in the paper leaves some open questions to be discussed. For instance, are 9 years of registered fault events in the European power grid sufficient to analyse their correlation with load curve indicators and topological characteristics?

An uncertainty analysis of the potential impact of shale gas on the global energy system

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Energy systems are complex systems, i.e. sets of interconnected components forming an integrated whole. Their collective properties cannot be found among the properties of the elements, and their behaviour cannot