Chapter 15
Forecasting Renewable Energy Technologies in Desalination and Power Generation Using Taxonomies

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ABSTRACT

Renewable Energy (RE) technologies are increasingly viewed as crucially important. Knowledge that helps to predict the likely growth of emergent technologies is essential for well-informed technology management. The vast amount of available data in publications hinders the acquisition and analysis of this knowledge. Therefore, there is a need for intelligent search techniques capable of grouping semantically similar concepts together, such that, for example, terms containing "photovoltaic" are hierarchically subsumed under solar energy-related technologies. Consequently, articles related to "Photovoltaics" should be included in the analysis. To accommodate this in an automated fashion, the authors deploy a renewable energy taxonomy for comprehensive trend discovery in publications and patents. This taxonomy is based on the hierarchical structure of Wikipedia categories and their subordinate Wikipedia terms. This paper analyzes promising trends of renewable energy sources in two case studies: power generation and desalination techniques.

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INTRODUCTION

For decision makers and researchers working in a technical domain, understanding the state of their area of interest is of the highest importance. Any given research field is composed of many subfields and underlying technologies which are related in intricate ways. A solid understanding of how these subfields are linked together as well as how important the different regions of this research landscape will confer a significant competitive advantage.

Knowledge that facilitates forecasting the likely growth and consequences of emergent technologies is also essential for well-informed technology management, which is currently relying largely on expert opinion. However, expert decisions can be influenced by personal perspectives or biases. Moreover, acquiring and analyzing such knowledge is hampered by the vast amount of data available in publications. Consequently, sifting through the –often electronically- available R&D literature is time consuming, yet non-exhaustive and subjective. In order to cope with this problem, automated forecasting techniques have been developed in recent years.

Energy and water availability are the main drivers for sustainable development and economical growth. Their rapid resource depletion imposes a significant challenge for the 21st century. Fast population growth and economic development as well as the dramatic climate change and its consequences have strained the conventional energy resources such as oil, gas and coal. Therefore, a worldwide concerted effort is needed in order to reduce the global carbon foot print. Hence, it is reasonable to shift focus to renewable energy based technologies.

Development and deployment of renewable energy is the best bet for meeting the energy demand towards sustainable growth. We are currently witnessing an ongoing global drive for integration of renewables in the present energy infrastructure. This movement can be observed both in academia and industry in terms of publication and patent statistics. Other measures include the volume of renewable energy related research funding.

In this work we developed a technology forecasting method that uses a taxonomy structure to group bibliometric information under their relevant taxonomy branches to provide a more detailed analysis of the technology under consideration. At the core of our approach is a general-to-specific ordered taxonomy derived from Wikipedia's RE-related categories. Its hierarchical tree-structure allows to group semantically related terms at various levels of abstraction. A taxonomy-based trend analysis can then retrieve information on a technology more exhaustively than the dominating search techniques in Technology Forecasting that are based on single or few keywords (as e.g., used in Guo et al., 2009; Fallah et al., 2009). Another related problem of the latter techniques is that simple term occurrence frequencies will invariably be noisy as the contexts in which this term appears will be extremely diverse and will contain a large number of extraneous mentions. However, if we can find collections of related terms (i.e., terms subsumed under a taxonomy branch) and use aggregate statistics instead of working with individual terms, we might reasonably expect that a lot of this randomness will cancel out.

1. BACKGROUND

Renewable Energy, Water and Sustainable Development

Choucri (1999) defines sustainable development as the process of meeting the needs of current and future generations without undermining the resilience of the life-supporting properties of nature and the integrity and security of social systems. Accordingly, to become sustainable society must address the viability of the environment including energy.