

## Accepted Manuscript

Title: Increasing flexibility of Finnish energy systems - A review of potential technologies and means

Authors: Satu Paiho, Heidi Saastamoinen, Elina Hakkarainen, Lassi Similä, Riku Pasonen, Jussi Ikäheimo, Miika Rämä, Markku Tuovinen, Seppo Horsmanheimo



PII: S2210-6707(18)30284-1  
DOI: <https://doi.org/10.1016/j.scs.2018.09.015>  
Reference: SCS 1253

To appear in:

Received date: 16-2-2018  
Revised date: 13-9-2018  
Accepted date: 14-9-2018

Please cite this article as: Paiho S, Saastamoinen H, Hakkarainen E, Similä L, Pasonen R, Ikäheimo J, Rämä M, Tuovinen M, Horsmanheimo S, Increasing flexibility of Finnish energy systems - A review of potential technologies and means, *Sustainable Cities and Society* (2018), <https://doi.org/10.1016/j.scs.2018.09.015>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Increasing flexibility of Finnish energy systems - A review of potential technologies and means

Satu Paiho\*, Heidi Saastamoinen, Elina Hakkarainen, Lassi Similä, Riku Pasonen, Jussi Ikkäheimo, Miika Rämä, Markku Tuovinen & Seppo Horsmanheimo

VTT Technical Research Centre of Finland Ltd, P.O Box 1000, FI-02044 VTT, Finland, E-mail addresses: [firstname.lastname@vtt.fi](mailto:firstname.lastname@vtt.fi)

\*Corresponding author. Contact: [Satu.Paiho@vtt.fi](mailto:Satu.Paiho@vtt.fi), phone: +358 50 331 5160

## Highlights

- Flexibility considerations extended to other sectors but electricity only.
- A review of enablers and means to increase flexibility of Finnish energy systems.
- The role of energy markets from flexibility perspective is assessed.

## Abstract

It is apparent that future energy systems need increased flexibility for example due to wider adoption of variable renewable production, general transition towards decarbonization, and bidirectional energy grids. When several energy sectors are considered holistically, the possible flexibility measures increase. This paper reviews potential means to increase flexibility of Finnish energy systems by comprehensively regarding both electricity and thermal systems. After introducing renewable energy data from Finland, the authors discuss how flexibility is defined. Then, several technological options to meet the increased flexibility needs are described and Finnish examples are given. These key technologies and solutions include energy storage, district heating and cooling, electric vehicles, smart meters, demand response, and ICT solutions. In addition, energy markets provide important flexibility means. Therefore, aspects related to electricity market design and heat trading are also assessed.

Download English Version:

<https://daneshyari.com/en/article/11032505>

Download Persian Version:

<https://daneshyari.com/article/11032505>

[Daneshyari.com](https://daneshyari.com)