



Research paper

Locally Integrated Energy Sectors supported by renewable network management within municipalities



Anja Kostevšek ^{a,*}, Janez Petek ^b, Lidija Čuček ^c, Jiří Jaromír Klemeš ^d,
Petar Sabev Varbanov ^d

^a Scientific Research Centre Bistra Ptuj, Slovenski trg 6, SI-2250, Ptuj, Slovenia

^b Local Energy Agency Spodnje Podravje, Prešernova ulica 18, SI-2250, Ptuj, Slovenia

^c Faculty of Chemistry and Chemical Engineering, University of Maribor, Smetanova ulica 17, SI-2000, Maribor, Slovenia

^d Centre for Process Integration and Intensification – CPI², Faculty of Information Technology, University of Pannonia, Egyetem u. 10, HU-8200, Veszprém, Hungary

HIGHLIGHTS

- The paper presents a new approach for accelerated inception of RES in municipalities.
- LIES with RES network increases energy efficiency and accelerates RES integration.
- A demonstration case of district heating on wood biomass within Ormož was performed.

ARTICLE INFO

Article history:

Received 9 December 2014

Received in revised form

11 January 2015

Accepted 13 January 2015

Available online 22 January 2015

Keywords:

Locally Integrated Energy Sectors
Municipal heat and power systems
Integration of renewable energy sources
Biomass district heating system

ABSTRACT

The decarbonisation of energy systems is one of the important issues of the present energy policies. One of the ways of achieving this is to focus on local energy systems, thus ensuring as much as possible their heat and power self-sufficiency by applying local renewable resource integration and transformation of the renewable energy. Increasing the share of renewables within the local energy balance could be accomplished by using a variety of approaches. One possibility is combining the Locally Integrated Energy Sectors' concept with the novel management and organisation of a renewables-based network. As a first priority, the proposed comprehensive approach focuses on increasing the energy efficiency of municipal heat and power systems using the Locally Integrated Energy Sectors' concept, which is followed by the integration of renewable energy sources with the establishment of a renewable-based network. The proposed approach is illustrated by a case study of district heating based on wood biomass for the municipality Ormož, Slovenia by integrating various end-users from different sectors.

© 2015 Published by Elsevier Ltd.

1. Introduction

The decentralisation and energy autonomy of energy systems is being supported by present energy policies [1]. Integration of Renewable Energy Sources (RES) within energy systems is one of the priority targets [2]. The establishment of sustainable municipal energy systems could be the answer to both of those objectives. There is a current trend towards the transformations of conventional more fossil fuel based energy systems into hybrid energy

systems – i.e. those being supplied by two or more energy sources [3] and smart energy systems (large scale cyber-physical systems for improving the efficiencies, reliabilities and robustness of power and energy grids by integrating advanced techniques) [4]. These are also being orientated towards national as well as the municipal energy systems [5]. The activities at the municipal level could contribute towards more thorough implementations of energy policies due to their direct contacts with end-users [6].

There are various energy policies with different target values covering different time horizons. The EU climate and energy package [7] sets out a commitment to reducing greenhouse gas (GHG) emissions by 20%, to increasing the share of RES to 20% of final energy consumption by 2020, and to improving the EU's

* Corresponding author. Tel.: +386 (0) 41579765; fax: +386 (0) 27480260.
E-mail address: anja.kostevsek@gmail.com (A. Kostevšek).

energy efficiency by 20% by 2020 [8]. Further activities cover an intention of moving beyond 20% GHG emission reductions [9]. In the Energy Roadmap 2050 [10] the EU has committed itself to reducing GHG emissions to 80–95% below 1990 levels by 2050, where the contribution of renewables is highly regarded for achieving decarbonisation of the energy systems [11].

A variety of methodologies and tools have been developed for encouraging RES integration within local communities, amongst them being renewable energy models [12], various scenario calculations [13], strategies for optimal utilisation of renewables [14], action plans for renewables' integration within heat and power systems [15], and designs of various renewable technologies [16]. However, the priority sequence for firstly increasing the energy efficiency of the energy system and afterwards integrating RES, is very important for achieving minimum Carbon Footprint as even renewable source applications also have some small footprints.

The novel approach comprises the previously-developed concept of Locally Integrated Energy Sectors (LIES) [17], and the establishment of renewables-based networks. Together they are able to support any transformation towards sustainable local energy systems. Within municipal energy systems (MES) there is the possibility of integrating a concept of LIES to accomplish greater energy efficiency [18]. LIES integrates various sectors e.g. industry, households, transport, agriculture, service and public sectors together in terms of energy usages. After implementing measures relating to energy efficiency, the following step could be conducted, which covers the identification of the potential usages for versatile RES from techno-economic and environmental aspects as well as the analysis of possible energy consumption. Renewable network

could be established, divided into supply, technology and demand sides [19]. When combining both concepts (LIES and RES network) this results in an efficient approach for accelerating RES within municipal energy systems.

This paper presents a novel approach for increasing RES utilisation which initially provides an increase in energy efficiency due to energy integrations achieved within a municipality. This is followed by a RES network establishment based on a rigorous evaluation and optimisation of the RES value chain. This presented case study – district heating system using wood biomass within the Ormož municipality – highlights the possible implementation of this novel approach.

2. Novel approach for increased RES inception

The share of renewables within present energy systems could be increased by the use of proper instruments for supporting this action [20]. The focus of this current novel approach is towards increasing the energy efficiency of the system and to increase the share of RES [21]. The steps are: (i) Increasing the energy efficiencies of the system via energy integration, (ii) Suitable RES options' evaluation for replacing fossil fuels. The RES utilisation should be supported by considering technical, economic, and environmental aspects [22]. Suitable organisation of the renewable value chain is required for supporting the optimal integration of RES.

The implementation of the LIES concept and the novel organisation of the renewable network are presented in Fig. 1. The three steps of the LIES concept implementation within the municipal

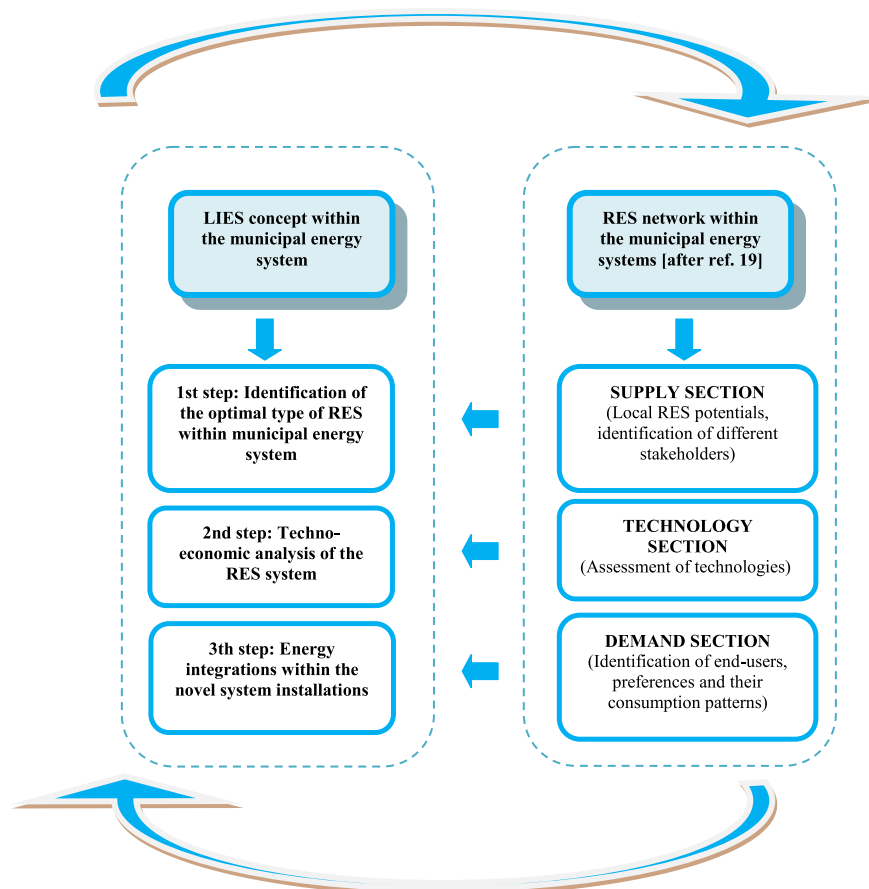


Fig. 1. Comprehensive approach comprising the Locally Integrated Energy Concept with RES network.

Download English Version:

<https://daneshyari.com/en/article/645435>

Download Persian Version:

<https://daneshyari.com/article/645435>

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