**Effects on local value-added and employment from transforming energy supply in an urban neighbourhood**

Anne Nieters, Fraunhofer IFAM, anne.nieters@ifam.fraunhofer.de

## Overview

In order to reach the global climate goal to keep the average surface temperature rise under 2°C, massive changes in the way energy is produced and used are mandatory. In this context, the decentralization of the entire energy system is becoming increasingly important. This transformation requires investments, which in turn influence regional value-added and employment positively.

In the city of Heide (Germany) an efficient and integrated energy system that delivers 100% renewable power, heat and mobility solutions is being developed. In our study we analyse the impacts on the regional value-added and employment resulting from this comprehensive transformation of the energy system. The core of the system which is being developed in Heide is a local heating and electrical operating grid. PV systems installed on the roofs of the houses supply electricity directly to a large heat pump. The generated heat is temporarily stored in a large-scale heat storage unit. The battery storage buffers the PV electricity when the thermal storage is overloaded. Sector coupling is achieved by means of electrolysis. If no PV electricity is available, the large heat pump is supplied by means of a CHP system. A gas boiler is used for redundancy and to increase the temperature on cold days.

Our approach is a comparatively simple method for estimating regional welfare effects (Kosfeld et al. 2013). Using the example of heat supply in Heide, we come to the conclusion that positive economic effects can arise in the region largely detached from the economic viability of investments in the expansion of a decentralized supply system.

## Methods

This paper analyzes the impacts on regional value-added and employment resulting from the transformation of an urban neighborhood towards renewable energy.The paper uses an additive method to estimate direct and indirect local value-added and employs multipliers to derive induced value-creation and employment effects. We apply this method to a district heating system with a PV-powered heat pump, a CHP plant and thermal and battery storage. We compare two scenarios: business-as-usual (conventional) and future-oriented (renewable) heat supply between 2021 and 2035.

In the literature regional economic effects of investments in renewable energies are estimated based on different approaches (Coon et al. 2012, Jenniches 2018, Rutovitz & Atherton 2009, Wei et al. 2010, Hirschl et al. 2015). In this study we focus on the concept of value-added which is defined and interpreted in many different ways (Bender et al. 2002, Gabler 1988, Haller, 1997, Statistisches Bundesamt 2003). Our method of calculating value-added is based on the addition of its individual components. Both, cost-effective-analysis of the production factors used and the income of the various actors involved in the transformation process form the basis. In addition to the value-added effects resulting directly from economic activities in the transformation process, e.g. plant installation, indirect effects are also taken into account. These result from the demand for intermediate inputs and services by companies in the same or a different economic sector and describe the effects that arise at upstream stages of the value chain. Examples include services in the area of tax consulting or insurance, or the material required to repair a plant.

Ultimately, the additional value added in the region leads to an expenditure of the additional income generated by the expansion of renewables and thus triggers a multiplier process that stimulates demand in the region over several rounds and further increases regional value-added (induced value-added effects). For this purpose, a multiplier is quantified for the region under consideration. This indicates the factor by which the value-added generated by the activities in the renewable energy economy is increased after a theoretically infinite number of expenditure rounds (Kosfeld, 2013). The multiplier takes into account the propensity to consume, tax and transfer rates, and outflows from the region.

Employment effects are quantified on the basis of industry-related employment intensities. They reflect the ratio between employees and turnover by describing how many employees are required to generate a certain turnover. Since information about the regionally remaining turnover are available, the employment effects can be derived.

Various scenarios are examined for the sensitivity analysis. Assumptions regarding the degree of regionalization of the individual activities in the transformation process are changed, as well as prices and cost factors.

## Results

## Some results are summarised as follows:

* Up to 2035 the scenario “renewables” generates more value-added than the conventional scenario. This applies to value-added both in absolute terms and per Euro invested.
* Correspondingly, the “renewables” scenario provides significantly more employment than the conventional one.
* The strongest employment effects are indirect both in the installation years and until 2035 and arise from the triggered upstream processes.
* Installation and operation of a heat pump account for the strongest employment effects in our scenarios.

## Conclusions

## The transformation of heat supply from conventional to renewable leads not only to a reduction in CO2 emissions resulting from heat generation but also boasts regional welfare and employment compared to the conventional scenario. Particularly if the transformation of an existing regional energy system is associated with higher costs than the maintenance and continuation of the conventional energy system, the economic effects for the region are positive. The analysis in this paper adds to the notion that investments which are not fully feasible from a business persepective may still lead to considerable positive effects in overall economic terms.

## References

Bender, D., Berg, H., Cassel, D., Gabisch, G., Grossekettler, H., Hartwig, K.-H., Hübl, L., Kerber, W., Nienhaus, V., Siebke, J., Smeets, H.-D., Thieme, J. & Vollmer, U. (2002). Vahlens Kompendium der Wirtschaftstheorie und Wirtschaftspolitik - Band 1. München: Franz Vahlen.

Coon, R. C., Hodur, N. M., & Bangsund, D. A. (2012). *Renewable energy industries' contribution to the North Dakota economy* (No. 1187-2016-93699).

Gabler, ed. (1988). Gabler Wirtschafts-Lexikon. 12. Auflage. Wiesbaden: Gabler Verlag.

Haller, Axel (1997). Wertschöpfungsrechnung. Stuttgart: Schäffer-Poeschel Verlag.

Hirschl, B., Heinbach, K., Prahl, A., Salecki, S., Schröder, A., Aretz, A., & Weiß, J. (2015). Wertschöpfung durch Erneuerbare Energien-Ermittlung der Effekte auf Länder-und Bundesebene.

Jenniches, S. (2018). Assessing the regional economic impacts of renewable energy sources–A literature review. *Renewable and Sustainable Energy Reviews*, *93*, 35-51.

Kosfeld, R., Gückelhorn, F., Raatz, A., Wangelin, M., Duwe, T., Steinbrink, H., & Miosga, M. (2013). Regionalwirtschaftliche Effekte der erneuerbaren Energien II: Einfluss der Regionalplanung und Raumordnung auf regionale Wertschöpfung.

Rutovitz, J., & Atherton, A. Energy Sector Jobs to 2030: A Global Analysis. 2009.

Statistisches Bundesamt (2003). Verordnung (EG) Nr. 2223/96 des Rates vom 25. Juni 1996 zum Europäischen System Volkswirtschaftlicher Gesamtrechnungen auf nationaler und regionaler Ebene in der Europäischen Gemeinschaft.

Ulrich, P., Distelkamp, M., Lehr, U., Bickel, P., & Püttner, A. (2012). Erneuerbar beschäftigt in den Bundesländern! Bericht zur daten-und modellgestützten Abschätzung der aktuellen Bruttobeschäftigung in den Bundesländern. *Employed in the renewable energy sector! Report for the data-and model-based estimation of the current gross employment of the German federal states. Study on behalf of the Federal Environment Ministry*.

Wei, M., Patadia, S., & Kammen, D. M. (2010). Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?. *Energy policy*, *38*(2), 919-931.