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Energy costs in Germany and Europe: An assessment based on a (total real unit) energy cost accounting framework

Oliver Kaltenegger[a,*], Andreas Löschel[a,b,c,d], Martin Baikowski[a], Jörg Lingens[a]

[a] University of Münster, Center of Applied Economic Research Münster (CAWM), Am Stadtgraben 9, 48143 Münster, Germany
[b] University of International Business and Economics, Beijing 100029, China
[c] Centre for European Economic Research (ZEW), L7, 1, 68161 Mannheim, Germany
[d] CESifo Research Network

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ABSTRACT

Affordable energy is one of the objectives of the EU's energy policy. This goal has been challenged by many factors influencing energy prices and costs such as developments in global energy markets, the EU ETS, and the promotion of renewables. Analysing energy costs (prices times quantity) instead of prices has the advantage of accounting for quantity adjustments. However, it does not allow for monitoring the burden that energy costs pose on firms. For this purpose, both the European Commission and the Energy Expert Commission of the German Government recommend using real unit energy costs, defined as energy costs as a fraction of value added. We develop an input-output based (real unit) energy cost accounting framework and study the trends in Germany and the EU between 1995 and 2011. We find that many of the discovered developments are not adequately represented in the political debate, especially with regard to indirect costs (via energy embodied in intermediate inputs), which are more difficult to assess. Indirect energy costs are on the rise, are larger than direct costs in many industries, are increasingly imported, and amplify the asymmetric impacts of legal exceptions available to energy-intensive industries.

1. Introduction

Affordable energy is one of the main objectives of the European Union's (EU's) energy policy. Explicit reference to this goal already appears in the directives on the liberalisation of the EU electricity and gas markets in 1996/1998, 2003, and 2009 and is now reiterated in Germany's and the EU's future long-term 2020, 2030, and 2050 energy strategies (BMWi/BMU, 2010; European Commission, 2010, 2011, 2014a). However, the developments in global energy markets, the EU Emissions Trading System (EU ETS), and the promotion of renewable energy sources have challenged the accomplishment of this goal. The latter aspect is of particular current interest because Germany and the EU have given long term commitments to make their energy systems climate-neutral by 2050. This shift towards sustainability will require additional investments and subsidies in the trillions and will thus affect energy prices. In Germany, the EEG surcharge, the mechanism that finances the promotion of renewable electricity generation under Germany's Renewable Energy Act (Erneuerbares Energien Gesetz, EEG), is already a significant electricity price component. In order to draw conclusions about how these factors affect energy affordability and competitiveness, the relationship between energy prices, energy costs, and competitiveness must be thoroughly understood and analysed.

To this end, we develop an input-output based (total real unit) energy cost accounting framework and use it to reveal major trends in Germany and the EU between 1995 and 2011. This study is geared towards energy costs rather than energy prices because costs factor in the quantities of energy consumed and therefore possible demand adjustments. In addition, our study is limited to energy costs that accompany intermediate consumption rather than final consumption because firms are primarily exposed to international competition. In this context, we focus on the burden of energy costs on firms. Both the European Commission (2014b) and the Energy Expert Commission of the German Government (Löschel et al., 2014, 2015a; Germeshausen and Löschel, 2015) recommend using real unit energy costs as an appropriate indicator for assessing this burden. Real unit energy costs are (direct) energy costs as a percentage of value added and measure the amount of money spent on energy to obtain one unit of value added. In this sense, the indicator measures the energy requirement in EUR to produce one EUR of value added. Hence, it is a proxy for competitiveness. Real unit energy costs allow for meaningful trans-national and trans-sectoral comparisons. However, real unit energy

* Corresponding author.
E-mail address: Oliver.Kaltenegger@wiwi.uni-muenster.de (O. Kaltenegger).

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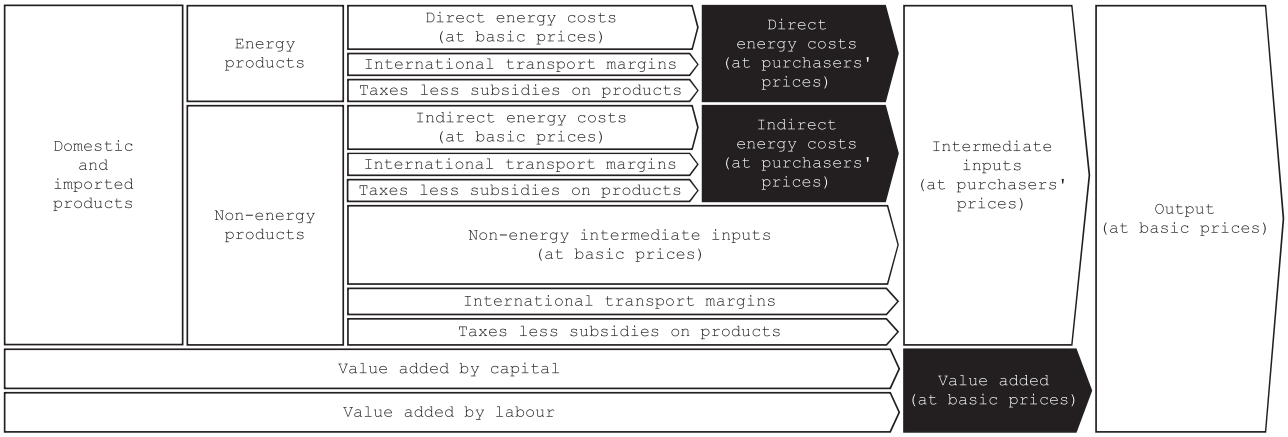

Fig. 1. Main aggregates of input-output based (total real unit) energy cost accounting. Source: Own elaboration.

costs alone do not account for the indirect energy costs in non-energy intermediate inputs.

During the last three years, real unit energy costs have become widespread in European energy policy (see also European Commission (2016, 2014c, 2014d)), but have only been used to compare direct energy costs in different sectors and countries. The indicator was also used in several peer-reviewed studies. For example, Sato and Dechezleprêtre (2015) used direct real unit energy costs to divide the European industries into energy intensive and non-energy intensive sectors. Their results support the notion that the trade impacts of carbon pricing depend on sectoral energy intensities. Similarly, Fitz Gerald et al. (2009) used direct real unit energy costs to exemplify the vulnerability of EU sectors to the introduction of an energy or carbon tax.

To date, no study analysed total (direct and indirect) real unit energy cost trends over time, nor did any study shed light on the underlying drivers. Hence, our study greatly extends previous analyses. We find that indirect energy costs are an increasingly important part of total energy costs. Taking indirect costs into account allows us to track energy costs that occur at earlier stages of the supply chain. Total energy costs in the EU amount to 16.8% of European value added. The fact that the burden of indirect energy costs is rising in the EU makes it an important cost component that should be monitored. We also analyse the underlying factors of the evolution of energy costs. Amongst others we found: Indirect energy costs are mainly imported into the EU. Petroleum products drove costs more than electricity, gas, steam, and hot water. Promoting renewable electricity has become a significant cost factor for companies and the economy-wide costs of Germany's renewable electricity promotion has reached 3.2% of total energy costs in 2011. Value added generation contributed to the fact that the burden of total energy costs on firms increased less in Germany's secondary sector than in the EU.

The remainder of this paper is structured as follows: Section 2 describes the methodology and data used in our analysis. In Section 3, we present the results. Finally, Section 4 derives some policy implications and concludes.

2. Methodology and data

We propose a framework for input-output based (total real unit) energy cost accounting that is fully compatible with the definitions in the System of National Accounts of the United Nations (2008 SNA) and the European System of National and Regional Accounts (ESA 2010). Fig. 1 shows all necessary aggregates, which also appear in standard national input-output tables compiled by statistical offices. The aggregates are also consistent with the System of Environmental-Economic Accounting (SEEA 2012). The strength of the SEEA Central Framework comes from its capacity to present information both in physical and monetary terms coherently, but the available official data infrastructure predominantly focuses on physical flows. In this study, however, we concentrate on monetary flows and thereby give an example of how to integrate monetised data into the System of Environmental-Economic Accounting.

The output of an industrial branch is the total monetary value of all goods produced by the industry during an accounting period (as the sum of all firms in that particular sector). Producing output requires intermediate inputs that consist of goods and services that are either transformed or used up by the production process. Value added is consequently the difference between output and the monetary value of all intermediate inputs, generated by the factors of production, i.e., labour and capital.

Direct energy costs are related to the energy products used as intermediate inputs. Costs associated with energy consumption for non-energy purposes, such as chemical feedstocks, machinery lubrication, and so on, are also part of direct energy costs. Indirect energy costs are those embedded in non-energy intermediate inputs and reflect the energy products used at earlier stages of the value chain.[1] Because they are potentially important, they should be quantified and factored into (total real unit) energy cost analysis. As mentioned above, real unit energy costs are calculated as energy costs per value added. According to the aggregate used in the numerator, we distinguish between (direct) real unit energy costs, indirect real unit energy costs, and total real unit energy costs.

All calculations in this study are based on data of the World Input-Output Database (WIOD; Timmer et al., 2015). The WIOD provides international supply and use tables and (inter-country) world input-output tables covering the period from 1995 to 2011. World input-output tables give a comprehensive summary of all transactions in the global economy between industries (and final users) across countries. Amongst others, these tables report (direct) energy costs, distinguishing between four different energy product groups, the output and value added of 35 industries in 40 countries (EU-27 and 13 other major countries). Output and value added are also available for the residual region (rest of the world). Related papers using the WIOD database analyse, inter alia, the development of energy intensity (Löschel et al., 2015b), material use (Pothen and Schymura, 2015), natural resource footprints (Wu et al., 2017), and the impacts of international trade and structural change on the environment (Löschel et al., 2013).

Energy cost analyses using national input-output tables and

[1] Fig. 1 also applies to earlier stages of the value chain.