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Energy Taxes for the Transition to a Low-Carbon Society

BY T FUNDER-KRISTENSEN, N DETLEFSEN, A BRUN, F ELEFSEN, O CORRADI, J HVIDBJERG, L K JKENSEN , H BØRSTING, P E MORTHORST AND HENRIK MADSEN

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Introduction

The hourly wholesale price of electricity reflects how clean Danish electricity is. However, things are different for end-consumers, as the wholesale price is only about 20% of the price they pay. This means that consumers can't make significant savings by shifting their consumption from hours when the wholesale electricity price is high, to periods where it goes down, or is even negative.

This is sub-optimal as with a high penetration of fluctuating renewables, we will require significant storage systems to have green electricity even in hours where the wind doesn't blow. The simplest way to reduce those storage needs is to make sure consumers consume at the right time, ideally by giving them an incentive to invest in smart devices (heating, cooling, washing, electric vehicle charging..). The current tax scheme on electricity and energy is prohibiting smart and flexible consumers to help balancing the system.

A dynamic tax scheme that follows physics

A main advantage of a dynamic tax scheme that follows physics is that the taxes can be estimated and improved based on prior and physical knowledge, and automatically adjusted when a given technology improves and eg. lead to a reduced pollution. Consequently these principle lead to schemes which adaptively and automatically follow the technological development. As a consequence the cleanest technology will then be give a fair change of being competitive.

The tax revenue can easily be ensured using the suggested principles. In fact this is just a factor which can be used to obtain the intended revenue.

The politicians have to decide on the revenue or the scaling factor, and then the technological mechanisms behind the taxes can be adjusted when
new knowledge is available. This also implies that we could use simple approximations to obtain a first layout of the schemes for dynamical energy taxes.

The charges must be physically anchored

The tax structure must not impair consumer conditions

- The cost of the individual main groups of consumers (private and industry) must not generally increase.
- The overall aim is to increase the flexibility of consumption and in the long term to reduce the price of energy.
- Transitional arrangements will be necessary.
- Resource focus in a broad sense is aimed at emission efficiency.

The tax structure is simplified to the source

- Charges are imposed on energy production.
- The energy generating unit is subject to a basic tax. A fuel charge is applied to the primary source proportional to the climate impact (polluter pays).
- Fuel taxes are levied widely. All fuels are taxed depending on CO2 neutral cycle length. (How many years did it take to store CO2 in the fuel you consume).
- The charges must reflect the development of technology on an ongoing basis.

The tax structure stimulates behavior, consumption and thus innovation

- The structure is transparent. Raises doubts about economic sustainability of innovation.
- Consumption Flexibility is rewarded. Innovation and export of services will increase.
- The structure requires the utilization of RE and hence also a development towards
- increased and better utilized RE (using wind power as much as possible).
- Stimulate the interplay between energy systems.
- Cross-energy storage have to play an important role in balancing of the power grid.

Key findings

The advantage of having a CO2-based tax is that different energy sources (such as heat, electricity, gas..) can be compared. For example, when deciding between heating up a house with an electric heater, or district heating, the cheapest solution should also be the one combining lower cost and lowest emissions, both balanced through a fixed CO2 price (DKK/gCO2eq).

- The CO2 intensity should reflects the use of all greenhouse gases (gCO2e).
- The CO2 intensity should reflects the electricity mix of electricity consumed in a given region (taking into account the CO2 intensity of electricity imported).
- The CO2 price can be chosen such that the total expected tax income is kept constant compared to the previous regime.

Contact

Torben Funder-Kristensen (tfk@danfoss.com), Head of Public and Industry Affairs, Danfoss Cooling Segment
Nina Detlefsen (nid@danskfjernvarme.dk), Chief Analyst, Grøn Energi, Dansk Fjernvarme
Adam Brun, (adbr@aarhus.dk), Fagleder Teknisk IT, Aarhus Kommune
Frank Elefsen (fre@teknologisk.dk), Director at Danish Technological Institute
Olivier Corradi (olivier.corradi@tmrow.com), Founder, Tomorrow and Data Scientist & Software Engineer
Jan Hvidbjerg (janhv@orsted.dk), Civil Engineer, Chemical engineering, Ørsted
Louise Krog Jensen (louise@plan.aau.dk), PhD Fellow, Institut for Planlægning, AAU
Hakon Børsting (hboersting@grundfos.com), Senior Manager, Control Technology at Grundfos Holding A/S
Poul Erik Morthorst (pemo@dtu.dk), Professor, DTU Management Engineering
Henrik Madsen (hmad@dtu.dk), Professor and Section Head at the DTU Compute

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