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DANISH ENERGY DEMAND FORECAST – MODEL AND CASES OF INTRODUCING ELECTRIC VEHICLES AND HEAT PUMPS

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INTRODUCTION

In order to meet the future challenges of depleting oil and gas resources, increasing energy prices and the need for reducing green-house gas emissions the Danish energy system will be characterised by a growing share of renewable energy, particularly within electricity production. Especially the issue of fluctuating wind energy is relevant as 20 percent of the Danish electricity production is already covered by wind energy.

Electric vehicles are expected to gain market shares in the future putting some pressure on the electricity system, but at the same time giving opportunities as electricity storage. Further, it is being questioned whether district heating with high construction costs and low operation costs is beneficial compared to individual solutions as heat pumps or solar panels to when facing decreasing heat demands.

AIM

The aim of the paper is to present a model for the Danish energy consumption, EMMA. In order to illustrate the applications of the model we analyse long term effect of introducing electric vehicles and heat pumps.

METHODOLOGY

We use the Danish macro-econometric model, EMMA to forecast the energy consumption in Denmark. EMMA describes the connections between the economic development and energy consumption and is a satellite model to the Danish macroeconomic model, ADAM, which describes the Danish economy. Both models are empirical and estimated on historical data. ADAM is mostly used for analysing the consequences of political initiatives while the primary purpose of using EMMA is forecasting Danish energy demand depending on the activity level in the Danish economy. The structure of the model is shown in Fig. 1.

EMMA consists of 20 sectors of which 11 are industry sectors and eight are service sectors and one public sector. The activity in sectors and income in households determine the demand for electricity and other energy types. Additionally, the activity level in the sectors and the income level in the household determine a level of goods transport and a level of passenger transport resulting in a transport energy demand.

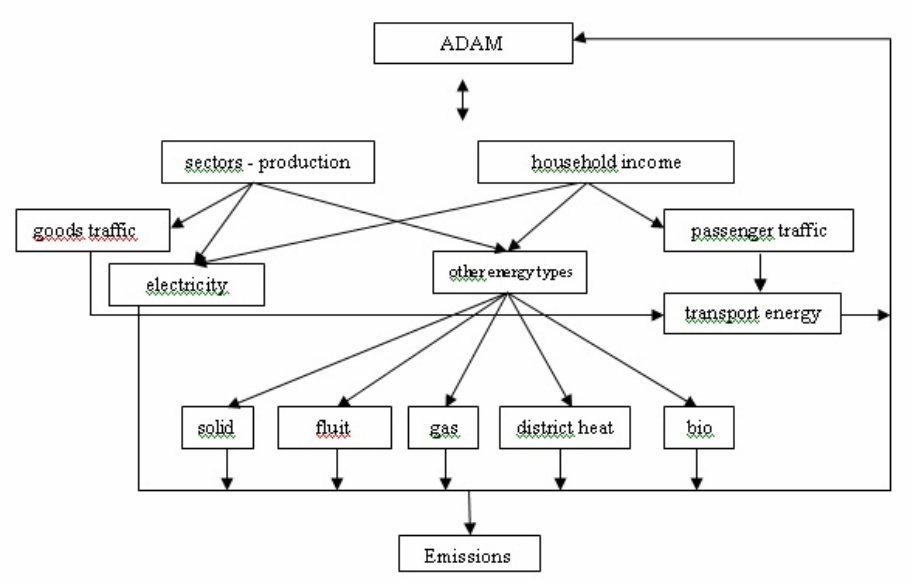

Fig. 1. Model structure of EMMA and its connection to ADAM

We introduce electric vehicles through the transport module of the model. The model determines the transport demand for transport to and from work and transport in the spare time. This transport consumption is divided between transport by car and by public transport. The load factor converts the transport demand into an amount of kilometres driven. Finally, the model determines energy efficiency (driven kilometres per litre of gasoline) and energy consumption.
Electricity consumption for heat pumps is based on forecasts of the number of heat pumps and an efficiency, and the effect on electricity and heat demand will be analysed.

RESULTS:
Based on the present economic forecast by the Danish Ministry of Finance we forecast the energy consumption in Denmark. Furthermore, we analyse two cases: introducing electric vehicles and introducing heat pumps.
Introducing electric vehicles will reduce the demand for transport energy, such as gasoline and diesel, and increase the demand for electricity. However, it is not a one to one relationship since the costs per kilometre in electric vehicles are almost half the costs per kilometre in a conventional car causing the transport consumption to increase. The first effect dominates and introducing electric vehicles results in significant energy savings.
Introducing heat pumps increases the electricity consumption but also affects the heat consumption.