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Electricity trade and CO₂ emission reductions in the Nordic countries

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Abstract

Agreements on emissions of CO₂ change the basic conditions for use of fossil fuels and by that the electricity markets. This paper describes, by using an equilibrium model, the challenge of meeting the Kyoto target and how the recently liberalised energy markets can help easing the joint target of the Nordic countries, Denmark, Norway, Sweden and Finland. Electricity trade serves in some cases as a substitute if emission trading is not allowed, but can even if permit trading is possible reduce marginal emission reduction costs further. The costs of meeting the Kyoto target differ among countries owing to different targets and different reduction costs. The analyses indicate that Denmark and Norway in terms of marginal reduction costs have accepted higher costs than Sweden and Finland.

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1. Introduction

In 1997 in Kyoto, the developed countries agreed to reduce emissions of greenhouse gasses of which the most important is CO₂ (UNFCC, 1998). The Annex B countries have agreed upon a system of unequal percentage reductions. The target year is 2010, while the benchmark levels for the emission level are the average emissions in the period 1990–1995. Several countries (except among others USA and Russia) have on later Conference of Parties ratified the agreement and several details regarding e.g. the specific rules have been developed. The most important

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Table 1
Key numbers (1999)

	Denmark	Norway	Sweden	Finland
Citizens, bill.	5.3	4.5	8.9	5.1
CO ₂ emission, bill (ton) (1998)	59	42	53	61 ^a
Electricity consumption (TWh)	34.8	121	142.9	77.9
Electricity production (TWh)	37	122.9	150.5	66.8
Electricity production				
Hydro power (%)	0	99	47	19
Nuclear power (%)	^b	^b	47	33
Other thermal power (%)	92	1	6	48
Other renewable (%)	8	^c	^c	^c

Source: Nordel (2000) and National statistics bureaus.

^a 1997.

^b None.

^c Less than 0.5.

principles from the Kyoto agreement, namely, the emission quota trade, joint implementation and clean development mechanism are the basic principles for this development. After having agreed upon a total reduction, the EU countries agreed upon how to distribute this reduction obligation among the individual countries. Also, at this level the different percentage reductions in the countries were agreed upon. Denmark has agreed to reduce emissions by 21%, Finland has agreed to keep emissions unchanged, while Sweden and Norway have agreed not to increase emissions by more than 4 and 1%, respectively.

The Nordic countries differ with respect to the composition of energy use and how electricity is generated (Table 1). These differences imply together with the different emission targets the potential gains from trade of electricity and emission permits.

The Danish thermal power production is primarily based on coal, while half the Finnish thermal power production is half coal based and half bio fuel based.

Norway and Sweden have already low emissions from electricity and district heating production. In Kyoto they may, therefore, have committed themselves to tight targets taking their possible abatement costs into consideration. Denmark on the other hand has a large base year emission from electricity and district heating based on coal. If this production is substituted towards less polluting fuels, emission reductions may be relatively low.

Sweden has officially decided to phase out nuclear power, and one block of the Barsebäck nuclear power plant is already closed. This creates special problems in meeting the emission target as the bygone production must be substituted by other maybe more CO₂-intensive production (Nordhaus, 1995; Löfstedt, 1997; Barrett, 1998).

Whether some countries are partly free riding in the Kyoto agreement is one major subject here. In Kyoto, it was also agreed that emission permits could be traded internationally, while liberalisation of the European electricity markets in the

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