

# **EFOM/ENV - Energy Flow Optimisation Model for the Czech Republic**

Workshop on  
Assessing The Impacts Of Environmental Regulation By  
Macroeconomic Models

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**Jiří Spitz – ENVIROS, s. r. o.**



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## Model used

- EFOM/ENV (Energy Flow Optimisation Model - Environmental)
  - the Czech version developed within PHARE and SYNERGY projects
  - linear optimisation model – cost minimisation
  - technological bottom-up model
  - covers energy production, transformations and consumption
  - energy carriers correspond to the energy balance
  - about 500 technologies
  - time horizon up to 2050 (5-year steps)
  - calculates emissions of CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, CO and particulates, other emissions are possible
  - use of additional abatement technologies

# Modelled sectors

- Sectors of the EFOM/ENV model (sectors are further structured but not by NACE)
  - Consumer
    - Agriculture
    - Industry
    - Transport
    - Services
    - Households
  - Transformation
    - Coal industry
    - Oil industry
    - Gas industry
    - Public electricity and heat production
    - Industrial combined electricity and heat production

# Hierarchical structure

- sectors (those from the previous slide)
  - producers (heat production, heat distribution, appliances...)
    - units (individual technologies)
      - processes (different heat:electricity production shares of the same unit)
- energy flows
  - internal – between producers
  - external
    - input (energy resources, imports...)
    - output (energy demand, exports...)

## Model results

- complete energy balances by all energy carriers, sectors and periods
- CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, CO and particulates emissions by sectors and periods
- installed capacities and productions (levels) of all technologies by periods
- abatement technologies connected with individual technologies
- energy flows (external and internal) by energy carriers and periods
- investment and total discounted costs by sectors and periods

## Typical model uses

- development of scenarios for
  - state energy policy
  - GHG emission projections
  - projections of other emissions
  - analyses for energy companies
  - data submissions into EU-wide RAINS/GAINS models

## Modelling Possibilities of Environmental Regulation

- global emission limits
- cost-abatement curves
- energy taxes
- preferential feed-in tariffs for energy produced from RES or co-generation
- emission taxes



## Global Emission Limits

- we can set system-wide limits for each pollutant in each period
- used for
  - modelling of international commitments (e. g. emission limits given by the CLRTAP protocol)
  - national emission targetts
- possible improvement
  - emission limits by sectors

## Cost-abatement Curves

- use of global emission limits for sensitivity analysis
  - calculate maximum emissions without any limits
  - calculate minimum emissions regardless of costs
  - stepwise decrease the limit from the maximum to the minimum value
- as a result we get the curve of emission reduction vs. marginal costs

# Energy Taxes

- each energy flow within the model can have its price
- we can use this item i. a. for introduction of energy taxes
- taxes can be differentiated by sectors and energy carriers

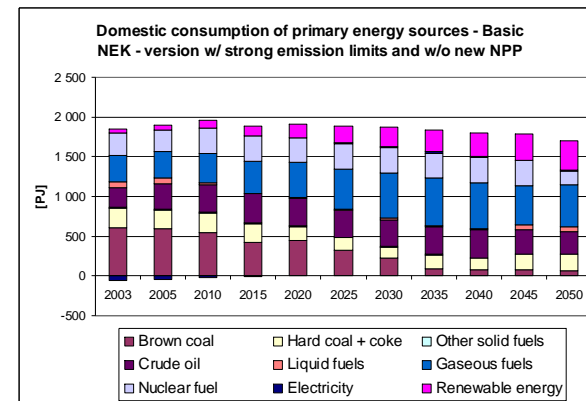
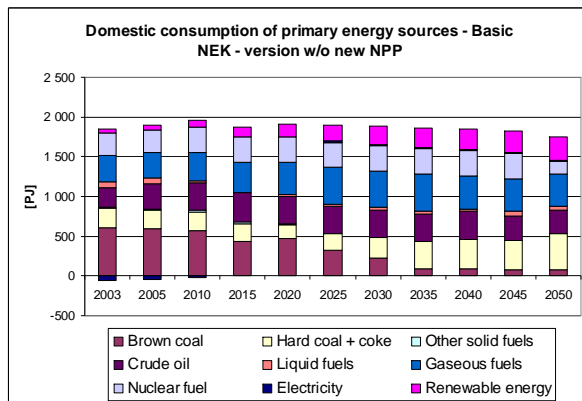
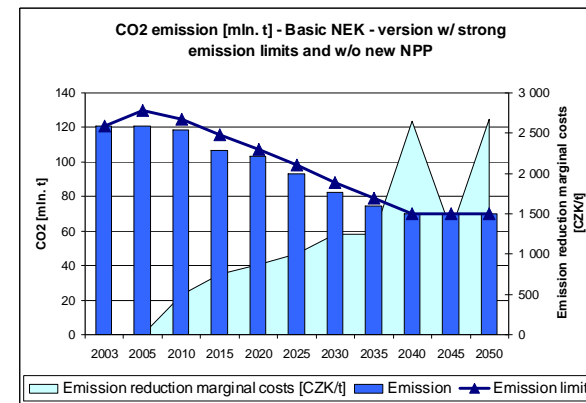
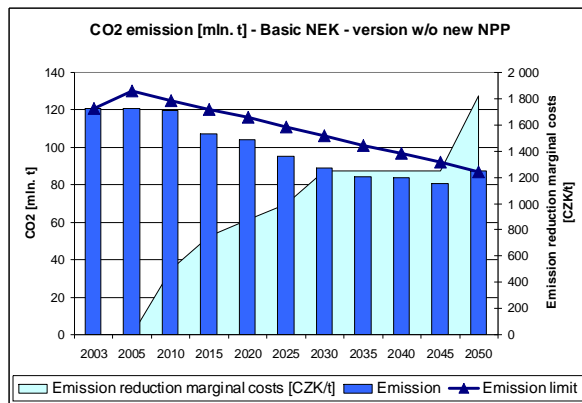
## Preferential Feed-in Tariffs

- opposite use of energy flows prices
- using negative prices we can model preferential feed-in tariffs for energy produced from RES or from co-generation

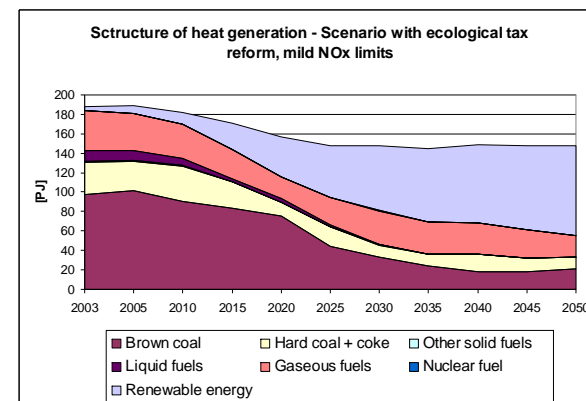
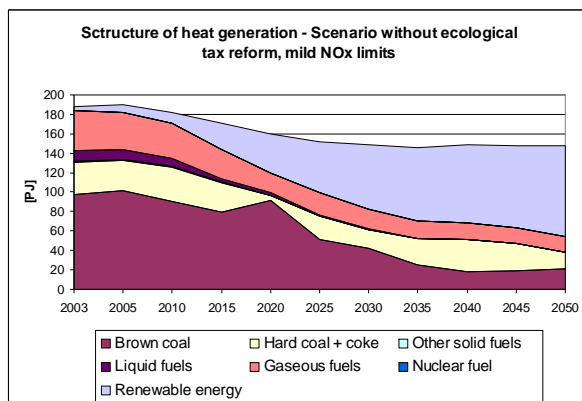
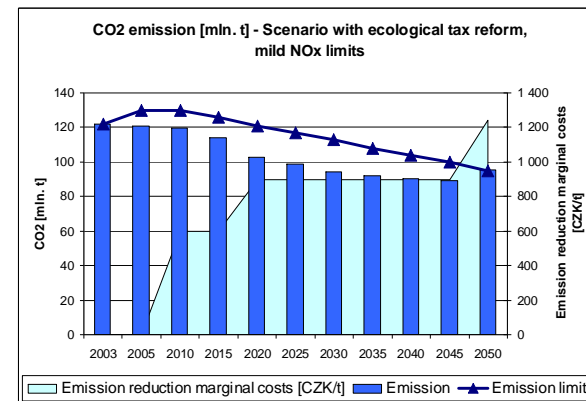
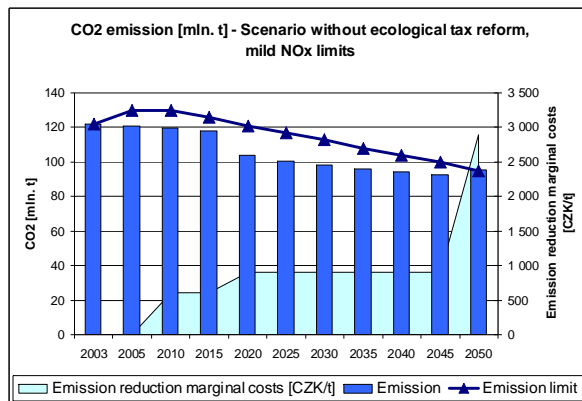
## Emission Taxes

- setting prices for emissions
- currently only on the global level
- possible improvement
  - emission prices on the sector or even technology level

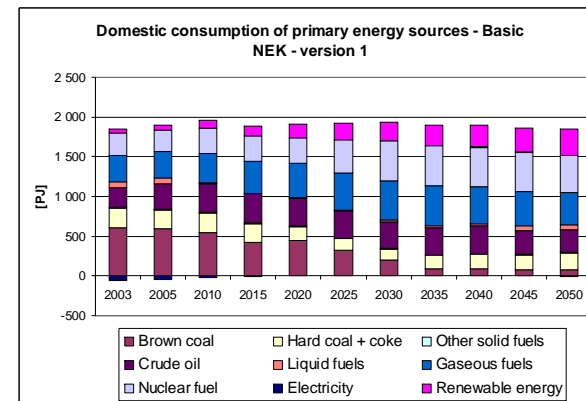
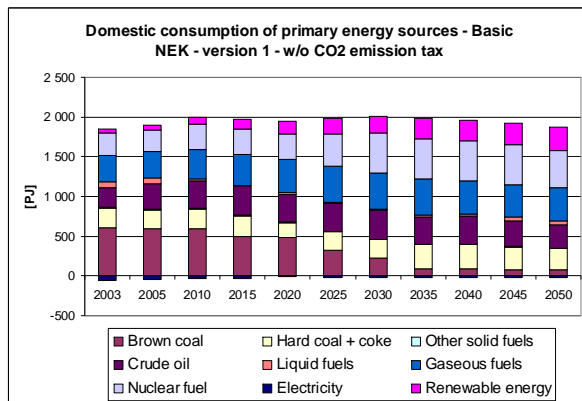
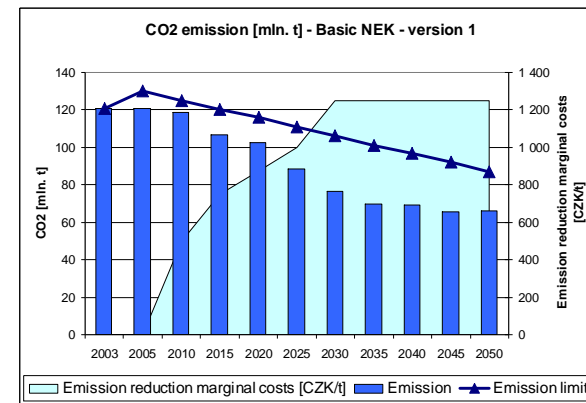
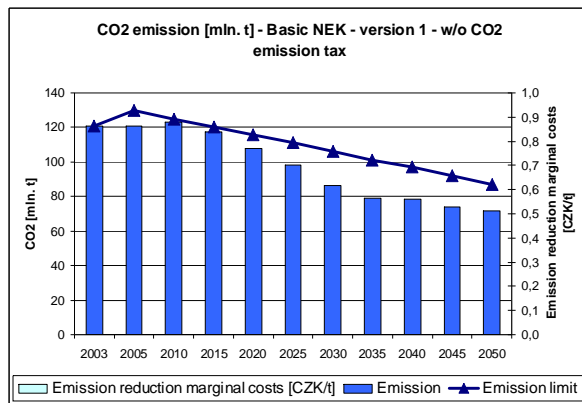
# Impact of CO<sub>2</sub> emission limits



# Impact of fuel taxes

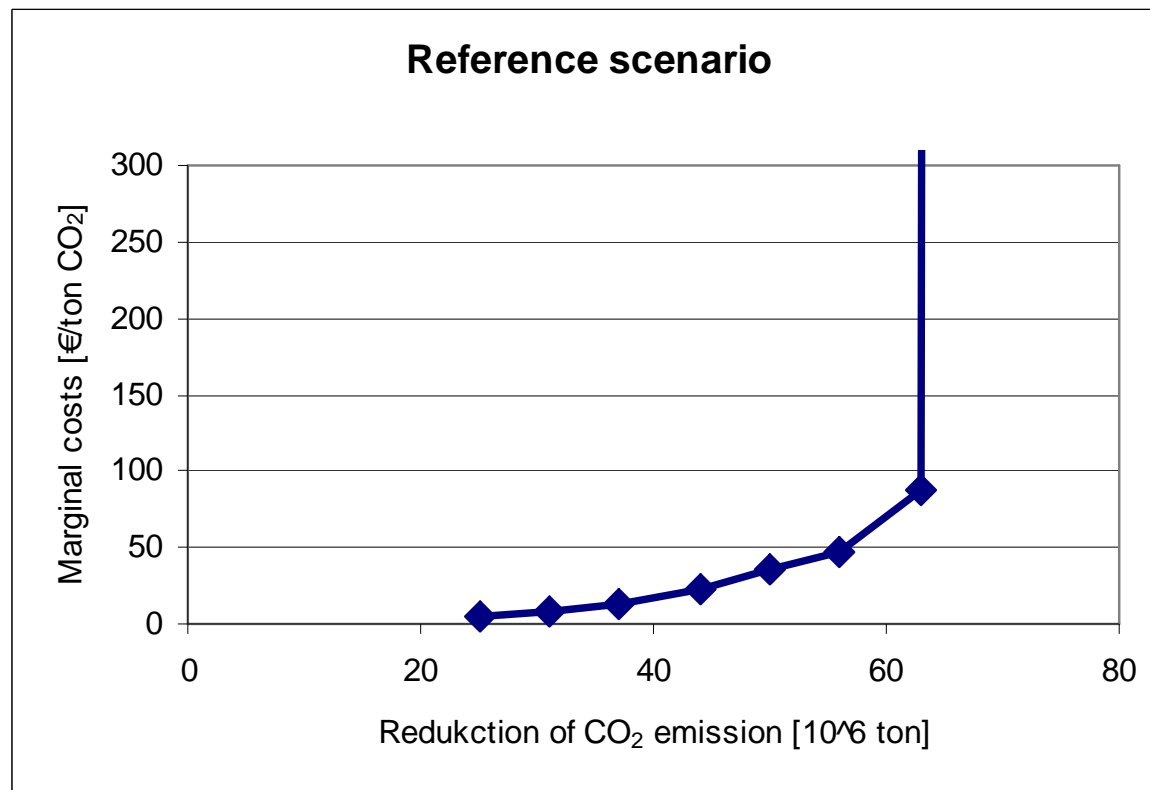


# Impact of CO<sub>2</sub> emission tax





# Example of cost-abatement curve



# Conclusions

## model EFOM/ENV

- covers the whole energy system
- is regularly used for scenario development and evaluation for various purposes
- can be used for modelling of some aspects of environmental regulation
- has some potential of methodological improvements for environmental regulation modelling
- covers only the energy system – no connection to macro-economy

## Contact

Jiří Spitz

ENVIROS, s. r. o.

Na Rovnosti 1

130 00 Praha 1

Czech Republic

tel.: +420 284 007 487

e-mail: [jiri.spitz@enviros.cz](mailto:jiri.spitz@enviros.cz)

