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Long term Climate Mitigation and Energy Use in Austria – The Impacts of Carbon and Energy Prices

Kurt KRATENA
Ina MEYER
Mark SOMMER

Austrian Institute of Economic Research - WIFO

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Outline: Long term Climate Mitigation and Energy Use in Austria

1. Objective of the study is to model different energy use scenarios for Austria - 2020/2030

2. Background: The EU policy framework, the climate and energy package, the 2030 strategy, the 2050 roadmap

3. Policy scenarios and data

4. Methodology: DEIO - Dynamic Econometric Input-Output Model

5. Results: Total final energy demand of household and industry sectors, economy-wide energy efficiency

6. Conclusion

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Objective of the study

Model alternative energy use scenarios for Austria up to 2020/2030 based on different assumptions on carbon pricing (3 energy use scenarios).

The energy use scenarios for Austria's economy serve as

- input data for calculating potential GHG emissions
- information tool to fulfill the reporting requirements under the Monitoring Mechanism of the UNFCCC

The study is a joint project of different Austrian research institutes under the lead auf the Austrian Environment Agency and the participation of stakeholders from political bodies, in particular the environment ministry

EU Policy Framework of Assessment

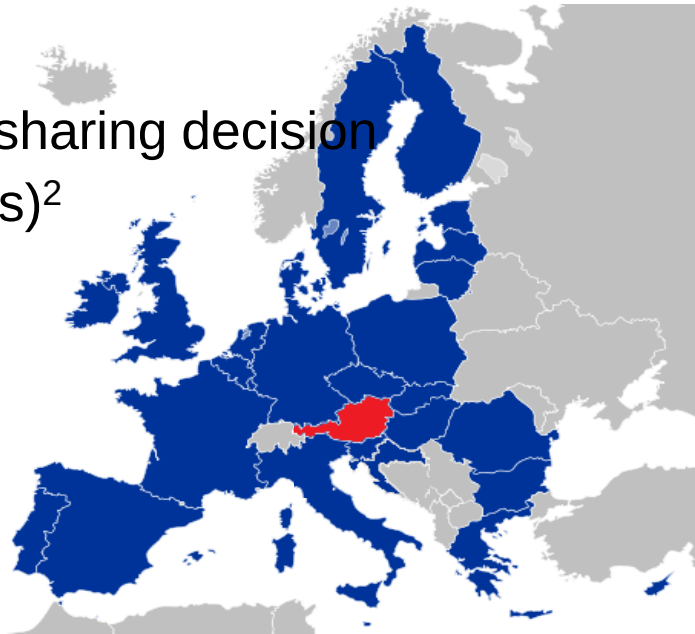
Integrated European approach to a climate and energy policy that aims to combat climate change, increase EU's energy security and strengthen its competitiveness

EU's 20/20/20 targets on climate and energy

- 20 % reduction of GHG emissions[1]
- 20 % share of renewable energy sources (RES) in final energy use including 10% RES in the transport sector
- 20 % improvement of energy efficiency

Designated targets for Austria

- 16 % reduction of GHG emissions in effort-sharing decision (EU-wide 10% reduction in non ETS-sectors)[2]
- 34 % RES share (25% in 2005)
- Stabilisation of final energy demand at 2005 level (1.100 PJ)



1) w.r.t. 1990 level
2) w.r.t. 2005 level

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Policy Scenarios

3 Scenarios:

WEM= “with existing measures”, climate and energy policy measures set by 8 march 2012 included, **reference scenario**

WAM=“with additional measures”, additional climate and energy policy measures:

energy efficiency (+1.5% p.a.)
increase in mineral oil tax (including VAT) of + 6 €ct

WAM+=“with additional long-term measures” (+), inducing a more stringent climate mitigation policy in terms of carbon prices **after 2020,** methodological refinements

Scenarios were jointly developed with stakeholders from governmental bodies and research institutes in order to gather knowledge and expertise from different perspectives.

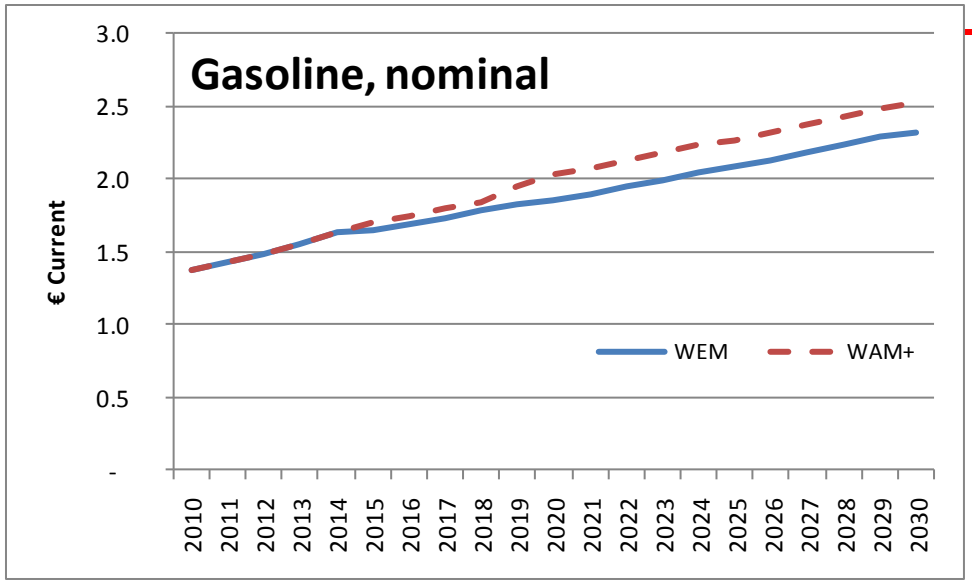
Policy Scenarios
main input/output

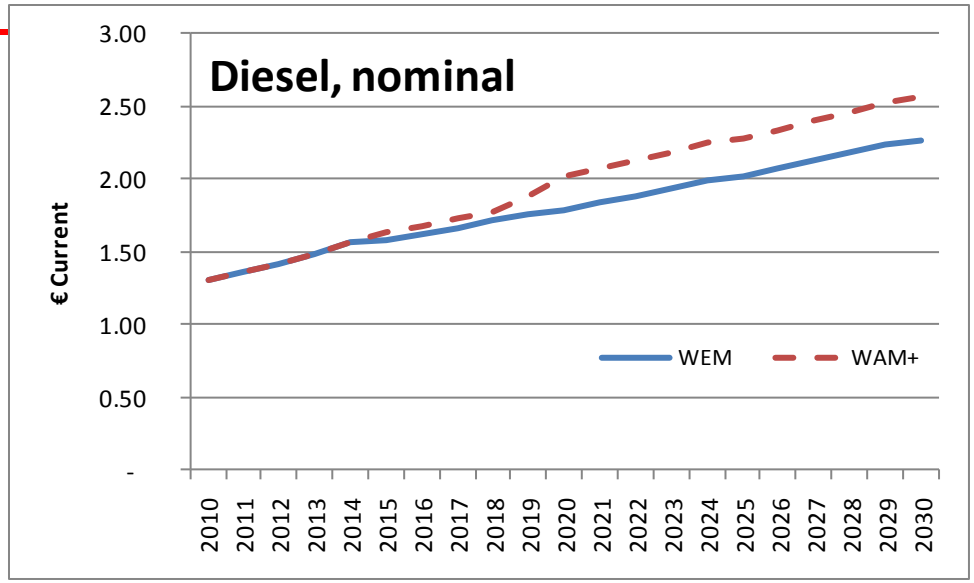
Scenario	WEM	WAM	WAM+
Economic Growth			
Ø GDP - Growth p.a. 2012- 2030	1,5%	~1.5 %	1.49%
Carbon and Energy Prices			
Price of CO_2-Certificates ETS Sectors	20 €/t CO_2 in 2020 30 €/t CO_2 in 2030	= WEM	20 €/t CO_2 in 2020 70 €/t CO_2 in 2030
CO_2 Tax non-ETS Sectors	n.a.	n.a.	20 €/t CO_2 in 2020 70 €/t CO_2 in 2030
Fuel Price Increase, nominal	n.a.	Diesel/Gasoline +6 ct in Jan 2015 +6 ct in Jan 2019	2020-2030 Diesel +27% Gasoline +25%
Methodological Settings			
Energy efficiency coefficients of the ETS sectors	estimated econometrically	increased	= WAM
WAM+ Specific Implementations			Disaggregation of 4 energy intensive sectors

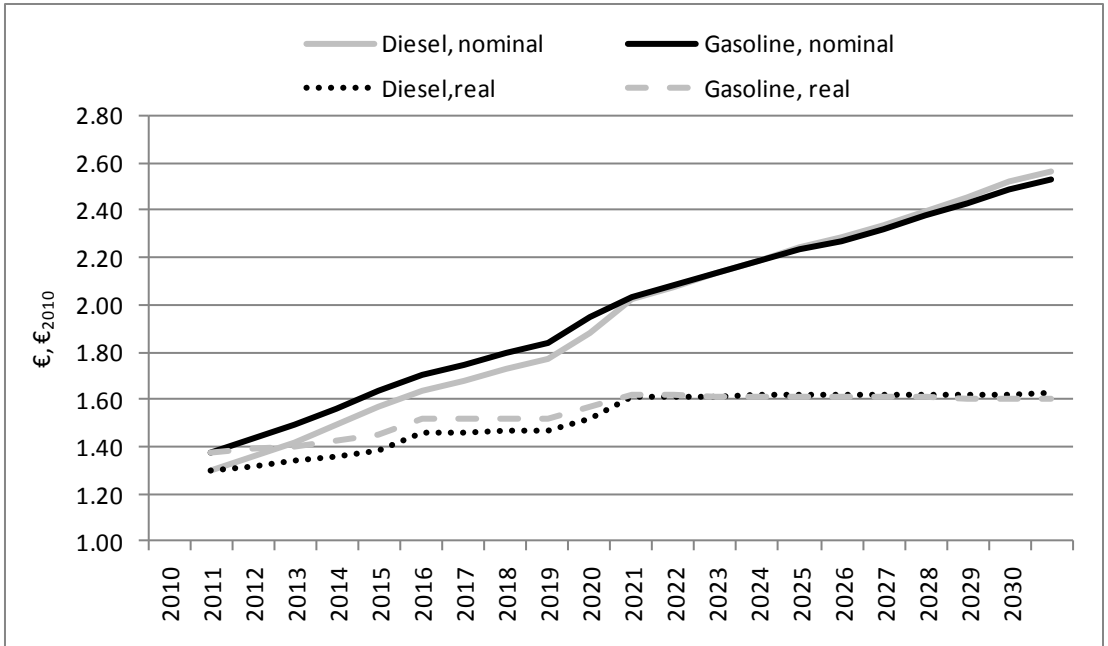
S: own representation

Policy Scenarios

fuel price development





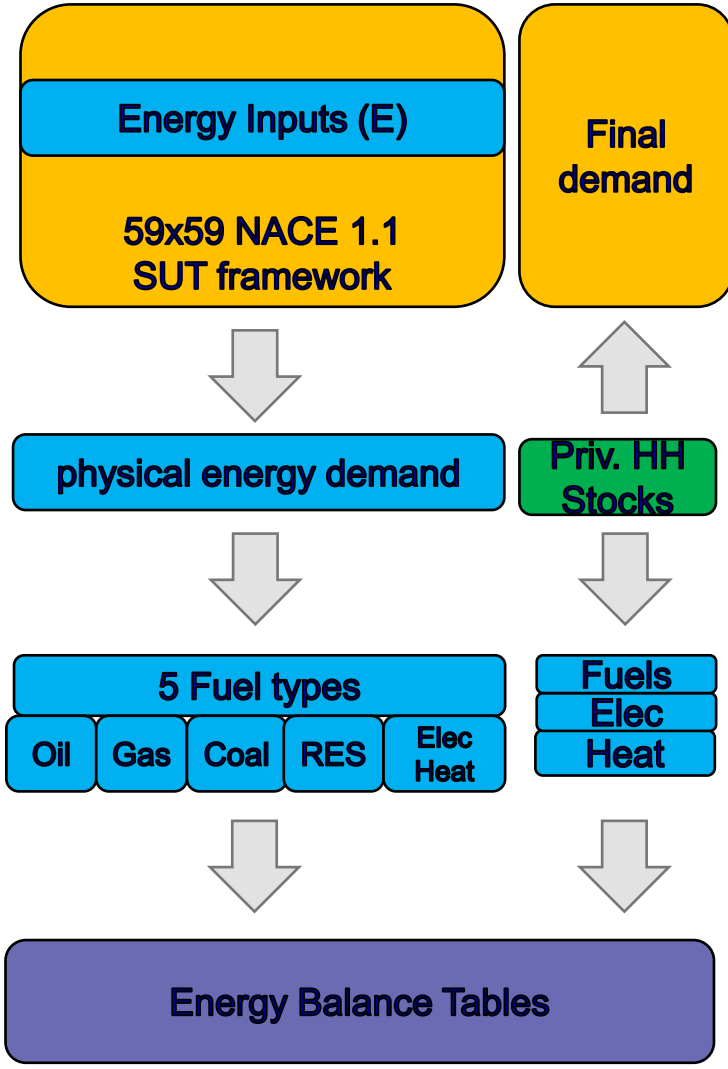


S: own representation

Methodology: Main Model Features

Dynamic Econometric Input-Output (DEIO) Model

- 59x59 sector Supply-Use-Table (SUT) framework
- extrapolation of final demand
  (exports, public consumption, investment)
- endogenous demand for energy commodity
  - price scenarios
  - technical progress
    from K,L,E,M^m,M^d Translog production functions[1]
- Derivation of physical energy demand
- Private households energy demand functions depend on
  - stock of durables (vehicles, ownhouses, appliances)
  - energy prices
  - energy efficiency[2] (“rebound effect”)
- Sub-Model (Translog) to derive fuel shares
- Disaggregated to Austrian Energy Balance
  (22 Fuel types, 18 Sectors)



1) Developed within Project „FIDELIO“ by the institute for prospective technological studies (IPTS)
2) Received from bottom-up models of the project partners

Model Features:

energy demand - private households – rebound effect

Energy demand by private households

- **three categories of energy demand based on different service demands**
  - Fuels (gasoline, diesel) — km-driven
  - Heat — room temperature
  - Electricity — lighting, TV, dish washers, etc.

- **using „service approach“ for the estimations, estimation based on:**

1. **energy services**
   instead of physical energy demand

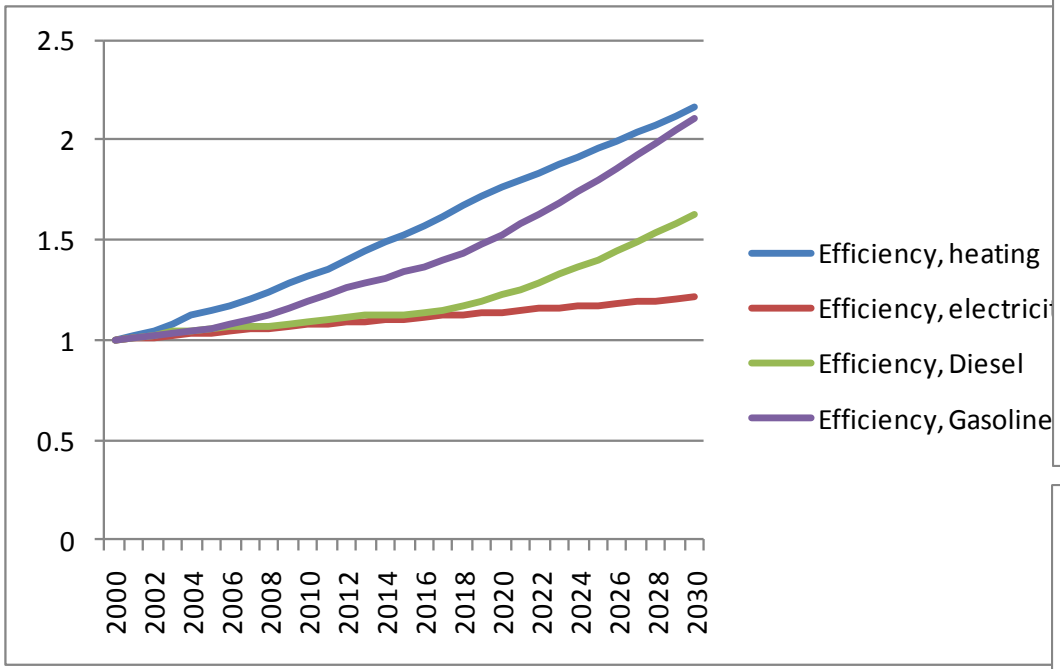
2. **Prices of energy services**
   linked to physical energy prices and energy efficiency indices of capital stocks

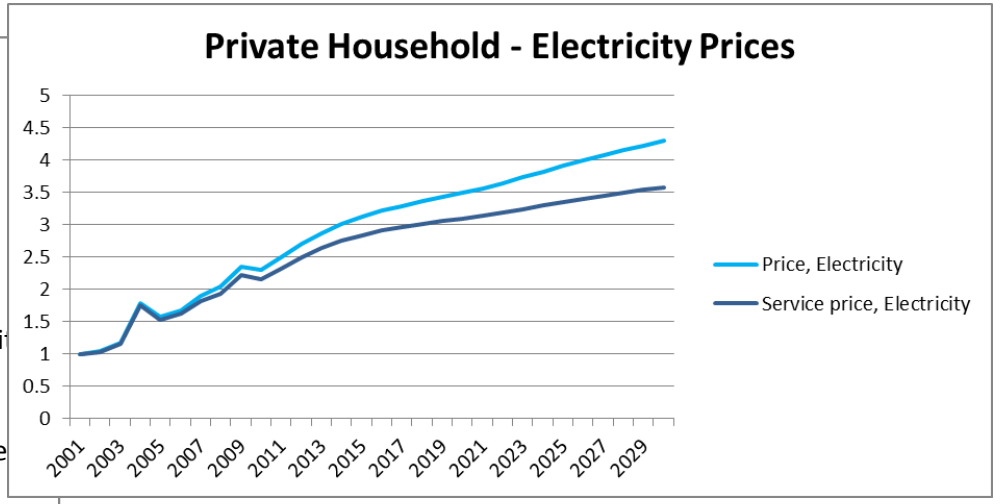
$$P_S = \frac{PE_C}{\eta}$$

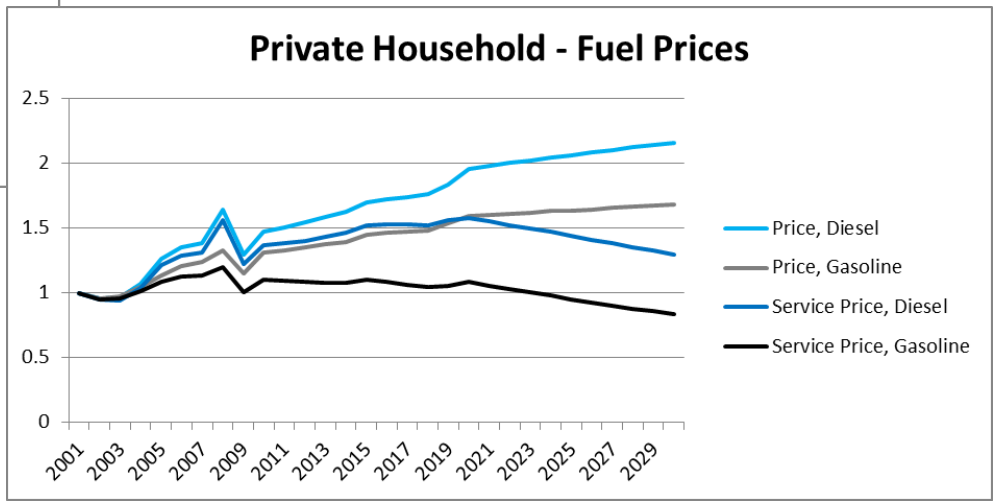
Model

energy demand - private households – efficiency of capital stocks – energy prices

Energy efficiency w.r.t. private household's →energy prices and service prices capital stocks







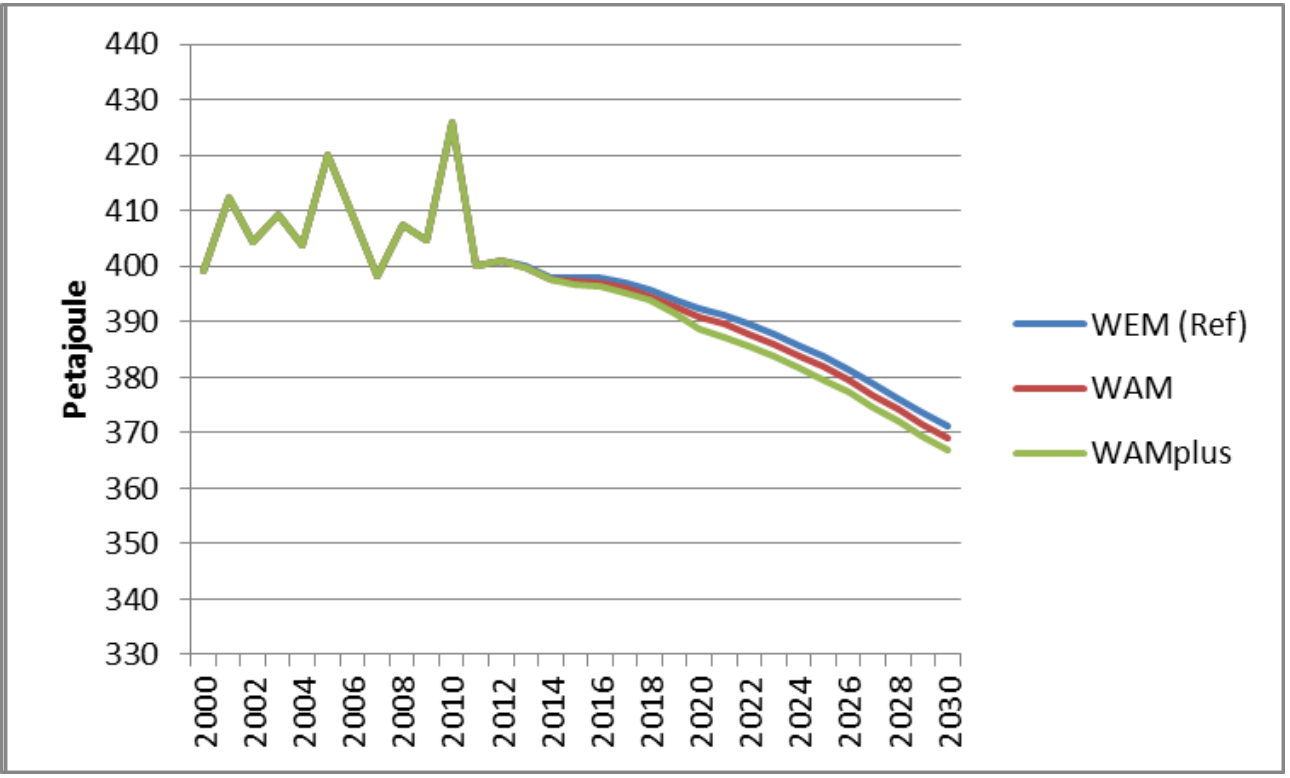
Development of efficiency – from technical bottom-up model
Source: AEA, EEG, TU Graz, WIFO calculations
Energy prices build on energy price trajectories of the IEA, WEO 2011

exogenous growth of durable stocks, partly linked to population such as housing

Results

energy demand - private households

Total final energy demand by private households



Effects WEM (Ref)

Stock increase
(vehicles, ownhouses …)

Energy Efficiency
(vehicles!)

Effects WAMplus

Mineral oil tax increase (fuels)
Adequate to historic reactions

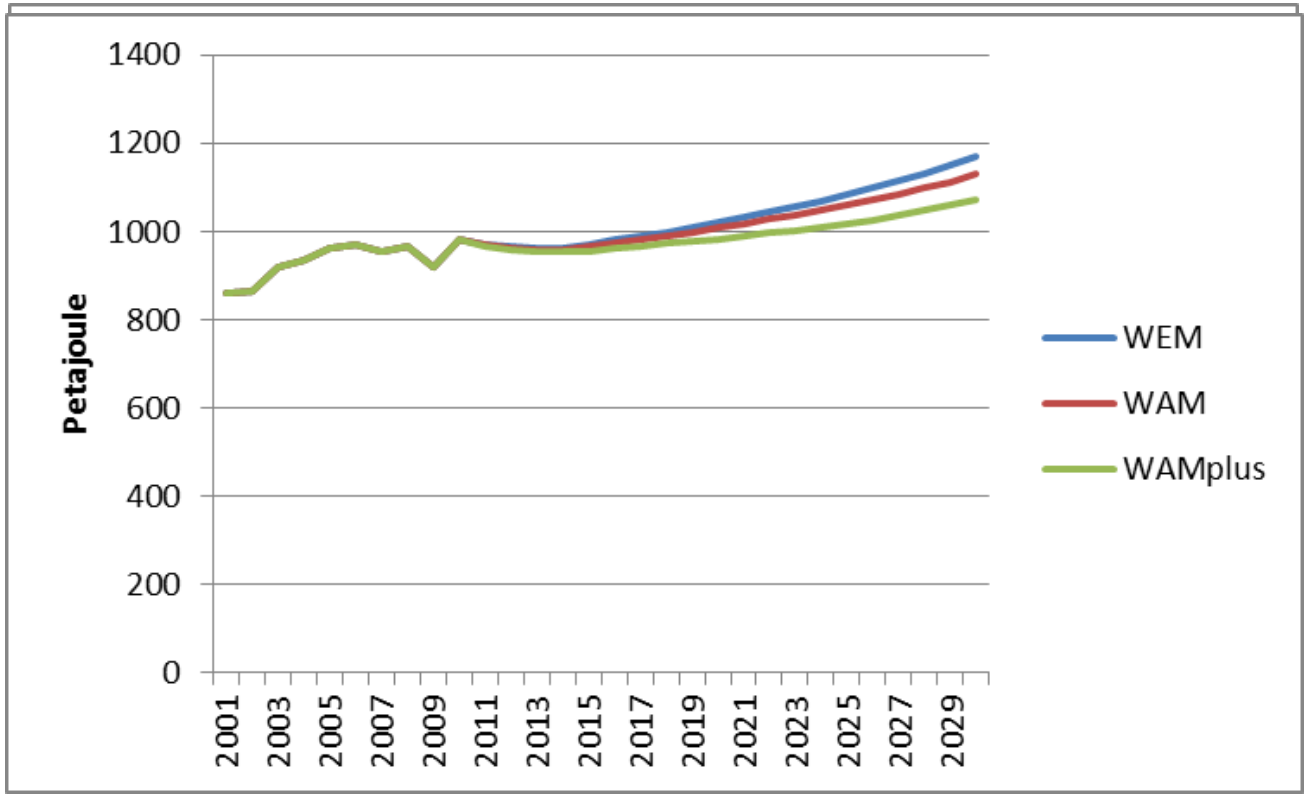
CO_2 Tax
(heating, electricity)
Small effect due to low CO_2 content

Source: WIFO calculations

Results

energy demand – industry & services

Total final energy demand by industry and service sectors



Effects WEM (Ref)

Economic Activity
(Domestic demand, exports…)

Estimated Energy Efficiency
(deterministic trend)

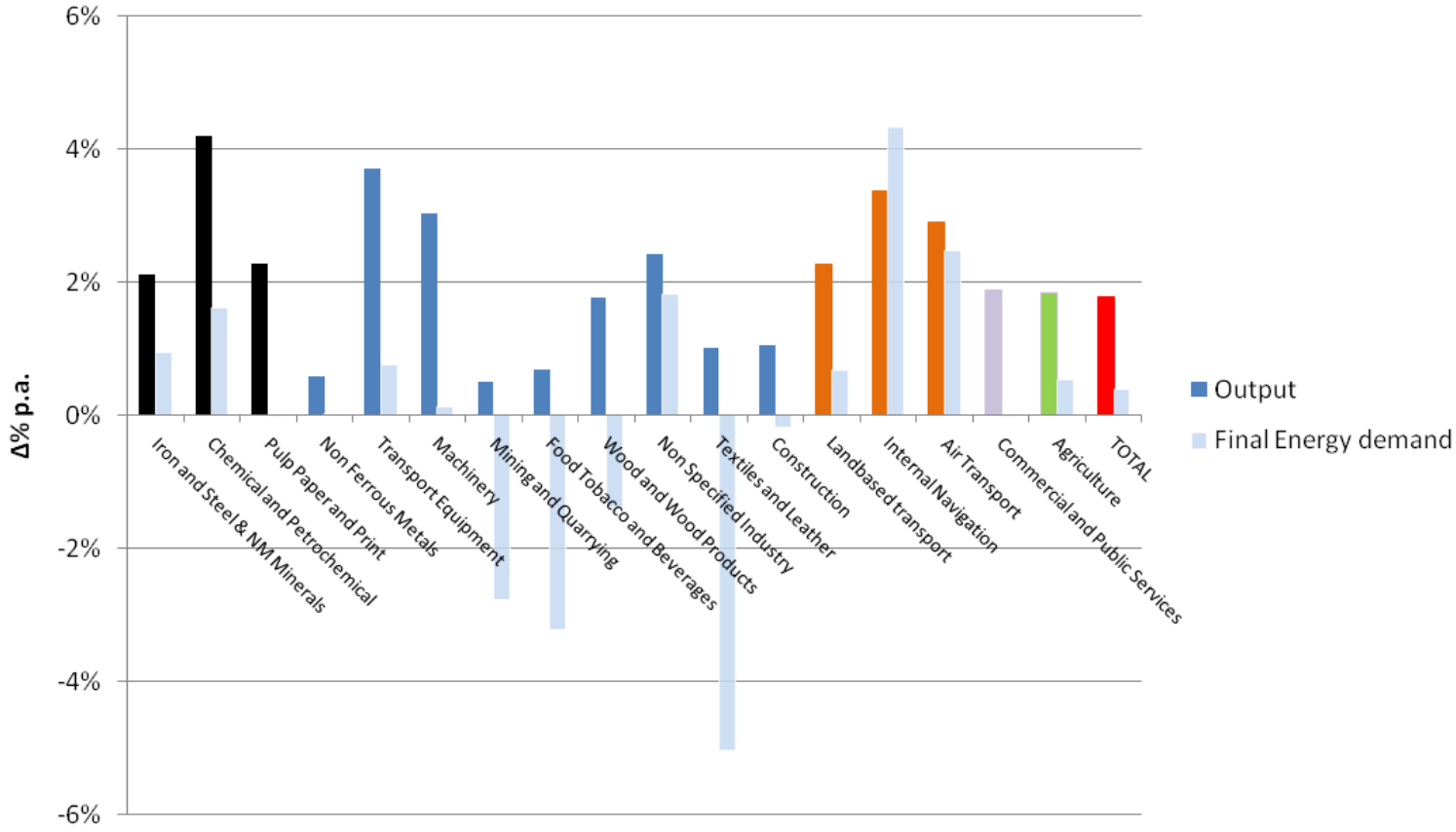
Effects WAMplus

Mineral oil tax increase (fuels)
Adequate to historic reactions

CO_2 Tax
(heating, electricity)
Due to estimated parameters and low CO_2 intensity in fuels (natural gas)

Source: WIFO calculations

Results: average annual growth in sectoral output and final energy demand, 2012-2030



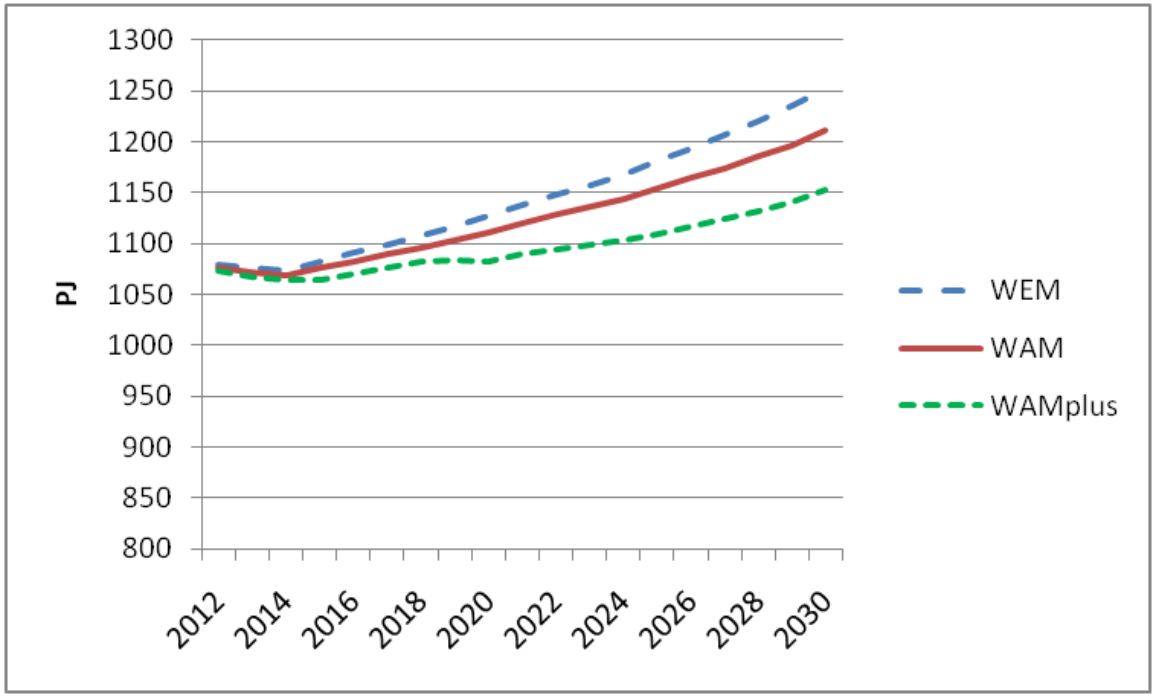
Annual growth rates 2012-2030 in production and energy demand
Scenario WAM plus
Source: WIFO Calculations

Annual growth

Total production: 1.8 % p.a.
Energy demand: 0.35% p.a.
→Efficiency gain ~1.4%p.a.

Results

Total final energy demand – economy-wide



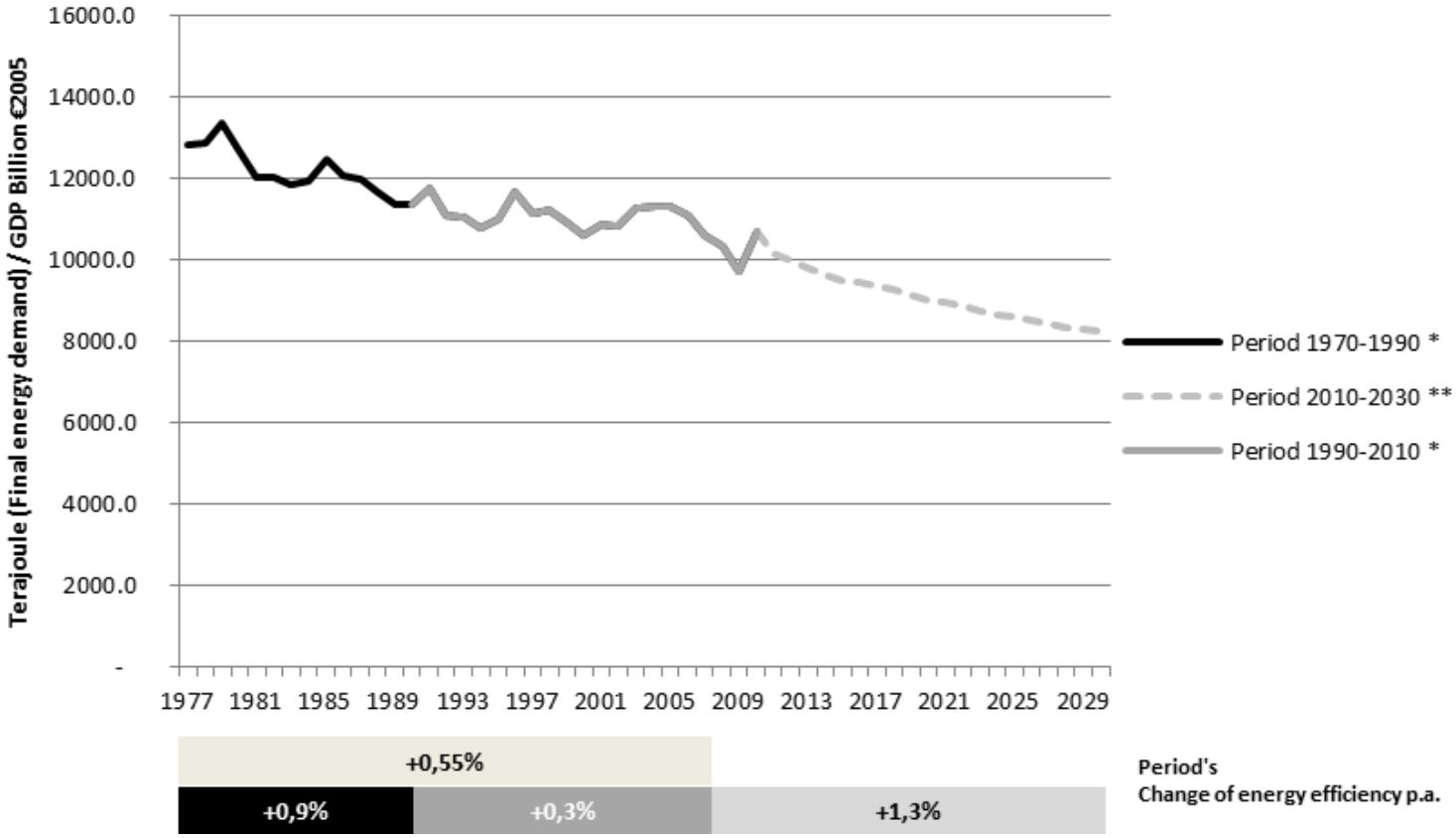
Even in ambitious scenario: only relative decoupling of GDP and energy demand.

Final Energy demand	WEM	WAM	WAM plus
2020 (PJ)	1,127	1,111 (-16 PJ)	1,083 (-44 PJ)
2030 (PJ)	1,251	1,210 (-41 PJ)	1,152 (-100 PJ)
2012-2030 (%)	+0,77 p.a	+0,6 p.a.	+0,35 p.a.

Source: WIFO calculations

Results:
energy efficiency (WAM+) in historical perspective

Energy intensity per unit of GDP is continuously declining



*) Source Statistical Institute Austria (Total Energy balance; Gross National Product by volume)
**) Source: WIFO calculations (WAMplus scenario)

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Conclusions

WAM+ scenarios shows that significant carbon and energy pricing can trigger
- growth in energy efficiency and
- a relative decoupling of GDP and energy demand

Industry & Services

- Estimated technical progess and price induced progress (incl. CO_2 certificate prices) **not sufficient** to decouple energy from production
  → further research

Private Households

- Expected efficiency improvements and price effects (taxes) are **sufficient** to reduce energy demand

Thank you for your attention!

kurt.kratena@wifo.ac.at
ina.meyer@wifo.ac.at
mark.sommer@wifo.ac.at

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Additional material

D. Sub Model – Interfuel substitution

- Own Parameter estimation (translog function)
- based on EU27 Data panel, World-Input-Output-Database, 1995-2009
- using energy prices &
    1. oil products
    2. natural gas
    3. coal
    4. renewables
    5. electricity & heat

unit cost function(= p

$$\log p_E = \alpha_0 + \sum_i \alpha_i \log($$

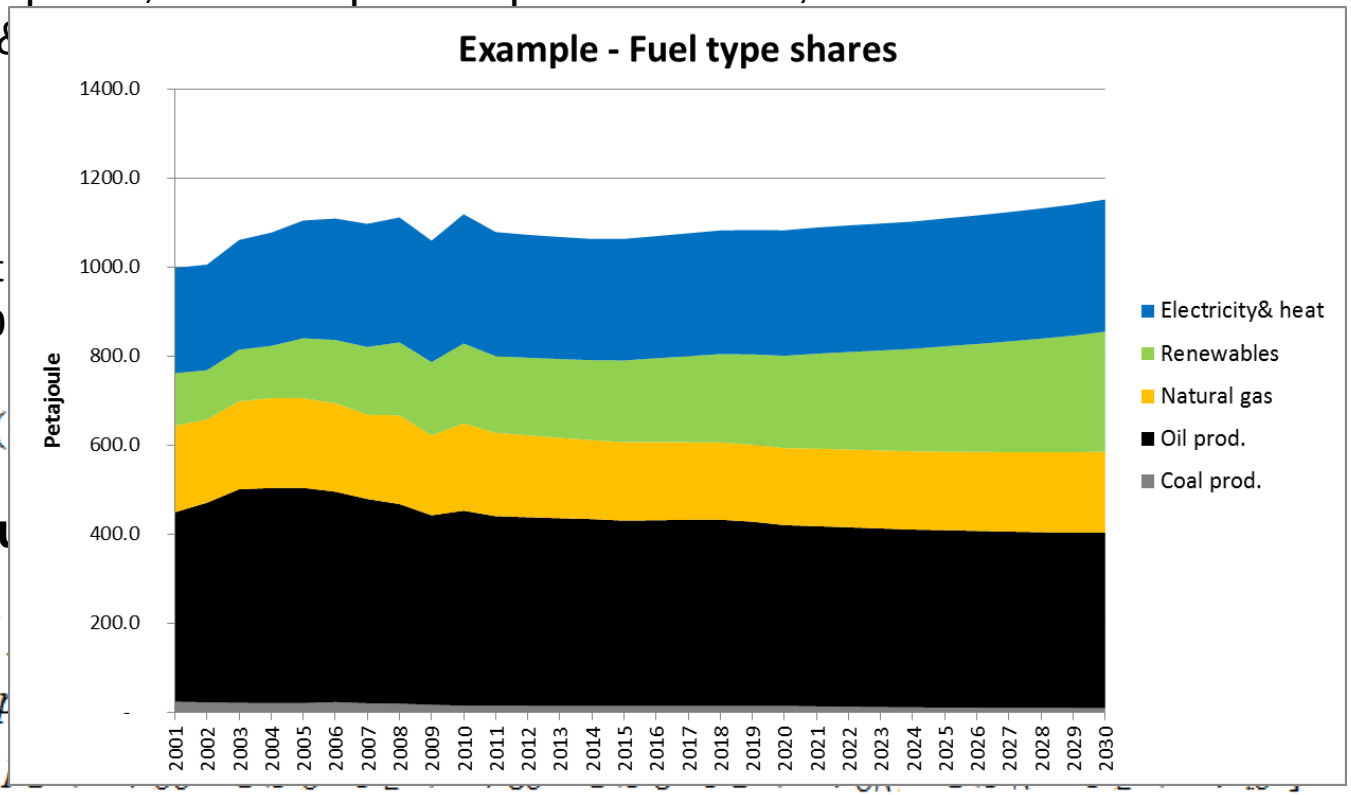
Deviation of Factor/Fu

$$v_O = [\alpha_O + \gamma_{OO} \log(p_O /$$

$$v_G = [\alpha_G + \gamma_{GG} \log(p_G / p$$

$$v_C = [\alpha_C + \gamma_{CC} \log(p_C /$$

$$v_R = [\alpha_R + \gamma_{RR} \log(p_R / p_E) + \gamma_{OR} \log(p_O / p_E) + \gamma_{GR} \log(p_G / p_E) + \gamma_{CR} \log(p_C / p_E) + \rho_{iR} t]$$



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Model

energy demand - private households

- **energy services linked to durable stock**
  - ownhouses (heating,electricity)
  - vehicles (fuel)
  - electrical appliances (electricity)

- **exogenous growth of durable stocks, partly linked to population**

- **estimation function structure**

$$log\left(\frac{Service}{Capital\ Stock}\right) = \alpha_0 + \gamma * log(P_s) + \theta_1 Param_1 + \theta_2 Param_2$$

Estimation based on data 1995-2011, on prices, heating degree days, trends, population

- **deviation of physical energy demand**

$$\text{Energy\_demand} = \text{Service}/\eta$$