Modelling Employment and Nuclear Power in the CGE Model *NEWAGE*

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NEA Expert Workshop on
"Modelling Employment in the Nuclear Power Sector"

13-14 February 2014
NEA Headquarters, Paris

AGENDA

1. Introduction

2. Modeling nuclear power and employment in the NEWAGE model
   - Basic model structure
   - Modelling employment, unemployment and wages
   - Modelling electricity generation technologies (incl. nuclear power)

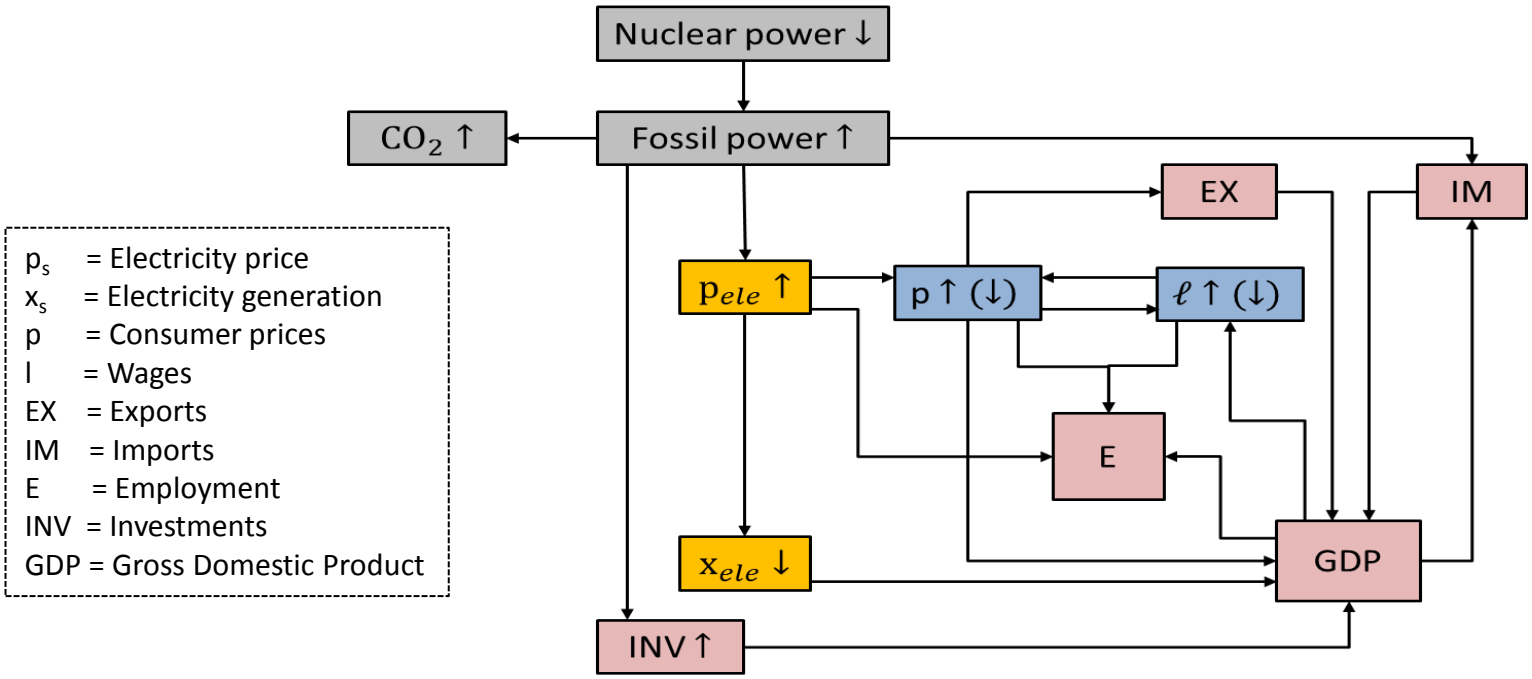
3. Exemplary NEWAGE calculations
   - IER (2011)
   - IER/ZEW (2010)
   - Küster, R. (2009)

4. Summary and outlook

Diverse gross effects complicate clear statements about net effect

- Gross effects include price effects, supply and demand effects (quantities), investment effects, foreign trade effects, substitution and income effects…:

Economic effects of phasing-out nuclear power [Fahl & Ellersdorfer, 2004]



- What is the size of the resulting net effect regarding employment levels?

➡ Need for a methodology that covers a closed circle of income

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NEWAGE: Concept and composition

Special / hybrid features:

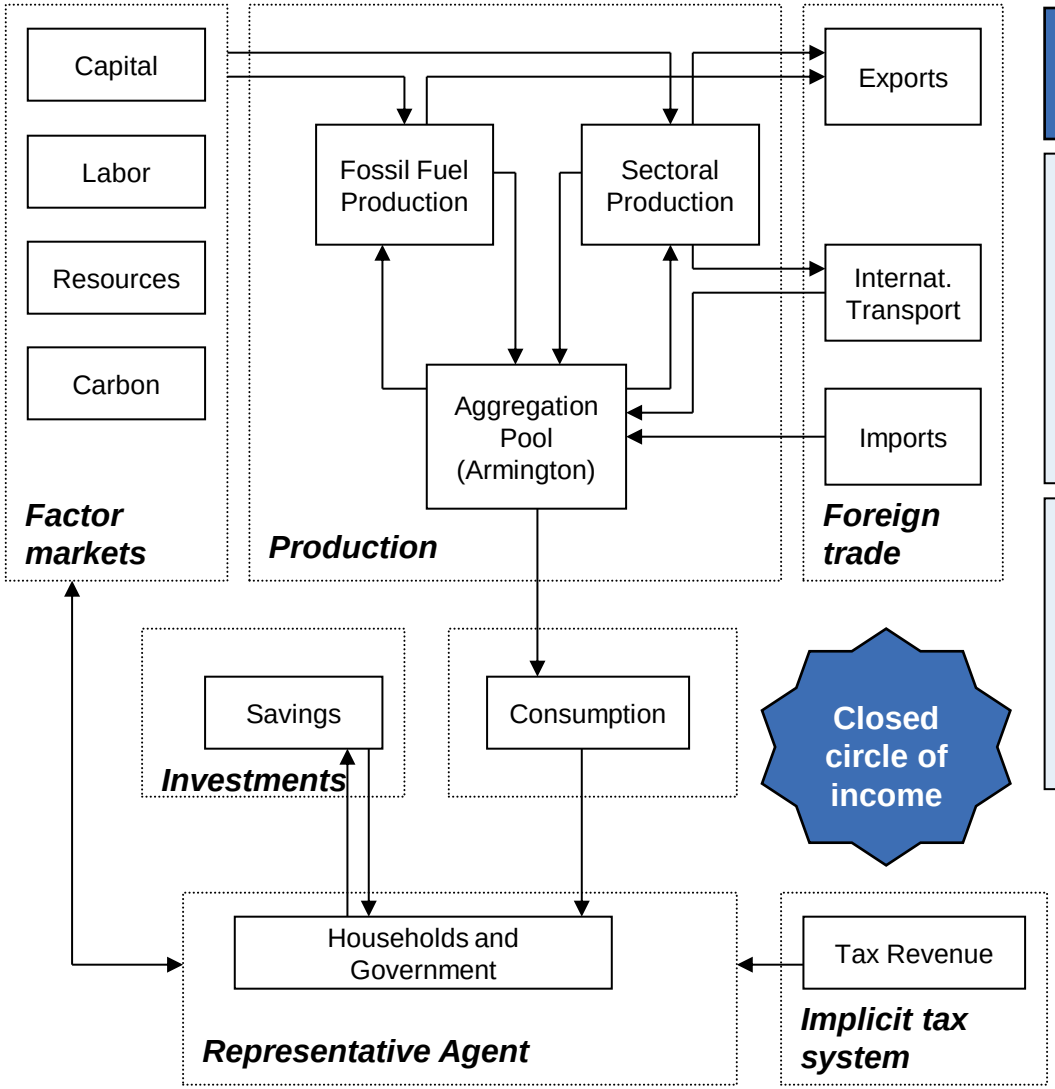
Imperfect Labor Market:
Rigid wages,
wage curve
Differentiation by qualification (skilled, unskilled)

Electricity Generation:
Technology based modeling: portfolio with 18 generation options

Main data sources:
GTAP8, IEA, et al.

Dynamics:
Recursive-dynamic, 2007-2035, 5-year steps

Technological Change:
Autonomous energy efficiency index (AEEI)

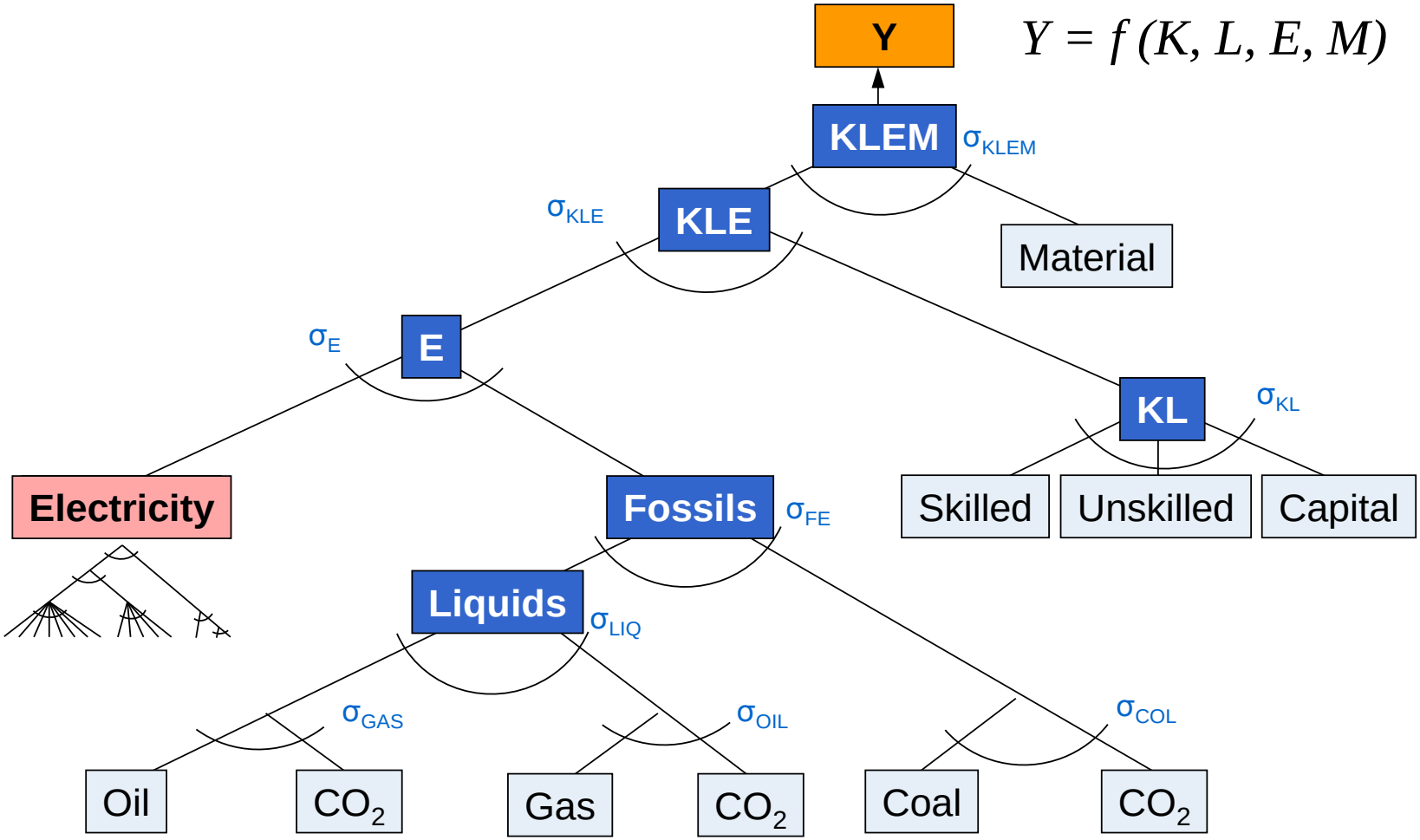


Flexible resolution of regions and sectors (current: 19x27)

19 sectors:
Energy (5)
Energy intensive (5)
Other manufacturing (4)
Construction
Transport
Agriculture
Services

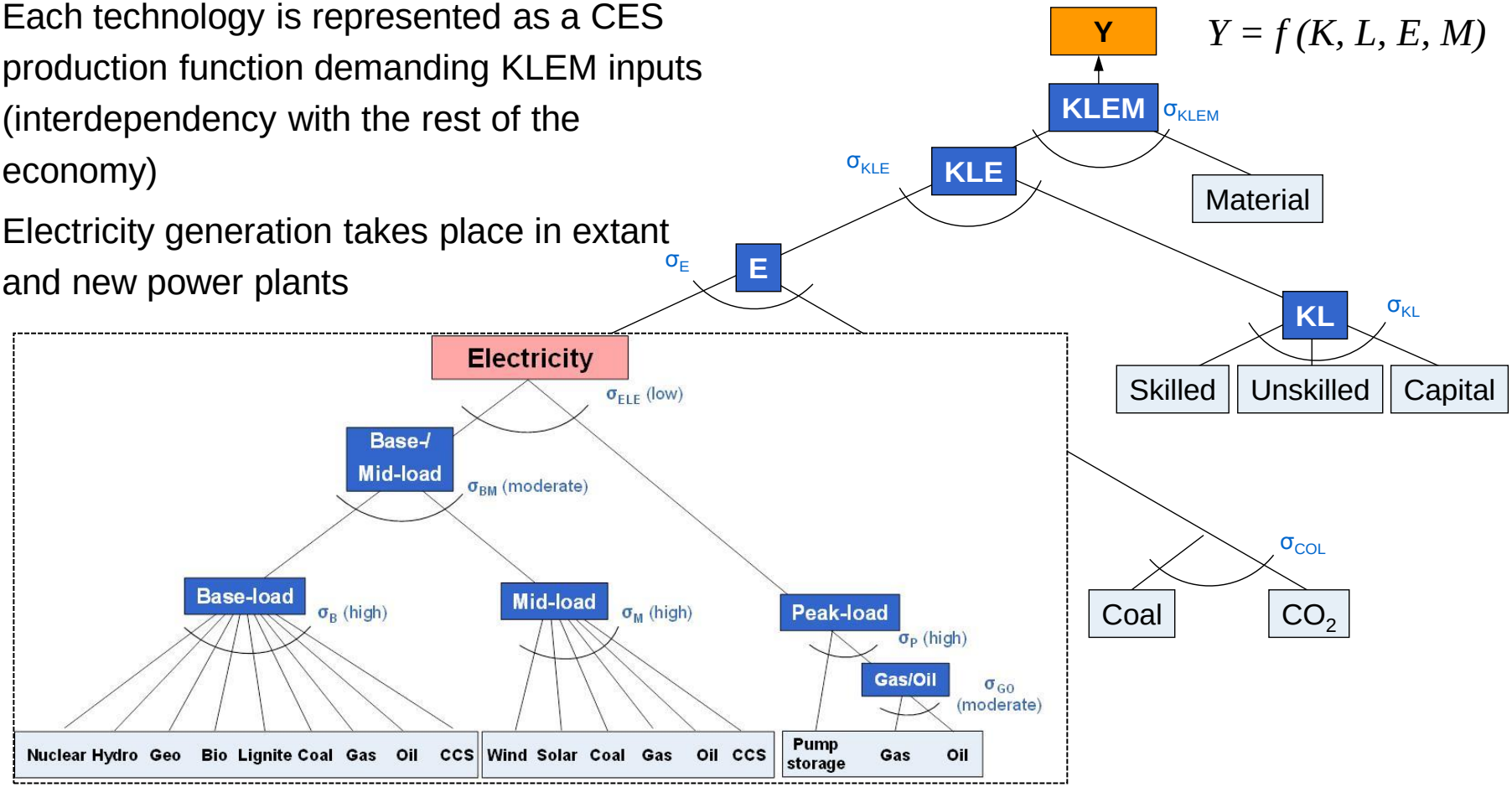
27 regions:
Germany (2)
EU-countries (8)
USA (1)
BRICS (5)
Other OECD (4)
Rest of world (7)

CES production functions in NEWAGE (KLEM-structure)



Modelling electricity generation in NEWAGE

- CES nesting of electricity generation technologies
- Each technology is represented as a CES production function demanding KLEM inputs (interdependency with the rest of the economy)
- Electricity generation takes place in extant and new power plants



Modelling (un)employment in NEWAGE

- 2 degrees of labor qualification: skilled and unskilled labor
- Corresponding wage functions:

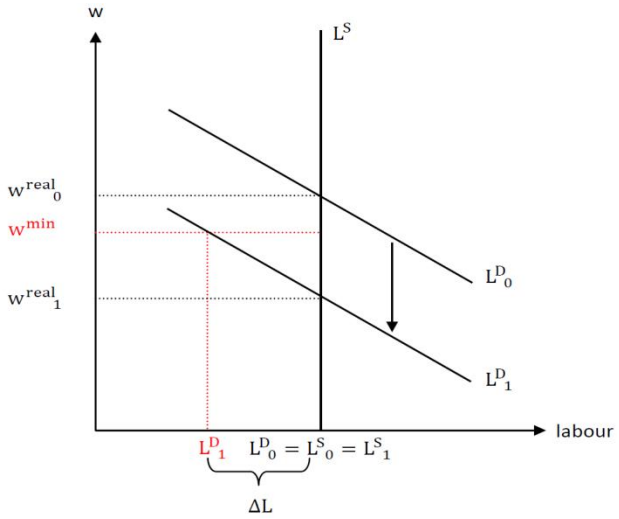
Unskilled labor: Real wage remains constant (minimum wage)

$$\frac{w_r}{P_r} \geq w_r^{min}$$

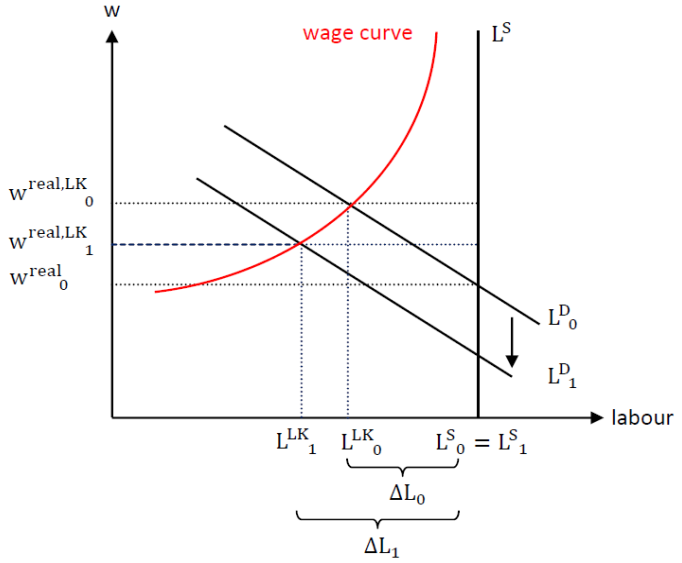
Skilled labor: Wage curve following Blanchflower & Oswald (1995) $\ln w^{real} = \beta \ln ur + \propto$

$$\frac{w_r}{P_r} = \frac{\frac{w_r^{BMK}}{P_r^{BMK}}}{ur_r^{BMK^{\beta}}} ur_r^{\beta}$$

Unemployment through wage rigidities:



Unemployment related to a wage curve:



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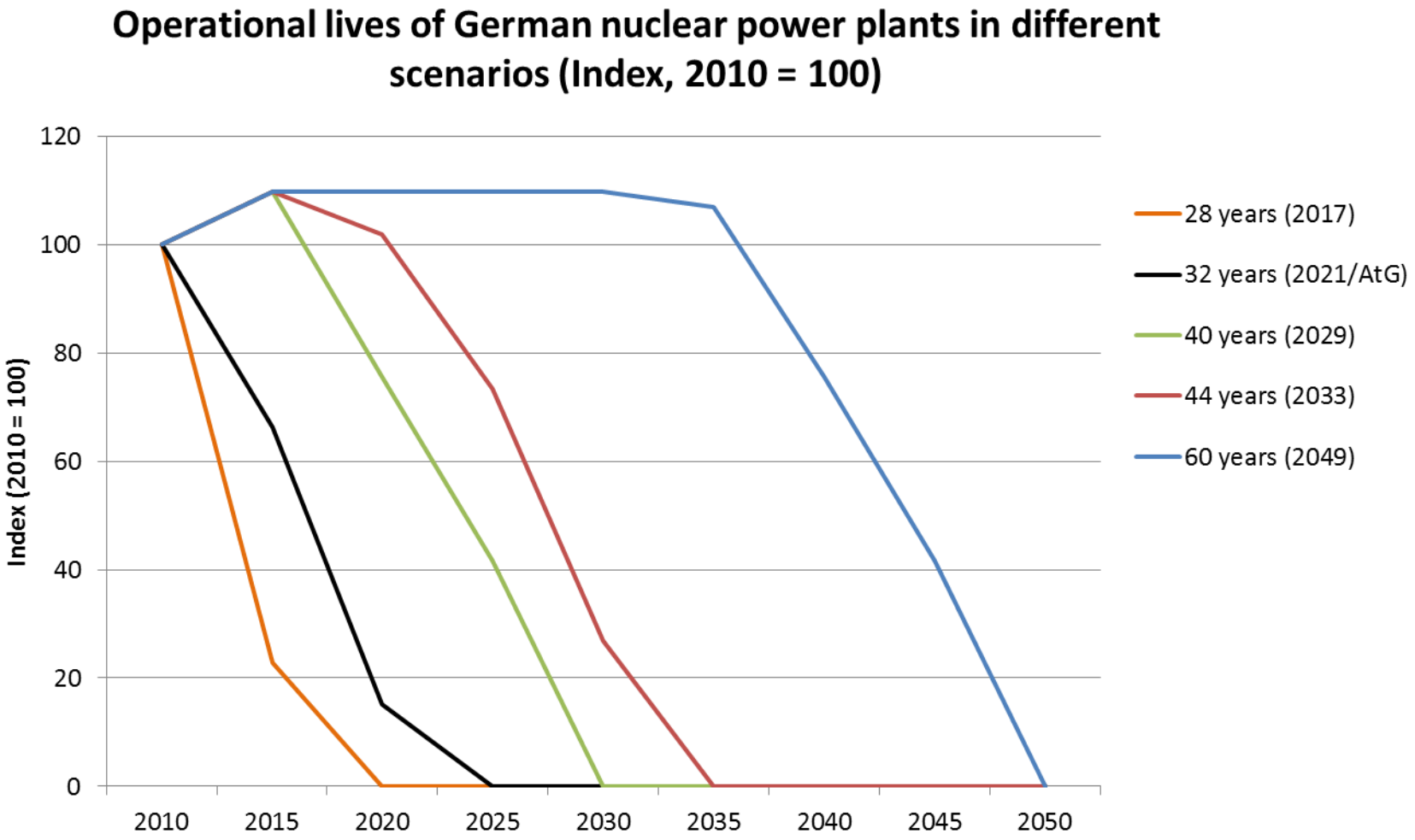
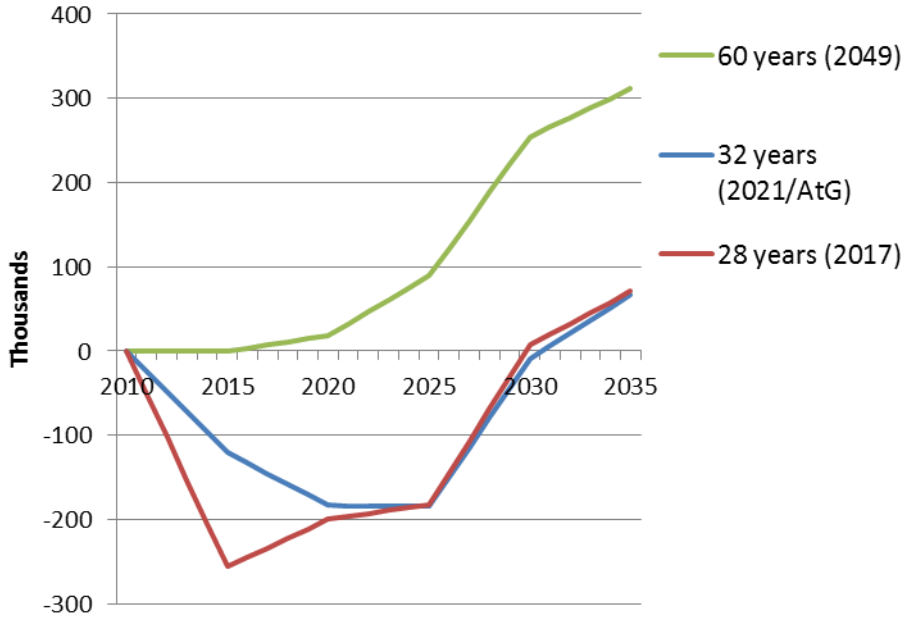
Scenarios for phasing-out nuclear power in Germany



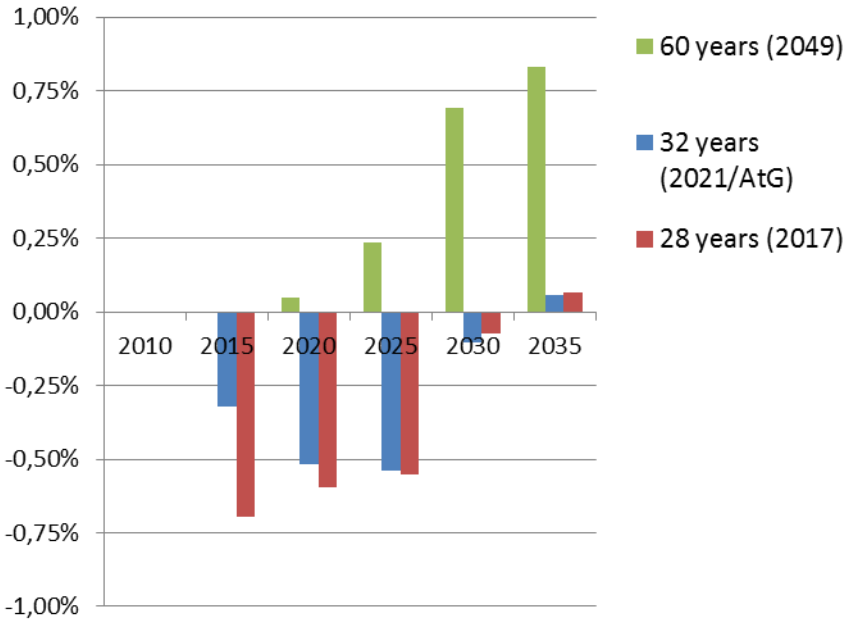
Net employment effects of nuclear power: Exemplary calculations (I)

- IER (2011): „*Effects of changing operational lives of German nuclear power plants – scenario analysis until 2035“ [in German]*, Institute of Energy Economics and the Rational Use of Energy (IER), University of Stuttgart, Working paper No. 10, June 2011

Employees in Germany in different nuclear phase-out scenarios compared to the reference scenario (44 years)



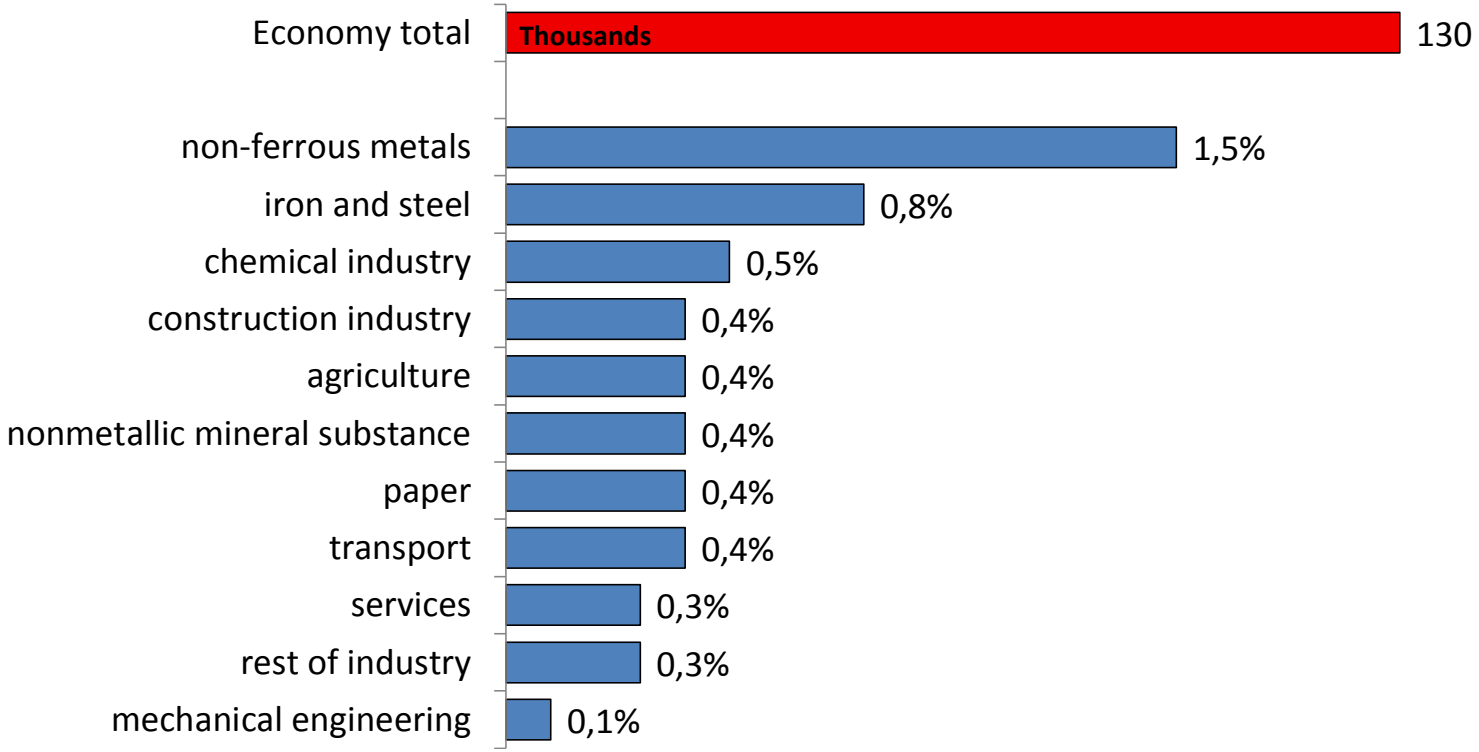
Real GDP in Germany in different nuclear phase-out scenarios compared to the reference scenario (44 years)



Net employment effects of nuclear power: Exemplary calculations (II)

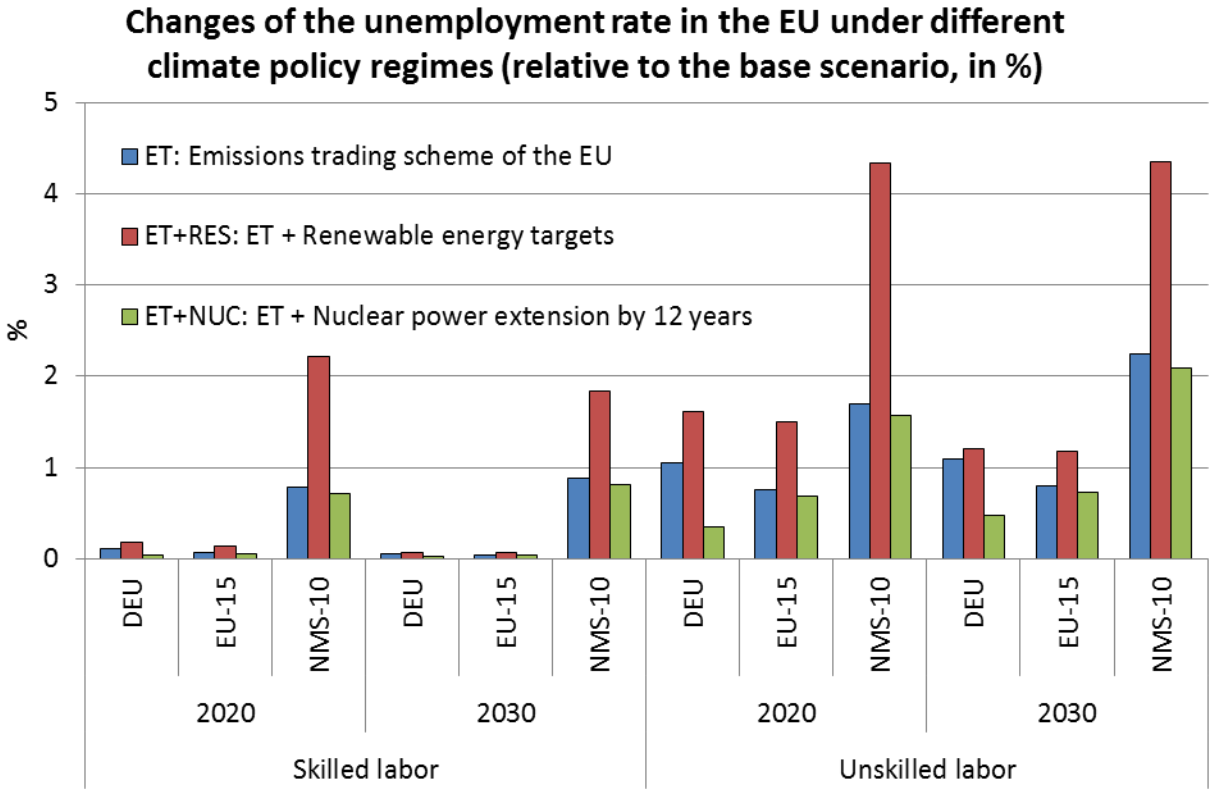
- IER/ZEW (2010): *„Energy market developments until 2030 – The energy forecast 2009“ [in German]*, a study for the German Federal Ministry for Economic Affairs and Technology (BMWi)

Change of employees in 2020 when extending lifetime of nuclear plants from 32 to 40 years in Germany



Net employment effects of nuclear power: Exemplary calculations (III)

- Küster, R. (2009): *„Climate protection, macro-economy and employment – Analysis of the German and European climate policy strategies using a CGE model“ [in German],* Dissertation, Mensch und Buch Verlag, Berlin



DEU	Germany
EU-15	EU-15 (w/o Germany)
NMS-10	EU New Member States

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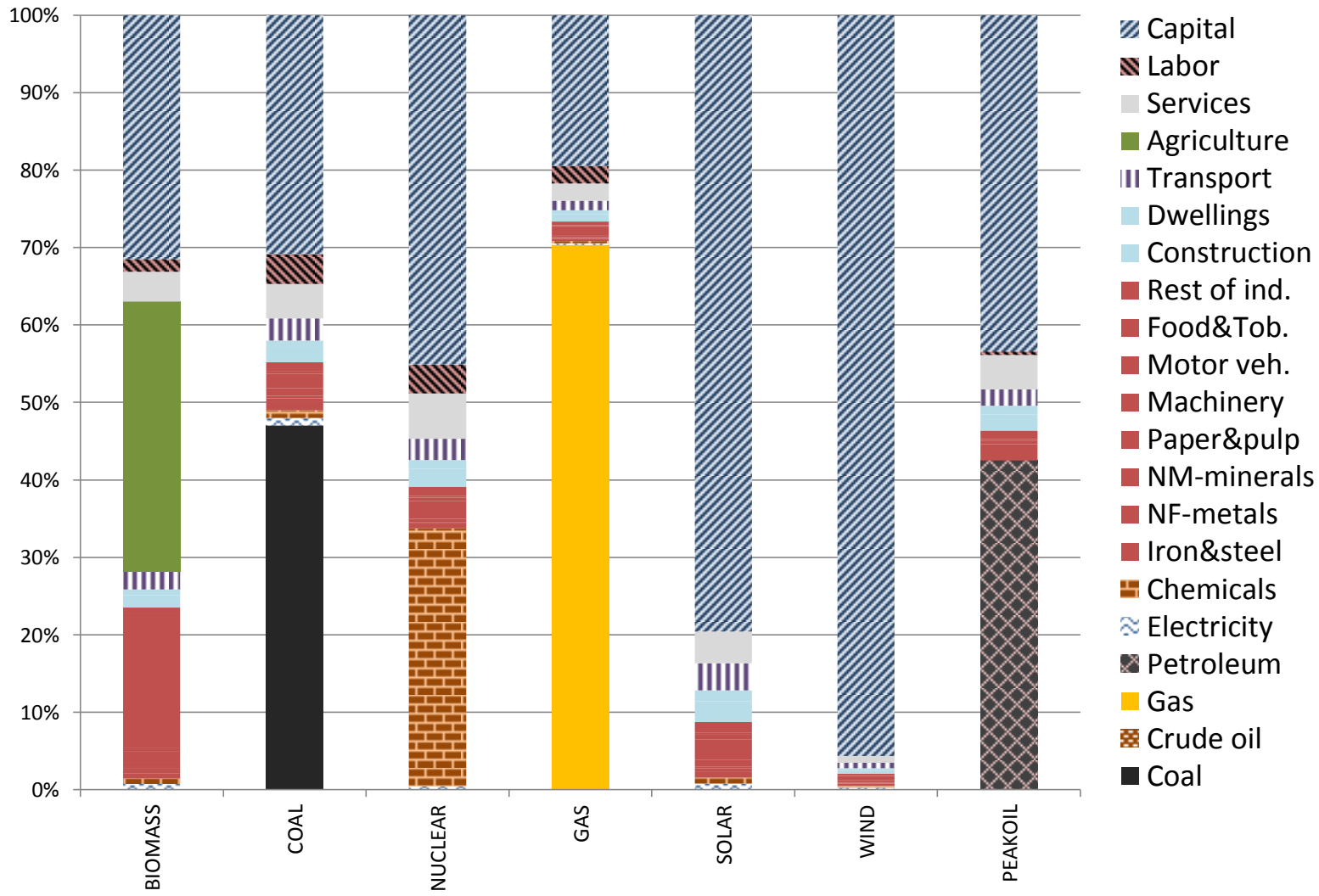
Summary and outlook

- NEWAGE calculates direct, indirect and induced economic impacts
  - Ability to assess net employment effects
- NEWAGE distinguishes 2 degrees of labor qualification (skilled, unskilled)
  - Ability to assess employment, unemployment and wage levels for both qualifications
- NEWAGE distiniguishes 18 different electricity generation technologies including nuclear power
  - Ability to assess economic impacts of technology-oriented energy policies (e.g. nuclear power phase-out)
- Usefulness of CGE models depend on the research objective (long-run policy experiments)
- <u>Future research:</u>
  - Technology-oriented modeling of household energy demand in order to assess interdependencies between household demand for energy and energy technologies (e.g. heating & transport) with other consumption goods *[ongoing PhD project]*
  - Modeling different household groups (e.g. distiniguished by income) in order to assess socio-economic effects of energy policies (e.g fuel poverty) *[project proposal]*

Back up

Input cost shares of generation technologies



Motivation and background

- Workshop on discussing appropriate methodological approaches for modelling economic impacts of the nuclear power sector, focussing on employment effects

- Methodology: necessity of distinguishing all relevant (gross) effects in order to quantify net effects:
  - **Direct effects (+/-)** refer to the changes in the sector of interest
  - **Indirect effects (+/-)** refer to the changes within the supply chain of the sector of interest (upstream and downstream)
  - **Induced effects (+/-)** refer to quantity and price related income changes of the consumers and utilities, and its resulting changes in income spending

- In the literature, input-output as well as CGE models represent the majority of methodologies for assessing (net) employment impacts