

The Value-Added of Sectoral Disaggregation: Implications on Competitive Consequences of Climate Change Policies

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Motivation

- Leakage and industrial competitiveness concerns are in the fore of the policy debate on unilateral emission abatement.
- Assessment of border tariffs as an *anti*-leakage and *pro*-competitive instrument hinges crucially on empirical data (availability and quality).
- Global economic datasets such as GTAP may suffer from the high level of sectoral aggregation to provide appropriate conclusions for unilateral climate policy design (such as outcome-based criteria for protective measures of energy-intensive and trade-exposed industries).

Research Agenda

- We discuss potentially important dimensions of sectoral heterogeneity by disaggregating three important energy-intensive and trade-exposed (EITE) composite sectors of the GTAP dataset.

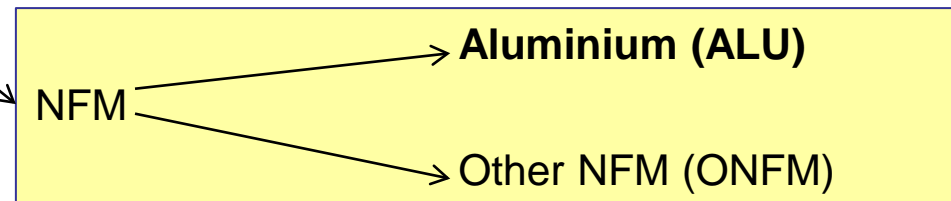
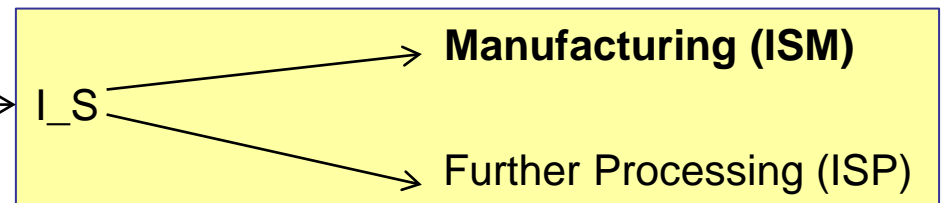
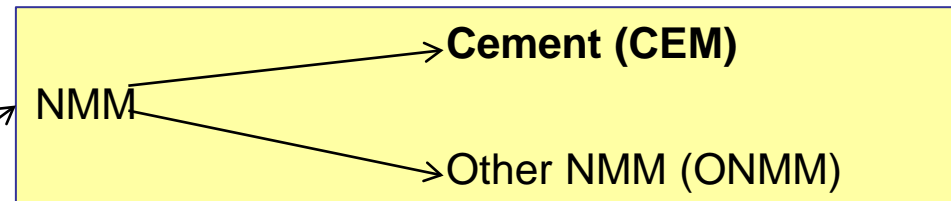
- Uncertainties concerning the characterization of EITE economic activities include:
 - Substitution possibilities in production
 - Trade responses
 - Production cost shares (KLEM input-output values)

- We study the value of disaggregation for alternative parameterization along these three dimensions, i.e.:
 - KLEM nesting and substitution elasticities
 - Armington elasticities
 - Energy cost shares

Sectoral Disaggregation (1)

<u>Primary energy goods</u>	
GAS	Natural gas works
COL	Coal transformation
CRU	Crude oil
<u>Secondary energy goods</u>	
ELE	Electricity and heat
<u>Energy intensive and trade exposed sectors</u>	
OIL	Refined oil products
LUM	Wood and wood-products
PPP	Paper-pulp-print
CRP	Chemical industry
NMM	Non-metallic minerals
I_S	Iron and steel industry
NFM	Non-ferrous metals
<u>Other goods and services</u>	
OMN	Mining
OME	Other machinery
OMF	Other manufacturing
CNS	Construction
CGD	Investment composite
TEQ	Transport equipment
TWL	Textiles-wearing apparel-leather
AGF	Agricultural and food products
TRN	Transport
SER	Commercial and public services and dwellings

Disaggregation:



Sectoral Disaggregation (2)

- Why have we chosen these (sub-)sectors?
 - Cement (CEM) accounts for ca. 5% of global CO₂ emissions, iron and steel manufacturing (ISP) for 6 to 7%
 - Share of aluminium (ALU) in global industrial trade is ca. 1%
- EXIOPOL database is used as primary data source for the disaggregation
 - Harmonized dataset of supply and use tables for 129 sectors and 43 countries, including all EU member states and all other major developed and developing economies
- Benefits of EXIOPOL data (to perform GTAP data disaggregation)
 - Best available compromise combining multilateral data with a relatively detailed sectoral resolution
 - Comprehensive selection of countries
 - Consistent classification system in contrast to using multiple data sources

Sectoral Disaggregation (3)

	Agricultural products	Coal	Oil	Gas	Electricity	Petroleum products	Non-ferrous metals		Further sectors	Private consumption	Investment	Exports	Total value of use
							Aluminium	Rest of Sector					
Agricultural products													
Coal													
Oil													
Gas													
Electricity													
Petroleum products													
Non-ferrous metals	Aluminium												
	Rest of Sector												
Further sectors													
Capital													
Labour													
Imports													
Total value of production													

Data on fuel use and electricity consumption

Data on private final demand

Production data

Trade data

Trade data

- Balancing of extended IO-tables is based on SPLITCOM (Horridge 2008).

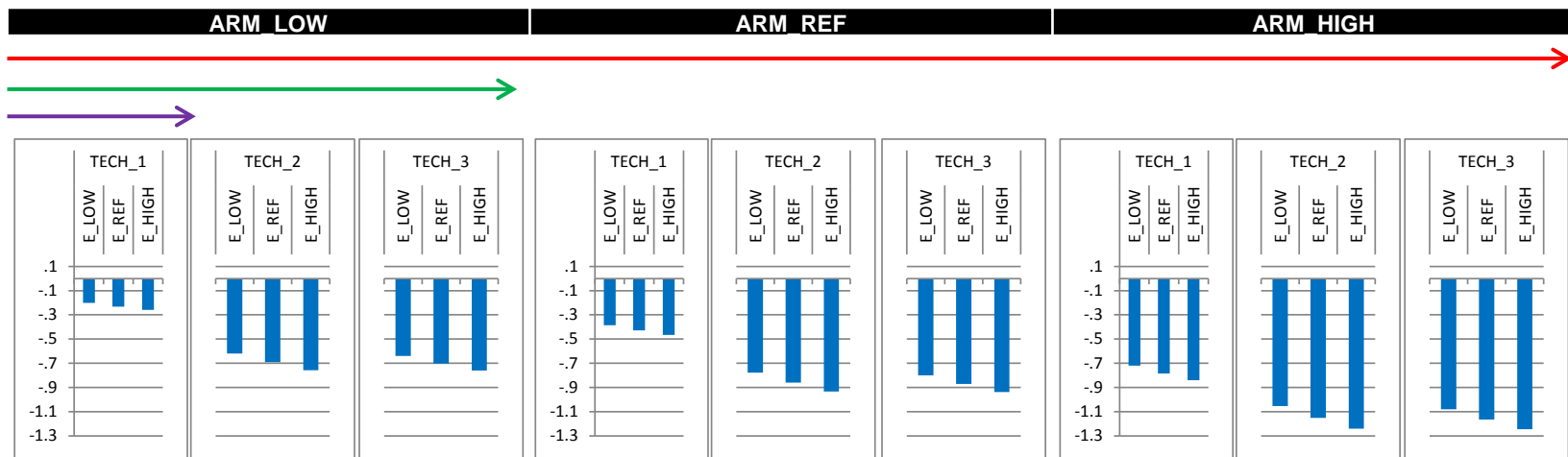
Policy Scenarios and Sensitivity Analysis

- Policy scenarios
 - *reference*: unilateral 20% CO₂ reduction by Europe
 - *tariff*: unilateral reduction + import tariffs / export rebates
- Sensitivity analysis on alternative assumptions for
 - Technology:
 - TECH_1 (KL-M)
 - TECH_2 (KL-E)
 - TECH_3 (KE-L)
 - Armington elasticities of EITE sectors
 - ARM_REF
 - ARM_LOW (0.5*reference elasticity)
 - ARM_HIGH (2*reference elasticity)
 - asymmetric (CEM, ALU and ISM: 2*reference elasticity; ONMM, ONFM and ISP: 0.5*reference elasticity)
 - Energy shares in disaggregated sectors
 - E_REF
 - E_LOW (20% less for CEM, ALU and ISM)
 - E_HIGH (20% more for CEM, ALU and ISM)

Heterogeneous Impacts at the Sub-Sectoral Level (CEM)

Output (% change from business-as-usual)

Reference scenario: 20% emissions reduction



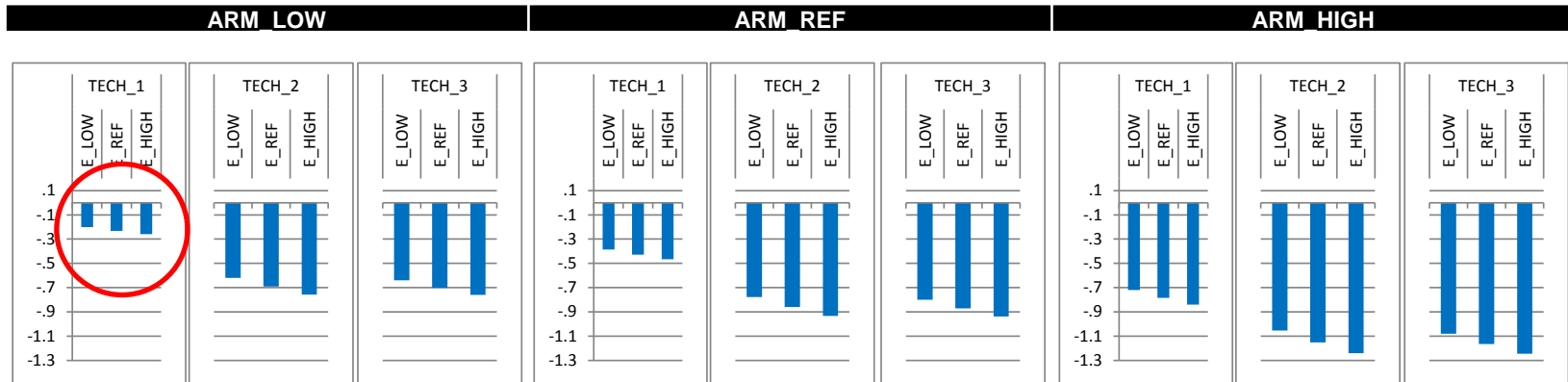
- Three different assumptions on Armington elasticities at subsectoral level
- Three different assumptions on technology at subsectoral level (nesting and substitution elasticities)
- Three different assumptions on IO shares at subsectoral level (energy cost share)

3x3x3 = 27 variants

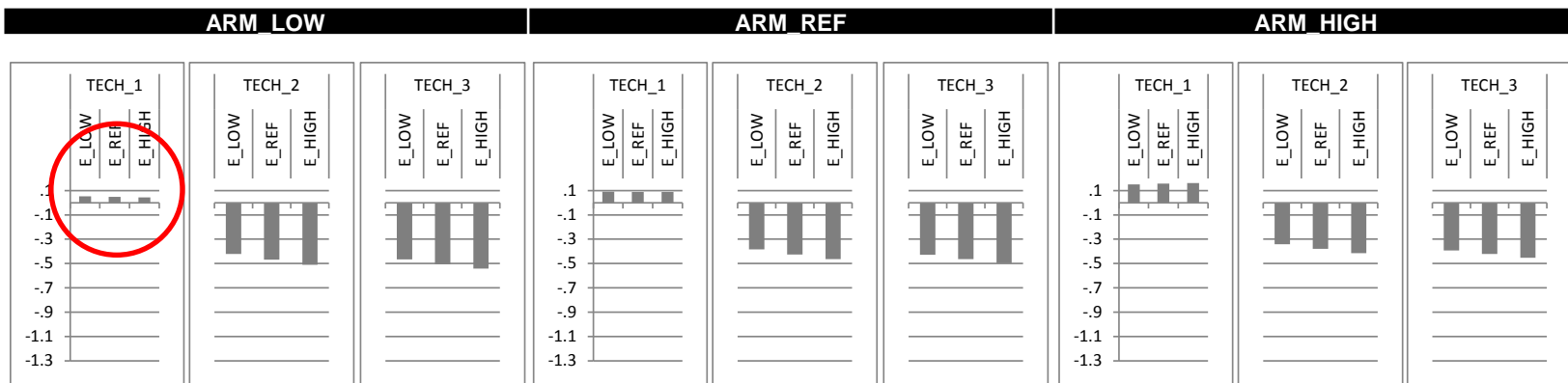
Heterogeneous Impacts at the Sub-Sectoral Level (CEM)

Output (% change from business-as-usual)

Reference scenario: 20% emissions reduction



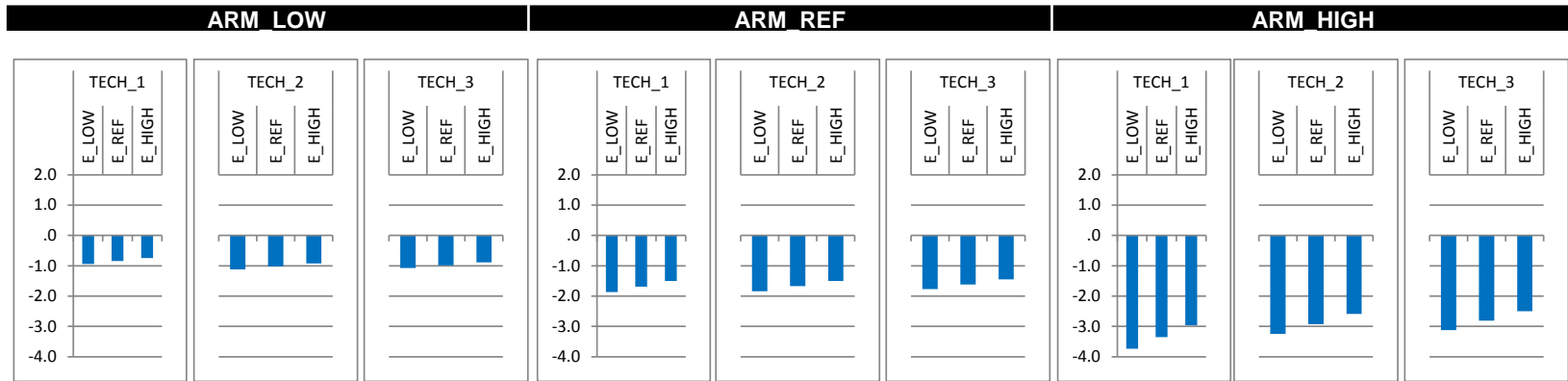
Tariff scenario: reduction + border measures



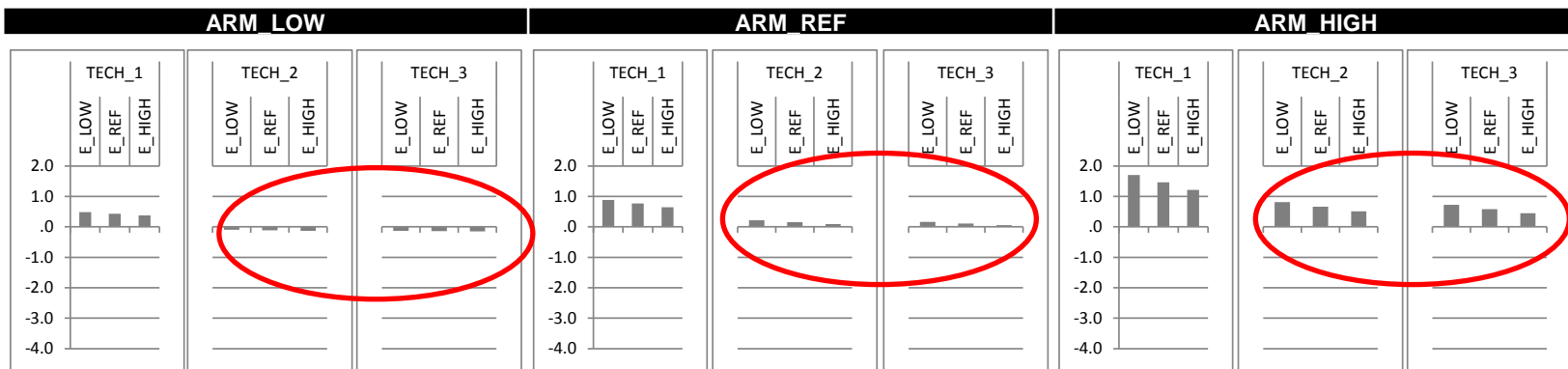
Heterogeneous Impacts at the Sub-Sectoral Level (ONMM)

Output (% change from business-as-usual)

Reference scenario: 20% emissions reduction



Tariff scenario: reduction + border measures

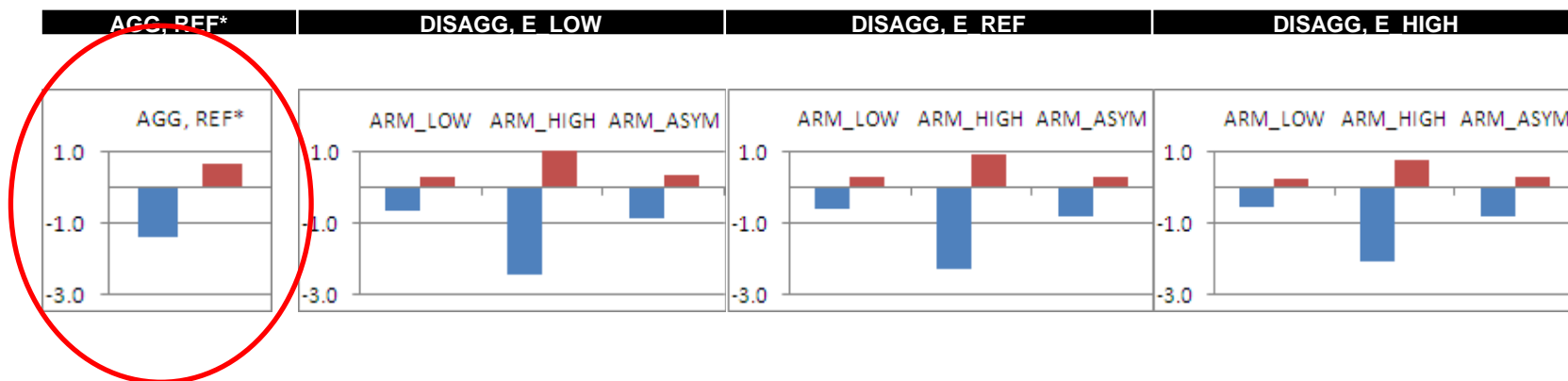


Merits of Disaggregation (NMM)

Output (% change from business-as-usual)

Reference scenario: 20% emissions reduction

TECH_1 with Variations in Armington elasticities and energy cost shares



AGG, REF*: TECH_1, ARM_REF, E_REF, Aggregated data set

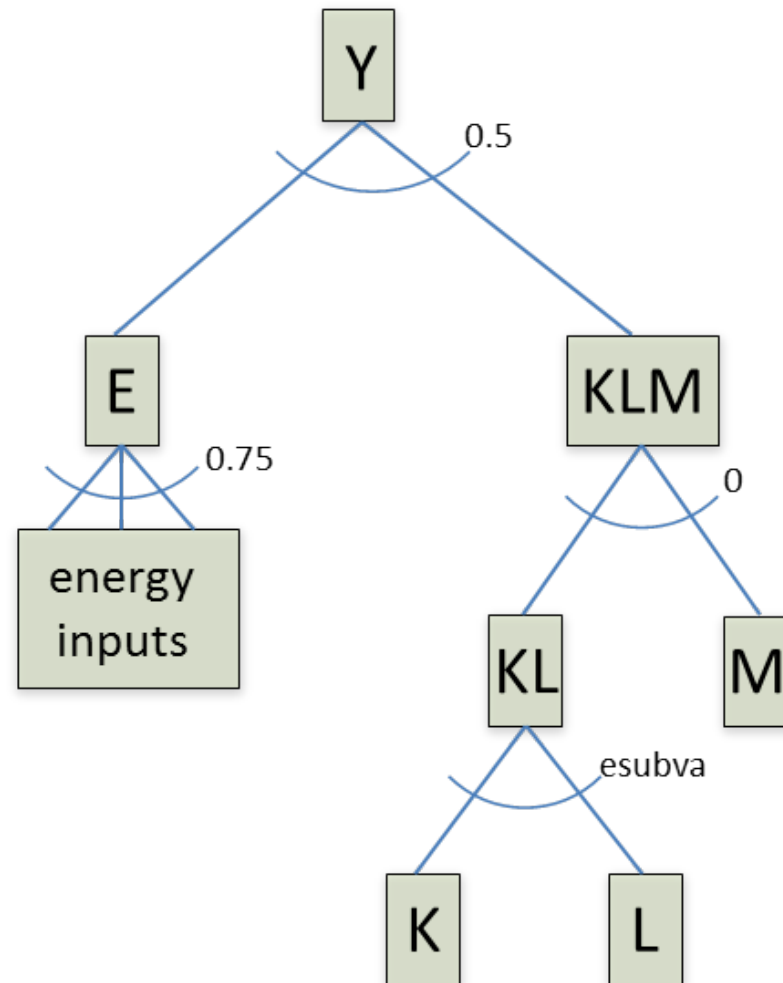
Summary and Conclusions

- Impacts (in magnitude and sign) for energy-intensive and trade-exposed are in particular sensitive to the choice of Armington elasticities.
- Empirical estimation of Armington elasticities at the sub-sectoral level is crucial for consistent assessment of impacts.

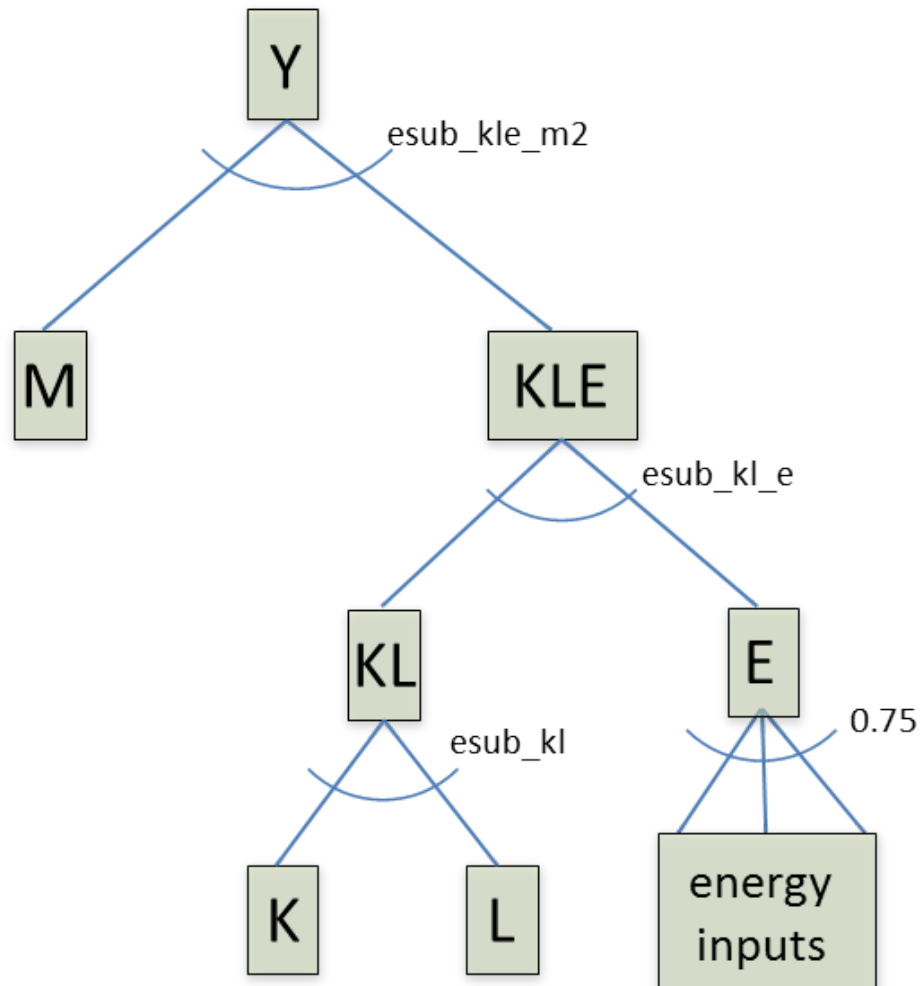
- Impacts furthermore are very sensitive to the choice of nesting structure – especially between TECH_1 and TECH_2/TECH_3.
- Correct technology specification is central, e.g. by including engineering-based approaches (bottom-up data).

- The composite disaggregate impact is consistent in sign with the aggregate GTAP sector effect. Effect of disaggregation not as pronounced for macroeconomic indicators and leakage as for sectoral indicators.
- One can use the GTAP level of sectoral aggregation if the interest in specific sub-sectoral implications is secondary.

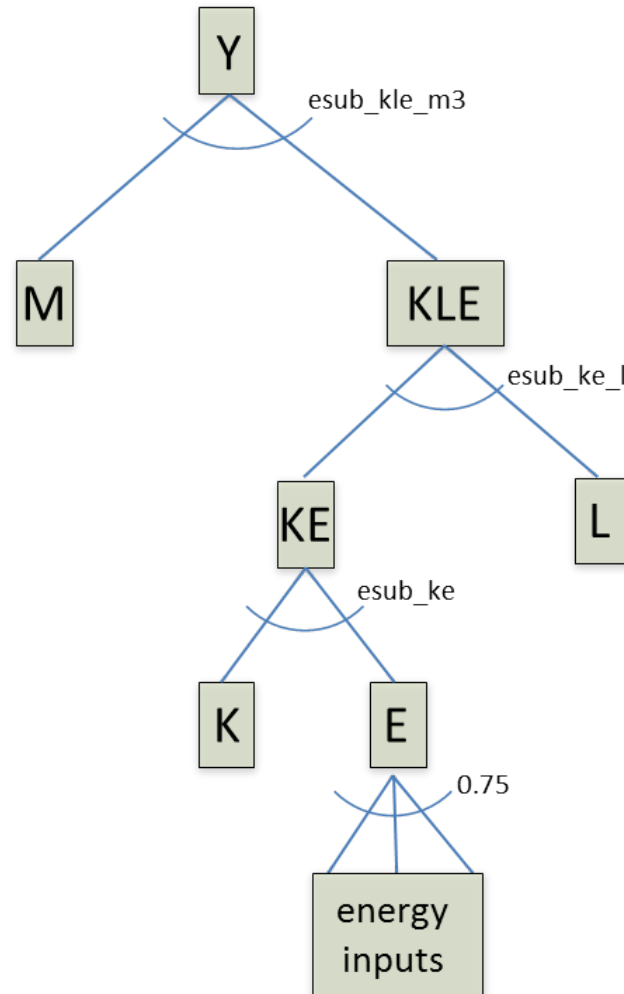
TECH_1



TECH_2



TECH_3



Elasticities

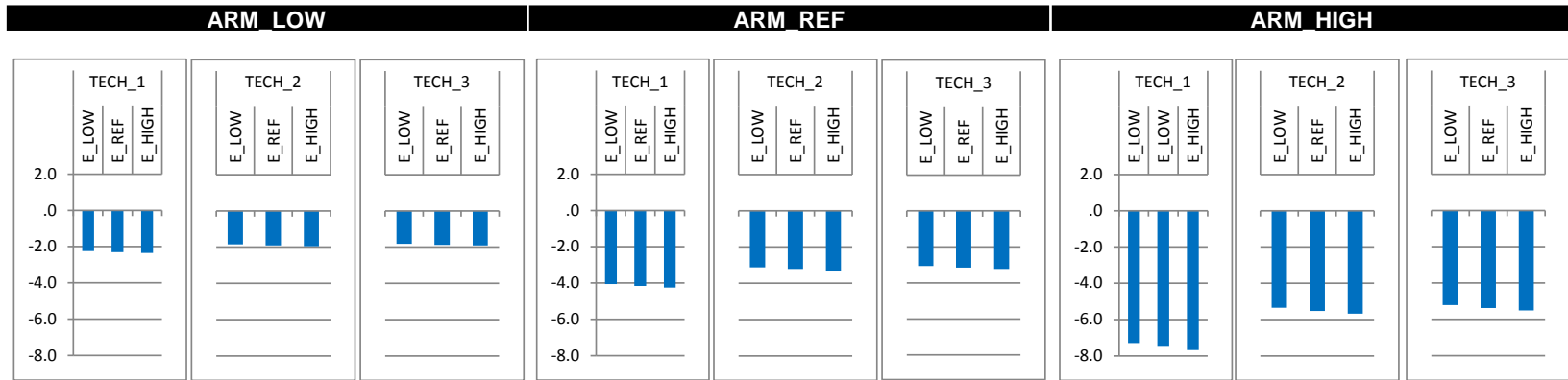
	CEM	ONMM	ALU	ONFM	ISM	ISP
esub_kle_m2	0.30	0.30	0.30	0.30	1.17	1.17
esub_kle_m3	0.99	0.99	0.99	0.99	1.05	1.05
esub_kl_e	0.41	0.41	0.41	0.41	0.64	0.64
esub_ke_l	0.21	0.21	0.21	0.21	0.25	0.25
esubva	1.26	0.71	1.26	1.26	1.26	1.26
esub_kl	0.36	0.36	0.36	0.36	0.22	0.22
esub_ke	0.35	0.35	0.35	0.35	0.29	0.29
Armington el. (reference case)	2.90	1.95	4.20	4.20	2.95	2.95

Note: Values for TECH_2 and TECH_3 are taken from Okagawa and Ban (2008) and were rescaled to match our sectoral structures. Values for TECH_1 were taken from the GTAP 7 database.

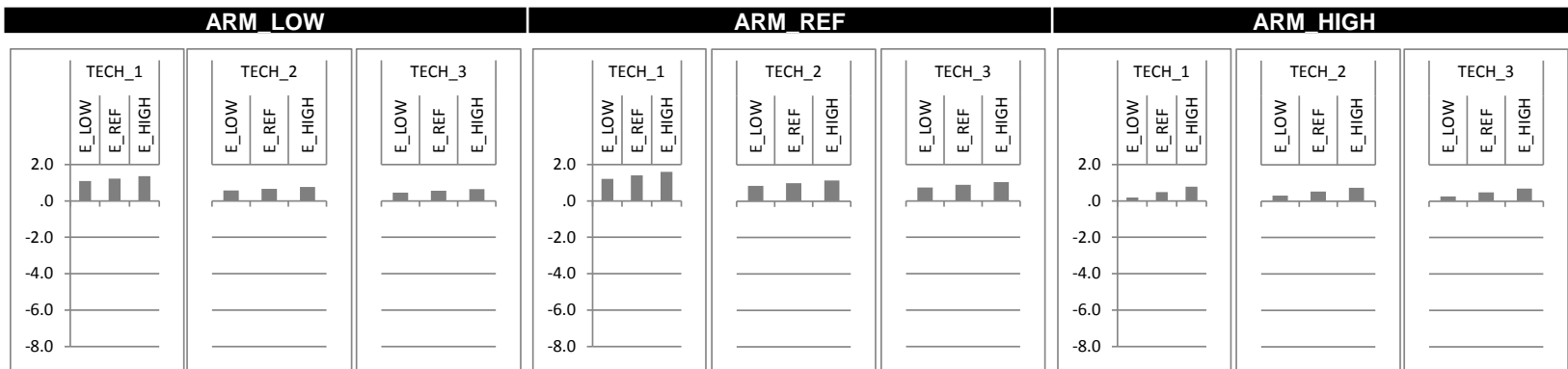
Heterogeneous impacts at the sub-sectoral level (ALU)

output % change

Reference scenario: 20% emissions reduction



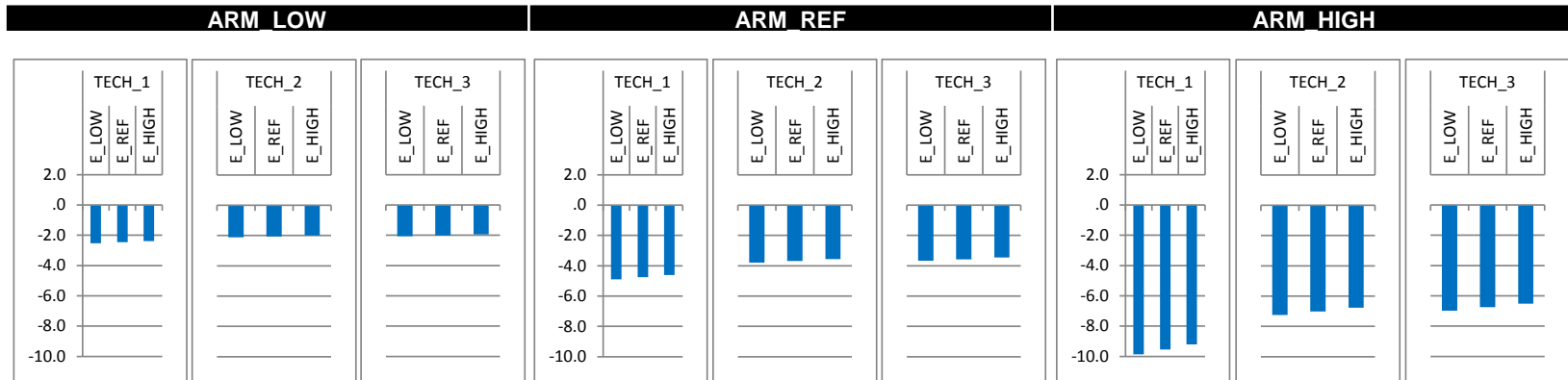
Tariff scenario: reduction + border measures



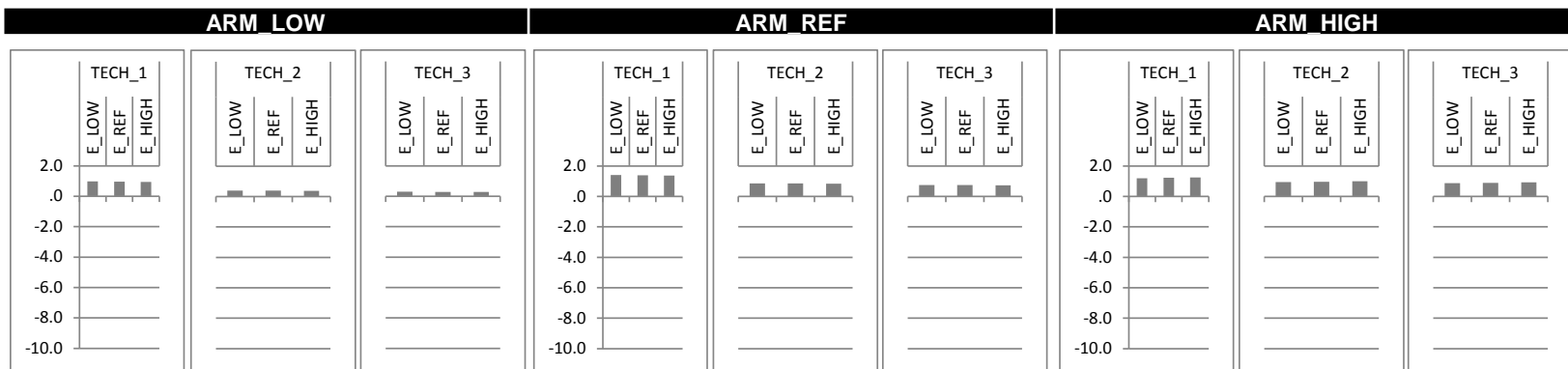
Heterogeneous impacts at the sub-sectoral level (ONFM)

output % change

Reference scenario: 20% emissions reduction



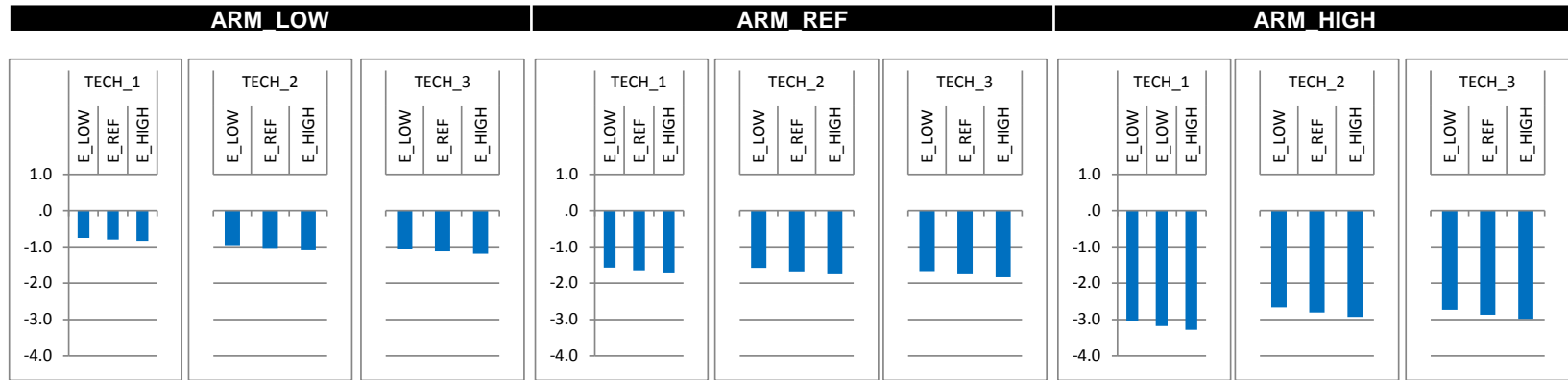
Tariff scenario: reduction + border measures



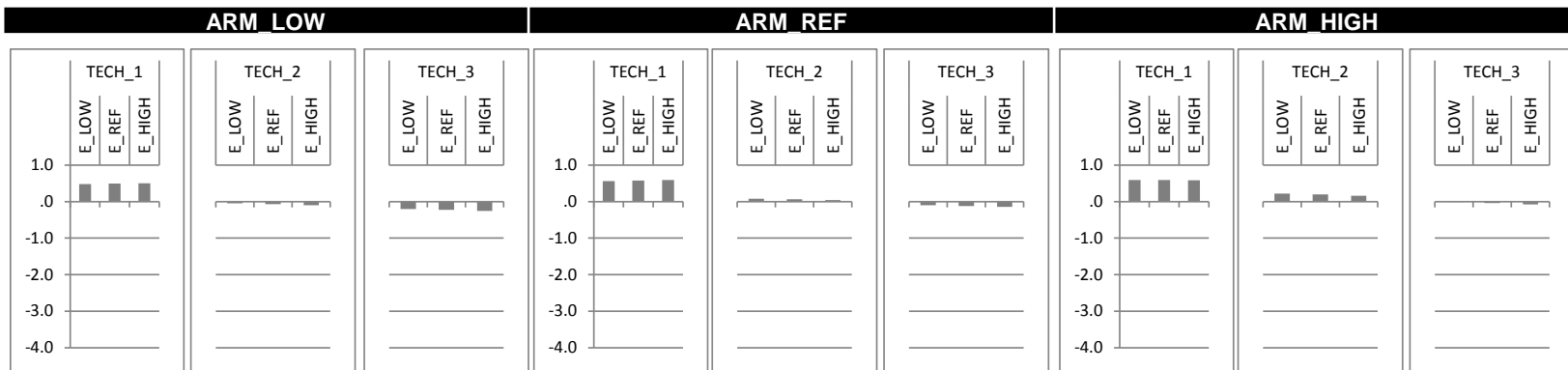
Heterogeneous impacts at the sub-sectoral level (ISM)

output % change

Reference scenario: 20% emissions reduction



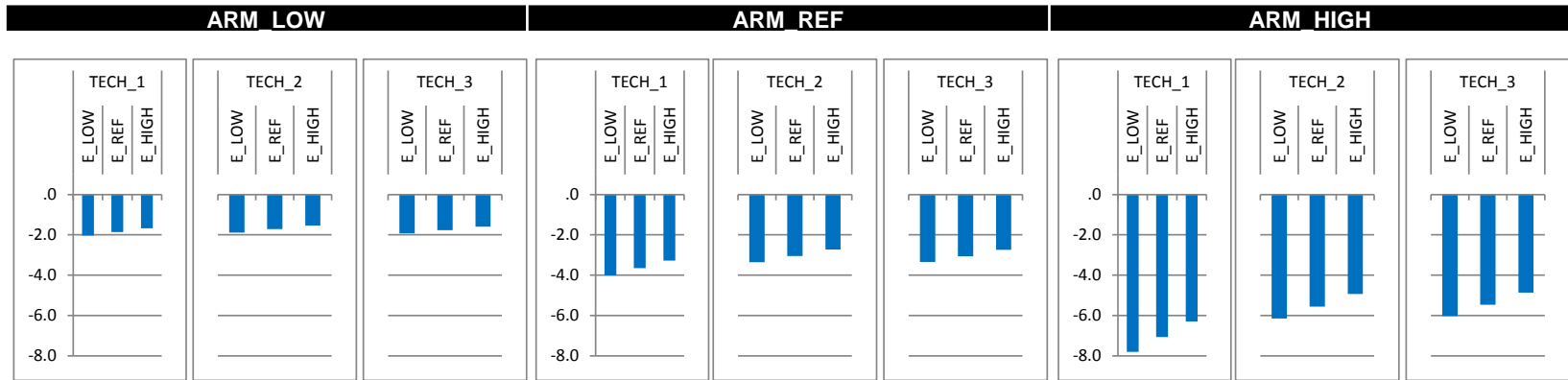
Tariff scenario: reduction + border measures



Heterogeneous impacts at the sub-sectoral level (ISP)

output % change

Reference scenario: 20% emissions reduction



Tariff scenario: reduction + border measures

