GWS SPECIALISTS IN EMPIRICAL ECONOMIC RESEARCH

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Economic effects of an increasing market penetration by electric drives – structural changes in a scenario analysis

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Contents

Background

- Project „Employment potentials on the way towards a Green Economy – scenario-based analysis of employment effects“
- Client is the Federal Environment Agency, project since 2012 FKZ 3712 14 101
- Four packages of measures / scenarios to describe a transformations process towards a Green Economy, among them **„Green Mobility“**
  - ⇨ Chapter within one of these packages: **„stronger market penetration of electric drives “**

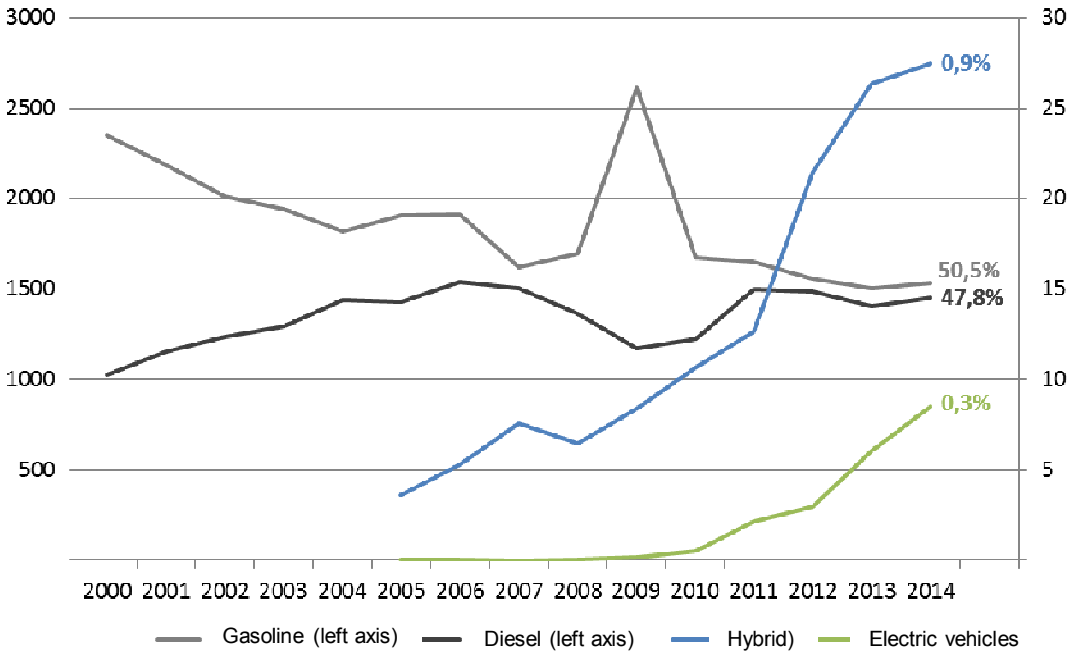
Definition / outline of the problem

- How does “more e-mobility” effect the employment in the long-term (and in the context of “Green Economy”)
- Focus
  - ⇨ Effects on employment throughout the economy
  - ⇨ Production and operation of more passenger e-vehicles
  - ⇨ Structural effects of manufacturing processes and changes in consumer demand
  - ⇨ Model-based analysis with PANTA RHEI
- Not a focus:
  - ⇨ Cost-benefit analysis and cost effectiveness on a micro-level
  - ⇨ Discussion of buyers premium or other incentives

Definition / outline of the problem

- Analyzed mechanisms
  1. Changes in input structures for vehicle construction and effects on value added and employment of economic sectors involved
  2. Substitution of fuels by electrical power and impacts on private consumption as well as energy use and carbon emissions

New registrations of passenger cars for a selection of fuel types (thousand cars), Share of all registrations in the year 2014



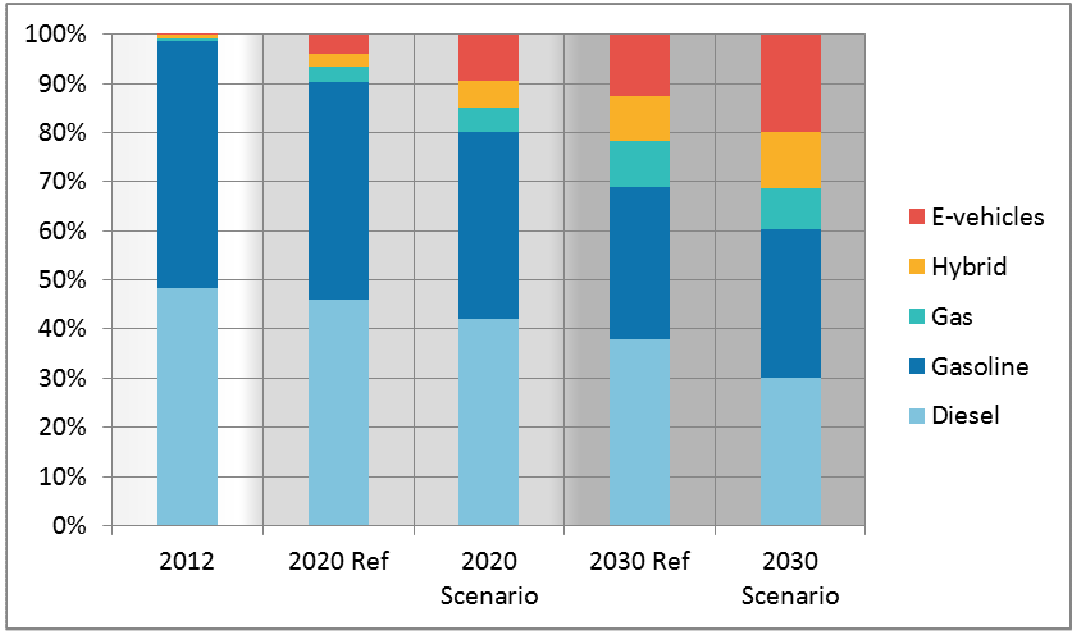
Definition / outline of the problem

- Electric vehicles (EV)
  - ⇨ Battery electric vehicle
  - ⇨ Battery electric vehicle with range extender
  - ⇨ Plug-in Hybrid
- Objective of the government: Stock of 1 million electric vehicles in the year 2020, 2030: 6 million
- Impact of more EV on the domestic market, and implicitly on the world market
  - ⇨ Assumption: Shifts in the domestic market determine the domestic production structures (or: domestic changes represent world market changes)

Modeling and the scenario

- Scenario of vehicle stock by fuel types
  - ⇨ Achievement scenario (1 or 6 million vehicles)
  - ⇨ Reference scenario, BAU 2014
  - ⇨ 21% market / production share compared to 14% in 2030 (+300,000)
  - ⇨ 2.9 million more EV in operation in the year 2030

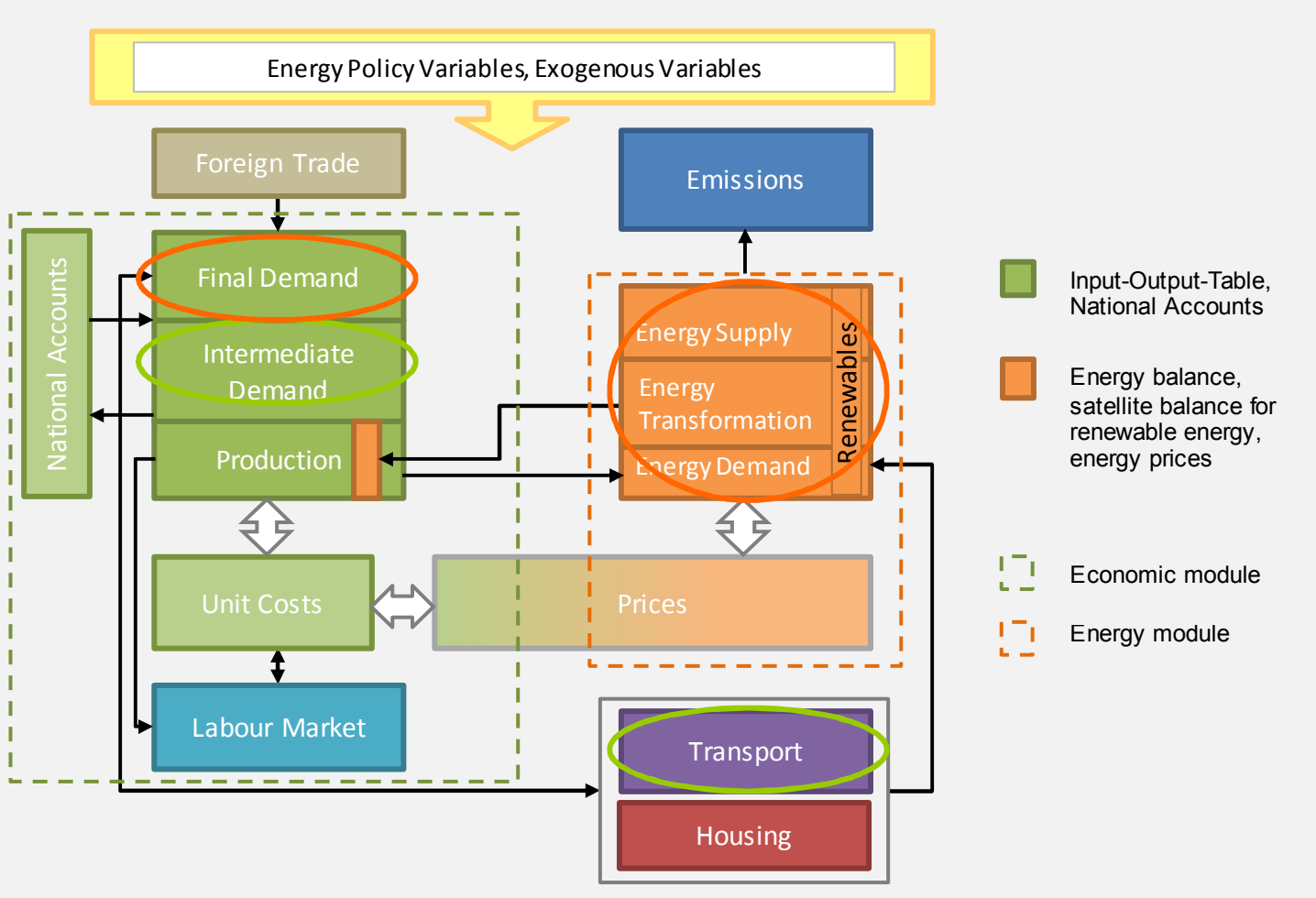
Development of new car registrations by fuel types



Passenger cars	2012	2020 Reference	2020 Scenario	2030 Reference	2030 Scenario
Vehicle stock (Million)					
Diesel	12.4	14.7	14.1	13.2	11.6
Gasoline	29.8	27.3	26.4	22.8	19.8
Gas (LNG, CNG)	0.5	1.1	1.4	2.9	3.3
Mild-Hybrid	0.1	0.7	1.2	2.3	3.6
E-Cars	0	0.5	1.2	3.2	6.1
Share of E-cars	0.0%	1.1%	2.7%	7.2%	13.7%

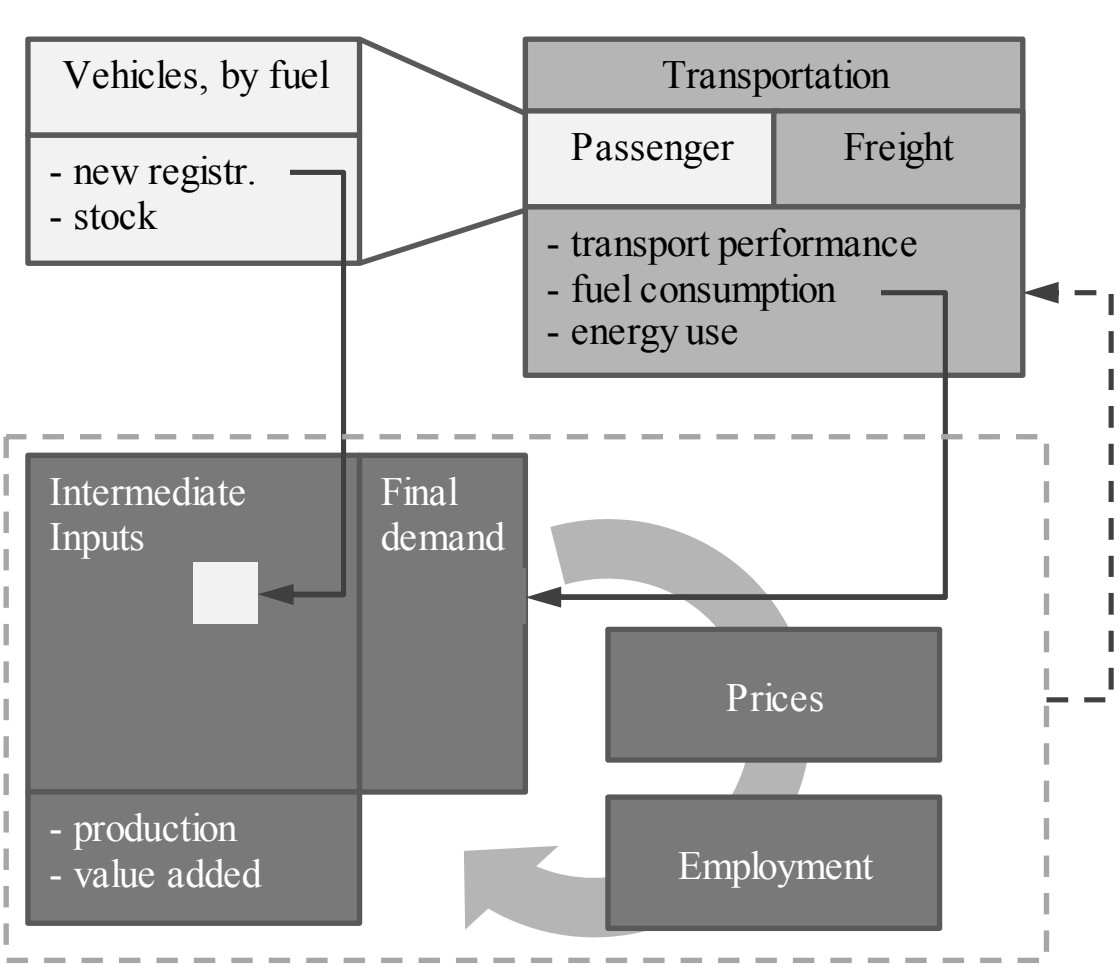
Modeling and the scenario

► Macroeconomic model PANTA RHEI



Modeling and the scenario

- Overview of major interrelations within PANTA RHEI related to the issue



Modeling – Input-coefficients

- Interpretation of the initial situation and production of more electric vehicles (Input-Output-Table, 2010)
- Substitution of **combustion engines and gears** by **electric drives and high-end batteries**

No (1-71)	Products (CPA)	Input-coefficient, %	Fewer inputs needed	More inputs needed
36	Motor vehicles, trailers and semi-trailers	↘ 35.2	Combustion engine, gear	Power electronics
30	Fabricated metal products	5.4	Fuel tank, gear, oil pan	
62	Other (company-related) business services	5.2		
33	Electrical machinery and apparatus n.e.c.	↗ 3.6	Conventional battery, dynamo, starter, spark plug	Electric drive, traction battery, power electronics
27	Basic metals	2.8		
24	Plastic products	2.6		
31	Machinery and equipment n.e.c.	2.2		
23	Rubber products	1.8		
	…			
22	Chemicals, chemical products and man-made fibers (ex. pharmaceutical products)	1.4		Chemical inputs for battery
29	Foundry products	1.3		

CPA 2002

Source: Federal statistical office, Input-Output-Table, own calculations

Modeling – Input-coefficients

1. Will the total intermediate input of the automobile industry increase or decrease?
   - Assumption: unchanged
2. Will the automobile industry purchase inputs from the electrical engineering industry or will they provide it themselves?
   - Assumption: Electronics increases its importance as a supplier of the automobile industry and is capable to do so
   - Alternative: new branches, new structures
3. Is a larger share of preliminary inputs imported?
   - Assumption: The imported inputs in electrical engineering increases more than the production (they more and more lose shares on the domestic supplier market)

Modeling – Summary

- New registrations: EV replace gasoline and diesel
- Electric power replaces gasoline and diesel, higher efficiency through hybrid cars
- Industrial inputs shift with the relations in the domestic market
  - ⇨ Relations / reactions derived from ELAB[1] study on personnel requirements according to production of main components
  - ⇨ Less own deliveries of the vehicles industry, more inputs from E-engineering suppliers
  - ⇨ Ratio of intermediate inputs to production remains the same

Input-coefficients

Deviation, in percentage points	2020	2025	2030
Motor vehicles, trailers and semi-trailers	-1.6	-2.1	-2.6
Electrical machinery and apparatus n.e.c.	+1.6	+2.1	+2.6

[1] Fraunhofer IAO, DLR-FK & IMU Institut (2012): Elektromobilität und Beschäftigung – Wirkung der Elektrifizierung des Antriebsstrangs auf Beschäftigung und Standortumgebung (ELAB). Stuttgart.

Results

- Generally, the scenario has very little effect on the overall economy
- In the short term positive impact on GDP; in 2030 the negative deviation is less than 1 percent
- Higher imports and lower exports decisive for GDP effect
- Little effect on employment, by 2027 positive

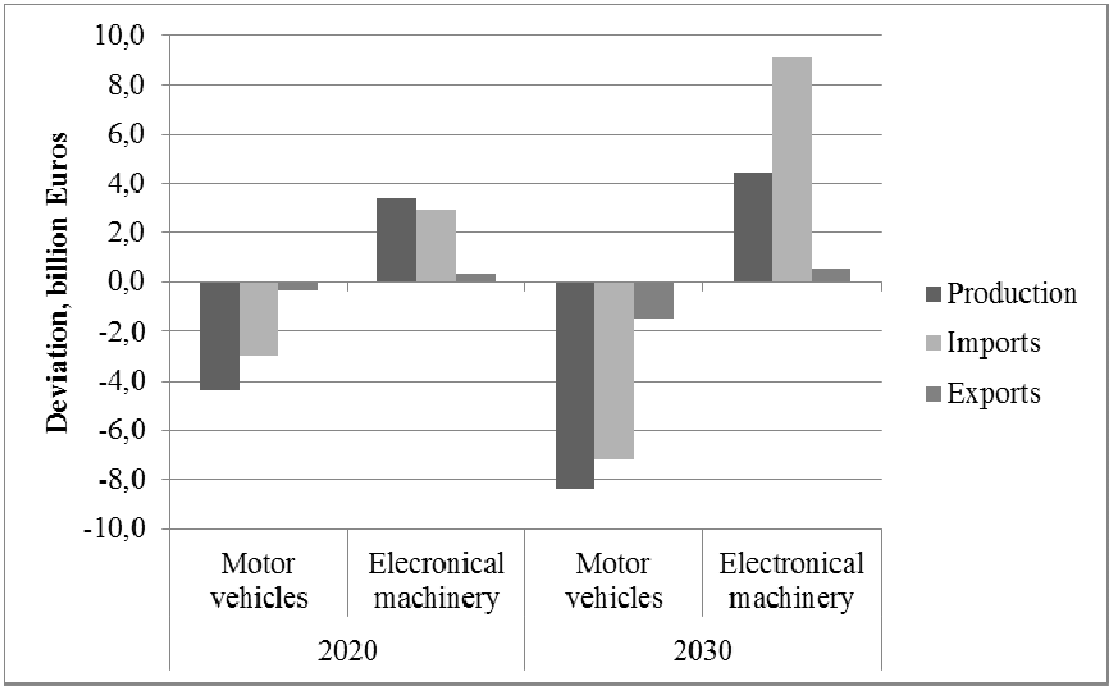
Deviation of macroeconomic indicators, e-mobility scenario compared to reference

	Year	2020	2025	2030	2020	2025	2030
Indicator	Unit	Absolute deviation			Relative deviation, %		
GDP	Billion Euros, price adjusted	0.3	-0.4	-2.2	0.01	-0.01	-0.07
Private consumption		0.1	0.0	-0.2	0.01	0.00	-0.01
Capital investment		0.0	-0.1	-0.3	0.00	-0.04	-0.09
Exports		0.0	-0.2	-0.7	0.00	-0.01	-0.03
Imports		-0.2	0.1	1.0	-0.01	0.01	0.05
Consumer price index	Index	0.0	0.0	0.0	0.01	0.02	0.01
Employment	,000 persons	2.6	1.0	-0.4	0.01	0.00	0.00
Primary energy consumption	PJ	-3.1	-8.5	-17.7	-0.03	-0.08	-0.17

Results, sectoral

- Critical for the long-term negative GDP-effect are the reactions of imports and exports from 2020:
  - ⇨ More imports of electronical goods, especially after 2020
  - ⇨ Less exports of the conventional automobile industry
- Short term increase in domestic demand in the electronics industry generate positive overall effects esp. via employment

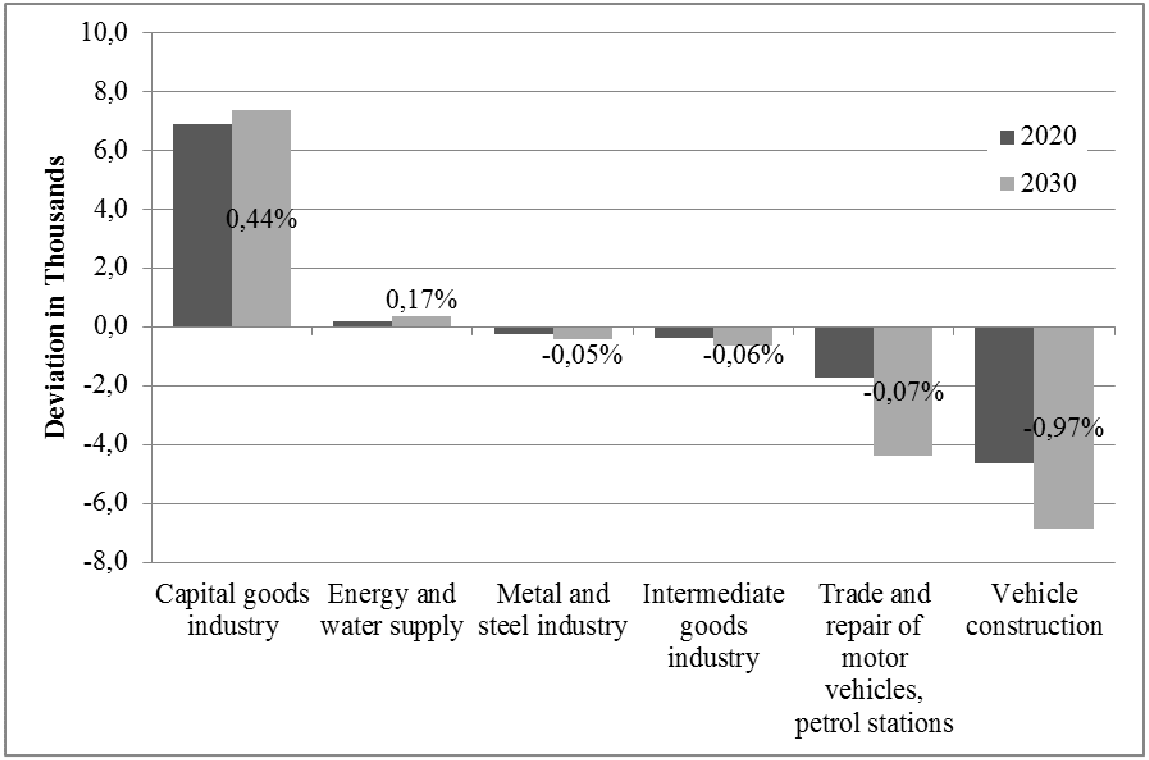
Deviation of production, imports and export: e-mobility scenario compared to reference



Results, employment sectoral

- Electrical and other capital goods industry increase strongly
- Vehicle industry falls markedly, initially less than electric increases, later more
- Negative reaction of metal and chemical industry
- Slight increase in energy-supply sector
- Significantly less employees in the commercial sector

Deviation of employment, e-mobility scenario compared to reference



Conclusions

- The (structural) effect of 0.5 or 3 million more e-cars is very low throughout the economy
- Rather positive employment effect from boost of electronical industry
- Automobile industry (given the past structure) is **highly integrated** and **metal-related**
- A modeling of the available input coefficients may represent the relevant shifts within the industry only to a rather limited extent
  - ⇨ How high is the degree of integration and the future adaptability of the automotive industry?
- Retained approach assumes higher cooperation of the automobile industry with a new electrical industry.
- By substituting fuels with power
  - ⇨ demand for energy supplier increase,
  - ⇨ part of the trade sector are weakened

Future issues

- More details by developing a satellite account for the automobile sector
- Investments and infrastructure changes (role of gas stations, public charging devices) are only partially taken into account
- Cost efficiency of electric vehicles can be considered, however, requires a detailed approach to performance, driving profiles and possibly support measures

Thank you for your attention.

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