Overview on DIACORE

Renewables in the EU: Costs and benefits of deploying RES
DIACORE Webinar, April 13th 2015,

Mario Ragwitz (Fraunhofer ISI)

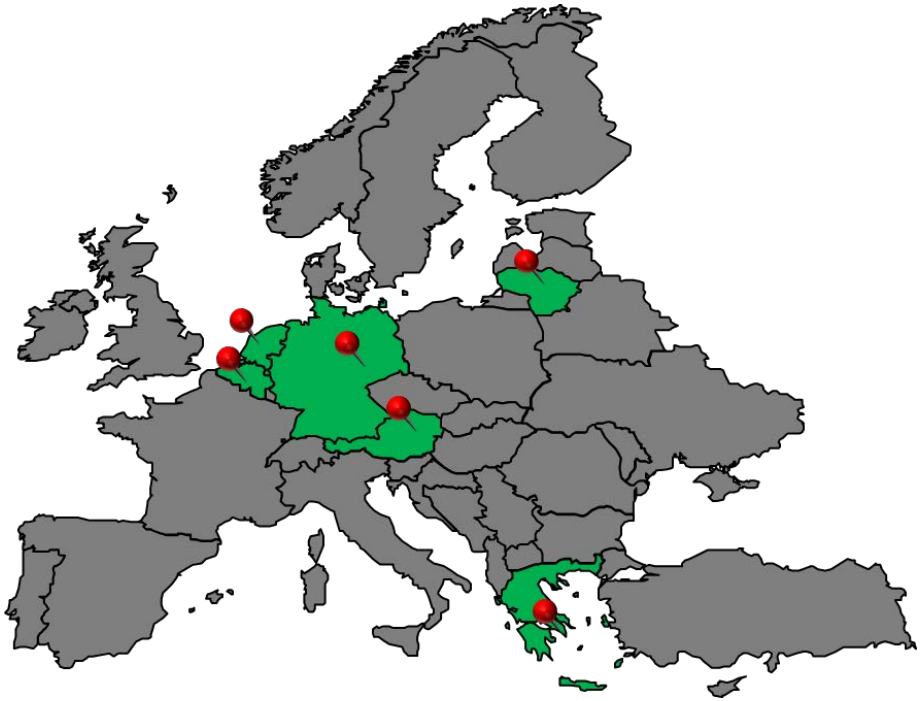
Co-funded by the Intelligent Energy Europe Programme of the European Union

Background

- Policy needs
  - Monitoring activities of MS success in meeting 2020 RES targets and modelling of main policy alternatives crucial for future policy development.
  - Need for wider convergence in RES support across the EU
  - Unbiased and scientifically robust analysis needed in a sometimes controversial discussion on the optimal support strategy
  - Importance of continuous stakeholder dialogue and involvement of national and European key decision makers
- Target group
  - National and European policy makers, renewable branch organisations, RES generators, energy consumers and suppliers
- Key data
  - Supported by Intelligent Energy for Europe Programme, managed by the Executive Agency for Small and Medium-sized Enterprises (EASME)
  - Project duration: 36 months (Started: 01/04/2013)

Partners

Fraunhofer ISI (Germany)	Fraunhofer Institute for Systems- and Innovations Research
EEG (Austria)	Vienna University of Technology, Energy Economics Group
Ecofys (Netherlands)	Ecofys Netherlands bv
CEPS (Belgium)	Centre for European Policy Studies
DIW (Germany)	German Institute for Economic Research
Eclareon (Germany)	Eclareon GmbH
UU (Netherlands)	University of Utrecht
NTUA (Greece)	National Technical University of Athens
AXPO (Austria)	AXPO Austria
LEI (Lithuania)	Lithuanian Energy Institute



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Expected outputs

- Creating an **interactive and web-based database** on key input parameters for policy implementation and assessed performance of existing and planned policies, monitoring **policy performance**
- Assessing **costs and benefits of RES** today and in the future (2020, 2030), including impacts from a system perspective (generation costs, externalities), distributional effects (policy costs incl. market values and merit order effects) to foster public acceptance
- Identifying relevance and severity of **policy related risks** threatening investments in the RES-sector
- Providing targeted solutions for **cooperation** and **coordination**, including a **transparency platform** on approaches and input parameters for determining remuneration of RES technologies and approaches for coordinating national policies
- Establishing an **interactive policy dialogue** with stakeholders at EU and national level providing up-to-date information platform and scientific knowledge base on RES support policy performance
- Deriving a fine-tailored **DIA-CORE policy package**

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Methodological framework

- Statistical analysis of historical data / development of quantitative indicators for success and failure of RES support schemes
- Profitability analysis of investments in RES projects
- Stakeholder consultation and surveys – internet based and by personal contacts
- Analytical analysis of market and policy interactions
- Technology-specific case studies for biomass and solar PV
- Quantitative analysis of the costs and benefits of present and future policy options based on the techno-economic model Green-X

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Achieved results and current status

- Update and improvement of historic indicators regarding the policy performance of EU Member States
- Survey on barriers and drivers framing the diffusion of renewables completed with feedback of ca. 180 respondents
- 1st policy workshop on “Renewables in the EU: Policy performance, drivers and barriers“ in June 2014
- 2nd policy workshop on “Costs and Benefits of RE deployment“ in October 2014

  → Report and policy brief on these topics available on the website
- Stakeholder consultation and survey ongoing to better understand financing requirement of investors, the relation to policy risk and capital costs
- Development of concept to assess costs and benefits of deploying renewables

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More information:

http://www.diacore.eu/

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Costs and benefits of deploying renewables

Overview on the concept and case studies

DIACORE-CEPS Webinar, April 13th 2015

by Barbara Breitschopf and Anne Held

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Co-funded by the Intelligent Energy Europe Programme of the European Union

Overview on the concept - motivation

Motivation for the concept

- increasing costs due to RE deployment and not immediately perceiveable benefits called for a justification of promoting RE deployment

→ what are the costs and benefits of RE deployment?

- recourse of policy makers to the purpose of RE deployment (e.g. mentioned in the German RE Act)
  - to enable *energy supply to develop sustainably*
  - to lower the macroeconomic costs of energy supply by long-term *external effects*,
  - to conserve *fossil energy reserves* and
  - to promote the *further development of technologies*.

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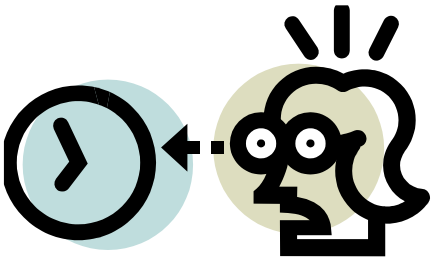
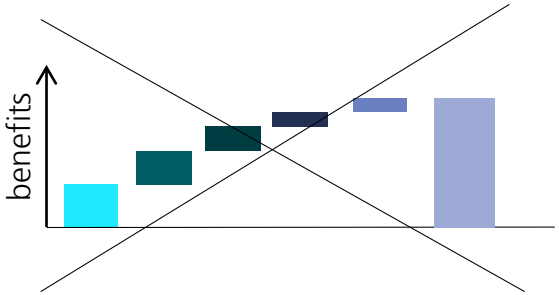
Overview on the concept - motivation

→ The RE act as a basis for an economic concept to assess benefits:

+ avoided emissions
+ less imports of fossil fuels
+ decrease in technology cost
+ price effects at the whole sales market
+ increase in investments and sales
+ increasing employment in “RE-sectors”

∑ benefits of RE deployment





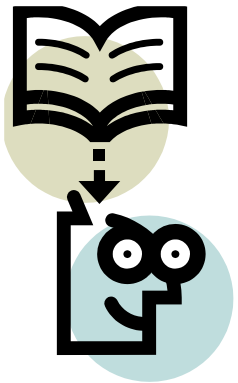
Overview on the concept - motivation

why not?

... because costs and benefits

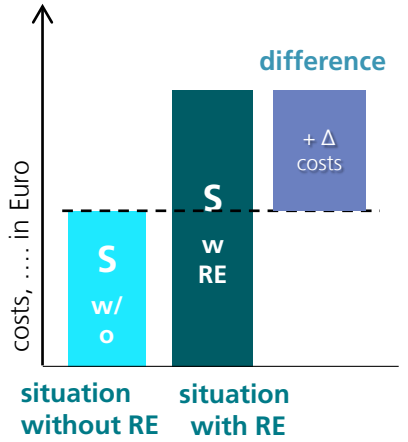
- occur at different levels
- affect different actors differently: ☺ or ☹
- are in some cases counted twice
- reflect in some cases just a shift of „money“ between actors
- cannot be simply added across levels and actors

→ call for a comprehensive cost–benefit concept

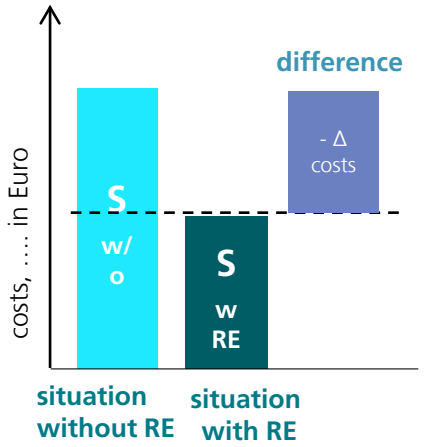


Overview on the concept - concept

- starting point for the elaboration of the concept:
  1. which effects can be observed by RE deployment?
  2. at which levels do these effects occur
  3. who is how affected (actors)
  4. how do these effects relate to each other?



- results
  1. **„additionality“ character**



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Overview on the concept

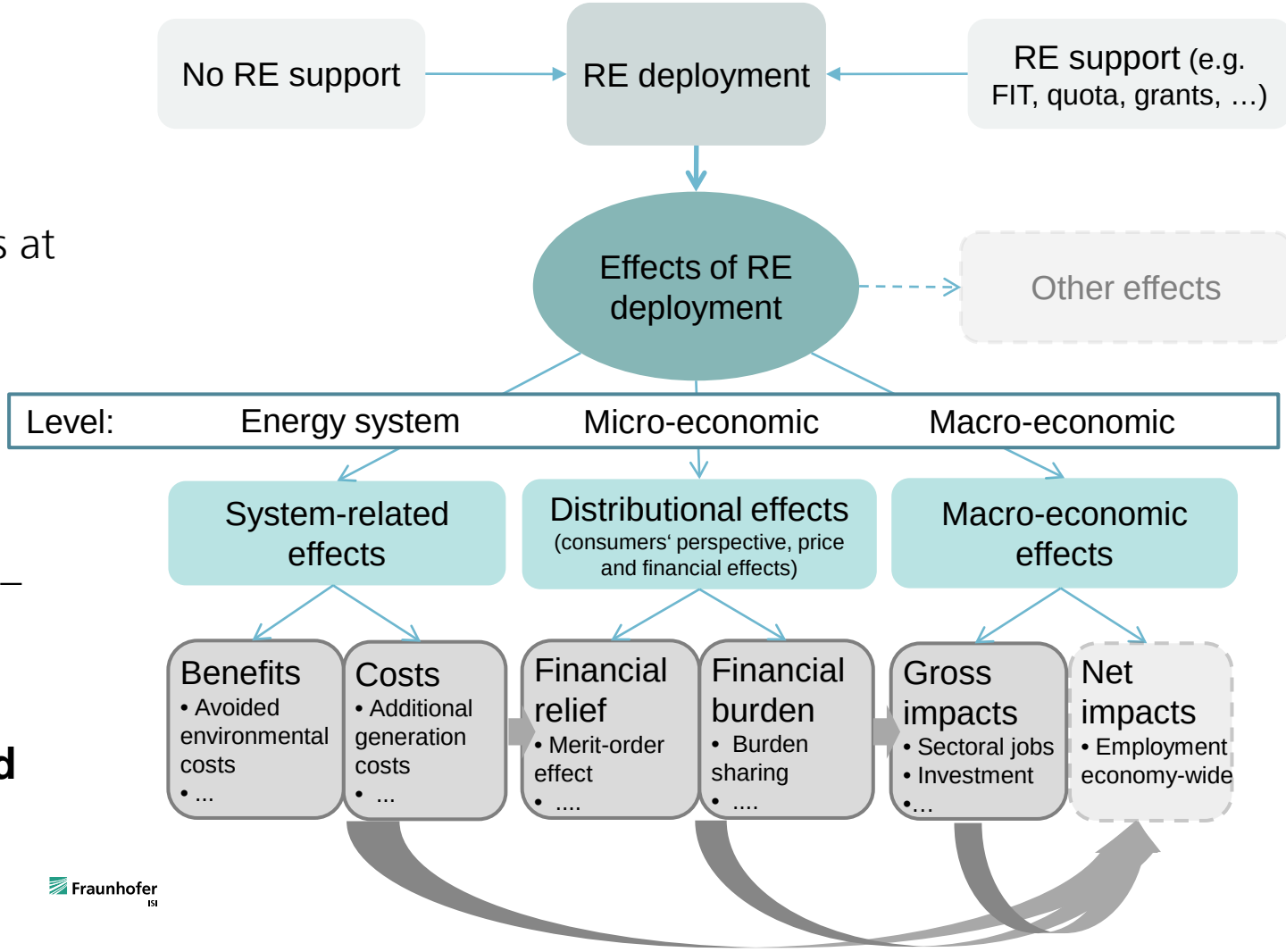
2. three levels - categories:

a) costs and benefits at the system level

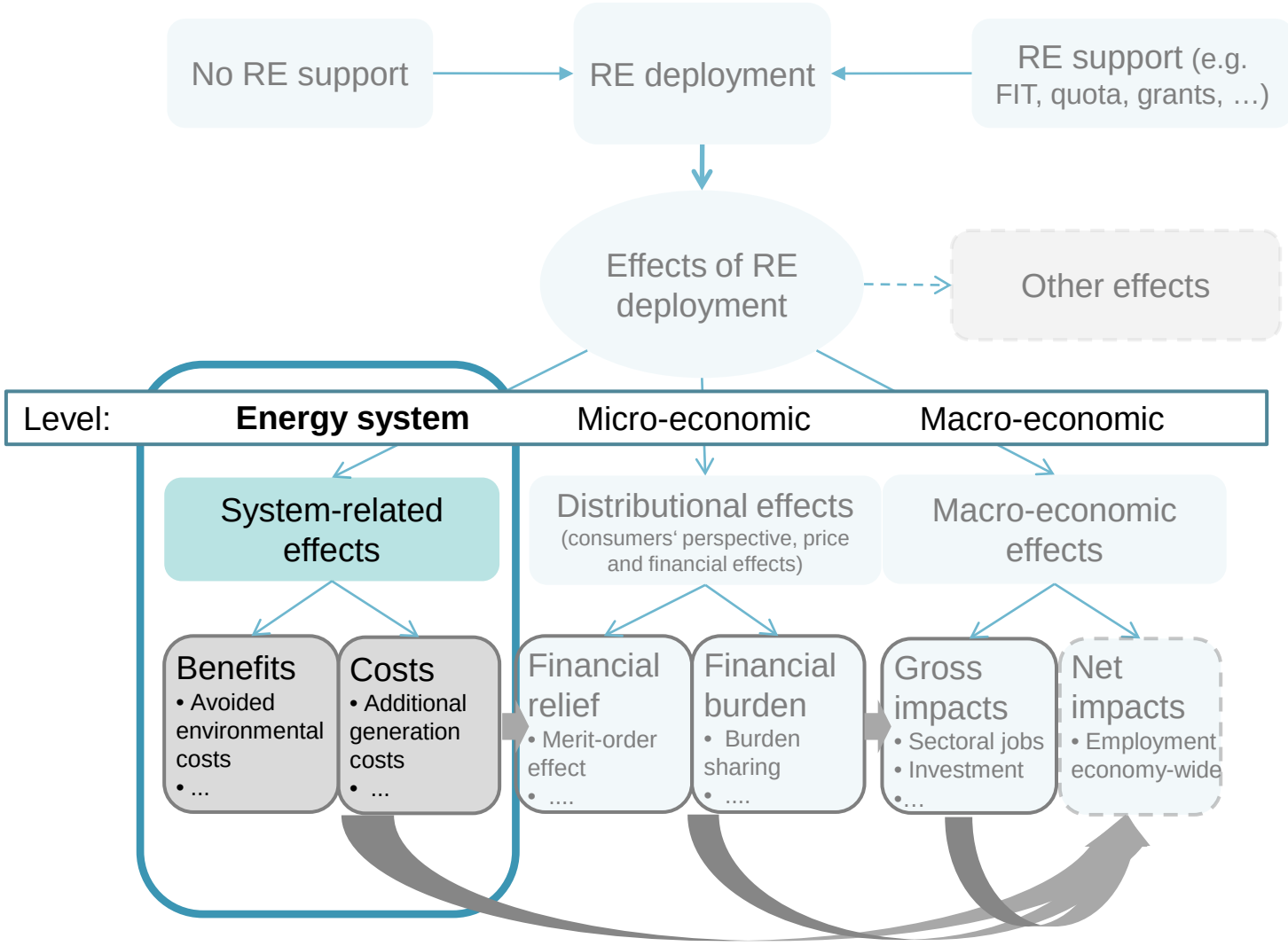
b) burdens or reliefs for different actors – micro level

c) economic effects – macro level

3. categories depend on each other



System-related costs & benefits



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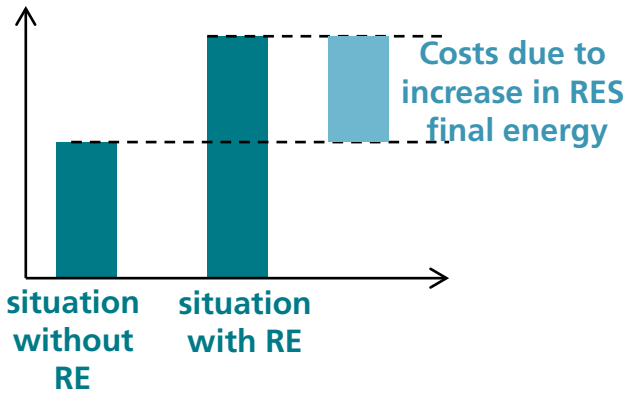
System-related costs and benefits

- Include all benefits and costs compared to a reference system



- Definition of „system“ may vary
  - Energy sector as a whole
  - Final energy sector: electricity, heat or transport
  - Technology
- Difficulty of directly assigning certain cost/benefit categories to technology level
  - Generation costs → **direct** allocation to technology
  - Grid infrastructure cost → only **indirect** allocation to technology
- Avoid double counting
  - Include CO_2 costs either in generation costs or in benefits from avoided CO_2 emissions

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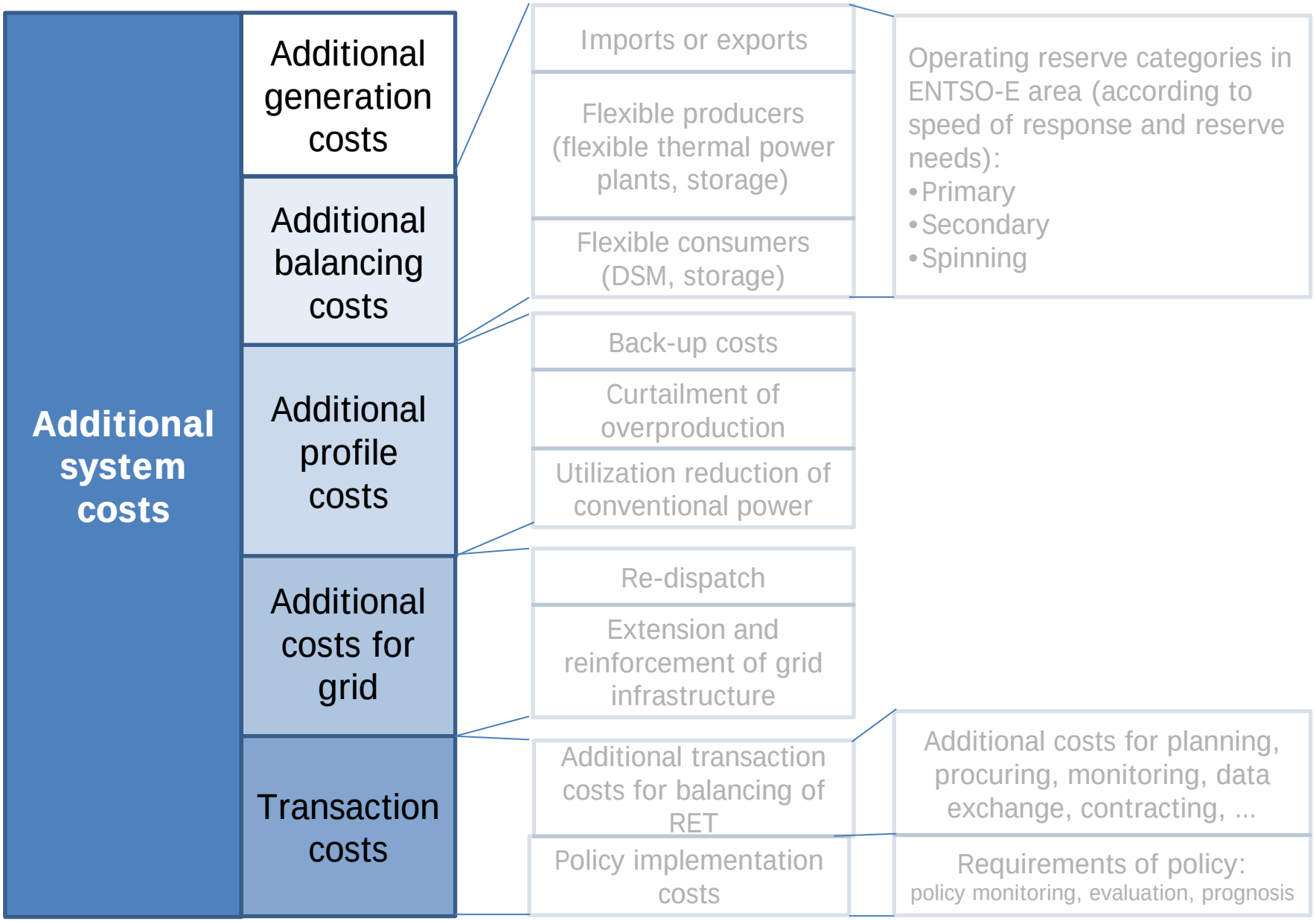
System-related costs - overview



System-related costs (1)

Types : additional system cost	Description
Generation costs • direct costs • relevant for heat and electricity	• costs of the RE generation technology - avoided costs of conventional generation • costs of combining RE and conventional technologies - avoided costs of conventional generation
Balancing costs • indirect costs • focus on forecast errors • relevant for electricity	• deviations from schedule of variable RE power plants • need for operating reserve and intraday adjustments • Balancing capacity: positive or negative
Profile costs • indirect costs • focus on back-up capacity • relevant for electricity	• increase of average generation costs of residual load as a result of RES-induced decrease of utilization of conventional power. • additional capacity of dispatchable technologies required due to the lower capacity credit of non-dispatchable RES • potential curtailment of electricity required

Ueckerdt et al. (2013)

System-related costs (2)

Types : additional system cost	Description
Grid costs • indirect costs • relevant for electricity (and biogas grid /heating)	• Reinforcement/extension of transmission or distribution grids • Congestion management including re-dispatch required to manage situation of high grid load.
Transaction costs • indirect costs • relevant for heat and electricity	• Market transaction costs (additional forecasting, planning, monitoring, data exchange, etc.) • Policy implementation costs

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System-related benefits

- Avoided emissions of greenhouse gas (GHG) and air pollutants
- Improving import dependency → reflected in the price (fossils, storage)
- Facilitate further technological development → reflected in future investments

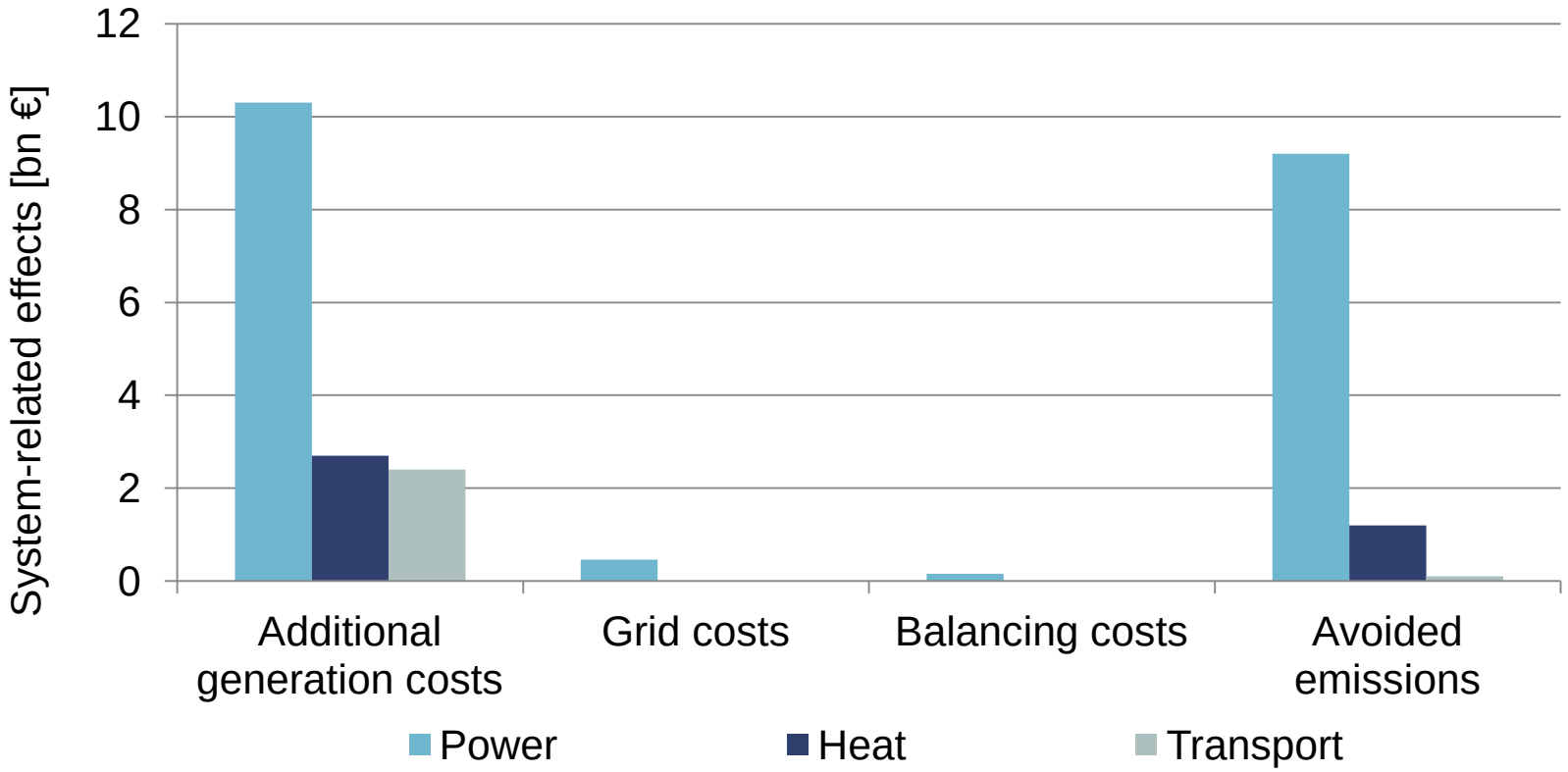
→ More difficult to quantify than system-related costs, e.g. social costs of GHG emissions

- Estimate avoided emissions at technology level:

  Use of emission factors for RE and fossil fuels and substitution factors showing a technology mix to be replaced as reference

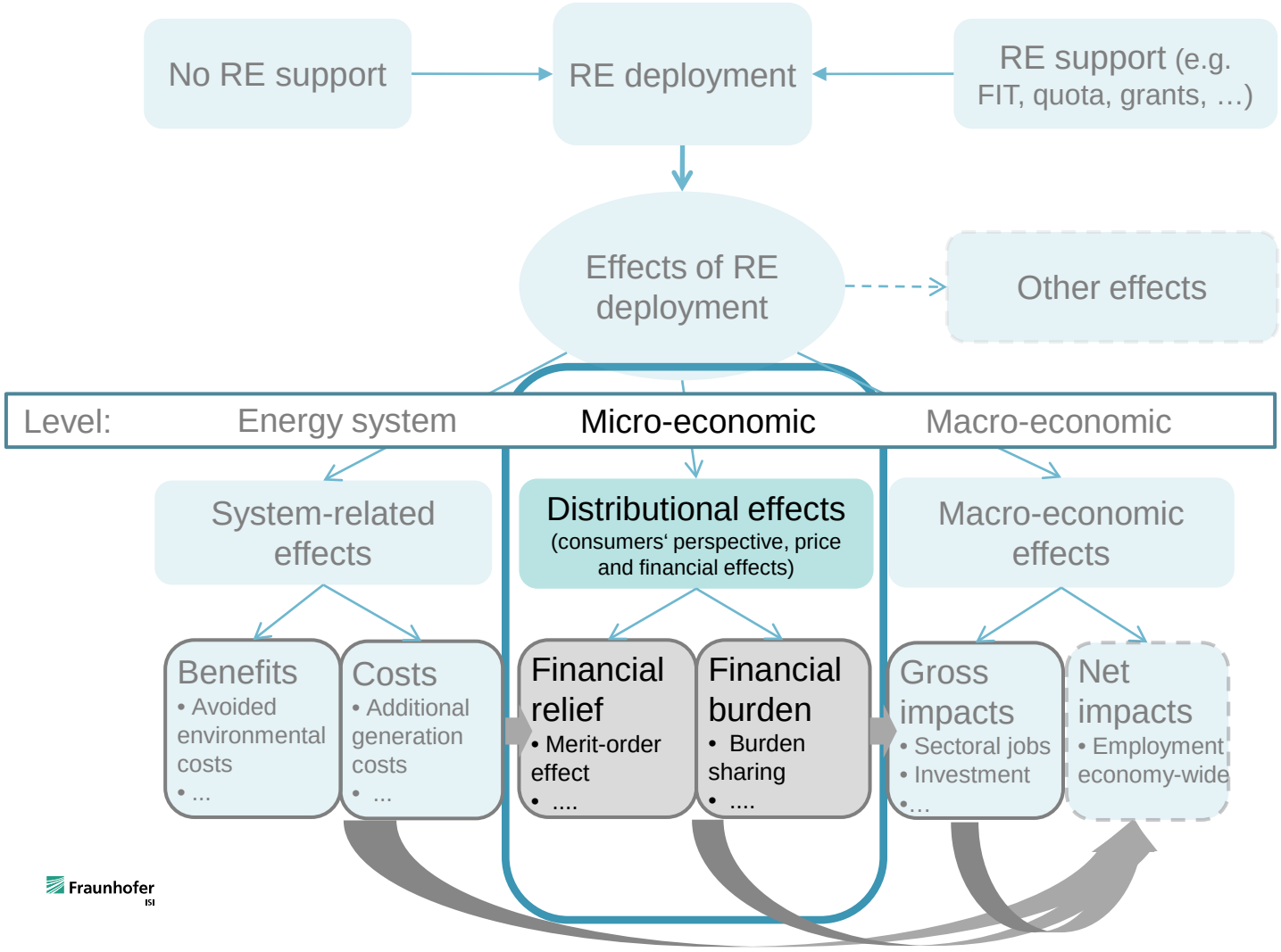
Case study

Case study
System-related effects in Germany 2012



Source: ISI, GWS, IZES, DIW (2013): Monitoring of costs and benefits of RET deployment, Update for 2012
http://www.impres-projekt.de/impres-de/content/veroeffentlichungen.php

Actor related - Meso level



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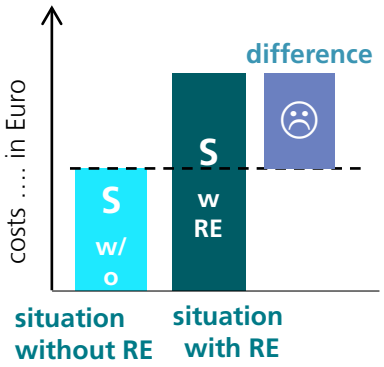
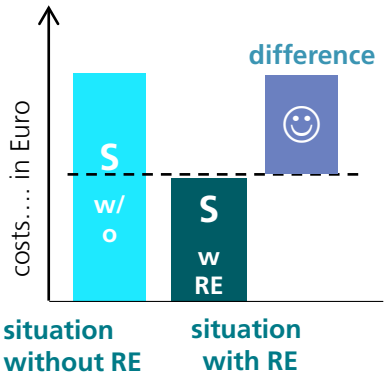
Distributional effects

- are induced by **policies** (policy specific)
- affect different **actors**
- depict **changes in costs (benefits), prices, quantity or quality** for different actors
- comprise **beneficial** effects for some actors and **negative** effects for other actor groups
- show who finances or "**pays the bill**" for RET deployment
- can**not** be **aggregated**
- do **not** reflect the real **use of resources**





→ reflect the final costs or benefits of RET deployment and RE policies that private households, firms, public household pay

Distributional effects: costs and benefits for different actors

Actor specific costs are distributional effects, they comprise:

- changes in **consumer or producer surplus** (price changes):
  - wholesale price (electricity suppliers, utilities through MOE), retail prices through levy (final consumer) and equalization scheme → competitiveness and energy poverty
  - margins of generators through FIT
- **scarcity rents**: land, equipment
- **capitalization effects**: real estate
- **utility changes**: individual marginal utilities
- **transitional effects**:
  - technology development ... → technology manufacturers, developers
  - trade advantages
  - changes in employment

→ financial and price effects

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Distributional effects

Types	Description	
Policy costs	**Consumer-based** burden sharing **Levies** for final consumers Special **exemptions / equalization schemes** for selected consumers e.g. energy intensive industries **Public budget-based** burden sharing, i.e. resulting policy support costs are financed through the state budget	**Financial effect** for electricity consumers (consumer surplus) and generators →production level (wholesale) →**consumption** (retail) level
Merit-order effect	**Change of market prices** due to changes in the merit order of the power supply (changes in the order of the generation portfolio).	**Price effect** for power market participants (consumer, producer surplus) → **whole sales** level
R&D support	Direct monetary **transfer from public budget to researching entity** to compensate for costs that cannot be covered because of non-realizable rents (on the short term) due to spill-overs and non-exclusion of uses (market failure)	**Financial effect** for technology developers or providers (consumer/producer surplus) → **technology provider** level

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Distributional effects

- Consumer based financing
  - market based scheme, UK with green certificates
  - regulation based scheme, e.g. Germany with Feed-in tariffs/premium

Instrument	Power sector
Guaranteed price or price supplement: Feed-tariffs Feed-in premium (with w/o caps)	Tariffs/premium (FIT/FIP) - whole sale market prices - all additional balancing and transaction costs.
Obligation: Quota with RET certificates Standards (share of RET w/o certificates)	 Total amount of certificates (kW) multiplied by their price (per year) n.e.

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Distributional effects

- Budget based financing

Instrument	Power sector
Guaranteed price or price supplement:	Should include: Difference between tariffs (premium) and whole sale market prices plus all additional balancing and transaction costs.
Feed-tariffs	
Feed-in premium (with w/o caps)	
Grants or subsidies	
Investment grants	Public budget for grants
Interest/repayment subsidies	Public budget for subsidies: based on foregone revenue from capital (interest rate) or directly paid subsidies
Tax credits	
Generation tax credit Investment tax credit	Public accounting of lost tax revenues

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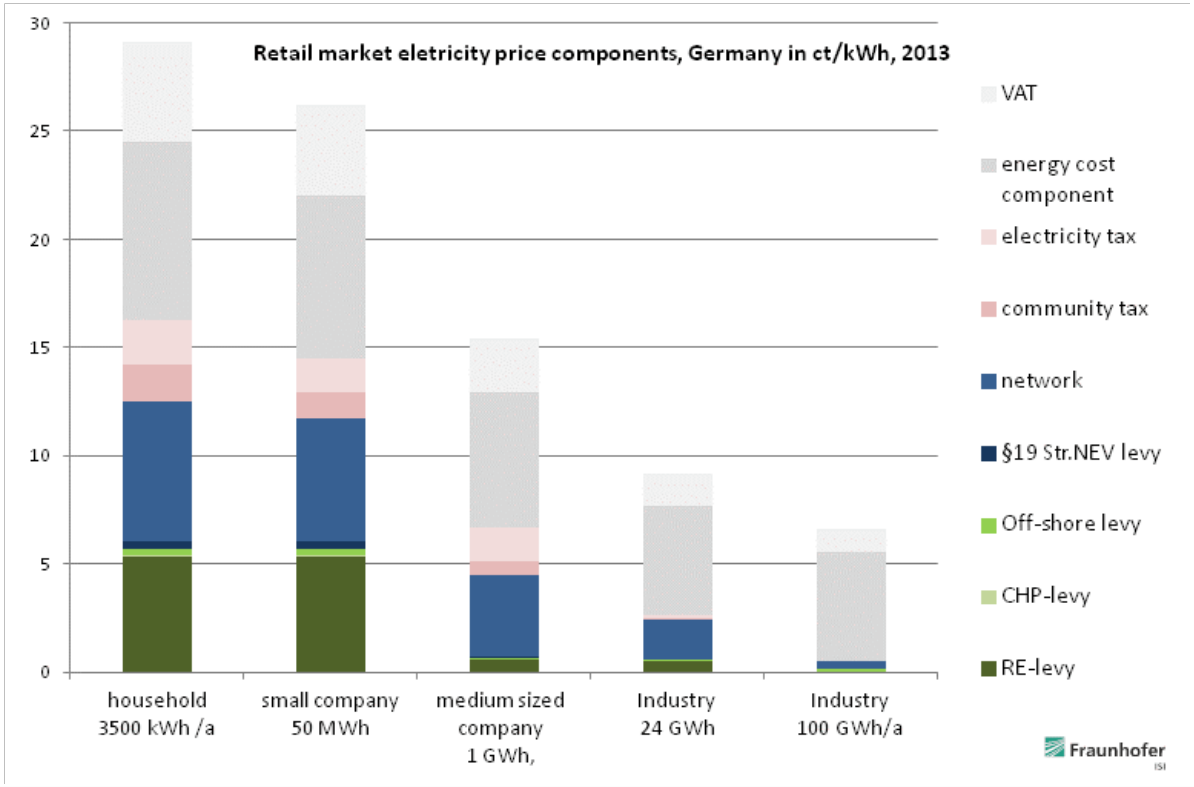
Case study

Micro-level effects: RE-levy in Germany

Retail electricity prices in Germany, by consumption and type of consumser → special equalization schemes for RE levy



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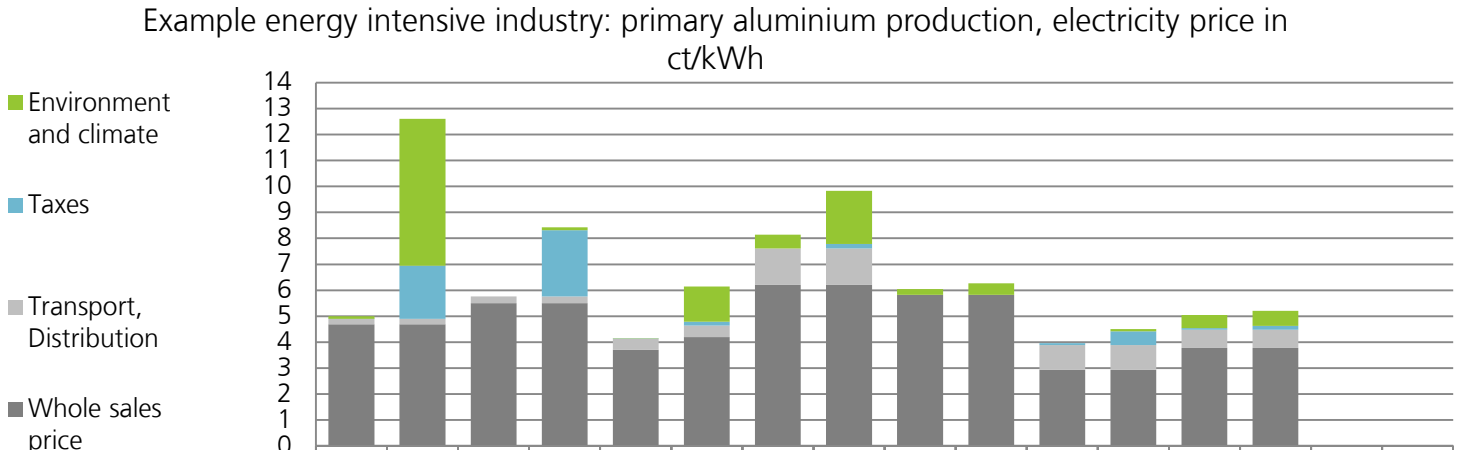
Effects of the special equalization scheme

Final power price paid by selected privileged and non-privileged industries, 2013:



	Germany		Netherlands		France		United Kingdom		Korea		Texas		Pensylvania		China	
	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V
Environment and climate	0.10	5.65	0.00	0.11	0.01	1.35	0.54	2.05	0.22	0.44	0.00	0.08	0.50	0.58	0.00	0.00
Taxes	0.01	2.05	0.00	2.55	0.00	0.15	0.00	0.18	0.00	0.00	0.07	0.53	0.06	0.14	0.00	0.00
Transport, Distribution	0.20	0.20	0.27	0.27	0.44	0.44	1.40	1.40	0.00	0.00	0.95	0.95	0.70	0.70	0.00	0.00
Whole sales price	4.69	4.69	5.50	5.50	3.70	4.20	6.21	6.21	5.82	5.82	2.94	2.94	3.78	3.78	0.00	0.00

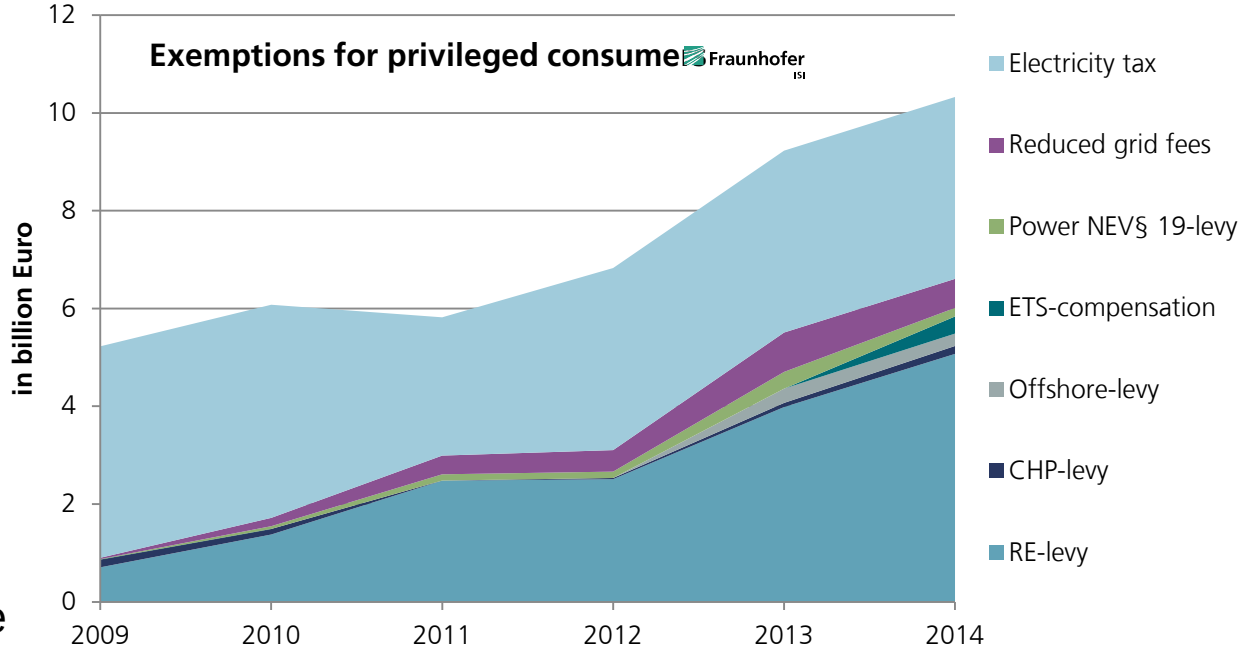
→ assessment of privileged volume

Effects of the special equalization scheme

Example: Germany's equalization schemes for taxes and levies in RE, CHP, offshore, ETS, grid fees:

= shift of (a part of the) levy or financing share of RET deployment

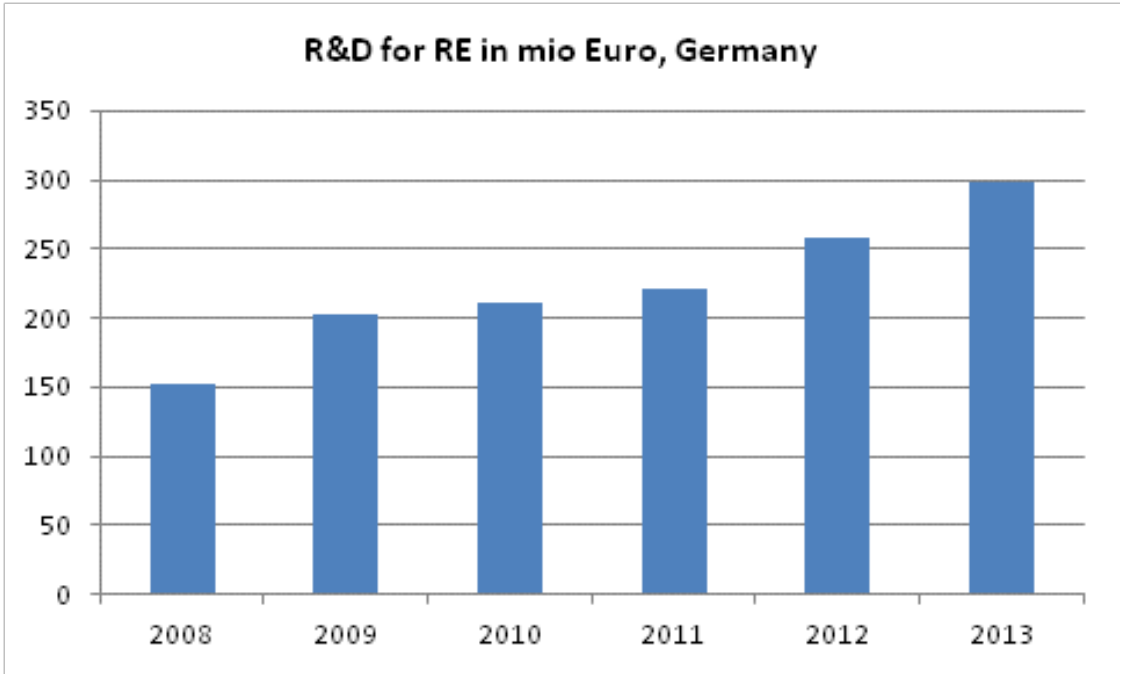
- to non privileged consumers in a regulation based scheme, or
- to consumers with lower bargaining power in a market based scheme



→ around 10 billion Euro are shifted (Germany)

Public R&D spending für RE technologies

Public R&D spending for RE technologies, Germany:



Source: BMWi, BMF; calculations by DIW 2014; in : http://www.impres-projekt.de/impres-wAssets/docs/2014_09_10_Monitoringbericht_FINAL_.pdf

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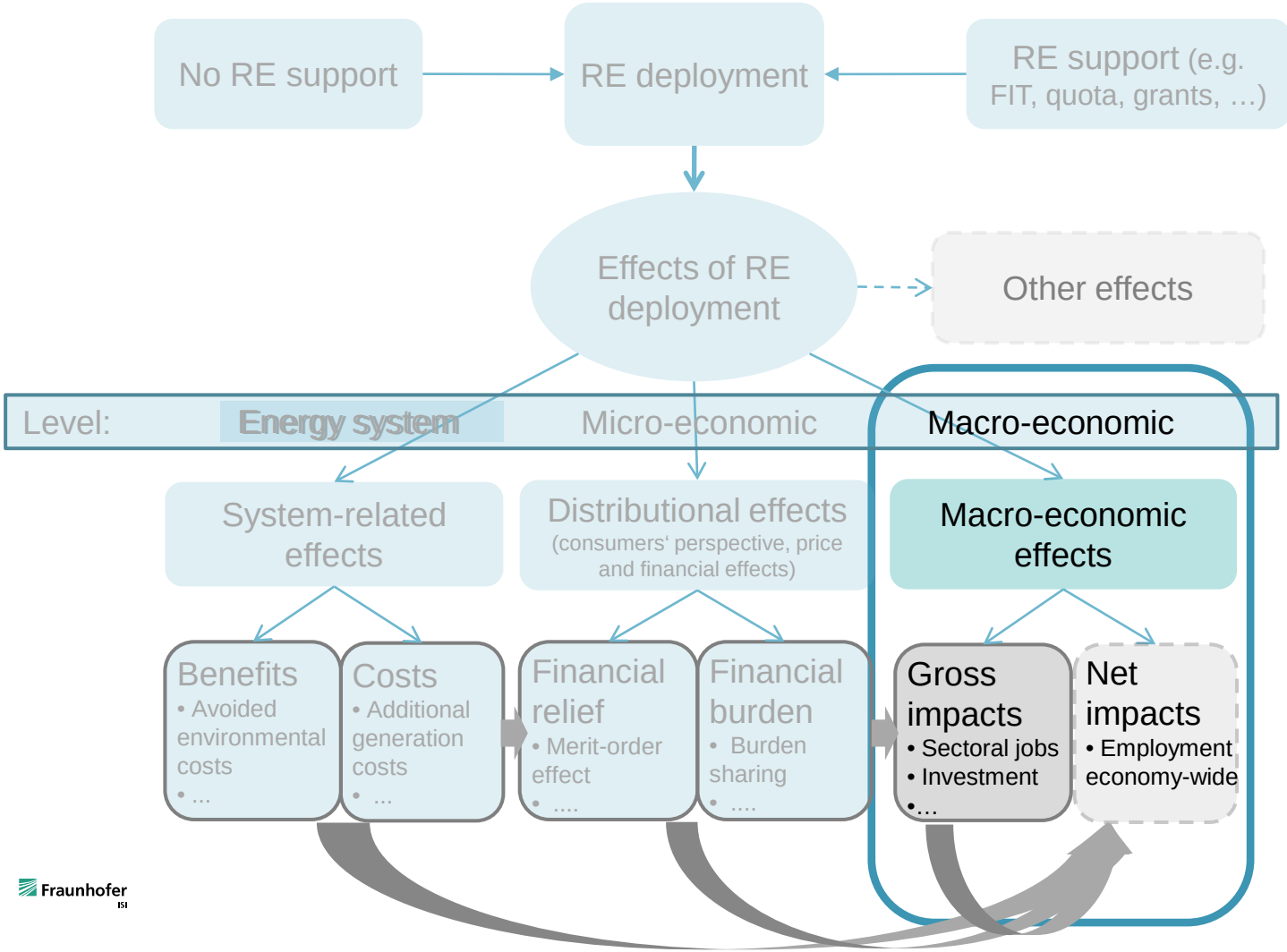
Macro-economic effects



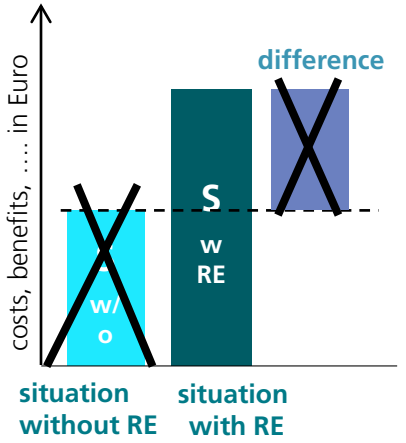
Macro-economic effects

…

- show how and to what degree the use of RE affects the **economy**
  - in some **selected sectors**, e.g. at the RE sector level → sectoral effects
  - in **all sectors** of the economy, i.e. in all industries and services of an economy → economy wide effects
- model based assessment - ideally incorporate system- and actor-related effects
  - **system related** effects through expenditures → e.g. input-output table,
  - **actor related** effects via prices, national accounting, ...
- many macro-economic impact assessment studies mix between sectoral and economy wide effects → but these are two different types of effects

Macro-economic effects

The “two types” of macro-economic effects:



1. **gross effects – sectoral effects**:

- scope of impact analysis
  - focus is on the renewable energy sector
  - do not include negative effects of RE deployment in the fossil fuel based sector
  - do not include price effects of RE e.g. lower consumption of HH due to higher electricity prices
- indictators
  - investment in RE (plants) or sales of „RE sector“
  - employment in „RE sector“
  - value added in „RE sector“

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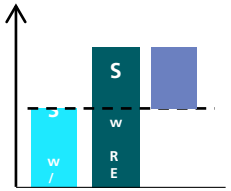
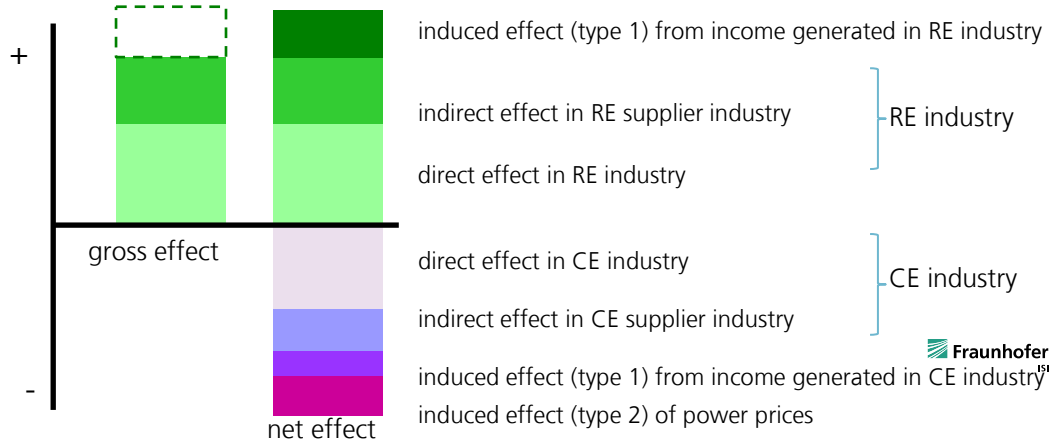
Macro-economic effects

2. net effects – economy wide effects:

- do include (ideally) ALL effects,
  negative and positive effects in all industries
  (up- and downstream) and sectors
  → compare a system with RE to a system without RE
- indicators: economy wide jobs, GDP





Case study

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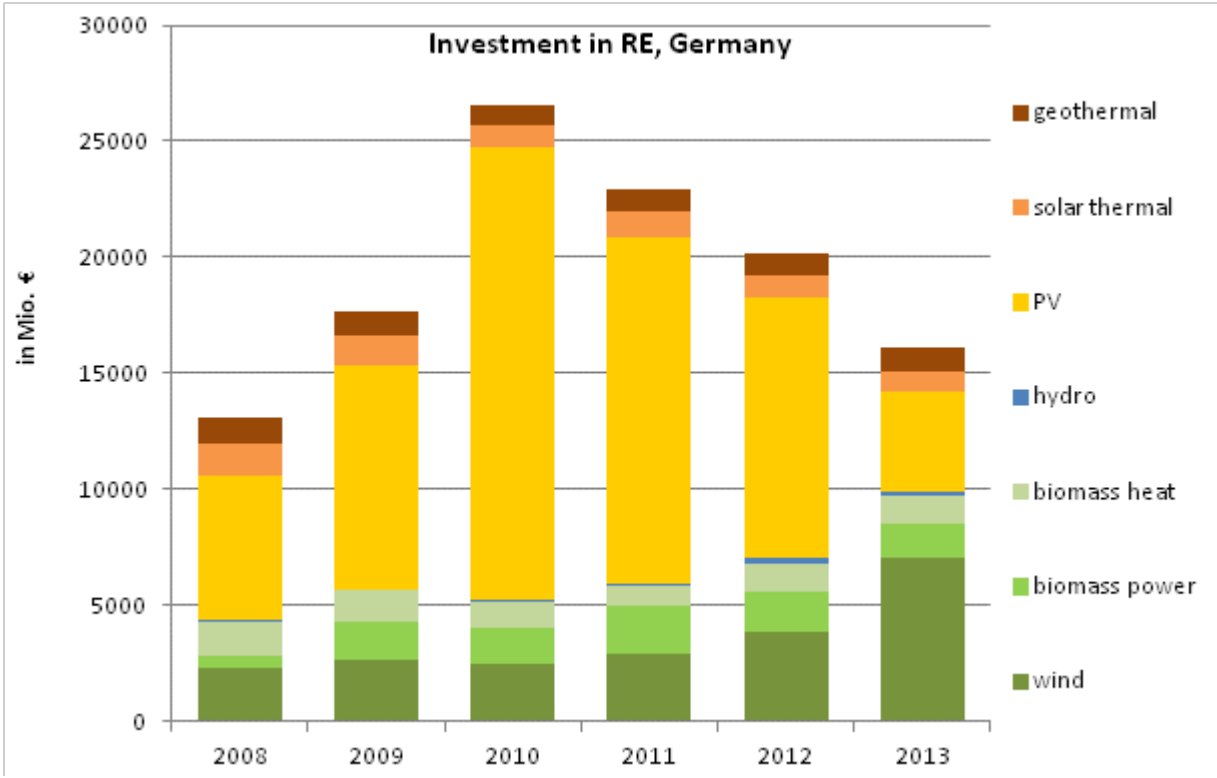
Macro-level: Investments in RE

Investment in RE in Germany comprises all expenditures for:

- manufacturing
- construction
- installation

→ for impacts on jobs take exports and imports into account



Source: O'Sullivan et al. (2010, 2011, 2012, 2013, 2014) in: http://www.impres-projekt.de/impres-en/content/arbeitspakete/ap5/monitoring.php

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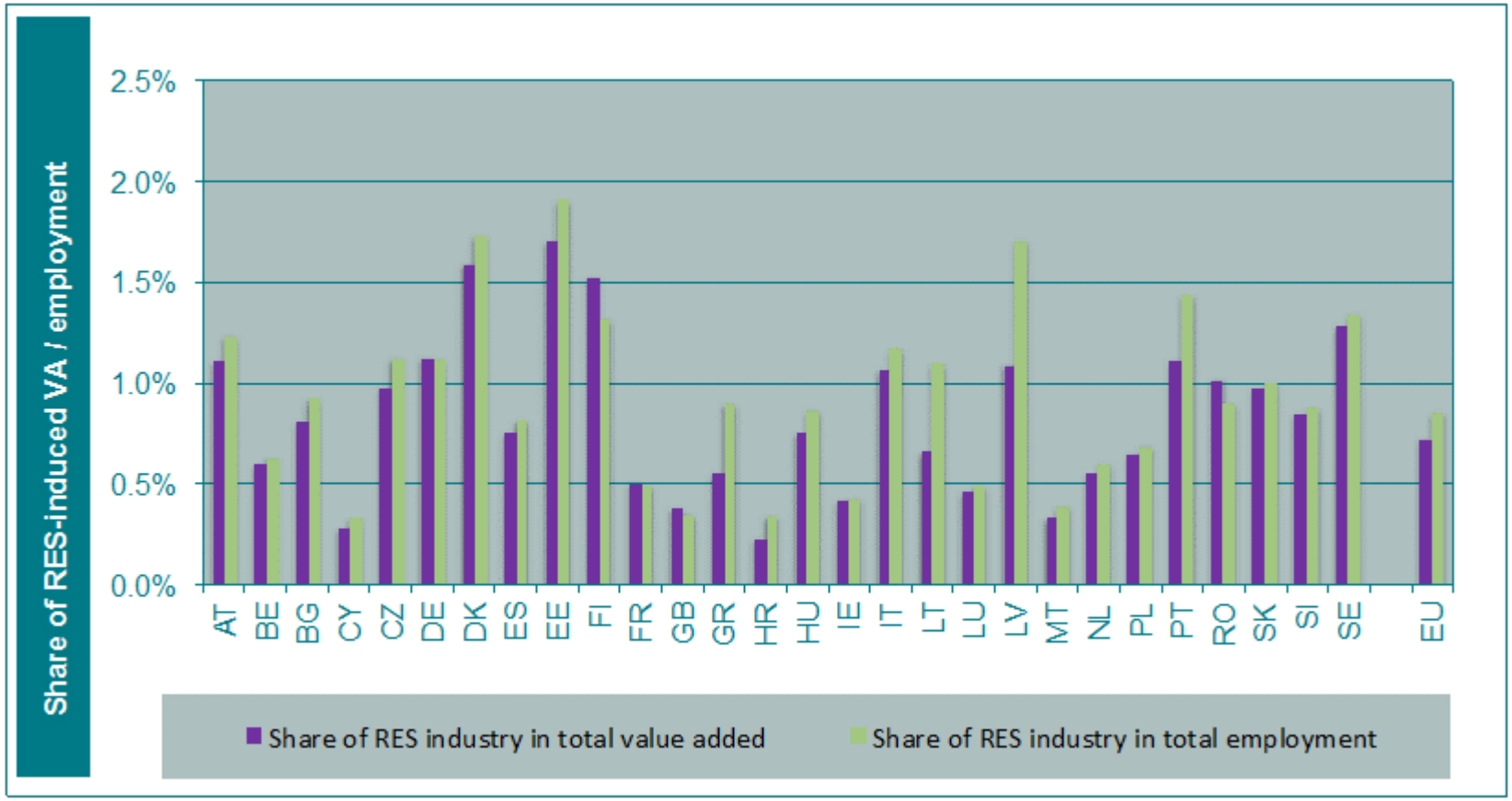
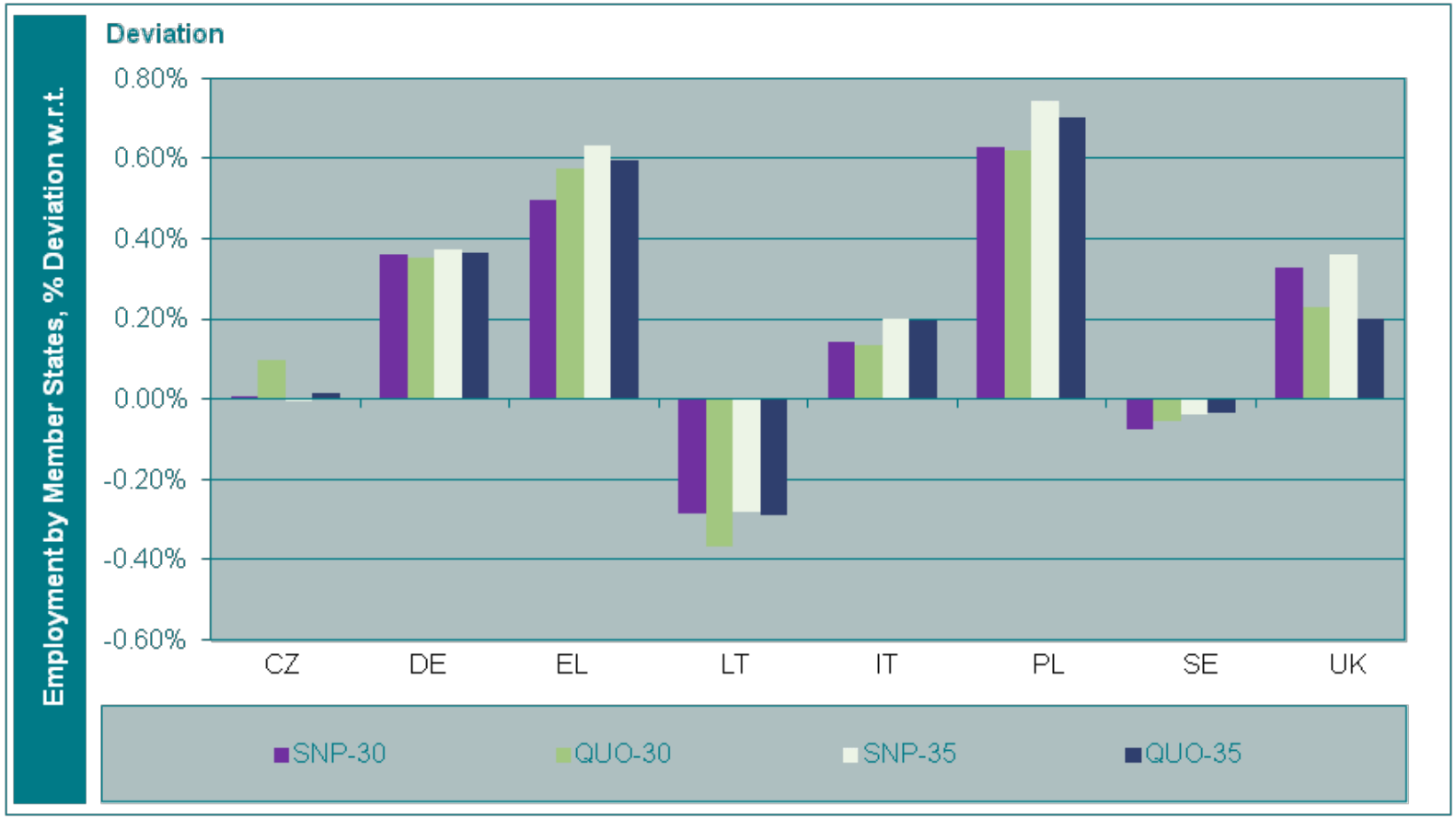
Macro-level: gross effects in EU countries



Source: EmployRESII 2014, calculation by rütter soceco

Macro-level: net effects in selected EU countries



Source: EmployRESII 2014, calculation by Fh-ISI

Summary and conclusions

- Assessing costs and benefits of increased renewables use is a challenging task
- Estimation of system-related costs challenging in particular in the electricity sector due to the dependency on the grid and difficulty of quantifying certain effects, in particular benefits → elaborate further approaches
- Variety of distributional effects, difficult to sum up → focus on main actors
- Many studies on gross or net effects, but difficult to include all effects → focus on the most relevant ones.
- High data requirements for appropriate assessment → establish RE statstics
- Only limited examples of comprehensively assessing costs and benefits for renewables, e.g. in Germany
- Similar analyses for other countries following a comprehensive and standardised approach would allow comparison and improve policy messages regarding different deployment pathways of renewable energy

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