

Costs and benefits of deploying renewables

Overview on the concept and some examples

DIACORE Policy Workshop, June 25th 2015

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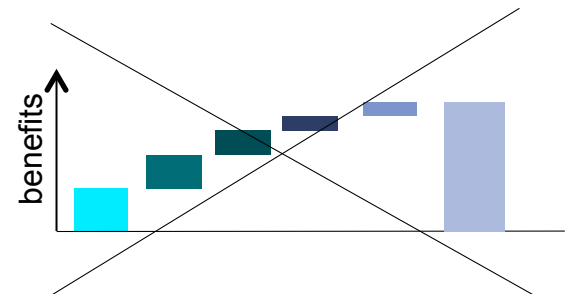
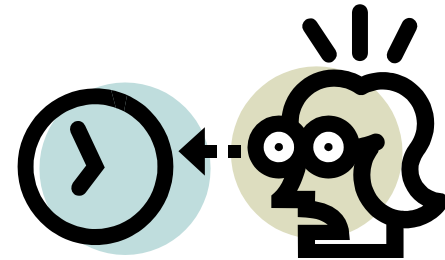


Overview on the concept - motivation

→ 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”

Σ benefits of RE deployment



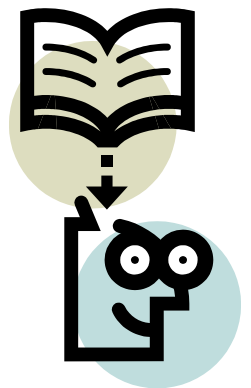
Overview on the concept - motivation

why not?

... because costs and benefits

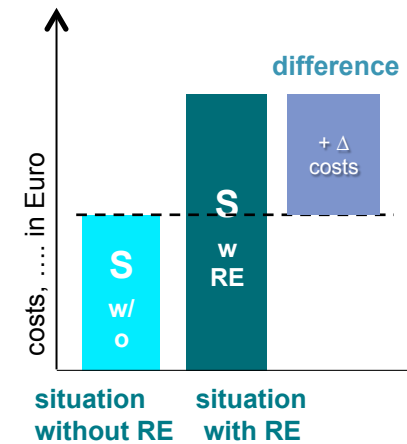
- occur at different levels
- affect different actors differently: ☺ or ☹
- are in some cases counted twice
- reflect in some cases just a shift of „money“ between actors
- cannot be simply added across levels and actors

→ call for a comprehensive cost–benefit concept

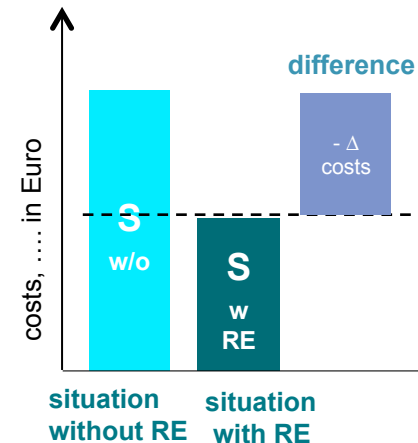


Overview on the concept - concept

- 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

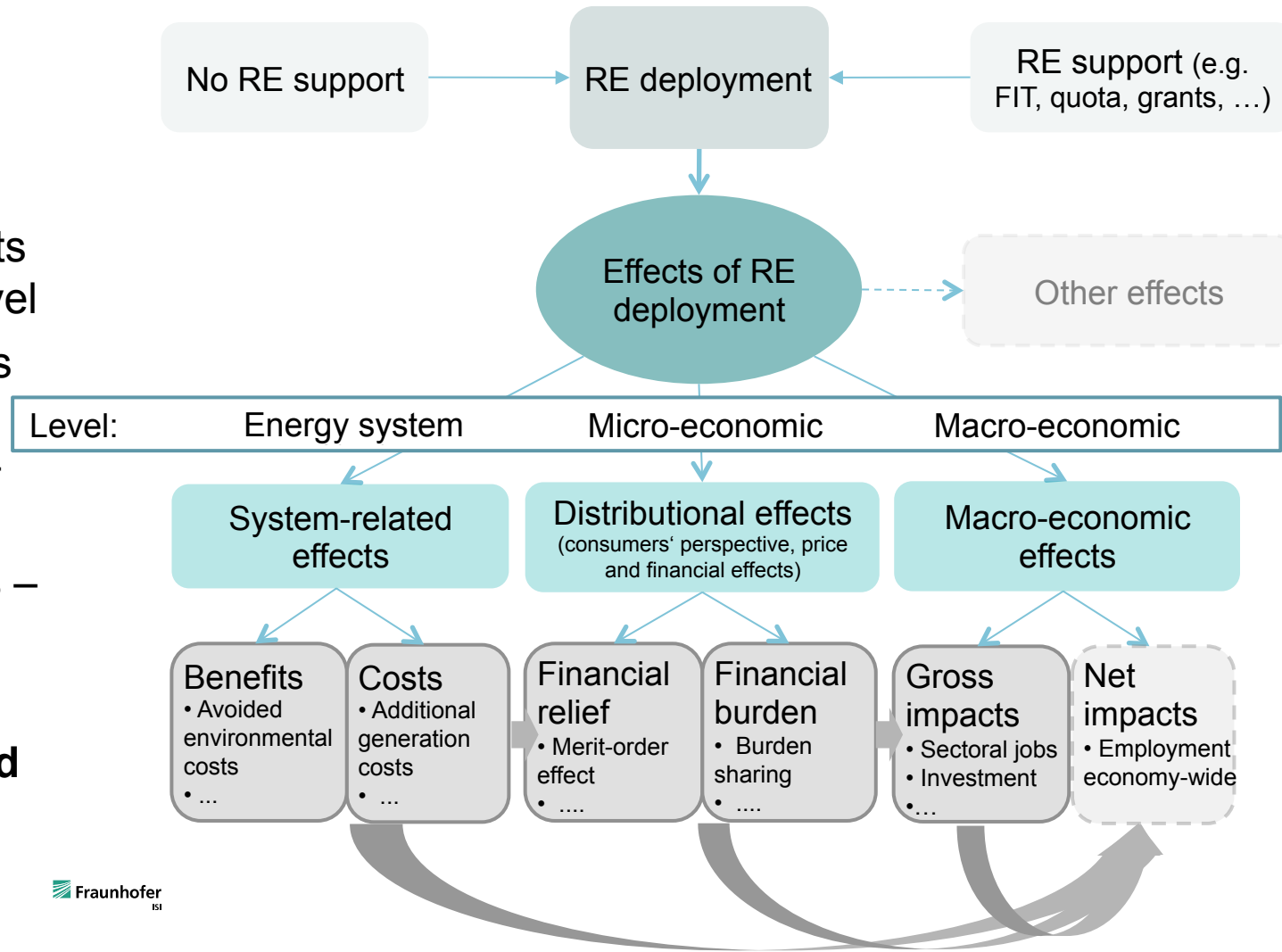


Overview on the concept

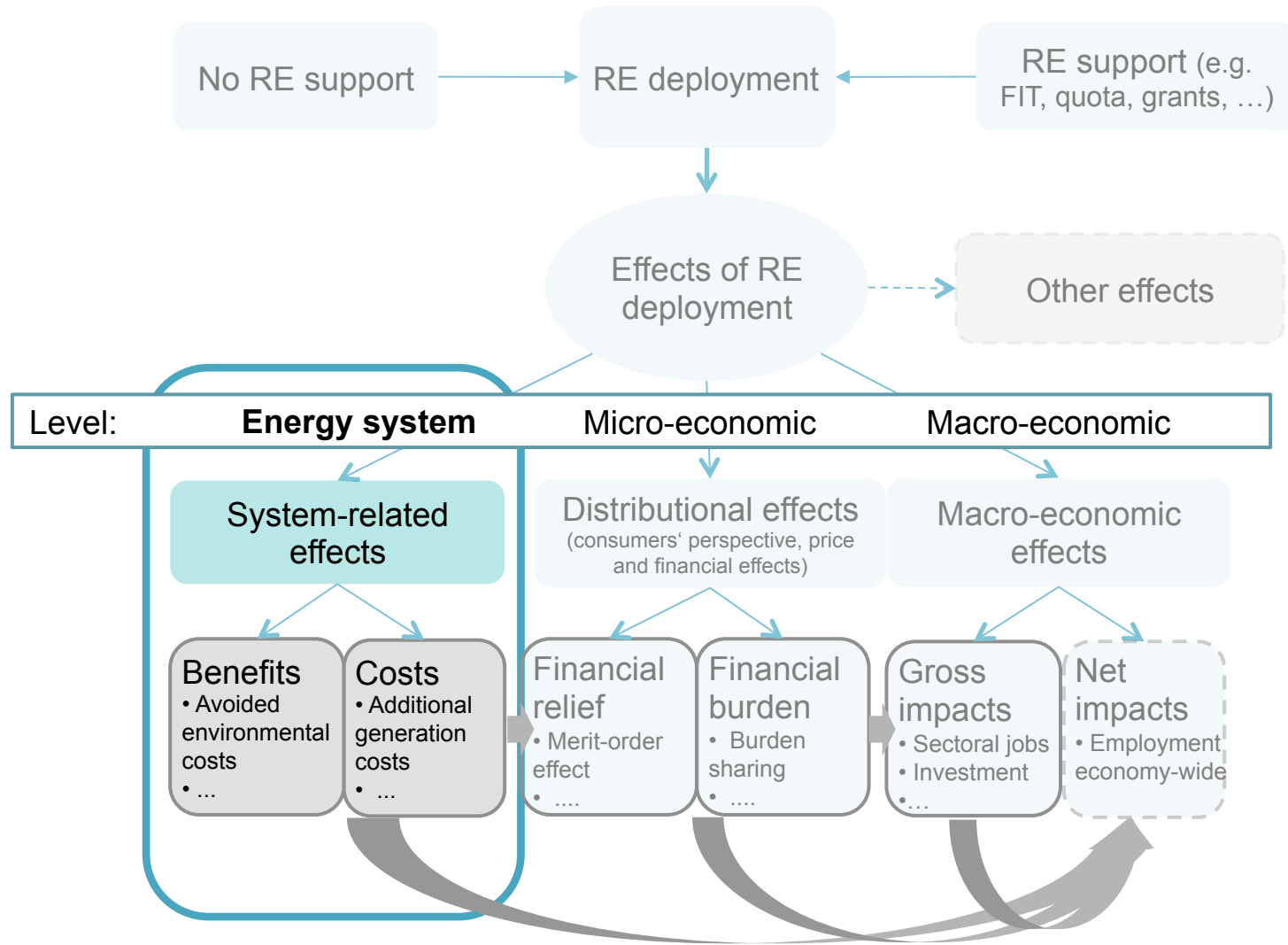
2. three levels - categories:

- 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

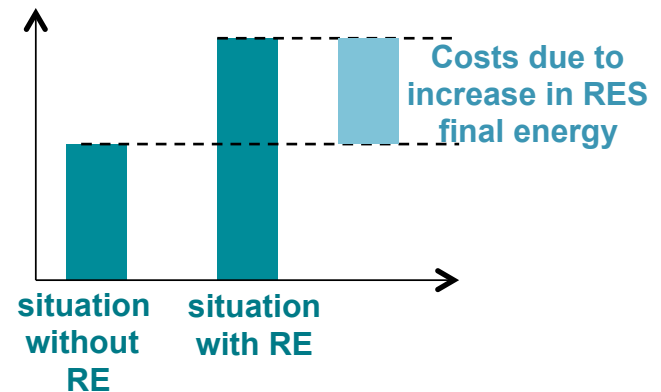


System-related costs & benefits

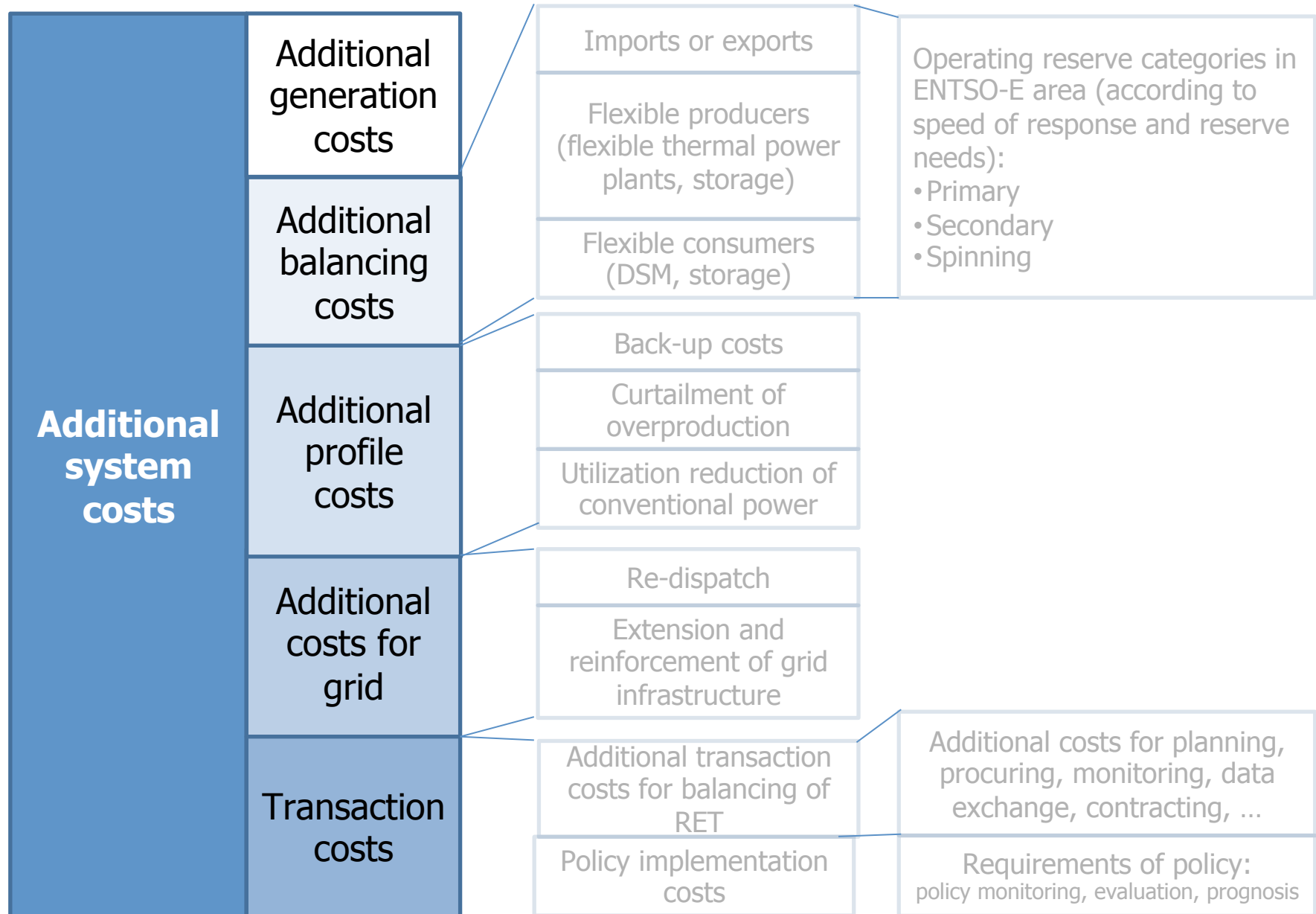


System-related costs and benefits

- 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 CO₂ costs either in generation costs or in benefits from avoided CO₂ emissions



System-related costs - overview

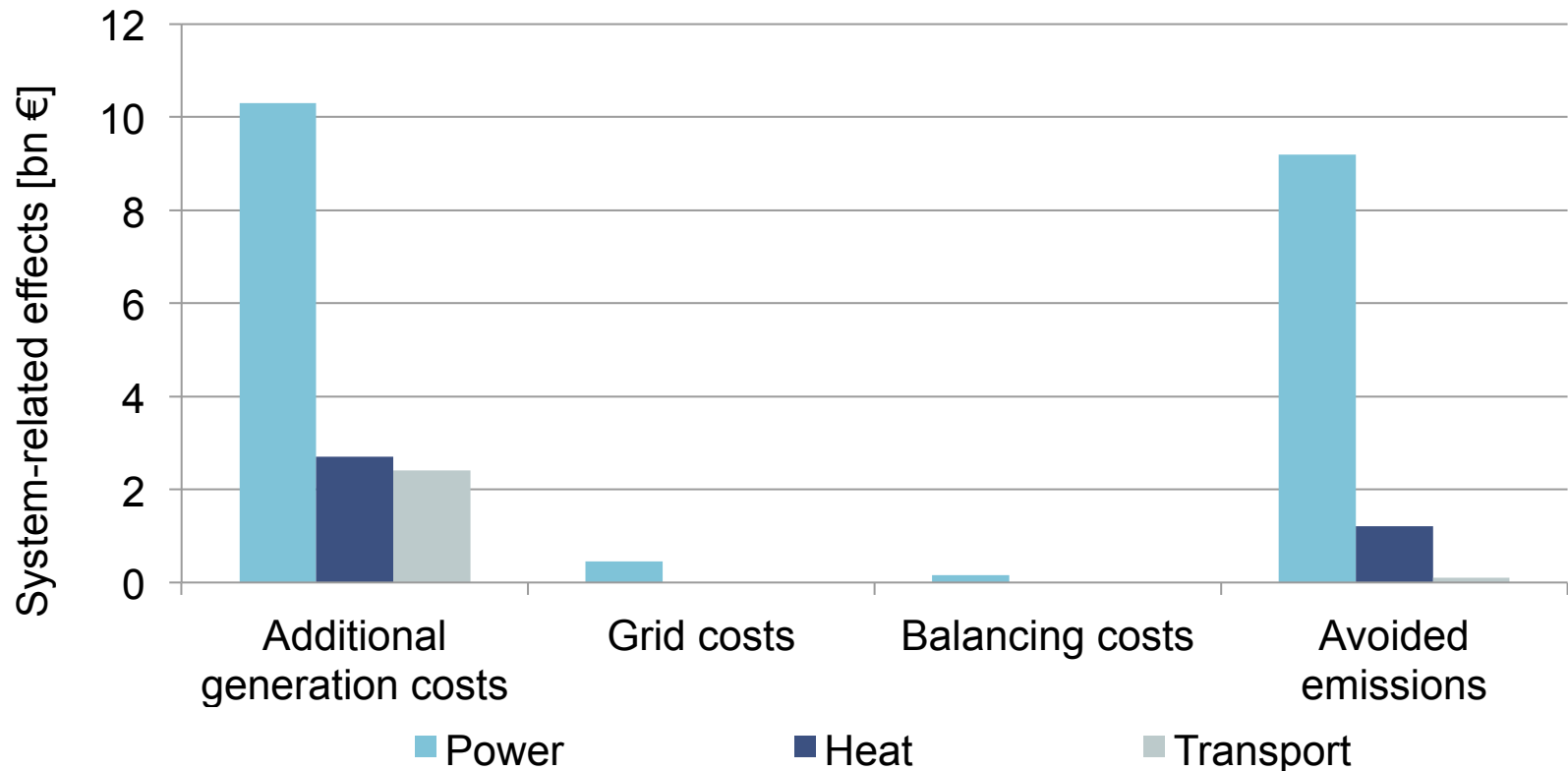


Case study

System-related effects in Germany 2012

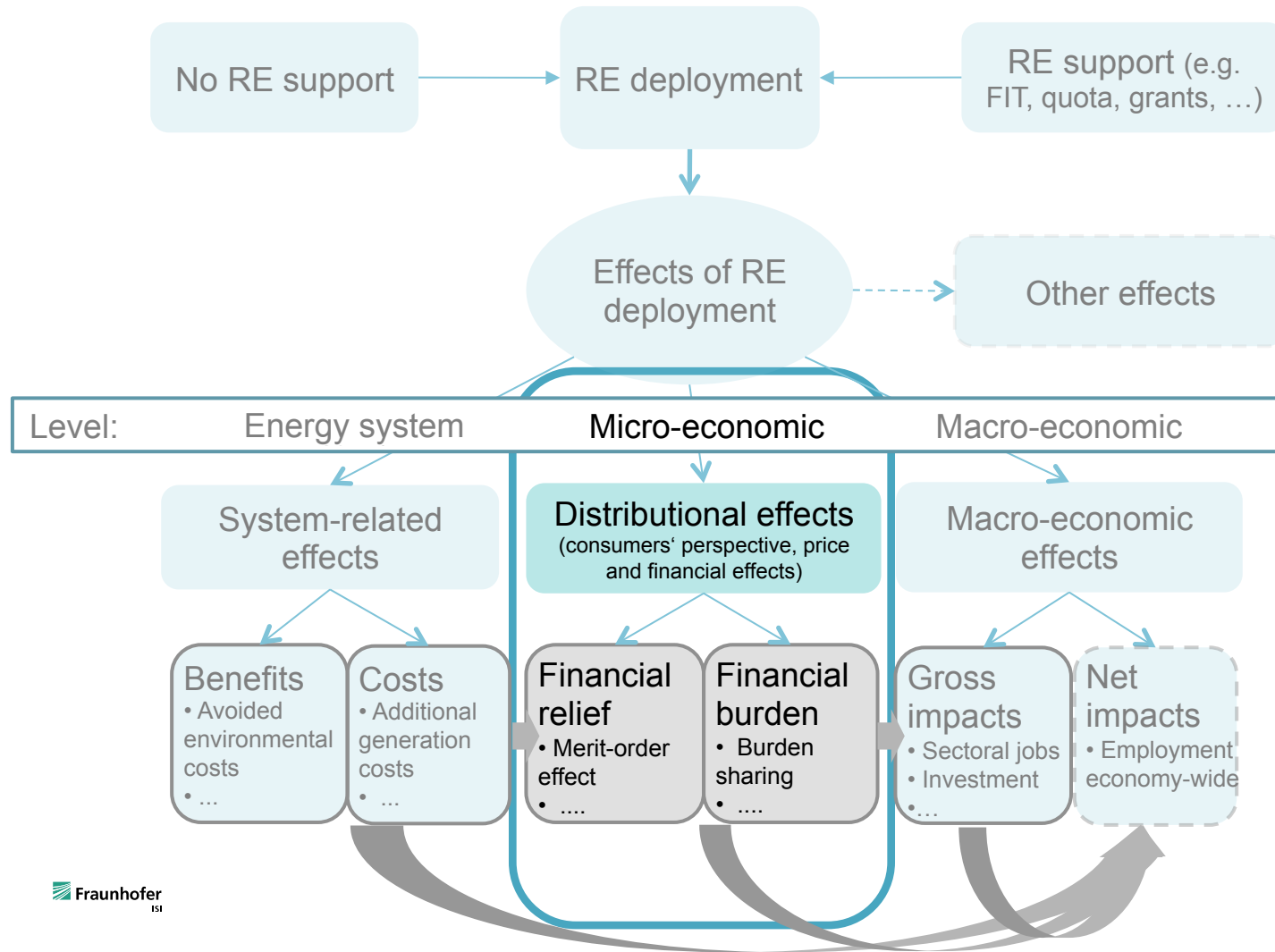
Case study

System-related effects in Germany 2012



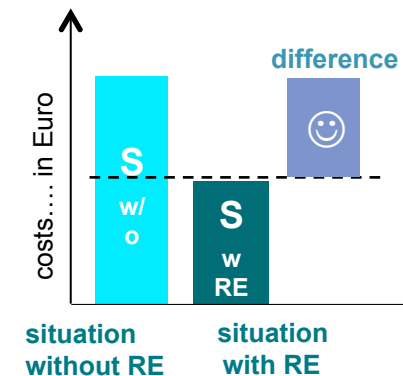
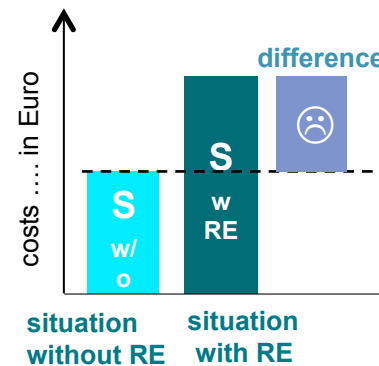
Source: ISI, GWS, IZES, DIW (2013): Monitoring of costs and benefits of RET deployment, Update for 2012
<http://www.impres-projekt.de/impres-de/content/veroeffentlichungen.php>

Actor related - Meso level



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
- **cannot** be **aggregated**
- do **not** reflect the real **use of resources**

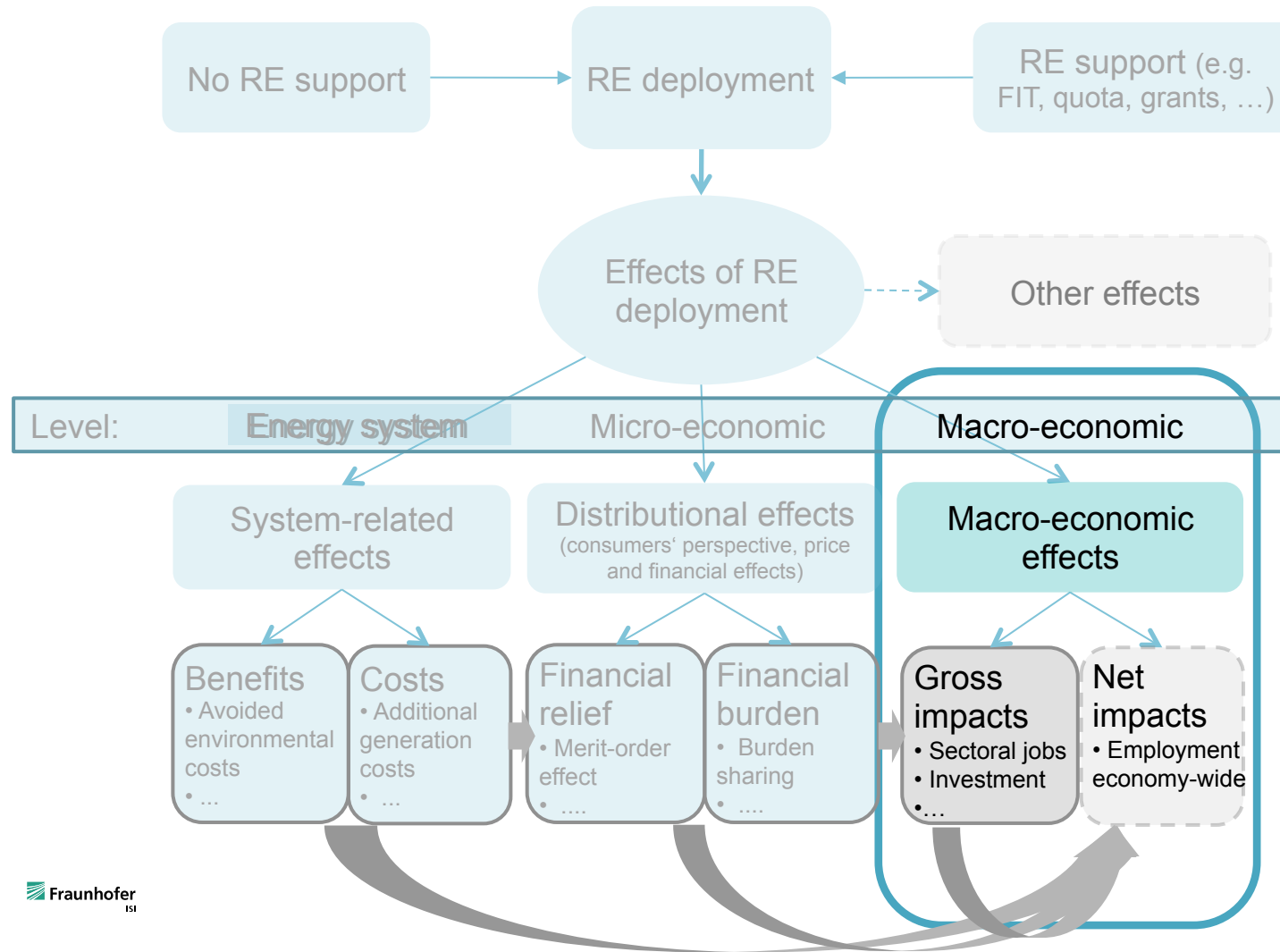


→ reflect the final costs or benefits of RET deployment and RE policies that private households, firms, public household pay

Distributional effects

Types	Description	
Policy costs	<p>Consumer-based burden sharing</p> <p>Levies for final consumers</p> <p>Special exemptions/equalization schemes for selected consumers e.g. energy intensive industries</p> <p>Public budget-based burden sharing, i.e. resulting policy support costs are financed through the state budget</p>	<p>Financial effect for electricity consumers (consumer surplus) and generators</p> <p>→ production level (wholesale)</p> <p>→ consumption (retail) level</p>
Merit-order effect	<p>Change of market prices due to changes in the merit order of the power supply (changes in the order of the generation portfolio).</p>	<p>Price effect for power market participants (consumer, producer surplus) → whole sales level</p>
R&D support	<p>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 spillovers and non-exclusion of uses (market failure)</p>	<p>Financial effect for technology developers or providers (consumer/producer surplus) → technology provider level</p>

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

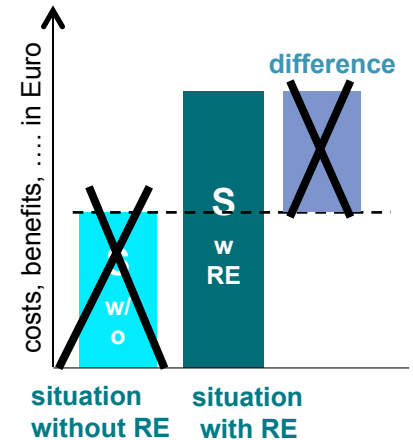


Macro-economic effects

The “two types” of macro-economic effects:

1. gross effects – sectoral effects:

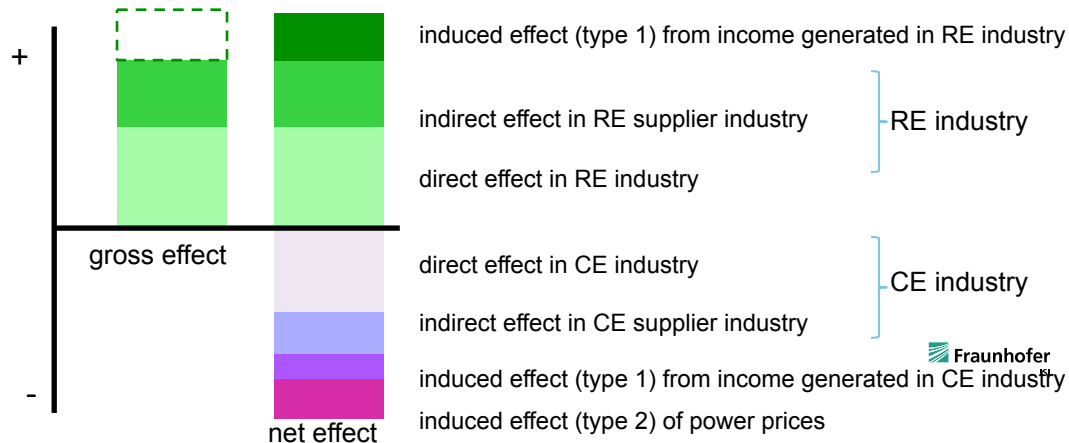
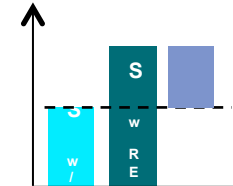
- scope of impact analysis
 - focus is on the renewable energy sector
 - do not include negative effects of RE deployment in the fossil fuel based sector
 - do not include price effects of RE e.g. lower consumption of HH due to higher electricity prices
- indicators
 - investment in RE (plants) or sales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



Macro-economic effects

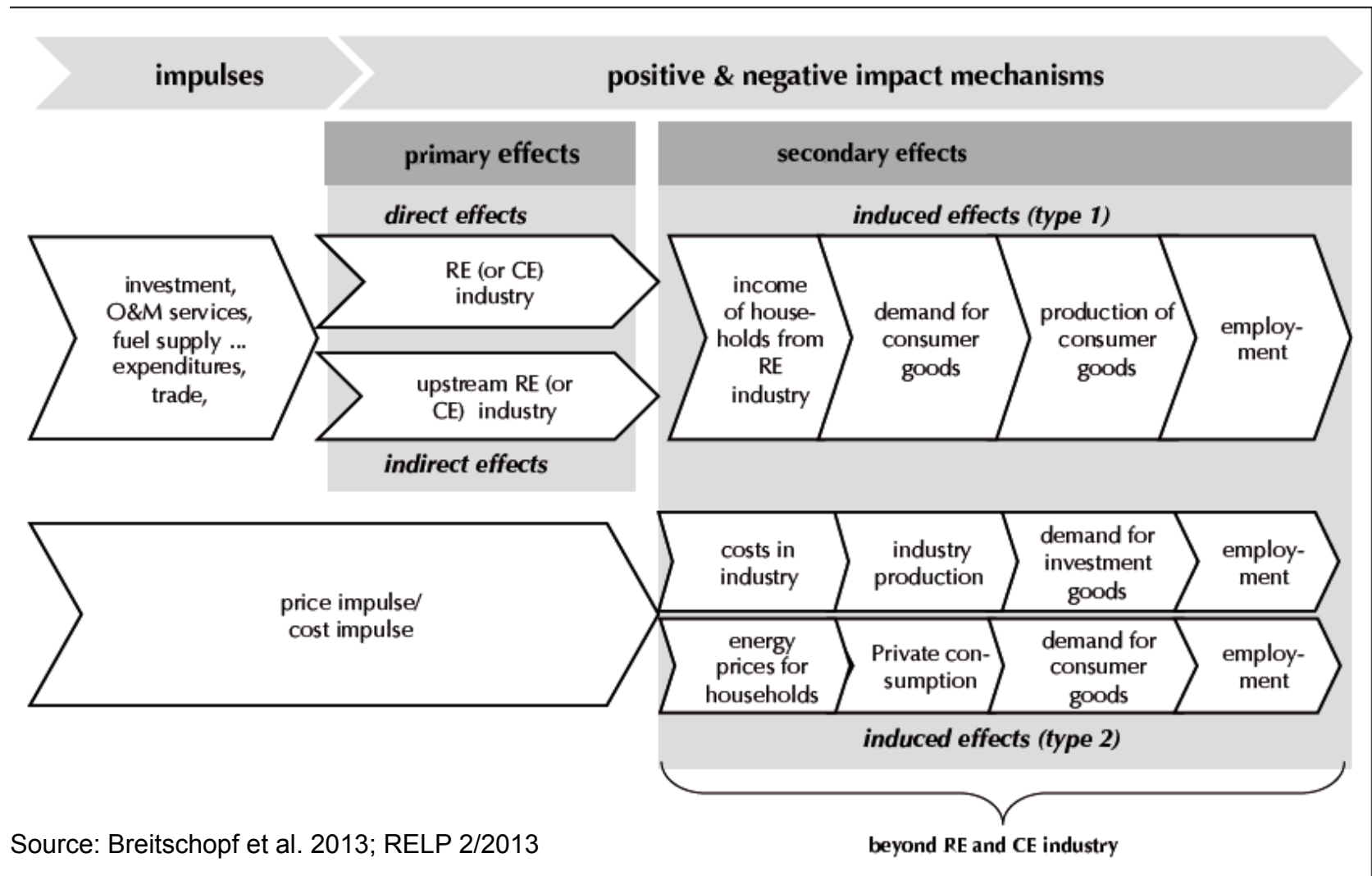
2. net effects – economy wide effects:

- 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



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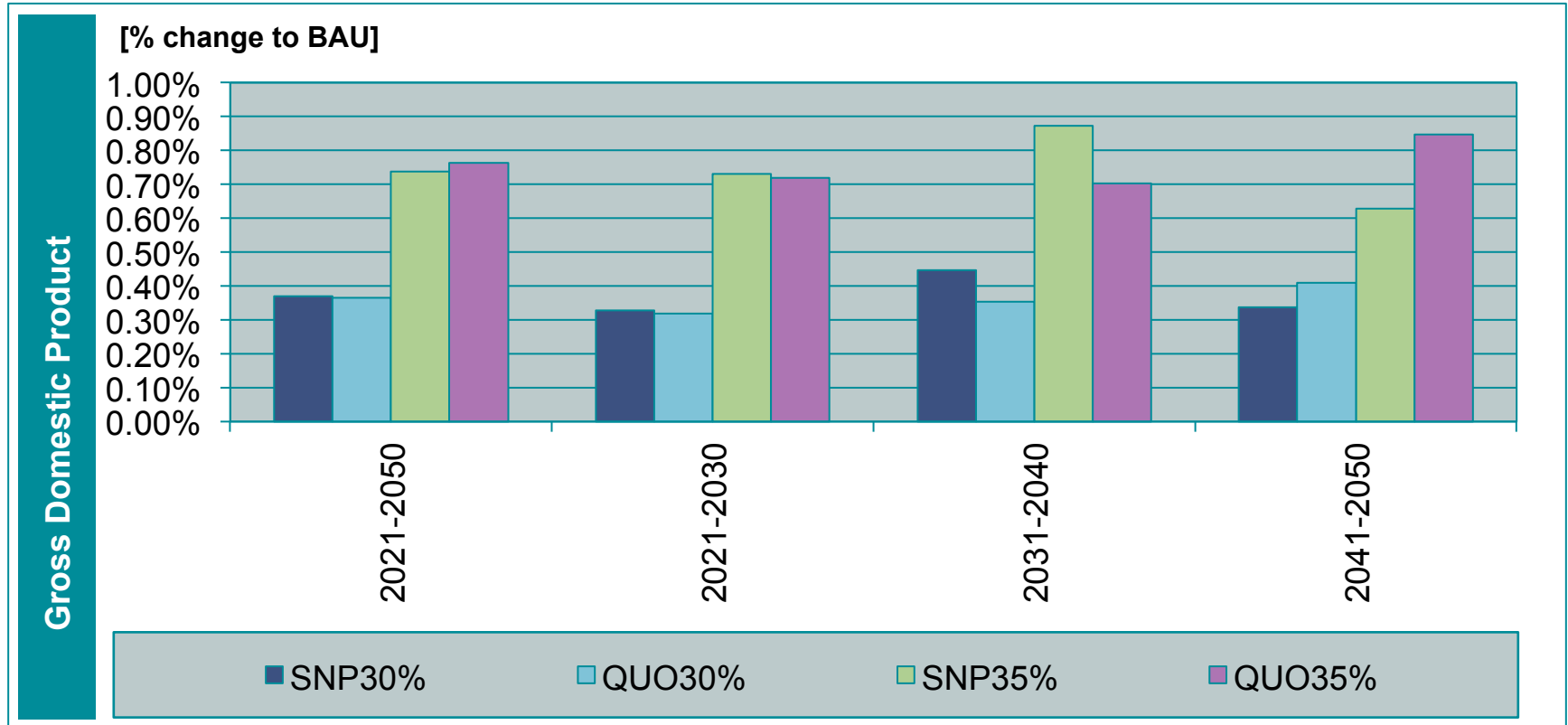
Macro-level: Gross and net effects



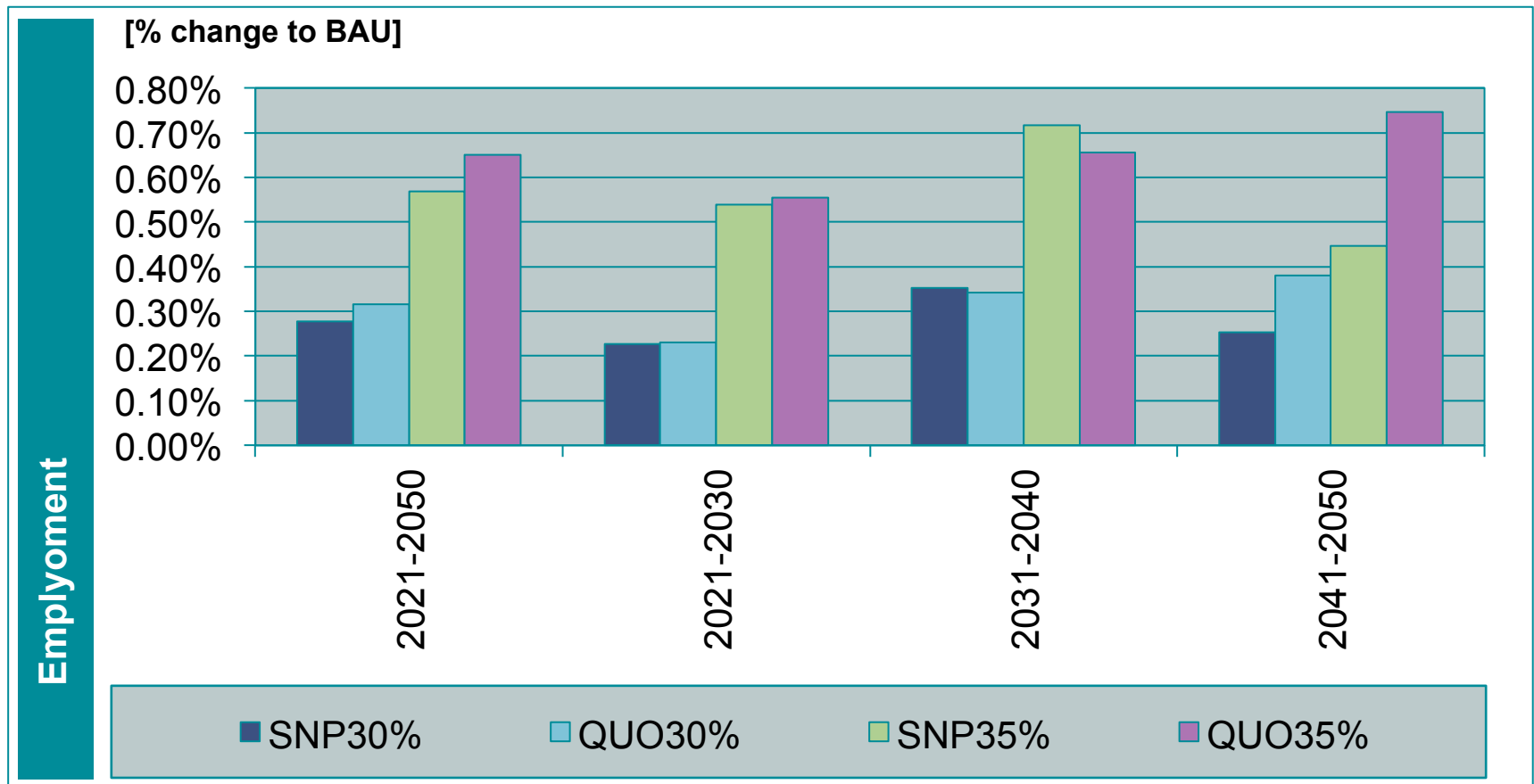
Case study

EU RES evolution until 2050

Results on net GDP on EU-28 level



Results on net employment on EU-28 level



Summary and conclusions

- Assessing costs and benefits of increased renewables use is a challenging task
- Estimation of system-related costs is challenging in particular in the electricity sector due to the dependency on the grid and difficulty of quantifying certain effects
- 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 statistics and database on flexibility options
- 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

More information:

WELCOME TO OUR WEBSITE

We welcome you to the Project "Policy Dialogue on the assessment and convergence of RES policy in EU Member States", started in April 2013 and carried out under the Intelligent Energy – Europe programme.



DIA-CORE intends to ensure a continuous assessment of the existing policy mechanisms and to establish a fruitful stakeholder dialogue on future policy needs for renewable electricity (RES-E), heating & cooling (RES-H), and transport (RES-T). Thus, **DIA-CORE** shall facilitate convergence in RES support across the EU and enhance investments, cooperation and coordination.

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Back-up slides

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

Overview on the concept - motivation

Motivation for the concept

- increasing costs due to RE deployment and not immediately perceivable 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*.

System-related costs (1)

Types : additional system cost

Description

Generation costs

- direct costs
 - avoided costs of conventional generation
- relevant for heat and electricity
 - 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
-

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

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.

Distributional effects

■ Budget based financing

Instrument	Power sector
Guaranteed price or price supplement: Feed-tariffs Feed-in premium (with w/o caps)	Should include: Difference between tariffs (premium) and whole sale market prices plus all additional balancing and transaction costs.
Grants or subsidies Investment grants Interest/repayment subsidies	Public budget for grants 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

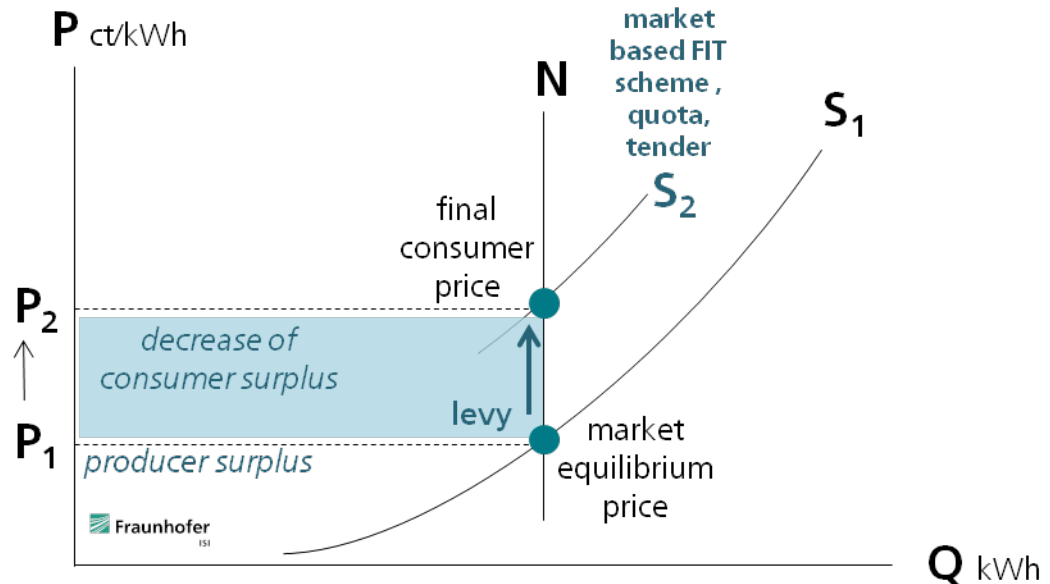
Distributional effects

Many distributional effects: transitional effects, change in utility, capitalization effects, scarcity rents, make analysis very challenging

... so analysis focuses on:

- changes of consumer surplus:

- price increases at the retail market for final consumers due to levies (FIT, quota) → (-) consumer surplus
- generators of RE power receive a premium (tariff > market price, TGC, ...) → (+) producer surplus



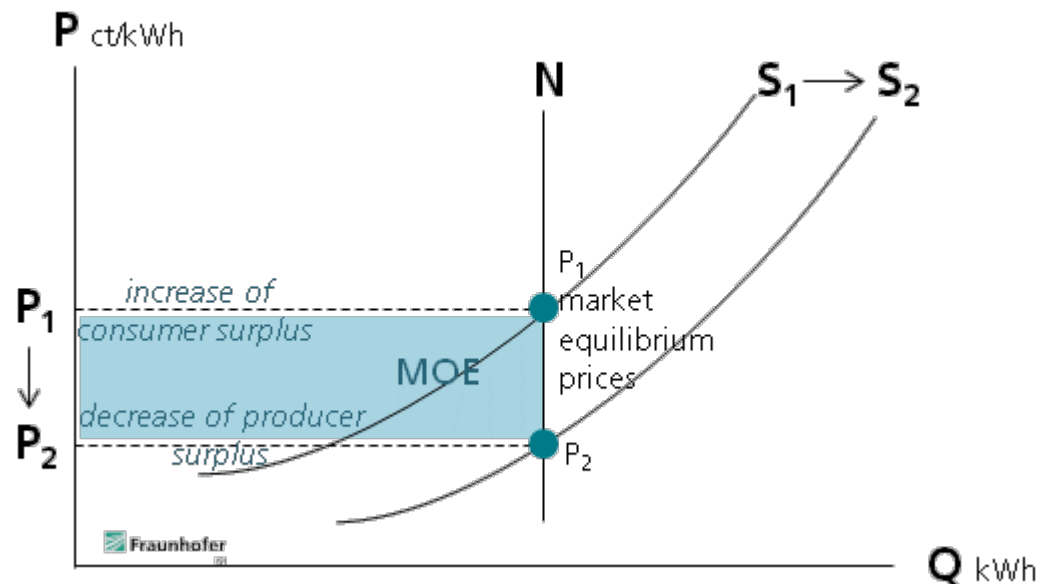
Distributional effects

- changes of producer surplus:

lower prices at the whole sales market due to supply shift
→ MOE e.g.

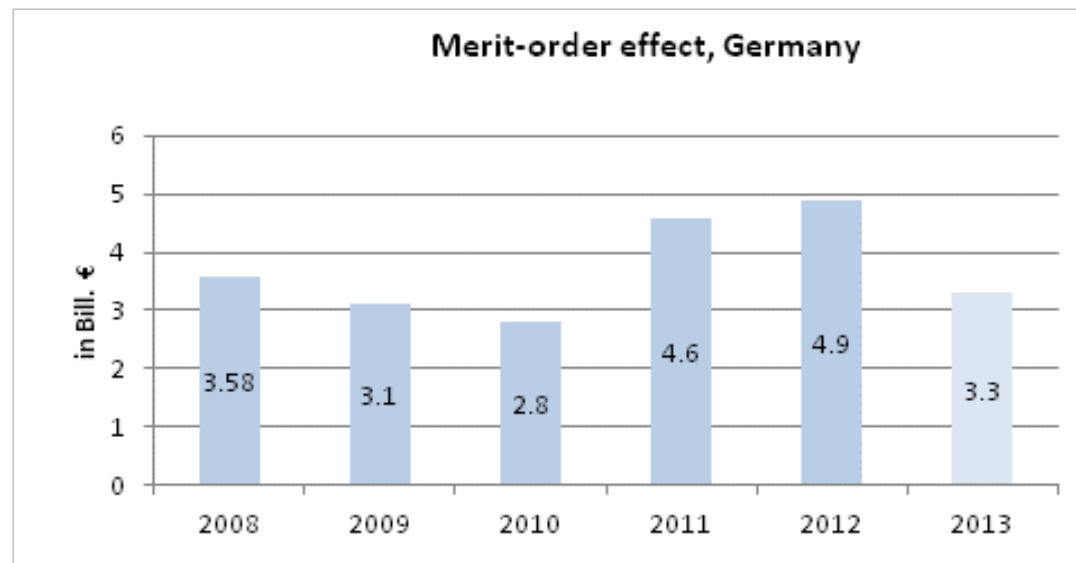
- lignite based power generators receive lower market price → (-) producer surplus

- electricity buyers pay less → (+) consumer surplus)



Price effect: merit order

- Price decrease at the wholesale market
- Volume of price decrease



Effects of the special equalization scheme

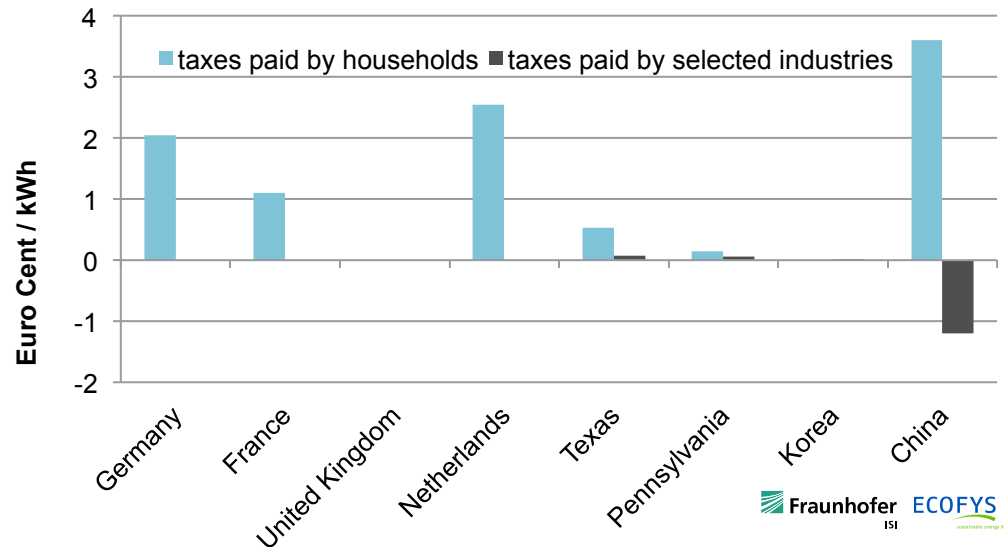
Starting point: 3 questions

1. components of the power price in selected countries ?

- whole sales price
- fees for transportation, distribution, measurement, billing
- taxes (federal – municipal)
- levies for environment and climate

2. policy “components” ?

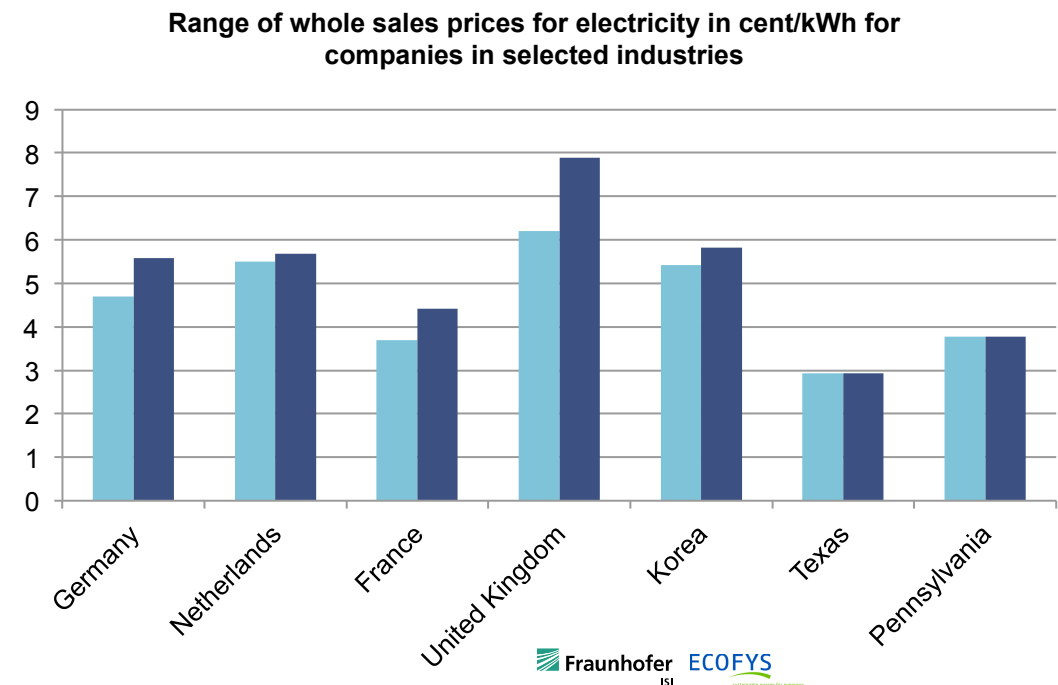
- taxes (ex. VAT)
- levies



Effects of the special equalization scheme

Data on prices or tariffs:

- whole sales prices
 - stock exchange,
 - supra/national statistics,
 - interviews with industry
 - and other sources

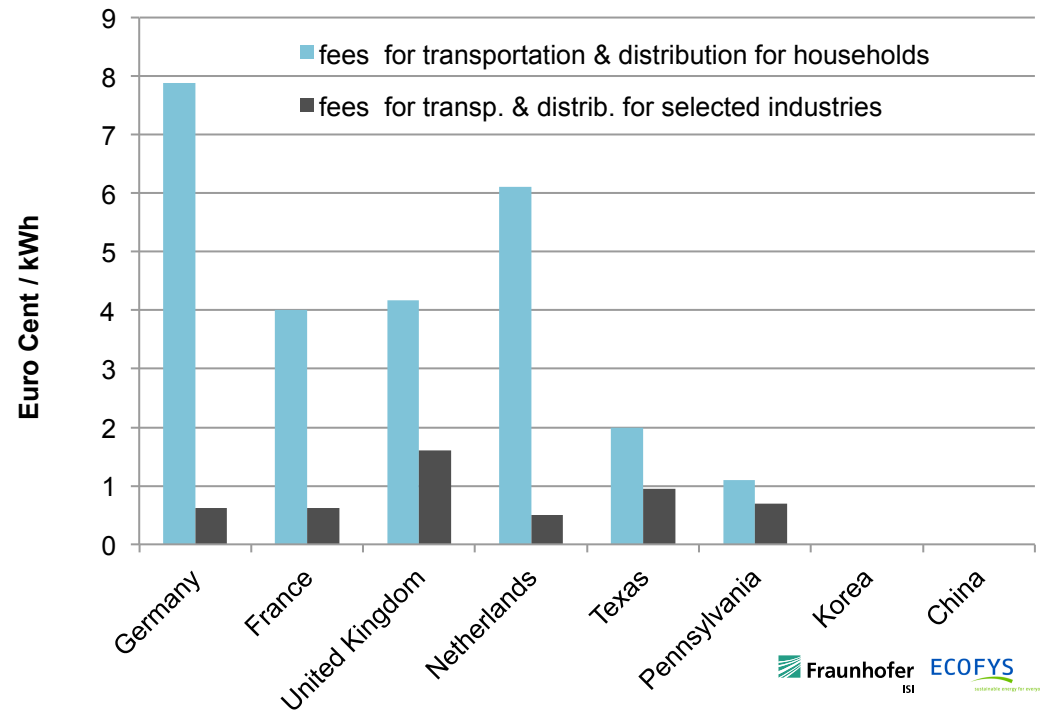


Effects of the special equalization scheme

Data on fees:

- transportation, distribution fees
 - supra/national statistics
 - and other sources

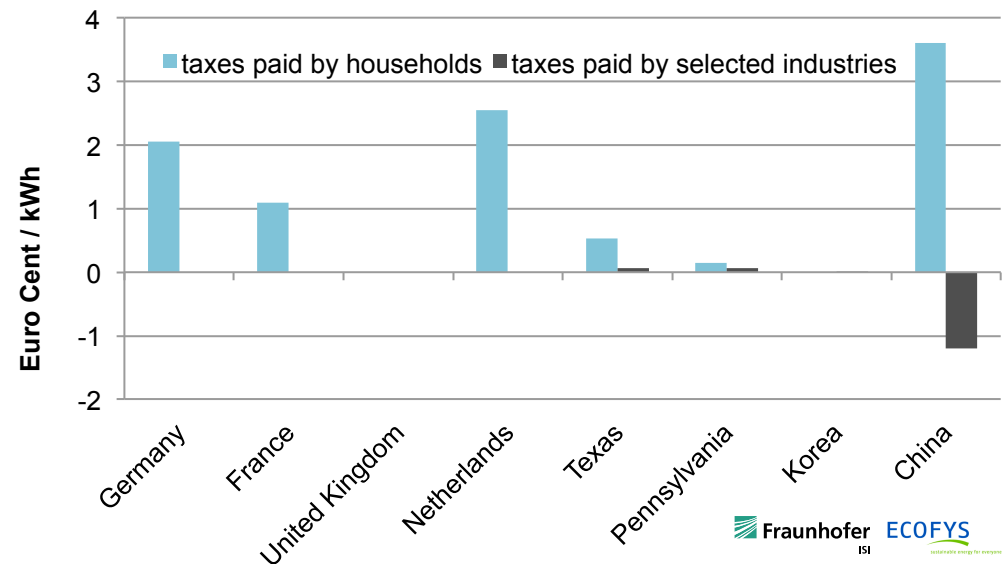
* China and Korea: no data



Effects of the special equalization scheme

Data on taxes

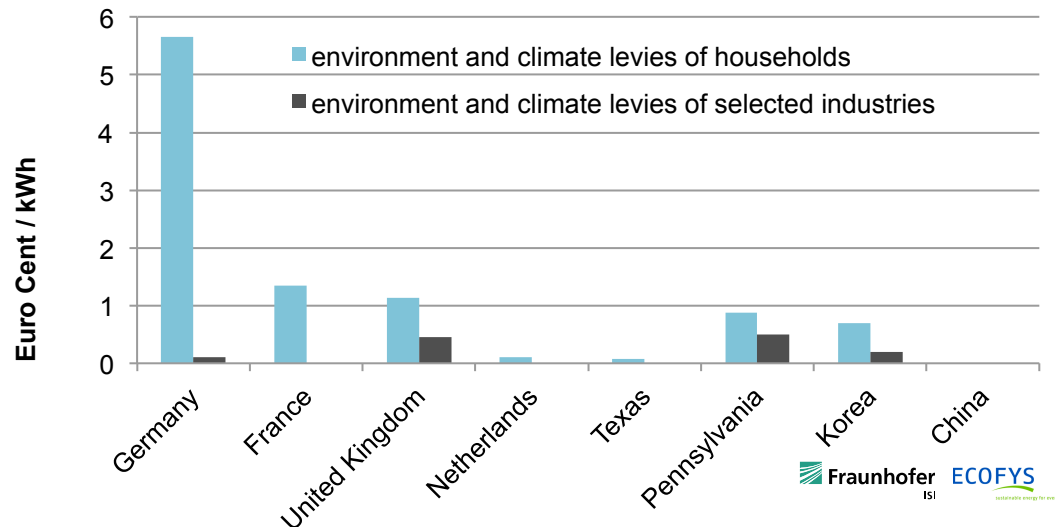
- taxes on electricity consumption – several special regulations for industries (sectors and processes) → households pay the highest taxes / unit of electricity
 - supra/national statistics
 - and other sources



Effects of the special equalization scheme

3. equalization schemes for taxes and levies based on diverse criteria ?

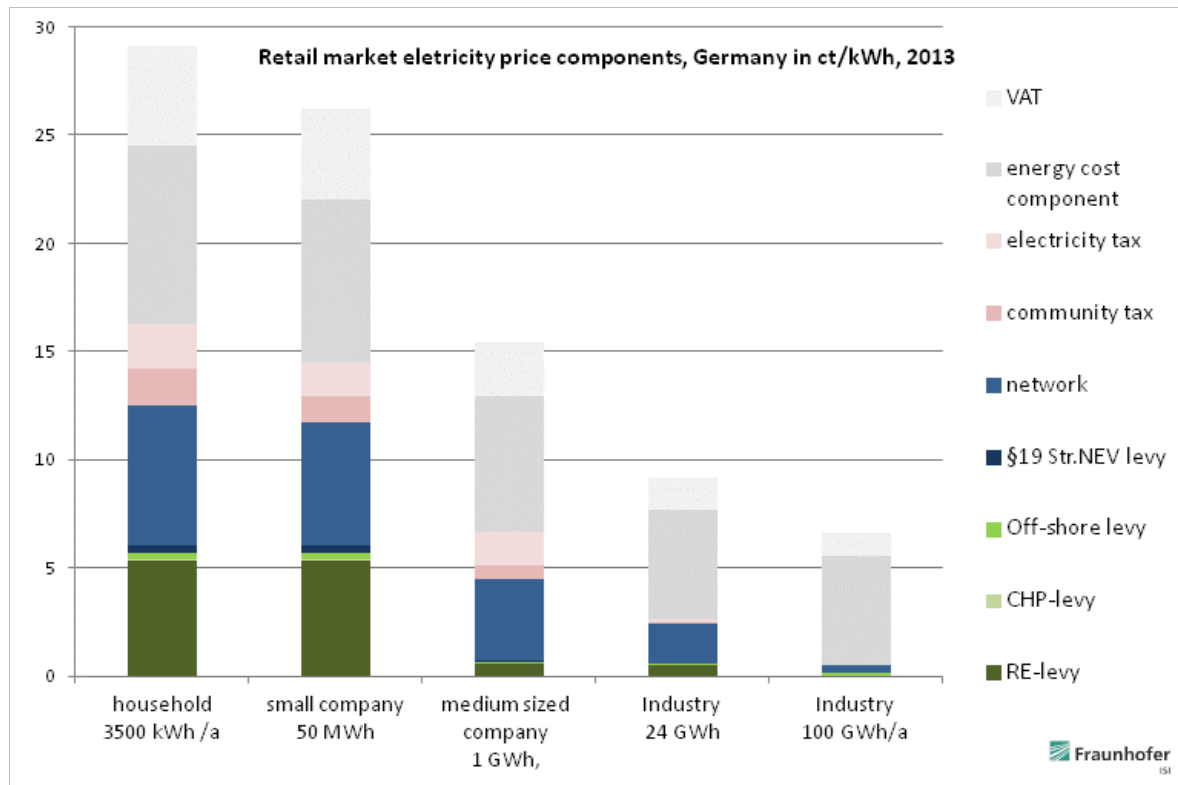
- electricity intensity (power costs /sales or value added)
- industry classification, processes
- power consumption, voltage or capacity,



Case study

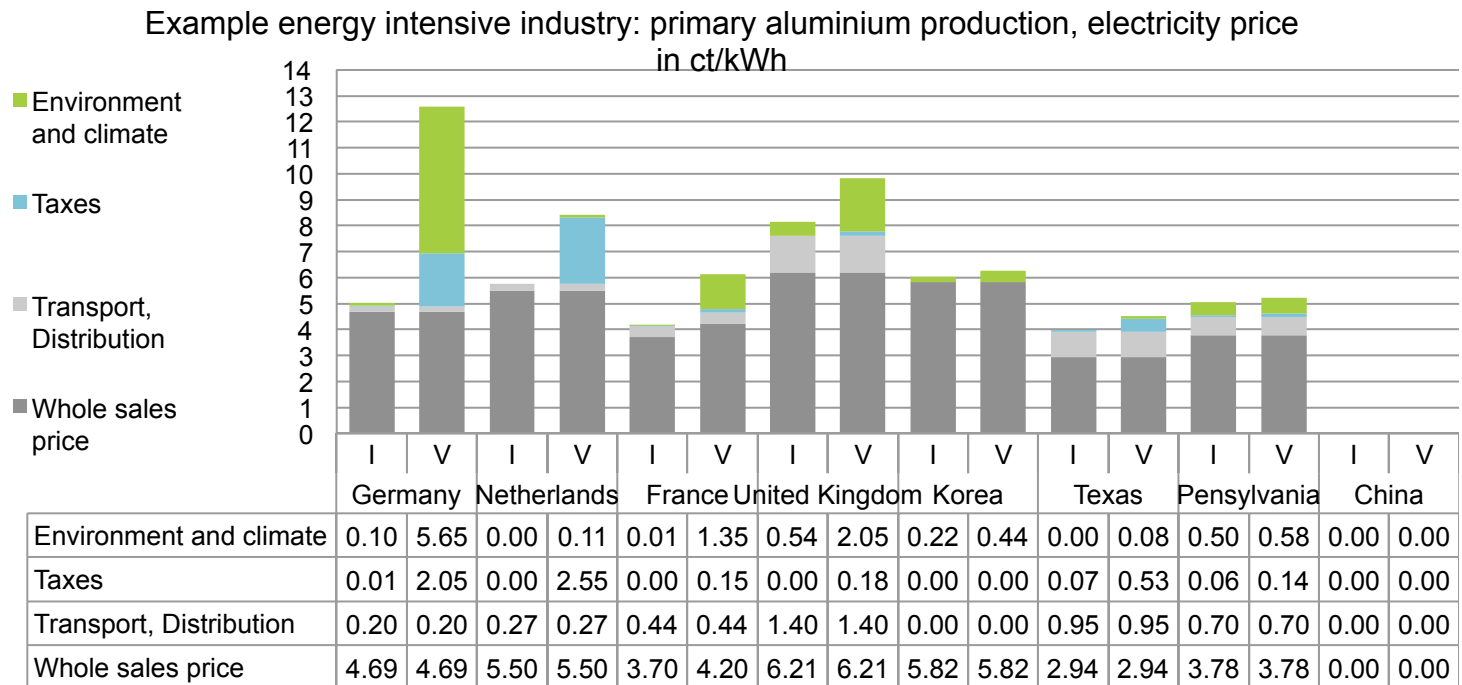
Micro-level effects: RE-levy in Germany

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



Effects of the special equalization scheme

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



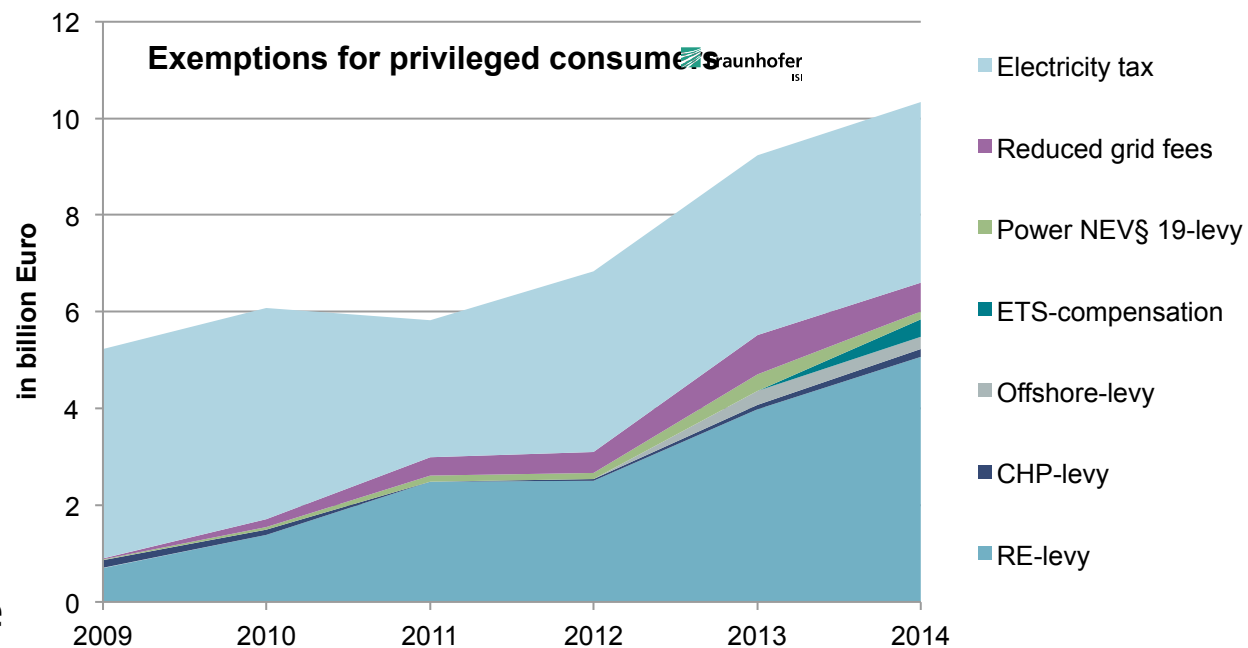
→ assessment of privileged volume

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

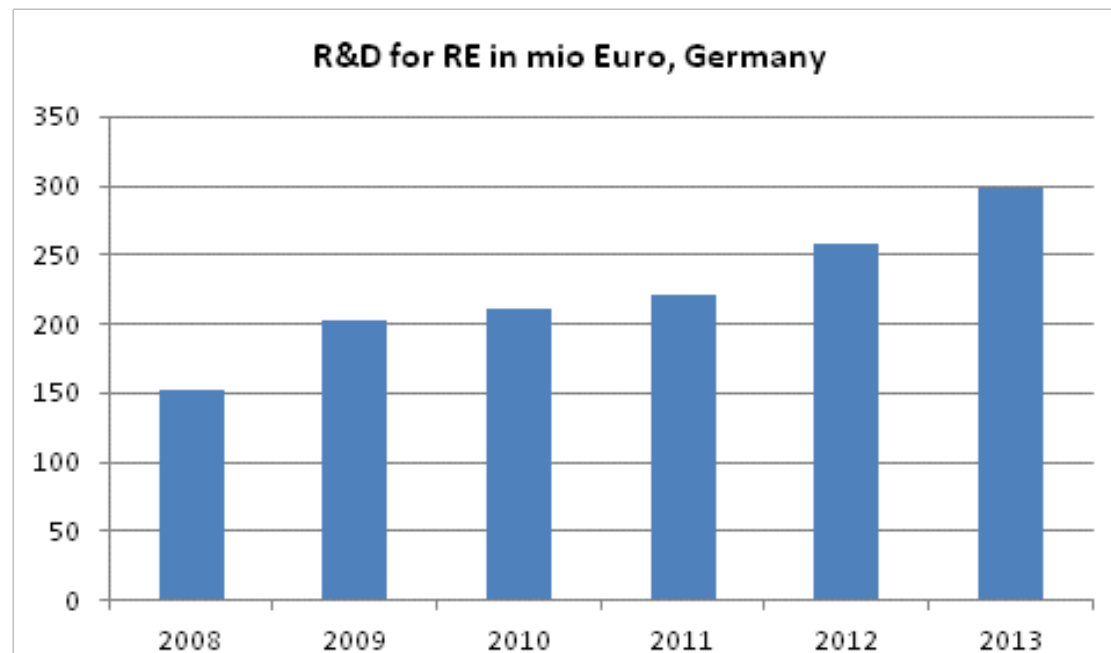
- to non privileged consumers in a regulation based scheme, or
- to consumers with lower bargaining power in a market based scheme



→ 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 :

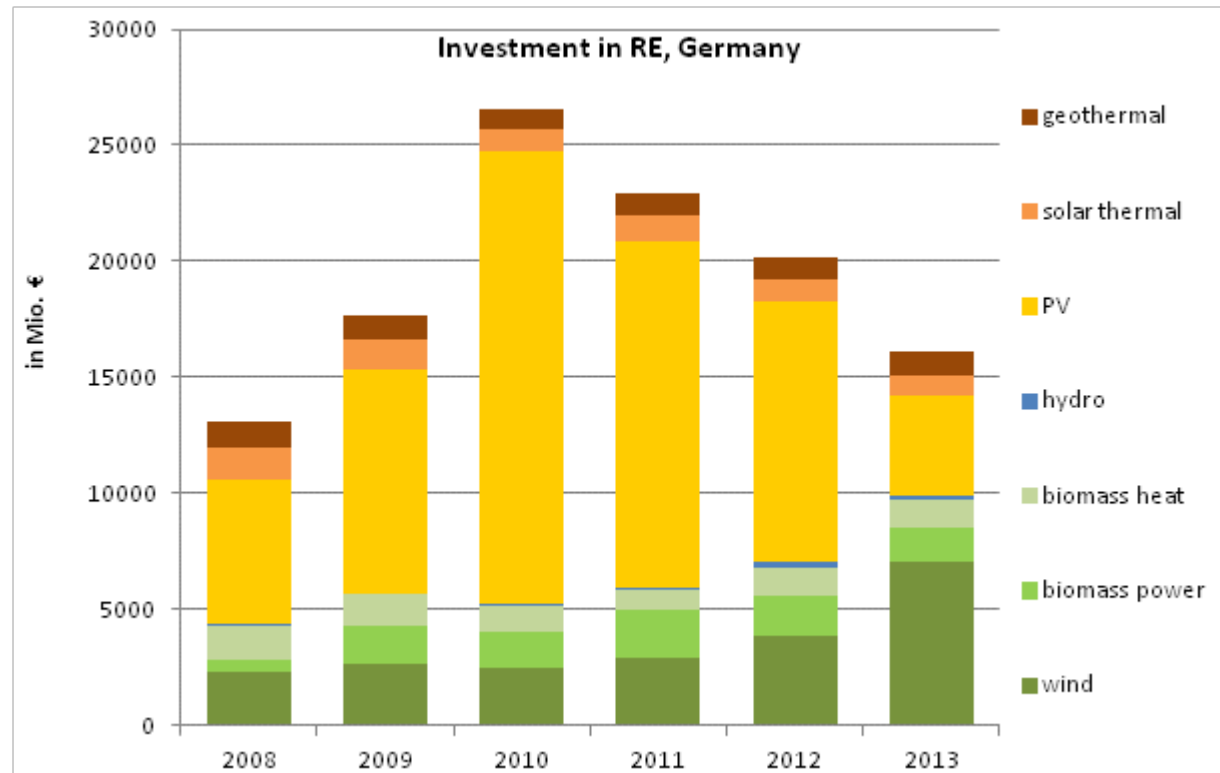
http://www.impres-projekt.de/impres-wAssets/docs/2014_09_10_Monitoringbericht_FINAL_.pdf

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>