Tools to assess socio-economic impacts

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On behalf of:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
of the Federal Republic of Germany

On behalf of
Federal Ministry for Economic Cooperation and Development

IRENA
International Renewable Energy Agency

Are economic impacts adding up?

→ Can we put all benefits into one pot ?

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

∑ benefits of RE deployment

Are all economic impacts benefits?

… but there are benefits and costs

- occur at different levels:
  individual household, energy sector, public budget, economy
- affect different actors differently:
  ☺ RE installation, ☹ fossil fuel based generator
- are in some cases counted twice:
  avoided emissions, decreasing imports
- cannot be simply added across levels and actors

→ **call for a comprehensive and clear concept**




Approach – starting point of the analysis:

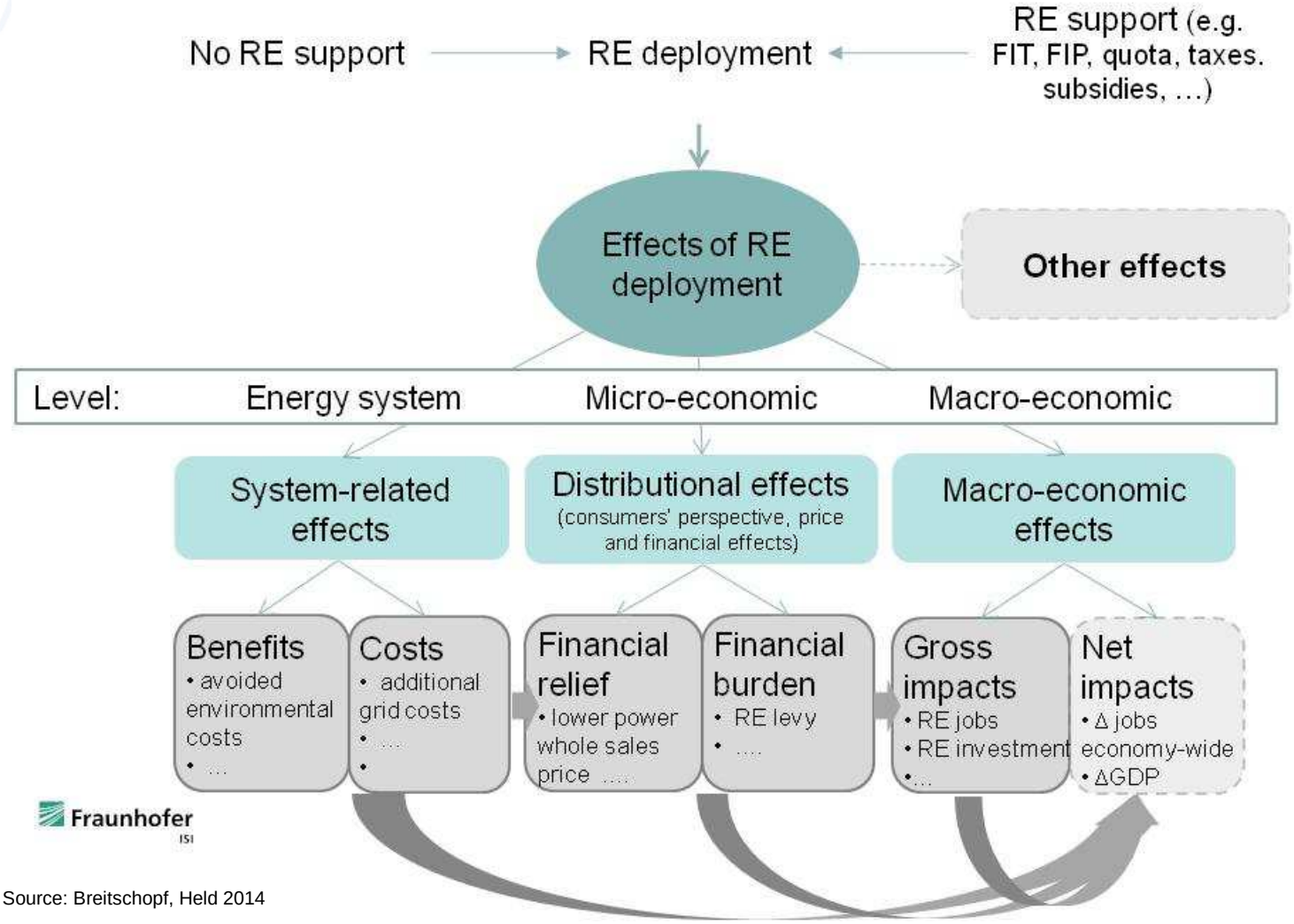
1. which **effects** can be observed from RE deployment?
   investments, expenditures, value added, profits

2. at which **levels** do these effects occur:
   individual, energy system, sector, macro level?

3. who is (how) affected → **actors**
   single households, RE manufacturers, fossil fuel based generators, fossil fuel suppliers

4. how do these effects **relate** to each other?
   less/more expenditures for electricity → more/less income available for other consumption?
   more investments in RET → more manufacturing or import of technologies?
   less fossil fuel imports → less subsidies or tax revenues for public budget?

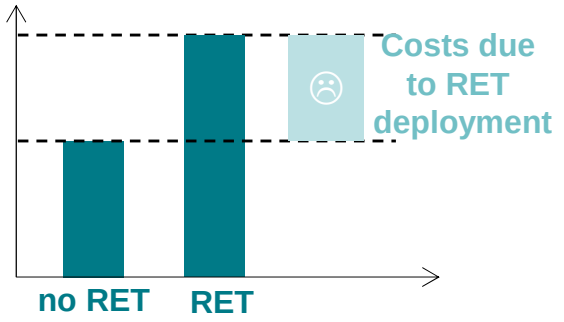
Socio-economic impacts



Source: Breitschopf, Held 2014

System-related costs and benefits

- System level perspective: include all benefits and costs of a system (RET) and compare them to a reference system (no RET)
- Definition of „system" may vary
  - energy sector
  - final energy sector: electricity, heat or transport
  - technology system



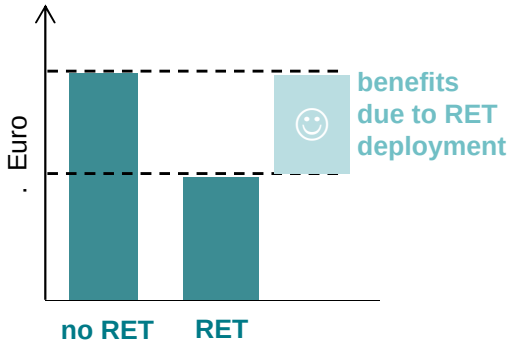
- Problem to assign cost and benefit to → technology level

  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

Distributional effects

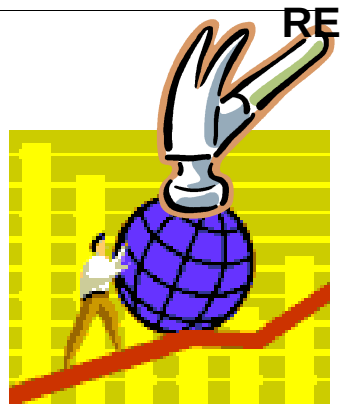


- **micro** level perspective
- induced by **policies** (policy dependent)
- affect different **actors** differently e.g. electricity bill of individual, generators
- depict **changes in costs (benefits), prices, quantity or quality** for different actors e.g. improved access to power
- can**not** always be **aggregated**

→ reflect the final remaining costs or benefits of RET deployment and RE policies for private households, firms, public households, ….

(scientific term: : changes in consumer / producer surplus, transitional effects, change in utility, capitalization effects, scarcity rents)

Macro-economic effects



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- effects at the macro level:
  - **selected sectors**, e.g. at the RE sector level
    → **sector specific effects** (mainly **gross** effects)
  - **all sectors** of the economy, i.e. in all industries and services of an economy
    → **economy wide effects** (mainly **net** effects)
- **tool/model based** assessment
- challenging to delineate impact between sector specific and economy wide effects

The Toolbox – Embarrassment of Riches

Graph: yeomansmarketing.co.uk

- How can we assess the socio-economic impacts?
- How can we produce meaningful numbers?
- Are the data available? Which data are needed?
- Is the budget available? How much is needed (Time and Money)?
- Who knows how to use this tool?
- What are the risks if I use the tool wrongly?

Deciding the scope

Geographical

- Country
- Larger Region, e.g. Arab region, Europe..
- Smaller Region, e.g. South Tunisia, Nile delta, Bavaria

Technological

- All RE
- All RE&EE
- Only Power generating
- Single technology

Economic sectors

- All – including households, consumption
- All production sectors
- Mainly SMEs
- Mainly RE&EE sector

How can we measure which effect?

RE sector studies	Impact studies beyond RE industry – but not economy wide	Economy-wide impact studies	Effects
employment factor approach			direct (+)
supply chain analysis			
IO modelling			direct and indirect (+)
	employment factor approach with scenario comparison (RE and CE industry)		direct and indirect (+ , -)
	IO modelling including an adjustment of the consumption vector (electricity prices)		direct and indirect (+) induced (-)
		full economic model with scenario comparison	direct and indirect (+ , -) induced (+ , -)

Source: Breitschopf, Nathani, Resch 2013

The employment factor approach

Employment factors (EF) provide a direct link between the $ physical units (Capacity installed of wind turbines, cubic meter of fuel wood) and employment

- Simple multiplication leads to an estimate of employment
- Transfer of EFs from one region to another required knowledge and data about the respective production and service structures
- The literature knows a very wide range of EF, because:
  - Indirect effects are included
  - Different system boundaries, different scales are mixed. E.g. jobs/MW PV for roof-top installation is not the same as for large solar parks

Calculation of jobs based on the employment factor approach

MANUFACTURING (FOR LOCAL USE)	=	MW INSTALLED PER YEAR IN REGION	x	MANUFACTURING EMPLOYMENT FACTOR	x	REGIONAL JOB MULTIPLIER	x % OF LOCAL MANUFACTURING
MANUFACTURING (FOR EXPORT)	=	MW EXPORTED PER YEAR	x	MANUFACTURING EMPLOYMENT FACTOR	x	REGIONAL JOB MULTIPLIER	
CONSTRUCTION	=	MW INSTALLED PER YEAR	x	CONSTRUCTION EMPLOYMENT FACTOR	x	REGIONAL JOB MULTIPLIER	
OPERATION & MAINTENANCE	=	CUMULATIVE CAPACITY	x	O&M EMPLOYMENT FACTOR	x	REGIONAL JOB MULTIPLIER	
FUEL SUPPLY (NUCLEAR)	=	ELECTRICITY GENERATION	x	FUEL EMPLOYMENT FACTOR	x	REGIONAL JOB MULTIPLIER	
FUEL SUPPLY (COAL, GAS & BIOMASS)	=	PRIMARY ENERGY DEMAND + EXPORTS	x	FUEL EMPLOYMENT FACTOR (ALWAYS REGIONAL FOR COAL)	x	REGIONAL JOB MULTIPLIER	x % OF LOCAL PRODUCTION
HEAT SUPPLY	=	MW INSTALLED PER YEAR	x	EMPLOYMENT FACTOR FOR HEAT	x	REGIONAL JOB MULTIPLIER	

Source: Rutovitz and Harris 2012

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Input Output Analysis

Economic tool for the analysis of direct and indirect effects

- Goes back to Wassily Leontief (Nobel prize 1973)
- Illustrates the effects of additional demands in one industry on all industries in the economy
- Input-Output Tables (see next slide) are available for more than 100 countries in the world
- Consistent analytical framework which helps to connect RE deployment analysis to economic analysis already done for other sectors or the whole economy

Inputs and outputs of the wind industry

Inputs (examples) 	*Production structure*	*Steel needs Steel and energy*	*Wind industry needs Steel and inputs from the wind industry*	*Construction needs steel and concrete*
Steel industry produces	***Steel***	***Value of inputs from steel to steel***	***Inputs steel to wind***	***Scaffolding, reinforcement***
Wind industry produces turbines, generators, nacelles etc.	***Wind industry***		***Inputs wind to wind***	
Construction sector gives inputs to wind industry and to residential sector	***Construction***	***Steel industry needs new buildings***	***Construction to wind (roads, towers, new buildings)***	
Inputs produced in other countries	***Imports***		***Imported inputs***	
Value Added	***Compensation of employee***			
	Profits			
Total output	***Total output produced with material input and labor***			

More than industry and services

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Full model of the economy

Models differ by economic theory and philosophy

- Computable General Equilibrium (few data)
- Macro-econometric (full system of national accounts and balances, time-series)
- Other simulation models (agent based, system dynamics) (full SNAB)

All include feedback reactions, distribution effects and adjustments of the economy

What can economic models do for the policy maker?

- tell them how relevant the RE sector is for the economy
- show how strongly the economy depends on RET
- show the number of jobs in the “RE sector” (per RET field)

- show the overall impact of RE use on the economy

Thank you for your attention

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- Back up

Distributional effects

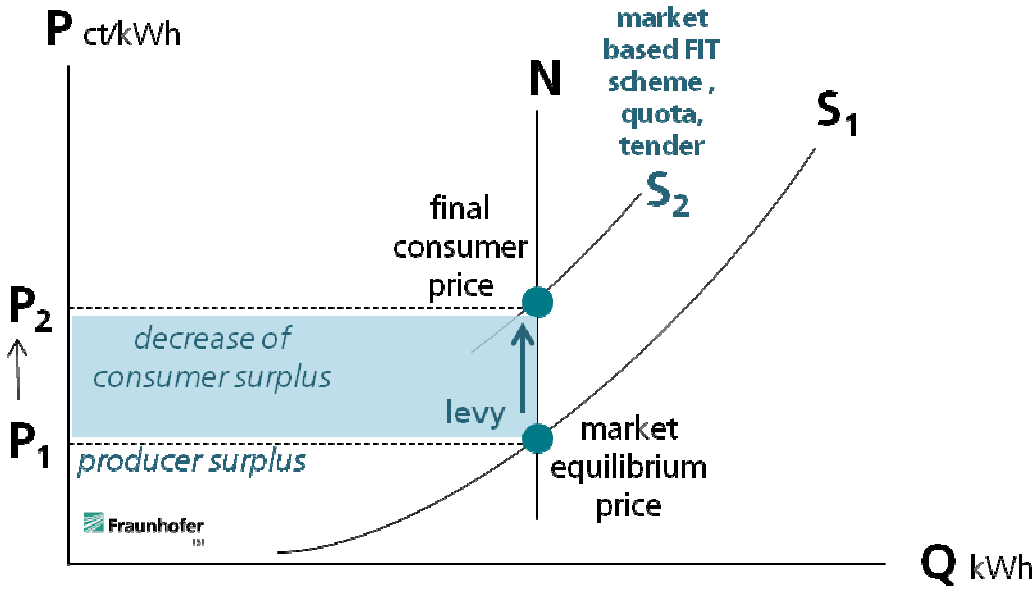
Many distributional effects: transitional effects, change in utility, capitalization effects, scarcity rents, …… make analysis very challenging

… so analysis focuses on:

- changes of consumer surplus:

  price increases at the retail market for final consumers due to levies (-)
  → FIT levy, tender or quota effect

  price decrease at the whole sales market due to supply shifts (+)
  → MOE



Distributional effects

- changes of producer surplus:

lower prices at the whole sales market due to supply shift
e.g. lignite based power generators receive lower market price (-)
→ MOE

generators of RE power receive a premium (tariff > market price, TGC, …) (+)
→ FIT, quota, tender