# The road to Paris & multi-level carbon pricing: Getting the "incentives right" at the global, European & national level

– Summary of Workshop–

Berlin, September 16, 2015 | Hotel AMANO

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STIFTUNG MERCATOR

Agora Energiewende

# Background & Objectives

In the light of "the road to COP21 in Paris" this year, much attention is given on how to achieve an ambitious climate agreement with policies to put a price on carbon at its center. In Europe the EU ETS, in the past perceived as a showcase for carbon pricing and a laboratory for multilateral cooperation, seems to be in a state of crisis. At the same time German policy makers plan to take national action and amend the EU ETS, which may further undermine it. This situation calls for new ideas and proposals how to put the "right incentives" in place.

Against this background, the intention of the workshop was to present and discuss such proposals – starting from the global level and working down to the EU and national level. This included both proposals for suitable instruments and challenges for getting them in place, and also interrelations between different levels. The workshop was moderated by Susanne Dröge (SWP) and Brigitte Knopf (MCC) and structured in the following sessions:

- **Session 1 – International level:** Input presentation "An International Carbon-Price Commitment Promotes Cooperation" by Peter Cramton (University of Maryland / EUI / University of Cologne), comment by Christian von Hirschhausen (DIW / TU Berlin)
- **Session 2 – European level:** Input presentation "Multilevel climate governance – EU ETS and the national preferences of the Member States" by Ottmar Edenhofer (PIK / MCC / TU Berlin)
- **Session 3 – German level:** Input presentation "Roads to Transition in German Energy Policy" by Felix Müsgens (BTU Cottbus), comment by Thies Clausen (Agora Energiewende)
- **Session 4:** Open discussion about interrelations between levels, ways forward and the role of science

The workshop brought together more than 30 participants from science, ministries, associations, think tanks and the private sector. It was held under the Chatham House Rule, meaning that participants are invited to share insights that were learned during the workshop, not to attribute statements or information to individuals. This report offers a summary of the highlights and range of discussion in the workshop. No attempt was made to achieve a consensus view. It was prepared by Michael Pahle (PIK), who received helpful comments from colleagues, the moderators and presenters. The input presentations can be found in the appendix.

# Workshop summary

## Session 1: International level

*Summary of the presented proposal*[1]*: To promote cooperation in international climate negotiations, negotiators should focus on a common commitment. Such commitments have the advantage of facilitating reciprocal "I will if you will" agreements in a group. Reciprocity is the basis for cooperation in repeated public goods games, and a uniform price would provide a natural focal point for a common international commitment. Such a price is also essential for efficient abatement. Countries would retain flexibility in how to implement the price – with cap-and-trade, a carbon tax, or a hybrid approach. Country risk is reduced relative to risk under international cap-and-trade since carbon revenues stay within the country. Price commitments also tend to equalize effort intensity and can facilitate enforcement. To encourage participation by less-developed countries, a green fund is needed to transfer money from richer to poorer countries. Transfers are smaller and more predictable with a uniform price commitment than with international cap and trade.*

Participants raised the following issues:

- Are additional technology policies needed, especially when the carbon price is (still) very low, e.g. lower than coal-gas fuel switch?
- What is the optimal number of players in the "coalition of the willing"? Can the proposal survive a large number of (heterogeneous) players?
- Shouldn't country specific commitments determined on country level be sustained in order to preserve flexible solutions?

Presenters pointed out that there may be reason to subsidize R&D efforts, yet, these should be determined separately. The essential element is establishing a serious carbon price. As to the size and composition of the "coalition of the willing" more research is needed. But in general after the coalition of the willing is established (and carbon pricing implemented) it might be necessary to exert pressure on other countries, for example via trade sanctions, with the goal to join the coalition. Lastly regarding the issue of country specific commitments they emphasized that the carbon price in combination with the green fund will be revenue neutral and therefore sustains incentives for individual commitments. Countries have the option of buying or selling carbon revenue credits and thereby efficiently taking on a higher or lower carbon price without compromising the global carbon price.

Participants made the following further remarks:

- In principle all institutional components are there already. In particular the GCF is an important achievement upon which to build the necessary transfers. Hence the proposal is also in line with the time after Paris, which can be a starting point. However, a major innovation would be to think about strategic GCF design – this is currently not a topic in the UNFCCC context.

[1]Source: **"An International Carbon-Price Commitment Promotes Cooperation"**, *Economics of Energy & Environmental Policy*, 4:2, 51-64, September 2015.

- An important challenge is that different countries disagree about the appropriate instruments to price carbon and the role of subsidies, which makes it difficult to find agreement. Against that background the G7 initiated a platform to further discuss this issue and consider mechanisms for internationally coordinating domestic carbon prices.

- With regard to the question of how to assess the Paris outcome, negotiators can be given some credit to build up the right institutions in Paris. Moreover, announcements and signals matter for the agreement that can be achieved, so it might be better not to be too critical with Paris in advance.

Presenters in particular acknowledged the importance of the GCF, but pointed out that a crucial idea that seems to be given up for Paris is a common commitment by at least a coalition of the willing, which is an essential pillar of any effective proposal. In addition, they pointed out that some kind of external enforcement is needed.

## Session 2: European level

*Summary of the presented proposal: Within the context of the EU ETS, the heterogeneity of Member States should be considered based on efficiency, solidarity and subsidiarity grounds. A key element for success is the appreciation and integration of multilevel climate policies. These structures benefit from price (or hybrid) instruments on the EU level with appropriate transfers. With strategic Member States pareto-improvements are possible with an EU ETS minimum price, and even if simple transfers are used.*

Participants made the following remarks:

- Right now anything that is done in terms of EU ETS reforms is essentially muddling through, but what is needed is a clear-cut reform. If this is what the proposal intends to be, it should be communicated as such.

- A minimum price in the EU ETS is in principle like a tax, so there is some similarity to the proposal of the first session not least because both rely on transfer mechanisms.

- Another option to take unilateral action within the EU ETS if the willingness-to-pay of a country is higher than the price would be to buy certificates and set them aside.

- The proposal seems to have great similarity to the optimization of global welfare in Integrated Assessment Models (IAM), which also goes along with substantial transfers.

- In face of the heterogeneity in Europe governance is important and needs to be considered. Moreover, in face of this it might also make sense to aim for a "collation of the willing" similar to the international level.

The presenter put forth that setting aside certificates is dangerous in a multilateral scheme because you can do this "only once" due to the risk that other countries may become hostile, which would undermine cooperation altogether. Regarding the alleged similarity with IAMs, an important difference is that within an IAM, which focuses on social welfare maximization and does not guaranty that all countries are made better off, the initial distribution of certificates (as one form of transfer) is independent from overall allocative

efficiency. This is different in the proposal presented here, which is based on a Lindahl equilibrium that links the initial distribution of certificates to allocative efficiency. More precisely, depending on the transfer scheme chosen different Pareto-improvements – which guaranty that no country is made worse off – are possible. Lastly, with respect to heterogeneity the proposal is more likely to work if the differences between countries are not too large. The important point however yet not well established in the ETS debate is the link between distributive and allocative efficiency. This implies to give particular attention to transfers.

## Session 3: German level

*Summary of the presented proposal: Germany has implemented national emission reduction targets in addition to the EU ETS, both in the past and for the future. The German Kyoto emission reduction target of minus 21 % in comparison to 1990 emission levels was reached. The next milestone towards a decarbonized German society is a reduction of 40 % until 2020 – again in comparison to 1990 levels.*

*The presentation argued that national policies on emissions reductions should be linked to European policies. This can be achieved both with a (binding) price floor in the ETS and by linking national policies to the number of certificates available in the ETS. The first was suggested in the presentation on European level (see above), the latter was included in the BMWi's proposal for a "Klimabeitrag".*

*Furthermore, the presentation broadened the scope by including the "horizontal dimension" of different policy instruments in addition to the "vertical dimension" of global, European and national perspectives. The presentation recommended that the situation after fifteen years of climate protection treaties and renewable energy promotion in Germany has significantly changed and should now be reassessed based on the currently available information.*

*The presentation addressed several questions which should be answered in this context:*

- *How should different instruments be linked efficiently?*
- *Do we want additional efficiency gains from (further) harmonization and competition (within Germany and beyond and within RES and beyond)?*
- *Do we want to coordinate the Energiewende with markets or regulation?*
- *Are we giving enough attention to non-ETS sectors (e. g. transportation, agriculture)?*
- *Are other countries learning from the Energiewende? What are they learning?*
- *What are the means (instruments) and what are the ends (objectives)?*
    - *renewable energy sources?*
    - *a decentralized energy system?*
    - *energy efficiency?*

Participants made the following remarks:

National action in general is instrumental in the sense that it creates political momentum that can be used on the European level. But it is important that it is in line with efficient European climate instruments.

- Sharing the "good experiences" gained from the Energiewende will serve the end of climate change mitigation more than only looking back and emphasizing the mistakes.

- The Energiewende provides a proof of concept that high shares of renewables can be integrated into the system, which according to most long-term scenarios will be necessary.
- Moreover, looking at the past the EEG might have been the driver of substantial learning effects for renewables.
- Subsidies on the national level are not the efficient solution, but if one accepts political constraints for carbon pricing, it is better than nothing. Without RES expansion, it is likely that emissions would be higher.

The remarks stimulated a controversial discussion centered on the following issues:

- The empirical evidence for the existence of the learning curve concept is lacking and the challenge to disentangle the potential effects of the EEG for global cost reductions has not been resolved.
- The fact that similar effects could in principle have also been achieved with an appropriate carbon price, and political economy issues might be the reason that no such price is in place. Moreover, it might be better to put the political effort not in the Energiewende but in establishing a carbon price. In this sense the Energiewende could even hamper the implementation of carbon pricing.
- The danger of subsidies that create lobbies.

## Session 4

Against this background, the discussion in the final session mainly evolved around the most promising avenues for further research and action. The following aspects already raised in previous session emerged as being of particular importance:

- The "heterogeneity problem", i.e. differences between the countries and respective implied transfers
- The "credibility problem", i.e. how can it be ensured that announced carbon price trajectories are credible to firms and innovators so that they act accordingly
- The "political economy problem", i.e. that a carbon price has no natural lobby group and winners that might support it politically

Regarding the "credibility problem", the opinion was raised that a sound policy is most likely to be trusted. This would be better achieved by efficient carbon pricing than by current incoherent polices. Regarding the "heterogeneity problem", participants in particular stressed the strategic role of transfers and respective institutions for overcoming the heterogeneity problem – both on the international level (GCF) and on the European level. They can be a door opener for common commitments and should not be considered separately, but are so far relatively poorly understood. In face of this, further research on transfer design is most promising and bound to become a very important new field in climate economics. Platforms such as the G7 carbon pricing forum recently established by Germany or the GCF could benefit from such proposals.

## Appendix

- **Presentation by Peter Cramton (Session 1)**; for more information also see **"Symposium on International Climate Negotiations"** (with Axel Ockenfels and Steven Stoft), *Economics of Energy & Environmental Policy*, 4:2, 1-64, September 2015. [**Podcast**, **Introduction**, **Gollier-Tirole**, **Stiglitz**, **Weitzman**, **Cramton-Ockenfels-Stoft**]
- **Presentation by Ottmar Edenhofer (Session 2)**
- **Presentation by Felix Müsgens (Session 3)**

# Price Carbon
## *I will if you will*

Peter Cramton, Maryland / EUI / Cologne
Axel Ockenfels, University of Cologne
Steven Stoft, Berkeley

16 September 2015

Symposium: International Climate Negotiations

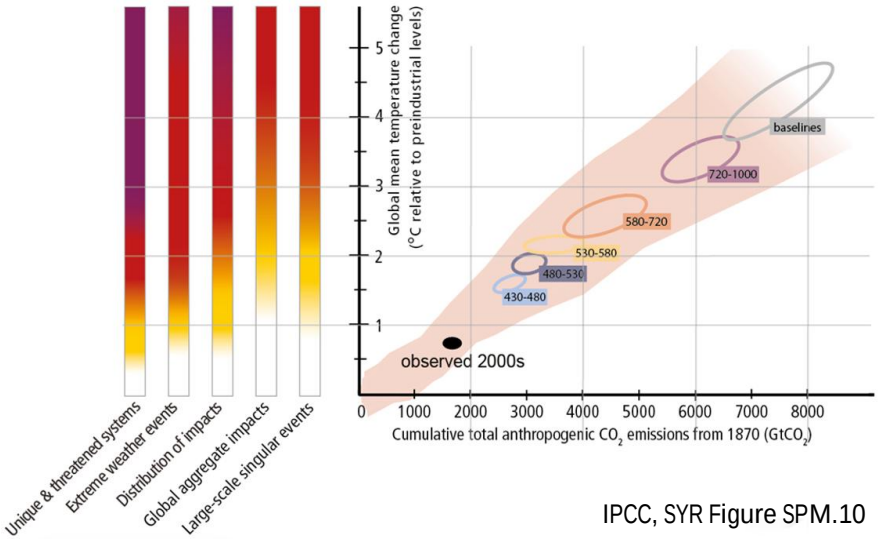
*Cramton, Ockenfels, Stoft (eds.), Gollier, Stiglitz, Tirole, Weitzman*
*Economics of Energy & Environmental Policy, 4:2, September 2015*

Price Carbon – I Will If You Will

*MacKay, Cramton, Ockenfels & Stoft*
*Nature, October 2015*

carbon-price.com

# Consensus Aspiration: 2°C goal




IPCC, SYR Figure SPM.10



# Economics: Price carbon

- Direct
- Efficient
- Transparent
- *Promotes international cooperation*



# Treaty Design: Promoting cooperation in international negotiations

# Individual commitments cannot promote cooperation

**APPENDIX I: QUANTIFIED ECONOMY-WIDE EMISSIONS TARGETS FOR 2020**

| DEVELOPED COUNTRY | *Quantified economy-wide emissions targets for 2020* | |
|---|---|---|
| | Emissions reduction in 2020 | Base year |
| | | |
| | | |
| | | |
| | | |

**APPENDIX II: NATIONALLY APPROPRIATE MITIGATION ACTIONS OF DEVELOPING COUNTRY PARTIES**

| DEVELOPING COUNTRY | *Actions* |
|---|---|
| | |
| | |
| | |
| | |
| | |

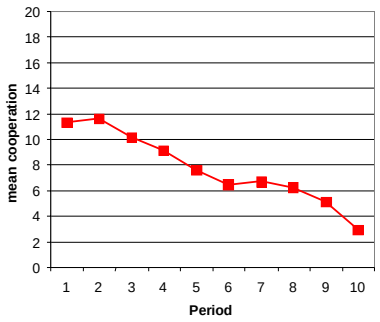


# Individual commitments cannot promote cooperation

- 10 players; individual endowment = $10
- Each $ pledged will be doubled and distributed evenly to all players
- Voluntary pledges are enforced
- Result: *Zero* cooperation, all pledge $0

## Dynamics of individual commitments: "Upward spiral of ambition"?

- History: Japan, Russia, Canada, and New Zealand left the Kyoto agreement
- Ostrom (2010), based on hundreds of field studies: insufficient reciprocity leads to a "*downward cascade*"
- Supported by theory and laboratory experiments






## Common commitment: "I will if you will"

# Trump: “I won’t ‘cause you won’t”



# “I will if you will” promotes cooperation

- 10 players; Individual endowment = $10
- Each $ pledged will be doubled and distributed evenly to all players
- *Pledge is commitment to reciprocally match the minimum pledge of others*
- Voluntary pledges are enforced
- Result: *Full* cooperation, all pledge $10

# Price is focal common commitment



- Direct, efficient, common intensity of effort
- Consistent with tax or cap & trade (flexible at country level)
- Consensus that price should be uniform reduces dimensionality problem:

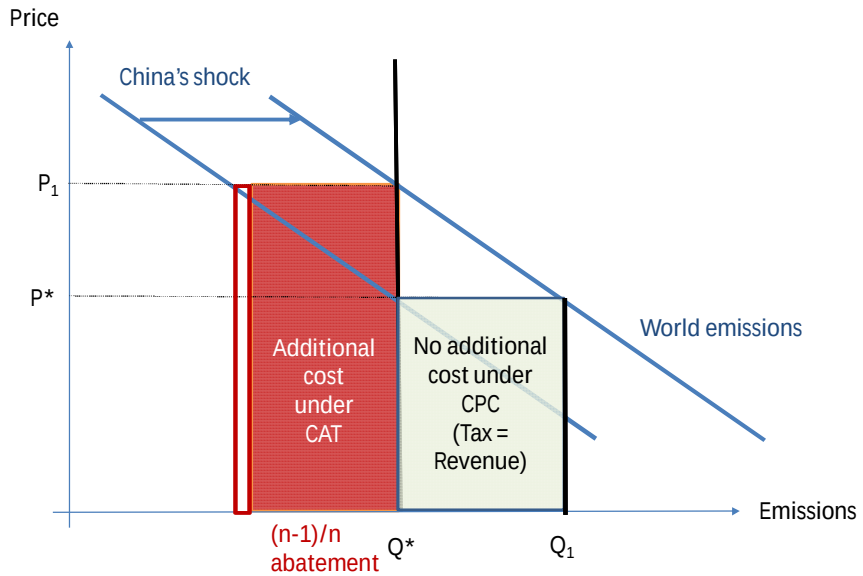
$$P_{Country} = P_{global}$$

- (No such consensus exists for quantity commitment)

# Price commitment reduces risk

- Countries keep carbon revenues
- Eliminates the risk of needing to buy credits
  - If China accepted a Do-Nothing Cap for the Kyoto years (as predicted by US DOE), and not cut emissions:
    - China would have been short 29.1 billion permits
    - Cost over $1 trillion at $35/ton
  - With a price commitment:
    - Only surprise abatement cost, and only if there is surprise abatement





# Sharing the burden



- Use Green Fund to maximize abatement
- As before, reduce dimensionality
  - Carbon price = intensity of cooperation
  - "Generosity parameter" = intensity of Green Fund
- Last resort enforcement with trade sanctions

## Designing the Green Fund

- Payment into Green Fund = G × XE × P*
  - G = Generosity parameter
  - XE = eXcess emissions
    (with respect to global per-capita average)
  - P* = global carbon price
- This addresses "differentiated responsibilities"
  - Rich, high-emission countries pay into fund
  - Poor, low-emission countries receive from fund

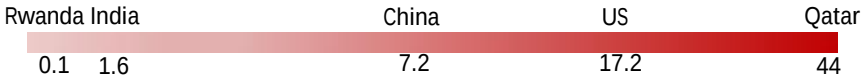


## Maximizing treaty strength

- If G is high, rich countries will want P* low
- If G is low, poor countries will want P* low
- Some moderate G maximizes the P* that a super-majority will accept

# A mechanism for the willing

- Countries with little stake in the Green Fund (near average emissions) first determine G
  - G will be determined so that both rich and poor countries benefit from an effective agreement




- Then countries vote for P*; the lowest price wins
  - No country i commits to a $P^* > P_i$, so any country could protect itself by naming a low $P_i$ if G were unacceptable
- Mechanism promotes a strong agreement



# Summary

- Keys to a strong climate treaty
  - "I will if you will" (common commitment)
  - Two parameters
    - Carbon price (common intensity of effort)
    - Green fund intensity (addresses asymmetries)
- Further research
  - Equilibrium simulations to identify best "climate club" and develop details of treaty

Price Carbon

*I will if you will*



Backup

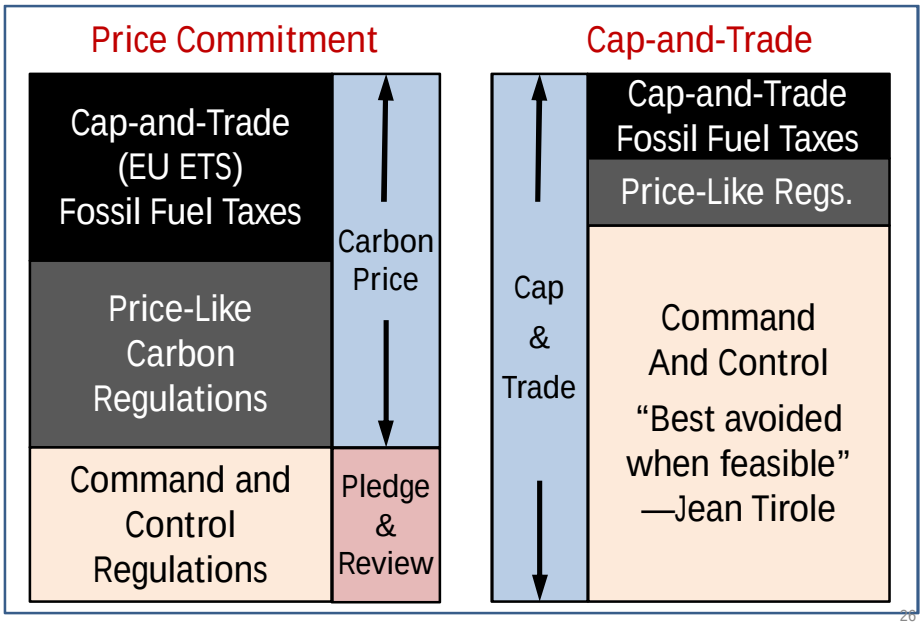
# Carbon price vs. cap & trade



## Price Carbon Emissions?

- Global Cap-and-Trade
  - Prices International Permits (Kyoto's AAUs)
  - No requirement to price *emissions*
  - Kyoto mainly caused renewable regulations
- Global Carbon Price Commitment
  - Pricing emissions is what counts
  - For a while renewables get credit—but only for the (carbon they actually save) × (global price)

## Pricing of Carbon *Emissions*






## Why Global Cap-and-Trade Fails

- Trading risk pushes up individual "targets"
- Free-riding pushes up individual "targets"
- No one can find a common-commitment
- 2°C pushes the global cap down
- It will never add up

# Climate games



## Two International Games

- Public-Goods Game:
  - Each country chooses its abatement, $A_j$
- Cap-and-trade Game
  - Each country chooses its target, $T_j$
  - Sells carbon credits for $P \times ( A_j - T_j )$
  - P = marginal cost of each country j
- Countries acts in their self interest

# Payoff = Net-Benefit

$$NB_j = b_j A - c_j A_j^2 + P (A_j - T_j)$$

- Climate benefit = $b_j \times$ (Total abatement)
- Abatement cost = $c_j \times$ (country abatement)$^2$
  - Marginal cost = $2 A_j = P$
- Carbon Trade Revenue = $P \times (A_j - T_j)$
  - Only under cap-and-trade



# Cap & Trade Can Beat Public Goods

| Game #1 | Public Goods | | Cap and Trade | | |
|---|---|---|---|---|---|
| Country | $A_j$ | P | $T_j$ | $A_j$ | P* |
| 1 | 0.5 | \$1 | 0.38 | 0.75 | \$1.5 |
| 2 | 0.5 | \$2 | 0.75 | 0.38 | \$1.5 |
| Total | 1.0 | | 1.13 | 1.13 | |

- Country 1: $b_j = 1$, $c_j = 1$
- Country 2: $b_j = 2$, $c_j = 2$

# Or Not

| Game #2 | Public Goods | | Cap and Trade | | |
|---|---|---|---|---|---|
| Country | $A_j$ | P | $T_j$ | $A_j$ | P* |
| 1 | 0.17 | $1 | – 0.08 | 0.25 | $1.5 |
| 2 | 1.00 | $2 | 1.08 | 0.75 | $1.5 |
| Total | 1.17 | | 1.00 | 1.00 | |

- Country 1: $b_j = 1$, $c_j = 3$
- Country 2: $b_j = 2$, $c_j = 1$
- Negative Target ➔ Cap > BAU emissions



# THE GLOBAL QUANTITY-TARGET, AND PRICE-TARGET GAMES

## Global-Target Games

- $N$ identical countries in the world
- The quantity-target game
  - Each country names a target $Q^T_j$
  - $Q^T$ = maximum (weakest) $Q^T_j$
  - National caps = $Q^T / N$
- The price-target game
  - Each country names a target $P^T_j$
  - $P^T$ = minimum (weakest) $P^T_j$
  - National carbon prices = $P^T$
  - Currency = Global index of major currencies (USD, euro, ...)



## Identical Countries ➔ Identical Games

- Every $P^T$ matches some $Q^T$ that would cause global price $P^T$
- Vote for $P^T$ or its matching $Q^T$
- The same holds in each identical country

## Optimal Cooperation

- *"I will if you will."*
- If you vote for a high P and set price, then P is high for all (and optimal)
- Voting for Q also works optimally



## Price handles some asymmetries

- Country 1: Temperate w/ renewable resources
- Country 2: Hot with only coal
- With a P-target, country 2 accepts high price because carbon revenues stay in country 2
- With a Q-target, Country 2 must pay country 1 a lot of money (to buy carbon credits)
- P-target minimizes transfers among countries

## But what if countries disagree about price

- Poor countries
  - Have a lower cost/ton of abatement
    - ➔ a greater social cost of abatement
  - Have a higher discount rate
    - ➔ less benefit from future climate
- Poor countries will vote for a low global $P^T$
- And the lowest price wins



## LINK THE GREEN FUND TO PRICE

## Green Fund Payment and Reward

- Green Fund Payment Received =

  $G \cdot \Delta E_j \cdot P^T$

- $\Delta E_j$ = (World emission) – (Country emission) on a per-capita basis.
- G = the strength of the Green Fund

Green-Fund Game Payoff Function:

$$NB_j = b_j A - c_j A_j^2 + G \cdot \mathbf{\Delta} E_j \cdot P^T$$



## Green-Fund Game

- Example Game with Three Countries
  - "U.S." = High, "China" = Average, "India" = Low emissions / capita
  - So China neither pays nor is paid Green Funds
  - India wants a low global price
  - As with other games,

    Self interest and no cheating

# Green-Fund Game Rules

1. China picks G
2. Then, all three vote for $P^T$
3. All get the Net-Benefit payoff

Strategy

- China will raise India's vote for $P^T$ by picking G>0, but not too high because the U.S. would vote for a lower $P^T$ than India



# Without the Green Fund

| Country | pop | *e* | Voted P | *P** | $A_j$ % |
|---|---|---|---|---|---|
| | billions | ton/cap. | $/ton | $/ton | % |
| U.S. | 0.3 | 18 | $31 | $10 | 6.7% |
| China | 1.2 | 5 | $31 | $10 | 6.7% |
| India | 1.0 | 1.1 | $10 | $10 | 9.1% |

# The Green-Fund Game

| Country | pop | *e* | Voted P | $A_j$ % | $A_j$ Cost | G. F. Benefit |
|---|---|---|---|---|---|---|
| | billions | ton/cap. | $/ton | % | ¢/capita/day | |
| U.S. | 0.3 | 18 | $26 | 18% | 11.5¢ | –4¢ |
| China | 1.2 | 5 | $31 | 18% | 3.2¢ | 0.0¢ |
| India | 1.0 | 1.1 | $26 | 24% | 1.0¢ | 1.2¢ |
| World | 2.5 | 5 | $26 | 18% | 3.3¢ | 0.0¢ |

- Poorest countries gain even ignoring climate benefits!



# The Green-Fund Game vs. Cap and Trade

| Game | Global price, P | P as a % optimal | A as a % optimal |
|---|---|---|---|
| Green-Fund Game | $26.40 | 93% | 93% |
| Global Cap and Trade | $9.51 | 33% | 33% |
| Optimal Outcome | $28.52 | | |

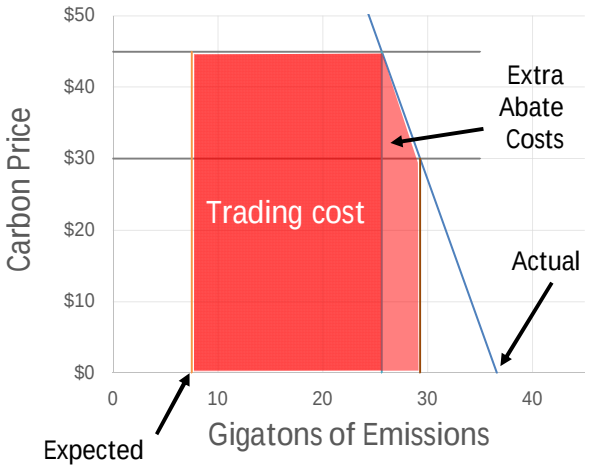
- Cap-and-trade has individual caps, no Green Fund, and same physical world

# Green-Fund Game Mechanisms

- The Green-Fund is also a climate incentive
  - Reduce your E/capita and pay less / get more
  - This works equally on every country
- Let near-average E/capita country vote for G
  - Then pick the median vote for G
- Trading carbon-revenue credits could make compliance more agreeable



# China avoids trading risk of cap & trade



POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

# Multilevel climate policies – The EU ETS and the heterogeneity of the Member States

Workshop: The road to Paris & multilevel carbon pricing:
Getting the "incentives right" at the global, European and national level

Berlin, 16 September 2015

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Beatriz Gaitan, Paul Nahmmacher, Christian Flachsland

Leibniz Gemeinschaft

MCC Mercator Research Institute on Global Commons and Climate Change

Technische Universität Berlin

European situation

## Climate policy at the EU-level

In 2005 implementation of the EU ETS

- total amount of EU-emissions fixed,
- permit price determined by the market,
- equalizes marginal abatement costs across the EU Member States,
- cost-efficient instrument to regulate GHG-emissions,
- transfers via initial allocation of allowances and redistribution of auction revenues.

Was the heterogeneity of the Member States efficiently considered in its design? Likely not ...

European situation

## Climate and energy policies at the Member States level

Member States' keep modifying their policies even after the EU ETS implementation, e.g.

- U.K.'s Climate Change Levy
  includes minimum price in addition to EU ETS
- German Energiewende
  policy package supporting long-term mitigation
- Sweden's carbon tax
  shifted fiscal burden from labor to carbon emissions (with exemptions for the ETS-sector)

→ Member States' heterogeneity: different (higher) ability- and willingness-to-pay for mitigation.



European situation

## Is the heterogeneity efficiently considered in the EU ETS?

Analysis based on two normative principles.

### Solidarity

Transfers across Member States are implemented to pursue a common goal, like climate change mitigation.

### Subsidiarity

In general, national governments can better address local preferences. Therefore, EU policies are only justifiable if they can improve on the Member States' action.

Theory

## Member States' income heterogeneity

*Based on Chichilnisky and Heal, 1994*

Emissions trading

equalizes marg. abatement costs for all Member States $i=1,\ldots,N$. Thus:

$$p_{ETS} = \frac{1}{MRT_i} = -\frac{\sum_k \lambda_k \frac{\partial U_k}{\partial a}}{\lambda_i \frac{\partial U_i}{\partial c_i}} = -\frac{\sum_k \lambda_k \frac{\partial U_k}{\partial a}}{\lambda_{j \neq i} \frac{\partial U_j}{\partial c_j}}$$



Theory

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If the income-level in Member States ***i*** is lower than in Member State *j*, then:

$$\frac{\partial U_i}{\partial c_i} > \frac{\partial U_j}{\partial c_j}$$

Theory

## Member States' income heterogeneity

*Based on Chichilnisky and Heal, 1994*

Emissions trading

equalizes marg. abatement costs for all Member States $i=1,\ldots,N$. Thus:

$$p_{ETS} = \frac{1}{MRT_i} = -\frac{\sum_k \lambda_k \frac{\partial U_k}{\partial a}}{\lambda_i \frac{\partial U_i}{\partial c_i}} = -\frac{\sum_k \lambda_k \frac{\partial U_k}{\partial a}}{\lambda_{j \neq i} \frac{\partial U_j}{\partial c_j}}$$

If the income-level in Member States $i$ is lower than in Member State $j$, then:

$$\frac{\partial U_i}{\partial c_i} > \frac{\partial U_j}{\partial c_j}$$

Requirement for allocative efficiency with ETS

- Equalization of marg. social valuations of private consumption,
- via optimal transfers from rich to poor countries, such that:
- E.g. by initial allocation of allowances or redistribution of auction revenues.

$$\frac{\lambda_i}{\lambda_j} = \frac{\frac{\partial U_j}{\partial c_j}}{\frac{\partial U_i}{\partial c_i}}$$



Design Principle 1

## Efficiency, transfers and solidarity

To reach a common European goal of emission reduction with an ETS

- transfers from rich to poor Member States are crucial.
- These transfers need to significantly alter the willingness-to-pay for mitigation in poorer Member States.
- Otherwise, an ETS is not efficient.

If significant (optimal) transfers cannot be implemented, then

- richer Member States shall pay higher carbon prices than poorer Member States.

Theory

## Interaction between EU and Member States‘ policies

Climate policies at different governmental levels

- National governments can better address local preferences (principle of subsidiarity)
- The EU-level can better address (global) public good provision.
- How to benefit from polycentric governance?

So far

- Member States’ policies (like taxes) in addition to the EU ETS are cancelled out. ETS nullifies expression of preferences.
- ETS transfers are impossible to be set optimal (Williams, 2012) if strategic Member States’ policies are present.

→ A price instrument at the EU-level can integrate the Member States’ policies (additivity of prices).



Design Principle 2

## Multilevel policies and subsidiarity

- Quantity instruments at the EU-level, such as the EU ETS, violate the subsidiarity principle.
- As soon as the cap is set, national preferences cannot be expressed in an ETS, because the cap determines the level of total abatement.
- An EU ETS minimum price or a carbon tax with appropriate transfers enables Member States to implement additional policies according to their (more ambitious) preferences.

Ongoing work on

# Institutional design in a non-optimal world

We start from the Member States' perspective.

Can the EU level achieve a Pareto-improvement* using

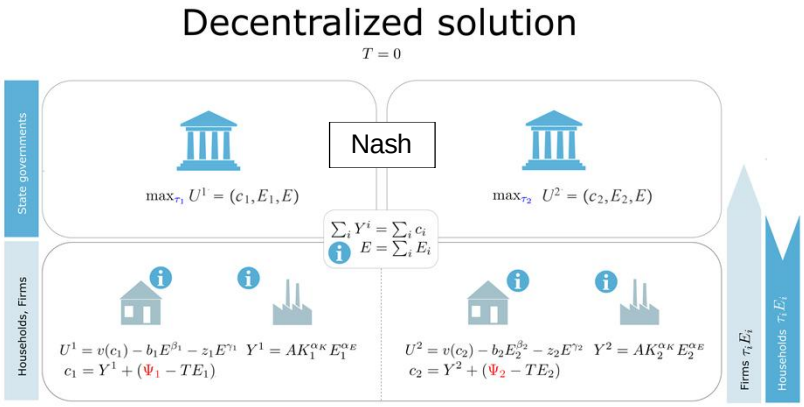
1. a uniform carbon price and
2. endogenous or simple** transfer schemes?

* make at least one state better off while the other state is not worse off.
** full state refund, equal per capita, historical emissions transfers



Outlook: ongoing work

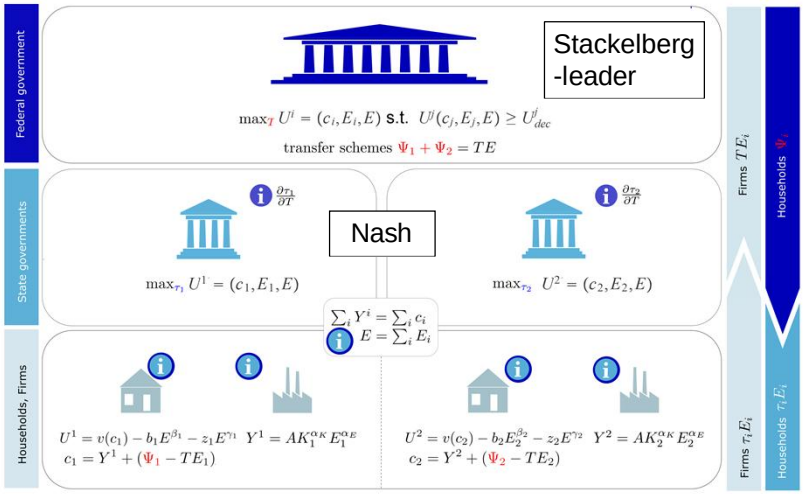
# Member States' policies provide the starting point




*(Roolfs, Gaitan, Edenhofer, Pahle and Knopf, in prep. )*

Outlook: ongoing work

## Role of EU-level: Improve on Member State policies

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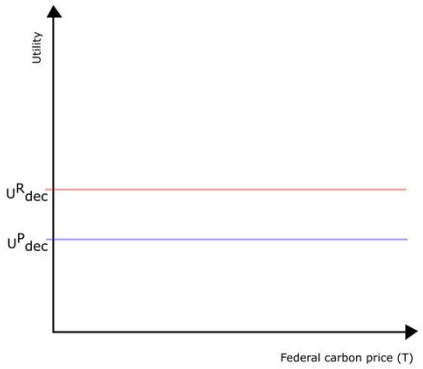
First results

## Equal per capita transfer, income heterogeneity

- Member States (rich R, poor P) set national carbon taxes (result in $U^i_{dec}$)

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## Equal per capita transfer, income heterogeneity

- Member States (rich R, poor P) set national carbon taxes (result in $U^i_{dec}$)
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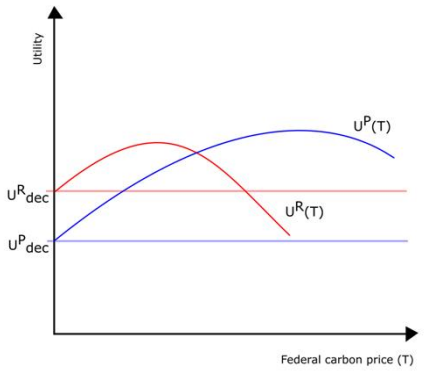


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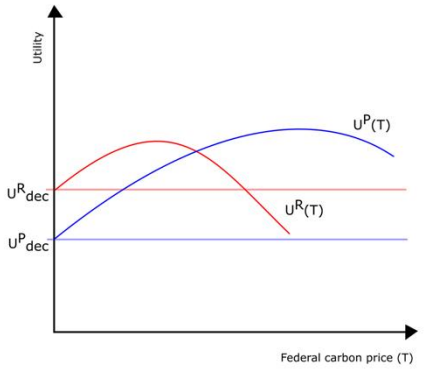
When is an equal per capita transfer and a uniform EU price ($T$) incentive compatible?

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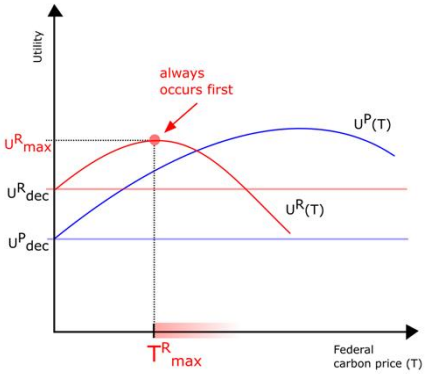
The rich State has higher mitigation cost due to large transfers, but

- agrees on equal per capita transfers
- as long as $T^{min}$ maximizes its utility.

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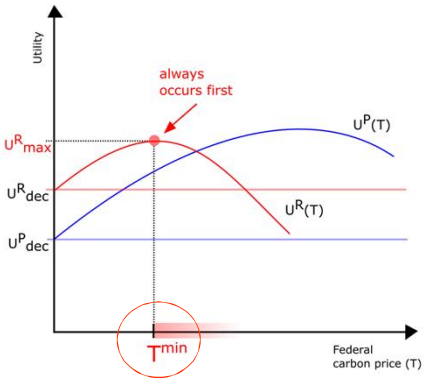


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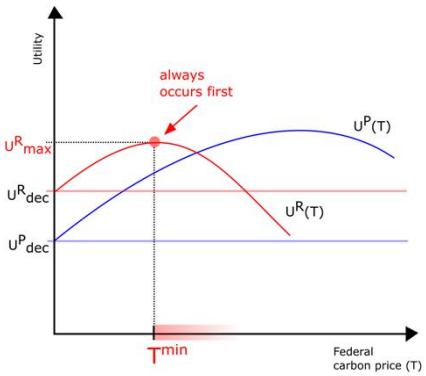
The poor State always benefits, due to

- income increase by transfers,
- externality internalization.




*(Roolfs, Gaitan, Edenhofer, Pahle and Knopf, in prep. )*



... conclusion for the EU and the design of multilevel climate policies

EU ETS

- Equalizes marginal abatement costs,
- Member States' heterogeneity and national ambitions for higher mitigation-level are not efficiently considered.

Minimum price for the EU ETS – two advantages

- Often overlooked: can integrate more ambitious (strategic) Member States' policies without undermining EU policy (allocative efficiency)
- Known: stabilization effect

Illustration of EU ETS minimum price proposal

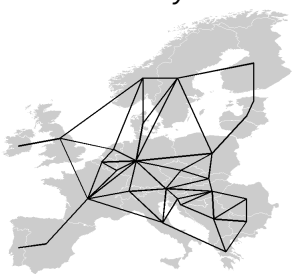
## LIMES-EU *Long-term investment model of the electricity sector*

Objective
- minimizing cumulated costs of electricity provision
- optimal investment and dispatch decisions for generation, storage and transmission capacities

Technologies
- generation *[nuclear, hard coal (+ccs), lignite (+ccs), natural gas cc/gt, hydro, wind on-/offshore, solar pv/csp, biomass]*
- storage *[diurnal, seasonal]*
- transmission *[net transfer capacities between regions]*

Geographical scope & resolution
- EU28 countries w/o Malta & Cyprus
- plus Norway & Switzerland & Balkan

Temporal scope & resolution
- 5 year steps 2010 – 2050,
- representative days per year
- perfect foresight



Policies
- $CO_2$ prices / RES targets
- EU and Member State level

Exogenous parameters
- electricity demand per region
- nuclear / ccs policies
- investment costs and fuel costs

*Nahmmacher et al. (2014)*



Illustration of EU ETS minimum price proposal

## Multilevel policy scenarios

| until 2030 | |
|---|---|
| EU policy | EU ETS cap and minimum ETS price of 5€ / 10€ / 15€ |
| German policy | Effective national carbon price of 20€<br>Therefore, variable fee X = 15€ / 10€ / 5€ such that<br>20€ = EU policy + X |

| after 2030 | |
|---|---|
| EU policy | EU ETS cap resulting in price of 20€ / 25€ / 30€ / 35€<br>subsequently rising by 5%/year until 2050 |

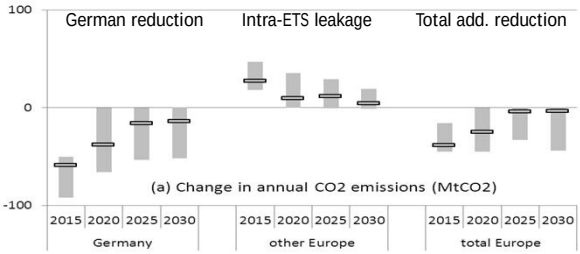
...resulting in 24 scenarios in total

Carbon prices in €/tCO2

Illustration of EU ETS minimum price proposal

# Effect of additional German policy on emissions

- German emissions reduce strongly.
- Cushioning of intra-ETS leakage:
  Emissions in neighboring countries increase, but less than decrease in Germany.
- Levels of emission changes depends on
  - price gap between EU and German policy, and
  - expected future carbon price.
- Overall effect of national policy positive.




The figure gives the range (grey) and median (black) over all scenarios.

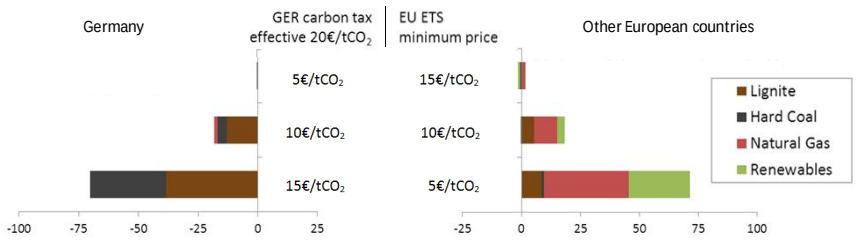


Illustration of EU ETS minimum price proposal

# Shift in electricity production

European countries

- replace reduced German electricity production,
- invest in less $CO_2$-intensive technologies, if future EU carbon price is expected to be sufficiently high.




Change of electricity production (TWh): Illustrative model results[1] for 2020 with different EU minimum prices acc. to scenarios.

[1]Model results for scenarios with a common European carbon price of 30€/$tCO_2$ in 2030.

Illustration of EU ETS minimum price proposal

## Conclusion from LIMES-EU simulations

- If Germany sets an additional carbon price while the EU ETS has implemented a minimum price European mitigation increases.
- The smaller the price gap between EU ETS minimum price and German carbon price the lower the costs:

| | | | |
|---|---|---|---|
| EU ETS Minimum price: | 5€/$tCO_2$ | 10€/$tCO_2$ | 15€/$tCO_2$ |
| Extra costs[1] of GER policy: | 35.4bn€ | 23.6bn€ | 11.9bn€ |

[1]*Total system costs until 2050 discounted to 2010 values.*



Concluding remarks

## Implications for an EU ETS reform

- The Member States‘ heterogeneity
  should be considered based on efficiency, solidarity and subsidiarity grounds.
- A key element for success:
  Appreciation and integration of multilevel climate policies:
  - Benefit from price (or hybrid) instruments on the EU level.
  - Appropriate transfer design crucial element.
- Pareto-improvements are possible
  with a minimum price, simple transfers and strategic States.

Concluding remarks

## Implications for the COP 21 Paris

- EU as a laboratory for multilateralism
  Lessons can be learned for global climate policies

- Success of EU ETS reform
  can send positive signal about plausibility of multinational cooperation.

- Coordination around a minimum price and appropriate transfers enable Pareto-improving reforms towards increasing the level of climate policy ambitions.

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# Roads to Transition in German Energy Policy

-

## Getting the “incentives right” at the global, European and national level

Prof. Dr. Felix Müsgens

PIK-Seminar “The road to Paris & multi-level carbon pricing ”

16 September 2015

## Different Levels of Climate Action

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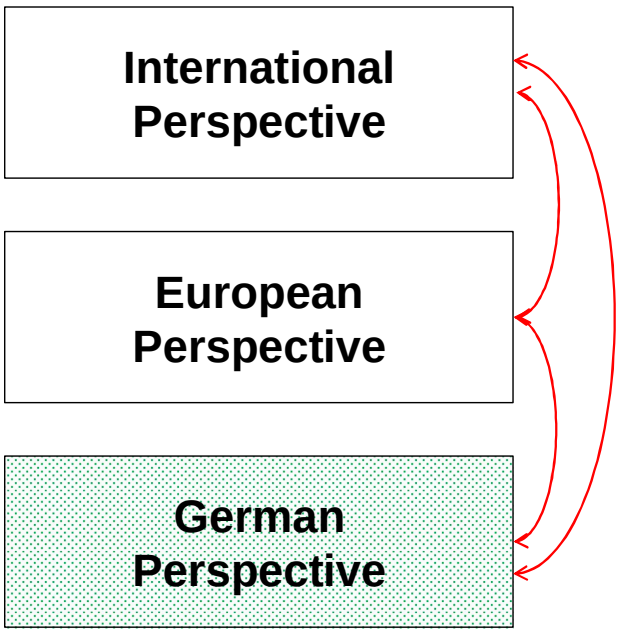

## The German Perspective

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- Global warming is a global challenge.
- German position globally:
  - Share of World GDP: 5 % (rank 4)
  - Share of energy related $CO_2$-emissions: 2 % (rank 6)
  - Per capita emissions are twice the global average.
- Germany is responsible at the global, European and national level.
  - Internationally: Kyoto and COPs
  - European level: ETS and others
  - Nationally:
    - Contribution to European and international debates – and fulfillment of obligations from treaties
    - Do more? What (and how)?



## Different Levels

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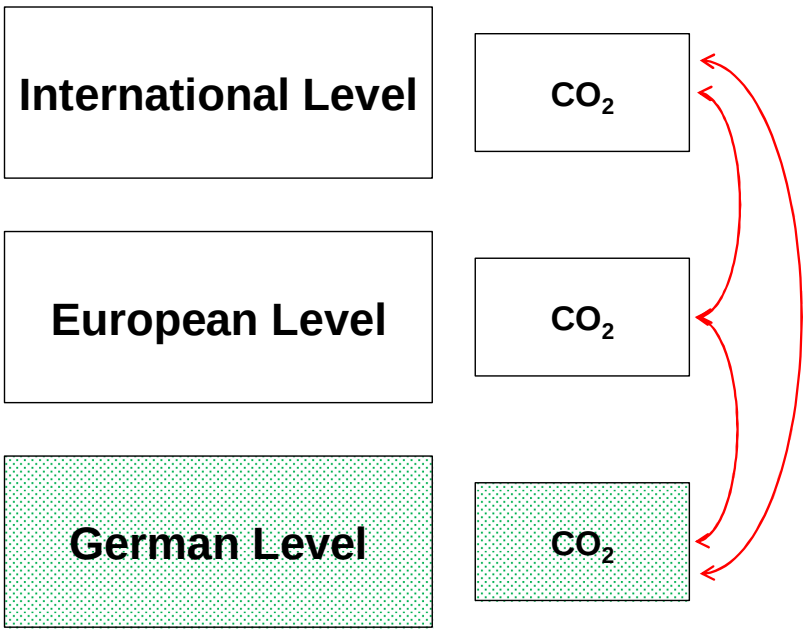
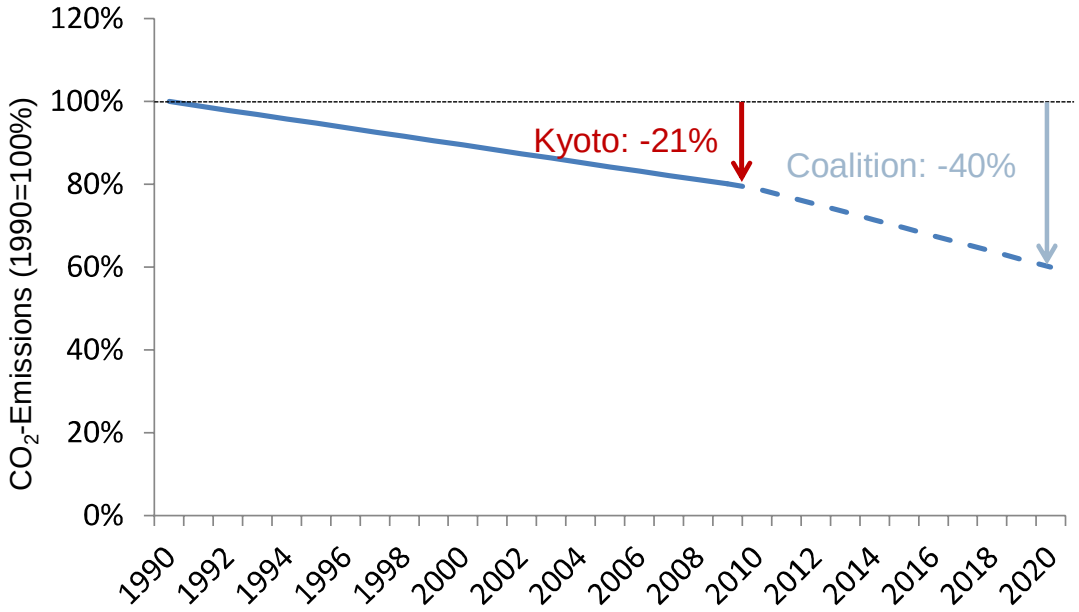


# Climate Protection – National Targets



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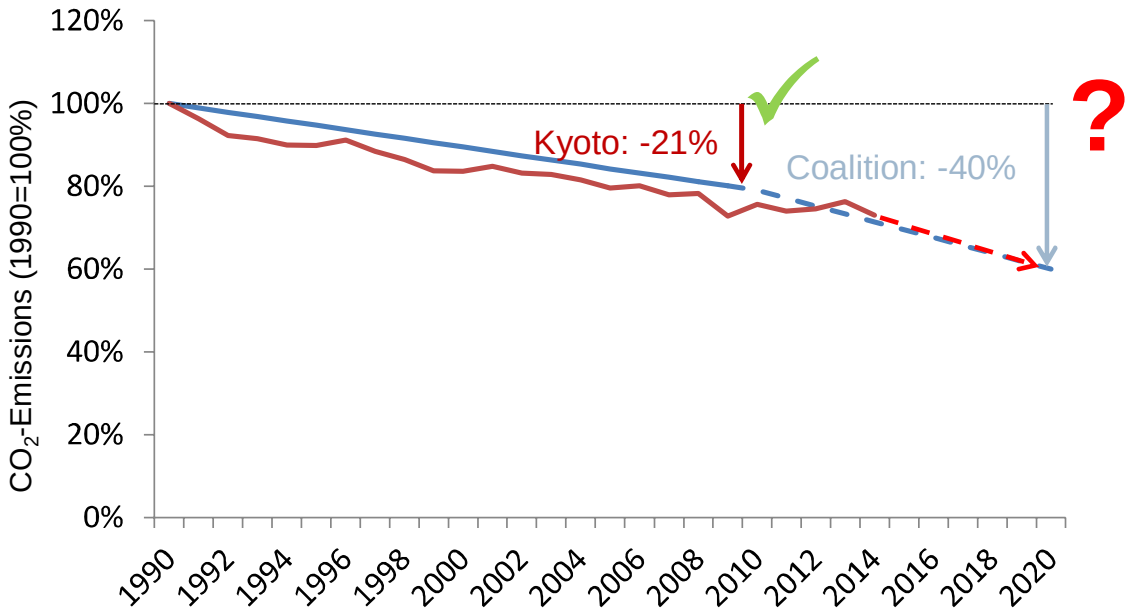
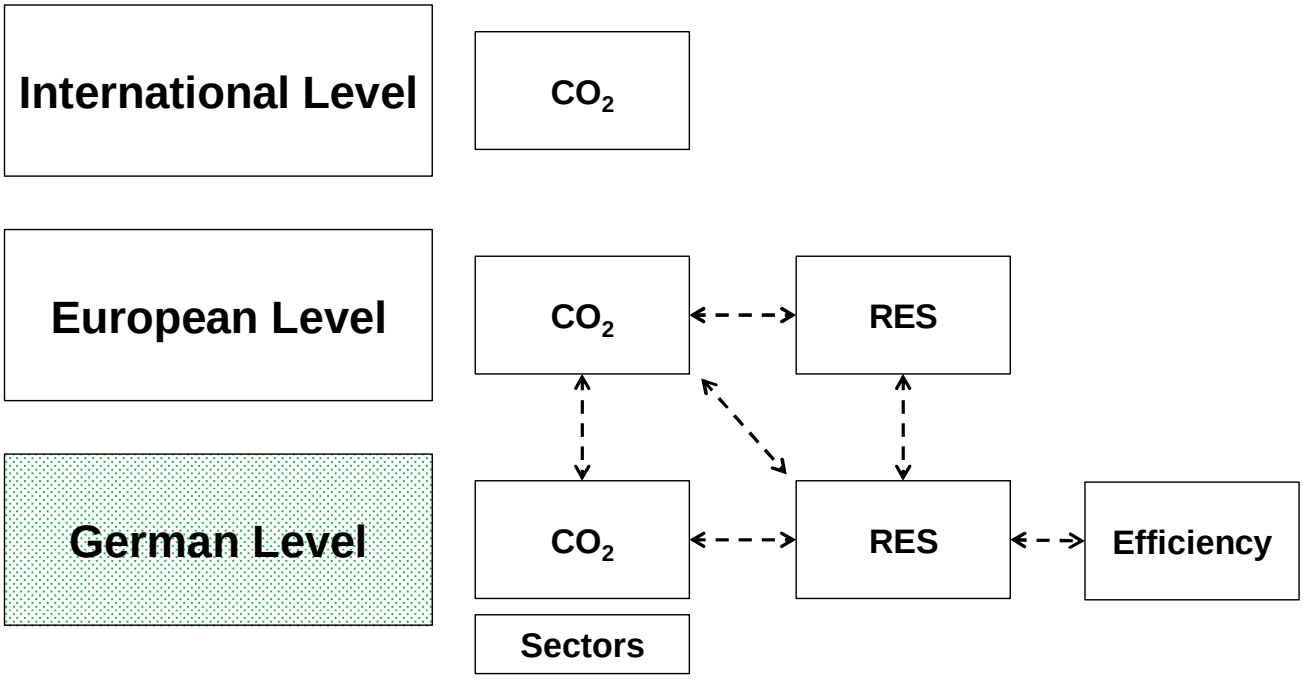


# Different Levels






# Central Questions for the Future

- What is the role of national $CO_2$ emission reduction targets in combination with the European emission trading system?
- How should different instruments be linked efficiently?
- Do we want additional efficiency gains from (further) harmonization and competition (within Germany and beyond and within RES and beyond)?
- Do we want to coordinate the Energiewende with markets or regulation?
- Are we giving enough attention to non-ETS sectors (e. g. transportation, agriculture)?
- Regulatory Risk
- Are other countries learning from the Energiewende? What are they learning?
- What are the means (instruments) and what are the ends (objectives)?
  - renewable energy sources?
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  - energy efficiency?
  - …

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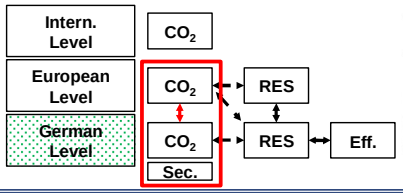


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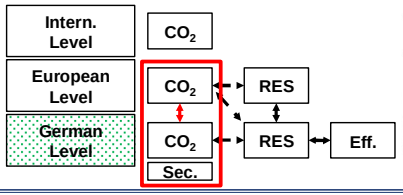
# Linking National Policies to ETS

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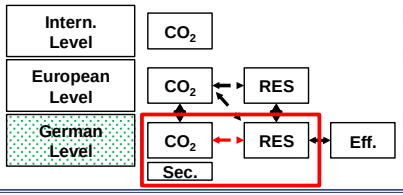
- Different preferences and different instruments in addition to ETS
  - U.K.'s Climate Change Levy
  - Sweden's carbon tax
  - German Energiewende
    - RES-Additions
    - “Klimareserve”
  - …
- Challenge: In the context of the ETS, these instruments…
  - … do not influence emissions at the European level
  - … may reduce cost efficiency within Europe
  - … lower ETS certificate prices - self-fulfilling prophecy?
- Possible Solutions
  - price floor
  - link national instruments to ETS (example: BMWi-proposal for „Klimabeitrag“)
    - effectively taking allowances out of the system

# Central Questions for the Future

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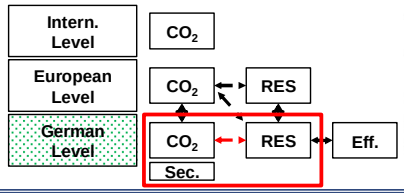
# Development of RES – 2000 to 2013
## RES-Share of Total Generation [%]

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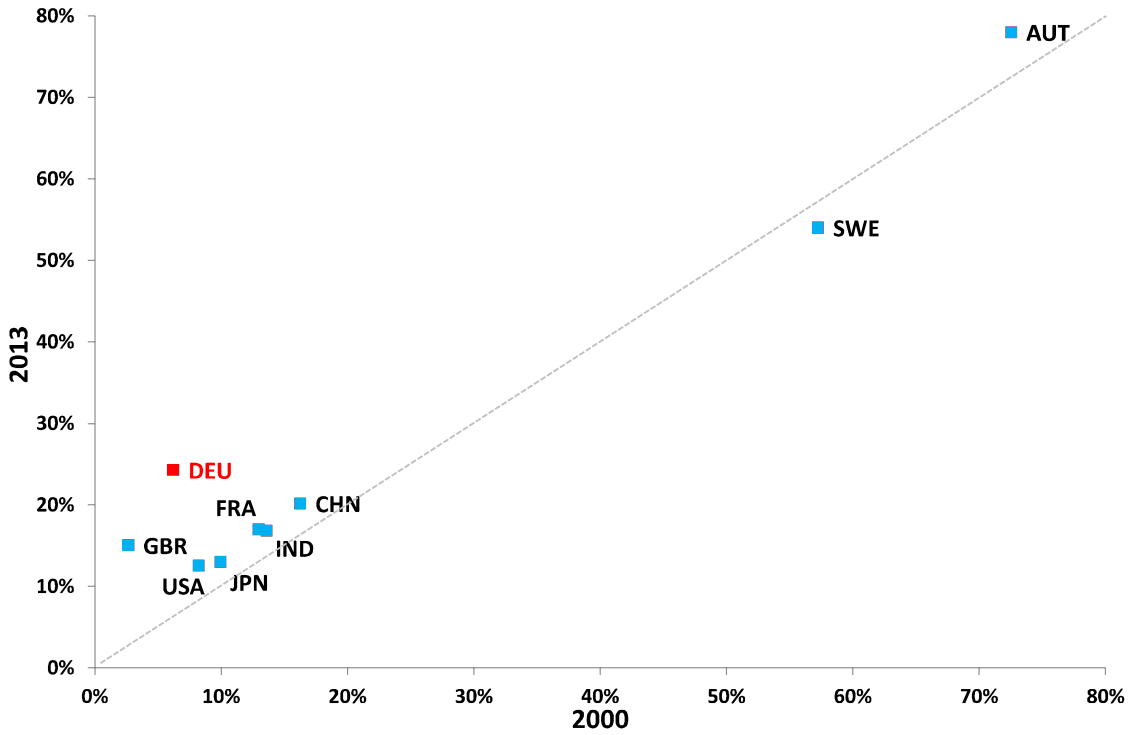
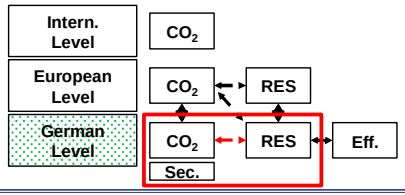


# National Emissions (1990: 100 %) and RES shares (in % of el. cons.)

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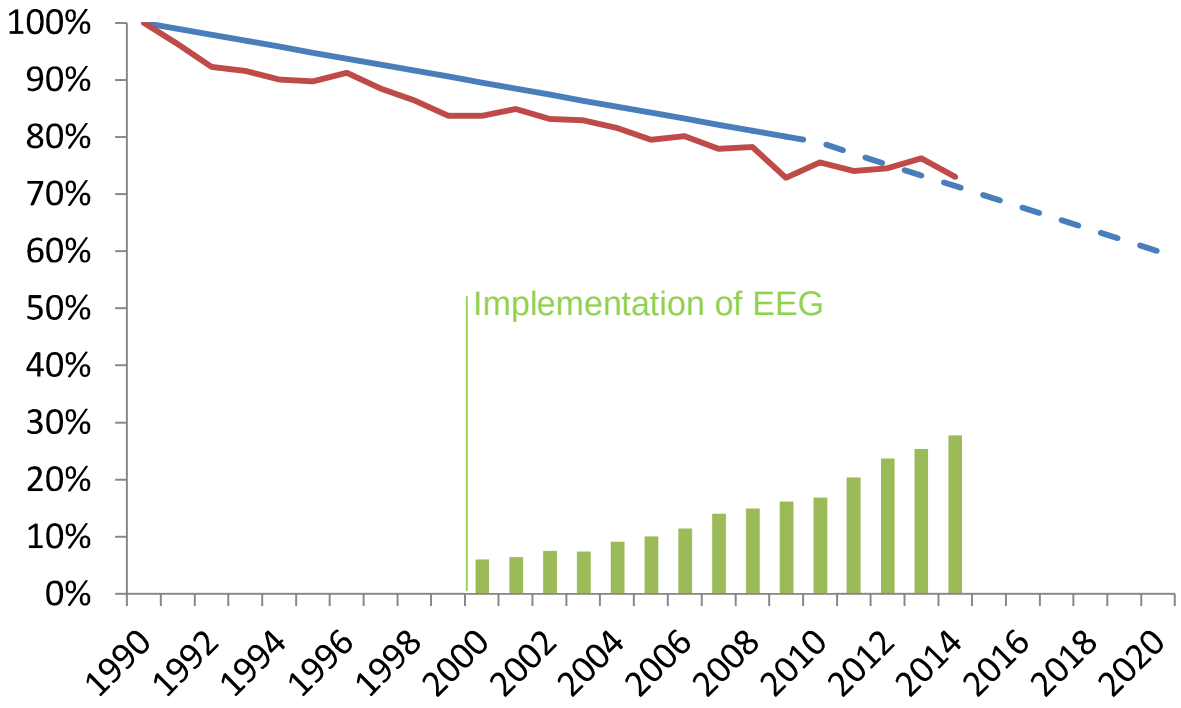
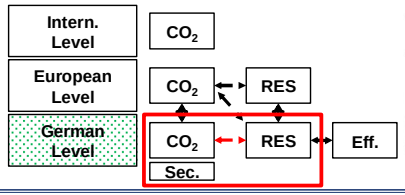





# Total Net Costs for German RES installed before 31/12/2011

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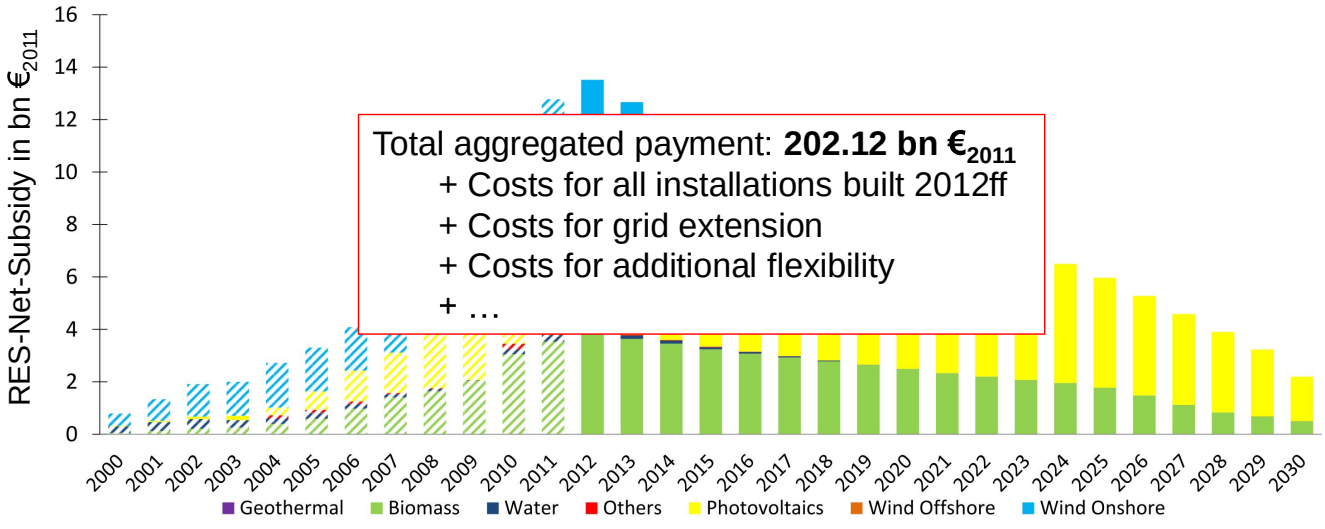
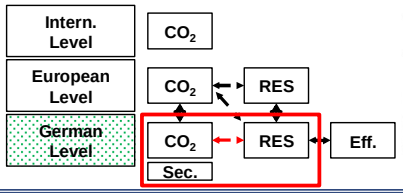
- The German "EEG" (RES-Act) specified that all RES installations receive feed-in tariffs for 20 years (plus year of installation).
- Below are estimates for the future cost burden for all RES plants built before the end of 2011 (again, only net costs are shown, market value for electricity has been subtracted):




Source: Kreuz, Müsgens, Wissen (2015)

# Benefits of RES-Promotion in Germany

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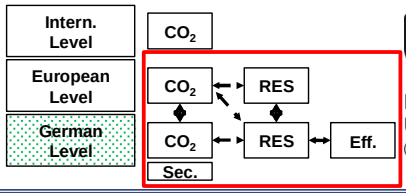
- Low carbon technology
- Correction of negative R&D externalities (i. e. market participants invest too little in renewables for fear of other companies copying advances)
- Correction of other negative externalities related to fossil fuels
  - Particulate matters (respirable dust)
  - $NO_x$, $SO_2$, …
- „Green Growth“
  - Jobs in economically weak regions (North and East Germany)
  - Know-How for Exports
- Reduction of fossil fuel imports

**Precise assessment is difficult …**

**… but necessary.**



# Central Questions for the Future

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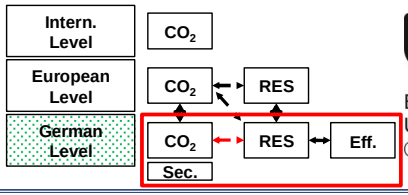
# Recent Trends in Germany: Increasing Harmonization and Competition

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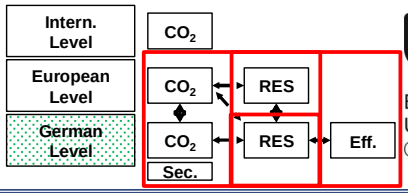
- $EEG_{2014}$
  - Stronger focus on cost efficiency (e. g. less biomass)
  - Increased competition through implementation of auctions
  - Increased reaction to wholesale price signals through (mandatory) direct marketing – improves system integration of RES
- Market design: „Electricity Market 2.0“ (white paper „An electricity market for Germany’s energy transition“)
  - Improved competition between different flexibility options
  - Strengthened balancing markets
  - Improved synchronisation between RES-feed-in and grid extension



# Harmonization

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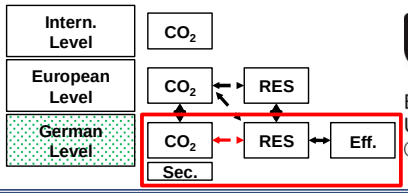
- On a national level, one may ask why different RES technologies receive different subsidies. Furthermore, whether it is necessary that the worse a wind site is, the more payment it receives.
- On a broader level, potential for bi- or multinational co-operation on RES could be considered.
- Furthermore, a long-term focus on emission reductions as the primary objective may be discussed. Model results:
  - On a European level, least-cost decarbonisation can lead to roughly 50 % of electricity generated by RES in 2050
  - Savings on a European level in comparison to a business-as-usual counterfactual scenario can amount to 20-40 bn € per year

(Source: Müsgens, 2015)

# Central Questions for the Future

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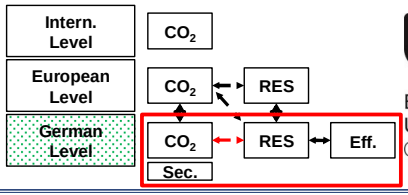
- What is the role of national $CO_2$ emission reduction targets in combination with the European emission trading system?
- How should different instruments be linked efficiently?
- Do we want additional efficiency gains from (further) harmonization and competition (within Germany and beyond and within RES and beyond)?
- **Do we want to coordinate the Energiewende with markets or regulation?**
- Are we giving enough attention to non-ETS sectors (e. g. transportation, agriculture)?
- Regulatory Risk
- Are other countries learning from the Energiewende? What are they learning?
- What are the means (instruments) and what are the ends (objectives)?
  - renewable energy sources?
  - a decentralized energy system?
  - energy efficiency?
  - …



# System Integration and Coordination – Markets or Regulation

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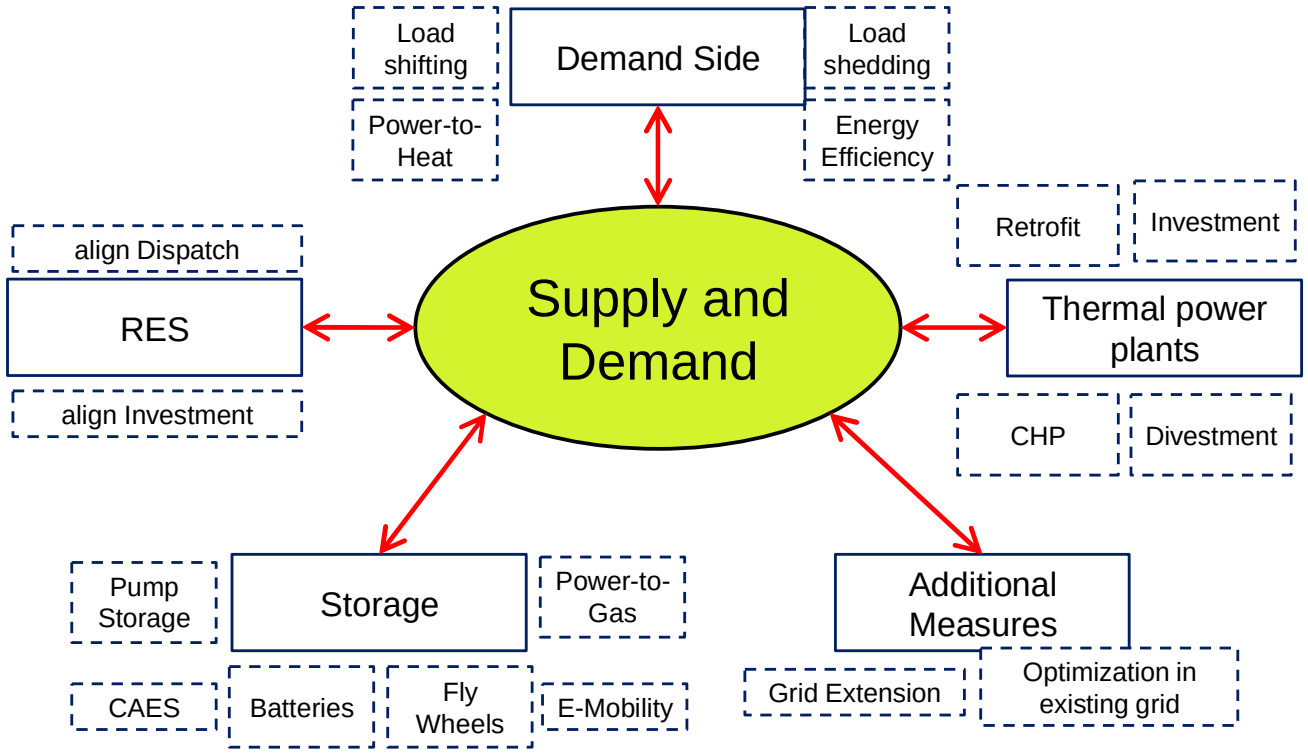
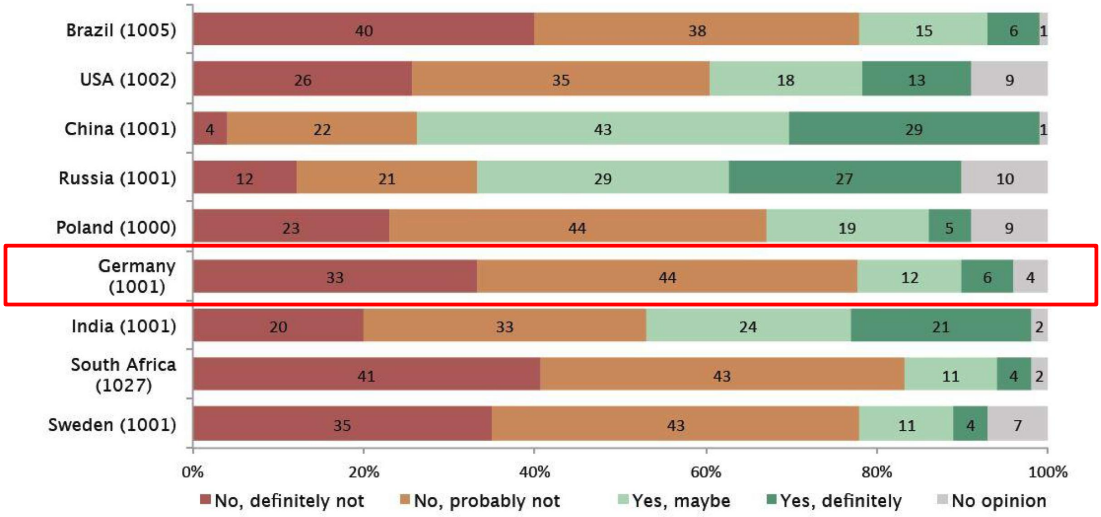


Q3. Do you think enough is being done politically to counteract climate change in order to eliminate the risk of extreme climate catastrophes? Base presented in parentheses next to each country.




Global Challenges Foundation Risk Survey:
The Pulse of International Sentiment



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# Cop21 in Paris – History Repeating Itself?


**Hopefully not!**

# Thank you for your attention!

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