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Designing effective and efficient climate and energy packages. Some reflections on German and international experiences.

German Federal Ministry for the Environment, Nature Protection, Building and Reactor Safety (BMUB) /
German Emissions Trading Authority (DEHSt)

Study Tour Chile

Dr Felix Chr Matthes

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Disclaimer and preliminary remarks

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- **The views and opinions expressed in this presentation are partly based on results from research commissioned by the German Federal Ministry for the Environment, Nature Protection, Building and Reactor Safety (BMUB), the German Federal Ministry for Economic Affairs and Energy (BMWi), the German Federal Environment Agency (UBA), the European Commission (EC) and the European Environment Agency (EEA).**
- **The contents of this presentation does however not necessarily reflect any official position of Germany or the European Union.**

Reminder: It is about designing climate policy at the intersection of various (energy) megatrends

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New quality of (global) fuel market uncertainties!

New quality of technology development / cost uncertainties!

New quality of regulatory uncertainties?

Liberalisation/ Restructuring	Deep Decarbonisation	Decentralisation Digitalisation	Infrastructure dependency	Sector integration
The competitive environment is there to stay Free customer's choice Unbundling	New technologies with new economic characteristics Energy efficiency implications	New technologies Strong coordination needs New players New economic appraisals	Stronger and partly new roles for transmission and distribution grids Unsettled role of storage	New energy demands Flexibility options from sector integration

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Climate Policy in Germany: A long history of climate policy programmes (targets, policies & measures)

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Year	Climate Policy Program	Key targets (all programs contain also policies & measures)
1990 (June)	First Climate Policy Programme (West Germany)	CO_2 emission reduction of 25% by 2005 (compared to 1987)
1990 (November)	First Climate Policy Programme (incl. E Germany)	CO_2 emission reduction of 25% by 2005 (compared to 1987) and more in East Germany
1992	Second Climate Policy Programme	CO_2 emission reduction of 25-30% by 2005 (compared to 1987)
1994	Third Climate Policy Programme	CO_2 emission reduction of 25-30% by 2005 (compared to 1987)
1997	Fourth Climate Policy Programme	CO_2 emission reduction of 25% by 2005 (compared to 1990)
2000	National (Fifth) Climate Policy Programme	CO_2 emission reduction of 25% by 2005 (compared to 1990) GHG-6 emission reduction of 21% by 2008/2012 (compared to 1990
2007	Integrated Energy and Climate Programme	GHG-6 emission reduction of 30% (unconditional) or 40% (conditional) by 2020 (compared to 1990)
2010	Energy Concept	GHG-6 emission reduction of 40% by 2020 (unconditional), 55% (2030), 70% (2040), 80-95% (2050, compared to 1990), energy efficiency & RES targets
2011	Energy Concept and Nuclear Phase-out	GHG-6 emission reduction of 40% by 2020, 55% (2030), 70% (2040), 80-95% (2050), all unconditional and compared to 1990, nuclear phase-out by 2022
2014	Climate Policy Action Plan	Gap closure for GHG-6 emission reduction of 40% by 2020 (compared to 1990)
2016	Climate Policy Plan 2050	Approval of 2020, 2030, 2040 and 2050 targets, sectoral targets for 2030

Memo items:
1. Germany's National Climate Change Programmes are embedded in European Union Climate Policy Programmes/Packages (2000, 2005, 2008, 2011, 2014, 2017/2018)
2. All German and EU programmes were based/accompanied on/by extensive modelling exercises (modelling cycles of typically 2 years)

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Sustainable/robust climate policy strategies
Targets, strategies and policy mechanisms

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- **Energy transition is an target-driven project (policy-driven structural change of the energy system)**
- **Long-term targets are crucial for consistent climate policies**
- **The technological, market and political environment for the needed transformation processes is however increasingly dynamic/volatile**
- **From a policy planning perspective a three step approach is needed**
  - targets (evaluation metrics, safeguarding policy arenas, consistency checks, creating analytical capital)
  - strategies: medium to long-term pathways for activities that can be defined without reference to specific policy implementation mechanisms (safeguarding policy arenas, missions, accountability, consistency, differentiation of phases, identification of crossroads)
  - implementation mechanisms (depending on the phases of transformation, market, political, social environment or arrangements)
- **Germany has a differentiated set of targets and a broad (and partly arbitrary) range of implementation mechanisms but a clear deficit in strategies (which is partly the reason for the recent challenges)**

A comprehensive target framework
Creating sectoral accountability is crucial

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	Targets as of …												
	2010	2016	2016	2016	2016	2016	2010	2014	2010	2010	2010	2010	2011
	Greenhouse gas emissions						Renewable energies		Energy efficiecy				Nuclear energy
	Total	Energy sector	Buildings	Transport	Industry	Agri-culture	Gross final energy	Power gene-ration	Primary energy	Space heating	Final energy ransport	electricity con-sumption	
2011													-41%
2015													-47%
2017													-54%
2019													-60%
2020	-40%						18%	35%	-20%	-20%	-10%	-10%	
2021													-80%
2022													-100%
2025								40 to 45%					
2030	-55%	-61 to -62%	-66 to -67%	-40 to -42%	-49 to -51%	-31 to -34%	30%						
2035								55 to 60%					
2040	-70%						45%	65%					
2050	-80 to -95%						60%	80%	-50%	-80%	-40%	-25%	
Base year	1990	1990	1990	1990	1990	1990	-	-	2008	2008	2005	2008	(2010)

BReg 2010, 2011, 2016, BT 2014

Realizing what transforming the energy system is really about: managing structural change

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- **Energy transition: towards a low/zero carbon, risk minimized and renewables-based energy system**
  - the technologies are available (globally): it is about getting the full value chain on the ground (with high local shares)
  - clean options are competitive and/or affordable on a LCOE basis: it is about creating business models (with high local shares)
- **Getting the value chain on the ground and creating business models (and making most out of it for the local economy) requires dealing with structural changes & appropriate regulatory/market arrangements**
  - changing characteristics of technologies: variable generation, more (but however not exclusively) distributed/decentralized
  - changing structures of costs: higher shares of fixed/capital costs
  - changing structures of players/market participants: much more diverse investors and operators with new/other (economic) appraisals, other financing approaches, sources or risk assessments
  - changing structures of grids: new spatial patterns, new role of self-generation, transmission, distribution, mini and micro grids

The variety of climate policy mechanism
What shall they deliver

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- **Climate policy suites shall address emission abatement from 4 levers**
  - clean dispatch
    - short-, medium- and long-term
    - rare alternatives , carbon pricing needs to play a crucial role
  - accelerating decommissioning of high-carbon assets
    - short-, medium- and long-term
    - few alternative mechanisms, carbon pricing can play a crucial role
  - strengthening low/zero carbon investments
    - medium and long-term
    - variety of alternative mechanisms (e.g. all remuneration schemes)
  - triggering downstream effects (changing consumption patterns)
    - medium- and long-term
    - variety of alternative mechanisms

A comprehensive and well-designed policy mix needs comprehensive and well-designed analysis

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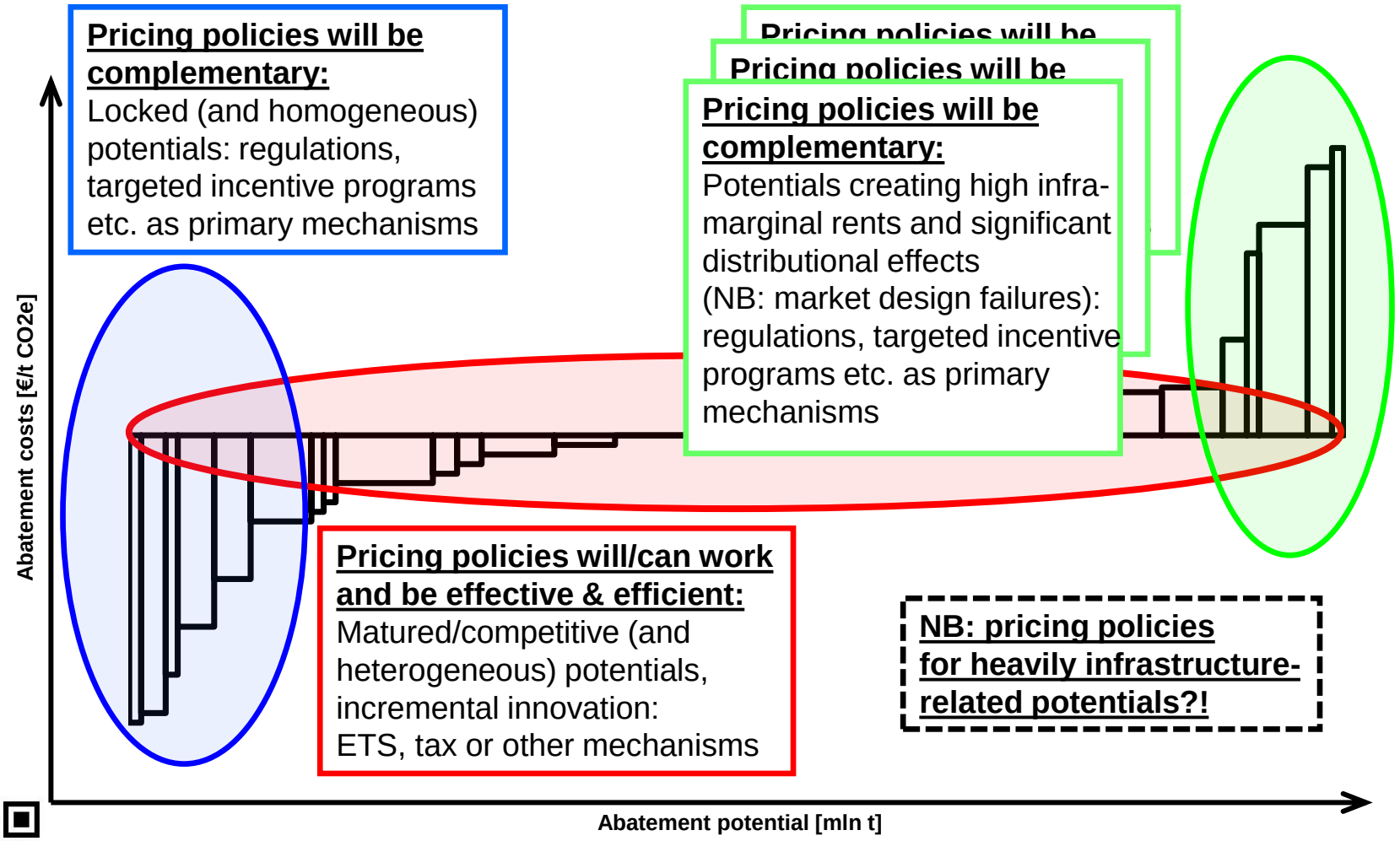

Öko-Institut 2010. IEA 2011+2015

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Carbon pricing as part of the policy mix
Responsive carbon pricing is of growing importance

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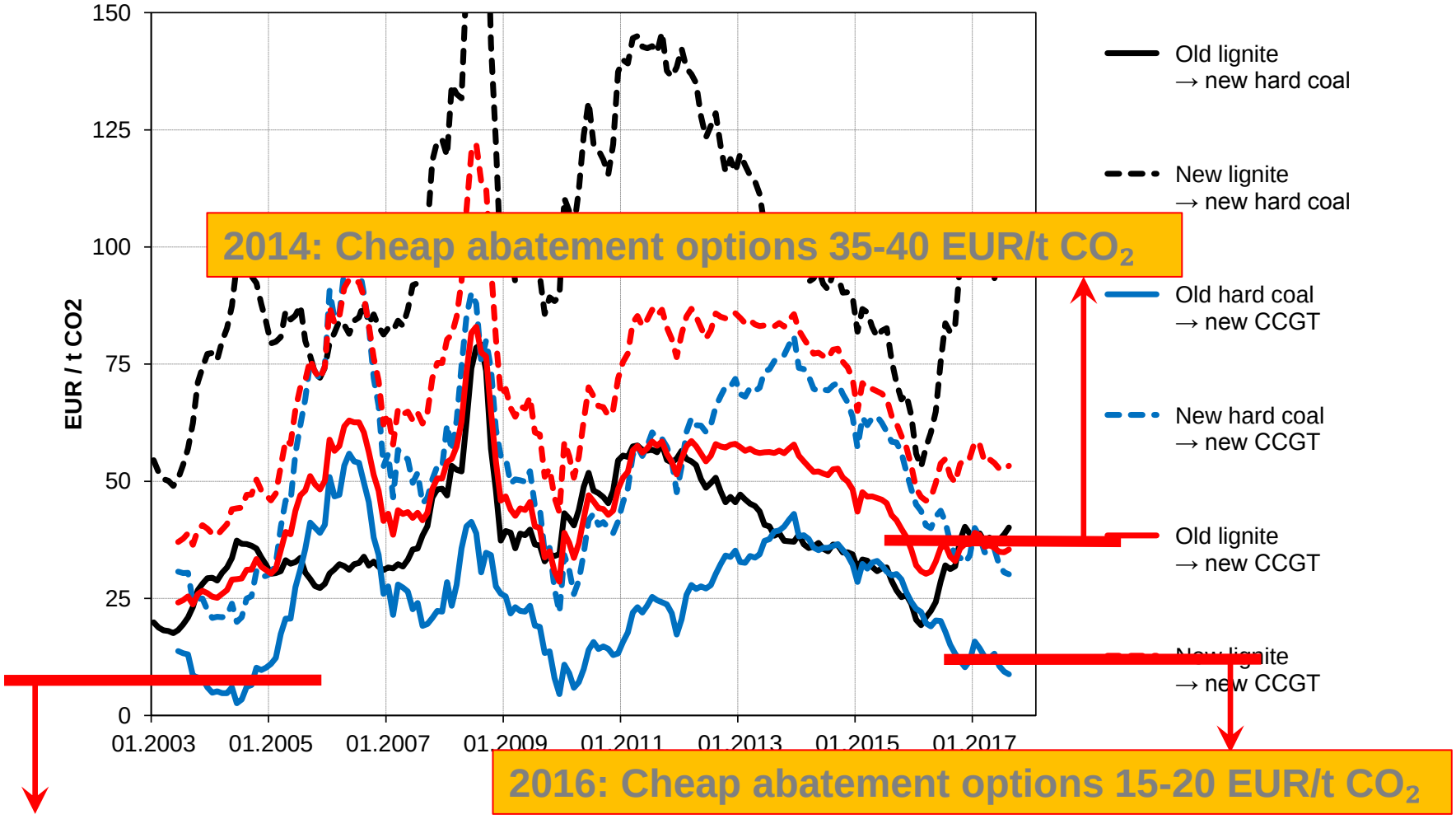

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Carbon pricing & companion policies
Options of policy coordination (1)

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- **Policy coordination by careful ex ante planning**
  - reflection of interactions in the design of policy mechanisms
  - significant uncertainties remain (policy uncertainties, macroeconomic uncertainties, fuel market environment, technological progress)
  - suitable for short revision cycles
  - dealing with uncertainties and/or real outcomes depends on positioning of an ETS in the policy mix:
    - ETS as a fallback mechanism for emission reduction (CA ETS, EU ETS after structural reform): remain with the cap
    - ETS as the spearhead mechanism for emission reduction (NZ ETS, initial plan for the EU ETS): adjust the cap (see previous presentation)

Carbon pricing & companion policies
The EU approach of ex ante planning (Phase 3)

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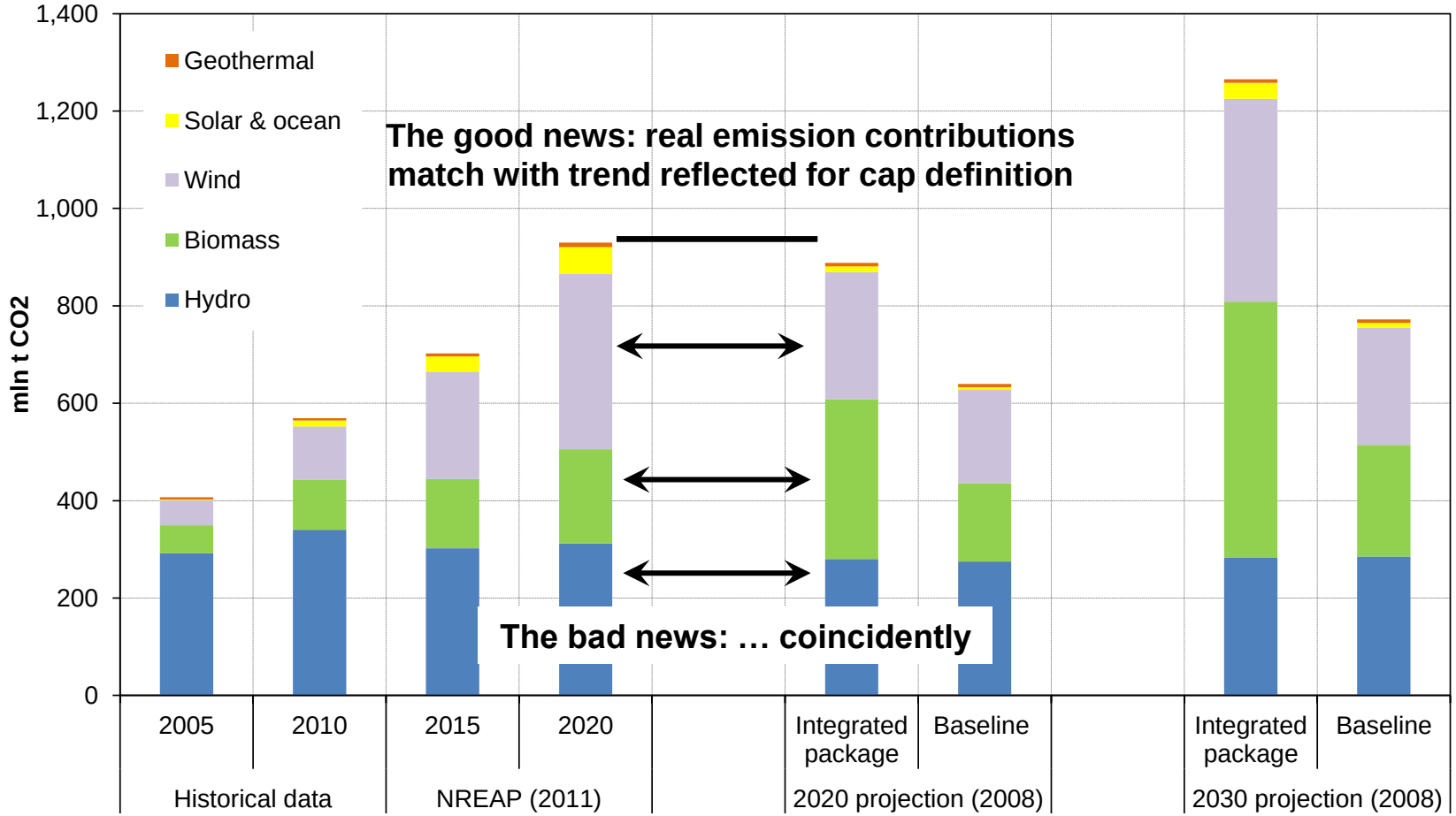

Carbon pricing & companion policies
Options of policy coordination (2)

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- **Policy coordination by designing responsive carbon pricing tools**
  - price control with quantity-based elements (tax instruments with offsetting instruments)
  - quantity control with explicit price elements (price floors etc.)
  - quantity control with quantity/scarcity-based price elements (MSR of the EU ETS, exchange rates)
  - other flexibility designs (conditional allowance cancellation, etc.)
- **Policy coordination by integrating the longer-term horizon**
  - explicitly: long-term caps (if appropriate and possible)
  - complementary: other framing options (long-term contracts etc.)

Carbon pricing & companion policies
Scoping the policy landscape is crucial

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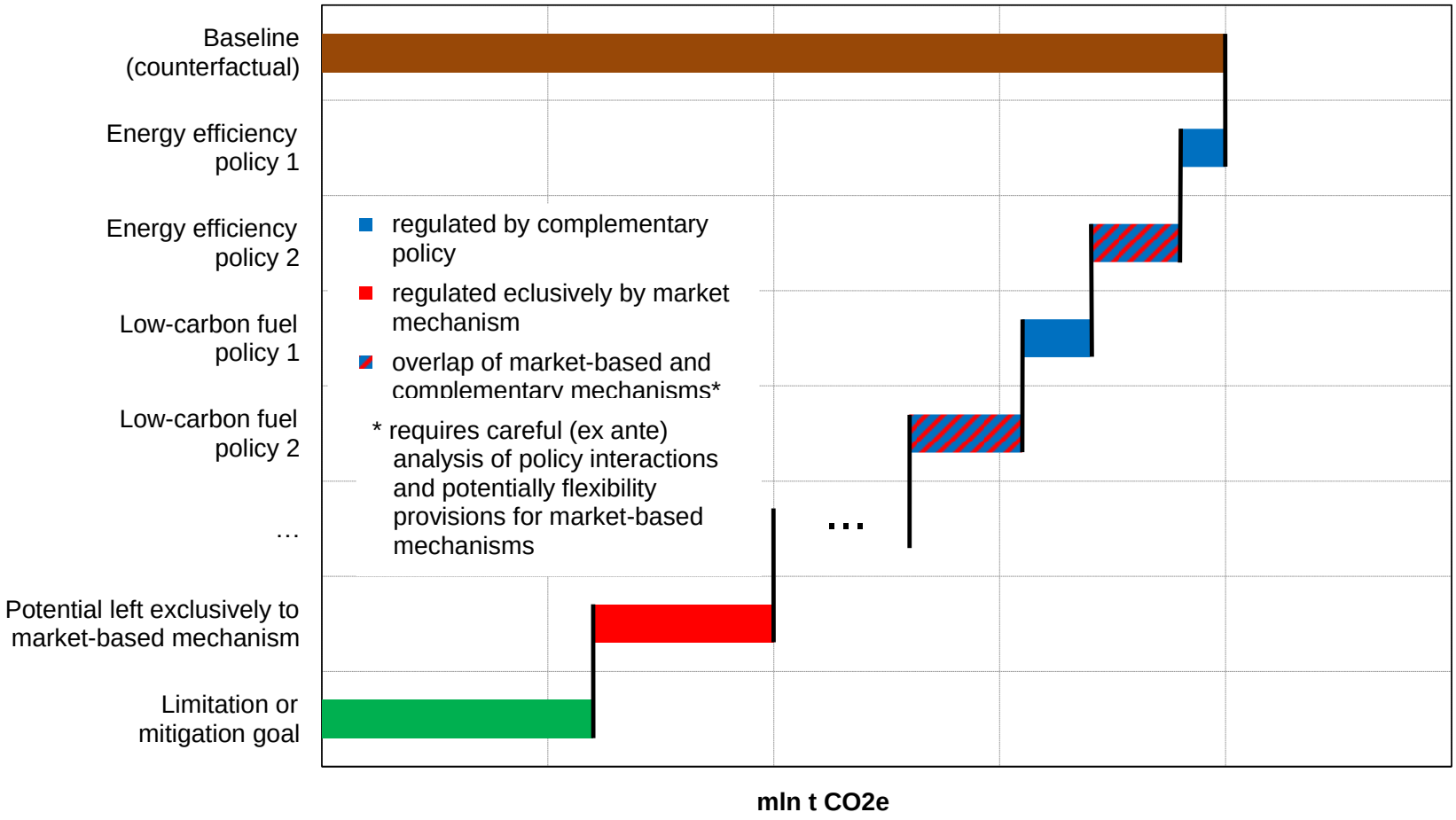

Carbon pricing as part of a broader policy mix
Conceptual considerations on revenue recycling

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- **There is a long discussion on approaches for revenue recycling**
  - straight forward in the text books
  - more complicated under real world conditions (political/cultural traditions, legal constraints, political windows of opportunity)
- **The traditional "Double Dividend" Approach**
  - using revenues to lower distorting taxes (labor taxes, contributions to pension and social security funds): making the use of natural resources more expensive and lower the costs of labor
  - mixed experiences
- **The "Triple Dividend" or "New Double Dividend" Approach**
  - using revenues from resource pricing mechanisms also/additionally (or even exclusively: the "new double dividend") to lower the (future) costs and distributional effects of emission abatement etc.
    - within the mechanism that generates the revenues
    - with a broader scope

The German Energy & Climate Fund (EKF)
The uncertainties of revenues

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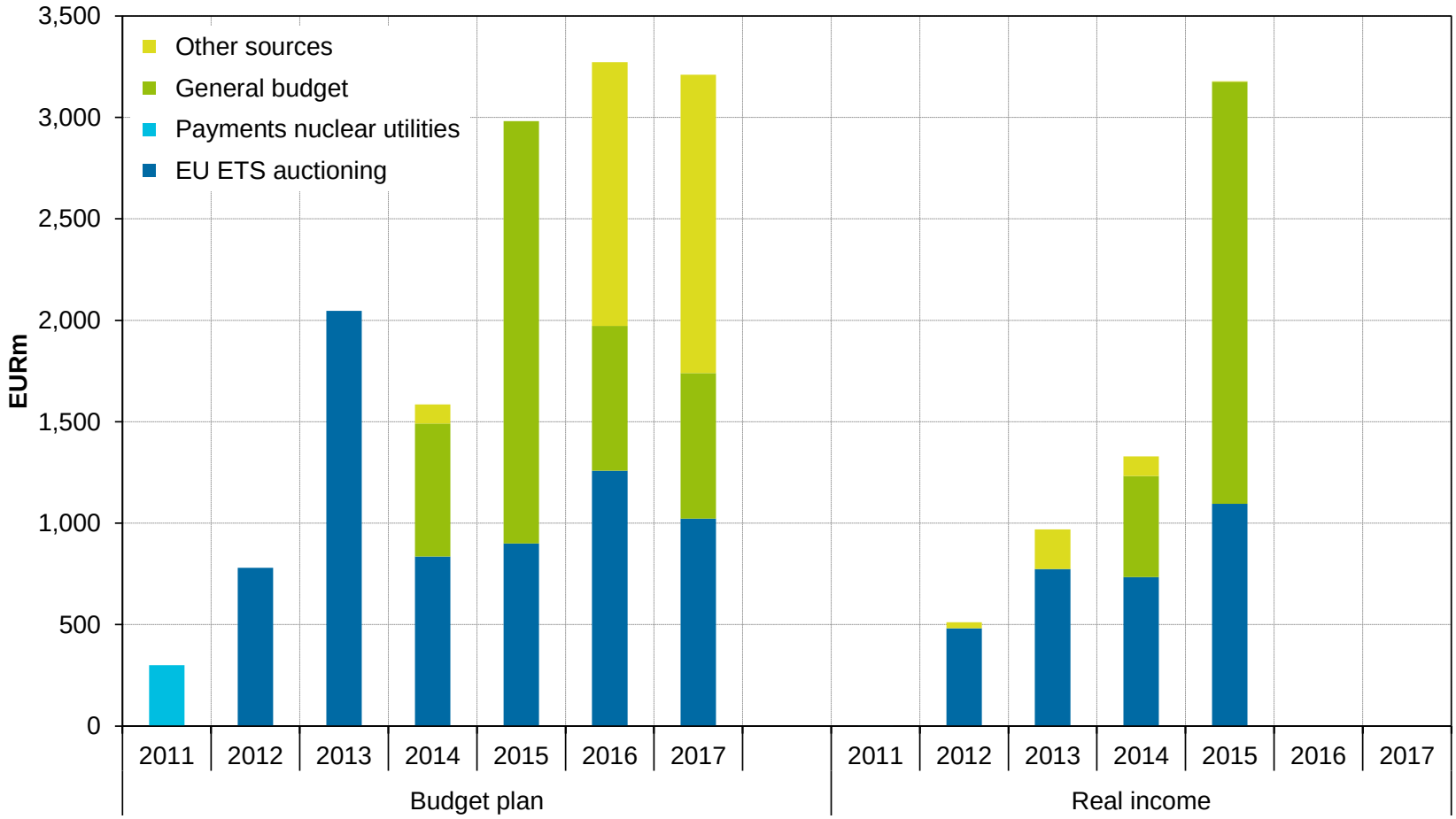

- planned revenues from auctions did not materialize due to the real EUA price developments
- in a highly uncertain market environment a complementary funding source (the Federal budget) was/is needed

The German Energy & Climate Fund (EKF)
Structure of planned & real expenditures

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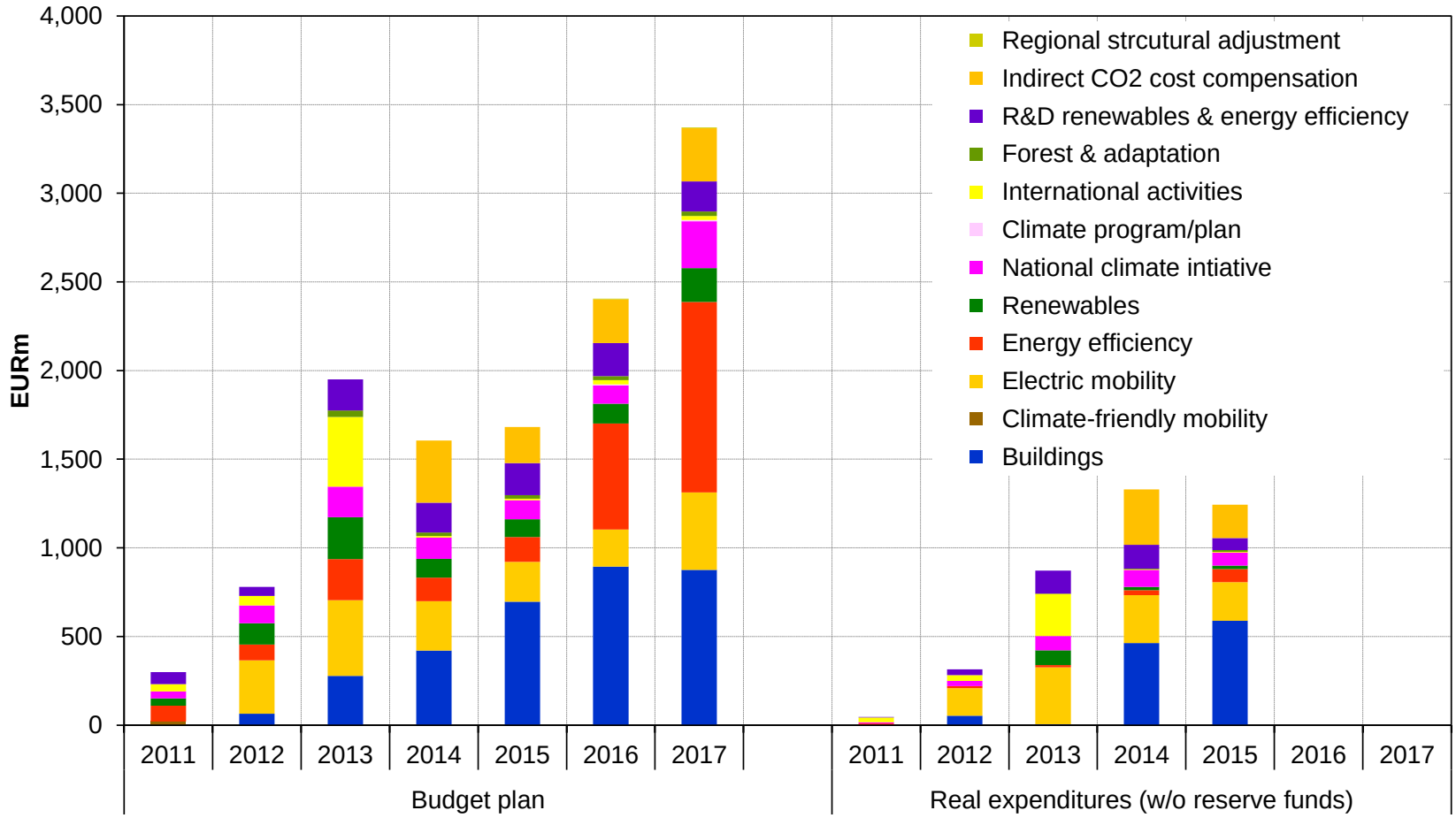

- broad range of programs and activities, significant changes over time, phase-in
- main focus (in terms of spending) on buildings, electric mobility, indirect CO2 costs compensation for energy-intensive industries and energy efficiency
- phase-in of new large-scale programs took significantly longer than expected

The NER 300 program under the EU ETS
Project awards

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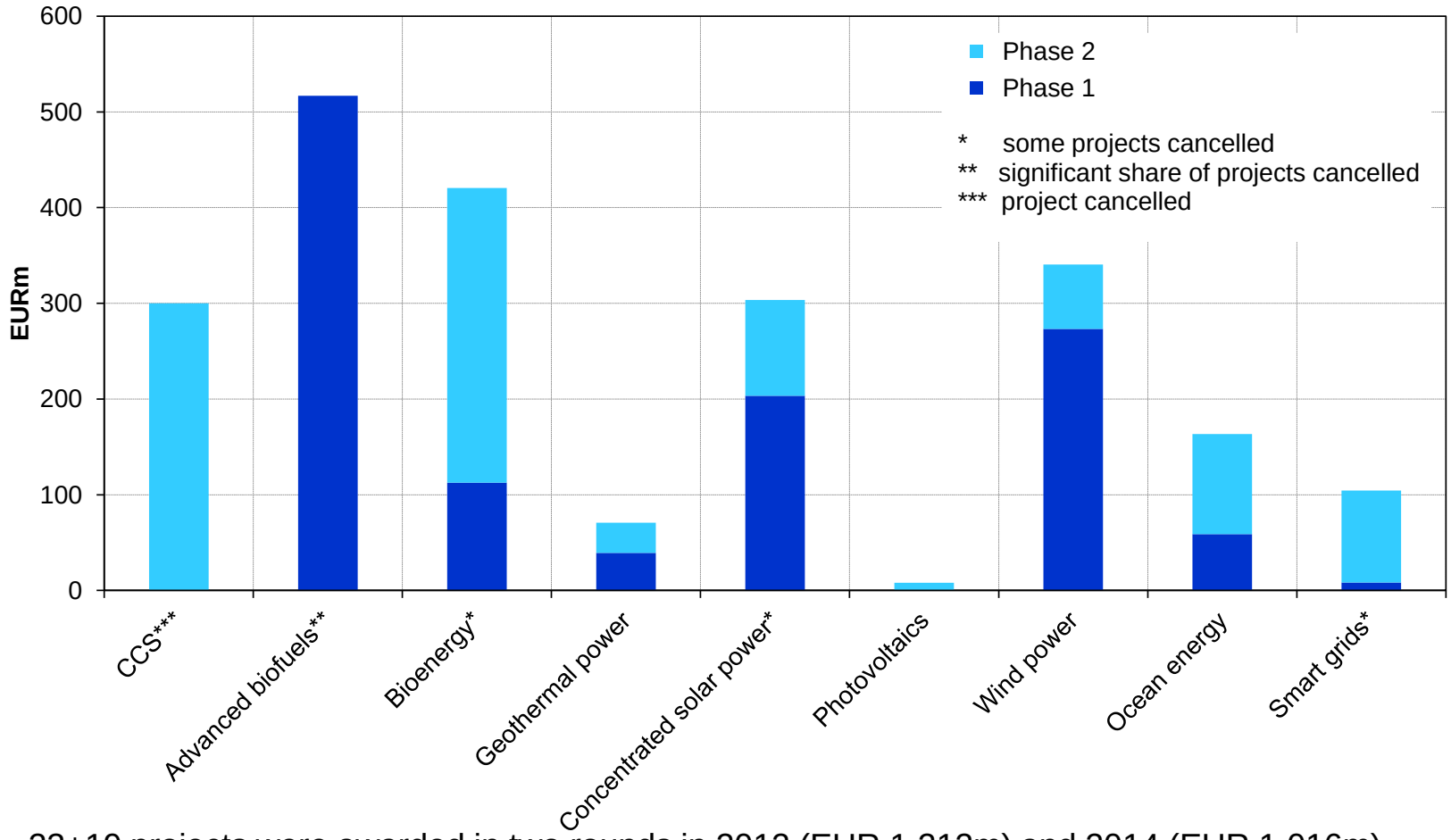

- 23+19 projects were awarded in two rounds in 2012 (EUR 1,212m) and 2014 (EUR 1,016m)
- some of them were however withdrawn (by both, project-specific reasons and a changing regulatory environment, e.g. for biofuels)
- projects for renewable energies clearly dominate the program, the only CCS project failed

The German EKF & the EU'S NER300 program
Lessons learned (1)

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- **Innovation programs that are financed by revenues from an ETS are part of a broader ecosystem of financing mechanisms**
  - positioning the "new mechanisms" depends on specific circumstances
    - essential: driving innovation related to ETS-regulated sectors (more focus on transformative options for non-power industries)
    - essential: compensation for energy-intensive industries (as well as probably low-income households)
    - nice to have: transition support & broader expenditures
  - clear legitimation is crucial: raising new revenues or improving the impact (and the acceptance) of an carbon pricing instrument
  - fiscal policy and legal issues may play a major role
- **Funding mechanisms that are depending on revenues from auctioning or sales in an ETS face the challenge of volatile income**
  - the architecture of the mechanism should foresee a backup/ compensation mechanisms

The German EKF & the EU'S NER300 program
Lessons learned (2)

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- **Careful choices on the implementation mechanisms need to be done: auctions, consignment auctions or conditional free allocation**
- **Large-scale innovation programs today face the challenges of a rapidly changing technology and regulatory environment**
  - careful analysis on longer term trends and the role that demonstration programs really can play is crucial
  - some flexibility is important, e.g. if large-scale projects are addressed
- **Evaluation is important**
  - earmarking sufficient funds is important (e.g. 5% of program volume)
  - developing clear evaluation criteria and methodologies is important as well as defining (different) priorities for (different) project clusters
  - "accompanying evaluation" can offer substantial improvements
- **Organizing the programs in phases with clearly defined evaluation and revision points is important**
  - linking it to the phases of an ETS is a smart approach
  - balancing flexibility/ability for improvement and limiting uncertainties

Domestic & global lessons for the EU ETS
The 10 essential elements for an advanced ETS

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1.	**A reliable data framework**	**… to make quantity-based emission control effective**
2.	**A consistent and robust governance framework**	**… to build trust, integrity and an accountable system**
3.	**An ambitious & effective cap**	**… to address a broad range of emission abatement levers and make ETS an integral part of the policy mix**
3a.	… with a longer time horizon	… to provide a clear trajectory and to enhance investors' confidence (in the long-term)
3b.	… with a market integrity reserve	… to maintain responsive and scarcity-based price formation (in the medium & long term)
		… to ensure the (short & medium term) integrity of the (necessary) policy mix
3c.	… with a price floor	… to enhance investors' confidence in the price signal (in the short- & medium-term)
3d.	… with allowance cancellation provisions	… to ensure the (long term) integrity of the (necessary) policy mix
4.	**A carefully designed and non-distorting allocation approach**	**… to go beyond distributional issues and ensure a cost-efficient quantity-based emission control**
4a.	… with (direct/consignment) auctioning	… to maintain a non-distorted price signal and raise revenues for compensation & innovation
4b.	… with product-based bench-marking for free allocation (if any)	… to address the broadest range of mitigation options possible
4c.	… avoiding updating/output-basing of free allocation	… to maintain the incentives for optimal production levels as far as possible
5.	**A liquid market with broad eligibility for trading**	**… to maintain effective price discovery and making hedging possible**

Learning by doing: Building trust that it can be done but also awareness on the shortfalls

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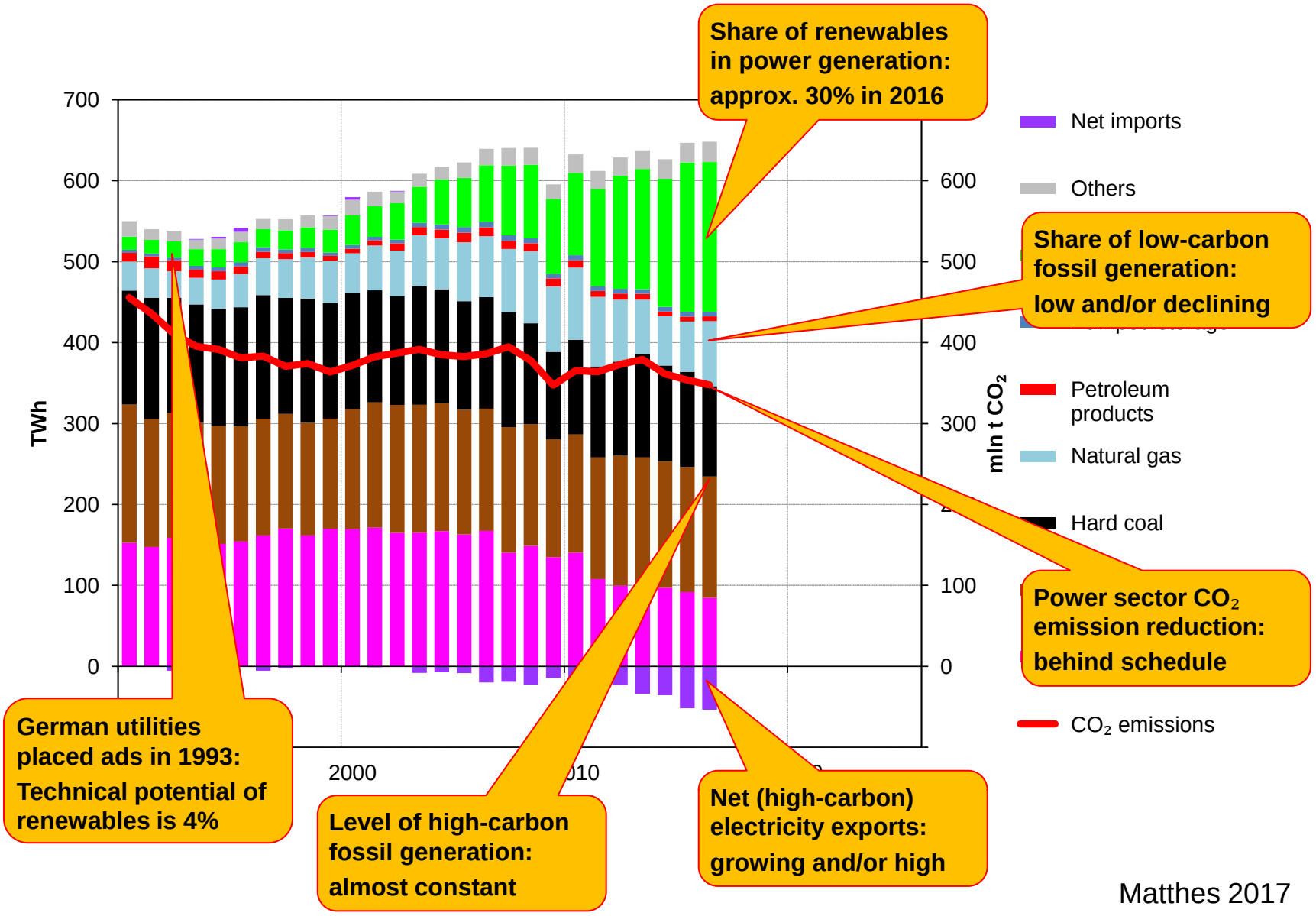

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Effective, innovative & efficient strategies
The Four-Pillars Approach

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- **Paving the way – for energy efficiency, clean generation & flexibility options (renewables & complementary flexibility)**
  - innovation, level playing field & roll-out for renewables (☺) and energy efficiency (😐)
  - sustainable economic basis (enabling coordination & investments) (😐)
- **Designing the exit-Game – for the non-sustainable capital stocks**
  - appropriate mechanisms that address security of supply, flexibility, emission levels and fixed costs (😐) – for nuclear power (☺) and high-carbon assets (☹)
- **Triggering the necessary infrastructure adjustments – with sufficient lead-times** ☹
  - integration of centralized, distributed, storage & DSM/flexibility options
  - reflection of the new geography of the energy system
- **Making the necessary innovation work – in time** ☺
  - for energy efficiency, generation, flexibility, storage and integration

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Thank you very much

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Backup

Climate & Energy Policy in Germany
Economic and energy background

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- **German population 82.5 million (2016)**
- **German GDP € 3,134 bn (US$ 3,468 bn) in 2016**
  - highly industrialized (26% of GDP from industry)
    - strong manufacturing industry
    - strong primary industries (2016: Crude steel production 42 mln t, Primary aluminum production 546,800 t)
  - strong net exporter (net trade surplus in 2016: ~ € 249 bn)
- **Primary energy (2016): Oil 34%, natural gas (22.5%), hard coal (12.3%), lignite (11.3%), renewables (12,6%) , nuclear (6,9%)**
- **Power generation (2016): lignite (23.1%), renewables (29%), hard coal (17.2%), nuclear (13.1%), natural gas (12.4%), others (4.3%)**
- **Energy sector strongly depending on energy imports (oil, gas, hard coal, nuclear): 71.3 of total primary energy imported (2016)**
- **Significant natural gas hub in Europe: 23% of imports are re-exported**
- **Electricity sector with significant net exports: net electricity exports of 8.8% of total net electricity generation (2016)**

Climate & Energy Policy in Germany
Political and administrative background

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- **Proportional representation system (for all jurisdictions)**
  - significant role of smaller parties: Liberals (FDP, since 1949), Greens (Bündnis 90/Die Grünen, since 1983), Left (Linke, since 1990), Far Right (AfD, since 2017)
- **Strong federal structures (significant impact of states on energy legislation and comprehensive system of checks and balances)**
- **Strong municipalities (~900 municipal utilities)**
- **Member of the European Union (internal market, increasing integration of energy and climate policies)**
- **Relatively strong public awareness on environmental and risk issues for a long time (acid rain, clean air, nuclear, water pollution)**
- **Relatively high energy prices for many years (taxation, high levels for security of supply = high share of infrastructure costs, remuneration of renewables) but relatively low share of energy costs in total consumption expenditures (2.3% electricity, 1.9% heating fuels, 3.0 motor fuels) or gross industrial production output (1.6%)**

Transforming the energy system
Not to forget the broader energy policy framework

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- **Liberalised energy markets (since 1996)**
  - utilities are increasingly vulnerable to switching customers
  - unbundled electricity and gas network operations (legal/ownership)
  - central trading platforms (electricity exchange) provide price transparency
  - broad market transparency on generation, networks
- **A strong tradition of decentral/cooperative economic activities (since the early 20th century)**
  - strong decentral/cooperative sector (businesses, financial sector etc.)
  - robust legal and institutional framework for the decentral/cooperative sector

Smart infrastructure roll-out can provide political/strategic flexibility: The old geography

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Low load / medium conventional region North

Low load

Medium nuclear capacities

Low conventional capacities

High load / high coal region West

High load

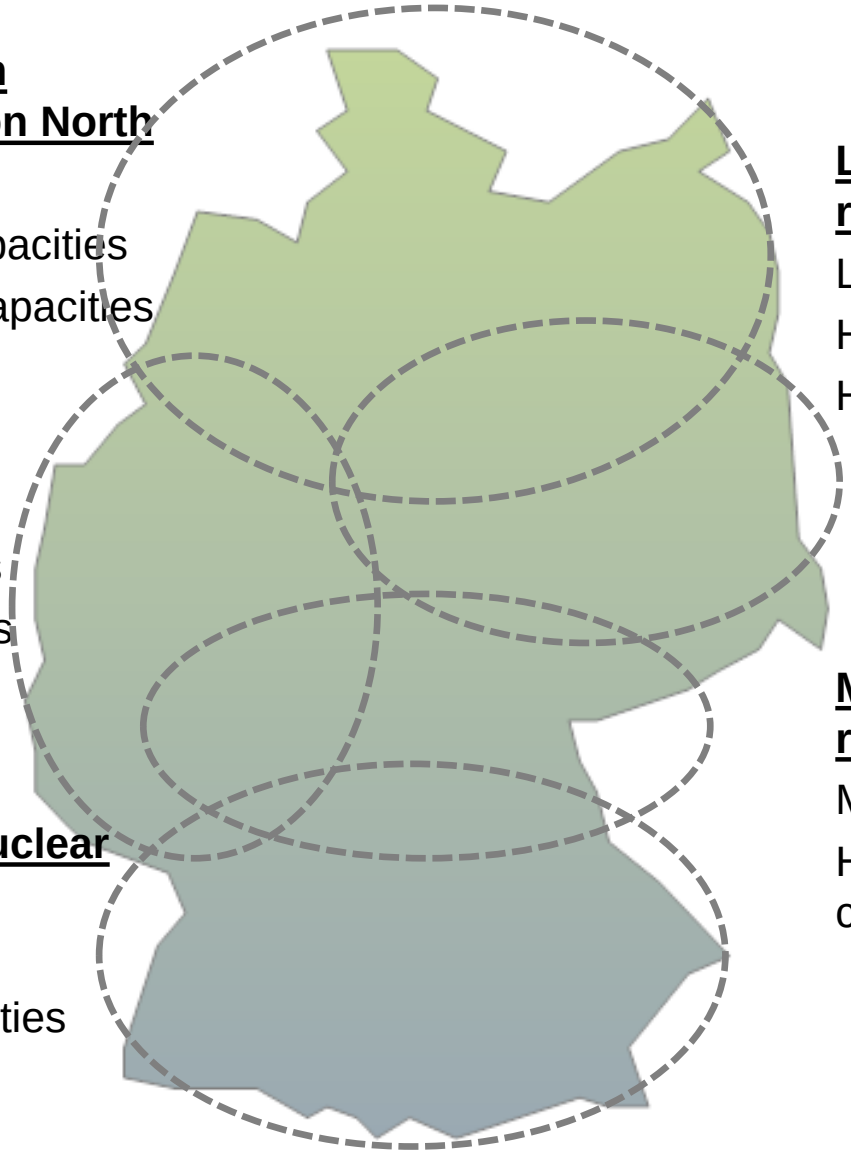
High coal capacities

High CHP capacities

High load / high nuclear region South

High load

High nuclear capacities



Low load / high coal region East

Low load

High coal capacities

High CHP capacities

Medium load / storage region Center

Medium-/ high-load

High pump-storage capacities

Smart infrastructure roll-out can provide political/strategic flexibility: The new geography

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High wind region North

Low load

High onshore/offshore wind

High load /medium RES region West

High load

Medium RES

High CHP

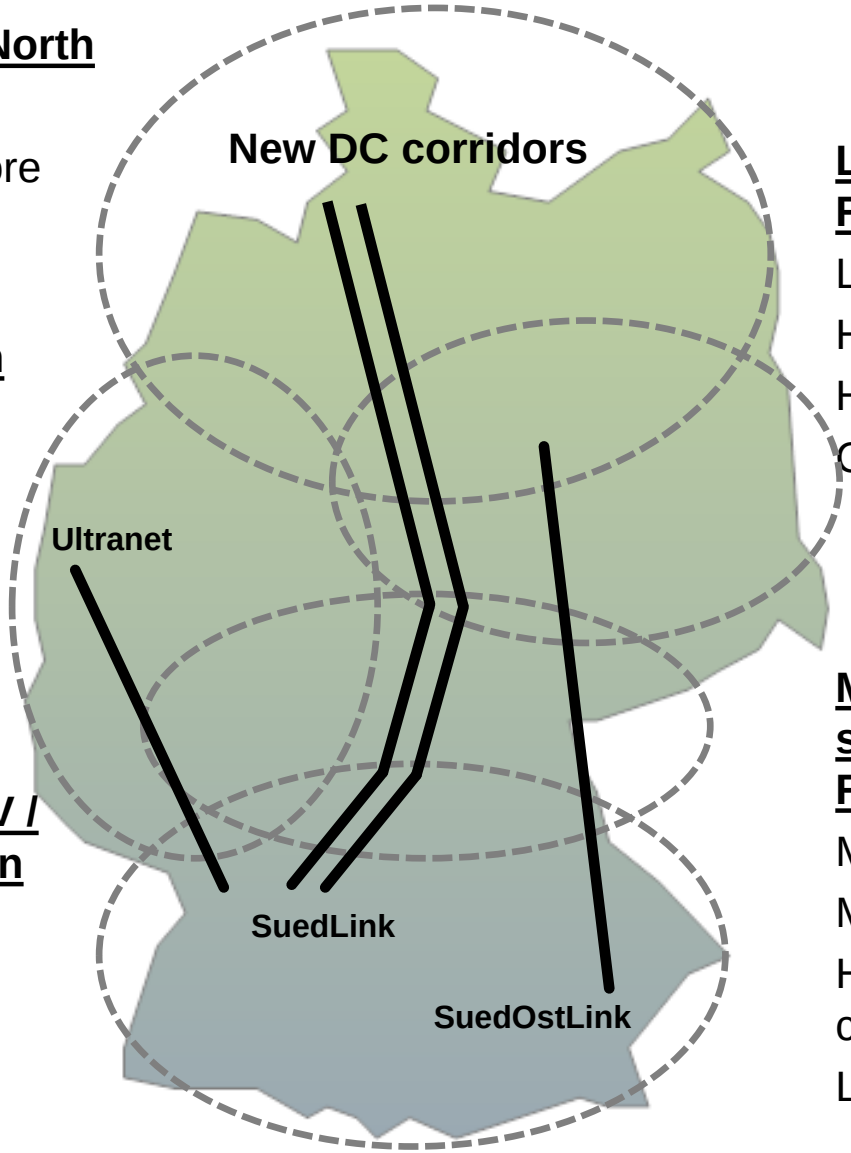
Coal phase-out

High load / high PV / high storage region South

High Load

High PV

Access to storage capacities abroad



Low load / high wind Region East

Low load

High wind

High CHP

Coal phase-out

Medium load / infra-structure & storage Region Center

Medium/high load

Medium RES

High pump storage capacities

Large electricity transits

Beyond the economics of the system
New structure of players, assets … and participation

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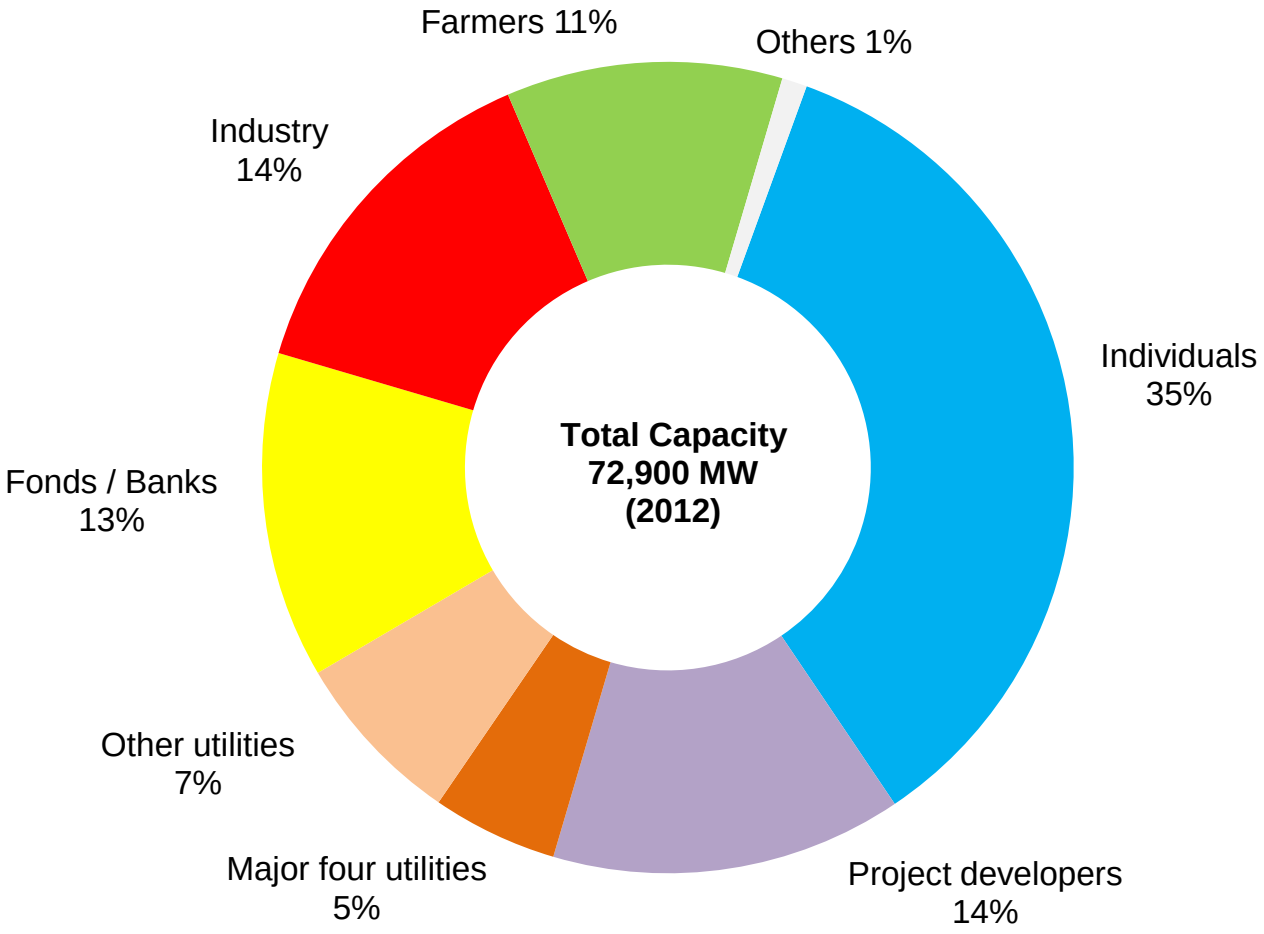
- **The traditional German power system**
  - running a (centralized) system based on <500 large generation units
- **The emerging new power System in Germany (as of summer 2016)**
  - approx. 1.6 million PV installations
  - approx. 28,200 wind power installations
  - approx. 9,200 biomass power plants
  - approx. 35,000 small- and medium-scale cogeneration plants
  - approx. 700 conventional power generation units
- **The need for a new market design**
  - for phase 1 of roll-out of renewables (0…25% market share) investment certainty and broad economic participation are priority #1
  - for phase 2 a new balance needs to be found between priorities from phase 1 and the increasing need for coordination and an appropriate sharing of risks
- **The (important) potential for economic participation**

Expansion of power generation from renewables
New structure of players & the need for coordination



trend:research 2013

German Energy & Climate Fund (EKF) Background

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- **German Energy & Climate Fund (Energie- und Klimafonds – EKF)**
  - created in 2010, originally to earmark the revenues from the nuclear fuel tax that was introduced in the context of the lifetime extension of the German nuclear power plants
  - from 2011 onwards: collecting the EU ETS auctioning revenues
  - one of the few complementary mechanism to the Federal budget (and at least partly controversial from the budget policy side)
  - focused on different dimensions of the energy transition
  - however not the only financing mechanism for the energy transition or climate policy
  - in some parts very dynamic and in some parts rather robust over time

The German Energy & Climate Fund (EKF)
Empirical evidence (so far)

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- **German Energy & Climate Fund (Energie- und Klimafonds – EKF)**
  - effectively focused on three main areas
    - locked emission abatement potentials (energy efficiency), with partly very long-term financing commitments
      - essentially in areas that are not covered by EU ETS
    - innovation (electric mobility, renewables, energy efficiency)
      - essentially in areas that are indirectly covered by EU ETS
    - compensation for indirect CO2 costs (electricity price increases from the CO2 cost pass-through by the power generators) for energy-intensive industries (based an EU legal framework)
      - essentially a complementary measure to EU ETS
  - in addition to this a funding source for manifold (small) activities
    - from international activities to preparation of regional adjustment
  - program activities are subject to specific evaluation

The German Energy & Climate Fund
A closer look to the National Climate Initiative (1)

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- **The National Climate Initiative is a specific program package**
  - organized in 6 programs
    - commercial cooling
    - mini CHP (combined heat and power)
    - municipal activities
    - electrical hybrid busses
    - agriculture and horticulture
    - innovative projects (target groups: businesses, consumers, municipalities, education)
  - annual funding: ~ EUR 100m, > EUR 200m from 2017
  - with few exceptions focused on activities on sectors that are not regulated by the EU ETS
    - exception 1: contribution to the Environment Innovation Program
    - exception 2: indirect effects from electricity savings and power generation from mini CHP

The German Energy & Climate Fund
A closer look to the National Climate Initiative (2)

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- **Holistic approach, addressing different mechanisms of decision making**
  - broad incentive programs for (technology) investments
  - informational programs
    - broad campaigns
    - specific decision making support
    - specific decision maker support
    - peer-to-peer/network/best practice activities
  - education
- **Major share (~90%) of funding is however directed to incentivize investment activities**
  - approx. 45% for municipal activities (street lighting etc.) (roll-out)
  - approx. 30% for cooling technologies (roll-out and innovation)
  - approx. 5% for mini CHP (roll-out and innovation)

- **Evaluation of the National Climate Initiative**
  - 2 rounds of evaluation completed
    - comprehensive evaluation reports publicly available
    - evaluation handbook (not yet available publicly)
  - "accompanying evaluation" (program improvement "on-the-fly" and early alerts)
  - comprehensive set of evaluation criteria with different priorities for different program activities
    - climate effects: emission abatement, energy savings, emission abatement per unit of funding
    - role model capabilities: feasibility, visibility, potentials for transfer
    - scope: target groups, regional scope
    - continuity: capacities/competences, human resources, continuation after program end
    - economic effects: abatement costs, employment effects, leverage of support, regional effects

The NER 300 program under the EU ETS
Background

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- **NER 300 = 300 m allowances from the New Entrant Reserve of the EU ETS (5% of the total amount of allowances available for phase 3 = 510 million allowances) were set aside to support innovative technologies**
  - legal basis is the EU ETS directive and a Commission Decision
  - operated by the European Commission (EC) and the European Investment Bank (EIB)
  - originally planned to drive forward the development of CCS, in the political process expanded to innovative renewable energies
  - two rounds of applications (2012 and 2014), funding of projects that withdraw their proposals were made available for the second round
  - unused NER300 funds will be channeled into InnovFin Energy Demo Projects (EDP) and Connecting Europe Facility (CEF) of EIB
- **EIB sold 300 million (phase 3) allowances into the market from December 2011 to April 2014 at exchanges and OTC**
  - 200 million allowances for EUR 1,609m (Dec 2011 to Sep 2012)
  - 100 million allowances for EUR 548m (Nov 2013 to Apr 20124)

- **Eligible projects**
  - innovative commercial-scale demonstration projects
  - detailed list of project categories (for details have a look at: https://ec.europa.eu/clima/sites/clima/files/ner300/docs/c_2010_7499_en.pdf)
  - different treatment in 2 groups: CCS & innovative renewables (iRES)
  - ranking of proposals according to cost-of-performance
  - no more than three projects per member states
  - co-funding with other national or European programs is possible but subject to approval, operators shall provide substantial co-funding
- **For more procedural details**
  - https://ec.europa.eu/clima/policies/lowcarbon/ner300_en

Revenue recycling mechanisms
Outlook for phase 4

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- **Revenue recycling plays a significant role in the revision process for the EU ETS, four mechanisms will be implemented**
  - Innovation Fund (monetization of 450m [600m] EUA)
    - CCS, iRES & low-carbon innovation in energy-intensive industries (successor to the NER300)
  - Modernization Fund (monetization of 2% of total cap = ~400m EUA)
    - low-carbon options for low-income member states
  - Just Transition Fund (monetization of ~180m EUA)
    - support for regions or sectors (coal mining regions etc.) that face more painful transition challenges
  - a more exotic mechanism: conditional free allocation
    - free allocation for East European power generators for specific modernization projects (subject to approval by EC)
    - some perverse outcomes in phase 3, environmental safeguards planned for phase 4