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Establishing Reference Scenarios, and Scenarios for mid- and long-term mitigation scenarios (e.g. 2030, 2050)

Partnership for Market Readiness (PMR) Technical Meeting
» Approaches and Tools to Setting Mitigation Scenarios «

Dr. Felix Chr. Matthes

Washington DC, September 26, 2014

Disclaimer

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- **The views and opinions presented in this paper are partly based on results from research commissioned by the German Federal Ministry for the Environment, Nature Protection and Reactor Safety, the German Federal Environment Agency and the European Commission.**
- **The contents of this presentation does not necessarily reflect any official position of Germany or the European Union.**

Modelling analysis gives answers
Asking the right questions to the models is key

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- **All models and scenario approaches have strengths and weaknesses, asking the right questions to appropriate models is the (more?!) crucial challenge**
  - Is it about setting the right targets (for regions, countries, sectors)?
  - Is it about designing policies or assessing policy mixes?
  - Is it about distributional effects?
- **What are the uncertainties and what are robust corridors of results?**
  - What are the key uncertainties in a specific setting and what are the most “affected” sectors?
  - Is clustering of uncertainties possible, are there interactions between specific uncertainties?
- **How can robust recommendations derived from numerical analysis?**
  - What is the role of clearing and review processes to increase accountability of numerical analysis?
  - How can results be aggregated to robust recommendations which can be understood by the political process?

Germany and the European Union
Changing focus of modelling analysis (1)

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- **Changing focus on target-setting**
  - 1990ies
    - national and EU target setting (Kyoto commitment, national 2005/2010 targets)
    - partly based on macro (top-down) modelling
    - mainly focused on analysis of potentials and policies & measures
  - 2005 and beyond:
    - essentially political decisions on long-term targets (decarbonization by 2050)
    - distribution of (interim) targets to sectors and Member States
    - increasing role of back casting exercises
  - essentially energy / other system models, some applications of econometric models, some CGE modelling

Germany and the European Union
Changing focus of modelling analysis (2)

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- **Increasing focus on policies and policy interactions**
  - numerical analysis of specific policies, their contributions, impacts, and interactions (mandatory bi-annual reporting by EU member states) – and the related uncertainties
  - carbon leakage assessments
  - essentially energy / other system models, some CGE modeling (carbon leakage)
- **The triple A question to the modelling community**
  - What mitigation potentials are and will be **A**vailable?
  - Can these potentials be implemented or combined in a way that certain targets are **A**chievable?
    - from a more technical perspective (capital stocks)
    - from the perspective of policies and measures
  - Are these targets and transitions **A**ffordable?

Germany and the European Union
Long tradition of modelling / scenario analysis (1)

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- **Germany**
  - wide range of scenario tools
    - many sector / system models, some CGE models, one major econometric models
    - run by universities, other research organizations, and consultancies, not a single one by government agencies
  - building analytical capital: major efforts on model comparisons (inputs, outcomes, methodologies) from 1995-2005
    - very comparable results from energy system models (with harmonized input data)
    - major differences for the results of macro / top-down modelling (even for harmonised input data – major impacts of methodological approaches)
  - post-processing (decomposition analysis) as an emerging tool for clearing processes

Germany and the European Union
Long tradition of modelling / scenario analysis (2)

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- **Germany (continued)**
  - increasing focus on higher resolution
    - time
    - spatial
    - structure of capital stocks (committed GHG emissions)
    - market structures and behavior
- **European Union**
  - broad range of models used energy / sectorial system, econometric, CGE
  - however, strong focus on PRIMES model (energy system model)
  - some attempts to implement peer-reviews of input data and results

Case study: Germany
Climate Scenarios & Projection Report (1)

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- **Regularly updated scenarios**
  - Climate Scenarios on an annual basis
  - Projection reports on a bi-annual basis (aggregated to EEA's trend & projections reports for the EU)
- **Scenario design**
  - Climate Scenarios
    - Actual Policies Scenario (all policies implemented before a pre-defined deadline)
    - Climate 80/90% Scenarios: decarbonization targets by 2050
  - Projection Reports
    - With Measures Scenario (= Actual Policies Scenario)
    - With Additional Measures Scenario
- **Time horizon**
  - up to 2030: strictly based on policies and measures
  - 2030-2050: trend projections for policy clusters

Case study: Germany
Climate Scenarios & Projection Report (2)

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- **Detailed assessment of policies and measures by type, emission reduction contribution, synergies and overlaps**
- **Uncertainty assessments are crucial on macroeconomic environment on effectiveness of policies**
- **Case study: building sector**

Maßnahme	Typ	Beschreibung / Ziele (Wirkungs-bereich)	Umsetzungs-stand (Wirkungs-beginn)	Direkte Emissionsminderung			
				2015	2020	2025	2030
				in Mio. t CO_2-Äqui.			
KfW-Programm Energieeffizient Sanieren	F	monetäre Förderung	ab 2001	4,4	7,9	11,5	15,1
KfW-Programm Energieeffizient Bauen	F	monetäre Förderung	ab 2005	0,1	0,2	0,2	0,3
KfW-CO_2-Gebäudesanierungsprogramm	*F*	*monetäre Förderung*		*4,5*	*8,1*	*11,8*	*15,4*
Marktanreizprogramm - Biomasse	F	monetäre Förderung	ab 1996	2,5	4,2	6,0	7,8
Marktanreizprogramm - Solar	F	monetäre Förderung	ab 1996	0,8	1,3	1,9	2,4
Marktanreizprogramm - Wärmepumpe	F	monetäre Förderung	ab 2008	0,3	0,6	0,8	1,0
Marktanreizprogramm - Wärmenetze	F	monetäre Förderung	ab 2008	0,7	1,2	1,7	2,2
Marktanreizprogramm - Erneuerbare Energien	*F*	*monetäre Förderung*		*4,3*	*7,3*	*10,4*	*13,4*
Städtebauförderprogramm - Stadtumbau Ost	F	monetäre Förderung	ab 2002	0,1	0,1	0,1	0,2
Städtebauförderprogramm - Stadtumbau West	F	monetäre Förderung	ab 2004	0,1	0,1	0,1	0,2
Städtebauförderprogramm - Aktive Stadt- und Ortsteilzentren	F	monetäre Förderung	ab 2008	0,0	0,1	0,1	0,1
Soziale Wohnraumförderung	F	monetäre Förderung	ab 2001	0,0	0,1	0,1	0,1
EnEV 2009 (gegenüber EnEV 2007)	R	Ordnungsrecht	ab 10/2009	1,2	2,3	3,4	4,5
EEWärmeG 2011 (durch Neubau)	R	Ordnungsrecht	ab 2009	0,2	0,3	0,4	0,5
Novellierung der Heizkostenverordnung	R	Ordnungsrecht	ab 2009	0,2	0,4	0,5	0,6
Energieberatung vor Ort	F	monetäre Förderung	ab 2006	0,1	0,2	0,3	0,4
Abzüge wegen Überschneidungen				1,5	2,6	3,8	5,0
Ungewichtete Summe der Wirkungen der Einzelmaßnahmen				10,7	18,9	27,1	35,3
Wirkungen der Einzelmaßnahmen (ohne Überlagerungseffekte)				9,3	16,3	23,4	30,4

Case study on Germany
Modelling framework for Projection Reports (1)

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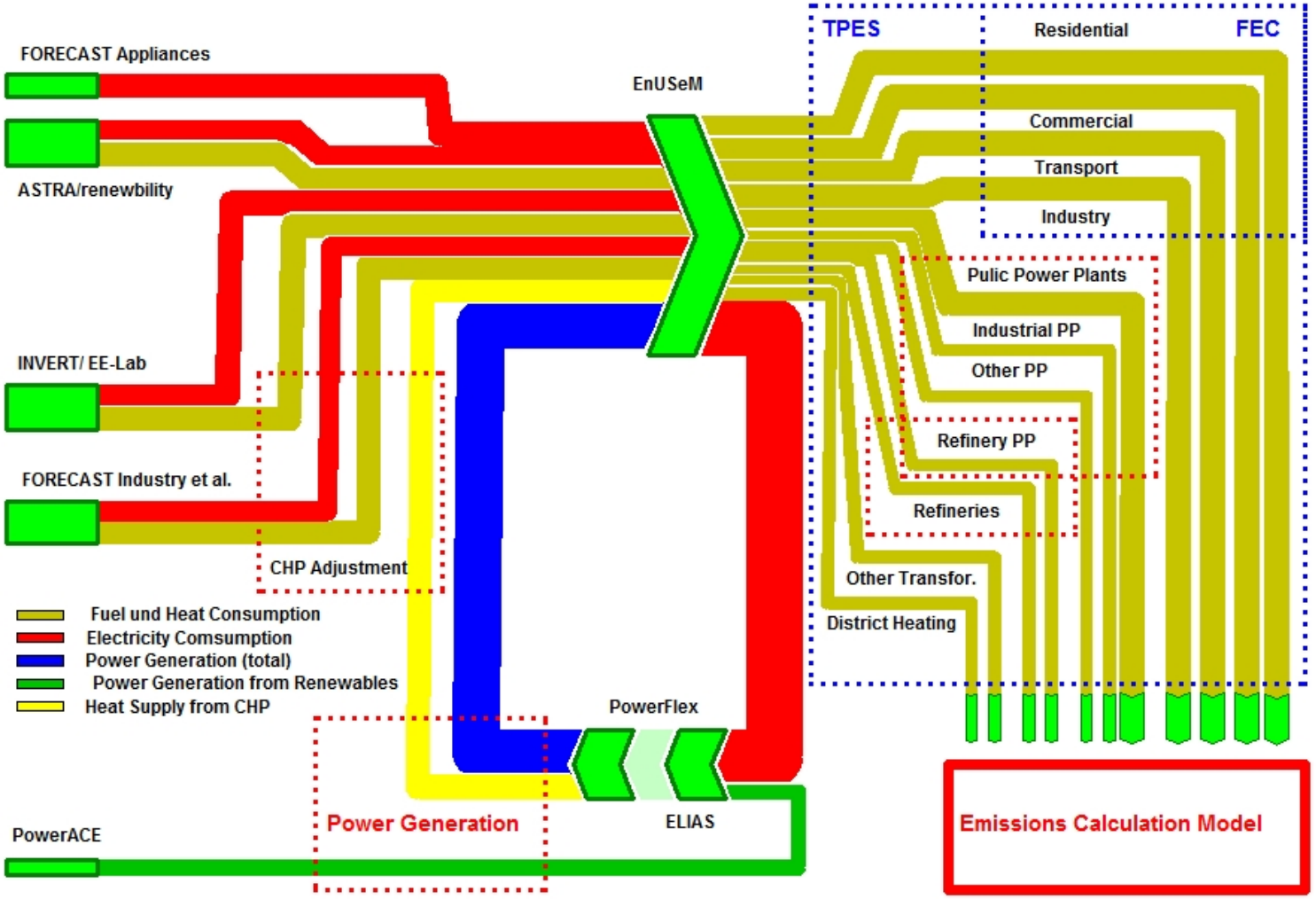

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Case study on Germany
Modelling framework for Projection Reports (2)

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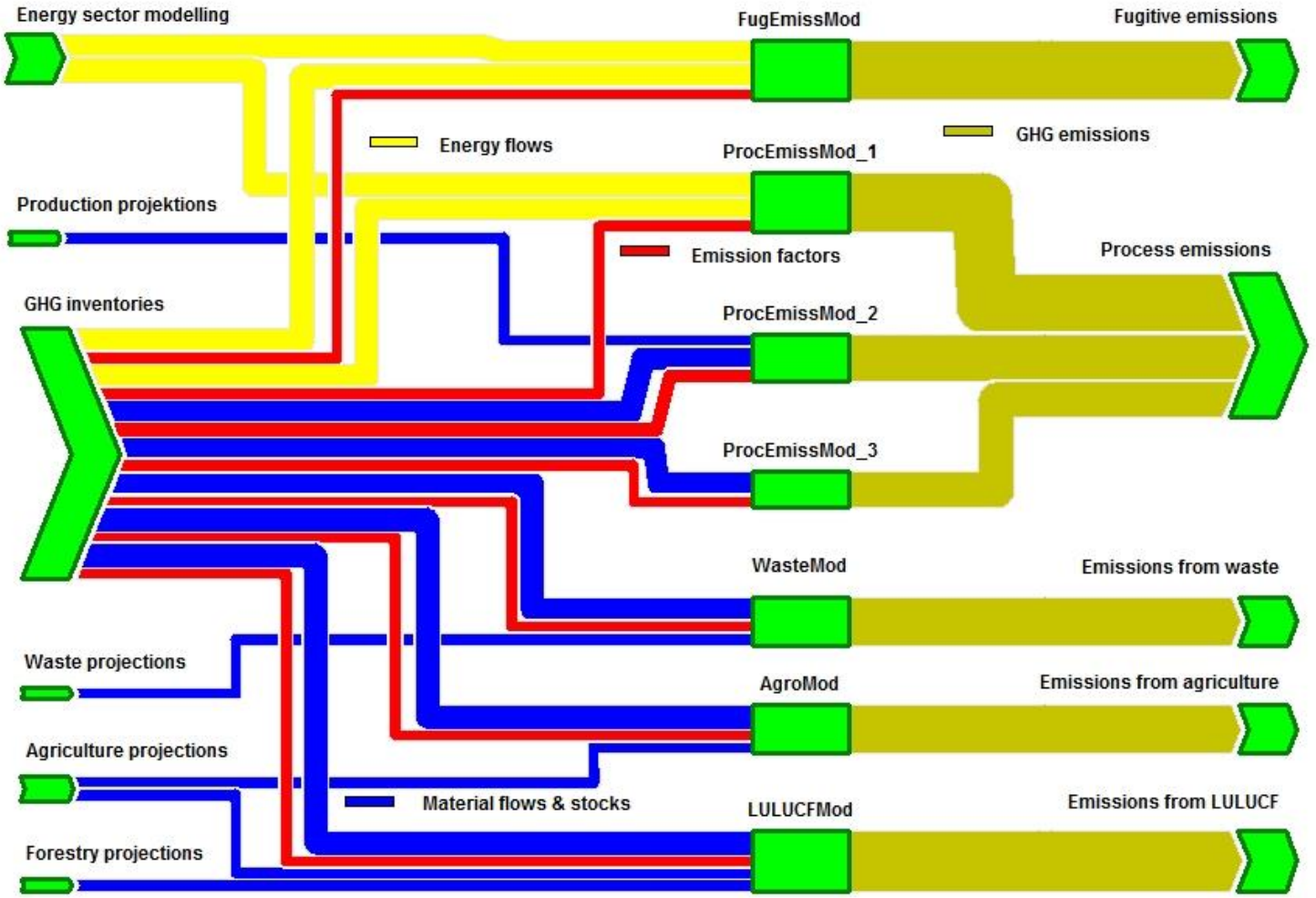

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Germany: The most recent 2050 analysis
Actual Policy Scenario

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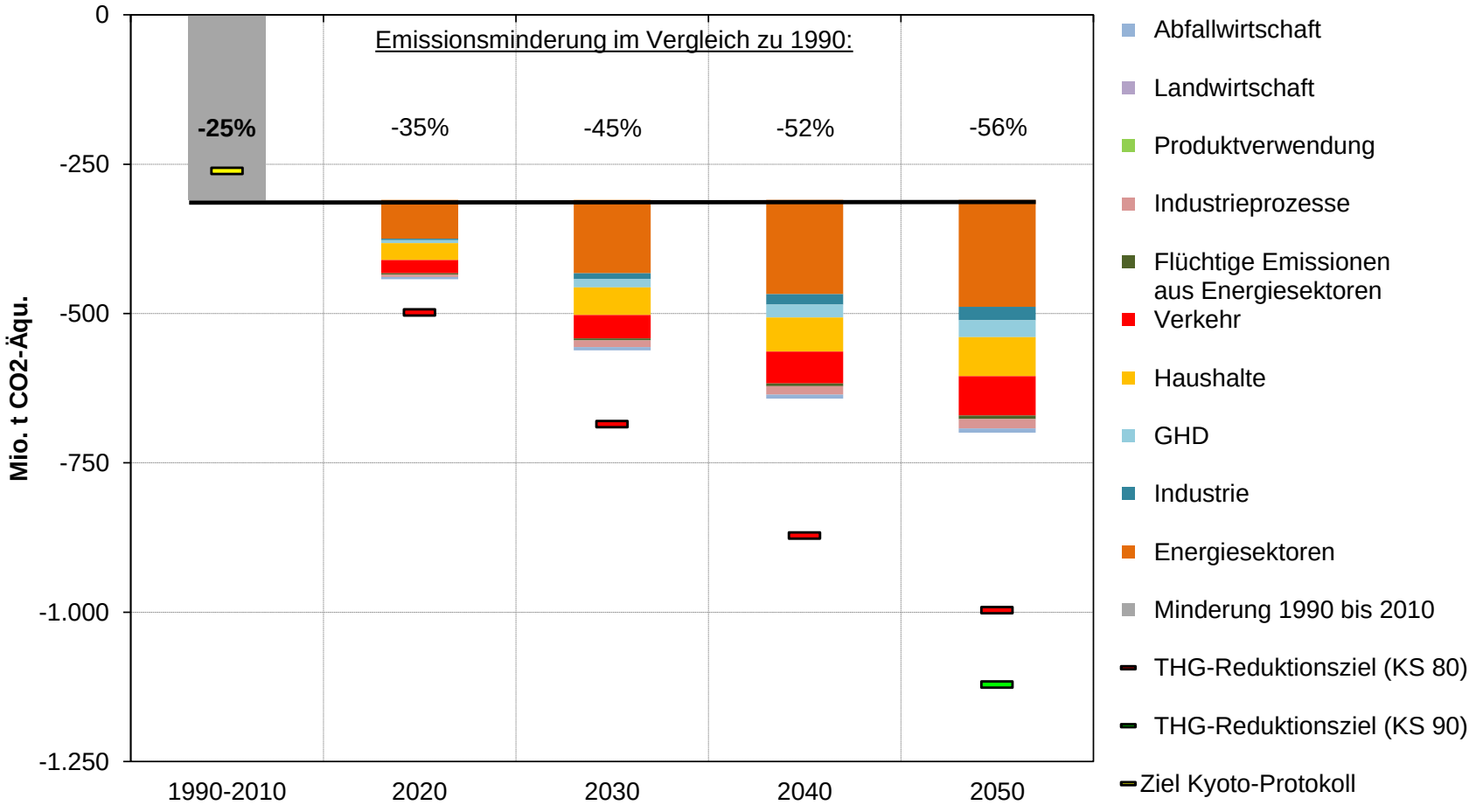

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Germany: The most recent 2050 analysis
Climate Scenario 80

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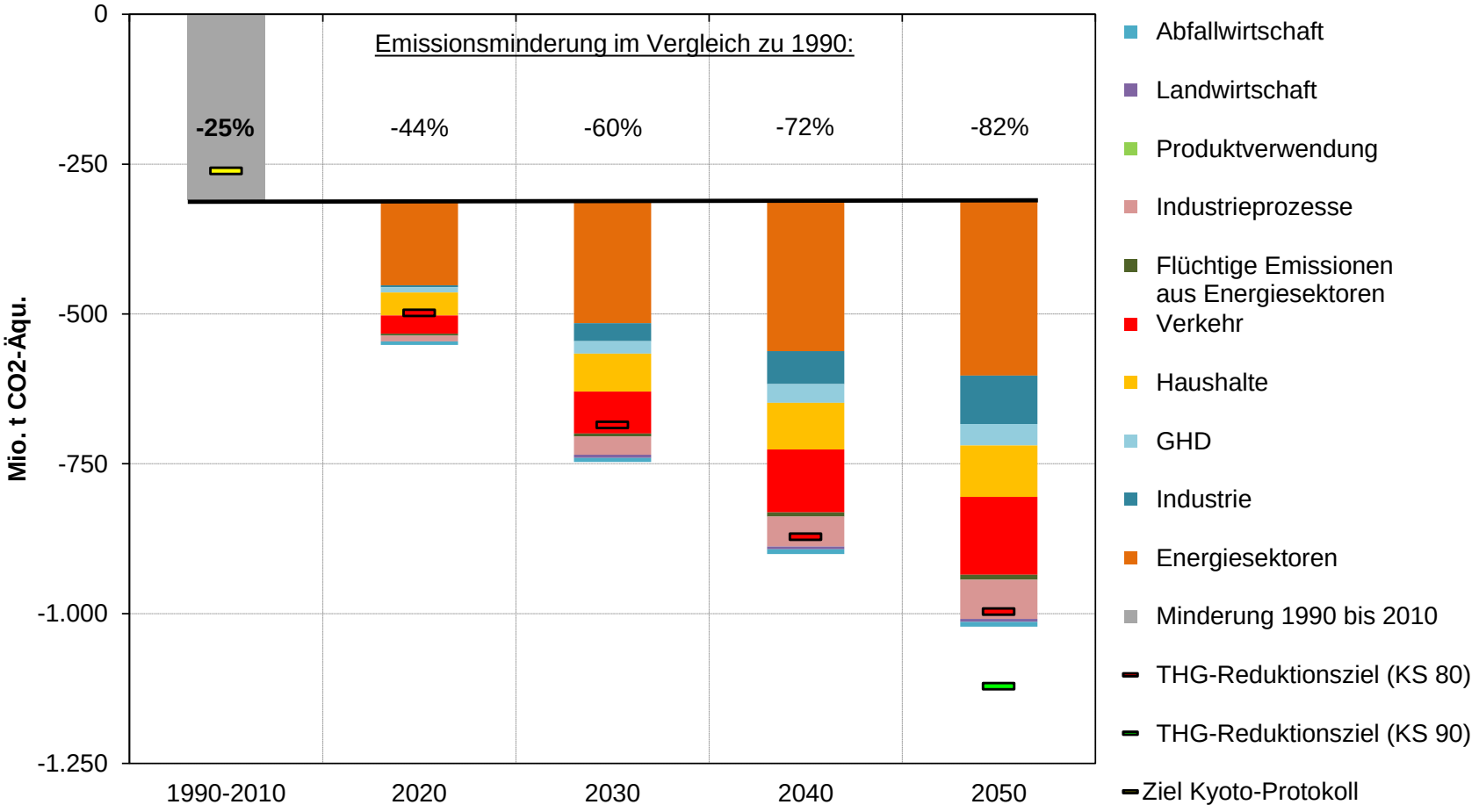

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Germany: The most recent 2050 analysis
Climate Scenario 90

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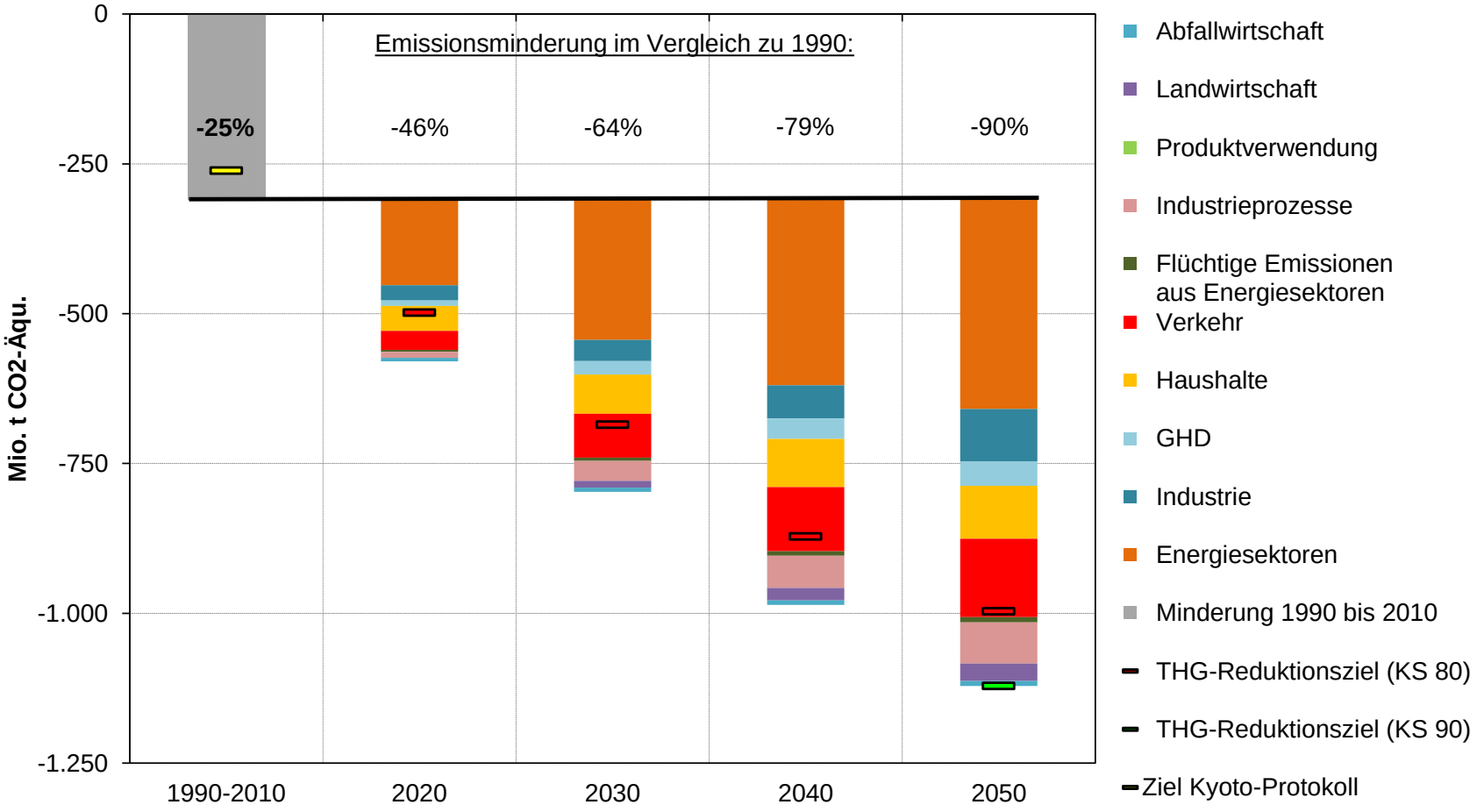

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Modelling / scenario analysis
Key role of reference scenarios/baselines

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- **Developing robust baselines is key**
  - if counterfactual is unrealistic, the comparison with alternatives becomes questionable
- **Input parameter-related uncertainties are unavoidable**
  - uncertainty assessments are relatively easy to implement
  - driving forces, energy & CO2 prices, technology potentials & costs
- **Careful application of methodological approaches for baseline setting is crucial (much more than for baseline deviations)**
  - social vs. private discount rates
  - perfect foresight?
  - costs vs. prices?
  - significant role for expert judgments

Modelling / scenario analysis
Key role of uncertainty assessments

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- **Demographic factors – not really significant for the Germany**
- **GDP and industrial value added**
  - industrial emissions
  - power sector emissions
  - freight transport emissions
- **Energy prices (and energy price spreads)**
  - power sector emissions
  - transport emissions
  - industrial emissions
- **CO2 prices (depend on fuel price spreads – at least for the EU)**
  - power sector emissions
- **Cost assumptions for key options**
- **Other constraints**
  - biomass, land use, underground use, infrastructures

Interactions between fuel and carbon prices
Fuel switching costs as a key issue

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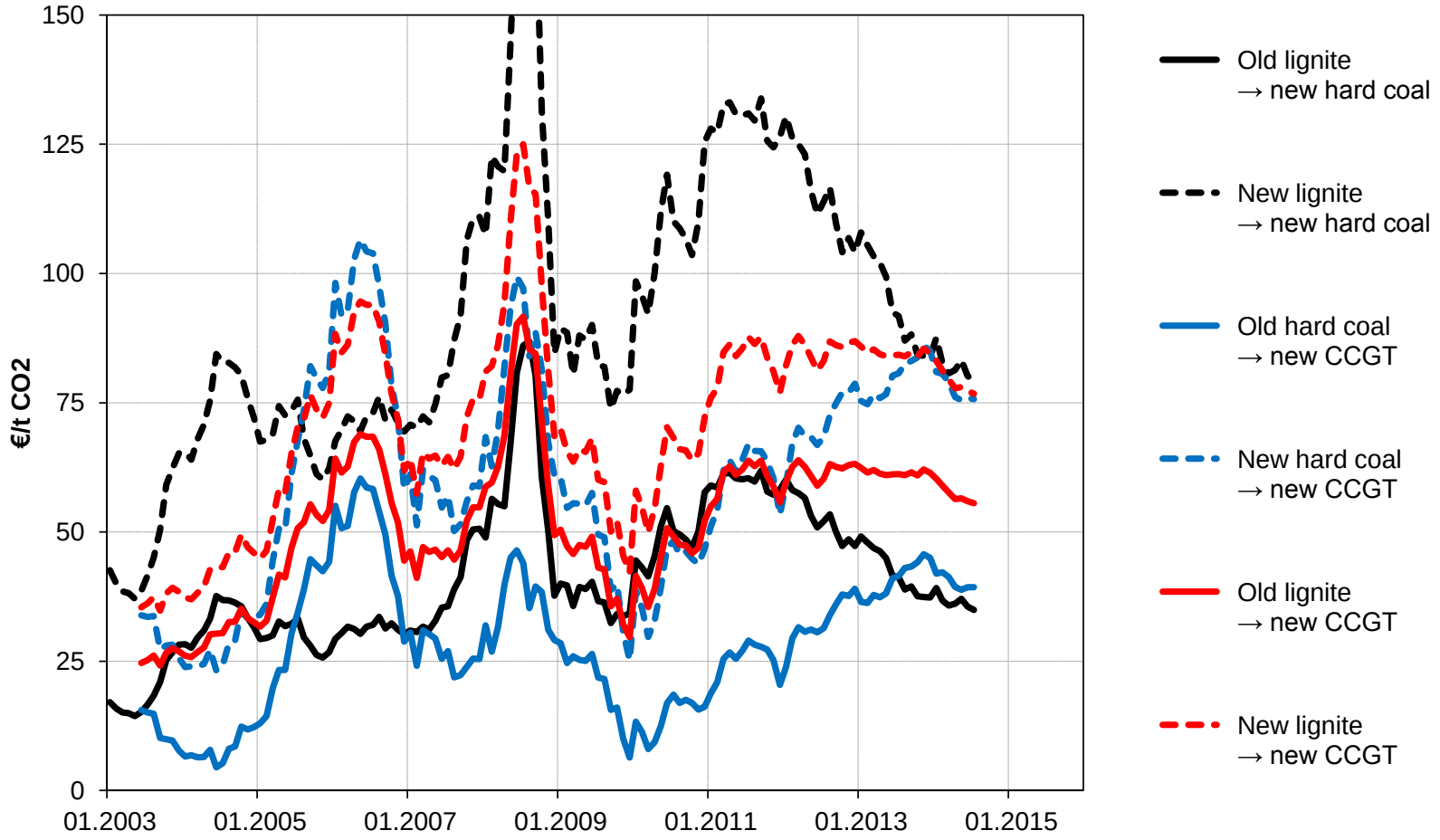

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Post-processing: Sectorial decomposition analysis as tool for clearing and strategy assessments

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$$E_i^s = A^s \cdot a_i^s \cdot ep_i^{tot} \cdot es_i^{fos} \cdot e_i^{fos}$$

$$es_i^{fos} = es_i^{tot} \cdot \left(1 - es_i^{ren} - es_i^{nuc} - es_i^{el} - es_i^{he} - es_i^{hy}\right)$$

Decomposition analysis

- **activity**
- **activity split**
- **energy intensity**
- **share of renewable energies**
- **share of nuclear energy**
- **share of electricity**
- **share of external heat supply**
- **share of hydrogen**

Emission reduction contributions
Energy efficiency, renewables & more

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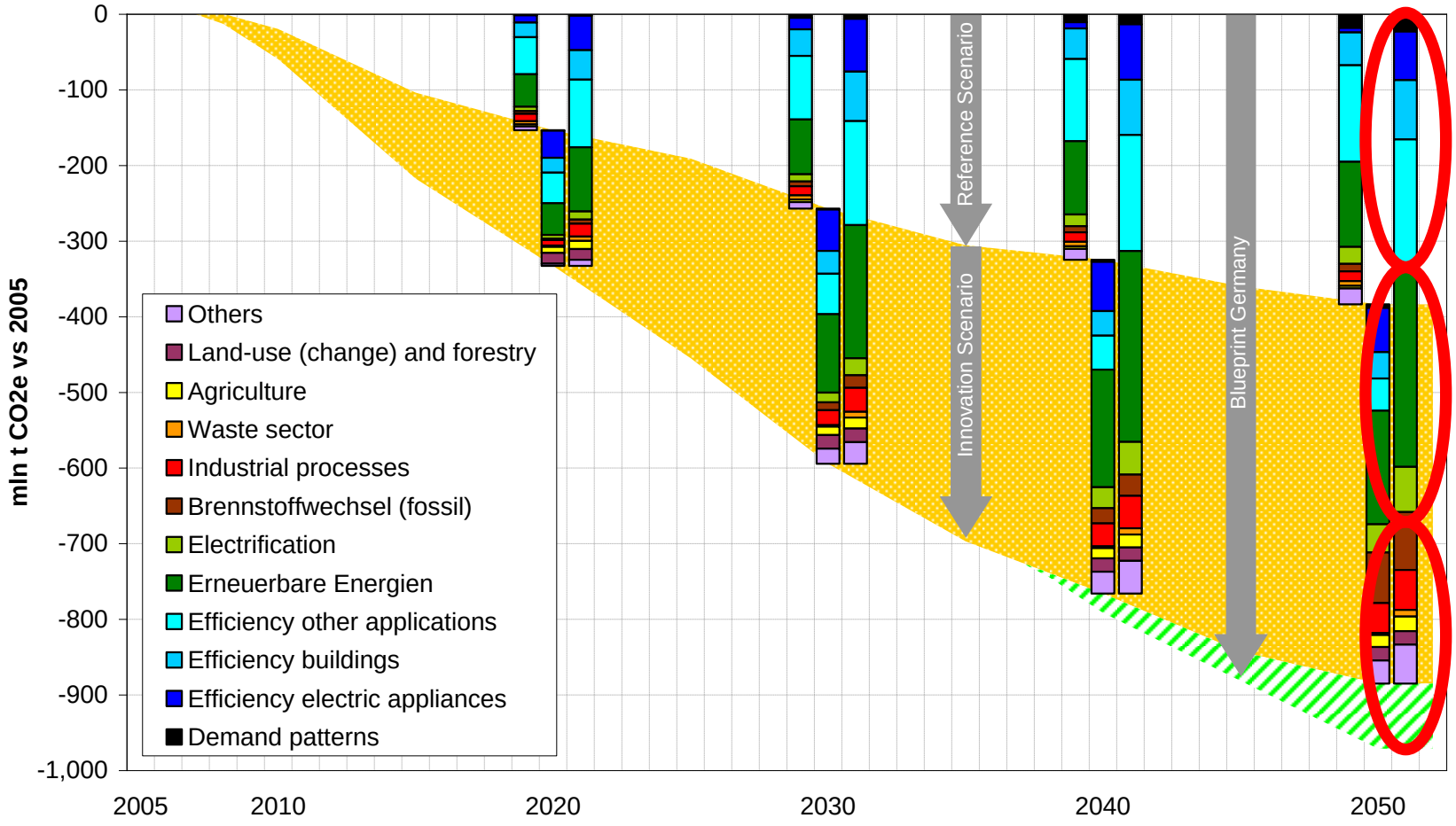
... are key pillars. Aggressive policies are need for each of these major pillars.



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Emission reduction contributions
A fresh look on priorities …

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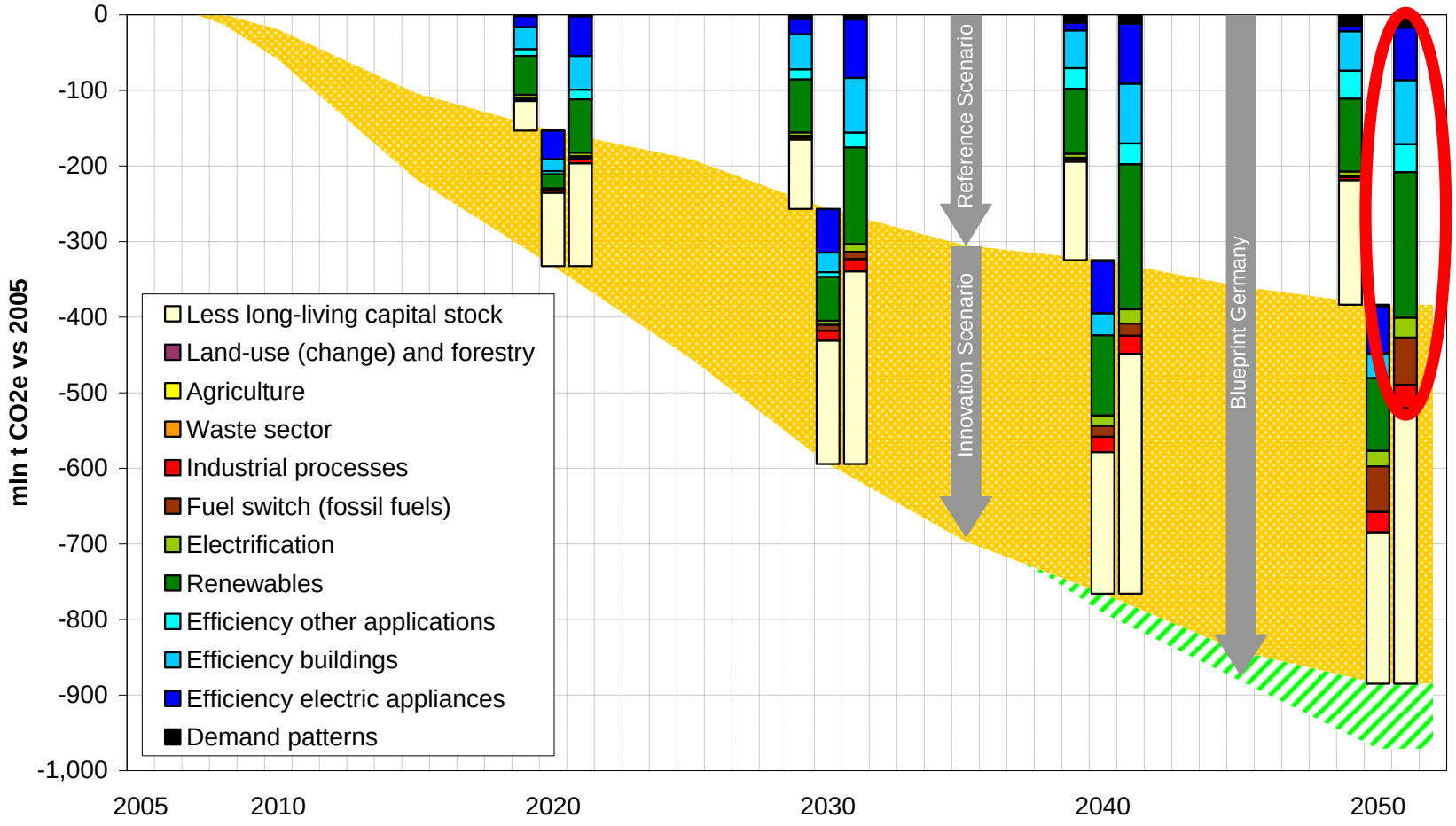
... is needed. The appropriate timing of modernization is key
- if one reflects the durable capital stocks



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Emission reduction contributions
A fresh look on priorities …

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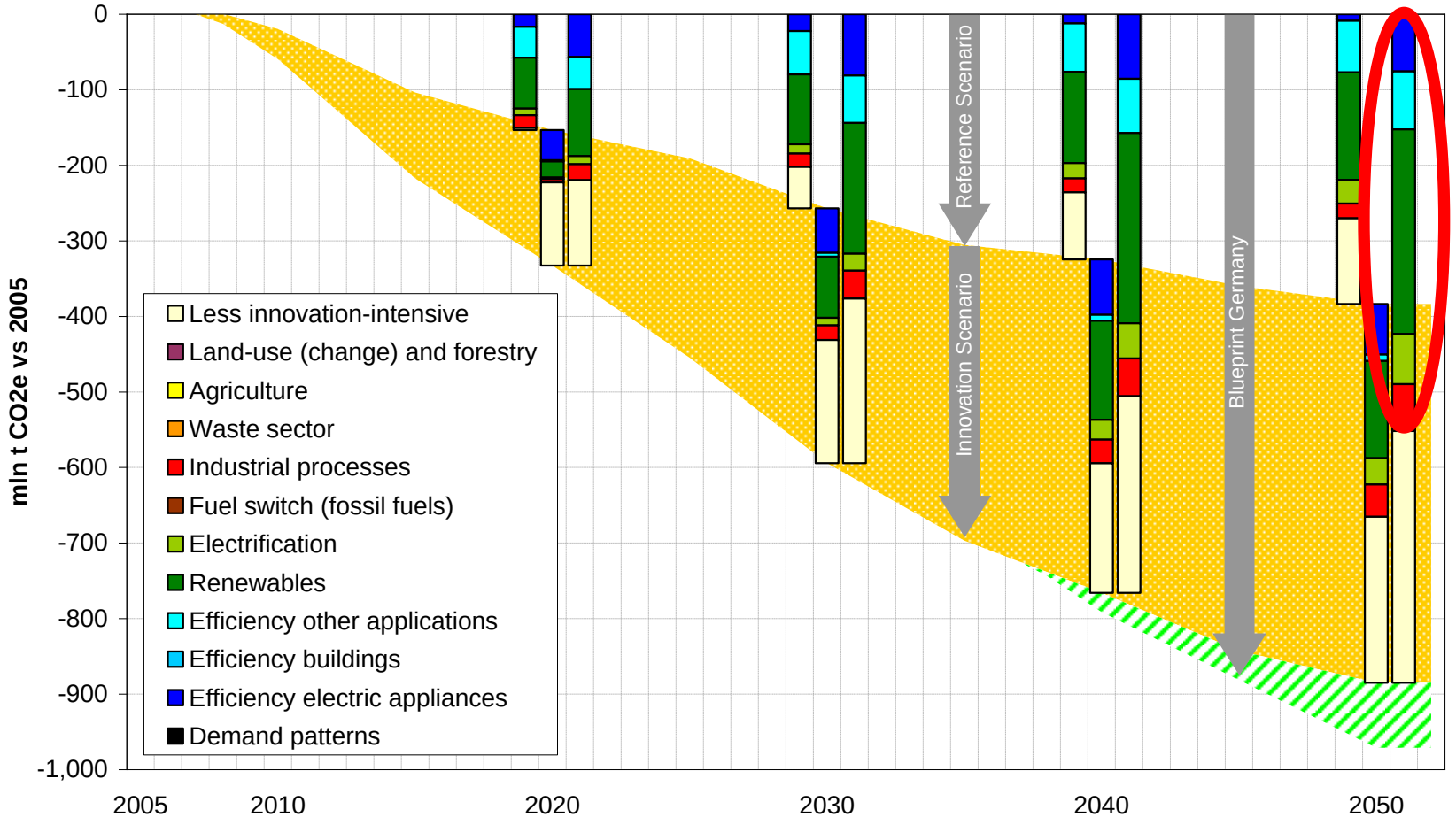
... is needed. Innovation is key and innovative greenhouse gas emission reduction options must deliver in time



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Modelling / scenario analysis
The role carbon pricing scenarios

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- **Analysis of carbon pricing instruments (depending on choice)**
  - economy-wide (not relevant for EU)
  - partial carbon pricing instruments
    - energy and emission taxes
    - emissions trading scheme
    - implicit pricing policies
    - policy interactions
- **Allocation of sectorial targets or specific policy designs (generic!)**
  - cost-effective attribution of mitigation efforts and the respective policy designs based on marginal abatement costs (= carbon prices)
  - policy interactions
  - distributional implications
- **Aggregate assessment of mitigation policies**
  - macroeconomic impacts, incl. carbon leakage assessments

Interaction analysis for carbon pricing scenarios
Assessment of mitigation contributions needed

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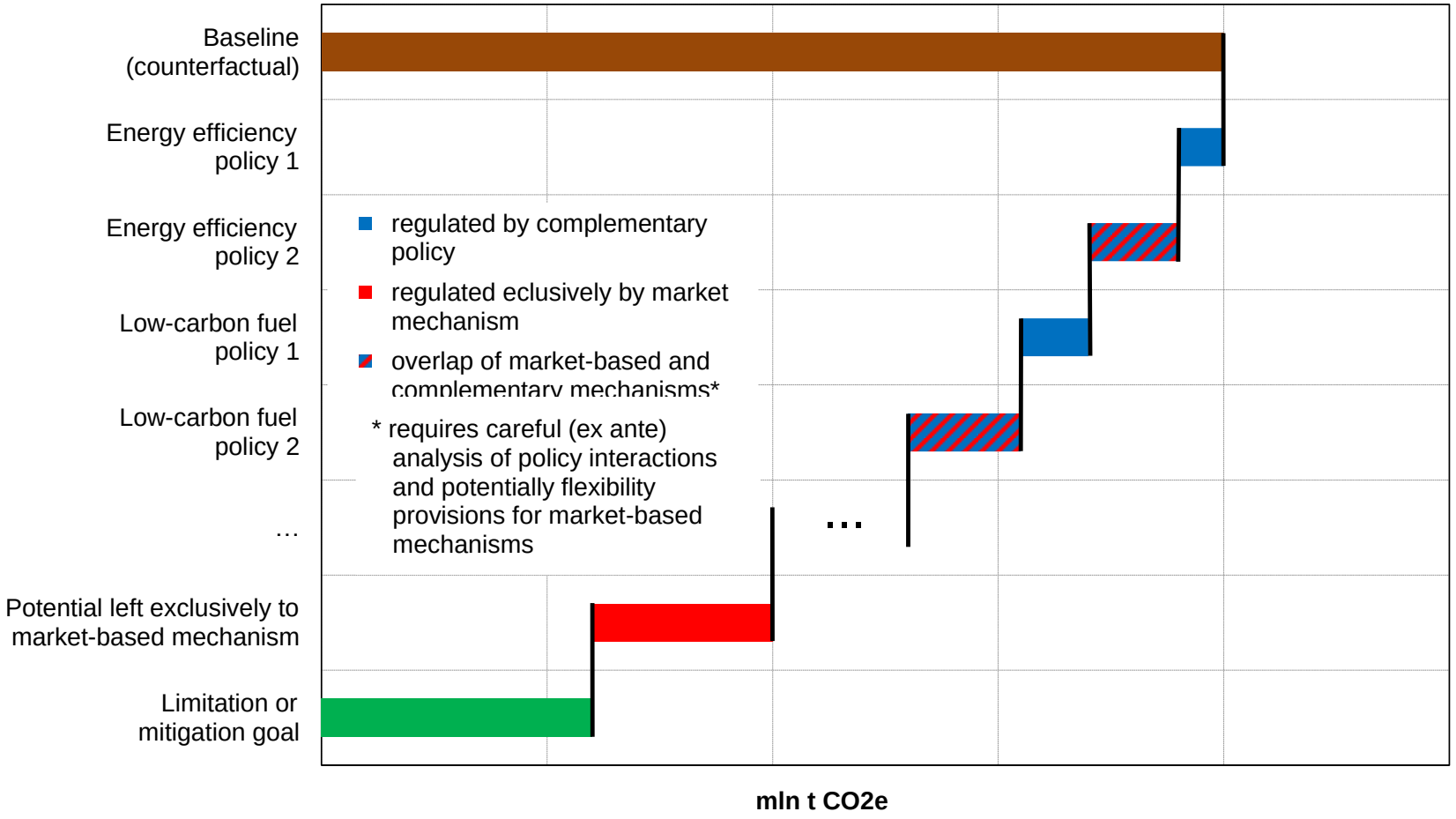

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Implicit carbon prices of other policies
Different regions and commodities in the EU

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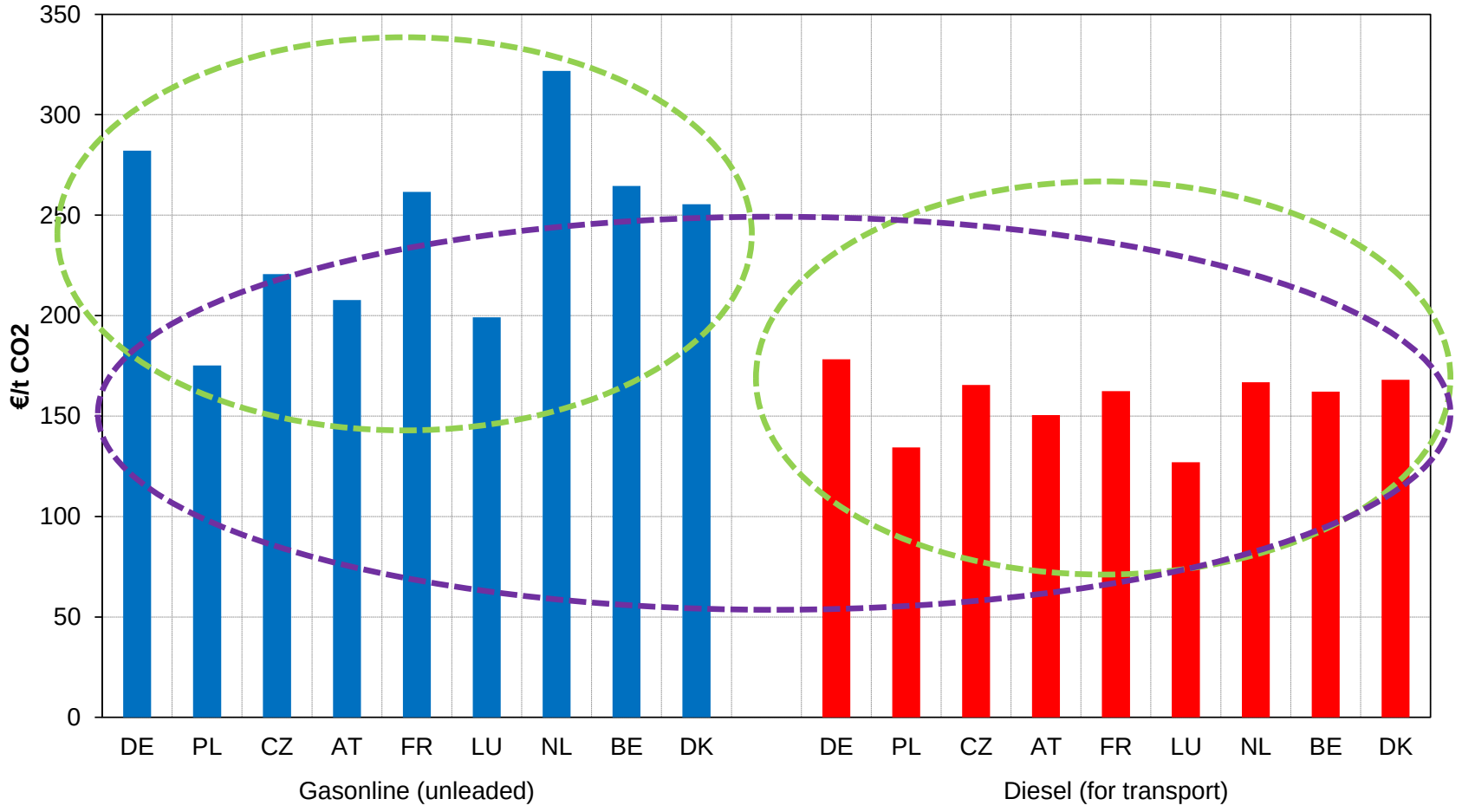
Uniform CO2 prices: neither among (EU) jurisdictions …

… nor for (different) commodities



Eurostat, Öko-Institut 2013

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

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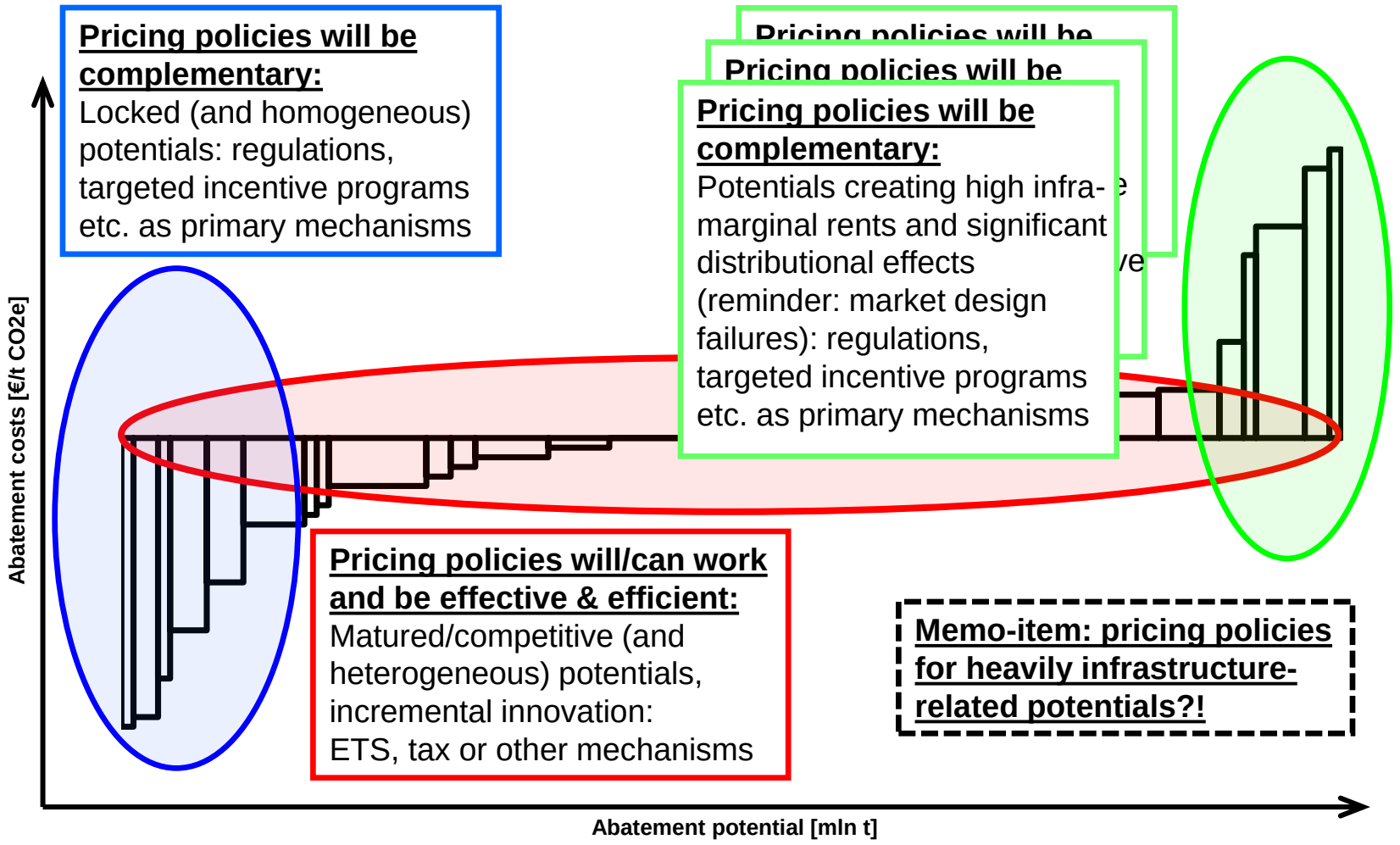

Öko-Institut 2010

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Thank you very much

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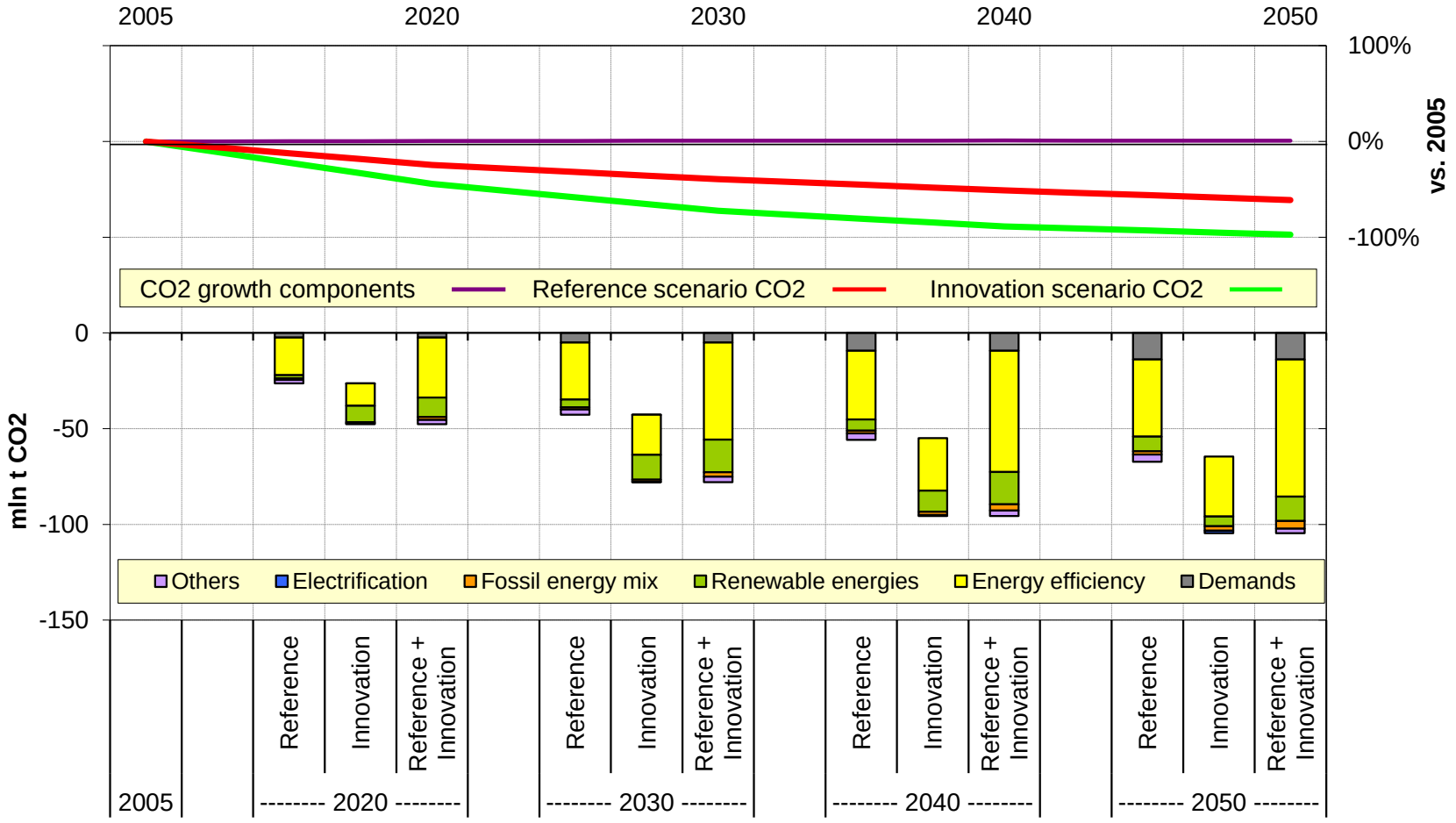
Backup

Levers of GHG emission reductions
Existing buildings



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Levers of GHG emission reductions
Passenger transport

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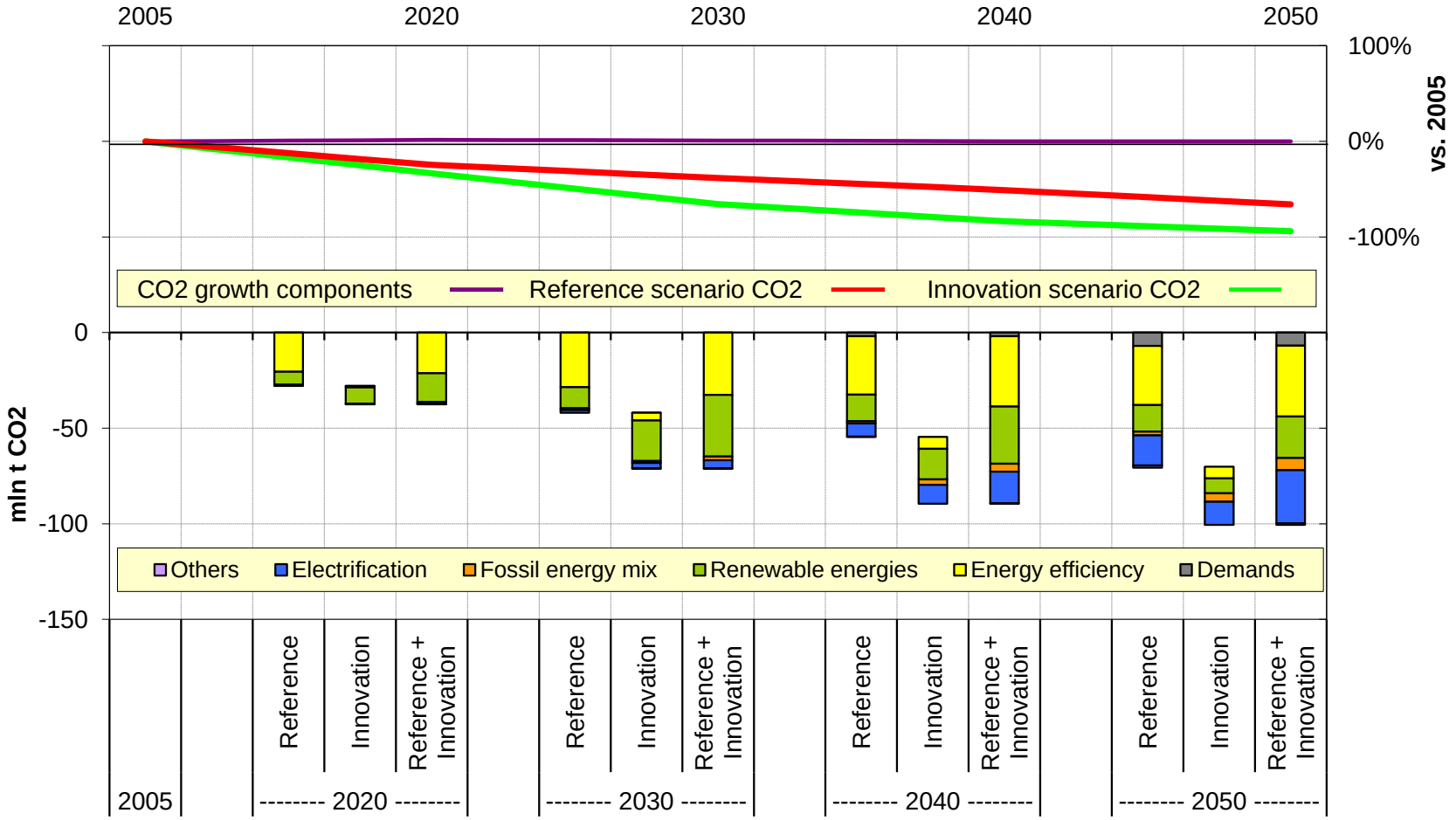

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Levers of GHG emission reductions
Electricity generation

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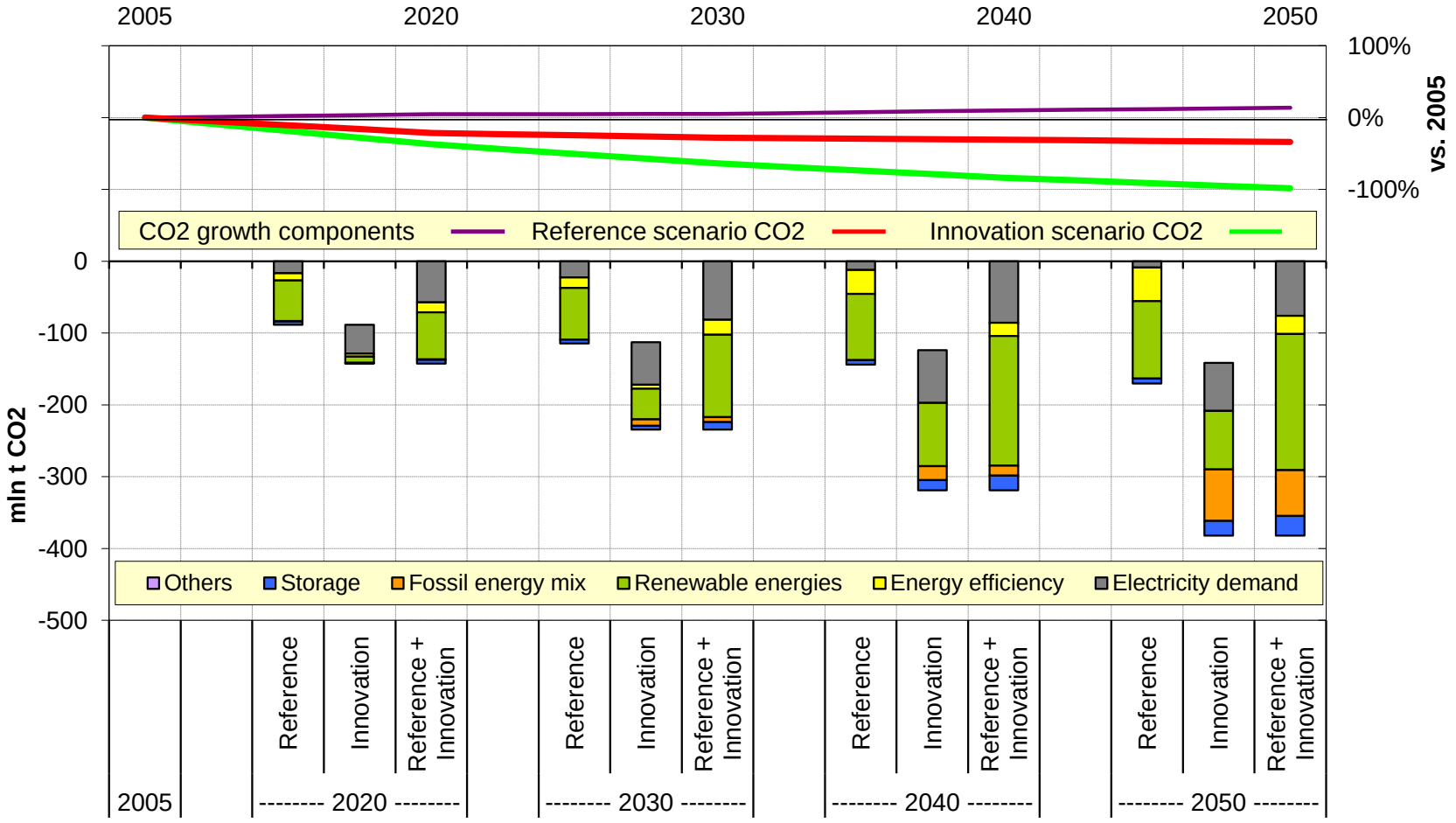

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