



TECHNISCHE
UNIVERSITÄT
DARMSTADT

23rd PhD workshop

on International Climate Policy

University of Malta, October 20th 2011

Agenda

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- PhD Project “Built Environment Analysis Model”



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- First projects with the model

Reference scenario for the German building stock

“Deep renovation” in the EU27 building stock

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- Questions to the audience!
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Built Environment Analysis Model



Key research questions

- What energy and CO₂-emission reduction potentials in buildings?
 - in which timeline
 - to what costs
 - with what limitations
- Which role play
 - Financial incentives
 - Normative restrictions
 - with what restrictions
- What is the building sector contribution to climate regimes?



Model based on sound
physical, technical &
economic assessments

Built Environment Analysis Model



Economic mitigation potentials by sector in 2030 estimated from bottom-up studies

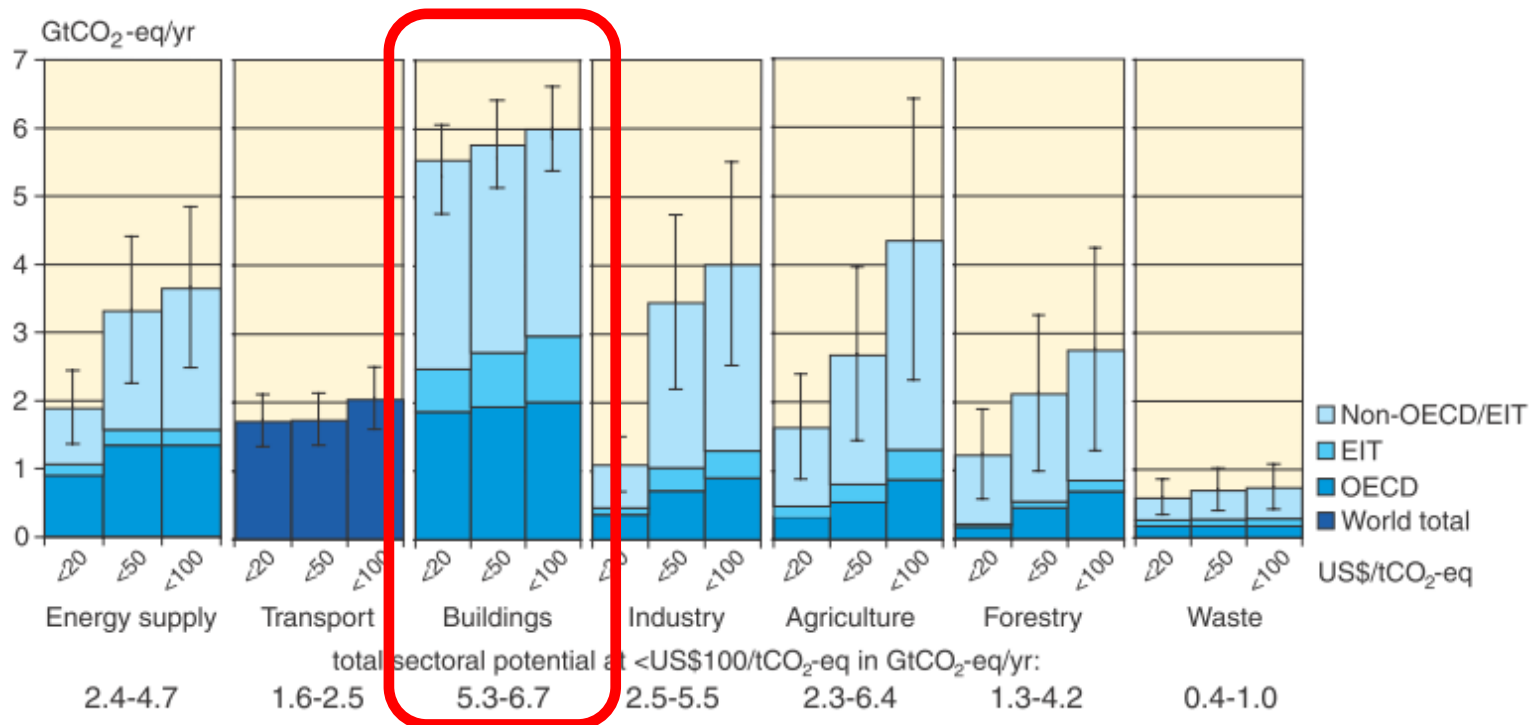
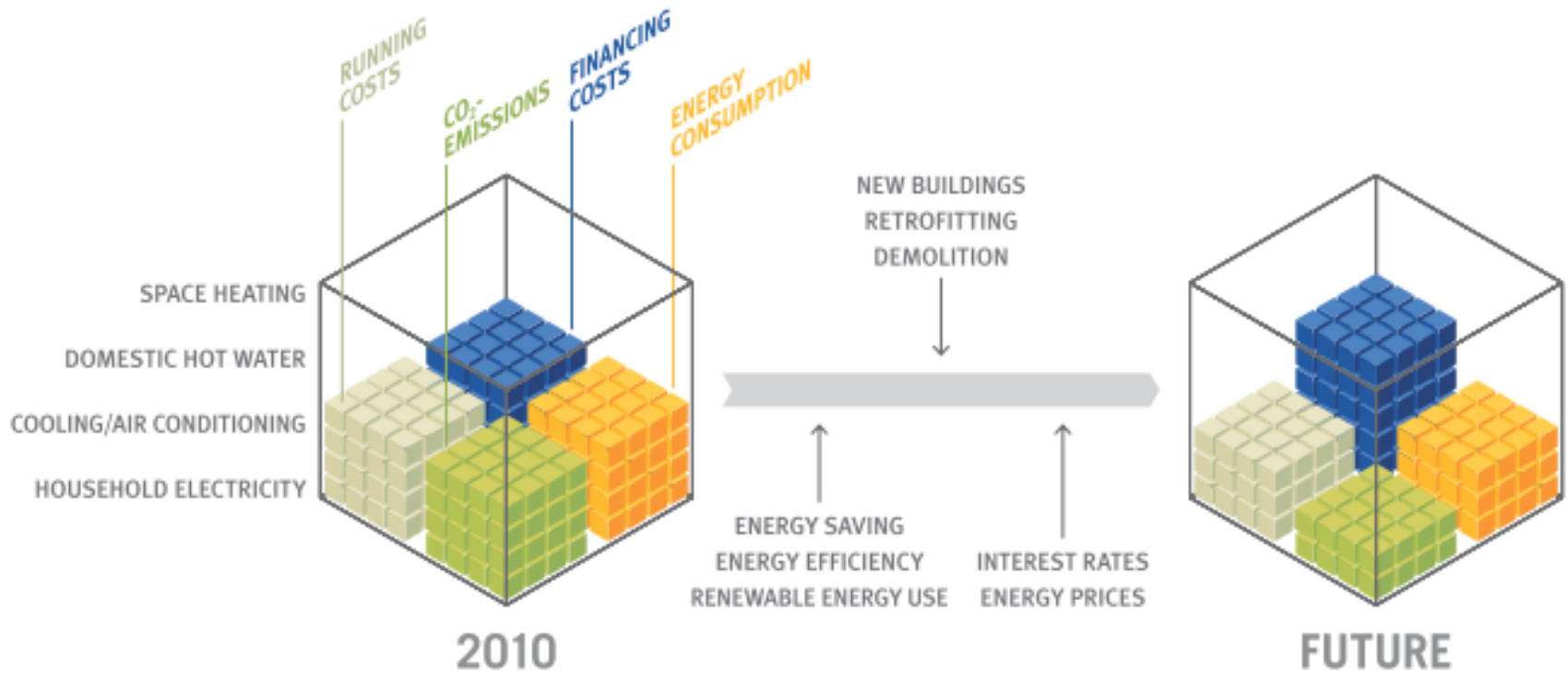


Figure 4.2. Estimated economic mitigation potential by sector and region using technologies and practices expected to be available in 2030. The potentials do not include non-technical options such as lifestyle changes. {WGIII Figure SPM.6}

Built Environment Analysis Model



Bottom-up modeling with BEAM²

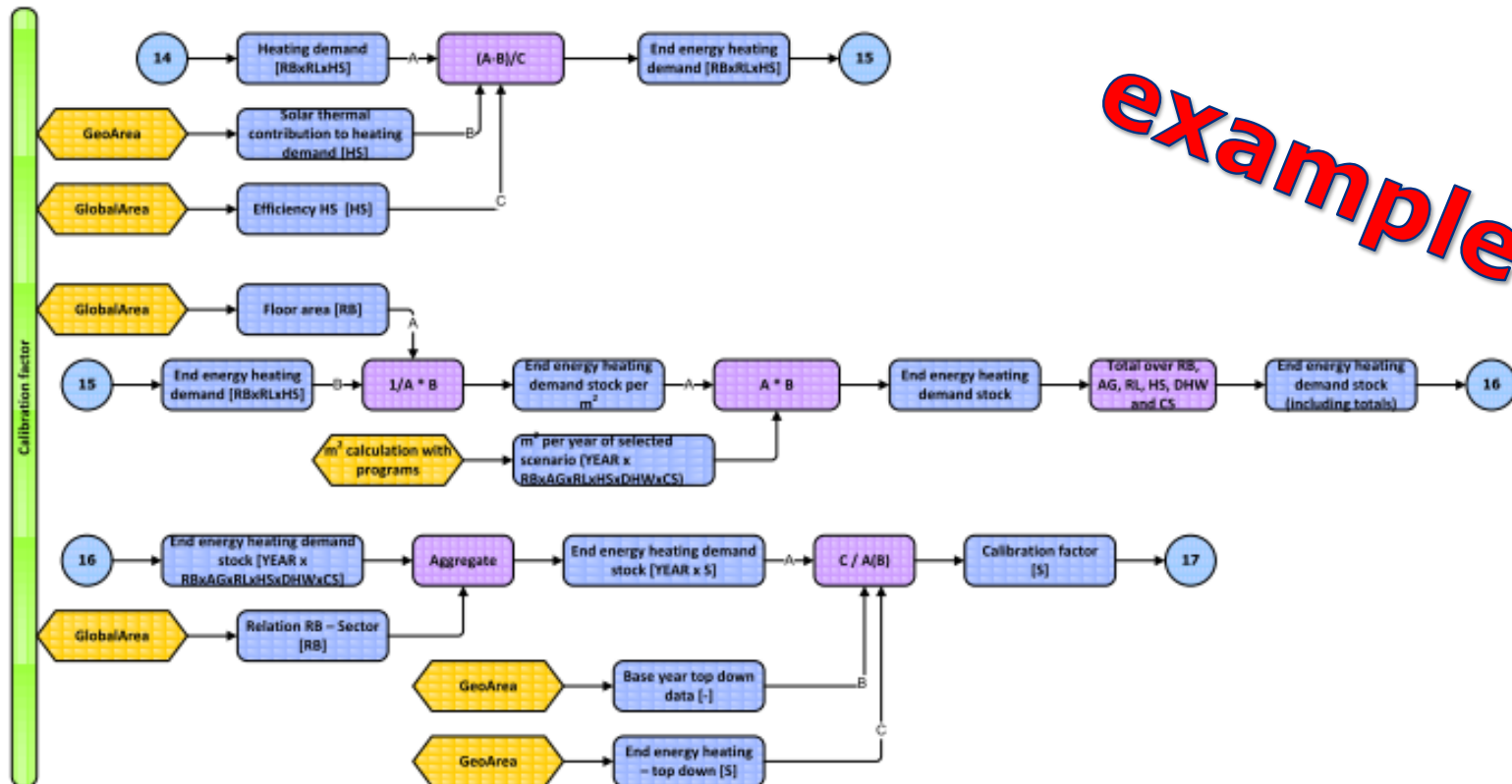
Source: Ecofys

Built Environment Analysis Model



- Implementation of first modules in a professional Oracle® database environment

example



Built Environment Analysis Model



http://beam2.anagosoftware.com - BEAM2 - V1.0 - Microsoft Internet Explorer

Info

BEAM2 model

Programs and Parameters

Period: Wednesday 12 January 2011

Actions

- Distribution
- Data Cube Export
- Save View
- Close View

BEAM2 model

- Global Area
- Geographical Area
- Scenario Area
- Programs and parameters
- Selection Reports
- M2 stock segments
- Effect Vectors
- Insulation investments
- Investments on appliances
- End energy
- Primary energy
- CO2 emission
- CO2 equivalent emission

http://beam2.anagosoftware.com - Reports - Microsoft Internet Explorer

Info

BEAM2 - SMALL_MEDIUM

SCENARI...
BEAM2 model
M2 stock segments
m² graph Germany2010_BAU

Actions

- Back
- Delete Report
- Publish Report
- Rename Report

m² graph Germany2010_BAU [RB: Semi-detached house, Small office building - AG: Before 1990, After 1990 - RL: For retrofit, New Buildings, ...]

HS: Total EHW: Total CS: Total Scenario: Germany2010_BAU

RB x AG x RL

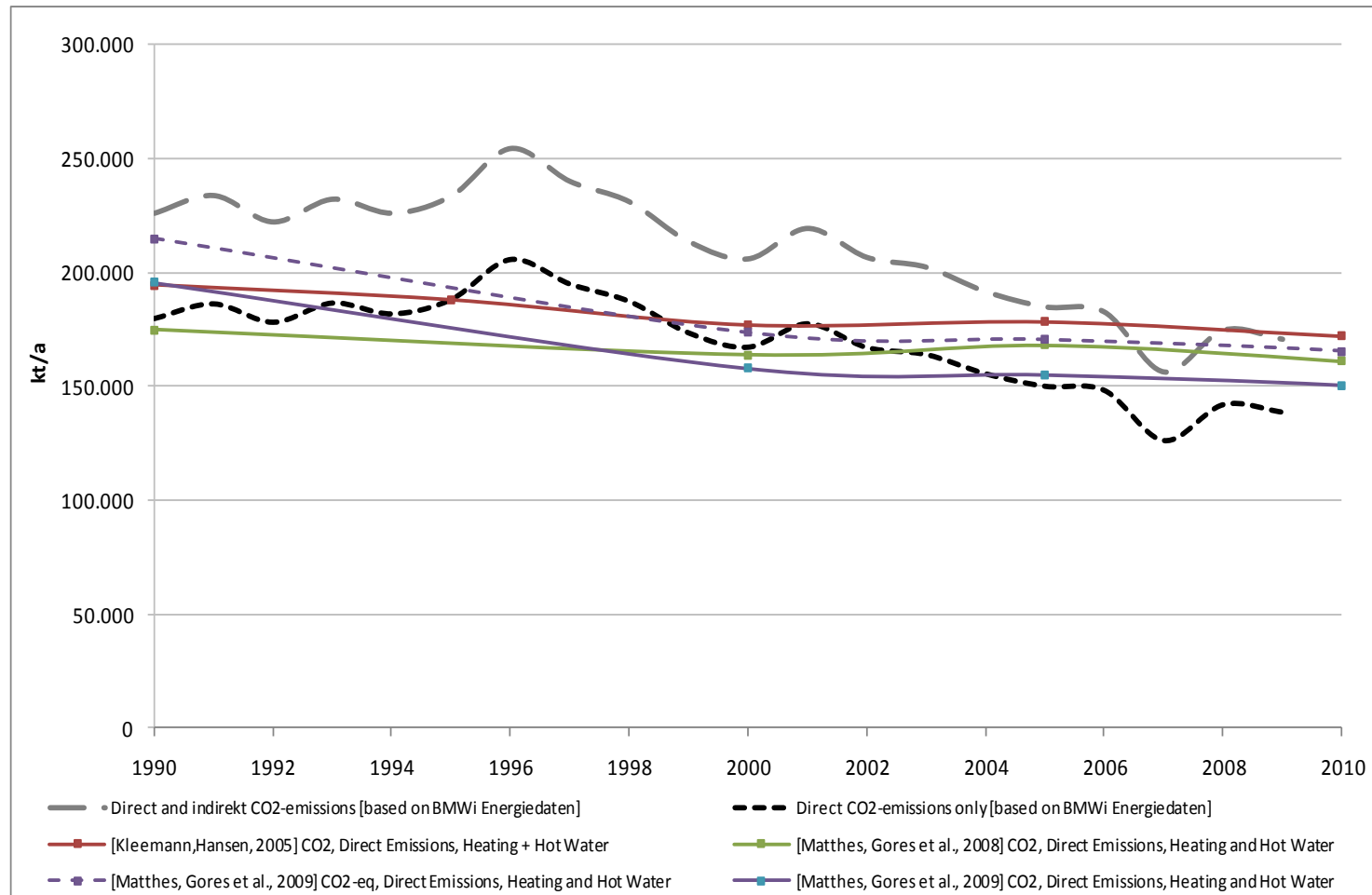
- Semi-detached house Before 1990 For retrofit
- Semi-detached house After 1990 For retrofit
- Semi-detached house Before 1990 New Buildings
- Semi-detached house Before 1990 Retrofitted Buildings
- Small office building Before 1990 For retrofit

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Reference Scenario

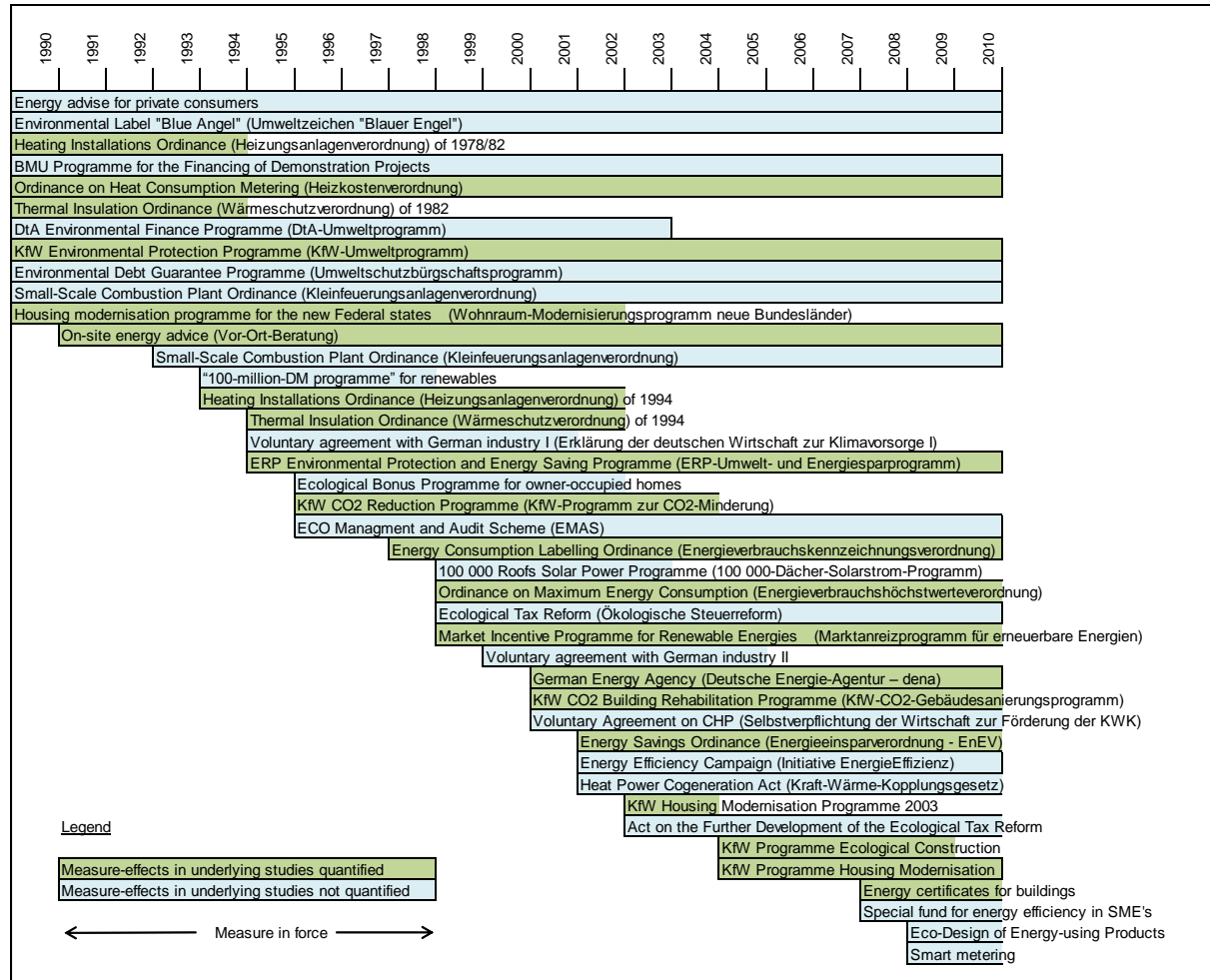
German Building Stock



Historic development of CO₂-/ CO_{2eq}-emissions in underlying studies between 1990 and 2010.
Not climate corrected.

Reference Scenario

German Building Stock



CO₂-mitigating measures in the German building sector between 1990 and 2010 in chronological order. Source: Mure II database

Reference Scenario

German Building Stock

Quantification of CO₂-emission reductions in 2010 [Mt CO₂/a].

Energy Saving Ordinance (EnEV) ¹⁾	1,75	Market Incentive Program Solar ¹⁾	0,56
Renewable Energy Heat Law (EEWärmeG) ¹⁾	0,31	Market Incentive Program Biomass ¹⁾	0,82
KfW Energy Efficient Retrofits ¹⁾	3,00	Market Incentive Program Heat Pumps ¹⁾	0,10
KfW Energy Efficient New Buildings ¹⁾	0,40	Non-residential Measures ²⁾	2,00
Social Housing ¹⁾	0,04	Replacement of Electrical Heating Systems ³⁾	1,50
Energy Performance Certificates & Advise ¹⁾	0,18	Retrofit of Federal Buildings ³⁾	0,11
Urban Redevelopment Eastern Germany ^{1),4)}	0,00	Modernization of Social Infrastructure ³⁾	0,32

Comment: Overall effects of measures, not additional potential against previous year. Sources: ¹⁾ [Matthes, Gores 2008], ²⁾ [Kleemann, Hansen 2005], ³⁾ [Doll, Eichhammer 2008]. ⁴⁾ Urban Redevelopment Eastern Germany: Until 2030 an effect of 0.2 Mt is expected.

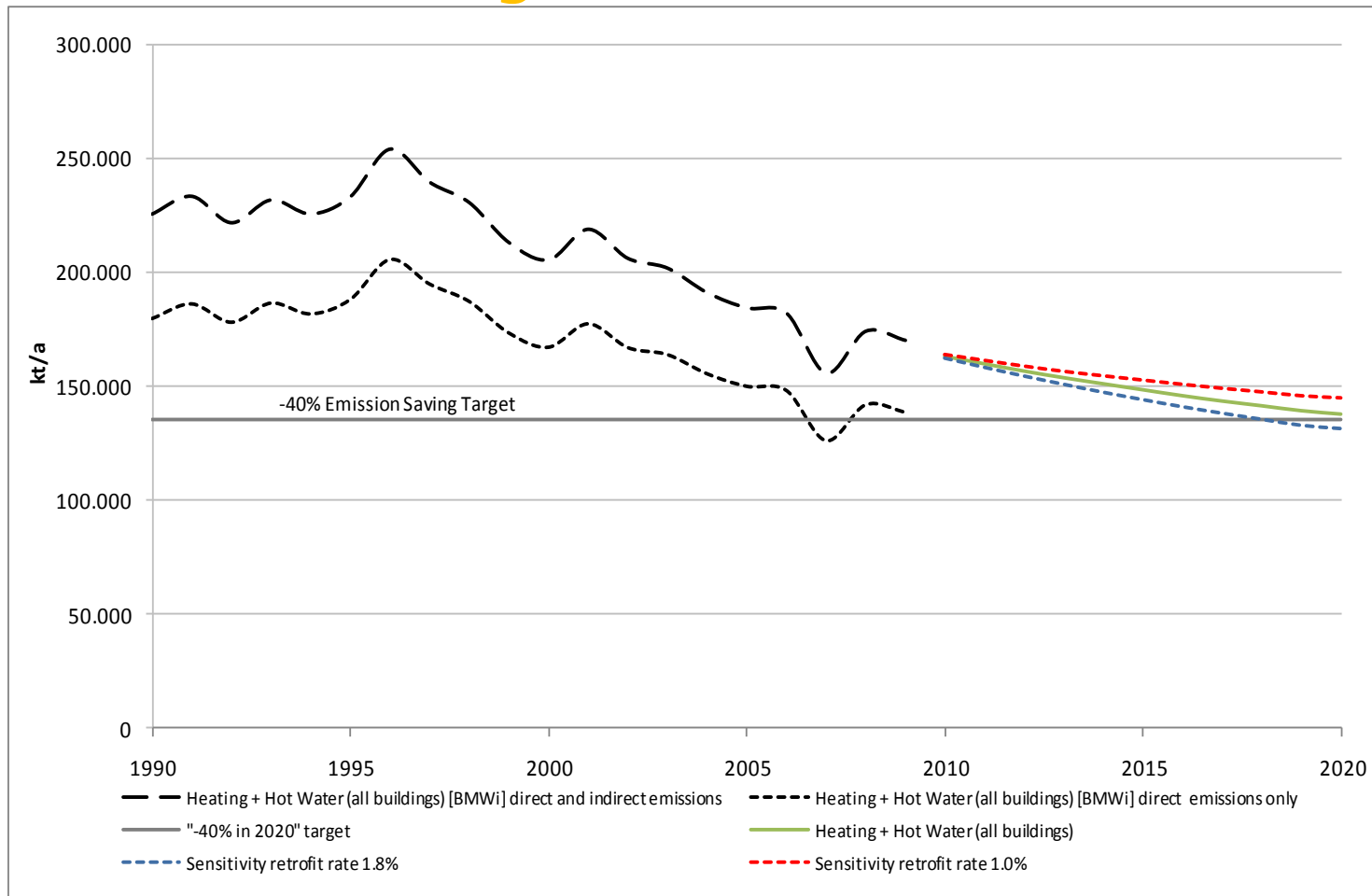


Future retrofit- and new-building rates.

	Residential buildings		Non-residential buildings	
	Retrofit	New building	Retrofit	New building
Energy Saving Ordinance 2009 (EnEV09) (Taking into account an energy-related retrofit efficiency of 70% for insulation measures)	1.20% (+/- 0.4%)	0.42%	1.40% (+/- 0.4%)	0.70%
KfW building-retrofit program	0.20%	-	-	-
KfW Energy efficiency new building program	-	0.28%	-	-
Total	1.40% (+/- 0.4%)	0.70%	1.40% (+/- 0.4%)	0.70%

Reference Scenario

German Building Stock



CO₂-mitigating potential for heating and hot water in residential and non-residential buildings up to 2010 from study evaluation and forecast until 2020. For 2010-2020, three scenarios with different retrofit-rates (1.0%, 1.4% and 1.8%) are calculated, resulting in different emission paths. Not climate corrected.

Questions to you

Comments and constructive criticism welcome!

- Further implementation ideas:
 - cost decreases due to scale effects and new technologies expected
 - emission factors for district heat and electricity will change in the future
 - Effectiveness of government expenses: money spend on financial incentives vs. additional tax revenues
 - Focus „advanced energy efficiency“ vs. „High share of renewables“



Best retrofit and new building schedule up to 2050 by assessing different paths