

OECD Workshop on Material Flow Indicators  
and related Measurement Tools  
23-24 May 2005, Berlin



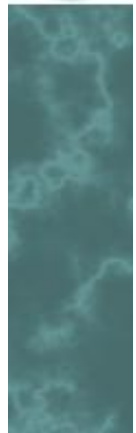
# Modelling MF in multi-sector economy-environment models

by

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# 1 Model PANTA RHEI: An Information Tool for the Analysis of Sustainable Development in Germany

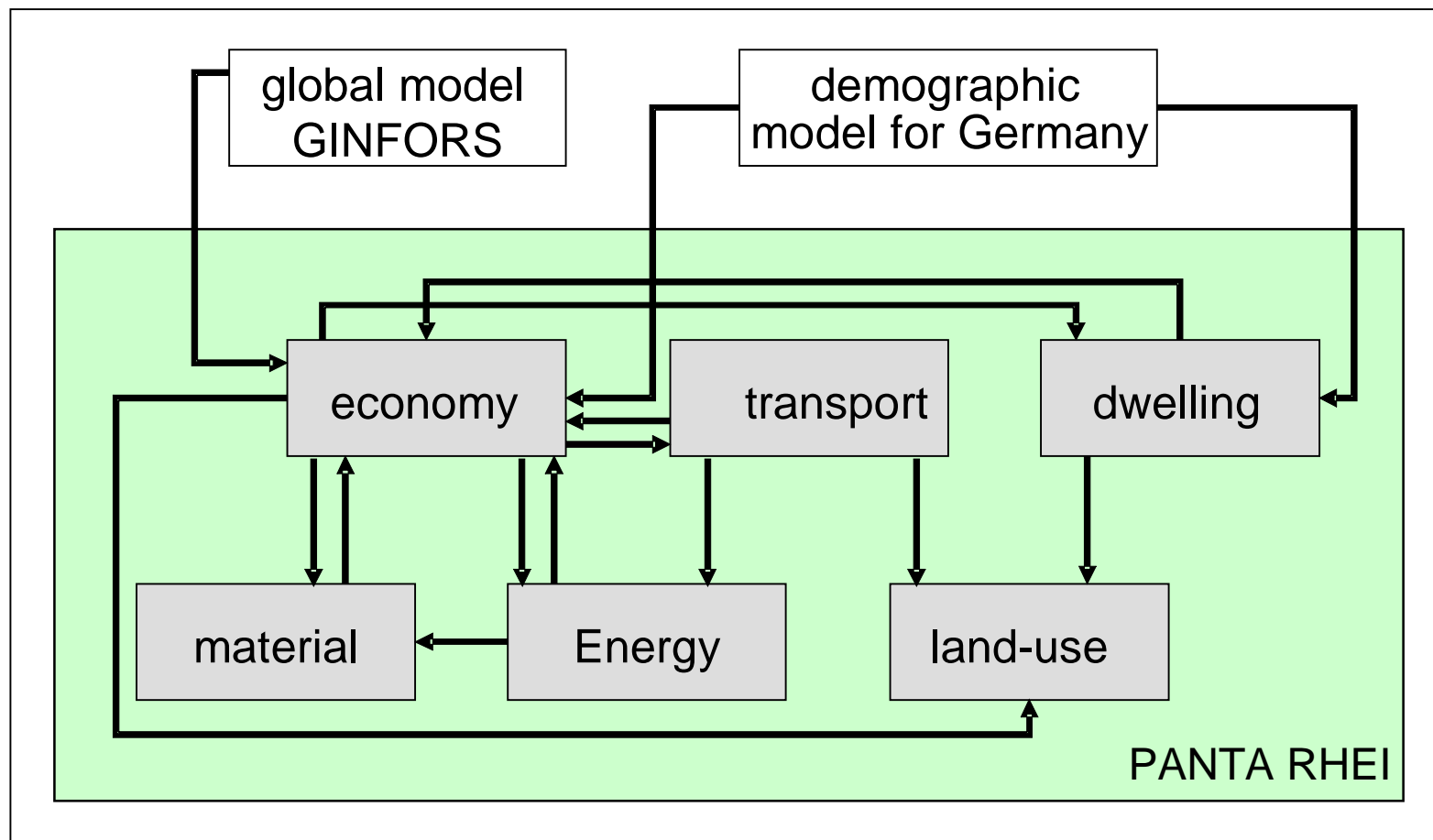
## 2 Main features:

- o Bottom up structure:
  - § modelling at the level of 59 homogenous economic sectors/branches (2 digit NACE classification)
  - § macroeconomic variables by aggregation
- o Full integration:
  - § interindustry connections
  - § consistent linkage of the industry accounts with the generation, distribution, redistribution and use of income
- o Empirical validation of parameters and model
  - § econometric estimation of parameters
  - § historical simulation (ex post)
  - § ex ante simulation
- o Ability to explain structural change
- o Solution year by year with a Gauss-Seidel algorithm

≈ **Database from 1991 to 2000:**

- System of National Accounts (SNA)
- Monetary IO tables (MIOT)
- NAMEA-type accounts of the GEEA (59 or more branches)
  - § energy
  - § air emissions
  - § built-up and traffic area
  - § transport
- Socio-Economic Accounts (SEA)
- MFA (Wuppertal Institute):
  - § 59 branches – 5 materials
  - § domestic extraction used – unused
  - § imports
  - § indirect flows associated with imports

### The Structure of the Model PANTA RHEI



≈ **Forecasts and policy simulations:**

Interdependent calculation of economic, social and environmental development allows for:

⊖ Business as usual or other forecasts

⊖ Policy simulations:

Change of model parameters can be traced back to a single or a few changes of policy parameters

⊖ Conducted policy simulations:

§ Energy and air emission taxes

§ Ecological tax reform

§ Policy measures to reduce transport (incl. road pricing)

§ Policy measures to reduce land-use

§ Support of renewable energy

§ Material input tax

§ Induced innovation

§ Information and planning policy

## 2 Baseline Forecast

### 2.1 Assumptions

#### ≈ **Economic and social policy:**

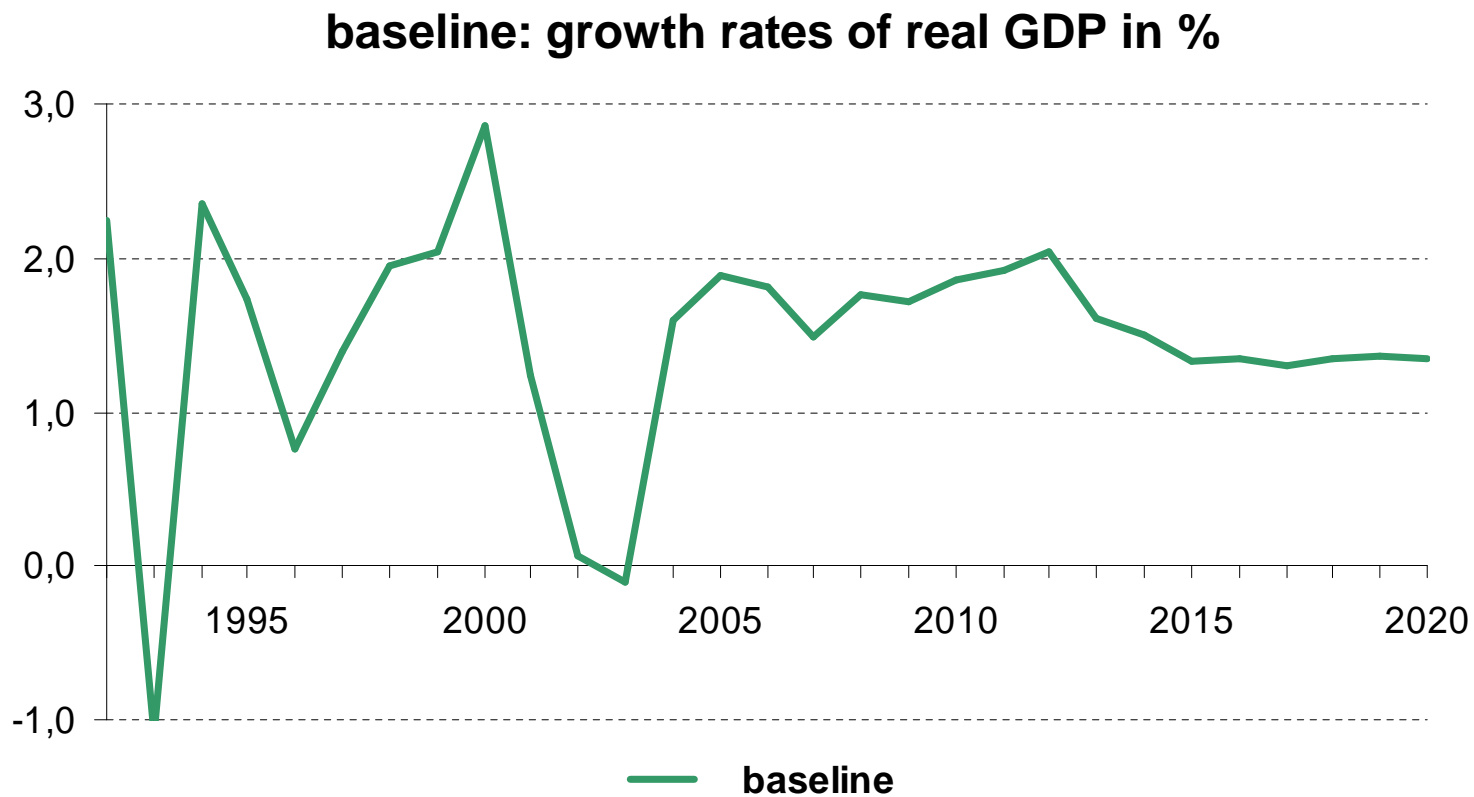
- ⊖ state of 2004,
- ⊖ no labour market reforms

#### ≈ **Environmental policy:**

- ⊖ climate policy instruments are calibrated to meet the Kyoto target
- ⊖ no business as usual

## 2.2 Results

- ≈ **Economy:**
- ∅ GDP: slow recovery



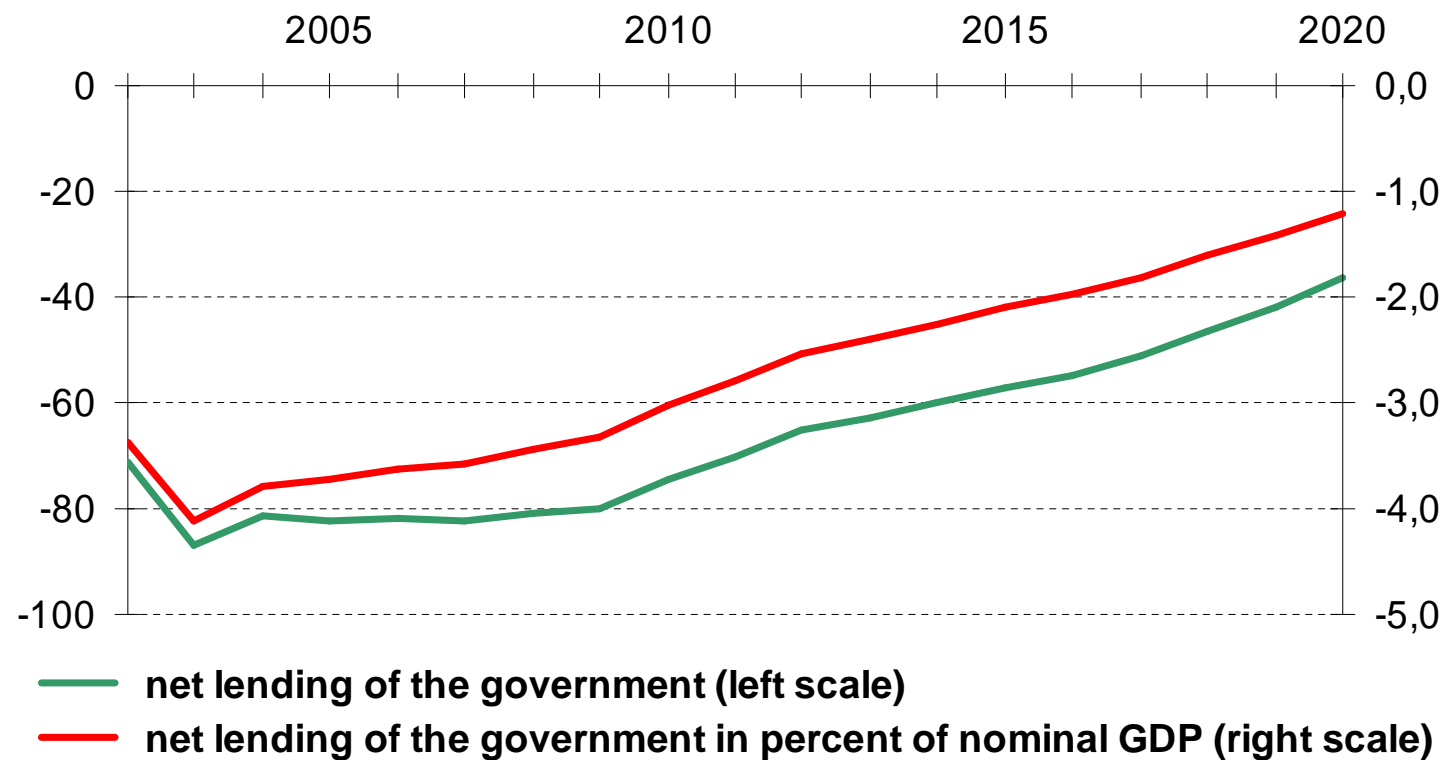
- unemployment: in the long run economic structural change and demographic change will help

**baseline: unemployment ratios (ILO concept)**



- o net lending of the government:  
Maastricht criterion will remain a problem till 2010

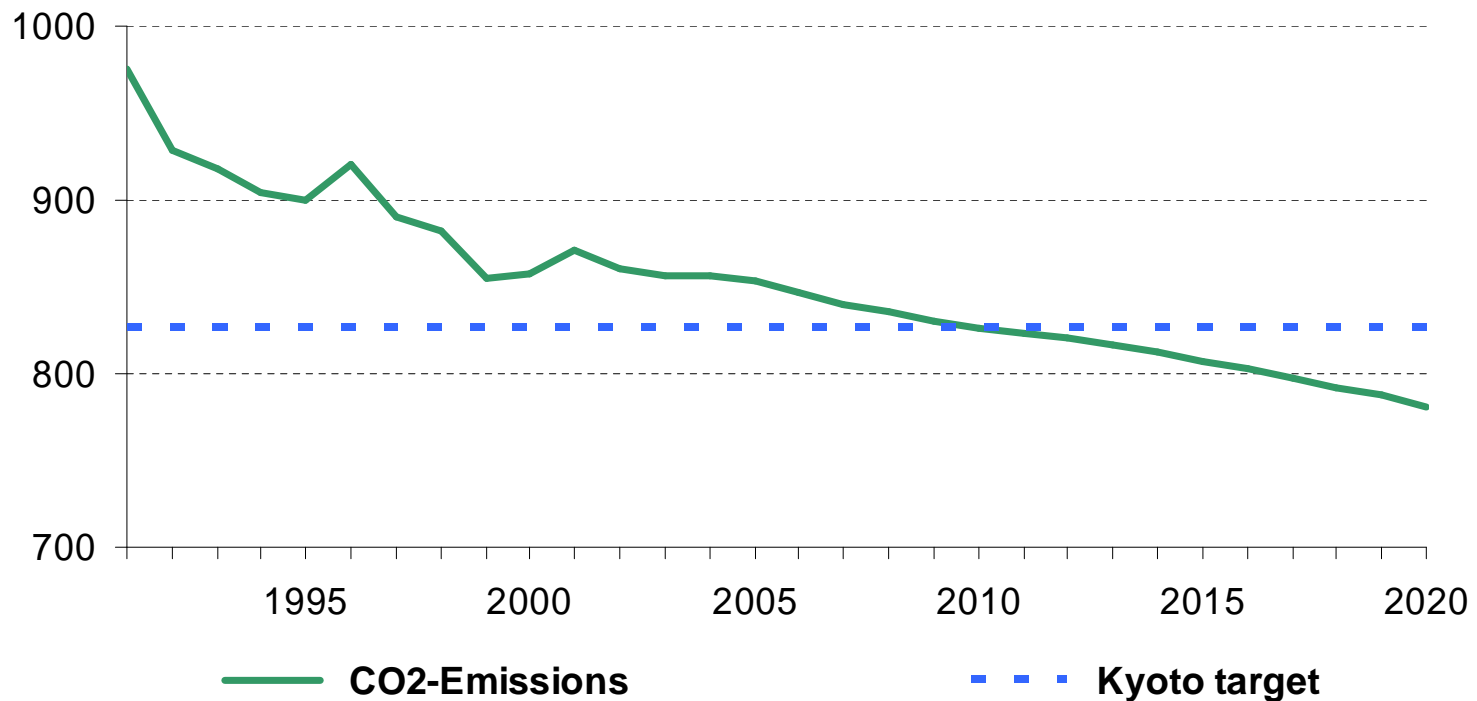
**baseline: net lending of the government  
in billion € and in percent of nominal GDP**



2 **Environment:**

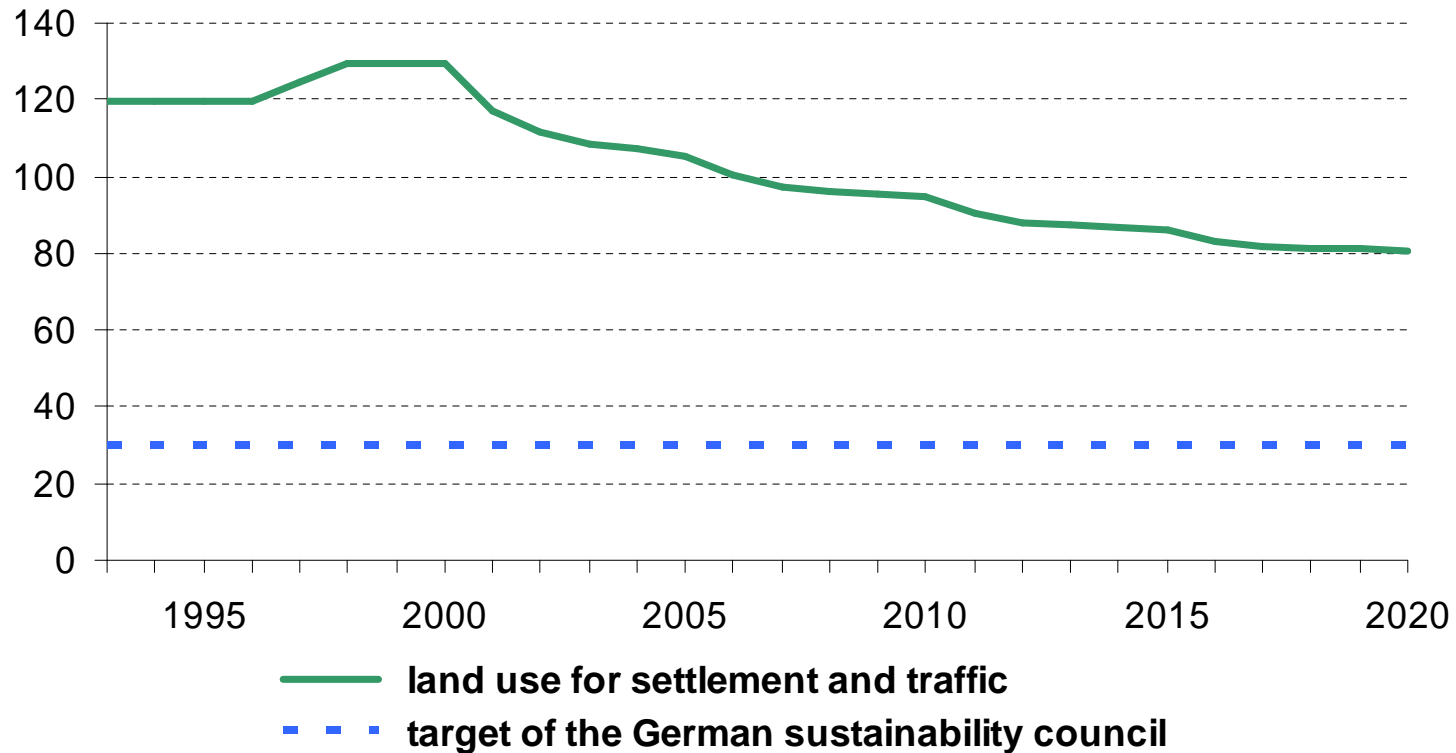
o CO<sub>2</sub> emissions: Kyoto target will be met

**baseline: CO<sub>2</sub> Emissions in mill. tons and target**



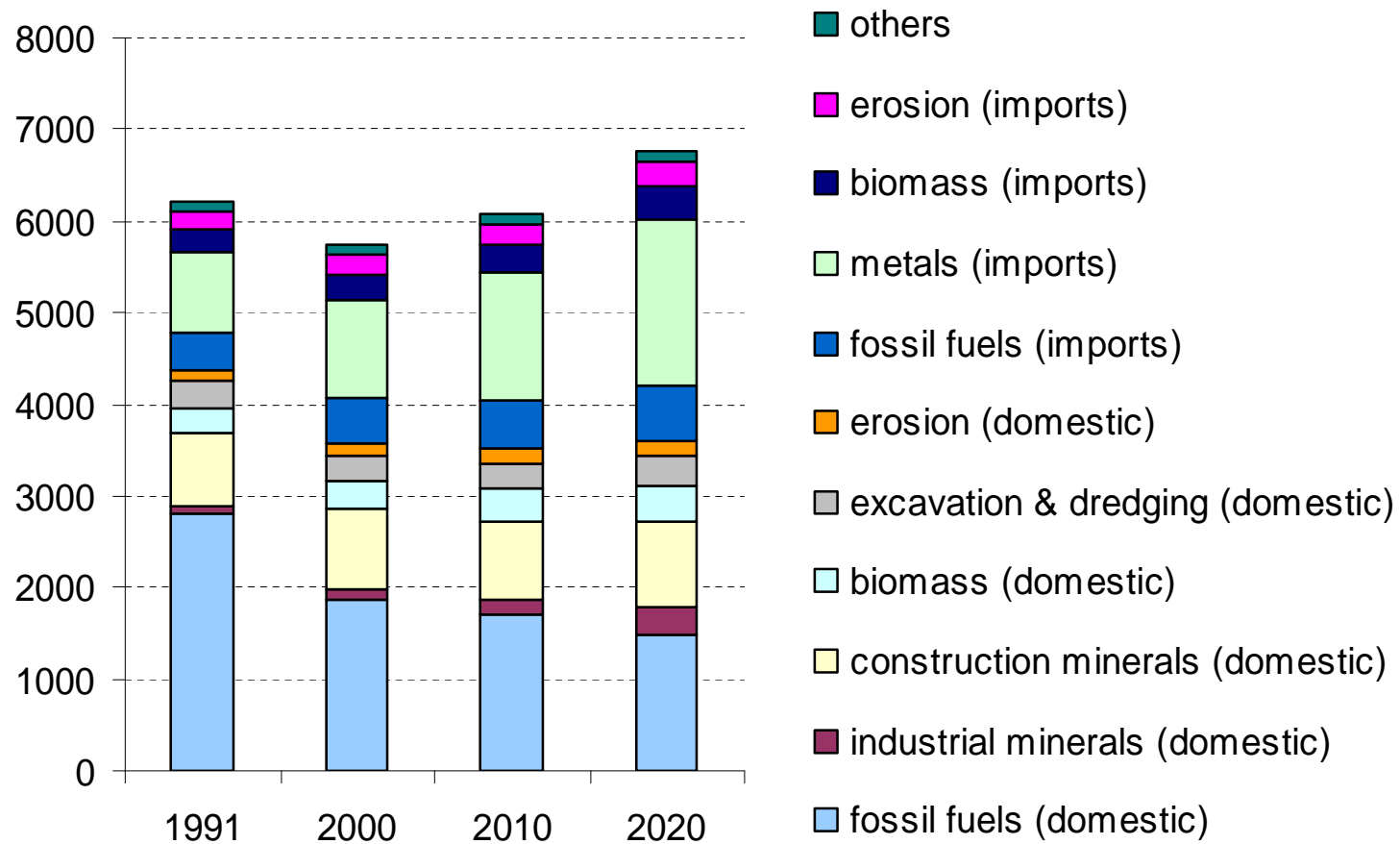
o land use: the target will not be reached

**baseline: change of land use for settlement and traffic  
in hectares per day and target**

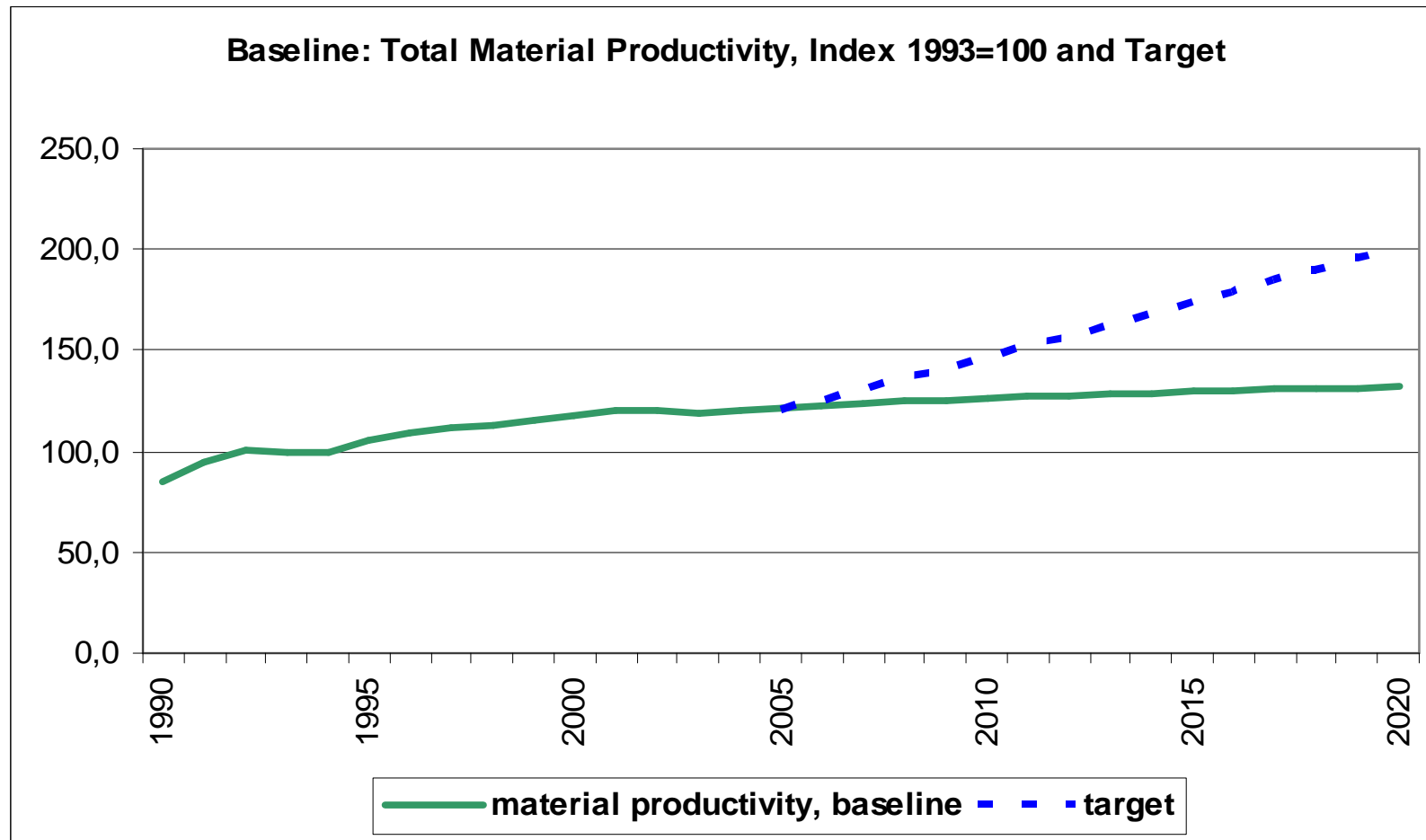


- o total material requirement: fossil fuels are falling, but imported metals are rising stronger

**baseline: total material requirement in mill. tons**



- total material productivity: the target will not be reached



### 3 Program for Growth of Material Productivity: The “Aachen” Scenario

- ≈ **Research work induced and sponsored by the Aachen foundation “Kathy Beys”**
- ≈ **Assumptions, based on consulting experience of A. D. Little and others:**
  - ⊖ 20 % reduction of material and energy costs of manufacturing sectors, construction and public administration in 11 years (linearly from 2005 to 2016),
  - ⊖ savings of material inputs induce for one year additional consulting and capital costs of the same magnitude,
  - ⊖ in the case of energy inputs the induced costs equal the savings of six years,
  - ⊖ one third of the additional costs are consulting costs, two third are capital costs.

≈ **Results:**

ō direct effects:

§ winners: receivers of material inputs

- domestic firms

§ losers: deliverers of material inputs

- domestic firms
- firms from foreign countries

è rising GDP (rebound effect!)

ō indirect effects:

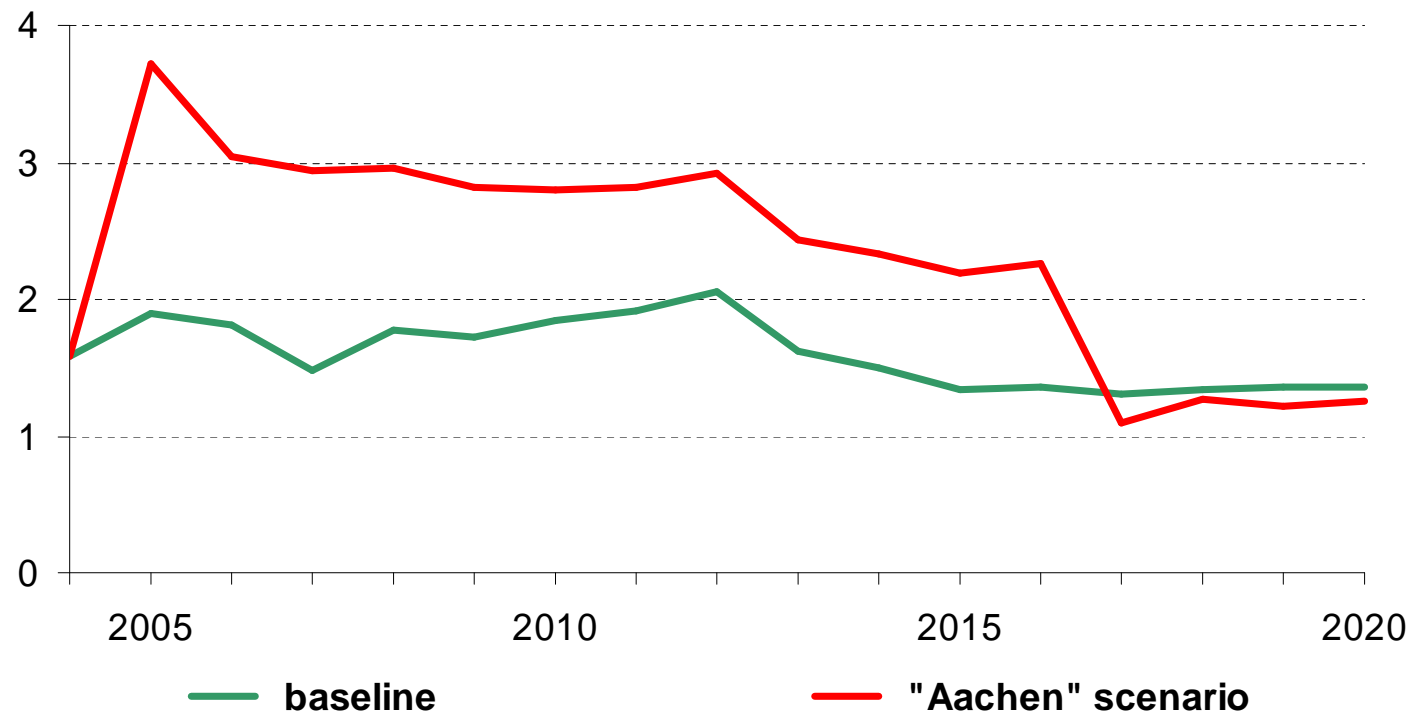
§ rising productivity

§ falling prices

§ rising production, income and employment

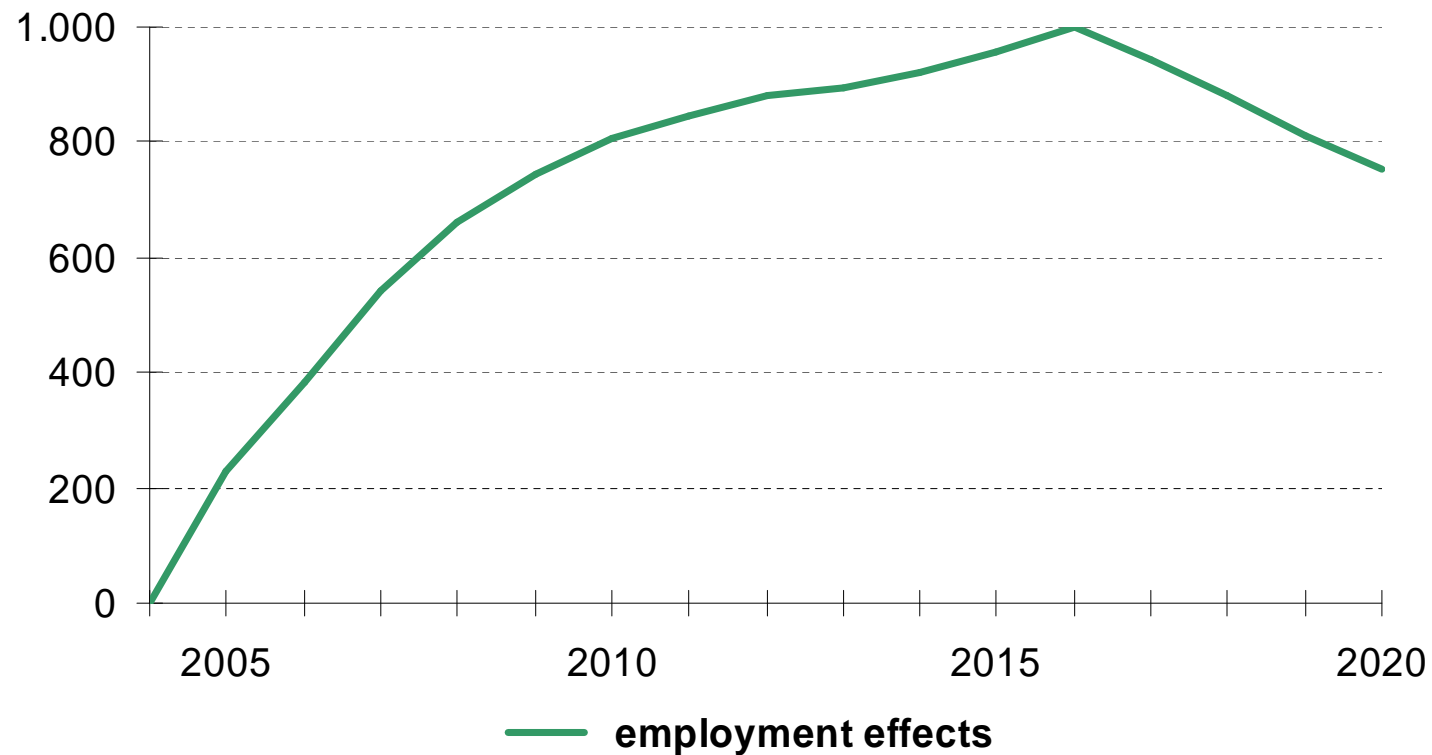
- o GDP: growth rate expands by 1 point per year

**GDP growth rates in the baseline  
and in the "Aachen" scenario**



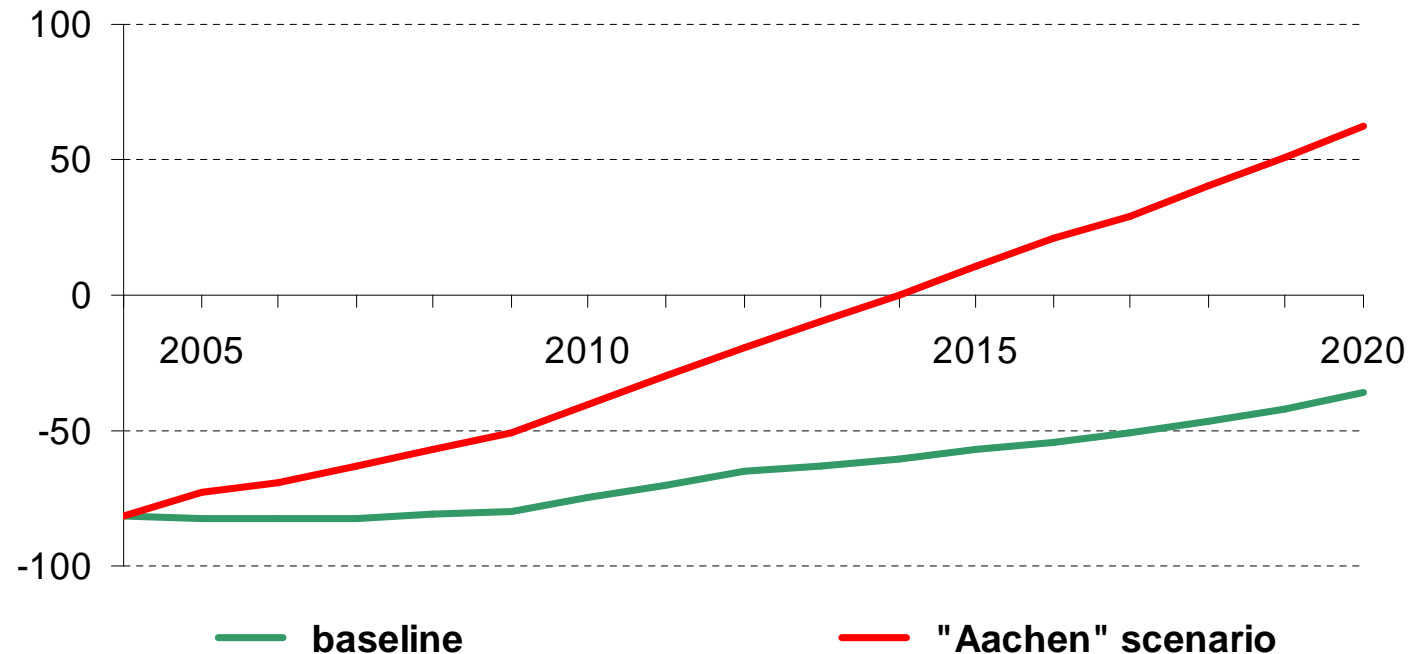
- o employment: rises up to 1 million persons in 2016

**"Aachen" scenario: effects on employment  
difference from the baseline in 1000**

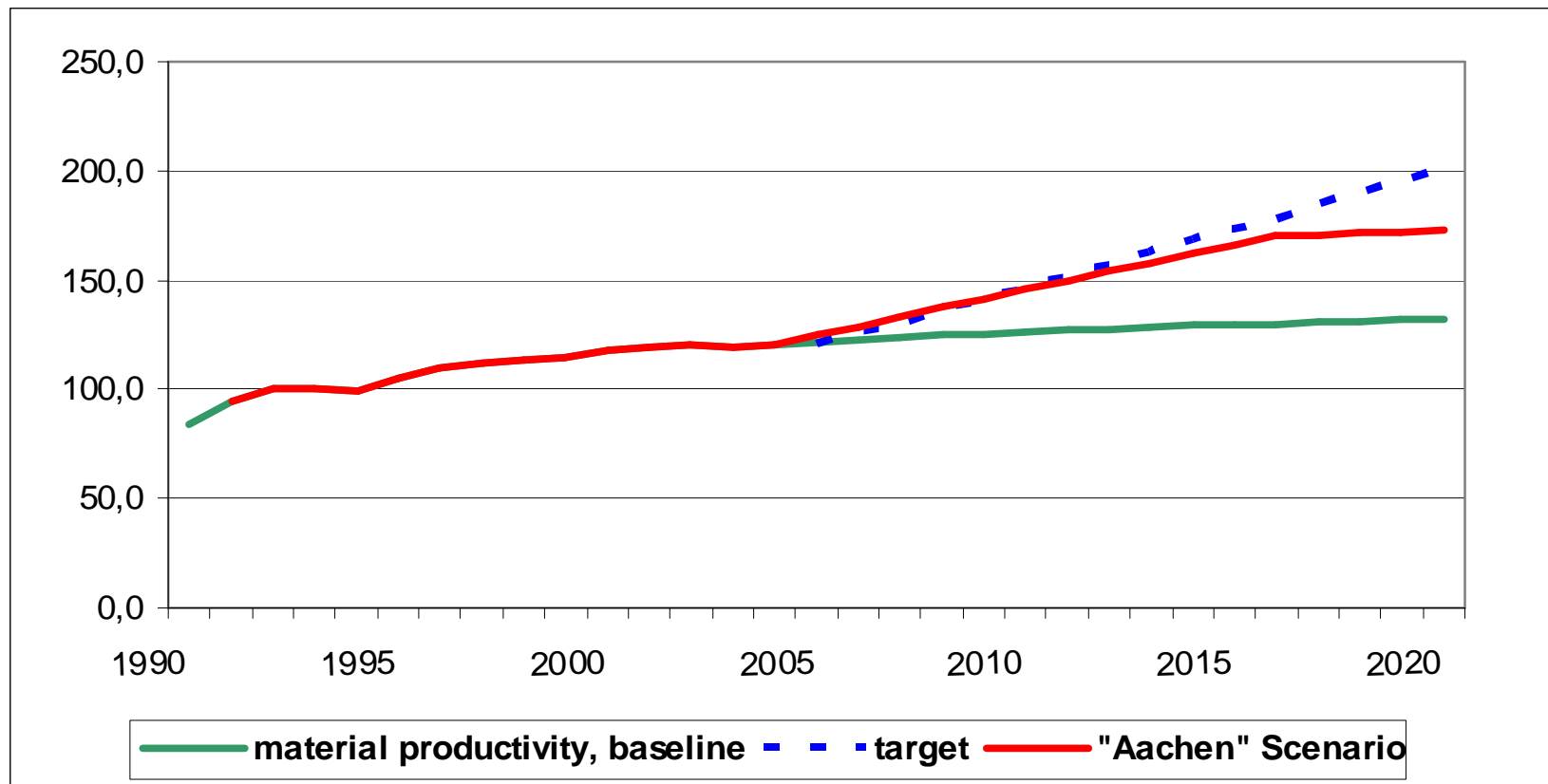


- net lending of the government: zero in 2014, plus 60 billion € in 2020

**net lending/borrowing of the government in the baseline  
and in the „Aachen” scenario in billion €**

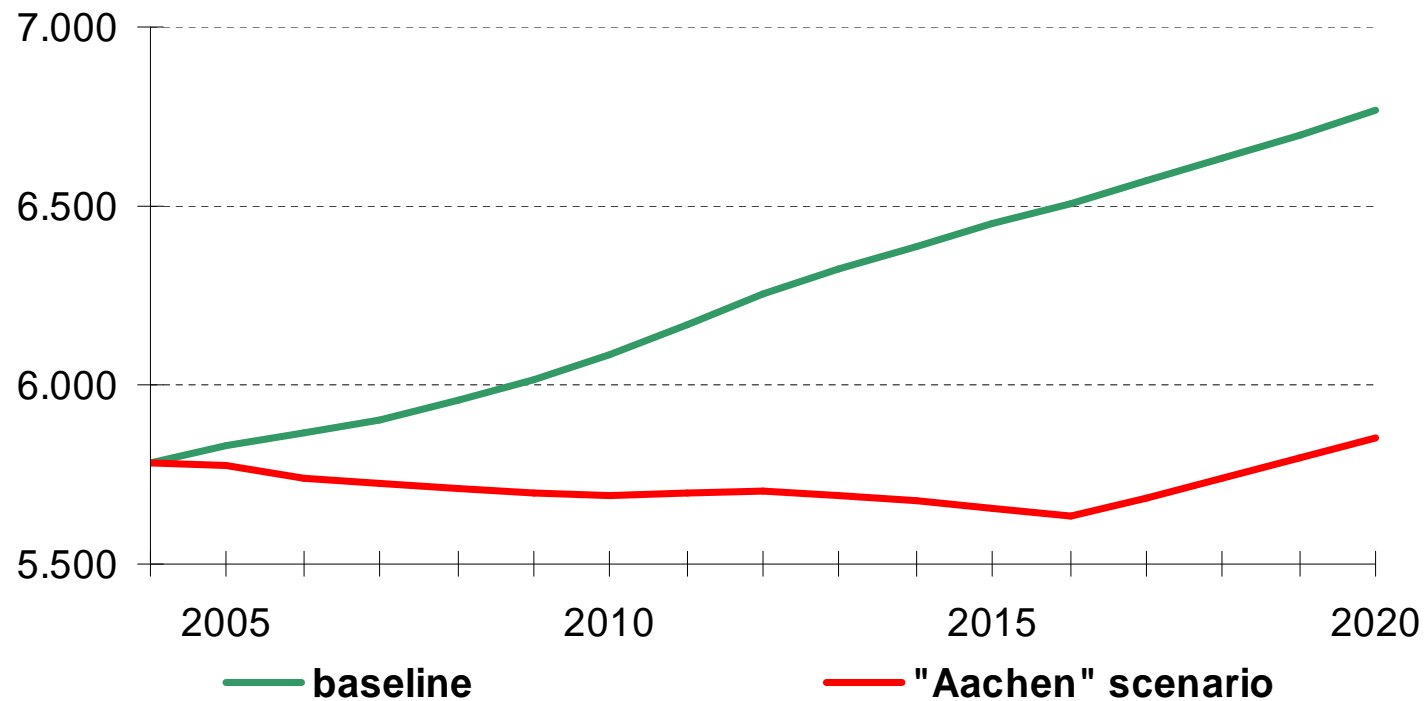


- material productivity: growth rate during the program about 2.9% per year



- total material requirement: rise of material productivity is just strong enough to disconnect economic total material requirement from economic growth

**total material requirement in the baseline and in the „Aachen“ scenario in mill. tons**



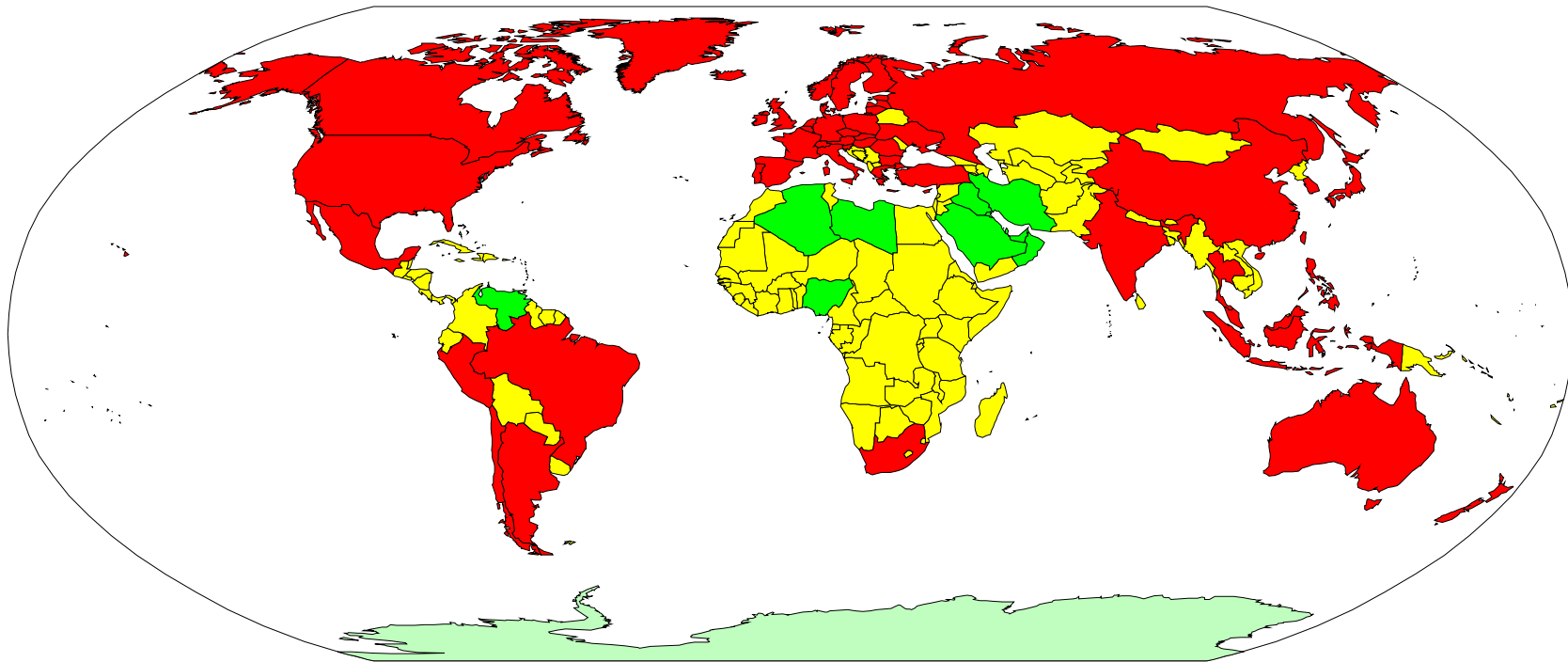
## 4 Global Model GINFORS

- ≈ **EU-funded project MOSUS ([www.mosus.net](http://www.mosus.net))**  
**National models similar but simpler than PANTA RHEI linked via monetary trade flows for 25 goods and services**
  - Importance of imported material flows
  - Material flows are explicitly calculated for 6 materials and all countries/regions
  - Evaluate policy measures in EU (OECD)
    - § in the economic, social and environmental dimension
    - § in a global context
    - § use country specific data for the extracting countries
    - § catch effects in countries outside Europe (leakage)
  - Quantification of resource use indicators

## 2 Data sources

model type		data sources	global coverage
trade		OECD, UN	40 countries, 2 regions (OPEC, ROW),
country models	input-output	OECD, Eurostat, national sources	24 countries
	macro	OECD/IMF	53 countries
	energy	IEA	53 countries
	material	SERI	53 countries
	land-use	IIASA	20-30 countries

## 2 Country Coverage



country models

OPEC ex. Indonesia

ROW

## 5 MFA requirements from a modeling perspective

- ≈ **Branch data according to MIOT is needed**
  - ⊖ to forecast material flow development
  - ⊖ to evaluate policy measures to reduce material flows
  
- ≈ **If monetary branches are not homogeneous in a physical sense, additional information is needed**
  
- ≈ **OECD data (bilateral trade data, MIOT) is very suitable for international analysis and should be extended to top extracting countries**