ENERGY EFFICIENCY POTENTIALS IN THE EU IN 2030: RESULTS AND UNDERLYING DATA

Wolfgang Eichhammer

Fraunhofer Institute for
Systems and Innovation Research ISI

Riga, 24 March 2015

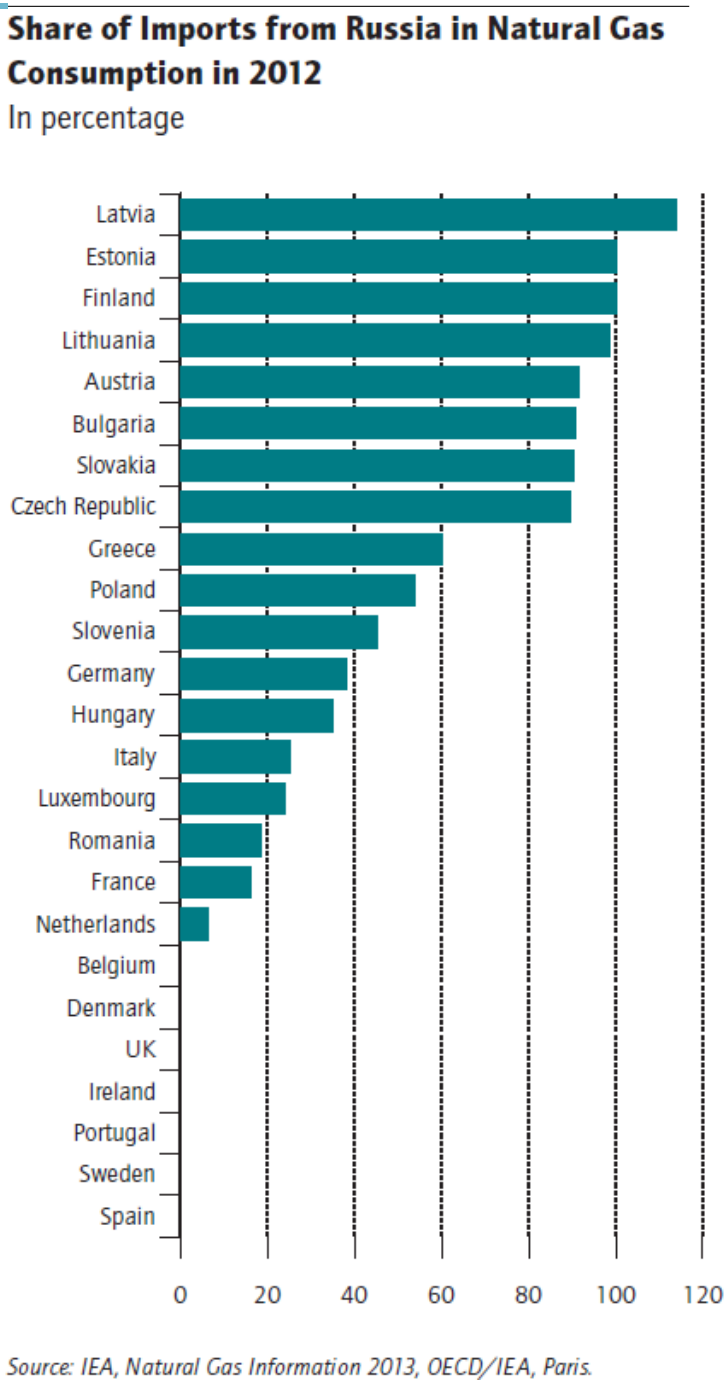
5th Plenary Meeting Concerted Action for the Energy Efficiency Directive

Fraunhofer ISI

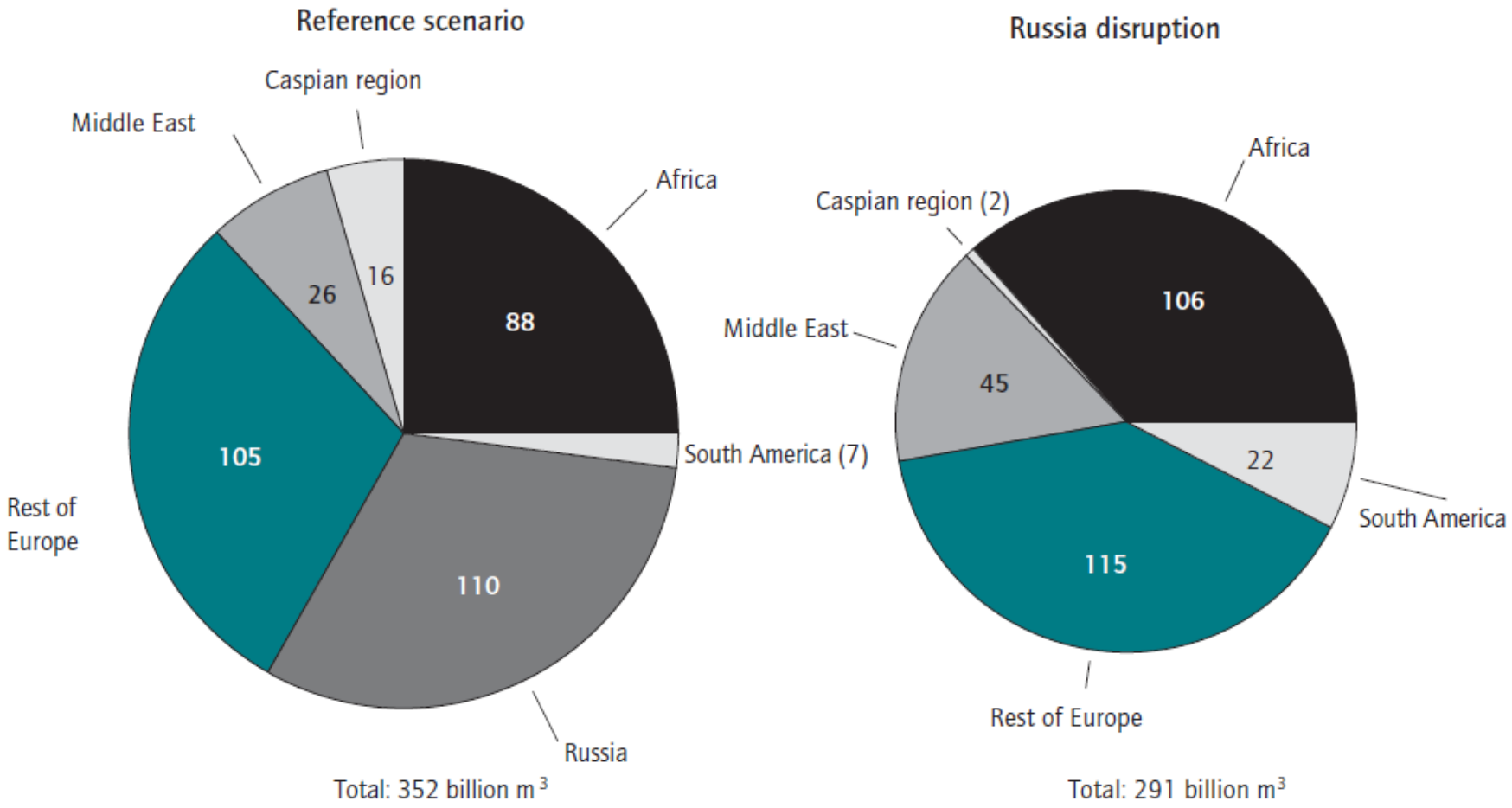
Eastern EU MS: High vulnerability due to high exposure to Russian gas dependency and comparatively high inefficiencies !

Primary energy intensity, climate corrected (www.odyssee-mure.eu)

	Unit	2005	2006	2007	2008	2009	2010	2011
European U	koe/€2005	0.16	0.16	0.15	0.15	0.15	0.15	0.15
Austria	koe/€2005	0.14	0.14	0.13	0.13	0.13	0.13	0.13
Belgium	koe/€2005	0.20	0.19	0.19	0.19	0.19	0.18	0.20
Bulgaria	koe/€2005	0.92	0.89	0.80	0.74	0.69	0.70	0.73
Cyprus	koe/€2005	0.18	0.19	0.18	0.18	0.18	0.18	0.17
Czech Rep.	koe/€2005	0.43	0.41	0.40	0.37	0.37	0.37	0.36
Denmark	koe/€2005	0.10	0.10	0.10	0.10	0.10	0.09	0.09
Estonia	koe/€2005	0.46	0.41	0.43	0.44	0.44	0.49	
Finland	koe/€2005	0.21	0.22	0.20	0.19	0.20	0.21	0.20
France	koe/€2005	0.16	0.16	0.15	0.15	0.15	0.15	0.15
Germany	koe/€2005	0.16	0.16	0.15	0.14	0.14	0.14	0.14
Greece	koe/€2005	0.16	0.15	0.15	0.15	0.15	0.15	0.15
Hungary	koe/€2005	0.31	0.30	0.29	0.29	0.29	0.29	
Ireland	koe/€2005	0.09	0.09	0.09	0.09	0.09	0.09	0.08
Italy	koe/€2005	0.13	0.13	0.13	0.12	0.12	0.12	0.12
Latvia	koe/€2005	0.35	0.33	0.31	0.31	0.35	0.36	0.33
Lithuania	koe/€2005	0.41	0.38	0.38	0.37	0.39	0.31	0.30
Luxembourg	koe/€2005	0.16	0.16	0.15	0.14	0.14	0.15	0.14
Malta	koe/€2005	0.20	0.19	0.20	0.18	0.18	0.17	
Netherlands	koe/€2005	0.15	0.15	0.15	0.14	0.14	0.15	0.14
Poland	koe/€2005	0.38	0.38	0.36	0.34	0.32	0.32	0.32
Portugal	koe/€2005	0.17	0.16	0.15	0.14	0.15	0.13	0.13
Romania	koe/€2005	0.47	0.46	0.43	0.41	0.38	0.39	0.39
Slovakia	koe/€2005	0.49	0.45	0.40	0.39	0.37	0.37	0.35
Slovenia	koe/€2005	0.25	0.24	0.23	0.23	0.23	0.23	0.23
Spain	koe/€2005	0.16	0.15	0.15	0.14	0.14	0.13	0.14
Sweden	koe/€2005	0.19	0.18	0.17	0.18	0.18	0.17	0.17
United King	koe/€2005	0.13	0.12	0.12	0.11	0.11	0.11	0.11



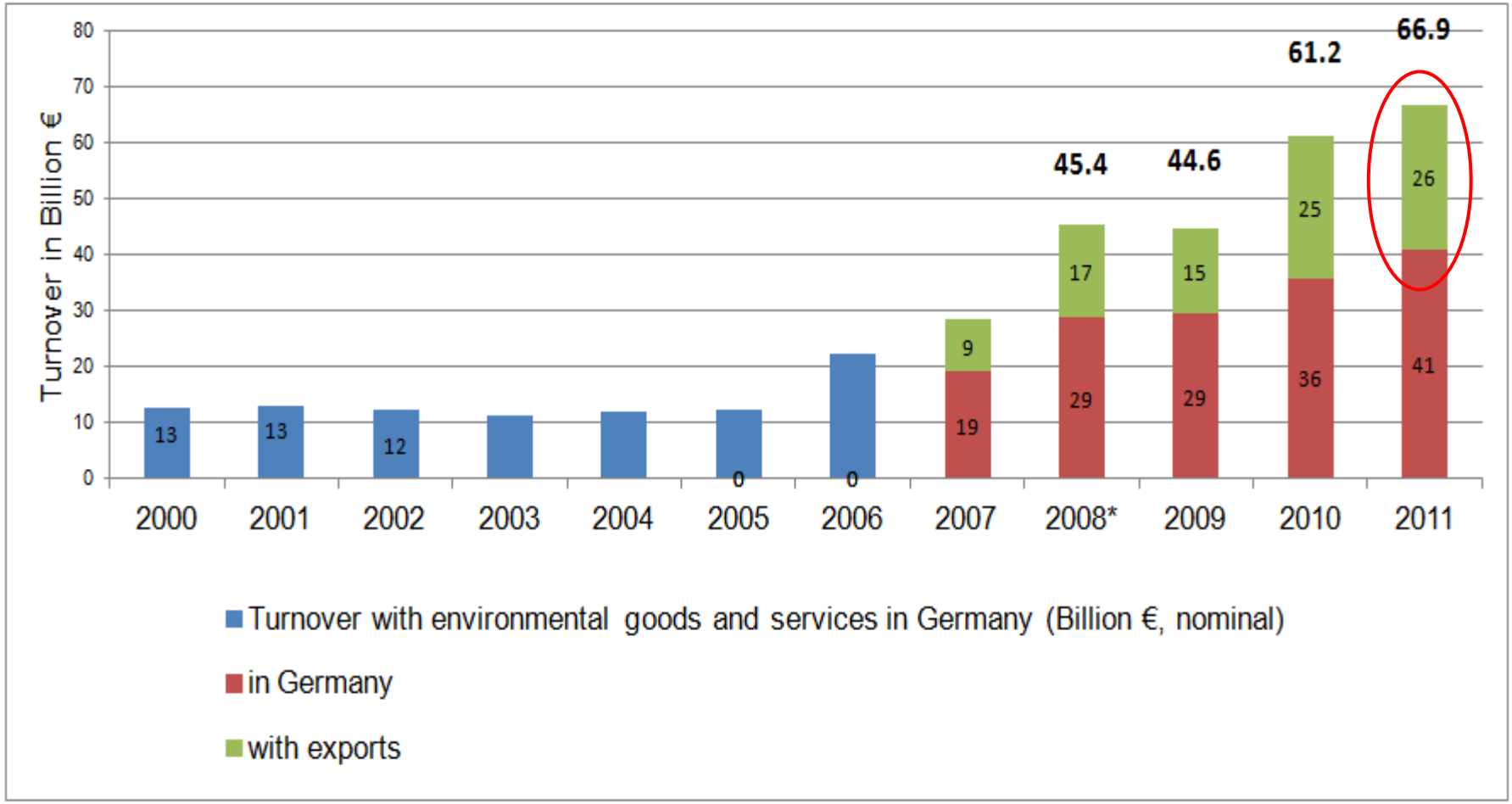
Composition of European Imports by Supplier in 2015 (in billion m3) – Change Scylla for Charybdis?



Source: DIW Economic Bulletin 8 / 2014 European Natural Gas Supply Secure Despite Political Crises
http://www.diw.de/sixcms/detail.php?id=diw_01.c.479314.de

Fraunhofer ISI

Germany: Turnover with environmental goods in Germany and for export



Fraunhofer ISI

Project for EU Commission / DG ENER

1. **Achievement of 2020 energy efficiency (EE) target:** -20% primary/final energy compared to fixed reference development (PRIMES 2007, pre-economic crisis baseline)

   Three methods:

   - **Bottom-up investigation of EE measures** reported by Member States in National Energy Efficiency Action Plans NEEAP 2, Art. 7 notifications on Energy Saving obligations (NEEAP3 not yet available by the time of analysis)
   - **Decomposition analysis** of statistical development 2008-2012 and projection to 2020
   - **Bottom-up modelling of EU-wide and national measures** in 4 scenarios

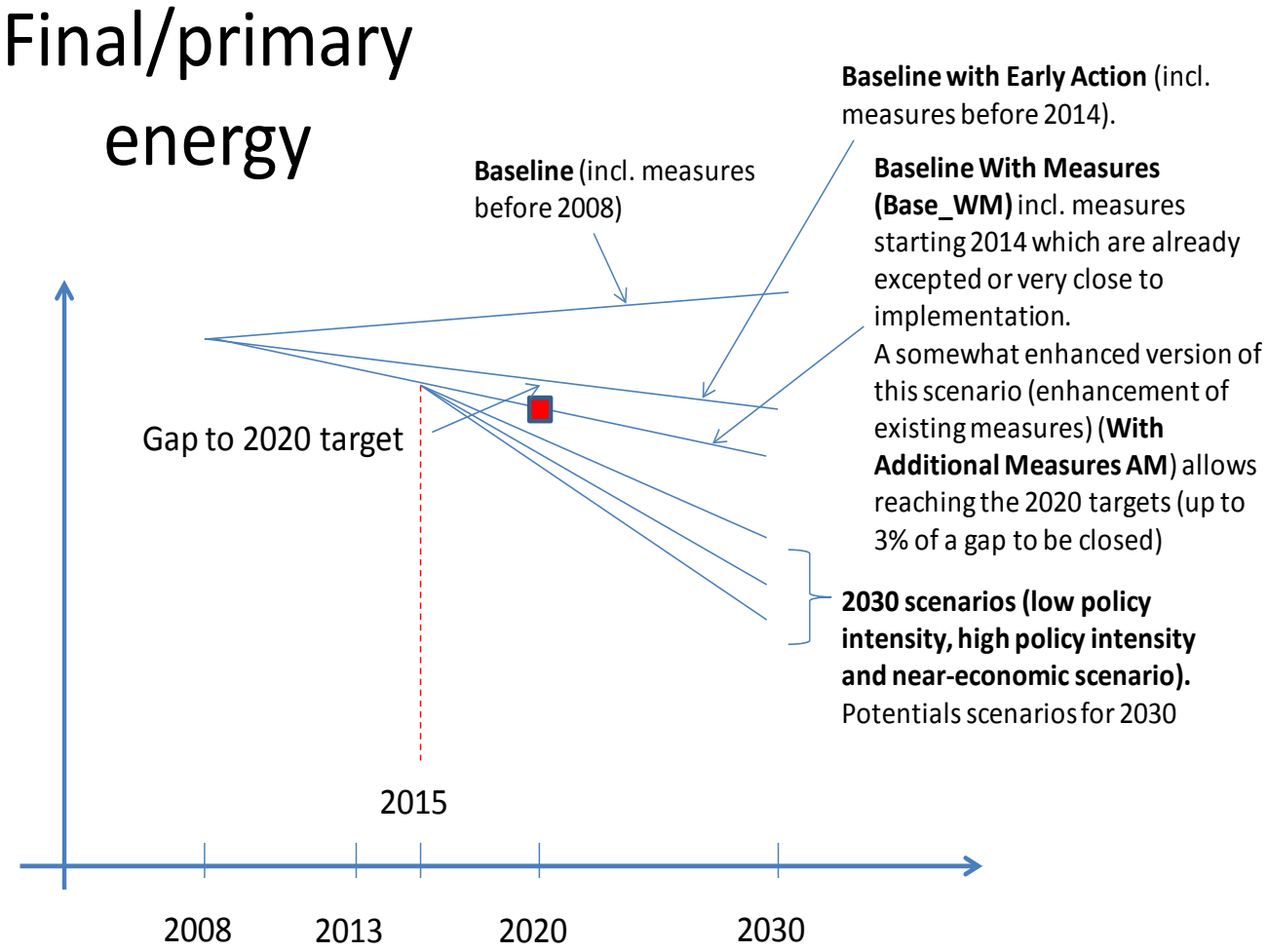
2. **Energy efficiency potentials for 2030:**

   Method:

   - **Bottom-up modelling of EU-wide and national potentials** in the extension of the 4 measure-based scenarios + 3 potentials scenarios

Fraunhofer ISI

Graphical presentation of the scenarios



Fraunhofer ISI

Bottom-up Models used for the Analysis of Energy Efficiency Options

- The **INVERT/EE-Lab model** (run by TU Wien) for residential and non-residential buildings
- The **FORECAST platform** (run by Fraunhofer ISI), including an industrial model as well as the electricity uses in the residential and service sector
- The **ASTRA model** (run by Fraunhofer ISI) providing potentials for the transport sector
- The **PowerACE model** providing efficiency options, including renewable for the power sector.

- Analysis of potentials and cost relative to the Base_inclEA scenario (reference development, close to PRIMES 2013)

Data sources for potentials

Statistical data (models gauged to statistical data and detailed indicators)

- Eurostat + National statistics
- Odyssee-MURE project
- Data from associations
- Data from specific surveys (e.g. tertiary sector in Germany)

Technical data

- Sectoral and branch-specific technical literature, technical information from awards,…
- Results of specific EU projects, for example ENTRANCE for buildings
- Electricity projections for several electricity suppliers
- Large number of implementation projects:
  - e.g. Learning Networks for Energy Efficiency (700 companies)
  - Benchmarking for compressed air

Fraunhofer ISI

Validation procedures

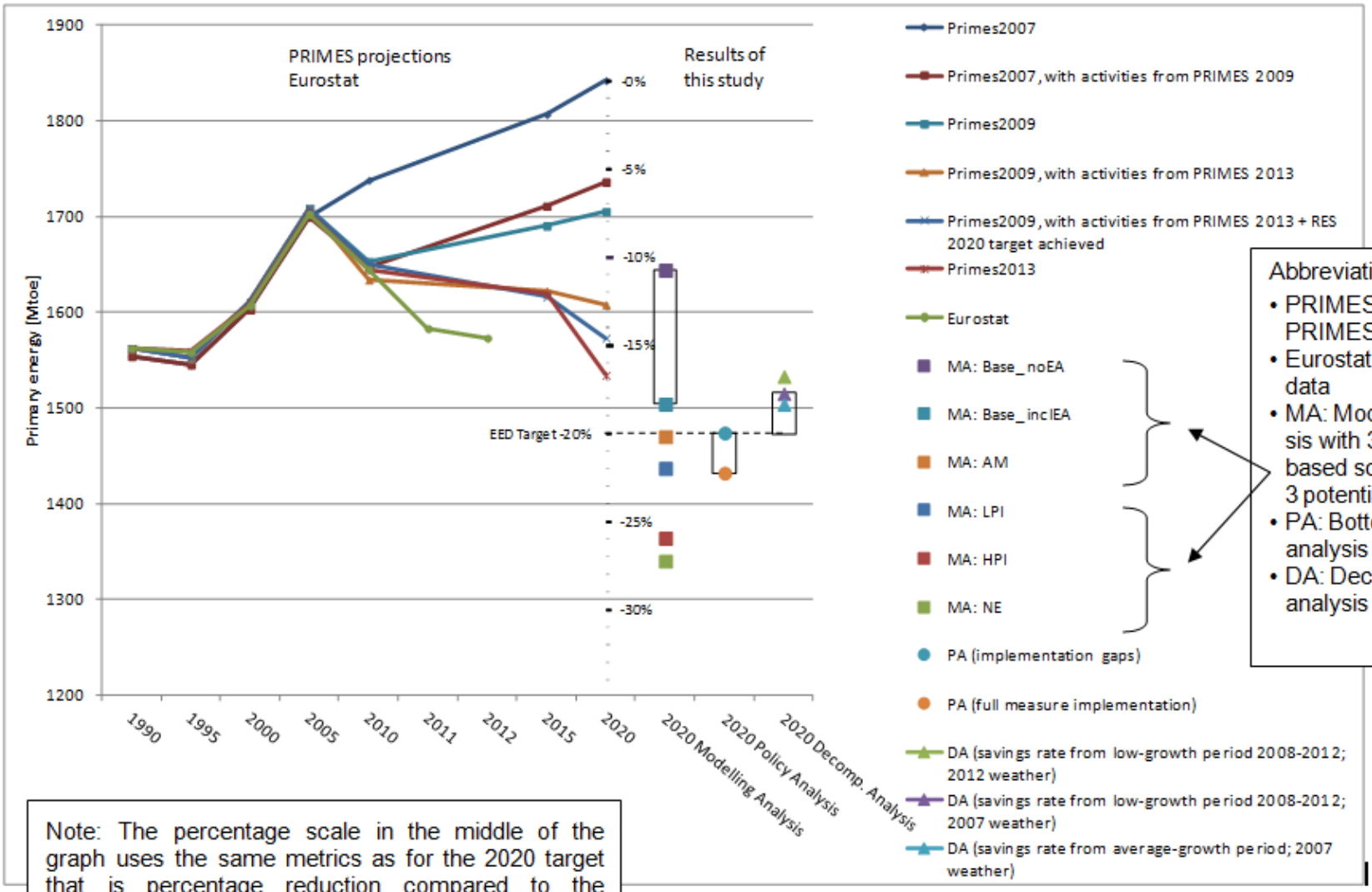
- Validation interviews with sectoral experts
- Several **sectoral validation workshops** in the past years (e.g. three groups of sectoral workshops in Brussels for transformation, residential /tertiary appliances/buildings , industrial processes/cross-cutting technologies, transport)
- Branch-specific workshops with industrial representatives
- Verificiation with top-down statistical data

Potentials depend not only on technical potentials but also on…

- Assumptions on investment cycles
- Assumptions on energy prices
- Assumptions on capital costs
- Activity levels
- …

Fraunhofer ISI

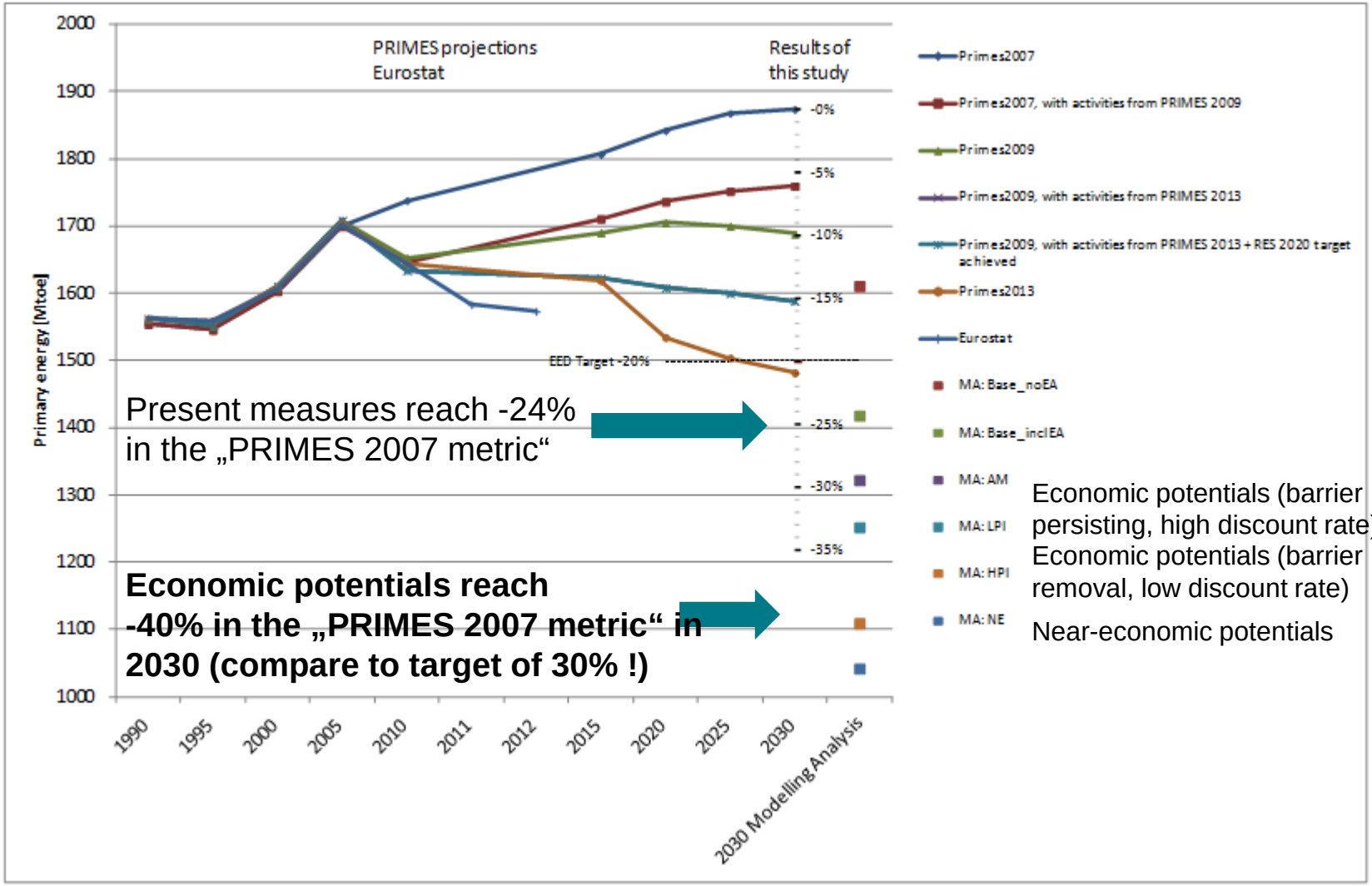
Figure 1: Summary of main results for the projected **primary** energy gap for the EU in **2020**



Note: The percentage scale in the middle of the graph uses the same metrics as for the 2020 target that is percentage reduction compared to the PRIMES 2007 baseline.

Fraunhofer ISI

The PRIMES 2007-metric for energy efficiency and economic Energy Efficiency potentials



EU COM: Communication on Energy Efficiency July 2014

Table 1. Costs and benefits of a range of different energy efficiency targets[34]

	REF2013 Baseline	GHG40 (40% GHG, 27% RES, 25% EE)	More ambitious objective for energy efficiency (%)					
			EE27	EE28	EE29	EE30	EE35	EE40
Energy Savings in 2030 (evaluated against the 2007 Baseline projections for Primary Energy Consumption)	21.0%	25.1%	27.4%	28.3%	29.3%	30.7%	35.0%	39.8%
Primary Energy consumption in 2030 (Mtoe) [Gross Inland Energy Consumption excluding non-energy use]	1490	1413	1369	1352	1333	1307	1227	1135
Energy systems costs without effect of energy efficiency on non-financial costs[35] (average annual 2011-2030 in bn €'10)	2067	2069	2069	2074	2082	2089	2124	2181
Investment Expenditures (average annual 2011-2030 in bn €'10)[36]	816	854	851	868	886	905	992	1147
Net gas imports in 2030 (in bcm)[37]	320	276	267	256	248	237	204	184
Fossil fuel imports costs (average annual 2011-2030 in bn € '10)	461	452	447	446	444	441	436	434
Employment in 2030 (million Persons)	231.74	n.a.[38]	n.a.	232.39	n.a.	232.53	233.16	235.21
Average Price of Electricity in 2030 (€/MWh)	176	179	180	179	178	178	177	182

The discount rate dispute…

Discount rates (in real terms)	Standard discount rates of PRIMES	Modified discount rates due to EED	
		2015	2020 - 2050
Power generation	9%	9%	9%
Industry	12%	12%	12%
Tertiary	12%	11%	10%
Public transport	8%	8%	8%
Trucks and inland navigation	12%	12%	12%
Private cars	17.5%	17.5%	17.5%
Households	17.5%	14.75%	12%

PRIMES 2013/EC

This boils down to the question in how far discount rates used to evaluate FUTURE policies shall reflect PRESENT indi-vidual decision making processes with rather imperfect mechanisms to include risk assessment into the discount rates.

PRIMES integrates **(perceived or existing) risks** into the discount rates to a large degree, our scenario approach essentially uses usual **capital costs, considering that there are instruments to mitigate the risks and the risk perception**

Sector	Scenario	Discount rate
Household – space heating and hot water	All [3]	3.1% to 3.7% [4]
Tertiary – space heating and hot water	All [3]	4.7% to 5.4% [4]
Household – Appliances	Potential_2030_LPI	Typically 6% (discount rates vary between different countries, appliances)
	Potential_2030_HPI Potential_2030_NE	2% (assuming removal of barriers from 2020)
Tertiary – Appliances	Potential_2030_LPI Potential_2030_HPI Potential_2030_NE	15% 5% 5%
Industry	Potential_2030_LPI Potential_2030_HPI Potential_2030_NE	Paypack up to 2 years accepted by 50% of companies; heating systems 15% Paypack up to 5 years accepted by 60% of companies; heating systems 15% Companies accept longer payback periods [3] heating systems 3%
Transport	N/A	N/A

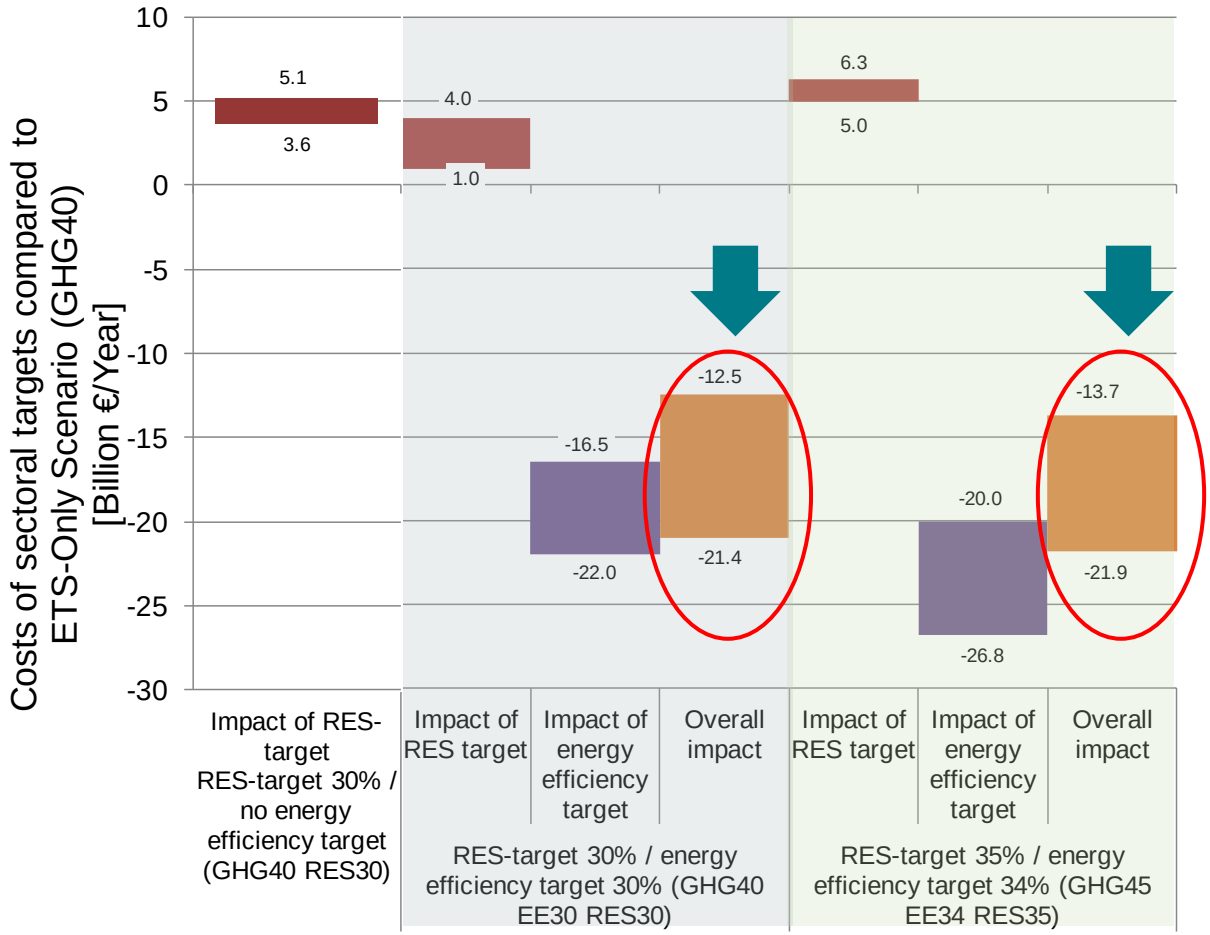
Fraunhofer ISI

The impact of such high discount rates on investment decisions is dramatic…

- Case that a standard individual house is replaced with a passive house building: Such a building may cost 300000 Euro and the additional costs for passive house standard are around 8% or **24000 Euro**.
- The original house may use 30000 kWh/year and the passive house 90% less energy. We assume 25 years lifetime for the investment.
- With a gas price of 5.5 centsEuro/kWh and a 17.5% discount rate the net present value of the energy saved is around **9800 Euro**.
- With a discount rate of 12%, this would reach around **13000 Euro**, with 9% around **16000 Euro**,
- On the other hand we may use typical capital costs of 2-4% as applied in our modeling. With 3% the net present value of the savings in the above example would be nearly **27000 Euro** over the 25 years lifetime assumed.

Role for policies to overcome non-economic barriers !

Concerning additional cost: energy efficiency and renewables – together a winning team…



- Range from RES-targets and energy efficiency targets results from different policy measures
- Additional average annual costs for RES-targets are moderate amounting from EUR 1 – 4 billion for a combined target of 30% for RES and 30% for energy efficiency
- **Energy efficiency targets reduce costs of RES-targets and leads to overall economic savings ranging from -13 to -21 billion Euro**

Fraunhofer ISI

Conclusions

- Supply dependency on fossil fuels is a permanent threat for our economies (in economic, in military and in policy terms)
- Economic energy savings may reach -40% in 2030 in primary energy terms
- Pay attention to the discount rate debate when reading about “least cost solutions” !
- Renewables and energy efficiency combined still lead to substantial cost benefits
- Energy Efficiency Policies need to concentrate on a stable long-term financing for upfront investments
- Benefits from energy efficiency in the form of innovation, employment and business cases

Fraunhofer ISI

Backup Slides

Bottom-up modelling of EU-wide and national measures in 4 scenarios

Scenario name	Short name	Explanation
Baseline No Early Action	BASE_noEA	Contains only measures before 2008. Can be roughly compared with the reference development of PRIMES 2009 (corrected for the drivers from PRIMES 2013), though the latter includes measures up to early 2009.
Baseline incl. Early Action	BASE_inclEA	Contains measures up to 2013 including. Can be compared with PRIMES 2013. Is useful in conjunction with EED (Art. 7) which admits "Early Action".
Baseline with measures	BASE_WM	Contains also measures which are already accepted or close to being accepted in 2014 and the near future. Sometimes this maybe very close to BASE_inclEA and can be the same.
Additional Measures	AM	Baseline with additional measures. Extends existing measures for each sector by around 3% in order to reach the EED target in case there is a gap. Some new measures (which represent a generalization of successful measures at the national level) are also proposed, especially for the transport sector and the space heating & hot water. The corresponding measures are listed in the report.

2. Energy efficiency potentials for 2030:

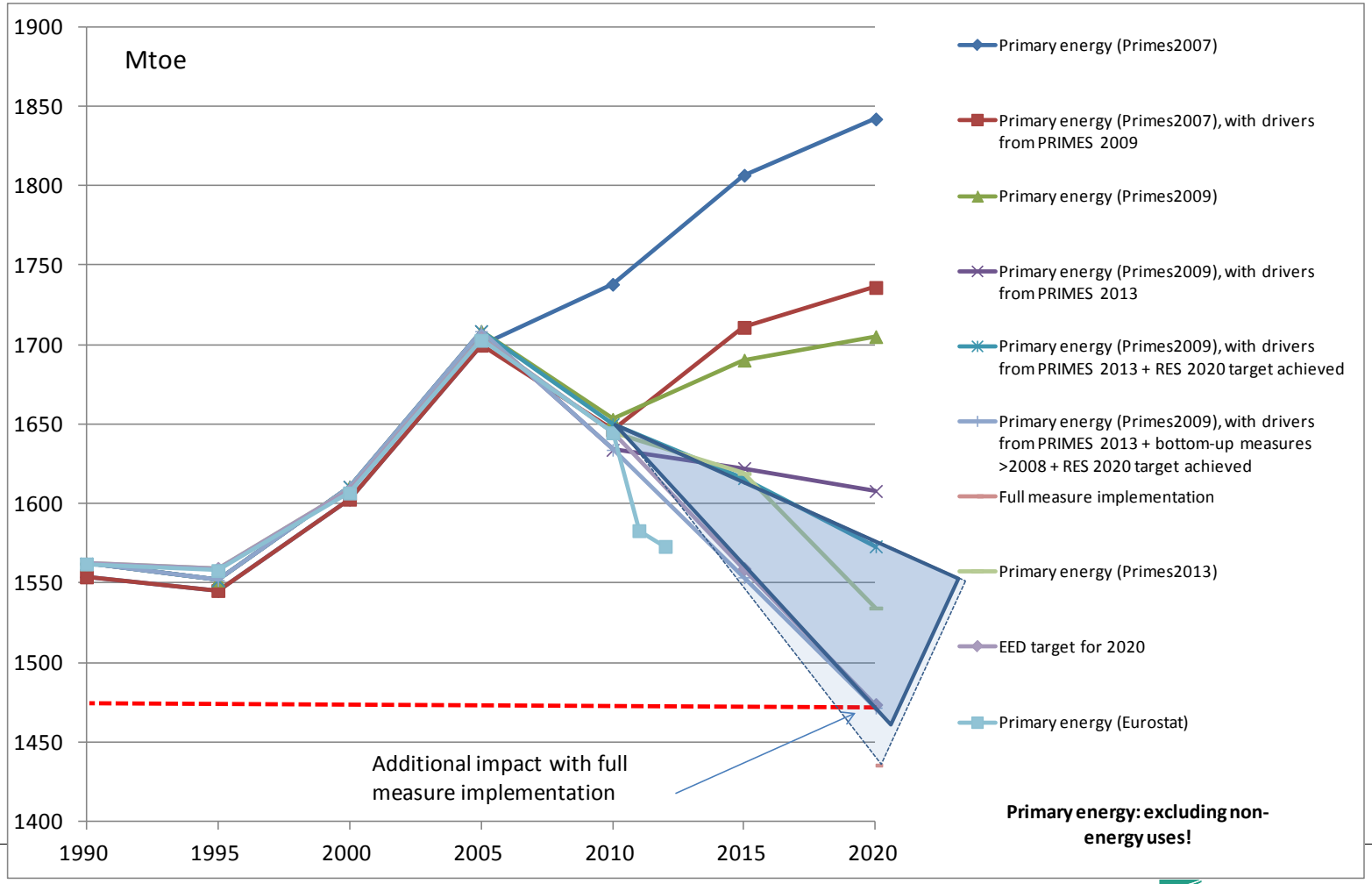
Method:

- **Bottom-up modelling of EU-wide and national potentials** in the extension of the 4 measure-based scenarios + 3 potentials scenarios

Scenario name	Short name	Explanation
Potential 2030 (low policy intensity)	Potential_2030_LPI	Potentials to 2030 with high discount rates and barriers persisting. The discount rates are sector and partially country specific. Details are provided in the report.
Potential 2030 (high policy intensity)	Potential_2030_HPI	Potentials to 2030 with low discount rates and barriers (partially or totally) removed. The discount rates are sector specific.
Potential 2030 (near economic)	Potential_2030_NE	Potentials which are not economic (that is the Net Present Value is negative given the discount rates used in the HPI scenario) but the scenario induces costs not much higher than present level energy consumption entails. This differentiates the NE potential from a pure "technical" potential which may include also higher cost.

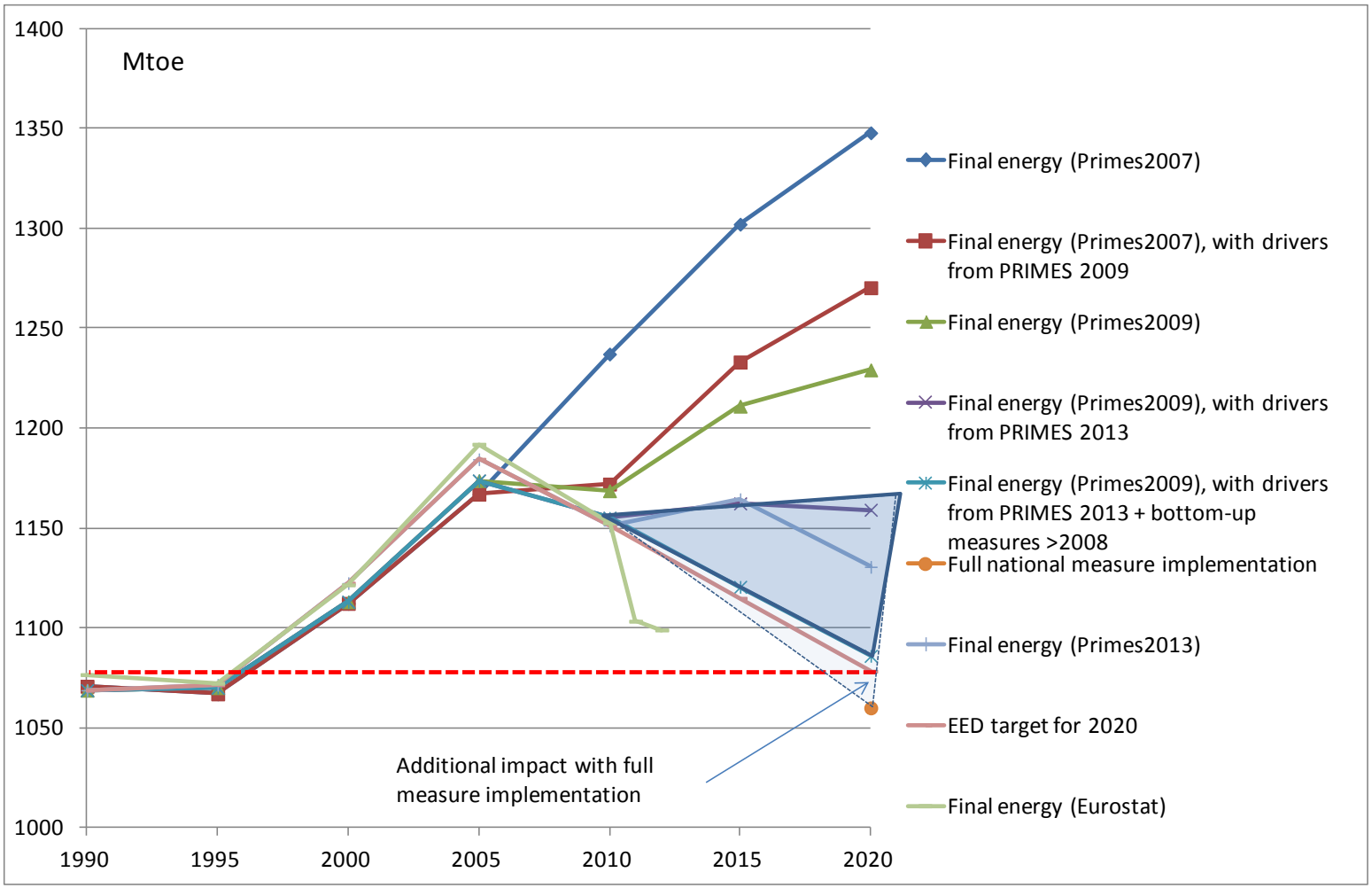
Fraunhofer ISI

Contribution of energy efficiency measures to the **primary** energy target of Article 3 (EED)



Fraunhofer ISI

Contribution of energy efficiency measures to the **final** energy target of Article 3 (EED)



Fraunhofer ISI