# THE ENERGY PICTURE OF EUROPE IN 2050 - SCENARIOS POLICIES –TECHNOLOGIES WEC EUROPE REGIONAL WORKSHOP

Paris, 06 December 2011

**Energy efficiency: What Potential and at What Price?**

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***Fraunhofer Institute for Systems and Innovation Research ISI***



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# Fraunhofer ISI/Fields of Work

- **Fraunhofer: Europe‘s largest organisation for applied research (60 institutes, 18000 persons, 1.5 billion Euro turnover)**
- **Research Field: How to couple innovation/economic development and energy efficiency/renewables**
- **Methods: Detailed demand models EU, energy efficiency indicators, PowerACE (hourly supply model EU)**
- **Involvement in Energy Efficiency Directive, Development of Emission Trading, Renewables deployment in Europe and beyond (North-Africa…Desertec…World Bank Clean Technology Fund)**




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# Overview

- Energy (efficiency) challenges for 2020 and 2050
- Energy efficiency : which potentials up to 2050 and at which price?
- Enablers for Energy Efficiency
- Energy efficiency as a key enabler for the future energy system




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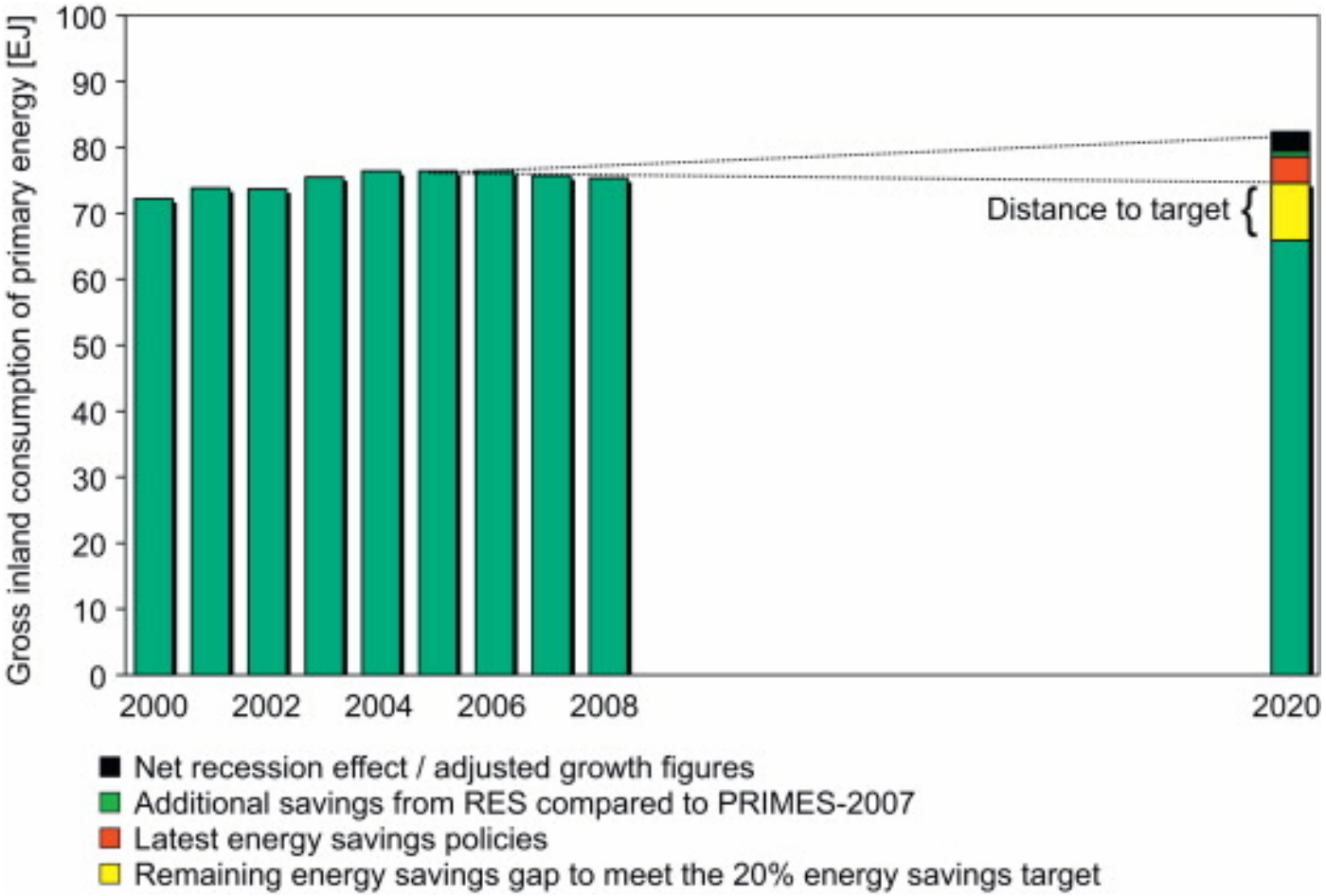
# Assessment of the energy savings policy gap 2020 with the PRIMES 2009 projections




**Source: Ecofys and Fraunhofer Institute ISI (2010a)**

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# The 2020 policy frame for energy efficiency needs to fit longterm requirements

- March 2011: 2050 Low Carbon Roadmap first official document which sets the scene for the European energy and climate policy up to 2050.
- All sectors need to contribute to the target (from a reduction in GHG emissions of 42-49 % for the agricultural sector compared to 1990 **up to 93-99 % for the power sector**).
- Energy Roadmap 2050
- Discussion around the Draft Directive for Energy Efficiency
- Role of energy efficiency insufficiently addressed in detail ➔ EU-wide study on Energy Efficiency Wedges for the German Environment Ministry by Fraunhofer ISI up to 2050




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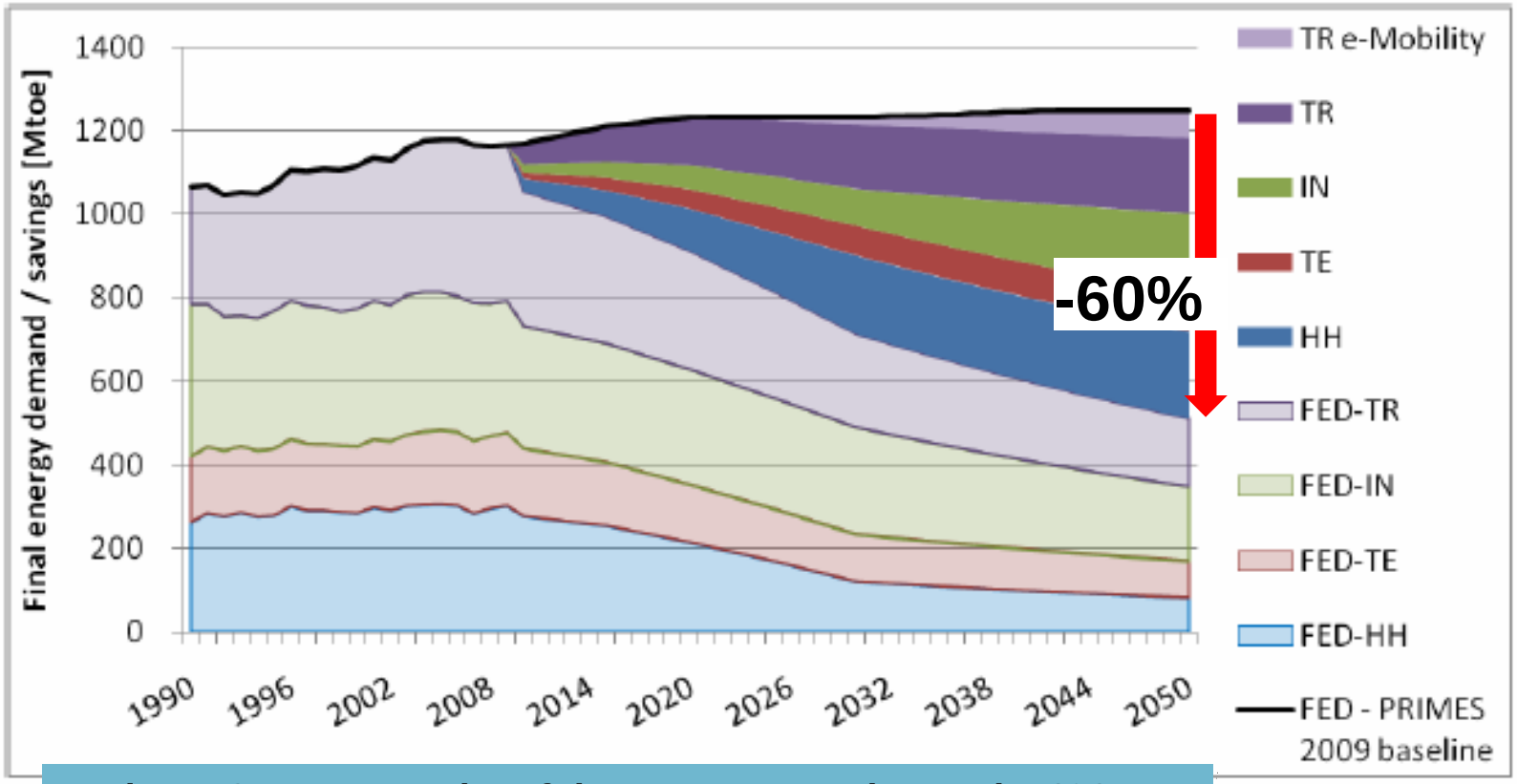
# **The energy challenge**: Total energy saving potentials in the EU27 until 2050




**Project "*Concrete Paths of the European Union to the 2°C Scenario: Achieving the Climate Protection Targets of the EU by 2050 through Structural Change, Energy Savings and Energy Efficiency Technologies* " for the German Ministry of Environment (Fraunhofer ISI**



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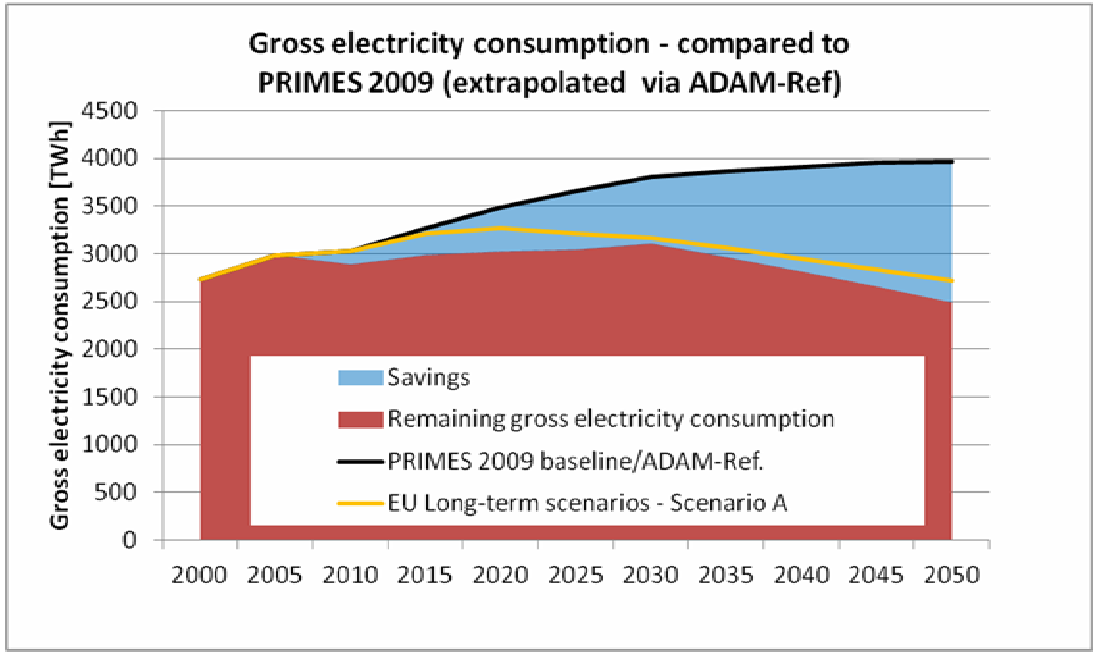
# Technical electricity saving potential

⇨ additional electricity demand for e-Mobility and heat pumps




| EU27, [TWh] | 2020 | 2030 | 2050 |
|---|---|---|---|
| PRIMES baseline | 3480 | 3803 | 3969 |
| Remaining load | 3020 | 3102 | 2485 |
| EU Long-term scenarios | 3266 | 3165 | 2721 |

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# Enablers for Energy Efficiency

- Technology Deployment
- Technology Innovation
- Policies and societal developments favouring a change in lifestyle and behaviour
- Innovative Financing
- Skilled staff (engineers, installers,….)




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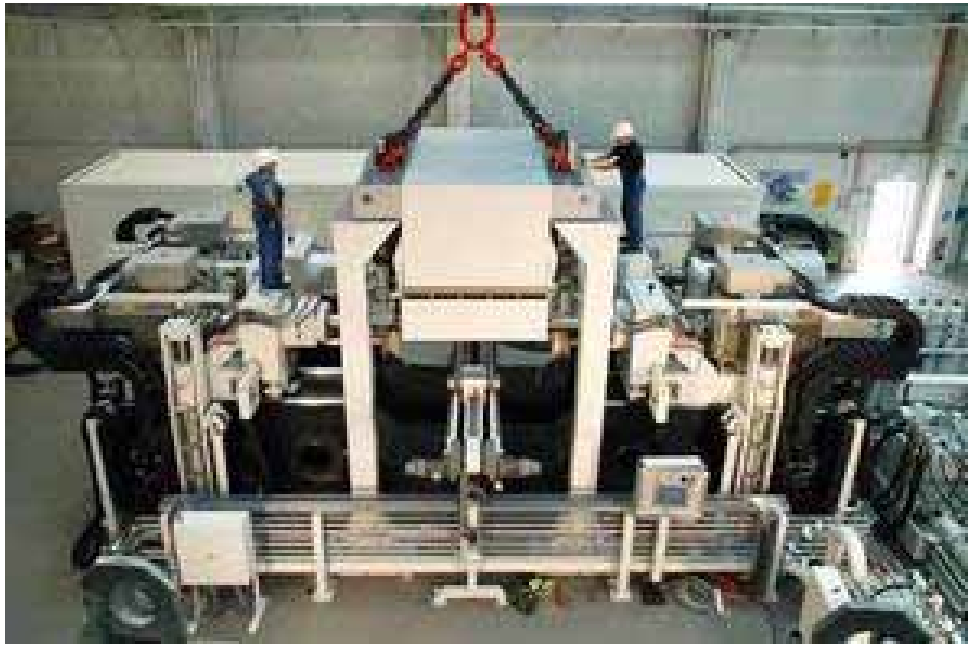
# The role of technology innovation in energy end-use: Aluminium working



*New furnace design for aluminium working: 50% less energy consumption by using* ***superconductors for magnetic heating***

*(1st price 2009 in the award for innovative climate and energy solutions iku in Germany organised by Fraunhofer for the German Industrial Head Organisation BDI and the German Ministry of the Environment*

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# How to cut energy consumption and $CO_2$ from cement production by >50%…

- **Cement : 5% of worldwide $CO_2$** = larger than air traffic
- Celitement: new hydraulic binders based on previously unknown calcium hydrosilicates that harden after gauging with the formation of calcium silicate hydrates (C-S-H phases).
- Developed at the Karlsruhe Institute of Technology + industry
- Produced in a two-stage process: **maximum temperatures of around 200 °C**
- Sharp reduction in the consumption of lime and energy.
- **Saves up to 50% of the $CO_2$ emissions in production**
- Produced on a kg scale; test plant with 100 kg per day prepared.




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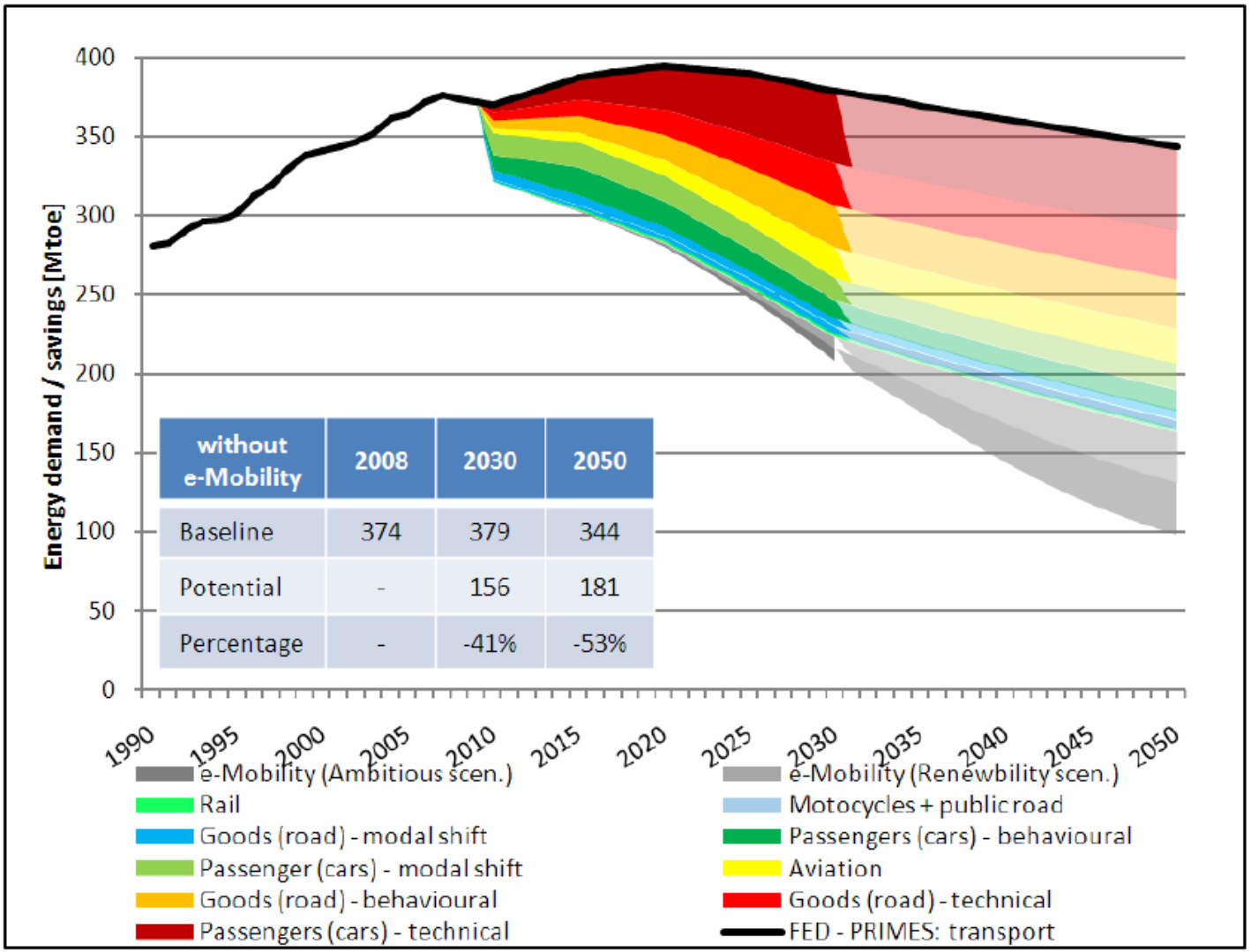
# Energy saving potentials in the transport sector: An important contribution from behaviour and modal shift




| without e-Mobility | 2008 | 2030 | 2050 |
|---|---|---|---|
| Baseline | 374 | 379 | 344 |
| Potential | - | 156 | 181 |
| Percentage | - | -41% | -53% |



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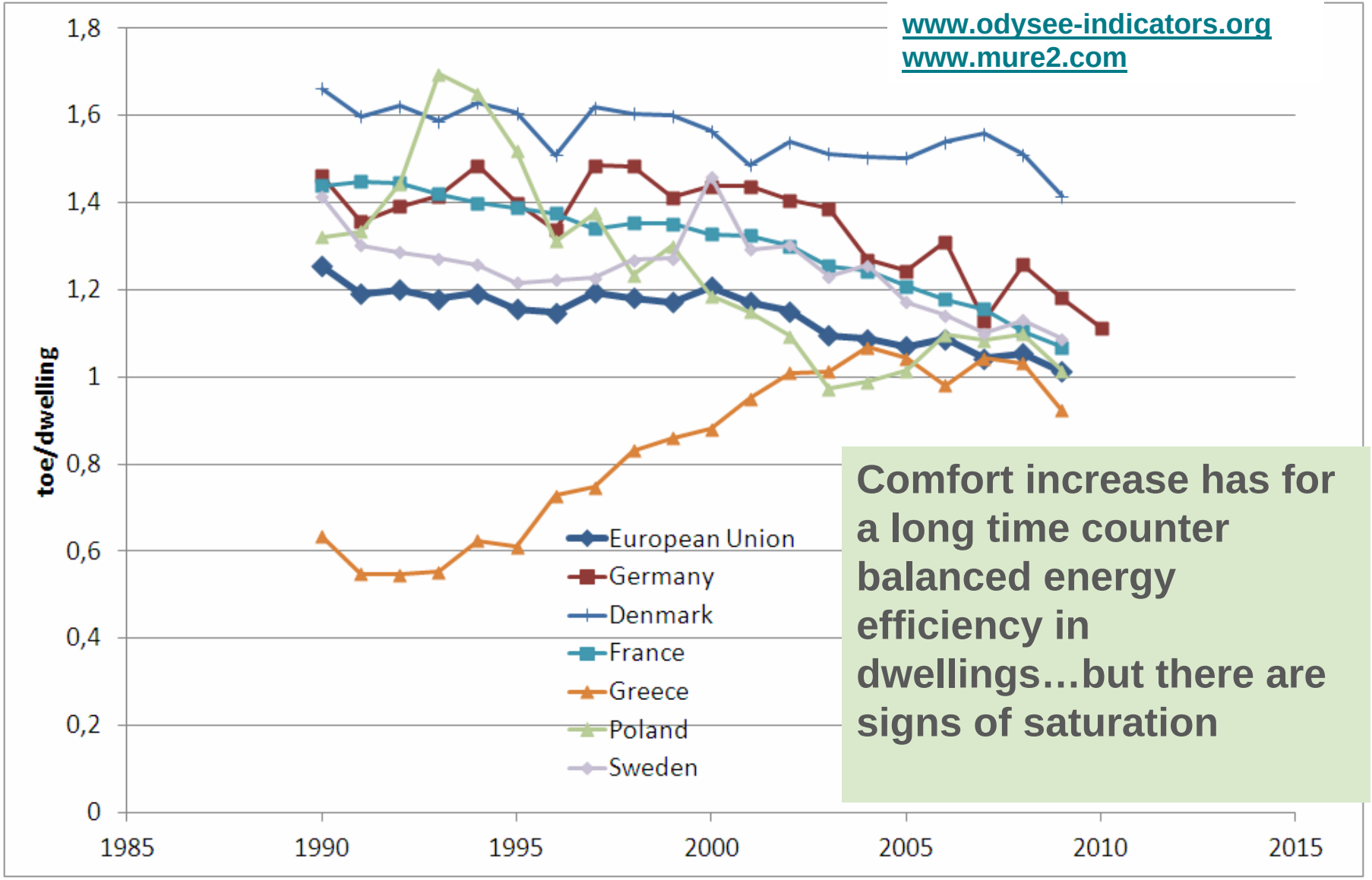
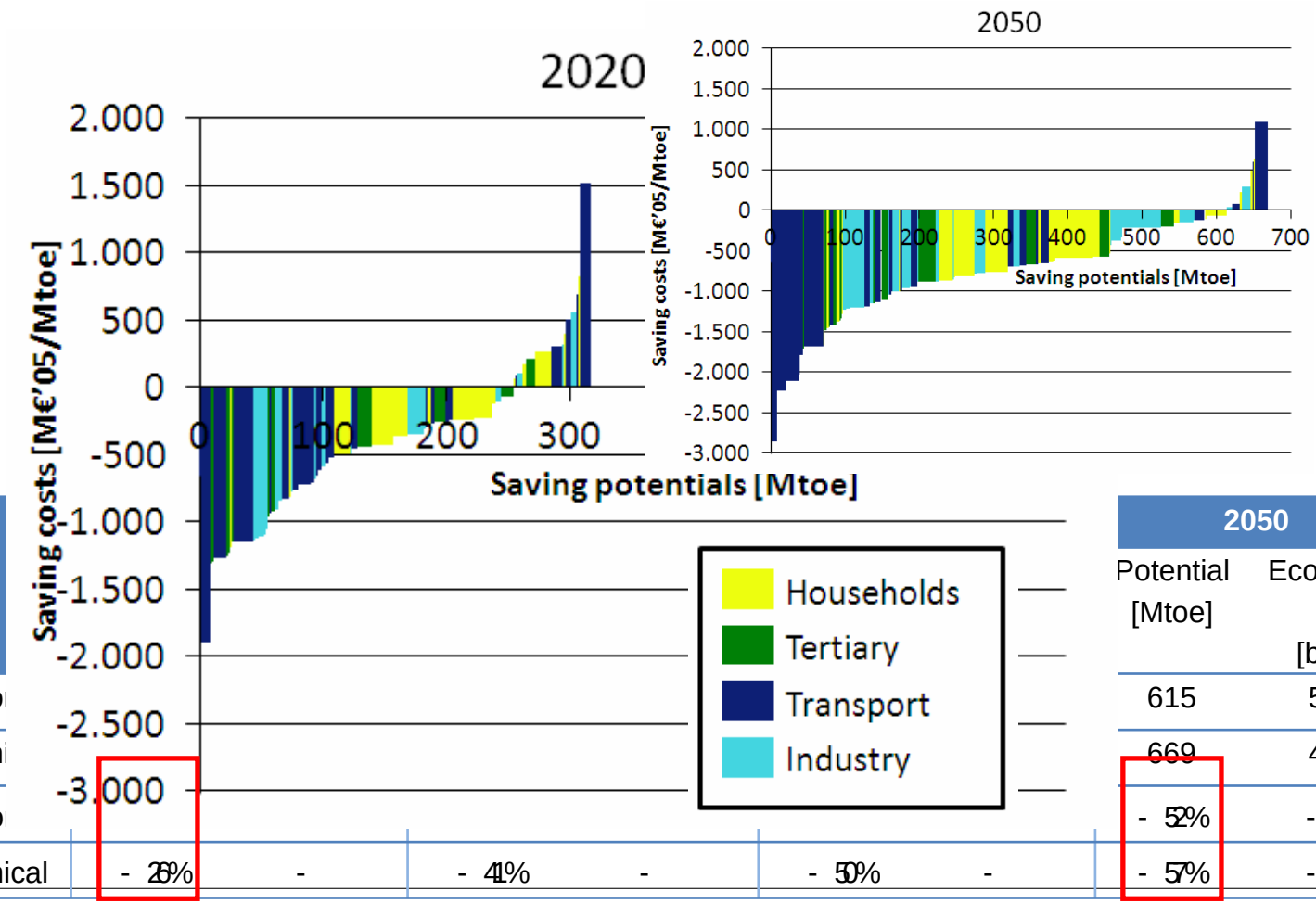
# The role of Behaviour/Comfort : Energy consumption in dwellings

www.odysee-indicators.org
www.mure2.com




**Comfort increase has for a long time counter balanced energy efficiency in dwellings…but there are signs of saturation**

# Most energy efficiency options are economic but…..




| | | 2050 | |
|---|---|---|---|
| | | Potential [Mtoe] | Economies [bn €] |
| **Overall** | Econo | 615 | 514 |
| | Techni | 669 | 488 |
| **Saving vs. Reference** | Econo | - 52% | - |
| | Technical | - 26% - - 41% - - 50% - | - 57% - |



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# …there is upfront investment to be provided

- Total **additional investment** to realise 200 Mtoe of additional energy savings in 2020 (remaining to achieve 20% target in 2020): €**900 billion** over the period 2010 – 2020 (Uncertainty range €800 – 1200 billion. We derived this number by combining data from several studies, both bottom-up and top-down.

- Buildings: €400 billion (uncertainty range €350 – 650 billion);
- transportation: €400 billion (uncertainty range €300 – 500 billion);
- industry: €100 billion.





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# The role of Innovative Financing

- **Example of developments in Germany:**
  - Large increase in funding by using funds generated from the emission trading scheme (3 billion Euro annually)
  - ETS NOT as the Holy Grail which makes all other instruments unnecessary but as an important financing tool
- **Examples from the EU level:**
  - Energy Efficiency Directive Art. 6: Financing through Energy Saving Obligations / Energy Efficiency Funds
  - Design of a “Technology Accelerator” financed from ETS surplus
  - UK Green Deal: Paying with the energy bill

# Energy and Climate Fund (EKF) in Germany: Income from Emission Trading: 3 billion Euro annually

- **National Climate Initiative: increase by 215 M€/a (total 283 Mio. €/a)**
- **Increase MAP (thermal renewables) by 215 M€/a (total 490 Mio. €/a)**
- **Increase Energy Efficiency Fund to 300 M€/a**
- **Increase R&D Energy Efficiency and Renewables**
- **Electricity price compensation 500 M€/a**
- **KfW Thermal Building Rehabilitation until 2014 (multi-billion Euro Programme: 1.5 billion Euro annually, doubling of thermal rehabilitation rate)**
- **Electromobility 300 M€/a**
- **International Climate Protection Financing 550 M€/a**

**Carbon price: 15 Euro/t.**
**Germany 225 Mt CO2: each Euro/t CO2 more or less are 200 MEuro**




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# Financing capabilities / Energy Poverty

- Germany: Contradictory debate about energy saving obligations. One important question is the role of existing instruments in particular regulation in existing buildings
- Cannot only tighten legislation on building stock: increasing issue of non-compliance because there is high upfront investment.
- Need to provide financing facilities, the more for persons with low income (UK: Fuel Poverty Targets in Energy Saving Obligations)
- **Fuel poverty will inevitably rise with oil prices beyond 100$/Barrel, if we do not support energy efficiency measures!**




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# Energy Efficiency as an important enabler for our future energy supply

Scenario reaches a RES-share of 95 %

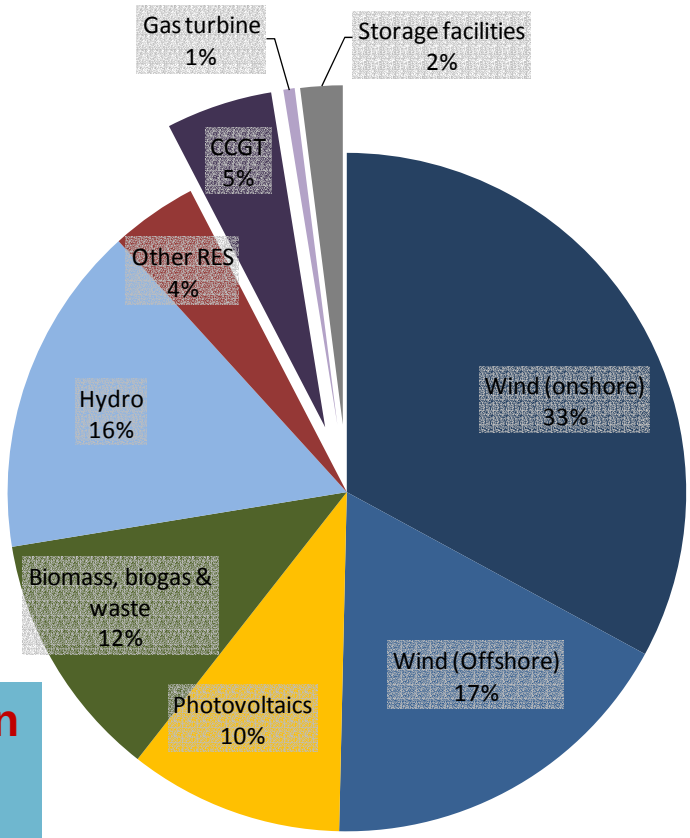
- ~ 50 % Wind power
- ~ 10 % photovoltaics

→Over 60% fluctuating generation

→Only a small share of the generation is dispatchable

→**How can this system be stable and reliable?**

→**What are the main enablers?**




**EU-wide study on (nearly) 100% renewables in the power sector in 2050 for the German Environment Ministry by Fraunhofer ISI.**

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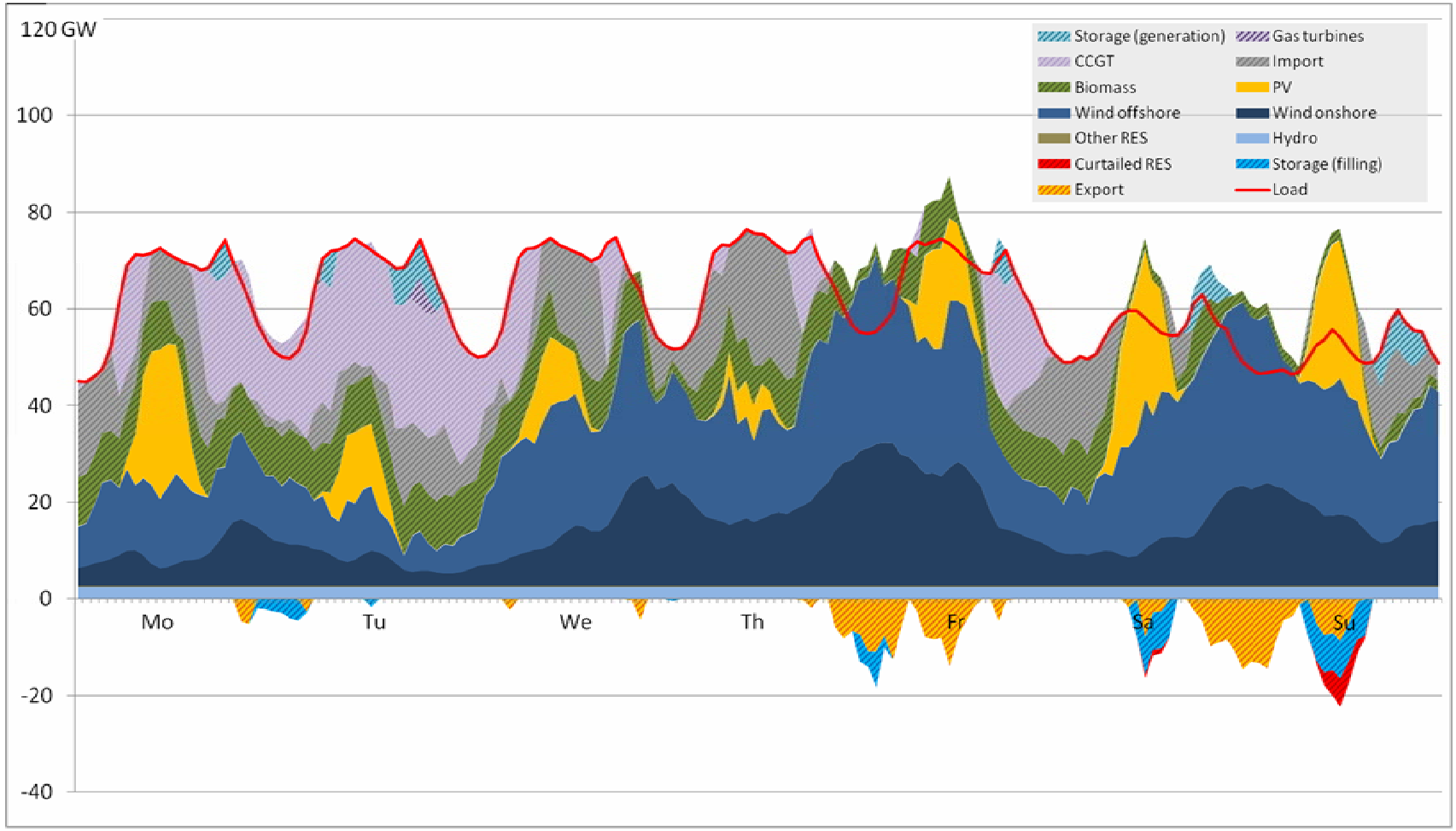
# Enabling technologies

## Hourly dispatch, Germany 2050, week 42




**PowerACE: hourly dispatch model (multi-agent moddeling) coupled with an investment model**

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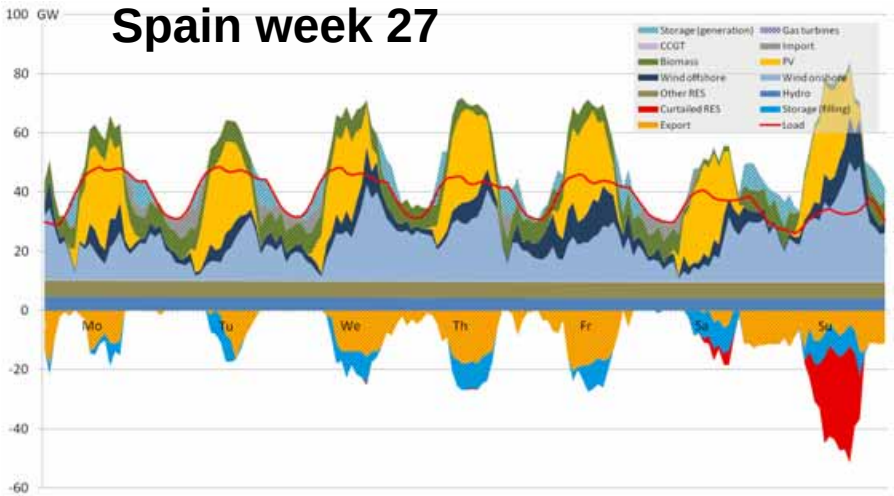
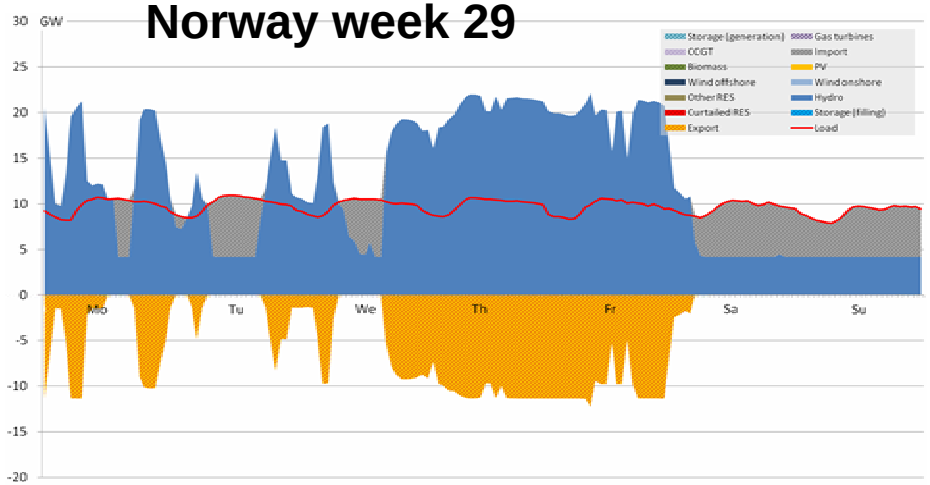
# Enabling technologies

## Hourly dispatch 2050, further examples

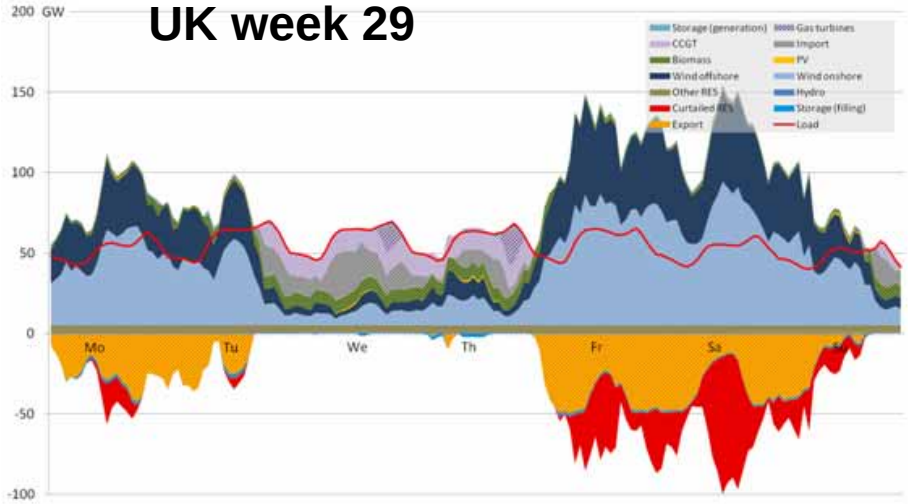
**Spain week 27**



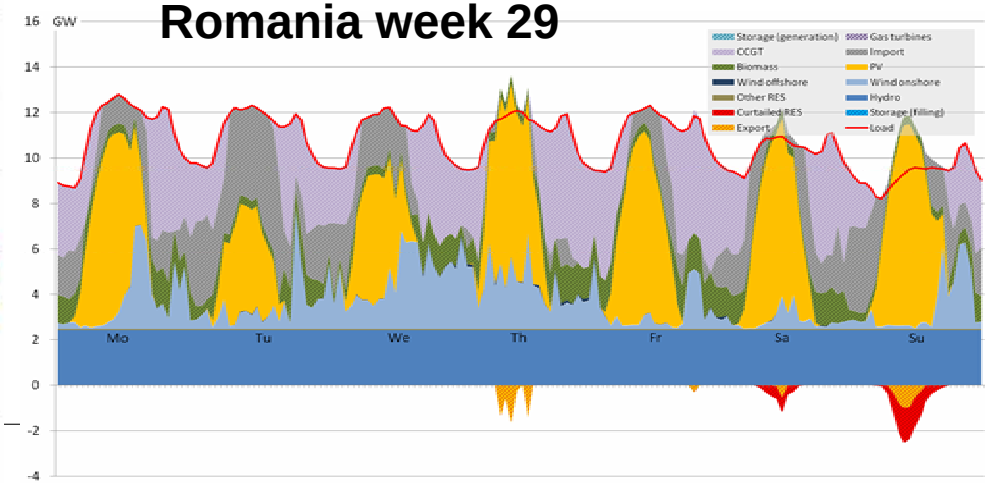

**Norway week 29**




**UK week 29**




**Romania week 29**



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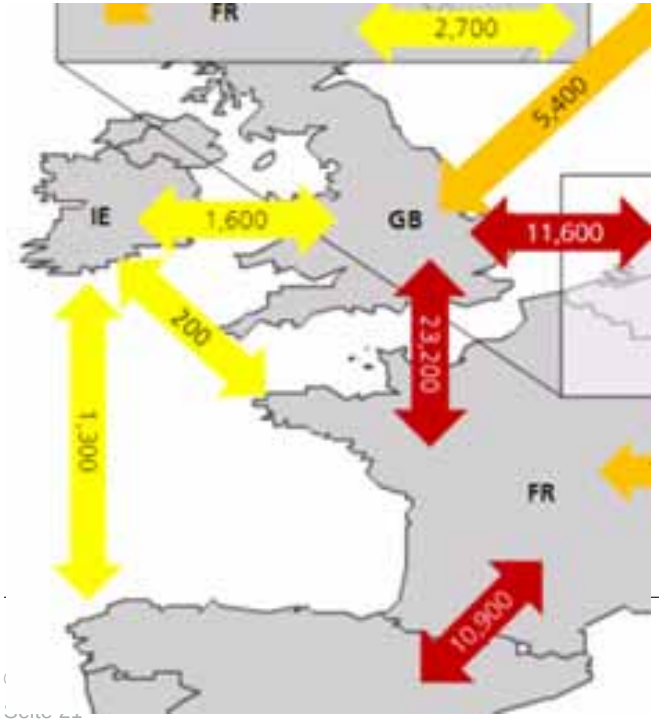
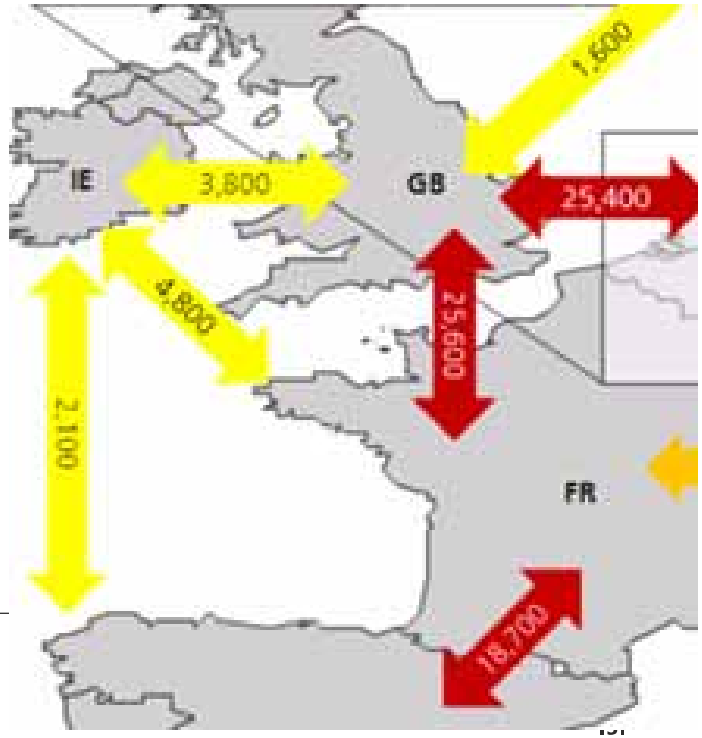
# Motivation: The 2020 policy frame for energy efficiency needs to fit longterm requirements

- Energy efficiency has a strong impact on how radically the electricity sector needs to be adapted ➔ EU-wide study on (nearly) 100% renewables in the power sector in 2050 for the German Environment Ministry by Fraunhofer ISI.




**+ 550 TWh net electricity demand**



# Conclusions

- **Energy efficiency…**
  - Requires a number of enablers to realise a potential of 60% reduction in primary energy by 2050 (technology deployment and innovation, behaviour/lifestyle, financing, overcoming fuel poverty)
  - Is an important enabler for our future energy system by supporting larger shares of renewables

# THANK YOU
# FOR YOUR ATTENTION!

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