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The blessings of energy efficiency

in an enhanced EU sustainability scenario

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The Assignment

- Based on a study for the European Parliament aimed at investigating *clearly distinct* alternative long term energy strategies which are compatible with long term climate mitigation policy (up to 2030) and account for depletion of conventional oil and gas reserves
- A key issue is the understanding of the risks in the various scenarios:

BAU
N+/CCS

EE
RE

1. Climate change within manageable limits
2. Dependency and vulnerability of geopolitics
   - (oil, gas, massive emission trade)
3. Managing societal transition

5 scenarios

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Energy supply and demand scenarios for EU25 up to 2030

- **BAU** (like new DG-TREN baseline)
- **Nuclear + & CCS** (+25% nuclear capacity)
- (Nuclear – (-25% nuclear capacity))
- **EE** (primary energy use in 2030 8% under 1990 level & RES share 15%)
- **RE** (primary energy use in 2030 20% under 1990 level & RES share 31%)

5 scenarios – key characteristics

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Scenario	CO_2 emissions (% ∆ 1990)	Primary energy supply (% ∆ 1990)	Import dependency*)	Nuclear share of electricity generation	RES share in PE supply	Energy efficiency growth rate (2000 - 2030)
BAU	+4.7%	+14.6%	64.8%	18.7%	12.2%	1.5%
N^+ & CCS	+1.3%	+16.4%	62.7%	23.6%	12.0%	1.5%
Energy Efficiency (EE)	-18.8%	-8.2%	59.8%	15.7%	15.0%	2.2%
Renewable Energy (RE)	-45.1%	-20.1%	49.1%	16.4%	31.4%	2.7%
Starting point (2000)	-3%		47%	14%	6%	-

*) As percentage share of primary energy consumption, nuclear fuel imports not included

Indicated changes in RE are rough but technically possible in EU25
Variations between member states allowable (and recommendable)
In DG-TREN BAU the share of nuclear decreases compared to 2000 -> N^+ means a stopping of the decline; despite the rapid increase in recent attention and R&D effort CCS can only contribute modestly up to 2030.

VATT *Key scenario implications 1*

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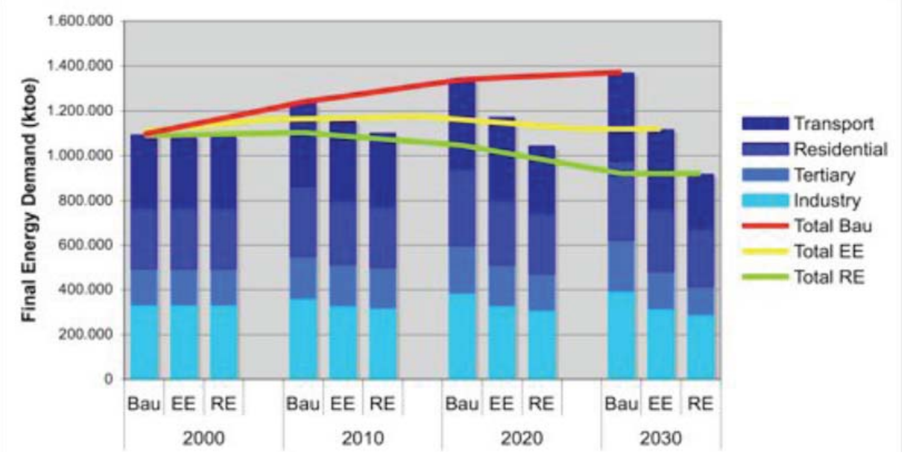
Comparison of scenarios:

Final energy demand



VATT *Key scenario implications 2*

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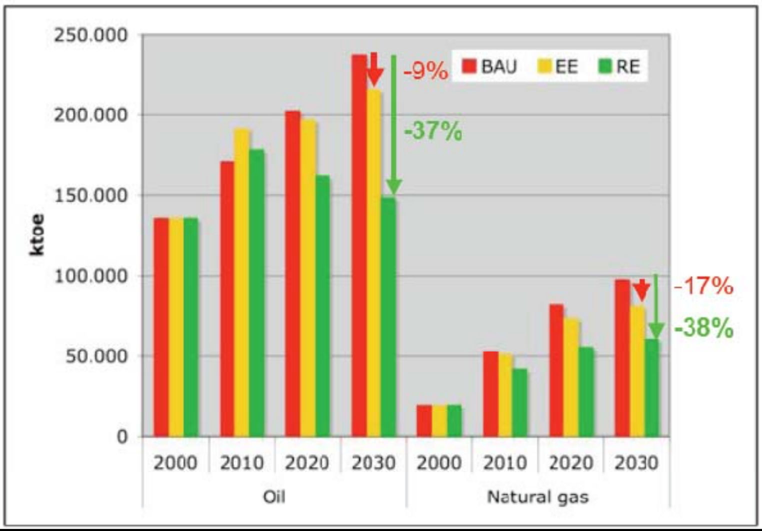
Import dependency of EU25 for oil and gas



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Ways to get there
- Efficiency 1

- The Directive on energy end-use efficiency and energy services as a platform to guide towards efficiency improvement targets
- The Directive on eco-design requirements for energy-using products to regulate strong minimum efficiency standards,
  - e.g. the top-runner approach or internalisation of external cost
- A new framework Directive on energy labelling
  - dynamic efficiency classes
  - an increasing amount of products, including cars.
- Ensuring national implementation and further revisions of the Directive on the energy performance of buildings as well as inclusion of the electricity consumption of the installed equipment in the regulation schemes.
- Promotion and rehabilitation of CHP-based district heating systems, also in NMS
- Promotion of micro-CHP in conjunction with the use of (local) renewable energy sources.
- Promoting the use of Demand-Side Management (DSM) and Demand-Side Bidding, i.e. through guidelines for retail tariff structures

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Ways to get there
- Efficiency 2

- Compensated energy taxation for users outside EU-ETS, (a possible alternative or predecessor for TWC, depending on a country's circumstances).
- Financial incentive programmes in order to accelerate renovation and dynamic improvement of dwellings.
- Differentiated vehicle purchase taxes and annual road taxes by fuel performance and emissions.
- Continued voluntary agreements with car makers for further emissions reductions of newly sold cars in the post-Kyoto period.
- Promotion of spatial planning at the local and national level that economizes the need for mobility
- Introduction of congestion taxes where relevant (in conjunction with the promotion of adequate public transport) and promotion of clean urban logistics (without spurring relocation outside the inner city).
- Consideration of an emission reduction scheme for the aviation sector or inclusion of civil aviation in the EU Emission Trade System (provided the use of grandfathering is greatly reduced).

Ways to get there
- Renewables

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- Promotion of RE in power generation through:
  - Redirecting investments towards RE capacity additions
  - Discouraging investments in fossil capacity
  - feed-in tariffs or quota or TGC
- Biofuels in transport
  - From 5% in 2010 to 25% in 2030
  - Fiscal measures
  - Guarding ecological integrity
- Renewable heat
- NB! RE scenario requires also tougher energy efficiency efforts than EE scenario!!

Comparison with other studies

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- ECN study for the Netherlands indicating that 2.1%/year efficiency gain is feasible but expensive; up to ~1.7% the costs would be reasonable
- ECN study & other studies indicate that variation in targets may by called for
- Table shows results for recent DG-TREN study by Mantzos and Capros (2006) compared to EE and RE

		Combined DG TREN		EE		RE	
		2020	2030	2020	2030	2020	2030
Primary energy	% vs. BAU	-13	-20	-12	-19	-16	-29
Renewable	Mtoe	325	394	186	229	315	418
energy use	%	20	26	11	15	20	31
CO_2 emissions	Mt	2969	2670	3122	2956	2795	2015
	% vs. 1990	-21.4	-29.3	-17.3	-21.7	-26.0	-46.6
Import	Mtoe			1107	1020	942	770
dependency	%	57	59	58	60	50	49

Economic benefits of enhanced energy efficiency

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- Reduced import dependency
  - lowers the energy import bills in the EE scenario by 24 billion € in 2020 and by 54 billion € in 2030, with similar decreases in the RE scenario, in which fossil fuel import costs go down by 73 billion € in 2020 and 140 billion € in 2030
- Reduced vulnerability of the EU economy towards energy price shocks.
- Mitigation of high investment needs in electricity generation and energy infrastructure by 1.1% ~ 1.5% of total GDP in the EE and by between 1.9% ~ 3.3% in the RE scenario.

  Challenge: reallocate this to investment in energy efficiency.
- A 20 to 45 billion € per year reduction of CO_2 emission rights costs due to less dependence on international emission trading, depending on the time horizon, scenario and emissions target.
- Other ancillary benefits, which are harder to monetise (e.g. health)

Reduced vulnerability

– benefit estimation

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- Reduced vulnerability estimates based on Jimenez-Rodriguez and Sánchez (ECB: 2004)
- for a 50% price shock in oil prices an average initial loss in GDP growth of about 1.5% can be assumed with current levels of import dependence -> so, lower import dependence in EE and RE brings benefits

Accumulated (5 year) value of reduced sensitivity to an oil price shock induced reduction in GDP growth (in billions of euros)

shock happening around the year:	RE	EE
2020	200	93
2030	300	156

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An attempt towards transformation

- Reorientation of investment portfolios in the energy system:
  - From supply side to demand side investments
  - Existing instruments (e.g. DSM and DSB) help but insufficient
  - Incite suppliers to invest at the demand side (‘negawatt’) e.g. via TWC or TWC-ETS systems
  - Provide support to keep uncertainty for energy companies manageable (redirection of investments may lead to temporarily more volatile wholesale energy markets)

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Sources of redirected funds

- Energy imports
- Reduced supply capacity investments – volume effect
- Reduced cost of emission trade
- Reduced energy acquisition cost for end-users (a cumulative effect containing the aforementioned issues)
- Ancillary benefits of other reduced emissions (not quantified in this study)
- Implied benefits of more stable economic growth (occurrence and timing uncertain)

Purposes of redirected funds

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- More expensive energy supply capacity - unit-cost effect
  - meaning that a part of the small-scale, installed capacity is more expensive per MW than the original capacity foreseen in BAU
- More expensive end-use equipment
  - despite learning effects, various types of equipment and, possibly, various kinds of buildings, will get more expensive due to more embodied human capital (knowledge) and high-tech materials
- Induced cost effects in some sectors following from higher unit-cost of energy and from land use effects of expanded biomass cultivation
  - in some sectors such as those with limited energy saving options, the higher unit-cost of energy will be transferred to the prices of products and services and similarly, the elevated demand for bio-fuel input may increase the cost of wood, land and some food staples.
- Expanding energy R&D and precipitating market uptake (i.e. pilot project support)
  - to ensure continued supply of affordable energy saving and renewable energy technology

net macro-level cost differences of EE and RE compared to BAU

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Whole period 2010 – 2030	Base oil price		High oil price	
Cost items	EE	RE	EE	RE
Energy acquisition costs for end-users (-/- 35% value added ESI)*)	-1820	-3426	-2340	-3861
Extra R&D efforts, notably, for energy efficiency & renewables	50	70	50	70
Investments in energy savings **)	1340	3340	1340	3340
Total 1	***-430***	***-16***	***-950***	***-451***
Benefits of the reduction of oil price sensitivity	-156	-300	-156	-300
Total 2	***-586***	***-316***	***-1106***	***-751***

Negative values = benefits, positive values = costs
*) Corrected for the overall loss in gross value added in the energy supply sector (~ 35%)
**) Estimated based on cost information of the Eurowhitecert study (Perrels et al. 2007). An EU wide average unit-cost is used for a given fraction of the potential and the fraction in RE is higher (=100%) than in EE, hence a higher average unit-cost. Includes the transport sector.

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Conclusions

- A BAU strategy has just as well risks as an alternative strategy has, yet the *nature* of these risks is *not* the same
- If the reallocation of investments can be managed smoothly alternative scenarios do not need to be more expensive (while having better prospects on emission reduction)
- Alternative scenarios do put more strains on *domestic change management* in exchange for reduced external dependency (and geopolitical risks)
- Even though many instruments are already available additional testing of innovative instrument packages is recommended