

# OVERVIEW OF ENERGY ECONOMIC ANALYSIS FOR THE EC

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## Summary of Presentation

- a. Brief presentation of the models
- b. Baseline Energy Scenario for the EU of end 2007
- c. Typical scenario for climate/energy package (package with JI/CDM and RES trade)
- d. New Energy Policy scenario (SER – Strategic Energy Review)
- e. Gas supply and demand outlook
- f. Work towards new Baseline Energy Scenario in 2009 reflecting the impacts of the Financial Crisis
  - World Outlook and assumptions about fossil fuel prices
  - Macroeconomic and Sectoral Outlook for the EU after the Crisis

## The Models operated by E3MLab

### PRIMES

Very detailed model of the European energy systems and markets with a modular structure covering the demand sectors, the supply sectors and price-driven market equilibrium. The model represents a wide variety of policy instruments and is rich in engineering and cost information.

### Prometheus

World energy model with endogenous formation of world oil, gas and coal prices and projections of demand and supply by world region. The model is fully stochastic and the outputs are probability distributions.

### GEM-E3

Macroeconomic general equilibrium model with multiple sectors and multiple countries. It includes details on energy and environment, so as to analyze their interactions with the economy.

The models are linked with models operated by other institutes:

GAINS (IIASA) on air pollution and GHG, POLES (LEPII) on energy, transport models (SCENES) and others.

# ENERGY - ECONOMY MODELS OPERATED BY E3MLAB

## Main Features of PRIMES

- Full coverage of the energy system, both in demand and supply
- Mixed representations:
  - Bottom-up (engineering, explicit technology choices) and
  - Top-down (microeconomic behaviors, consistent economic decisions by agent)
- Modular, with separate modules for each demand and supply sector and separate decision making
- Decentralized decisions form demand and supply of each energy commodity
- Market-oriented: market equilibrium prices drive energy balancing of demand and supply per energy commodity
- Electricity and/or Gas trade within the EU Internal Market and beyond is simulated
- Extensive set of policies represented
  - Taxes, subsidies, Tradable Permits or certificates
  - Technology supporting policies
  - Environmental policy instruments

## System Coverage

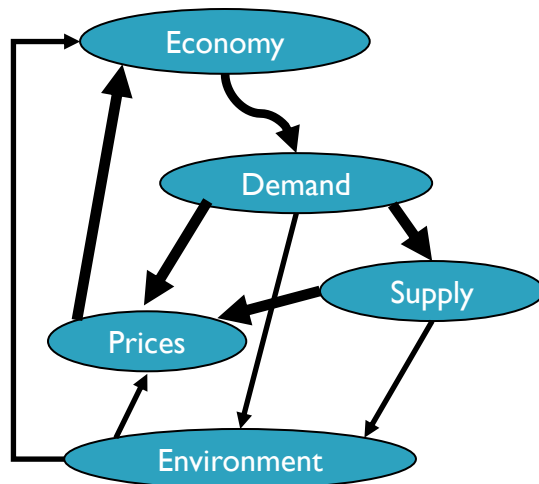
- Geographical coverage
  - Each EU-27 member-state taken individually
  - Also, candidate MS and neighbors, such as Norway, Switzerland, Turkey, South East Europe
- Network coverage
  - Electricity and gas interconnections over Eurasian area
  - For electricity and gas markets, the European countries can be simulated as an interlinked system
- Core of the model: market linked sub-models for demand sectors, power/steam generation, fuel supply
- Satellite models: Biomass supply, refineries, detailed transport sector model, gas supply (Eurasian), H2 supply
- Time frame : 2000 to 2030 (2050) by five-years periods
- Model results fully calibrated to Eurostat data for the period 1990 to 2005 (simulated). Projections start from 2010

## Sectoral and Technology Details

- 12 industrial sectors, subdivided into 26 sub-sectors using energy in 12 generic processes (e.g. air compression, furnaces)
- 5 tertiary sectors, using energy in 6 processes (e.g. air conditioning, office equipment)
- 4 dwelling types using energy in 5 processes and 12 types of electrical durable goods (e.g. refrigerator, washing machine, television)
- 4 transport modes, 10 transport means and 10 vehicle technologies
- 14 fossil fuel types, new fuel carriers (hydrogen, biofuels) 10 renewable energy types
- Main Supply System: power and steam generation with over 150 power and steam technologies and grid interconnections
- Other sub-systems: refineries, gas supply, biomass supply, hydrogen supply, primary energy production
- 7 types of emissions from energy processes

## INPUTS FOR A SCENARIO

- GDP and economic growth per sector (many sectors)
- World energy supply outlook – world prices of fossil fuels
- Tax and subsidy policies
- Interest rates, risk premiums, etc.
- Environmental policies and constraints
- Technical and economic characteristics of future energy technologies
- Energy consumption habits, energy efficiency options, parameters of supply curves for primary energy, potential of sites for new plants, ...



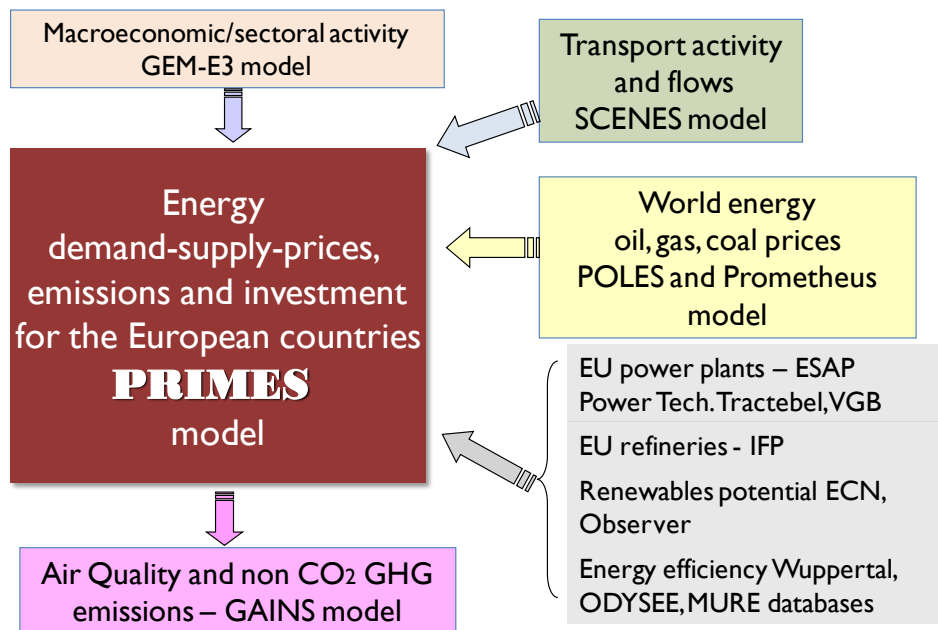
## OUTPUTS OF A SCENARIO

Per country and time period

- Detailed energy balance (EUROSTAT format), including
- Detailed balance for electricity and steam/heat
- Production of new fuels
- Transport activity, modes/means and vehicles
- Association of energy use and activities
- Investment, technologies and vintages in supply and demand sectors
- Energy supply per subsystem and primary energy
- Energy costs, prices and investment expenses
- Emissions from energy
- Policy Assessment Indicators

Additional material

- GDP and economic outlook
- World energy supply outlook



## ENERGY-ECONOMY-ENVIRONMENT SYSTEM COVERAGE

### Economy system (exogenous, links with GEM-E3)

- GDP, demographics, exchange and interest rates
- Activity by sector, income of households
- Transport activity flows

### Energy demand system

- Consumption habits, durable goods and comfort
- Manufacturing technology, industrial processes and energy needs
- Transportation modes/means and technologies as drivers of energy needs

### Energy supply system

- Primary energy supply (depletable and renewable sources)
- Secondary energy supply (power generation, refineries, etc.)
- Energy System Balances

### Energy Markets

- Competition, price formation and regulation, import/export

### Environment Impacts

- Energy-related emissions and carbon prices

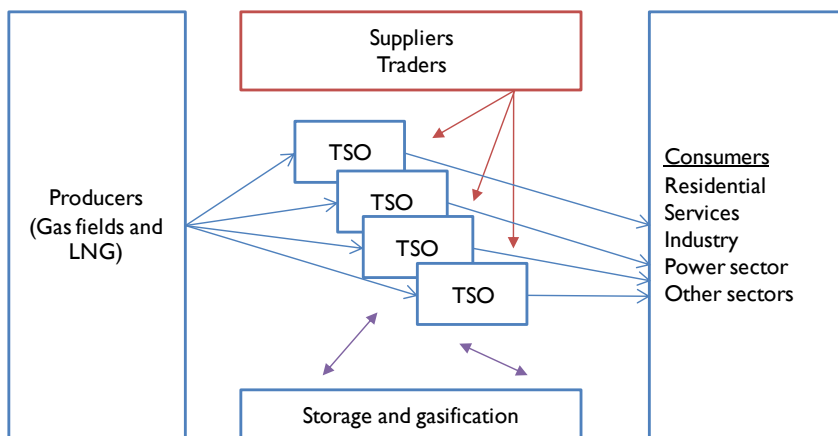
## Policy Instruments

- Technology promoting policy both in demand and in supply sectors
- Standards on appliances, processes and plants and other energy efficiency regulation
- Investment policy (whenever exogenous, e.g. networks)
- Taxes and subsidies
- Emission constraints and environment-related directives (LCP, BAT, ...)
- Emission Trading Schemes
- Green Certificates
- Reliability standards
- Price and competition regulation

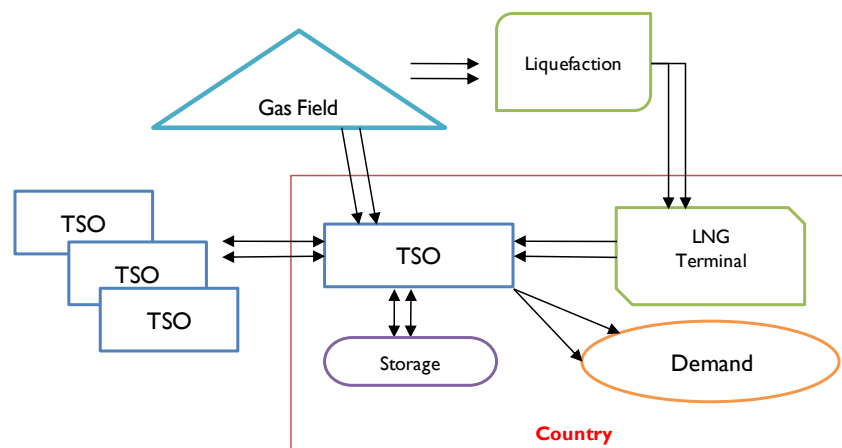
- Very detailed electricity and steam sub-model
- Optimal unit commitment with endogenous investment
- More than 150 explicit technologies
- DC linear optimal power flow with single load node per country (34 nodes) and present and future interconnectors ☐ endogenous flows and trade of electricity
- Inventory of existing and planned power plants
- Technical and Economic data for old and new plants, with and without cogeneration and CO2 capture
- Economics of investment and pricing related to liberalized market conditions
- Environmental policies and technologies including ETS
- Commodities (simultaneously determined):
  - Electricity - High, Medium, Low Voltage for Grid Power and in situ for own use (non grid)
  - CHP Steam/Heat in situ for own use and
  - CHP with steam/heat distribution)
  - Steam/Heat from Industrial Boilers
  - District Heating
- Stylized Companies: Utilities, Industrial small producers, Regulated Networks
- Elastic Demand – fairly disaggregated
- Plant site-related costs
- Non linear cost-supply curves (fuel resources, RES, sites)

**SCHEMATIC OVERVIEW**

**Commercial flows**



**Physical flows**



**Scope of the Gas Supply Model**

- Geographic coverage (55 countries in total) : Europe, Russia, Caspian area, Middle East, Gulf area, North Africa, China-India fully represented and in addition Japan-Korea and North America for LNG
- All types of gas infrastructure in detail: pipelines, gas storage, LNG terminals, Liquefaction trains, Fields
- Investment in new gas infrastructures is exogenous
- Time period: 2000 – 2030 (5-years time steps)
- Market competition and oligopoly rents are modeled
  - Distinct gas companies
  - Price elastic demand
  - Oligopoly competition combined with regulated markets (where applicable)
- Commercial gas exchanges and prices are endogenous, as also the physical gas flows
- Demand for gas calibrated to PRIMES projections

**Gas model structure**

- Every gas agent (producer, consumer, TSO, trader) is represented as a distinct decision maker
- Pipeline gas and LNG are treated as distinct commodities competing against each other
- Physical flows across the gas network and engineering-type constraints are modelled
- Gas demand seasonal variability is included (typical days)
- Market equilibrium is solved as a Cournot oligopoly
- Gas prices are endogenous (not linked to oil prices)
- Results
  - Gas Balance
  - Origin and Destination of Commercial flows
  - Flows over gas infrastructure
  - Congestions, economic performance of infrastructure
  - Costs and Prices

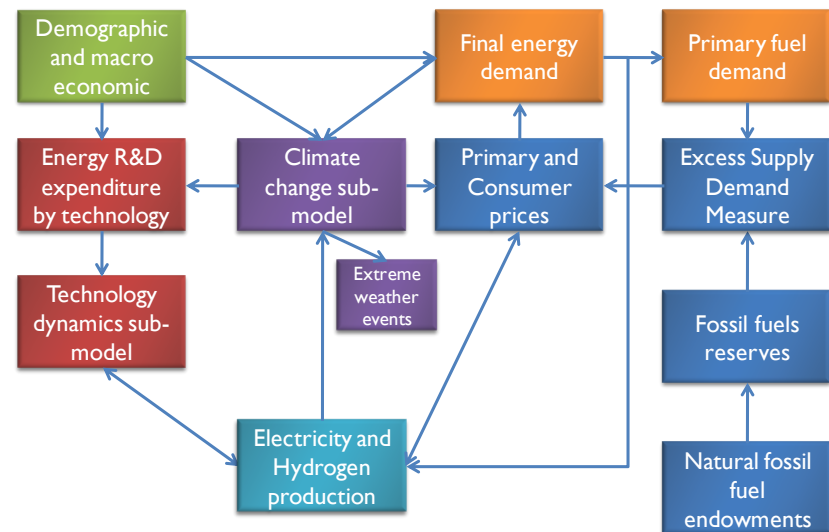
## Prometheus Model Overview

- PROMETHEUS is a full scale simulation model of energy supply, energy demand and energy prices at world and regional level, including
  - Projection of demographic and economic activity growth
  - Energy system balances
  - Energy demand sectors, including transport sector
  - Power generation
  - Hydrogen production and use technologies
  - Production and market equilibrium of primary resources (oil, gas, coal, nuclear, RES)
  - Technologies and their dynamic learning-by-doing
- All exogenous parameters are stochastic (known as probability distributions)
- PROMETHEUS generates stochastic information (probability distributions) for all energy, environment and technology results, yearly up to 2050
- Results Include demographic and economic activity indicators, energy consumption by fuel, fuel resources and prices, CO2 emissions, greenhouse gases concentration, temperature change, technology uptake and dynamic technology improvement

## Why stochastic models?

- The World and its future are obviously subject to variability that can not be fully and explicitly modelled
- Scenarios using deterministic models may explore possibilities but give no indication of their likelihood
- The output of a stochastic model are probability distributions and not single numbers as the deterministic models do
- Probability distributions are useful to measure risk, which is strategically important in itself
- Prometheus world energy stochastic model is the first of its kind operational model in the EU

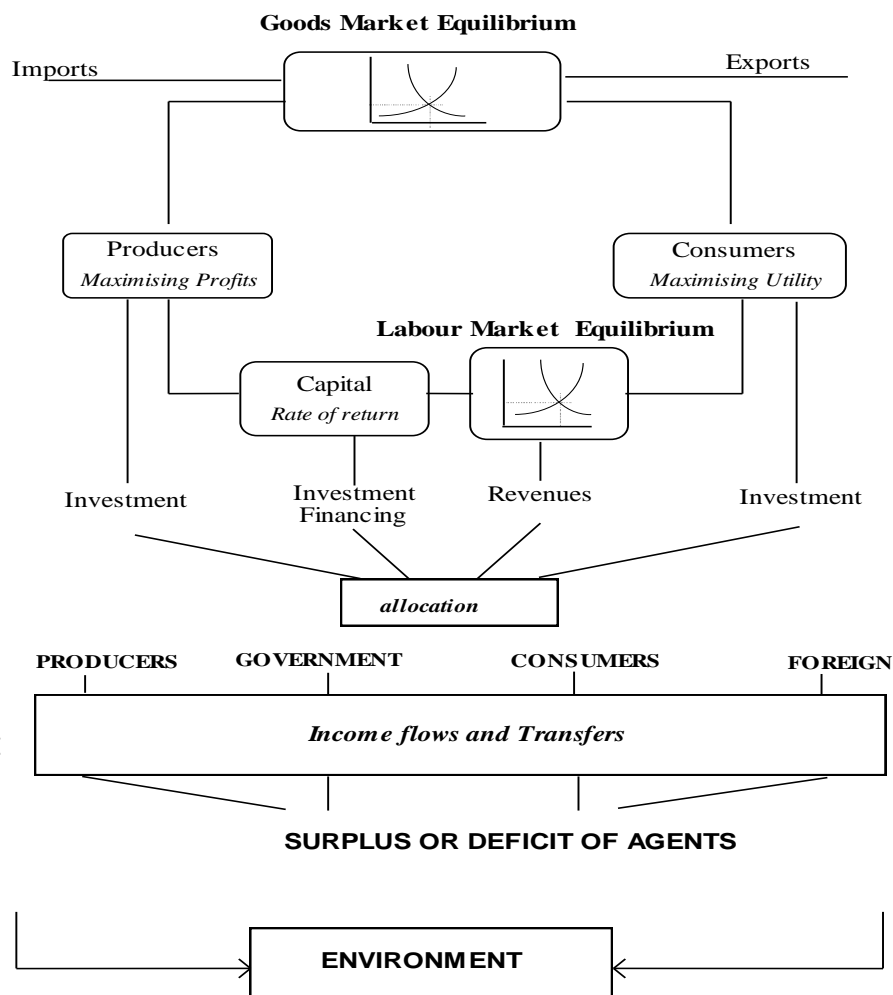
## Sub-models in PROMETHEUS



## Model Overview

- GEM-E3 is a multi-country computable general equilibrium model built to evaluate the economic impacts of structural policies and mainly the interactions between the economy, the energy system, the environment and the technological progress
- GEM-E3 is a modeling framework providing the user with many modeling options: a European model, a World model, and a series of different modeling options
- Model data for the EU based entirely on EUROSTAT
- Multiple sectors and endogenous trade
- As options the model include endogenous technology progress and innovation, imperfect competition with product differentiation, bottom-up energy system with depletable resources, dynamics, equilibrium unemployment and imperfectly adjusting investment
- Long experience of policy analysis with GEM-E3 for the European Commission:
  - Analysis for the EU Single Market
  - Climate change policies
  - Energy policies
  - Taxation, Social Security, Double Dividend
  - Research and Development Policies

## GEM-E3 Model Scheme



- Detailed projections 2000 - 2030
- Quantified by using the PRIMES energy system model for all EU27 countries
- POLES and Prometheus models used to project world energy markets
- Extensive update of information from previous baseline
- Higher energy import price cases have been also quantified with PRIMES distinguishing two sub-cases:
  - Gas prices following oil prices
  - Decoupling of gas prices from oil prices

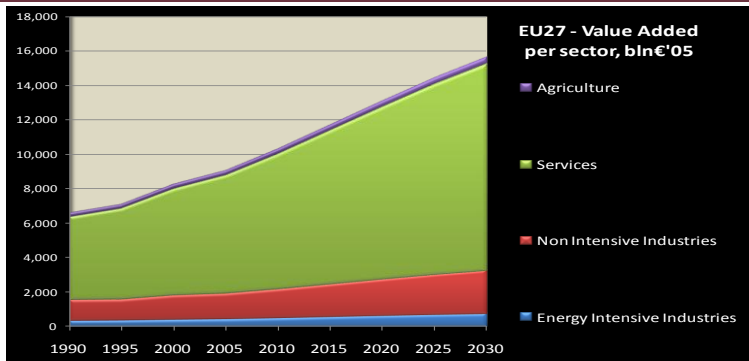
- The Baseline scenario assumes
  - Continuation of past trends and policies
  - Policies as implemented in the MS up to the end of 2006 and No new policies
  - Economy and Technology evolves
  - Market forces are the main drivers
  - Possible market failures not considered, e.g.
    - Environmental impacts
    - Security of Supply
- The Baseline scenario serves as a reference to compare against alternative scenarios

## THE 2007 ENERGY BASELINE SCENARIO (COMPLETED END 2007)

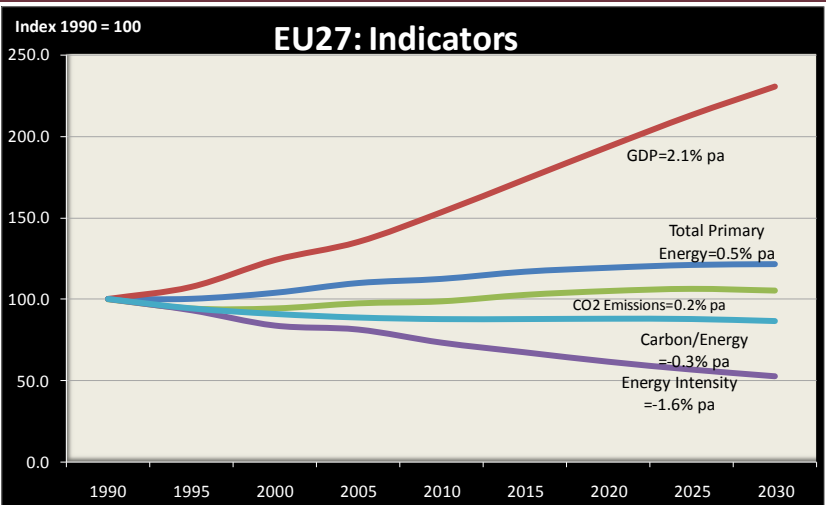
### Recent policy scenarios starting from the 2007 Baseline

- Typical scenario for climate/energy package (package with JI/CDM and RES trade)
- New Energy Policy scenario (SER)
- Gas supply and demand outlook

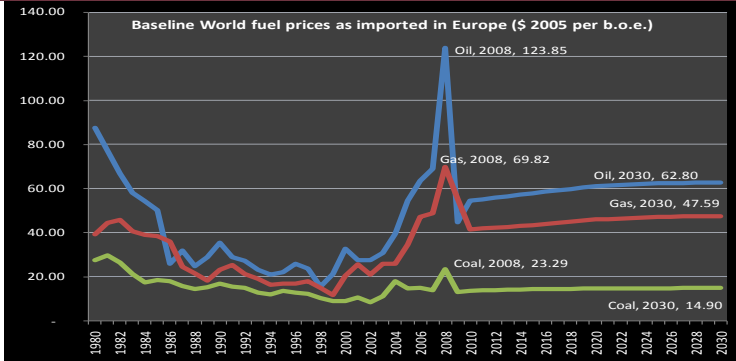
Macroeconomic Assumptions



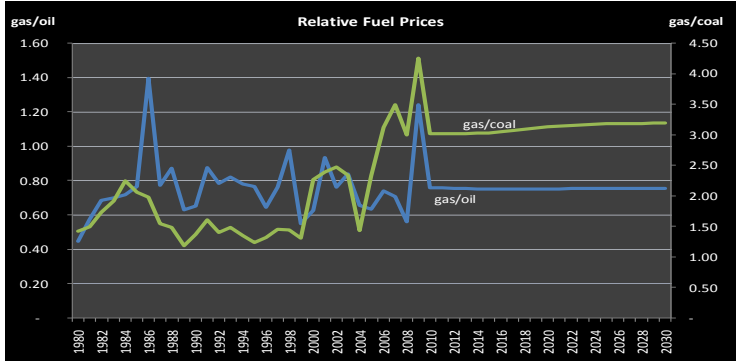
Main Trends



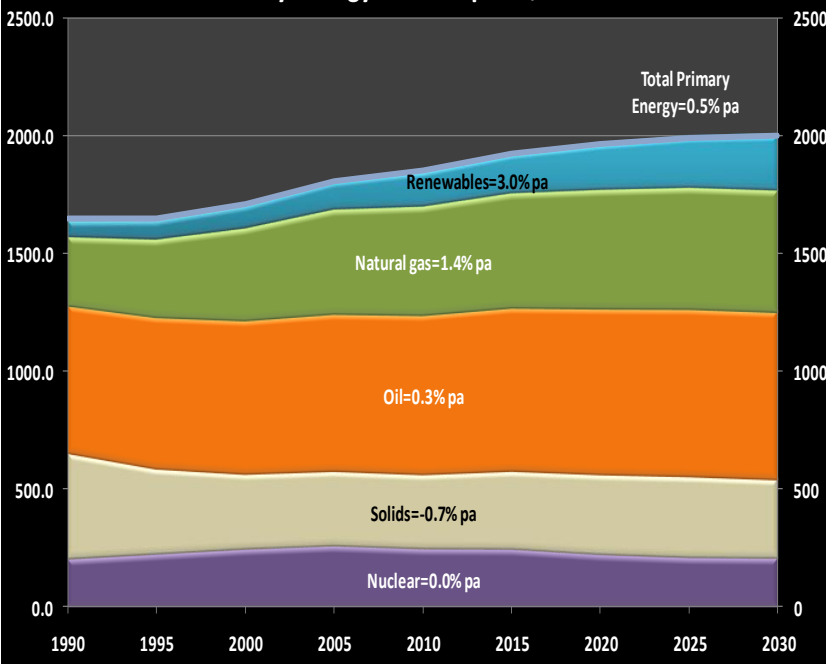
World Fossil Fuel Prices



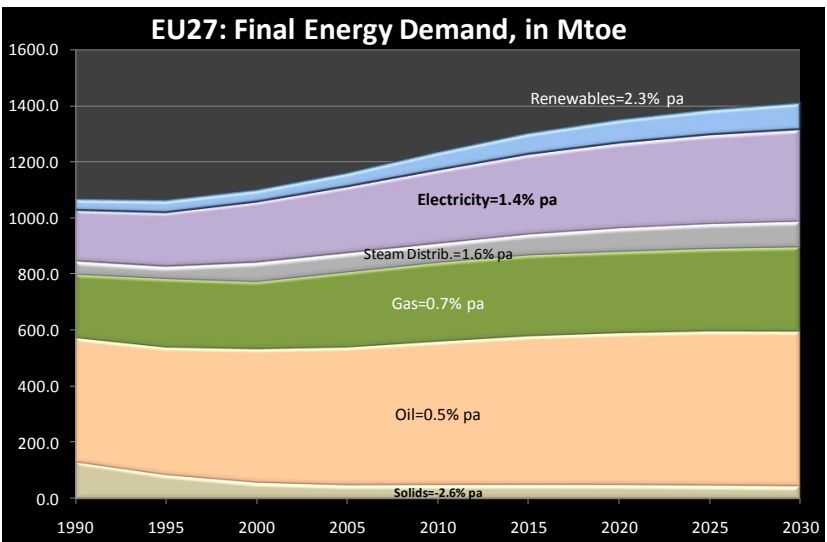
Gas to Coal Competitiveness



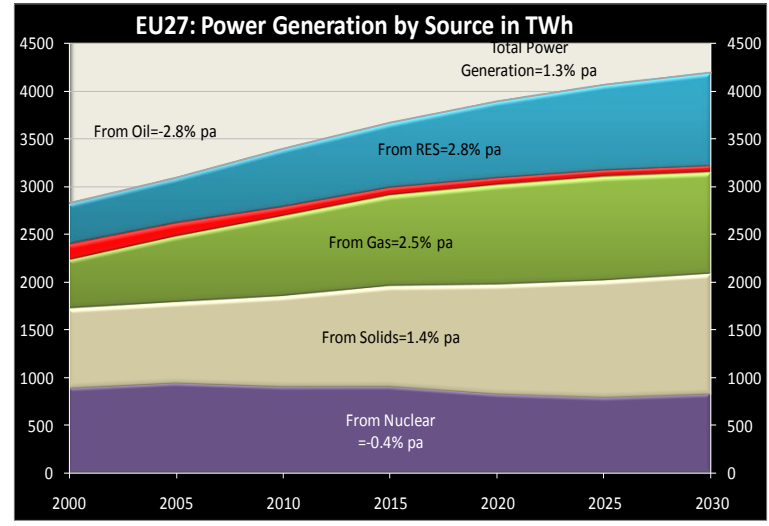
EU27: Total Primary Energy Consumption, in Mtoe



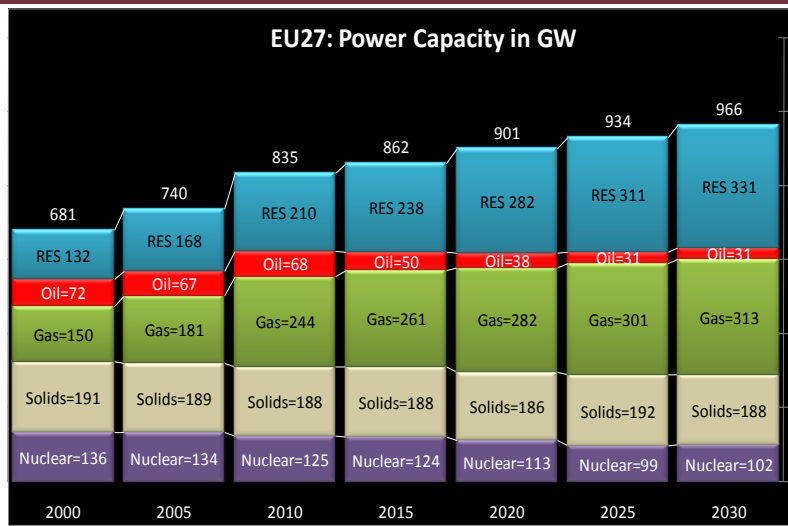
### Final Energy Demand



### Power generation



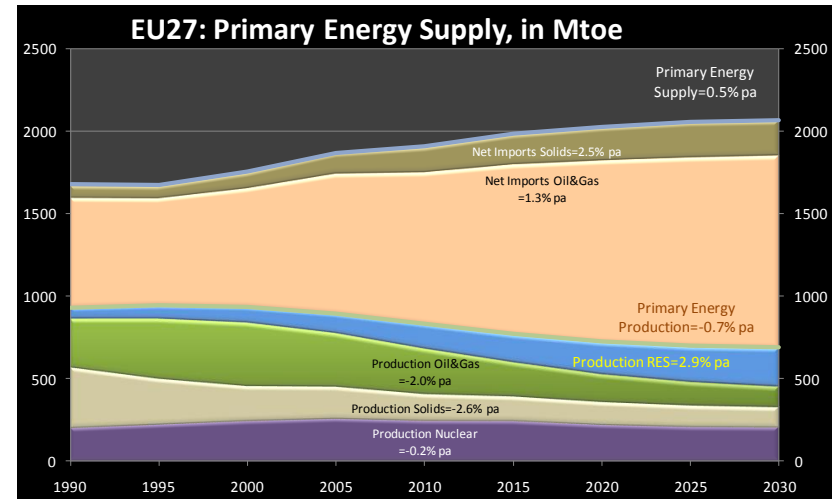
### Power capacities



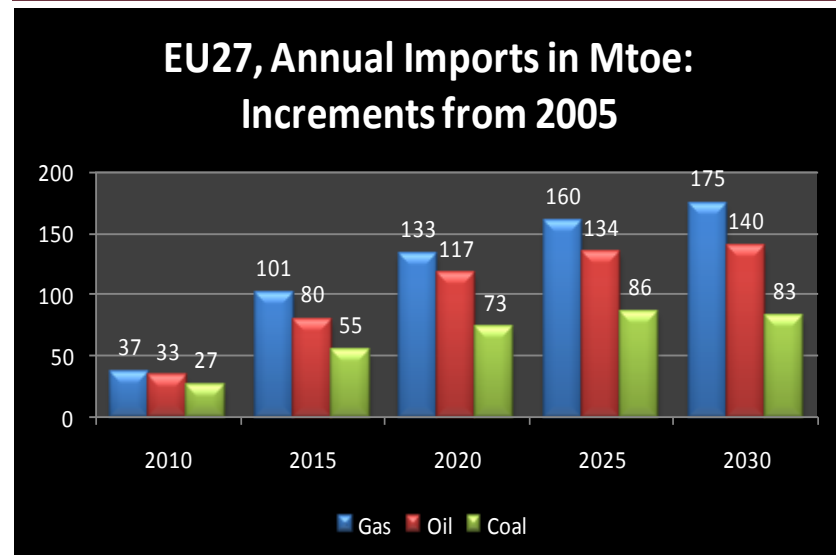
## Conclusions about the Baseline scenario

- The Baseline Scenario involves significant changes in the energy system of the EU27, following changes in the economy and in technology
- The Baseline Scenario involves
  - Important energy intensity improvement
  - Significant development of Renewables
  - Economic efficiency in delivering energy services to end users
- The Baseline Scenario describes an unsustainable future as it deviates from targets about reduction of Carbon and other GHG emissions

## Primary Energy



## Energy Imports



TYPICAL SCENARIO ON CLIMATE CHANGE/ENERGY PACKAGE  
(WITH JI/CDM AND RES TRADE)

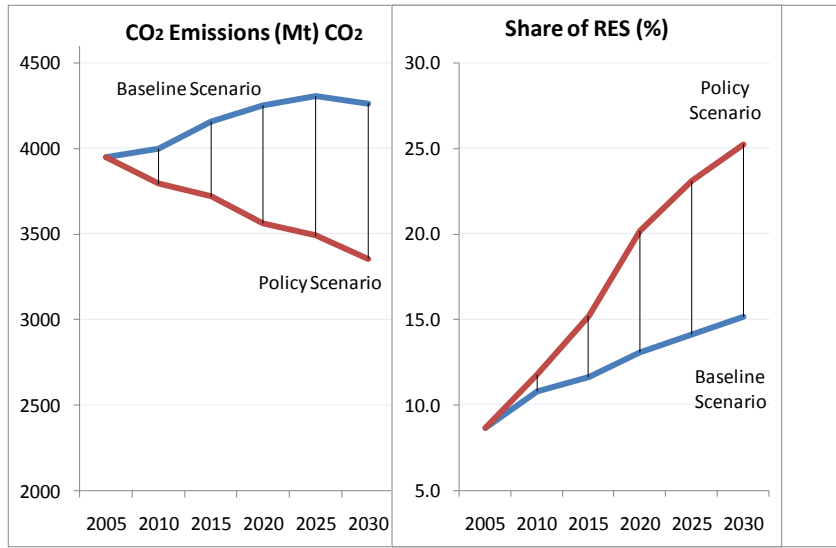
## Typical Climate Change / Energy Package Scenario

- Designed to represent the objectives to achieve in 2020
  - 20% reduction of GHG emissions below 1990 level
  - 20% RES in gross final energy consumption
- Policy instruments
  - EU ETS with full auctioning operating at the EU level for reaching 21% CO2 emission reduction in ETS sectors compared to 2005
  - Ji/CDM carbon credits applicable on ETS only, assumed at 30 EUR/t CO2
  - Non ETS sectors take emission reduction targets (for all GHG) by country, differentiated according to GDP/capita
  - RES target achieved at the EU level with full trade of Guarantees of Origin

## Effects of policies in analysis for Package and SER

- The carbon prices induce directly and indirectly reduction of demand for energy in all sectors, including reduction of electricity demand compared to the Baseline
- The ETS CO2 market price induces changes in the fuel mix and investments away from carbon intensive forms. It also leads to higher electricity/steam prices, which further induce lower demand.
- The RES obligation implies giving priority to RES power technologies among the various low carbon technologies. The direct RES applications also induce lower emissions in non-ETS sectors.
- Lower consumption and higher use of indigenous RES reduces import dependence, compared to Baseline
- All policies entail higher costs per unit of energy services (including investment costs in energy savings) but shift the economy's expenditures towards domestic goods and services, generating income and employment in the EU.

## Targets and Instruments



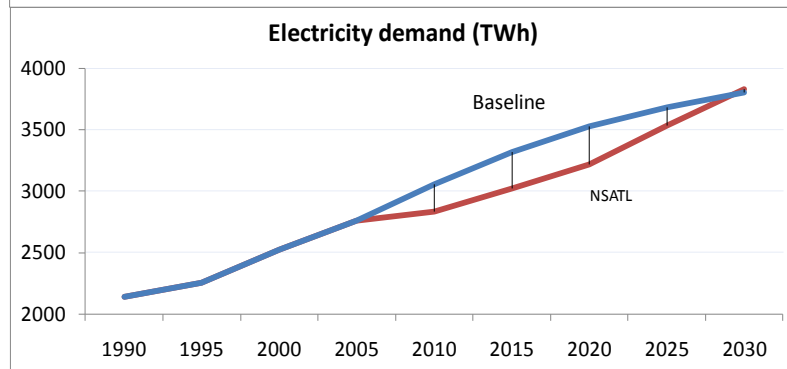
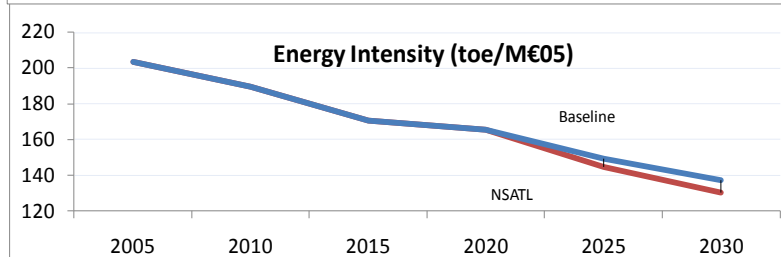
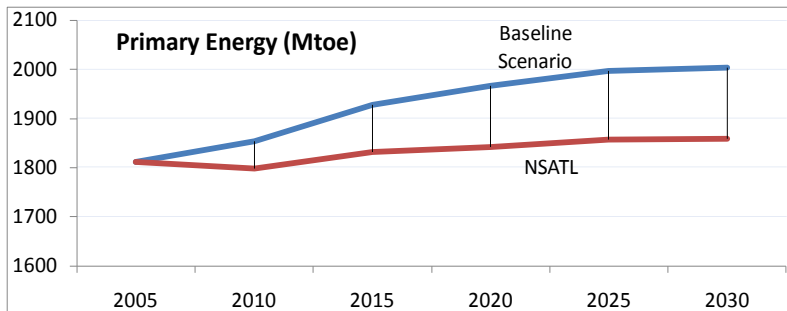
% change and % diff. from Baseline

	2010	2015	2020	2030
<b>CO2 Emissions (Mt)</b>	-5.14	-10.57	-16.28	-21.39
<b>Share of RES (%)</b>	0.98	3.54	7.12	10.07

### DRIVERS

- ETS Price: 30 €/ t CO2 in 2020
- Non ETS Sectors: GHG emission reduction obligations per Member-State
- Marginal Costs of RES in 2020: 49.5 €/MWh (equal to price of RES trade)

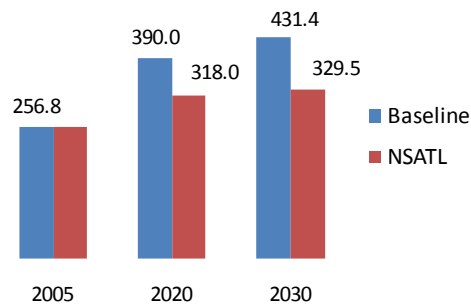
## Energy efficiency improvement is the dominant



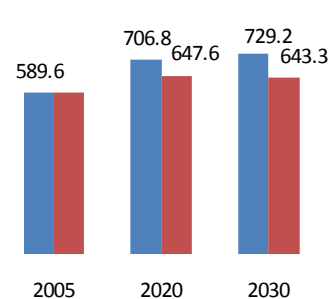
## Summary of Changes

NSATL Scenario	% Change of Consumption from Baseline		% Diff. of shares from Baseline	
	2020	2030	2020	2030
<b>Gross Inland Consumption</b>	-6.4	-7.3		
Solids	-24.8	-27.1	-3.4	-3.6
Oil	-8.4	-12.1	-0.8	-1.8
Natural gas	-14.8	-20.1	-2.3	-3.6
Nuclear	-2.0	-2.8	0.5	0.5
Renewables	49.4	58.9	6.0	8.5
<b>Final Energy Consumption</b>	-5.1	-7.5		
Energy Intensive Industry	-1.5	-2.5	0.6	0.9
Other Industries	-3.2	-4.4	0.2	0.4
Residential	-3.9	-7.2	0.3	0.1
Tertiary	-11.5	-14.6	-1.0	-1.2
Transport	-5.4	-8.0	-0.1	-0.2
<b>Final Energy Consumption</b>	-5.1	-7.5		
Solids	-1.7	-4.7	0.1	0.1
Oil	-8.5	-13.1	-1.4	-2.4
Gas	-10.8	-20.9	-1.4	-3.4
Electricity	-8.8	0.8	-0.9	2.1
Steam Distrib.	-6.2	-7.5	0.0	0.0
Renewables	46.8	36.9	3.6	3.5

**Gas Net Imports (Mtoe)**



**Oil Net Imports (Mtoe)**



# STRATEGIC ENERGY REVIEW SCENARIO

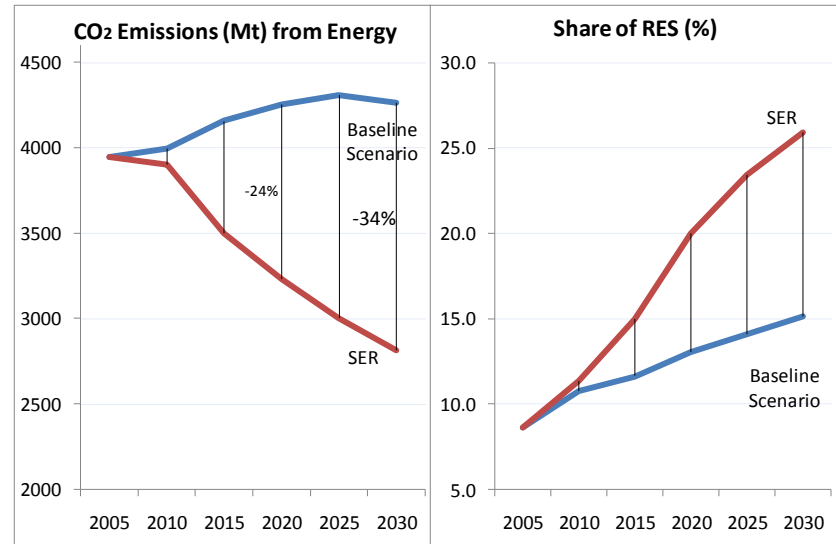
## SER: Strategic Energy Review Scenario

- Designed to represent the objectives to achieve in 2020
  - 20% reduction of GHG emissions below 1990 level (within the EU, without emission reduction credits from CDM), ensuring maximum energy efficiency contribution of reaching the targets
  - 20% RES in gross final energy consumption
- Policy instruments
  - EU ETS with full auctioning operating at the EU level for reaching 21% CO2 emission reduction in ETS sectors compared to 2005
  - RES target achieved at the EU level with full trade of Guarantees of Origin
  - Energy Efficiency and RES policies in the final demand sectors not belonging to the ETS (without considering carbon prices as a driver)
- SER scenarios are available for both moderate and high energy import prices

### Explanations

- The numerical value of the drivers is a result of the model, not an assumption
- The carbon values (ETS clearing prices) correspond to true costs passed through to consumer prices
- The efficiency value is the calculated marginal cost of energy efficiency in non-ETS. The underlying policies are bottom-up (standards, labeling, etc.).
- The Renewables value is the market price of the tradable GOs and also affect consumer prices if entailing additional costs from Baseline

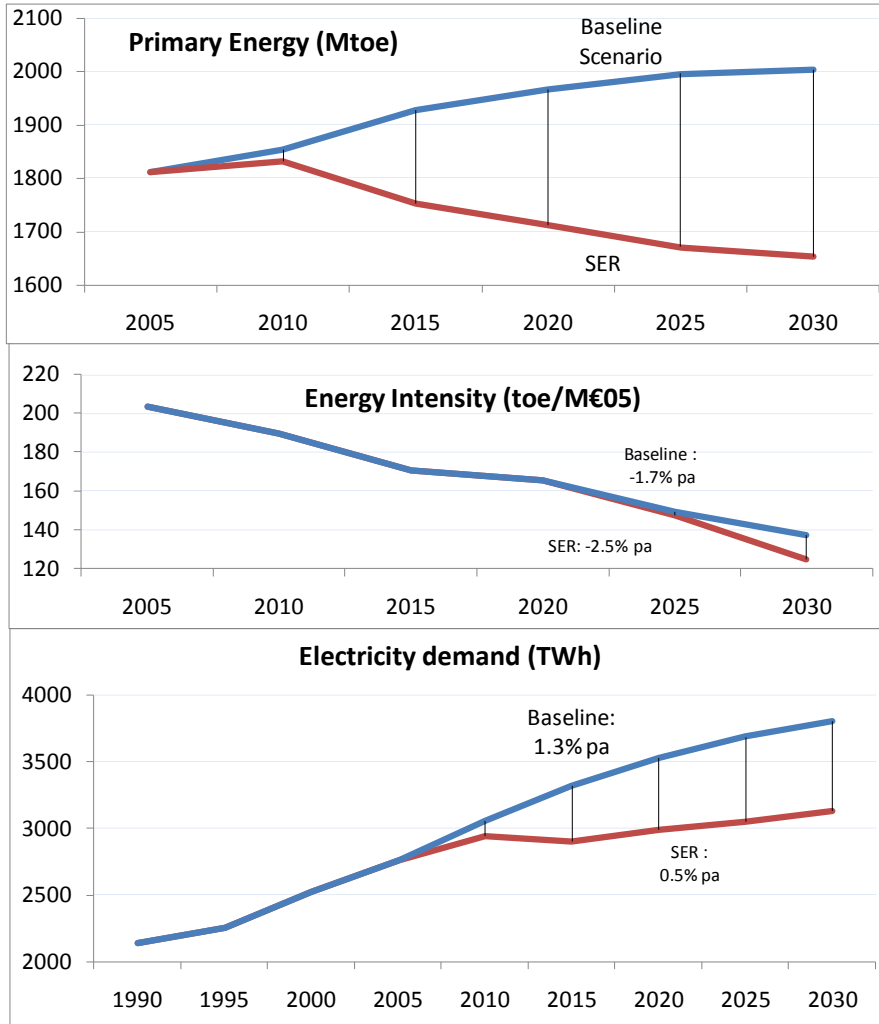
## Targets and Instruments



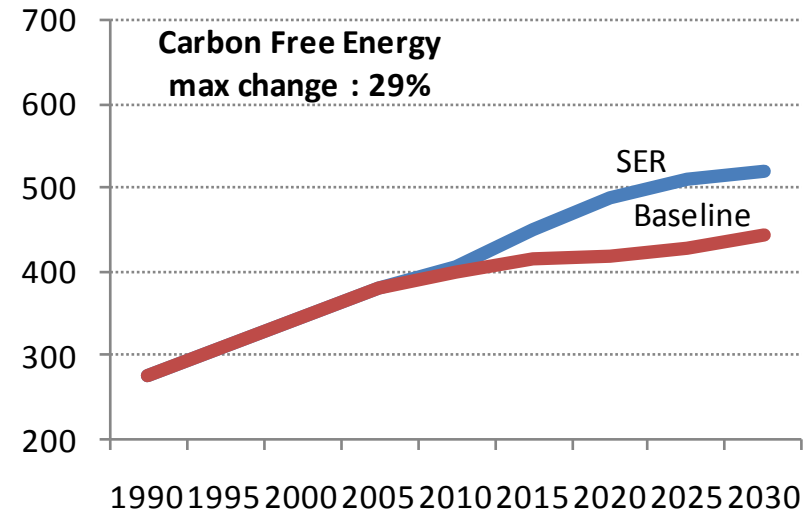
### Drivers

Carbon value for ETS (€/ t of CO2)	41.0
Efficiency value for non ETS (€/ toe)	220
Renewables value (€/MWh)	40.75

### Energy efficiency improvement is significant



### Carbon Free Energy increases



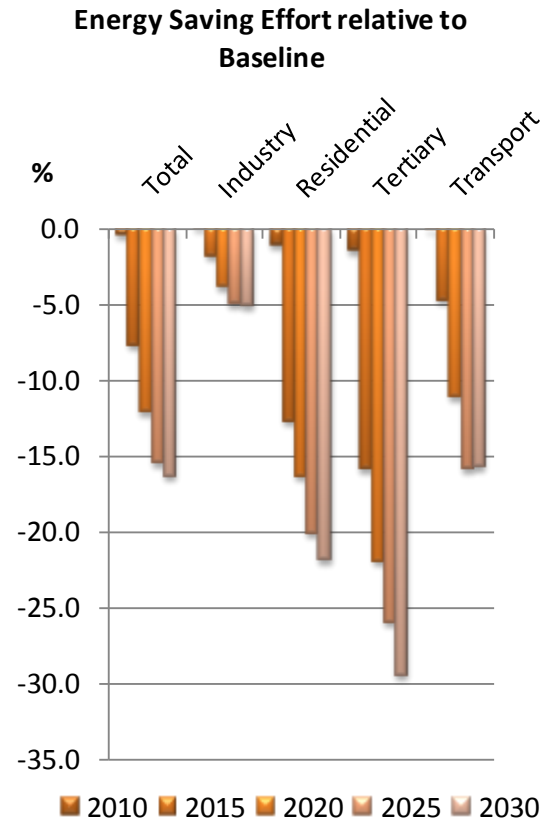
### Main Results of Energy Efficiency

- Total primary energy requirements decline continuously after 2010
- Energy Intensity gains of 2.5% per year on average is ambitious, but is possible as a result of rigorous efficiency policies
- Electricity demand growth decelerates (even stagnates) between 2010 and 2020, and starts increasing again after 2020 when more carbon free options are available in power generation

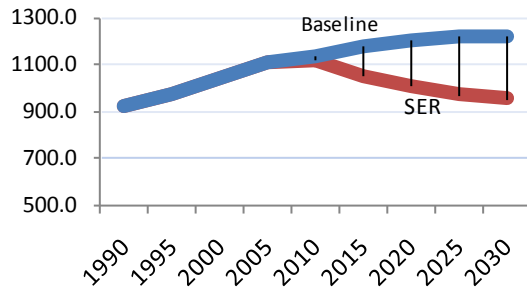
## Summary of effects on Energy Balance

SER Scenario	% Change of Consumption from Baseline		% Diff. of shares from Baseline	
	2020	2030	2020	2030
<b>Gross Inland Consumption</b>	-13.0	-17.5		
Solids	-36.7	-46.0	-4.7	-5.8
Oil	-13.3	-17.7	-0.1	-0.1
Natural gas	-21.0	-28.5	-2.4	-3.4
Nuclear	-1.5	-16.4	1.5	0.1
Renewables	37.1	46.0	5.8	9.1
<b>Final Energy Consumption</b>	-12.1	-16.4		
Energy Intensive Industry	-3.0	-4.0	1.8	2.5
Other Industries	-5.2	-6.8	0.8	1.2
Residential	-16.3	-21.9	-1.2	-1.6
Tertiary	-22.0	-29.5	-1.7	-2.4
Transport	-11.0	-15.8	0.4	0.2
<b>Final Energy Consumption</b>	-12.1	-16.4		
Solids	-8.9	-11.8	0.1	0.2
Oil	-13.9	-19.2	-0.8	-1.3
Gas	-19.0	-25.8	-1.8	-2.6
Electricity	-15.2	-17.6	-0.8	-0.3
Steam Distrib.	-10.9	-9.8	0.0	0.3
Renewables	31.3	26.6	3.3	3.8

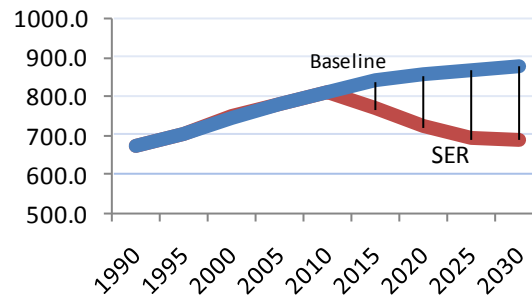
## Results show energy saving potentials by sector



**Total consumption of Oil and Gas (Mtoe)**



**Final consumption of Oil and Gas (Mtoe)**



## Renewables

	SER (Mtoe)		% Change from Baseline	
	2020	2030	2020	2030
RES in Gross Final Energy Consumption	244.1	314.3	38.6	47.4
Electricity Generation	88.7	126.0	30.8	53.3
Heat/Steam Production	38.5	58.0	100.2	105.4
Biomass direct use	67.7	74.3	18.6	21.4
Solar energy direct use	18.6	21.7	234.7	203.0
Biofuels in Transport	30.5	34.3	17.6	0.6
RES in Primary Energy	269.7	346.5	37.1	46.0

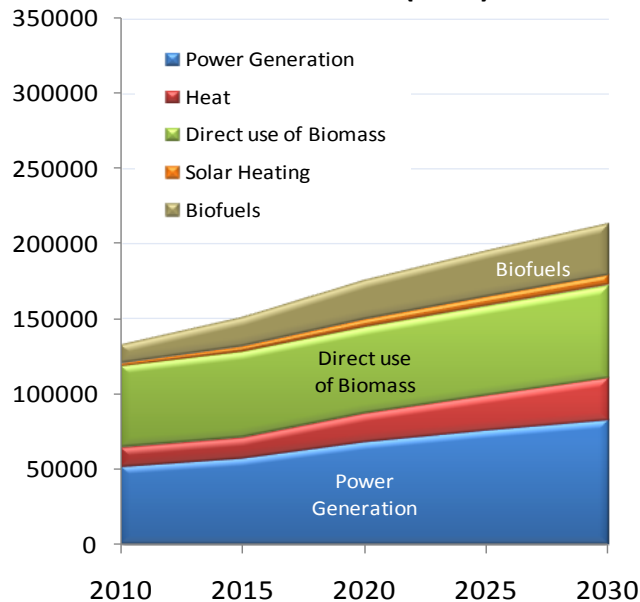
  

	Shares in the SER (%)		% Diff. from Baseline	
	2020	2030	2020	2030
RES % in Power Generation	31.5	43.3	11.3	20.5
RES % in Steam Boilers	24.3	25.8	10.2	11.3

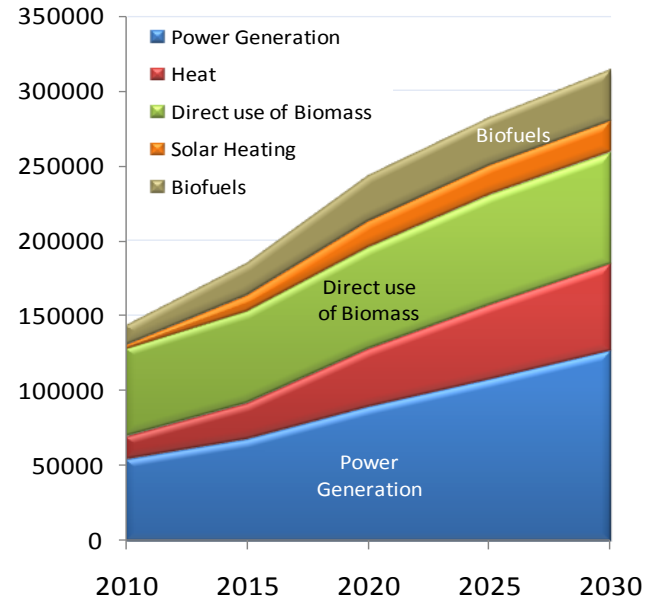
## Comments

- SER induces 68 Mtoe RES more than Baseline in 2020 and 101 Mtoe more in 2030
- Roughly 75% of the additional RES develop in power and heat/steam production
- Direct uses of solar energy develop faster but remain low in terms of volume
- Penetration of biofuels is higher in 2020 relative to Baseline but remains almost unchanged from Baseline in 2030

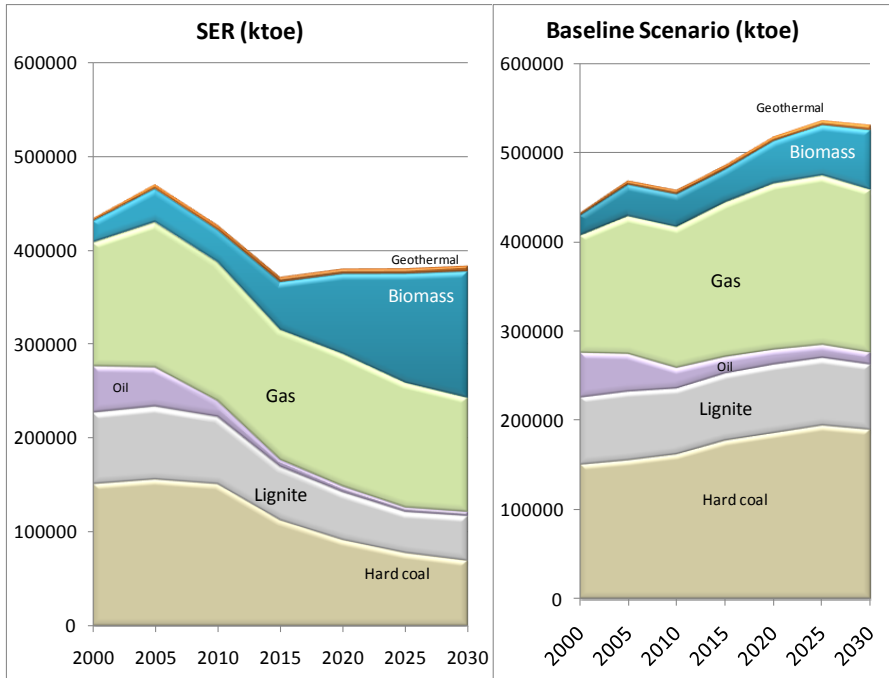
RES in Baseline (ktoe)



RES in SER(ktoe)



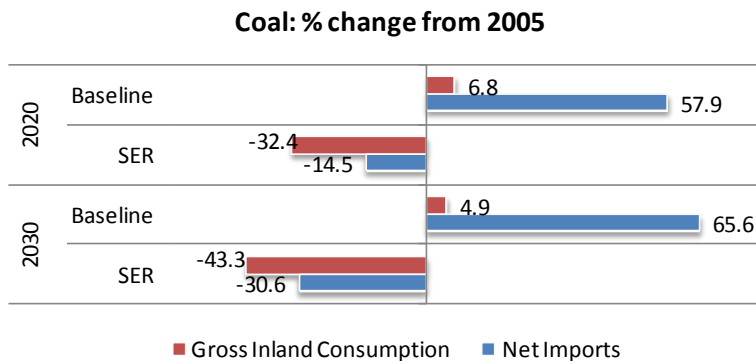
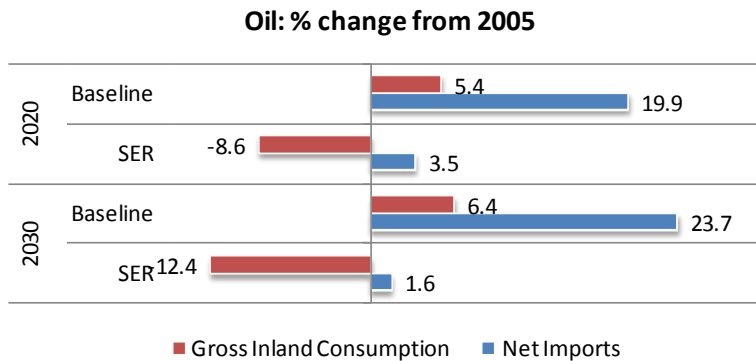
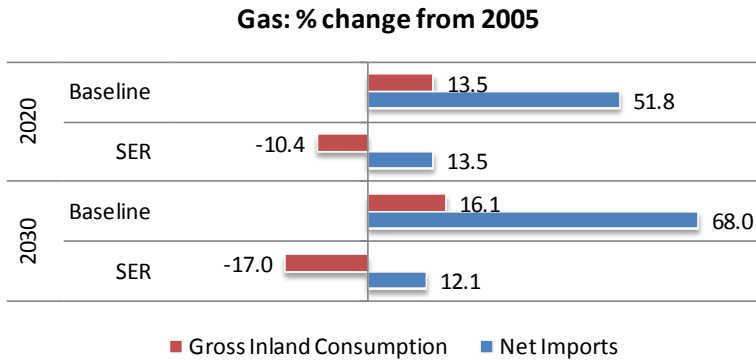
## Fuels Used in Power Generation



## Power Generation

- Significant reduction of coal consumption in power generation. Lignite is less affected.
- Gas used for power generation remains in SER rather stable over time, contrasting its increase in the Baseline
- Considerable increase in the use of biomass and waste energies for power generation

## Fossil Fuel Requirements of the EU27



## Comments

- Stabilization of total gas needs at the level of 2005, however gas imports still increase relative to 2005 because indigenous production of gas declines
- Considerable reduction of total oil needs and imports
- SER induces drastic decrease in coal consumption and imports relative to 2005

## CONCLUSIONS

- ▶ The policies included in the Strategic Energy Review induce considerable benefits in terms of GHG emission reduction and diversification of energy supplies
- ▶ The RES technologies and the RES resources including biomass-waste are considerably developed
- ▶ All sectors will experience large changes
- ▶ Cost and prices will increase substantially but overall the economy will shift spending towards domestic goods and services
- ▶ **If high world energy prices prevail, GHG and RES targets may be overshoot as a result of the SER policies**

## STRATEGIC ENERGY REVIEW SCENARIO

# GAS DEMAND AND SUPPLY OUTLOOK FOR THE EU27

## Main features of Gas Demand

- Gas is the fuel of choice because of efficiency, cleanliness and convenience
- Demand for gas has grown by more than 50% since 1990
  - 150% increase for power and steam generation
  - 25% increase for direct use by final consumers
- However, gas price volatility affects long term gas demand:
  - Price-inelastic in final demand and in small CHP
  - Price-elastic in large-scale power generation
- Gas price indexation to oil prices is a risk factor and is preventing greater increase of gas demand by power generators

## Issues about Gas Demand in Power sector

- The emergence of combined-cycle power technology and the low prices experienced up to 2004 have induced massive building of new gas-based power capacities in the period from 1996 to 2005
- Gas power investment is also convenient when uncertainty prevails (electricity market liberalisation in 1996-2005), because of its low capital intensiveness
- But after 2005, because of the soaring oil prices, electricity companies revised their long-term plans and re-considered investing in coal (also facilitated by optimism about super-critical plants and about CCS for the longer term)
- Nevertheless, uncertainty still persists in relation to unknown future CO<sub>2</sub> prices, which favour gas over coal

### Baseline Gas Supply Scenario

For Europe, Gas demand is calibrated to Trends 2030 Baseline scenario. For other countries projections by IEA and US/DOE/EIA are taken. The scenario adopts an optimistic view about gas reserves, upstream investment and pipeline projects

- Gas demand grows by 2.14% pa in 2005-2030 (EU27 0.61%)
- Gas demand by Asian countries grows fast (China and India get 14% of total gas supply, from 7% in 2005)
- Yet to find Gas reserves represent 20% of today known

Field production capacity in 2030 is 50% up from today (development of new fields of which several are small)

Pipelines in 2030 have capacity 60% up from today

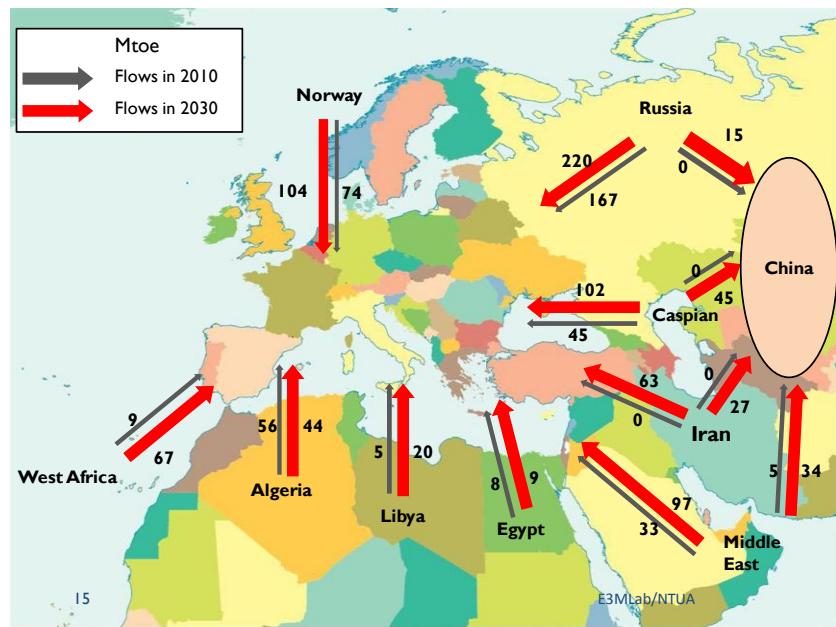
The LNG market develops smoothly in the long term, however mainly outside Europe

Liquefaction and LNG terminals increase by 80% from today (24% in Europe)

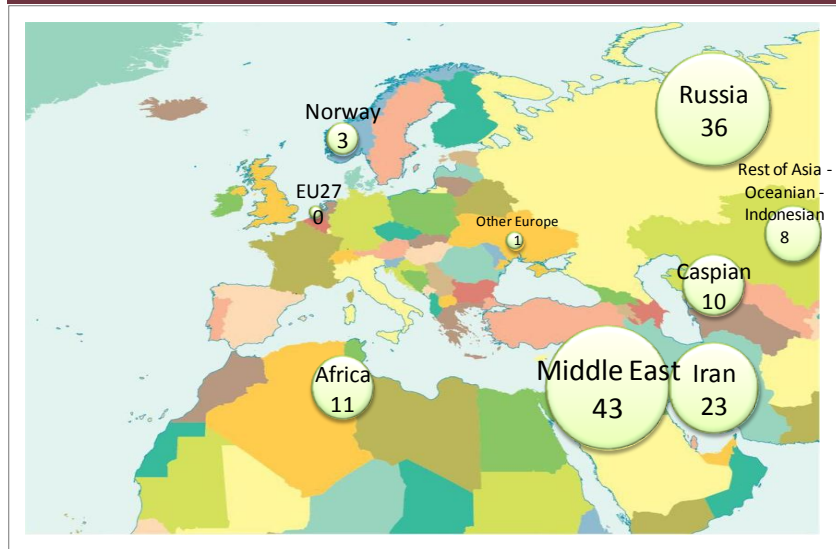
### Example of Inputs (pipeline project assumptions)

	Baseline	Date	Bcm
Nabucco	YES	2015	32
Turkey Greece Italy (TGI)	YES	2015	16
South Stream	YES	2015	31
Transadriatic Pipeline (TAP)	YES	2015	16
Ionian Adriatic Pipeline (IAP)	NO		5
Turkish corridor (links with Caspia, Iran and Middle East)	YES	2015	60
Yamal	YES	2015	64
Nord Stream	YES	2015	66-100
Caspian north	YES	2015	76
Western Balkans	YES	2015	4
Africa to Europe pipelines	YES	2010-15	36
Baltic Ring (incl. Poland)	YES	2015	19
Russia towards East	YES	2020	30-50
Caspian and Gulf towards East	YES	2015-2020	80-110

### Summary of projected physical flows of gas



### Remaining gas reserves by 2030 (Tcm)



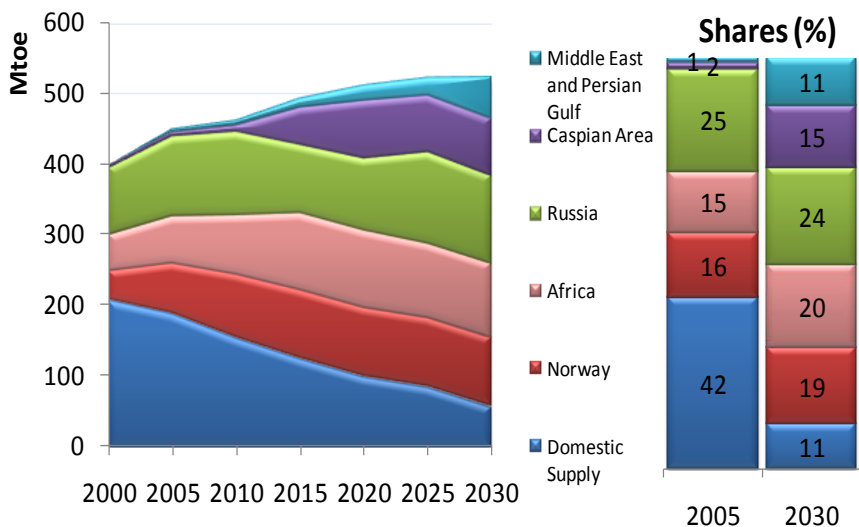
**Comments on Gas Supply**

- ▶ The Caspian area and the Middle East-Gulf emerge as commercial suppliers of the EU27
- ▶ Africa's share increases by 5 percentage points in 2030, compared to 2005
- ▶ The Norwegian share also increases
- ▶ Russia's commercial share remains around 25%
- ▶ Domestic gas represents only 11% of gas supply in 2030

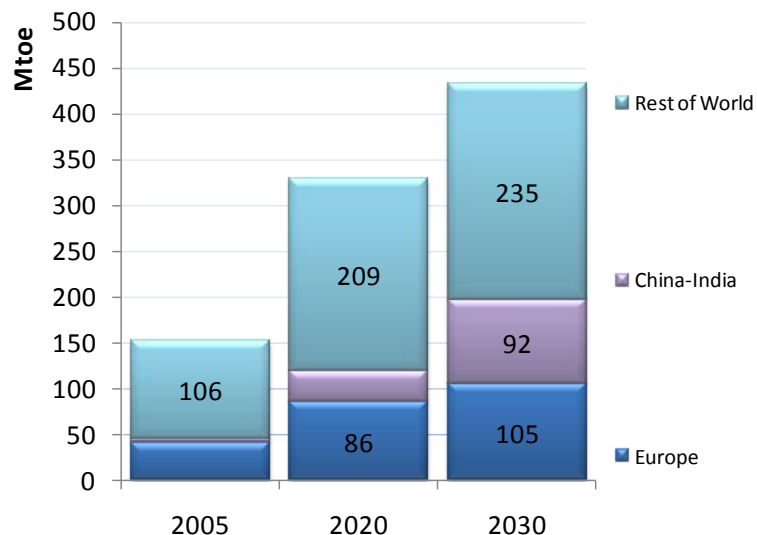
**Comments on LNG**

- ▶ Market growth 4.6% per year over 2005-2030
- ▶ LNG demand by non European countries is growing fast
- ▶ LNG to China, Japan, Korea and North America comes from different origins (Oceania, Indonesia, Latin America)
- ▶ LNG consumed in Europe comes mainly from Africa
- ▶ LNG from Middle East and Gulf goes to various markets, including Europe

**Commercial Origin of Gas for EU27**



**Global LNG Consumption**



## Conclusions

The new gas model of PRIMES provides in-depth analysis and insights about gas supply

Gas prices in EU27 are found to rise significantly (2% per year above inflation)

High growth of demand for gas in the long term under the new policy approach only if EU-ETS clear at high CO2 prices and energy-efficiency and RES policies fail

Imports rising more than gas demand due to declining EU production

Russia expected to deliver a quarter of EU gas needs also in 2030 under trend conditions

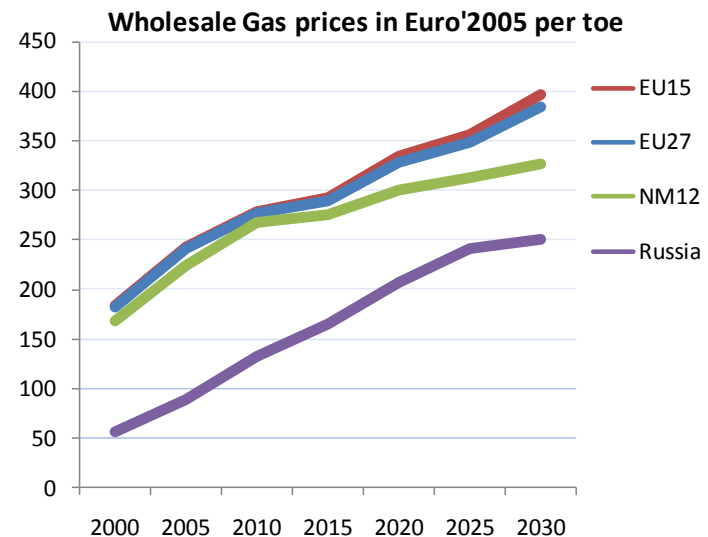
Africa, Caspian and in the long term Middle-East and Persian Gulf become important in gas supply to the EU

Higher contribution of LNG in the context of a global LNG market is quite feasible and enhances diversification

## Gas prices

- ▶ Gas prices in EU27 grow by 1.9% per year between 2005-2030 (above inflation)
- ▶ This growth is explained by gas resources and market conditions (not by indexation to oil prices)
- ▶ Gas producing countries are projected to experience escalation of domestic prices towards true costs
- ▶ LNG prices are projected to grow by 0.7% per year and thereby reducing price difference to pipeline gas to 30% by 2030

Gas prices as projected by the gas market model (not linked to oil )



## 2009 ENERGY BASELINE WORK INCLUDING IMPACT OF CRISIS

## World Energy Analysis by using the Prometheus model

Outlook for growth rates can be divided into four broad periods:

The Recession (2008-2012)

The Recovery (2012-2020)

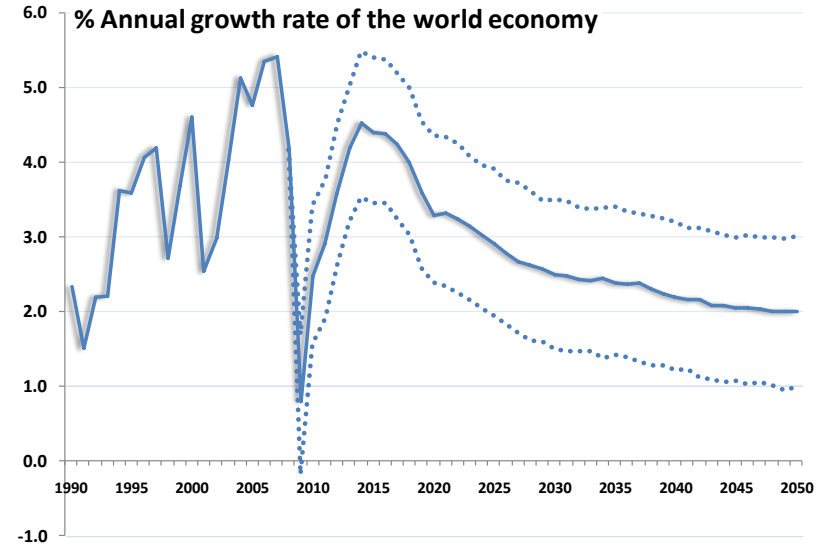
A Gradual Slowdown (2020-2030)

The Longer Term

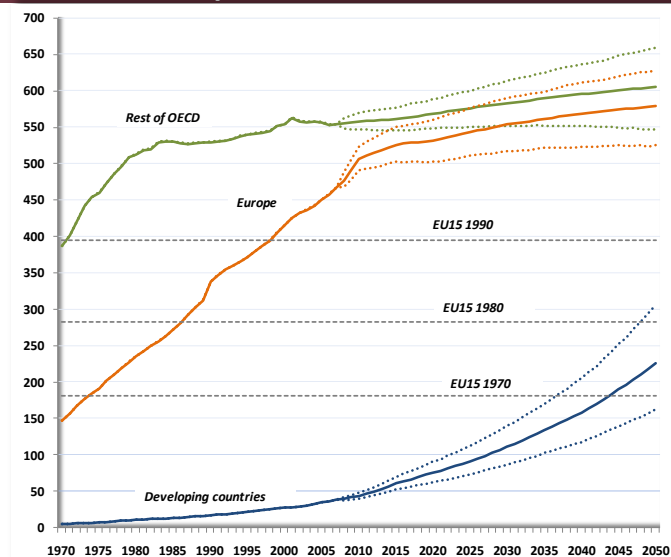
*In the period 2006-2030 the average annual growth rate of world economy is 3.3% (mean)*

*In accordance with IEA WEO 2008*

## World economy prospects

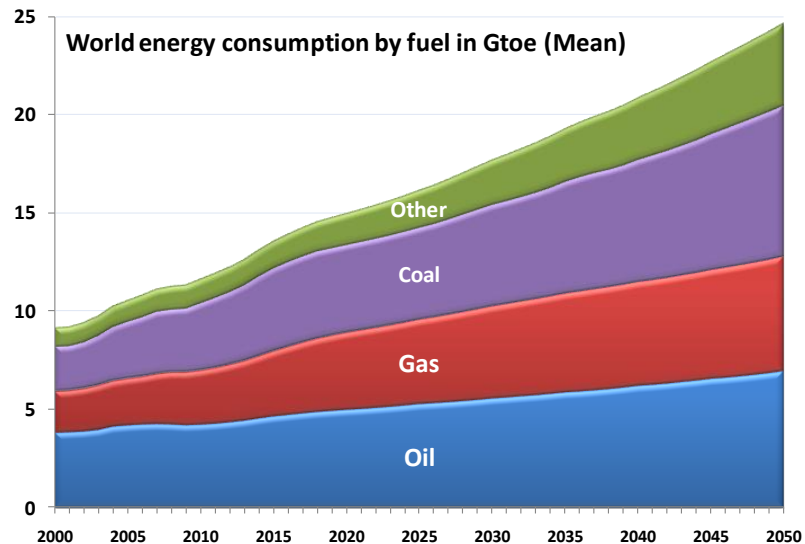


## Number of vehicles per thousand inhabitants

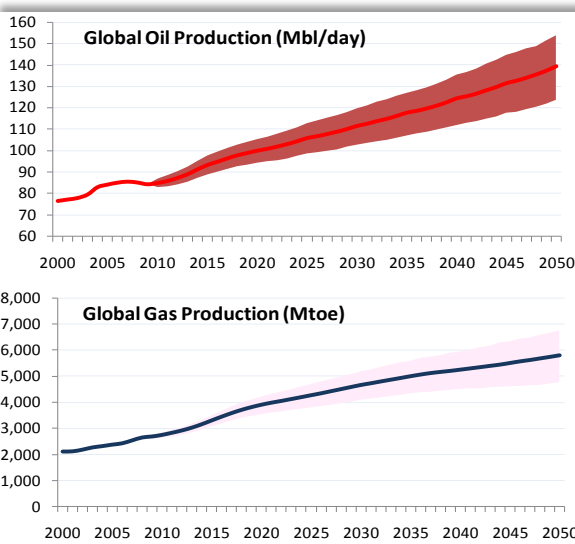


The range shown in the graphics corresponds to probabilities  $\pm 30\%$  from mean (the solid line)

### World Primary Energy in 2009 Baseline

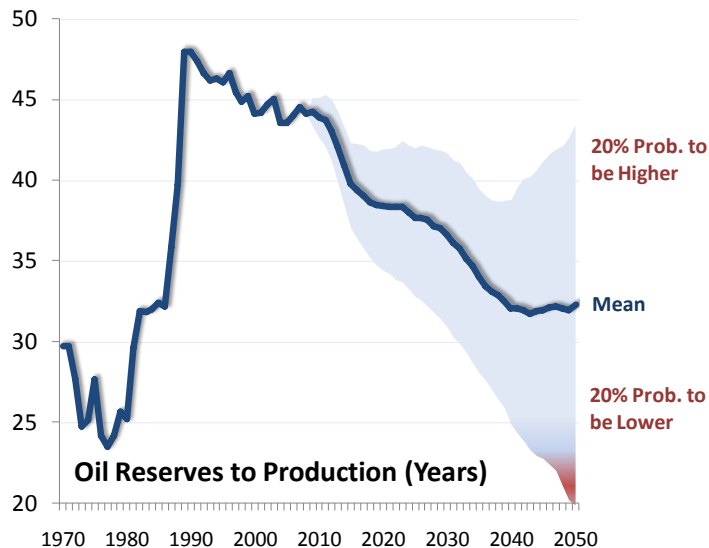


### Oil and Gas Production

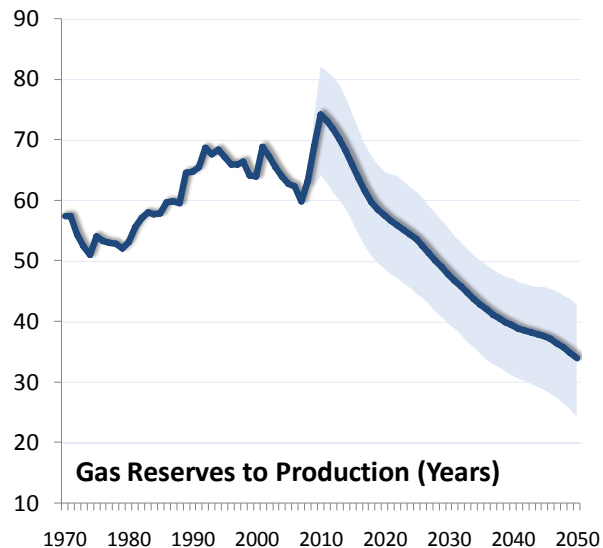


Non conventional oil: 27% of total oil in 2030, 53% in 2050

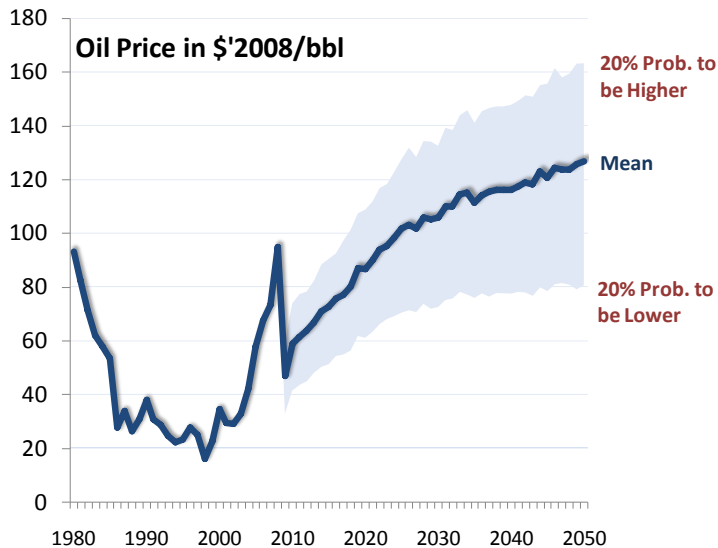
### Reserves to Production ratios for conventional oil



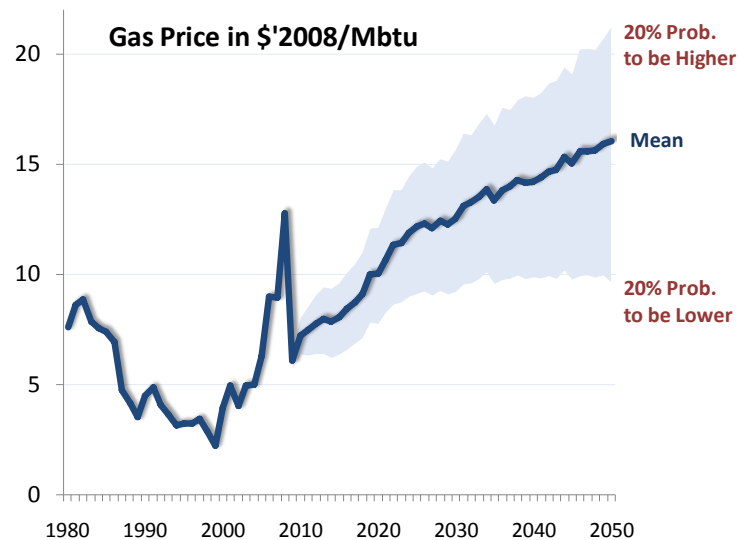
### Reserves to Production ratios for gas



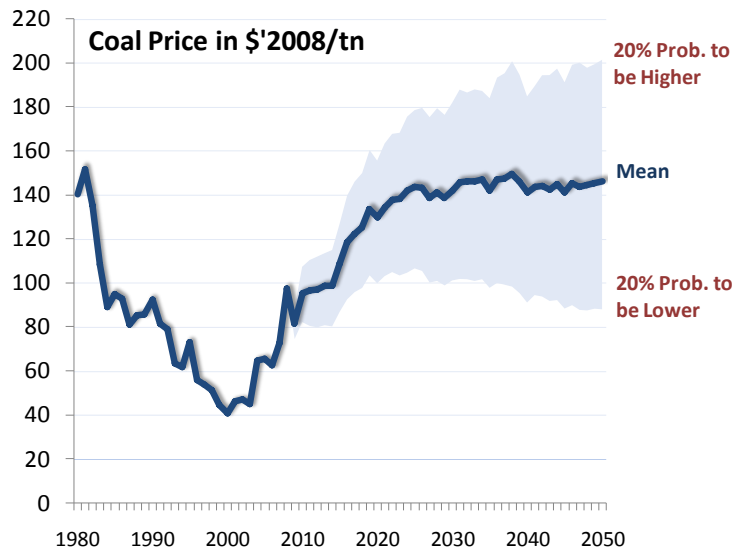
### Oil Price projection



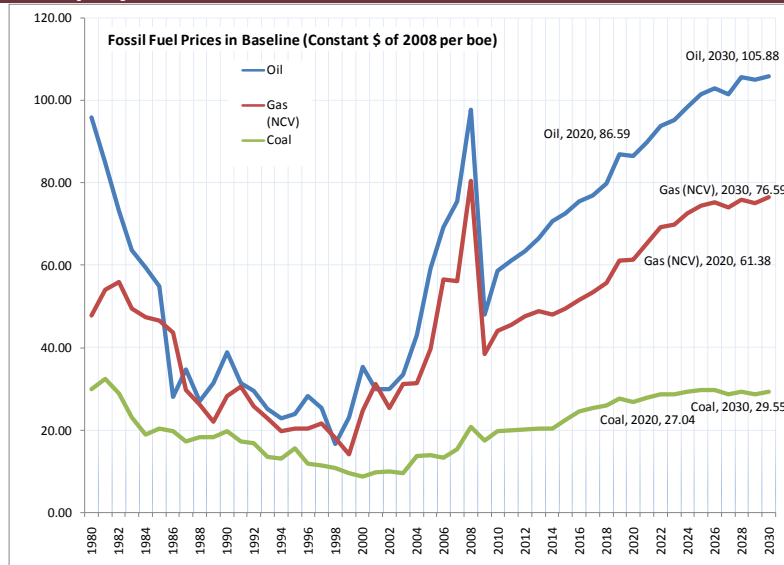
### Gas Price projection



### Coal Price projection



### Price projection retained in PRIMES model for 2009



## Macroeconomic Projection for the EU using the GEM-E3 Model

The projection serves as input to the preparation of the new Energy Baseline scenario for the EU

It covers the period 2010-2030 per Member-State, includes updated historical data and concern:

- GDP (volumes)
- Households' income
- Population
- Value Added per sector (used as proxy of activity)
  - 22 sectors
  - Energy intensive industries represented as 10 sectors
  - Rest of industry (6 sectors)

## Simulation of Economic Recovery

Important policies and financial measures put in place

Reduction of basic interest rates

Expansion of money supply (lower cost of capital)

Progressive reduction of risk premium

Expansionary effect of the fall in the price of energy products

Global trade expansion

Hence

Higher demand from rest of World

Demand (private and exports) recover gradually

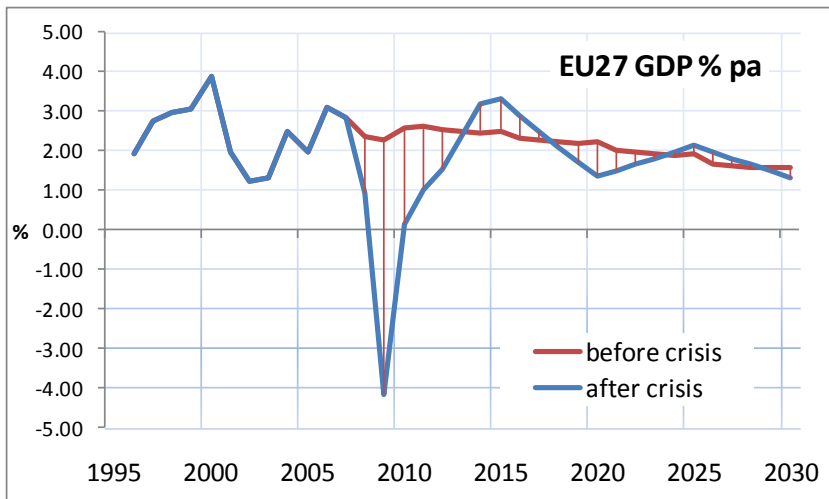
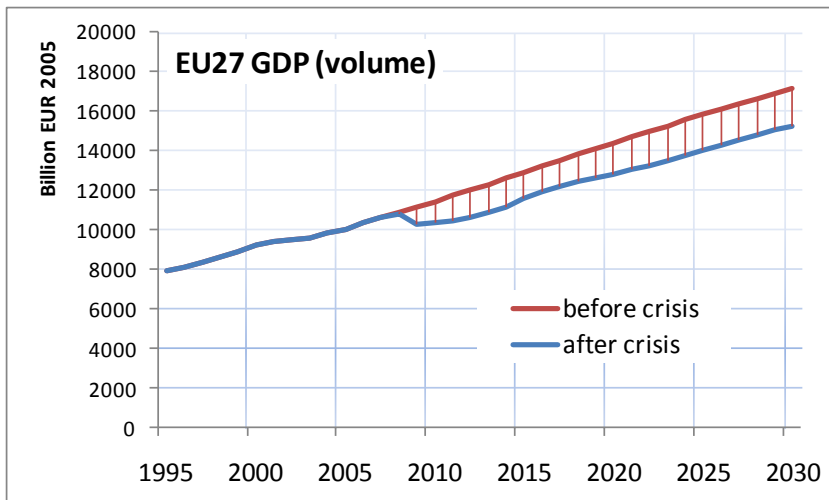
Investment grows again

*However, permanent loss of GDP and welfare*

## Effects of the Financial Crisis

- As a result of the Financial Crisis, global economic prospects deteriorated markedly in the final quarter of 2008
- Loss of financial assets induced reduction in bank lending, reduced confidence and increased uncertainty
  - Slowdown of private investment in all sectors
  - Lower final consumption and purchasing of durable goods
- Lower credit availability detrimental for emerging economies through reduction in global trade
  - Drop in exports, so further slowdown of investment
  - Lower demand drives increasing unemployment, which further increases uncertainty and reduces consumption
- Vicious cycle of recession with deflationary tendencies
- Modelling
  - A “shadow” interest rate is introduced to represent credit rationing and increased risk premium, which
    - Affects negatively private investment (higher capital cost)
    - Reduces purchasing of durable goods
  - Higher rate of savings of households in the short-run, hence reduced consumption
  - Demand from rest of World is assumed to decrease in the short-run
    - Lower exports by the EU result in lower activity, less private investment and increase in unemployment, hence further slowdown of private consumption and expenditure in durable goods and houses

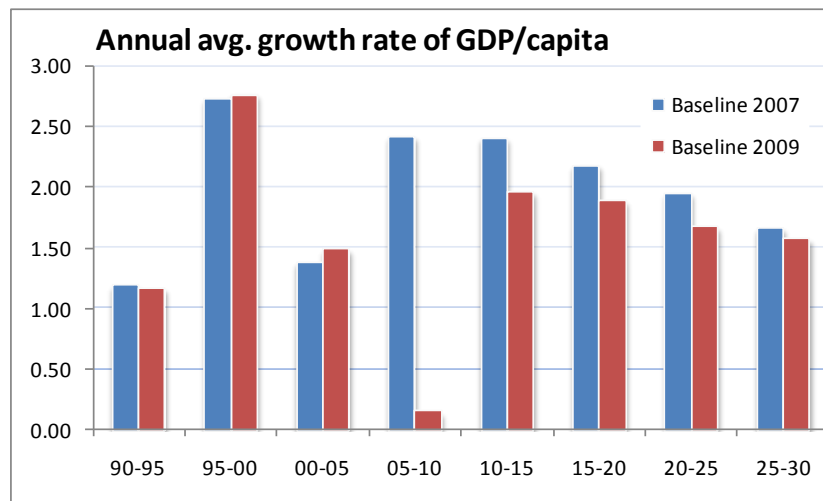
## GDP Results



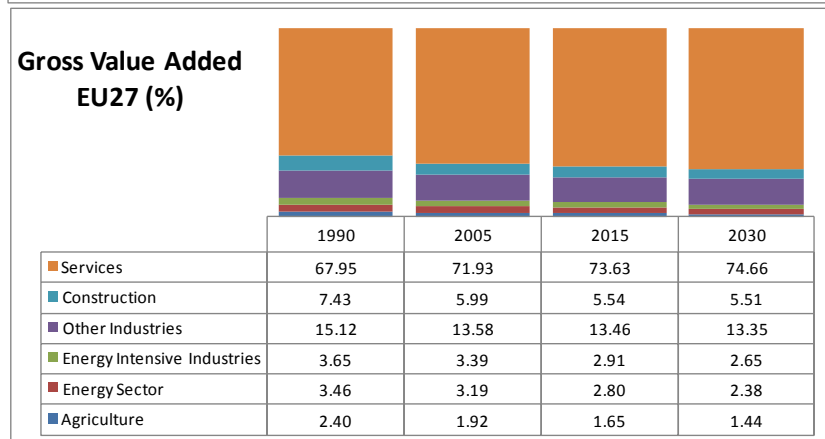
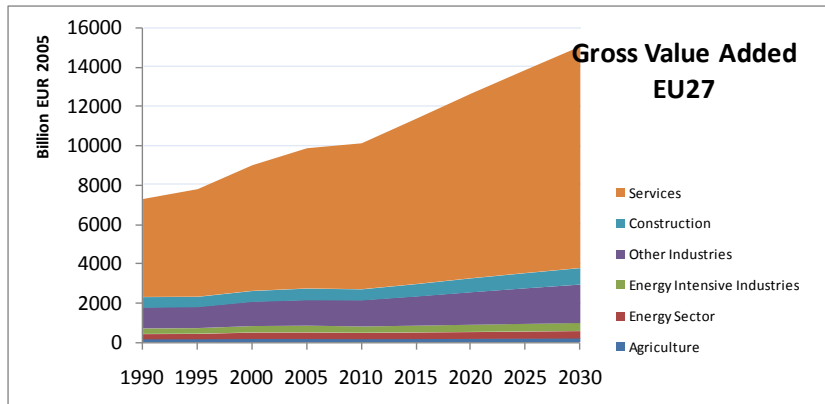
## Baseline 2009 vs. Baseline 2007

- Shaded area corresponds to permanent loss of real GDP
- Economic recovery after the crisis enables higher productivity gains, allowing faster growth rates between 2014 – 2018
- However, not enough to compensate for the losses
- Growth rate convergence in the long term
- Compared to the Baseline of 2007, the new projection shows lower GDP and higher population; hence lower GDP per capita
- Growth rates of GDP/capita slowdown significantly in the years around 2010
- Consumption expenditures per household follow the GDP per capita trajectory

## Income projections



## Sectoral projections



## Structure of growth by sector

- The services sector dominates EU GDP and is projected as the fastest growing sector
- Non energy intensive industries are the second faster growing sector
- Energy intensive industries display a positive, albeit low growth (less than 1% pa between 2005 and 2030)
- Chemicals is the fastest growing industry within the energy intensive sector, however fertilisers and basic chemicals are growing more slowly
- Building materials slowdown as a result of the crisis and their growth pace in the long term remains slow
- Basic metals industry is projected to maintain activity in the EU, after a significant drop in short term
- The engineering industry (equipment goods) dominates the EU industrial structure and is projected to grow fast, after some slowdown due to the crisis
- Pharmaceuticals and cosmetics are the fastest growing non energy intensive industry, but their share in VA terms is small
- Food industry and others (wood, rubber, plastics) are also growing faster than average
- Textiles are declining

# Conclusions

- ▶ The macroeconomic and multi-sectoral projection is of major importance for the energy system projection
- ▶ Summary
  - ▶ Simulation of the financial crisis (as known by may 2009) and its effects on real activity by using the GEM-E3 model
  - ▶ Long term trends aligned to Commission's DG ECFIN 2009 Ageing Report
  - ▶ Sectoral and country-specific consistency ensured by using the GEM-E3 general equilibrium model

ECONOMIC PROJECTIONS TAKING ACCOUNT OF THE CRISIS