

Workshop Energy & Resources

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Challenges

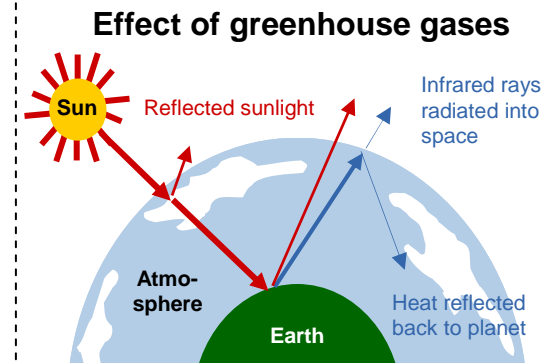
Climate change is a fact, threatening humans and biosphere



Climate change and impact

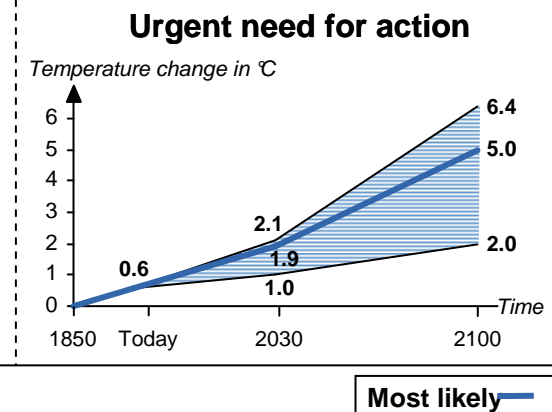
Climate change ...

- Anthropogenic **greenhouse gas emissions** ¹⁾ from fossil fuel burning and land use **shift the radiation balance** of the earth and cause warming
- Scientific consensus that doubling of CO₂ from pre-industrial levels (280 ppm) by non-acting till 2035 **causes unacceptable global temperature increase**
- **Feedback amplifies warming**



... threatens humans and biosphere

- Melting may cause **flooding of >4 million km² affecting > 300 million people**
- **Spread of diseases** expected (Malaria, Dengue fever etc.)
- More frequent **extreme weather conditions jeopardize crops and living conditions**
- **15-20% of species face extinction at only 2°C warming**

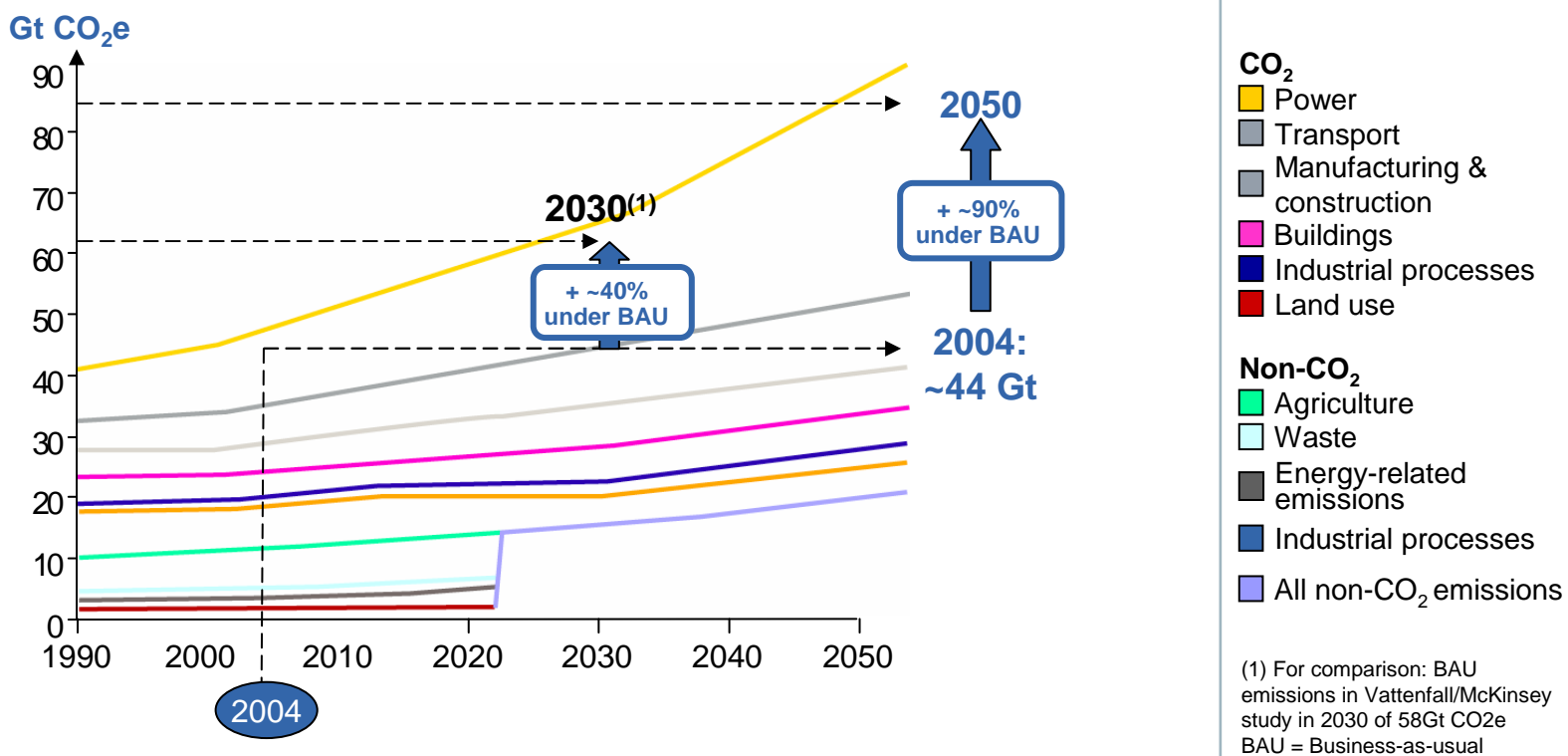


1) Carbon dioxide, methane, nitrous oxides, etc.

Business as usual leads to 90% increase in greenhouse gases by 2050



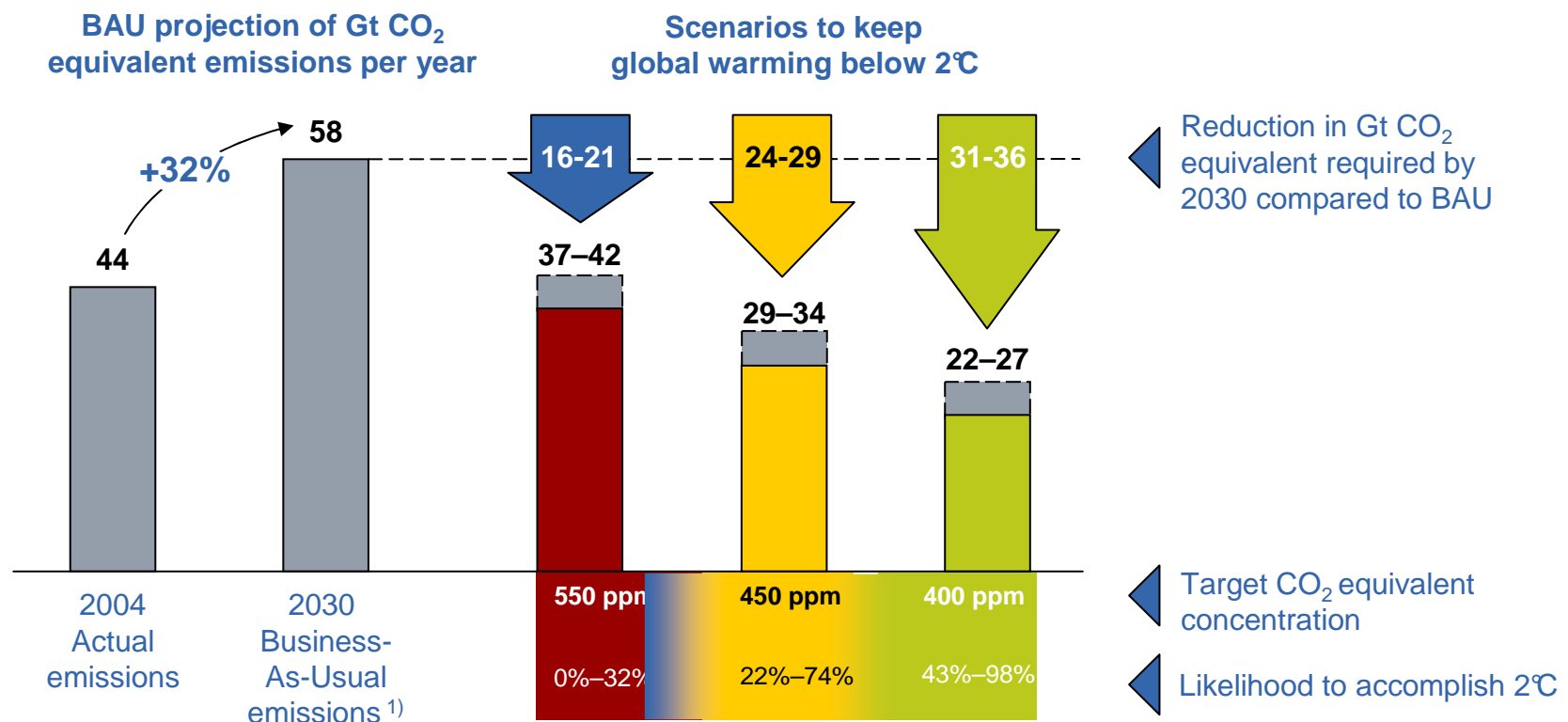
Global CO₂e emissions (1990-2050, in Gt CO₂e emissions per year)



Source: Stern Review

Drastic actions are required to limit global warming to 2°C

Scenarios for reduction demand (2030, in Gt CO₂ equivalent emissions per year)



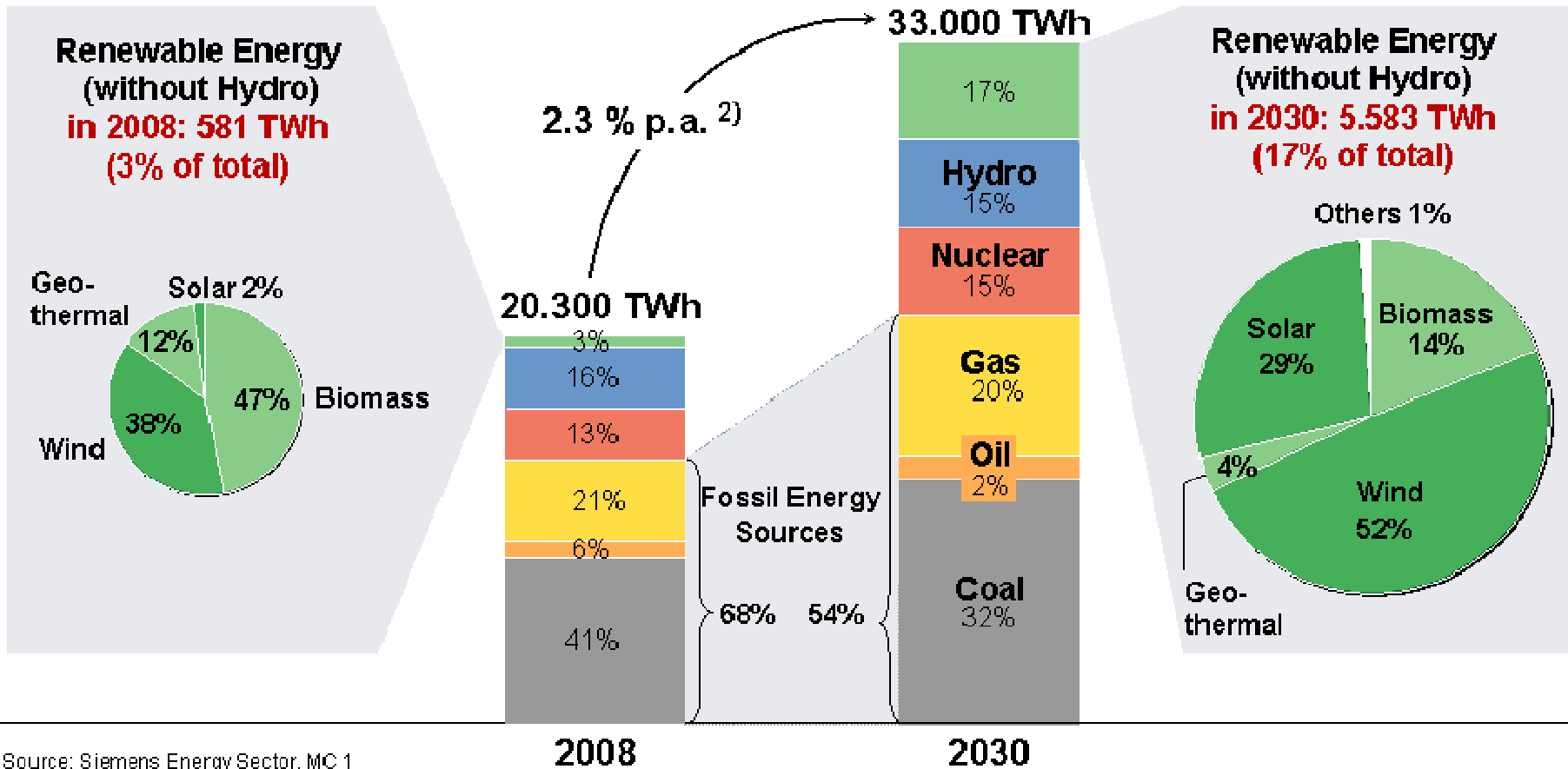
1) According to IEA, EPA

Source: IEA WEO 2006 and 2007, Vattenfall

The world's energy consumption will continue to rise - despite the crisis



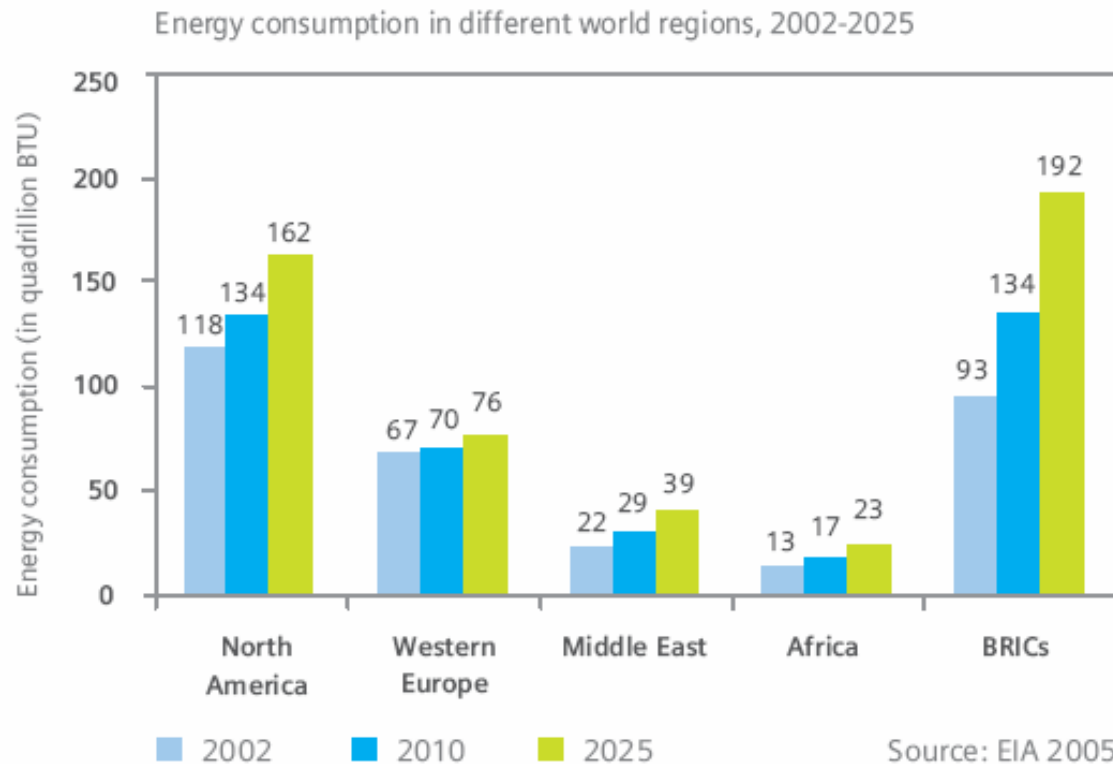
Power Generation (in TWh¹)



Source: Siemens Energy Sector, MC 1

1) Terawatt hours 2) Primary energy demand increases 1,6% p.a.)

Rapidly increasing energy consumption, mainly in BRIC countries

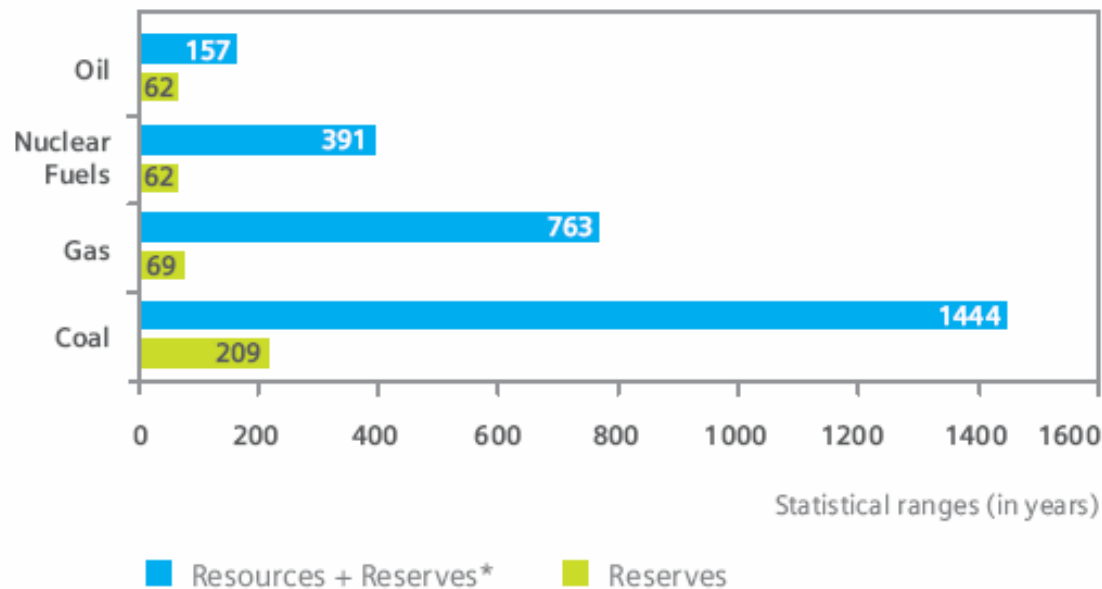


Most rapid growth expected in non-OECD countries

- **Fastest growth evident in BRIC economies**
- **Growth driven by industrialization and rising per capita consumption, although per capita consumption remains at low level**

Coal will last the longest

Statistical ranges of fossil and nuclear fuels



* Reserves: The amount currently technologically and economically recoverable.

Resources: Quantities technically or economically not (yet) recoverable or not yet proven.

Source: Dresdner Bank 2005

Ensuring the supply of resources

- **Improve production infrastructure in order to assure supply**
- **Promote diversification in order to guarantee long-term supply**

Growing relevance of energy security

Political implications

- **Energy supply questions are entering the political agenda:
Nationalization of energy industries (e.g. in Russia, Bolivia, Venezuela)**
- **China: Energy supply is vital for economic development (e.g. contracts with Iran to secure supply create dependencies and influence diplomatic behavior)**
- **Inter-regional trade of energy resources increasingly important (international attention will focus on maintaining the security of sea-lanes and pipelines)**

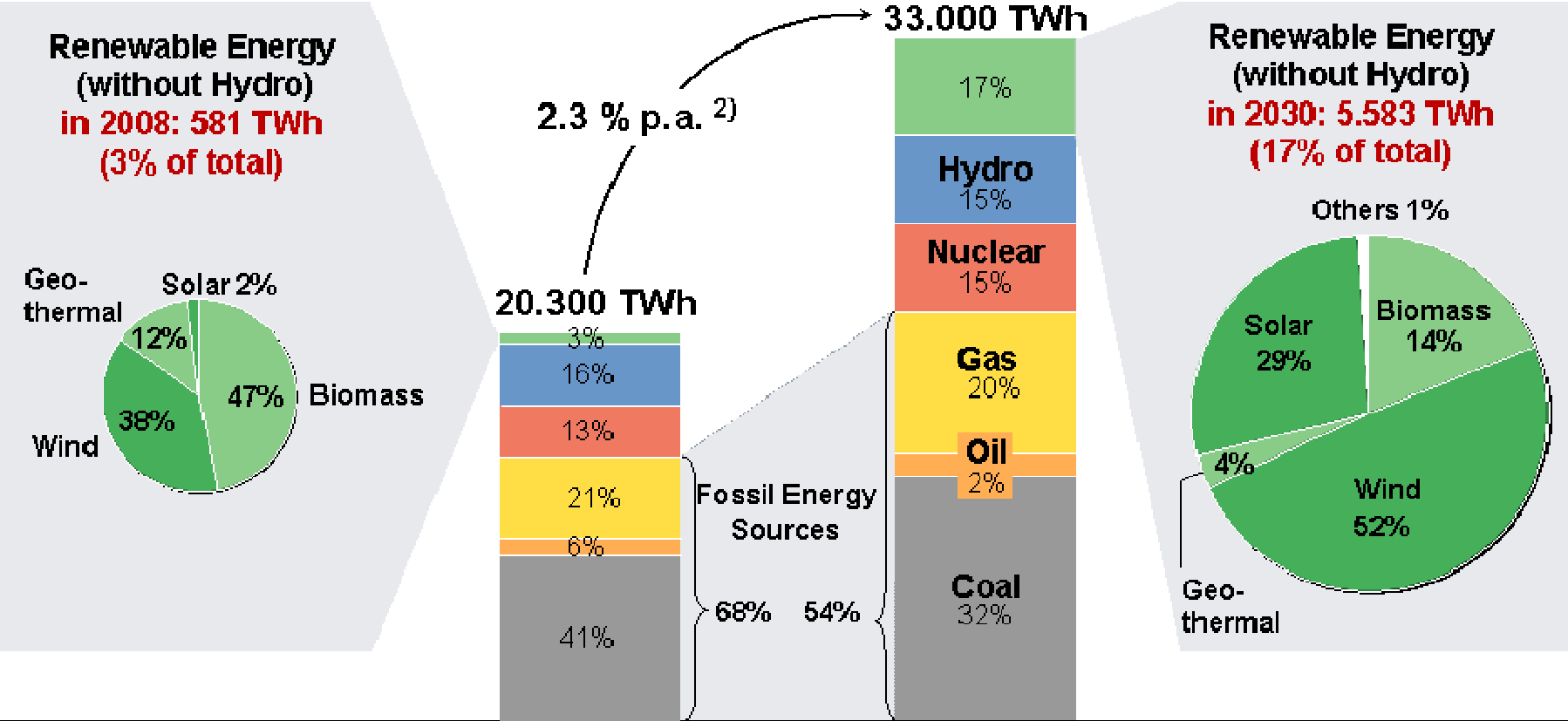
Managing political conflict

- **Challenge of fair resource supply needs to be addressed**
- **Conflicts have to be prevented**



Energy mix will change but fossil fuels remain important

Power Generation (in TWh¹)



Source: Siemens Energy Sector, MC 1

1) Terawatt hours 2) Primary energy demand increases 1,6% p.a.)

Innovations play crucial role in securing reliable, environmentally sound energy supply



Siemens Environmental Portfolio

- Nearly one quarter of our revenue is generated by products and solutions that make a direct, quantifiable contribution to environment and climate protection* (~ €19 billion).
- By 2011, income from our environmental portfolio should grow to €25 billion.
- In fiscal 2008, energy-efficient products and solutions in our environmental portfolio saved about 148 million tons of CO₂ for our customers.

Fossil Power Generation 	Renewable Power Generation 	Power Transmission 	Power Distribution
Water Technologies 	Healthcare 	Mobility 	Solutions for Industry
Lighting (OSRAM) 		Building Technologies 	

* Status in fiscal 2008, reviewed by PwC

Fossil Power Generation: Combined Cycle Power Plants

SIEMENS

Combined-cycle power plants belong to the most energy efficient fossil-fired power generators. The new gas turbine from Siemens in Bavarian town Irsching is expected to set a new efficiency record: over 60 percent.

Key features

- High efficiency due to combination of gas and steam turbines
- Further efficiency enhancements possible thanks to higher combustion temperatures and innovative turbines

Environmental value

- Only 345 g CO₂-emissions per kilowatt hour, compared to 578 in average power generation worldwide
- Significant emissions reduction anticipated

Customer value

- Low fuel consumption*
- Low operating costs*

*Compared to conventional fossil-fired power plants



Fossil Power Generation

Coal-fired power plant with 50 % efficiency rate

SIEMENS

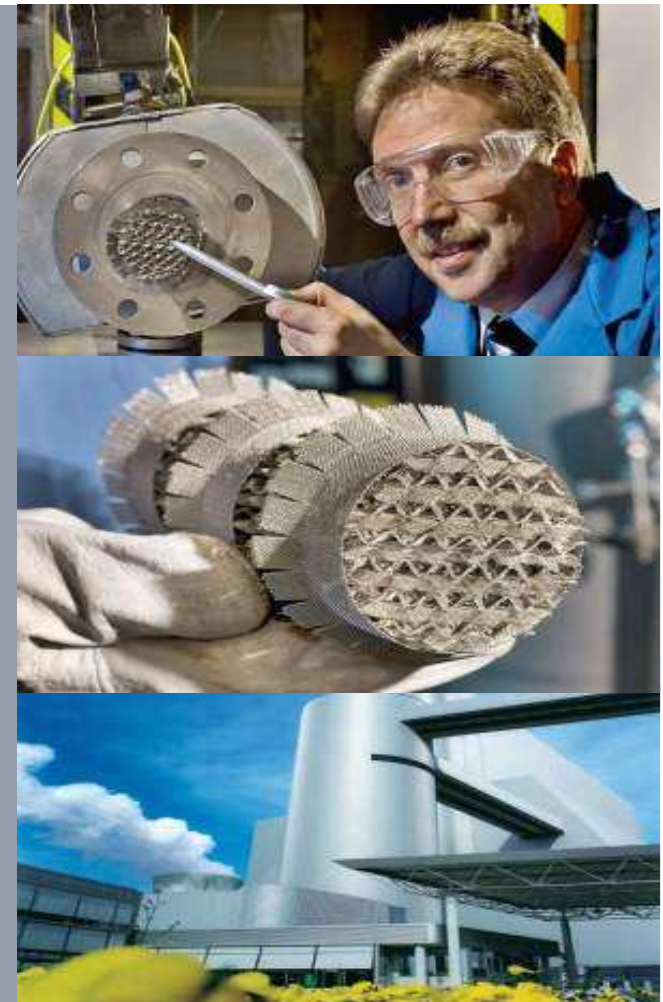
- Siemens is developing a coal-fired power plant that will operate at a steam temperature of about 700°C and have an efficiency rating of at least 50 %.
- With this efficiency rating, only 669 grams of CO₂ will be emitted per kilowatt hour. The average efficiency rating of coal-fired power plants worldwide today is 30 %, with about 1,100 grams of CO₂ produced for every kilowatt hour generated.
- The 700-degree power plant would emit 40% less CO₂ compared with today's global average, and consume 40% less coal for the same amount of electricity.



Clean coal electrification: CO₂ capture and storage

SIEMENS

- Siemens is developing two technologies for CO₂ capture and storage (CCS) for new and existing power plants: combined cycle power plants with integrated gasification combined cycle (IGCC) and CO₂ capture from the flue gas of power plants (post-combustion capture).
- Siemens and E.on are constructing a pilot plant for precipitation of CO₂ from coal-fired power plants near Hanau (Germany).



CCS: Carbon Capture and Storage
IGCC: Integrated Gasification Combined Cycle

Renewable Power Generation: Floating Wind Turbines

SIEMENS

- In the past, offshore wind turbines have had to be anchored in water with a maximum depth of 30 to 40 meters. In the future, floating offshore wind turbines in the middle of the sea will be able to operate at water depths of more than 200 meters.
- “Floating wind turbines” for extreme depths of water is a cooperative project being undertaken with Norwegian energy company StatoilHydro.
- Siemens is to deliver the first wind turbine for the demonstration plant at the end of 2009, which is to be installed off the Norwegian coast.



Renewable Power Generation: Solar thermal plants

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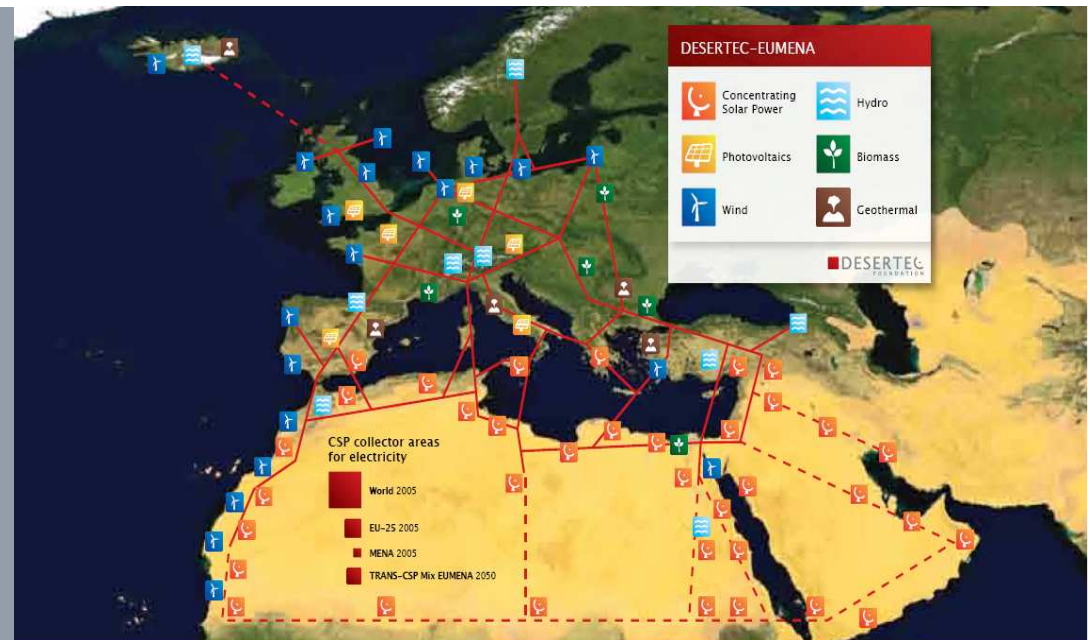
- Siemens is the global market leader in the field of steam turbo sets for solar thermal power plants.
- Apart from Nevada Solar One (USA) with a capacity of 64 Mwe, the largest solar thermal power plants in the world are Andasol I and II in Spain. They are operated with two 50-MW steam turbines from Siemens.



Renewable Power Generation: Solar Electricity from the Desert for Europe

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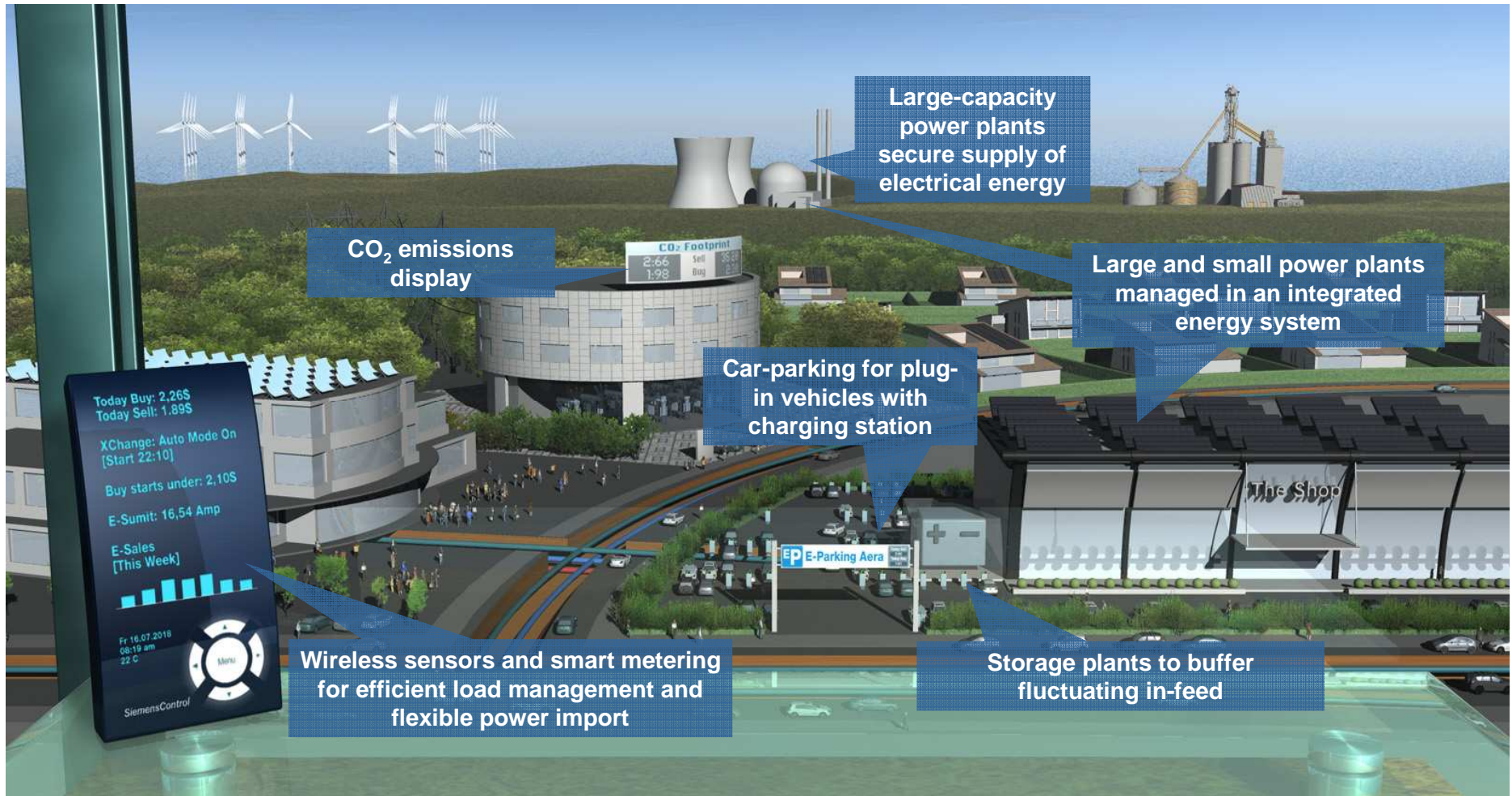
Within 6 hours deserts receive more energy from the sun than humankind consumes in a year.



- Future solar power plants and wind farms in North Africa could supply electricity as far afield as Europe.
- The concept will require transnational power highways that are able to efficiently transmit electricity across thousands of kilometers. Such high-voltage direct current transmission lines already exist, for example in China.

Future energy supply: Smart Grid and systemic optimization lead to the integrated energy system

SIEMENS



Electro Mobility: On the way to the low CO2 car of the future

SIEMENS

- With electricity from renewable energies the electrical mobility minimizes the CO2 emissions in the passenger traffic
- The car can be used not only as mobility device, but also as mobile energy stores in the Smart Grid
- 2011 the first standard electric cars will be on the market
- Until 2020 already 4.5 million electric cars could drive in Germany



Solutions for industry: Industrial motors

SIEMENS

Optimizing the energy efficiency of all industrial drives and motors would reduce CO₂ emissions worldwide by 600 million tons and increase industrial productivity at the same time.

Key features

- Economic and flexible operation of every single drive
- Saved energy can be fed back into the power system
- Use of frequency converters and optimization of systems

Environmental value

- Energy savings between 10 to 15 % per unit
- Annual abatement potential worldwide:
600 Mt CO₂

Customer value

- Far smaller energy consumption saves money
- Investments normally pay off in less than two years



Lighting: Energy saving lamps and LED's

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Energy saving lamps and LED's offer significant savings compared to an incandescent lamp.

Key features

- Energy saving lamps live 15 times longer than conventional incandescent light bulbs
- LED's life is up to 50 times longer

Environmental value

- Consume up to 80% less energy*

*Compared to a conventional incandescent bulb

Customer value

- Economic investment which pays back over the life time



Building technologies: Energy performance contracting

SIEMENS

Energy performance contracting for buildings means: cut energy and operating costs through modernization and optimization, pay for the investment with the achieved savings.

Key features

- No investment costs for the customer through contracting model
- Guaranteed energy savings
- Building modernization by state of the art technology and applications

Environmental value

- Energy savings of 20 to 30% in average

Customer value

- Lower energy and operating costs
- Reduction of maintenance costs
- Increase of property value

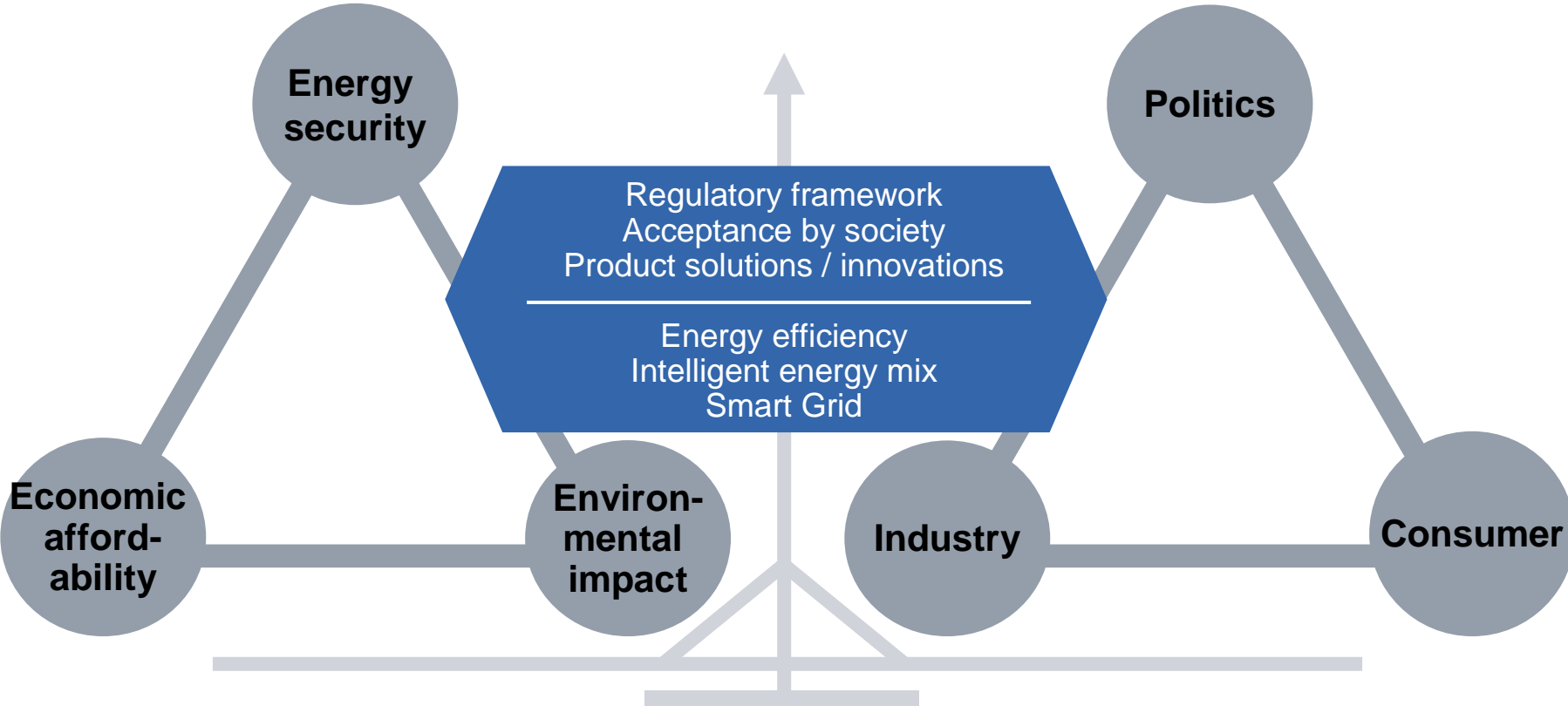


An integrated energy system requires the balance of two triangles



Sustainable energy

Pyramid of stakeholders



The integrated energy system