Introduction: Is energy security possible without renewables?

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ARIZONA STATE UNIVERSITY

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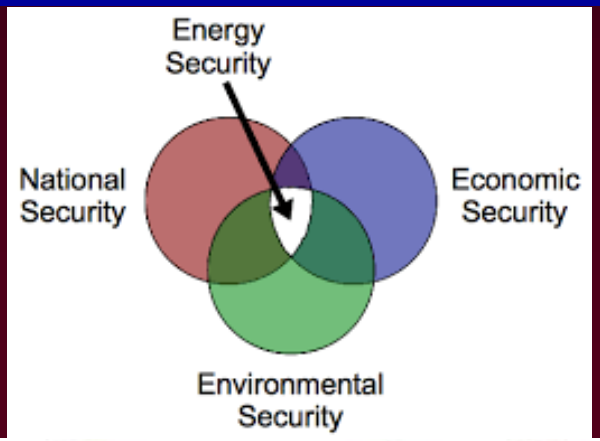


RTU VASSI

Baltic-American Freedom Foundation

ASU Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

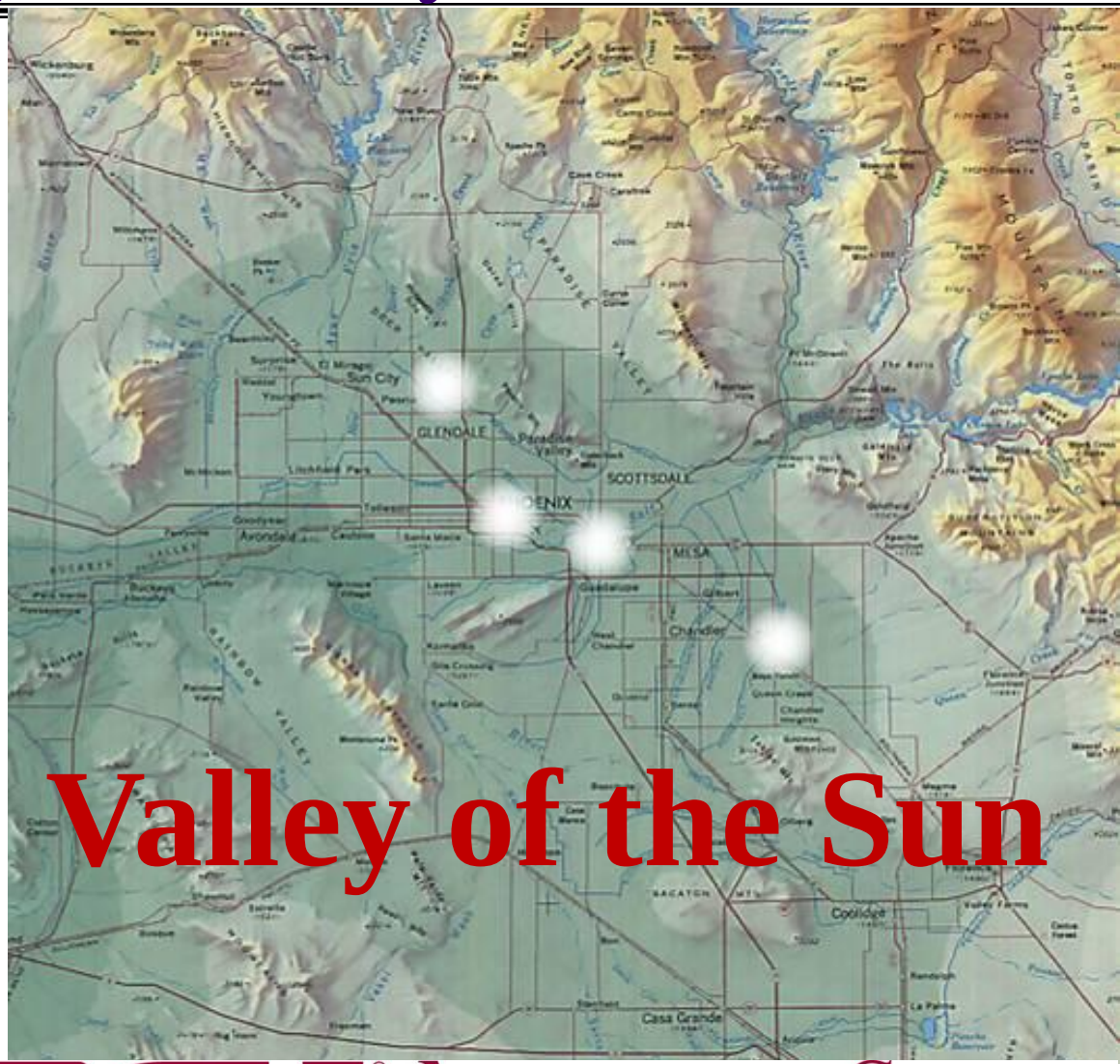
One University in Many Places

West Campus

Downtown Phoenix

Tempe Campus

ASU's Polytechnic campus

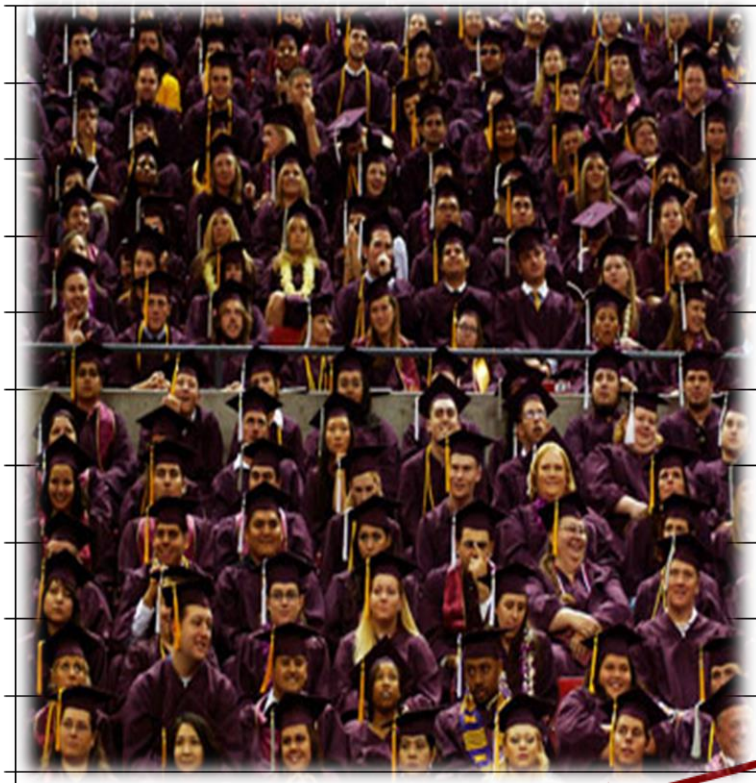


Valley of the Sun

ARIZONA STATE UNIVERSITY

ASU in Fall 2012

ASU Enrollment in 2015

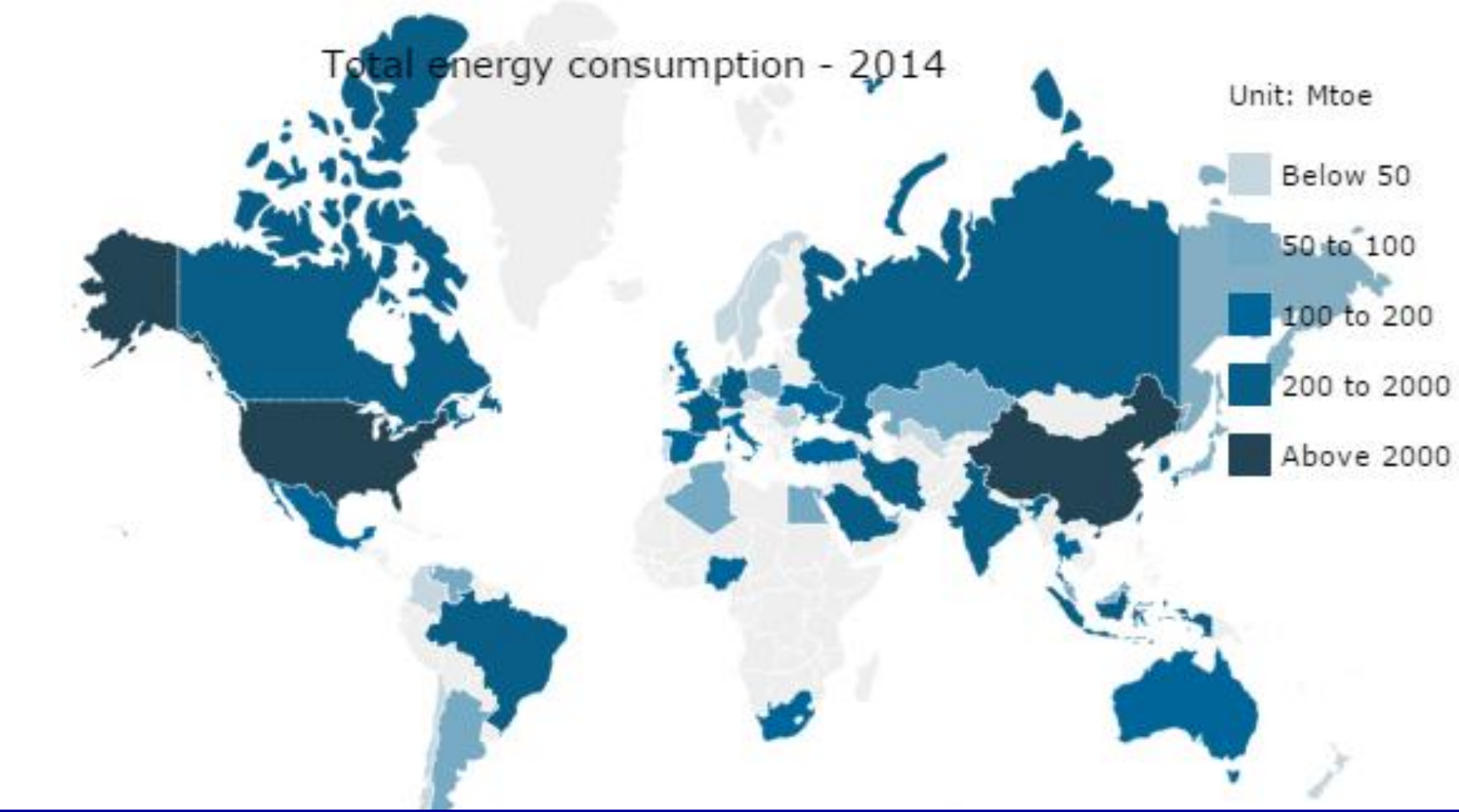


95,000
90,000
85,000
80,000
75,000
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000

1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

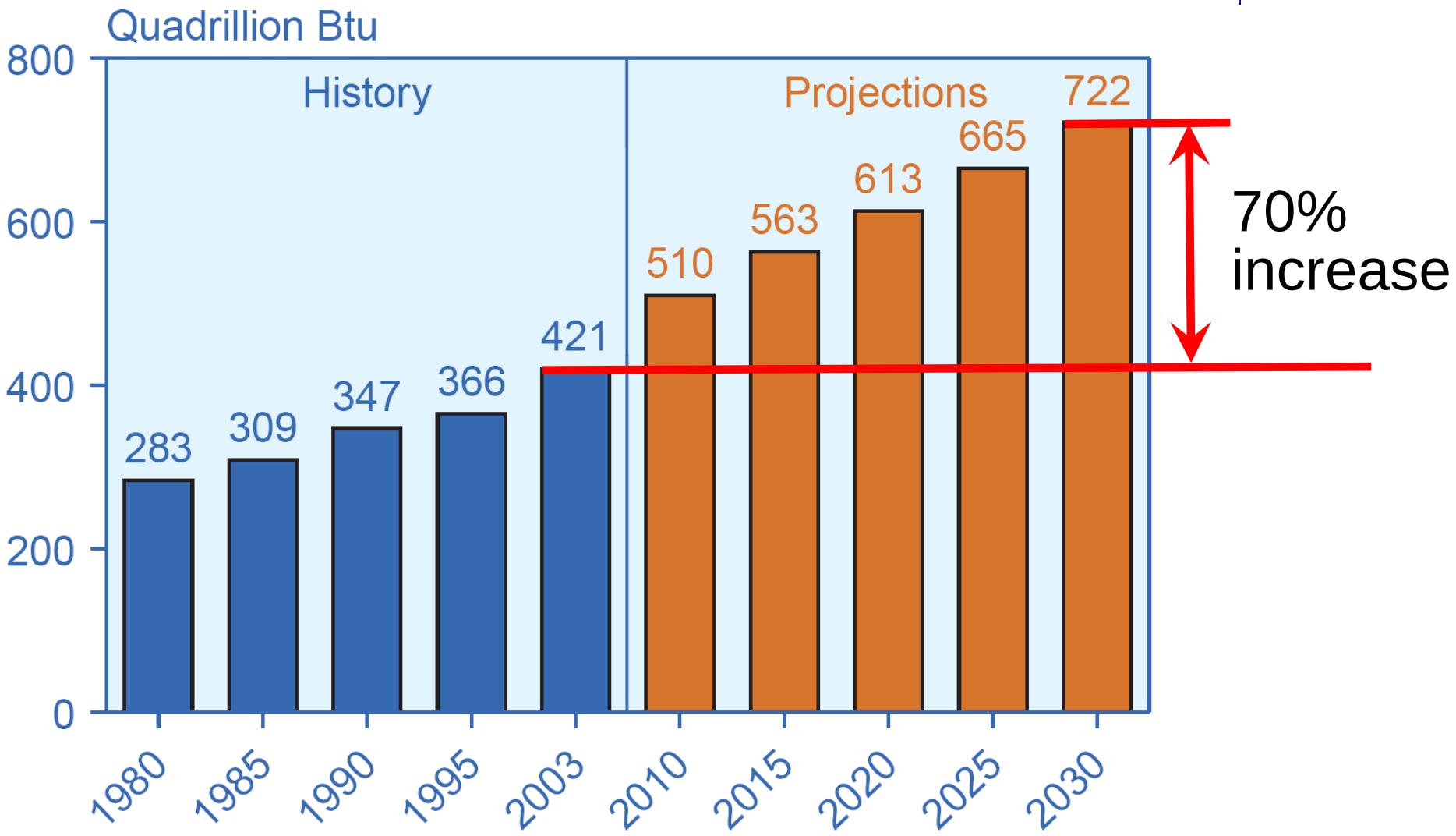
Enrollment at ASU in fall 2015 has reached a record 80000+ students

Total energy consumption



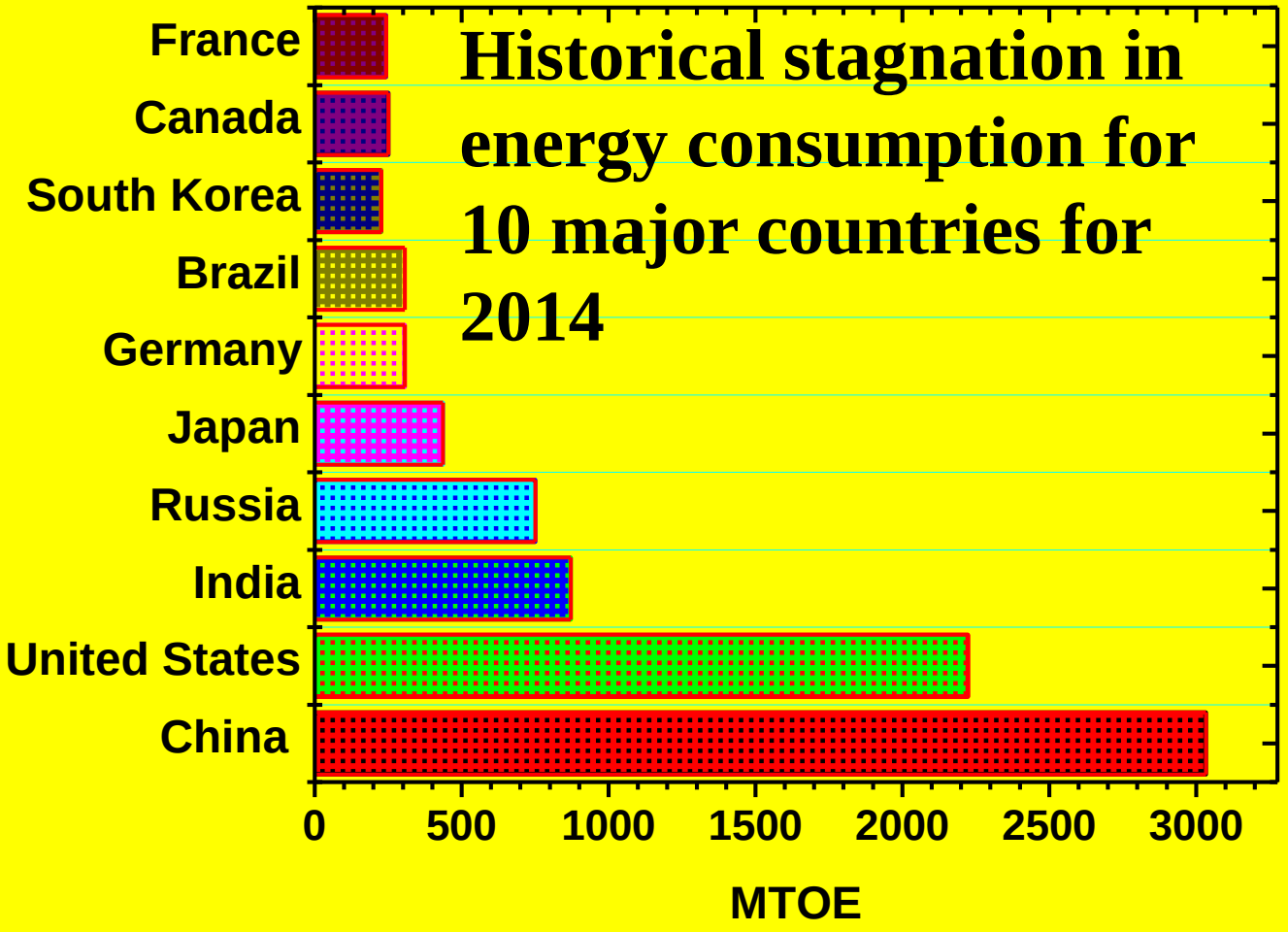
The **toe** is the amount of energy released by burning one tonne of crude oil **(1 toe = 39.68 MBtu and 1 kWh = 3412 Btu)**

Total global energy demand

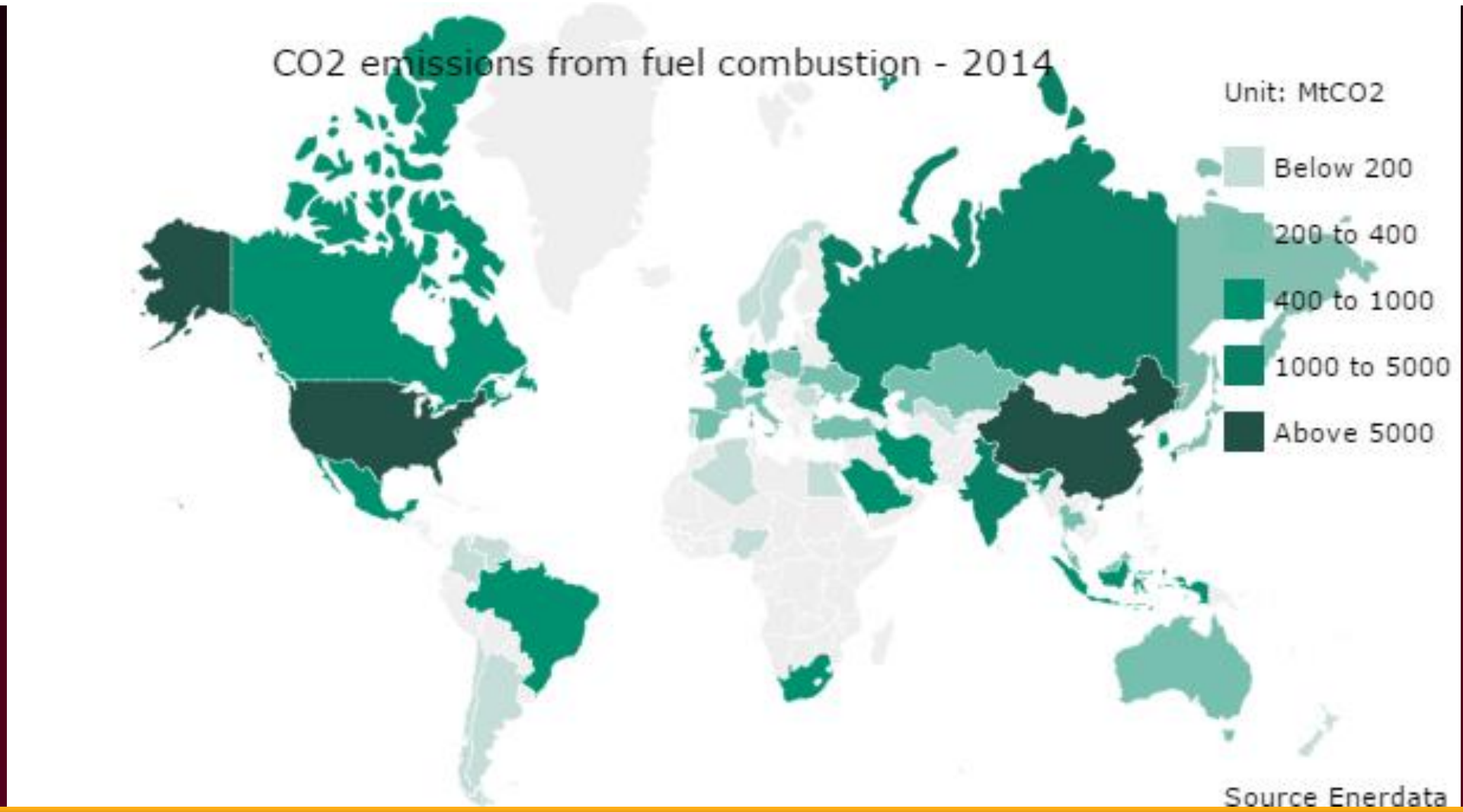


Quadrillion Btu(quad):1 quad = 10^{15} Btu and 1 kWh = 3412 Btu

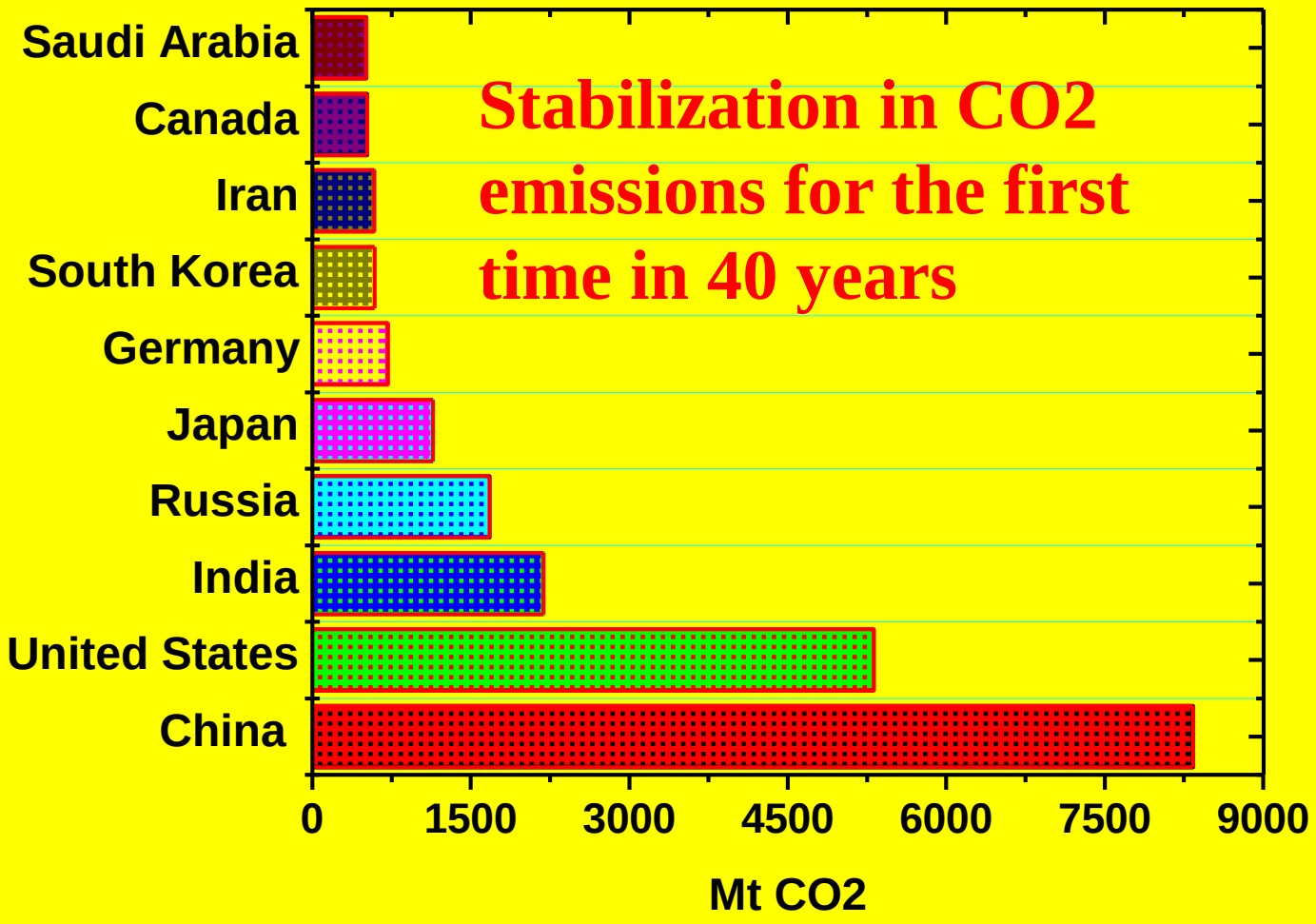
Total energy consumption



CO2 emissions from fuel combustion

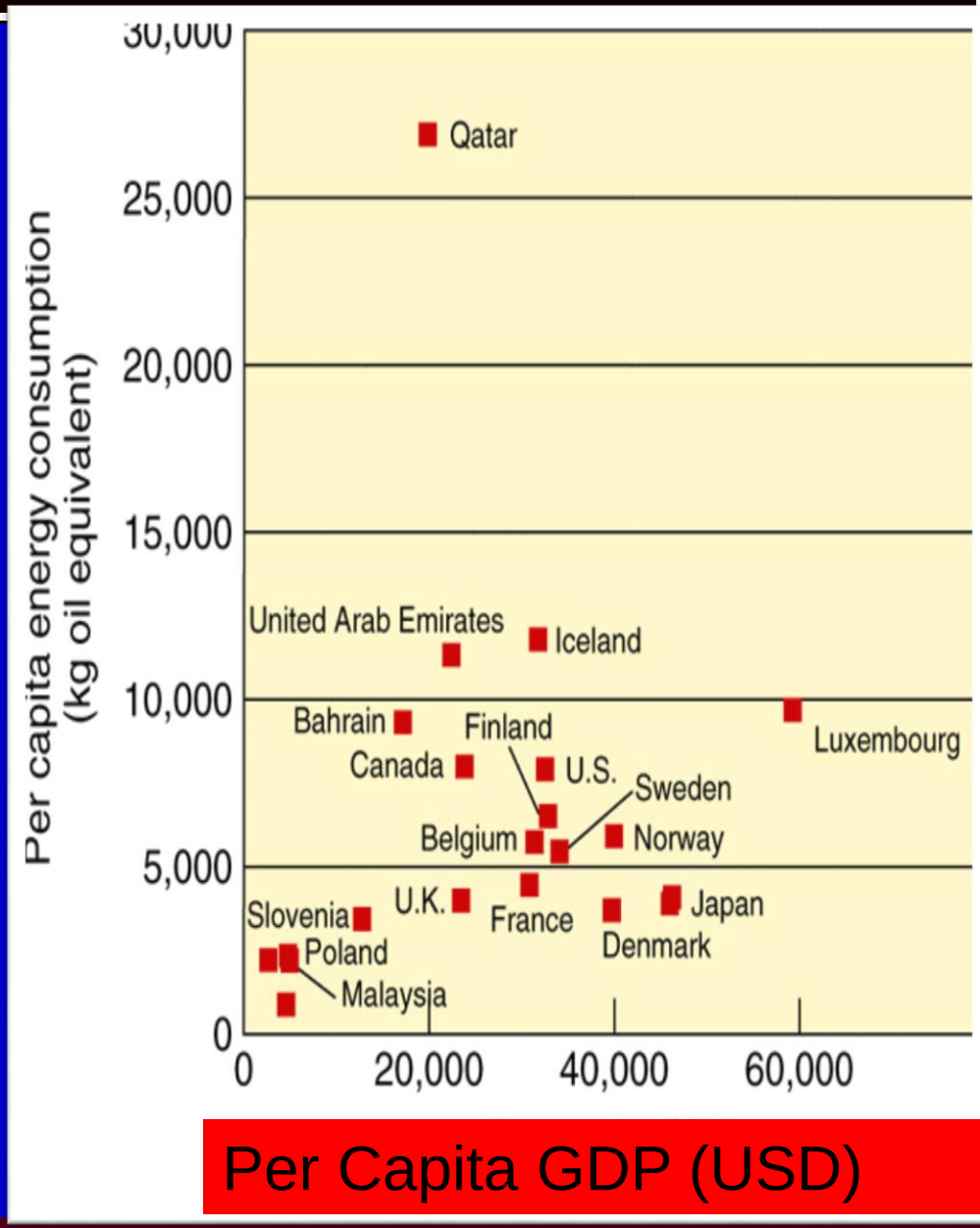


CO2 emissions from fuel combustion in 2014

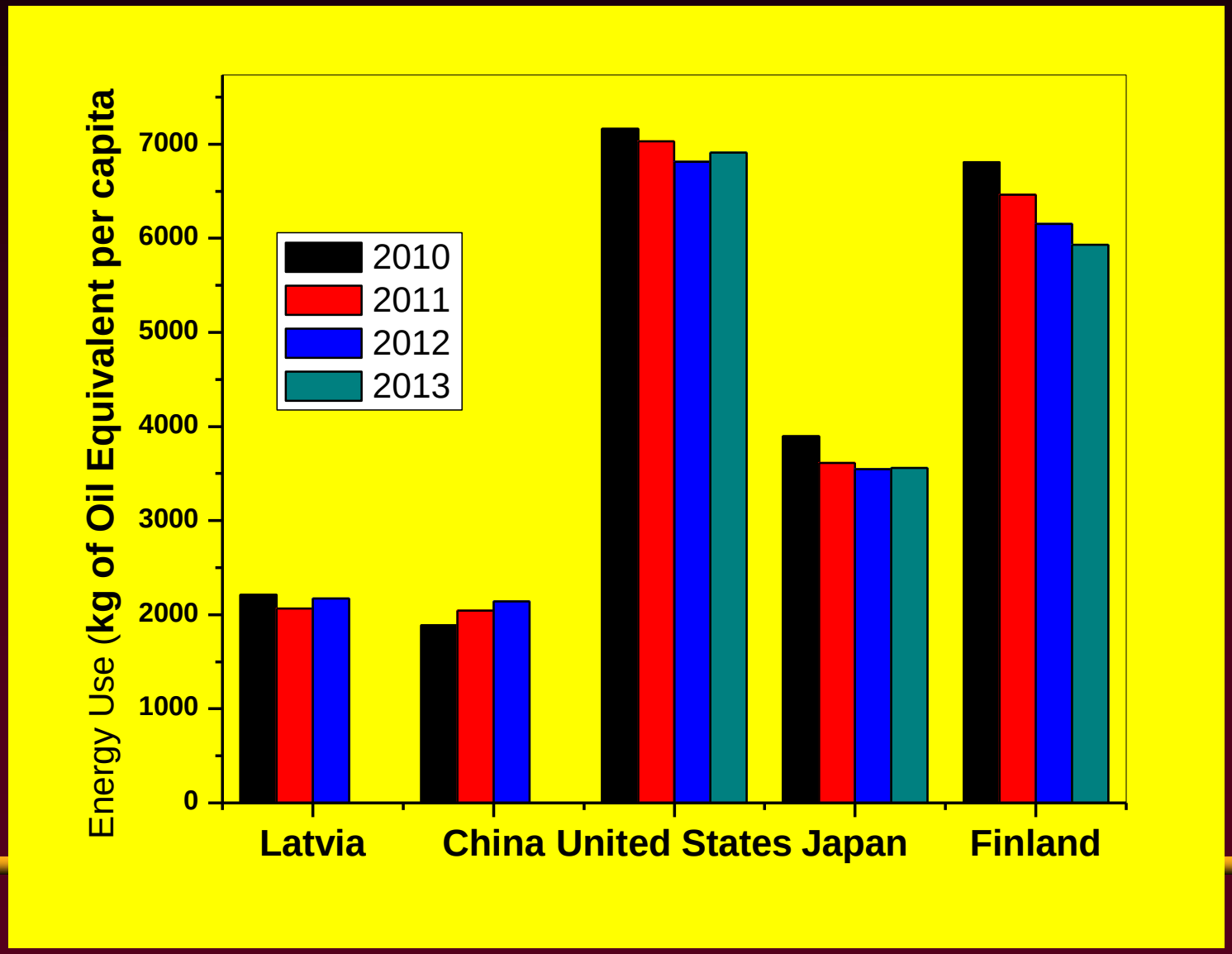


Energy Use Trends

- A general trend is for higher energy use to correlate with a higher standard of living
- In an average year, each person in the U.S. and Canada consumes more than 300 times the amount of energy consumed by a person in one of the poorest countries of the world; however,
- Several European countries have higher living standards than the U.S., yet they use about half as much energy.



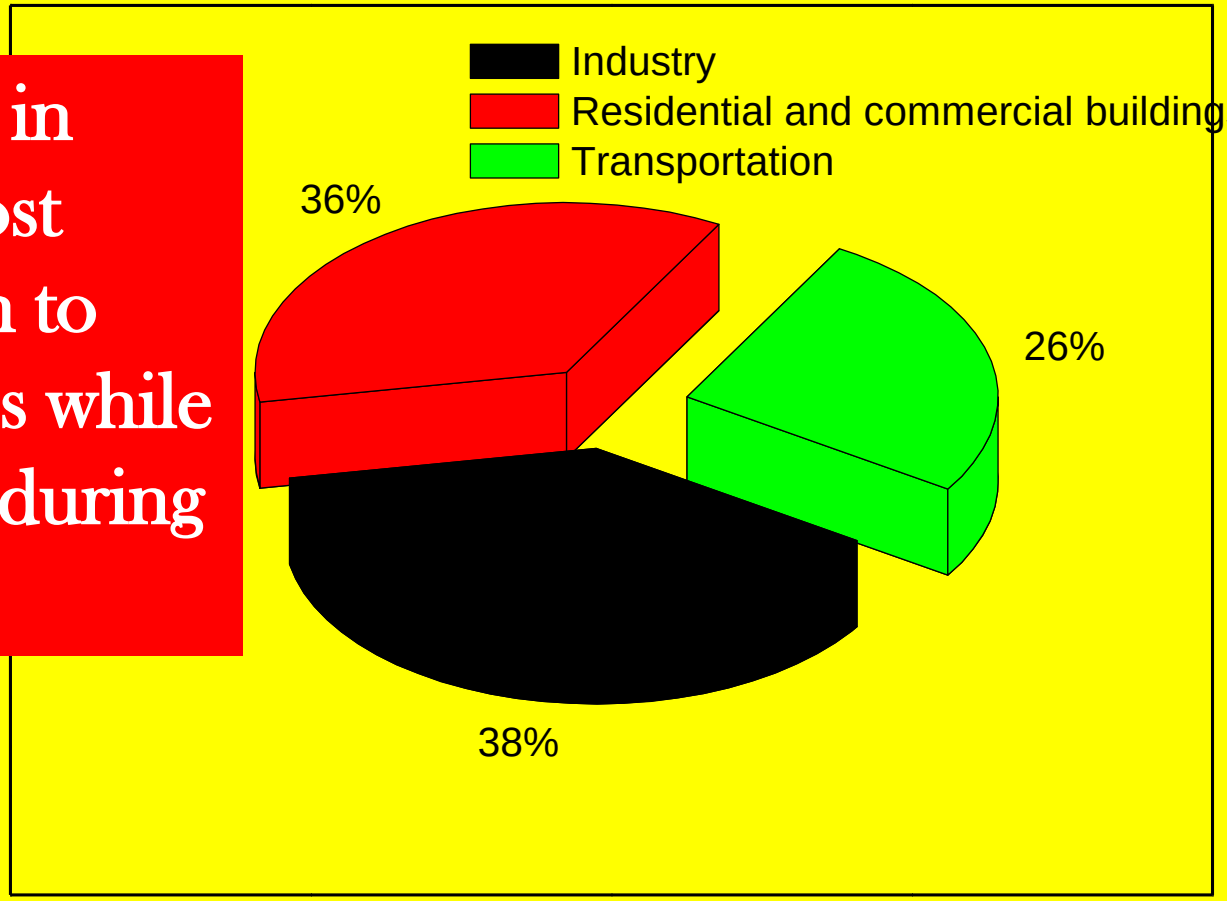
Energy Consumption in Latvia



How do we use Energy?

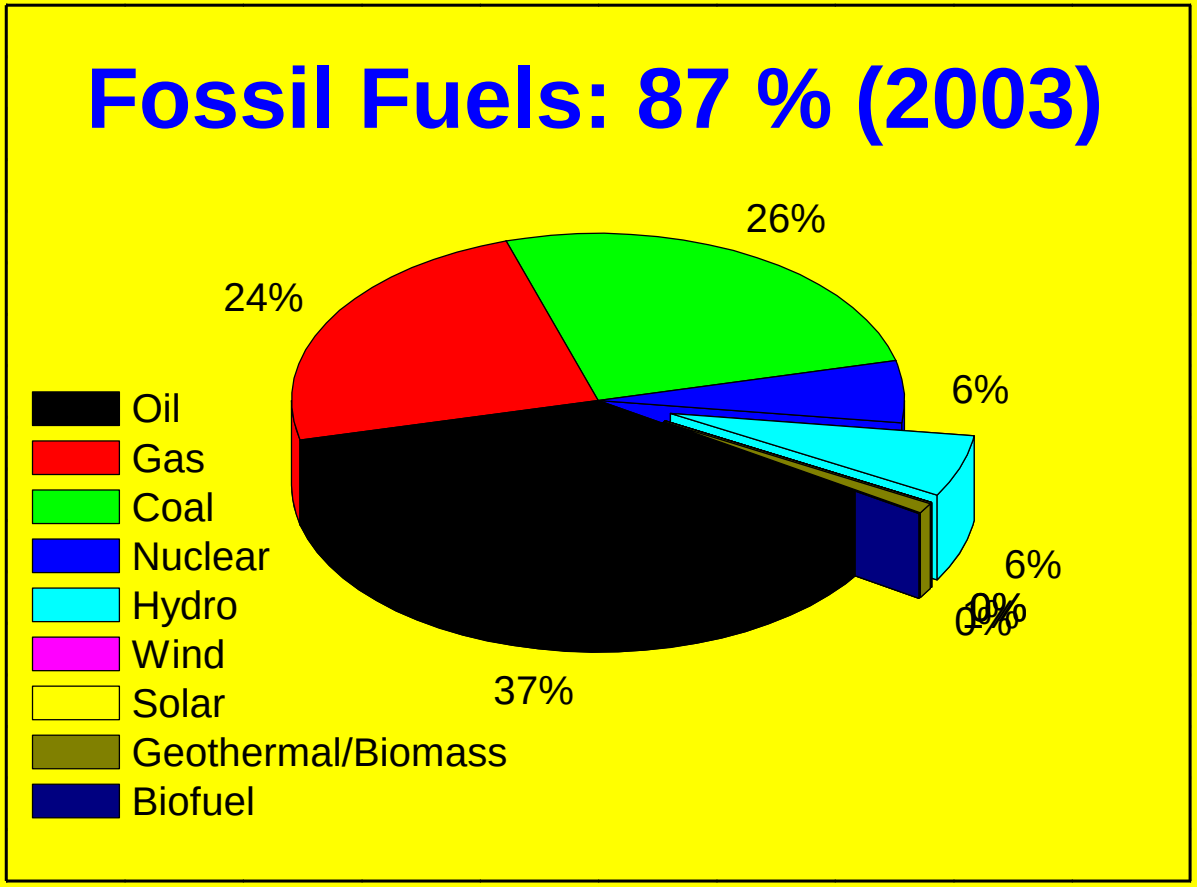
- What are the commercial uses of energy?

Half of all energy in primary fuels is lost during conversion to more useful forms while being shipped or during use.



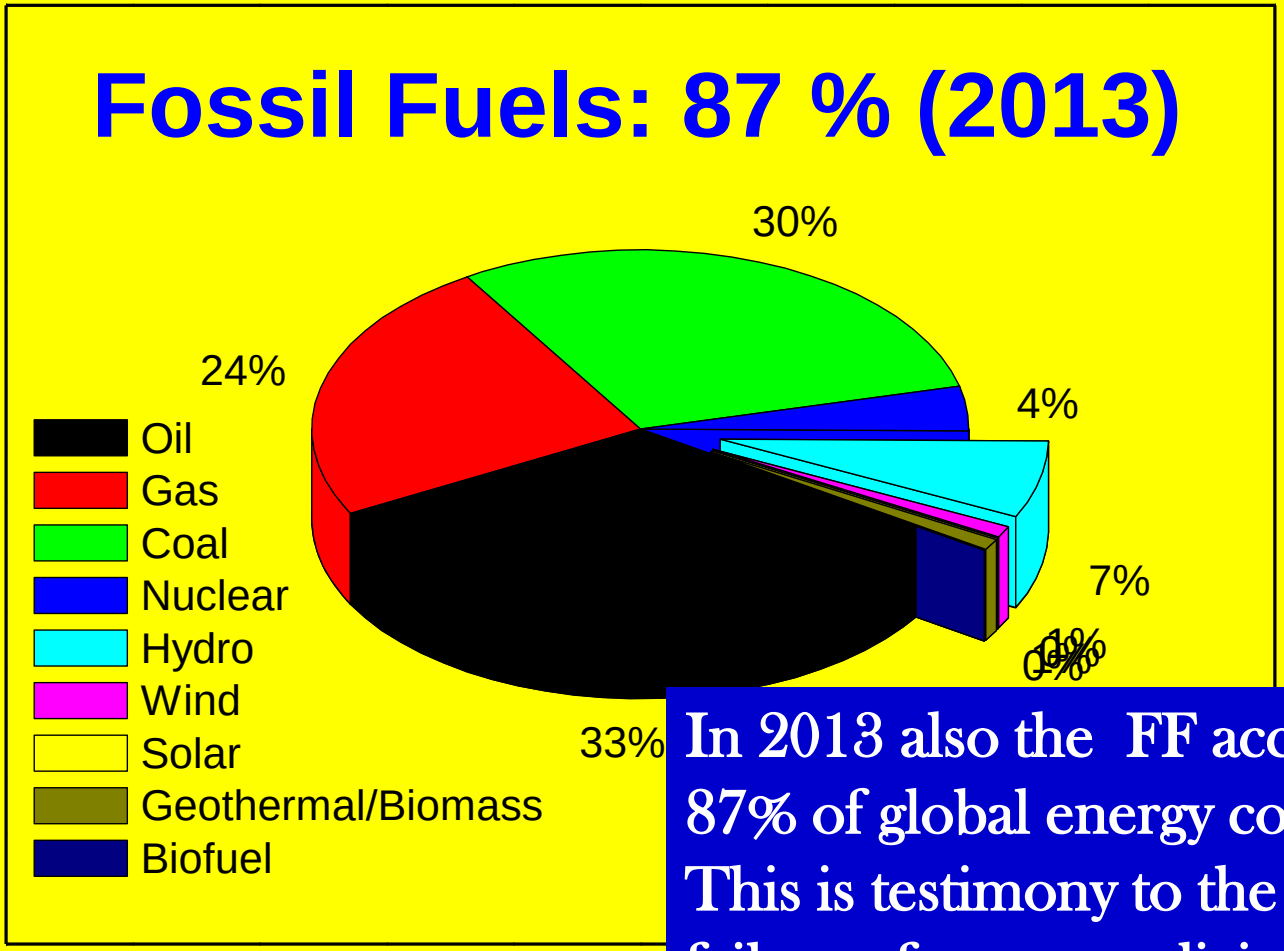
The share of global energy consumption in 2003

In 2003, FF accounted for 87% of global primary energy consumption.



The share of global energy consumption in 2013

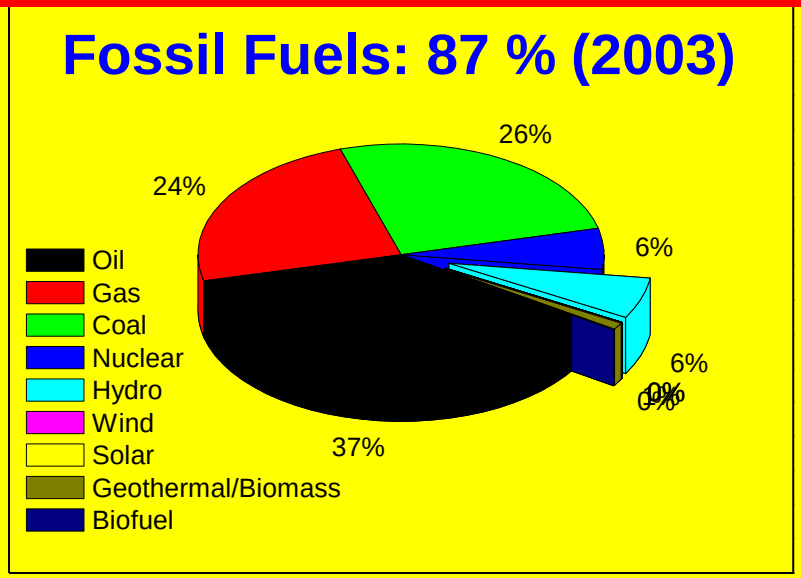
FFs dominate with nuclear/hydro making up most of the rest.

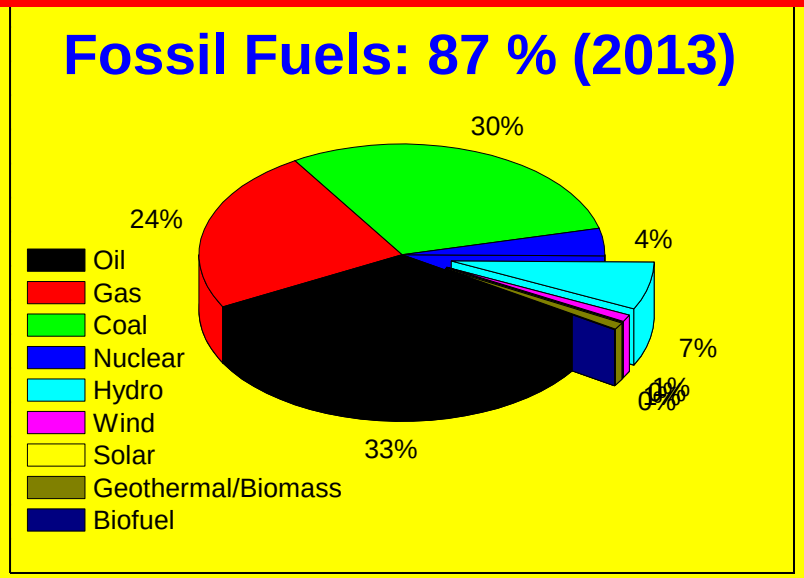


In 2013 also the FF accounted for 87% of global energy consumption. This is testimony to the absolute failure of energy policies aimed at reducing CO_2 emissions

How we changed: 2003 to 2013

In 2013 FF had 87% share the same as in 2003





- Oil has declined since 2003 from 37 to 33%.
- Coal has increased from 26 to 30%.
- In 2003 nuclear was 6% and has declined to 4% in 2013.
- New renewables are in part substituting oil (biofuel) and nuclear (geothermal, wind, solar).

Coal and Natural Gas

Coal

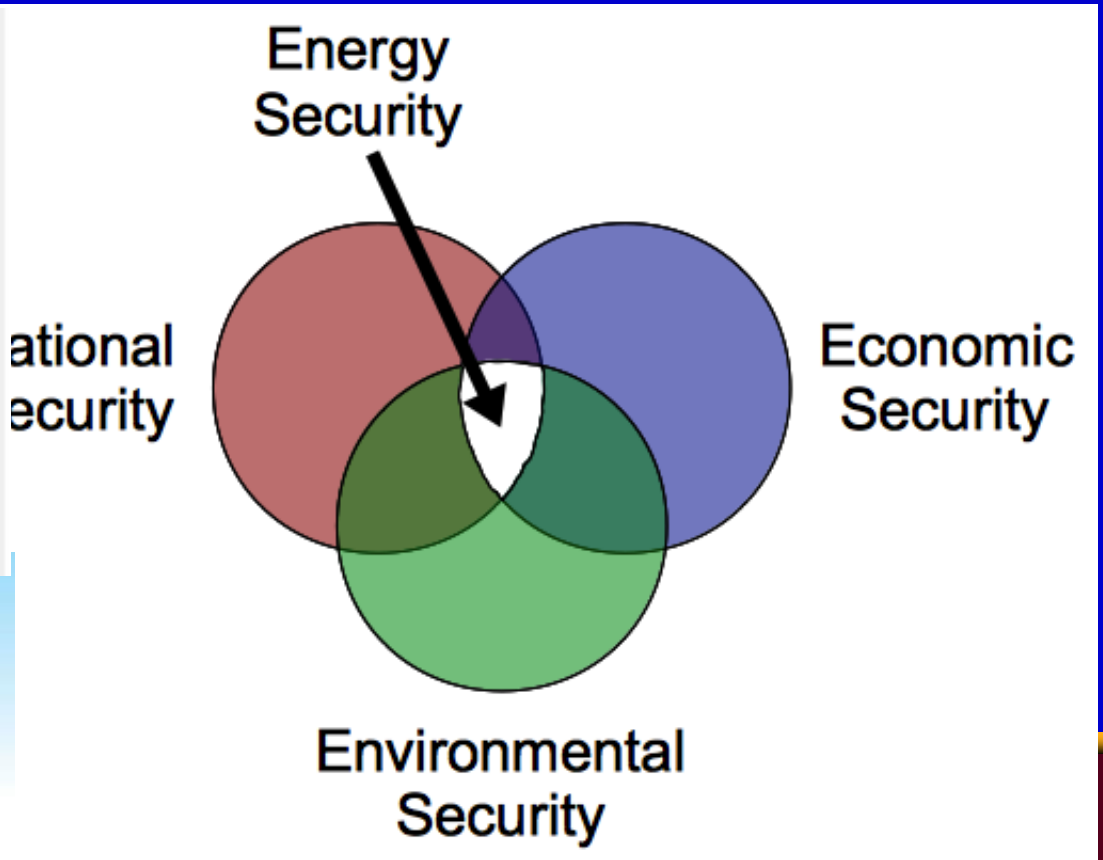
- 2/3 is lost during thermal conversion in the power plant
  - 10 % is lost during transmission and stepping down to household voltages.

Natural gas

- Only 10% of its energy content is lost during shipping and processing.
- Gas-burning furnaces are ~ 75-95 % efficient.

Energy Security

Energy is available WHEN needed at a Predictable Price

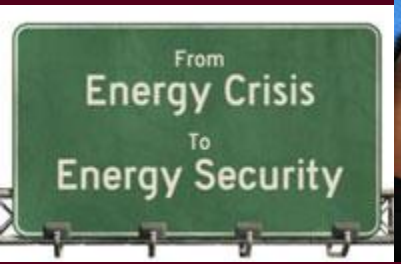


What is Energy Security?

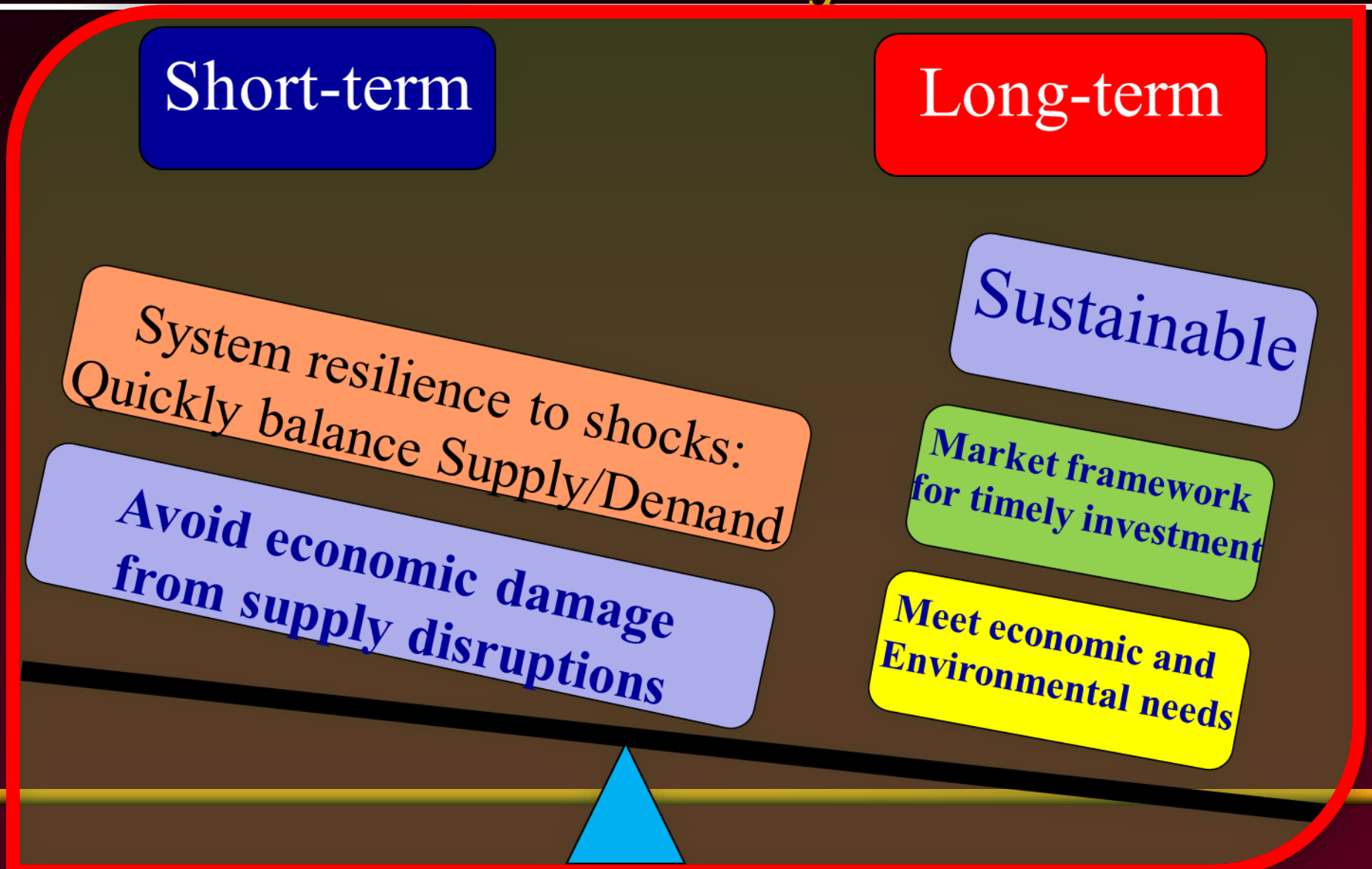
"The uninterrupted availability of energy sources at an affordable price"

Energy security has two dimensions:

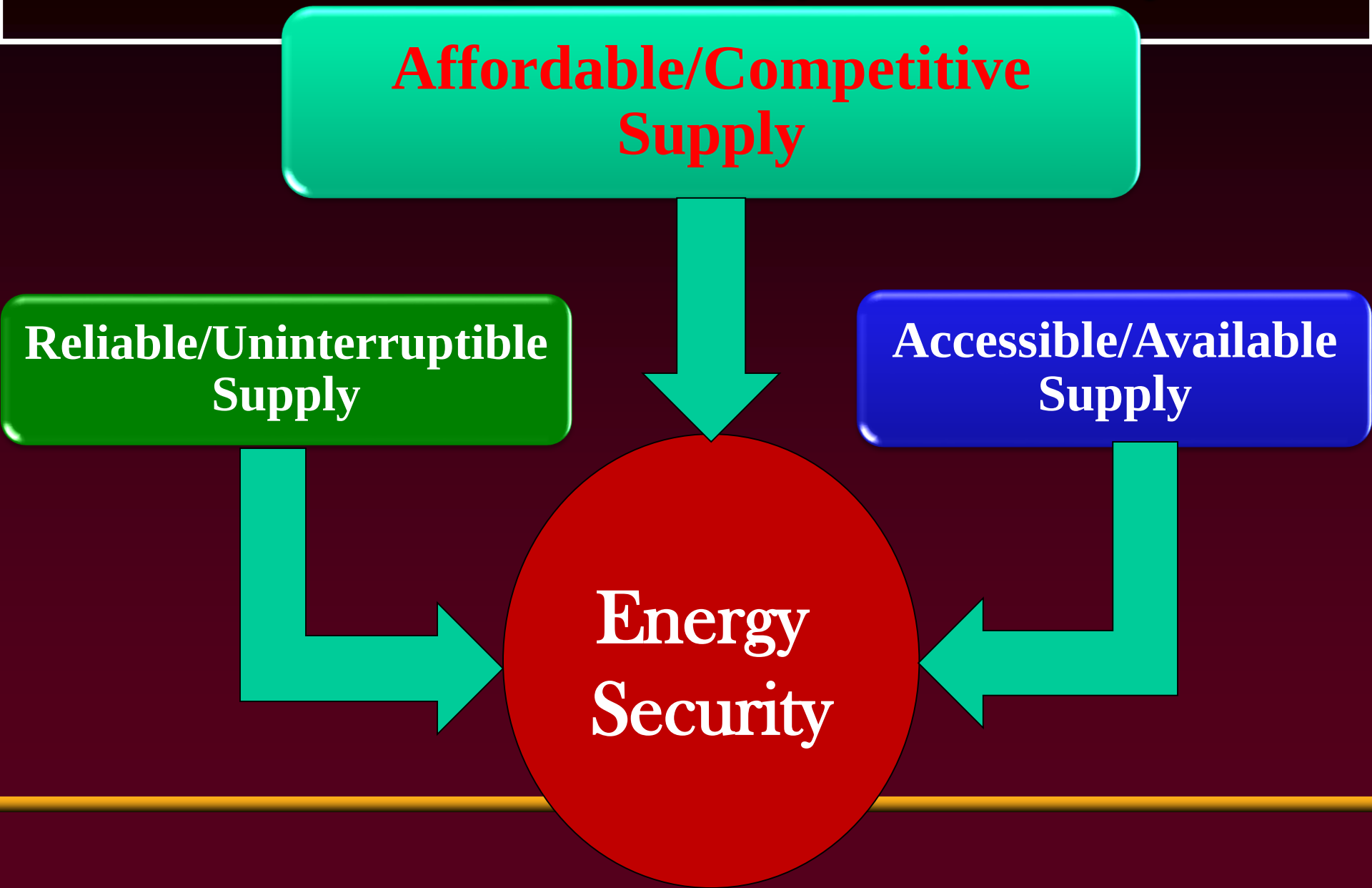
- **Short-term energy security** focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance.
- **Long-term energy security** mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs.



The Time Dimension Of Energy Security



Defining Energy Security



How to measure Energy Security?

- **Investor and consumer confidence:**
  - Time to restore service following a disruption and other reliability metrics
- **Secondary indicators:**
  - Energy trade deficit,
  - imports versus domestic production,
  - diversity of sources and delivery mechanisms, and
  - others Includes Physical and Cyber Perspectives

Energy security Indicators

- **The dependence of countries on fossil-fuel imports is one indicator of energy security. In 2013,**
- **European Union: $555 billion**
- **China : $304 billion**
- **United States $278 billion**
- **Japan $259 billion and**
- **India $135 billion.**

One of the Indicators

Energy Strategy for the Year 2030

The Energy Strategy 2030 sets the following objectives of the energy policy:

- **Competitive economy**
- **Sustainable energy**
- **Secure supply**

Energy Strategy for the Year 2030

Competitive economy

Balanced, efficient, economically, socially, and ecologically justified energy policy based on market principles ensuring further development of the economy, its competitiveness in the region and world

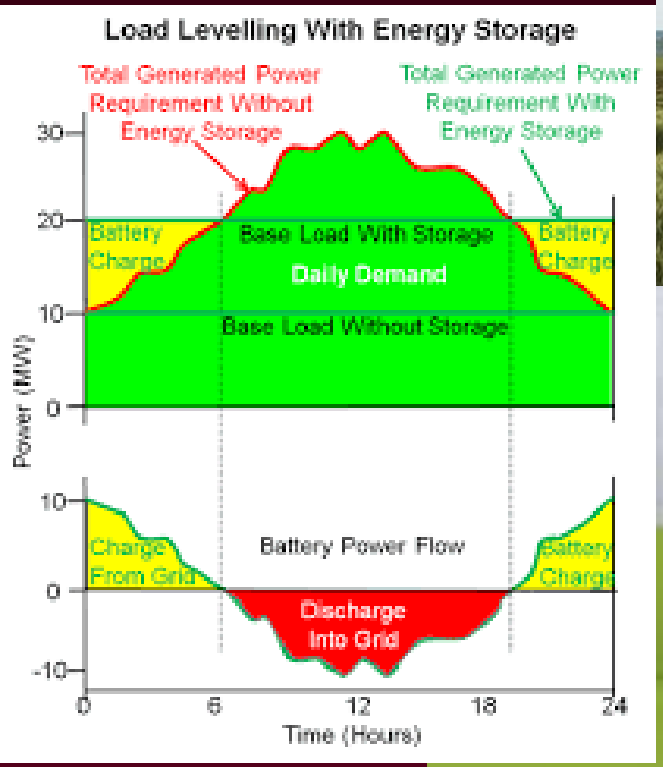
Energy Strategy for the Year 2030

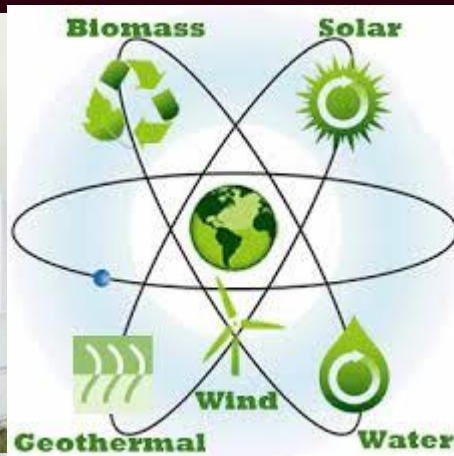
Sustainable energy – reduced dependency on imported energy resources, new and efficient technologies for the use of renewable resources are encouraged, measures to improve energy efficiency are implemented

Energy Strategy for the Year 2030

Secure supply

Stable energy supply and developed infrastructure provided to energy users





European Council adopts Energy and Climate policy package for 2030

Heads of state agreed a

- **binding carbon reduction** target of at least **40%**, -
- **renewables target of 27%** binding at EU level only, and
- **27% non-binding EU-wide energy efficiency** target.

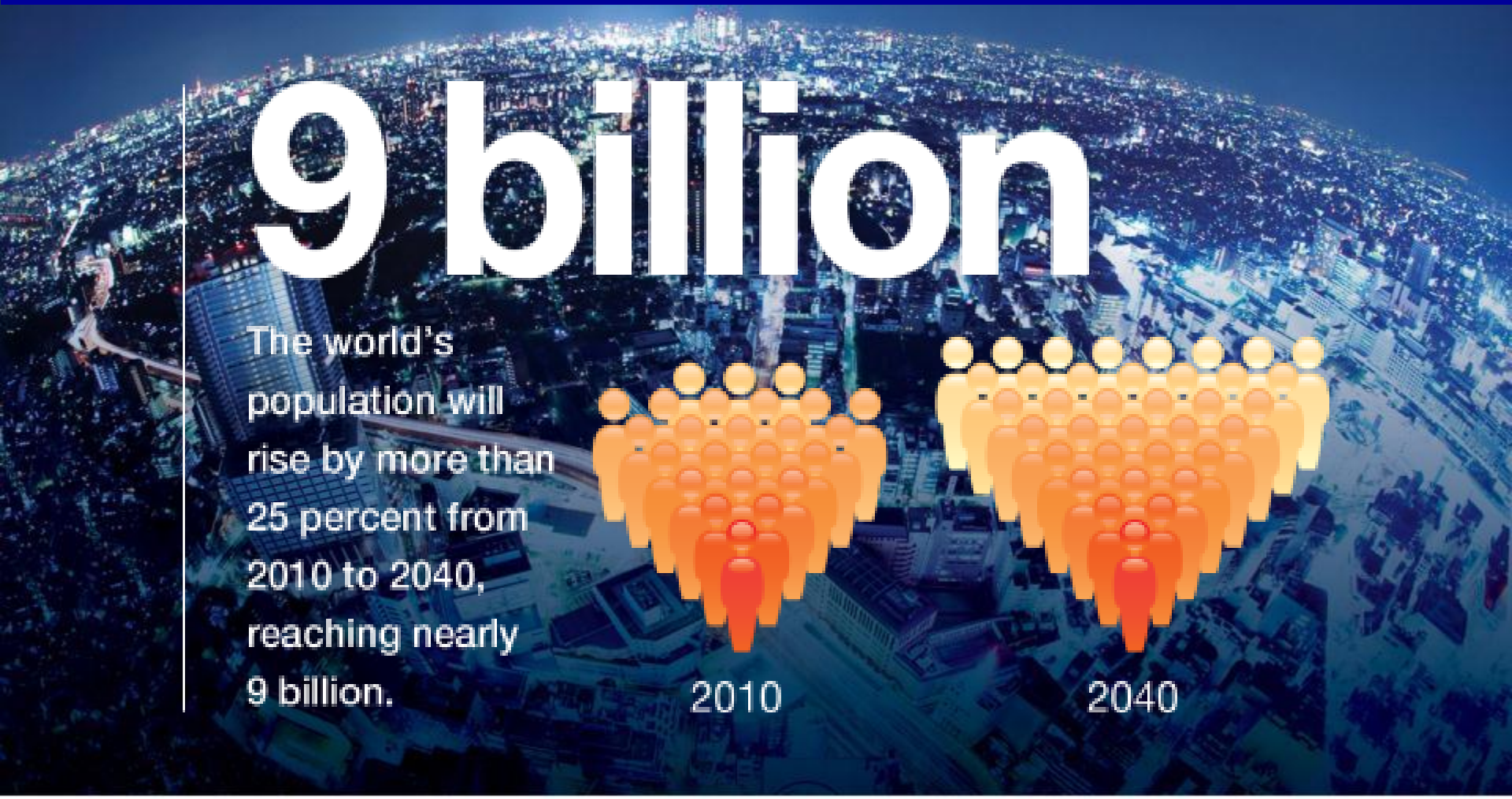
European Energy Security Strategy

In response to the political crisis in Ukraine and the overall importance of a stable and abundant supply of energy for the EU's citizens and economy (28 May 2014) the European Commission released an EU energy security *strategy*.

This strategy proposes the following short-term measures:

- **Increasing gas stocks**
- **Developing emergency infrastructure such as reverse flows**
- **Reducing short-term energy demand**
- **Switching to alternative fuels**

Global Fundamentals

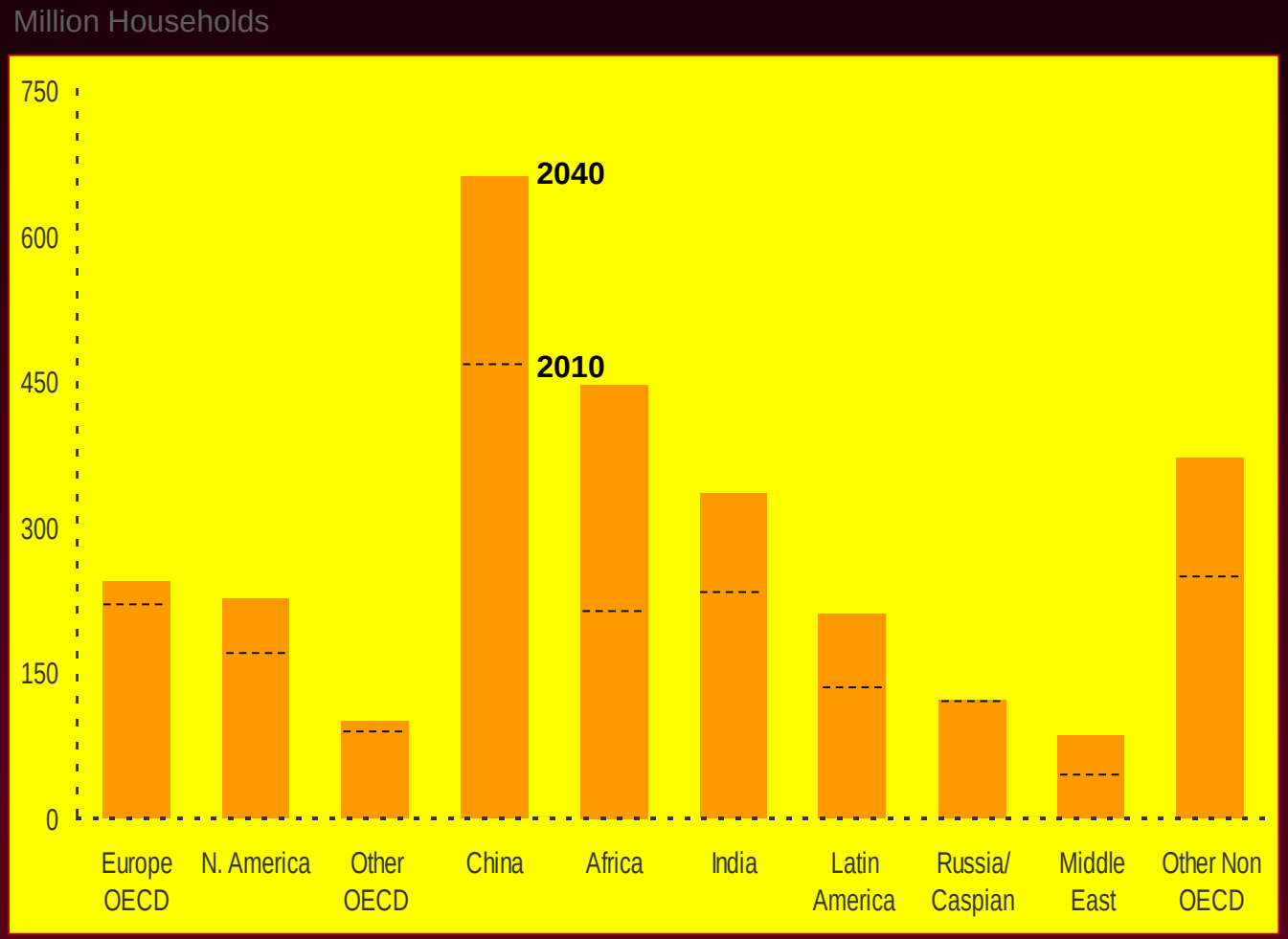


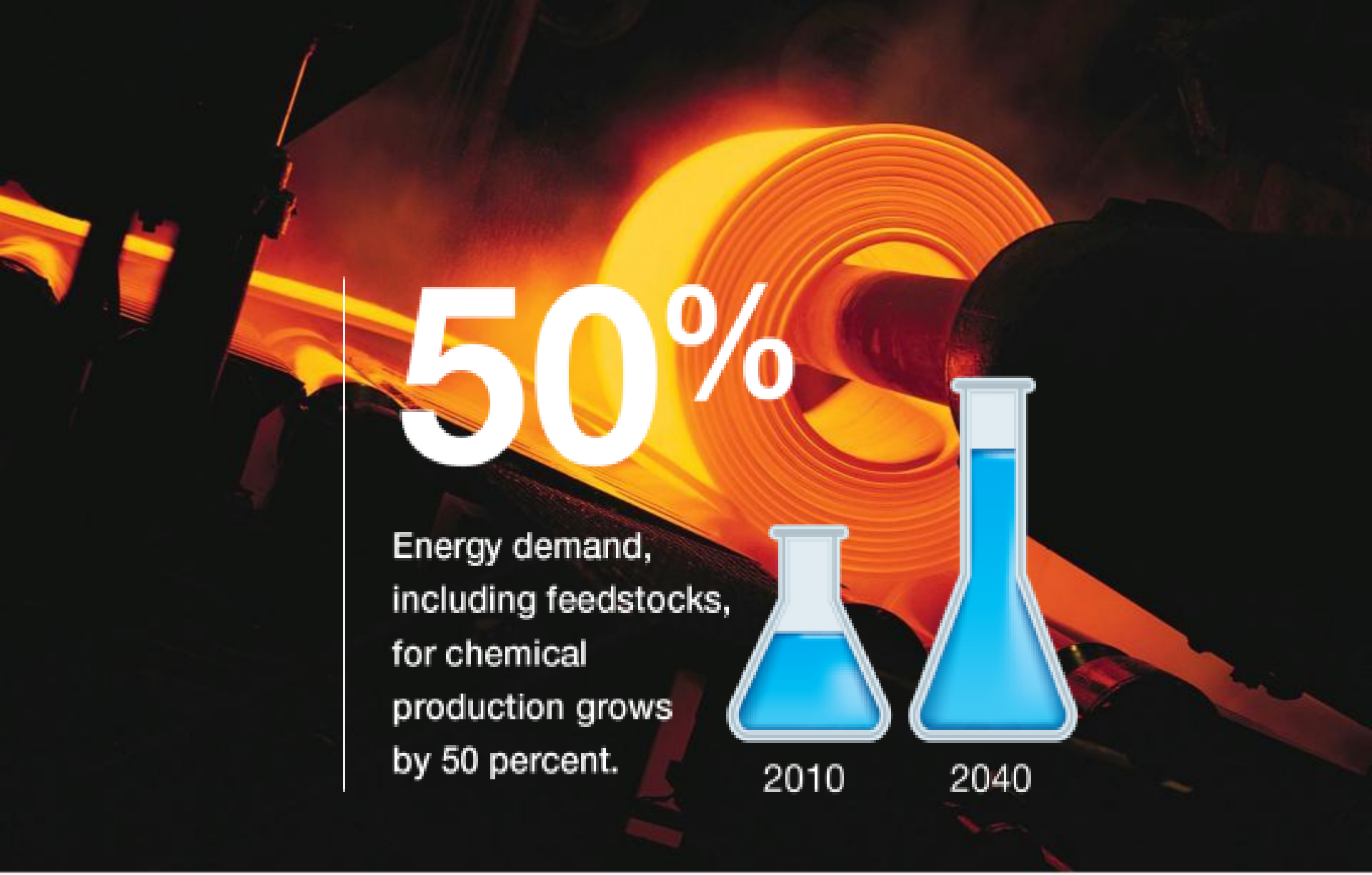
Residential/commercial

60%

As the world transitions to cleaner fuels, electricity and natural gas will account for more than 60 percent of the world's residential/commercial energy demand by 2040.

Household Growth Drives Residential Demand




50%
Energy demand, including feedstocks, for chemical production grows by 50 percent.
2010
2040

Industrial

Electricity generation

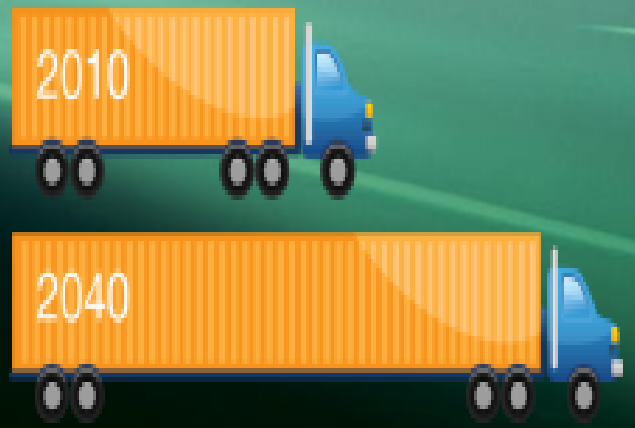
85%

Global electricity demand will grow by 85 percent over the *Outlook* period.

Transportation

65%

Heavy duty transportation demand grows 65 percent by 2040.



Supply

60%

Oil and gas will supply about 60 percent of global energy demand in 2040, up from 55 percent in 2010.

Geopolitics

There are a number of sources of tension, both present and future, related to energy security and the threat of insecurity:

Scenario	Explanation	Consequences
Oil hits $100	•Sustained oil price of over $100 per barrel, for several years.	•Prolonged economic recession and rising fuel poverty in OECD countries
Middle East meltdown	•Tensions in the Gulf escalate into war between Muslim factions; possibly involving Iran, Iraq, Israel, Syria, Turkey and others.	•Interruption of oil and gas flows; rising prices; tension between China and USA to secure oil supply
The nuclear option	•Wholesale shifting towards nuclear to replace fossil fuels, leads to global spread of nuclear power and technology	•Power stations become 'soft targets' for terrorism; enriched uranium and depleted plutonium get into the wrong hands….
Energy superpowers	•The Gulf States hold 60%+ of oil reserves and Russia/Qatar/ Iran 60%+ of gas; the world has not shifted to renewables.	•Energy superpowers begin to 'name their price' and take care of their friends; major geopolitical shifts
Arctic attack	•Canada, Russia, USA and EU begin to exploit the Arctic for oil and gas, but without clear delineation of territorial areas.	•A war or words over who has the right to exploit what, quickly becomes a new cold war – possibly a hot one……

34 countries in Organization for Economic Co-operation & Development

Future challenges

There are some that are obvious:

- Reduce dependency on fossil fuels to increase energy security
- Increase renewable energy use as fossil fuels become more expensive/peak
- Reduce greenhouse gas emissions
- Increase access to energy in developing nations

Mix it up

•Wind, solar and others can be used to diversify energy sources.

•This would increase security, but could also reduce greenhouse emissions.

Technology for all

•Aid could be used to help developing nations grow their renewable sectors

•Intermediate technology is key to this.

•They need energy, but without greenhouse emissions.

Tax it down

•Green taxes i.e. taxing fossil fuel use, could encourage efficiency

•Greenhouse emissions would fall as efficiency rises

•The dirtiest fuels could be taxed the most.

Self generation

•Homes can generate renewable energy using ground source heat pumps, micro-wind and solar PV / thermal

•This would diversify the energy mix, reduce emissions and increase self-reliance.

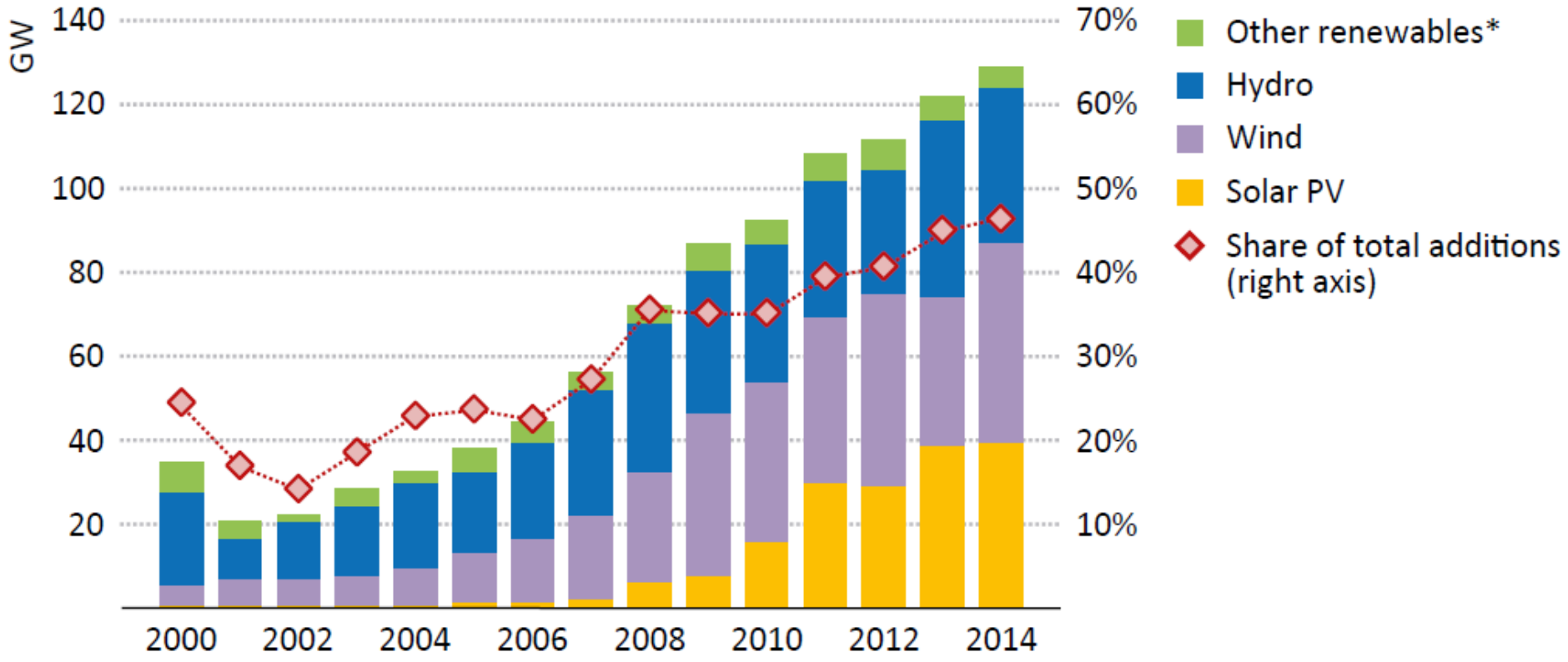
Energy Supply, Demand & Security

Wide range of energy resources, with different security of supply and environmental issues

Non-renewable	Renewable	Recyclable
• A finite stock of resources, which will run out	• A flow of resources, which is infinite in human terms	• Can be used repeatedly, if managed carefully
• Coal, oil, gas (plus oil shale, tar sands, lignite etc.)	• Wind, solar, hydroelectric, wave, tidal, geothermal	• Biomass, nuclear (with reprocessing of fuel)
• Significant environmental impacts during extraction (oil wells, opencast mines) • Greenhouse gas emissions during use, and acidic emissions	• May require large areas (solar arrays, wind farms) for operation. • Limited / no greenhouse emissions.	• Large land area needed for biomass. • Largely unresolved issues of storing high level radioactive waste.

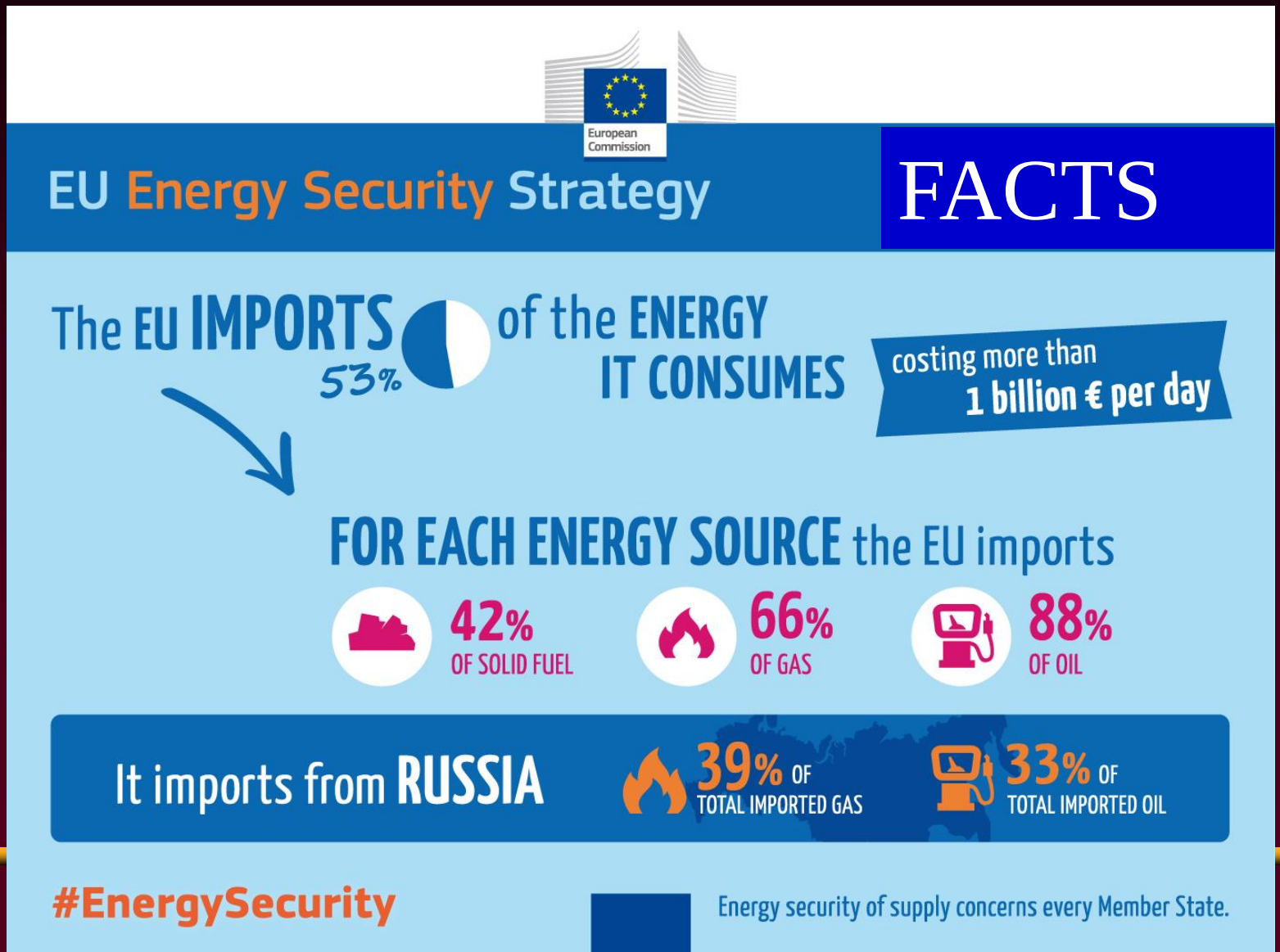
Global Renewables: Capacity additions and types

- 37 % is Wind Power
- One third is Solar PV

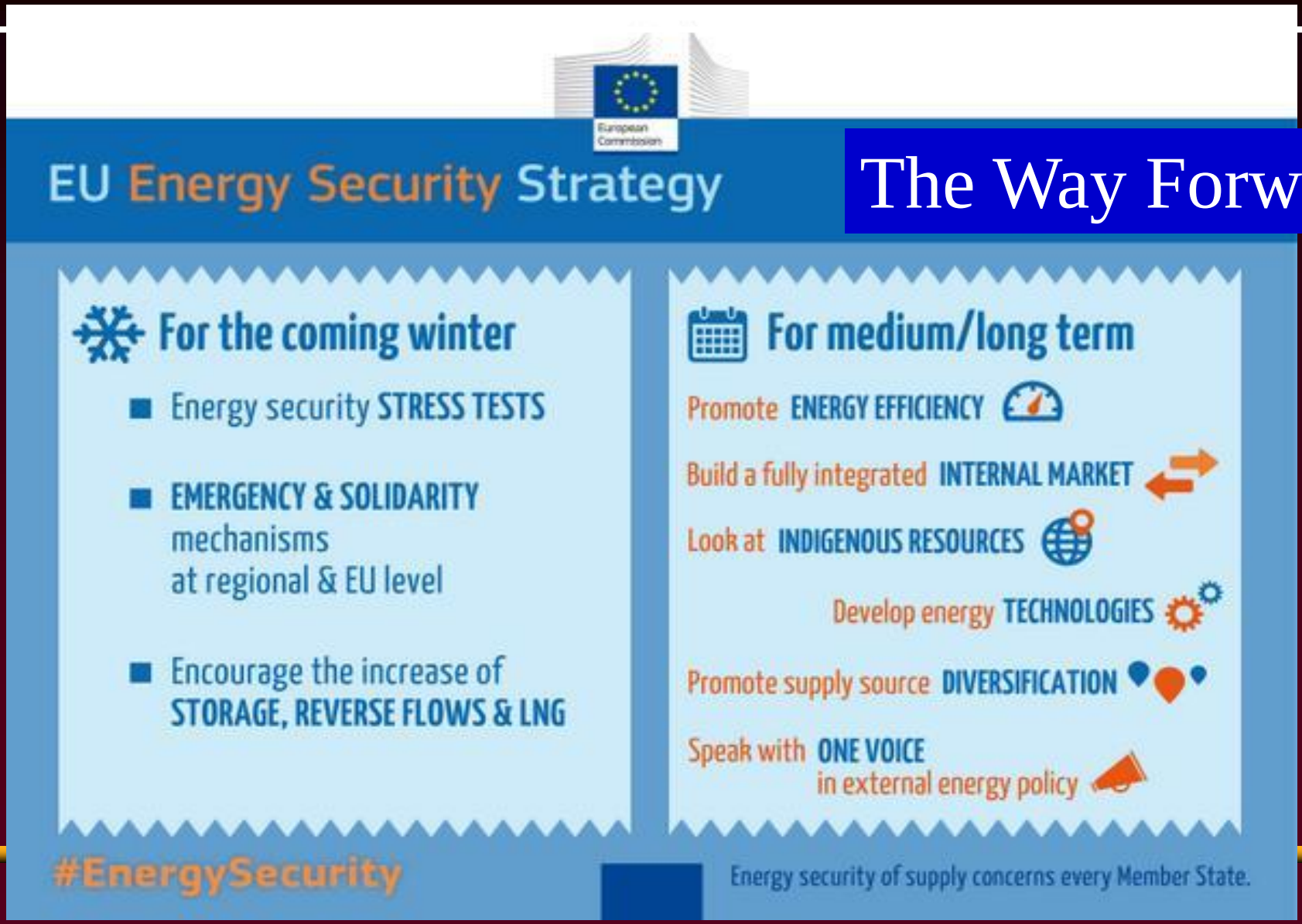


* Includes geothermal, marine, bioenergy and concentrating solar power.

EU Energy Security Strategy



EU Energy Security Strategy

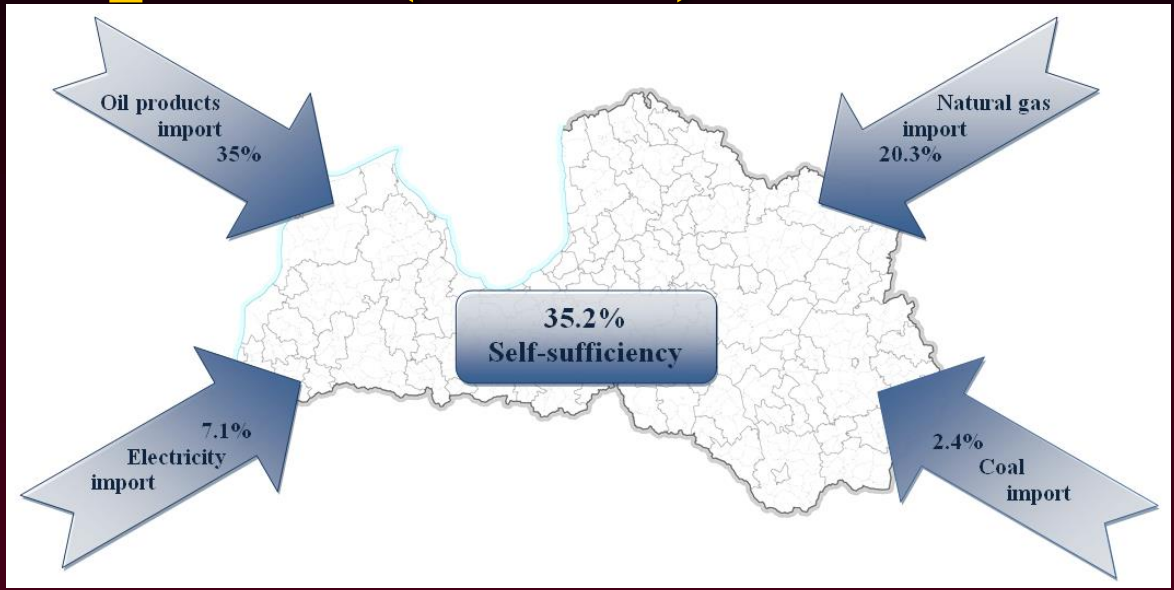


Looking at Latvia (Parliamentary Republic)

- EU Member: since 2004
- Population – 2011: 2,067,887
- Urban: 66 %. Rural: 32%
- Territory 64,589 km2, with over 44 percent territory covered by forests
- GDP - $ 34.921 billion
- per capita - $13,662

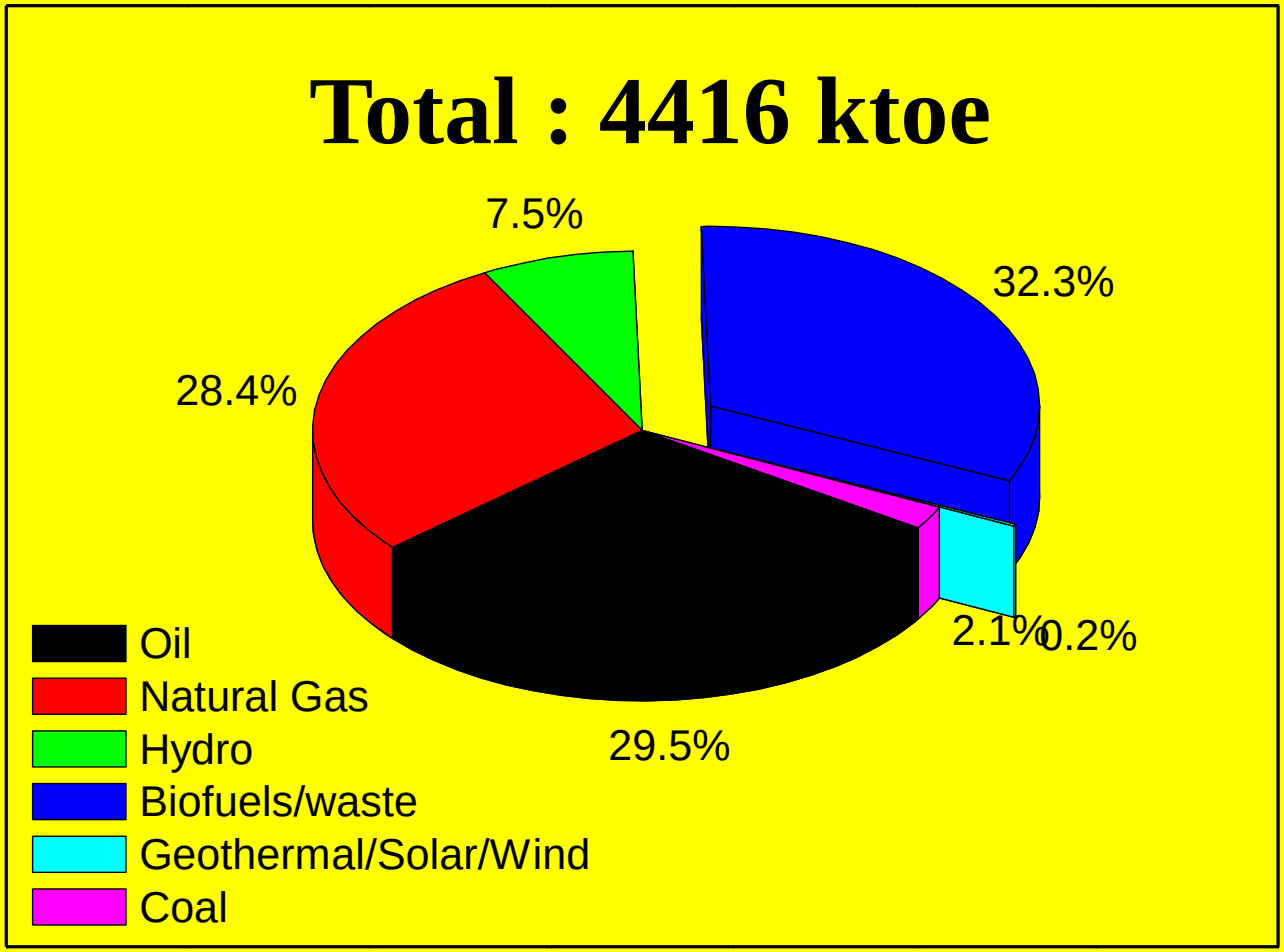
Latvian Energy Self Sufficiency and Import (2012)

- Not rich in the natural energy resources – 65 % is imported.
- Dependence on the external energy sources is ever increasing.
- Most used Renewable Energy Sources are wood and hydro resources; besides, the wind energy and energy from waste.

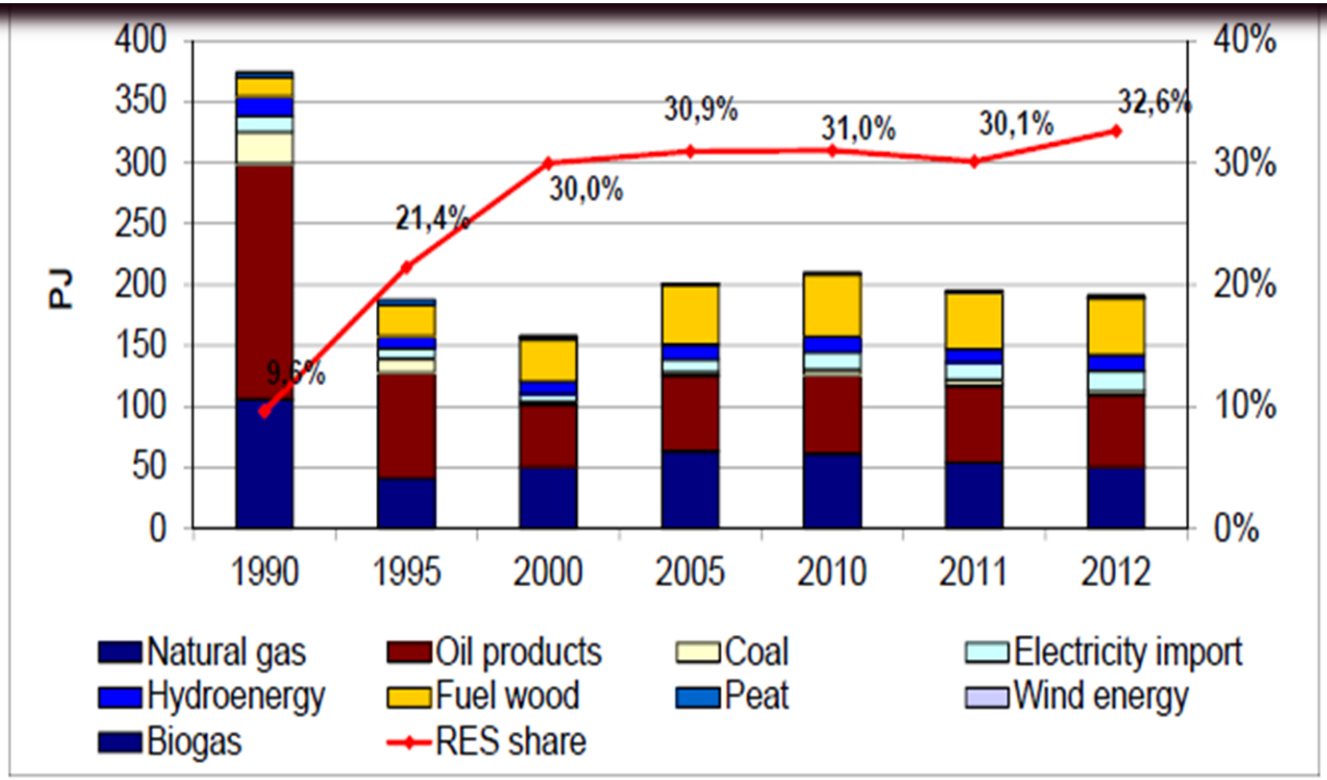


Total primary energy sources: 183 PJ
Self Security : 35 %
Firewood (25 %), Hydro/Wind (8%

Latvia's Total Primary Energy Supply in 2012



Dynamic of Primary Energy Resources Supply and Share of Renewables



The RES share in the consumption of primary resources increased from 9,6% in 1990 up 32,6% in 2012. This happened owing to the wide utilization of wood fuel. The production of electricity from RES in 2012 was 55.03 % of the total its production.

Energy Legislation in Latvia

Electricity Market Law reinforces RES promotion and their access to the grid on fair conditions.

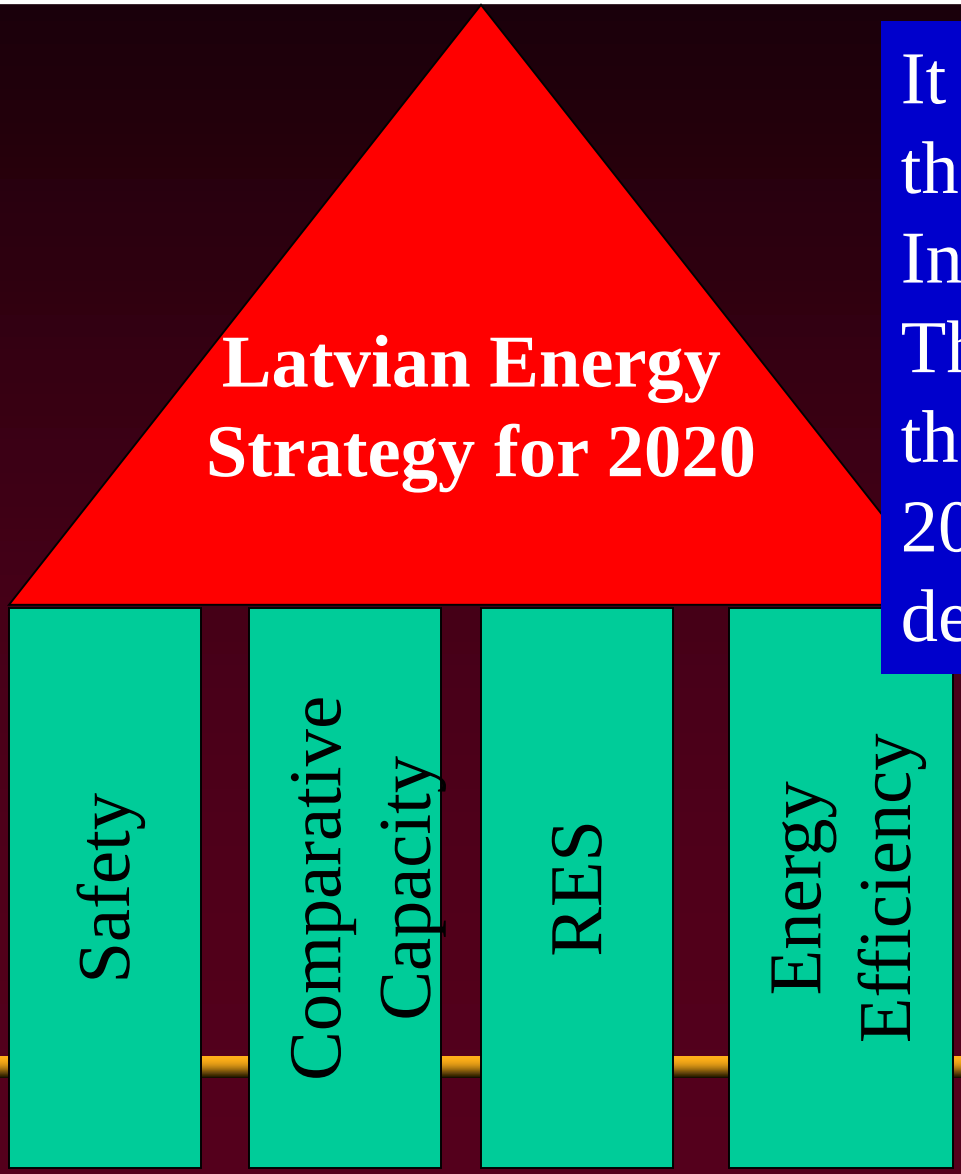
- Renewable Energy Law was accepted (15.02.2011) by the Cabinet of Ministers, but not approved yet by the Parliament.
- In Latvian National Renewable Energy Action Plan Share of RES in Gross Final Energy Consumption by year 2020:

 2010 – RES total in Energy mix 29,9%;

 2020 - 40%.

 2010 - RES electricity in the electricity mix 48,5%.

Latvian Energy Strategy for 2020



It is vital importance to increase the Latvian Energy Independence.
Therefore, it is Obligatory that the state Energy Strategy for 2020 includes the RES development

2020 - **RES – 60 %**

- **Hydro – 58,8 %**
- **Solar (2 MW) - 0,1 %**
- **Wind - 17,5%**
- **Biomass – 23,6 %.**

Latvia and Lithuania commit to strengthen regional energy security

Adding security to the Latvian energy mix:**LATVENERGO CHP**

- **Security of supply is a concern for Latvia which is heavily dependent on imported energy to fuel the country's rapid economic development.**
- **One way of offsetting this is to ensure that existing energy sources operate at optimal efficiency levels.**

The project has increased the plant's capacity to protect Latvia from a possible electricity supply shortfall, reduced the dependence on imported energy and improved the country's security of supply and energy mix.

The second CHP unit at the TEC-2 power site in Riga.

Conclusion

- **Energy Security is impossible without RES**
- **Energy Policy and Roadmaps needs to be developed and adopted by all the countries**

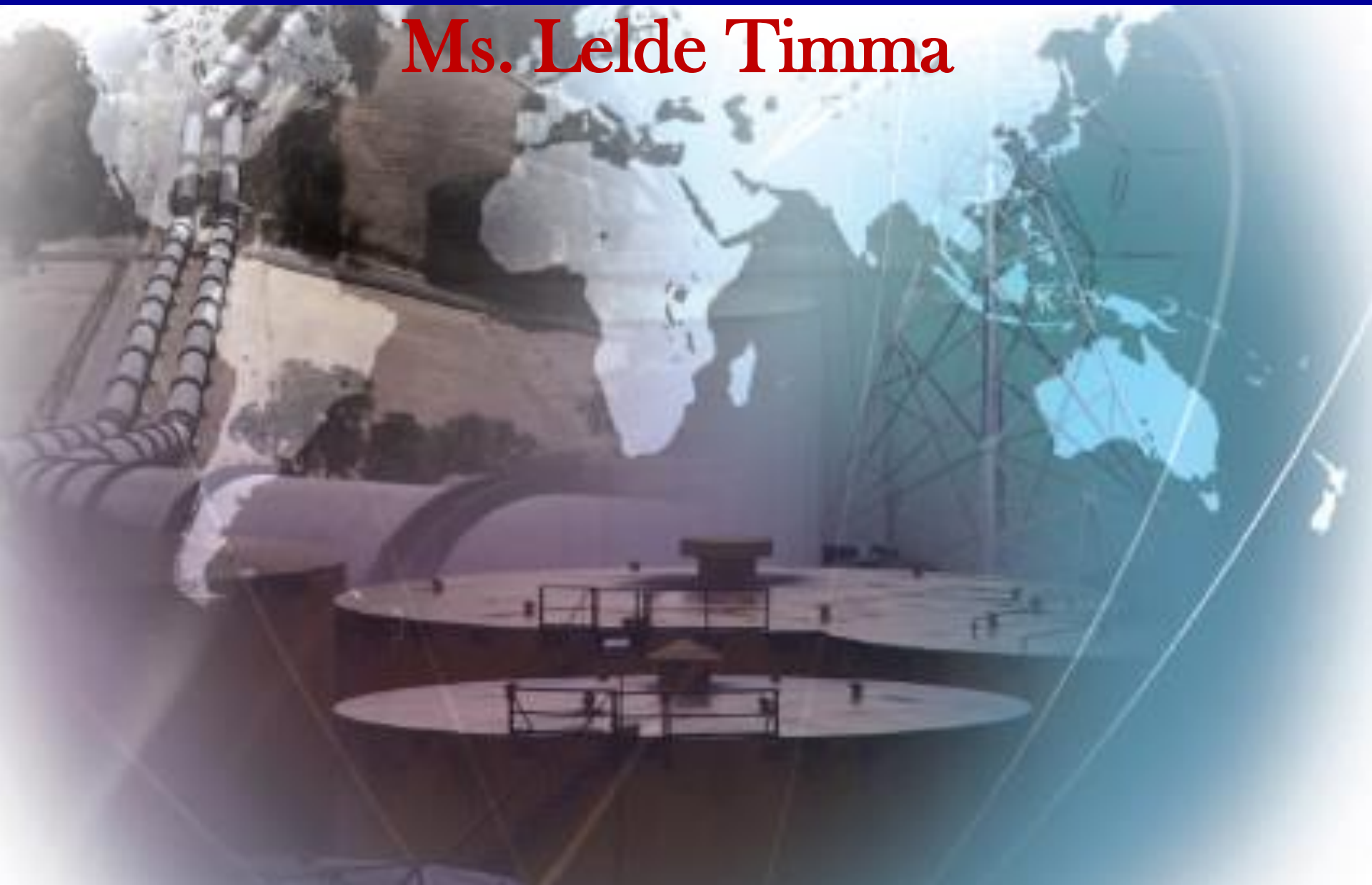
What is done in ASU?

Milestones as of August 1, 2015:

Total Solar Generation Capacity: 24.1 MW equivalent (PV: 22.5 MW; Solar thermal: 1.6 MW equivalent)

Total energy from Solar FY 2015: 40,412,653kWh

Acknowledgement



Ms. Lelde Timma

Developing countries

Developed Countries

Our energy-dependence (1)

Our energy-dependence (2)