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Environmentalists rethinking Nuclear Energy
Bruno Comby
Brussels, 3 february 2015



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The old and new vision of ecology

Considering the environmental benefits of nuclear energy





The life of an environmentalist

- **Childhood in nature**
- **Director of the Comby institute (IBC)**
- **President of EFN (Environmentalists For Nuclear Energy)**

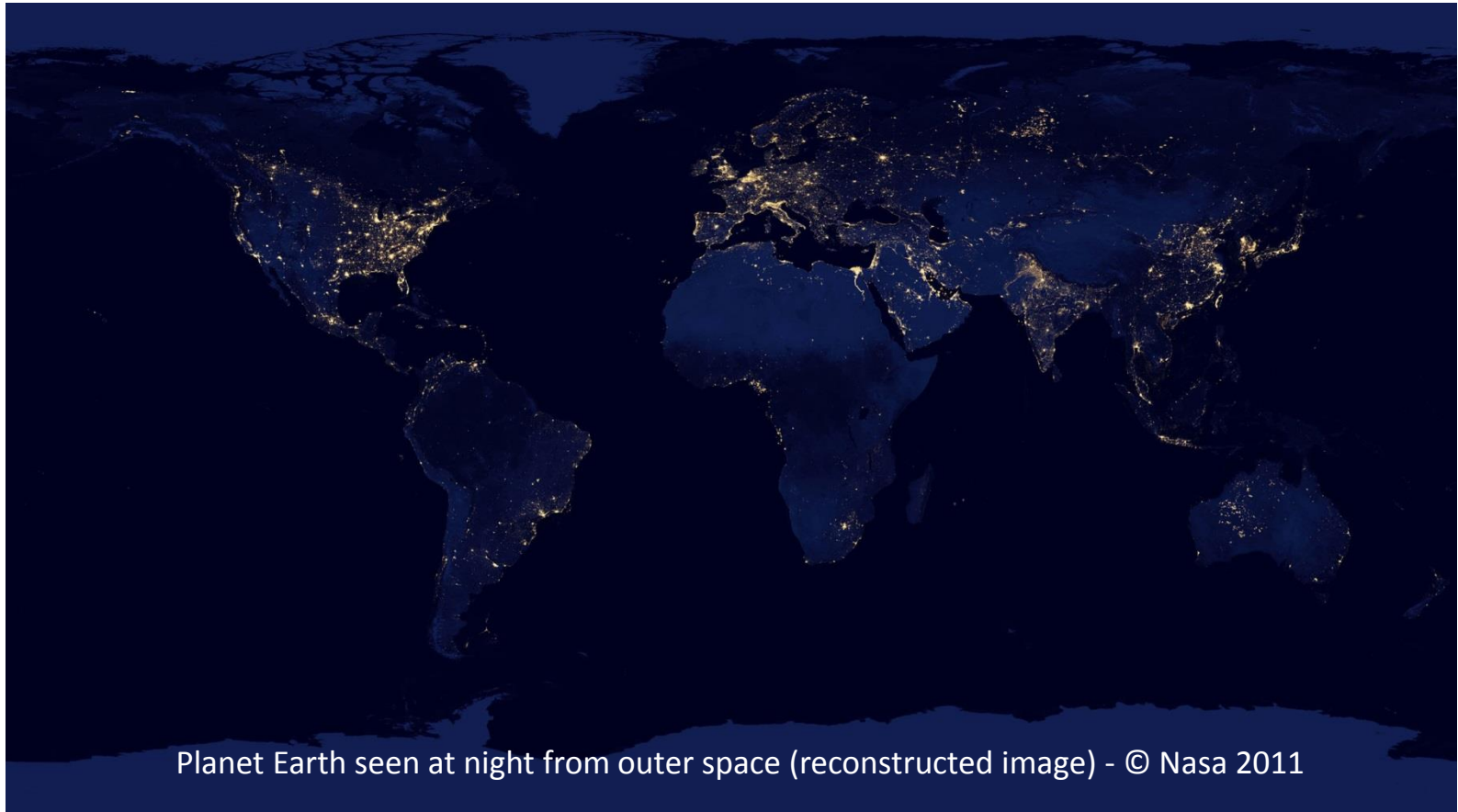




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Photo of the world at night

Today, **20%** of the world's population
consumes 60% of the energy



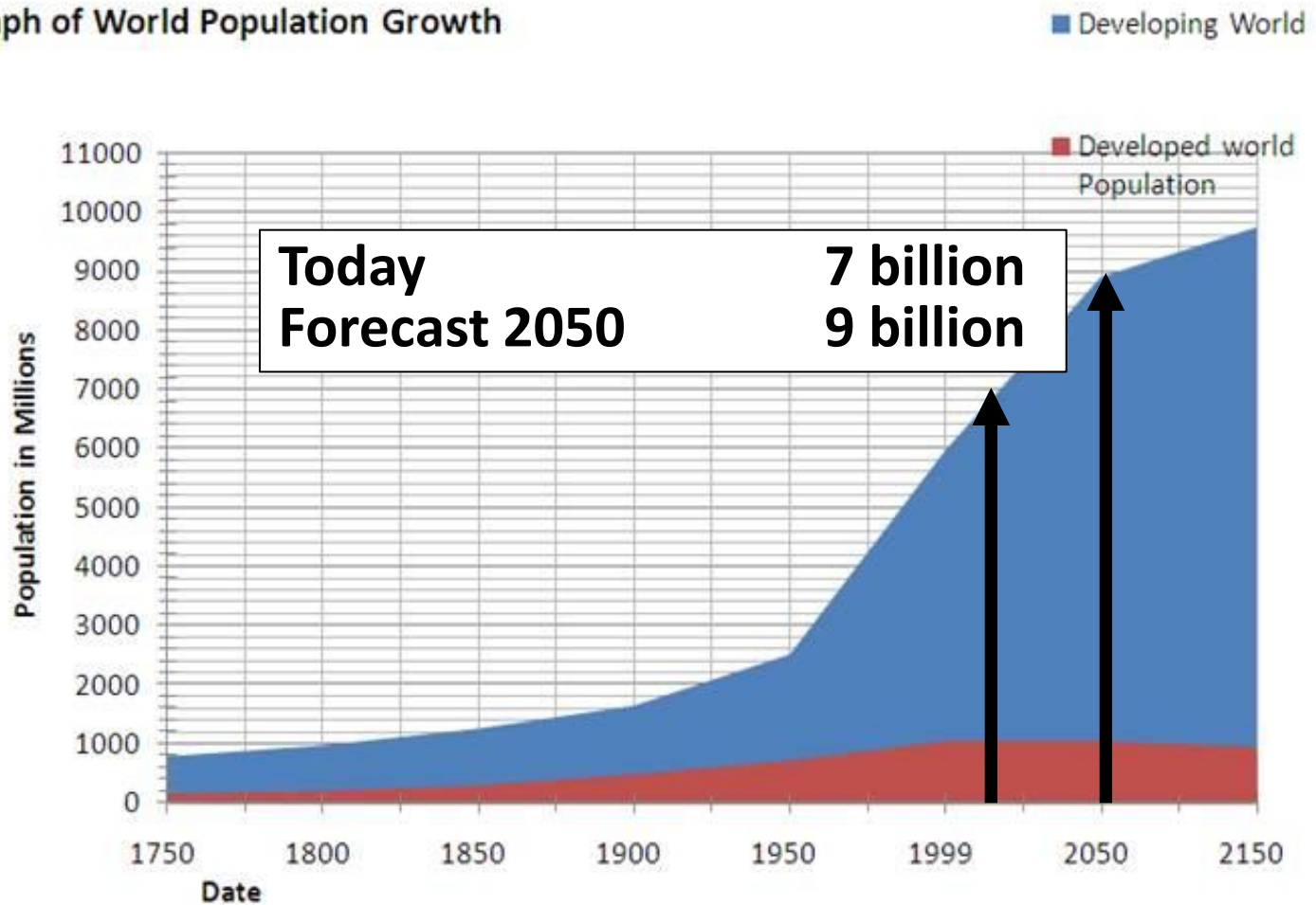
Planet Earth seen at night from outer space (reconstructed image) - © Nasa 2011



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World population

A Graph of World Population Growth



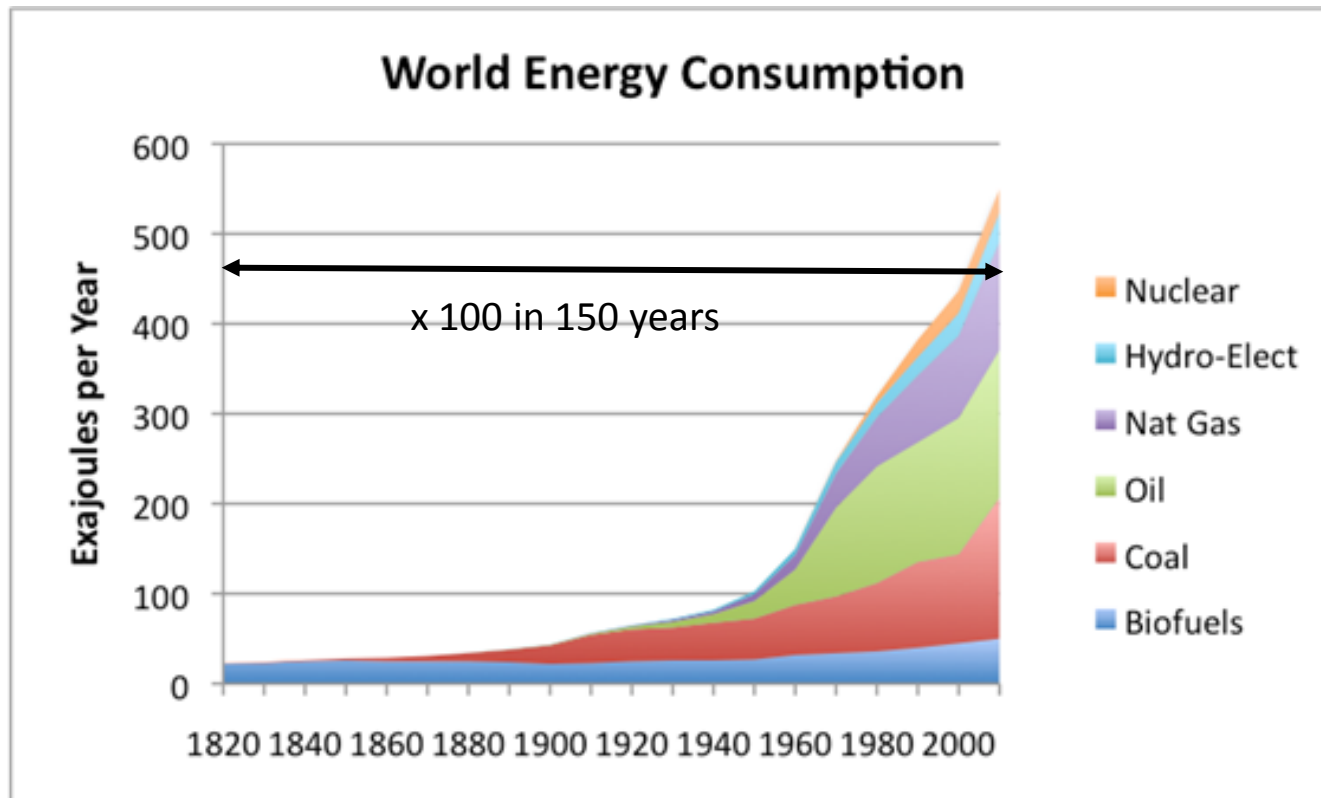
Source : Worldbank



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World Energy Consumption since the Industrial Revolution

- **Energy consumption** has **greatly increased** since 1850
- Today, energy consumption is increasing rapidly **in developing countries**, and is **stabilizing in industrial countries**



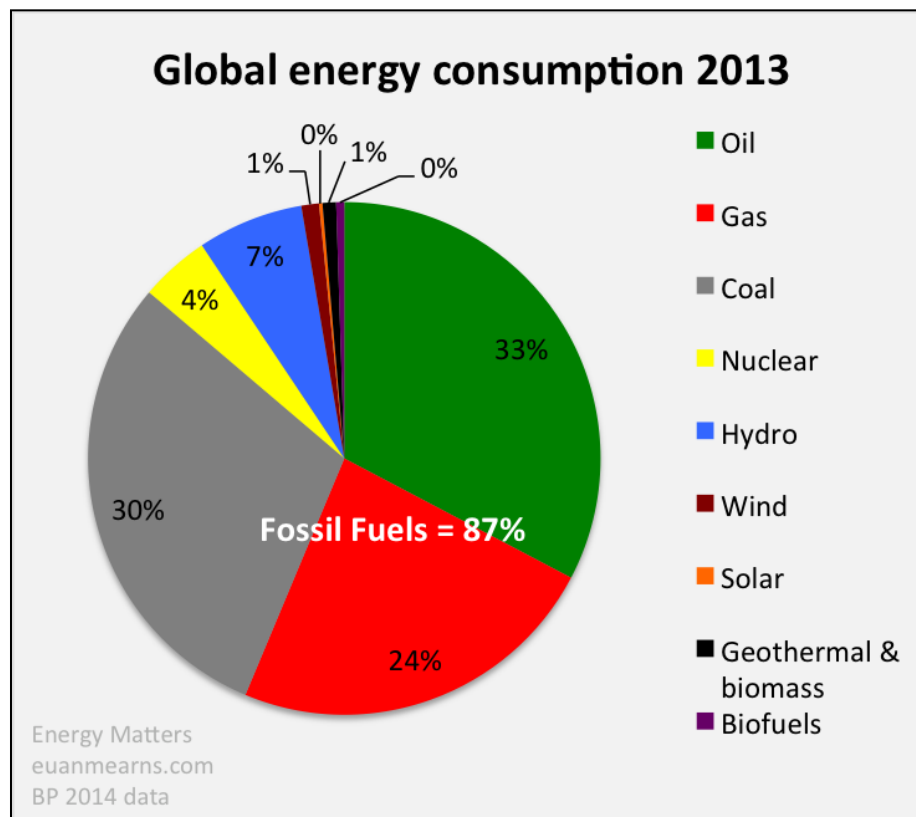


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Energy sources (world)

excluding biomass & fire wood

- **87% of the energy is fossil** (coal, oil, gas) and **contributes to the greenhouse effect**
- **Wind + geothermal + solar = 1%**
- 9,1 Gtoe/yr + biomass \sim > 10 Gtoe/yr



Source : BP, 2014⁷

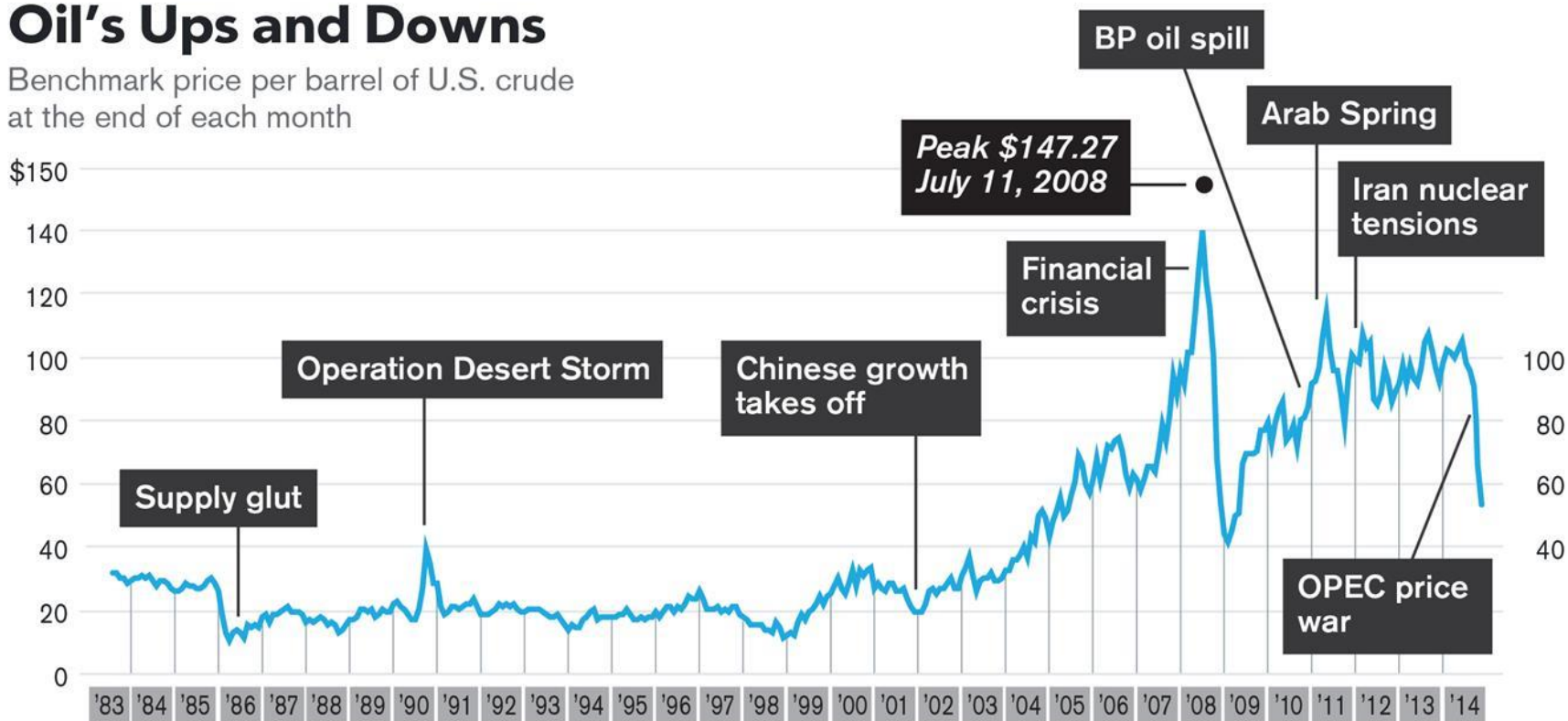


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Price of crude oil

Oil's Ups and Downs

Benchmark price per barrel of U.S. crude at the end of each month



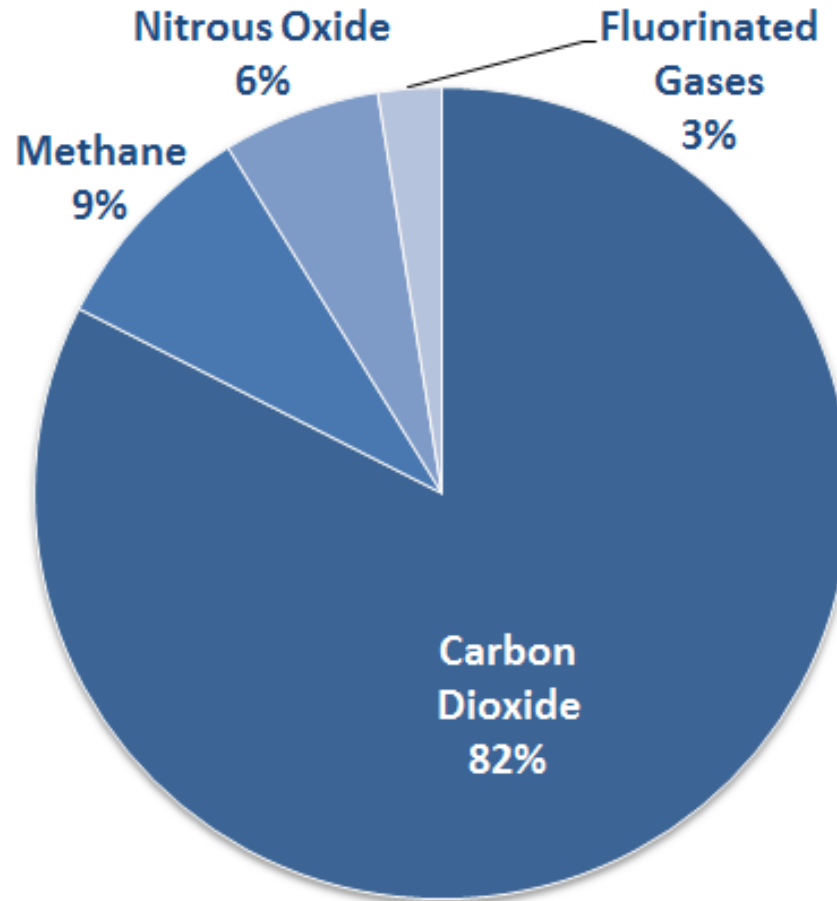
Source : Bloomberg, 2014



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Contribution to climate change

Share in the emission of greenhouse gases



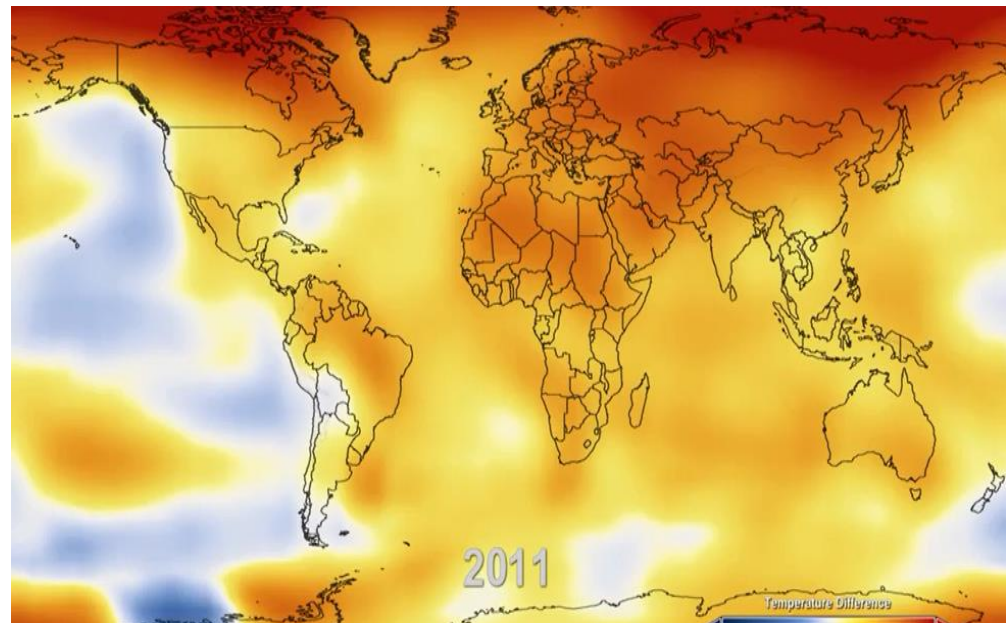
Source : EPA 2013
Ref: USA Greenhouse Gas emissions 2012



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Greenhouse gas effect

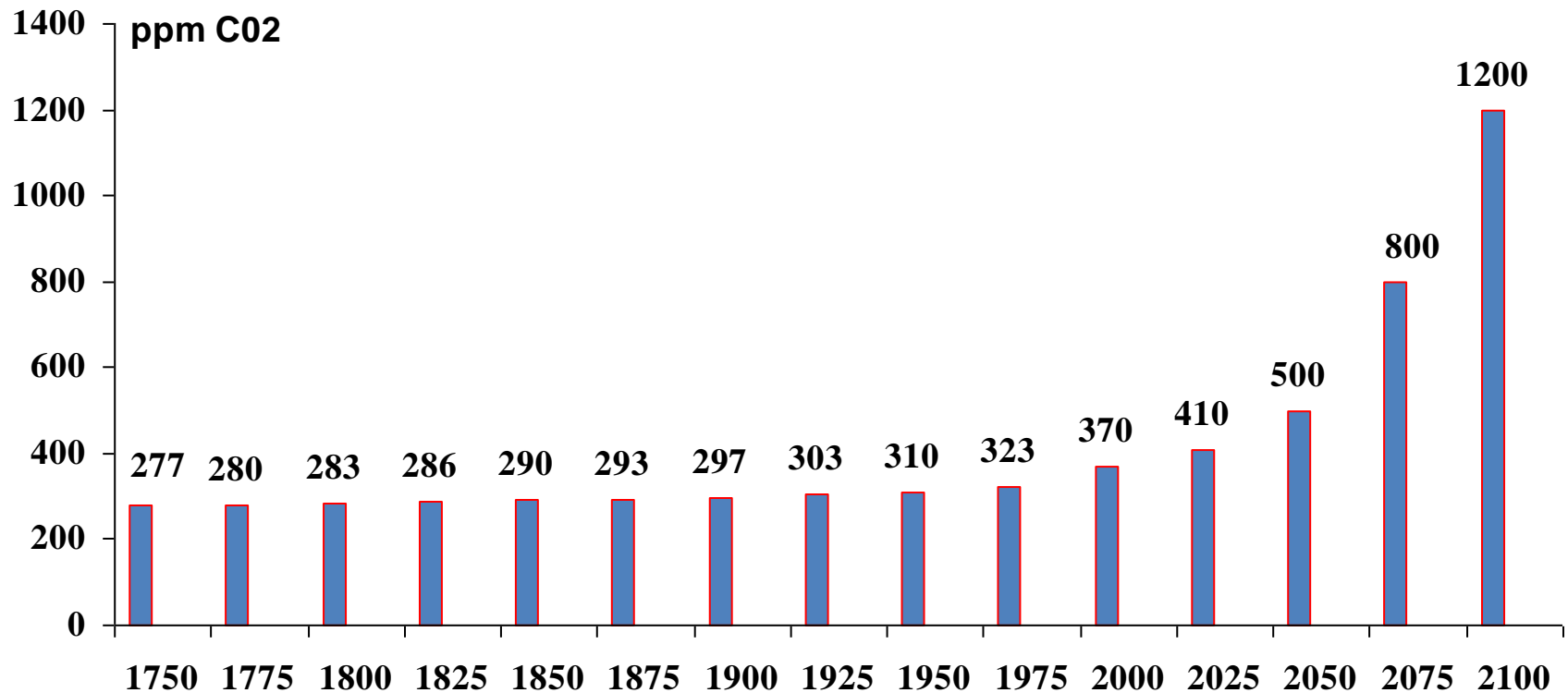
- 20th century : **0,5 to 1 Celsius increase**
- 21st century : **1,5 to 2 Celsius increase**
- Let's suppose we **stop emitting greenhouse gases today, what impact will it have on climate change?**
- A **GLOBAL EFFECT** with a **long time constant**
- **URGENT** action is required





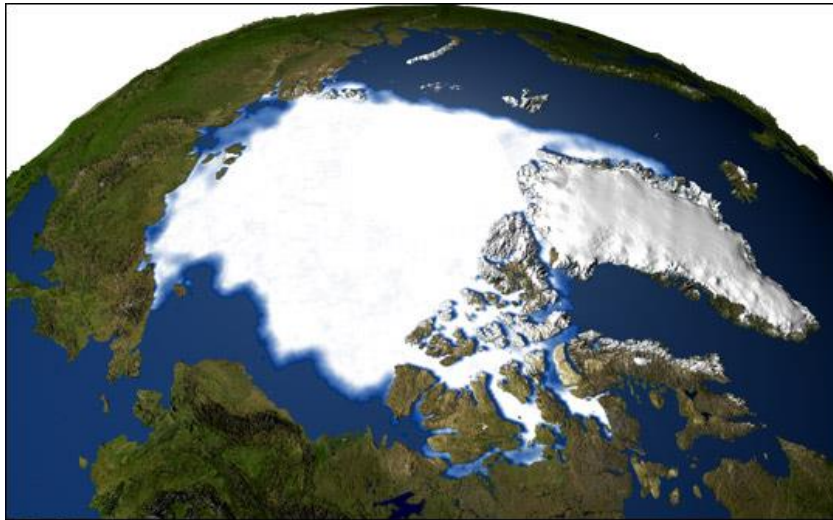
CO2 concentration in the atmosphere

The CO2 content of the atmosphere is higher than it has ever been in the last 400,000 years, and it continues to rise

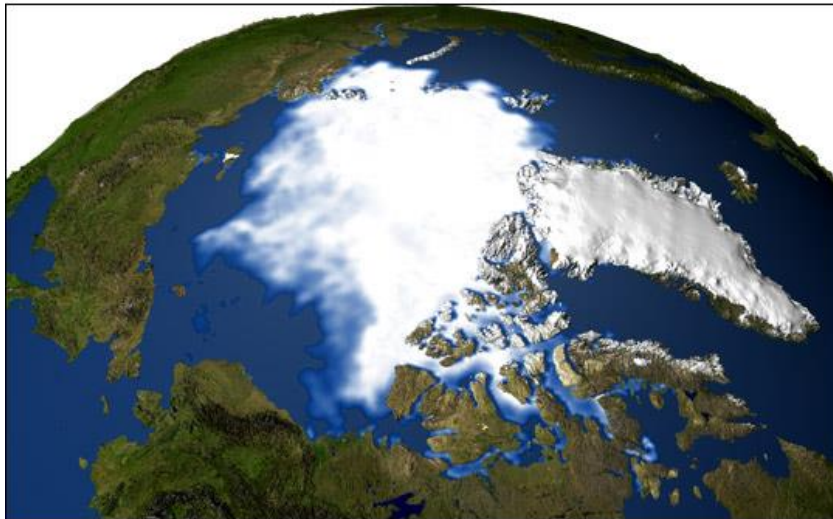




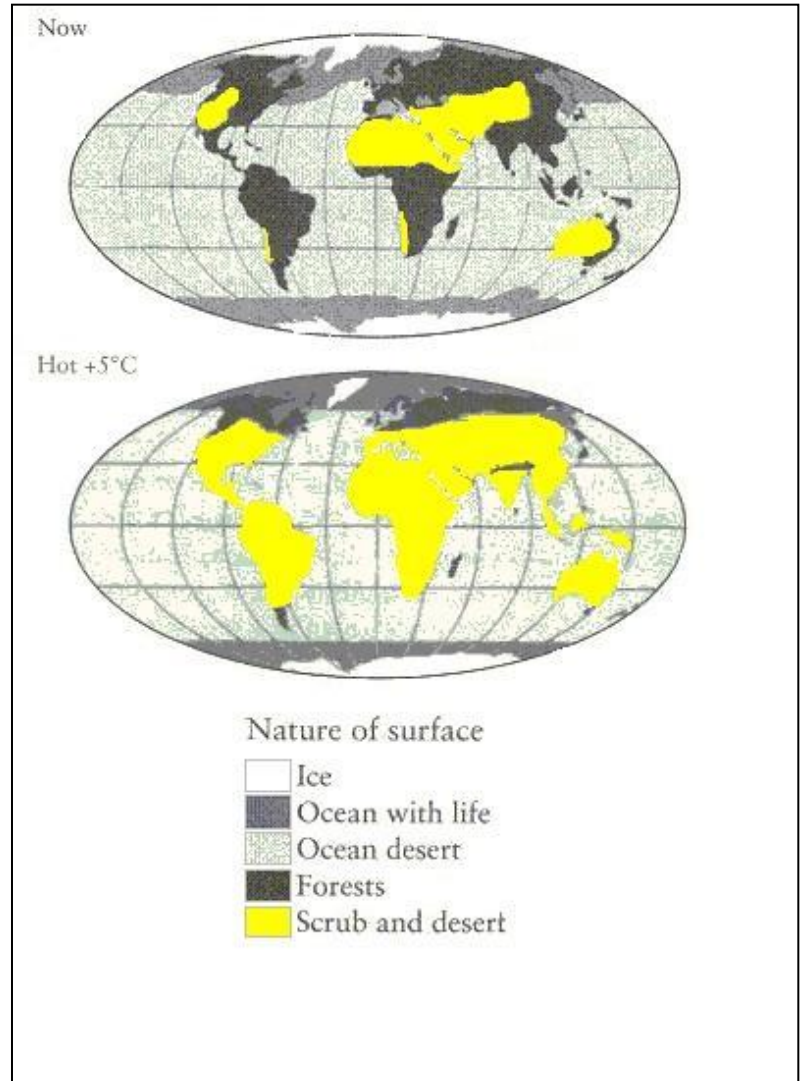
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1979 SSMI Composite Data



2003 SSMI Composite Data



Source: The Revenge of Gaia / James Lovelock

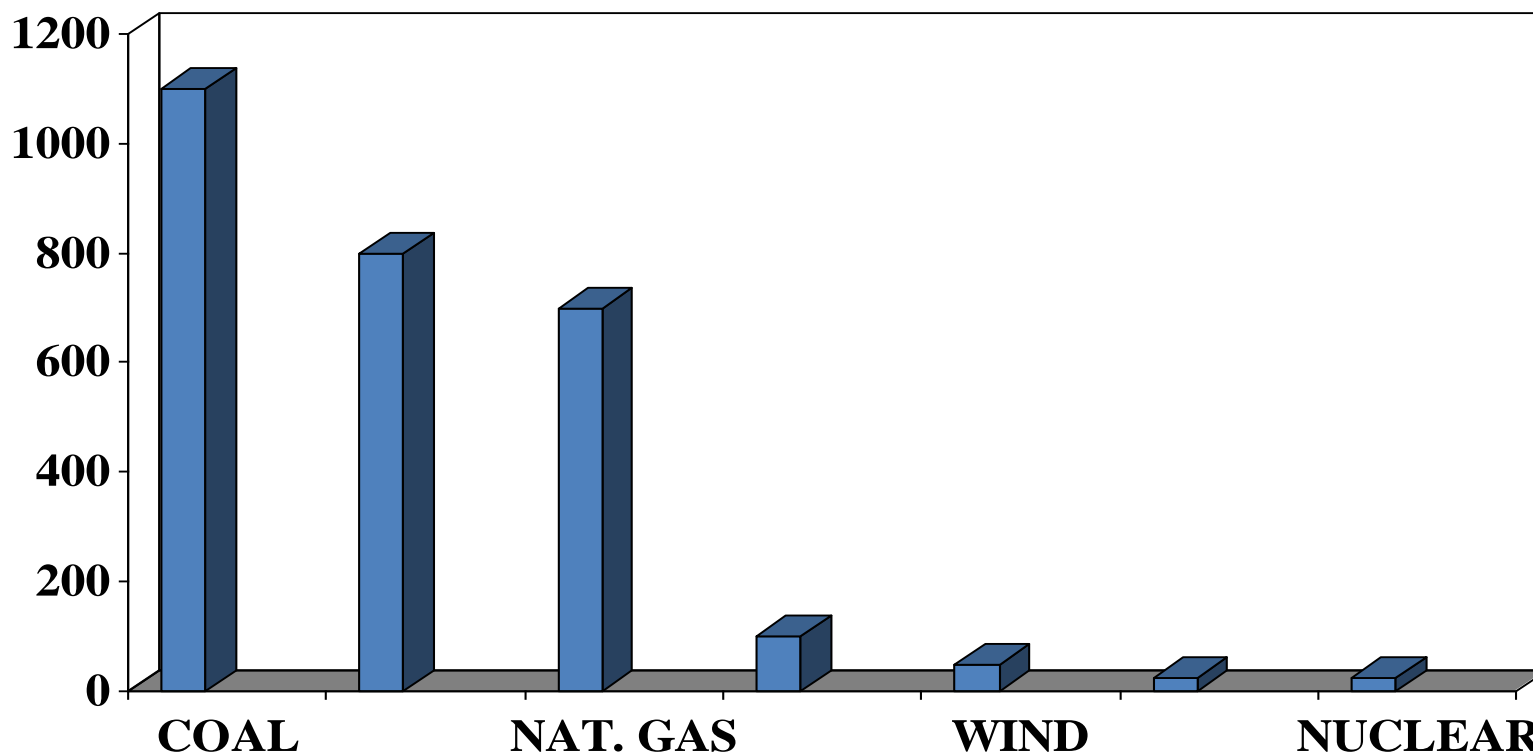


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Greenhouse gas emissions of various energy sources

(in grams of CO₂/kWh)

**RENEWABLE ENERGIES AND NUCLEAR : VERY SMALL CONTRIBUTION TO THE GREENHOUSE EFFECT
(10 to 40 times less per kWh than fossil energies)**





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What can we do?

- **ENERGY CONSERVATION**
- **ENERGY EFFICIENCY**
- **CLEANER ENERGIES**
- **EU leaders agreed on 23 October 2014 the domestic 2030 greenhouse gas reduction target of at least 40% compared to 1990**





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Clean electricity

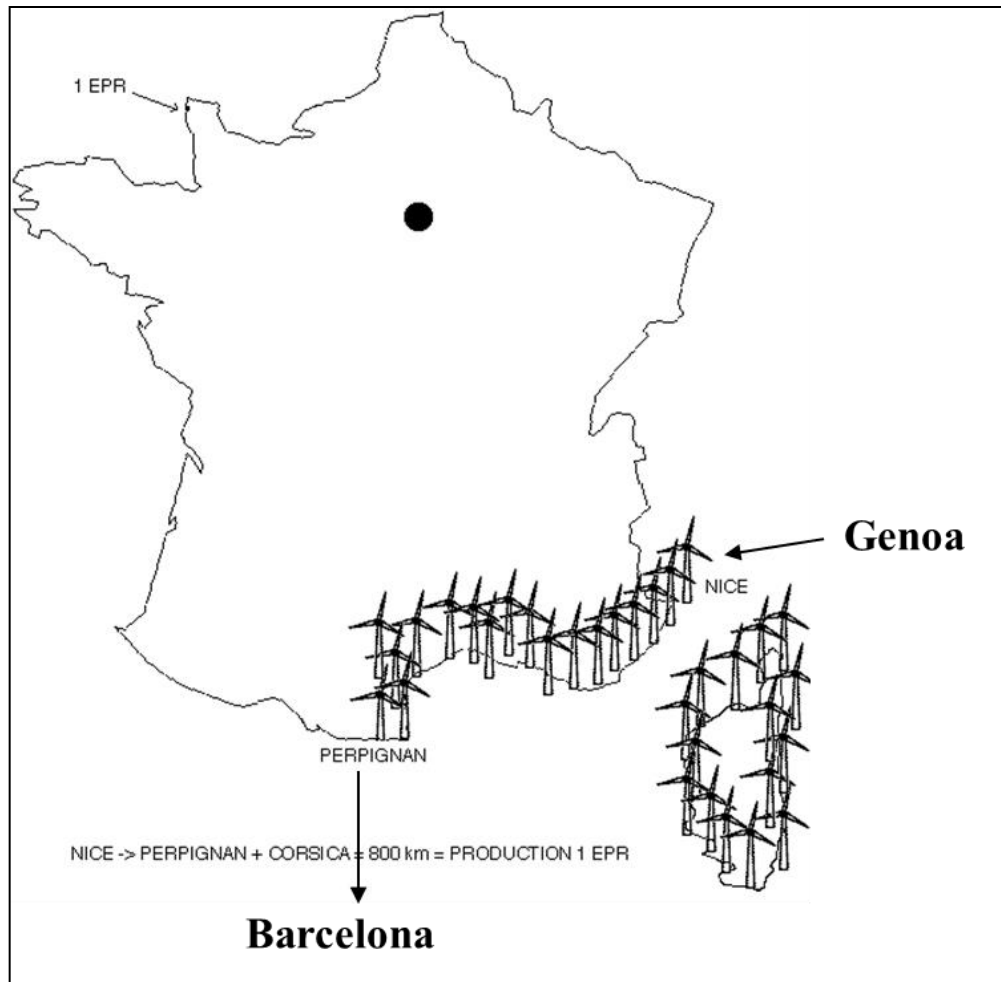
- **Let's ban carbon from electricity production**
- **This leaves us with:**
 - **Renewables**
 - **Nuclear**





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Wind energy can help but it will not suffice

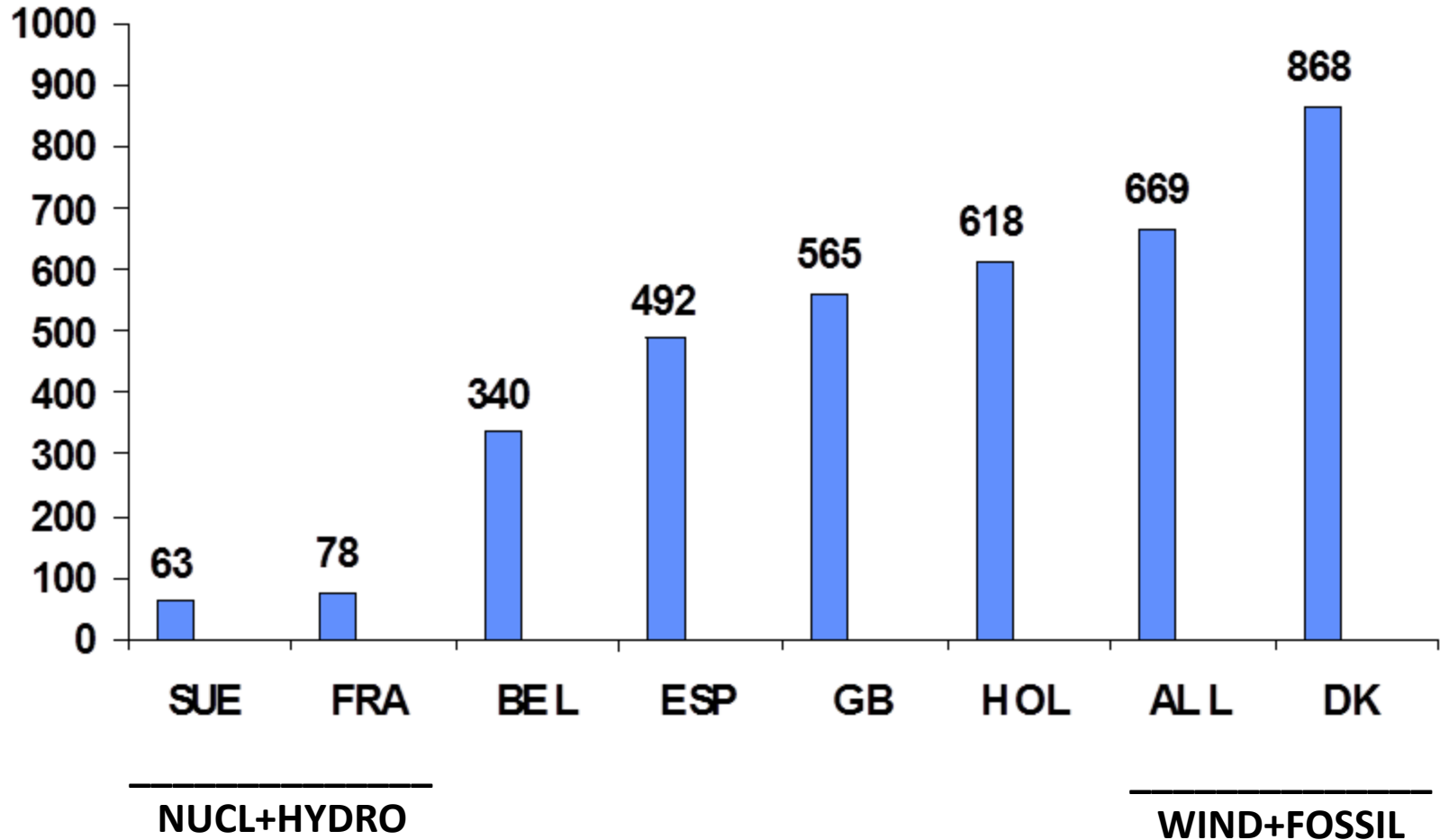




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CO2 emissions in Europe

(TONS of CO2 /GWh)





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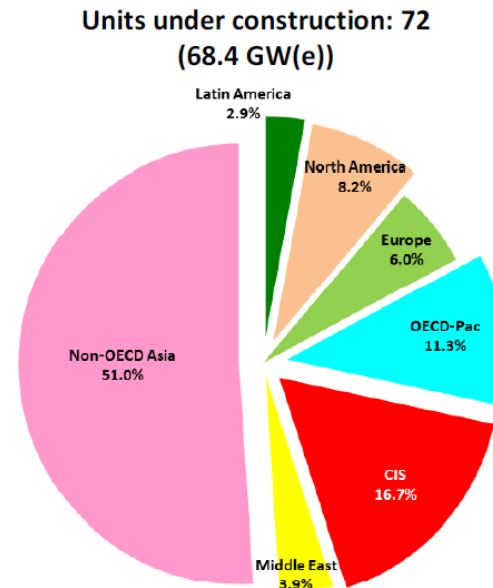
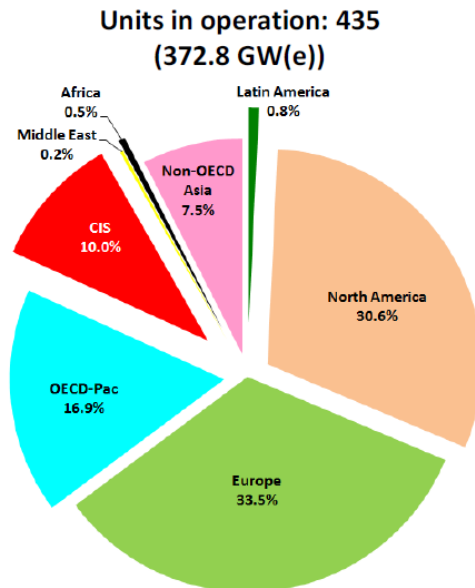
Solar energy can help meet the demand, but only when the sun shines





Nuclear energy growing worldwide

- **Positive news from** France, UK, USA, Russia, China, India, Canada, Poland, Emirates, Turkey, Bulgaria, Vietnam, Finland, ...
- **Nuclear phase out** in Germany
- **In Europe:** 30 % of energy produced is nuclear
- **In the world:** nuclear is 3rd largest source of electricity (11% of global electricity production)





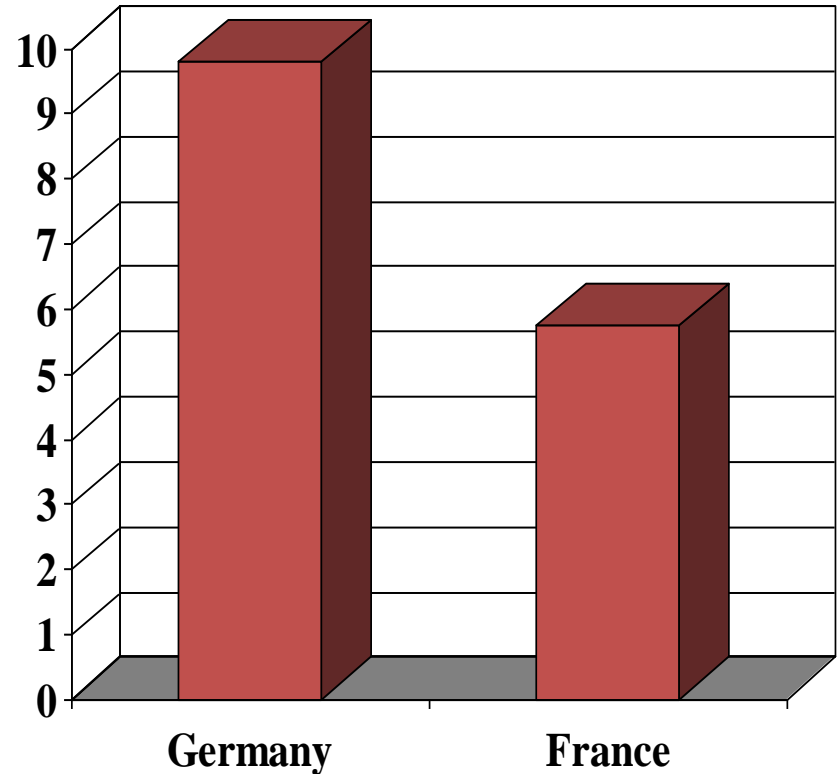
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CO2 emissions France and Germany

(per person, per year)

The example to be followed is France, not Germany :

- **CO2 emissions (source IEA 2008)**
 - DE = 9.79 Tons CO2/hab
 - FR = 5.74 Tons CO2/hab
- **Cost of electricity to families**
 - DE = 23.6 cts/kWh
 - FR = 12.0 cts/kWh
- **Cost of electricity to industry**
 - DE = 12 cts/kWh
 - FR = 8 cts/kWh



Source (for costs): Observatoire des Energies 2010



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All clean energies and efforts are necessary

- The world **needs more energy**
- There is **no fundamental contradiction between energy conservation, eco-construction, eco-transportation, eco-thinking, nuclear energy and renewable energies**
- **All clean energies** should be developed





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Nuclear energy

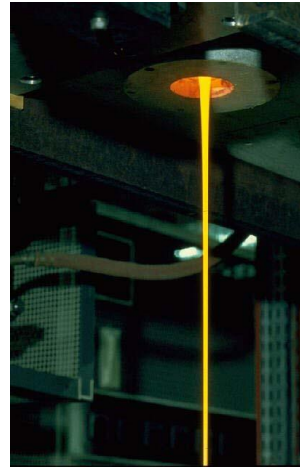
- Is quite compact
- Factor 1 million (1g U = 1 ton oil)
- Consumes very little uranium (20 T=1m³ per year)
- Produces very small volumes of waste





Nuclear waste is not a problem

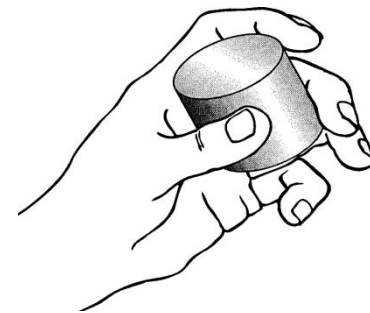
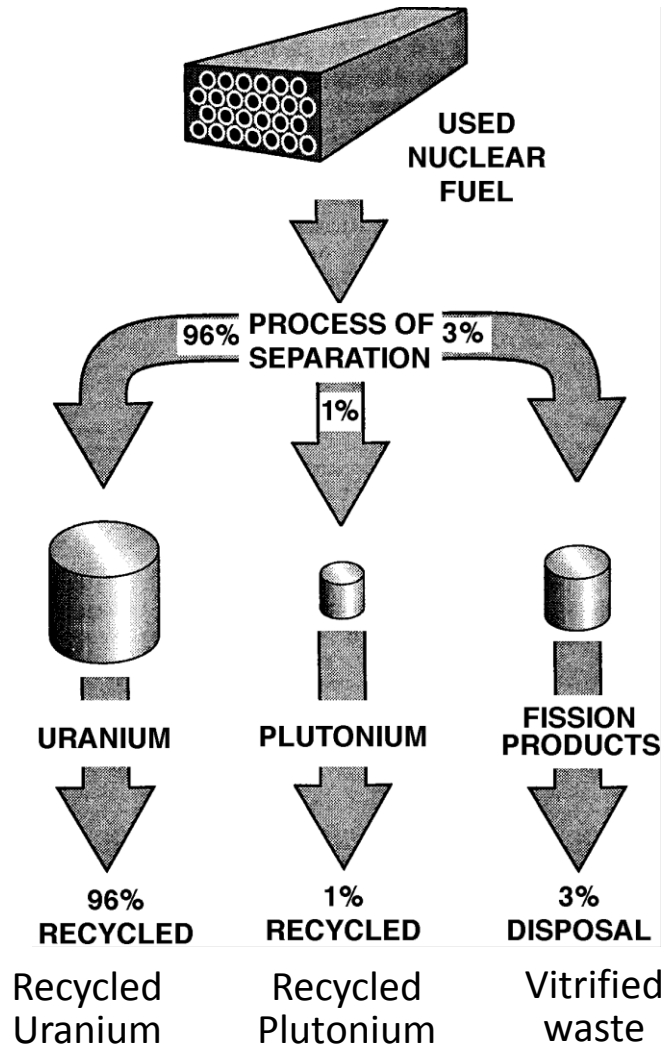
- The **volume** of the waste is **small**
- Nuclear waste is **confined** - **not rejected**
- Nuclear waste **decays spontaneously**
- **Initial toxicity** decreases very rapidly
- **Few meters** of earth **stops the radiation**
- Used fuel **can be reprocessed**





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Reprocessing of nuclear waste is highly ecological



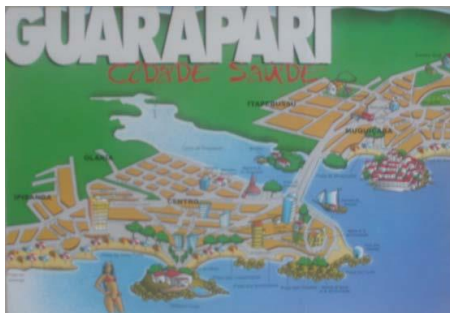
Volume of vitrified waste produced by a typical French family in 30 years



Radioactivity is natural

- **Airplane:** 5 $\mu\text{Sv}/\text{hour}$
- **In Guarapari (Brazil):** up to 50 $\mu\text{Sv}/\text{hr}$ on beach
- **In Ramsar (Caspian Sea):** up to 150 $\mu\text{Sv}/\text{hr}$ in houses
- **La Hague NPP:** 0.001 $\mu\text{Sveq}/\text{h}$
- **La Bourboule:** 0,2 to 3 $\mu\text{Sv}/\text{h}$
- **U@home:** 10 kg/meter (3ppm)

>> To protect the populations more efficiently, radioprotection rules should include natural radiation, not just industrial exposure

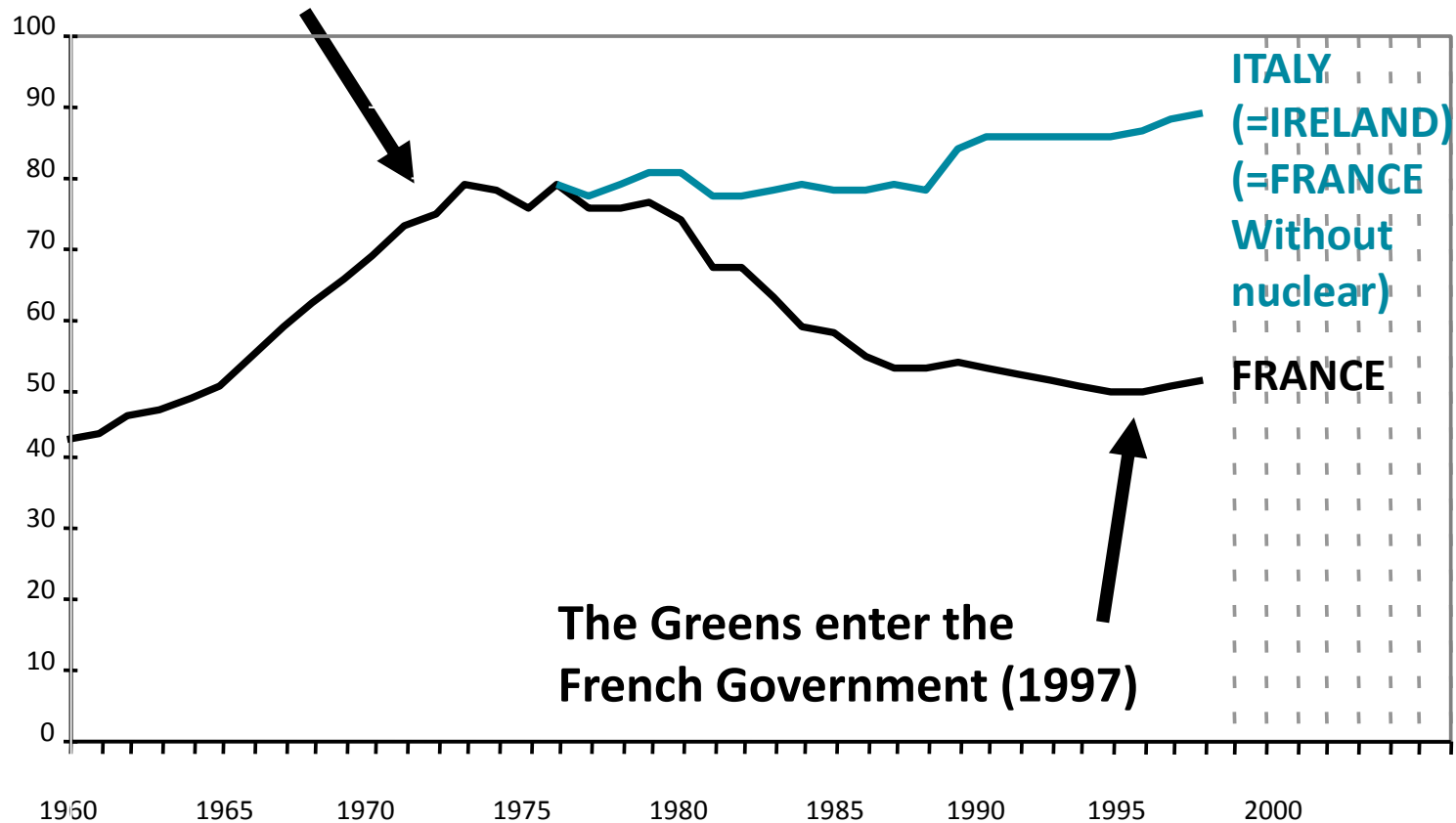




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Energy dependance

Start of the French nuclear program (1973)

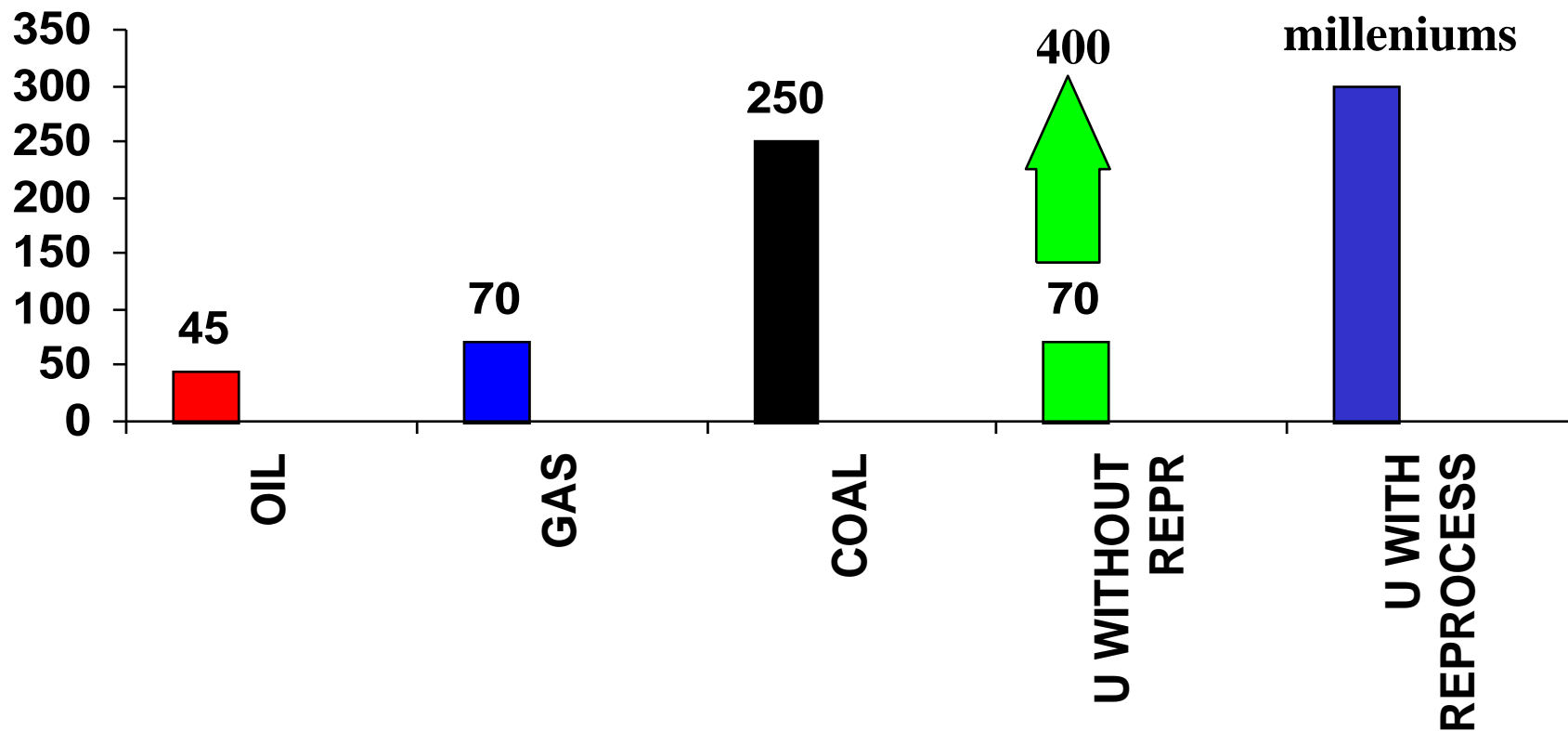




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Proven reserves

YEARS
(at current consumption rate)



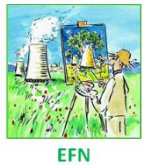
Source : Oil and Gas Journal : CME 2001 / DGEMP 2002 / NEA RED BOOK 2003



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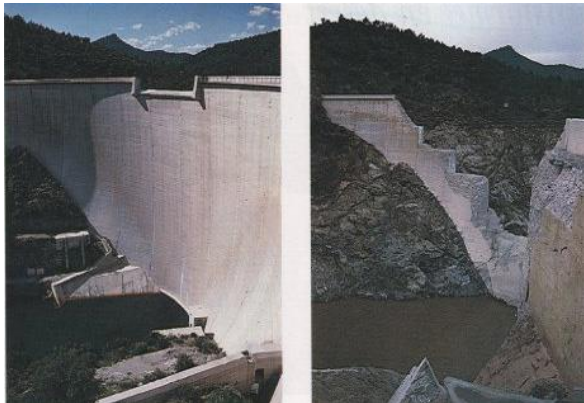
Risks and accidents





No energy source is free of risks

- **Hydro :**
 - Malpasset, 1959 : 423 died
 - Morvi, 1979 : 30 000 died
 - world average = hundreds/year
- **Gas :** Ghislenghien, 2004 : 22 died
- **Steam :** Mississippi, 1865 : 1547 died





The Chernobyl accident

- **Man-made disaster**, perfect example what not to do:
- **Major mistakes:** faulty design, no containment, safety systems bypassed, incorrect training, forbidden test, ...
- **WHO report** : 4,000 casualties (1986-2006)





The Fukushima accident

- **A natural disaster** : wave above expectations
- 20,000 died **from tsunami** (only 2 in NPP to date)
- All reactors **stopped automatically**
- **4 reactors destroyed, 3 melted cores, 2 H2 explosions**
- **Early evacuation, limited public health impact**
- 4 workers died (none from radiation)
- 6 workers > authorized 250 mSv (no health impact)
- **Tsunami predictions inadequate (wave 5.7m -> 14 m)**
- **Emergency cooling systems not sufficient + inundated**
- **Lessons learned & stress-tests : safety is now improved around the world**



Risk of terrorist attack

- **CONCLUSION EU STRESS TESTS:**

- Specifically, the tests measured the **ability of nuclear facilities to withstand damage** from hazards such as earthquakes, flooding, terrorist attacks or aircraft collisions
- The **safety standards** of nuclear power plants in Europe are **generally high, the plants are robust**

- **CONCLUSION DRONES:**

- **Drones are not capable to impact on the nuclear part of an NPP**
- Potential drone attacks might have **targeted the (unprotected) transformers**
- These attacks would rather **aim a black-out or power cut than a nuclear accident**

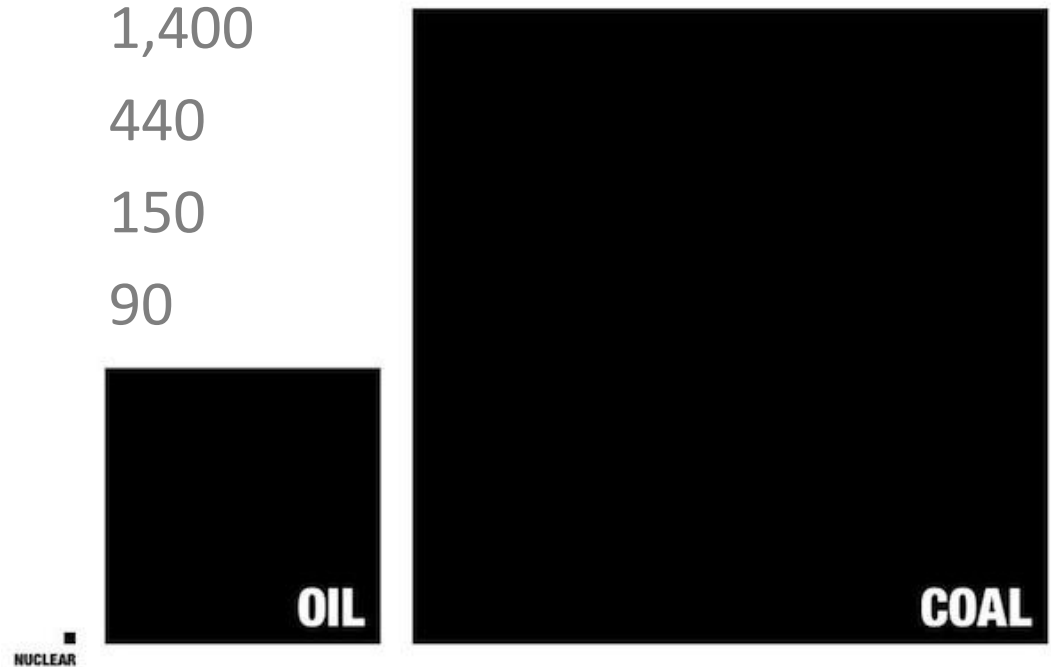




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Mortality rate different energy sources (deaths/trillionkWhr)

- Coal 170,000
- Oil 36,000
- Biofuel/Biomass 24,000
- Natural Gas 4,000
- Hydro 1,400
- Solar (rooftop) 440
- Wind 150
- Nuclear 90





Conclusions

- A **major energy crisis** is down the road
- The world needs **more clean energy**
- **Conservation, renewable energies and clean nuclear energy** are a **perfect match**
- **COP21 Paris**





EFN : Environmentalists for Nuclear

- An **international network** gathering over **12,000 members** and supporters in favour of clean nuclear energy
- **EFN's mission** : information about energy and the environment
- **Growing rapidly**
- In **65 countries**
- On **5 continents**





More information

More information : www.ecolo.org

The book : www.comby.org

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