

# **Expanding the Scope: Nuclear Power in a Sustainable Development Perspective**

**Loreta Stankeviciute**  
PESS, Department of Nuclear Energy  
International Atomic Energy Agency (IAEA)



**IAEA**

International Atomic Energy Agency

# Energy and the Sustainable Development Goals



**1 NO POVERTY**  
End poverty in all its forms everywhere



**2 ZERO HUNGER**  
End hunger, achieve food security and improved nutrition and promote sustainable agriculture



**3 GOOD HEALTH AND WELL-BEING**  
Ensure healthy lives and promote well-being for all at all ages



**4 QUALITY EDUCATION**  
Ensure inclusive and quality education for all and promote lifelong learning



**5 GENDER EQUALITY**  
Achieve gender equality and empower all women and girls



**6 CLEAN WATER AND SANITATION**  
Ensure access to water and sanitation for all



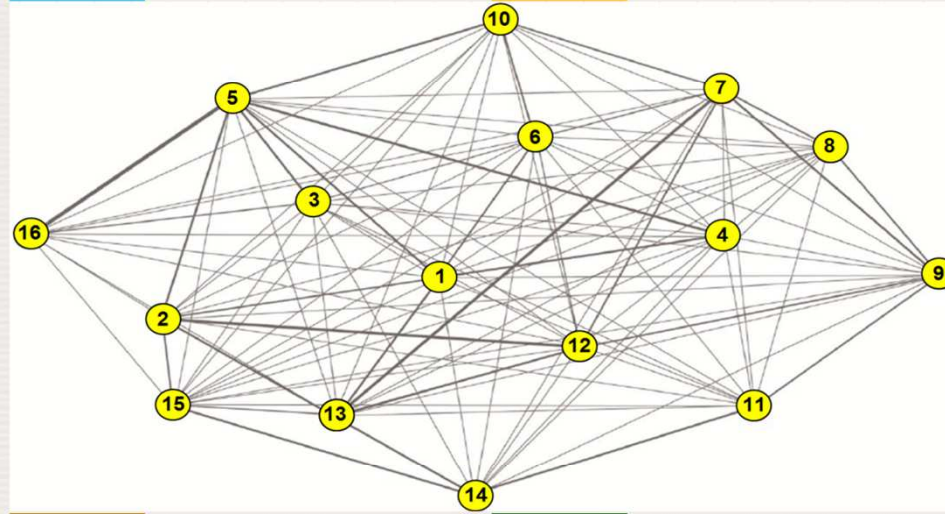
**7 AFFORDABLE AND CLEAN ENERGY**  
Ensure access to affordable, reliable, sustainable and modern energy for all



**8 DECENT WORK AND ECONOMIC GROWTH**  
Promote inclusive and sustainable economic growth, employment and decent work for all



**9 INDUSTRY, INNOVATION AND INFRASTRUCTURE**  
Build resilient infrastructure, promote sustainable industrialization and foster innovation



**10 REDUCED INEQUALITIES**  
Reduce inequality within and among countries



**11 SUSTAINABLE CITIES AND COMMUNITIES**  
Make cities and human settlements inclusive, safe, resilient and sustainable



**12 RESPONSIBLE CONSUMPTION AND PRODUCTION**  
Ensure sustainable consumption and production patterns



**13 CLIMATE ACTION**  
Take urgent action to combat climate change and its impacts



**14 LIFE BELOW WATER**  
Conserve and sustainably use the oceans, seas and marine resources



**15 LIFE ON LAND**  
Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss



**16 PEACE, JUSTICE AND STRONG INSTITUTIONS**  
Promote just, peaceful and inclusive societies



**17 PARTNERSHIPS FOR THE GOALS**  
Revitalize the global partnership for sustainable development



# A historical review of Nuclear and Sustainable Development



Source: Leila Mead, IISD

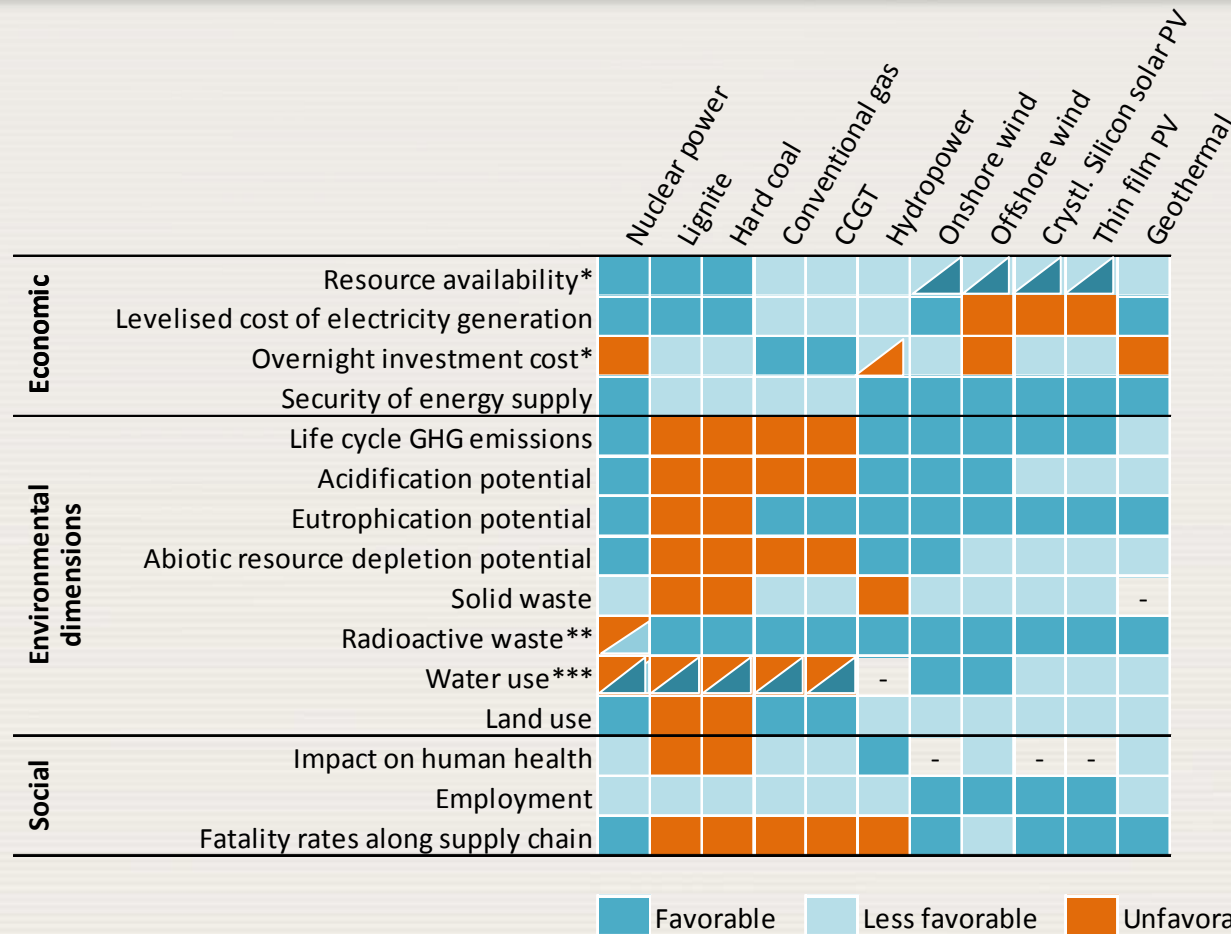
## CSD – 9 (2001)

- Exhaustive debate
- Agreement to disagree on nuclear's role in sustainable development
- Agreement that the “choice of nuclear energy rests with countries”

## WSSD (2002)

- JPOI: a series of actions promoting clean and affordable energy (renewable energy, efficiency improvements, advanced energy technologies)
- Nuclear power is an advanced energy technology

# Nuclear compares favourably across many sustainability indicators



\* Sensitive to geographical location for solar, wind and hydro technologies

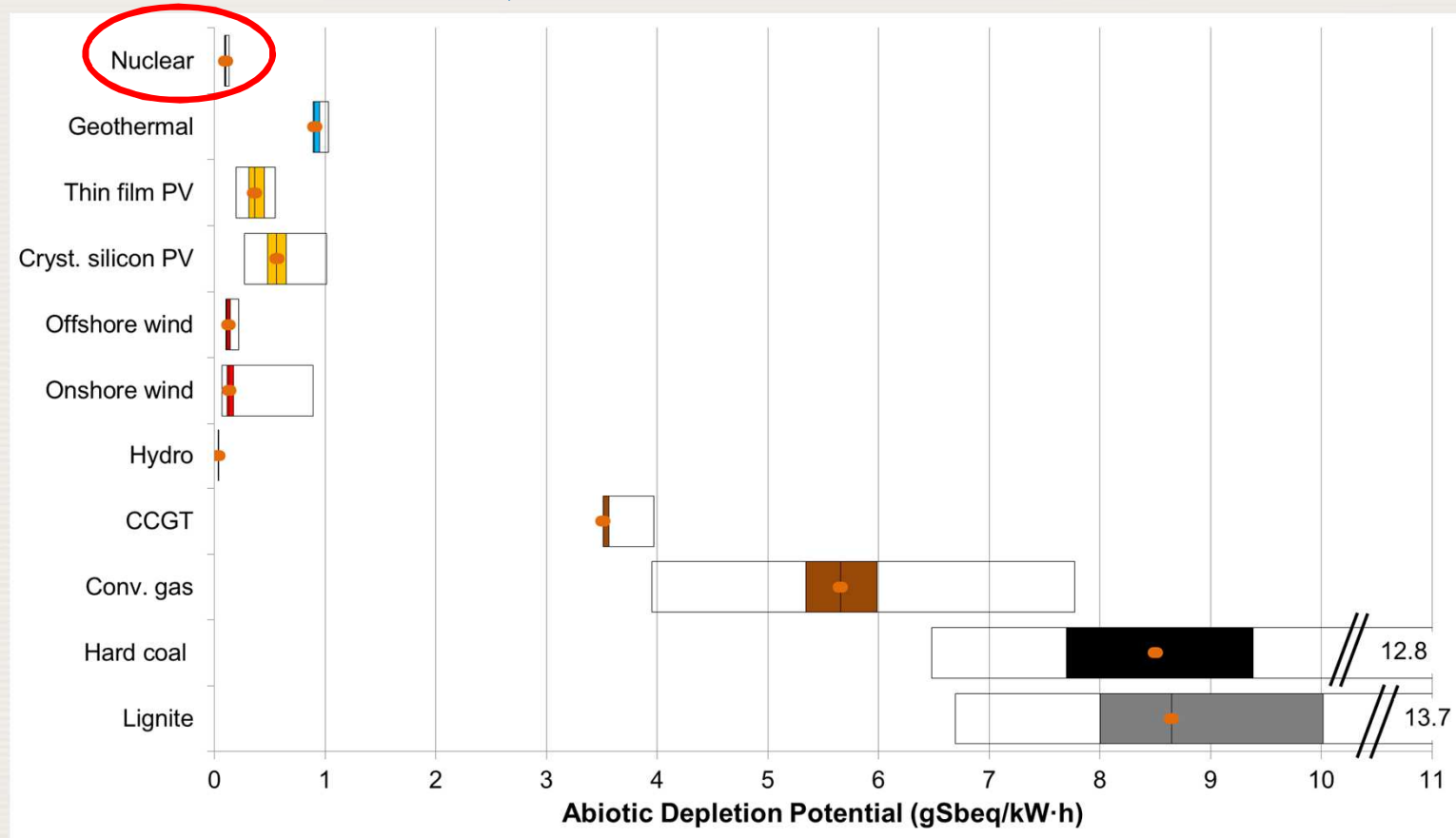
\*\* Closed fuel cycle in fast reactors reduce the volume of HLW and radiotoxicity per unit of electricity generated

\*\*\* Dry cooling system eliminates water needs for cooling in thermo-electric power plants

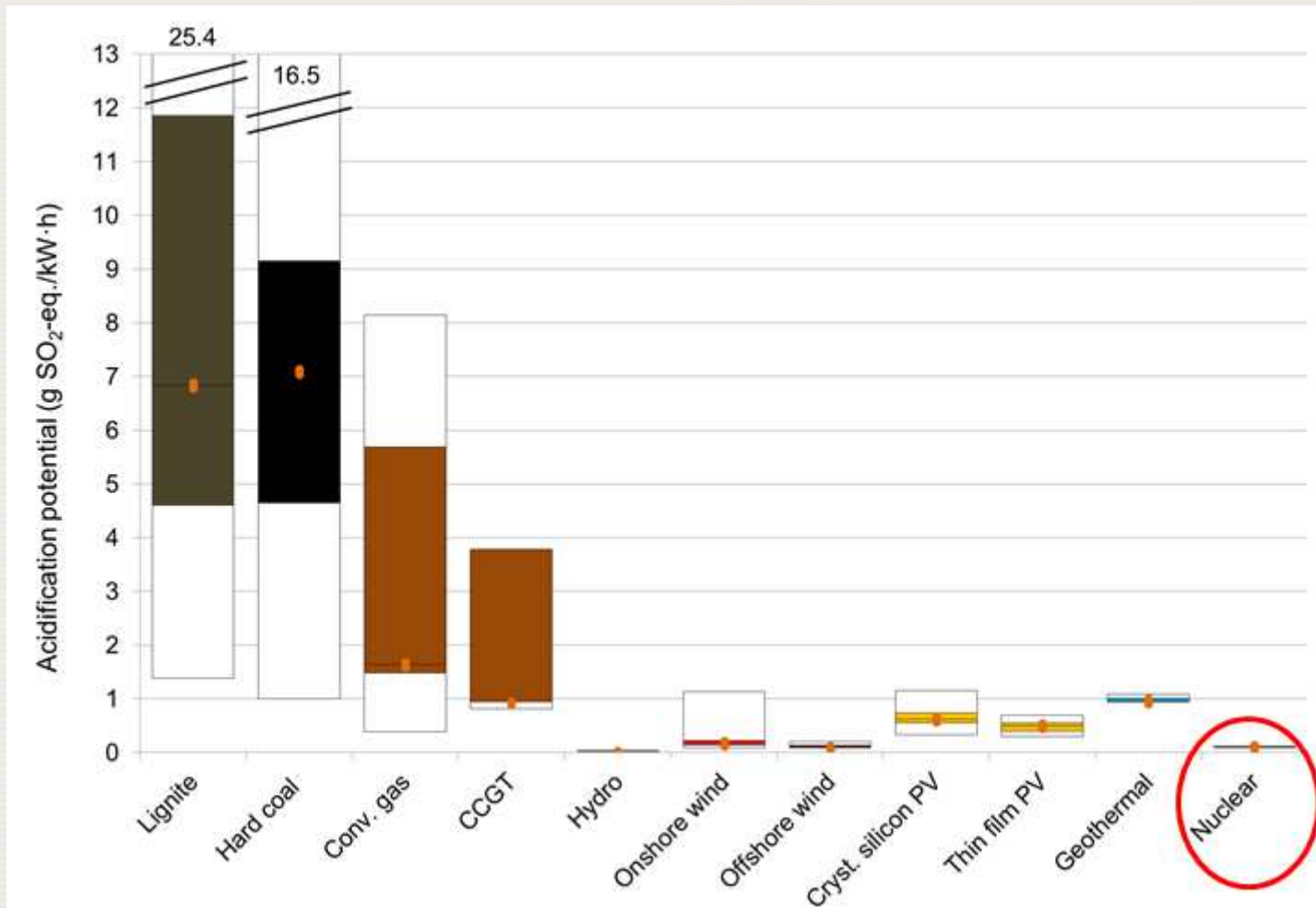


# Nuclear power has low potential for abiotic resource depletion

- ARD potential: depletion of fossil fuel + mineral (eg. iron, copper, nickel, rare earth metals, uranium)



## .. low acidification potential





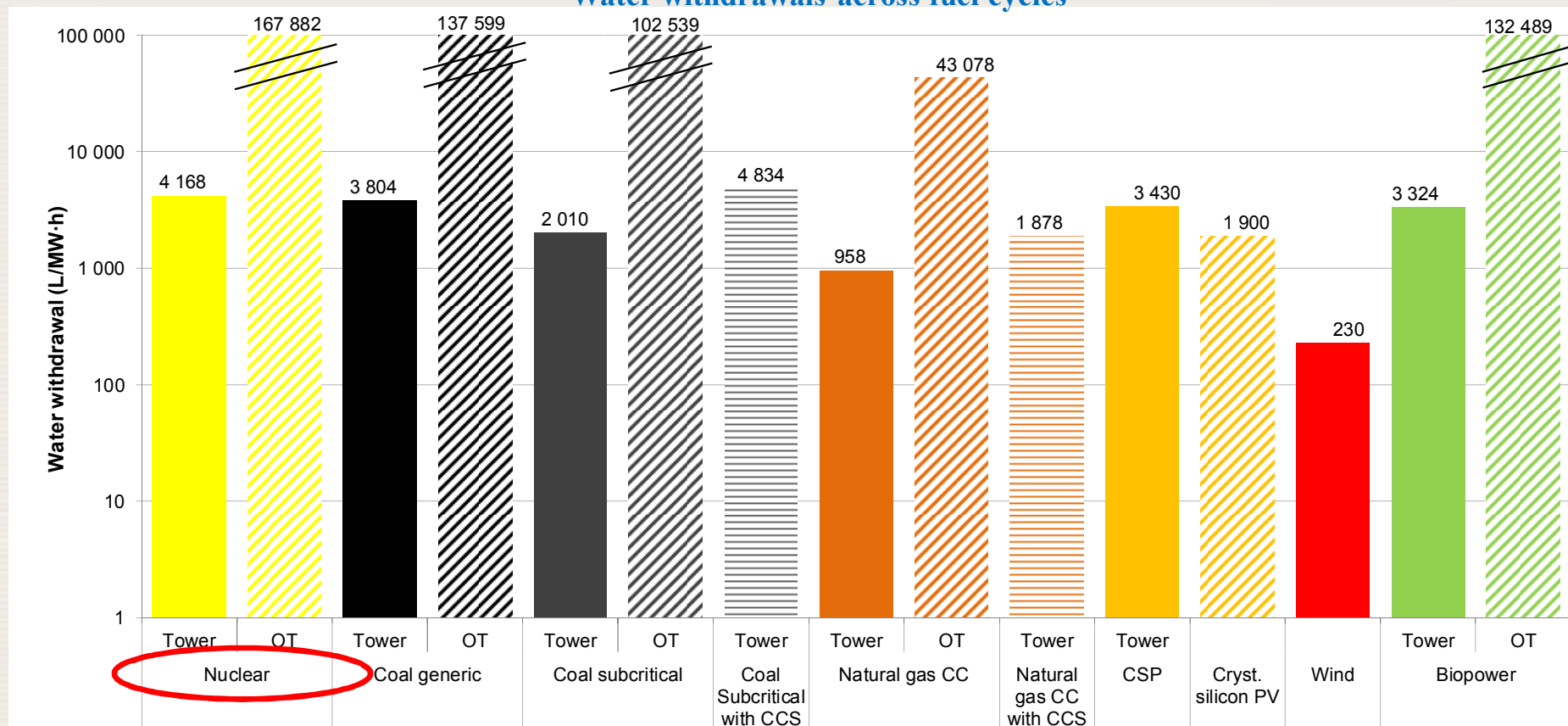
## .. but high water requirements for cooling

- In case of water scarcity, alternatives exist for inland NPPs

  - ⇒ Wet recirculating towers, dry cooling..

  - ⇒ Advanced reactors including SMRs - higher efficiencies less cooling waters withdrawn

Water withdrawals across fuel cycles



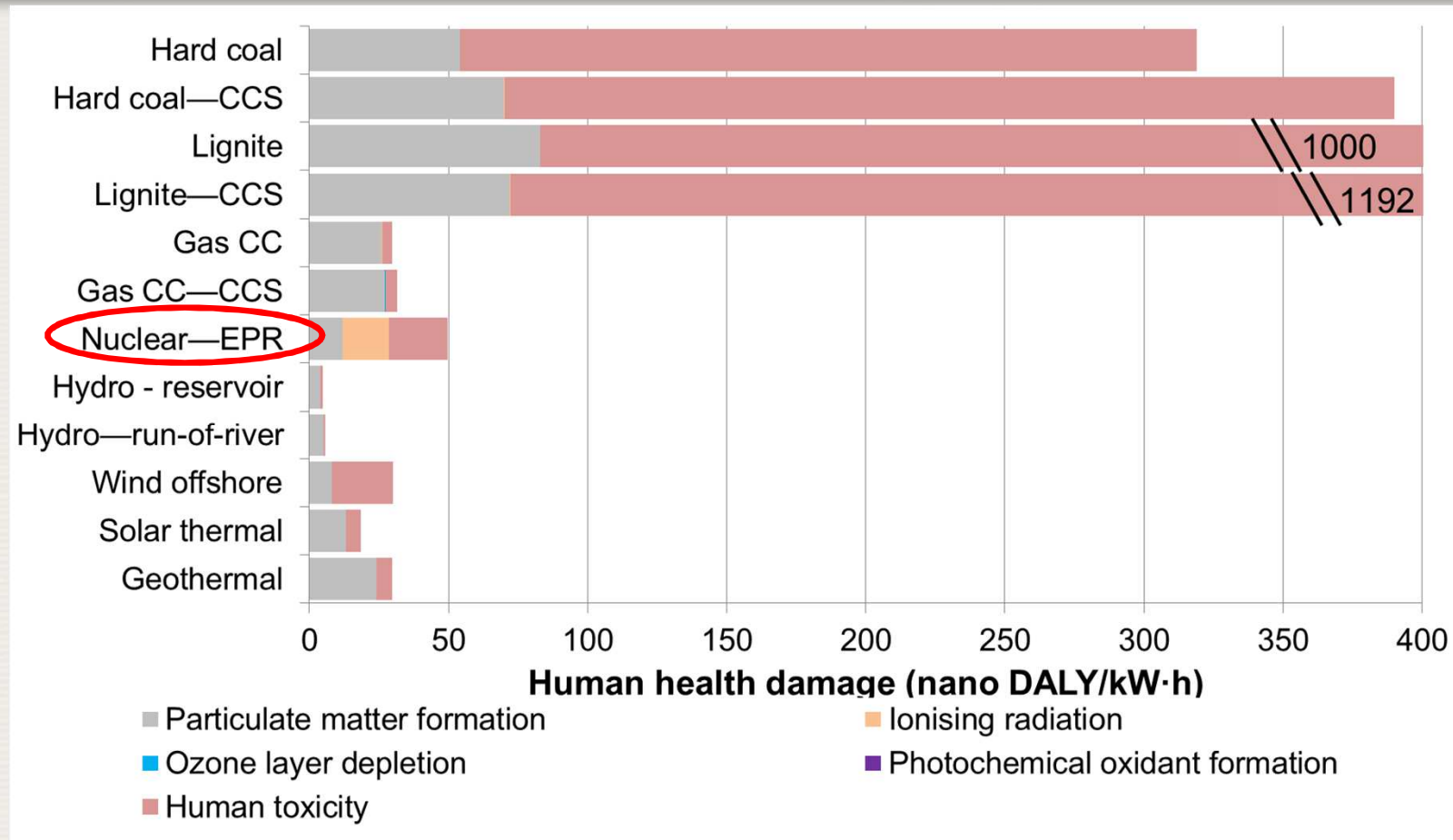
## ..low volumes of waste due to high density of uranium

- Around 80% of all nuclear waste has already been sent for safe disposal
- Only 2% - 3% of radioactive waste is HLW – challenges in terms of radiotoxicity and long half-life
  - ⇒ Consensus on disposal in stable geological formations + multiple engineering barriers
  - ⇒ First deep geological repositories to be expected within a decade (Finland, Sweden)
  - ⇒ Spent Nuclear Fuel as a resource? Subject to reprocessing, retrievability
- Future technologies can significantly reduce the volume and half-life of HLW

	Once-through fuel cycle	Closed nuclear fuel cycle
HLW (Plutonium+americium+curium) (kg/TW·h)	27.9	0.15
Time for radiotoxicity to reach the level of uranium ore	Several hundred thousand years	Several centuries



## .. low human health impacts



- Natural exposure to ionising radiation is several magnitudes higher than artificial

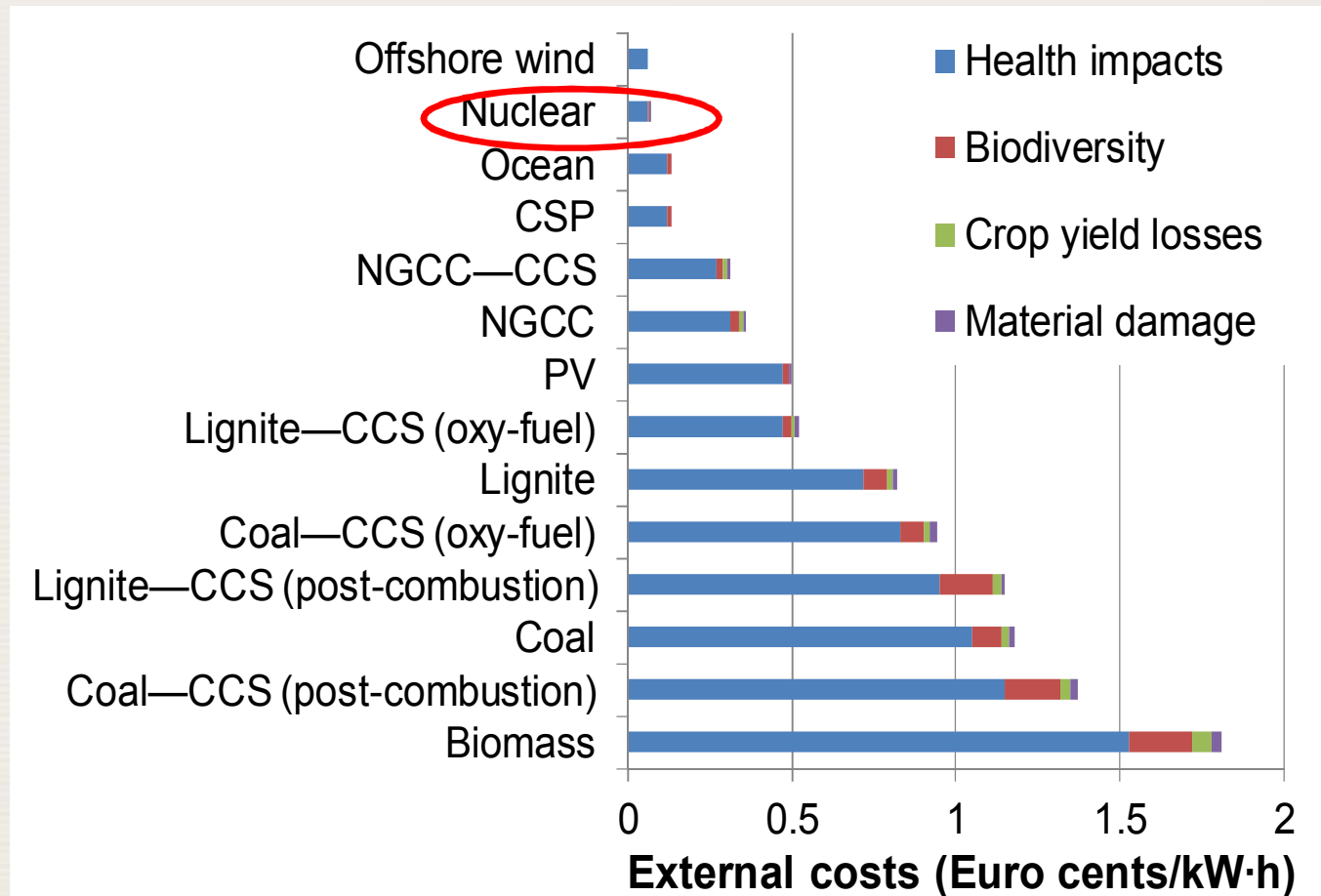
⇒ Natural – 2420  $\mu\text{Sv}$ , Medical – 620  $\mu\text{Sv}$ , Nuclear fuel cycle – 0.2  $\mu\text{Sv}$



## .. thus low external costs

- Environmental and health damage cost not reflected in the price of electricity

Average external costs in the EU



# Nuclear power contributes to economic growth and new employment

- Nuclear, CSP and small hydro provide comparable number of jobs per MWe of installed capacity

Comparison of permanent direct local jobs per megawatt of installed electric capacity.

Technology	Jobs/MWe
PV	1.06
Nuclear	0.5038
CSP	0.47
Micro Hydro < 20 MW	0.45
Hydro > 20 MW	0.19
Coal	0.1866
Hydro > 500 MW	0.1137
Hydro Pumped Storage	0.0954
Combined Cycle	0.0544
Wind	0.049

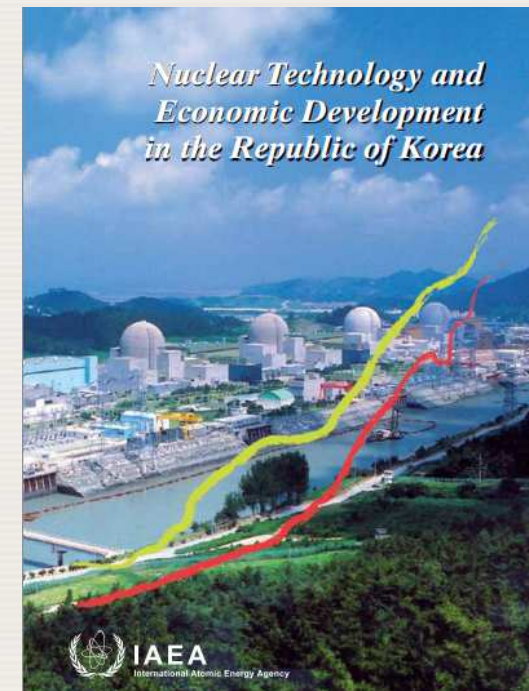
Source: Harker and Hirschboeck, 2010

...there are also indirect jobs

⇒ In USA, for every 100 direct jobs in nuclear plant, 726 indirect and induced jobs are created in the rest of economy

- In comparison to its alternatives, more skilled labour is necessary to design and operate nuclear technologies

⇒ High potential to generate economic value



# Nuclear power and sustainable development

- Is nuclear power consistent with SD ?

⇒ Nuclear power compares favourably to alternatives with respect to SDGs attainment

- Today's advantages

⇒ Low GHG emissions, enhanced energy security, stable and predictable generation costs, internalisation of most externalities, small and managed volumes of waste, ample resources, small land footprint, small impact on ecosystems and human health

- Today's concerns

⇒ Disposal of HLW, safety and non-proliferation, public perceptions → acceptability

- Technology subject to change: closed fuel cycles

⇒ Reduced needs for uranium, less HLW and shorter radiotoxicity

- One Size Does Not Fit All

⇒ Identify trade-offs, set priorities in a national context



⇒ More in the forthcoming report



# IAEA - Planning and Economic Studies

<http://www.iaea.org/OurWork/ST/NE/Pess>



[www.iaea.org/nuclearenergy](http://www.iaea.org/nuclearenergy)



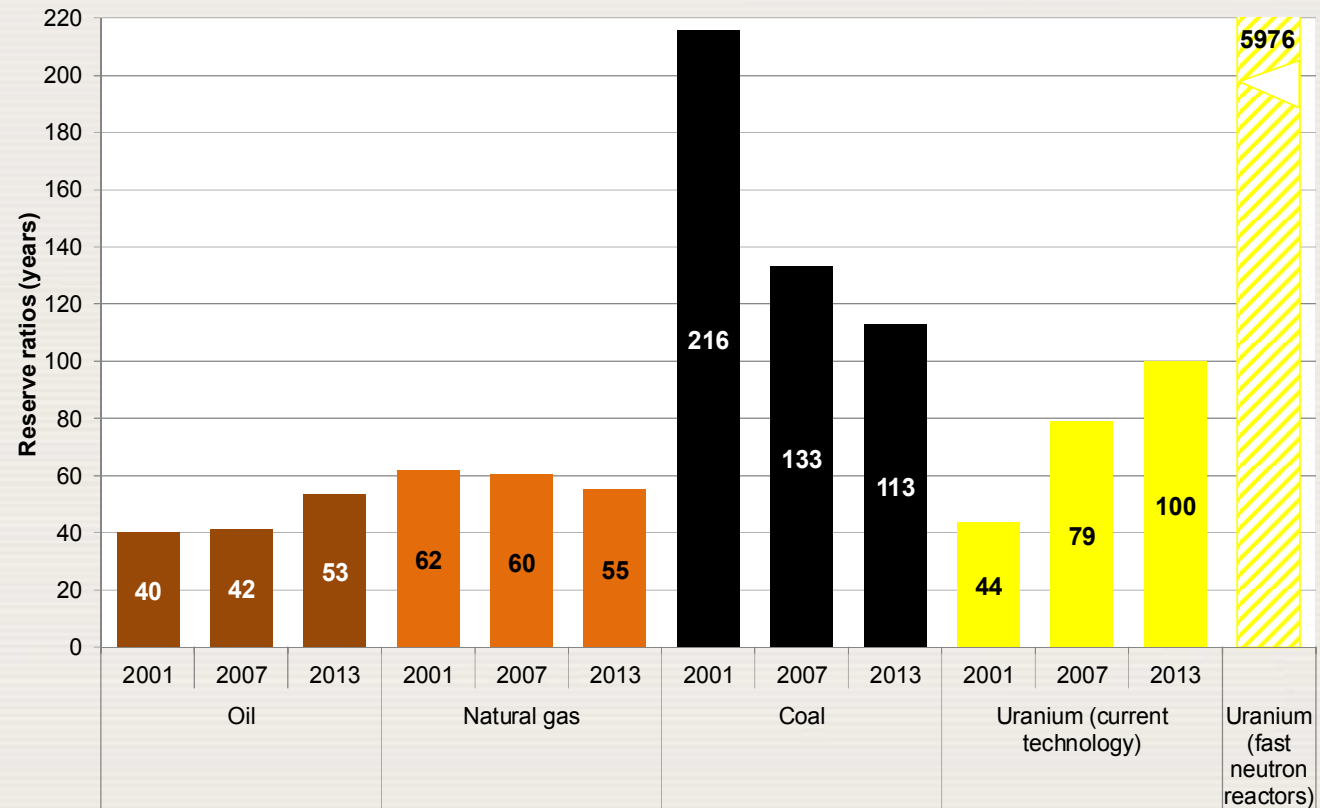
*...atoms for peace.*



@IAEANE

# Adequate resources

- Supplies are plentiful and resources are well diversified
- Small fuel volumes
- Possibility to accumulate significant stockpiles



⇒ Nuclear power contributes to enhanced energy security