# High-impact EURATOM fission research

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DG RTD G.4 (Euratom fission)

University of National and World Economy: Info Day on EURATOM (in the frame of an UN educational project for students and PhDs on nuclear energy), Sofia, Bulgaria, 12 September 2016

# Outline of my presentation

- Need of a clean energy to fight pollution and climate change

- Why nuclear could be the best energy source
  - Current nuclear assets in the EU
  - A foresight exercise: is the nuclear share going to increase?

- Is it possible to change public perception on nuclear? Do we make good communication? Do we make good decisions? How decisions are taken?

- What is targeted by the Euratom fission programme (RTD work programme) ?

- Is Bulgarian participation to the Euratom fission calls… efficient?

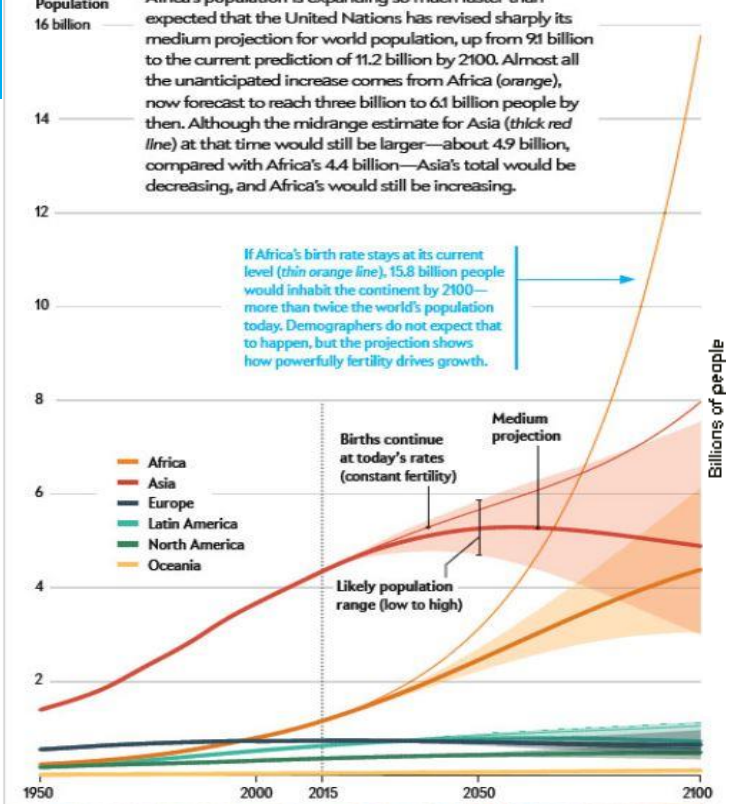
- Conclusions

# Africa Drives Global Population Growth

Total Population
16 billion

Africa's population is expanding so much faster than expected that the United Nations has revised sharply its medium projection for world population, up from 9.1 billion to the current prediction of 11.2 billion by 2100. Almost all the unanticipated increase comes from Africa (*orange*), now forecast to reach three billion to 6.1 billion people by then. Although the midrange estimate for Asia (*thick red line*) at that time would still be larger—about 4.9 billion, compared with Africa's 4.4 billion—Asia's total would be decreasing, and Africa's would still be increasing.

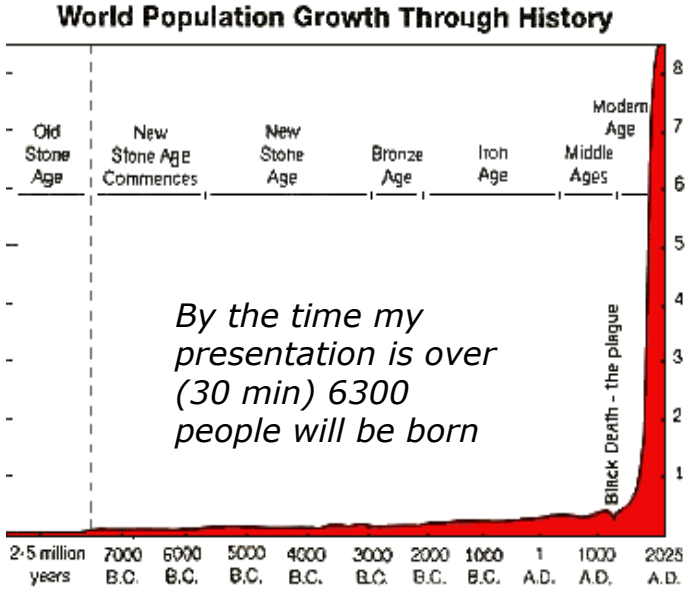
If Africa's birth rate stays at its current level (*thin orange line*), 15.8 billion people would inhabit the continent by 2100—more than twice the world's population today. Demographers do not expect that to happen, but the projection shows how powerfully fertility drives growth.



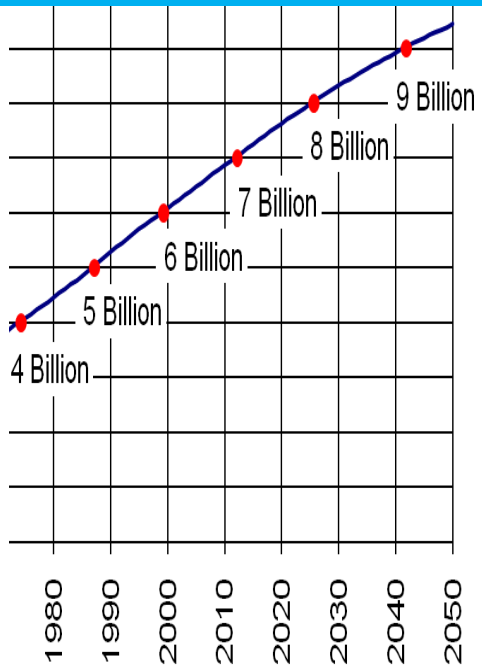

CREDIT: JONATHAN TORGOVNIK *Getty Images*

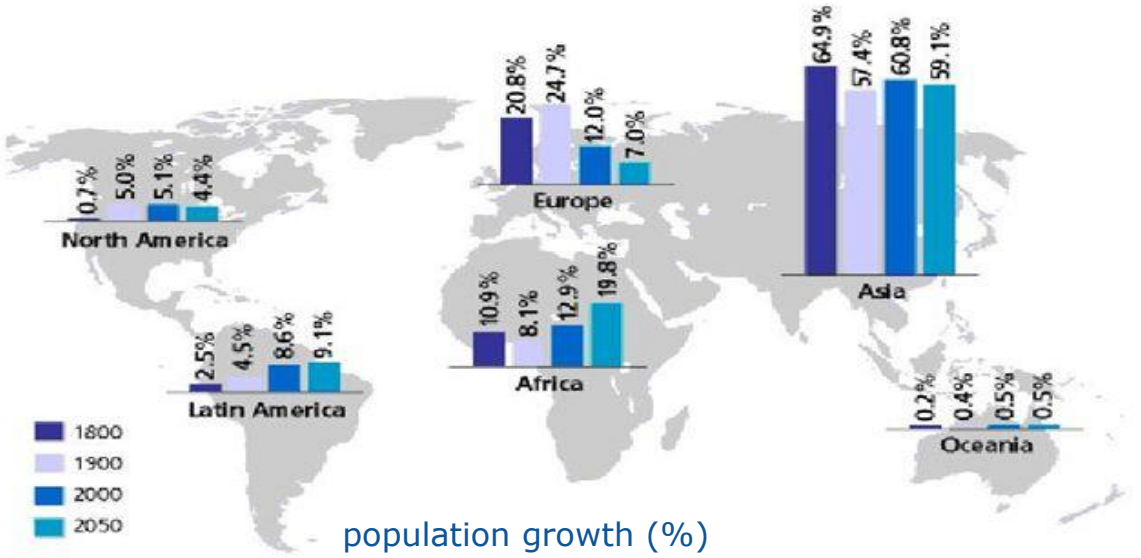
Counselor from Marie Stopes International educates women gathered at a hospital in Rabai, Kenya, about family-planning options, including emergency contraception.

# World population increased by 4.5 billion in the last 60 years



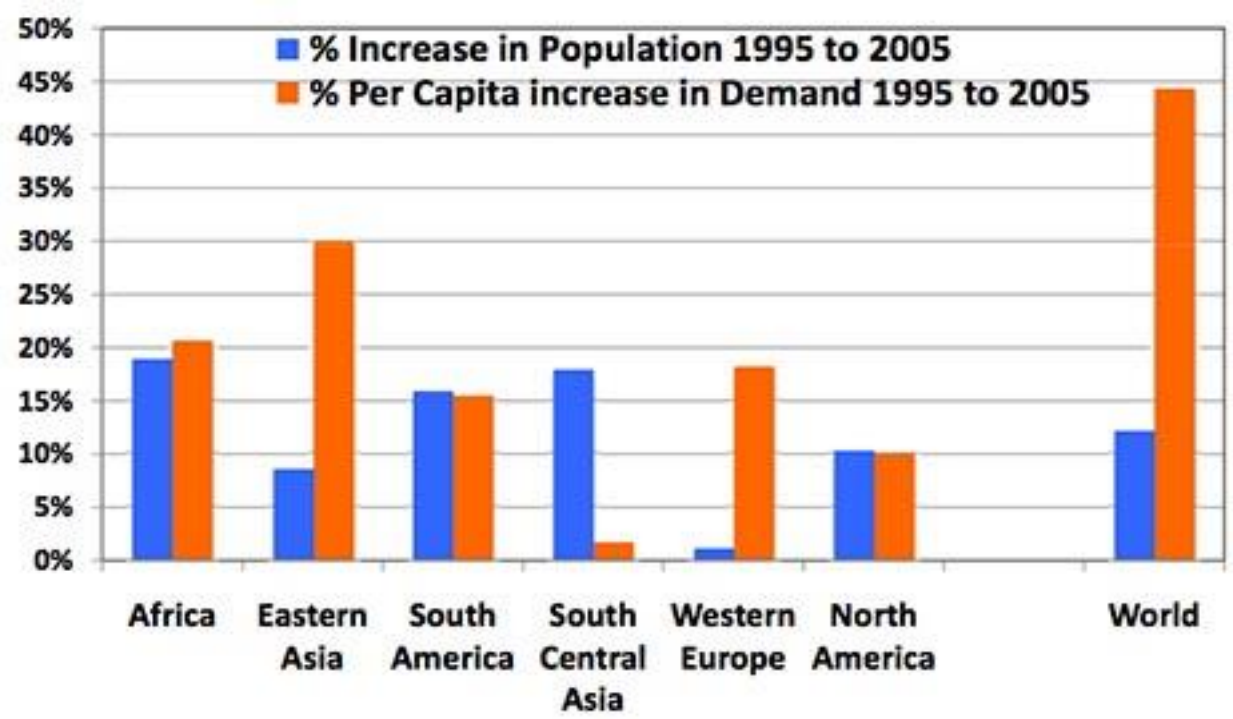

*By the time my presentation is over (30 min) 6300 people will be born*




population growth (%)

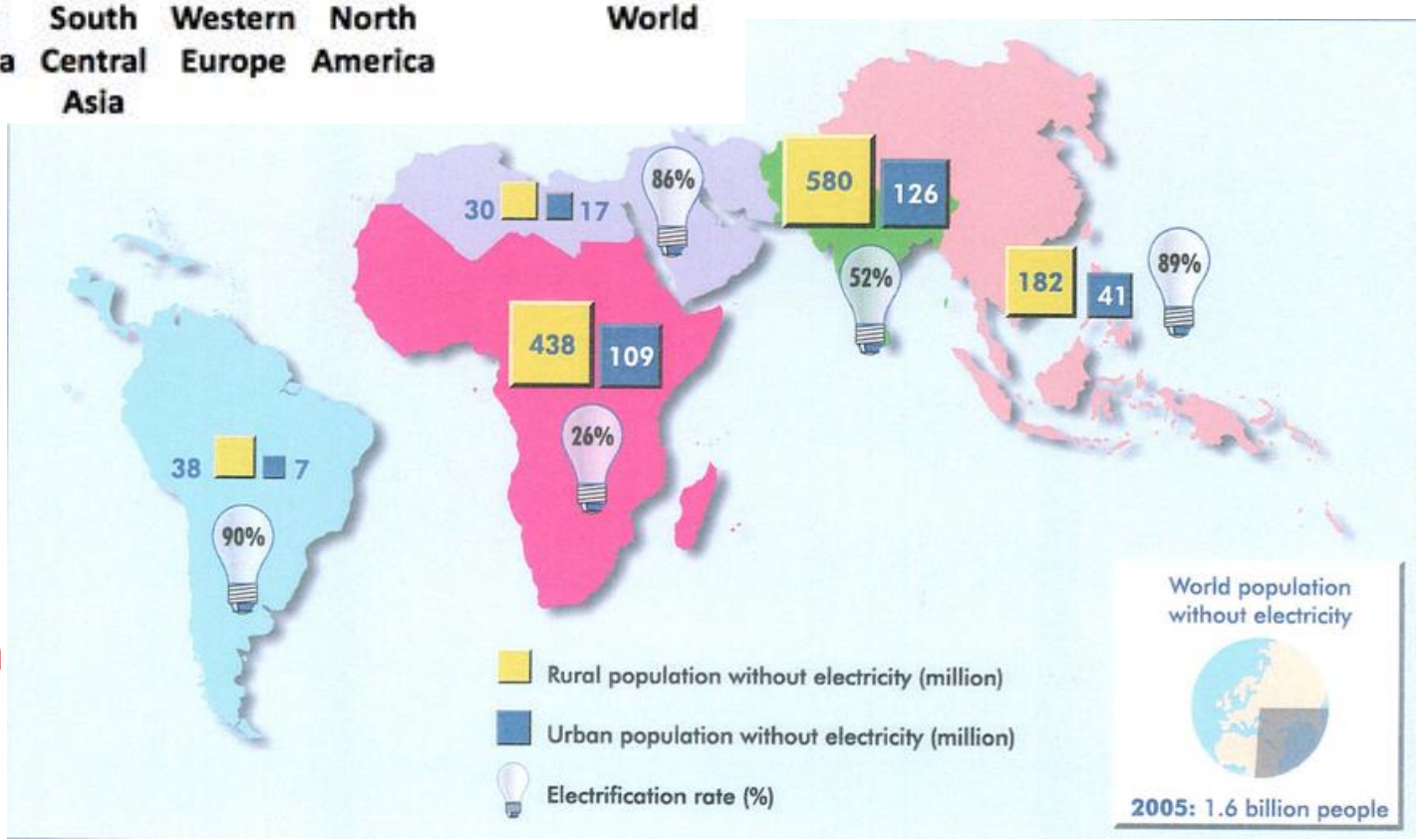
# Increase in world energy demand



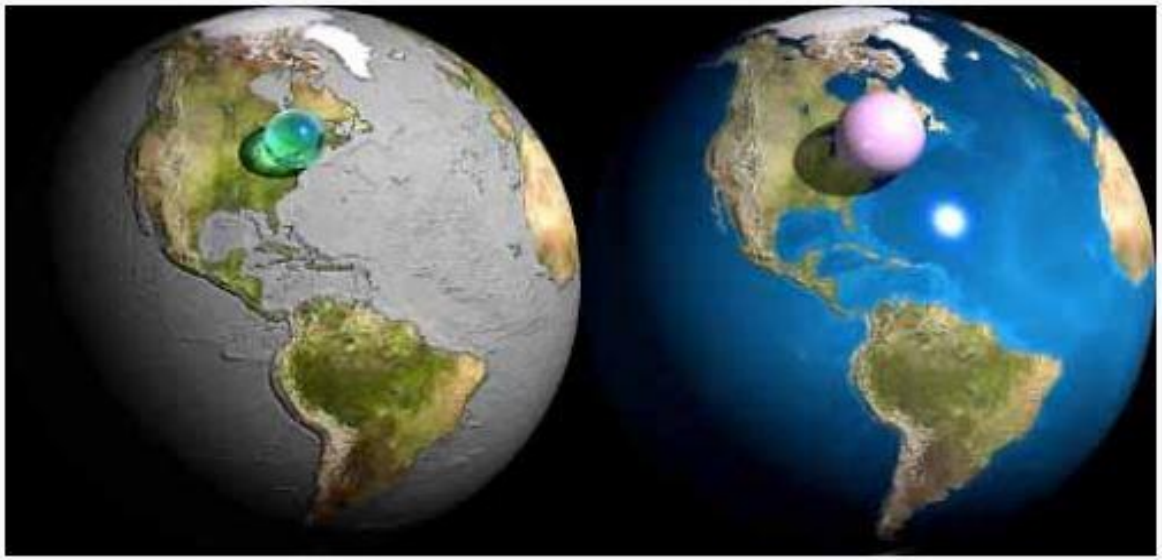

**85% is generated by burning fossil fuels thereby increasing climate change & pollution**

**25% of the world's population has <u>no electricity</u>**

**World energy consumptions are expected to grow by 50% in 2050**

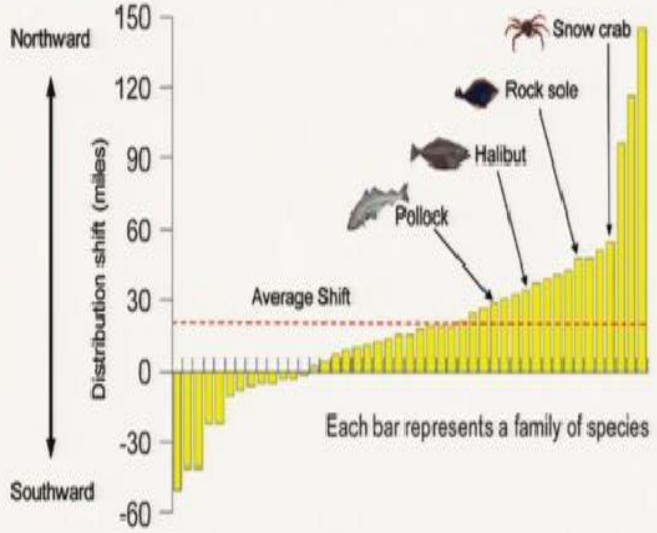


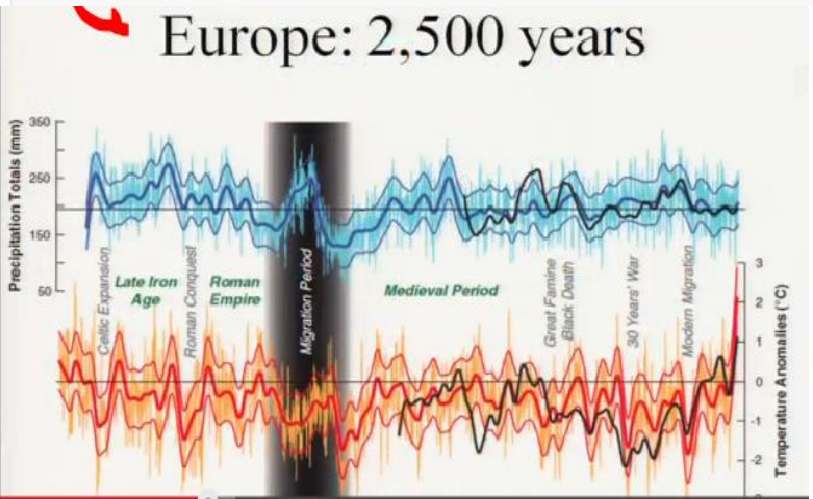
# Our planet is vulnerable… and mankind too !



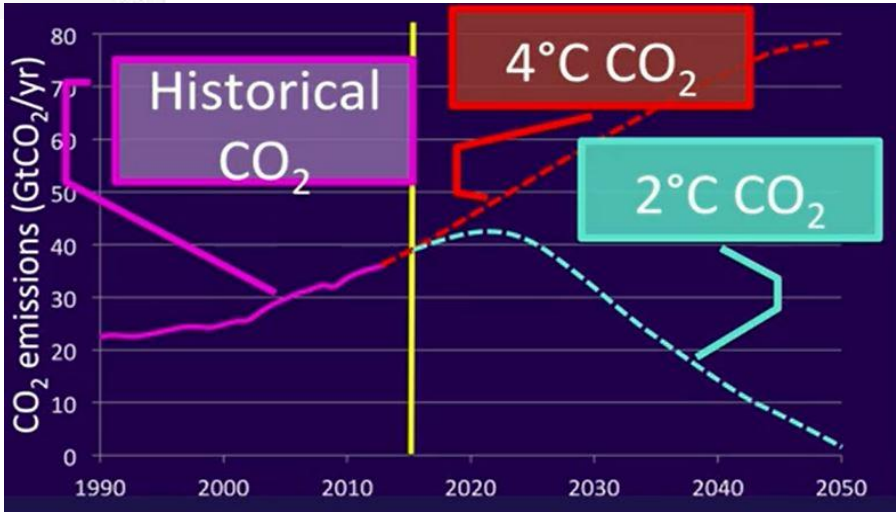
This image shows the volume of all the world's water if put in the form of a sphere (green) and the volume of the atmosphere (pink) if the air were all at sea-level pressure. *(Credit: Adam Nieman, Science Photo Library)*

On average, by 2006, the center of the range for the examined species had moved 19 miles north of their 1982 locations.

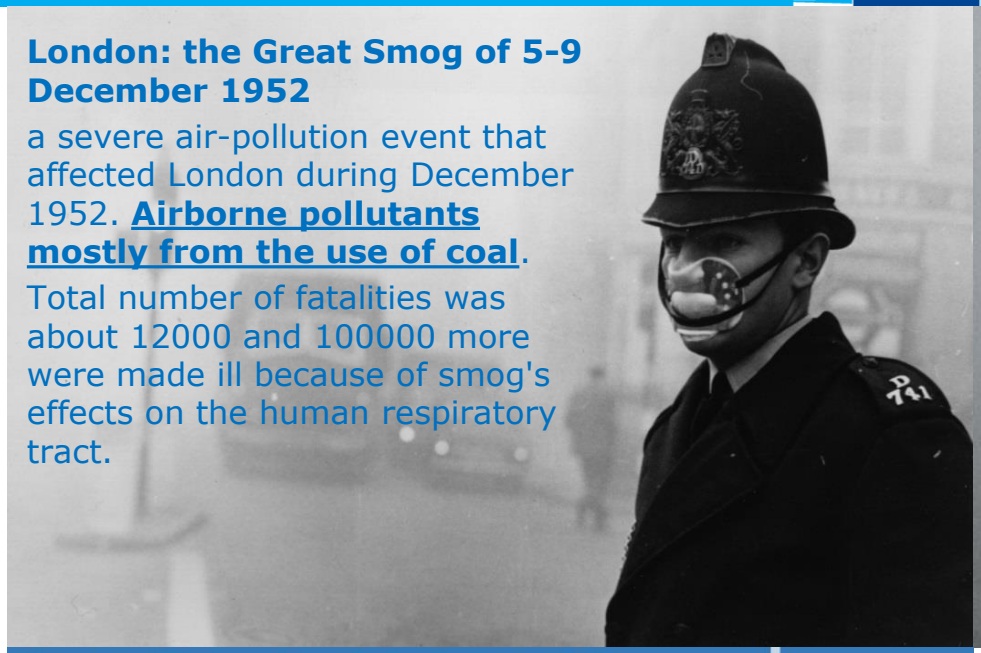



**Today: 35-40 billion tons of $CO_2$ are released each year**



# Our planet is vulnerable... and mankind too: today's towns are polluted by fine particulates/$CO_2$ which are not visible to the eye



**London: the Great Smog of 5-9 December 1952**

a severe air-pollution event that affected London during December 1952. **Airborne pollutants mostly from the use of coal**.

Total number of fatalities was about 12000 and 100000 more were made ill because of smog's effects on the human respiratory tract.

**Beijing: first red alert on 8 December 2015**

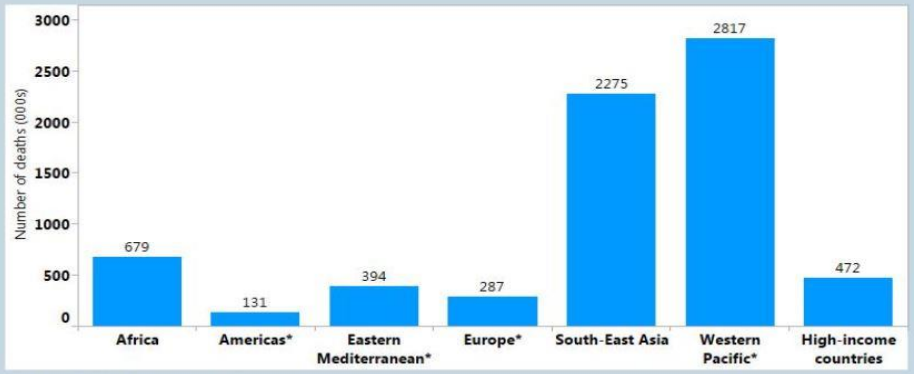
vehicles were ordered off the roads and schools and factories closed.

All large-scale outdoor activities were cancelled.

**Chinese government is considering a cap on coal consumption**.

**Deaths attributable to joint effects of both household and ambient air pollution, 2012**
**By WHO region**

World Health Organization




* Low- and middle-income countries

***Note:*** *Due to the overlap of exposure to both household (indoor) and ambient (outdoor) air pollution, this figure provides indicative values only and should be interpreted with caution.*

## World Health Organization:

- **3.7 million deaths per year triggered by fine particulate/CO2 pollution**
- **between 2030 and 2050 climate changes are expected to cause approximately 250000 deaths per year**

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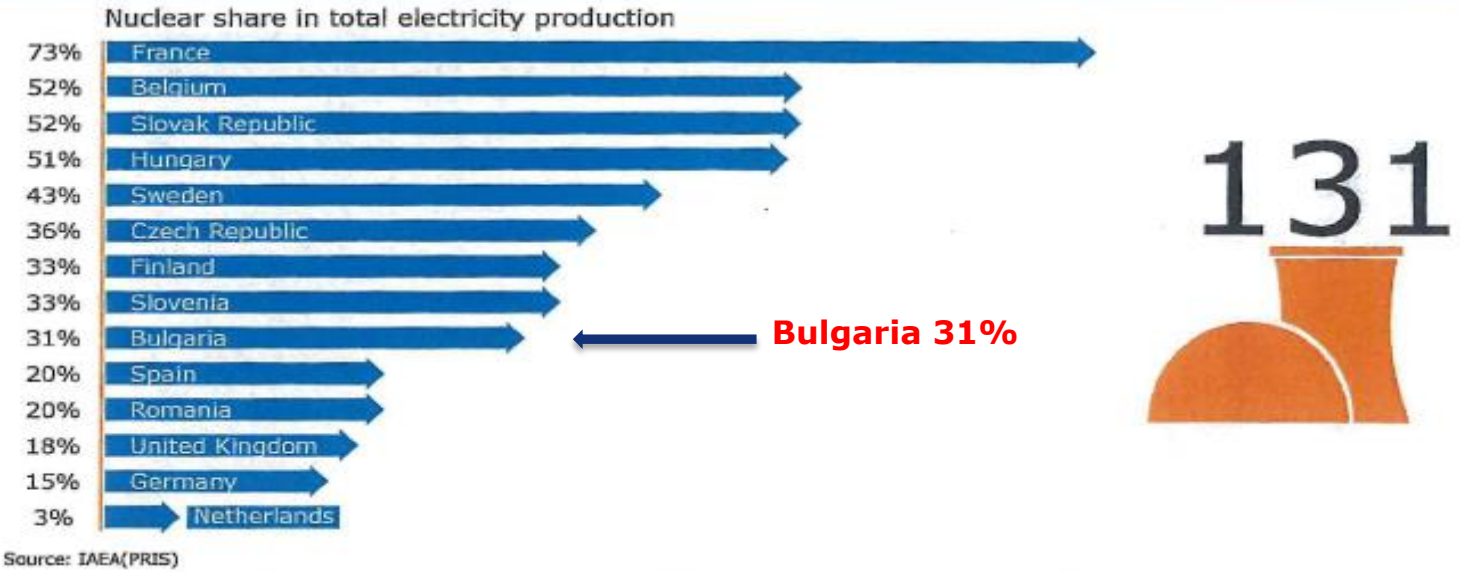
# Nuclear industry is an important asset of the EU (Foratom data)

## Generating 27 % of EU's electricity


## ...in 14 countries with 131 nuclear reactors



# Nuclear energy is efficient, cheap and with high capacity factors

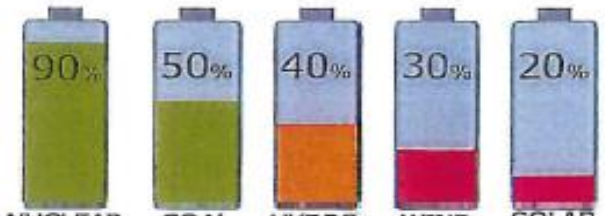
## Providing a reliable energy source...

Nuclear produces electricity at full power

**85 to 90%**

of the time thus enhancing security of supply

**Energy performance***

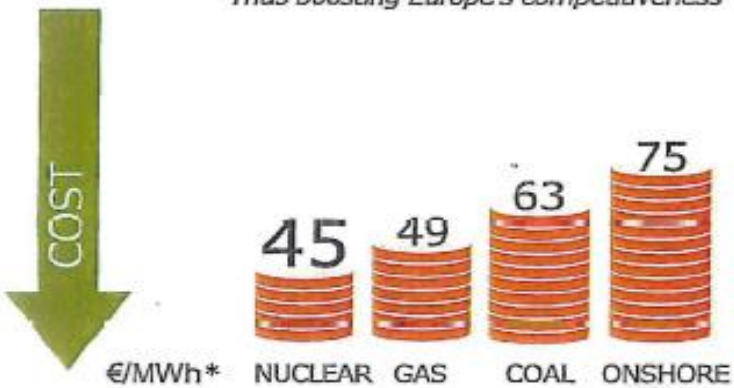



*% of rated capacity factor

Source: NEI, 2012

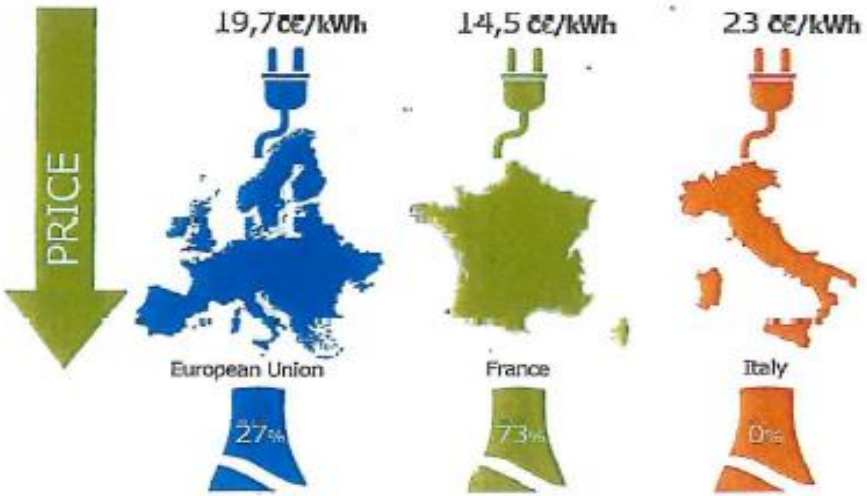
## ...at prices you can afford

*Thus boosting Europe's competitiveness*




*LCOE for Europe including a carbon price of €23/ tonne of $CO_2$

Source: Projected Costs of Generating Electricity, IEA and OECD/NEA, 2010

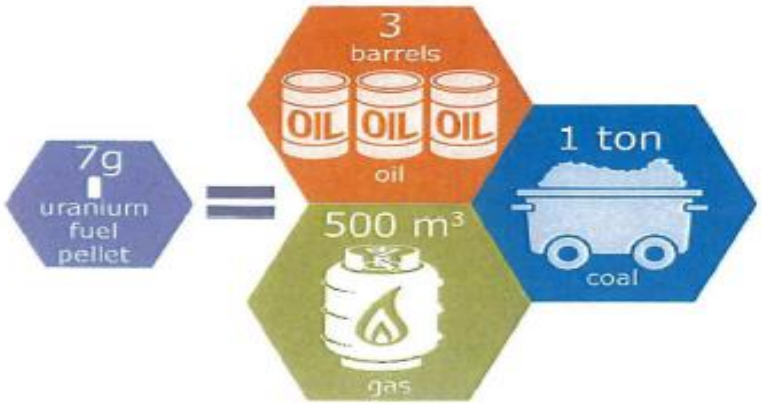



Source: Eurostat, November 2013

# … and stable prices in a sustainable economy

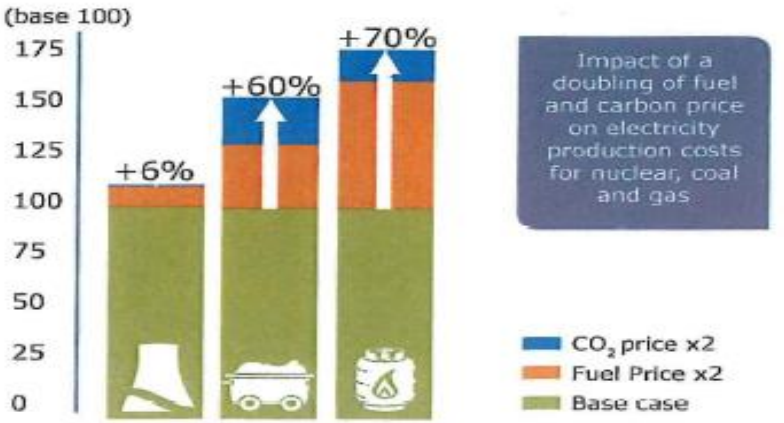
## Providing an independent source of energy at a stable price

*Quantity of fuel necessary to produce a given amount of electricity*




Source: American Nuclear Society

*The cost of nuclear power is less vulnerable to fuel price fluctuations*




Source: AREVA, 2014

## Contributing to EU energy policy goals


53% of low-carbon electricity

Turnover of € 70 billion/year

The energy choice of **14** EU members states


over **20** nuclear reactors

**Planned**
BULGARIA CZECH REPUBLIC FINLAND HUNGARY POLAND ROMANIA SWEDEN SLOVENIA UNITED KINGDOM

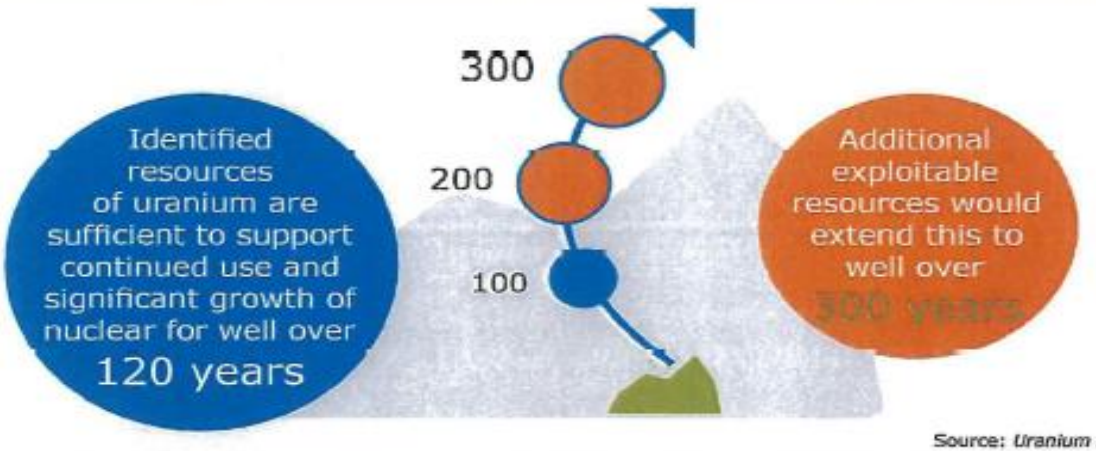
**4** nuclear reactors

**Under construction**
FINLAND FRANCE SLOVAKIA

Source: FORATOM

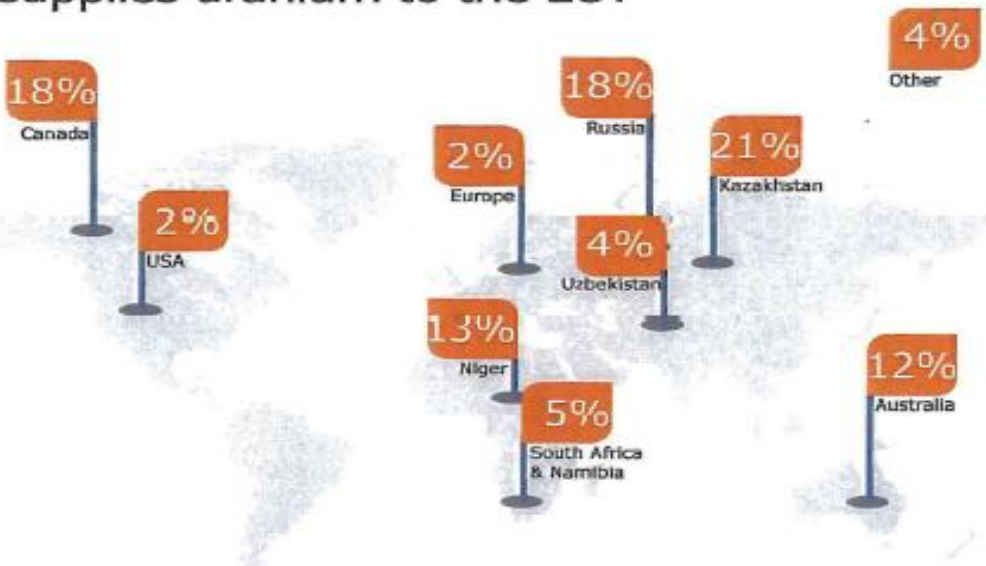
# Nuclear could assure a good security of supplies

## Harnessing abundant natural resources from stable countries




Source: *Uranium 2014: Resources, production and demand*, IAEA

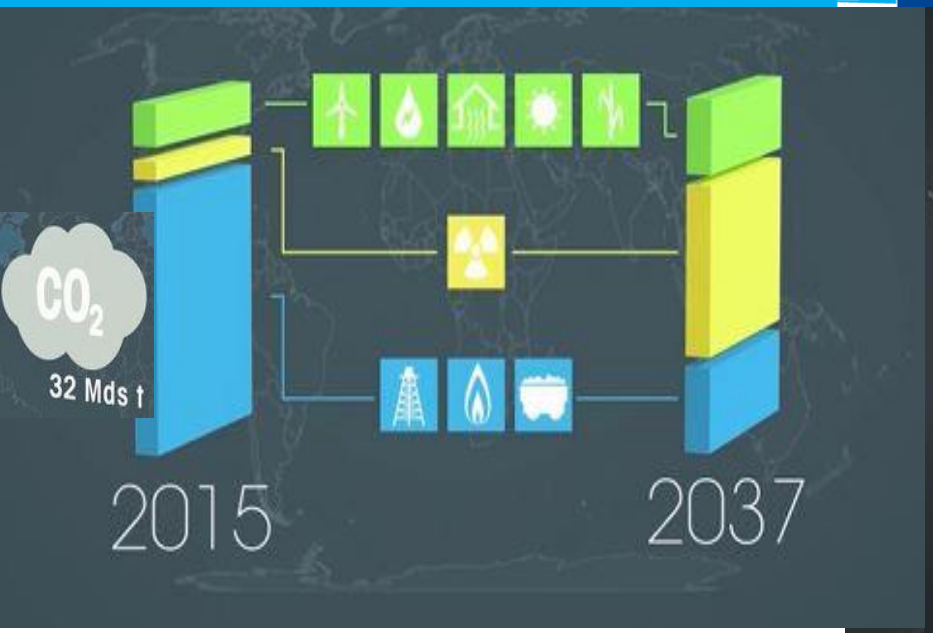
## Who supplies uranium to the EU?




Uranium resources are available from a diversity of suppliers

Source: EURATOM suply agency, 2013

# A foresight exercise: ArteTV- le dessous des cartes (http://ddc.arte.tv/)




***BBC:***

***The UK needs China to build its nuclear plants. Through a 2 billion Pound "guarantee" China is contributing to the first nuclear plant in the UK for 20 years, Hinkley Point C***

***This "unprecedented co-operation with China" will allow the construction of more nuclear plants (a Chinese-designed nuclear reactor could be built in Essex)***

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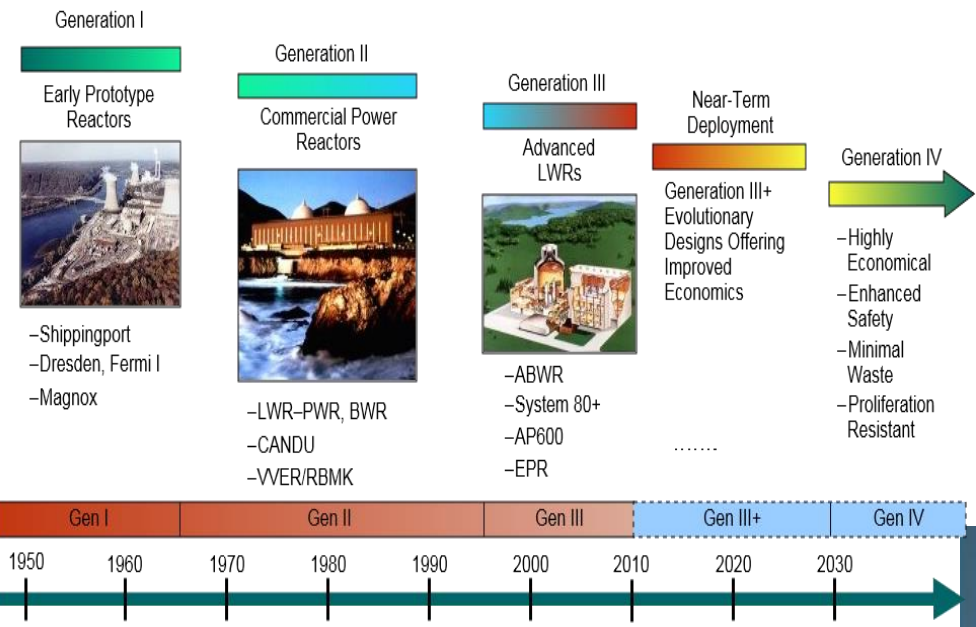
**the new geo-political equilibrium based on nuclear**

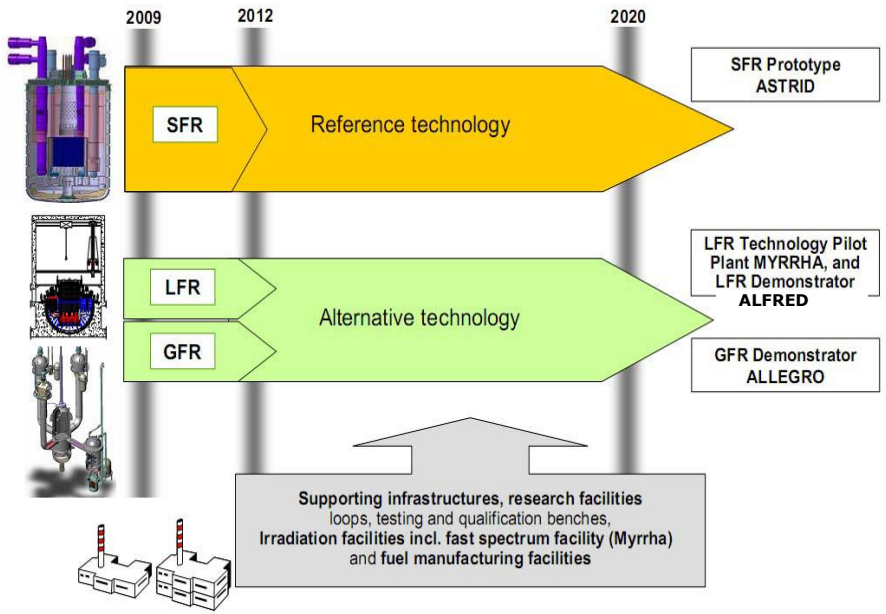
**In 30-years' time China, Russia, India and South Korea will export nuclear technologies in several part of the world (essentially the current/cheapest LWRs' technology with non-negligeable proliferation risks)**

# 2040: Target for the deployment of Gen-IV Fast Neutron Reactors with Closed Fuel Cycle

European Commission

**Generation IV**: Nuclear Energy Systems Deployable no later than 2030 and offering significant advances in sustainability, safety and reliability, and economics




*Fast breeder reactors could use the full potential of fission energy for several thousands of years, minimize wastes and improve proliferation resistance*

https://www.gen-4.org/gif/jcms/c_9260/public

GEN IV International Forum

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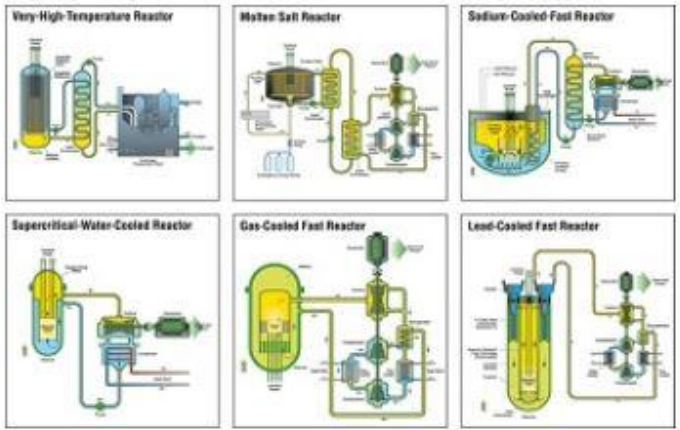
A Technology Roadmap for Generation IV Nuclear Energy Systems


# Generation IV Systems

For more than a decade, GIF has led international collaborative efforts to develop next generation nuclear energy systems that can help meet the world's future energy needs. Generation IV designs will use fuel more efficiently, reduce waste production, be economically competitive, and meet stringent standards of safety and proliferation resistance.

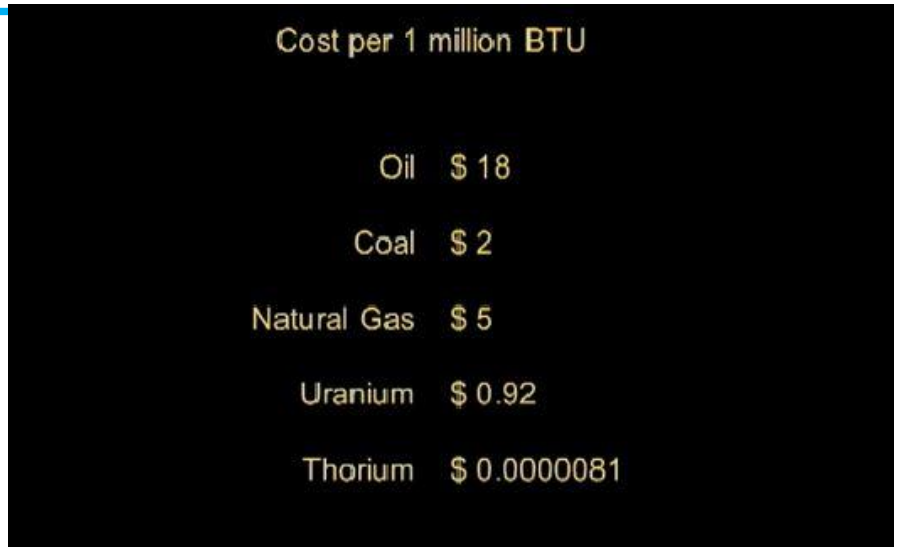
With these goals in mind, some 100 experts evaluated 130 reactor concepts before GIF selected six reactor technologies for further research and development. These include the: Gas-cooled Fast Reactor (GFR), Lead-cooled Fast Reactor (LFR), Molten Salt Reactor (MSR), Supercritical Water-cooled Reactor (SCWR), Sodium-cooled Fast Reactor (SFR) and Very High Temperature Reactor (VHTR).

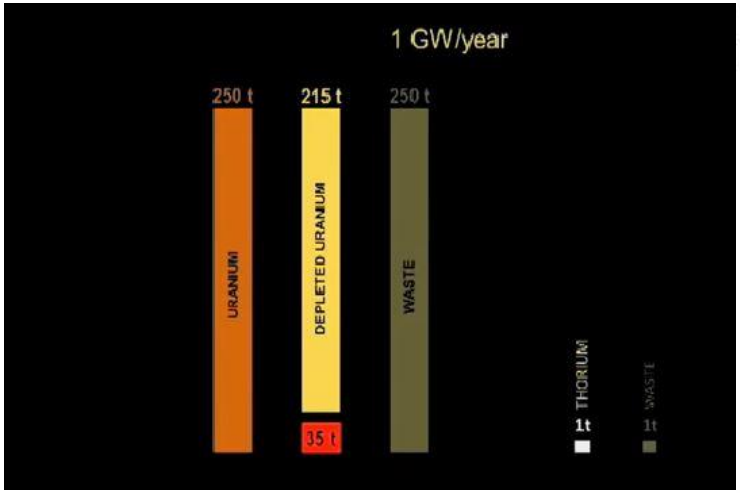



Some of these reactor designs could be demonstrated within the next decade, with commercial deployment beginning in 2030. China has begun construction of a prototype High Temperature Reactor (HTR-PM) a first step towards the development of the VHTR. Both France and Russia are developing advanced sodium-fast reactor designs for near-term demonstration. A prototype lead fast reactor is also expected to be built in Russia in the 2020 time frame.

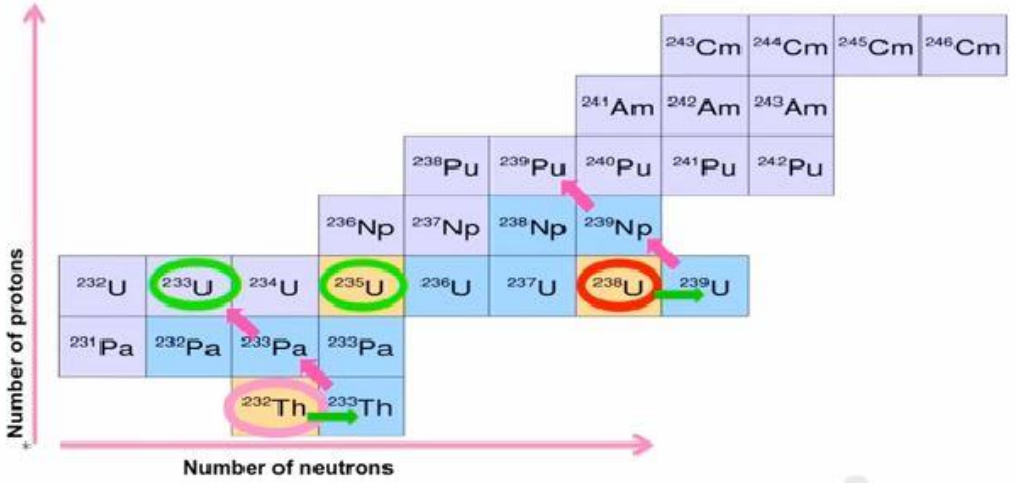
# Thorium-fuelled molten-salt modular reactors (sustainable source of power, inherently safe and proliferation-resistant) is most probably today's best nuclear option

European Commission


One major issue with nuclear power is the generation of long-lived radioactive waste



# An industrial interest for (molten-salt) small modular reactors is conditional to public acceptance

European Commission

- *50MW MSRs (Molten Salt Reactor)*
- *built in a factory/*
- *Fast breeder/*
- *Liquid fuel (Thorium in solution)*
- *High burn up/*
- *High-temperature Brayton cycle (45-50% efficiency)/*
- *Low pressure primary system/*
- *30 years operation with no refuelling/*
- *No proliferation risks/*
- *Hydrogen-free/*
- *Intrinsically safe/ stable operation/*
- *No Core melt/*
- *SA- free/liquid*

**Operated 22000 hours in Oak Ridge in 1952 (Weinberg's reactor)**


"perfecting nuclear fission": https://www.youtube.com/watch?v=5HL1BEC024g

**The Guardian (https://www.theguardian.com/world/2014/mar/19/china-uranium-nuclear-plants-smog-thorium)**

# China working on uranium-free nuclear plants in attempt to combat smog

## Beijing brings forward deadline for world's first thorium-fuelled facility in attempt to break reliance on fossil fuels

The Qinshan plant, outside Shanghai, is China's first nuclear power facility. Photograph: Eugene Hoshiko/AP

*.. China is developing a new design of nuclear power (thorium molten salt) technology in an attempt to reduce coal-combustion air pollution.*

*In an effort to reduce the number of coal-fired plants, the Chinese government **has brought forward by 15 years the deadline** to develop a nuclear power plant using the radioactive element thorium instead of uranium*

*"In the past, the government was interested in nuclear power because of the energy shortage. Now, they are more interested because of smog," Professor Li Zhong, a scientist working on the project, told the Hong Kong-based South China Morning Post.*

*According to the World Nuclear Association (WNA), China has 20 nuclear plants in operation and another 28 under construction, all uranium-fuelled reactors. China has been importing large quantities of uranium as it attempts to reduce its reliance on fossil fuels. However, according to the WNA, thorium is much more abundant.*

*The researchers on the project said they had come under considerable pressure from the government for it to be successful. Li said nuclear power was the "only solution" to replace coal, and thorium "carries much hope".*

*"The problem of coal has become clear," he said: "if the average energy consumption per person doubles, this country will be choked to death by polluted air."*

*"China has an ambitious nuclear-generation programme. It plans to have almost 60 gigawatts of nuclear energy by 2020 and up to 150GW by 2030, so the Chinese have plans to get a significant amount of nuclear into the energy mix."*

*The researchers on the project told the South China Morning Post their work would be likely to face some opposition from Chinese citizens after the nuclear disaster at Fukushima, in Japan….*

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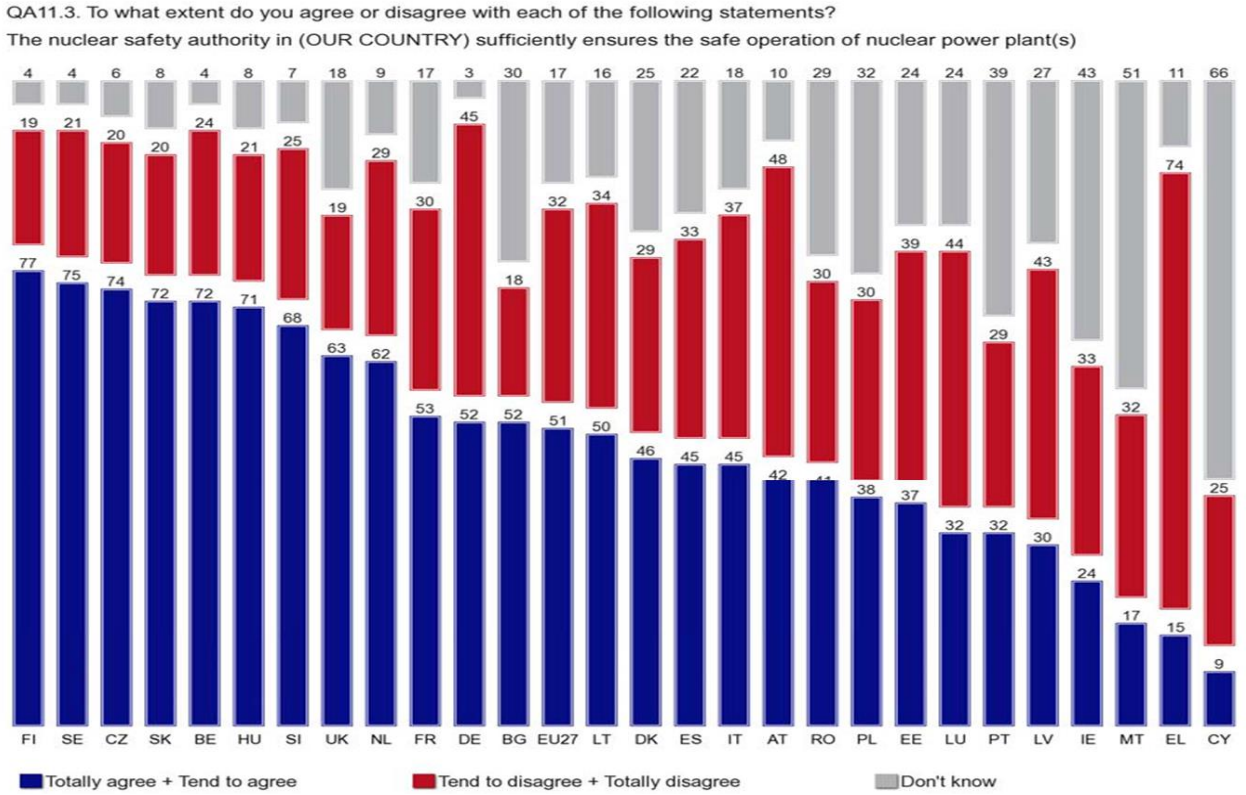
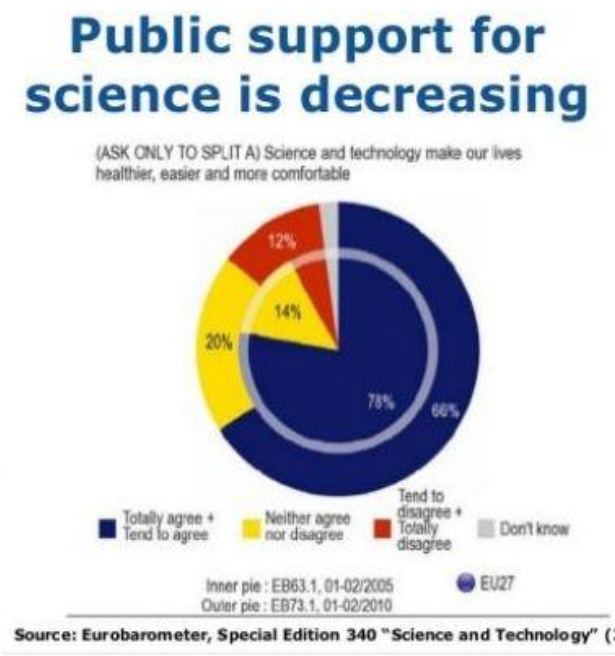
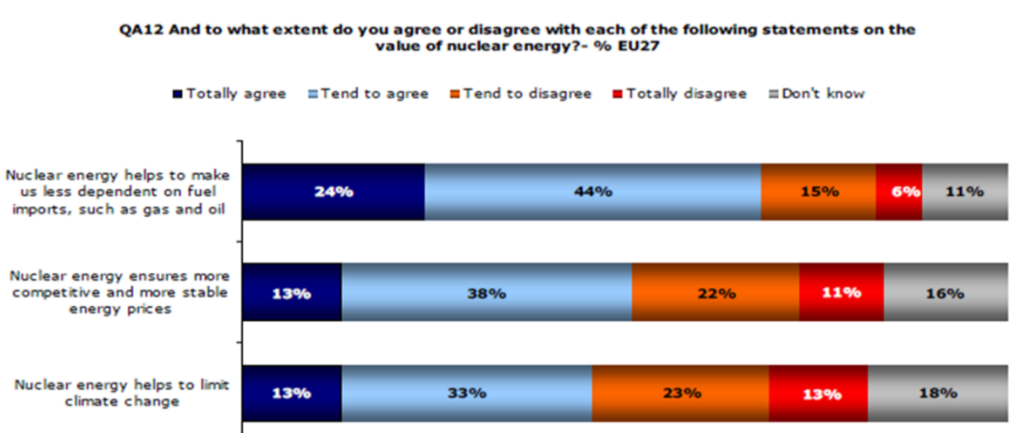
# Trust in nuclear safety authorities: do they perform adequately ? (Sep 2009 during the so-called "nuclear renaissance" i.e. before Fukushima)



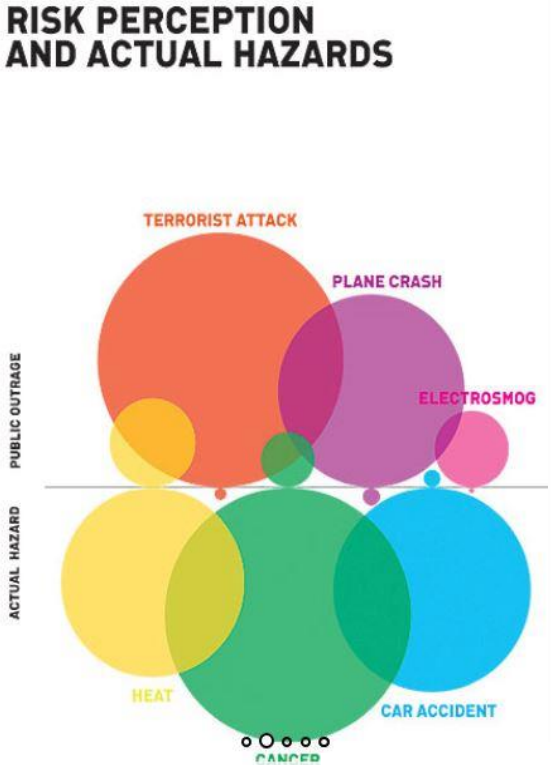

**68% agree that it decreases energy dependence**

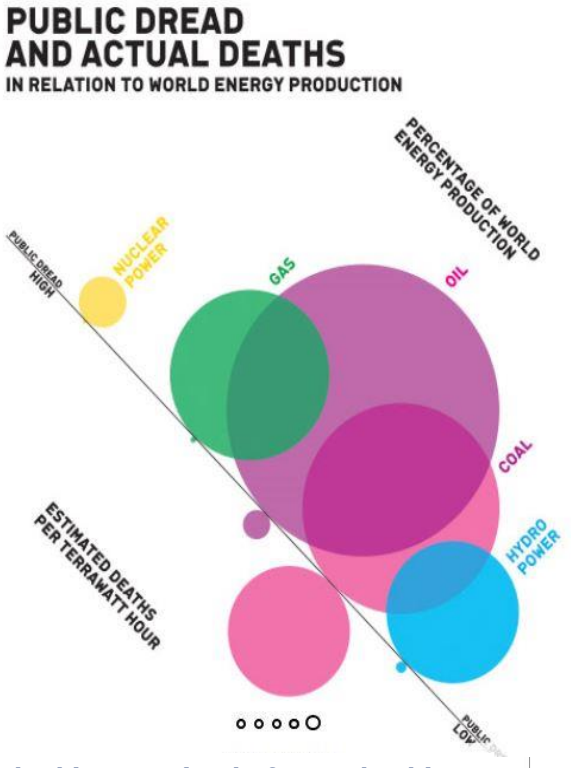
**51% agree that it ensures more stable energy prices**

**46% agree on the positive role in the fight against climate change**

**…. which means that there is "no acceptance of nuclear energy"**

# Risk perception and evidence are different things. Embedding of SSH (Social Science & Humanities) in future Euratom work programmes will help in improving public acceptance ?



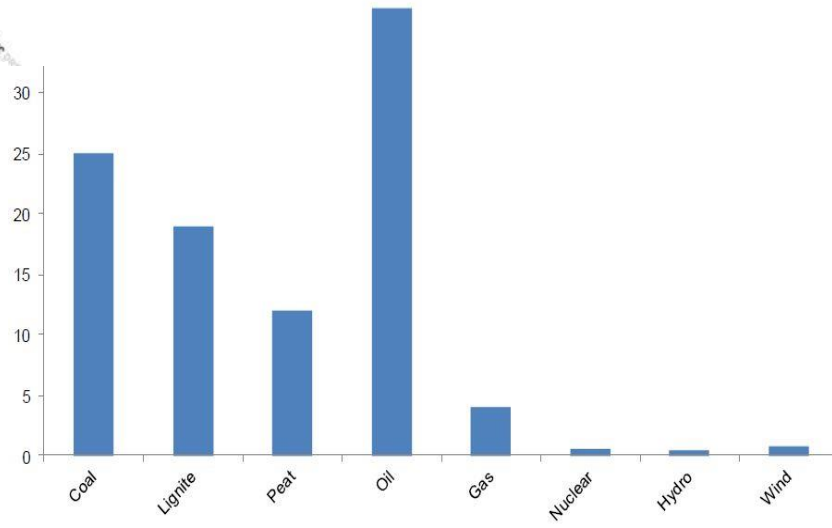




**NB: Statistic published in 2010 i.e. before Fukushima**

EU national parliaments reflects more and more the **public misperception** of nuclear energy which is based on the fact that **an accident at a nuclear plant is not acceptable because of high radiological risks…**

**…but are these risks causing real casualties?**

Mean value of health effects of generating electricity in the EU (deaths/TWh) – source ExterneE, excludes climate change




Where are the consequences of past accidents as Windscale (0,02 MCi of I-131), TMI (0.000018 MCi), Chernobyl (49 Mci?) and Fukushima (2 Mci?) ?

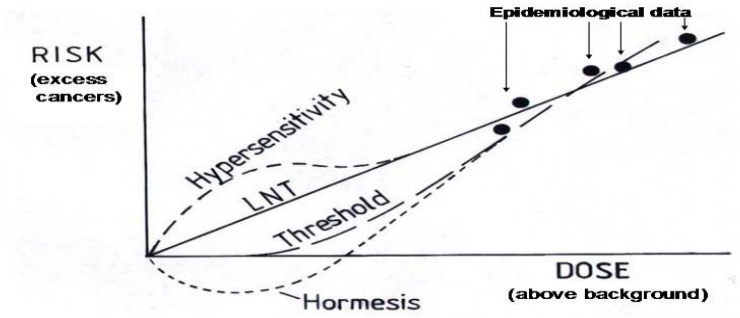
The LNT (Linear-No-Threshold) model is a linear extrapolation of high-doses' effects to the potential effects at low-doses is only for ALARA purposes and cannot be used for predictions of mortalities

# Nuclear medicine: Health Physics Society

http://hps.org/hpspublications/articles/Benefitsofmedradexposures.html

European Commission

**The Linear-No-Threshold (LNT) model** assumes, in the absence of evidence, that the rate of cancer at low doses can be extrapolated from observations at high doses (Hiroshima and Nagasaki epidemiological data)





***Health Physics Society: benefits versus risks of nuclear medicine (risks are assessed with the LNT model)***

***A case study***

*With a conventional (non-nuclear) pre-operation evaluation of the disease, a thoracotomy is ordered in 81 percent of the cases, with 41 percent of these being futile (meaning that the procedure is not successful in removing the diseased tissue and therefore cannot possibly be curative)*

*Through a PET (positron emission tomography), thoracotomy is ordered in only 65 percent of cases reducing futile interventions to only 21 percent. Surgical-related mortality is reported as 6.5 percent*

*Considering 2192 lives saved with an effective dose of 7 mSv the LNT model would predict 61 excess cancer deaths each year*

*Thus the net benefit in terms of lives saved is 2192 - 61 = 2131 per year.* ***It is important to recall that the lives saved are actual lives saved, whereas the lives lost from the 7 mSv exposure are theoretical lives lost*** *(i.e. fatal cancers predicted by extrapolation of the LNT model down to this low-dose level. Data for the LNT model begin at doses above 100 mSv).*

**Use of radiation in medicine saves hundreds to thousands of lives every year**

**In any case the entirely theoretical risks (fatal cancers) predicted by the LNT model are orders of magnitude smaller**

# Is communication from nuclear stakeholders improving public acceptance?

**Public Understanding of Nuclear Energy: it's not (at all) about the science**

**Why the safest large-scale energy source is regarded as the most dangerous by significant numbers of people?**

**How is it possible that Fukushima, a middle-ranking industrial accident of the kind that happens eight or ten times every year in the world, has become a major human tragedy?**

**The public "*commonsense-based*" aversion to nuclear energy is the result of years of miscommunication and misunderstanding (to the point of irrationality) by the 'nuclear community' – i.e. the industry, its regulators and its supporters**

Themes

- Agriculture & food
- Energy
  - Fossil fuels
  - Nuclear fission
  - Nuclear fusion
  - Rational energy use
  - Reliability of supply
  - Renewable energy sources
  - Other
- Environment
- ERA-NET
- Health & life sciences
- Human resources & mobility
- Industrial research
- Information society
- Innovation
- International cooperation
- Nanotechnology
- Pure sciences
- Research infrastructures
- Research policy
- Science & business
- Science in society
- Security
- SMEs
- Social sciences and humanities
- Space
- Special Collections
- Transport
- Video reports

Countries

- Countries
- Algeria
- Argentina
- Australia
- Austria

Success Stories

Published: 17 June 2013

Related category(ies):
Energy | Environment

Countries involved in the project described in the article:
Austria | Czech Republic | Denmark | France | Germany | Greece | Hungary | Italy | Netherlands | Norway | Romania | Russia | Slovakia | Spain | Sweden | Ukraine | United Kingdom

Add to PDF "basket"

## United response to nuclear safety

**Radioactivity as a result of the Chernobyl nuclear power plant disaster in the 1980s is still present in the environment. But 17 national emergency management organisations and 33 research institutes have come together to prevent or minimise the impact of such a thing happening again. Their objective has been to ensure that Europe can respond better to similar emergencies in the future.**

European Approach to Emergency Management
© Shutterstock

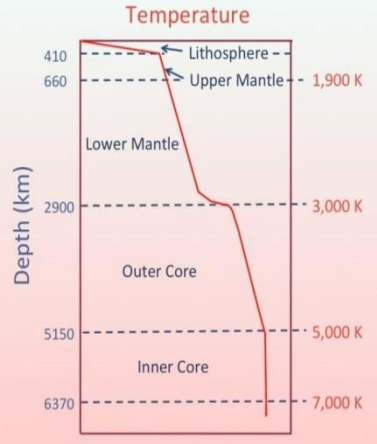
Over a five-year period, the project EURANOS ('European Approach to Nuclear and Radiological Emergency Management and Rehabilitation Strategies') utilised scientific knowledge and technology in preparing Europe's response in the event of a radiation emergency, and developing long-term plans for rehabilitation. This was supported with funding of EUR 14.7 million, of which nearly EUR 7 million came from the European Commission.

The project was seen as vital because of the varying levels to which individual countries were equipped to respond to radiation emergencies. Such an incident could occur in a country as a result of an accident or of a deliberate terrorist attack. This could then have a knock-on effect from one country to another. But by sharing expertise, data and technology between Member States, Europe can place itself at a better position to respond more effectively to a radiation emergency.

Some of the measures the project devised included a compendia containing a wealth of state-of-the-art information for emergency management. The project also further improved 'Decision Support Systems' (DSS) aimed at providing support to the national emergency management teams (EMT) in collecting on-line and real-time measurements. This involved analysing the current radiological situation, estimating its future development, and ranking the countermeasures.

# why radioactivity is so easy to detect ? The Avogadro's number !

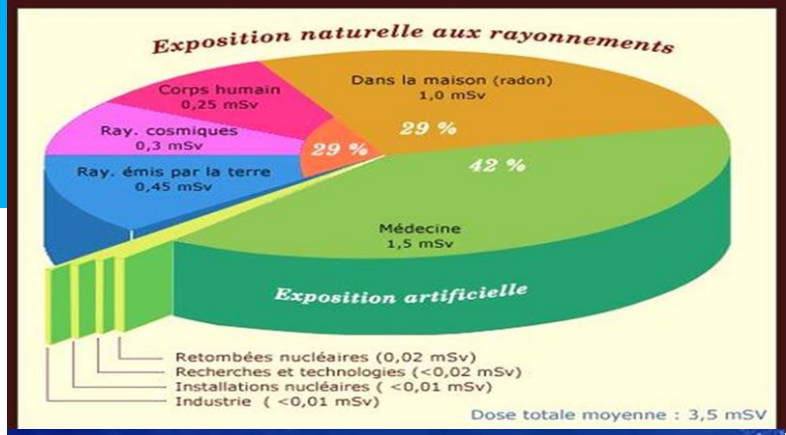
European Commission




## *Radioactivity from Chernobyl is still present in the environment ?*

Yes, as much as terrestrial natural radioactivity by Potassium, Uranium and Thorium which made life possible on Earth

(50% of the heat given off by the Earth)





## *A curious parallel: what about* the number of molecules of Julius Caesar's last gasp?

What are the chances you just inhaled a molecule which Caesar exhaled in his dying breath? The answer is that, with probability better than 99 percent, you did just inhale such a molecule (http://maddenation.com/archives/2004/01/02/caesars_last_breath.php)

**The human body is radioactive: 10% of the dose from natural sources comes from our own body!**

The number of nuclei decaying per second is very high (10000 per second) but at the same time the ratio of nuclei decaying is infinitesimally small (approximately 10-24).

This because of the Avogadro's number which represents for example the number of water molecules in 18g of water. It has a value of $N=6.022 \times 10^{23}$ i.e. 602 thousand billion billions. The number of atoms in the human body is about 10000 times higher than this. These immensely high numbers must be borne in mind when thinking about the atomic world

**Doses by medical applications are today larger than natural doses (total annual doses have doubled in the US) !**

# Non-nuclear man-made activities lead to some 85000 deaths in technological disasters every ten years

In April 2013 a NASA paper* estimated that the use of nuclear power rather than fossil fuels had saved some 1.84 million air pollution-related deaths (while saving the emission of 64 billion tonnes of carbon dioxide) with up to a further 7 million lives to be potentially saved over the following four decades should a major new nuclear programme by initiated globally (and depending on which fuel it displaced)

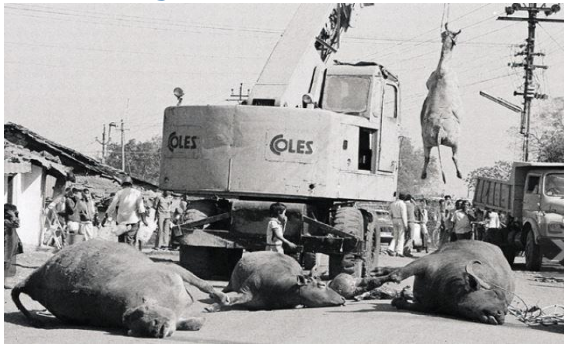
* Kharecha P. and Hansen J. (2013), *Environmental Science and Technology*

By the way… why a terrorist attack should target a nuclear plant?

Chernobyl health effects (estimated by World Health Organisation and United National Committee on the Scientific Effects of Atomic Radiation) were less than 50 deaths onsite, 6000 thyroid cancers with about 10 deaths and possibly 4000 people with shortened lifespan over 70 years (undetectable against natural level of cancer)

Banqiao hydro dam China 1975 – estimated 170000 deaths (26000 from flooding, 145000 from disease/starvation)

The chemical (pesticide) plant in Bhopal exposed 500000 people to poisoning gas and other chemicals. More than 7000 people died (reliable non-governmental estimations) within two weeks and another 8000 or more have since died from gas-related diseases



# "Knowledge-based" (?!) decisions: the Monty Hall problem

*Scientists reacting to public resistance to scientific developments have argued that once the public knows the scientific facts, they will welcome the scientific innovation*

*This interpretation ignores research on how people's knowledge informs their attitudes*

*This work indicates that while people with low levels of factual knowledge tend to become more positive about science, once they learn a bit more, they tend to start thinking more critically*

*The more knowledgeable people are, the more polarised their attitudes become. Thus telling people more (about e.g. genetically modified food or nuclear energy) is more likely to generate protest rather than support. So, **if** we are trying to "sell" nuclear energy **by teaching people** nuclear science, we may be disappointed !*

**This test shows people critical attitude towards a challenge of knowledge, in this case in the field of probabilities (http://ed.ted.com/featured/PWb09pny)**


*So… is the "education/ public information" a mith ?*

*Only anti-nuclear lobbies are essentially active. Fear or interest ?*

*Do we need new ("anti-manipulation") laws to reduce "democratic entropy" ?*

# Public response to safety-based communication

## How the public reacts?

"***These 'nuclear experts' don't think as I do. I understand that whatever is done, safety cannot be completely guaranteed. And what about human error ? How can they be sure they have thought of everything? If a big accident would be as serious as they seem to think, there is no reason for using nuclear energy rather than something else*** "

Statistics show that human error is the cause of 70% to 80% of accidents (for both aviation and nuclear industry)

Aviation

- in the early 90's there were around 2000 deaths and 250 crashes per year
- between 2001 and 2010 the accident rate was cut by 42%
- currently (last five-year average) there are 86 accidents per year (with 20% causing fatalities) i.e. the equivalent of one accident per 2.4 million flights

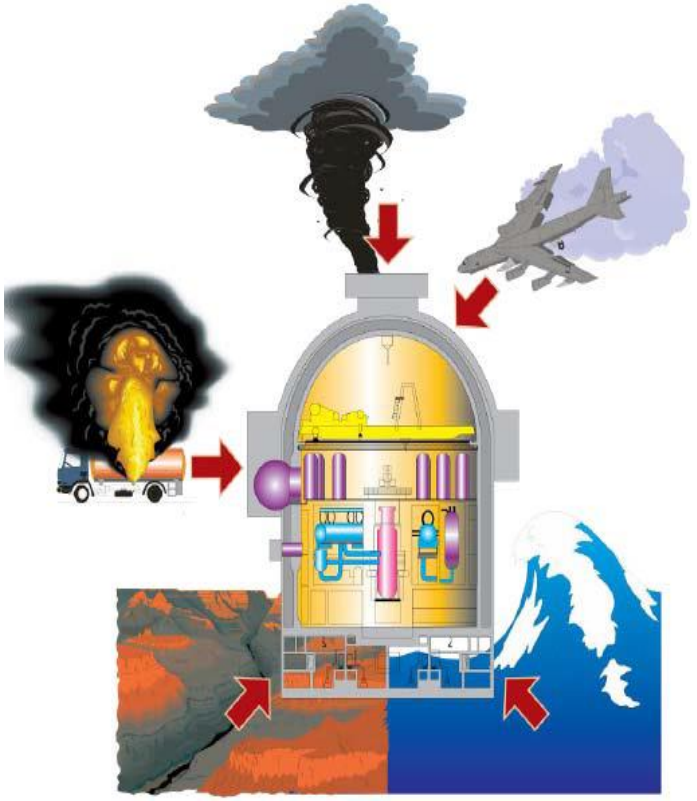
In 2014 there were an average 102465 flights per day (ATAG "Aviation Benefits Beyond Borders", April 2014)

**So far roughly 10*E5 casualties in the history of commercial flights ?**

Nuclear

- TMI, Chernobyl and Fukushima are the only major accidents to have occurred in over 16000 cumulative reactor-years of commercial nuclear power operation in 33 countries
- Chernobyl (pro weapon-designed technology) was the only accident (an organizational/ societal tragedy) which caused casualties (around 50 deaths)

To allow a step forward in the field of nuclear energy (similarly to aviation) we need: 1) **research on innovative nuclear technologies** (i.e. able to guarantee inherent safety & security, low-proliferation risks, security of supply and sustainability) and above all 2) a **"psychological rationality" in the communication to the large public**



"Stress Tests" after the Fukushima accident (Great East Japan Earthquake 11/03/2011)

# The "bias" of non-experts/large public: why ?

**The sentence:**
**1) "radioactivity released by a nuclear plant is harmful to life"**
**is believed a "more serious information" (alerting about a danger)**
**than the sentence:**
**2) "nuclear technology can be safer than all other human industrial activities"**

**Apart from the lack of a logical comparison between the two sentences the main psychological process here is: LOSS AVERSION (a cognitive bias that arises from heuristics). In fact, the negative psychological impact we feel from a danger/loss is about twice as strong as the positive impact of a gain of a similar thing (see for example: http://ed.ted.com/lessons/the-psychology-behind-irrational-decisions-sara-garofalo)**

***Paradoxical facts:***

- ***People living near coal-fired power plants are exposed to higher radiation doses than those living near nuclear power plants (Coal Combustion - ORNL Review Vol. 26, No. 3&4, 1993)***
- ***The collective radiation background dose for natural sources in Europe is about 500,000 man-Sieverts per year. The total dose from Chernobyl is estimated at 80,000 man-Sieverts, or roughly 1/6 as much***
- ***Atomic weapons tests conducted in the 1950s and 1960s all together are estimated to have put some 100 to 1,000 times more radioactive material into the atmosphere than the Chernobyl accident***

# Nuclear energy needs a new communication from the scientific community

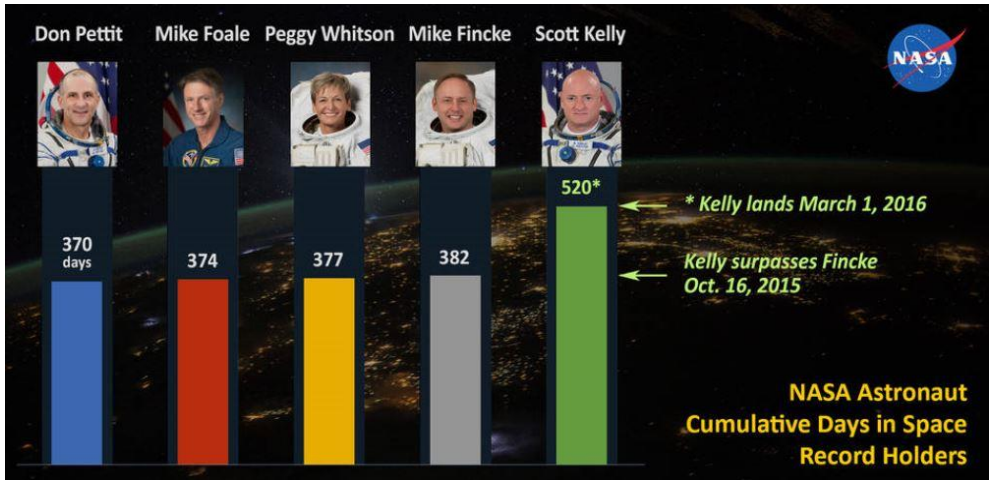
European Commission

After Fukushima accident, many foreign nationals were evacuated from Tokyo, thereby getting a much greater dose of radiation from flights then what they would have received by staying. A comparison of risks (radiation vs. cities' air pollution) would have suggested to go instead into the Southern regions of Fukushima

Personnel working in intercontinental flights double the average annual natural dose (2.4 mSv) -a passenger of a London-New York flight receives a dose equivalent to a panoramic dental radiography (dose rate is 100 times higher than at sea level)

Several NASA astronauts received up to 520 mSv (1mSv per day) i.e. more then 3 times the average dose received by the "Fukushima 50s" workers

**Sizeable population groups receive on Earth 10-20mSv (4-8 times the annual dose)**




## A new communication to challenge opposition? Examples: ☺

The total radioactivity released in the Pacific Ocean following the Fukushima accident represents the natural radioactivity of 3 km3 of seawater, i.e. 1-2% of the natural radioactivity of the seawater still not open for fishing (600 km2)

**TMI accident** caused milk contamination by radioactive iodine … however if you make a smoothie with a banana (using a perfectly uncontaminated milk) you have a beverage which is roughly 50 times more radioactive that TMI's milk.

Nuclear waste?

In one sense, nuclear reactors are *cleansing* Earth of radioactivity—by making the decays happen faster than in nature.

To get rid of waste, make the decays happen even faster than that!

# Outline of my presentation

- Need of a clean energy to fight pollution and climate change

- Why nuclear could be the best energy source
  - Current nuclear assets in the EU
  - Is the EU going to increase the nuclear share?

- Is it possible to change public perception on nuclear? Do we make good communication? Do we make good decisions? How decisions are taken?

- What is targeted by the Euratom fission programme (RTD work programme) ?

- Is Bulgarian participation to the Euratom fission calls… efficient?

- Conclusions

# Euratom H2020 WP2016-17 Fission-Call

## deadline: 5 Oct 2016

**~ 40%** **Reactor systems**

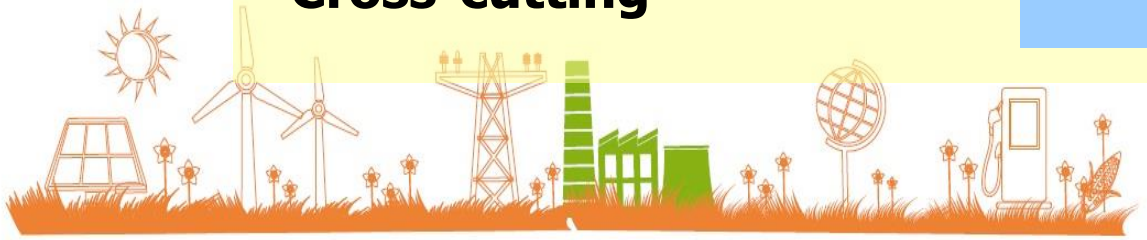
- Safety of existing nuclear installation
- Future nuclear systems for increased safety
- Fuel cycle, Partitioning and Transmutation
- Cross-cutting aspects

**~ 20%** **Waste management and geological disposal**

**~ 20%** **Radiation protection**

**~ 20%** **Research infrastructures**
**Training and mobility**
**Cross-cutting**

**Total Euratom Fission budget**
**105,04 M€**



European Commission

# Reactor systems Safety

**NFRP 1: Continually improving safety and reliability of Generation-II and -III reactors.** Safety and reliability improvements are to be sought in a number of areas, with due consideration to the NUGENIA roadmap

Funding scheme: Research and Innovation Actions, RIAs

**NFRP 2: Research on safety of fast neutron Generation-IV reactors.** Safety improvements of critical fast neutron Generation-IV systems and their supporting reactor islands, as identified by ESNII in the SET Plan Integrated Roadmap

Funding scheme: Research and Innovation Actions, RIAs

**NFRP 3: Investigating the safety of closed nuclear fuel cycle options and fuel developments.** Fuel cycle chemistry and physics for the optimisation of fuel design and manufacture, reprocessing including MOX

Funding scheme: Research and Innovation Actions, RIAs

European Commission

# **Reactor systems** Safety & cross-cutting

**NFRP 4: Research on the safety of Small Modular Reactors.** Safety features of SMRs, notably passive ones, and provide a set of essential technical specifications to comply with EU Safety Directive

Funding scheme: Research and Innovation Actions, RIAs

**NFRP 5: Materials research for Generation-IV reactors.** Materials behaviour under conditions typical for Generation-IV reactor concept, refinement of physical models and/or modelling-oriented experiments for compatibility between structural materials, the coolant and advanced fuels

Funding scheme: Research and Innovation Actions, RIAs

| A – Support safe operation of nuclear systems | Budget |
|---|---|
| NFRP 1 to NFRP 5 (indicative) ..... | **55.45 M€** |
| EC contribution (indicative) ..... | **2-5 M€ per proposal** |

European Commission

# Infrastructures

**NFRP 10: Support for the optimised use of European research reactors.** allow the more efficient use of research reactors in Europe for the purpose of energy research and training and the production of medical radioisotopes

Funding scheme: Coordination and Support Actions, CSAs

**NFRP 11: Support for the EU security of supply of nuclear fuel for research reactors.** Reactor materials research, isotope production, silicon doping, nuclear science, engineering and related E&T.

Funding scheme: Research and Innovation Actions, RIAs

| D – Management of research reactor availability in Europe | Budget |
|---|---|
| NFRP 10-11 (indicative) ..... | **7.7 M€** |
| NFRP 10 EC contribution (indicative) ..... | **0.5-1 M€ per proposal** |
| NFRP 11 EC contribution (indicative) ..... | **4-6 M€ per proposal** |

European Commission

# Action E - SUPPORT THE DEVELOPMENT OF NUCLEAR COMPETENCES AT EU LEVEL

## NFRP 12: Support for careers in the nuclear field

**Specific Challenge:** This action aims at addressing the difficulties encountered with maintaining and renewing an adequate number of well-educated and trained researchers and professionals

**Scope:** Special attention to initiatives meant to attract new talent and develop competences and expertise beyond the academic curricula. This could be achieved through proposals of "*Euratom Fission Training Schemes*" complemented by setting up a strong grant programme to support the participation of students in nuclear training programmes in the EU. These programmes would address the integration of students and bright young researchers into Euratom-supported research projects

**Proposals should cover periods between six months and two years**. The aim is to respond to the needs of the nuclear industry, regulatory bodies and TSOs. Also important are the so-called nuclear activities of proximity, which include medical applications and transport of radioactive materials

**Links should be established with the 'European Nuclear Education Network' (ENEN) and the Euratom fission science and technology platforms.** In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged and will be considered during the evaluation

## Full info at:

http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/euratom/h2020-wp1617-euratom_en.pdf
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-guide-pse_en.pdf

# Other actions

**B.1: Support for fission research & innovation (R&I) investment projects of pan-European relevance through the InnovFin instrument.** Fission Research and innovation investment projects of pan-European relevance need to be supported, on a case-by-case basis by the EIB involving an in-depth analysis of the project consortium composition, business plan and associated revenue streams. Euratom financial contribution will be matched by EIB and could have an overall multiplier effect of around six in terms of volume of EIB loans (estimated at around EUR 240 million overall)

Funding scheme: InnovFin

| B – Other actions | Budget |
|---|---|
| B.1 InnovFin (indicative) ..... | **20 M€ Euratom + 20 M€ EIB** |
| EIB Direct lending (indicative) .....<br>Nuclear Fission projects budget (2017-2018)... | **25-240 M€ (max.) per proposal**<br>**480 M€ (max. eligible budget)** |

# Other actions and INCO

**B.7** Contribution to the Organisation for Economic Cooperation and Development (Nuclear Energy Agency) / Secretariat for the Generation-IV International Forum (GIF)

Funding scheme: Subscription

**B.4, B.6** Studies for the mid-term evaluation of Euratom Framework Programmes in the period 2014-2018 (Fission + Fusion)

Funding scheme: Experts and framework contracts


**B.2, B.3, B.5** SOFT Prize, Experts contracts for fission evaluations, project reviews, and fostering international cooperation (Ukraine, China)

Funding scheme: Recognition prize, Experts contracts

European Commission

# Non-EU participation in Fission Grant Agreements according to EC contribution [in k€]

| Third parties | Entities | Participations (in projects) | Co-financed participations | EC contribution | Participants' total cost |
|---|---|---|---|---|---|
| Switzerland | 12 | 59 (in 49) | 57 | 13,313 | 26,320 |
| Russian Fed. | 7 | 14 (in 12) | 10 | 3,024 | 6,187 |
| Ukraine | 8 | 13 (in 11) | 12 | 1,033 | 1,584 |
| Japan | 9 | 12 (in 11) | 4 | 550 | 7.857 |
| U.S. | 9 | 10 (in 10) | 4 | 418 | 2.945 |
| Kazakhstan | 2 | 3 (in 2) | 3 | 253 | 345 |
| CERN (Int.Org.) | 1 | 2 (in 2) | 2 | 217 | 341 |
| Serbia | 2 | 2 (in 2) | 2 | 164 | 219 |
| Norway | 6 | 23 (in 15) | 1 | 145 | 8.638 |
| Belarus | 1 | 1 (in 1) | 1 | 92 | 103 |
| South Africa | 3 | 6 (in 5) | 1 | 41 | 2.630 |
| Australia | 1 | 3 (in 3) | 0 | 0 | 2.101 |
| China | 2 | 2 (in 2) | 0 | 0 | 1.266 |
| S. Korea | 3 | 5 (in 4) | 0 | 0 | 792 |
| Canada | 2 | 3 (in 3) | 0 | 0 | 764 |
| India | 1 | 2 (in 2) | 0 | 0 | 200 |
| *totals* | *69* | *158 (in 101)* | *97* | *19,032* | *62,951* |

# Euratom fission call 2014-2015: 69 proposals, 22 projects selected, total costs 129.6 Mi€, EC funded 102 Mi€ (incl. JHR access rights)

| Proposal Number | Acronym | Topic | Issues to address |
|---|---|---|---|
| **661913** | SOTERIA | NFRP-01-2014 | Safe long term operation of light water reactors |
| **662157** | IVMR | | Management strategy of in-vessel melt retention in existing and future NPPs |
| **654935** | SESAME | | Safety assessment of thermal hydraulics in metal cooled reactors |
| **662320** | INCEFA - PLUS | | Covering gaps in fatigue assessment (light water reactor environments) |
| **662284** | FASTNET | NFRP-02-2014 | Emergency preparedness and emergency response for water-cooled NPPs in Europe |
| **661891** | SAMOFAR | NFRP-03-2014 | Reactor safety of molten salt fast reactor (MSRs) |
| **662116** | sCO2-HeRo | | Supercritical CO2 residual heat removal system |
| **653951** | JOPRAD | NFRP-04-2014 | Towards a joint programming on geological disposal for high activity long lived radioactive waste |
| **662152** | SITEX-II | NFRP-05-2015 | Networking independent technical expertise in the field of safety of deep geological disposal of radioactive waste |
| **662177** | Modern2020 | NFRP-06-2014 | Development and demonstration of monitoring strategies and technologies for geological disposal |
| **661880** | MIND | | Influence of microbial processes on geological disposal of radioactive wastes |
| **662147** | Cebama | | Cement-based materials for geological disposal |
| **662287** | CONCERT | NFRP-07-2015 | European joint programme on radiation protection research |
| **661935** | HERACLES-CP | NFRP-08-2015 | Low enriched uranium-molybdenum reactor fuel for 99Mo medical isotopes |
| **662186** | MYRTE | NFRP-09-2015 | Further development of state-of-the-art fast neutron installation for transmutation |
| **662125** | CORONA II | NFRP-10-2015 | Establishment of training academy for VVER-type reactors |
| **662268** | HoNESt | NFRP-12-2014 | History of nuclear energy and society |
| **661292** | NUCL-EU 2020 | NFRP-13-2015 | Network of National Contact Points |
| **662167** | BRILLIANT | NFRP-14-2014 | Baltic region initiative for innovative nuclear technologies |
| **662136** | VINCO | | Visegrad countries (CZ, HU, PL, SK) initiative for nuclear cooperation |
| **662149** | SPRINT | NFRP-15-2015 | Support to secretariat of SNETP |

# Enhanced innovations within the DG RTD Euratom fission indirect actions

**Euratom must concentrate on innovative actions with multiplier effects at EU level**

**Work Programme 2014-2015 (last call)**

NFRP 3 –2014: New innovative approaches to reactor safety

- ***sCO2-HeRo:*** *a supercritical CO2 safety system able to remove residual heat from nuclear fuel without needs of external power sources*
- ***SAMOFAR:*** *safety of molten salt fast reactor*

*Future possible ideas: a "rational EU regulatory framework" to pave the way to licensing simplifications (e.g. no site-specific small modular reactors, SMRs ?)*

NFRP 8 –2014: High density uranium fuel and targets for the production of medical isotopes

- ***HERACLES-CP:*** *reduction of proliferation risks by minimising the use of highly-enriched uranium in research reactors as well as in the supply chain for medical isotopes*

# One concrete need: harmonization of nuclear regulatory approaches in Europe


One example: the French operator EDF, currently building a nuclear plant in the UK, had to apply for a "certification" (by submitting Safety and Environmental reports to the British Nuclear Regulators) despite a construction license already awarded by the French, Finnish and Chinese regulators

In 2012 the AREVA-designed EPR plant was allowed "to be re-designed in accordance to UK regulatory standards" and the licensing process is still under way

Harmonised EU nuclear safety regulations should be established: still too large differences between national regulations both in methodology and in scope exist (e.g. licenses for construction, operation, decommissioning, etc. see COM(2016) 177 final)

The objectives of standardization of practices, codes and standards through the harmonisation of regulatory approaches would bring improvements in three different fields of endeavour:

- improving the safety level of nuclear installations through shared design approaches and licensing processes
- supporting the deployment of nuclear energy within the European market (i.e. a "wiser energy use while fighting climate change" targeted by the Junker Commission) and setting up the basis for an effective standardisation of reactor component assessment
- benefiting of a larger EU-spread public acceptance and cost reduction

# H2020 Euratom Participant Portal

RESEARCH & INNOVATION

Participant Portal

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## News

The 3rd Health Programme and the Consumer Programme, managed by the Consumer, Health and Food Executive Agency (CHAFEA), and the Research Fund for Coal and Steel (RFCS) are now using the European Commission's experts database to select experts for assignments including the evaluation of proposals and monitoring of projects. If you are already registered as an expert and wish to also indicate your interest in these programmes, please update your profile by ticking "RFCS (Research Fund for Coal and Steel)" and/or " Third Health Programme (managed by Chafea)" ('Programme Selection' section). New experts registering can indicate their interest in working for any of the programmes listed in the 'Programme Selection' section.

## Experts

H2020 ONLINE MANUAL

Join the database of independent experts for European research and innovation.

The European Commission appoints independent experts to assist with research and innovation assignments including the evaluation of proposals, monitoring of projects, and evaluation of programmes, and design of policy.

## New experts

### Who can be an expert?

You have a chance of being selected as an expert if you:

- have high-level of expertise in the relevant fields of research and innovation (see call for details on types of expertise).
- can be available for occasional, short-term assignments

REGISTER AS EXPERT

### What do expert assignments involve?

Experts, as peer reviewers, assist in the:

- **evaluation** of proposals
- **monitoring** of actions

In addition, experts assist in the :

- **preparation, implementation or evaluation of programmes** and **design** of **policies**. This includes the Horizon 2020 Advisory Groups.

Assignments mainly concern research and innovation, falling within the Horizon 2020 programme designed to address the challenges Europe is facing through funding excellent science, technology and innovation.

Take a look at the most recently funded projects.

# Outline of my presentation

- Need of a clean energy to fight pollution and climate change

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**-Is Bulgarian participation to the Euratom fission calls… efficient?**

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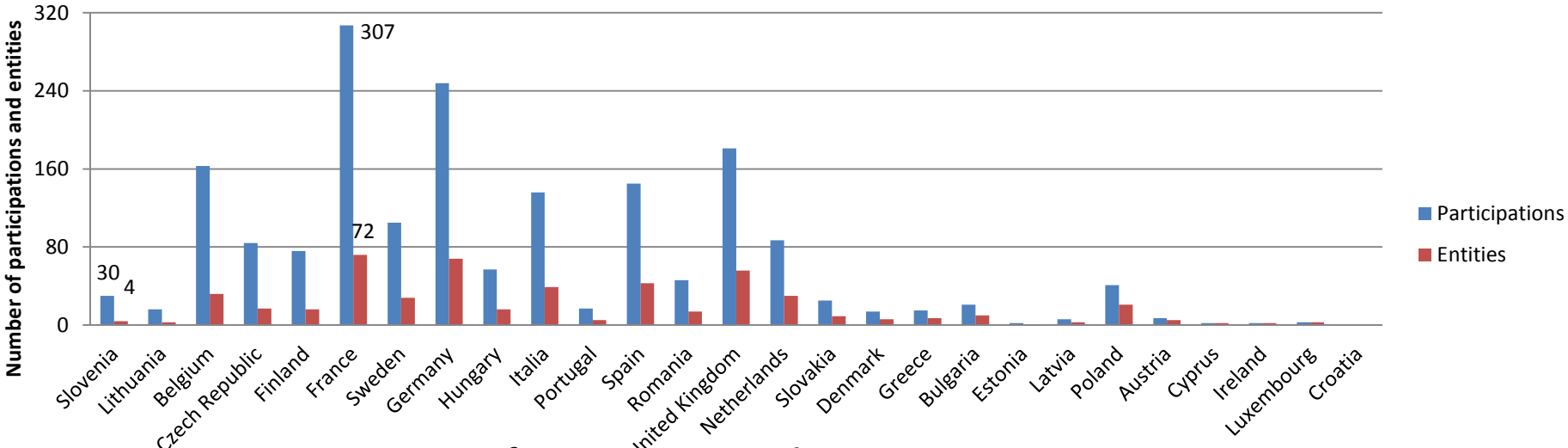
# Bulgarian participation in Euratom fission FP7 (2007-2013): 22 participations by 10 entities in 15 projects (2.75 M€, EC funded 1.6 M€)

| Project Call Identifier | Project Acronym | Project Title | Project Start Date | Project End Date | Project EC Contribution | Project Total Cost | Organisation Legal Name | Participant EC Contribution | Participant Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| FP7-Fission-2008 | PERFORM 60 | Prediction of the Effects of Radiation FOr reactor pressure vessel and in-core Materials using multi-scale modelling - 60 years foreseen plant lifetime | 1/03/2009 | 31/12/2013 | 5.985.465,00 | 13.596.130,20 | BG H2 SOCIETY SDRUZHENIE | 54.700,00 | 109.400,00 |
| FP7-Fission-2008 | SARNET2 | Severe Accident Research Network of Excellence 2 | 1/04/2009 | 31/03/2013 | 5.750.000,00 | 39.588.707,20 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 77.223,00 | 219.126,40 |
| FP7-Fission-2008 | SARNET2 | Severe Accident Research Network of Excellence 2 | 1/04/2009 | 31/03/2013 | 5.750.000,00 | 39.588.707,20 | Energy Institute JSC | 24.477,00 | 54.000,00 |
| FP7-Fission-2008 | NURISP | NUclear Reactor Integrated Simulation Project | 1/01/2009 | 30/06/2012 | 5.998.466,00 | 10.314.023,14 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 105.540,00 | 211.080,00 |
| FP7-Fission-2008 | SARNET2 | Severe Accident Research Network of Excellence 2 | 1/04/2009 | 31/03/2013 | 5.750.000,00 | 39.588.707,20 | TECHNICAL UNIVERSITY OF SOFIA | 32.952,00 | 98.969,60 |
| FP7-Fission-2009 | DoReMi | Low Dose Research towards Multidisciplinary Integration | 1/01/2010 | 31/12/2015 | 12.999.999,00 | 21.427.418,97 | SOFIISKI UNIVERSITET SVETI KLIMENT OHRIDSKI | 206.820,00 | 269.760,00 |
| FP7-Fission-2010 | IPPA | Implementing Public Participation Approaches in Radioactive Waste Disposal | 1/01/2011 | 31/12/2013 | 1.599.988,00 | 2.398.335,20 | Center for the Study of Democracy | 0,00 | 41.112,00 |
| FP7-Fission-2011 | CORONA | Establishment of a Regional Center of Competence for VVER Technology and Nuclear Applications | 1/12/2011 | 30/11/2014 | 969.780,00 | 2.244.178,00 | RISK ENGINEERING AD | 92.990,00 | 201.163,00 |
| FP7-Fission-2011 | CORONA | Establishment of a Regional Center of Competence for VVER Technology and Nuclear Applications | 1/12/2011 | 30/11/2014 | 969.780,00 | 2.244.178,00 | KOZLODUY NPP PLC | 130.830,00 | 283.016,00 |
| FP7-Fission-2011 | CORONA | Establishment of a Regional Center of Competence for VVER Technology and Nuclear Applications | 1/12/2011 | 30/11/2014 | 969.780,00 | 2.244.178,00 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 92.990,00 | 225.612,00 |
| FP7-Fission-2011 | NEWLANCER | New MS Linking for an Advanced Cohesion in Euratom Research | 1/11/2011 | 31/10/2013 | 900.033,00 | 1.032.152,80 | TECHNICAL UNIVERSITY OF SOFIA | 66.320,00 | 73.600,00 |
| FP7-Fission-2011 | NEWLANCER | New MS Linking for an Advanced Cohesion in Euratom Research | 1/11/2011 | 31/10/2013 | 900.033,00 | 1.032.152,80 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 51.360,00 | 57.600,00 |
| FP7-Fission-2011 | RENEB | Realizing the European Network in Biodosimetry | 1/01/2012 | 31/12/2015 | 999.182,59 | 1.551.318,60 | NATIONAL CENTRE OF RADIOBIOLOGY AND RADIATION PROTECTION | 17.976,00 | 20.160,00 |
| FP7-Fission-2012 | NURESAFE | NUCLEAR REACTOR SAFETY SIMULATION PLATFORM | 1/01/2013 | 31/12/2015 | 5.600.000,00 | 9.328.144,31 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 105.419,20 | 205.299,20 |
| FP7-Fission-2012 | CESAM | Code for European Severe Accident Management | 1/04/2013 | 31/03/2017 | 3.597.179,00 | 6.258.591,40 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 75.300,00 | 147.960,00 |
| FP7-Fission-2013 | ASAMPSA_E | Advanced Safety Assessment : Extended PSA | 1/07/2013 | 30/06/2016 | 2.999.999,49 | 4.043.346,65 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 68.453,25 | 76.770,00 |
| FP7-Fission-2013 | NUGENIA-PLUS | Preparing NUGENIA for HORIZON2020 | 1/09/2013 | 31/08/2016 | 6.000.000,00 | 10.283.733,59 | RISK ENGINEERING AD | 14.400,00 | 36.000,00 |
| FP7-Fission-2013 | ASAMPSA_E | Advanced Safety Assessment : Extended PSA | 1/07/2013 | 30/06/2016 | 2.999.999,49 | 4.043.346,65 | TECHNICAL UNIVERSITY OF SOFIA | 67.731,00 | 75.960,00 |
| FP7-Fission-2013 | ARCADIA | Assessment of Regional CApabilities for new reactors Development through an Integrated Approach | 1/11/2013 | 31/10/2016 | 1.499.435,38 | 1.961.683,31 | TECHNICAL UNIVERSITY OF SOFIA | 83.219,25 | 93.330,00 |
| FP7-Fission-2013 | PLATENSO | Building a platform for enhanced societal research related to nuclear energy in Central and Eastern Europe | 1/09/2013 | 31/08/2016 | 999.760,38 | 1.224.778,40 | Center for the Study of Democracy | 49.998,00 | 56.073,60 |
| FP7-Fission-2013 | EUTEMPE-RX | EUropean Training and Education for Medical Physics Experts in Radiology | 1/08/2013 | 31/07/2016 | 1.658.000,00 | 1.864.346,20 | TECHNICAL UNIVERSITY OF VARNA | 122.056,00 | 136.399,60 |
| FP7-Fission-2013 | ARCADIA | Assessment of Regional CApabilities for new reactors Development through an Integrated Approach | 1/11/2013 | 31/10/2016 | 1.499.435,38 | 1.961.683,31 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 51.146,00 | 57.360,00 |
| | | | | | | | | **1.591.900,70** | **2.749.751,40** |

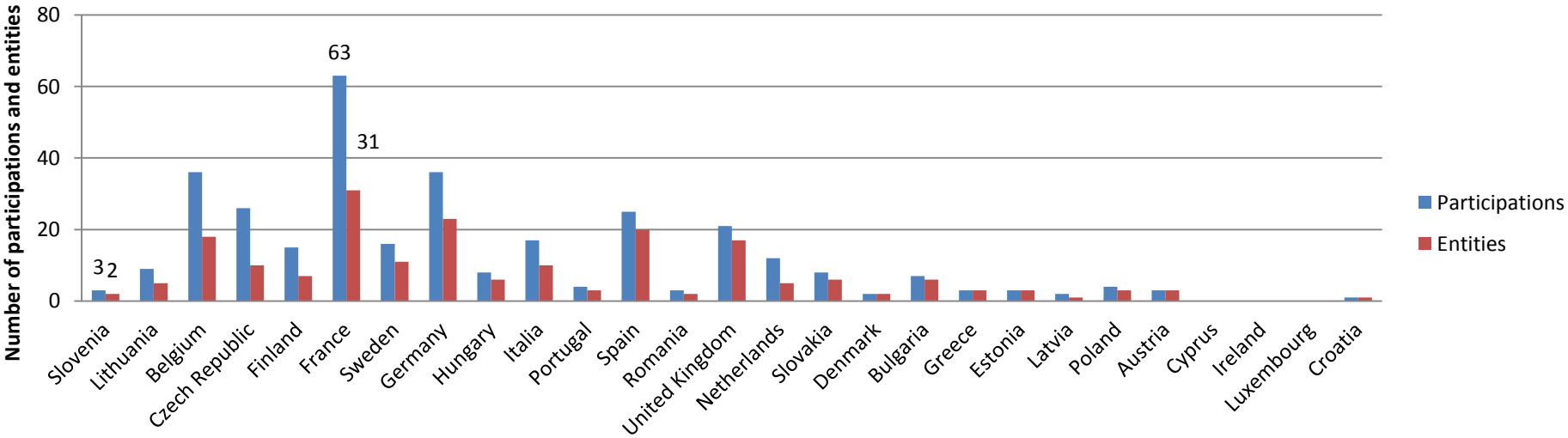
# Bulgarian participation in Euratom fission call 2014-2015: 6 entities in 5 projects (total costs ~1 Mi€, EC funded ~0.5 Mi€

| Project Call Id | Project Acronym | Project Title | Project Start Date | Project End Date | Proj Maximum Grant Amount | Proj Total Costs | Participant Legal Name | Participant Short Name | Part Maximum Grant Amount | Part Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|
| NFRP-2014-2015 | IVMR | In-Vessel Melt Retention Severe Accident Management Strategy for Existing and Future NPPs | 1/06/2015 | 31/05/2019 | 4.831.454,00 | 8.205.085,00 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 40.800,00 | 51.000,00 |
| NFRP-2014-2015 | SITEX-II | Sustainable network for Independent Technical EXpertise of radioactive waste disposal - Interactions and Implementation | 1/06/2015 | 30/11/2017 | 1.177.182,50 | 1.484.330,00 | GEOLOGICHESKI INSTITUT PRI BAN ST.DIMITROV | GI-BAS | 12.187,50 | 12.187,50 |
| NFRP-2014-2015 | CONCERT | European Joint Programme for the Integration of Radiation Protection Research | 1/06/2015 | 31/05/2020 | 19.822.878,00 | 29.249.863,00 | NATIONAL CENTRE OF RADIOBIOLOGY AND RADIATION PROTECTION | NCRRP | 44.800,00 | 67.375,00 |
| NFRP-2014-2015 | CORONA II | Enhancement of training capabilities in VVER technology through establishment of VVER training academy (CORONA II) | 1/09/2015 | 31/08/2018 | 1.017.605,00 | 2.063.938,75 | KOZLODUY NPP PLC | KNPP | 152.353,00 | 324.156,25 |
| NFRP-2014-2015 | CORONA II | Enhancement of training capabilities in VVER technology through establishment of VVER training academy (CORONA II) | 1/09/2015 | 31/08/2018 | 1.017.605,00 | 2.063.938,75 | RISK ENGINEERING AD | RISKENG | 141.273,00 | 300.581,25 |
| NFRP-2014-2015 | CORONA II | Enhancement of training capabilities in VVER technology through establishment of VVER training academy (CORONA II) | 1/09/2015 | 31/08/2018 | 1.017.605,00 | 2.063.938,75 | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | INSTITUTE OF NUCLEAR RESEARCH AND NUCLEAR ENERGY - BULGARIAN ACADEMY OF SCIENCES | 100.169,00 | 213.125,00 |
| NFRP-2014-2015 | HoNESt | History of Nuclear Energy and Society | 1/09/2015 | 31/08/2018 | 3.052.269,00 | 3.052.269,00 | UNIVERSITY OF PLOVDIV | UNIVERSITY OF PLOVDIV | 21.437,49 | 21.437,49 |
| | | | | | | | | | **513.019,99** | **989.862,49** |

## Euratom FP7/ FP7+2 No. of participations and entities per EU country -134 projects



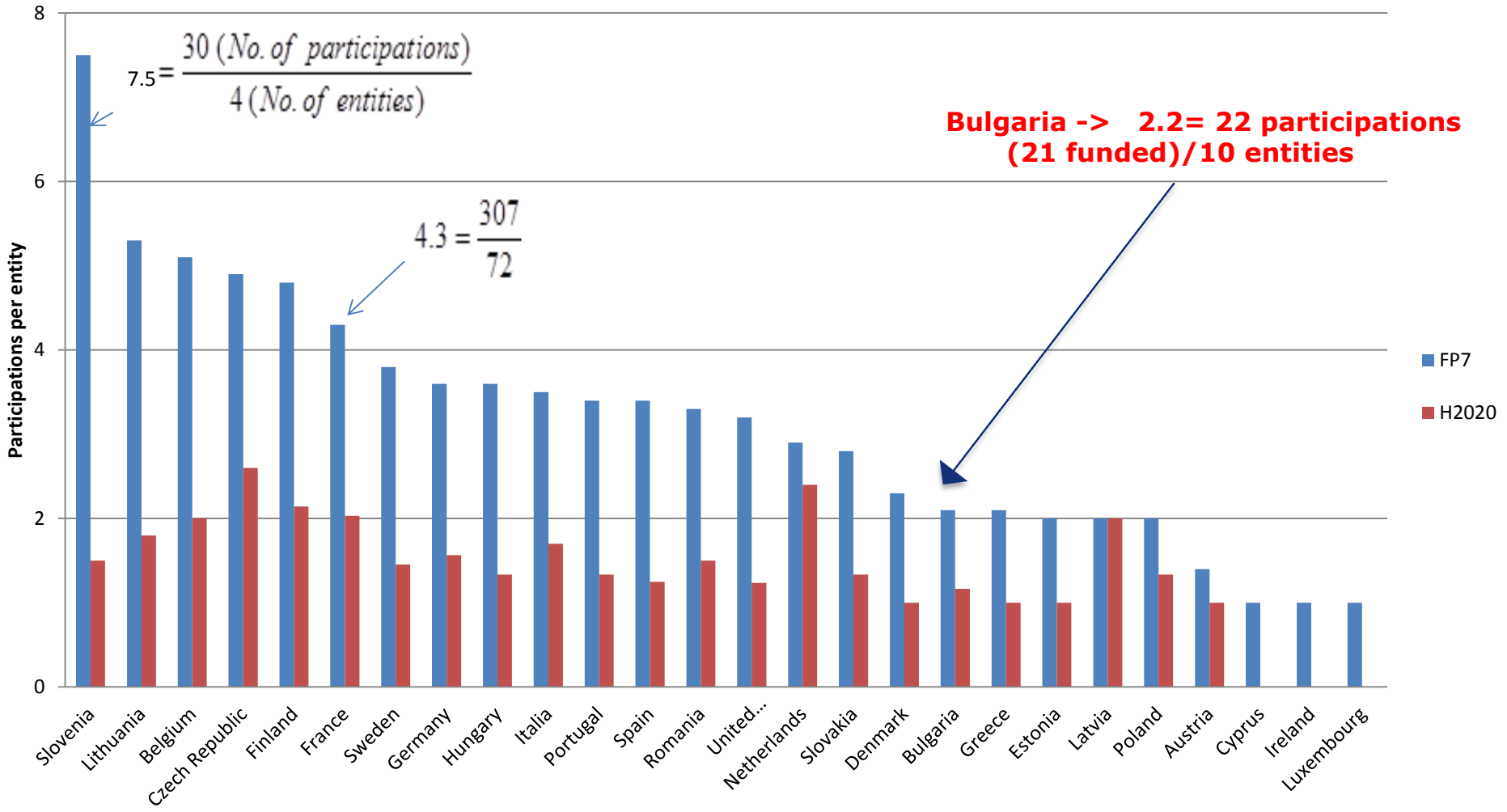

## Euratom H2020 No. of participations and entities per EU country -22 projects



# Euratom FP7 / H2020 Comparison

European Commission

## Average No. of participations per entity



# Outline of my presentation

- Need of a clean energy to fight pollution and climate change

- Why nuclear could be the best energy source
  - Current nuclear assets in the EU
  - Is the EU going to increase the nuclear share?

- Is it possible to change public perception on nuclear? Do we make good communication? Do we make good decisions? How decisions are taken?

- What is targeted by the Euratom fission programme (RTD work programme) ?

- Is Bulgarian participation to the Euratom fission calls… efficient?

- Conclusions

# Conclusions: a new vision for nuclear energy… ..and Euratom could help!

European Commission

- *Common and coherent communication aiming at protecting nuclear energy from manipulation and wrong information*
- *Strong focus on closing remaining LWRs safety issues (as Severe Accident issues) to convince decision-makers and public*
- *Necessity to develop an industrial EU vision for partnership (with US, China and Russia?) together with a good scientific framework with universities and research bodies for the demonstration of GEN-IV safer nuclear technologies (FBRs, MSRs, cogeneration, fission-fusion hybrids..)*
- *Improvement of international cooperation with non-EU countries for the establishment of a worldwide "convincing" roadmap on GEN-IV safety (for example on MSRs?)*
- *Strengthening of mobility as a modern research mechanism: pooling /exchanging international researchers /students*

# From a nuclear renaissance to a nuclear "risorgimento"

Renaissance implies a flourishing of arts and culture while Risorgimento implies a combat…
…a pacific combat for unity and divulgation !

European Commission


# *Thank you!*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