Nuclear Decommissioning in Europe and JRC Scientific Support

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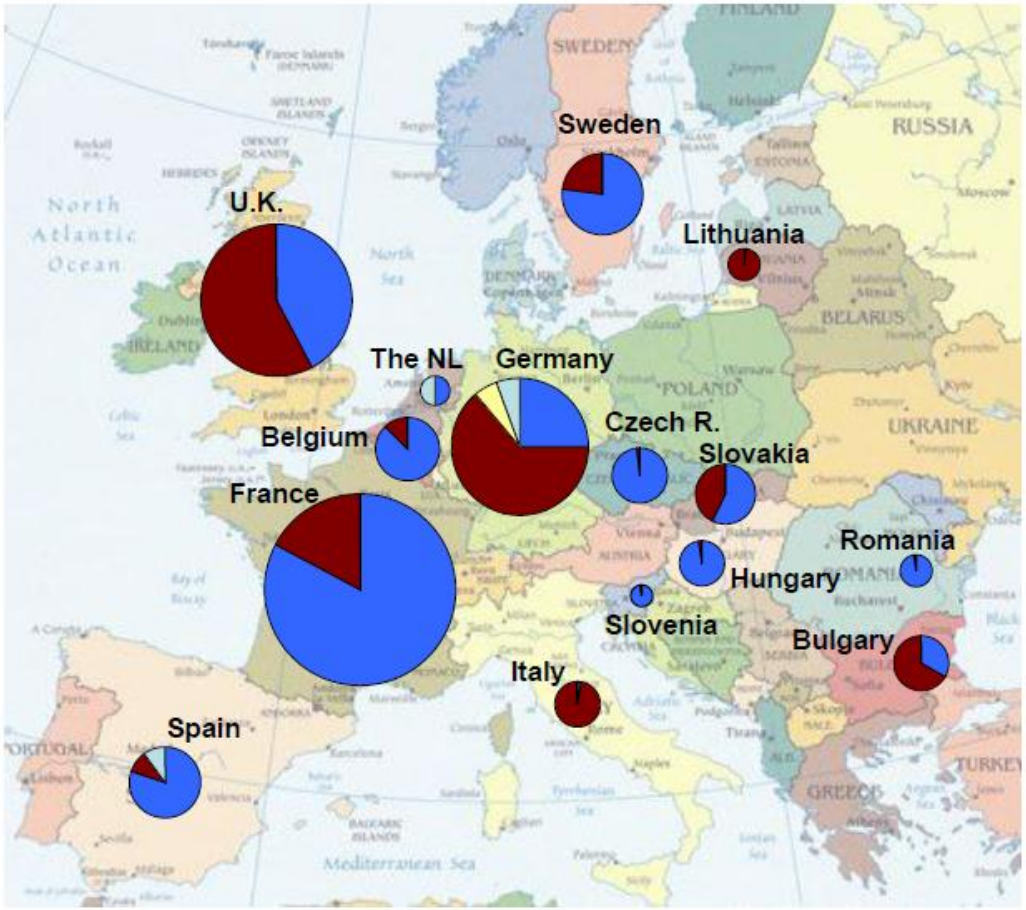
Nuclear decommissioning

*"Nuclear decommissioning is **the final step** in the lifecycle of a nuclear installation covering all activities from shutdown and removal of fissile material to environmental restoration of the site."*

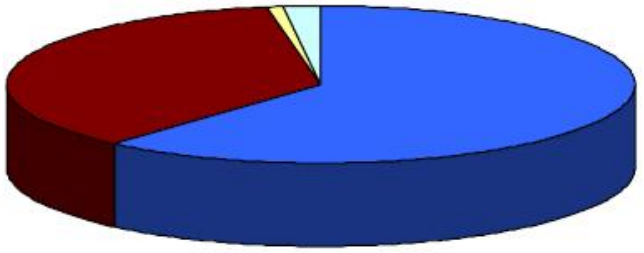



*Feasibility of decommissioning will only be demonstrated if all operations can be performed with due consideration of **safety and security** concerns.*

Situation nuclear power plants in the EU



- Operational
- Shutdown - Dismantling
- Fully Dismantled
- Long Term Safe Enclosure



TOTAL
Power reactors in EU: 220
Operating reactors: 135

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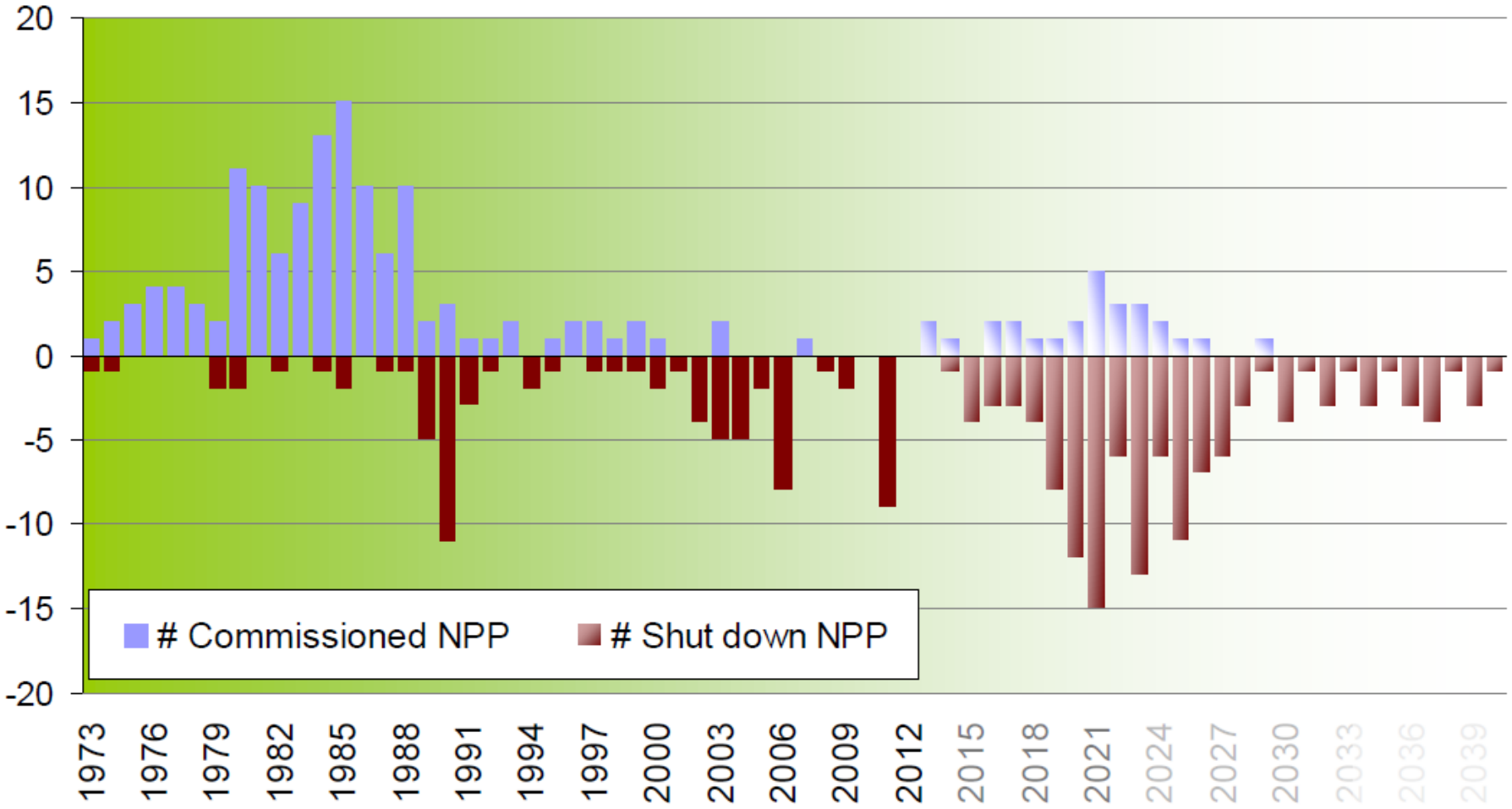
Commissioning and Shutdown & Forecast



Main NPP decommissioning projects in EU

As condition for EU-Accession:

LI *- Ignalina 1-2 (RMBK) /* ***BG*** *- Kozloduy 1-4 (VVER) /* ***SK*** *- Bohunice 1-2 (VVER)*

Other:

UK *- 25 reactors (mainly Magnox)*

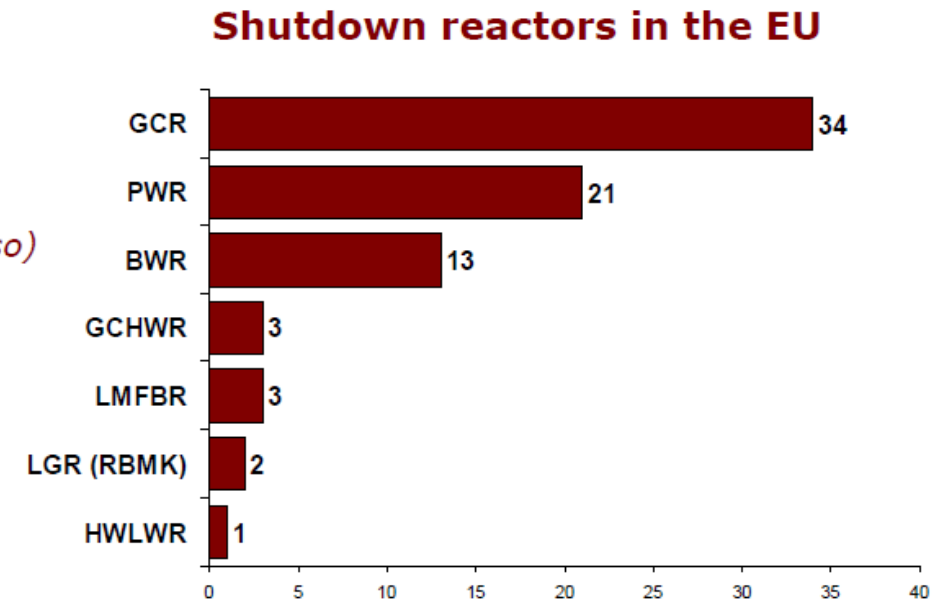
FR *- Chinon, Bugey and St Laurent (6 GCR);*
Brennilis (GCHWR), Chooz (PWR),
Phénix and Super-Phénix (LMFBR)

IT *- full NPP fleet (Latina,Garigliano,Trino,Caorso)*

DE *- Greifswald (5 VVER),*
Niederaichbach (GCHWR),
Gundremmingen-A (BWR)

BE *- BR-3 (PWR)*

ES *- Vandellos-1 (GCR), Jose Cabrera (PWR)*



Resources need

European Human Resource Observatory for Nuclear sector ("EHRO-N"):

- EU-27 : **total** workforce in the nuclear industry is approx. **500.000**
- **16% (77.000)** of these are 'nuclear experts', i.e. nuclear engineers, nuclear physicists, nuclear chemists, radiation protection specialists
- By **2020** some **40.000 new** nuclear experts will be needed to replace the retiring personnel and to cater for additional capacity.

*Although not analysed in the EHRO-N study, it can be reasonably expected that a fraction of these, about **5.000-10.000 experts** will have to acquire competence in the field of decommissioning and waste management*

Waste production

- Waste treatment and disposal ≈ **20 to 40 % of decommissioning costs**
- Experience feedback on waste production:

  PWRs, BWRs, PHWRs: 10 t / MWe

  VVERs: 17 t / MWe

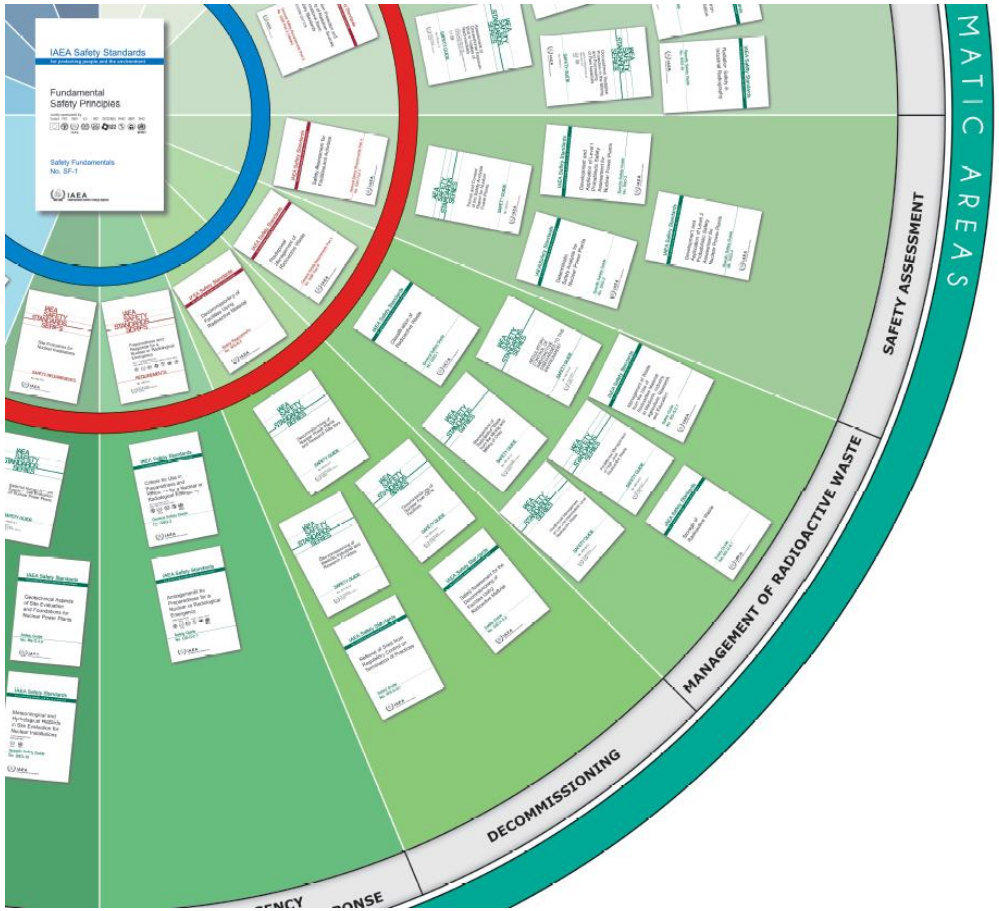
  GCRs: 100 t / MWe

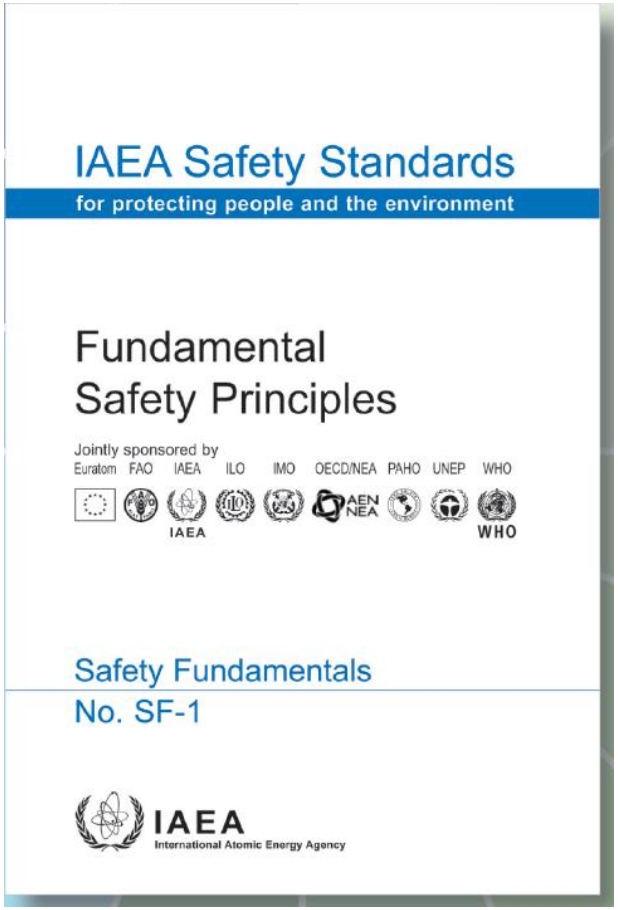
  about 90% can be recycled or disposed of as conventional waste

- **Waste reduction** further to be achieved by:
  - *planning and management of waste streams*
  - *development of decontamination techniques*
  - *dedicated waste processing facilities and equipment*
  - *development of adequate radiation monitoring*

source: OECD

Safety Standards for Decommissioning





Scientific Support to Decommissioning

Context

the European Parliament, during its debates on the future Euratom research programme, requested that:

"JRC builds upon its experience with the decommissioning of JRC nuclear facilities and further reinforces its research to support safe decommissioning in Europe. "

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Roundtable organised by JRC on "Scientific Support for Nuclear Decommissioning

Aim: to bring industry and science together to share best practices, identify bottle necks and consider future prospects and priorities for European nuclear decommissioning

1. Development of Innovative Technologies:

- improvement of measurement techniques:
  - radiological characterisation of waste
  - clearance
- site characterisation techniques

2. Standardisation:

- towards "reference centre" for radiological measurements (assessment measurement techniques, inter-comparisons, technical advice, reference samples)
- validation of activation calculations, improvement of nuclear data

3. Education and training:

- assessment of training needs and training opportunities in the EU
- support E&T decommissioning network
- integration of the Ispra summer school in JRC's European Safety and Security School (EN3S)

4. Knowledge Management:

- organisation of dedicated seminars
- support to IAEA and OECD/NEA
- reiteration roundtable, associated paper

Conclusions 1/2

- Decommissioning market is in full expansion, in particular in Europe.
- Significant impact on employment; shortages of qualified nuclear staff expected, including in decommissioning field
- Even without nuclear “renaissance”, decommissioning will be a long term activity (until > 2050)

Conclusions 2/2

- Currently, an industrial experience exist, however…
  … further attention is necessary for:
  - Development of the most suitable techniques, with respect
  - to safety and waste limitation
  - Standardisation and harmonisation
  - Offering dedicated training opportunities
  - Implementing experience feedback in design new facilities
  - Set-up of an efficient regulatory oversight in MS
- Demonstration of decommissioning at an industrial scale, as a last but feasible step of the nuclear life-cycle, is essential for the credibility of the nuclear energy option