

International Perspective on Decommissioning in OECD Nuclear Energy Agency Countries

**Workshop on "Current and Emerging Methods for Optimising
Safety and Efficiency in Nuclear Decommissioning"**

7-9 February 2017, Halden, Norway

Inge WEBER

Division of

Radiological Protection and Radioactive Waste Management

OECD Nuclear Energy Agency, Paris

„...the problem of decommissioning is principally not a technical problem; the technical problem is largely solved; one may improve, one can do many things, but basically the technical problem is solved.“¹

Source: Decommissioning of Nuclear Power Plants: Proceedings of a European Conference held in Luxembourg, 22–24 May 1984

Content

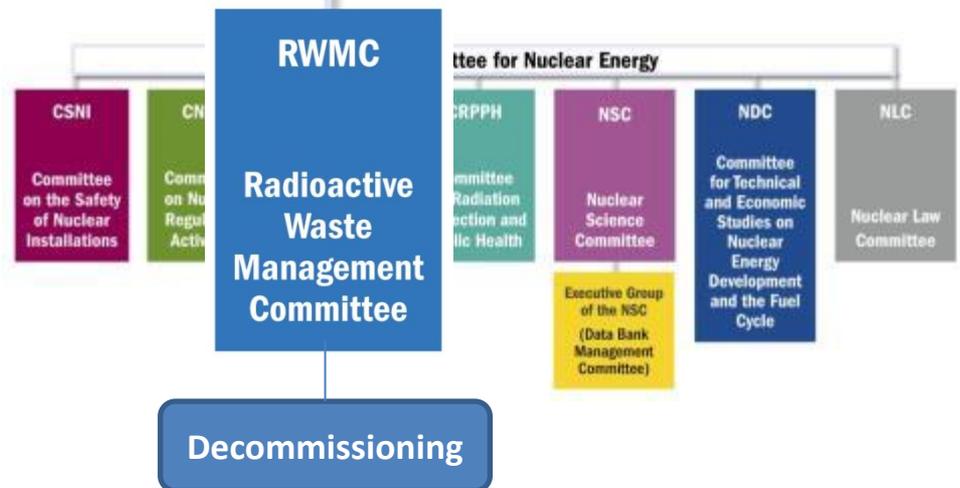
- » Brief introduction into NEA and the Decommissioning Activities
- » Future Development of Decommissioning in OECD Countries
- » Financing of Decommissioning
 - » Decommissioning Cost Estimation
 - » Decommissioning Funding
- » R&D for Decommissioning
- » Conclusions

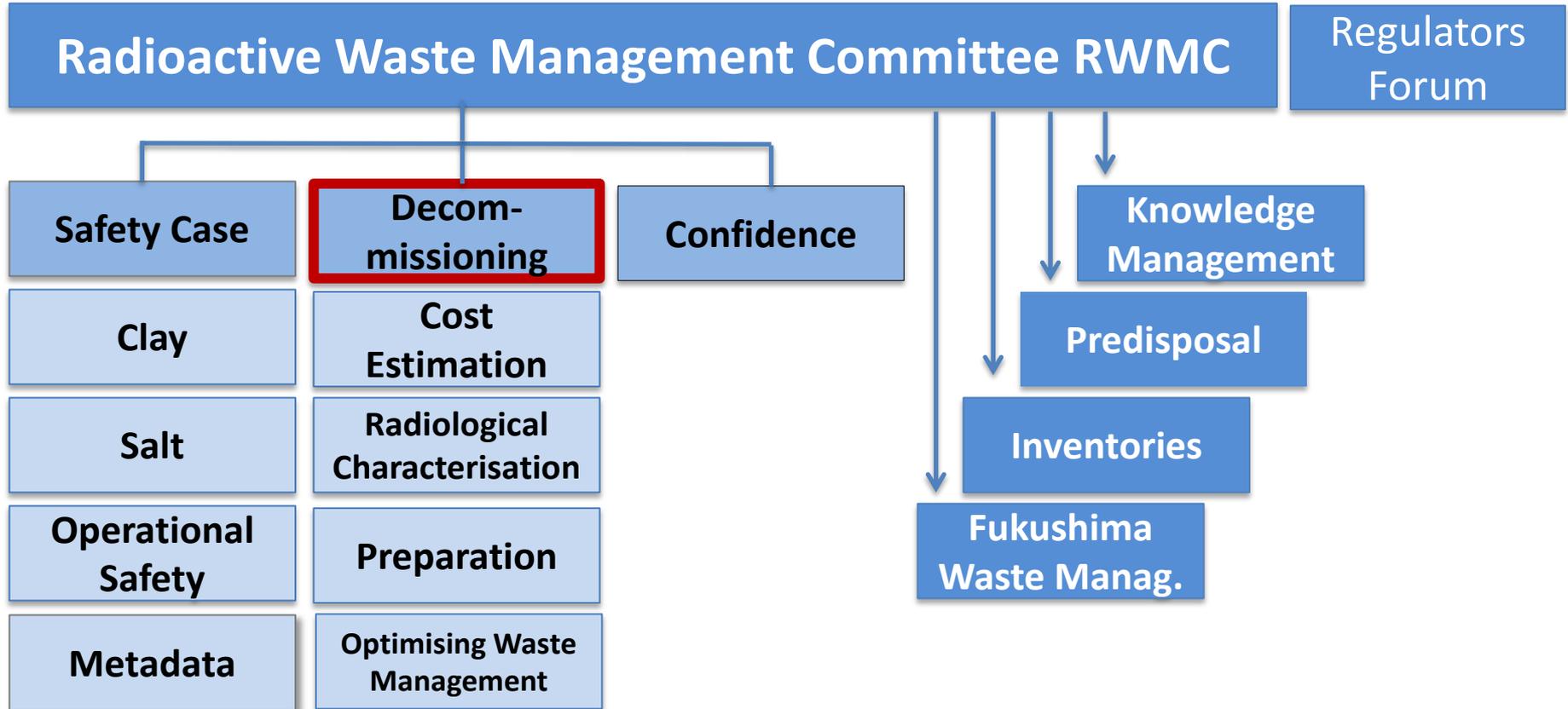
Content

- » **Brief introduction into NEA and the Decommissioning Activities**
- » Future Development of Decommissioning in OECD Countries
- » Financing of Decommissioning
 - » Decommissioning Cost Estimation
 - » Decommissioning Funding
- » R&D for Decommissioning
- » Conclusions

The NEA: A Forum for Co-operation for the Most Advanced Countries in the World

- 🌐» Founded in 1958
- 🌐» 31 member countries
- 🌐» 7 standing technical committees
- 🌐» 75 working parties and expert groups
- 🌐» 21 international joint projects





OECD/NEA joint projects in the radioactive waste management area:

- **Co-operative Programme for Decommissioning (CPD)**
- Thermochemical Database (TDB)
- NEA/IAEA/EC: Status and Trends in Radioactive Waste Management

Content

- » Brief introduction into NEA and the Decommissioning Activities
- » **Future Development of Decommissioning in OECD Countries**
- » Financing of Decommissioning
 - » Decommissioning Cost Estimation
 - » Decommissioning Funding
- » R&D for Decommissioning
- » Conclusions

Status Quo in Decommissioning of Nuclear Power Reactors

Situation ¹	In operation	Shutdown/under decommissioning	Fully decommissioned
Nuclear Power Reactors Worldwide	449	160	15
Nuclear Power Reactors OECD NEA	350	148	15

¹ PRIS database, IAEA, Feb 2017

Future Challenges in Decommissioning in OECD NEA Expected Shutdowns for Decommissioning

America and Asia

Country	Permanent Shut Down*	Decommissioning completed	NPR In Operation*	Shut Down before 2030**	Under Construction*
USA	34	12	99	5***	4
Canada	6		19	14	
Korea	0		24	9	3
Japan	17		42	23	2

*based on PRIS database (Feb 2017)

** based on assumption of shutdown after 40 years operational time

*** due to license extension for several reactors

Future Challenges in Decommissioning in OECD NEA Expected Shutdowns for Decommissioning Europe

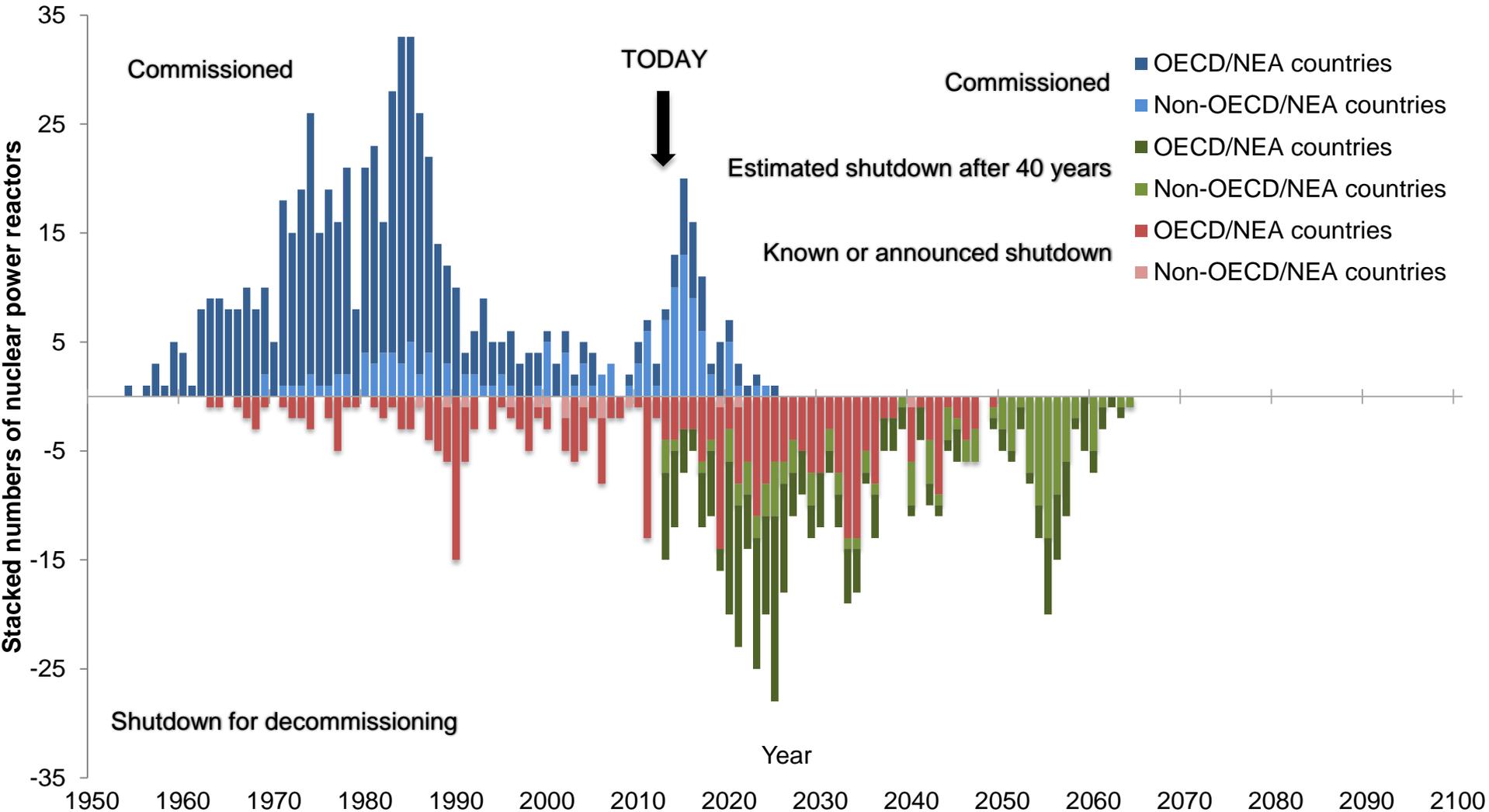
Country	Permanent Shut Down*	Decommissioning completed	NPR In Operation*	Shut Down before 2030**	Under construction*
UK	30		15	15	
Germany	28	3	8	8	
France	12		58	1 ***	1
Finland			4	2	1
Hungary			4		
Russia	6		35	23	7
Belgium	1		7	7	
Sweden	3		10	4	
Switzerland	1		5	4	
Spain	2		7	7	
Italy	4				
Netherlands	1		1		
Slovakia	3		4		2
Slovenia			1	0 ***	10

*based on PRIS database (Feb 2017)

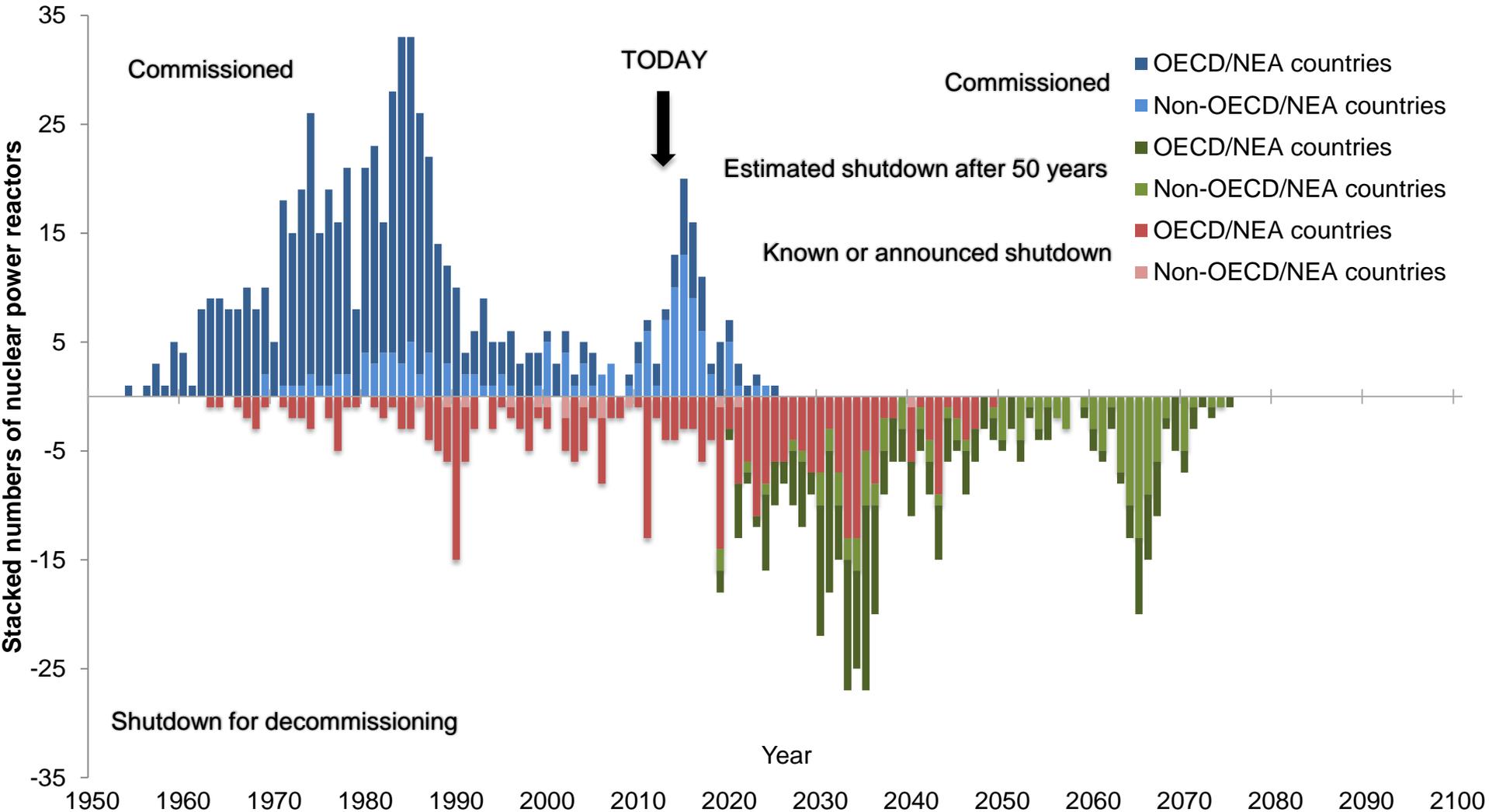
** based on assumption of shutdown after 40 years operational time

*** due to license extension

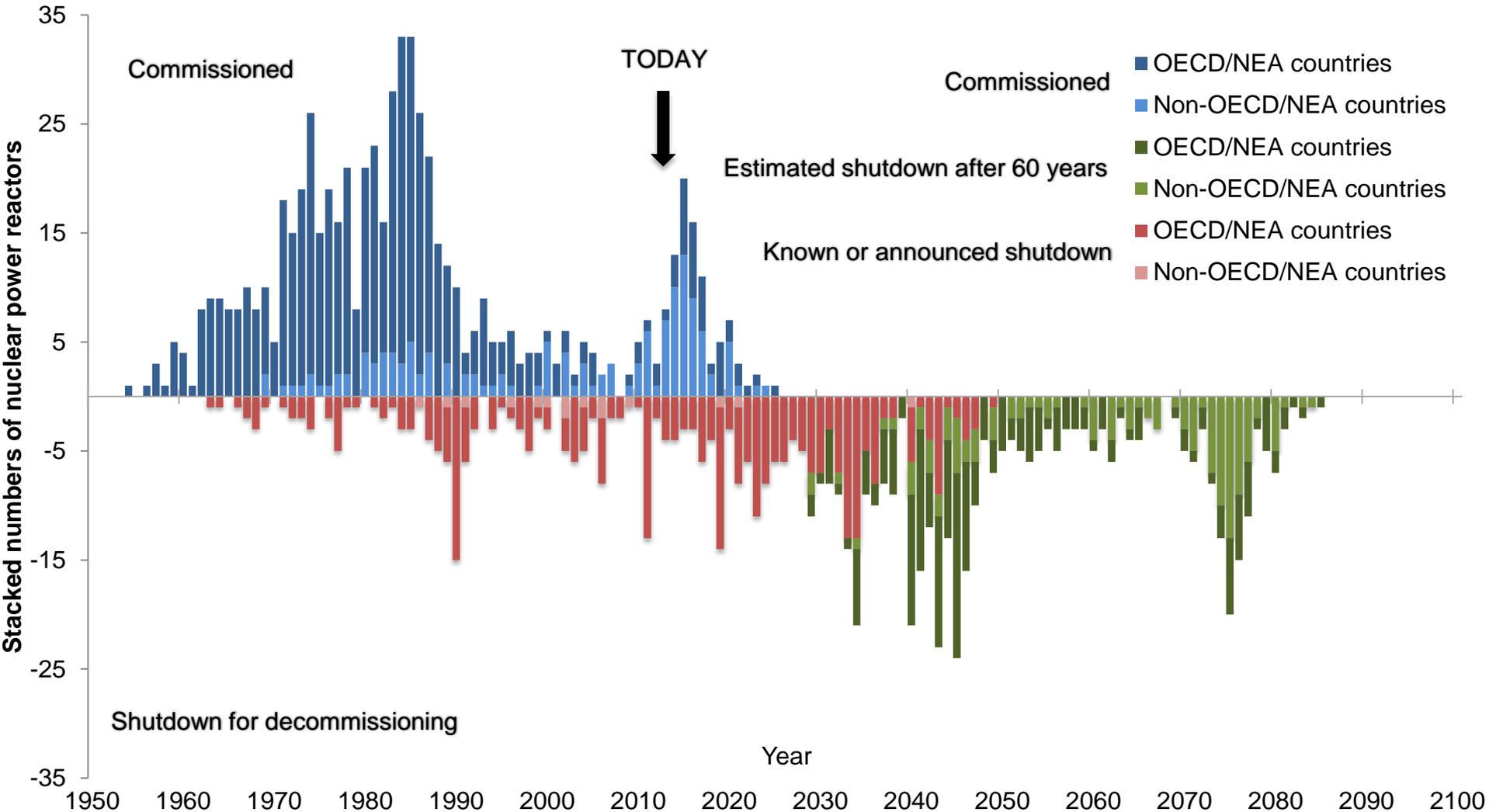
Nuclear Power Reactors Worldwide



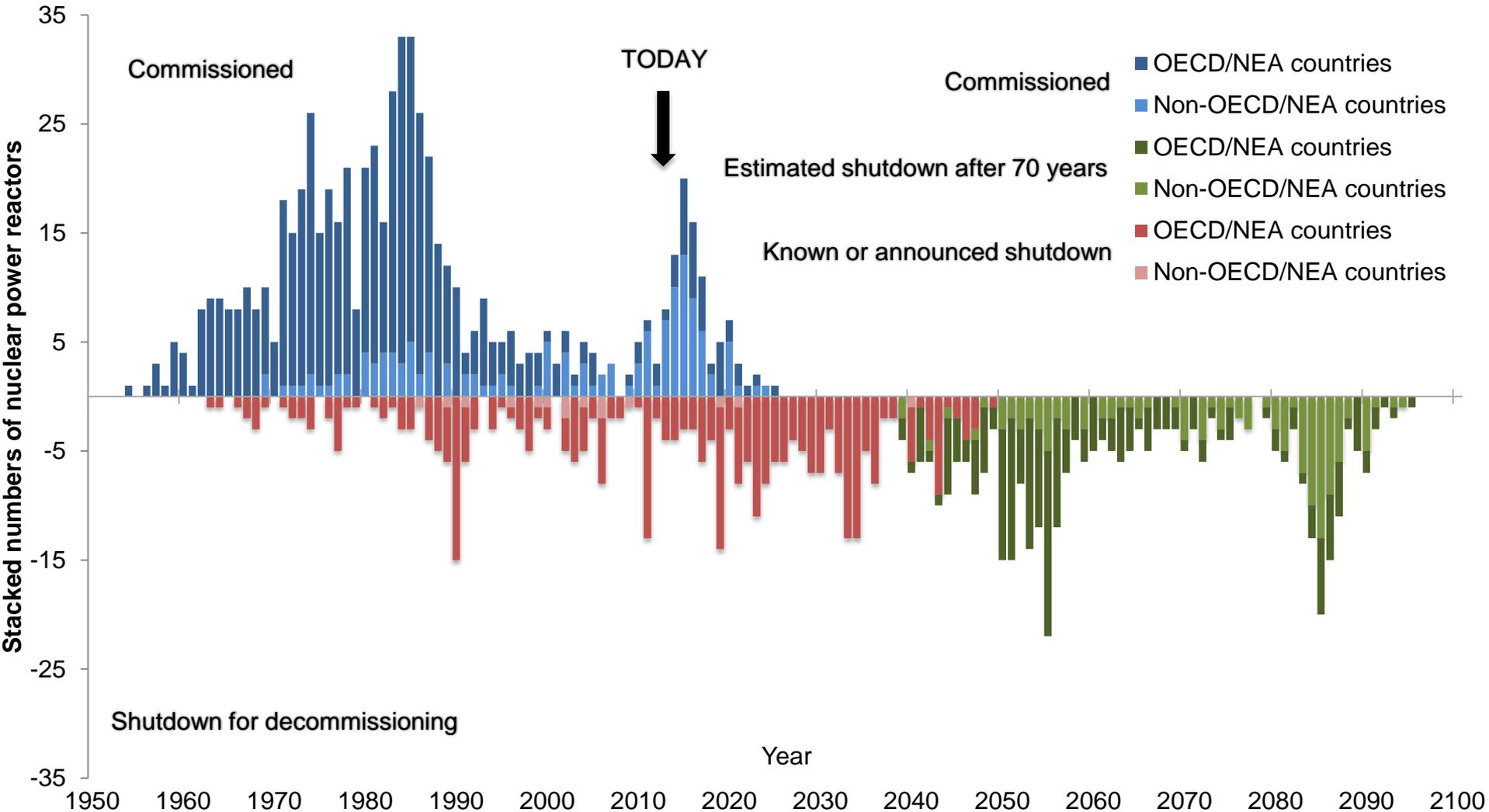
Nuclear Power Reactors Worldwide



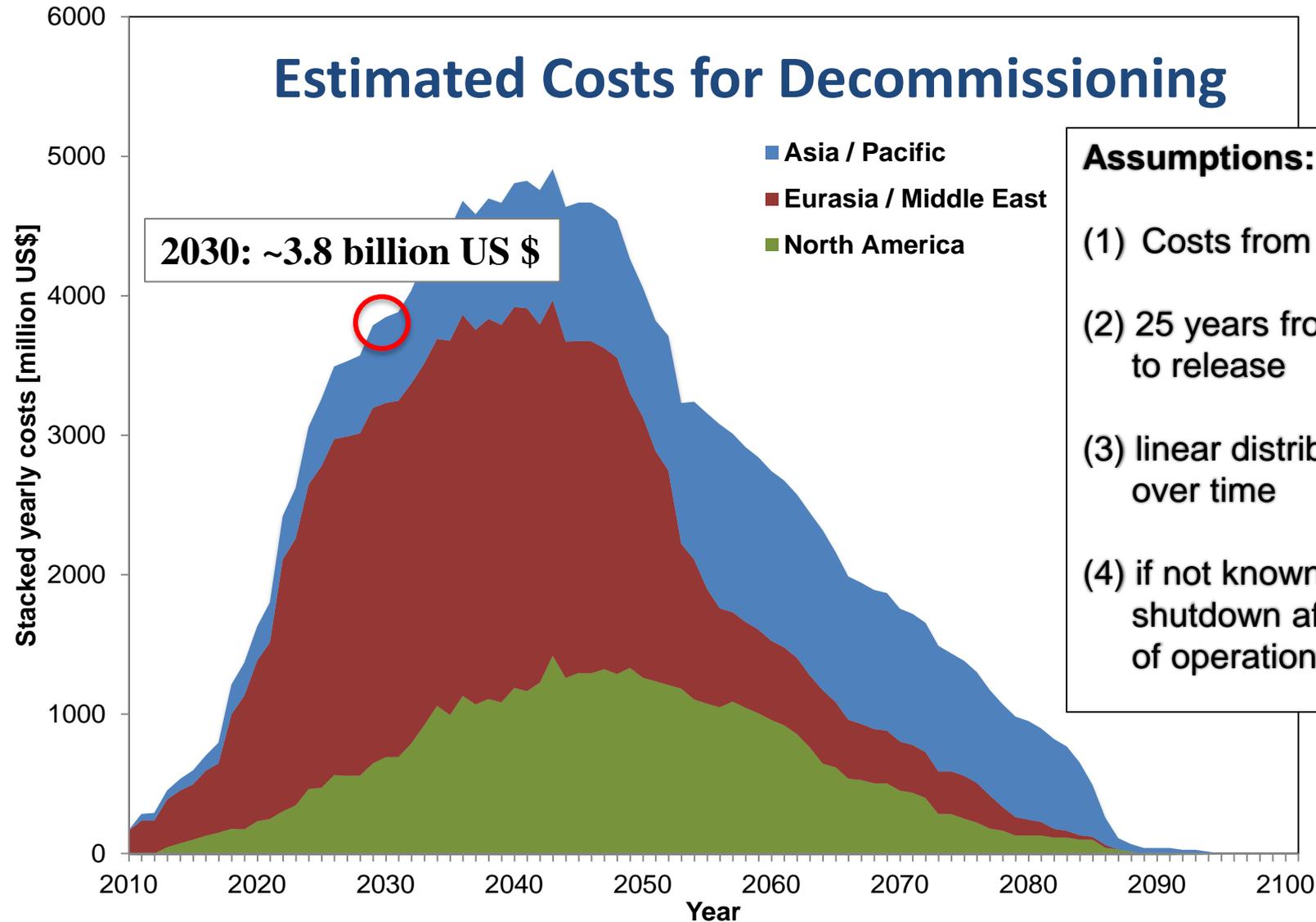
Nuclear Power Reactors Worldwide



Nuclear Power Reactors Worldwide



Estimated Costs for Decommissioning



Assumptions:

- (1) Costs from NEA 2003
- (2) 25 years from shutdown to release
- (3) linear distribution of costs over time
- (4) if not known, reactor shutdown after 40 years of operation

Content

- » Brief introduction into NEA and the Decommissioning Activities
- » Future Development of Decommissioning in OECD Countries
- » **Financing of Decommissioning**
 - » **Decommissioning Cost Estimation**
 - » **Decommissioning Funding**
- » R&D for Decommissioning
- » Conclusions

**Decommissioning
Cost Estimation**

**Decommissioning
Funding**

**Financing
of
Decommissioning**

Purpose and Nature of Cost Estimates

Nuclear Facility's Lifecycle



Decommissioning cost studies have been made for many purposes.

They differ in details on:

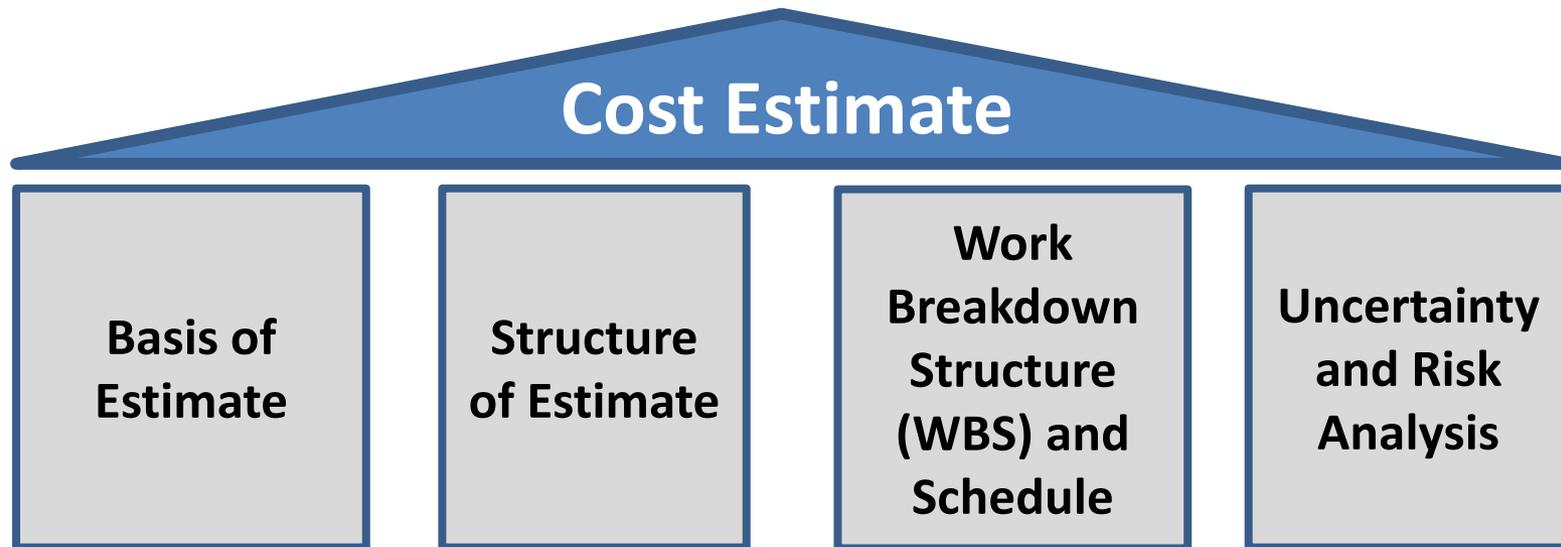
- 🌐 Stage in the facility's lifecycle
- 🌐 Intended use of the estimation
- 🌐 User of the estimates

➔ **Important to identify the purpose and describe the nature of estimate**
(incl. degree of detail, level of reliability of information and used resources)



Increasing availability of information leads to increasing degree of completeness & accuracy

Basic Elements of Decommissioning Cost Estimates



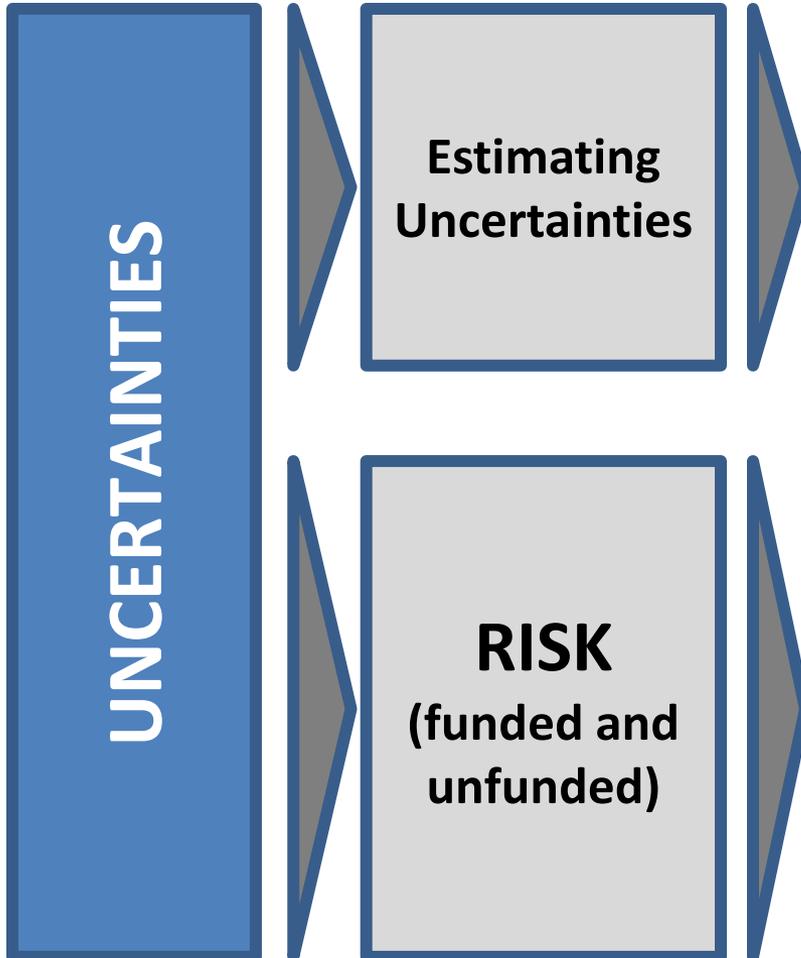
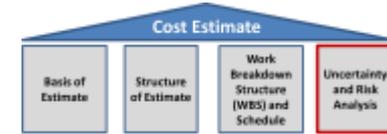
Documentation of context and circumstances of the cost estimation

Categorisation of cost elements for determination of their effect on overall cost estimate

Organisation of work in the decommissioning project (logical groupings of cost elements and work activities)

Uncertainty and risks within and beyond project scope

Uncertainties and Risk Analysis

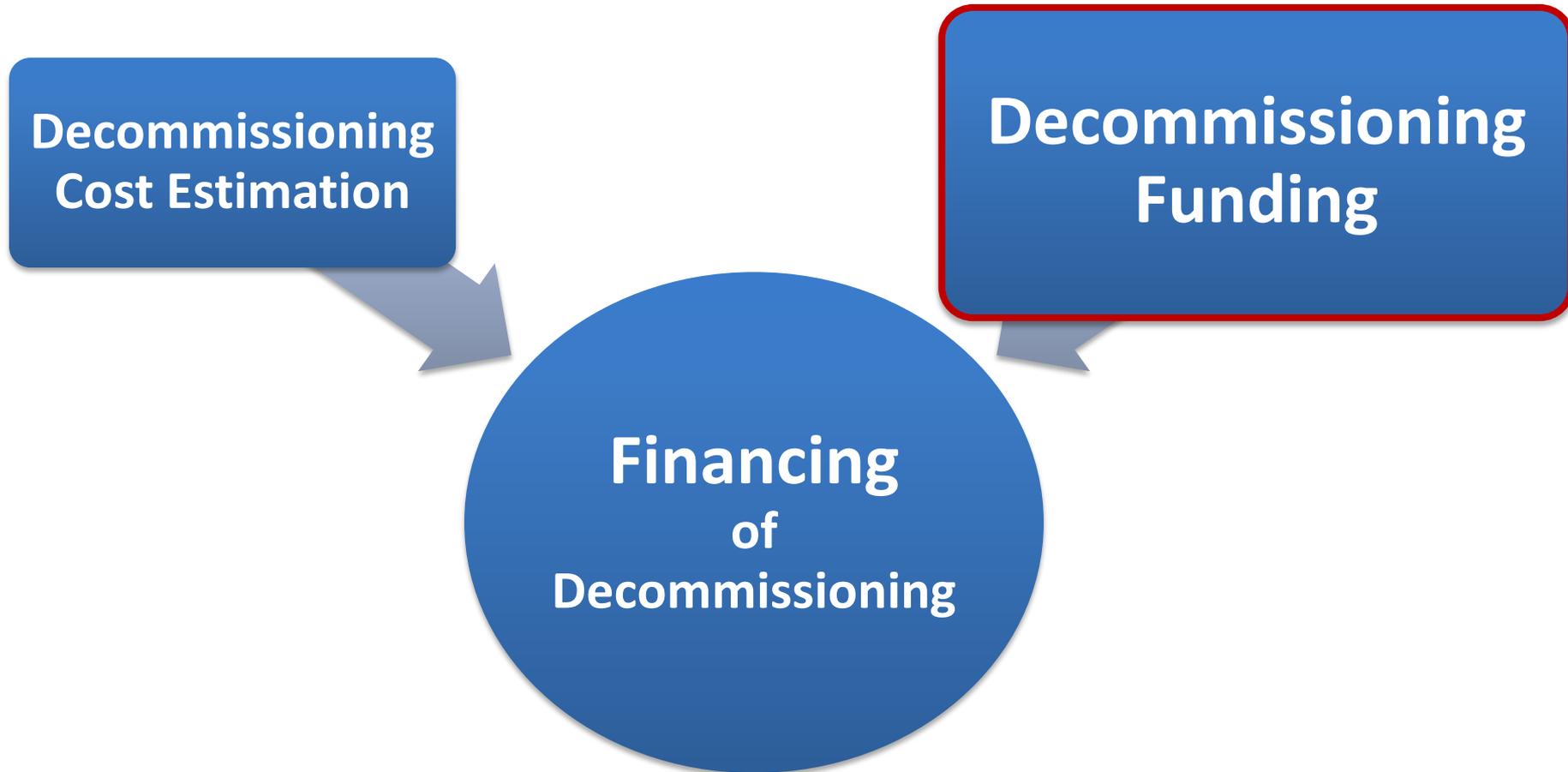


Inside Project Scope

- **Predictable events** that occur during the work activities (tool or equipment breakdowns, interruptions caused by late equipment delivery, etc.) and the novelty of some of the tasks.
- **Assumed to be fully spent**

Outside Project Scope

- **Potential events** as problems with project delivery, currency exchange fluctuations, unexpected inflation rates, regulatory changes, or opportunities such as availability of new technologies or disposal routes, etc.
- Handled by a Risk Analysis: Risk Appetite
- **Costs may increase (problems) or decrease (opportunities)**



Decommissioning Funding

- 🌐 Objectives:
 - Assuring adequacy and timely availability of funding for safe decommissioning
 - Reducing potential risks of residual unfunded liabilities and burden on future generations

- 🌐 Differences in decommissioning funding systems across countries:
 - Scope of funding
 - Funding mechanisms: collection, timeline and management
 - Control and oversight of funds

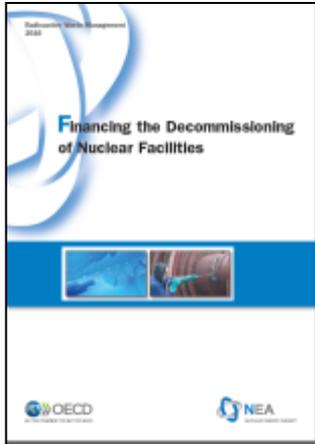
➔ **No single best system that optimally fits all national contexts and legal frameworks**

- 🌐 Legal and/or regulatory frameworks are required and have been put into place in most countries for the creation of decommissioning funds.

Uncertainties in Decommissioning Funding

- » Long time horizons involved
- » Viable waste management options essential for decommissioning
- » Potential changes in financial markets (discount rates, rates of interest etc.), in energy policies or in the conditions and requirements for decommissioning each facility;
- » Risk of not being sufficient or available for decommissioning obligations through
 - Unplanned and premature final shutdown
 - Escalation of costs
 - Underperformance of funds
 - Financial difficulties or bankruptcy of operating company
 - ...

Further Reading



Publication Blue Booklet: Financing the Decommissioning of Nuclear Facilities (2016)

- 🌐» Originally prepared as background note for the April 2016 policy debate of the NEA Steering Committee for Nuclear Energy
- 🌐» Provides an overview and basic knowledge including
 - Overview of decommissioning financing
 - Decommissioning cost estimation
 - Decommissioning funding
- 🌐» <http://www.oecd-nea.org/rwm/pubs/2016/7326-fin-decom-nf.pdf>

**Upcoming
Report**

Addressing Uncertainties in Cost Estimates for Decommissioning Nuclear Facilities

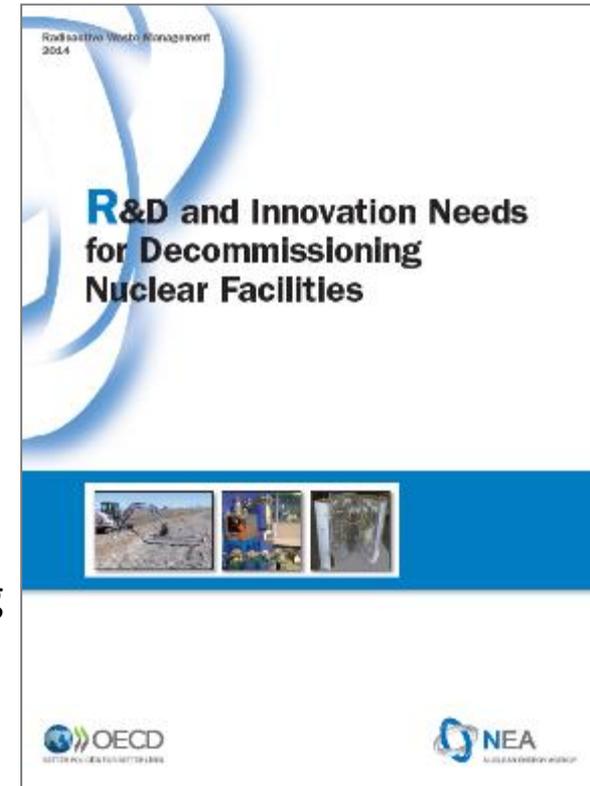
- 🌐» Guidance for cost estimators and reviewers to address all aspects of cost for a decommissioning project
- 🌐» Description of treatment and presentation of uncertainty and risk basing on current good practice; supplementary to ISDC
- 🌐» **To be published in April 2017**

Content

- » Brief introduction into NEA and the Decommissioning Activities
- » Future Development of Decommissioning in OECD Countries
- » Financing of Decommissioning
 - » Decommissioning Cost Estimation
 - » Decommissioning Funding
- » **R&D for Decommissioning**
- » Conclusions

R&D and Innovation Needs for Decommissioning Nuclear Facilities

- WPDD Task Group activities 2010-2014
- Reference book, over 260 pages, published in 08/2014
- Areas with greatest potential for future improvements through R&D:
 1. Characterisation and survey prior to dismantling
 2. Segmentation and dismantling
 3. Documentation and remediation
 4. Materials and waste management
 5. Site characterisation and environmental monitoring
- Highlights cross-cutting topics



● <https://www.oecd-nea.org/rwm/pubs/2014/7191-rd-innovation-needs.pdf>

R&D Challenges on Way Forward

- 🌐» International co-operation to be institutionally enhanced:
responsibility of international organisations
- 🌐» Infrastructure for co-operation and demonstration
- 🌐» International collaboration vs. competition
- 🌐» Demonstration is a vital step of R&D to reduce risks for decommissioning projects
when applying new or advanced technologies
- 🌐» Resources:
 - Long-term sustainability of human resources required
 - Education, training and tutoring
- 🌐» Seeking harmonisation and international standardisation
- 🌐» Knowledge management over generations
- 🌐» Stakeholder Management: politics and public opinion

Content

- » Brief introduction into NEA and the Decommissioning Activities
- » Future Development of Decommissioning in OECD Countries
- » Financing of Decommissioning
 - » Decommissioning Cost Estimation
 - » Decommissioning Funding
- » R&D for Decommissioning
- » **Conclusions**

Conclusions

- 🌍» Decommissioning of nuclear facilities of growing interest and increasing importance
- 🌍» Uncertainties as major challenge in decommissioning financing:
 - International efforts to address uncertainties in cost estimations
 - Key relevant project and cost data typically required for benchmarking not readily available
 - **Economic stability** is necessary for sound, long-term funding system
- 🌍» Optimising decommissioning through R&D
 - Ensuring safest, most economic and environmentally-friendly technology is developed and employed.
 - Demonstration is a vital step of R&D
 - Infrastructure for co-operation and demonstration required
 - International co-operation and co-ordination to be enhanced: responsibility of international organisations

NEA invites to join and support international co-operative R&D efforts

Merci, Danke, Grazia, Takk, Grazie, Tack, Gracias, Arigatô, Спасибо and Thank You

Contact:

Inge WEBER
Nuclear Decommissioning Specialist
OECD Nuclear Energy Agency
+33 (0)1 45 24 10 44
inge.weber@oecd.org



More information @ www.oecd-nea.org
All NEA reports are available for download free of charge.

Follow us:   