Decommissioning Activities at the OECD/NEA

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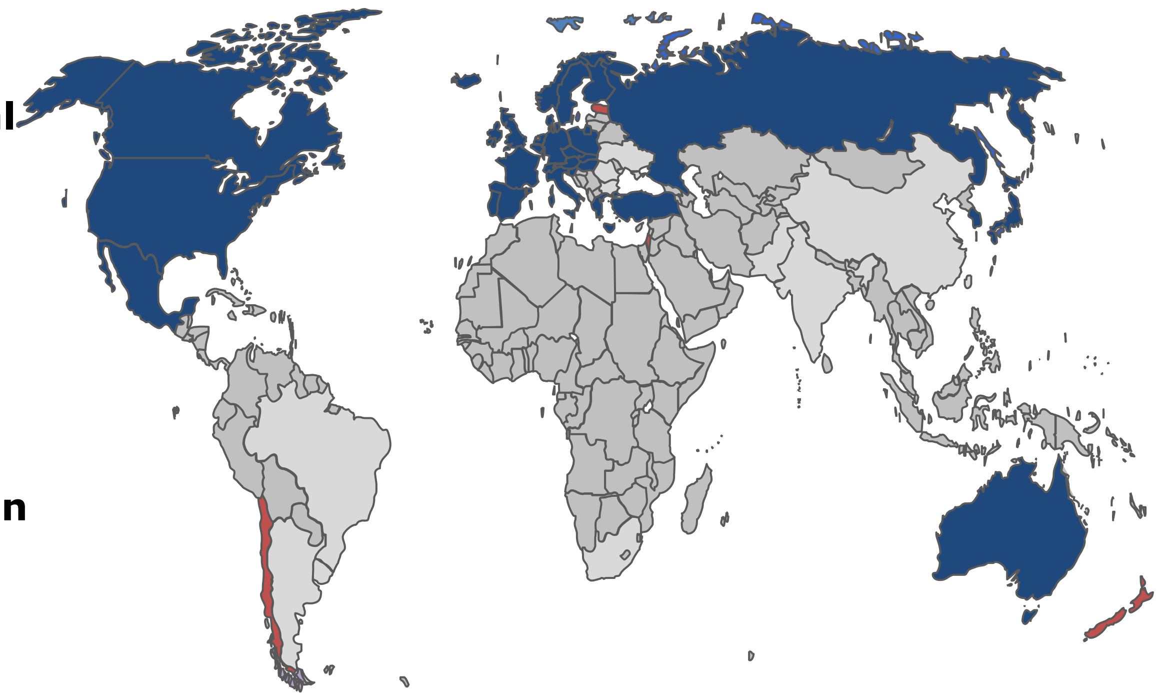
NEA Member Countries and Mission

Chile, Estonia, New Zealand and Israel are OECD countries but not in NEA
Russian Federation is NEA country, but not yet member of the OECD

- To assist its member countries in maintaining and further developing, through **international co-operation, the scientific, technological and legal bases** required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.
- To provide authoritative assessments and to forge **common understandings** on key issues as **input to government decisions on nuclear energy policy** and to broader OECD policy analyses in areas such as energy and sustainable development.



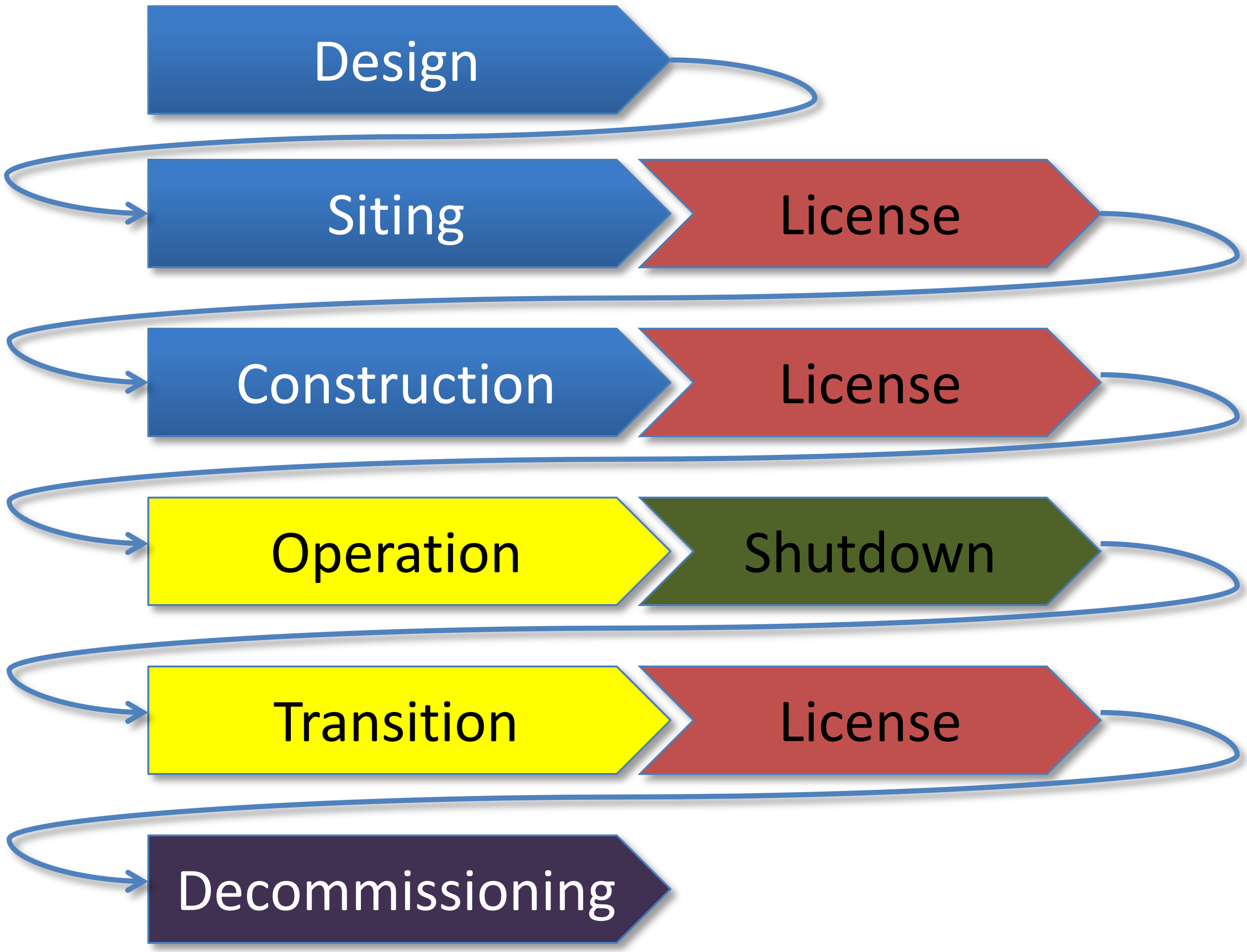
The NEA's current membership consists of 31 countries in Europe, North America and the Asia-Pacific region. Together they account for approximately 90% of the world's installed nuclear capacity.

NEA Committee Structure

As of 18 September 2012

WPDD	CPD
Working Party on Decommissioning and Dismantling	**Co-operative Programme for Decommissioning**
Since year of 2000	Since year of 1985
Open to all OECD NEA countries	Confidentiality, CPD Agreement
Governments	Companies
Strategy makers, regulators, implementers	Implementers from projects
Policies, strategies	Procedures, techniques
81 members from 23 countries 51 implementers, 17 regulators 8 policy makers, 5 int. organisations	62 Projects, 25 organisations, 12 countries + 1 non-OECD member + EC
CPD provides advice and technical input to WPDD	

Decommissioning: Stages of the Nuclear Facility Life Cycle



Scope of Decommissioning

Design → Siting → Construction → License → Operation

Shutdown

Transition Period

- Removal of fuel
- Systems drained and dried
- Treatment of operational waste
- Pre-dismantling decontamination (optional)

License

Decommissioning

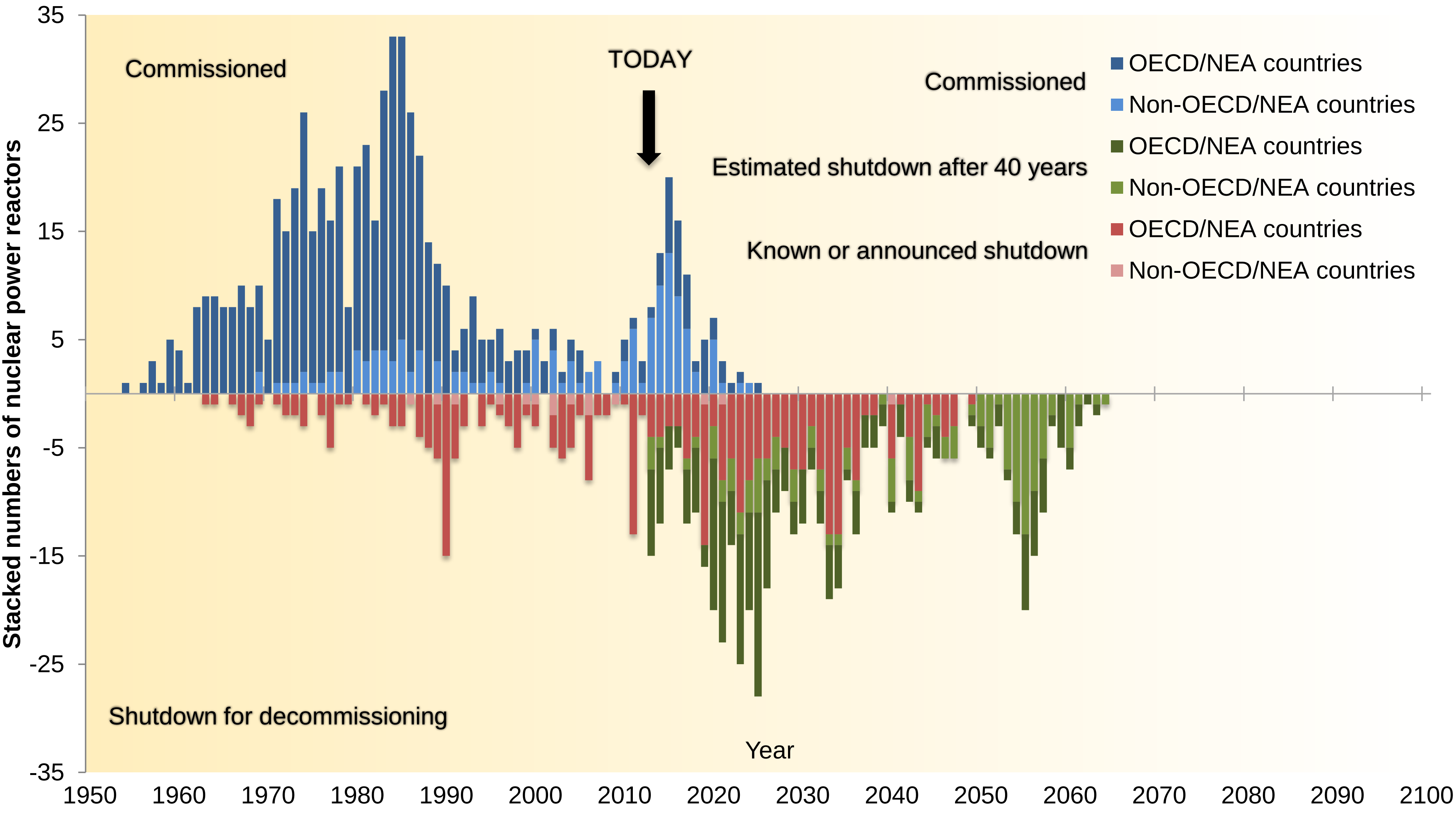
- Dismantling of systems and components
- Decontamination of buildings
- Waste treatment, packaging, (transport, disposal)
- Demolition of buildings
- Site restoration
- Partial or full release from regulatory control

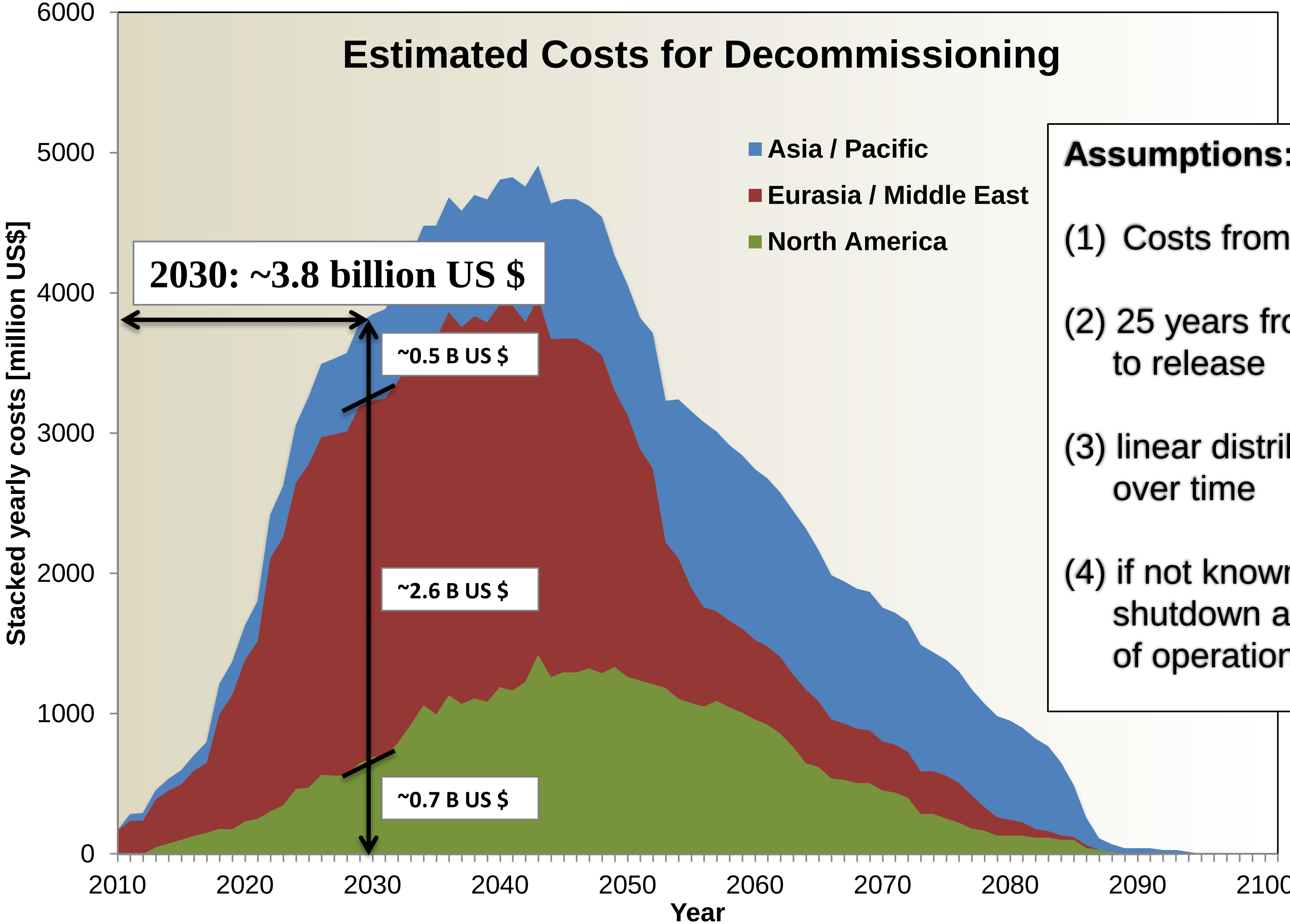
Future in Decommissioning of Nuclear Power Reactors

Situation [1]	In operation	Shutdown/under decommissioning	Fully decommissioned
Nuclear Power Reactors Worldwide	438	147	15
Nuclear Power Reactors OECD NEA	358	135	15
NEA Proportion	82 %	92 %	100 %

[1] PRIS database, IAEA

Nuclear Power Reactors Worldwide





Assumptions:

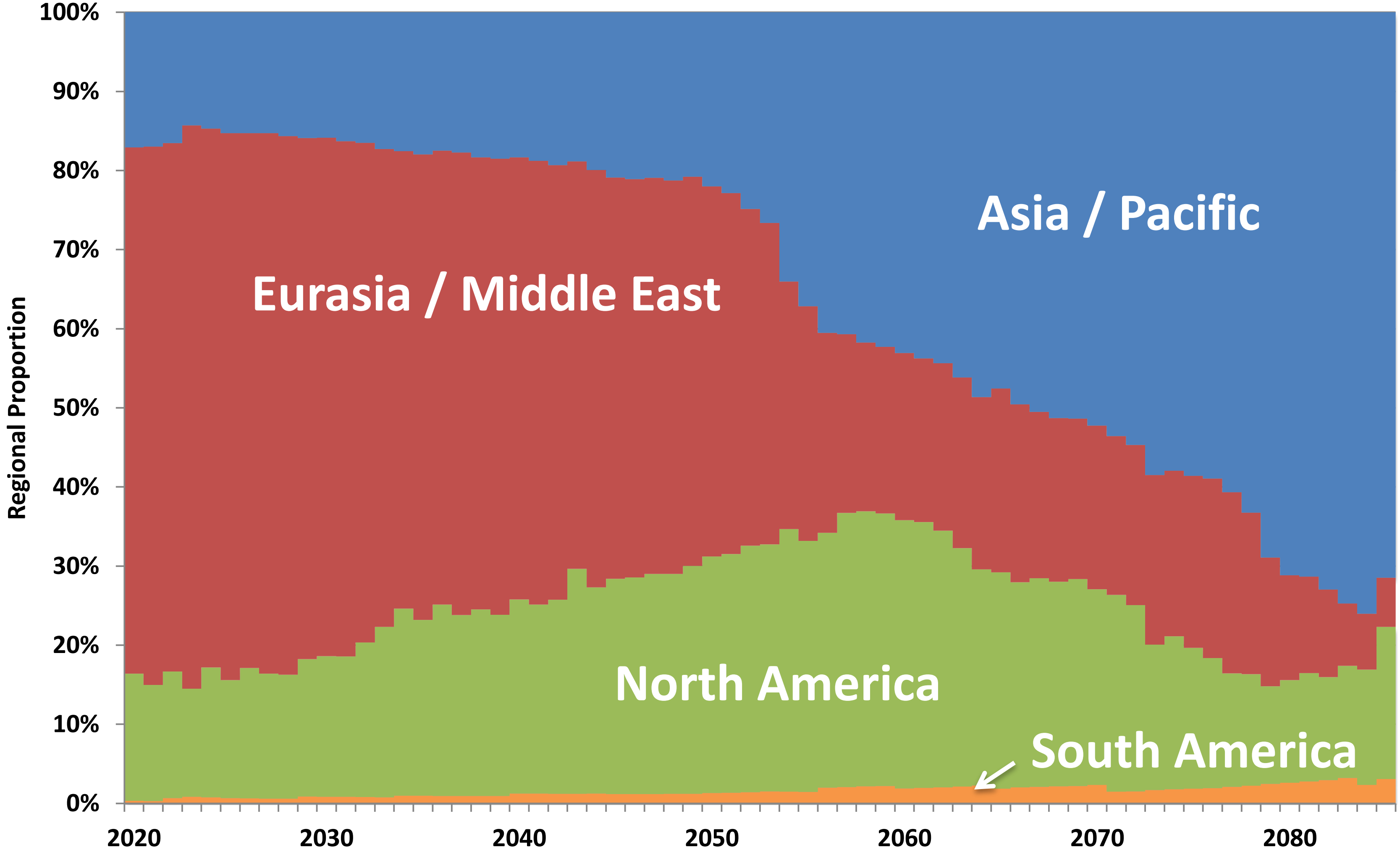
(1) Costs from NEA 2003

(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

Regional Proportional Decommissioning Costs



NEA Findings in Selected Areas of Decommissioning

1. Decommissioning Costing
2. Record and Knowledge Management during Operation for Decommissioning
3. Characterisation of Inventory for Decommissioning
4. Adapting Regulation
5. Decommissioning Considerations for New Build
6. Improving Technologies

1. Decommissioning Costing

- **Funds:** the cost estimates must be understood, and reviewed. A stable and more accurate cost estimation requires to avoid changes in the project scope and regulatory standards and it needs accurate inventory through characterisation

- Main **cost drivers** are identified
  - Project scope, changes in regulatory requirements, stakeholders demands, waste inventory and processing, SF management, disposition of clean building material, experienced personnel, duration of decommissioning

- To minimise **budget overruns & delays**, professional project management and its tools is needed

"Decommissioning is not a rocket-science – just proper project management"

2. Record and Knowledge Management during Operation for Decommissioning

- The data necessary for decommissioning have to be identified timely
- Record of all changes in design, operational records, knowledge,
  (you cannot document too much during operation)
- For non-standard events, interview operational staff on design changes and operational history (that might not be recorded)
- After operational shutdown, a FIRST comprehensive characterisation of the inventory has to be performed

3. Characterisation of Inventory for Decommissioning

- Knowledge transfer from operators to decommissioners after shutdown
- Early assessment of potential sources for contamination (to develop sampling strategy)
- Establish clear characterisation objectives for each characterisation campaign and select characterisation methods and tools
- Dialogue with stakeholders during development and performance of the characterisation plan, and post-shutdown clean-up activities
- Early set up of clearance regulations and unambiguous definitions of the clearance process
- Establish an inventory database with quality assurance functions

4. Adapting Regulation

- A new risk context (from operation / routine activities to decommissioning / unique activities) requires a proportionate and flexible regulatory response

- An appropriate regulation of:
  - Health and safety of the workforce (new radiological hazards)
  - Modification of plant and equipment (safety functions)
  - Control of radioactive contamination
  - Control of human and organisational issues (training, certification)
  - Knowledge retention (feedback for projects, opt. regulation)

- Interaction between different regulatory authorities during decommissioning process

- Find the right balance between safety and flexibility. **Avoid overregulation!**

5. Decommissioning Considerations for New Build

- Decommissioning already benefits form optimal maintenance during operational phase

- Design should take into account the following aspects:

1. **Decommissioning activities (**dismantling, waste minimisation, facilities' inter-dependences)
2. **Site factors** (elimination of leakages to the environment, environmental data collection infrastructure)
3. **Facilities and system design** (minimising infiltration of contamination, facilitating easy removal)
4. **Structural design** (access, space, modular systems, optimised shielding)
5. **Operational design** (early detect leakages, record keeping systems)
6. **Material design and waste management** (delineation of zones, segregation of materials, minimisation of activated material)

6. Improving Technologies (RD and Innovation needs)

- OECD NEA Report on R&D Needs and Innovation in Decommissioning – draft, to be published in 2014
  - Goal: to define the aspects of decommissioning with greatest potential for future improvements through R&D
  - It is not intended to develop R&D solutions but to assist in reaching a consensus on which items future R&D work should be focused
  - including identifying potential projects that might best be addressed on a collaborative basis.
  - Over 250 pages reference document

6. Improving Technologies

PHASE 1

to undertake an analysis of R&D needs for decommissioning and to assign broad priorities to these

PHASE 2

to define relevant R&D projects that might be undertaken on a collaborative or jointly funded basis

6. Improving Technologies

The work was split 5 themes:

a. Characterization and survey prior to dismantling
b. Segmentation and dismantling
c. Decontamination and remediation
d. Materials and waste management
e. Site characterization and environmental monitoring

For each theme:

- Theme overview (summary of current practices and guidance, summary of R&D challenges and needs)
- Suggested additional research and development
- Suggested areas of collaboration

2. Improving Technologies

a. <u>Characterization and survey prior to dismantling</u>

– **Developing an international approach or standard for statistical sampling** (representativeness, grid density, defining an acceptable

International approach does not necessarily mean harmonisation! It means to share information and experience to optimise the use of human, financial and technological resources.

– **International approach for scaling factors** between easy to measure and hard-to-measure nuclides
– Developing an **international approach** or standard **for estimating** the level of **impurities** in metals and concretes, especially for new reactors.

2. Improving Technologies

b. Segmentation and dismantling

- The use of remote systems has to be further improved in their efficiency
- The generation of secondary waste during segmentation and dismantling should be further reduced

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2. Improving Technologies

c. Decontamination and remediation

– New physical and chemical processes should be further improved and applied to decontamination of concrete (e.g. laser cleaning, scabbling, nitrogen blasting, gel coating)

– Further improvement of specialized tools in robotic technology in high radiation or highly contaminated areas,

2. Improving Technologies

d. Materials and waste management

- Managing **problematic wastes** – **hazardous** (PCBs, asbestos, etc.) and **mixed** waste
- Treatment of **organic materials** (bituminized waste, resins, oils, nitrates), **and activated sodium and graphite**
- **Conditioning of waste** (different grouts, foam concrete**,** improving waste incorporation)
- **Long-term performance of waste-forms** (e.g. impact of super-plasticisers on radionuclide migration in concrete)
- Management (clearance, recycling) of **low contaminated materials**

2. Improving Technologies

e. Site characterization and environmental monitoring

- Exchange of information and joint testing of 3-D modelling for **subsurface contaminant transport and groundwater modelling**, as well as atmospheric and ocean plumes
- Exchange of information on advanced technologies for **radiological characterization, detection, and monitoring**
- Exchange of information on approaches, methodologies, models, and **scenarios used to demonstrate compliance with clean-up criteria**.

Summarising Considerations

- Decommissioning is getting a matured industry, but research, development and innovation are still needed
- Use of project management and its advanced procedures and tools are inevitable
- Increasing safety and project management demands have significant impact on decommissioning costs

Further Challenges:

- Comprehensive and optimised waste management routes up to final disposal Optimisation includes infrastructure, economic and societal aspects (Public acceptance)
- Site restoration of (large) contaminated areas
- Organisational aspects (transition from operation to decommissioning)
- Workforce, experienced professionals, young generation

Thank you for your attention