Future Challenges in Decommissioning of NPPs Worldwide

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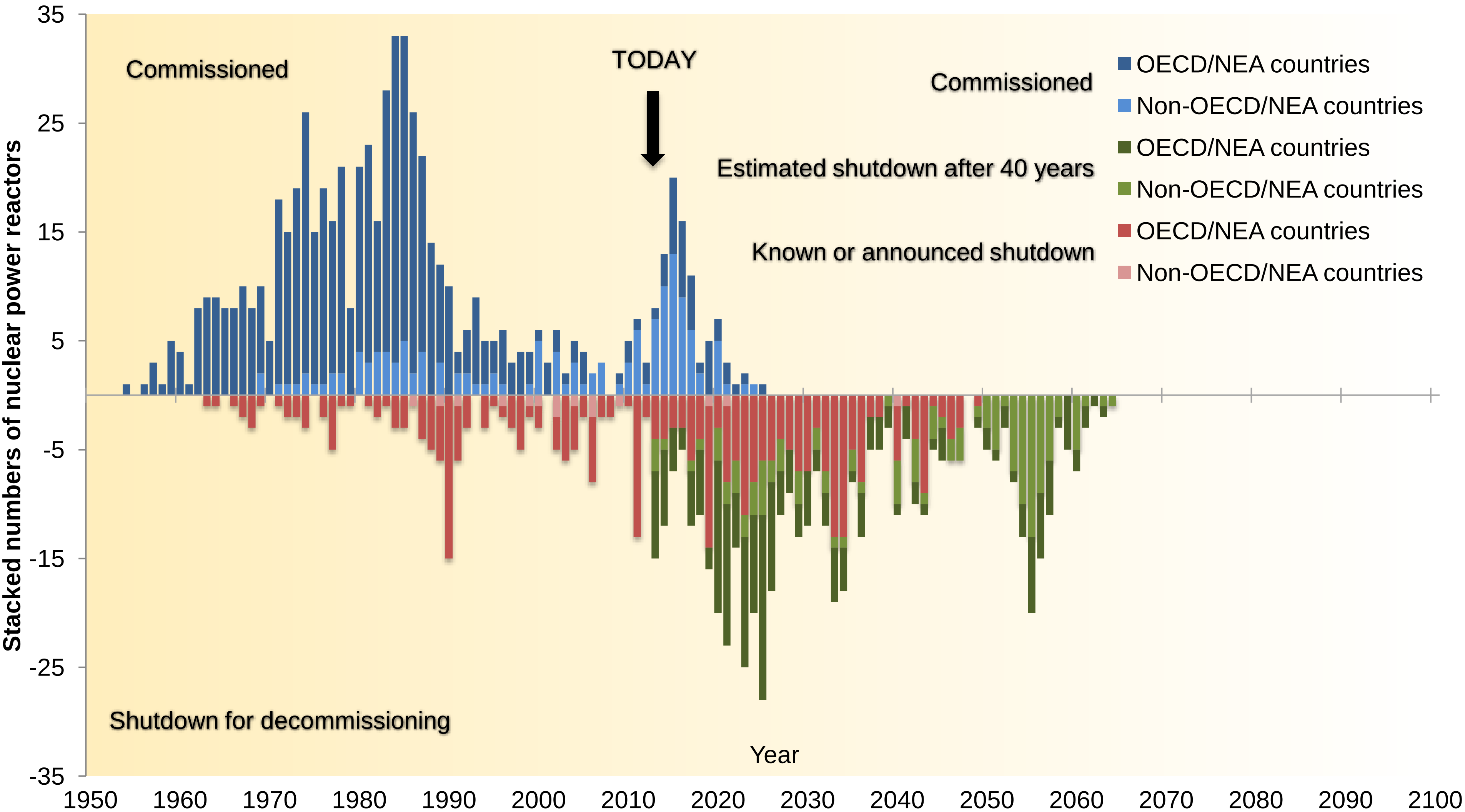
Future in Decommissioning of Nuclear Power Reactors

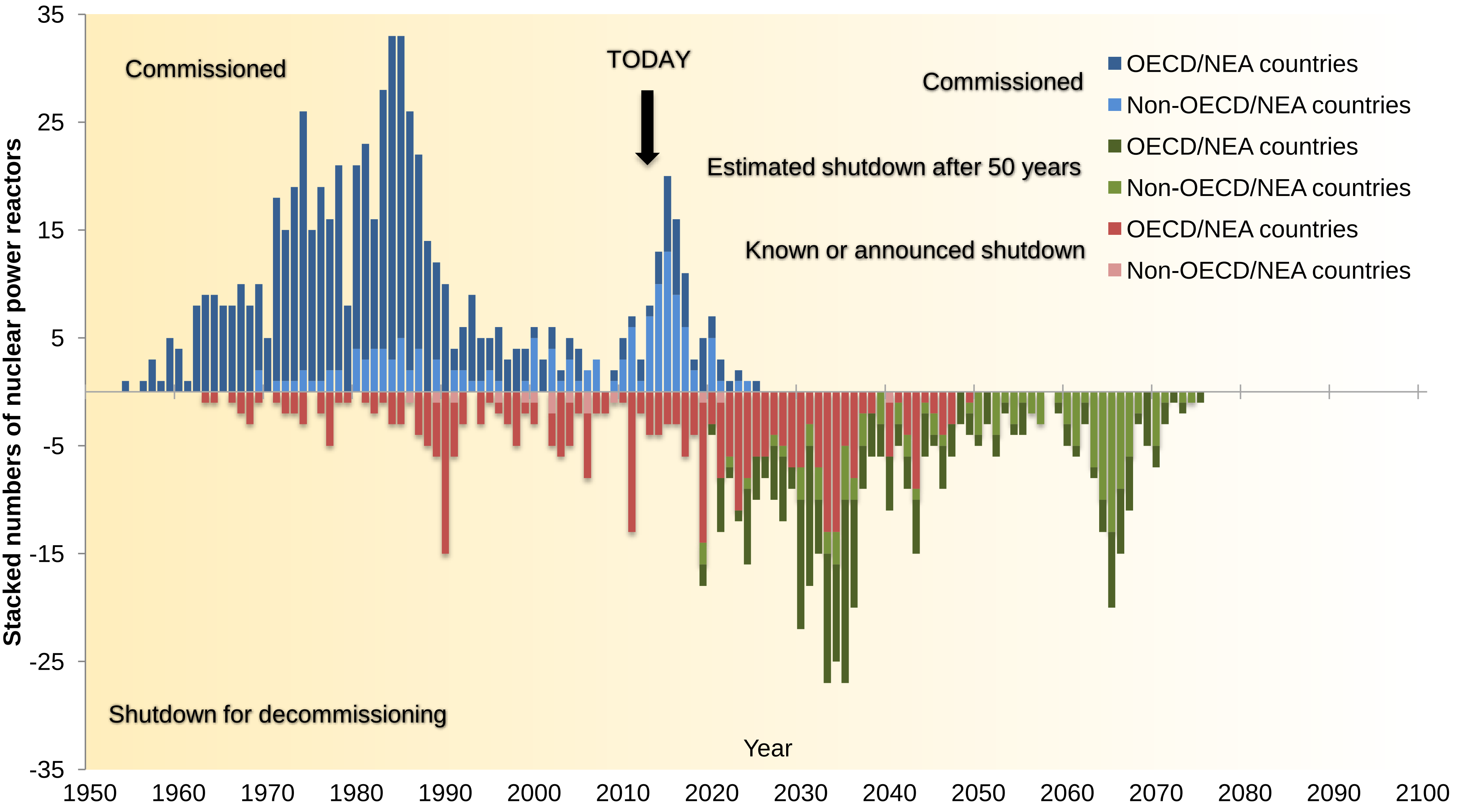
Situation [1]	In operation	Shutdown/under decommissioning	Fully decommissioned
Nuclear Power Reactors Worldwide	438	147	15
Nuclear Power Reactors OECD NEA	358	135	15
NEA Proportion	82 %	92 %	100 %

[1] PRIS database

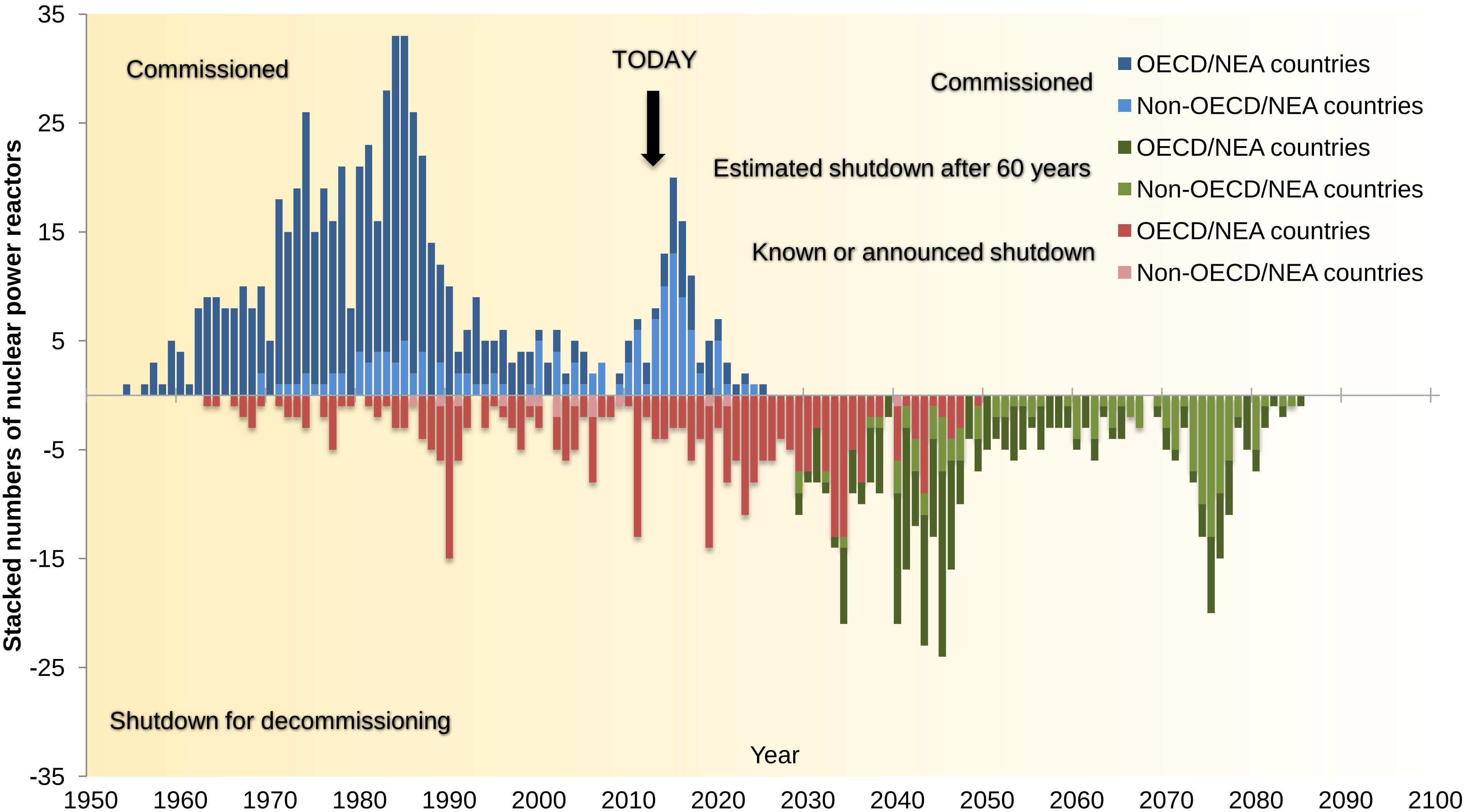
Nuclear Power Reactors Worldwide



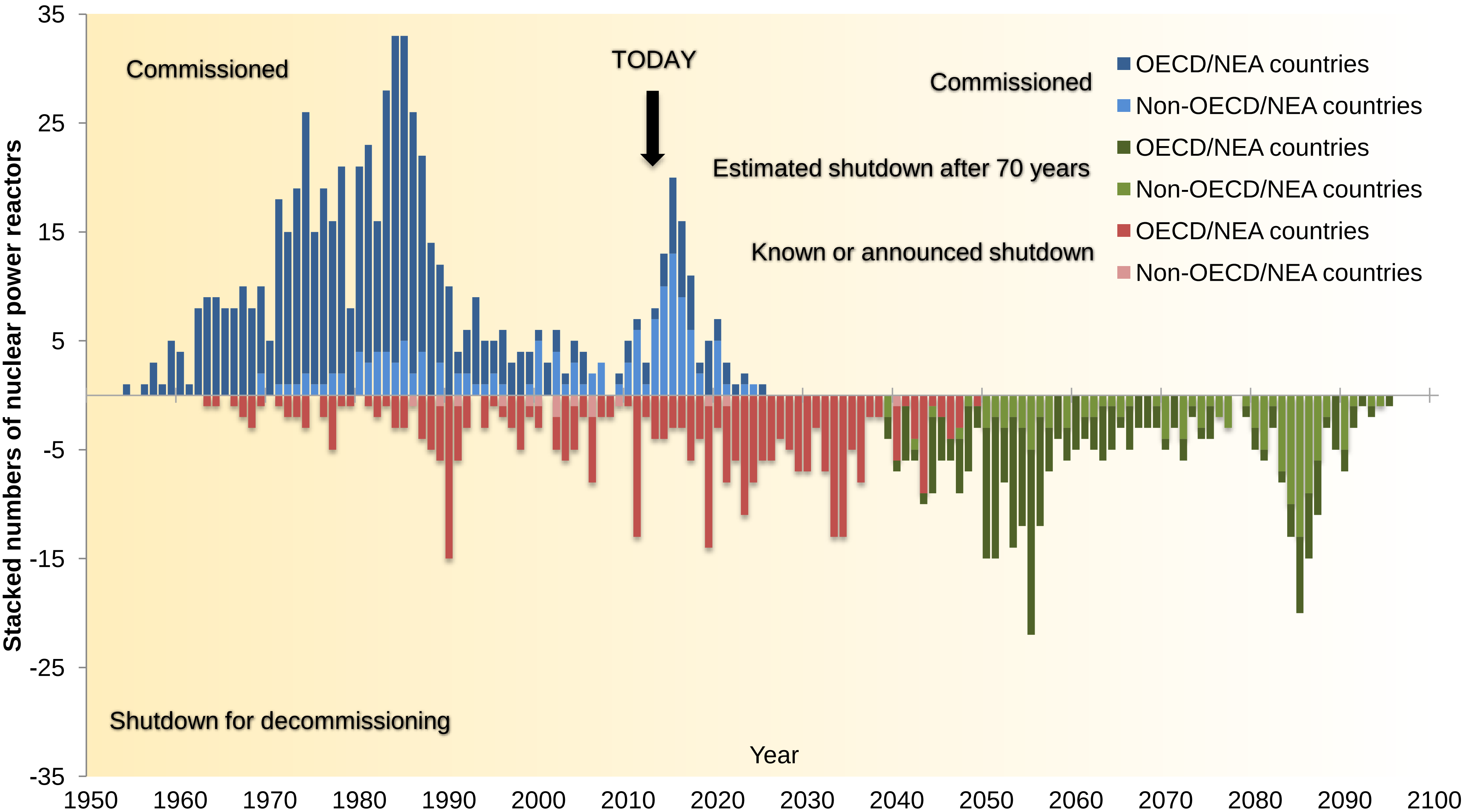
Nuclear Power Reactors Worldwide

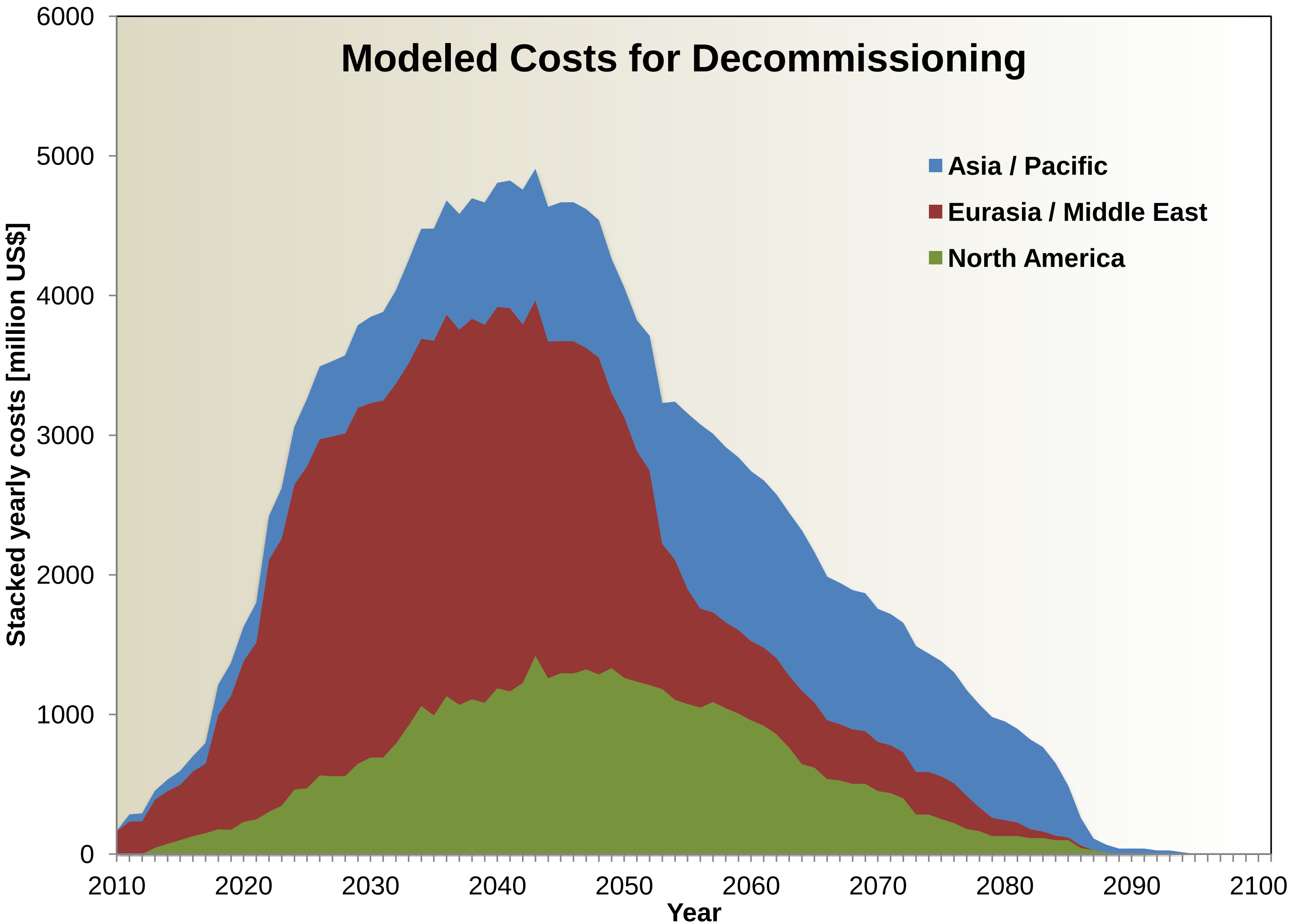


Nuclear Power Reactors Worldwide



Nuclear Power Reactors Worldwide





Assumptions:

(1) Costs from NEA 2003

(2) 25 years from shutdown to release

(3) Linear distribution of costs

(4) if not known, reactor shut-down after 40 years

What are the future issues to work on?

Progress can still be promoted in several areas:

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

1. Decommissioning Costing

- Constant need: robustness, transparency, auditability, and traceability of cost estimates
- Main cost drivers are identified
  - Project scope, regulatory requirements, stakeholders demands, waste inventory, experienced personnel, duration of decommissioning
- It is unadvisable to compare entire projects costs because of different project's scope, assumptions and boundary conditions
- A stable and more accurate cost estimation requires to avoid changes in the project scope, fixing regulatory standards during planning phase, assuring accurate inventory through materials and soils characterisation
- Use project managerial cost & budget controls to avoid frequent project budget & time overruns

2. Improving Technologies

- Many techniques, tools and equipment have been adopted from non-nuclear industry and adapted for decommissioning
- There is still a need for further research, development and innovations for decommissioning in order to reduce cost, radiation dose or time
- Although recent R&D outputs are of proprietary/business character, there is a space for international co-operation
- Proposed areas with the greatest potential for future improvements:
  - Characterization and survey prior to dismantling
  - Segmentation and dismantling
  - Decontamination and remediation
  - Materials and waste management
  - Site characterization and environmental monitoring

3. Record and Knowledge Management during Operation for Decommissioning

- Awareness of decommissioning during operation requires thinking also in decommissioning view
- Timely identifying the data necessary for decommissioning (planning, costing, radiation & conventional safety)
- Keeping info on changes in design, operational records, knowledge, operational waste
- Centralising the data for decommissioning (incl. drawings & operational records)
- Updating the data for decommissioning - additional cost for operations
- Interviewing (long-serving) operational staff (and retired staff) on non-recorded changes and operational history (including non-standard events)
- After operational shutdown: a characterisation plan and performance (access to areas), confirming physical data through a site walk-down
- Input data change after decommissioning project start - > change management (expensive)

4. Characterisation of Inventory for Decommissioning

- Operational culture impacts later characterisation (monitoring programmes – leaks, ground / subsurface / surface water; recording of operational events and results of monitoring)

After shutdown:

- Knowledge transfer to decommissioners (dec.operation company, contractors)
- Early assessment of potential sources for contamination (for sampling strategy), and associated dose levels
- Establish clear characterisation objectives for each characterisation campaign, selection of characterisation/survey methods/tools/instruments,
- Consultation with regulatory authorities – build confidence, avoid misunderstandings
- Dialogue with stakeholders during develop and performance of the characterisation plan, and post-shutdown clean-up activities
- Early set up of waste acceptance criteria, clearance criteria and clear definitions of the clearance process
- Inventory database with built-in quality assurance functions

5. Adapting Regulation

- A new working and risk context (from operation to decommissioning, from routine to a set of unique activities) requires a proportionate regulatory response, flexibility
- A proper balance in regulating of:
  - Health and safety of the workforce
  - Modification of plant and equipment
  - Control of radioactive contamination
  - Control of human and organisational issues
  - Knowledge retention

- Some identified issues
  - Oversight of funding provisions
  - Interaction between regulatory authorities during decommissioning process

6. Collecting Lessons Learned for New Build

- Decommissioning is increasingly recognized as an important aspect of plant design
- Decommissioning plans are required from pre-licensing. This focuses attention on decommissioning already at the design stage.
- Design supports optimal operation and maintenance, indirectly decommissioning
- Direct design demands for decommissioning have been addressed
  - Long term stability of structures, material components of particular reactor systems, avoid embedding pipes, assure shielding pipes
  - Monitoring systems for early detection of leaks and contamination, and plant chemical parameters (for corrosion)

Summarising Considerations

- Decommissioning is getting a matured industry, however, research, development and innovation are still needed
- Non-routine operations, changing work environment and risk profile
- Increasing safety, project management and consequently cost demands

Challenges:

- Waste management routes up to final disposal
- Site restoration of (large) contaminated areas
- Workforce, experienced professionals, young generation
- Organisational aspects (transition from operation to decommissioning)
- Public acceptance

Thank you for your attention