Preparing for the Future: Innovation and Education
NEA Activities

Tatiana Ivanova
Head of the Division of Nuclear Science

ATOMEXPO 2019
OECD NEA Round Table “Preparing for the future: innovations and education”
Sotchi, 15 April 2019

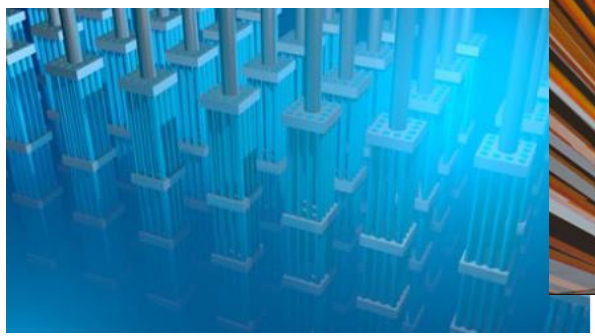
Outlook for innovations

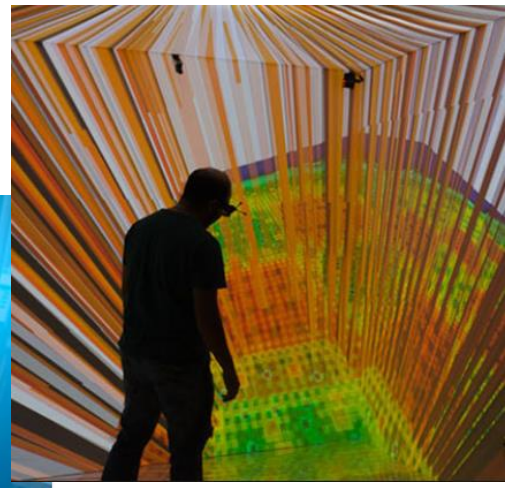
Nuclear innovations headwinds:

- The **cost and risk** of nuclear innovation has become prohibitive in many countries for industry engagement
- **Regulators** in most countries are not actively engaging in technology evolution, but wait for the finished technology development to be presented for approval
- Much of the **global infrastructure** was built more than 50 years ago and is shrinking steadily
- The **new generation of scientists, engineers and technicians** need to be exposed to real-world innovative projects

Innovations transforming the nuclear energy include:

- New classes of advanced reactors, including small modular reactors
- Enhanced load-following capacity of nuclear reactors
- Co-generation strategies
- Advanced manufacturing
- Advanced fuels and materials
- Advanced modelling and simulation
- Advanced instrumentation





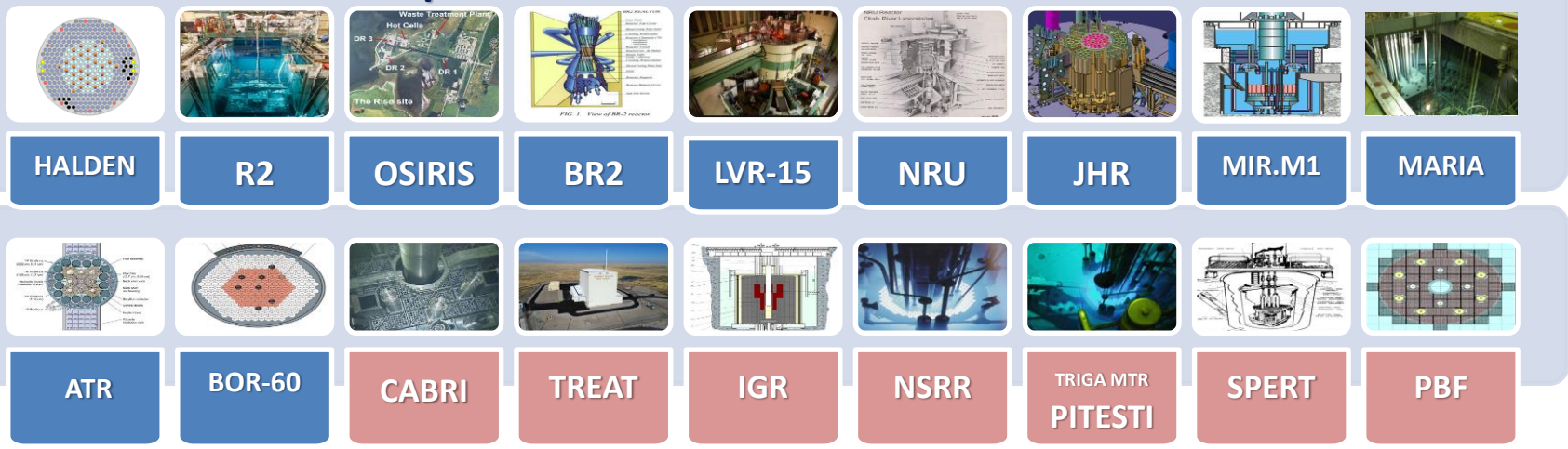
"Anyone seeking profits must be innovate…"
Joseph Alois Schumpeter

Innovations and international cooperation

To reduce existing barriers associated with developing and deploying innovations in the nuclear domain there is the need for a concerted effort to:

- Harness collective skills and means
- Create sound and robust confidence in new technologies for decision making and licensing
- Open the international market
- Attract investments, reduce the risks and increase the returns to private nuclear developers
- Optimise resources and deployment times
- Optimise the use of experimental infrastructure

Example: Material and Fuel Research Facilities



NEA Proposal for a new post-Halden framework

Multinational NEA Framework for In-pile Fuel and Material Testing

Pursuant to Article 5 of the NEA Statute, the Framework will be established as an international joint undertaking

- Ensure continuity and sustainability in the field strategic for safety and economy
- Build a collective awareness of needs and capabilities
- Identify gaps requiring investments and facilitate related implementations
- Create opportunities for cross-cutting activities:
  - ✓ State-of-the-art instrumentation and modelling & simulation
  - ✓ Preservation and quality management of experimental data
  - ✓ Professional development and educational activities

Joint Experimental Programmes (JEEPs)

- Enable in-pile experiments in fuel and material test reactors and PIE facilities

P2M tests in BR2 & PIE in CEA. Proposed by CEA, SCK•CEN, EDF

LOCA tests in MIR.M1. Proposed by RIAR

LOCA tests in CABRI. Proposed by IRSN and CEA

RIA tests in NSRR. Proposed by JAEA

Cladding creep tests in LVR15. Proposed by UJV ReZ

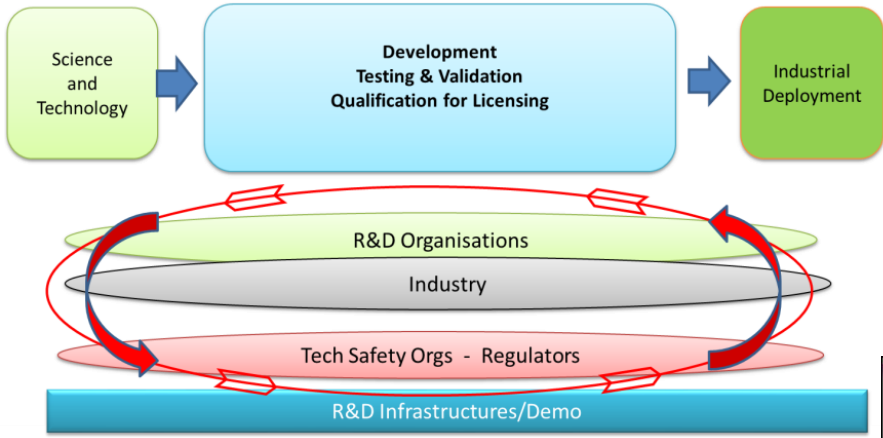
Potential tests in ATR, TREAT (INL)

Tests for validation of 3D M&S. Proposed by INL.

Future proposals

NEA and innovations

- **NEA "Nuclear Innovation 2050" (NI2050) initiative:**
  - builds a cooperative framework enabling innovative fit-for-purpose nuclear fission technologies
  - applies multilateral strategies to support more effective deployment of innovative nuclear technologies
- **NI2050 selected topic areas are:**
  - accident-tolerant fuels
  - advanced fuels and materials
  - severe accident knowledge management
  - passive safety systems
  - management of ageing structures
  - heat production and cogeneration
  - modelling and simulation etc

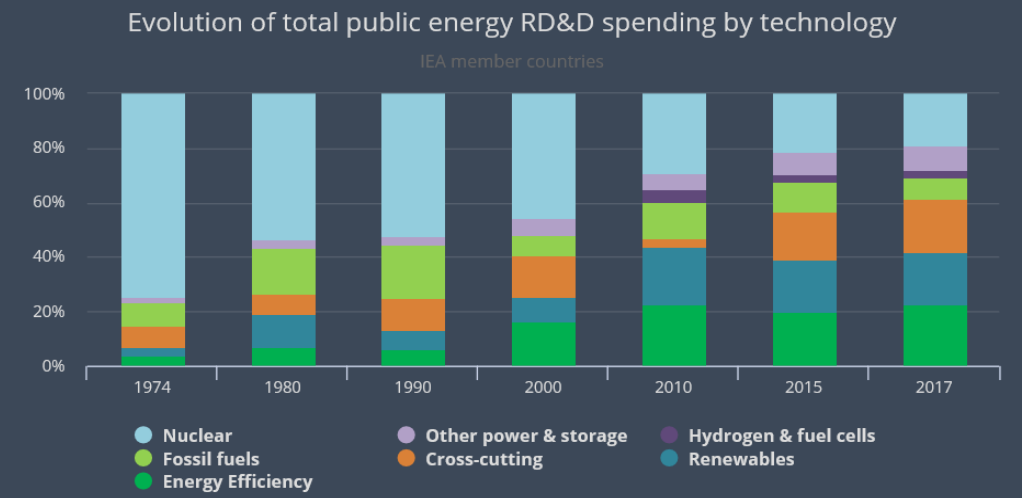


- **NI2050 is supported by other NEA initiatives in the development, safety and science areas**

Education: Challenges and needs

- Lack of graduates and skills
- Retirement of the workforce
- Lack of ‘scientific schools’ or preservation and transfer of knowledge to individuals and knowledge flow within the organisations
- Lack of ‘real-world’ challenging problems resulting from stagnation and slow innovation processes…

Investment in energy RD&D has become progressively more diverse. Nuclear, dominant in 1974 with 74% of the total, witnessed year-on-year reductions, falling to just 19% in 2017. On the other hand, energy efficiency (23%), renewables (18%) and cross-cutting RD&D (20%) all increased their shares. Mirroring this trend, RD&D budgets on fossil fuels, which saw peaks in the 1980s and 1990s, have been declining over the past years, from 14% in 2013 to just 8% in 2017, their lowest share since 2000.



Passing Knowledge on to the new generation of experts

Explicit knowledge

Gained through education, mentoring easy to codify and transfer.

Codification and preservation in database, books, reports, procedures etc.

Tacit knowledge

Based on personal experiences and hands-on training.

Challenges:

- Human resources turnover is comparable to the technology turnover (~30 years)
- Scarcity of challenging 'real-world' projects.

NEA contributions

- Continuous contributions in the fields of nuclear science, radioactive waste management, radiological protection and law
- Trainings and schools
- **Collections of evaluated experimental data**
- **Databases**

- **Nuclear Education Skills and Technology (NEST) Framework**

NEA Nuclear Education, Skills and Technology (NEST) Framework

Goals and added value

- Offering hands-on training and transfer of practical know-how through participation in multi-disciplinary and multi-national projects and activities
- Exposing students and young professionals to challenges and real-world problems
- Enabling skills and knowledge to be preserved, transferred, shared and developed through training by innovation
- Establishing exchanges and cooperation among participating organisations

NEST: Current status

- **Entered into force on 15 February 2019**
- **1st Management Board meeting, 28 March 2019**
- **Approved projects:**
  - Hydrogen Mitigation Experiments for Reactor Safety, led by PSI, Switzerland
  - Collaborative Laboratories for Advanced Decommissioning Science, led by CLADS, Japan
  - Radioactive waste management, led by Rosatom, Russia
  - Small Modular Reactors and Molten Salt Reactors, led by Canada and the United States

PARTICIPATING ORGANISATIONS

NEST PDC UGR Project on decommissioning

Scope of work

The **NEST-PDC UGR** project addresses the main issues of **RW management, including characterization, decontamination and disposal**. It will focus on decommissioning of Uranium Graphite Nuclear Reactors. Hands-on training will consist of several activities which will make use of the fully-fledged infrastructure, **pilot & experimental facilities** present at the sites:

- Specially-manufactured equipment for graphite remote sampling
- Graphite incineration facility
- RW repository mock-up models for investigation of geological barriers

NEST Management Board

Leading organisation: "PDC UGR" JSC

NEST Fellows
Graduate, postgraduate students and young professionals

Participating Organisations

- **Seversk Technological Institute/MEPhI branch**
- **National Research Nuclear University MEPhI**
- **National Research Tomsk Polytechnic University (TPU)**
- **Faculty of Chemistry, Lomonosov Moscow State University (MSU)**
- **Politecnico Milano**
- **ROSATOM**
- **Sogin Latina NPP**
- **Siberian Department of the Federal Environmental, Industrial and Nuclear Supervision Service "ROSTECHNADZOR"**

POCATOM

Pilot facilities for testing technology of graphite treatment

Thank you for your attention

All NEA publications and institutional documentation available at
www.oecd-nea.org