

The IAEA's Role in Advancing Radiation Science and Technology

Celina Horak, SH-RCRT

IAEA Medium Term Strategy 2024–2029



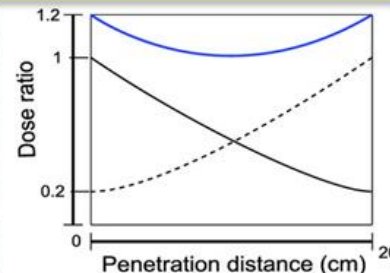
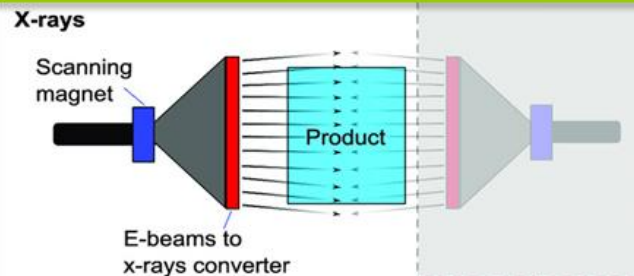
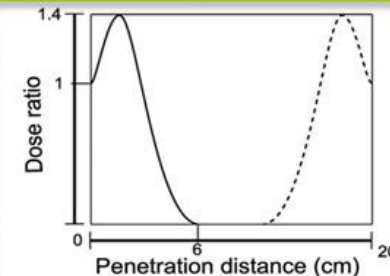
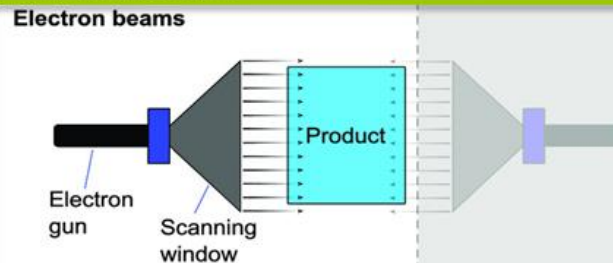
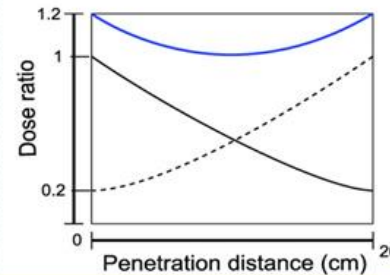
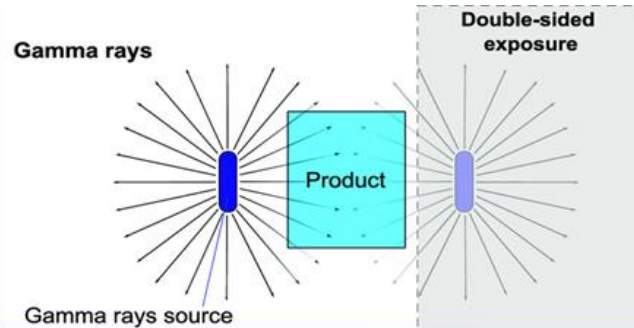
“the Agency will support the building of nuclear science competencies in Member States which chose to use radiation technologies. The Agency will also continue to provide an essential forum for disseminating information on technological developments

*The Agency's strategy for **radioactive sources** aims to enhance global safety, security, and management, ensuring safe use and minimizing risks. It also strengthens control measures to prevent illicit activities.*

*...“the Agency will continue to explore the **use of accelerators** for various radiation technology applications and to promote applications of advanced nuclear/radiation techniques for industrial development...”*

What can the IAEA do?

Radiation Technology



Radiation Sources:

- Radioisotope sources (Gamma ray)
- Radiation Generators (EB, X ray)

Quality Management:

- Inter-Comparison Dosimetry
- IQ, OQ, PQ

Guidelines:

- Setting-up facilities
- Feasibility studies

Training program for E-beam processing:
Fundamentals, Advanced, Operational, Quality Management, and Simulation

Safety and Securities:

- Maintenance and Upgrade
- Safety program implementation

What can the IAEA do?

Radiation Applications

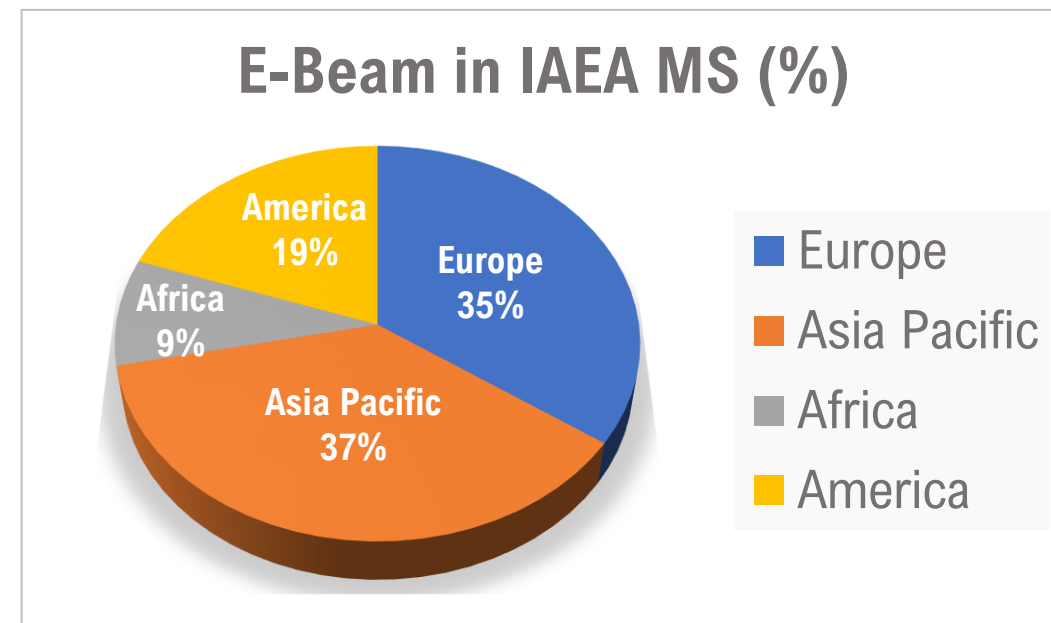


Current trend on radiation technologies:



Increased demand on E-Beam technology!!

Region	MS	Ms with EB (2024)
Europe	48	15
Africa	52	4
Asia Pacific	46	15
America (N & S)	34	6
Total number of EB	180	40



What can the IAEA do more to help?

1

Organization of strategic Meetings

- to find the best solution to MS
- to share the technology advancement, from concept idea
- to provide the optimal radiation sources/configuration to IAEA initiatives:
 - + NUTEC Plastic Recycling,
 - + Atoms for Climate,
 - + Atoms for Food,
 - + Zodiac.

2

Transportable E-Beam for training, promotion, on-site demonstration

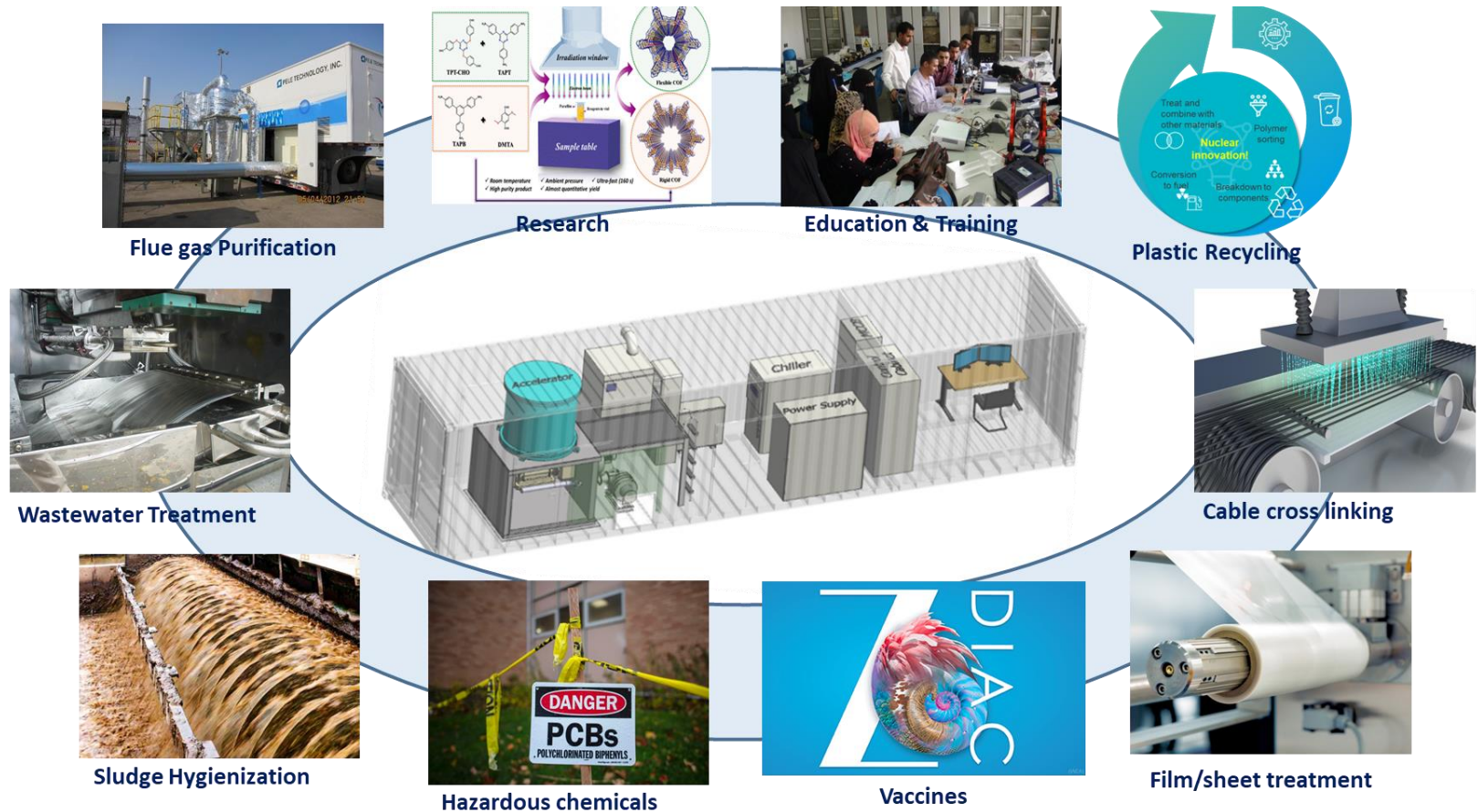
3

Making electron accelerators technology accessible to Member States

What can the IAEA do more to help?

2 Train countries on the required roadmap for establishing the technology, provide hand-on training and potential applications;

Transportable Electron Beam in IAEA



What can the IAEA do more to help?

2

Train countries on the required roadmap for establishing the technology, provide hand-on training and potential applications;

Transportable Electron Beam in IAEA

1. Pilot scale Demonstration

- Flue gases/VOCs from Power plants, Marine diesel, Industries (2,000 Nm³/h at 15 kGy max.)
- Water/Wastewater from Industries, Municipal WW plant (500 m³/d at 2 kGy max.)
- Liquid sludge from Municipal WW plant (200 m³/d at 5 kGy max.)

2. Removal of Hazardous industrial Wastes on the site

PCBs, Pesticides, POPs in limited storage

Remediation of contaminated environment from disasters

3. Demonstration of Polymer Modification and Recycling

Cross-linking of Wire/Cable.

Films/sheet for industrial uses.


Treatment of plastic wastes

What can the IAEA do more to help?

- 3 Making electron accelerators accessible for Member States for both research and industrial applications. Generic specifications at an appropriate price through group (bulk) purchasing – long-term procurement

Concept Note Electron beams for Development

Enhance the capabilities of interested Member States in using electron accelerators to bridge the gaps between advanced and developing countries in the adoption of radiation technologies for both research and industrial applications.



Radioisotope Production
and Radiation Technology

Electron beams for Development

Making electron accelerators accessible for Member States for both research and industrial applications

THE RATIONALE

Irradiation facilities play, directly or indirectly, a significant role in the Member States' development goals and in the practical application of IAEA initiatives, such as NUTEC Plastics, Atoms4Food, Atoms4Climate.

Many governments and international organizations encourage and provide institutional support for the adoption and development of alternative non-radioactive technologies (e-beam and X-ray) to the use of high risk radioactive sources (mainly cobalt-60) wherever possible, despite known technological and financial challenges for wider deployment in different regions of the world.

The main advantage of these alternative technologies is their ability to be turned on and off for safety and their minimal security risks. Also, since they do not produce residual radioactivity, they do not result in radioactive waste. Historically, such accelerators were complex and rather expensive. However, lately, numerous models have been developed for various applications, and many of them are compact, versatile, and much more reliable.

OBJECTIVE

Enhance the capabilities of interested Member States in using electron accelerators to bridge the gaps between advanced and developing countries in the adoption of radiation technologies for both research and industrial applications.


KEY TECHNOLOGY

- 2 MeV self-shielded electron beam system (1 kW power), for research and development of industrial applications, or
- 7-10 MeV electron beam system (20 kW power), aimed at large scale industrial applications.

PROPOSED ACTIVITIES

- Assistance in devising national strategies for optimum use of electron beam (e-beam) technology.
- Capacity building in Member States in the use of e-beam machines and in the implementation of the project.
- Procurement of e-beam machines at an appropriate price through group procurement, via cost-sharing.
- Delivery and installation of the machines in Member States upon following the necessary regulatory approval mechanisms.

Concept Note



DURATION

Three years

BENEFICIARY COUNTRIES


All IAEA Member States

EXPECTED OUTCOMES


Enhanced capabilities in Member States for radiation applications for scientific research, food safety, health care, industry, recycling of plastics and remediation of pollutants.

Worldwide increase in the number of Member States that use e-beam technology.

Contact us



#ebeam4development



IAEA Nuclear Sciences and Applications

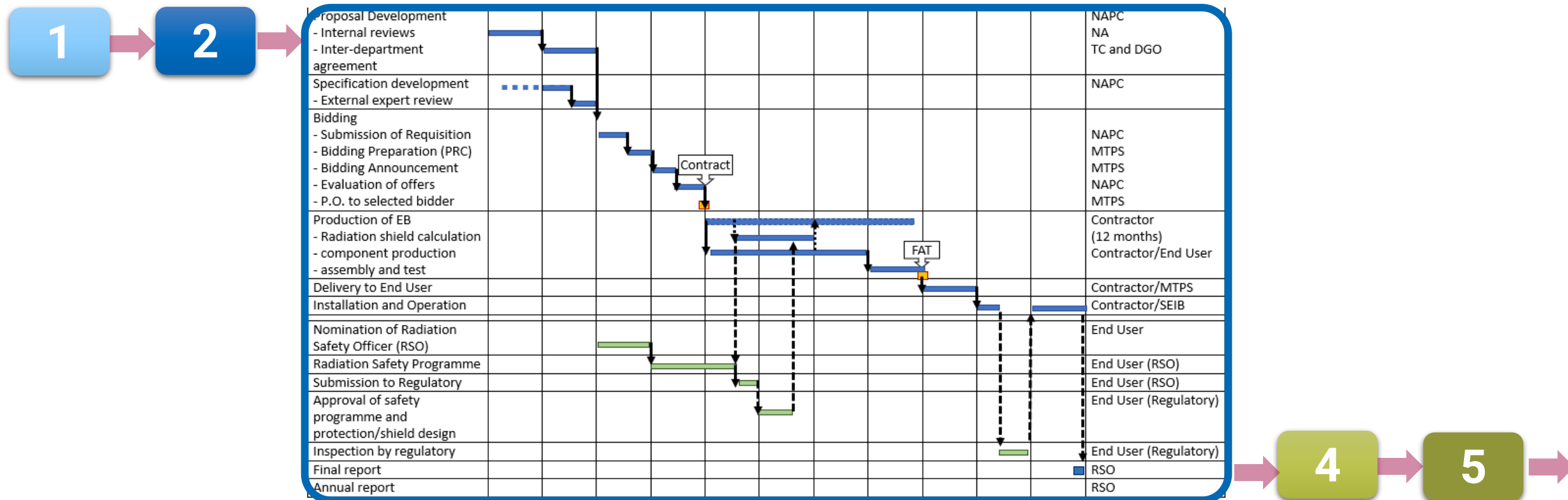
What can the IAEA do more to help?

- 3 Making electron accelerators accessible for Member States for both research and industrial applications.
Generic specifications at an appropriate price through group (bulk) purchasing – long-term procurement

Baby Project:	Purpose	- Alternative to small self-contained gamma irradiators - To introduce the radiation technologies to the developing countries
	Specification	Beam energy: up to 2 MeV max. Beam power: 1-2 kW Beam extraction: 40 cm scanner (single scan) Shielding: self-shielded (or partial shielded)
Star Project:	Purpose	Countries with enough experience and regulatory framework, As alternative to Gamma irradiation facility
	Specification	Beam energy: 10 MeV Beam power: 20 kW Beam extraction: 60 cm scanner (single or double scan) Shielding: concrete-shielded (borne by the Recipient)

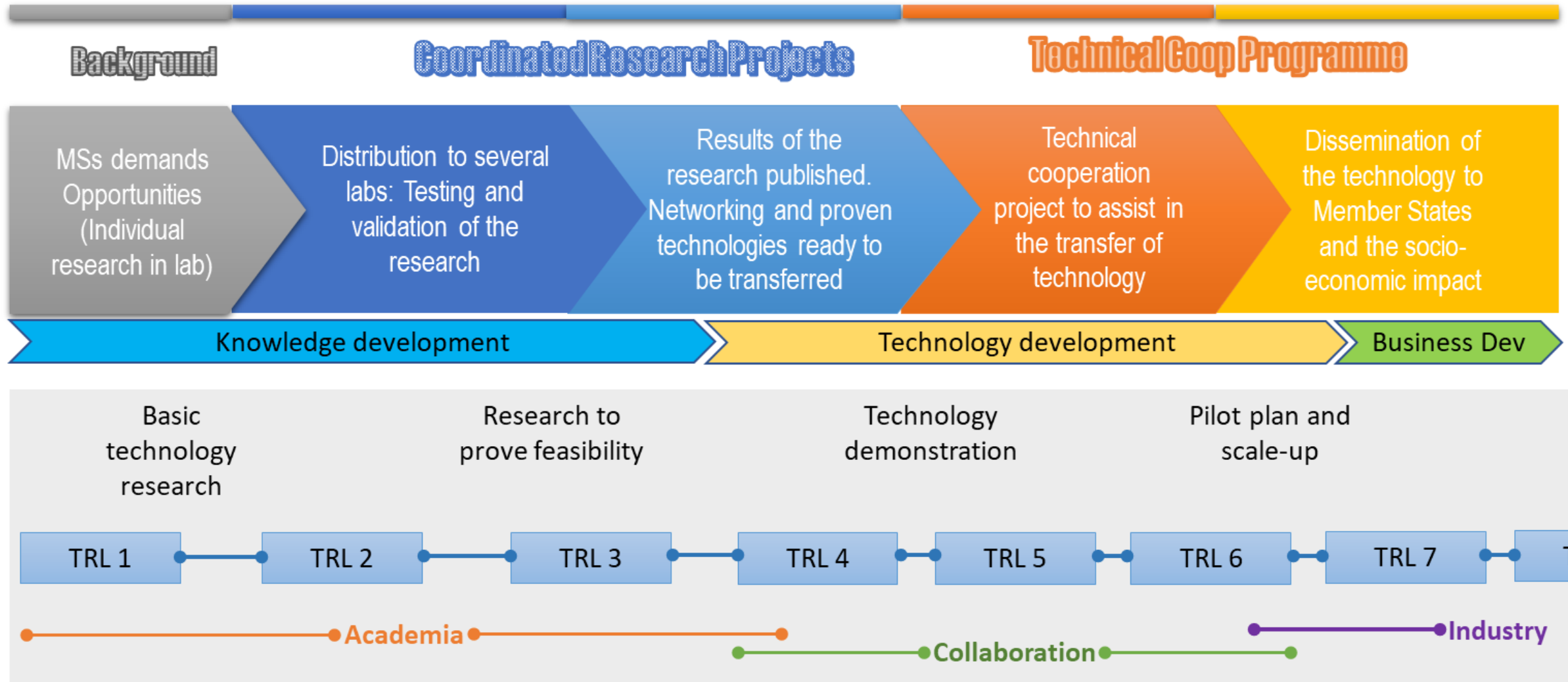
What can the IAEA do more to help?

3 Making electron accelerators accessible for Member States for both research and industrial applications. Generic specifications at an appropriate price through group (bulk) purchasing – long-term procurement



What IAEA does?

Mechanisms



What IAEA does?

R&D: Coordinated Research Projects (CRPs)

- Health Applications:

- 2 ongoing: [Enhancing the Beneficial Effects of Radiation Processing in Nanotechnology \(2019 – 2024\)](#)
[Radiation Effects on Polymer Materials Commonly Used in Medical Devices \(2021 – 2025\)](#)
- 1 planned: [NEW Biomaterials for sustainable health care \(2025 - 2029\)](#)

- Material modification

- 2 ongoing: [Development of Radiation-Grafted Membranes for Cleaner and Sustainable Energy \(2019 – 2024\)](#)
[Strengthening the Use of Biomass for Synthesis of Bioplastics and Other Compounds \(2023 – 2027\)](#)
- 2 planned: [NEW Modelling and Simulations of Radiation Effects in Polymers \(2026 – 2030\)](#)
[NEW: Transforming plastic into a 'renewable' alternative to fossil-based production, with reduced environmental impact](#)

What IAEA does?

R&D: Coordinated Research Projects (CRPs)

- Environmental Applications:

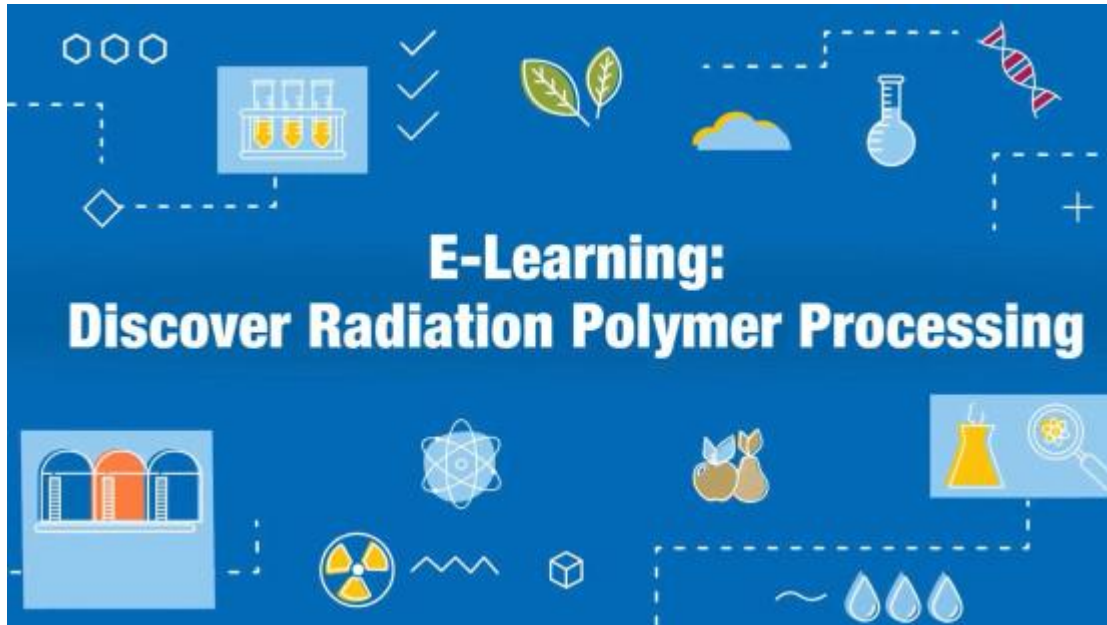
- 2 closed: Radiation Inactivation of Bio-Hazards Using High-Powered Electron Beam Accelerators 2018 - 2024
 Radiation Technologies for Treatment of Emerging Organic Pollutants (2019 – 2024)
- 2 ongoing: Recycling of Polymer Waste for Structural and Non-Structural Materials (2021 – 2026)
 Mitigating Greenhouse Gases using Radiation (2025 – 2029)

- Cultural Heritage:

- 1 ongoing: Development and Implementation of Cultural Heritage Preservation using Ionizing Radiation Technology (2023 - 2027)

What IAEA does?

Education programme: e-learning



- Fundamentals of Radiation Technology
- Radiation processing of polymers
- Radiation-assisted environmental applications
- Training program for E-beam processing: Fundamentals, Advanced, Operational, Quality Management, and Simulation

What IAEA does?

Education programme: Guidelines/technical publications

Publication	Title	Expected publication
Textbook	• Nanomaterial synthesis and modification by ionizing radiation	1Q 2027
	• Radiation processing: guidance for facility selection and upgrade	on hold
Radiation Technology Series	• Best practices in disinfection of cultural heritage artefacts and archives using ionizing radiation	2Q 2025
	• Mathematical Modelling of Radiation Processing	4Q 2025
	• Guidelines for routine control and quality management of irradiation facilities	4Q 2026
	• Guidelines for Environmental Application of Ionizing radiation	2Q 2026
	• Radiation-grafted Membrane for Cleaner and Sustainable Energy	4Q 2025
TECDOC	• Instructive Surfaces and Scaffolds for Tissue Engineering Using Radiation Technology	on hold
	• Development and Implementation of Cultural Heritage Preservation using Ionizing Radiation Technology	3Q 2025
	• Enhancing the Beneficial Effects of Radiation Processing in Nanotechnology	3Q 2025
	• Radiation Based Technologies for Treatment of Emerging Organic Pollutants	3Q 2025
	• Advanced Electron Beams for Industrial Applications	4Q 2025
	• Quality Management of Irradiation Facilities	3Q 2025



C.Horak@iaea.org