

Technical Cooperation Report for 2022

Report by the Director General



IAEA

International Atomic Energy Agency
Atoms for Peace and Development



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Preface

The Board of Governors has requested the transmission to the General Conference of the attached Technical Cooperation Report for 2022, the draft of which was considered by the Board at its June 2023 session.

The Director General is also hereby reporting in fulfilment of the request contained in resolution GC(66)/RES/8 on “Strengthening of the Agency’s technical cooperation activities”.

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Summary

The Technical Cooperation Report for 2022 provides an overview of the Agency's Technical Cooperation (TC) activities during the year, covering actions to strengthen the technical cooperation programme, programme resources and delivery, and programme activities and achievements. Examples of project activities and achievements are listed in Annex 1 according to thematic area, and Annex 2 lists the TC programme Fields of Activity, grouped for reporting purposes. The report responds to General Conference resolution GC(66)/RES/8.

Part A covers the context for the technical cooperation programme in 2022, opening with a section on how the technical cooperation programme contributes to the delivery of activities related to ZODIAC, NUTEC Plastics, Rays of Hope and climate change. Part A also provides an overview of the programme in 2022, covering the Agency's participation in global development dialogue, and its efforts to build human capacity, including through youth outreach, specialist schools, postgraduate support and legislative assistance. Part A goes on to describe how the programme is tailored to the needs of Member States, giving an overview of South-South and triangular cooperation, as well as responses to emergencies. It closes with a wrap up of efforts to make the programme more efficient and effective, addressing strategic partnerships, improvements to project design and quality monitoring, and female participation.

Part B presents a summary of financial and non-financial programme delivery indicators. It reviews the resources received for the TC programme through the Technical Cooperation Fund (TCF) and mobilized through extrabudgetary and in-kind contributions. Payments to the TCF in 2022 totalled €88.8 million¹, or 97.5% of the TCF target set for the year.² New extrabudgetary resources for 2022 came to €35.2 million and in-kind contributions were €0.3 million. Overall, implementation for the TCF reached 84.4% in 2022. Food and Agriculture, Health and Nutrition and Nuclear Safety and Security were the top areas of disbursement for the programme.

Part C highlights programme activities and achievements, and covers assistance to Member States in the peaceful, safe, and secure application of nuclear science and technology. It highlights regional and interregional activities and achievements in technical cooperation in 2022, and presents an overview of the activities of the Programme of Action for Cancer Therapy (PACT).

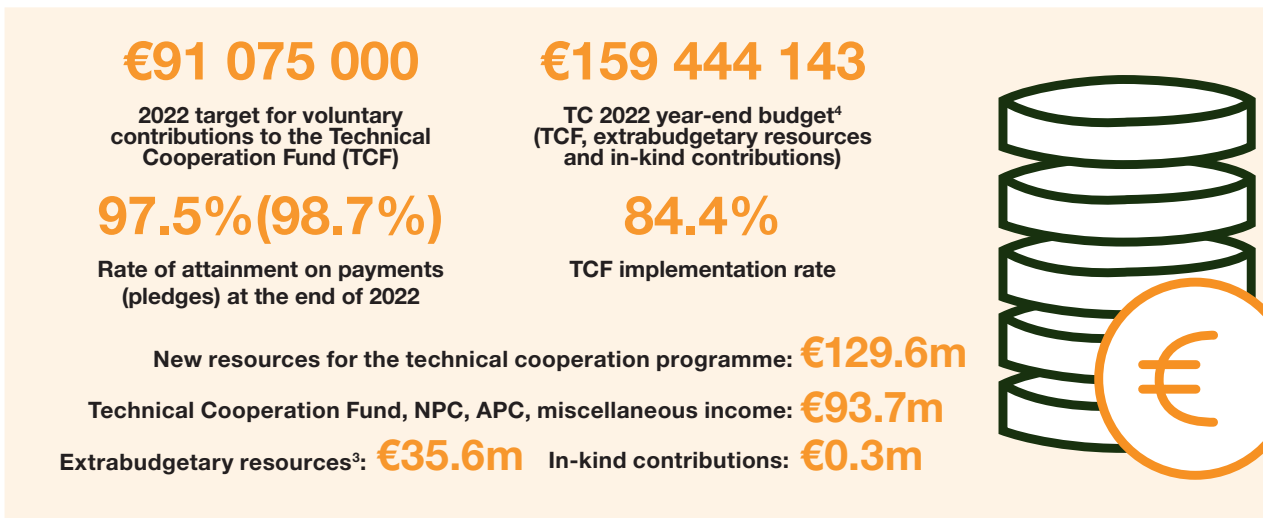
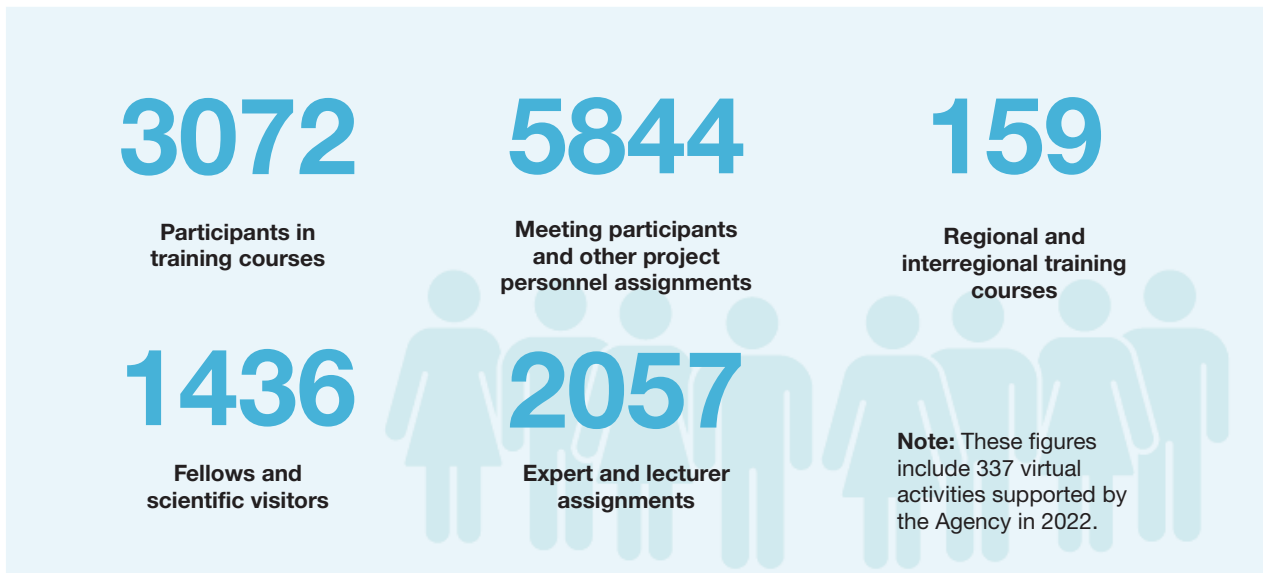
A brief selection of project examples is presented in Annex 1 according to thematic area, covering health and nutrition, food and agriculture, water and the environment, industrial applications, energy planning and nuclear power, radiation protection and nuclear safety, and nuclear knowledge development and management. Annex 2 lists the technical cooperation programme Fields of Activity.

¹ This figure does not include National Participation Costs, assessed programme cost arrears and miscellaneous income.

² Total payments received in 2022 include €1.6 million either of deferred or of additional payments by 11 Member States. Excluding these payments, the 2022 rate of attainment on payments would have been 95.7%.

The Agency's Technical Cooperation Programme in Figures

(as at 31 December 2022)



³ Includes donor contributions and government cost-sharing. Please refer to Table A.5 of the Supplement to this report for details.

⁴ Year-end budget is the total value of all technical cooperation activities approved and funded for a given calendar year plus all approved assistance brought forward from previous years but not yet implemented.

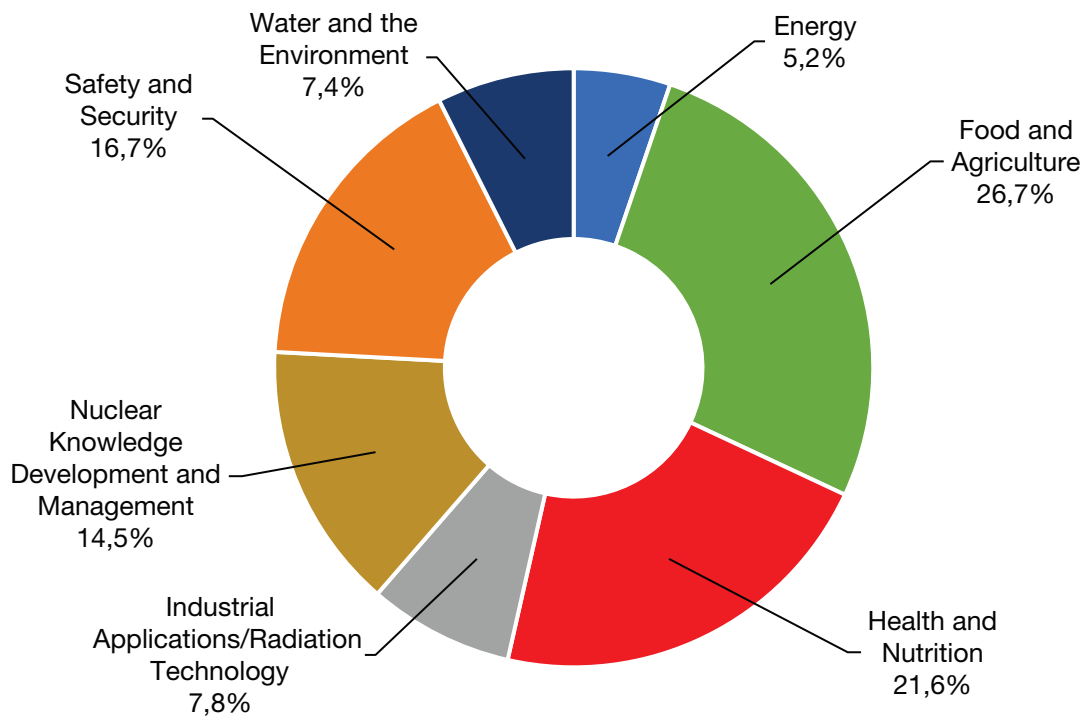


Figure 1: Actuals by technical field for 2022.⁵

⁵ Throughout this report, percentages in charts may not add up to 100% exactly due to rounding. Unless otherwise stated, all figures are denominated in Euros.

Technical Cooperation Report for 2022

Report by the Director General

This document responds to the request by the General Conference to the Director General to report on the implementation of resolution GC(66)/RES/8.

Part A of the report provides an overview of the progress achieved in delivering the technical cooperation programme in 2022.

Part B reports on the management of financial resources and programme delivery at an aggregate level in the calendar year 2022.

Part C reports on regional activities and programme achievements during 2022, and on the Programme of Action for Cancer Therapy.

Annex 1 provides examples of project activities and achievements in specific thematic areas.

Annex 2 lists the technical cooperation programme Fields of Activity.



A.

Strengthening the Agency's Technical Cooperation Activities

A. Strengthening the Agency's Technical Cooperation Activities⁶

A.1. DELIVERING THE TECHNICAL COOPERATION PROGRAMME

In 2022, many countries eased their COVID-19 restrictions, and the Agency was able to begin holding events and training courses in person once again. Lessons learned regarding delivery of the technical cooperation (TC) programme during the pandemic were identified, and options for strengthened e-learning, hybrid missions and greater online engagement, including through pre-courses for subsequent face-to-face training, were utilized where appropriate alongside traditional in-person approaches. Programme implementation reached 84.4%.

The TC programme continued to play a key role in implementing the flagship initiatives ZODIAC, NUTEC Plastics and Rays of Hope. In addition, the TC programme supported climate change monitoring, mitigation and adaptation efforts through some 300 ongoing projects. Member States interested in the potential of small and medium-sized or modular reactors also received support through national and regional projects, as well as through a dedicated interregional technical cooperation project that focuses on the contribution of nuclear power to climate change mitigation.

A.2. TECHNICAL COOPERATION IN 2022: AN OVERVIEW

Global developments in 2022: The context for the TC programme

Global development dialogue

The Agency highlighted the support it provides to its Member States' efforts towards the achievement of the 2030 Agenda and the Sustainable Development Goals at key high-level events in 2022, including the fifth session of the United Nations Environment Assembly and a special session of the United Nations Environment Assembly (UNEP@50), the United Nations High-level Political Forum on Sustainable Development, and the 7th United Nations Multi-stakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals.

At the 27th session of the Conference of the Parties of the UNFCCC (COP 27), the work of the IAEA technical cooperation programme in climate change adaptation was presented at side events on climate change adaptation in the Andes and Himalaya, and on monitoring greenhouse gases in partnership with the World Meteorological Organization. A further side event highlighted how isotope hydrology is helping water experts in Central America protect groundwater resources and build resilience against the effects of climate change.

⁶ Section A responds to section A.1. General, section A.2. Strengthening technical cooperation activities, section A.3. Effective execution of the technical cooperation programme, section A.5. Partnership and collaboration, and section A.6. Implementation and reporting, of resolution GC(65)/RES/10, Strengthening of the Agency's Technical Cooperation Programme.

The Agency also attended the United Nations Global South-South Development Expo where it showcased the contributions of nuclear technology to global development at a virtual and online exhibition, and shared its experience in South-South and triangular cooperation at a side event in collaboration with the United Nations Office for South-South Cooperation, the UN Economic and Social Commission for Asia and the Pacific, and the Government of Thailand.

Dialogue continued with the United Nations Office of the Special Adviser on Africa through participation in the Interdepartmental Task Force on African Affairs meetings at the technical and principal levels. Meetings focused on support to the implementation of the AU-UN Framework for the Joint Implementation of Agenda 2030 and the 2063 Agenda, with the goal of maximizing the impact of recovery efforts in Africa, and with energy as a key enabler for the achievement of the Sustainable Development Goals.

The Agency was present at the Seventy-eighth Session of the Economic and Social Commission for Asia and the Pacific (ESCAP) in Bangkok in May, and at the Seventh Session of ESCAP's Committee on Environment and Development of the Economic and Social Commission for Asia and the Pacific in November, which had the theme 'Protecting our planet through regional cooperation and solidarity in Asia and the Pacific'.

At the invitation of the Government of Indonesia during its G20 Presidency, the IAEA participated in the G20 Energy Transition Working Group and co-hosted a virtual workshop on the role of nuclear in energy transitions. The Agency also participated in the G20 Research and Innovation Initiative Gathering and the Research and Innovation Ministers Meeting. Contributions were provided to the fourth G20 Report on Actions against Marine Plastic Litter, which was launched on the occasion of the G20 Environment Ministers' Meeting 2022. At the Second Asian Development Bank Innovation Fair the Agency highlighted the socio-economic impacts of various nuclear technologies in relation to the UN Sustainable Development Agenda.



IAEA Director General Rafael Mariano Grossi visits the REMARCO stand at the UN OCEAN Conference. (Photo: REMARCO)

In June, the Agency hosted a side event at the 2022 United Nations Ocean Conference in Portugal, with the participation of the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO). The side event focused on addressing marine plastic pollution.

The Agency's participation in these and other global events in 2022 facilitated engagements with international financial institutions, the private sector and philanthropic foundations – all essential to resource mobilisation actions, including for the flagship initiatives NUTEC and ZODIAC – and helped to position the Agency as an experienced partner in the global advancement of South-South and triangular cooperation.

Advancing cancer control

The Programme of Action for Cancer Therapy (PACT) continued to advocate for improved access for cancer control in low- and middle- income countries, including through participation in several international forums and events, including the 75th World Health Assembly, World Cancer Day, London Global Cancer Week, and the World Cancer Congress, where Agency experts emphasized the need to forge new, and expand traditional partnerships in the global fight against cancer.

Jointly with the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC), the IAEA, through PACT, convened a series of national cancer control plan (NCCP) webinars for Ministry of Health focal points to strengthen capacities in cancer control planning and governance by creating a forum for interactive dialogue to share lessons learned on NCCP development and implementation.

Nuclear power, small modular reactors, climate change, and support for adaptation

The Agency is providing support to Member States interested in the potential of small modular reactors (SMRs) and microreactors (MRs) through the interregional project INT2023, 'Fostering Capacity Building on Small Modular Reactors and Microreactors and their Applications in IAEA Member States – A Contribution of Nuclear Power to the Mitigation of Climate Change'. The goal of the project is to support Member States in the deployment of SMRs and microreactors. It aims to enable national stakeholders to understand key characteristics of SMR and MR technologies and their applications, and to formulate, in line with IAEA Safety Standards, country-specific legislative and regulatory frameworks, as well as generic user requirements and criteria for SMR technologies. The project offers effective capacity building through training and technology transfer activities on all aspects of SMR development, and supports the sharing of regulatory experience and user requirements among countries. Participating countries also receive technical assistance to evaluate the contribution of SMRs and MRs and their potential electric and non-electric applications (in line with SDGs 6, 7, 9, 12 and 13).

Forty-seven countries have confirmed their participation in the project, and 17 donor countries are providing support. The Agency is also reaching out to potential donors for support through in-kind contributions, funding of activities, event hosting and the provision of experts, as well as to additional potential Member State recipients.

In 2022, three events were carried out under this project to build Member State knowledge and capacity. An interregional training course on understanding the physics and technology of such reactors was carried out in July using the Agency's educational simulator. In August, a workshop built understanding of the economic competitiveness of SMRs and microreactors. In November, a hybrid interregional training course was delivered in Moscow, Russian Federation, which focused on fuel design optimization and fuel cycle options for SMRs.

Carbon sequestration mitigates global warming by slowing down the atmospheric CO₂ increase. CO₂ is naturally captured by the environment, but actions can be taken to enhance this process (changes in land use and agricultural practices, or conservation of aquatic vegetated ecosystems). Comprehensive, reliable estimates of existing carbon stocks and sequestration rates are important for establishing appropriate conservation practices, and for adopting suitable climate change mitigation and adaptation strategies related to CO₂ emissions. Twelve Africa Member States met in October during the first project coordination meeting for project RAF7020, 'Establishing Regional Capacities to Assess the Importance of Carbon Sequestration in Aquatic Systems for Climate Change Mitigation, Environmental Conservation and Economic Purposes (AFRA)' to discuss regional capacities and gaps in the field, and to agree on key priorities to be addressed. The project aims to strengthen regional capacities in using nuclear and isotopic techniques to apply standardized methodologies for carbon accounting in aquatic ecosystems.

A.3. CONTRIBUTING TO NUTEC PLASTICS, ZODIAC AND RAYS OF HOPE

NUTEC Plastics

NUTEC Plastics assists Member States' efforts to address plastic pollution, providing support for potential recycling using radiation technology, and for marine monitoring using isotopic tracing techniques. NUTEC Plastics assistance is being implemented through several regional and national technical cooperation projects.

In Africa, actions under regional project RAF1010, 'Reutilizing and Recycling Polymeric Waste Through Radiation Modification for the Production of Industrial Goods (AFRA)' aim to accelerate the transition to a circular plastic economy by applying nuclear science

and technology solutions. Sixteen African Member States are currently participating in the project, with many designating their project counterparts from national marine laboratories. Interactions with the Global Plastic Action Partnership (GPAP) regional working group for Africa of the World Economic Forum have identified areas of synergy under the NUTEC initiative.

Ten countries in the Asia and the Pacific region are participating in regional project RAS1024, 'Reutilizing and Recycling Polymeric Waste through Radiation Modification for the Production of Industrial Goods'. The Philippines, Malaysia, Indonesia, and Thailand, who have the most advanced national plastics recycling programmes of the ten, have been identified as pilot countries for the project and have made significant progress in technology development in 2022. Two National Stakeholders Meetings were held in 2022 to engage government and potential industrial partners. The Agency facilitated the participation of the Philippines' research team in the Asian Development Bank Innovation Fair, where they showcased their progress in developing plastic recycling.

In Latin America and the Caribbean, regional project RLA1020, 'Promoting Radiation Technology in Natural and Synthetic Polymers for the Development of New Products, with Emphasis on Waste Recovery (ARCAL CLXXIX)', aims to demonstrate the feasibility of radiation technology in converting different polymeric wastes into value-added products. In November, laboratory staff from Argentina, Chile, Costa Rica, Panama, Peru and Venezuela participated in a regional training course in Brazil on scaling up the application of radiation technology from the laboratory scale to pilot and industrial scale plants, emphasizing on waste recovery.



*Collecting microplastics in sand, Costa Rica.
(Photo: REMARCO)*

Specialists from the Regional Network for marine-coastal stressors in Latin America and the Caribbean (REMARCO) finalized four harmonized microplastics sampling protocols for coastal areas. This achievement aligns with the IAEA NUTEC Plastics initiative and will contribute to harmonized approaches for microplastics monitoring programmes being implemented in the region. The aim is to obtain comparable data and to collect regional information on the quantity of microplastics in the region's marine and coastal environments.

The Agency signed two separate Memorandums of Understanding (MoU) with Argentina and Cuba, setting out a framework for scientific cooperation under NUTEC Plastics on control of plastic pollution in Antarctica and the Caribbean, including the organization of expert missions and educational and training activities to build capacity to collect and analyse data on the identification and distribution of microplastics.

ZODIAC

The Zoonotic Disease Integrated Action (ZODIAC) project aims to enhance national and regional capacities for the detection, surveillance, and control of emerging or re-emerging zoonotic diseases. By the end of 2022, 150 Member States had nominated ZODIAC National Coordinators (ZNCs) and 126 had nominated ZNLs. The ZODIAC Portal was launched in 2022, providing access to educational and training videos and to recordings of ZODIAC Briefings.

Implementation of the project is supported through the TC programme under interregional TC project INT5157, 'Supporting National and Regional Capacity in

Integrated Action for Control of Zoonotic Diseases', which supports national and regional capacity building in the ZODIAC National Laboratories (ZNLs). Several virtual interregional training courses and workshops were held in 2022, reaching over one thousand participants. Topics covered included generic methods for validating standard operating procedures, the use of IAEA genetic sequencing services, and current developments of whole genome sequencing platforms, among others. A recorded course on 'The Use of the iVetNet Platform' was accompanied by two live virtual Q&A sessions in June. A virtual interregional workshop on 'Monkey pox and Lassa fever Infections in Animal Reservoirs and the Risks for Public Health Transmission - What Do We Currently Know and the Way Forward?' was held in June, and was addressed by IAEA Director General Rafael Mariano Grossi and high-level representatives of FAO and WHO.

	ZNCs nominated	ZNLs nominated
Africa	44	42
Asia and the Pacific	34	25
Europe	42	37
Latin America and the Caribbean	30	22
Total	150	126



IAEA Director General Rafael Mariano Grossi addresses the ZODIAC workshop on Monkey pox and Lassa fever. (Photo: D. Calma/IAEA)

A ZODIAC progress meeting for ZNCs and ZNL representatives was conducted for Africa and Europe regions in January, and for Asia and the Pacific region in February. Serology and molecular diagnostic equipment was procured for 30 ZNLs (12 ZNLs from Africa, 5 from Asia and the Pacific, 7 from Europe and Central Asia, and 6 from Latin America and the Caribbean) and whole-genome sequencing platforms were procured for 9 ZNLs (3 from Africa, 2 from Asia and the Pacific, 2 from Europe and Central Asia, and 2 from Latin America and the Caribbean). In addition, three fellowship trainings on whole-genome sequencing were completed by fellows from Indonesia, Senegal and Tunisia. A first in person training course on Generic Verification of Standard Operating Procedures (SOPs) for Serology and Molecular Diagnostic in ZNLs was implemented in September at the Institut Pasteur de Dakar, Senegal, where 23 participants from 19 French-speaking African Member States received training.

Rays of Hope

In February, on the margins of the African Union Summit, IAEA Director General Rafael Mariano Grossi, together with President Macky Sall of Senegal, launched the Rays of Hope initiative to support Member State efforts to increase access to affordable, equitable, effective and sustainable radiation medicine services. The Director General issued a joint statement with Director General Tedros Adhanom Ghebreyesus of the World Health Organization (WHO), noting that cancer treatment remains inaccessible in many parts of the world, and that "the IAEA and WHO remain committed to upscaling their long-standing close



IAEA Director General Rafael Mariano Grossi and President Macky Sall of Senegal at the launch of the Rays of Hope initiative during a side event at the Summit of Heads of States of the African Union in February 2022. (Photo: IAEA)

collaboration toward common goals, closing the cancer care inequity gaps and accelerating progress toward the achievement of the 2030 UN Agenda for Sustainable Development”.

Support under Rays of Hope has already been initiated in seven African countries: Benin, Chad, Democratic Republic of the Congo, Kenya, Malawi, Niger and Senegal. An assessment of training and equipment needs have been completed for most of them. Benin is currently building a new hospital that will include radiotherapy services. Chad is making preparations for its first cancer therapy centre in N’Djamena and plans to launch its National Cancer Control Plan (NCCP) in early 2023. Malawi will complete its bunker in 2023 in preparation to receive a radiotherapy machine, and Kenya is also planning to expand radiotherapy access. Senegal has recently completed its NCCP, detailing an ambitious national objective to scale-up cancer care outside Dakar,

in particular increasing access in Diamniadio. A further 19 countries in the region are finalizing an assessment of their needs, which include training of medical professionals and procurement of diagnostic imaging and radiotherapy equipment.

Several Member States in Asia and the Pacific have also expressed interest in participating in Rays of Hope, including as anchor centres. ImpACT Review findings and recommendations are expected to inform the strategic direction of national Rays of Hope activities. Resource mobilization in the region is being explored, including extrabudgetary contributions, government cost sharing, and public-private partnerships.



New mammography equipment and training will help to increase diagnostic capacities in Uruguay’s public health sector. (Photo: N. Schloegl/IAEA)

In November, the IAEA Board of Governors approved an off-cycle TC project to strengthen radiation therapy and medical imaging in Ukraine. The project is intended to strengthen existing services in order to meet the increasing demand, particularly in some medical institutions that have become key locations for cancer patients coming from different regions in the country. It will contribute to the effective delivery of cancer diagnosis, management and treatment by providing equipment and strengthening human resource capabilities. The project is being implemented and delivered through existing Agency mechanisms, under the Rays of Hope initiative focusing on prioritizing high-impact, cost-effective and sustainable interventions to help meet national needs and commitments, and in partnership, when relevant and as necessary, with WHO and other stakeholders.

In Latin America and the Caribbean, Memorandums of Understanding (MoU) have been signed with Argentina, stating that the IAEA and Argentina will collaborate towards the establishment of an IAEA Rays of Hope Anchor Centre, and with Cuba, focusing on coordination, collaboration and control in the Caribbean region.

A short film on Paraguay’s fight against cancer was shown at the Scientific Forum on Rays of Hope

in September. The film was completed by the BBC in cooperation with the Agency and focuses on the first publicly available brachytherapy machine in Paraguay, which was procured through a national project in 2018.

Uruguay received a state-of-the-art digital mammography unit with tomosynthesis for highly accurate and detailed breast imaging in 2022. The new unit will enable early detection of suspicious lesions and reduce false-positive results in dense breast tissue. Under the Rays of Hope initiative and through the TC project URU6041, 'Improving Capabilities in Three-Dimensional Mammography (Tomosynthesis)', the Pereira Rossell Central Hospital received equipment, training and expert advice for acceptance testing. The institution has also established a quality control programme for the improvement of services.

A.3.1. Building human capacity

The technical cooperation programme is the major vehicle through which the Agency transfers nuclear technology to Member States and builds their capacities in the peaceful use of nuclear science and technology. As a One House programme, it brings together skills and expertise from across the Agency to meet Member State needs.

Under the Sub-regional Approach to the Pacific Islands, nuclear science and technology will have a significant impact in the short and medium term on key development areas. The IAEA and the Australian Nuclear Science and Technology Organization (ANSTO) partnered with the University of the South Pacific to develop and deliver a two-week virtual lecture series for university teaching staff from faculties of science and related fields and post-graduate research students from the South Pacific. Roughly 300 participants joined virtually and in-person. The lectures covered key areas of research being undertaken to help achieve the SDGs and offered participants the opportunity to learn more about nuclear science and technology in the region.

Reaching the next generations

Thirty-five universities and institutions in the Asia and the Pacific region became members of the International Nuclear Science and Technology Academy (INSTA) in 2022, which advocates for empowering educators through the expansion, sustained understanding and use of nuclear science and technology at the tertiary level.

The student and teacher winners of the 2021 Nuclear Science and Technology Education competition, supported by RAS0079 'Educating Secondary Students and Science Teachers on Nuclear Science and Technology' visited the IAEA and participated in the Long Night of Research at the Vienna International Centre. Other finalists visited nuclear facilities in Jordan, including the Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME). A working version of the 'Guidebook Series for Introducing Nuclear Science and Technology in Secondary Education' was launched under the same project.

Specialist schools

Two preparatory webinars for the School for Drafting Regulations for Radiation Safety (SDR-Rad) were held in February, one with the support of RER9158, 'Strengthening the Regulatory Infrastructure for Radiation Safety', and another with the support of RAS9096, 'Strengthening Radiation Safety Infrastructure'. A preparatory webinar for the School for Drafting and Revising on Radiation Safety and Security of Radioactive Material (SDR-Comb) was held in July with the support of RLA9087, 'Building Capacity and Sustaining



One of the student winners from the Virtual NST Education Competition answers a question posed by a visitor at the Long Night of Research at the IAEA. (Photo: I. Lim).

the National Regulatory Bodies'. Two preparatory webinars for the School for Drafting Regulations for the Safe Transport of Radioactive Material (SDR-Trans), were held in November with the support of RAF9063, 'Strengthening Competent Authorities for the Safe Transport of Radioactive Material (AFRA)'. Participants were introduced to the requirements for joining the Schools and received guidance on preparing to draft new or revise existing regulations. The webinars brought together regulators and lawyers, from Europe, Asia and the Pacific, the Caribbean and Africa respectively, entrusted with drafting or revising the regulations.

The first Spanish-language IAEA School for Drafting Regulations on Radiation Safety and Security of Radioactive Materials was held in August. The School aimed to assist participants with the drafting and revision of their countries' national regulations on radiation safety and security of radioactive material. Students learned how to ensure the compatibility of their national regulations with the relevant IAEA safety standards and nuclear security guidance and gained an understanding of how regulations need to be integrated within their national legislative frameworks.

In November, an IAEA School on Nuclear and Radiological Leadership for Safety was delivered in Spanish in Mexico. The School focused on providing participants from the region with the knowledge required for strengthening the implementation of a systemic approach to safety: the interaction between humans, technology and organizations within the national nuclear infrastructure. Around 20 early to mid-career professionals from 16 countries in Latin America and the Caribbean participated, gaining a better understanding of the different aspects related to leadership for safety and safety culture. Within the school programme, a special event took place to motivate junior to mid-career female professionals to pursue their leadership potential. Three high level female leaders, along with a female manager who herself had been a participant in a previous School in Latin-America, shared their experience in the nuclear and radiological field.

PhD and postgraduate support

Under RAF0062, 'Supporting Human Resource Development in Nuclear Science and Technology – Phase II (AFRA)', nineteen candidates were selected to start the master's programme (MSc) in nuclear science and technology at the University of Alexandria, Egypt, and the University of Ghana, which are both recognized as AFRA Regional Designated Centres for Higher and Professional Education. Under the same project, seven doctoral candidates completed their PhD sandwich fellowship programme in 2022 and returned to their home country universities to finish their PhD programmes. In addition, sixteen candidates from sixteen Member States, including several least developed countries, were awarded PhD sandwich fellowship programmes to pursue their PhD research work at foreign universities. Their research areas include human health and nutrition, food and agriculture, radiopharmacy, nuclear physics, industrial applications and radiation safety.

Two PhD candidates from Lao People's Democratic Republic have begun long term training in Public Health and International Health at Kansai Medical University, supported by LAO6005, 'Addressing Malnutrition of Children Using Stable Isotope Techniques'. Long-term training in Radiation Disaster Medicine at Hiroshima University for PhD candidates from Iran, Mongolia, and the Philippines continued throughout 2022 under project RAS0089, 'Developing Human Resources to Support the Utilization of Nuclear Technology for Development Including Emerging Needs'.

With IAEA support, seven students from Afghanistan, Burkina Faso, Ethiopia, Ghana, Mongolia and Philippines have successfully secured a full scholarship for the Tsinghua University International Master's Programme in Nuclear Engineering and Management (TUNEM), a two year professional degree programme jointly sponsored by the Chinese government and the Chinese nuclear industry for 30 international students annually.

Postgraduate Educational Courses (PGEC) in Radiation Protection and Safety

In 2022, under RAF9067, 'Sustaining the Establishment of Education and Training in Radiation Safety and Human Resource Development – Phase II (AFRA)', two Postgraduate Educational Courses (PGECs) on Radiation Protection and the Safety of Radiation Sources were hosted by Ghana and Morocco, in the English and French languages respectively. These six-months courses were attended by 45 candidates from 30 Member States in Africa, including 18 least developed countries. Based on a standard syllabus and featuring both theoretical and practical training elements, as well as field visits and hands-on activities, the PGEC aims to help students acquire a sound basis in radiation protection and the safety of radiation sources. Upon completion of training, participating students will have acquired the basic knowledge and skills to support their future professional career as regulators and advisers in radiation protection and safety.

A PGEC in Radiation Protection and the Safety of Radiation Sources in the Arabic language took place in Jordan and 192 participants from 12 Arabic speaking countries and territories attended. Malaysia also hosted a PGEC, attended by 13 participants from the Asia and Pacific region. In Europe, 19 students from 14 countries attended a PGEC taking place at the Greek Atomic Energy Commission in Athens, which began in October 2022. A PGEC was delivered in hybrid format for countries in Latin America and the Caribbean, hosted by the Argentinean Nuclear Regulatory Authority, attended by 14 participants from ten countries in the region.

Legislative and drafting assistance

In 2022, the Agency conducted several workshops, missions and meetings to raise awareness, advise and train on developing and revising national legislation and adhering to and implementing the relevant international legal instruments.

In Africa, legislative support was provided under RAF0061, 'Establishing and Enhancing National Legal Frameworks (AFRA)', for the review of the draft comprehensive nuclear laws of Burkina Faso, Central African Republic, Libya, Nigeria and Somalia. Awareness raising missions and workshops on specific elements of nuclear law and international legal instruments were also carried out whether virtually or in-person in Vienna for Benin, Burkina Faso, Comoros, Egypt, Kenya, Nigeria and Senegal.

Legislative assistance was provided to Member States in the Asia and the Pacific region under TC regional project RAS0090, 'Establishing and Enhancing National Nuclear Legal Frameworks in Member States'. More than 60 experts participated in two sub-regional workshops in Viet Nam in August 2022 and in the United Arab Emirates in December 2022. Country specific legislative assistance was also provided to Kuwait, Saudi Arabia, and Viet Nam.



The IAEA Director General delivered remarks at a sub-regional workshop on nuclear law was organized in cooperation with the Government of Viet Nam through the Viet Nam Atomic Energy Agency (VAEA), the Ministry of Science and Technology and the Department of International Organizations of the Ministry of Foreign Affairs. (Photo: VAEA)

Under the regional TC project RLA0072, 'Establishing and Enhancing National Nuclear Legal Frameworks in Member States' a sub-regional workshop was held for Spanish speaking Member States in Latin America and the Caribbean region. The workshop, held in Argentina in September 2022, resulted in the development of informal bilateral workplans identifying future legislative assistance activities.

In terms of training, the first in-person Nuclear Law Institute (NLI) to take place after the pandemic was held from 10 to 21 October, gathering 57 participants from 54 Member States. The Agency also sponsored 15 grantees to attend the International School of Nuclear Law which was held in Montpellier, France, from 22 August to 2 September 2022, and eight grantees to attend the Nuclear Inter Jura Congress 2022: INLA and The Nuclear Industry: The Next 50 Years, which was held in Washington, D.C., USA, from 23 to 27 October 2022.

Following the success of the 2020 webinar series on nuclear law, the Agency hosted a second webinar series from October 2021 to September 2022. Four webinars were held in 2022 covering the following topics: the CPPNM and its Amendment, Small Modular Reactors and Nuclear Law, the Legal Framework for the Management of Transboundary Nuclear Risk and Openness and Transparency in International and National Nuclear Law. Around 1000 participants with policy, legal, regulatory or technical backgrounds from almost 100 Member States attended the webinar series.

A.3.2. Tailoring support to Member State needs

South-South and Triangular Cooperation

Through South-South cooperation, the IAEA's technical cooperation programme brings countries together to find solutions to development challenges through a range of regional and interregional projects.

The Agency contributed five case studies to a publication of the United Nations Office for South-South Cooperation, sharing its experiences in regional collaboration to enhance water management, support integrated actions for the control of zoonotic diseases and the prevention of pandemics, build capacity in radiation medicine and support access to quality cancer diagnostic, treatment and therapy, and enhance food safety to protect the health of people and increase economic growth.

The Sub-regional Approach to the Pacific Islands (SAPI) complements national IAEA technical cooperation programmes through relevant regional projects to maximize impact and provide support and capacity building to address development concerns in the Pacific Islands. For example, under regional project RAS6104 'Supporting the Improvement of Nutrition Programmes (SAPI)', the IAEA has supported the School of Medicine, College of Medicine, Nursing & Health Sciences at the Fiji National University by providing a body composition analyzer and a fourier transformed infrared spectrophotometer (FTIR). The School of Medicine is a WHO Collaborating Centre for Obesity Prevention and Management, and the goal of the project is to establish a regional hub in the Pacific based in Fiji where other small Pacific Islands can be trained and collaborate in nutrition programmes in the Pacific. Under a further regional project, RAS5098, 'Improving the Resilience of Crops to Climate Change through Mutation Breeding – Phase II (SAPI)', a six-week group fellowship on mutation induction and mutation breeding in seed and vegetative propagated crops provided comprehensive training for participants from six Pacific Island Member States. A two week regional training course on mutation induction and mutation breeding was also held at the Pacific Community, Centre for Pacific Crops and Trees in Suva, Fiji. This course was attended by 20 participants including three from Samoa, marking the country's first ever participation in the TC programme.

Specific examples of South-South cooperation in 2022 among countries and territories in Asia and the Pacific facilitated by the Agency include Jordan hosting fellows from Iraq, Yemen, and the territories under the jurisdiction of the Palestinian Authority, Iran hosting fellows from Afghanistan, and Pakistan hosting fellows from Iraq and Syria.

The Programme of Action for Cancer Therapy engaged with counterparts at Ministries of Health under INT6064, 'Supporting Member States to Increase Access to Affordable, Equitable, Effective and Sustainable Radiation Medicine Services within a Comprehensive Cancer Control System', to tailor support to address the needs of low- and middle-income countries. The Programme fostered South-South cooperation by engaging regional experts and encouraging networking among the project counterparts that will support the sharing of good practices and experiences to improve cancer control in the different regions.

Responding to emergencies

In January 2022, Tonga suffered the eruption of the undersea Hunga Tonga–Hunga Ha'apai volcano and the tsunamis that followed. The Agency engaged with Tonga's Ministry of Health, Tonga's Permanent Mission in New York, the UN Country Team, embassies of different countries, the World Bank, the Asian Development Bank, the European Union and civil society, among others, to present IAEA experience in responding to natural disasters and to the COVID-19 pandemic. Under the health-related project RAS6099, 'Developing Sustainable, High Quality, and Safe Medical Diagnostic Imaging and Radiotherapy Services (SAPI)', the procurement of a COVID-19 emergency support package, a digital radiographic X-ray system and a portable ultrasound was initiated. In addition, a software license for medical ultrasound E-Learning training modules was acquired to help national health care systems in the Pacific to ensure the development and sustainable implementation of high quality and safe medical diagnostic imaging.

Following an outbreak of Lumpy Skin Disease in Mongolia in 2022, the Agency delivered 200,000 doses of vaccines through MON5026, 'Improving the Diagnosis and Treatment of Transboundary Animal Diseases with Potential Pandemic Patterns'. The Government of Mongolia presented a letter of gratitude from the Chief Veterinary Officer to the IAEA during the 66th General Conference.

In 2022, following historic flooding in Pakistan, the Agency and the Food and Agriculture Organization of the United Nations (FAO) consulted closely with Pakistan's government and national agriculture and veterinarian institutes to develop an emergency support package to assist the country in applying nuclear science to better understand the impact of the flood on soils and crops, as well as the potential spread of animal and zoonotic diseases.

Mexico received Agency support after an outbreak of Mediterranean fruit fly in Colima in 2021. Medfly is considered one of the most devastating insect pests worldwide due to the damage it inflicts on a wide range of fruit and vegetable crops, and Mexico estimated that the outbreak could affect over 189 billion Mexican pesos (€8.8 billion) worth of horticultural crops that the country produces each year for export if not brought under control. The Agency, in cooperation with the Food and Agricultural Organization of the United Nations (FAO), provided an effective emergency response that continued throughout 2022, and assisted national plant protection authorities in Colima to bring the outbreak towards an end. Assistance included developing and providing guidance for the execution of an emergency action plan using the sterile insect technique.

The IAEA provided technical support to Peru for the evaluation and management of the environmental damage caused by an oil spill in January in Callao, Lima. An action plan was developed to improve marine environmental management and response preparedness for future similar emergencies. Identified actions include strengthening capacities for analysing hydrocarbons in the environment, the application of nuclear and isotopic techniques to carry out a national marine monitoring programme to assess the impact of the oil spill, sediment dating, strengthening of analytical capacity in relevant laboratories, and procurement.

Cuba received IAEA assistance to address the damage caused by a fire at the Matanzas super tanker base. Equipment for environmental monitoring and air quality was procured to support local efforts to measure the effects of the fire and to make mitigation decisions thereafter. Additional support was provided to Cuba following Hurricane Ian, which

included the procurement of mobile X-ray equipment for four hospitals and equipment for the determination of environmental contaminants and water quality.

In response to the earthquake of August 2021, the IAEA procured 4 portable X-ray units to support Haiti. The equipment was installed in 2022 in the 'Hôpital Universitaire de la Paix', 'Hôpital Universitaire Justinien', and 'Institut Medico Legal'.

A.3.3. Building awareness of the technical cooperation programme

Outreach on technical cooperation in 2022

124 Agency web articles on technical cooperation

7907 @IAEATC Twitter followers (growth of 12% from 2021) and **453** tweets posted

2502 @IAEAPACT Twitter followers (growth of 23% from 2021) and **185** tweets

4594 LinkedIn followers and **72** posts

New outreach material on the TC programme issued in 2022 included The IAEA Technical Cooperation Programme: Selected Highlights 2021, a special report for COP27 entitled Nuclear Technologies and Climate Adaptation in Africa and a film on tackling freshwater management in Malta using isotope hydrology, and a video

on cancer prepared in partnership with the BBC.

Social media continued to offer a cost-effective channel for outreach on the programme, and both the @IAEATC and @IAEAPACT Twitter accounts grew significantly: @IAEATC Twitter followers grew by 12%, with 453 tweets issued on the channel; @IAEAPACT followers grew by 23%, with 185 tweets issued. 72 posts were made on the IAEATC LinkedIn channel. These activities enhanced programme visibility among key, targeted audiences and increased awareness of the TC programme's contribution to socio-economic development at the national and regional levels.

Six technical cooperation side events were organized during the 66th regular session of the General Conference: 'Revealing Secrets Using Nuclear Techniques', 'Diagnostic Radiology Medical Physicists: Who Are We?', '20th Anniversary of ARASIA', 'Plans for PCMF Upgrade', 'Enhancing Capacities of Member States in Africa to Achieve Food Security Through the Peaceful Use of Nuclear Techniques', and 'Improving National Frameworks for Radiation Protection in Medical Exposure in Europe and Central Asia'. Two exhibitions on TC were organized, at the General Conference and the Global South-South EXPO.

A Seminar on Technical Cooperation for Permanent Missions, held in Geneva, was attended by ten Members States whose Permanent Missions are based in Geneva.

A.4. BUILDING A MORE EFFICIENT, MORE EFFECTIVE TECHNICAL COOPERATION PROGRAMME

A.4.1. Revised Supplementary Agreements and Country Programme Frameworks

By the close of 2022, 19 countries had signed Country Programme Frameworks (CPFs). The total number of valid CPFs was 112. All newly signed CPFs contain a concise and focused medium-term programme plan and are linked with relevant objectives of national and/or sectoral development plans and strategies, and the Sustainable Development Goals (SDGs). The CPF preparation process applies a results-based approach to programme planning, implementation, monitoring, reporting, and self-evaluation, guided by the TC central criterion and the consideration of gender perspectives.

CPFs signed in 2022		
Belarus	Jordan	Qatar
Botswana	Malaysia	Rwanda
Côte d'Ivoire	Mongolia	Saint Lucia
Dominican Republic	Montenegro	Viet Nam
Estonia	Nepal	Zimbabwe
Fiji	Papua New Guinea	
Guatemala	Philippines	

The total number of Revised Supplementary Agreements Concerning the Provision of Technical Assistance by the International Atomic Energy Agency (RSAs) is now 143.

A.4.2. Maximising programme impact through strategic partnerships

In 2022, the Agency leveraged partnerships with the Beijing Research Institute of Uranium Geology, the East China University of Technology and the Beijing Research Institute of Chemical Engineering and Metallurgy to advance cooperation in the area of exploration and exploitation of uranium resources; with the African Union on cooperation in the areas of human health and nutrition, food and agriculture, water and the environment, industrial applications, energy planning and nuclear power infrastructure building, as well as radiation and nuclear safety and security; with Argentina on cooperation in the implementation of Rays of Hope, and on cooperation in the area of nuclear technology for plastic pollution control in Antarctica; and with Cuba focusing on collaboration in the field of cancer in the Caribbean region.

The Agency signed a Cooperation Agreement with the WMO to jointly support the implementation of INT7020, 'Developing Capacity towards the Wider Use of Stable Isotopic Techniques for Source Attribution of Greenhouse Gases in the Atmosphere'.

In September, the Agency signed an action plan with the Community of Latin American and Caribbean States (CELAC) on collaboration in the peaceful use of nuclear science and technology. The action plan also aims to strengthen regional infrastructure and the development of national capacities that contribute to the achievement of the Sustainable Development Goals.

On the margins of the 66th IAEA General Conference, delegates from Cambodia, Lao PDR and Viet Nam agreed to expand their ongoing triangular cooperation in the application of nuclear technology, and to extend their cooperation agreement for a further five years. The three countries have been working together since September 2019, when national representatives signed a series of Practical Arrangements establishing a framework for South-South cooperation in non-destructive testing, nuclear medicine and mutation breeding.

Actions under ongoing partnerships

The IAEA and the Asian Development Bank (ADB) continued discussions about their cooperation under the existing Cooperative Framework Agreement to cover the Agency initiatives Rays of Hope, NUTEC and ZODIAC, as well as in the field of agriculture. The Agency participated in the second ADB Innovation Fair in October, where it showcased its support for innovative activities in the region. The Agency also organized a webinar for ADB staff to present the contribution of nuclear science and technology to food security. The webinar used success stories to showcase the impact of the work conducted by the Joint

FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture and the TC programme, and facilitated discussion and interaction between the Agency and the ADB.

The second coordination meeting for the implementation of the Practical Arrangement between the Agency and the Association of Southeast Asian Nations, held in July, highlighted the development areas where the IAEA technical cooperation programme is contributing to the attainment of the Sustainable Development Goals.

A.4.3. Continual improvement in project design quality and monitoring

Efforts continued throughout 2022 to increase the relevance, efficiency, effectiveness, coherence, ownership, sustainability and impact of the 2022–2023 TC programme and the 2024–2025 TC programme currently under preparation. Guidelines for the Planning and Design of the IAEA 2024–2025 TC programme were issued in January 2022.

The TC project report processing platform (TC Reports) was updated to facilitate tracking of progress and to link the yearly progress of TC projects with final achievements. Efforts continue to allow for aggregated portfolio reporting, and relevant templates and user guides were updated accordingly. Project Progress Assessment Reports (PPARs) for the 2021 reporting period were received for 844 TC projects, a submission rate of 83%. The PPAR submission rate has increased steadily over the last 10 years, most noticeably since the introduction of the PPAR automated process (e-PPARs) in 2017. The analysis of the feedback from project counterparts on the implementation of the TC programme shows that despite the challenges presented by the global COVID-19 pandemic, the efforts made by the entire project teams to support delivery of activities and to adjust accordingly were highly appreciated.

Actions to support knowledge management, organizational learning and training for TC programme stakeholders in 2022 aimed to enhance the efficiency, effectiveness and relevance of the support provided to Member States.

Training on the use of the Logical Framework Approach (LFA) methodology in project design was provided to TC stakeholders, and support was provided upon request during the design phase for 2024–2025 TC programme.

The Office of Internal Oversight (OIOS) carried out several evaluations and audits of the work of TC in 2022. One hundred and fifty-one OIOS recommendations have been addressed since 2019. All recommendations owned by TC issued prior to 2021 have been closed.

A.4.4. Female participation in the technical cooperation programme

The Agency strongly encourages the expansion of female participation in the TC programme, and gender must be carefully considered during the development of technical cooperation project designs. Member States are encouraged to nominate female NLOs, meeting and training course participants, fellows and scientific visitors, and counterparts.

The third Training Course on Supporting Women for Nuclear Science Education and Communications (W4NSEC), organized in cooperation with the Australian Nuclear Science & Technology Organization (ANSTO), and aimed at women educators was held in December bringing together 28 women from 17 countries in Africa, Asia and the Pacific, Europe and Latin America and the Caribbean. The course is part of a continuing education programme for female university science teachers and science communication professionals and is designed to empower impartial teaching and to inform participants how nuclear science and technology is contributing to the achievement of the UN Sustainable Development Goals.

The IAEA-supported regional chapter of Women in Nuclear (WiN) in Latin America and the Caribbean advanced initiatives aimed at supporting equal female participation in nuclear science and technology. In September, the guide '*Somos Potencia*' (We Are the Power), a guide for gender mainstreaming in the nuclear sector in the region was published. The guide identifies the main obstacles that women experience in the nuclear sector. It aims to strengthen the capacities of national nuclear institutes by presenting potential strategies to promote the inclusion of gender mainstreaming at all levels, and consequently enabling the active and equal participation of women. It was informed by a regional survey in 2022 of over 200 respondents from Latin America and the Caribbean, which highlighted that there are still obstacles to achieving gender equality in the nuclear sphere, with 40 per cent of women surveyed stating that they had experienced or witnessed gender bias in their workplace.

In October 2022 the Executive Committee of WiN ARCAL was elected. The Committee outlined a new action plan for the period 2022–2025, identifying further actions to promote equal female participation in nuclear science and technology through the empowerment of women and the promotion of their contribution to technical, scientific and leadership roles in the field.

The Programme of Action for Cancer Therapy increased female participation in 2022 by engaging several female junior experts for both impACT Review and National Cancer Control Programme advisory support missions, enabling them to strengthen their skills by working hand-in-hand with senior experts.

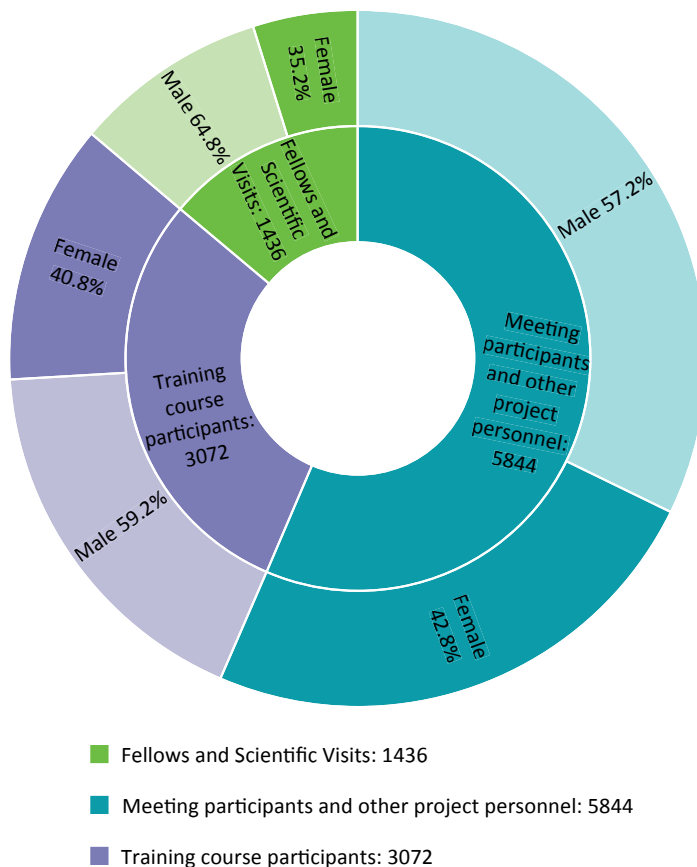


Figure 2: Male/female participation in the TC programme.

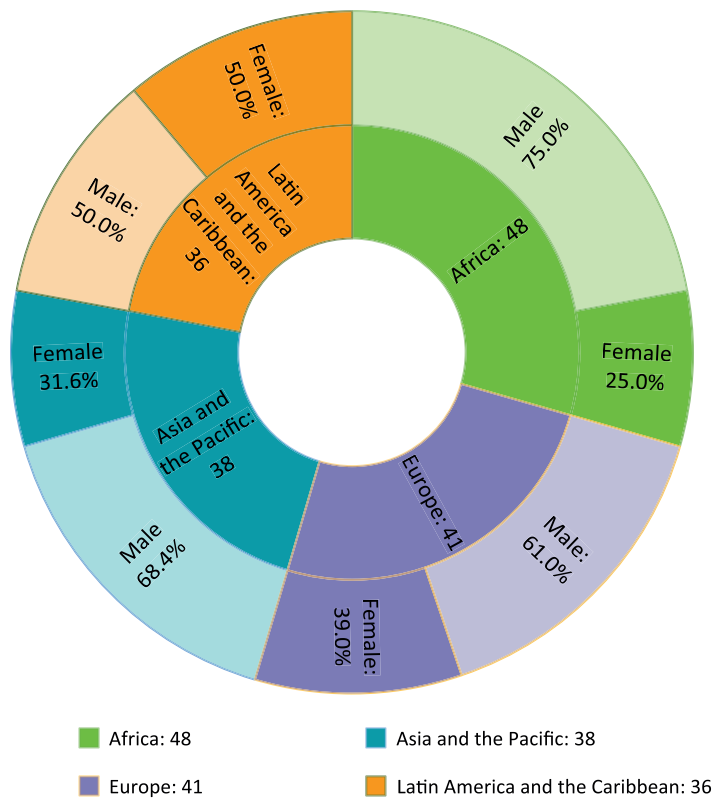


Figure 3: Percentage of male and female NLOs by region.

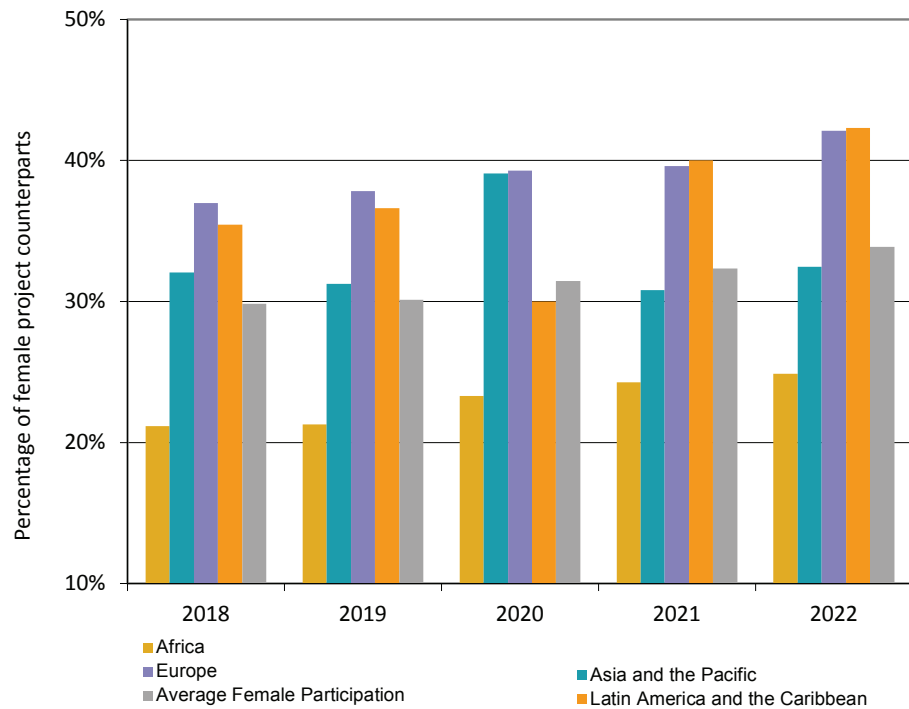


Figure 4: Female project counterparts by region, 2018–2022.

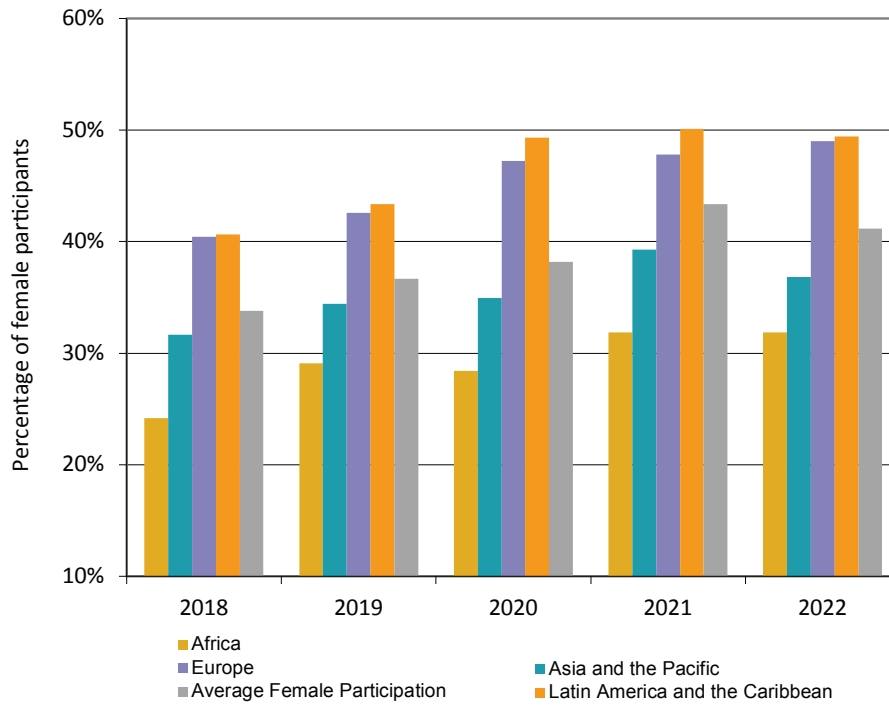


Figure 5: Female participation in training as fellows, scientific visitors, training course participants, meeting participants and other project personnel, 2018-2022.



B.

TC Programme Resources and Delivery

B. TC Programme Resources and Delivery⁷

B.1. FINANCIAL OVERVIEW

B.1.1. Resources for the technical cooperation programme⁸

At the end of 2022, €89.9 million of the €91.1 million target for the 2022 Technical Cooperation Fund (TCF) had been pledged and €88.8 million in payments had been received. Total TCF resources including National Participation Costs (NPCs), Assessed programme cost (APCs) arrears, and miscellaneous income amounted to €93.7 million (€88.8 million TCF, €4.0 million NPCs, and €0.9 million miscellaneous income). New extrabudgetary resources for 2022 came to €35.6 million and in-kind contributions amounted to €0.3 million.

The rate of attainment on pledges at 31 December 2022 was 98.7% and the rate of attainment on payments on the same date was 97.5% (Fig.6). One hundred and twenty-five Member States, including 18 least developed countries, paid their TCF target in full or partially. Total payments received in 2022 include €1.6 million either of deferred or of additional payments by 11 Member States. Excluding these payments, the 2022 rate of attainment on payments would have been 95.7%.

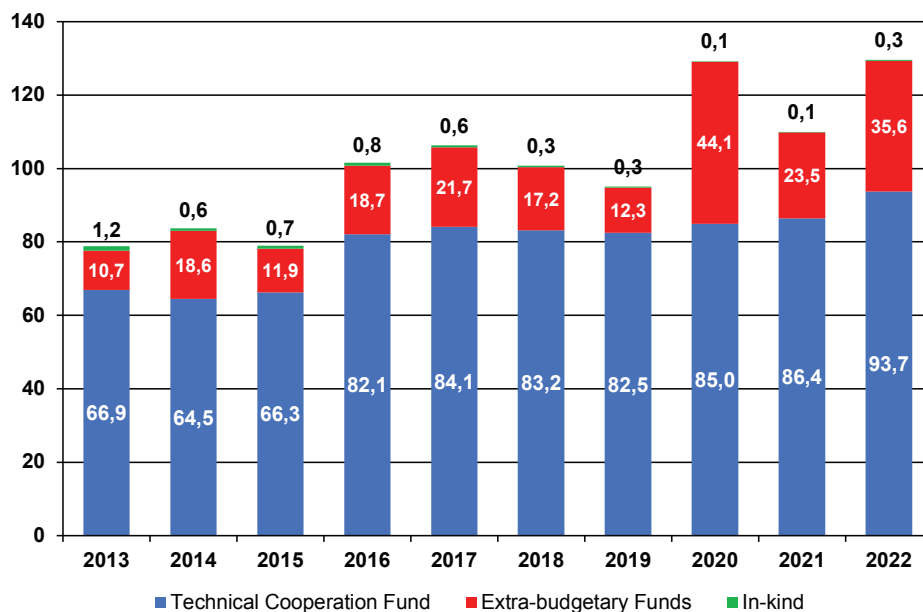


Figure 6: Trends in TC programme resources, 2013–2022.

⁷ Section B responds to section A.4. Technical cooperation programme resources and delivery, of resolution GC(66)/RES/8, Strengthening of the Agency's Technical Cooperation Programme.

⁸ Unless otherwise stated, all figures are denominated in Euros.

Table 1: TC programme resources in 2022

2022 target for voluntary contributions to the TCF	91.1 million
Technical Cooperation Fund, NPC, APC, miscellaneous income	93.7 million
Extrabudgetary resources ⁹	35.6 million
In-kind contributions	0.3 million
Total new resources for the TC programme	129.6 million

Table 2: Payment of National Participation Costs (NPCs) and assessed programme cost (APC) arrears

	Received in 2022	Outstanding payments at end 2022
NPCs	4.0 million	0.8 million
APCs	0 million	0.7 million

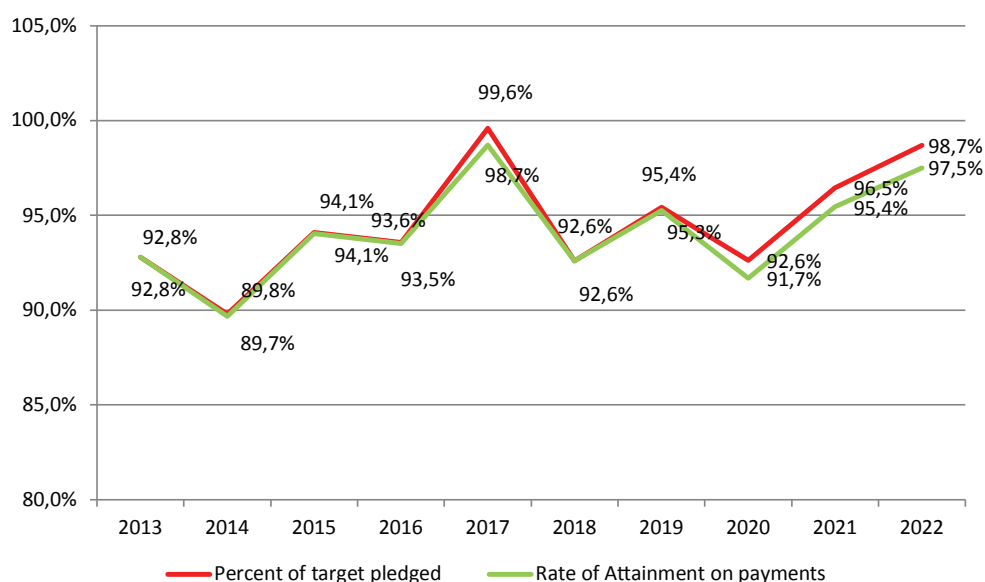


Figure 7: Trends in the Rate of Attainment, 2013-2022.

Extrabudgetary and in-kind contributions

Extrabudgetary contributions from all sources in 2022 (donor countries, international and other organizations, government cost sharing) accounted for €35.6 million. The breakdown of the €35.6 million is as follows: €2.7 million funding for activities where the donor is the recipient (commonly referred to as government cost sharing); €32.9 million from donors, of which €5.8 million was received through the Peaceful Uses Initiative mechanism; and €0.5 million from international and bilateral organizations. Seventeen African Member States provided extrabudgetary contributions amounting to €0.5 million for regional technical cooperation projects through the AFRA Fund. More detail is contained in Table 3 (extrabudgetary contributions by donor), Table 4 (government cost sharing) and Table 5 (contributions to PACT). In-kind contributions accounted for €0.3 million.

⁹ Please refer to Table A.5 of the Supplement to this report for details.

Table 3: Extrabudgetary contributions (where the donor is not the recipient) allotted to TC projects in 2022, by donor

Algeria	65 257	Morocco	47 748
Angola	8 606	Namibia	9 490
Australia	1 022 697	Norway	513 992
Belgium	417 500	Philippines	9 465
Botswana	16 087	Portugal	20 000
Brazil	75 000	Russian Federation	736 000
Bulgaria	48 040	Rwanda	2 110
Chile	9 470	Seychelles	1 425
Czech Republic	101 346	South Africa	186 605
Democratic Republic of the Congo	5 757	Spain	270 000
Djibouti	712	Sudan	37 122
Egypt	76 494	Sweden	301 552
Ethiopia	8 624	Switzerland	80 000
France	290 000	Uganda	5 423
Korea, Republic of	128 000	United States of America	28 256 751
Libya	31 802	Chiyoda Technol Corporation, Japan	10 000
Madagascar	2 380	Nihon Medi-Physics Co., Ltd., Japan	10 000
Malaysia	10 000	Sumitomo Heavy Industries, Ltd., Japan	10 000
Mauritius	4 701	Tokyo Nuclear Services Co., Ltd., Japan	10 000
Monaco	40 000	Total	32 880 156

Table 4: Funding where the donor is the recipient (Government cost sharing) allotted to TC projects in 2022

Albania	90 000	Pakistan	142 119
Angola	67 320	Poland	40 000
Cameroon	17 038	Saudi Arabia	30 000
Costa Rica	98 172	Serbia	150 000
Cyprus	66 500	Slovenia	40 000
Iran, Islamic Republic of	50 000	United Republic of Tanzania	150 000
Jordan	60 000	Türkiye	162 540
Malta	275 000	Uzbekistan	100 000
Mauritius	80 000		
Republic of Moldova	1 118 311	Total	2 737 000

Table 5¹⁰: Extrabudgetary contributions resulting from PACT resource mobilisation efforts, 2022

Member State	Amount
Belgium	417 500
Monaco	40 000
Russian Federation	221 000
Sweden	276 295
United States of America	22 371 918
Korea Nuclear International Cooperation Foundation (KONICOF)	20 000
Chiyoda Technol Corporation, Japan	10 000
Nihon Medi-Physics Co., Ltd., Japan	10 000
Sumitomo Heavy Industries, Ltd., Japan	10 000
Tokyo Nuclear Services Co., Ltd., Japan	10 000
Total	23 386 713

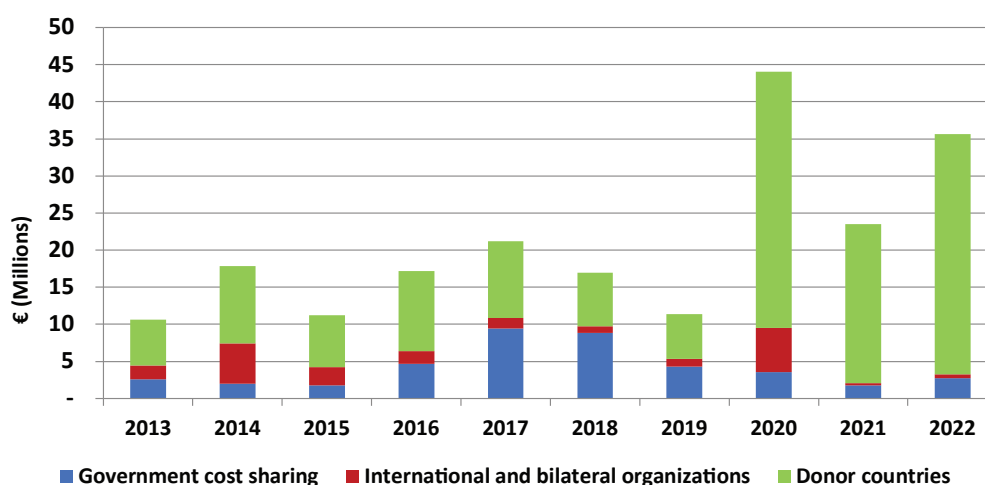


Figure 8: Trends in extrabudgetary contributions by donor type, excluding contributions to PACT, 2013–2022.

B.2. DELIVERING THE TECHNICAL COOPERATION PROGRAMME

B.2.1. Financial implementation

TC programme delivery is expressed in both financial and non-financial terms. Financial delivery is articulated in terms of actuals¹¹ and encumbrances. Non-financial delivery (i.e. outputs) can be expressed numerically in terms of, for example, experts deployed, training activities, and purchase orders obligated.

Financial implementation for the TCF, measured against the budget for 2022 at 31 December 2022, reached 84.4% (Table 6).

¹⁰ Funds presented under Table 5 are already reported in Table 3 above under the respective Donors. Some contributions are made directly to PACT activities and some in support of TC programme activities.

¹¹ Actuals are the equivalent of disbursements in line with the terminology in use since the implementation of the Agency-wide Information System for Programme Support (AIPS/Oracle).

Table 6: TCF financial indicators for 2020, 2021 and 2022

Indicator	2020	2021	2022
Budget allotment at year end ¹²	116 306 630	122 435 851	123 565 216
Encumbrances + actuals	93 473 177	102 940 738	104 347 914
Implementation rate	80.4%	84.1%	84.4%

B.2.2. Unallocated balance

At the end of 2022, the unallocated balance¹³ amounted to €3.2 million. €6.4 million were received as advance payments for the 2023 TCF in 2022. Some €0.1 million of cash is held in non-convertible currencies which cannot be used in the implementation of the TC programme.

Table 7: Comparison of the unallocated balance of the TCF

Description	2021	2022
Unallocated balance	€1 086 966	€3 193 034
Advance payment in 2020 and 2021 for TCF for following year	€12 884 788	€6 373 727
Non-convertible currencies that cannot be utilized	€15 580	€16 606
Currencies that are difficult to convert and can only be used slowly	€522 890	€288 926
Adjusted unallocated balance	€14 510 225	€9 872 293

B.2.3. Human resources and procurement

Human resource and procurement indicators show the non-financial delivery of the TC programme. Regarding procurement, a total of 1881 purchase orders were issued in 2022.

Table 8: Delivery of outputs: non-financial indicators for 2022

Expert and lecturer assignments	2057
Meeting participants and other project personnel	5844
Fellowships and scientific visitors in the field	1436
Training course participants	3072
Regional and interregional training courses	159

Note: These figures include 337 virtual activities supported by the Agency in 2022

Table 9: TC procurement in 2022

Division	Requisitions	Purchase orders issued	Value of purchase orders issued
TCAF	540	580	20 965 989
TCAP	453	541	18 221 346
TCEU	255	315	10 608 992
TCLAC	427	444	16 673 181
PACT	1	1	3 000
Total	1676	1881	66 472 509

¹² 2022 budget allotment at year end includes carry-over from previous years of €6.5 million, already allotted to projects.

¹³ Total funds not allocated in 2022 were allocated to TC projects in 2023.

At the end of 2022, 1 308 projects were active, and an additional 530 projects were in the process of being closed. During 2022, 135 projects were closed.

B.2.4. Programme Reserve projects

No Programme Reserve projects were requested in 2022.



C.

Programme Activities and Achievements in 2022



Africa 2022

C. Programme Activities and Achievements in 2022¹⁴

C.1. AFRICA

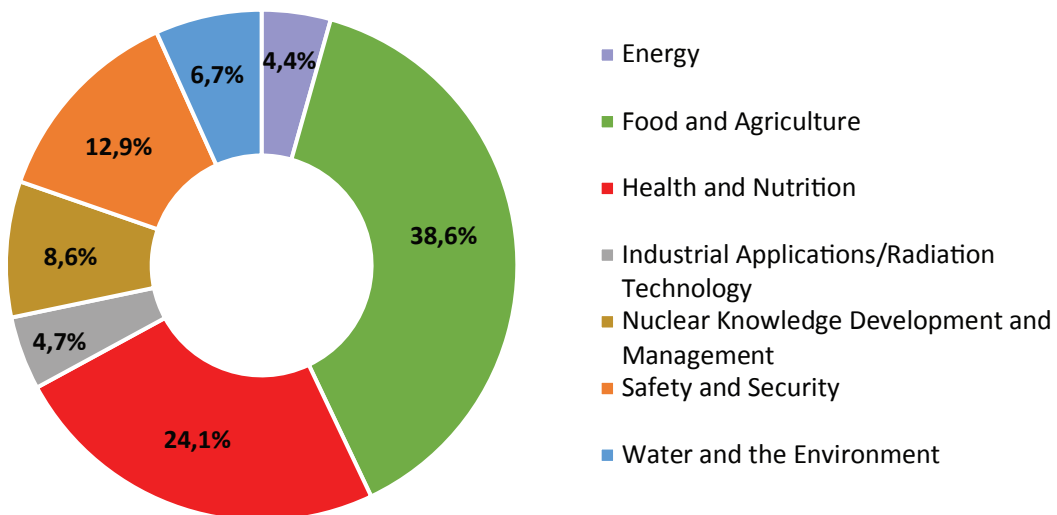
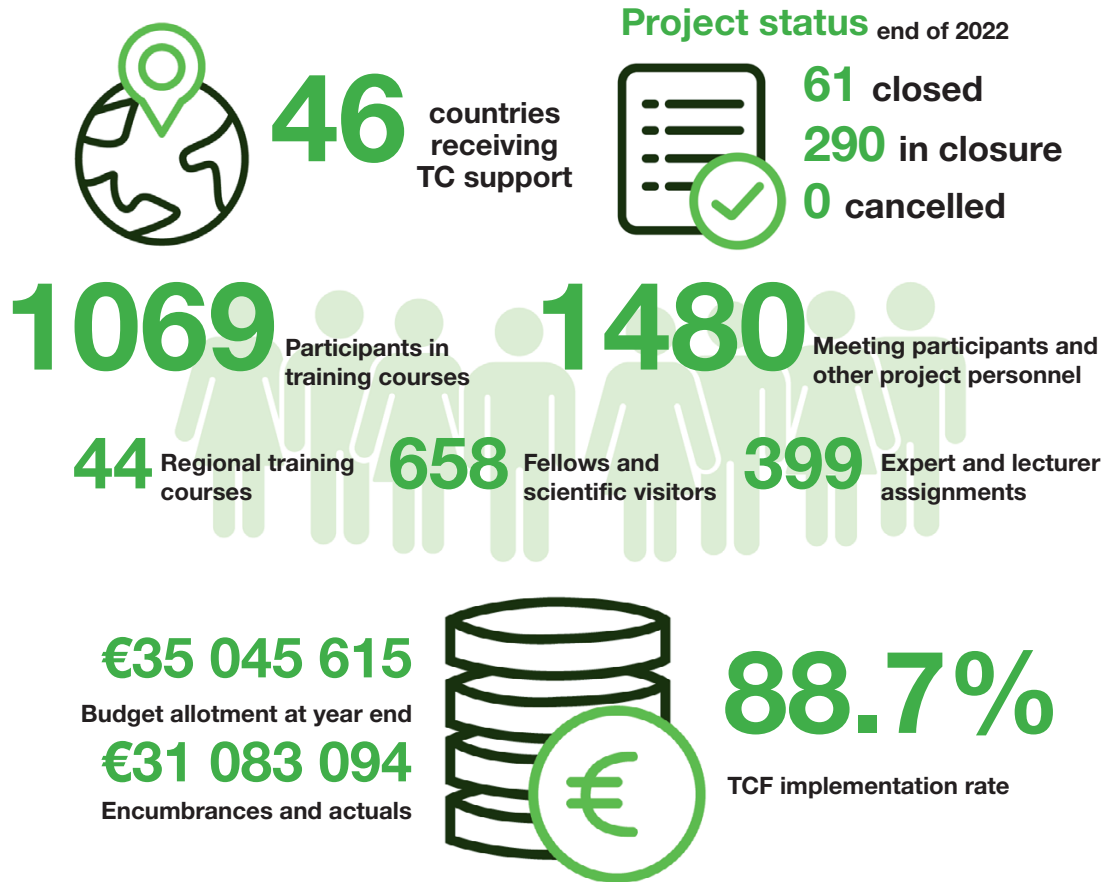


Figure 9: Actuals in the Africa region in 2022 by technical field.

¹⁴ Section C responds to section A.1. General, section A.2. Strengthening technical cooperation activities, and Section B. Programme of Action for Cancer Therapy, of resolution GC(66)/RES/8, Strengthening of the Agency's Technical Cooperation Programme.

C.1.1. Regional highlights in Africa

In 2022, 46 Member States in the Africa region, of which 27 were least developed countries, participated in the TC programme through 390 national projects and 62 regional projects. The programme achieved an implementation rate of 88.7%.

CPFs signed in Africa in 2022

Botswana

Rwanda

Côte d'Ivoire

Zimbabwe

Four Member States signed CPFs in 2022. All 46 African Member States have signed the Revised Supplementary Agreement (RSA), the most recent being Comoros in 2022. Benin established its regulatory body during 2022 and Burundi promulgated its nuclear law.

Close collaboration between Agency personnel and national and regional stakeholders in developing project designs for the 2024–2025 TC cycle has resulted in the development of 122 new project proposals, of which 115 are for national projects and seven for regionals.

The regional meeting of National Liaison Officers (NLOs) and AFRA National Coordinators was held in Abuja, Nigeria, in March 2022. Fifty-one participants from 37 African countries considered important regional issues such as the challenges and lessons learned in delivering the programme during the pandemic, promoting women in nuclear science and technology, partnerships in the TC programme in Africa, and strategic aspects of key thematic areas in support of the realisation of the 2030 Agenda.

A number of Practical Arrangements (PA) continue to provide a framework for cooperation in Africa. These include PAs with the African Union Commission (2022–2026), the French Society of Nuclear Medicine (2020–2023), and the Pakistan Atomic Energy Commission (2021–2024).

C.1.2. Project highlights

In 2022, a linac and brachytherapy technology were procured using funds provided to the Agency by Niger as government cost sharing as part of an Islamic Development Bank (IsDB) loan to Niger, to support the expansion of radiotherapy services in Niger within the Rays of Hope initiative.

Tunisia's irradiation facility has been back in operation since 2019, after a long period of inactivity due to source decays, with the support of TUN1014, 'Establishing a Quality Management System and Marketing Strategy for a Gamma Electron Beam Irradiation Facility'. The irradiation facility is used for the decontamination and sterilization of Personal Protective Equipment (PPE), including surgical masks and Face Shields. With Agency support the facility was able to operate in industrial mode throughout the pandemic, managed by well-trained local staff to meet local needs. More than 50 million face masks were sterilized and the facility is providing services for 46 Tunisian industries. The Agency provided blended training (online and on-site) for facility staff and an electron paramagnetic resonance (EPR) dosimetry system was procured to finalize the implementation of a national reference structure that would be able to provide calibration and audit services to more local institutions.

The Agency has provided introductory and advanced training courses in high-resolution soil moisture monitoring and mapping using Cosmic Ray Neutron Sensor (CRNS) and Remote Sensing Digital Technology through regional project RAF5086, 'Promoting Sustainable Agriculture under Changing Climatic Conditions Using Nuclear Technology (AFRA)'. Cosmic Ray Neutron Sensors have been procured for 23 African countries. In Morocco, the CRNS has already been used together with satellite imagery data to generate high-resolution soil moisture maps to support efficient agricultural water management. For Ethiopia, Kenya and Sudan, the CRNS will be used as part of the regional response to the armyworm infestation in East Africa.

A first Regional Meeting of High-Level Representatives to support the development of new research reactor programmes in Africa took place in Vienna in August, supported

by RAF1009, ‘Supporting Embarking Countries in Establishing National Infrastructure for Research Reactors (AFRA)’. The meeting was attended by Ministers of Science and Technology and Permanent Secretaries from Ethiopia, Niger, Rwanda, Senegal, Uganda, United Republic of Tanzania and Zambia, as well as by project counterparts – all countries which have expressed interest in acquiring research reactors. The discussions with Ministers focused on the different applications of research reactors and their contributions to socio-economic development. Financing modalities were also discussed, and issues that require government commitment were highlighted, including the legal, technical, regulatory and safety infrastructure, and the training of qualified human resources for embarking on a research reactor programme. As a result of these discussions, some of the countries have completed pre-feasibility studies following the IAEA Milestones approach and are currently seeking partnerships with potential providers of this technology.



High-level participants in the regional meeting on research reactors for the embarking countries in Africa. (Photo: O. Yusuf/IAEA)

The 10th African Conference on Research Reactors Safety, Utilization and Operation took place in November in Cairo, Egypt. The conference brought together scientists and engineers from 16 African countries which have operational research reactors, or which are embarking on research reactor programme. The conference, supported by the regional TC project RAF1011, ‘Strengthening Research Reactor Safety, Operation, and Utilization (AFRA)’, aimed to enhance knowledge exchange and promote networking, partnership, and collaboration within the Africa region.

Regional project RAF9069, ‘Strengthening the Implementation of Basic Safety Standards and Radioactive Waste Management – Phase II’, is designed to build the radioactive waste management capacities of national waste operators and regulatory bodies. In 2022, support was provided to upgrade five radioactive waste facilities in Egypt, Ethiopia, Ghana, Morocco and Nigeria. Disused and abandoned sources were recovered, conditioned, and rendered safe and secure in Ethiopia, Mauritania and Nigeria, and 22 waste operators from seven countries (Cameroon, Ethiopia, Ghana, Kenya, Mauritania, Mauritius and Nigeria,) were trained through a series of hands-on practical training courses. In previous years (2018–2019) sources were also conditioned and secured in Morocco, Egypt, Senegal, Uganda, and Zimbabwe. Four new radioactive waste facilities have already been established with support provided through the project in Cameroon (2019), Senegal (2018), Uganda (2019) and Zimbabwe (2019), where there were previously no facilities.

C.1.3. Regional cooperation

The 33rd AFRA Technical Working Group Meeting (TWGM) took place in Kigali, Rwanda from 18 to 22 July 2022. AFRA National Coordinators discussed the performance of the AFRA Programme and made recommendations to improve its delivery and effectiveness. Algeria was selected to host the next TWGM in July 2023. The meeting recommended the recognition of five AFRA Regional Designated Centres in Algeria, Egypt, South Africa, and Tunisia. The meeting also recommended seven regional TC project proposals to be submitted for the 2024–2025 TC cycle, addressing human health, food and agriculture, radiation safety, legislative assistance, support for nuclear institutions and technical cooperation among developing countries, and management of AFRA.

The 33rd Meeting of AFRA Representatives took place in Vienna in the margins of the 66th annual session of the IAEA General Conference. The meeting was attended by IAEA Director General Rafael Mariano Grossi, high-level representatives of State Parties, AFRA



IAEA Director General Rafael Mariano Grossi at the opening of the 33rd meeting of AFRA Representatives. (Photo: D. Calma/IAEA)

National Coordinators, representatives of the Vienna-Based African Group, donor countries and partner organizations. The meeting participants endorsed the 2021 AFRA annual report and recognized five new Regional Designated Centres. Four are recognized for the repair and maintenance of nuclear instrumentation (Algeria, Egypt, South Africa, and Tunisia) and one for postgraduate education in radiopharmacy (Morocco).

The AFRA High-level Policy Meeting (HLPM), originally scheduled for March 2020 in Aswan, Egypt, and postponed due to the travel restrictions related to Covid-19 pandemic, was held in December 2022 in Cairo, Egypt. The Technical Meeting of AFRA National Coordinators reviewed the status of implementation of the Plan of Action adopted at the AFRA High Level Policy Seminar in November 2017. The High-Level Meeting which included Ministers in charge of science technology and Heads of Delegations of AFRA State Parties,

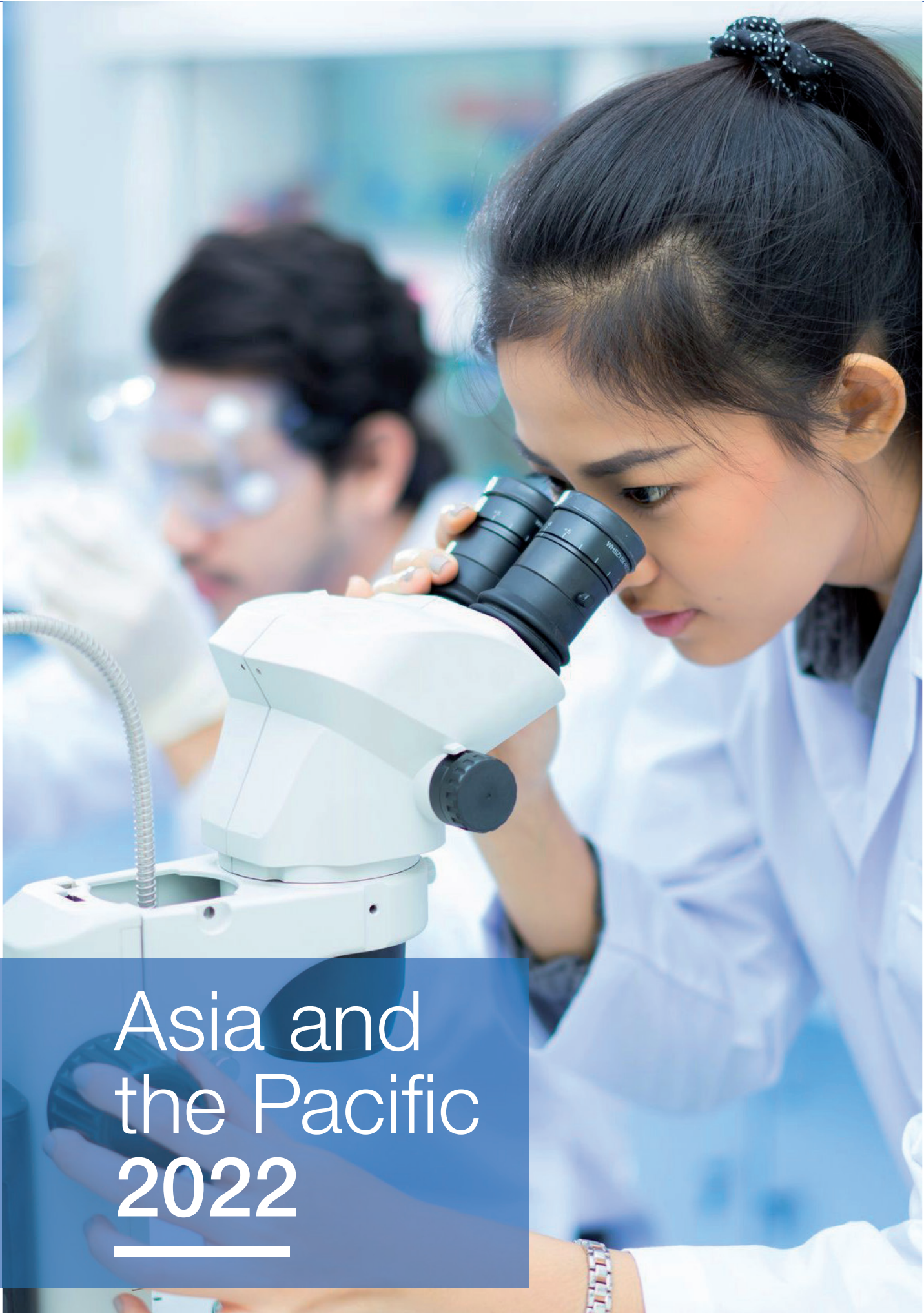
adopted a new AFRA Plan of Action and Political Declaration which establishes AFRA's future strategic directions regarding its governance, programme, and resource mobilization.

Contributions to the AFRA Fund

The total contribution of AFRA State Parties to the AFRA Fund in 2022 came to €470 343, demonstrating the Parties' continued commitment to AFRA activities and regional ownership of the programme. The AFRA Fund available is estimated at € 1.8 million. The funding will be allotted to the relevant projects in 2023 to support the implementation of unfunded activities.

Table 10: Voluntary contributions to the AFRA Fund for TC activities, 2022

Country	Amount received	Country	Amount received
Algeria	65 257	Mauritius	4 701
Angola	8 606	Morocco	37 748
Botswana	16 087	Namibia	9 490
Democratic Republic of the Congo	5 757	Rwanda	2 110
Djibouti	712	Seychelles	1 425
Egypt	76 494	South Africa	186 605
Ethiopia	8 624	Sudan	7 122
Libya	31 802	Uganda	5 423
Madagascar	2 380		
		TOTAL	470 343



Asia and the Pacific 2022

C.2. ASIA AND THE PACIFIC

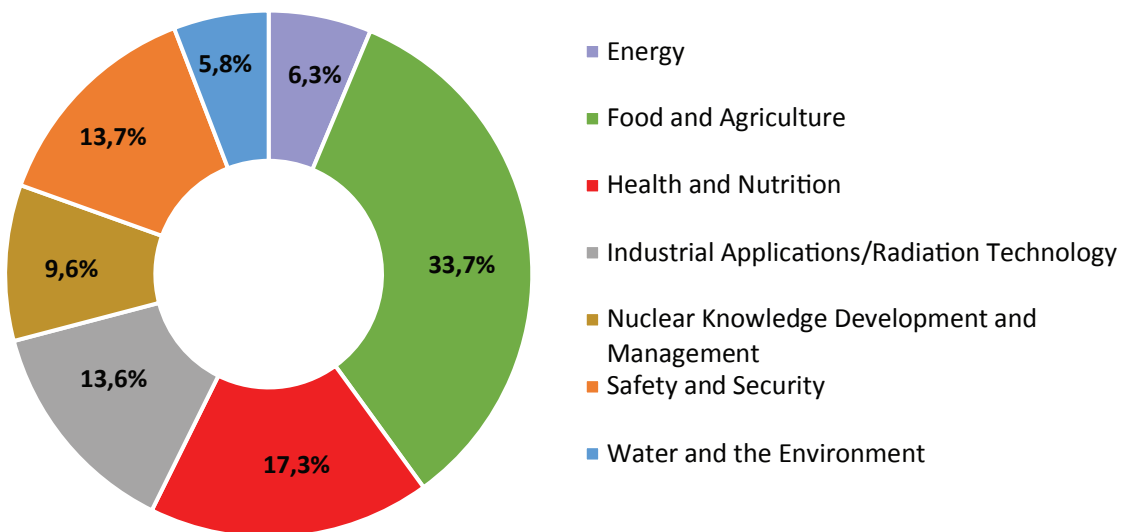
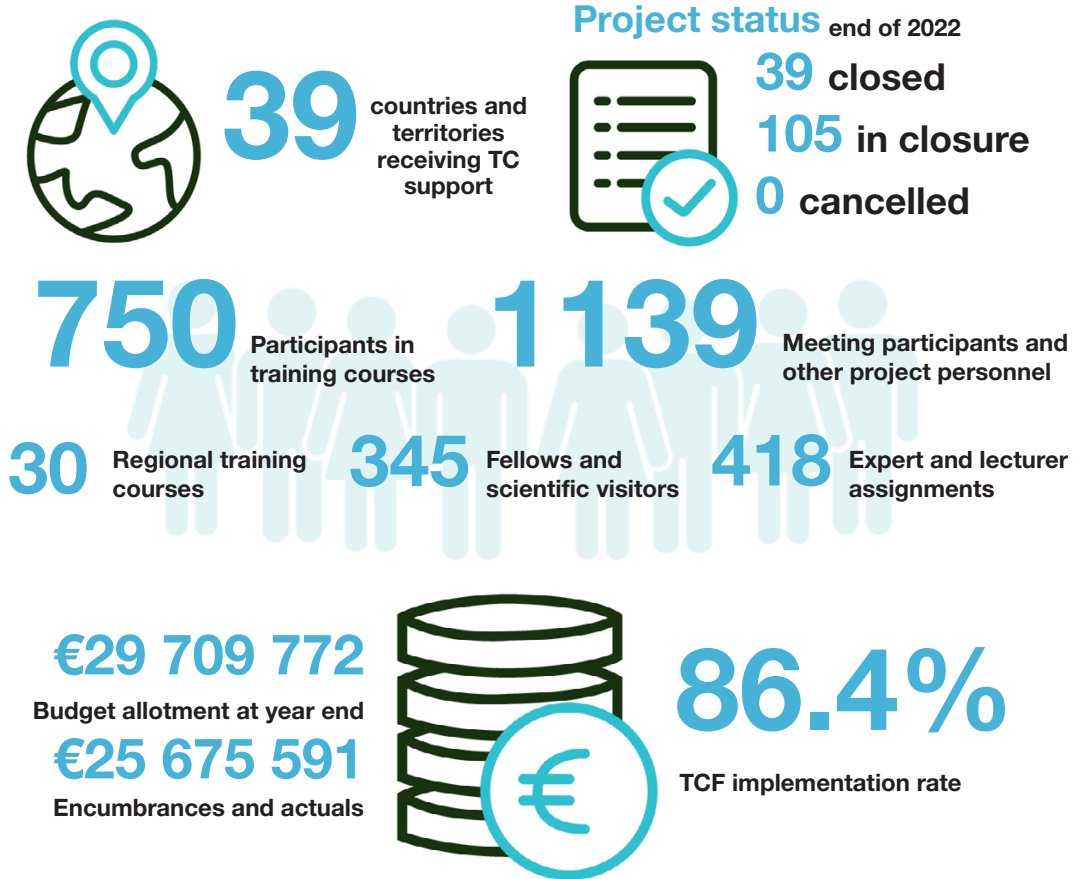


Figure 10: Actuals in the Asia and the Pacific region in 2022 by technical field.

C.2.1. Regional highlights in Asia and the Pacific

CPFs signed in Asia and the Pacific in 2022

Fiji	Nepal
Jordan	Papua New Guinea
Malaysia	Philippines
Mongolia	Qatar
Viet Nam	

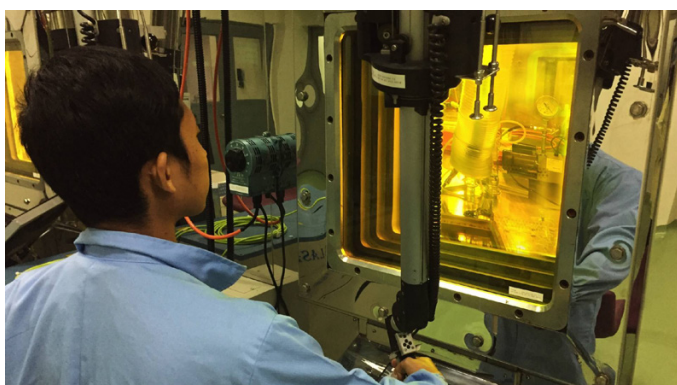
In 2022, the TC programme in Asia and the Pacific enhanced the capabilities of 39 countries and territories, including seven Least Developed Countries and seven Small Island Developing States, through 317 national and 79 regional projects. The programme achieved an implementation rate of 86.4% in the region.

Nine countries in the region signed CPFs in 2022.

Throughout 2022, the TC programme in Asia and the Pacific focused on the key thematic areas of food and agriculture, human health and nutrition, radiation and nuclear safety infrastructure, and water and the environment.

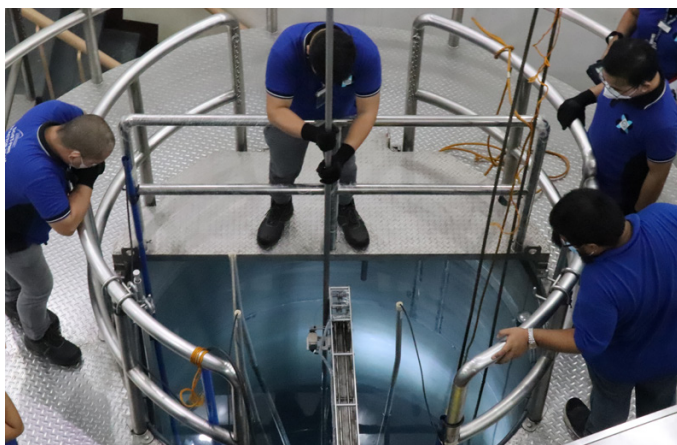
C.2.2. Project highlights

Under regional project RAS5096, ‘Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques’, 43 participants from Asia and the Pacific received training on how to generate reliable food safety laboratory test results by implementing good statistical practices in analytical method establishment and application, routine food safety testing and monitoring programmes.



Participants in the regional training course received guidance in the application of the latest protocols and procedures in the preparation and quality control of PET-based radiopharmaceuticals, using Copper-64 and Zirconium-89. (Photo: IAEA)

In 2022, under regional project RAS6090, ‘Promoting the Preparation of Emerging Radiopharmaceuticals for Positron Emission Tomography-Based Molecular Imaging and Radionuclide Therapy’, 58 medical practitioners in Asia and the Pacific received training on the production and quality control of theranostic radiopharmaceuticals. The regional project, launched in 2018, aims to close capacity gaps and to support Member States to ensure the availability of locally produced radiopharmaceutical products. Participants learned about the production and use of Zr-89 and Cu-64 products at the Institute for Nuclear Sciences Applied to Health, University of Coimbra, Portugal, through a series of videos and multimedia training materials, which described the complete laboratory process, from preclinical studies to post-production quality assurance.



A fuel rod being loaded into the core of a subcritical assembly. (Photo: Philippine Nuclear Research Institute)

In June 2022, the Philippine Nuclear Research Institute loaded 44 nuclear fuel rods into the core of the newly constructed tank of the Subcritical Assembly for Training, Education and Research (SATER). SATER will support nuclear education programmes at the University of the Philippines Diliman and Mapua University, and will also be used for reactor physics experiments, and as a demonstration facility for neutron irradiation and neutron activation analysis. Agency support was provided through project PHI0015, ‘Building Capacity in Nuclear Science and Technology by Re-establishing the Research Reactor-I as a Triga Fuel Subcritical Assembly’, which provided technical assistance for fuel inspection, reactor design, dosimetry and in developing national regulations related to research

reactors, and PHI0016, 'Building Capacity for the Safe Operation and Utilization of the Research Reactor's Subcritical Assembly for Training, Education and Research', which focused on reactor engineering, operation and utilization, as well as the development of a reactor training programme for scientists, engineers and university lecturers in the country.

Through the ongoing regional project RAS7038, 'Monitoring the Marine Environment for Enhanced Understanding of the Abundance and Impact of Marine Plastic Pollution', the Agency is helping countries in the Asia and the Pacific region to develop harmonized criteria and standards to ensure the proper generation of marine plastic data and its analysis. As a first step to help harmonize guidelines for the sampling, separation and identification of microplastics in beach sands, seawater and marine sediments, the IAEA held a regional meeting with experts in the region under the umbrella of NUTEC Plastics. Draft protocols for sample collection and preparation were finalised at the meeting, and it was agreed that microplastics samples would be collected from sand, seawater and marine biota.

Courses conducted under regional project RAS7028, 'Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems (RCA)', delivered training for 147 people, over 76 600 samples of seawater, sediment and biota were collected and analysed for radionuclides, and six proficiency tests were carried out. More than 3,900 data were submitted to the ASPAMARD database during the period 2017–2022, providing the reference baseline for radioactivity levels in the region.

C.2.3. Regional cooperation

A ministerial declaration to mark the 50th anniversary of the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA) was issued at a special RCA ministerial-level meeting on the margins of the 66th General Conference. The declaration re-affirmed the RCA's commitment to promoting the peaceful application of nuclear science and technology in addressing regional challenges and enhancing the socioeconomic wellbeing of the region, enabling the sustainable development of the region and beyond. The anniversary was also marked by an exhibition titled 'RCA - 50 Years of Formulation and Development'.



IAEA Director General Rafael Mariano Grossi at the Ministerial Level meeting to mark the 50th anniversary of the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA). (Photo: D. Calma/IAEA)

IAEA Director General Rafael Mariano Grossi joined the RCA Regional Office event to celebrate the 20th anniversary of the office's establishment at an international symposium sponsored by the Ministry of Science and ICT and other relevant institutes in the Republic of Korea, titled 'Cooperative Leadership in Nuclear Science and Technology and Sustainable



IAEA Director General Rafael Mariano Grossi presents the Social and Economic Impact Assessments of the RCA Programme in the areas of radiotherapy and non-destructive testing. (Photo: IAEA)

Development in the Asia-Pacific Region: Future Vision of the RCARO’.

Over one hundred national representatives from 22 State Parties attended the annual meeting of RCA National Representatives on the margins of the IAEA 66th General Conference. At the meeting, two new social and economic impact assessment reports conducted by the RCA were launched. In total, three publications on the social and economic impact assessment of the RCA projects on mutation breeding, radiotherapy, and non-destructive testing (NDT) were successfully completed by 2022.

The NDT impact assessment found that the RCA programme has contributed to strengthening NDT capacities in the participating State Parties over the past 20 years. It has increased the scope and scale of the demand for and the use of NDT leading to improved health and safety and economic value. The

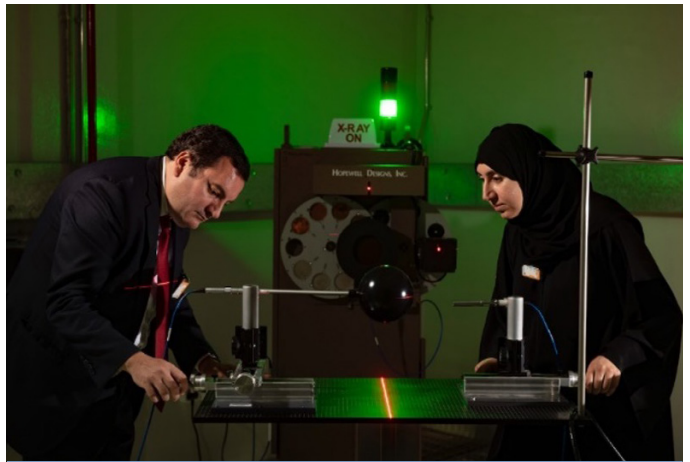
mutation breeding assessment found that the RCA programme has supported a significant body of research in the field of plant breeding. Following support and capacity building channelled through the TC programme, more than 7300 promising breeding lines of fruit and vegetable were developed, and in total, 254 new and improved mutant varieties of crops—selected from among the 7300 promising lines—have been certified and officially released to farmers. The radiotherapy assessment found that the RCA programme has supported State Parties to strengthen their radiotherapy work forces and increase access to quality radiotherapy. These impacts have in turn contributed to an increase in life span and better quality of life, as well as economic benefits.

State Parties to the Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) celebrated the 20th anniversary of the agreement at a special celebratory ceremony on the margins of the IAEA 66th General Conference. The event was attended by Ambassadors and Representatives from ten ARASIA State Parties, together with the IAEA Director General Rafael Mariano Grossi and the ARASIA Chair. At the ceremony, the Director General launched the publication ‘Breaking Through to Progress: A Collection of Success Stories from ARASIA highlighted the impact of 20 years of technical cooperation and progress in the ARASIA State Parties towards attaining several SDGs.



IAEA Director General Rafael Mariano Grossi speaking at the celebration of the 20th anniversary of the Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA). (Photo: D. Calma/IAEA)

ARASIA also issued a booklet on Secondary Standards Dosimetry Laboratory (SSDL) Regional Resource Centres, which provides detailed information on the region's SSDL capacities and on the services that ARASIA designated Regional Resource Centres can provide.



Staff members of the Federal Authority for Nuclear Regulations (FANR) Secondary Standards Dosimetry Laboratory (SSDL) providing calibration services in radiation protection fields. (Photo: Federal Authority for Nuclear Regulation, United Arab Emirates)



Europe 2022

C.3. EUROPE

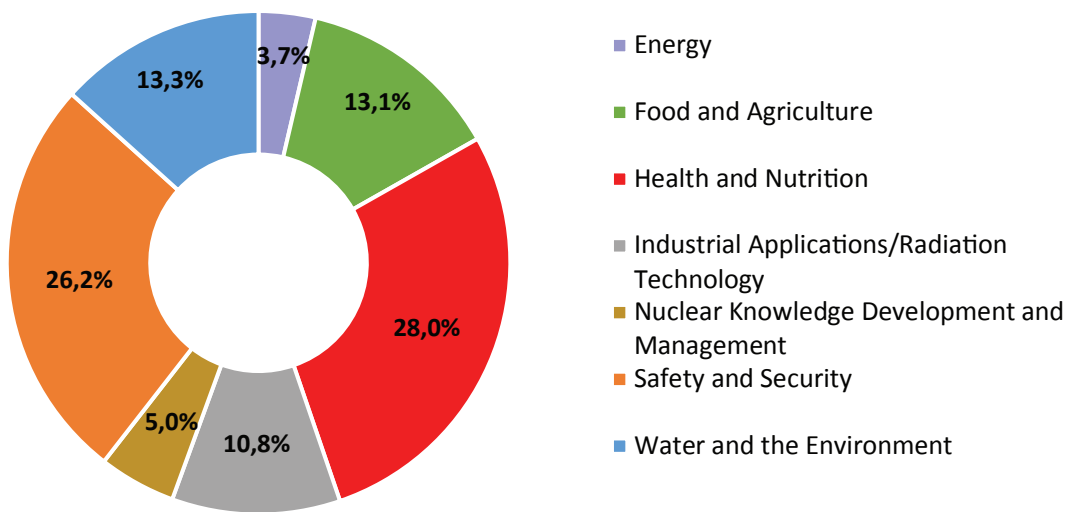
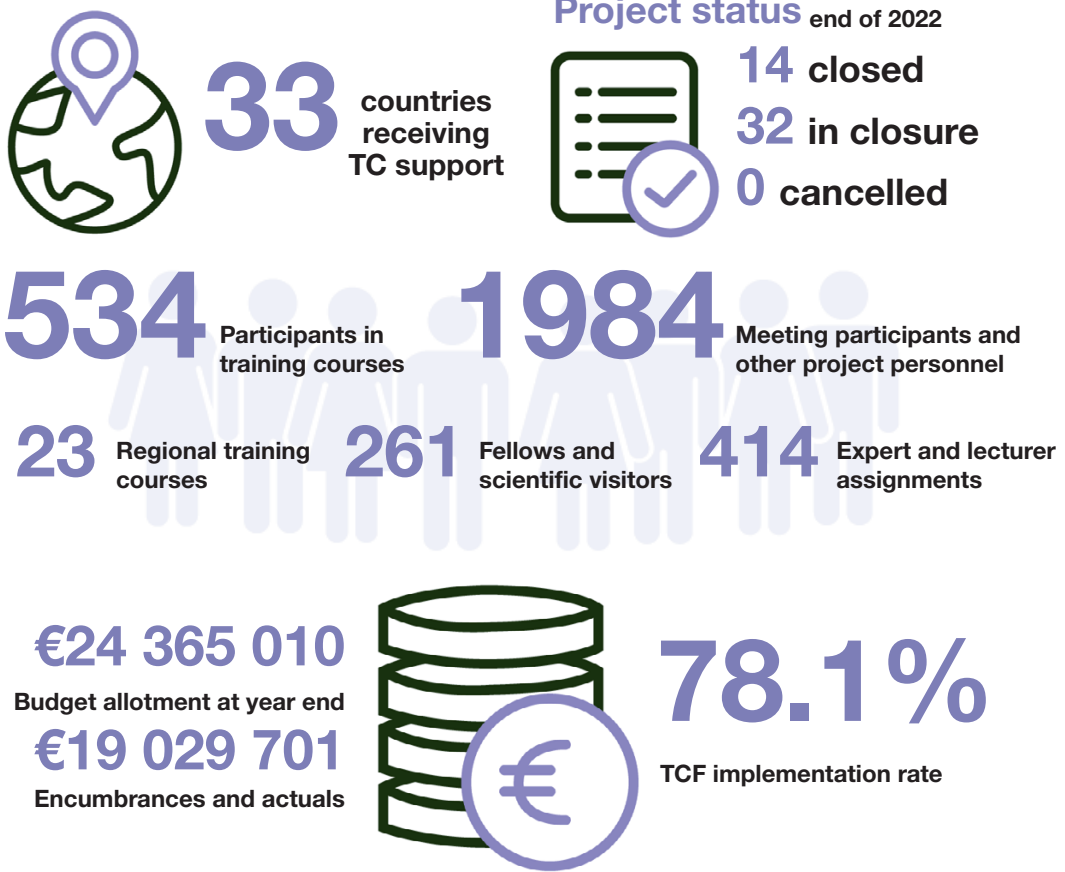


Figure 11: Actuals in the Europe region in 2022 by technical field.

C.3.1. Regional highlights in Europe

CPFs signed in Europe in 2022

Belarus	Estonia
Montenegro	

In 2022, the TC programme supported 33 Member States in Europe and Central Asia through 167 national and 49 regional projects. The programme achieved an implementation rate of 78.1%.

Three CPFs were developed and signed in 2022.

In line with Member States’ priorities, the TC programme focused strongly on the thematic areas of health and nutrition, nuclear and radiation safety, nuclear energy, and waste management.

At the NLO meeting in May, regional TC project proposals for the 2024–2025 technical cooperation cycle were prioritized, and 79 national and 13 regional projects were moved to the design phase.

The changed operating environment resulting from the COVID-19 pandemic resulted in the extension of 93 ongoing projects to allow for the implementation of the remaining activities.

C.3.2. Project highlights



Collection of Aedes mosquito larvae in the public drainage system, Cyprus. (Photo: K. Deufrains/IAEA)

The TC project with Cyprus, CYP5020, ‘Developing a National Rapid Response Strategy for the Prevention of the Establishment of the Asian Tiger Mosquito’, was originally designed to prevent an invasion of the Asian tiger mosquito (*Aedes albopictus*) by improving the current monitoring system at potential entry points and preparing a rapid response plan in case of introduction. However, during TC expert mission to the island in May, specimens of *Aedes aegypti* mosquito were found. *Aedes aegypti* mosquitoes are the primary vectors (carriers) of serious tropical diseases such as Dengue, Zika, and Chikungunya. Following the expert mission, on request from the Member State, the Agency developed an emergency response plan for Cyprus. Later in 2022 the Asian Tiger Mosquito was also found on the island. The scope of project CYP5020 was adjusted to support Cyprus in addressing this issue, and the IAEA dedicated further resources to support national efforts to control the invasive species.

In Türkiye, activities under project TUR5027, ‘Implementation of SIT for Suppression and Eradication of Medfly’, aim to introduce area wide SIT to control Medfly, which is causing losses to citrus production and export. In 2022, a technical feasibility study was conducted, and recommendations were provided on the selection of the pilot area, the fruit fly surveillance network, the mass rearing laboratory and the type of irradiator for sterilizing the fruit flies.



Fruit sampling, Türkiye. (Photo: Özge Helvacioğlu)

A new compilation of case studies covering six countries in Europe and Central Asia highlighted different potential pathways to achieving low-carbon energy targets in line with the Paris Agreement – an international treaty aiming to reduce global warming. The six case studies in the publication, ‘Energy Planning Support to Europe and Central Asia’, were developed in the framework of regional technical cooperation project RER2017, ‘Assessing the Role of Low Carbon Energy Technologies for Climate Change Mitigation’. Based on countries’ anticipated energy demands, the case studies evaluate multiple possible energy sources in different development scenarios. The findings revealed that the paths to net zero emissions will be varied.

Under RER1021, ‘Enhancing the Use of Radiation Technologies in Industry and Environment’, a regional workshop on radiation processing

for environmental applications was held in Ankara, Türkiye, attended by more than 120 national stakeholders and international participants. The workshop included a visit to the laboratories of the Turkish Nuclear, Energy and Mineral Research Agency (TENMAK), as well as to electron beam and irradiation facilities where the wastewater treatment is being tested, as well as a visit to the Museum of Anatolian Civilizations where many artefacts were irradiated by the Agency.

Through RER7012, ‘Determining Long Term Time Trends of Air Pollution Source Tracers by Nuclear Techniques’, the technical cooperation programme has assisted Member States to improve regional air quality by analyzing the sources and mechanisms of transboundary air pollution. Over 20 participating Member States improved their knowledge of source apportionment methodologies and shared common practices in using the receptor model and long-range transport tools. The IAEA supported the collection of information on air pollution source profiles, source contribution and the role of long-range regional transport. The results could support evidence-based policymaking for Member States on air pollution mitigation measures targeting the reduction of particulate matter 2.5 concentrations.

Activities in the region’s newest Member State, Turkmenistan, began under its first national TC programme. Four national TC projects are addressing the priority areas of cancer diagnosis and treatment, radiation safety and regulatory infrastructure, and radioactive waste management.



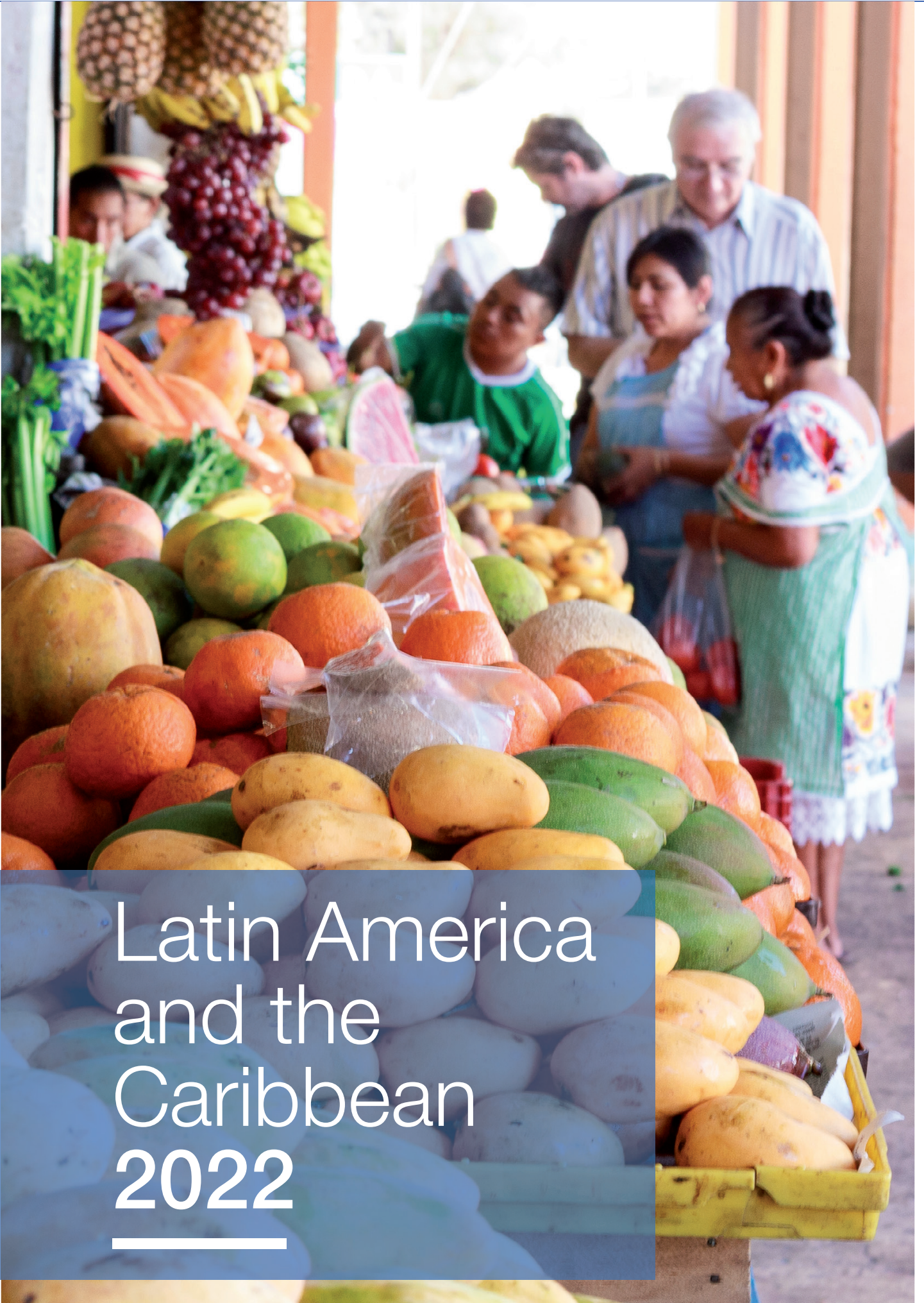
TENMAK Electron Beam Facility, Türkiye. (Photo: T. Furusawa/IAEA)



In 2022 IAEA DG Rafael Mariano Grossi visited the Metsamor Nuclear Power Plant in Armenia (Photo: D. Candara)

C.3.3. Regional cooperation

The strategic document ‘Regional Profile for Europe and Central Asia (2022–2027)’ was endorsed by 33 Member States at the NLO meeting on the margins of the IAEA’s 66th General Conference. The Profile focuses on key regional priorities and provides a blueprint for future activities. The new planning document has four priority thematic areas: nuclear and radiation safety, nuclear energy, human health, and isotope and radiation technologies. The Profile is a key thematic reference for Member States and the Secretariat to aid in the formulation of regional projects.



Latin America and the Caribbean 2022

C.4. LATIN AMERICA AND THE CARIBBEAN

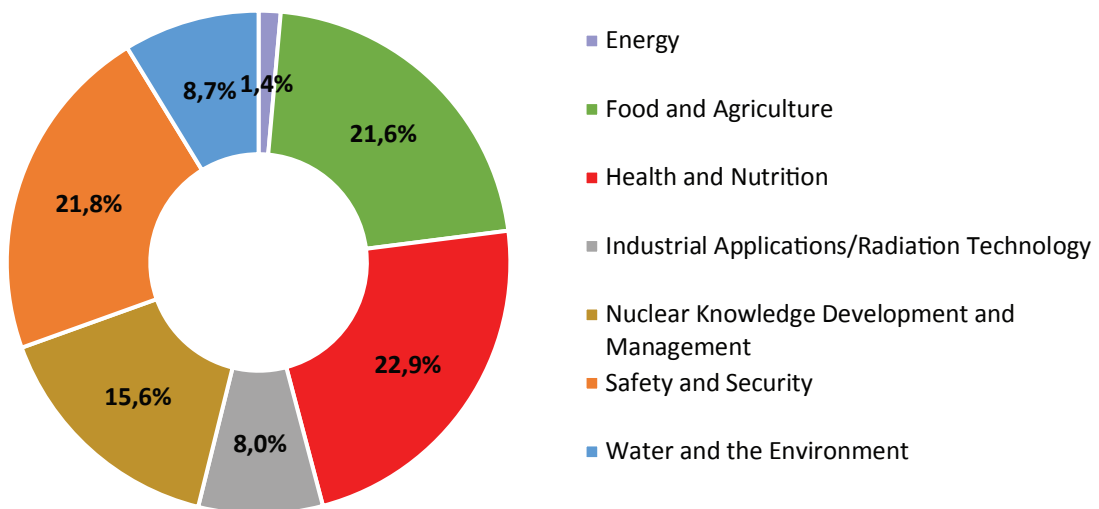
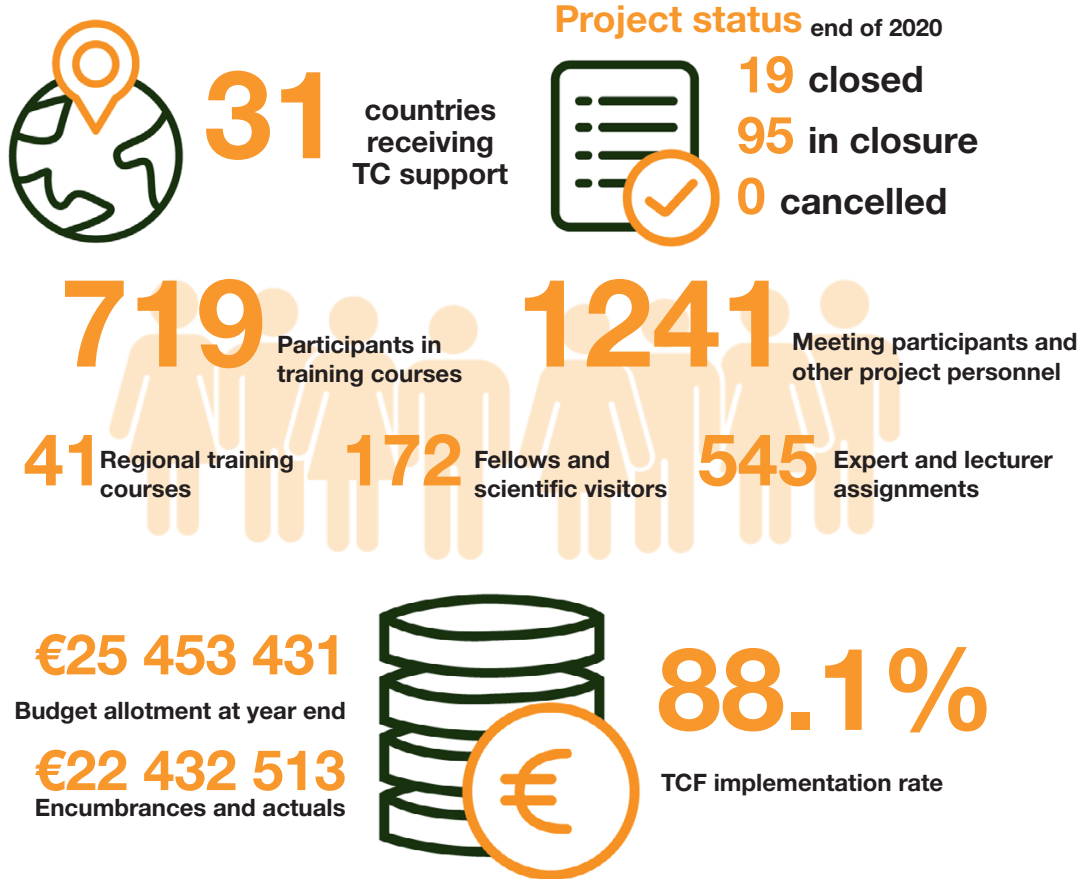


Figure 12: Actuals in the Latin America and the Caribbean region in 2022 by technical field.

C.4.1. Regional highlights in Latin America and the Caribbean

CPFs signed in Latin America and the Caribbean in 2022

Dominican Republic

Guatemala

Saint Lucia

In 2022, 31 Member States, including one least developed country (Haiti), were supported through 215 national projects and 62 regional projects. The programme achieved an implementation rate of 88.1% in the region, primarily focusing on human health, food and agriculture, radiation safety as well as water and the environment.

Three Member States signed CPFs in 2022.

A regional consultative process, including Member States and regional stakeholders, was implemented to select 11 regional project proposals for the 2024–2025 TC cycle.



The Guatemala Country Programme Framework was signed for the period of 2022–2027. (Photo: J. O'Brien/IAEA)

In February 2022, twelve scientists from Latin America received training in mutation breeding for resistance to Fusarium Wilt disease, which affects critical banana plantations in the region. The training was conducted at the IAEA laboratories in Seibersdorf and was supported by the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture.

The Regional Network for Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO) finalized a set of harmonized sampling strategies that will help guide the collection and analysis of microplastics samples to obtain comparable data and achieve a regional database on microplastics in marine and coastal environments.

In 2022, the IAEA-supported regional chapter of Women in Nuclear in Latin America and the Caribbean (WiN ARCAL chapter) advanced initiatives aimed at supporting equal female participation in nuclear science and technology. In September, the guide 'Somos Potencia' (We Are the Power), a guide for gender mainstreaming in the nuclear sector in the region, was launched. The members of the first Board of the ARCAL chapter were elected.

C.4.2 Project highlights

Through a series of regional projects, the Agency is providing expert advice and capacity-building to Member States in Latin America and the Caribbean on the prevention and progressive control of the New World Screwworm (NWS) fly. The NWS fly, *Cochliomyia hominivorax*, causes a parasitic infestation of the body called myiasis which affects both animals and humans, and is endemic in most South American and Caribbean countries. In 2022, Uruguay became the first country in South America to establish an NWS eradication programme using the sterile insect technique. With IAEA assistance, and in collaboration with the Panama-United States Commission for the Eradication and Prevention of Screwworm (COPEG), government representatives and technicians from national institutions received training on and insight into the technical, programmatic and legal requirements of such a programme. Professionals from nine additional countries in Latin America and the Caribbean received training on diagnosis, surveillance, emergency response and quarantine measures in the framework of the regional project RLA5088, 'Advancing Surveillance and Progressive Control of the New World Screwworm Using the Sterile Insect Technique'.

The Agency released several new Spanish-language e-learning courses in 2022 on radiation safety, supported by regional project RLA9088, 'Strengthening Regional Capabilities of End Users and Technical Support Organizations on Radiation Protection

as well as Emergency Preparedness and Response'. Courses covered medical response to radiological emergencies, radiation protection in dental radiology and reference levels in medical imaging diagnosis, as well as a train-the-trainer course for medical physicists in the event of a radiological emergency.

In 2022, two digital mammographs units were delivered to Honduras to support the early diagnosis of breast cancer in women through national project HON6005, 'Improving Cancer Control through Human Resources Training in Radiation Medicine and Establishing a Nuclear Medicine Department'. The equipment will be operational at the San Felipe General Hospital, the national reference centre for cancer in the country, as of early 2023, and it will lead to better breast cancer management in women.

Artificial intelligence (AI) has recently attracted much attention for its potential use in healthcare applications, including its use to improve and extract more information from medical images. In Argentina, national project ARG6021, 'Advancing Nuclear Medicine and Radiology Through Innovative Data Driven Methodologies', aims to strengthen physical infrastructure and to build capacities to establish new methodologies to increase the quantity and quality of clinical data available. The aim is to use AI to provide more accurate reporting for better treatment decisions for the benefit of patients. Several scientific visits were carried out in 2022 to learn about AI based systems in healthcare and how data driven strategies, such as machine and deep learning, may boost diagnostic accuracy and analysis of clinical information to improve decision-making.

Peru received assistance through national project PER1017, 'Increasing the Use of the RP-10 Nuclear Research Reactor to Meet the Demand of Several Socioeconomic Sectors', for the preparation of a strategic plan and a business plan to increase the use of their reactor. The plans identify actions to benefit several socioeconomic sectors, including industry, mining, health and the environment, as well as actions to be taken to ensure the sustainability of the reactor.

C.4.3. Regional cooperation

The Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) continues to lead cooperation in the region in line with Agenda ARCAL 2030 (Regional Strategic Profile for the period 2022–2029). In 2022, a guide for implementation of these strategic documents, defining the baselines, indicators, and goals to be achieved in the period 2022–2029, was finalized, and an action plan to strengthen communication and outreach to promote nuclear applications and disseminate results was formulated. Five thematic webinars were organized jointly by the Agency and ARCAL to provide information to the scientific community and the general public about nuclear technology and its social and economic impact on the region.



Senior representatives of CARICOM technical institutions met IAEA Director General Rafael Mariano Grossi to discuss their ongoing collaboration, facilitated through the TC programme. (Photo: D. Calma/IAEA)

The IAEA and the group of the Caribbean Community (CARICOM) Member States in the IAEA have cooperated closely to prepare a Regional Strategic Framework (RSF) to identify and prioritize the region's most pressing problems and needs that can be addressed using nuclear technologies, covering the period from 2020 to 2026. In November, the Regional Steering Committee of the RSF held its first in-person meeting in Vienna with representatives of seven CARICOM IAEA Member States and eight CARICOM technical institutions in attendance. During the event, the representatives of the CARICOM technical institutions met with IAEA Director General Rafael Mariano Grossi to discuss on-going collaboration and visited the IAEA laboratories at Seibersdorf and the Hydrology Laboratory at the Vienna International Centre. The Regional Steering Committee members discussed ongoing work in the region that aligns with RSF goals related to energy, radiation technology, water and environment, radiation safety, human health, agriculture and food production. The meeting participants reviewed the progress made in implementing the RSF over the first two years and agreed on actions to be taken towards achieving the outcomes in each of the thematic areas.

Mr Hua Liu, Deputy Director General, Head of the Department of Technical Cooperation Regional paid an official visit to Jamaica from 27 June to 1 July 2022. He attended the official inauguration of the first nuclear medicine department at the University Hospital of the West Indies in the presence of the Honourable Andrew Holness, Prime Minister of Jamaica.

During the week, meetings were held with high-level representatives from different sectors to discuss present and future cooperation in the areas of human health, food and agriculture, water and environmental management, industry, energy and safety. Mr Liu visited national and regional institutions that closely collaborate with the IAEA in the framework of the technical cooperation programme, including the Planning Institute of Jamaica, the Hazardous Substances Regulatory Authority, the University of the West Indies, the National Cancer Treatment Centre, the Scientific Research Council, the National Vector Control Programme, the Centre for Marine Sciences and the International Centre for Environmental and Nuclear Sciences (ICENS), which houses the only research reactor in the Caribbean.

Mr Liu's visit also provided an opportunity to discuss the potential impact of the support offered by the IAEA to CARICOM Member States in the context of the Regional Strategic Framework for Technical Cooperation with the IAEA-CARICOM Member States 2020-2026 (RSF). The regional meeting on the Provision of Technical and Scientific Support Services to Regulatory Functions in IAEA-CARICOM Member States enabled discussions with participants from the region on an integrated approach aimed at increasing the availability of Technical and Scientific Organizations (TSO) to support regulatory functions and infrastructure in the Caribbean sub-region. The meeting introduced the general characteristics, organizational aspects and types of services of TSOs, and marked the starting point of a model initiative targeted at fostering the optimization of resources through sub-regional cooperation, with the common goal of ensuring the safe and secure application of nuclear science and technology in the Caribbean region.

The 23rd Meeting of the ARCAL Technical Coordination Board (OCTA) took place in May, attended by 16 national ARCAL representatives and representatives from Spain. At the meeting, national ARCAL coordinators reviewed the progress made in the implementation of the ARCAL communication and partnership strategies. They also discussed the need to carry out impact monitoring and to develop an evaluation plan and selected the ARCAL TC project proposals to for the 2024–2025 TC cycle.

C.5. INTERREGIONAL PROJECTS

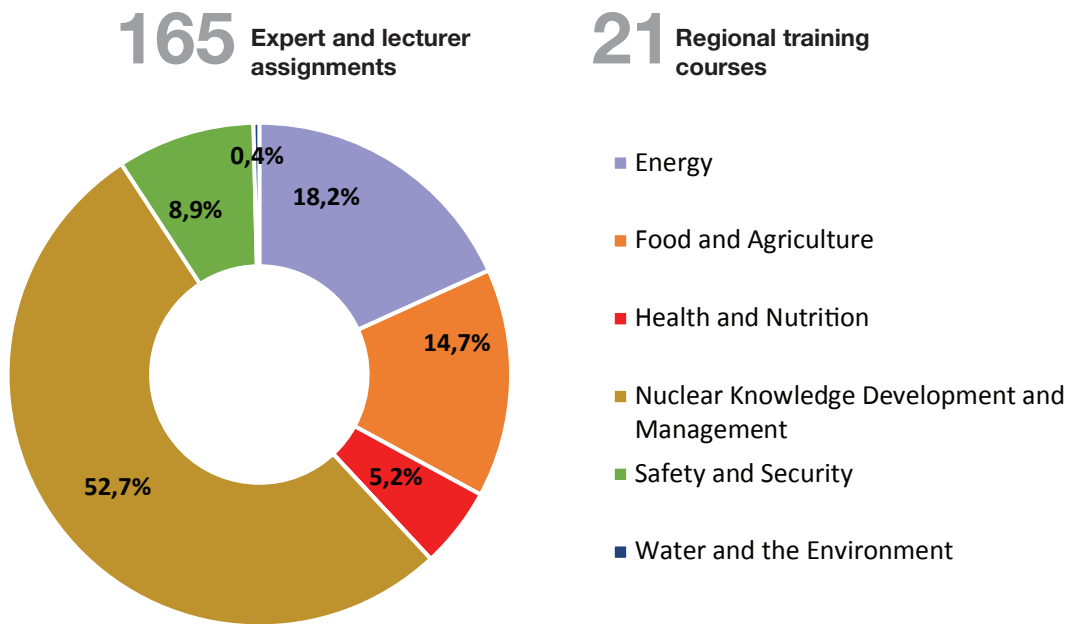


Figure 13: Interregional actuals in 2022 by technical field.

Interregional projects deliver technical cooperation support across national and regional boundaries and address the common needs of several Member States in different regions. In 2022, actuals under interregional projects totalled €10 million. Eight interregional projects were in closure status at the end of the year.

In 2022, the Agency, through the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture and the TC programme, scaled up actions to support developing country efforts to prevent and control the banana wilt disease caused by *Fusarium Tropical Race 4* (TR4). Interregional project INT5158, ‘Strengthening Member State Capacities to Combat Banana Fusarium Wilt (TR4) through Early Detection, New Resistant Varieties, and Integrated Management’, launched in March, will pursue South-South and triangular cooperation to strengthen Member State capacities to combat TR4 through early detection, the development of new varieties resistant to banana wilt, and area-wide integrated pest management. An international symposium, titled ‘Banana Fusarium Wilt (TR4) – Early Detection, Genetic Resistance, and Integrated Management’ was held in Quito, Ecuador, in March to exchange experiences and foster a collaborative network among international organizations, Member States from Latin America and the Caribbean, and scientific representatives from affected countries in Asia, Europe and Africa. Experts presented progress on detection of the pathogen and its different races, biological control of the pathogen, existing resistant varieties, as well as breeding through conventional means.

The Agency is cooperating with the World Meteorological Organization through TC project INT7020, ‘Developing Capacity towards the Wider Use of Stable Isotopic Techniques for Source Attribution of Greenhouse Gases in the Atmosphere’. The project helps Member States to develop capacities in stable isotope analysis to determine the origins of greenhouse gas emissions, and thus will provide decision-makers with information necessary to take meaningful actions to effectively reduce greenhouse gases. A Regional Training and Analysis Center is being established in Argentina at the National Meteorological Service in Buenos Aires. In 2022, the first draft of the good practice document ‘Guidelines for Measurements of Isotopes in Atmospheric CH₄ to Characterise CH₄ Sources’ was prepared.

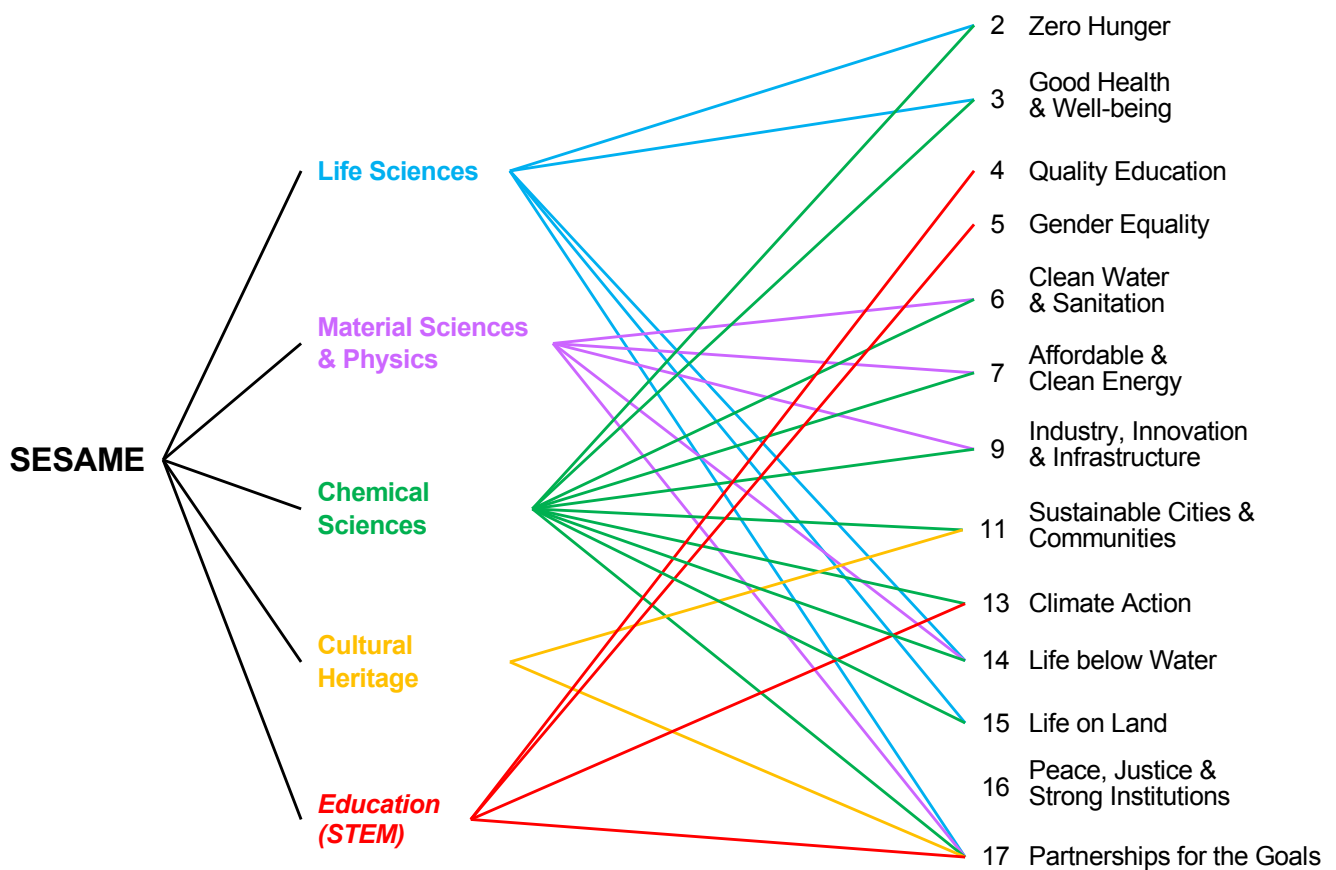
Through project INT2021, ‘Supporting Member States Considering or Planning to Introduce or Expand Nuclear Power Programmes in Developing the Sustainable National

Infrastructure Required for a Safe, Secure and Peaceful Nuclear Power Programme’, Member States receive Agency assistance to create an enabling environment to facilitate the safe, secure and sustainable introduction or expansion of nuclear power, with a focus on building nuclear infrastructure and nuclear safety frameworks. With support from donor countries, 16 Agency-organized global events were conducted in 2022, benefiting 42 participating countries.

Under interregional project INT2022, ‘Supporting Capacity Building in Member States for Uranium Production and Safety of Naturally Occurring Radioactive Material Residue Management’, the Agency conducted a Uranium Production Site Appraisal Team (UPSAT) in May 2022 to review the Mongolian uranium exploration and mining regulations as well as the Badrakh in-situ recovery uranium pilot plant project.

In 2022, 30 participants took part in a two month-long group fellowship training course on ‘Uranium Geology and Exploration, Uranium Production, Radiation Safety and Environmental Remediation’ in the Czech Republic, supported by interregional project INT2022, ‘Supporting Capacity Building in Member States for Uranium Production and Safety of Naturally Occurring Radioactive Material Residue Management’. A virtual workshop on the Holistic Approach to NORM Management was attended by 105 participants from around the world.

An overarching stakeholder engagement plan was developed in 2022 under interregional project INT0099, ‘Maximizing the Socioeconomic Benefit of the SESAME Lightsource’, to show the alignment of Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) with many of the SDGs, and to examine the alignment of SESAME’s capabilities with the strategic needs of current and potential SESAME member states.



In 2022, implementation of INT6062, 'Strengthening Capacity for Cervical Cancer Control through Improvement of Diagnosis and Treatment', focused on human capacity development. Three group trainings and one expert mission were conducted, training almost 100 professionals from participating countries in the comprehensive management of cervical cancer and related techniques.

Responding to the growing need for more radiotherapy professionals with sound knowledge on the QUATRO methodology who can also serve as national, regional and international auditors, a training course in Vienna was organized under the interregional project INT6063, 'Improving Quality of Radiotherapy, Nuclear Medicine and Radiology Services Through the Implementation of Quality Management Programmes'. The objective of a comprehensive audit is to review and evaluate the quality of all components of a radiotherapy programme, including human resources, procedures, services, patient protection and safety infrastructure, as well as the implementation of international standards and best practices. The course was attended by 87 participants, from 35 countries, including radiation oncologists, medical physicists and radiotherapy technologists, and are expected to take leading roles in their countries as future QUATRO auditors and also to support other countries in their regions and beyond.

C.6. PROGRAMME OF ACTION FOR CANCER THERAPY (PACT)

C.6.1. PACT highlights in 2022, including Rays of Hope, advocacy and resource mobilisation

116 Expert and lecturer assignments

0 Regional training courses

In 2022, PACT continued to support the efforts of low- and middle-income countries to integrate radiation medicine into comprehensive national cancer control programmes. PACT activities focused on analysing cancer control capacities, facilitating expert advice for national cancer control planning, assisting with strategic document development and mobilizing resources for cancer-related projects.

Following the launch of the IAEA flagship initiative, Rays of Hope, PACT supported the convening of colleagues from across the Agency to prepare an integrated approach. impACT Review assessments and National Cancer Control Plans were among the many factors considered in defining priority needs in radiation medicine under Rays of Hope. Resource mobilisation efforts continued, with the Agency forging new partnerships with traditional and non-traditional donors to support Member States in addressing gaps in cancer diagnosis and treatment under Rays of Hope.

Member States showed strong support for the Agency's cancer control activities, initiating or renewing their commitments. A total of €34.1 million was mobilized from Belgium, Finland, France, Israel, Japan, KONICOF, Monaco, the Republic of Korea, the Russian Federation, Sweden, and the United States, with €34 million mobilized for Rays of Hope specifically, particularly in Africa and Ukraine.

The Agency led the fourth annual strategic consultation on cancer control with the International Agency for Research on Cancer (IARC) and the World Health Organization (WHO). The three agencies met following the 2022 World Cancer Congress (WCC) in Geneva, Switzerland. The Annual Strategic Consultations facilitate planning for effective collaboration between the three UN agencies, which all share the goal of improving global cancer control. The 2022 discussions focused on the development of tools for cancer prioritization and planning, data collection matters, and coordinated action at country-level.

PACT also participated in several high-level events, including the 75th World Health Assembly, World Cancer Day, London Global Cancer Week, and the WCC as well as WHO Regional Committee Meetings. Additionally, PACT continued to collaborate with the City Cancer Challenge Foundation (C/Can) and the Union for International Cancer Control (UICC), sharing information on cancer activities in selected countries. The IAEA provided financial support to scientists from ten Member States to attend the WCC in Geneva.

During 2022 PACT provided advisory support to develop National Cancer Control Programmes (NCCP) to ten Member States (Benin, Burundi, Botswana, Kenya, Paraguay, Senegal, Sierra Leone, Sudan, Zambia and Zimbabwe) with the aim of facilitating the development of evidence-based, country-specific and prioritized strategic documents to tackle the cancer burden. To complement the work done through regular virtual meetings with the teams appointed by the Ministries of Health, in-country expert missions were conducted in Benin, Botswana, Burundi, Kenya, Paraguay, Senegal, Sierra Leone, Zambia and Zimbabwe to participate in national workshops involving a wider group of stakeholders, including civil society organizations, academia, patients' representatives and cancer survivors. This also contributed to strengthen south-south cooperation through the creation of a network of cancer control professionals at the regional level, fostering longer-lasting mutual support for capacity building and the exchange of knowledge and ideas to advance the implementation of cancer control activities in sustainable ways.

In addition, in order to facilitate Member States to access the best available science, processes and resources to enable robust cancer control planning and implementation, the IAEA, WHO and IARC organized a series of webinars for Ministries of Health counterparts, aiming at facilitating interactive dialogue among countries to share lessons learned on NCCP development and implementation. The first workshop, held in September 2022, registered a wide participation of Member States that presented their best practices and challenges in cancer control planning and governance.

C.6.2. imPACT Reviews

imPACT (integrated mission of PACT) Reviews are designed to support national health authorities in national cancer control planning and decision-making processes, measuring progress in implementation and the mobilization of funds to establish or strengthen cancer services. imPACT recommendations highlight areas where the IAEA and its partners can offer programmatic interventions to enhance national cancer control systems or can contribute, for example, to the establishment of safe radiation medicine practices. In addition to key technical partners, the imPACT Review team brings together specialist staff from across the Agency.

imPACT Reviews were conducted in Colombia, Lao PDR, the Syrian Arab Republic and Uzbekistan through a hybrid approach; virtual meetings to follow-up on imPACT Review recommendations were conducted in Costa Rica and El Salvador. Technical preparatory work began for imPACT Reviews in Cambodia, El Salvador, Fiji, Jordan, Papua New Guinea and Sudan.

In August, the IAEA published Methodology for imPACT Reviews. This was accompanied by an article 'Evolution of the joint IAEA, IARC and WHO cancer control assessments (imPACT Reviews)', which was published in the Lancet Oncology.

imPACT Review Colombia

Colombia requested its first imPACT Review in 2011 and, based on the review recommendations, launched its Ten-Year Cancer Control Plan one year later. A follow-up imPACT review was conducted in November at the request of the Ministry of Health and Social Protection. The Review provided a comprehensive assessment of the country's cancer control capacities by a team of 11 international experts in all areas of cancer prevention and control. The interdisciplinary team visited 19 cancer facilities, meeting close to 100 local actors to explore existing geographical and economic inequalities in access to cancer care services.

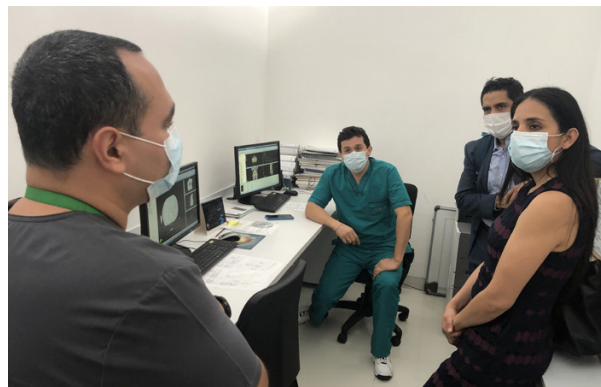
The imPACT Review identified gaps in the provision of cancer control and looked at the provision of services in remote regions of the country and vulnerable populations. The Review findings stressed the need for an early detection programme to reduce the number of cancer cases presenting at an advanced stage. Discussions also took place regarding the information systems for cancer surveillance with which to enhance the national cancer registry by tracking data related to cancer patients and survivors.

imPACT Review Lao PDR

Lao PDR first hosted an imPACT Review in 2014, and in light of the growing prioritization of cancer as a public health priority, the Ministry of Health of Lao PDR requested a follow up imPACT Review to provide a technical assessment of their national health capacities. The follow up Review has provided an opportunity to take stock of national progress and to determine plans for the future.

imPACT review missions in 2022

Colombia	Syrian Arab Republic
Lao PDR	Uzbekistan



An imPACT Review was carried out in Colombia in November 2022. (Photo: IAEA)

Responding to the recommendations arising from both the 2022 and the 2014 Reviews, national counterparts are now working to establish a new national comprehensive cancer centre, whose construction and management is benefiting from guidance provided through the imPACT review and by the recently published WHO-IAEA Framework on the topic.

The imPACT Review also supported the ongoing efforts of the Lao PDR Ministry of Health in ensuring cancer is integrated into the overall health agenda. At the policy level, a key focus has been integrating cancer into the broader non-communicable disease (NCD) programmes. At the level of clinical care, emphasis has been on the importance of health promotion and prevention of cancer, specifically at primary health care level, while highlighting the need to invest in tertiary care in the longer-term.

imPACT Review Syrian Arab Republic

Following a request from the Government of Syria, IAEA and WHO staff, together with an international expert, visited Syria in October. The team conducted observational visits to key hospitals, primary care facilities and civil society organizations in Damascus and Latakia, and met with the Minister of Health, Minister of Higher Education, the Atomic Energy Commission, the First Lady and senior government staff to raise awareness about the imPACT Review findings and recommendations and to identify support under the IAEA technical cooperation programme. The team also participated in roundtable discussions with National Cancer Control Committee members and other stakeholders to advance cancer control prioritization and planning (including for the planned 2024–2025 TCP cycle) on key issues that included the referral pathway, coordinated and integrated cancer care and workforce challenges.

As a result of the imPACT Review the National Cancer Control Committee has revised its national cancer control strategic plan for 2019–2029, integrating the imPACT Review recommendations and expert guidance to advance strategic cancer control priorities, including in the areas of radiotherapy, diagnostic imaging and nuclear medicine.



Following a request from the government of Syria, IAEA and WHO staff visited Syria in October. (Photo: IAEA)

imPACT Review Uzbekistan

The Uzbekistan Ministry of Health requested a 2022 imPACT Review in order to track progress since the conclusion of the 2014 Review mission, and to inform the development of a new national cancer control programme (NCCP) and further investments in cancer control.

The imPACT Review noted the significant expansion of radiotherapy services, particularly in the past eight years, with the number of functioning external beam radiotherapy machines growing from five machines in four cancer care institutions to 19 in 15 institutions. The Review team provided actionable guidance to expand and enhance cancer care in Uzbekistan—particularly in the areas of breast, cervical and childhood

cancers—by scaling up prevention and early diagnosis services and improving quality and access to treatment.

The 2022 imPACT review also included an in-depth analysis of infrastructure, equipment and workforce needs in the main cancer care hospitals in the country. This information is now being used to define corresponding equipment, financial resources and workforce capacity building activities for upcoming oncology projects.

C.6.3. Development of strategic documents

Ten countries received expert advisory support to develop a National Cancer Control Programme (NCCP), including through a number of in-country workshops held in partnership with WHO and IARC (Benin, Burundi, Botswana, Kenya, Paraguay, Senegal, Sierra Leone, Sudan, Zambia and Zimbabwe).

To enable Member States to move from the planning stage to implementation, PACT provided countries with assistance to develop bankable documents that will support the mobilization of resources from international financial institutions (IFIs) and other donors. In 2022, the IAEA provided expert advisory support to Burundi, Central African Republic, Democratic Republic of Congo, Tanzania, Togo and Zambia for the preparation of bankable documents for the establishment or expansion of radiotherapy services, contributing to nationally led resource mobilisation efforts.



*Participants at the NCCP workshop in Benin.
(Photo: IAEA)*

List of frequently used abbreviations

AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
Agency	International Atomic Energy Agency
APCs	assessed programme costs
ARASIA	Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology
ARCAL	Regional Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean
CPF	Country Programme Framework
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
imPACT	integrated mission of PACT
IARC	International Agency for Research on Cancer
LDC	least developed country
NLA	National Liaison Assistant
NLO	National Liaison Officer
NPCs	National Participation Costs
NPP	nuclear power plant
NCCP	National cancer control plan/programme
PACT	Programme of Action for Cancer Therapy
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
SIDS	small island developing States
SIT	Sterile insect technique
SDG	Sustainable Development Goal
TC	technical cooperation
TCF	Technical Cooperation Fund
UICC	Union for International Cancer Control
WHO	World Health Organization



Annex 1.

**Achievements in 2022:
Project Examples by
Thematic Sector**

Annex 1. Achievements in 2022: Project Examples by Thematic Sector

A. Health and Nutrition

A.1. REGIONAL HIGHLIGHTS

The TC programme in Africa supports Member State efforts to enhance access to quality cancer treatment, nuclear medicine and diagnostic radiology. It also assists with assessing the efficacy of nutrition intervention campaigns using nuclear and nuclear-related techniques. In 2022, the programme supported human resource development – especially in terms of long-term training leading to the qualification of key personnel to operate facilities.

Assistance for health and nutrition in the Member States of the Asia and the Pacific region ranged from enhancing cancer treatment capabilities and conducting human resource activities to developing the knowledge of medical workers and procuring essential equipment for the analysis of factors affecting the recovery of malnourished children.

All Member States in Europe and Central Asia have at least one radiotherapy facility in the country, and support to keep up with technology development and its safe use is a high priority for the region. Under the regional project RER6040, ‘Enhancing Radiotherapy Delivery Through Improved Use of Advanced Dosimetry and Radiotherapy Techniques’, Member States identified common challenges and needs in radiotherapy in the region, discussed possible solutions, and agreed on the priorities to be supported in the period 2023–2025. Although radiotherapy practitioners have benefitted from various training opportunities at every level from basic to specialized, there is continuing high demand for such training to meet growing needs in the region, including the possibility to use online platforms. In addition, some Member States in the region still lack properly functioning nuclear medicine facilities, and efforts continue to address these gaps.

Human health and nutrition remain a priority in the Latin America and the Caribbean region, where many countries are affected by both communicable and non-communicable diseases. In 2022, the Agency helped Member States expand access to their cancer services through the provision of training and equipment for radiotherapy, nuclear medicine and diagnostic imaging at public hospitals across the region.



A.2. RADIATION ONCOLOGY IN CANCER MANAGEMENT

In Nigeria, the Agency is providing support under NIR6029, ‘Consolidating Three-Dimensional Conformal Radiation Therapy Cancer Screening and Treatment and Advancing New Treatment Techniques in Radiotherapy Centres’, for the training of medical professionals, including nuclear medicine physicians, medical physicists, and radiation technologists. In 2022, brachytherapy equipment was procured for the University College Hospital, Lagos University Teaching Hospital, the Federal Teaching Hospital, Gombe, and the University of Benin Teaching Hospital.

In 2022, IAEA assistance was provided through BEN6010, ‘Supporting the Establishment of a Radiotherapy and Nuclear Medicine Department at the University Hospital Centre of Abomey-Calavi’, to support fellowship training for medical professionals, including one radiation oncologist, two nuclear medicine physicians, two medical physicists, three radiopharmacists and two nuclear medicine technologists.

Under MAG6010, ‘Strengthening the Capacity and Quality of Radiotherapy and Nuclear Medicine Services’, Madagascar has received Agency assistance for its efforts to revitalise its radiotherapy service. A brachytherapy unit was procured and installed in April 2022 and the first brachytherapy patient was treated in July 2022.



A new orthovoltage radiotherapy machine was installed in the Dr AB May Cancer Center, Namibia, in 2021 to treat skin cancer patients. (Photo: W.Midzi/Dr AB May Cancer Center)

Skin cancer and related cancers, such as Kaposi sarcoma in particular rank, as one of the leading forms of cancer in Namibia. In late 2021, under NAM6013, 'Expanding Radiotherapy Services', the Agency delivered a new orthovoltage radiotherapy machine — a machine that uses radiation to kill cancer cells — to Namibia's Windhoek Central Hospital. In 2022 the orthovoltage machine treated its first patients. Over 600 skin cancer patients per year can now receive medical care for skin cancer.

A brachytherapy unit was procured for Mongolia's National Cancer Center through MON6022, 'Improving Radiotherapy Capacity Through the Introduction of Linear Accelerator Based Advanced Technologies', supporting the national programme for cancer treatment. This equipment is necessary for treating certain types of cancer, specifically in the head and neck, breast, cervix, prostate and eye.

In August, the first public service offering brachytherapy techniques for ocular cancer patients was opened at the Luis Razetti Hospital in Venezuela with the support of the IAEA. This milestone was achieved under national project VEN6020, 'Building Ocular Brachytherapy Capacities at the Ocular Oncology Unit of the Dr. Luis Razetti Oncology Institute'. The hospital treats an average of 150 paediatric patients per month.

A.3. NUCLEAR MEDICINE AND DIAGNOSTIC IMAGING

A webinar was held with strategic partners at the first coordination meeting for RAF6058, 'Strengthening the Capacities for Radiopharmacy and Medical Physics and Radiology for Expansion and Sustainability of Medical Imaging Services — Phase II (AFRA)'. The webinar, entitled 'Pathway towards improved radiology services in Africa', was attended by the meeting participants (30 radiologists and medical physicists present in the room) and a further 140 online participants from the region. A paper supported by the project, 'Medical physics services in radiology and nuclear medicine in Africa: challenges and opportunities', published in the Journal of Clinical Medicine, has received several thousand views online.



Participants at the training course 'Leaders in Nuclear Medicine'. (Photo: O. Yusuf/IAEA)

Twenty-one senior nuclear medicine professionals, including heads of departments, from 15 African Member States participated in a training course, 'Leadership in Nuclear Medicine', organized under RAF6057, 'Strengthening the Quality of Nuclear Medicine Services (AFRA)'. The event aimed to enhance the leadership skills of senior personnel involved in managing nuclear medicine facilities. Participants explored the newest approaches to problem identification, decision-making, team building, communication and staff development.

Diagnostic radiology services are being improved in Hungary with Agency support through HUN6004, 'Implementing a Formal Quality Assurance Programme in Diagnostic Radiology at End User Level'. In 2022, medical staff benefited from IAEA sponsored scientific visits to enhance their know-how of application of physics in diagnostic and interventional radiology and organization and supervision of quality control (QC) at the national level. The Agency provided QC tools and supported the translation of the IAEA publication Diagnostic Radiology Physics: A Handbook for Teachers and Students into Hungarian, enhancing patient care. The translation is expected to be completed in 2023.

In June, Jamaica officially opened its first public nuclear medicine centre at the University Hospital of the West Indies, to support the early diagnosis and treatment of cancer both in-country and throughout the region. Under the umbrella of two national projects, JAM6012, 'Re-Establishing Nuclear Medicine Capacity', and JAM6014, 'Building Capacity for Cancer Diagnostics and Treatment Services Related to Nuclear Technologies', the Agency provided the new centre with essential equipment such as a SPECT/CT diagnostic machine, a dose calibrator and equipment for radiopharmacy facilities and phantoms, together with a supply of the material and reagents necessary for nuclear medicine. The Agency also provided training for staff, including nuclear medicine technologists, radiopharmacists, radiologists and medical physicists, in clinical applications of nuclear medicine, and IAEA experts advised the country on how to establish an accredited training programme for nuclear medicine professionals.



Prime Minister of Jamaica Andres Holness and Deputy Director Hua Liu attend the inauguration of the first public nuclear medicine centre in Jamaica. (Photo: N. Schloegl/IAEA)

A.4. RADIOISOTOPES, RADIOPHARMACEUTICALS AND RADIATION TECHNOLOGY

With the support of regional project RAF6054, 'Strengthening and Improving Radiopharmacy Services (AFRA)', five qualified radiopharmacists from the four Francophone countries of Cameroon, Niger, Tunisia, and Senegal were awarded an MSc degree in radiopharmacy in 2022, within the framework of the IAEA-established master's programme in Morocco. An additional four radiopharmacists from Ethiopia, Kenya, Uganda, and Zambia completed their MSc degrees in South Africa.

RAF6054 also supported the establishment of the African Association of Radiopharmacy (AfrAR), by specialists from twenty-one African countries to strengthen their capacities and better meet national needs for the safe preparation and administration of radiopharmaceuticals used in diagnosing, treating and managing cancer and other diseases. The association, formed in March 2022 with the support of the IAEA, the Society of Radiopharmaceutical Sciences (SRS) and the European Association of Nuclear Medicine (EANM), will contribute to the development of the radiopharmaceutical field in the region. The association plans to enhance awareness of radiopharmaceuticals as medical products among health professionals in Africa and sensitize decision-makers on the importance of radiopharmacy services, as well as the need for their regulation based on international standards.



Practical training sessions on the use of radiopharmaceuticals with African experts took place in Indonesia. (Photo: Indonesia's National Nuclear Energy Agency /BATAN)

A number of African countries are working on expanding and upgrading their radiopharmaceutical production facilities. With Agency support under TUN6021, 'Enhancing National Availability of Positron Emission Tomography Radiopharmaceuticals through Building Production Capabilities and Training', Tunisia has been able to start using positron emission tomography. Algeria has also recently installed and commissioned a medical cyclotron.

In Mongolia, project MON1009, 'Developing Capacities for the Production of Radioisotopes', aims to increase the sustainability of the national cancer control programme by establishing the capacity for the production and dispensing of medical radioisotopes. Following a series of meetings and discussions in 2022, existing gaps in laboratory supplies that affected the national programme were determined, and procurement was initiated with the goal of significantly strengthening the capacity of the national laboratory.



Establishment of primary skin cell culture at the Tissue Engineering Laboratory, Costa Rica Institute of Technology. (Photo: Costa Rica Institute of Technology)

In March, as part of an ongoing IAEA technical cooperation project, RLA1018, 'Strengthening Capacities for Irradiating Tissues as Scaffolds for Tissue Engineering to Use in Regenerative Medicine', more than 170 healthcare professionals and medical experts joined a one-day webinar to learn about available tissue banking services in the Latin America and the Caribbean region. Organized and co-hosted with the Costa Rica Institute of Technology, the virtual event aimed to raise public awareness of tissue banking through presentations by Costa Rican and international experts. The presentations highlighted successful experiences in the region using safe, sterile tissue, and described regenerative therapies using tissue engineering.

A.5. DOSIMETRY AND MEDICAL PHYSICS

In Israel, a microscope-based platform capable of identifying and quantifying radiation exposure in people was procured under project ISR6028, 'Developing a National Biological Dosimetry Capability – Continuation'. The platform strengthens national capacities and the efficient functioning of the biological dosimetry laboratory.

More than 20 medical physicians from all over Pakistan received training at a workshop on the dosimetry of static and small fields in September, supported by PAK6027, 'Enhancing and Strengthening Nuclear Medicine and Oncology Institutions in Cancer Diagnostics and Treatment and Ensuring Human Safety by Adopting Best Practices in Cancer Management'.

For several years Uzbekistan has benefitted from Agency assistance in establishing its first Secondary Standards Dosimetry Laboratory. With support through UZB6015, 'Establishing the Secondary Standards Dosimetry Laboratory', a gamma beam radiation protection calibration system, an X-ray calibration system and the radioactive Cs-137 source were delivered to the counterpart and installed in mid-2022. A two-week Agency expert mission to advise on the commissioning of the gamma beam irradiator and X ray unit took place in September 2022. The capacity building activities and equipment procurement have upgraded skills and infrastructure to allow the SSDL to provide quality assurance, accuracy and validity of measurements in the industrial, medical and other sectors. The laboratory's improved calibration conditions and the intercomparison of measuring instruments of radiation will help to establish modern national calibration laboratories.

A.6. NUTRITION FOR IMPROVED HEALTH

A curriculum for the first Master of Science in Applied Nutrition and Nuclear Techniques has been developed under RAF6059, 'Building Capacity to Use Stable Isotope Techniques to Improve Micronutrient Status Among Children (AFRA)', and subsequently endorsed by a meeting of stakeholders. The curriculum will be implemented in institutions ready to

provide training to students in the region. It was approved in South Africa at the North-West University as an MSc in Nutrition with Nuclear Techniques.

In Nepal, malnutrition accounts for more than 50% of child mortality. A series of meetings was held in 2022 under NEP6009, 'Expanding Nuclear Techniques to Address Childhood Malnutrition', to determine Nepal's laboratory equipment needs, leading to the procurement of a high-performance liquid chromatography unit used for specific vitamin analysis, and a microwave plasma atomic emission spectrometer used to analyse multiple mineral composition of foods. This additional laboratory capacity will enable a more comprehensive analysis of the factors affecting the recovery of malnourished children, especially the composition of food used to feed young children.

B. Food and Agriculture

B.1. REGIONAL HIGHLIGHTS



In 2022, food and agriculture continued to be one of the highest priority areas for the IAEA's technical cooperation programme for Africa. Member States received assistance to contribute to sustainable agricultural development and global food security. There is an emerging trend in the region to design integrated projects involving several nuclear techniques that address broader thematic topics such as enhanced food security and climate change adaptation. A side event at the 66th General Conference brought together delegates from Africa and other parts of the world to review progress in the agricultural sector as



The side event 'Enhancing Capacities of Member States in Africa to Achieve Food Security Through the Peaceful Use of Nuclear Techniques' examined integrated approaches to agriculture to meet the challenges of climate change. (Photo: D. Calma/IAEA)

regards adapting to climate change. Panellists discussed ways in which nuclear science and technology help increase the efficiency of agricultural production, protect soil and water resources, ensure the safety and quality of food, and facilitate export and trade of agricultural produce.

In the Asia and the Pacific region in 2022, TC projects in the food and agriculture sector ranged from crop mutation induction to the development of an experimental irradiated vaccine against a parasite worm infection in goats and an economic feasibility assessment estimating the returns on investment of False Codling Moth control using an integrated pest management and SIT based approach.

In Europe and Central Asia, the Agency is helping to strengthen national food monitoring programmes through projects focused on developing capacities for testing and monitoring food contaminants and residues. Support focuses on training staff and improving the analytical infrastructures of

the laboratories, and contributes directly to improved food safety and boosting trade in foodstuffs.

Enhancing the preparedness capacities of the veterinary sector to confront emerging and re-emerging diseases of livestock and wildlife is another priority area in the Europe region. The Agency is providing training on the evaluation of current biosafety and biosecurity status in officially designated laboratories. Member States in the region also upgraded their skills on nuclear and nuclear related techniques for the early detection of lumpy skin disease, sheep and goat pox, peste des petits ruminants and African Swine Fever (ASF).

Food and agriculture continue to play a pivotal role in Latin America and the Caribbean. In 2022, the TC programme worked with Member States to train and equip food safety laboratories throughout the region. The Agency also partnered with international organizations to launch a regional effort to combat pests that pose a threat to human health and agriculture. This effort included building national capacities in the use of sterile insect technique (SIT) to enhance the region's capacity to conduct area-wide insect pest management. In 2022, a major milestone was reached when Uruguay became the first country in South America to establish a New World Screwworm eradication programme using SIT.

B.2. CROP PRODUCTION

The Central African Republic has been facing an invasive spread of the Fall Armyworm since 2016, which is causing drastic losses in maize, a major crop that feeds 80% of the population. Through CAF5013, 'Improving Productivity of Maize and Developing Resistant Armyworm Maize Varieties Using Radio-Mutagenesis Techniques', and CAF5015, 'Improving Productivity of Maize and Developing Resistance to Fall Armyworm Using

Radiation-Induced Novel Genetic Diversity – Phase II’, support from the Joint FAO/IAEA Centre has been provided for capacity building in induced mutagenesis and mutation breeding, with the goal of developing improved maize mutant lines with resistance to the Fall Armyworm. Infrastructure for controlled screening was set up with the installation of a greenhouse, and training was provided in screening for resistance under controlled conditions.

Uganda is receiving support through UGA5043, ‘Improving Cassava and Rice Disease Resistance through Mutation Breeding Techniques’, to tackle Cassava Brown Streak Disease. Conventional breeding methods had been too slow to produce varieties that could withstand the disease, so the National Crops Resources Research Institute (NaCRRI) turned to a nuclear-based breeding technique and is working with the IAEA and the Food and Agriculture Organization of the United Nations (FAO) to develop cassava varieties that are both resistant to the virus and high yielding. So far, 42 new cassava lines have been developed through this method, and four of them have initially shown some level of resistance to Cassava Brown Streak Disease. In 2022, three cassava mutant lines underwent preliminary yield trials, and tissue culture protocol for irradiation of cassava materials was optimised.



Evaluating new cassava varieties on a Ugandan farm in the northwest of the country. (Photo: P. Nalela/NaCRRI)

In Kuwait, efforts to improve the production of barley are being supported through K UW5005 ‘Implementing Mutation Induction to Improve Barley Production under Harsh Environmental Conditions - Phase III’. In 2022, the seeds of the Kuwait 5 variety were planted in the field to generate a homogenous seed population for mutation induction. The mutant screening process for salt tolerance was performed on the seeds saved from the M3 generation in the field.

B.3. AGRICULTURAL WATER AND SOIL MANAGEMENT

Cotton is a leading cash and fibre crop in Azerbaijan, but national production is less than 3 tons per hectare. Project AZB5004, ‘Strengthening Best Soil, Nutrient, and Water Agricultural Practices for Cotton Production’, aims to develop climate smart agricultural practices of improved soil, nutrient, and water management to enhance cotton production in Azerbaijan. The Agency has supported capacity building of Azerbaijan researchers via hybrid training, prepared a production guideline which provides step-by-step information on climate smart agricultural practices, and established On-Farm-Trials in farmer’s fields which produced tangible results on the ground. Cotton production and quality were significantly increased from 3 tons per hectare to 6 tons per hectare. In 2022, the On-Farm-Trials using climate smart agricultural practices were extended to more regions and showed higher cotton productivity and quality.

In Slovenia, a series of technical cooperation projects on agricultural water and soil management have led to the successful establishment of improved practices to protect groundwater from agricultural non-point and point pollution. However, high concentrations of nitrate (>50 mg/l) and desethyl atrazine (>0,1µg/l) persist in certain areas, and new emerging pollutants are entering the water cycle from various sources, such as intensive agricultural practices from arable land, industrial and urban areas. A national training event was organized on the application of stable isotopes for water quality assessment in 2022, under the umbrella of project SLO5005, ‘Strengthening Agricultural Land Use and Management to Reduce Emerging Contaminants and Improve Water Quality’. The training event targeted participants with diverse technical and water management backgrounds, including drinking water companies, university and private research institutions, national park managers, the Geological Survey of Slovenia, and representatives from farmers and the agricultural sector, and helped to raise awareness of water scarcity and water pollution by nitrates and micropollutants.

In 2022, on-farm demonstrations of the best management practices for rice and cassava production were conducted in Lao PDR under project LAO5006, 'Enhancing Crop Production with Climate Smart Agricultural Practices and Improved Crop Varieties'. A Farmers' Field Day for Rice was organized in four provinces, attended by 48 local agricultural officers and 146 farmers. Two mutant rice varieties (Saphart 1 and Houykhod 2) were released by the Department of Agriculture.

The final coordination meeting of RLA5077, 'Enhancing Livelihood through Improving Water Use Efficiency Associated with Adaptation Strategies and Climate Change Mitigation in Agriculture (ARCAL CLVIII)', concluded that the project offered innovative sustainable agricultural practices that can have a direct impact on the environment and the economy. Under the project, participating Member States carried out case studies on a variety of crops to compare a traditional production strategy with one that contributes to climate change adaptation. They learned to use AquaCrop to assess water use efficiency, and to determine nitrogen use efficiency using ^{15}N labelled fertilizer. Project participants also learned to extract water from the soil for stable isotope analysis, as well as to estimate evapotranspiration partitioning into transpiration and evaporation, and to conduct cost benefit analyses.

B.4. LIVESTOCK PRODUCTION

Togo achieved a milestone to improve bovine productivity in Lomé in 2022: the first set of calves were born in October 2022 following successful artificial insemination supported by TOG5005, 'Enhancing Animal Production Using Artificial Insemination'.

Veterinary services in Zimbabwe have increased the production of *Theileria parva* vaccine doses from 1,500 to 20,460 doses in 2022, supported by ZIM5025, 'Producing *Theileria parva* and Other Tick Borne Disease Vaccines'. A further increase to 80,000 doses is expected once the laboratory becomes fully operational in 2023.



A researcher at Cameroon's National Veterinary Laboratory) preparing a sample for RT-PCR analysis as part of the country's efforts for the early detection and control of peste de petits ruminants. (Photo: IAEA)

Cameroon has enhanced the early diagnosis of animal diseases at the National Veterinary Laboratory (LANAVET) with the support of CMR5024, 'Improving Goat and Sheep Productivity in Rural Areas Using Nuclear-Derived Techniques for Genetic Marker Identification, Reproduction Harnessing and Feed Analysis'. The development of these skills, complemented by regular advice from the Agency, has led to the successful accreditation of the lab as ISO 17025-compliant, the only such veterinary laboratory in Central Africa. As a result, LANAVET has been able to increase its capacity, and now supports several countries in the region by exporting seven different veterinary vaccines. Farmers in Benin, Burkina Faso, Chad, Cote d'Ivoire, Gabon, Ghana and Nigeria all benefit from support by LANAVET.

An experimental irradiated vaccine against a parasite worm infection in goats was developed by the University of Peradeniya, Sri Lanka under project SRL5049, 'Supporting Control of Stomach Worm Infection in Goats', using nuclear technology. The Agency supported Sri Lanka to improve the vaccine formulation, and to scale up production for testing under field conditions. The counterpart has now been approached to test the vaccine in sheep.

B.5. INSECT PEST CONTROL

A release programme of sterile *Aedes albopictus* mosquitoes, the vector for chikungunya and dengue, has been initiated in the Champs de Mars area in Mauritius under MAR5028, 'Enhancing National Capabilities on the Suppression of *Aedes Albopictus* in an Urban Locality Using the Sterile Insect Technique as Part of an Integrated Vector Management Strategy'.

In the northern parts of KwaZulu-Natal, South Africa, the first SIT release trial was carried out in 2021 with 13,000 sterilised *Anopheles arabiensis* male mosquitoes in the rural area of Mamfene, near the town of Jozini, supported by SAF5017, 'Assessing the Sterile Insect Technique for Malaria Mosquitoes – Phase III'. A further release exercise was conducted from May to December 2022, with 30,000 sterile male mosquitoes being released each week.

In Israel, the use of the sterile insect technique has become a mainstream component of a national agricultural system under project ISR5022, 'Establishing the Sterile Insect Technique Methodology for the Management of the False Codling Moth'. With Agency support, Israel prepared an economic feasibility assessment estimating the returns on investment of False Codling Moth control using an Integrated Pest Management and SIT based approach.

The project TUR5026, 'Conducting a Pilot Program on Integrated Management of *Aedes Aegypti* Including Sterile Insect Technique', aims to establish capacity to apply the sterile insect technique to control *Aedes* species in the Black Sea Area as part of an area wide integrated pest management (AW-IPM) programme. In order to establish a network in mosquito rearing and surveillance at national level, the areas concerned were surveyed and surveillance activities were carried out during the active season. Mosquito rearing and colonisation activities were performed in the counterpart institute and stakeholder institutions to develop the necessary technical capacity, and meetings were held with local communities to increase public awareness of mosquito distribution and disease pattern and control strategies. A mosquito mass rearing module, together with entomological equipment and supplies for field and lab studies, was provided to support the establishment of a mass rearing facility in 2022. As a result, the counterpart institute has now established study conditions and a laboratory large enough to produce the weekly targeted number of mosquitos.

The Agency is providing technical support to Brazil through BRA5061, 'Using the Sterile Insect Technique to Apply a Local Strain in the Control of *Aedes Aegypt* (Phase II)', which aims to strengthen national capacities in the use of the sterile insect technique (SIT) to reduce the populations of the mosquito vector *Aedes aegypti* and contribute to the national vector control plan. Data collected as part of a pilot project in Brasilia showed that there has been a 50% reduction in the wild mosquito population since the initiation of releases of sterile males as compared with the untreated control area. In 2022, the data management system for mosquito entomological surveillance was customised and successfully implemented in the country. The information it contains, recorded in a central database, includes harmonised data collected from more than 27,000 trap surveys. The project team uses the database to conduct a weekly analysis which guides adaptations in the management of the vector control plan.



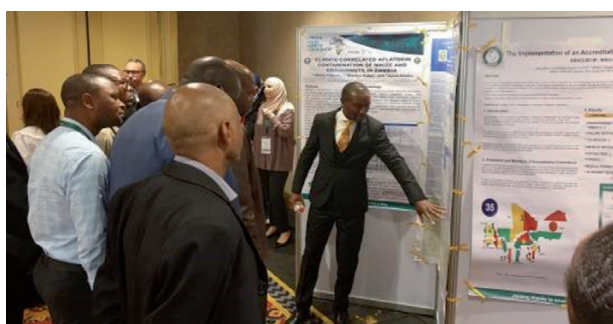
Insect collection in Fındıklı district, Türkiye. (Photo: Murat Ozturk)



Mass rearing facility for *Aedes aegypti* and *Aedes albopictus*, operated by the Ministry of Health and Wellness of Jamaica. (Photo: Jamaica Ministry of Health and Wellness)

Jamaica has also piloted a mass rearing facility for *Aedes aegypti* and *Aedes albopictus*, which is operated by the Ministry of Health and Wellness as part of the Ministry's Vector Control Programme. The programme is spearheaded by the Mosquito Control Research Unit of the University of the West Indies, Mona and has received support in the form of capacity building and equipment under regional technical cooperation project RLA5083, 'Enhancing Capacity for the Use of the Sterile Insect Technique as a Component of Mosquito Control Programs'.

B.6. FOOD SAFETY



A participant presenting his poster on the impact of climate change on mycotoxins and laboratory accreditation at the African Food Safety Workshop, jointly held by the IAEA and the FAO in Johannesburg, South Africa, 27 June–1 July 2022. (Photo: J. Sasanya/IAEA)

An African Food Safety Workshop was organized in July by the Agency, the Food and Agriculture Organization (FAO) of the United Nations and the National Metrology Institute of South Africa (NMISA) to support initiatives to enhance food safety across the continent. Over 280 experts and researchers from food safety regulators, food testing laboratories, food manufacturers and governmental and non-governmental organizations in 43 countries shared experiences on topics, including prevention of food fraud, radionuclide monitoring, and the use of radio receptor assays and stable isotopic techniques for veterinary drug and pesticide residues, as well as for mycotoxins, toxic metals and biotoxins. Participants discussed responses to food borne illnesses and disease outbreaks, the setting of maximum residue limits, and implementation of effective food monitoring and surveillance programmes.



The IAEA is supporting Zambia in testing beef and products derived from cattle and other animals for residues and contaminants that can lead to food poisoning. (G.Monga/CVRI)

Under ZAM5024, 'Establishment of a Veterinary Drug Residue Monitoring Facility at The Central Veterinary Research Institute', the IAEA and FAO are working with Zambia to address drug resistant microbes as well as food contamination in meat and other animal products. This involves strengthening the capabilities of the country's Central Veterinary Research Institute (CVRI). The IAEA is supporting the CVRI in delivering better services and has increased the technical knowledge of laboratory analysts through guidance and training. The ultimate aim is to ensure food is up to quality standards and rates of food poisoning are lowered.

Under RAF5088, 'Building Capacity for Food Irradiation by Facilitating the Commercial Application of Irradiation Technologies — Phase II (AFRA)', a regional meeting was held with project counterparts and representatives

of Texas A&M University to discuss and agree on measures and actions to support the use of gamma radiation, X-ray and electron beams in controlling pathogenic bacteria and mycotoxin producing fungi in food and in agriculture.

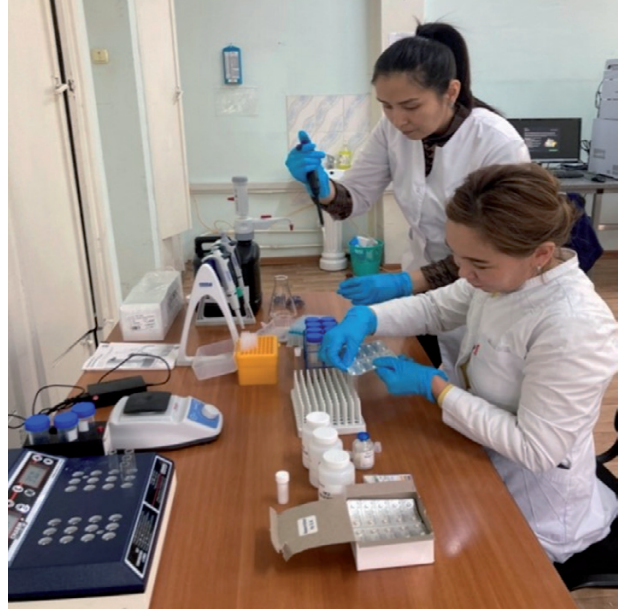
TC project GEO5001, 'Enhancing National Programmes for Testing and Monitoring Food Contaminants and Residues', is supporting the improvement of the national food

monitoring programmes of Georgia's State Laboratory of Agriculture. In 2022, five laboratory staff were trained in Latvia on mycotoxin analysis and toxic metal analysis in food and further developed their leadership capabilities in food safety control at the Latvian Institute of Food Safety, Animal Health and Environment. Equipment was also purchased for Georgia's State Laboratory. The enhancement of the laboratory's physical and human capacity is contributing strongly to food safety and boosting trade in foodstuffs in Georgia.

Kyrgyzstan is also receiving Agency assistance to establish capacities for effective testing and systematic monitoring of residues and food contaminants at the Laboratory of the Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health and the laboratories of the Center for Veterinary Diagnosis and Expertise. In 2022, project KIG5001, 'Establishing Effective Testing and Systematic Monitoring of Residues and Food Contaminants and of Transboundary Animal Diseases', provided support for two fellowships and two scientific visits at the Latvian Institute of Food Safety, Animal Health and Environment to transfer knowledge in veterinary drug and pesticide residue analysis, and food microbiology testing. The Agency also procured analytical equipment to enhance the capabilities of both laboratories.

The Agency is supporting food safety in Dominica through national project DMI5002, 'Enhancing Capacity to Monitor Agrochemical Residues in Foods and Related Matrices', which focuses on building capacity in the testing and analysis of levels of agro-chemical residues and chemical contaminants in food. In 2022, the Agency procured a radio receptor assay system for the Dominican Bureau of Standards which will support food safety testing in the country, as well as equipment for the screening, quantification and confirmatory analysis of chemical hazards in food.

The Agency has also supported food safety in the Bahamas under national project BHA5001, 'Developing Laboratory Capacity for Testing Contaminants in Animal and Related Products Including Fish in Bahamas'. Bahama's Food Safety and Technology Laboratories received specialized equipment to build its capacity in food safety control and improve laboratory information management.



Conducting analytical studies at the Laboratory Testing Center of the Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health of the Kyrgyz Republic. (Photo: A. Dzhumakanova/Ministry of Health)

C. Water and the Environment

C.1. REGIONAL HIGHLIGHTS



In Africa, the technical cooperation programme has sought to expand the good practices developed in characterizing groundwater resources in the Sahel to new areas in the south of Africa. Water quality studies using nitrogen isotopes are also being carried out in the region with the support of regional project RAF7021, 'Enhancing, Planning, Management and Sustainable Utilization of Water Resources (AFRA)'.

Projects throughout the Asia and the Pacific region regarding water and the environment focused primarily on water desalinization. The technical cooperation programme continued its efforts to enhance Member States capacities in performing marine and terrestrial environmental analysis.

The Agency is assisting Member States in Europe and Central Asia to enhance environmental monitoring and assessment capabilities to protect the environment. Addressing water and environmental related issues with nuclear and isotopic techniques is one of the four thematic areas of the new Regional Profile for Europe and Central Asia (2022-2027). Through capacity building projects, the technical cooperation programme enabled Member States to apply nuclear techniques for efficient and sustainable land and water management and to preserve the environment and remediate challenges.

In 2022, the Agency supported Member States in Latin America and the Caribbean in water resource management. Through the technical cooperation programme, Member States were assisted in applying isotope hydrology as a tool for water resource assessments and sustainable water management. The technical cooperation programme has also partnered with the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO) to finalize a strategy for sampling microplastics in coastal areas in the region. This milestone directly contributes to the marine monitoring component of the NUTEC Plastics initiative and supports Latin America and the Caribbean to maintain a database on microplastics in marine and coastal environments.

C.2. WATER RESOURCE MANAGEMENT

Through RAF7019, 'Adding the Groundwater Dimension to the Understanding and Management of Shared Water Resources in the Sahel Region', and RAF7021, 'Enhancing, Planning, Management and Sustainable Utilization of Water Resources (AFRA)', 16 doctoral students from Africa's Sahel region participated in a water resource management conference in Vienna. The students presented on the outcomes of their research and discussed potential solutions to ameliorate water resource scarcity in the Sahel region. There was a particular focus on increasing demands on groundwater resources.

Under RAF7021, 'Enhancing, Planning, Management and Sustainable Utilization of Water Resources (AFRA)', the Agency supported a sampling campaign for noble gas utilization in isotope hydrology in Senegal. The results are being used to better characterize groundwater resources in the Senegalo-Mauritania Basin.

Fifteen PhD students completing sandwich fellowship programmes are completing their studies



Doctoral students attend a water resource management conference on 11 March 2022 in Vienna, Austria. (Photo: J. O'Brien/IAEA)

on isotope hydrology under project RAF7021, 'Enhancing, Planning, Management and Sustainable Utilization of Water Resources (AFRA)'. In 2022, the Agency awarded students from 11 countries a further seventeen sandwich fellowships – ten to doctoral students, five to master's students and two to postdoctoral professionals. The students play a crucial role in implementing the project in their countries.

Through technical cooperation project MAR7007, 'Strengthening National Isotope Hydrology Capacity and Developing Evidence Based Materials for Groundwater Management', the Agency used nitrate isotopes to assess the origin of waste disposals in Mauritius. Authorities had detected nitrate contamination in streams and rivers that can threaten protected areas and fisheries due to increased harmful algal blooms. The sources of the pollution were provided by nitrate isotopes, which could inform the adaption of a targeted pollution control strategy.

In Jordan, a workshop on water desalinization using small modular reactors was conducted in November under JOR2015, 'Supporting the Implementation and Construction Activities of the First Nuclear Power Plant'.

The status of environmental monitoring capacities in the Europe and Central Asia region, including technical analytical capabilities and the existence of legal frameworks, has been mapped with the support of RER7014, 'Improving Environmental Monitoring and Assessment for Radiation Protection in the Region'. Fellows have been trained on different methods for environmental sampling, and specialists from 24 Member States learned to apply in situ methods and techniques for data collection and data visualization to characterize radioactively contaminated land in both existing and emergency exposure situations during a regional training course. Agency support also included the enhancement of the environmental monitoring capacities of the laboratories in participating countries.

Using nuclear techniques, the Agency is assisting Maltese water authorities to better map and understand groundwater availability. Water movement is tracked through isotope hydrology, by measuring the unique isotopic 'fingerprints' of water samples. Through the project MAT7001, 'Applying Isotope Hydrology to Groundwater Management', Maltese experts have improved knowledge of freshwater resources. The knowledge gained could inform policies on land and water management.

In 2022, regional project RLA7024, 'Integrating Isotope Hydrology in National Comprehensive Water Resources Assessments', and national projects in El Salvador, Honduras and Paraguay contributed to building regional capacity in isotope hydrology. Four laser spectrometers were installed in Bolivia, El Salvador, Honduras, and Paraguay, respectively. The Agency also supported the installation of a liquid scintillation counter in Argentina and the acquisition of a second tritium enrichment unit in Mexico to bolster the region's capacity to analyze tritium. Twenty-four fellows received training on subterranean hydrology. As a result of the project, Colombia is now formulating three new environmental management plans for aquifers and Bolivia has developed a national groundwater information system which includes provisions for recording isotopic data on groundwater. Mexico has consolidated its National Network for Monitoring the Isotopic Composition of Pluvial Precipitation (RENIP), which has already contributed to the development of isotopic maps with national coverage and local meteoric lines. Regional coordination amongst the Corridor Seco Member States (Costa Rica, El Salvador, Honduras, Mexico, Nicaragua) has resulted in the creation of isotopic monitoring networks and regional conceptual models in transboundary regions.

The Agency assisted Honduras under national project HON7002, 'Strengthening Capacity in Isotope Hydrology for Determining the Water Balance in Tegucigalpa'. Through the characterization



Sampling noble gases in Honduras. (Photo: Jose Corcho)

and management of groundwater resources, the project has improved annual water availability and water security in the city of Tegucigalpa. In 2022, the Agency carried out a groundwater sampling campaign for noble gases to determine the age of water used for domestic, agricultural, and industrial purposes in and around Tegucigalpa, Honduras. This information contributes to understanding which aquifers have a higher risk of contamination by human activities or could be affected by longer episodes of drought.

C.3. MARINE, TERRESTRIAL AND COASTAL ENVIRONMENTS



The Regional Research Observatory on the Environment and Climate was inaugurated by President of the Republic of Djibouti and Head of the Government Ismail Omar Guelleh. (Photo: IAEA)

The Agency assisted Djibouti in establishing an observatory to research the impact of climate change on the environment. Through national projects DJI7003, 'Using Isotopic and Hydrometeorological Tools to Understand Climate Change Impact on Groundwater', DJI9003, 'Establishing a National Regulatory Infrastructure for Radiation Safety and Occupational Exposure Control Programmes', and DJI5001, 'Developing Nuclear/Isotopic and Complementary Food Safety Testing Capabilities', the technical cooperation programme is supporting Djibouti in food and water resource management in the face of climate change. Through nuclear techniques, the new Regional Research Observatory on the Environment and Climate will produce data and climate models that can inform policies on climate adaptation and resilience in Djibouti, and potentially the region.

Through project BAH7002, 'Introducing Inductively Coupled Plasma Techniques in Environmental Analyses', the Agency provided Bahrain with a high-capacity bench laboratory drying oven, electrodeposition system, muffle furnace, laboratory consumables, reference materials and inductively coupled plasma mass spectrometer. In addition to these procurements, the Agency also provided training to enhance Bahrain's analytical capabilities in performing marine and terrestrial environmental analysis.

Under regional project RLA7025, 'Strengthening Capacities in Marine and Coastal Environments Using Nuclear and Isotopic Techniques', specialists in the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO) finalized a harmonized microplastics sampling protocol strategy for coastal areas in the region. With IAEA support, four harmonized protocols were developed that focus on the collection and analysis of microplastics in beach sand, surface water, seawater, and marine sediments. This milestone directly contributes to the marine monitoring component of the NUTEC Plastics initiative and ensures that the region has comparable data on microplastics in marine and coastal environments for a regional database. As of July 2022, 20 laboratories from 20

Member States have engaged in monitoring microplastics in marine and coastal environments, including over 120 beaches in Latin America and the Caribbean. Furthermore, the Agency equipped 21 Member States with microplastic sampling kits. Specialized equipment for the analysis of microplastic pollution has improved the capacities of laboratories in Belize, Brazil, Chile, Ecuador, Jamaica and Panama.

With support from the same project, the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO) participated in the UN Ocean Conference in Portugal to promote their approaches and results in the areas of ocean acidification, harmful algal blooms, marine pollution and microplastics pollution. REMARCO connects specialists and laboratories in 18 Latin America and the Caribbean



REMARCO participated in the UN Ocean Conference in Portugal with IAEA support. (Photo: REMARCO)

countries with the ultimate goal to transfer science-based information to decision makers and communities.

The Agency provides nuclear technology and science-based resources to Member States that can enable them to make climate-smart decisions. Ocean acidification monitoring and the reconstruction of historical trends are key to understanding the severity and impacts of ocean acidification and global warming. In May 2022, three countries in Latin America and the Caribbean submitted marine sampling data to the United Nations' SDG 14.3.1 Data Portal, a monitoring tool developed by UNESCO's Intergovernmental Oceanographic Commission for the sharing of ocean acidification data. The data can enable countries to make informed decisions that have an impact on the environment.

The Agency is supporting the Brazilian Navy to establish an environmental monitoring laboratory in Antarctica through national project BRA7013, 'Using Nuclear Technologies for Environmental Monitoring and Treatment for Radiation Overexposure'. In 2022, an expert mission was conducted to review the scientific programme and facilities for the Brazilian Antarctic station – Commandante Ferraz – and advise on the current project work plan for its establishment. The new research laboratory will build the country's capacity in the use of nuclear technologies for environmental monitoring, as well as the delivery of treatment for patients with radiation overexposure.

D. Industrial Applications

D.1. REGIONAL HIGHLIGHTS



In 2022 the TC programme in Africa focused particularly on research reactors and assisted several countries wishing to follow the IAEA Milestones approach to conduct feasibility studies.

In the Asia and Pacific region in 2022, the component of the TC programme related to industrial applications and radiation technology focused on areas such as building capacity for the production of radioisotopes and supporting the operation of research reactors.

In Europe and Central Asia, the TC programme focuses on strengthening regional capacity for the safe and efficient use of radiation processing for various applications, such as recycling of polymer waste, control and detection of pollution, characterization and preservation of cultural heritage artefacts, inspecting and certifying the integrity of civil structures, and the development of novel materials. The programme also supports harmonization of quality assurance and control procedures in line with EU and international standards.

Latin America and the Caribbean is vulnerable to natural events like earthquakes, floods and hurricanes that can cause considerable damage to physical infrastructure. The Agency has assisted the region in leveraging non-destructive testing (NDT) techniques to assess the safety and integrity of built structures following natural disasters. In 2022, expert missions were conducted in Argentina and Chile to deliver practical demonstrations on primary and secondary NDT techniques for civil structures.

D.2. RADIOISOTOPES AND RADIATION TECHNOLOGY FOR INDUSTRIAL APPLICATIONS

With support delivered through the IAEA's technical cooperation programme MAT1001, 'Training and Upgrading of Technical Capabilities for Scientific Application in the Field of Cultural Heritage', a 1-tonne X-ray diffractometer was procured for Heritage Malta and staff were trained on the use of X-ray diffraction (XRD). In 2022, staff at Heritage Malta's Diagnostic Science Laboratory attended IAEA-organized training courses to learn how non-invasive, non-destructive radiation techniques can be applied to observe both historic

and real-time changes in sampled materials. Heritage Malta subsequently hosted a regional training course in Valletta to share their new skills and experiences with experts from eight countries in Europe and Central Asia.

In 2022, important steps were taken under project RLA1014, 'Advancing Non-Destructive Testing Technologies for the Inspection of Civil and Industrial Structures (ARCAL CLIX)', to establish four subregional centres in Argentina, Chile, Mexico and Peru. These centres will offer support for the region in the event of emergencies by providing technical assistance and lending NDT equipment for the diagnosis of structures at risk. Expert missions in Argentina and Chile delivered practical demonstrations of primary and secondary NDT techniques for civil structures. A major milestone was reached in November when participants received level 2 certification in NDT for civil engineering during a regional training course organized by the Italian Association for Non-Destructive Testing (AIPnD). AIPnD is also assisting the



Non-destructive testing (NDT) techniques provide reliable data on the strength and integrity of materials without interfering with potentially already weakened or hazardous structures, using different types of radiation to detect defects in concrete, pipes and welding. The techniques are safe and quick, contributing to the protection of civilians. (Photo: IAEA-ARCAL)

region through the project with the formulation of a detailed emergency response protocol for civil structures.

National project ARG1029, 'Implementation of Radiation Technology Using Electron Beam for Industry and Environmental Applications', supports the development of e-beam technology in Argentina. In 2022, several capacity building events were conducted, included a scientific visit for national staff to learn about management systems for linear accelerators, dosimetry, and corresponding quality systems. Under the project, an electron linear accelerator has been procured, which will help to mitigate the environmental contamination caused by industrial and domestic liquid effluents as well as generating value-added products in various industrial sectors.

D.3. RESEARCH REACTORS

Under RAF1009, the Division for Africa hosted a first of a kind Regional Meeting of High-Level Representatives to support the development of new research reactor programmes in Africa. In addition to the Project Counterparts, this meeting brought together Ministers of Science and Technology and Permanent Secretaries from Ethiopia, Niger, Rwanda, Senegal, Uganda, United Republic of Tanzania and Zambia – all have expressed their wish to acquire research reactors. The discussions with Ministers focused on the different applications of research reactors and their contributions to socio-economic development. Financing modalities were discussed, and the meeting also highlighted issues that require Government commitment including the legislative, technical, regulatory and safety infrastructure, and the training of qualified human resources for embarking on a research reactor programme. As a result of these discussions, some of the countries have completed pre-feasibility studies following the IAEA Milestones approach and are currently seeking partnerships with potential providers of this technology.

The Maria Research Reactor of Poland has been in operation since 1974. In 2022, an Operation and Maintenance Assessment for Research Reactors (OMARR) review mission and a pre-OSART visit were conducted under the framework of POL1015, 'Strengthening Competences for the Long-term Safe Operation of the Maria Research Reactor'.

E. Energy Planning and Nuclear Power

E.1. REGIONAL HIGHLIGHTS



The TC programme in Africa has focused on assisting sub-regional energy planning in order to provide inputs to the African Union's Continental Master Plan. This builds on previous work which brought together countries to develop sub-regional plans in West, North and East Africa. These plans are being expanded and will also include Southern Africa.

Many countries in the Asia and the Pacific region received Agency assistance for energy planning and nuclear power in 2022. The Agency also worked to enhance Jordan's national capabilities in exploiting uranium ores in a safe and environmentally friendly manner.

The countries in Europe and Central Asia operate the largest fleet of the nuclear power plants (NPPs) in the world, supplying clean and reliable electricity to millions of businesses and households. In 2022 the TC programme continued its commitment to assist Member States to ensure the safe operation of these complex facilities, as well as to provide support to countries embarking on or expanding nuclear power programmes. Member States in the region continue to cooperate on energy planning and received Agency assistance to achieve their Paris Agreement target through the strengthening of institutional capacities to develop national energy and climate plans and strategies.

The Latin American and Caribbean region faces a growing demand for energy and has identified the need for a comprehensive analysis of energy supply and demand scenarios. In August, Member States from the region met in Uruguay to finalize the Regional Study of Energy Supply, which aims to strengthen their capacity to support their national energy planning process and formulate an integrated regional model.

E.2. ENERGY PLANNING



Energy planning specialists from Latin America and the Caribbean attended training in the Dominican Republic in May on modelling regional energy supply. (Photo: Ilse Berdellans)

In 2022, regional project RLA2017, 'Supporting the Preparation of Sustainable Energy Development Plans at a Regional Level (ARCAL CLXVI)', provided Member States with assistance to develop sustainable energy plans, use planning tools, and formulate development scenarios at the regional level. Capacity building activities included the delivery of a regional training course on IAEA energy planning tools, which resulted in the update of national energy supply case studies and discussions on the parameters for the integration of national studies into one regional energy supply study. The integration of the country studies considers current and future regional energy connections and energy markets, with a view to reaching a regional model on which to build future scenarios.

Furthermore, participating Member States from Latin America and the Caribbean met in August to review the preliminary results of the regional integration using MESSAGE and finalized the Regional Study of Energy Supply. The review covered general costs, import/export costs and annual

electricity generation by plant or by technology in the base year, among other considerations. As a result of these efforts, countries in the region strengthened their capacity to support their national energy planning process and formulate an integrated regional model.

E.3. INTRODUCTION OF NUCLEAR POWER

The report of an Integrated Nuclear Infrastructure Review Phase 1 Mission was handed to the President of Uganda in 2022. The mission, carried out at the request of the Government of Uganda and hosted by the Ministry of Energy and Mineral Development within the framework of project UGA2003, 'Supporting Nuclear Power Infrastructure Development in Uganda', took place in Kampala in late 2021. The aim of the mission was to review the country's infrastructure development for a nuclear power programme, using Phase 1 of the IAEA's Milestones Approach.

Since announcing their ambition to pursue nuclear power to meet growing energy demands, Saudi experts have been working closely with the IAEA under SAU2010, 'Developing the Infrastructure for the Nuclear Power Programme', to prepare the infrastructural, legal, radiation protection and emergency preparedness conditions for the introduction of nuclear power. As part of these ongoing efforts, Saudi Arabian experts met in Vienna in 2022 to update key components of their Integrated Work Plan (IWP) and to review the implementation of projects designed to support the country's emerging nuclear power industry. Fourteen experts from the King Abdullah City for Atomic and Renewable Energy (KA-CARE) shared updates on the country's nuclear power programme and presented national priorities and planned activities for the next three years.

Bangladesh's 2022 Integrated Work Plan meeting provided an opportunity for Bangladeshi counterparts to share updates on the IWP status. Together, the attending IAEA and Bangladeshi experts identified a total of 42 activities to be completed in 2022 and 2023.

The Jordan Uranium Mining Company (JUMCO) announced the production of 20 kg of yellowcake from 160 tonnes of uranium ore at a newly operational processing facility, which is supported by project JOR2017, 'Enhancing the National Capabilities in Exploiting Uranium Ores in a Safe and Environment Friendly Manner'.



INIR Phase 1 official handover ceremony, hosted by H.E. President Yoweri Museveni. (Photo: Ministry of Energy and Mineral Development)

E.4. NUCLEAR POWER REACTORS

In 2022, the Agency organized an expert meeting under project ARM2005, 'Enhancing Nuclear Safety for the Extended Design Operation Lifetime of the Armenian Nuclear Power Plant', to discuss and provide advice on the Armenian Nuclear Power Plant (ANPP) implementation plan to address the open issues identified in the Safety Aspects of Long-Term Operation Follow Up Mission. The project also supported a scientific visit by two ANPP specialists to the Dukovany Nuclear Power Plant in the Czech Republic to deepen their understanding of strategy, planning and implementation of knowledge management programmes in nuclear power plants. Online training was provided to support the development of capacities to implement non-destructive testing methods for six specialists in thermography, four specialists in eddy current testing and four specialists in ultrasonic testing. The training will be followed by an official examination and certification programme. A thyroid uptake probe system was procured as part of the radiation protection enhancement of the ANPP.

F. Radiation Protection and Nuclear Safety

F.1. REGIONAL HIGHLIGHTS



In Africa, efforts continue to strengthen regulatory infrastructure in all the thematic safety areas. This is particularly important for countries wishing to establish their first radiotherapy facilities. Burundi has promulgated its nuclear law.

Projects in the Asia and the Pacific region under the thematic area of nuclear, radiological, and waste safety focused on radiation safety infrastructure, emergency preparedness and response and radiation protection training in 2022.

In 2022 the Agency continued to support Member States in Europe and Central Asia in the safe, effective and efficient management of their radioactive waste and decommissioning. Member State understanding and knowledge was improved in various areas, including predisposal planning and integrated waste management, storage and final disposal of waste, and the decommissioning of facilities and sites. Furthermore, the capacity of regulatory bodies, service providers and operators was enhanced regarding radiation protection of workers occupationally exposed to ionizing radiation, and on radiation safety in NORM industries.

Nuclear safety and radiation protection remain priorities for the Latin America and Caribbean region. The Latin American and the Caribbean School on Nuclear and Radiological Leadership for Safety was held to help governments to foster leadership for safety and safety culture by helping early to mid-career professionals to develop their safety leadership potential. The training is essential to improve understanding of what leadership means in practice in nuclear and radiological working environments given their inherent complexities, and supports generational changes in the regulatory authorities of the region.

F.2. GOVERNMENTAL REGULATORY INFRASTRUCTURE FOR RADIATION SAFETY



The meeting with senior officials of Comoros was implemented within the framework of the IAEA Legislative Assistance Programme under the Agency's TC Programme. (Photo: O. Yusuf/IAEA)

With Agency support, the Union of Comoros has finalized the draft of the country's comprehensive national nuclear law. The Agency hosted a meeting for senior officials of Comoros to highlight the importance of joining and implementing the legal instruments adopted under IAEA auspices, with a focus on those to which the country is not yet party.

Under project BGD9019, 'Strengthening the Nuclear Regulatory Supervision Process During the Nuclear Power Plant Commissioning Phase', an Integrated Regulatory Review Service (IRRS) team conducted the first IRRS mission to Bangladesh to review the responsibilities and functions of the government and activities of the regulatory body. The mission identified a number of areas of good performance of the Bangladesh Atomic Energy Regulatory Authority.

The Nuclear Regulatory Authority (NRA) of Türkiye is receiving assistance under TUR9023, 'Strengthening the Nuclear Regulatory Authority's Regulatory Capabilities on Safety and Security', to address the challenges of licensing the country's first nuclear power plant. In 2022, expertise was provided on how to perform safety culture self-assessments, leadership and management for safety. Two fellows were trained at the IAEA, one in the

field of governmental regulatory infrastructure for nuclear installations safety, and another in emergency preparedness and response.

Countries in Europe and Central Asia received support to strengthen their national regulatory infrastructures for radiation safety in planned and existing exposure situations. At the Greek Atomic Energy Commission 21 regulatory specialists from 18 countries enhanced their knowledge on the application of a graded approach in regulating facilities and activities with radiation sources used in medicine, industry, agriculture, research and education. In addition, an online webinar was organized for 18 countries to prepare for their participation in the School of Drafting Regulations, which took place in January 2023.

RLA9087, 'Building Capacity and Sustaining the National Regulatory Bodies', aims to enhance the regulatory infrastructure of Member States that are also members of the Caribbean Community (CARICOM) for the safe use and sustainable management and control of radioactive sources. In 2022, regulators from eight CARICOM States participated in a regional train-the-trainer course on the use of radiation safety equipment. Participants will transfer the knowledge and skills they received through the training to radiation safety practitioners in their home institutions with the assistance of the IAEA.

F.3. RADIATION PROTECTION OF WORKERS, PATIENTS AND THE PUBLIC

Cote d'Ivoire has an expanding oil and natural gas production sector, located mainly offshore, as well as inland mining activities, including tantalite mining. These industries may expose workers to radiation and, if not managed properly, may also cause exposure of the public and contamination of the environment with waste containing naturally occurring radioactive materials (NORM). With Agency assistance delivered through project IVC9008, 'Strengthening National Environmental Radiological Surveillance Laboratories Using Nuclear Sciences and Techniques', Cote d'Ivoire's regulatory body, the Radiation Protection and Nuclear Safety Authority (ARSN), acquired equipment and established radioanalytical capabilities. The Ivorian Anti-Pollution Centre (CIAPOL) also upgraded its radiochemistry facilities for measurements of alpha-emitting radionuclides, to complement and support ARSN's analytical needs. In addition to the equipment, the project also supported training of ARSN and CIAPOL staff in alpha and gamma spectrometry analysis. Cote d'Ivoire is now in the process of designing and implementing a national environmental monitoring programme.

In December 2022, a workshop on Regulation of Exposure to Radon and Technical Training for Calibration and Quality Assurance for the Radon Detection was held in Yaoundé, Cameroon. The activity was hosted by Cameroon's Institute of Geological and Mining Research under the project CMR9010, 'Strengthening the National Radon Action Plan to Mitigate Public Exposure to Radon in Dwellings and Workplaces'. With continued support from the IAEA, scientists in Cameroon have conducted surveys for radon in over 3000 dwellings, including in areas rich in uranium deposits. The workshop and technical training have helped to enhance national competencies in radon measurement.

Under project SYR9012, 'Strengthening Radiation Protection in Medical Exposure', a patient dosimetry thermoluminescent dosimeter (TLD) kit was installed in the Patient Dosimetry Laboratory at the Atomic Energy Commission of Syria and one adult anthropomorphic phantom type (ART phantom) was also delivered.

In June 2022, a regional workshop on Workplace Monitoring Techniques was held in Nicosia, Cyprus, supported by RER9149, 'Improving the Radiation Protection of



Researchers at Cameroon's Institute of Geological and Mining Research preparing a soil sample for test of radon concentration. (Photo: IAEA)



Exercises on proper PPE use, instrument selection and contamination monitoring during the Cyprus workshop on radiation protection of workers. (Photo: E. Alic/IAEA)

Workers Occupationally Exposed to Ionizing Radiation'. The workshop has helped 34 radiation protection experts from 20 countries in Europe and Central Asia to apply the latest practical techniques for workplace radiation monitoring. Held in collaboration with the European ALARA Network, the workshop focused on monitoring techniques, instrument characteristics, calibration, verification and interpretation of results. In addition to exercises on proper PPE use, instrument selection and contamination monitoring, participants visited the Secondary Standard Dosimetry Laboratory of Nicosia General Hospital's Department of Medical Physics.

In July 2022, a regional workshop on Radioanalytical Analysis of NORM samples and an Intercomparison Exercise was held in Athens, Greece. The regional workshop was hosted by the Government of Greece through the Greek Atomic Energy Commission (EEAE) and included a series of presentations, practical activities, and demonstrations for radioanalytical analysis (including gamma spectrometry, alpha spectrometry, and LSC) for NORM characterization with interactive group discussions. The workshop, attended by 32 participants from 25 countries, was a follow-up to the virtual workshop held in November 2021. The structure of the regional workshop was based on three analytical techniques to provide participants with the knowledge and skills needed to perform the prior radiological evaluation of industrial processes involving

NORM through radioanalytical techniques in line with the GSR Part 3 requirements and GSG-7 recommendations. This was the event initiating the intercomparison exercise for the determination of radionuclides in NORM samples to be performed in the context of the regional project (RER9155) with a network of laboratories in the region.

Support was provided on the methodology for data collection and establishment of national diagnostic reference levels for paediatric radiology in Bosnia and Herzegovina in 2022 under BOH9014, 'Strengthening Radiation Protection of Paediatric Patients in Diagnostic and Interventional Radiology'. The support focused sharing international recommendations and experience on establishing diagnostic reference levels, and provided advice on planning the new national patient dose survey.

Since December 2021, experts and radiotherapy practitioners in Latvia have been studying, assessing and sharing recommendations designed to enhance the quality of services offered by the Riga East University Hospital, supported by the national project LAT9015, 'Strengthening Radiation Safety Culture in Medicine and Improving the Knowledge of Regulatory Personnel'. Following the conclusion of a QUATRO audit in May 2022, experts met with over 50 counterparts from Latvian hospitals and the Ministry of Health to introduce the QUATRO methodology and share the experience of the Riga East University Hospital.

A new regional safety project RLA9091, 'Strengthening Regional Capabilities for End Users and Technical Support Organizations on Radiation Protection and Emergency Preparedness and Response in Line with IAEA Requirements', which aims to strengthening regional capabilities for radiation protection and emergency preparedness and response in line with IAEA requirements started in Latin America and the Caribbean in 2022. Training courses and virtual workshops were conducted as part of an intercomparison exercise for whole-body external dosimetry services. These events provided 19 laboratories in the region with the opportunity to demonstrate compliance with their own quality management system, compare results with other participants and develop plans to improve their dosimetry systems.

Under the regional project RLA9087, 'Building Capacity and Sustaining the National Regulatory Bodies', a regional Train-the-Trainer course on the use of radiation detection equipment was held for Agency Member States that are also CARICOM members, hosted by Texas A&M University College Station, United States of America. The training course was attended by 15 participants from 10 countries and included a series of lectures and working sessions, hands-on exercises, and demonstrations related to the use of radiation detection instrumentation. It provided participants with the knowledge and skills to train others in their countries.

F.4. EMERGENCY PREPAREDNESS AND RESPONSE

Nineteen nuclear professionals from Francophone countries in Africa took part in a three-week IAEA School of Radiation Emergency Management, held for the first time in French. The course, which took place in Rabat, Morocco, focused on mitigating the consequences of nuclear or radiological incidents and emergencies and was supported through RAF9069, 'Strengthening the Implementation of Basic Safety Standards and Radioactive Waste Management – Phase II (AFRA)'.

A national training course on Medical Response to Radiation Emergencies was held in October, attended by 42 participants from the United Arab Emirates. The course was implemented under project UAE9017, 'Strengthening Capabilities to Respond to a Nuclear or Radiological Emergency'.

A regional training course on Development and Use of Operational Intervention Levels (OILs) for Reactor Emergencies was held in Bangkok, Thailand from 3 to 7 October 2022. The training course was implemented under project, RAS9092, 'Strengthening the Capacity to Respond to Radiological Emergencies of Category II and III Facilities (RCA)'.

A School of Radiation Emergency Management for Latin America was held under regional project RLA9090, 'Strengthening Regional Capabilities of End Users and Technical Support Organizations on Radiation Protection as well as Emergency Preparedness and Response in Line with IAEA Requirements', and an EPREV follow up mission to Slovenia was conducted under SLO9022, 'Strengthening Capacity in Emergency Preparedness and Response and Emergency Radiation Monitoring'.



Opening session of the School of Radiation Emergency Management in July 2022, Rabat, Morocco. (Photo: AMSSNuR)

F.5. RADIOACTIVE WASTE MANAGEMENT, DECOMMISSIONING AND ENVIRONMENTAL REMEDIATION

Under PRC9001, 'Establishing the National Regulatory Framework for Radiation Safety', the Ministry of Defence of the Republic of the Congo successfully secured two disused Co-60 radiotherapy sources which were exported to an authorized institution abroad for disposal in February 2022.

In Europe, the Agency supported the transfer of knowledge to plan and implement decommissioning projects of small medical, industrial and research facilities in 2022 through project RER9146, 'Enhancing Capacities in Member States for the Planning and Implementation of Decommissioning Projects'. Project activities supported the enhancement of capabilities of the regulatory bodies, service providers, and operators of small facilities engaged in developing decommissioning plans or with responsibility for the practical implementation of decommissioning tasks. At a meeting at the national radioactive waste management company in Chisinau, Republic of Moldova, thirteen specialists shared their experiences and lessons learned on technologies for conducting decommissioning of small

facilities as well as on the management of waste generated from decommissioning such facilities. In addition, 13 specialists participated in a virtual workshop to review and improve their existing decommissioning plans for their selected pilot facilities. The Agency also supported participation in relevant technical meetings addressing different aspects for decommissioning. These regional events provided participants with additional tools and understanding of the international standards, regulations and good practices related to decommissioning small facilities that can be implemented in their own countries. In addition, the Agency supported expert missions such as that requested by Portugal for investigating the options for management of NORM residues from decommissioning of phosphate processing facility.

The Agency is helping the National Radioactive Waste Management Organisation (SISP Special Facilities of the Republic of Moldova) to enhance its technical capabilities through MOL9009, 'Enhancing Technical Capabilities for Decommissioning of Near Surface Radon Type Facility and Environmental Remediation'. Moldova has prepared the relevant documentation, including the new quality management system for decommissioning the facility, and has received necessary equipment. The establishment of the containment facility for the removal of legacy waste and decommissioning of the RADON type storage facility is underway.

The regional project RER9154, 'Enhancing the Implementation of Integrated Programmes for the Safe Management of Radioactive Waste' is enhancing radioactive waste management capabilities in Europe by leveraging regional cooperation, knowledge sharing and infrastructure development. In 2022, a workshop on 'Establishment of Low and Intermediate Level Waste Characterization Methodologies and Infrastructures', took place in Yerevan, Armenia, attended by 35 participants from 21 Member States. They discussed methodologies for waste characterization, considering the origin of the waste, the different waste streams, the needs of the characterization laboratories, as well as available analytical technologies and techniques. As a result, expertise in the region was gained in applying proper methodologies for a characterization programme for the various kinds of radioactive waste fluxes or packages, establishing the needs for and setting up the characterization laboratories, and developing, implementing and optimizing the characterization techniques.

Under the ongoing national project EST9007, 'Enhancing the Effectiveness of the Legislative, Regulatory and Organizational Infrastructure and Technical Capabilities of Radiation Protection and Nuclear Safety', Estonia has received advisory expertise to finalize a road map for disposal of radioactive waste in accordance with the IAEA Safety Standards. In 2022, advice was provided to support the country to perform a comprehensive examination of the existing waste characterization system and infrastructure, waste inventory system and status of the waste acceptance criteria. This assistance provided the country with know-how to further develop and achieve a safe and confident radioactive waste management system.



*Experts visit low level repository sites in Lithuania.
(Photo: V. Ognerubov/INPP)*

Lithuania has prioritized the decommissioning of the Ignalina Nuclear Power Plant since its shut down 2009. Under LIT9020, 'Enhancing National Capabilities for Decommissioning and Radioactive Waste Management, Safety Assessment, Oversight, Licensing and Emergency Preparedness', an Agency-led team provided guidance on radioactive waste management and disposal, especially of disused sealed radioactive sources. The experts visited the operational waste retrieval facility, the very low level waste landfill repository and near surface repository. This support contributed to enhancing the capabilities for decommissioning and radioactive waste in Lithuania.

In Argentina, support is being provided to the national deep geologic repository programme through project ARG9016, 'Building Capacities for Selecting and Characterizing Potentially Suitable Sites for the Geological Disposal of Radioactive Waste and Spent Nuclear Fuel'. Technical support and advice have been provided through virtual and in-person workshops to address and consider key strategic aspects for such a long-term final disposal option.

G. Nuclear Knowledge Development and Management



G.1. REGIONAL HIGHLIGHTS

The technical cooperation programme provides human resource capacity building in Africa through long-term training and other opportunities, which can lead to professional certifications and postgraduate degrees.

In 2022, the Agency facilitated support for human resource development among countries and territories in the Asia and the Pacific region and supported education for sustainability through training and education activities. In May 2022, the 2021 Nuclear Science and Technology Education Competition winners visited the IAEA to participate in the Long Night of Research and provide youth with insight on the important role of nuclear science and technology in socioeconomic development.

In Europe and Central Asia, the technical cooperation programme supports education and training in nuclear knowledge management. As part of RER0049, 'Enhancing the Capacities of Educational Institutions for the Sustainable use of Nuclear Technologies', the Agency trained 59 participants through two regional workshops on nuclear and radiation education. Under the inter-regional project INT2021 'Supporting Member States Considering or Planning to Introduce or Expand Nuclear Power Programmes in Developing the Sustainable National Infrastructure Required for a Safe, Secure and Peaceful Nuclear Power Programme', 15 post-graduate students were supported to complete nuclear energy master's degree programmes, in 2022. In addition 26 post-graduate students began master's degree programmes in medical physics under INT0095, 'Supporting Member States in Human Capacity Building Related to Nuclear Science and Technology and Quality Management of the Technical Cooperation Programme'.

The IAEA is working in Latin America and the Caribbean to assist Member States in strengthening education, training and knowledge management in the nuclear field to help address challenges in developing and retaining human resources. In November 2022, the Agency launched a new occupational radiation protection e-learning course. The course was developed in response to a request from the Agency Member States of the Caribbean Community (CARICOM) and includes modules on ionizing radiation, radiological protection, radiation monitoring and occupational exposure control. It is widely accessible for basic training purposes and is now available via the IAEA's learning management platform.

G.2. CAPACITY BUILDING, HUMAN RESOURCE DEVELOPMENT AND KNOWLEDGE MANAGEMENT

At the Africa Regional Forum on Sustainable Development, the IAEA hosted a side event on 'Building Human and Institutional Capacities in Africa in the Peaceful Use of Nuclear Science and Technology' with the support of the United Nations Economic Commission of Africa (UNECA). The Agency also contributed to a high-level panel discussion titled 'Opportunities in Advanced Energy Technologies.' These side events focused on capacity building in practical applications of nuclear science and technology in Africa with the aim of supporting climate change adaptation efforts. More than fifty regional stakeholders attended to discuss enhancing academic programmes and supporting knowledge sharing to improve human resource development in the nuclear field.

In June 2022, the Agency supported the training of 41 participants from 14 African countries in nuclear power production at the School of Nuclear Energy Management (NEM) in South Africa under RAF0049, 'Supporting Programme Review, Pre-Project Assistance and

Capacity Building in Project Design, Monitoring and Evaluation’. The two-week training course included a comprehensive overview of nuclear power, from energy planning and nuclear law to safety, security and radioactive waste management. The course was held in collaboration with contributors from the Nuclear Energy Corporation of South Africa, the Department of Mineral Resources and the National Nuclear Regulator. NEM Schools are focused on the managerial and technical competencies required to support and sustain national nuclear energy strategies. They are aimed at young professionals in countries that are developing, or embarking on, a nuclear power programme.

In 2022, the technical cooperation programme supported education for sustainability through training and education activities, under RAS0091 ‘Supporting Nuclear Science and Technology Education at the Secondary and Tertiary Level.’. The working version of the ‘Guidebook Series for Introducing Nuclear Science and Technology in Secondary Education’ was launched. The 2021 Nuclear Science and Technology Education Competition winners visited the IAEA to participate in the Long Night of Research and provide youth with insight on the important role of nuclear science and technology in socioeconomic development. Finalists visited nuclear facilities in Jordan, including the Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME).

In order to ensure the safe, sustainable and reliable operation of institutions in the nuclear field, the IAEA supports human resource development in Europe and Central Asia. Due to increasing demand for nuclear personnel in the Czech Republic, the Agency has provided assistance in nuclear knowledge development, including fellowship training on neutron imaging at the Centro Atomico Bariloche in Bariloche, Argentina.

Through RLA0065, ‘Furthering Knowledge Management Implementation in Nuclear Organizations and Strengthening Nuclear Education’, the technical cooperation programme supported the organization of a workshop in Santiago, Chile where educators shared experiences, deepened their knowledge and reinforced educational practices on nuclear technology topics. The project aims to enhance the availability of nuclear expertise and knowledge in the region and builds upon the NUCLEANDO initiative, which provides a collection of online resources to help science teachers to incorporate nuclear science concepts into their curricula. On the margins of the workshop, the Agency hosted the Latin American Regional Nuclear Knowledge Management School and International Symposium on Education, Training, Dissemination and Management, allowing participants to share their experiences and knowledge and to interact with a broad range of colleagues and nuclear knowledge management experts.



IAEA School of Nuclear Energy Management hosted in Pretoria, South Africa, 2022. (Photo: DMRE)



The IAEA supported a 4-month fellowship at the RA-6 reactor in Bariloche, Argentina, in 2022. (Photo: J. Matouskova, Bariloche, Argentina, 2022)

Annex 2. TC Programme Fields of Activity¹⁵

Nuclear Knowledge Development and Management
Capacity establishment, programme knowledge management and facilitation of cooperation among Member States (01)
Building national nuclear legal infrastructures (03)
Industrial Applications/Radiation Technology
Reference products for science and trade (02)
Research reactors (08)
Radioisotopes and radiation technology for industrial, health-care and environmental applications (18)
Accelerator technology (32)
Nuclear instrumentation (33)
Energy
Energy planning (04)
Introduction of nuclear power (05)
Nuclear power reactors (06)
Nuclear fuel cycle (07)
Food and Agriculture
Crop production (20)
Agricultural water and soil management (21)
Livestock production (22)
Insect pest control (23)
Food safety (24)
Health and Nutrition
Comprehensive cancer control (25)
Radiation oncology in cancer management (26)
Nuclear medicine and diagnostic imaging (27)
Radioisotopes and radiopharmaceuticals production for medical applications (28)
Dosimetry and medical physics (29)
Nutrition for improved health (30)
Water and the Environment
Water resources management (15)
Marine, terrestrial and coastal environments (17)
Safety and Security
Governmental and regulatory infrastructure for radiation safety (09)
Safety of nuclear installations, including siting and hazard characterization (10)
Governmental and regulatory infrastructure for nuclear installations safety (11)
Radiation protection of workers and the public (12)
Transport safety (13)
Nuclear security (14)
Emergency preparedness and response (16)
Radioactive waste management, decommissioning and remediation of contaminated sites (19)
Radiation protection in medical uses of ionizing radiation (31)

¹⁵ Updated in 2020 for the IAEA TC programme 2022–2023. The field of activity number is shown in parentheses.



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