II. The nexus between science, technology and innovation (STI), and culture, the MDGs and sustainable development

A. Science base, technology, innovation and capacity building for sustainable development

Science, technology, and innovation (STI) have a critical role to play in achieving sustainable development and the MDGs. In addition to being a powerful force for change in the world, STI generate results that can: inform development policies and programmes for greater impact; open new avenues for addressing major challenges facing societies; and play a significant role in economic recovery. In accordance with its Statute, the IAEA supports its Member States in the safe and secure application of nuclear science and technology in the fields of energy, health, food and agriculture, water and the environment, radioisotope production and radiation technology. More specifically, Article II of the Statue states that the IAEA "shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity" while Article III authorizes the IAEA – inter alia - to encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world; to perform any operation or service useful in research on, or development or practical application of, atomic energy for peaceful purposes; to foster the exchange of scientific and technical information on peaceful uses of atomic energy; and to encourage the exchange and training of scientists and experts in the field of peaceful uses of atomic energy. A strong nexus between science, technology and innovation and sustainable development has been a basic prerequisite for both the IAEA's work and success since its inception.

For more than five decades the IAEA's Technical Cooperation Programme (TC), Coordinated Research Projects (CRPs), Collaborating Centres and system of dedicated laboratories and Networks of a scientific, regulatory or technical nature have proven to be extremely efficient and effective tools to ensure and foster the development, transfer and dissemination of science, technology and innovation in a safe and secure manner. IAEA contributions to the MDGs are delivered within this context through substantial programmes and technical cooperation in areas such as energy, human health, food and agriculture, and environmental resource management.

a. Science-Policy-Society Interface

In the IAEA's view a gap between science and policy exists in the UN system which ultimately has various implications including at societal levels (i.e. the best solutions for development problems are not always used). Collaboration and cooperation between scientists and policy makers as well as between scientific, technical and political developmental organizations need to be expanded for science, technology and innovation to be effective as development tools. . A method to achieve a better understanding of each other's work could be the creation of a *global science-policy interface* that serves as a condition for receiving: (1) *scientific research funding*, to encourage a direct contribution of S&T to development challenges; and (2) *development funding*, so it can be used as a tool to maximize the extent to which development programmes are science-based.

b. STI Education

To advance STI's application in development work, education, training and capacity building are paramount. The IAEA offers services to Member States which include, *inter alia*, capacity building, supporting human resources development, research, training (on-site, distance), expert visits, symposia, joint research activities and fellowships. Training courses and workshops for instance cover a wide range of topics related to the peaceful application of nuclear technology in various sectors and help build local expertise, and strengthen networking by bringing together researchers and technicians from across the developing world. All these services focus on the safe

and effective use of peaceful applications of nuclear energy and nuclear technology. Over the past five decades the IAEA and its Member States have built a sound foundation of institutions and personnel in many developing countries that now provide an important regional resource — in terms of capabilities and expertise. Today, developing countries are better positioned to use nuclear science and technology to improve public health, provide sufficient food, energy and water, and sustain a safe environment.

c. Research, monitoring and observations

The IAEA is unique in the UN family in having twelve nuclear applications laboratories that support the development of innovative technologies and provide training. A network of more than 500 national and international research institutions and experimental stations works closely with our laboratories. In the IAEA's view such networks and comparable platforms are of the utmost importance to share best practices, exchange information, benefit from comparative advantages and ensure state-of-the-art quality through constant research, monitoring and observations.

d. Science Diplomacy

The IAEA is a leader in scientific diplomacy as it requires partners to maximize the impact of its work. Apart from its worldwide interaction with the scientific community, the IAEA collaborates with numerous organizations at national, regional and global levels to promote scientific cooperation and address common development problems related to the MDGs. At the global level, for example, the IAEA is currently establishing closer cooperation with, *inter alia*, UNIDO in cleaner industrial production and energy planning; FAO in food and agriculture; UNICEF and WHO in nutrition and health; UNCCD in desertification, soil degradation and drought; and UNESCO inter alia to enhance developing world scientists' expertise in physics and mathematics. Within this context, the IAEA's building of Member State capacities in nuclear science and promoting the sharing of scientific knowledge is of tremendous importance. Regional centres of expertise play an important role in sharing the benefits of nuclear science and technology among Member States.

f. Access, usage and application of technology information

The Agency maintains a wide range of databases of nuclear, atomic and molecular data which underpin modern technology applications in fission and fusion energy production as well as medical and analytical applications. The databases are available primarily through on-line services to Member States. In addition, to give an example, more than 11 000 reports, manuals and technical documents were downloaded in 2011. An important activity is the development of software tools that enable data to be retrieved and displayed in ways that make the data more understandable and useful (see also II.C).

C. The changing geography and models of innovation

A shift in STI is taking place in terms of geography and models of innovation. Recent OECD studies have noted that emerging economies such as Brazil, the Russian Federation, India, Indonesia, China, South Africa and South Korea – most of which have participated in the IAEA's technical cooperation programme - are playing larger roles in STI, especially with regard to environmental technology[1]. Models of innovation within the UN system are also changing as key development players are increasingly collaborating with scientific organizations such as the IAEA (*see section A.d above*) so as to enhance the efficiency and effectiveness of their work through evidence-based programme and project delivery.

[1] OECD, 2010 and OECD, 2012.

The IAEA itself is also employing new innovative models for development. For example, via its Human Health Campus platform, the IAEA provides online training to medical professionals in nuclear medicine, oncology, medical physics, radiopharmacy and nutrition. The IAEA also conceptualized a Virtual University for Cancer Control (VUCC) supported by a Regional African Cancer Training network (RACT network), collectively called VUCCnet. The VUCCnet Pilot Project aims to contribute to ongoing efforts by Member States in Africa to address cancer control workforce shortages by promoting a combination of e-learning and traditional teaching approaches that provide effective, low cost educational opportunities to students in sub-Saharan Africa. Another example is the IAEA's Ocean Acidification International Coordination Centre which brings scientists and economists together to translate potential environmental impacts of ocean acidification into socio-economic impacts, which complements science-based policy development for mitigating and responding to ocean acidification. Overall, the Center serves the scientific community, policymakers, universities, and the media by coordinating facilitating, promoting and communicating global actions on ocean acidification and acting as a hub for scientific information on ocean acidification.

b. Internationalization of R&D and innovation

International Organizations play an important role in the internationalization of R&D and innovation. Key vehicles are conferences, expert workshops and other gatherings at the regional, interregional or international level as well scientific publications. For some years now the IAEA has had a positive experience with the provision of tool kits, e-learning and the wide dissemination of publications and public information via the internet. Concerns over energy resource availability, climate change, and energy security suggest an important role for nuclear power in supplying energy in the 21st century. The International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) was established in 2000 to help ensure that nuclear energy is available to contribute to meeting the energy needs of the 21st century in a sustainable manner. INPRO promotes a mutually beneficial dialogue between countries with nuclear technology and countries considering these technologies to develop new nuclear energy capacity and supports national strategic and long-term planning and decision making and an awareness of technology innovation options for the future.

Fusion, a form of nuclear energy generated when light-weight atoms fuse, is the process at work in every star´s core, releasing an enormous amount of energy. Researchers have been trying to harness fusion and reproduce it on earth in a controlled manner. If they succeed, they will provide the world a safe, sustainable, environmentally responsible and abundant source of energy. For decades, the scientific community has been pursuing nuclear fusion. The IAEA helps Member States to build up knowledge on controlled nuclear fusion and facilitates the involvement of developing Member States in the work of leading fusion laboratories and initiatives, such as ITER, the International Thermonuclear Experimental Reactor. While research on nuclear fusion continues, many spin-offs relating to plasma physics and fusion technology are already benefiting society through improvements in materials (such as ceramic, metals and coatings), industrial processes (such as welding and waste removal), electrical technology, transportation and other scientific areas.

III. Shaping the course of development: The Role of STI

A. Filling the MDGs Gap

At present, STI are not reflected as an MDG or as a target of the MDGs. To fill this gap, STI must be placed at the forefront. This can be done by incorporating STI into the targets of the post-2015 development agenda.

a. Mainstreaming STI to support achievement of the MDGs

Mainstreaming STI in support of achieving the MDGs requires understanding and visibility amongst development players. However, under present circumstances the impression prevails that STI tend to be overlooked as offering solutions to development problems. Mainstreaming STI in the achievement of the MDGs requires that development players understand and recognize the contribution that STI make. However, STI are still often overlooked as offering solutions to development problems. In this regard, the 2010 OECD/DAC conclusion that nearly 50% of the total IAEA budget could be considered "Official-Development Assistance", and that the IAEA was thus an "ODA-eligible organization", was a highly positive step forward in raising awareness in the development community of the potential contributions that STI can make in development.

B. Integrating STI and sustainable development

Suggestions for better integrating STI and sustainable development were provided at Rio+20 as reflected in the final outcome document *The Future We Want* where Heads of State agreed that evidence-based development programmes were paramount to achieving sustainable development in the areas of: human health and nutrition; food and agriculture; climate change; water and marine environments; biological diversity; desertification, land degradation and drought; and energy. Realizing these objectives, however, requires a stronger science-policy interface based on inclusive, evidence-based and transparent scientific assessments; reliable, relevant and timely data; and capacity-building, monitoring and assessment.

b. Focus on new and/or priority challenges (clean energy, water technologies, technology for food security, non-communicable diseases)

With nearly 50% of its total budget dedicated to development issues, the IAEA's STI contributions to human health, food and agriculture, clean and affordable energy and environmental resource management play an important role to meet global priority challenges and to achieve sustainable development goals. At the heart of the IAEA's activities is building local capacity through technology transfer. Working with its Member States, the IAEA's role is to make sure that this technology is used safely and effectively, and can also be locally sustained. This means providing training to develop local expertise and ensuring that any needed infrastructure is in place before technology is transferred. For example:

- **Human Health:** In the developing world infectious and non-communicable diseases as well as malnutrition create a socio-economic burden that threatens sustainability. The safe, well-coordinated use of nuclear techniques to detect, diagnose and treat disease and to combat malnutrition contributes to improved health and social stability throughout the world. For over 40 years, the IAEA has helped its Member States to build sustainable capacity in the use of radiation medicine and has assisted more than 110 low and middle-income countries to apply nuclear technologies for prevention, diagnosis and treatment of cancer and non-communicable diseases in the most effective and safest way. In addition, the human health programme supports the application of nuclear techniques in nutrition, in particular stable (non-radioactive) isotope techniques, to combat malnutrition in all its forms. The IAEA's nutrition programme, in cooperation with WHO and UNICEF, uses nuclear techniques to monitor a wide variety of nutritional problems. These techniques include reference methods for assessment of body composition, bone mineral density, human milk intake, total daily energy expenditure, micronutrient bioavailability and vitamin A status.

- **Food and Agriculture:** The Joint FAO/IAEA Programme is currently responsible for providing scientific and technical support for over 200 national and regional Technical Cooperation Projects, as well as for Inter-regional and Regional Training Courses

channelled to recipient countries for the purpose of providing equipment, expert advice and training. The cooperation has proven very successful over the years, approximately 600 research institutions and experimental stations in Member States cooperate in 40 Coordinated Research Projects and the IAEA can recommend such close interaction to foster the impact of STI on development in a sustainable manner. The services focus on increasing food security and safety by creating sustainable solutions for soil and water management in agriculture, controlling crop and animal pests and diseases, enhancing livestock productivity and ensuring food safety and quality. Scientific methods used include stable (non-radioactive) isotope techniques, plant mutation breeding, food fortification, sterile insect technique, food irradiation, and isotopic and elemental fingerprinting.

- **Environmental resource management:** Isotope and related nuclear techniques are effective and unique tools for obtaining hydrologic information for a broad range of water resource management issues. The IAEA is the lead UN agency in this area and provides the basic means of using these techniques in the form of global reference data and isotope reference materials. As isotope techniques are more effective when used as an integral part of hydrologic practices, the programme also aims to coordinate its activities with other national and international organizations active in the water sector. In particular, collaborative programmes with the WMO, UNESCO, the World Bank, FAO and UNEP are presently active.
  The IAEA contributes to the ecological and economic sustainability and conservation of clean and healthy environments, provides scientific information and assistance to international organizations such as WHO, UNDP, UNEP and FAO and enhances capacity building of Member States who experience elevated levels of radiation or pollution of either natural or anthropogenic origin. IAEA services promote effective management of water and other natural resources for environmental sustainability. In addition to effective soil and water management for agriculture, work is focused on the effective management of freshwater resources, mapping renewable and non-renewable trans-boundary groundwater resources, improving scientific understanding of the water cycle, and advancing scientific understanding of how to better protect ocean and marine ecosystems. Under its mandate of encouraging and assisting research and practical applications of nuclear techniques for development and environmental health, the IAEA has demonstrated that these play an important role in the protection of the environment from radioactive and non-radioactive pollutants. Also in this area, the combination of in-house laboratories and regional as well as international networks has proven successful.

- **Clean and affordable energy**: Today, approximately one fifth of the world's population lack access to electricity and one third lack access to clean cooking facilities. Poverty eradication and sustainable development will require access to the clean and affordable energy services that electricity and clean cooking facilities provide. Expanding access to such services requires careful planning. The IAEA helps developing countries and economies in transition build their energy planning capabilities with respect to all three pillars of sustainable development — economic, environmental, and social. The IAEA develops and transfers planning models tailored to their special circumstances. It transfers the latest data on technologies, resources, and economics, trains local experts, jointly analyses national options and interprets results. This assistance treats all energy supply and demand options, including efficiency improvements, equally. The IAEA helps establish the continuing local planning expertise needed to independently chart national paths to sustainable development. Countries using or introducing nuclear power are helped to do so safely, securely, economically and sustainably.

C. Improving the application of STI for the post-2015 development agenda

STI's application in the post-2015 development agenda can be improved if it is reflected as a target within set goals.

VII. Recommendations

Based on its experience as a scientific and technical organization and its tradition of close interaction with experts in Member States to help meet their development needs through nuclear science, technology and innovation for more than five decades the IAEA would make the following recommendations to promote sustainable development through STI:

- Enhance outreach and cooperation between development and scientific sectors to make scientific research '*development-driven*' and development work '*science-based*' (i.e. science informs development policy and development issues inform scientific research).

- Establish strategic programmatic, financial, and technical partnerships among scientific and development organizations to maximize the potential contributions of STI to development.

- Use development and scientific fora effectively to bring about increased collaboration between science and development policy and practice.

- Include the scientific community in large scale planning of development funding so science-based solutions are considered from the beginning.

- Provide more information to the development community on the scientific research agenda so development practitioners can plan how and when to incorporate findings and successful applications into future development programmes.

- Promote regional and interregional cooperation to optimize resources, create synergies and maximize the circle of beneficiaries.

- Ensure that research funders that pursue multidisciplinary, collaborative, global research agendas use scientists with a mentality for and training in *problem-based research.*

- Create a *global science-policy interface* to serve as a condition for: (1) *scientific research funding*, to encourage direct contributions of STI to contemporary development challenges; and (2) *development funding*, so STI is used as a tool to maximize the extent to which development programmes are science-based.