

20/20

Vision for the Future

Background Report
by the
Director General
for the
Commission of Eminent Persons

February 2008



IAEA

International Atomic Energy Agency

Atoms for Peace

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Foreword

Dear Commissioners,


This report was prepared by the IAEA Secretariat in answer to two questions I raised: “What kind of IAEA will the world need in the timeframe up to the year 2020 and beyond?” and “How can the IAEA best fulfil that need?”. The report describes the current work of the Agency and then — on the basis of best technical judgement and expected trends — suggests future priorities.

The use of nuclear power and other nuclear applications for meeting basic human needs is likely to expand in the 2020 timeframe. The world will rightly expect all nuclear activities to be as safe as possible. The human and financial costs of nuclear safety, security and proliferation related events can be incalculable in their impact and scale — so efforts to reduce risks and mitigate consequences represent money well spent. And efforts to help relieve hunger, combat disease and raise the living standards of the poor are key to improve human security. It is, perhaps, in this light that the longer term future of the IAEA should best be viewed.

The recommendations that the Commission will make are intended to trigger discussion among Member States and between these States and the IAEA Secretariat about the future of this important institution and how best it can contribute in the coming years to the efforts of the international community to achieve development, peace and security.

I renew my deep gratitude to all of you for agreeing to be part of this Commission and I look forward to receiving your recommendations.

Yours sincerely,

A handwritten signature in black ink, consisting of a large, stylized 'M' followed by a series of loops and a final horizontal stroke.

Mohamed ElBaradei
Director General

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Executive Summary

For fifty years the International Atomic Energy Agency (the ‘Agency’) has worked to bring the benefits of nuclear technology to humankind, while minimizing its risks. This report presents the results of a review by the IAEA Secretariat of the role of the IAEA up to the year 2020 and beyond. It consists of a ‘foresight’ analysis, a forward-looking review and prioritization of the Agency’s key areas of work, and a brief discussion of resource issues.

Trends over the coming decades indicate a growing world economy, a continuing rise in population, and increasing pressure on the environment. The rising demand for low carbon emitting energy supplies to fuel sustainable development is likely to have a strong impact on the IAEA, as it could lead to substantial growth in the use of nuclear power and, correspondingly, increased concerns about the associated risks. In addition, continuing population growth and longer human life spans will create challenges for food security, water availability, resource conservation, environmental protection and human health — problem areas which nuclear applications and technology can help address. The increasingly interdisciplinary nature of science and technology will provide opportunities for the IAEA to develop partnerships with a range of stakeholders to advance nuclear R&D, particularly in areas where research to serve the needs of the most disadvantaged is underfunded, or where no other actor is qualified or willing to take the lead.

A substantial increase in the use of nuclear power would result in calls for the Agency to give priority to promoting the efficient, safe and secure use of facilities in States, including those new to nuclear power, as well as helping to prevent and mitigate nuclear accidents. Its activities in this respect are likely to continue to include the establishment of authoritative guidelines, as well as the dissemination of experience, new knowledge and best practices, the provision of training, and the organization of peer reviews.

The Agency may be asked to play a catalytic role in developing, and perhaps managing, a new framework

introducing greater international management of the nuclear fuel cycle. This could initially cover a multinational regime for the assurance of fuel supply, and might later expand to multinational management of spent fuel. An expected increase in the need for the storage, reprocessing and recycling of spent fuel will create additional demands for the IAEA’s technical support. Work on the disposal of radioactive waste, in particular high level waste, and the decommissioning of older reactors will also have high priority.

Nuclear techniques will continue to be used to help address challenges to basic human needs. Member State capacities in the nuclear field, however, have developed significantly over the past five decades, and in addition to the IAEA a range of new partners, in particular the private sector, are becoming involved. The timing may thus be right for the IAEA to begin to shift its focus in its technology transfer work from operational activities towards more normative functions (for example, setting guidelines and standards), greatly increasing its emphasis on partnerships and networking, and on its role as an information hub. In collaboration with other

key partners, priority should be given to providing more comprehensive, issue driven, assistance in three thematic clusters: disease prevention and control; food safety and security; and natural resource management and ecosystem sustainability. There is scope for the IAEA’s laboratories to become increasingly ‘virtual’ — managing rather than carrying out practical activities. The result will be more targeted services and activities. Safety and security in nuclear applications will remain a priority.

An expansion in the civil use of nuclear technology brings with it increasing concern about the risk of accidents and the threat of nuclear terrorism. The Agency will continue to give high priority to strengthening prevention measures at both the national and international levels, and establishing measures to help ensure a rapid and coordinated response should prevention fail. The development of the currently planned security guidelines and safety standards should be complete by 2010 and 2020, respectively. An evolution in the 2020 timeframe

“Nuclear techniques will continue to be used to help address challenges to basic human needs.”

from voluntary to mandatory international peer reviews could help increase safety worldwide and help enhance public confidence.

The spread of nuclear material, technology and know-how may pose increased proliferation risks in a globalized world. The IAEA is likely to remain a major actor in preventing the spread of nuclear weapons.

Although a revival in nuclear power would require additional verification ('safeguards') activities, the IAEA's workload is not likely to increase proportionally if States accept greater transparency measures under a new verification standard. The need for IAEA inspectors in the field is likely to decrease due to the use of new technology and a change in the way States are evaluated. Verification activities will increasingly become information driven, with more evaluation work at the Agency's headquarters. Meeting future challenges will require a robust IAEA 'toolbox' containing: the necessary legal authority to gather information and carry out inspections, state-of-the-art technology, a high calibre workforce and sufficient resources.

The IAEA may be called on to take on new roles in the future, such as verifying fissile material from dismantled weapons or verifying compliance with a potential global ban on the production of fissile material for weapons. It could thus contribute to both non-proliferation and disarmament.

Restrictive budgetary policies imposed on the IAEA have led to a significant shortfall in resources — including, in particular, insufficient capital investment in the Safeguards Analytical Laboratory where critical nuclear samples are analysed — as well as heavy reliance on voluntary contributions for key areas such as safety, security and technical cooperation. The focus on efficiency gains, management reform and internal streamlining will remain rigorous. Also, certain activities that the Agency has carried out for many years could be outsourced, partnered or left to other players, public or private. This could result in savings. However, a significant increase in funding will nevertheless be required for the IAEA to carry out the activities foreseen in this report.

“Restrictive budgetary policies imposed on the IAEA have led to a significant shortfall in resources ...”

Consequently, funding for core activities needs to be through assessed contributions rather than, as sometimes at present, through unpredictable and conditional voluntary contributions. In addition, where appropriate, innovative funding mechanisms, such as private donations, endowments, user fees and sponsorships, will be explored.

The major challenges likely to face the Agency in the 2020 timeframe are: growth in the use of nuclear power, brought on by the demand for clean energy; greater demand for the use of nuclear applications in health, food and the environment; increased emphasis on maintaining a high level of safety; combating the threat of nuclear terrorism; and strengthening of the safeguards system to ensure its effectiveness, credibility and independence.

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Introduction

In late 2007, the Director General established a Commission of Eminent Persons to review the current activities and make recommendations regarding the future activities and priorities of the IAEA (the ‘Agency’) in the light of recent and expected developments relevant to the Agency’s mission. In order to provide the necessary background information for the Commission, he initiated a review by the Secretariat of the likely role of the Agency up to the year 2020 and beyond. This report presents the outcome of that review.

The report begins with a ‘foresight’ analysis — based on a survey of best current projections — of what the world might look like in the 2020 timeframe in terms of developments that would affect the mission of the Agency. This is followed by four sections outlining corresponding major changes foreseen in the Agency’s work, in terms of both “what kind of IAEA the world will need” and “how the IAEA can best fulfil that need”. The report then addresses the current financial challenges to the Agency, and discusses how existing funding mechanisms, as well as innovative approaches, can best be used to meet those challenges.

Context

The IAEA was established in 1957, at a time when the world was beset by fears of a proliferation of nuclear weapons, but also a time when emerging nuclear science and nuclear techniques were raising hopes of benefits in many spheres of human life. The mandate of the newly formed IAEA — subsequently captured in its ‘Atoms for Peace’ logo, derived from US President Eisenhower’s seminal speech to the United Nations General Assembly in 1953 — was to help alleviate those fears and realize those hopes.

In the intervening decades, the role of the Agency has grown, evolving in response to Member State needs. Early expansion in civilian nuclear power was accompanied by the development of nuclear applications in health, agriculture, hydrology and

industry. In 1970, the hitherto limited Agency ‘safeguards’ programme took on greater significance when, under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), all non-nuclear-weapon States Party undertook to sign a safeguards agreement, granting the Agency inspection and monitoring powers to verify that nuclear material was being used only for peaceful purposes. Later, in the 1990s, after the uncovering of Iraq’s clandestine nuclear weapons programme, the need to strengthen Agency safeguards became apparent and a ‘model additional protocol’ to safeguards agreements was enacted, designed to grant the Agency more information as well as extended access to national nuclear sites.

In 1986, the Agency responded to the accident at the nuclear power plant in Chernobyl by undertaking a fundamental expansion of its safety programme. This programme has since become a major factor in promoting a worldwide, broadly based, ‘culture’ of safety in the use of nuclear power and other nuclear applications.

Similarly, the attacks of 11 September 2001 led to an immediate expansion of Agency activities relating to nuclear security — helping countries to protect against, and be ready to respond to, terrorist attempts to acquire nuclear weapons, attack nuclear facilities or misuse radioactive material.

These events also led to the development of international treaties, conventions and other instruments for safety and security.

At the same time, the transfer of nuclear technology to the developing world has evolved from the supply of equipment or the sending of expert missions to a focus on cooperation for sustainable development, building on the skills and infrastructure of Member States, which act as full partners in the process (the evolution from ‘technical assistance’ to ‘technical cooperation’).

To advance its Atoms for Peace mission, the IAEA must address both of the objectives for which it

“The IAEA was established in 1957, at a time when the world was beset by fears of a proliferation of nuclear weapons, but also a time when emerging nuclear science and nuclear techniques were raising hopes of benefits in many spheres of human life.”

was founded. The priorities given to these two objectives differ among Member States. For the majority of developing countries, access to civilian nuclear technology has been the priority, while for developed countries emphasis has been placed on verification and security. Efforts to reach consensus on respective programmes of activity and budget levels are complicated further by the fact that the Agency's verification activities are driven by legal responsibilities for both the Agency and Member States — whereas there is no corresponding clear benchmark for technology transfer activities.

Despite its growing mandate and the recognition of the importance of its work — as witnessed, for example, by the awarding of the 2005 Nobel Peace Prize to the IAEA and the Director General — the Agency has for most of the past two decades been operating within budgetary restrictions (essentially 'zero growth') imposed on virtually all UN system organizations irrespective of their mandate or management practices. These have led to a chronic deficit in capital investment and an over-reliance in many areas on extrabudgetary contributions from individual countries — contributions that often come with restrictions and conditions on their use.

The IAEA in relation to other organizations

The question "Why the IAEA?" is touched on several times in the report. In general terms, the advantages offered by the Agency include: its special access to nuclear facilities, material and information; its independence and objectivity; its international character and ability to build consensus worldwide (and its considerable experience in doing so); and its capability to establish — and assist Member States in complying with — international norms and

standards concerning nuclear matters. The Agency can mobilize international technical expertise of considerable breadth and quality. And, finally, it has vast experience as a clearing house for information that can help Member States make well informed decisions about assessing the risks and the benefits of nuclear options.

The IAEA's role and position in the multilateral system is well established. In certain areas, the IAEA will play a central or a leading role, for example in non-proliferation efforts and in the implementation of international conventions on safety and security. In other areas, it has a more supportive role, working in partnership with other inter-governmental bodies, NGOs and industry groups, such as the OECD/NEA, WANO and WNA, as well as academic institutions and professional societies. In the development area, the IAEA plays a more modest, but nevertheless important, role, contributing specific knowledge and capacity to the larger programmes of other UN organizations and public or private institutions.

Criteria and priorities

Within this context, several criteria have been used in determining where the Agency could most effectively concentrate its efforts and resources in the coming decades. The primary goal is to respond to the particular needs and priorities of Member States, with a focus on areas where other actors — such as other organizations and the private sector — cannot provide services as effectively as the Agency. In addition, assessments will continue to be made of nuclear techniques to ensure that they retain comparative advantages. In cases where nuclear techniques become mature, the Agency's work could evolve towards a more normative role (for example, setting guidelines and standards).

"The Agency can mobilize international technical expertise of considerable breadth and quality."

Towards 2020 and Beyond: Global Trends and Events Likely to Affect the IAEA

The major trends and developments which are shaping, or likely to shape, the world towards 2020 and beyond present both opportunities and challenges to the IAEA and its Member States in the advancement of human development and security. Demographic and economic trends will be major drivers. The United Nations predicts that the world population will grow from the current 6.5 billion to some 8 billion by 2030, while the World Bank estimates that the output of the world economy will grow at an annual rate of 3%, doubling from today's \$35 trillion to \$72 trillion in the same timeframe. In both cases, the contribution of developing countries will be significant: 97% of population growth will occur in the developing world, and economic growth will increasingly be powered by developing countries.

The projected demographic and economic patterns will drive a mounting demand for energy, a development of key significance to the IAEA. Growing urbanization and industrialization will cause electricity needs to grow even faster than energy needs in general. To meet those demands and sustain growth, countries will seek access to affordable and reliable energy supplies. Energy security is already considered to be a primary challenge for many countries.

At the same time, growing public awareness of the deteriorating state of the environment is likely to affect the energy choices and policies of countries. With the earth's natural resources already under considerable strain and concerns over climate change intensifying, there will be pressure for countries to reduce their dependence on fossil fuel based energy production and seek different options and solutions to support sustainable development. Nuclear energy is emerging as one potential option. Thus, many projections forecast significant growth in the use of nuclear power, with some countries introducing it for the first time and others expanding their existing capabilities. The IAEA will likely be called upon to help countries assess the nuclear power option and ensure that the projected expansion in the use of such energy takes place in a safe and secure manner.

Globalization — the increased interconnectedness of people and places — will be central to future economic growth. However, the benefits of globalization will not be shared equitably. Indeed, inequalities — within and between nations and regions — are likely to grow. International organizations such as the IAEA have a role to play in helping to narrow the gap and assisting those most in need. Nuclear techniques can play a small but sometimes important role in helping to address poverty, hunger and disease — problems likely to escalate in the face of growing populations, longer life expectancies, urbanization, water scarcity, food security and competition for natural resources.

Highly visible inequalities in income, wealth and access to basic human services and development opportunities may also lead to tension and conflict, both within and between countries. With extremist groups already interested in acquiring destructive capabilities, nuclear and radiological terrorism will continue to be a major threat. The detonation of a nuclear explosive device or the dispersal of radioactive material by a 'dirty bomb' could prompt unpredictable changes in society. Hence, countries are likely to pay increasing attention to taking preventive action, and to need IAEA expertise and assistance in this sphere.

Moreover, apprehension over the proliferation of nuclear weapons is likely to persist. The wider use of nuclear energy and the spread of nuclear know-how, technology and material may intensify these concerns. There is worry about the state of health of the nuclear non-proliferation regime, which the IAEA supports through verifying compliance with relevant legal agreements. Fears are intensifying that the regime is seriously threatened and needs to be bolstered in many ways.

Unforeseen events

Past unforeseen events — such as the Chernobyl accident in 1986, the 1991 discovery of a clandestine

“Growing urbanization and industrialization will cause electricity needs to grow even faster than energy needs in general.”

nuclear weapons programme in Iraq, and the terrorist attacks of 11 September 2001 — changed the world in significant ways. These events were strong catalysts for change within the Agency, resulting in important strengthening of the IAEA's verification, safety and security roles. They also underlined the need for flexible and rapid response and, in the longer term, reorientation of existing, or creation of new, programmes.

Future events with significant potential impact on the IAEA might include the clandestine development

of a weapons programme, the theft of nuclear or radioactive material, the explosion of a 'dirty bomb', or a major accident at a nuclear facility. The social consequences of such events would be enormous and the economic impact would be far greater than the allocation of funds *in advance* to strengthen the safeguards, security and safety programmes of the IAEA. The Agency must be in a position to help minimize the likelihood of such events through prevention measures, and to react through emergency preparedness and response capabilities should they occur.

Nuclear Reactors and Fuel Cycle Facilities: Rising Expectations?

Historically, interest in nuclear power has fluctuated considerably. Following a rapid expansion in the IAEA's early years, particularly in the 1970s, growth slowed near the end of the 1980s for a variety of reasons, including the Three Mile Island and the Chernobyl accidents. Since that time, the pace of nuclear power growth has largely matched that of global electricity.

A significant change appears to be on the horizon due to a growing world population, economies consuming larger volumes of energy and electricity, growing concerns about climate change and greater confidence stemming from improved nuclear power plant performance and safety records. To meet future demand, States are turning to nuclear power as one potential solution. Indeed, nuclear power is projected to undergo a potentially significant expansion in the next decade, with some commentators envisaging even a nuclear 'renaissance'. To help plan and prepare for the future, the IAEA annually publishes two nuclear power growth scenarios, a high and low projection (Fig. 1).¹ The 2007 updates project that nuclear electricity generation may grow by 15–45% by 2020 and by 25–95% by 2030.

¹ Under the low projection, which assumes that no new nuclear power reactors will be constructed beyond those already under construction or currently planned, nuclear power will grow only slightly. The high projection takes into account nuclear projects proposed beyond those already firmly committed.

According to these scenarios, some countries will consider nuclear power for the first time, while others will expand their existing production capabilities. Future requests for IAEA assistance are likely to come particularly from States interested in exploring or initiating nuclear power programmes. They are likely to request assistance to ensure that their programmes will be efficient, safe and secure.

Another important shift that is projected is the location of this future growth. To date, nuclear power has been mainly used in industrialized countries. However, much of the future growth is expected to take place in the developing world: 16 out of the 34 new reactors currently under construction are in developing countries, particularly in Asia.

Any discussion on future energy trends will need to take into account the global energy imbalance. Currently, some 1.6 billion people live without access to electricity. In some African countries, annual per capita electricity use is as low as 50 kilowatt-hours, while in the member countries of the OECD it is 9700 kilowatt-hours — roughly 200 times higher.

While recognizing that each State must make its own energy choices and that 'one size does not fit all', the IAEA can help ensure that the nuclear power option is open and accessible for any State that chooses it. It will also need to continue emphasizing that the path to nuclear power requires a well defined

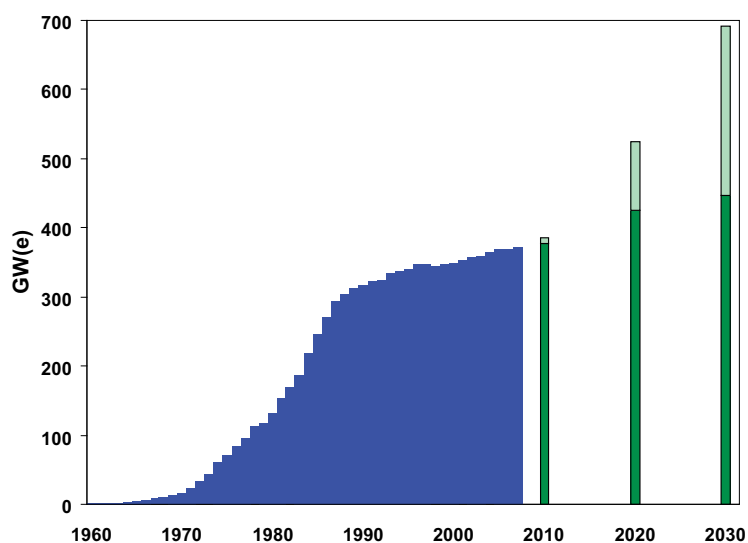


FIG. 1. Historical growth in global nuclear power capacity (blue) plus estimates of future growth according to the IAEA's low projection (dark green) and high projection (light green).

‘roadmap’, and helping States to take the various steps required along the way.

An expansion in nuclear power would require greater international cooperation. The IAEA provides a primary forum for stakeholders to meet, share their expertise and respond to future challenges. These stakeholders include States introducing nuclear power, States with existing nuclear power, and neighbouring States, as well as various actors such as technology providers, private companies, nuclear operators, NGOs and other international organizations.

Facilitating the efficient and responsible use of nuclear energy

The IAEA will continue giving high priority to facilitating the efficient, safe and secure use of nuclear power plants, fuel cycle facilities, research reactors and other facilities. The number of nuclear power reactors is predicted to increase by up to 60% and associated fuel cycle facilities up to 45% by 2030.² The IAEA foresees that related assistance requests could triple by 2020.

It will be particularly important to support the decision making processes of States introducing nuclear power for the first time — the ‘newcomers’ — and to ensure they can make informed choices on nuclear energy and technology.

The rising number of requests for general IAEA assistance in energy planning reflects the value of the IAEA’s reputation for quality, independence and objectivity. Moreover, more countries are specifically evaluating the nuclear power option, a recent example being the States of the Gulf Coordination Council. The trend is expected to continue, and rising requests today for energy planning assistance are likely to translate into a growing number of requests in the future for implementation assistance. In addition to legislation and regulation, this assistance is likely to focus on developing and sustaining the necessary nuclear power infrastructure and building expertise in the organization that

will run the power plant, complementing assistance provided by governments, private firms, industrial associations and other international organizations. The IAEA’s comparative advantages will be in: establishing authoritative guidelines; disseminating experience, new knowledge and best practices; providing training; and assembling expert teams for peer reviews.

IAEA guidelines, such as the *Milestones in the Development of a National Infrastructure for Nuclear Power*,³ distil the lessons from past experience to assist planning and speed efficient and safe implementation. The IAEA will also assist States in such areas as nuclear law, setting standards and building a safety and security culture, site selection, bid evaluation, quality assurance, financing options, knowledge management and plant life management (i.e. incorporating future refurbishment and eventual decommissioning into management planning from ‘day one’).

Growing requests for IAEA assistance are expected for nuclear energy used to desalinate sea water. Water, like energy, is a basic need, and competition for water resources is expected to increase in the future.

In those countries already operating nuclear power plants, the Agency will disseminate experience with

operating technology, management efficiency, quality assurance, knowledge management and major refurbishments. With licence renewals now extending reactor lifetimes to 60 years, and

with the increasing number of reactors worldwide, the IAEA foresees increased demand for all these activities.

Towards a new framework for the nuclear fuel cycle: Fuel supply assurances

A global nuclear expansion would likely drive a corresponding increase in the demand for nuclear fuel and fuel cycle services.

“... rising requests today for energy planning assistance are likely to translate into a growing number of requests in the future for implementation assistance.”

² For planning purposes, the figures given here are for 2030 rather than 2020, taking into account that the IAEA will need to begin assisting States well in advance.

³ IAEA Nuclear Energy Series No. NG-G-3.1, IAEA, Vienna (2007).

The IAEA Director General has proposed the creation of a new multinational framework for the nuclear fuel cycle. A fully developed framework is a complex endeavour to be developed in stages. The first step would be to establish mechanisms to assure the supply of nuclear fuel. States would have confidence that they would be able to obtain nuclear fuel in a predictable and stable manner over the longer term. While a well functioning market is likely to ensure this, a back-up mechanism could add further confidence by helping to protect against political disruptions. Such a mechanism will also make less likely the spread of sensitive fuel cycle facilities.

There has been considerable interest in this idea, with several States and other stakeholders proposing a variety of possible approaches for the assurance of supply. The various proposals now on the table envisage new responsibilities for the Agency, ranging from deciding when fuel supplies could be released to an ambitious vision of the actual construction, operation and monitoring of enrichment plants, with the former entailing only minimal cost and the latter very substantial investments.

This development, if it materializes, would mean a growing 'nuclear broker' role for the Agency. The Agency would take on the function of overseeing a nuclear fuel bank. That role is envisaged, in fact, in the IAEA Statute and now, more than a half a century later, it is being revisited.

Finding solutions for spent fuel and radioactive waste

The expansion of nuclear power will create new demands for spent fuel management and waste disposal. The Agency is likely to give high priority to these issues as they are often seen as creating potential risks and unsolved problems and have a high public visibility. The nuclear industry has over 50 years of experience managing spent fuel. The safety record is good, and the first priority will be to maintain that record in both experienced and newcomer countries.

High level geological waste disposal, however, has not yet been demonstrated. The Finnish, French,

Swedish and US repository programmes are the most developed, although none of these countries is likely to have a repository in operation much before 2020. The IAEA could facilitate the flow of information from States which are most advanced in developing deep geological facilities or conducting research in this field. Also, it could assist countries to conduct more uniform assessments of their high level waste disposal options.

"States would have confidence that they would be able to obtain nuclear fuel in a predictable and stable manner over the longer term."

The disposal of low and intermediate level waste is established in several countries. However, Agency support will be needed to implement such disposal in additional countries, both

those with nuclear power and those with only other forms of radioactive waste, such as that from hospitals.

For countries with limited waste or without access to geologically suitable disposal sites, multinational disposal at sites with good geology might be an option. Several studies have identified the potential benefits, in terms of possible economic, non-proliferation, safety and security advantages, of multinational disposal as well as the institutional and political issues standing in the way. The IAEA could help States arrive at a solution that fits their needs.

Helping to decommission nuclear facilities

The decommissioning industry is well established and will grow as many power and research reactors are expected to retire before 2020. The IAEA can help improve the flow of knowledge and experience among those engaged in decommissioning, and can encourage organizations in developed countries to provide decommissioning assistance to those with lesser capabilities.

A related area where the IAEA can provide advice is the remediation of uranium mines resulting from earlier mining activities. Most uranium today is produced from well designed and operated mines for which the IAEA has a role to play in helping to maintain the application of best practices, best technology and best standards. Overall, the need for IAEA assistance and attention will largely be in relation to new mines in less prepared locations.

Efficient use of research reactors

Many of today's research reactors will have passed retirement age by 2020. The number in operation is expected to decrease, from 245 today to between 100 and 150 in 2020. They will likely be replaced by new multi-purpose reactors that are fewer in number and more expensive, use low enriched uranium fuel and are built and/or operated by international consortia. States will increasingly need IAEA assistance with the decommissioning of older reactors and the management of spent fuel and waste. The need for assistance in strategic planning and institutional arrangements for possible regional and international research reactor coalitions, networks and shared-user facilities is expected to increase moderately.

Sharpening the focus on innovative activities

For innovation in nuclear reactor and fuel cycle technologies, increased international cooperation is required. The IAEA assembles diverse expertise, facilitates information exchange and acts as a catalyst for coordinated research among both established nuclear suppliers and users and prospective suppliers and users. It cannot independently conduct or finance R&D, but it engages directly with those who do — in industry, governments and other international organizations — and it can engage both established countries and new centres of innovation to help ensure that new designs meet the needs of all countries. As new manufacturers enter the business, the IAEA can help ensure that their safety culture and quality assurance are strong. The IAEA also provides an essential forum for coordinating expectations about technological developments and for promoting synergies. Examples already in place include the International Project on Innovative Nuclear Reactors and

Fuel Cycles (INPRO) and IAEA Technical Working Groups on advanced designs across the full range of technologies: water cooled reactors; metal cooled reactors; gas cooled reactors; fast reactors; and accelerator driven systems.

Demands on the IAEA's compilation of the nuclear data⁴ fundamental to all research and innovation will also grow, as will the effort necessary to help ensure their high quality and comprehensiveness.

The underlying objective of these efforts will continue to be improvement of important nuclear power technology characteristics: increased proliferation resistance, safety, security and performance on the one hand; and decreased costs, construction times and complexity on the other. In particular, technological innovations will continue to be a key source of safety improvements.

Depending on the availability of resources and developments in Member States, it is likely that lower priority will be assigned to Agency activities in hydrogen production, nuclear fusion and uranium mining. For example, near term work on hydrogen production is expected to progress largely in established nuclear power countries (however, the IAEA can help ensure that the interests of unrepresented prospective users are not overlooked). With regard to nuclear fusion, the IAEA will focus on fostering cooperation and the involvement of countries outside the major players in the International Thermonuclear Experimental Reactor (ITER) project.

“Demands on the IAEA’s compilation of the nuclear data fundamental to all research and innovation will also grow.”

⁴ Data concerning properties used in nuclear physics, for example the probability that a particular nuclear reaction will occur.

Meeting Basic Human Needs: The Role of the IAEA in Development

The IAEA is responsible for ensuring that the advantages of nuclear technology are used to benefit human well-being and sustain socioeconomic development, while also seeking to ensure that the risks associated with nuclear technology are minimized. It carries out this responsibility by assisting Member States in obtaining safe and secure access to peaceful nuclear applications for sustainable development.

Member State capacities in the nuclear field have developed significantly since the IAEA was established. A variety of disciplines and sectors have begun to work more cooperatively to deal with the greater scale of challenges to human well-being. New actors have entered the field; the private sector, for example, plays an essential role in advancing and promoting nuclear science and technology and various governmental organizations offer alternative solutions to development problems. With all these changes a central concept remains — no sustainable human development is possible without security, and no lasting security is achievable without development. The IAEA's development activities are thus central to the achievement of its overall mandate.

Today, some 115 countries benefit directly from the IAEA's technical cooperation programme. As the relevance of nuclear applications for development and meeting basic human needs increases, so too does the demand for support from the Agency. Already, existing financial and human resources are insufficient for keeping pace with the requests for support expressed by Member States, leading the Agency to investigate other implementation options, such as more regional collaboration, regional agreements, country to country support and partnerships.

In the future, demographic and environmental trends will further drive demand for IAEA services. Many Member States, in particular the least developed, are likely to require continued support. It is expected that the IAEA will prioritize, in collaboration with other key partners, issue-specific assistance in three main thematic clusters — disease prevention and

control, food safety and security, and sustainable management of natural resources and ecosystems — with a lesser focus on a fourth cluster, industrial process management.

While these thematic clusters suggest increased levels of activity, the IAEA expects to reduce its activities in other areas (depending in part on the availability of resources). These include mature nuclear technologies (those that no longer require development or those in which Member States have acquired sufficient capacity), or technologies no longer considered to have a comparative advantage.

Disease prevention and control

Expanding populations, longer life spans and greater urbanization will create stress on health care systems worldwide and drive increasing demand for IAEA support in the use of nuclear technologies for diagnosis and treatment, advice on the deployment of hi-tech solutions, and safety and regulatory measures in nuclear medical practices.

In developing countries, the incidence of chronic diseases, such as cancer and cardiovascular disease, is projected to increase dramatically and radiotherapeutic and nuclear imaging techniques will become more important. Cancer control will be an important focus of activity for the IAEA in the future. Until recently, the IAEA has focused primarily on providing equipment and associated training to support cancer treatment. However, the Agency has begun efforts to provide more comprehensive support to Member States through the creation of formal partnerships with, for example, WHO to improve early detection, treatment, aftercare and palliative care, as exemplified by the existing IAEA Programme of Action for Cancer Therapy (PACT).⁵

⁵ PACT is a comprehensive, multidisciplinary alliance initiated by the IAEA in 2004 to help developing Member States deal with an emerging cancer epidemic and provides a test case for possible thematic approaches in other areas. It has built formal partnerships with organizations in different sectors, uses a variety of funding mechanisms, and offers technical assistance and advice.

Radiopharmaceutical production is another area where Member States might request assistance. Nuclear imaging procedures require radiopharmaceuticals which are often too expensive for low to middle income countries. The ability to produce cheap radiopharmaceuticals locally could have a significant impact in developing countries, leading to increased requests for IAEA assistance regarding best production practices, quality assurance and regulatory aspects. The use of stable isotopic techniques to develop effective nutritional interventions to address such issues as the 'double burden of malnutrition' (under-nutrition and obesity) is likely to become a higher priority for many Member States.

In contrast, as noted above, the IAEA is likely to reduce activities related to the provision of technologies that are mature or readily available through the private sector. For example, radioimmunoassay techniques used in human health (and animal production) studies are in the process of being replaced by non-radioactive, tracer based assays. Also, large radioactive sources for the treatment of cancer are increasingly being replaced by linear accelerators.

Food safety and security

Climate change and a larger world population are likely to result in increased pressure to guarantee both the quantity and quality of food. Therefore, food safety and security will receive increasing attention. Nuclear techniques improving agricultural productivity are increasingly likely to focus on improving crop varieties to enable them to grow under the harsh conditions brought about by climate change. Combined technology packages based on mutation induction and genomic screening techniques could improve plant breeding and support the development of sustainable biofuels. The IAEA will also promote the development and application of radiation and isotopic techniques for the control of transboundary diseases and pests in technology packages that offer added value to the sustainable intensification of agricultural production.

Techniques for the diagnosis of transboundary animal diseases could become more important and focused

on nuclear and nuclear related molecular technologies for early and rapid detection. The IAEA will work with countries to develop and improve diagnostic and characterization technologies for detecting different pathogens (for example, avian influenza virus) not only in diagnostic laboratories, but also in the field. It will also assist in the use of radiation to produce deactivated live disease viruses, which is a key step in providing safe animal vaccinations.

The projected expansion of international agricultural trade will require the integration of pre- and post-harvest pest control measures so that Member States can meet regulations for international agricultural export markets and, in particular, overcome pest problems related to food and food products. Along with climate change driven alterations in the

geographical distribution of pests, this is likely to lead to an increased demand for the area-wide use of the radiation based sterile insect technique (SIT) to protect crops and livestock from pests. A project on fruit flies in Latin America has already

resulted in significant socioeconomic benefits, allowing fruit exports. In some areas, the potential for increased Agency support could depend on the success of Agency projects currently under way, for example in relation to the control of tsetse flies in parts of Ethiopia.

The use of ionizing radiation for the control of food-borne microbes and pests is also expected to increase. In view of the increasing hazards arising from contamination by a wide spectrum of environmental pollutants and chemical additives, IAEA coordinated research programmes on additional screening techniques could be required. However, food irradiation as a mature technology is likely to need only minor input by the Agency.

Natural resource management and ecosystem sustainability

Nuclear techniques offer useful tools to assess and monitor natural resources and ecosystems, thereby supporting the development of efficient management strategies to preserve marine and terrestrial environments, particularly in the face of climate change. Such techniques can also be used to mitigate

“Nuclear techniques ... are increasingly likely to focus on improving crop varieties to enable them to grow under the harsh conditions brought about by climate change.”

soil degradation, and to strengthen efforts for the conservation of water, air, oceans and land resources. Through the development and improvement of stable and radioactive tracer isotopic techniques, the IAEA will assist Member States to monitor impacts of climate change, agricultural practices and land use on the quality and quantity of natural resources.

The competition for water resources is expected to increase in the future, and the rate of consumption is likely to continue to grow faster than that of the population. The agricultural sector will remain the largest user. The IAEA will facilitate the use of isotope hydrology and other nuclear tools to support the integrated management of water resources related to ground or surface water, land resources and coastal zones. The unique data provided by these techniques could become even more valuable as climate change alters the hydrological cycle. One current example of how activities can evolve in the future is the IAEA's effort to integrate groundwater considerations into the management of the Nile River Basin.

As climate change and ecosystem sustainability become increasingly urgent problems, the IAEA could offer a package of appropriate nuclear assessment tools. In a wider context, environmental impact assessments should be integrated into the services offered by the Agency.

The Agency's future activities in the area of natural resource management and ecosystem sustainability will be based, in part, on the integration of services that are currently spread across several programmes, resulting in efficiency gains. Additionally, there will be decreases in those areas of work that can be more readily performed by the private sector (for example, assessing dam safety using nuclear technology). Reductions are also anticipated in standard monitoring exercises in water, oceans, and air and land ecosystems.

Evolving nuclear technologies to support industrial process management

The economic growth of developing countries will lead in many cases to increasing industrial activities. Radiation based techniques can help optimize industrial processes. Much of this optimization is

likely to be undertaken by the private sector. Where this sector does not provide sufficient access to the relevant technology, Member States are likely to need continued IAEA support, particularly with respect to advice on best practices and supporting safety and regulatory structures. Radiation treatment, processing and diagnostic technologies aiding in the development, manufacture and analysis of advanced materials, including nanotechnology, is likely to become an area of interest for many Member States. However, IAEA support for mature technologies, such as non-destructive testing, could be phased out.

The use made of research reactors, accelerators and allied nuclear techniques may increase in response to established and new applications in health, the environment and the preservation of cultural heritage. Further, the role of research reactors and accelerators as a cornerstone of education and training in nuclear sciences is likely to remain relevant for human capacity building.

A changing context, an evolving role

In the future, the IAEA is likely to move away gradually from operational activities towards normative functions, greatly increasing the emphasis on partnerships and networking, and on the role that the Agency can play as a hub for nuclear information (for

example, the IAEA's role as the central repository for collecting and maintaining nuclear data). Operational functions are likely to be increasingly decentralized. Member State cooperation is also likely to evolve, with the

Agency focusing more in some areas on less or least developed countries (for example, in capacity building), and providing a more targeted delivery to middle income countries in other areas. Actual procurement by the Agency of large items of equipment may be scaled back, as it is an area where most Member States are becoming self-sufficient.

Laboratories and regional networks

The IAEA is currently the only United Nations organization that operates its own laboratories. These facilities, located in Vienna, Monaco and Seibersdorf, provide applied research, educational and analytical support in development, safety and verification.

"The IAEA will facilitate the use of isotope hydrology and other nuclear tools to support the integrated management of water resources ..."

These needs arose from the complex nature of most nuclear applications and their critical safety aspects, as well as the need to perform experimental research and teach analytical techniques in fields where Member States lacked sufficient knowledge and capacity. As Member States become increasingly self-reliant, these services as well as other IAEA technical services could be outsourced to national or other international laboratories and institutions, or to IAEA Collaborating Centres.

The role of the IAEA's laboratories is thus expected to change significantly, as they move towards a more 'virtual' mode of operation in which the IAEA plays a coordinating role, based on its knowledge of networks and Member State capacities. This will allow Member States to draw on a vastly enlarged and up-to-date pool of resources. At the same time certain physical laboratory functions will be retained where independence is important, most notably in the area of analytical support for safeguarding nuclear material, the provision of reference materials for quality assurance in sciences and trade, and radiation dosimetry calibration services for radiological protection and medical applications. The laboratories will continue to focus on areas where no other actor is likely or willing to undertake work that could be of significant benefit to Member

States. Importantly, it should be understood that the Agency will continue to coordinate required support (such as training) through laboratories in Member States.

Decentralized country and regional based networks of scientific institutions are likely to become the main source for technology transfer and capacity building. The establishment of IAEA regional offices responsible for managing technical cooperation programmes with Member States could facilitate this more decentralized approach. While greater resources and time would be required initially to implement these changes, and to build formal partnerships, in the long run — potentially by 2020 — this evolution could enable the IAEA to better support regional needs, at lower cost.

“The role of the IAEA’s laboratories is thus expected to change significantly, as they move towards a more ‘virtual’ mode of operation.”

Finally, the use of nuclear applications is bound to grow as nuclear technology takes advantage of the synergies and opportunities for innovation in today's interconnected world. Rising populations, longer life expectancy and environmental stress will create challenges in the fields of health, food security, natural resources and water availability. In addressing these challenges, the IAEA, through its Member States, can bring together a broad and probably unique knowledge base in nuclear technology, nuclear energy and nuclear applications.

Underpinning Nuclear Safety and Security: Preventing Nuclear Accidents and Nuclear Terrorism

The growing use of nuclear technology in Member States will bring significant benefits but will also entail risks. It will be essential to avoid accidents like those at Three Mile Island and Chernobyl, and prevent terrorists from acquiring nuclear weapons or detonating ‘dirty bombs’. The growth in civil nuclear technology needs, therefore, to be complemented with an equally ambitious enhancement of global safety and security.

Safety and security share the ultimate goal of protecting people and the environment from the harmful effects of radiation, but they are different in both cause and process. Nuclear accidents are caused by human and/or technical failures or extreme natural events, and the likelihood of their occurrence can be scientifically estimated. In contrast, malicious events are intentional, much less predictable, and involve an adversary intent on evading prevention measures. That said, from the perspective of both operators and regulators, prevention measures must cover all safety and security requirements. Measures to combat illicit trafficking and nuclear proliferation are also closely interlinked but involve different constituencies. Taken together, these measures constitute a global nuclear order dedicated to ensuring that the benefits of nuclear technology will be available to all in a peaceful, safe and secure manner.

Safety and security are primarily the responsibility of the State, but recognition of the far reaching consequences of accidents or nuclear terrorist acts has strengthened global arrangements to address these risks — a process which is ongoing. The IAEA plays an important role, supporting the development and implementation of international conventions and codes of conduct and helping to establish international standards and guidelines. Most of the conventions recognize the IAEA as the competent body to assist States in their implementation.

Safety risks

The renewed interest in nuclear power, the ageing of existing installations, wider applications of radioactive sources in the medical and industrial fields, and the need to implement solutions for the disposal of nuclear waste present serious safety and public communication challenges today and will do so in the future. As an example, recent tsunamis and earthquakes have demonstrated the need to re-evaluate the safety of existing and future nuclear power plant designs against extreme natural events.

Losing control of, or misusing, radiation sources can lead to accidents, over-exposure of people, or malicious use. The IAEA will continue to have a central

“... the IAEA will have a role, in cooperation with organizations such as WHO and ILO and professional societies, in the education and training ... of practitioners and in informing ... patients undergoing radiation procedures.”

role in coordinating international action to strengthen the control of radioactive sources from ‘cradle to grave’, and to mitigate the effects of unauthorized disposal. Accidents and radiation overexposure in medical procedures, some fatal, continue to occur at an unacceptably high frequency. There is an urgent need to promote the implementation of

actions to prevent accidents and to protect radiation workers, patients, the public and the environment from unnecessary exposures to radiation. In the years ahead, the IAEA will have a role, in cooperation with organizations such as WHO and ILO and professional societies, in the education and training of vast numbers of practitioners and in informing an even greater number of patients undergoing radiation procedures.

Centralized waste storage facilities in many States are ageing and their safety will need to be reassessed. Public concern over environmental protection and the long term cumulative impact of radioactive discharges of nuclear facilities is expected to increase. By 2020, the emphasis in work related to waste safety is likely to shift from analysing concepts for

disposal to the evaluations of specific proposals for the geological disposal of high level waste.

With the expansion of the use of nuclear power and other nuclear techniques will come a corresponding increase in the transport of uranium, fresh and spent fuel, radioisotopes and waste. Given the emergence in recent years of denials of shipment of radioactive material, this challenge could rapidly grow in volume and complexity. The IAEA will need to play an increasing coordination role in promoting safe and secure transport.

Security threats

Comprehensive security requires a combination of prevention, detection and response measures set within a robust civil and criminal legal framework. The stakeholders include operators and users, regulators, port and airport authorities, customs, security and intelligence forces. Security measures should rest upon a realistic assessment of the threat. The security of nuclear material suitable for use in nuclear weapons has always been, and will remain, of the very highest priority. Accordingly, prevention measures, especially physical protection, must continue to be of the highest achievable level.

New technology, and risk reduction programmes, will address some of the problems,⁶ but the need to reach the highest levels of security will remain a long term imperative.

As understanding of the potential threats involving the dispersal of radioactive materials by dirty bombs, sabotage and other means has improved, the priority given to their security has increased. This is especially true for radioactive sources, the security of which, until recent years, was largely addressed through control and inventory measures, and also for highly radioactive material produced as a result of the expanded use of nuclear energy.

International measures to help States to improve their level of protection are already in hand,⁷ supported by the emerging IAEA security recommendations and guidelines, and by evaluation services and capacity building activities. Much remains to be done, in combination with safety and safeguards work. Prevention is a major long term goal for the IAEA: one which will require attention through 2020 and beyond. It will also be important to build detection capabilities at borders and elsewhere to interdict stolen or lost materials being trafficked. This includes improving technology, but the actual development of detection instruments and scientifically advanced forensic methods will be of relatively low priority for the IAEA, given the involvement of other actors. The Agency will, however, continue to have a coordinating role.

Preventing and mitigating nuclear accidents

High priority will also be given by the Agency to preventing and mitigating nuclear accidents. As noted

above, States embarking on new nuclear power programmes are increasingly looking to the IAEA for help. Safety depends on technology, the appropriate legal framework, an effective national regulatory body, and the existence of a

safety culture throughout the government and industry. To advance these, the IAEA is likely to continue through 2020 and beyond to: publish guidance; provide training; disseminate operating experience, new knowledge and best practices; provide peer reviews; and coordinate research. As a possible new initiative, the IAEA could work together with importing countries and reactor vendor countries and companies to ensure that the safety infrastructure is in place for new power reactors.

Strong growth is expected in this area, particularly in the demand for peer reviews, as an expansion of nuclear power will call for ever greater transparency. The IAEA will not be the sole provider of any of these activities. However, it will add value where

“The IAEA will need to play an increasing coordination role in promoting safe and secure transport.”

⁶ For example, by reducing or eliminating in civil applications the use of high enriched uranium, and utilizing separated plutonium in more proliferation resistant forms.

⁷ The amended Convention on the Physical Protection of Nuclear Material, UN Security Council Resolutions 1540 and 1373 and the Code of Conduct on the Safety and Security of Radioactive Sources.

markets and governments do not provide sufficient transparency and information.

The early hours after a nuclear or radiological emergency are crucial. They can mean the difference between minor consequences and substantial health and economic effects. Early detection, notification and response is key to saving lives and managing the public response to an emergency, whatever the cause. Effective emergency preparedness and response require both national capabilities and, because radiation does not respect national boundaries, international cooperation. As the use of nuclear technology expands, so will the expectations of States for the IAEA to coordinate the international response to emergencies in accordance with roles assigned to it by international conventions. The IAEA has established an incident and emergency centre but its ability to carry out these roles is insufficient.

Enhancing safety and security

Safety and security both require continued vigilance and should always be considered as works in progress. For example, gaps exist today in the coverage of international conventions and codes of conduct and in the development and application of the normative infrastructure. And the number of countries that have subscribed to the international instruments needs to increase. These gaps need to be filled as a matter of high priority. As the expectations and demands of States increase, so will the need for the IAEA to help promote more effective and integrated approaches.

International safety standards and security guidelines and recommendations provide practical advice to States on how to meet their international obligations.⁸ They also support States in meeting

their national safety and security objectives. The IAEA will give high priority to completing the currently planned series of security documents by 2010, and by 2020 the new structure of universally accepted safety standards should be in place. As each series is completed, the Agency's work on such documents will shift to maintaining their relevance, incorporating lessons learned, and developing further documents addressing any new needs and technologies. By 2020, it is expected that many of the nuclear security documents will have become, de facto or de jure, international security standards and incorporated into national security policies and regulations.

The IAEA will provide significant assistance to States to assess their safety and security needs and vulnerabilities. In this regard, the Agency will continue to coordinate evaluation missions to appraise national application of IAEA safety standards and security guidelines and to provide appropriate advice.

In the future, it is possible that States may also use such missions to provide assurances of compliance with international safety standards and security guidelines. Although it has never been invoked for this purpose, the IAEA Statute already authorizes the Agency to provide for the application of safety standards, through legally binding undertakings by States. Such an evolution in the 2020 timeframe from voluntary to mandatory international peer reviews could help increase safety worldwide and help increase public confidence.

Assessments of national security needs, combined with enhanced information collection capabilities, have led to the development of integrated nuclear security support plans agreed between individual States and the IAEA. These plans already involve over 40 States. The number of States with such plans will increase substantially and, by 2020, it is forecast that 70% of these plans will have been implemented and attention turned to self-sufficiency and sustainability issues.

The training of legislators and regulators, facility operators and users, customs and other security

“... the Agency will continue to coordinate evaluation missions to appraise national application of IAEA safety standards and security guidelines and to provide appropriate advice.”

⁸ For safety, they cover such areas as legal and governmental infrastructure, emergency preparedness and response, the siting, design and operational safety of facilities, radiation, and waste and transport safety. In the area of security, guidelines cover issues such as nuclear security culture, threat analysis, facility and radioactive material security, transport security, combating illicit trafficking and detection equipment specifications.

officials will remain a high priority for both the IAEA and the requesting States. As new facilities are built and a new generation of professionals emerges, the demand for training is likely to increase.

Finally, the IAEA foresees a coordinating role in the development of new security related technologies by others and acting as a hub for receiving,

disseminating and analysing information. It will give priority to the exchange and analysis of information on illicit nuclear trafficking and other unauthorized activities, and to developing new information resources and information networks. Partnerships with other international organizations, for example Interpol, OECD/NEA, WCO and WHO, will be further broadened.

Non-Proliferation, Disarmament and the IAEA

While the expansion of nuclear energy will bring greater prosperity to different parts of the world, it may also increase proliferation risks. For many States, attaining nuclear technology and know-how will be a matter of economic, scientific and technological advancement. But without appropriate control measures, nuclear material and technology could be misused to build nuclear weapons.

Proliferation risks are also being exacerbated by globalization. Covert nuclear trade networks can illegally procure sensitive technology in one part of the globe and sell it in another, concealing their clandestine shipments within the enormous volumes of legitimate global trade. Interactions and transactions between dealers and clients are being facilitated by the revolution in communication technologies and the erosion of national borders.

However, science and technology will continue to offer new ways and means of responding to proliferation concerns. The IAEA will be able to develop and make use of better equipment and advanced information and communication technologies, resulting in more effective techniques and approaches to verify that the civilian nuclear programmes of States remain peaceful. Also, in the longer term, risks may be reduced through the development of more proliferation resistant nuclear technology.

Maintaining stability and peace will become even more important in an increasingly globalized and interdependent world. In the nuclear area, the IAEA is expected to continue to play a key role in the management of global nuclear order through the practical realization of the principle 'trust but verify'. The international community will continue to rely on the IAEA for objective and independent verification of States' nuclear programmes. States parties to the NPT and nuclear-weapon-free zone treaties recognize it as the competent body to carry out that role.

During the past decade the cornerstone of the non-proliferation regime — the NPT — has been beset by concerns about compliance and growing tension between its non-proliferation and disarmament related aspects, as demonstrated by the deep divisions in meetings of the NPT States parties in recent years. However, nuclear non-proliferation and disarmament are mutually reinforcing, and the IAEA will be well positioned for the advancement of both and ready to contribute to strengthening the regime during this crucial time.

Changing the culture of verification

The IAEA performs verification through a set of activities by which it confirms that States are not using their civil nuclear programmes to build nuclear weapons. The rights and obligations of States and of the Agency are established in 'safeguards agreements', under which: States submit information to the Agency about nuclear material, facilities and activities; and the IAEA verifies nuclear material, inspects facilities and evaluates information about the States' nuclear programmes. Over 160 States have concluded such agreements with the IAEA.

To carry out its verification activities effectively, the IAEA needs to have adequate inspection authority and access to all relevant information and locations. The Agency's two main types of legal instruments are comprehensive safeguards agreements (CSAs) and additional protocols (APs).⁹ Together, the two instruments enable the Agency to conclude that

*"The international community
will continue to rely on the IAEA
for objective and independent
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nuclear programmes."*

⁹ Based on IAEA document INFCIRC/153 (Corr.), approved in 1971, CSAs provide for the application of safeguards to all nuclear material in all peaceful nuclear activities in a State. All non-nuclear-weapon States party to the NPT or nuclear-weapon-free zones are required to conclude CSAs with the IAEA. Based on INCIRC/540 (Corr.), approved in 1997, APs provide for measures to strengthen the effectiveness and improve the efficiency of IAEA safeguards that cannot be implemented under the legal authority of CSAs.

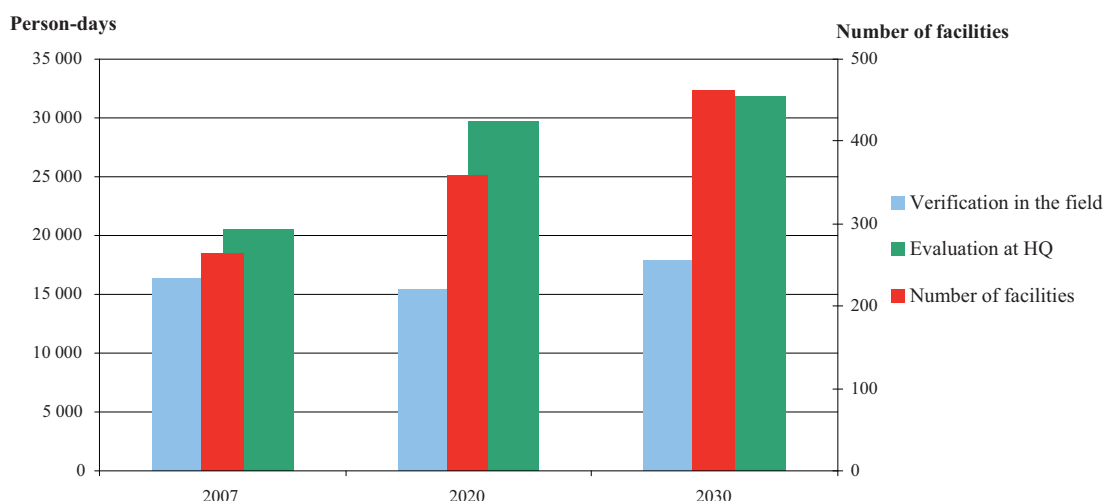


FIG. 2. Person-days for verification and evaluation and number of facilities to be verified (based on the IAEA's high projections of the number of facilities that will be subject to safeguards).

States are not diverting nuclear material to nuclear weapons.¹⁰

Yet, today, 30 NPT State parties have not even brought in force their required CSAs and some 100 States have yet to conclude an AP. By 2020, or earlier, the CSA–AP combination should, in the Secretariat's view, be the universally accepted verification standard, if verification is to be credible. It will also be important for the IAEA — the Secretariat and the Member States — to fully utilize all measures available under these legal instruments.

This new standard would not only increase transparency, but would also enable the Agency to optimize its verification activities, resulting in a reduced inspector presence and workload in the States.¹¹ Realizing such efficiencies will be increasingly important, especially in light of the

projected expansion in the use of nuclear energy. Many additional nuclear facilities, material and activities will be subject to IAEA safeguards. For example, by 2030,¹² the overall in-field verification effort could increase only by some 10% compared with the current level if all States concluded an AP, even though the number of facilities subject to safeguards is expected to almost double by then. Without APs in all States, the in-field workload would most likely be a further 15% higher.

However, these efficiencies can be realized only if States give the IAEA the necessary legal authority — under both a CSA and an AP — so that it can confidently conclude and continuously reaffirm that they are not diverting nuclear material and have no undeclared nuclear material and activities. The process by which the IAEA evaluates State programmes is information driven and determines its inspection activity in the field. The Agency assesses all available information about a State's nuclear activities, from the declarations by States to open source information. Although field inspections are expected to increase only modestly by 2030, this 'desk evaluation' at IAEA Headquarters — representing the largest share of verification work — will require significant additional effort (see Fig. 2). Evaluating States will become more complex, given the increasing volumes of information available to the IAEA, the increasing number of States and facilities

¹⁰ While a CSA provides the legal authority for the Agency to verify not only that declared nuclear material is not diverted to nuclear weapons but also that there is no undeclared nuclear material in a State, it is only for a State with both a CSA and an AP that the Agency has the practical tools to do so. The AP was developed to address these limitations after the IAEA's experiences in the 1990s in Iraq and the Democratic People's Republic of Korea highlighted the need for improving the Agency's ability to detect undeclared nuclear programmes.

¹¹ Such efficiencies can be gained through the implementation of 'integrated safeguards', which are the optimum combination of all measures available under CSAs and APs to achieve maximum effectiveness and efficiency, allowing measures to be applied at reduced levels at certain facilities. Integrated safeguards can be implemented only after the IAEA has drawn a broader conclusion concerning the absence of undeclared nuclear material and activities in the concerned State.

¹² This section considers changes to the verification programme in light of the 2030 projections because preparations for the future will need to take place well in advance, even before 2020.

being verified, and the spread of sensitive material and technology. By 2030, the IAEA may need to increase its evaluation activities by up to 50%.

While the universalization of CSAs and APs is a key goal, it will also be important to continue tackling the limitations identified in the existing legal framework. Unaddressed, these limitations can hamper the process of assessing the nuclear programmes of States. For example, the list of equipment and materials for which States are required to provide export and import information under an AP could be expanded to reflect the evolution of nuclear technology as well as address items likely to be involved in the clandestine nuclear trade. Moreover, various voluntary reporting schemes providing relevant information not covered under existing agreements will need to be evaluated to see how the current irregular and limited reporting by States could be enhanced.

Besides expanding the legal tools, the Agency will need to move with the times when it comes to its technical capabilities. Having state-of-the-art verification technology will remain an important requirement, particularly for the detection of clandestine nuclear activities. The IAEA would benefit greatly from having the capacity to commission R&D in safeguards technology, be it in cooperation with Member States or the commercial market. It will need to strengthen existing detection capabilities, especially with regard to environmental sampling, satellite imagery and information analysis. For example, the increasing number of environmental samples taken will require the IAEA to improve its own laboratory capabilities as well as to expand its network of analytical laboratories in Member States.

The IAEA will also have to overcome technological challenges. With the volume of spent fuel projected to almost double by 2020, the IAEA will seek to review its current safeguards approaches. The increasing number of facilities approaching the end of their life cycles presents another growing verification challenge during the shutdown and decommissioning phases. In addition, new types of

nuclear reactors and associated nuclear fuel cycle technologies will emerge, requiring the IAEA to begin designing dedicated safeguards approaches and techniques well in advance. The IAEA will also work with States and facility providers and operators to design and operate ‘safeguards friendly’ nuclear installations to facilitate efficient and effective verification.

Covert nuclear trade networks will also impose new demands. A worldwide analytical approach cross-referencing all nuclear trade relevant information will be required. To detect attempts by covert networks to acquire nuclear material and technology, the IAEA needs information from States, particularly with regard to procurement enquiries and export denials. Information on suspicious orders received, but not filled, by private companies provides valuable early information.

Even with the most sophisticated verification system, the IAEA must be able to count on the cooperation of States through State or regional systems of accounting for and control of nuclear material, systems which are required under CSAs. It is foreseen that the Agency will continue supporting States which cannot fulfil their safeguards related obligations due to lack of resources and also enhance cooperation with States with highly developed systems to fully optimize safeguards implementation.

Moreover, in view of their mutually reinforcing effect, the IAEA might even in the long term explore the possibility of integrating certain activities related to safeguards, safety and security. This could create potential synergies and efficiencies.

Towards a new framework for the nuclear fuel cycle: Non-proliferation benefits

IAEA verification has undergone a remarkable transformation in the last decade. To continue to serve the international community in a rapidly changing world, the IAEA must recognize change, adjust and take on new roles and tasks to meet new demands.

“It is foreseen that the Agency will continue supporting States which cannot fulfil their safeguards related obligations due to lack of resources and also enhance cooperation with States with highly developed systems to fully optimize safeguards implementation.”

As discussed in a previous section, the projected expansion in nuclear power may result in more States opting to develop a national fuel cycle. As a result, they will also master the proliferation sensitive parts. At the front end, the principal concern is the enrichment of uranium, and at the back end it is the separation of plutonium in reprocessing plants.

While effective and universal implementation of IAEA safeguards under CSAs and APs will remain the primary technical barriers to proliferation, the new framework referenced earlier could also help minimize proliferation risks resulting from the rise in uranium enrichment capacity and spent fuel reprocessing. By providing an assured supply of nuclear fuel, the new framework would reduce the incentive for States to develop full fuel cycle capabilities at the national level, therefore reducing the number of sites where sensitive facilities are operated. Thus, multinationally controlled or owned fuel cycle installations would provide enhanced assurance to the international community that the most sensitive parts of the civilian nuclear fuel cycle are less vulnerable to misuse.

Verifying nuclear disarmament

Although the IAEA's primary role is the verification of the non-proliferation commitments of States under the NPT and nuclear-weapon-free zone treaties, its Statute provides for a possible role in assisting States in the verification of nuclear disarmament.¹³ Indeed the IAEA Statute directs the Agency to conduct its activities "in conformity with policies of the United Nations furthering the establishment of safeguarded worldwide disarmament".¹⁴

The NPT represents a balance of rights and obligations with regard to nuclear disarmament, non-proliferation and the peaceful use of nuclear energy. While non-nuclear-weapon States pledged to forego nuclear weapons and accept IAEA

safeguards on the entirety of their nuclear activities, the weapon States made a commitment to "pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament".¹⁵ In the future, the IAEA may be called on to assist in the verification of various steps towards the achievement of that goal.

For example, the nuclear weapon States may place additional nuclear material that is excess to their military needs under safeguards or convert it into forms unusable in weapons or useful for peaceful purposes, such as nuclear fuel. The IAEA is already

verifying small quantities of unclassified forms of excess fissile materials. Moreover, it has developed a verification system for classified forms under the Trilateral Initiative with the Russian Federation and the USA,¹⁶ which has been ready

for implementation since 2002. However, no material has yet been made available to be placed under IAEA monitoring.

The IAEA should also be ready to break new ground by beginning to verify other nuclear disarmament activities, for which it has the necessary competence and experience. For example, a treaty banning the production of fissile material for nuclear weapons would be an important development as well as a key element of the new fuel cycle framework.¹⁷ Should negotiations begin and conclude successfully, this could have a major impact on the IAEA if it were tasked to verify compliance. Previous estimates indicate that the cost of such verification could be very significant — comparable to the cost of current IAEA safeguards verification (€140 million per year).

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¹³ Under Article III.A.5 of the IAEA Statute, the IAEA is authorized "to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State party, to any of that State's activities in the field of atomic energy".

¹⁴ Article III.B.1 of the IAEA Statute.

¹⁵ Article VI of the NPT.

¹⁶ Report on the Trilateral Initiative: IAEA verification of weapon-origin material in the Russian Federation & the United States, IAEA Bulletin 43 3 (2001) 49.

¹⁷ Such a treaty is commonly referred to as the Fissile Material Cut-off Treaty (FMCT), suggesting a focus on prohibiting production after an agreed cut-off date, or the Fissile Material Treaty (FMT) that would seek to address also past production (existing stocks of fissile material).

In the future, the IAEA may also be called upon to again verify the dismantling of actual nascent nuclear weapons programmes — another area for which it has the necessary competence

and experience, as demonstrated by its support in the dismantlement of the weapons programmes in South Africa, Iraq and the Libyan Arab Jamahiriya.

Resourcing the IAEA

The preceding sections have identified the anticipated areas of substantial increases and decreases¹⁸ in the activities of the IAEA by 2020. Overall, for the IAEA to carry out those activities, significant additional funding will be required — even after reducing activities in areas of lower priority and realizing all possible efficiency gains.

In that context, this section first describes the Agency's current financial situation, and then considers how existing funding mechanisms, as well as new innovative sources — together with efficiency measures — might be used to address both it and future challenges. Issues faced as regards human resources are also highlighted.

The current financial situation

The IAEA was described in 2003 by the UN Secretary-General's High-level Panel on Threats, Challenges and Change as an “extraordinary bargain”.¹⁹ And in 2006, the US Office of Management and Budget gave a unique virtual 100% value-for-money rating to the US contributions to the IAEA.²⁰

At the same time, however, in 2002, an independent external review²¹ determined that the IAEA was showing signs of systems stress and could not sustain its achievements in the long term. The study recognized that applying the UN-wide policy of maintaining budgets at a constant level — the policy of ‘zero real growth’ — to the IAEA with its expanding programme requirements had resulted in the deferral of investment in systems and human resources development, and in neglected investments

in infrastructure and equipment.²² The report also concluded that this would result in a ‘dilution of technical knowledge in core organizational competencies’.

The zero real growth policy has prevailed in Member State decision making regarding the IAEA budget for much of the past two decades. Exceptionally, in 2003 — facing the possibility of a failure of the Agency's safeguards system — a 10% increase in the budget was approved, to be phased in over four years (2004–2007).²³ This

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increase was directed at immediate operational shortfalls, but, again, did not address the looming infrastructure deficit. Otherwise, increases during the last twenty

years have been limited to responding to compelling, immediate demands such as follow-up to the accident at Chernobyl, or urgent safeguards requirements. Meanwhile, some other needs have been funded on an ad hoc basis with donations from Member States, often with restrictive or conditional clauses burdening their use, and partially from efficiency gains.

The pressing need to upgrade the IAEA Safeguards Analytical Laboratory (SAL) is an example of the current situation. The laboratory evaluates sensitive samples taken at nuclear facilities — analyses that must be performed in a cost effective, accurate, confidential and timely manner. SAL was built in the mid-1970s and its maintenance and the investment in its equipment have been deficient as yearly budgets were mainly used for operational costs. A sum of approximately €50 million is now needed to prevent a potential failure in this area, which could put the credibility of IAEA safeguards at risk.

Expensive technical equipment (sometimes running to tens of millions of euros) has to be installed in facilities for safeguards purposes. In the longer term,

¹⁸ Possible areas for decrease could include: hydrogen production; nuclear fusion; uranium mining; radio-immunoassay; the use of large radioactive sources for cancer treatment; food irradiation; non-destructive testing; assessing dam safety; standard environmental monitoring and radioecology; research in Agency laboratories; nuclear forensics; and the provision of equipment for border monitoring.

¹⁹ United Nations General Assembly, A/59/565, 2 December 2004.

²⁰ Contributions to the IAEA, <http://www.whitehouse.gov/omb/expectmore/summary/10004639.2006.html> (2006).

²¹ “At What Cost, Success”, Mannet of Switzerland, 14 October 2002.

²² With regard to neglected or deferred investments, the current funding deficit for infrastructure and IT projects is estimated at €80 million, with an additional €180 million in unfunded liabilities for contributions towards health insurance for qualified retirees, and other employee separation benefits.

²³ See IAEA document GC(47)/INF/7.

it might be considered whether part of the cost of such equipment could reasonably be borne on a routine basis by the facility under safeguards and/or the Member State concerned.

The Agency's required implementation in 2010 of the International Public Sector Accounting Standards (IPSAS) will provide at least a mechanism for the accumulation of funds for infrastructure and other investments — a mechanism that does not exist at present — and will generally improve effectiveness in the management of financial resources and information. But IPSAS itself will not alleviate the underlying funding deficit.

Funding options

Currently, two thirds of the IAEA budget — €300 million — comes from assessed contributions by Member States ('regular budget'), while the remaining third — €150 million, including funding for the technical cooperation programme — comes from voluntary contributions, again mostly from Member State governments.

It is critical that full funding for Agency activities in the areas of safety, security and safeguards be secured through assessed contributions, rather than have them rely partially — as at present — on less secure voluntary or 'extrabudgetary' contributions. In that regard, it should be noted that currently 90% of the nuclear security programme, 30% of the nuclear safety programme and 15% of the verification programme are dependent upon voluntary funding.

The introduction of a contingency fund financed from assessed contributions would further alleviate the uncertainty associated with the timing of receipt of Member State contributions and help respond to emergencies and unforeseen events, such as nuclear accidents or terrorist attacks, or urgent verification requests. The unanticipated request in 2007 for the Agency to conduct verification activities related to the shutdown of nuclear facilities in the Democratic People's Republic of Korea, for example, required a

sudden fundraising effort to finance this unfunded activity.

The important technical cooperation activities are currently funded entirely by the voluntary Technical Cooperation Fund, and the minimum annual targets for the level of that fund, set by Member States, are not being fully met. And, despite a steady increase in the services delivered through the technical cooperation programme, there remain a significant number of approved projects for which no funds are available. The funding of this programme in a more predictable and assured manner is essential.

Voluntary funds to support a limited number of very specific projects or activities and in-kind contributions, such as equipment, services and expertise, will nonetheless continue to be necessary. However, these types of contributions reflect the donor's priority, conditions are often attached to their use, and their timing is unpredictable, thus rendering objective programmatic decision making difficult. A good practice identified internationally to address these limitations is the provision of voluntary contributions in support of broad thematic areas — rather

than specific projects or activities. Such contributions are provided with very limited conditions. Contributions of this nature from a variety of sources can be pooled and can be provided on a multi-year basis to facilitate the predictability of funds.

"It is critical that full funding for Agency activities in the areas of safety, security and safeguards be secured through assessed contributions, rather than have them rely partially ... on less secure voluntary or 'extrabudgetary' contributions."

By 2020, the IAEA will also have explored, and, wherever possible, utilized, additional and innovative funding mechanisms, as appropriate.

In this regard, private donations are playing an increasing role in funding international public goods, and will be sought in a broader and more systematic manner. The Nuclear Threat Initiative,²⁴ for example, has offered the Agency \$50 million for a nuclear fuel bank project contingent upon it raising an additional \$100 million from other donors

²⁴ A non-profit organization with a mission to strengthen global security by reducing the risk of use and preventing the spread of nuclear, biological and chemical weapons.

and gaining agreement on the structure of such a bank.²⁵

Endowments in the form of gifts of money or other assets, such as those common in universities and other public organizations, could also be a source of additional income.

And finally, in keeping with a growing trend in national and international public service organizations, user fees could be charged, for example in connection with the IAEA's provision of training, technical assistance, equipment, safety guidance or inspection services.²⁶

Efficiency measures

The Secretariat will continue to vigorously pursue opportunities to improve its efficiency, both in its programme activities, as well as in its management practices. In the timeframe to 2020, it will redouble its efforts through an institutionalized 'quest for efficiency', adopting proven practices while keeping its focus on its core activities and those to which it can bring a high added value.

Information and communication technology will continue to play a critical role in improving the way the IAEA delivers its programme and communicates, both internally and externally. In particular, an enterprise resource planning system will be in place. The benefit of such an integrated information system to support programmatic activities has been demonstrated in the private and public sectors and in other international organizations and a 2006 feasibility study concluded that it would result

in efficiency savings equivalent to €6 million per annum in staff time, a 25% return on investment.

The Secretariat will be using best practice tools, including a comprehensive application of quality management, and benchmarking, and it will continue its commitment to a more systematic approach to identifying, quantifying and reporting on efficiency gains. In the 2020 timeframe, a number of additional opportunities for outsourcing will be considered, including:

laboratory work (where independence and confidentiality are not issues), translation, publishing and printing, conference services and procurement.

Human resources

The IAEA depends upon a specialized, high calibre and talented workforce. Over 60% of the regular budget is currently spent on staff, most of it with substantial experience in nuclear science and engineering. And with a diminishing pool of nuclear professionals on which to draw, and increasing competition from the private sector, staffing the IAEA is becoming an increasing challenge.

At the same time, there is growing complexity in the work to be done. Future safeguards inspectors, for example, will increasingly need not only to be knowledgeable about traditional and advanced fuel cycles and plant operations, but also to possess sophisticated analytical skills in the detection of early signs of weapons development.

Yet, in the face of these challenges, the Agency is constrained by the UN 'Common System', which governs employment rules and procedures and salary levels. If the Agency is going to be able to attract the high quality professionals on which it depends, the salary structure, benefits system and other conditions of service must become more flexible.

"Information and communication technology will continue to play a critical role in improving the way the IAEA delivers its programme and communicates, both internally and externally."

²⁵ NTI Press Release, December 28, 2007. In addition, the US Congress allocated an additional \$50 million on 26 December 2007.

²⁶ The IAEA would not be unique in doing this. For example, OPCW, ITU and WIPO offset part of their budgets with such fees.

Concluding Remarks

The major challenges likely to face the Agency in the 2020 timeframe are: growth in the use of nuclear power, brought on by the demand for clean energy; greater demand for the use of nuclear applications in health, food and the environment; increased emphasis on maintaining a high level of safety; combating the threat of nuclear terrorism; and strengthening of the safeguards system to ensure its effectiveness, credibility and independence.

If sufficient resources are not made available, some activities which the Agency has hitherto carried out would need to be assigned lower priority, with a corresponding reduction in effort.

The provision of the necessary support for the IAEA to carry out its mandate effectively must be seen

in the context of the consequences of its not being able to do so — such as increased risks of nuclear accidents, nuclear terrorism and proliferation, and reduced access by Member States to beneficial nuclear technologies and expertise to meet basic human needs, including energy.

Overall, the international community must be able to maintain its reliance on the IAEA for authoritative and objective information and impartial assessments on issues of crucial importance. For the Agency to remain an ‘extraordinary bargain’ and fulfil its unique role in peace and development, the continued confidence of Member States, expressed through the provision of adequate resources, will be essential through 2020 and beyond.

Abbreviations

GC	General Conference of the IAEA
INFCIRC	Information Circular (IAEA)
Interpol	International Criminal Police Organization
ILO	International Labour Organization
ITU	International Telecommunications Union
NGO	non-governmental organization
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OECD/NEA	Nuclear Energy Agency of the OECD
OPCW	Organisation for the Prohibition of Chemical Weapons
WANO	World Association of Nuclear Operators
WCO	World Customs Organization
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WNA	World Nuclear Association