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Options for a facilitation mechanism that promotes the development, transfer and dissemination of clean and environmentally sound technologies

Report of the Secretary-General

Summary

The present report has been prepared pursuant to General Assembly resolution 66/288, in which the Assembly endorsed the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want". Paragraph 273 of the annex to the resolution contains a request that relevant United Nations agencies identify options for a facilitation mechanism that promotes the development, transfer and dissemination of clean and environmentally sound technologies, as well as a request that the Secretary-General make recommendations regarding the facilitation mechanism to the Assembly at its sixty-seventh session.

The report summarizes recent trends, provides an overview of the proposals received and outlines recommendations on the functions, format and working methods of a technology facilitation mechanism, as well as on a potential way forward to achieve improved technology facilitation.

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Contents

I. Introduction

1. The General Assembly, in its resolution 66/288, endorsed the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want". The outcome document contains a section on technology (sect. VI.B). In response to the requests contained in paragraph 273, the present report provides a synthesis of proposals received for a technology facilitation mechanism and outlines recommendations on the functions, format and working methods of such a mechanism, as well as on the options for progress in this regard.

2. All 53 organizations of the United Nations who were members of an expanded Executive Committee on Economic and Social Affairs, during the preparations for the United Nations Conference on Sustainable Development, were invited to make proposals on the functions, format and working methods of a potential technology facilitation mechanism, to outline their contributions to such a mechanism, and to indicate partners whose involvement they considered to be essential. The Secretary-General expresses his appreciation to the 22 organizations and bodies that contributed to the present report, namely, the Economic Commission for Africa (ECA), the Economic Commission for Europe (ECE), the Economic and Social Commission for Asia and the Pacific (ESCAP), the Economic Commission for Latin America and the Caribbean (ECLAC), the Economic and Social Commission for Western Asia (ESCWA), the Department of Economic and Social Affairs, the International Atomic Energy Agency (IAEA), the International Maritime Organization (IMO), the International Telecommunication Union (ITU), the Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, the United Nations Capital Development Fund, the United Nations Conference on Trade and Development (UNCTAD), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Framework Convention on Climate Change, the United Nations Industrial Development Organization (UNIDO), the United Nations Office for Project Services (UNOPS), the United Nations Development Programme (UNDP), the United Nations Entity for Gender Equality and the Empowerment of Women (UN-Women), the United Nations Environment Programme (UNEP), the World Bank, the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO). The full text of the proposals is available from the new website on sustainable development: sustainabledevelopment.un.org.

3. The present report also considers proposals contained in official submissions for the preparatory process of the United Nations Conference on Sustainable Development, prepared by Member States, organizations of the United Nations system and intergovernmental organizations, and by major groups, from 2011 to 2012,[1] as well as other relevant international technology commitments, such as those contained in Agenda 21: Programme of Action for Sustainable Development (Agenda 21), the Plan of Implementation of the World Summit on Sustainable Development (Johannesburg Plan of Implementation), the outcome document of the Conference and various other agreements. Unless otherwise noted, the data used in this report are derived from official statistics compiled in UN-Data.[2]

[1] Available from www.uncsd2012.org/rio20/index.php?menu=115.

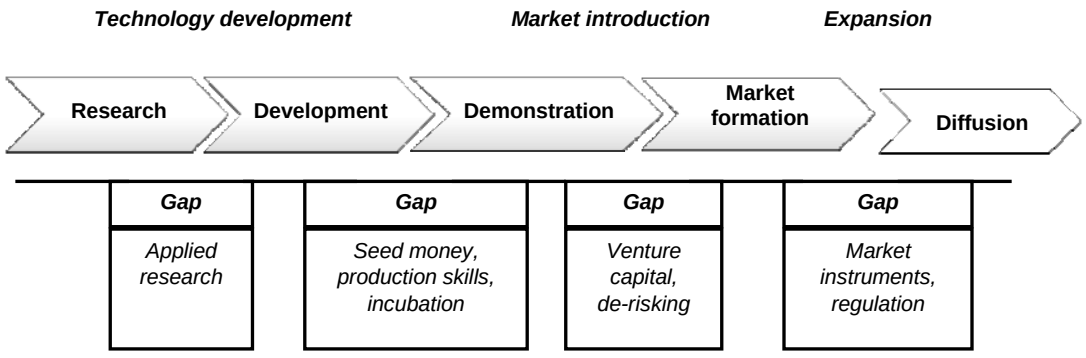
[2] Available from data.un.org.

4. Section II of the present report outlines recent trends in the global technology system and sustainable development and concludes with a list of lessons learned for technology facilitation. Section III provides a synthesis of proposals for a technology facilitation mechanism, and section IV sets out recommendations for consideration by Member States.

II. Global technology system and sustainable development

5. Technologies follow a well-known path through different stages in their life cycle, from research to development, demonstration, market formation, and eventual diffusion in the marketplace. Significant gaps exist between these stages and need to be overcome (see figure 1). An effective technology innovation system is one that excels in each stage and seamlessly bridges the gaps between them. In such a system, capacity-building, finance and technology transfer can play an important role in all stages. For example, research is impossible without transfer of measurement or production technologies. Against this background, the report makes explicit distinctions between trends and interventions within and between the technology stages. This follows the perspective of innovation policy and industrial ecology, which was first adopted by Japan in the early 1970s and by the National Academy of Engineering of the United States of America in the early 1990s.[3]

Figure 1
Bridging gaps between technology stages



Source: Wisanu Subsompon, "Technologies developed by universities — an opportunity for SMEs", *Tech Monitor*, Special feature: globalization of technology transfer, March-April 2009, Asia and Pacific Centre for Transfer of Technology of the Economic and Social Commission for Asia and the Pacific (ESCAP).

6. Typically, the role of Governments is progressively reduced in moving from research to diffusion, but large differences among countries exist in this respect.

7. Technologies are not independent of each other, but form part of clusters and international systems. For example, energy technologies form part of a complex global energy system where technologies are not substitutable at will, nor are their research, development and demonstration potentials independent from each other. In

[3] Chihiro Watanabe and Kayano Fukuda, "National Innovation Ecosystems: The Similarity and Disparity of Japan-US Technology Policy Systems toward a Service-oriented Economy", *Journal of Services Research*, vol. 6, No. 1 (2006), pp. 159-186.

fact, most new technologies derive from a combination of existing technologies. This also explains why research, development and demonstration capacity depends on manufacturing and/or production skills, and vice versa. A related phenomenon is technology convergence where combinations of technologies from hitherto unrelated sectors drive innovation. Much innovation in the biopharmaceutical industry derives from a convergence between biotechnology, information technology and nanotechnology. Consequently, an effective technology mechanism should address all technology stages and all sectors.

8. Owing to space limitations, many of the illustrations in the present report are examples from one sector (the energy sector), in view of its overarching role in sustainable development. However, unless otherwise indicated, the report's conclusions hold across all sectors, including information and communications technology, nanotechnology, biotechnology, agriculture and food technologies.

A. Global trends in science and technology for sustainable development

9. The landscape of science and technology issues and institutions has changed significantly since 1992.

Global technology progress

10. At the end of 2011, an estimated 2.3 billion people were Internet users, the majority of whom were in developing countries.[4] Information-sharing and knowledge generation has grown at an accelerated pace. Several technology-intensive developing economies have become world leaders not only in the manufacturing and trade of technologies, but also increasingly in research and innovation. Over the past 20 years, the number of people in the emerging global innovation community has more than doubled. It is estimated that $1.2 trillion was spent on research and development, globally, in 2009, with the contribution of middle- and low-income countries more than doubling over the previous 15 years.[5] Communication and interconnection in this increasingly urbanized cluster have reached levels that would have been unimaginable just a few decades ago. All of this should, in principle, put humanity in a much better position to find solutions to sustainable development challenges. At the same time, persistent poverty means that opportunities to mobilize the ingenuity of more than 4 billion poor people are wasted.

11. Technology has greatly shaped society and the environment. While technological progress has addressed many problems, it has also added new problems.[6,7] To varying degrees, all technologies consume resources, use land and pollute air, water and the atmosphere. While increasing eco-efficiency of technology use has greatly reduced the amounts of resources consumed and pollution produced per unit of output over the long run, absolute amounts of pollution have continued to increase. An urbanizing world must innovate at an ever faster rate, with the general

[4] Available from www.internetworldstats.com/stats.htm.

[5] World Intellectual Property Organization (WIPO), *World Intellectual Property Report 2011 — The Changing Face of Innovation*, Geneva.

[6] Arnulf Grübler, *Technology and Global Change*, Cambridge University Press, United Kingdom of Great Britain and Northern Ireland, 1998.

[7] Jared M. Diamond, *Collapse: How Societies Choose to Fail or Succeed*, Viking Press, New York, 2005.

pace of life inevitably quickening, just in order to sustain continuous growth driven by wealth creation and to avoid a planet of slums, social strife and environmental destruction.[8]

12. Against this background, Governments have called for concerted actions to accelerate change towards cleaner technology. Many technology optimists believe such acceleration is essential and call it the technology innovation imperative.[9] The importance of a "global green technological transformation, greater in scale and achievable within a much shorter time frame" than in the past, that "must enable today's poor to attain decent living standards, while reducing emissions and waste and ending the unrestrained drawdown of the earth's non-renewable resources" was stressed in the *World Economic and Social Survey 2011*.[10]

13. Actual progress in technology performance at the global level has fallen far short of such ambitions.[10] For example, the declared goal of establishing a renewable low-carbon energy technology system on a global scale remains elusive, with modern renewables (excluding hydro) jointly accounting for 0.8 per cent of primary energy, compared to the fossil fuels share of 81 per cent in 2009.[11] Global CO_2 emissions have increased considerably faster since the year 2000 than in previous decades.[12] Despite national and international efforts to accelerate and direct energy technology change, the pace of the global energy/fuel transitions has slowed significantly since the 1970s.[13]

Global eco-efficiency

14. It is technically feasible to multiply global eco-efficiency by 4 or 5 ("factor 4" or "factor 5") by 2050.[14,15,10] This would allow global wealth to be multiplied by 2 or more, while halving resource and energy use. It could also mean providing the present level of services while reducing resource and energy consumption by 75 to 80 per cent.[16] However, such a global eco-efficiency goal is highly ambitious. It

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[8] Geoffrey B. West, "Integrated sustainability and the underlying threat of urbanization", in: Schellnhuber et al., *Global Sustainability — a Nobel Cause*, Cambridge University Press, 2010, pp. 9-18.

[9] John P. Holdren, "The energy innovation imperative: addressing oil dependence, climate change, and other 21st century energy challenges", *Innovations: Technology, Governance, Globalization*, vol. 1, No. 2, pp. 3-23.

[10] Department of Economic and Social Affairs, *World Economic and Social Survey 2011*, available from www.un.org/en/development/desa/policy/wess/wess_archive/2011wess.pdf.

[11] International Energy Agency, *Key World Energy Statistics*, 2010.

[12] Detlef van Vuuren and Keywan Riahi, "Do recent emission trends imply higher emissions forever?", Climatic Change, vol. 91, No. 3, 2008, pp. 237-248.

[13] C. Marchetti and N. Nakicenovic, "The dynamics of energy systems and the logistic substitution model", International Institute for Applied Systems Analysis, RR-79-13, 1979, and Charlie Wilson and Arnulf Grübler, "Lessons from the history of technological change for clean energy scenarios and policies", *Natural Resources Forum — Special Issue: Green Economy and Sustainable Development*, vol. 35, No. 3, pp. 165-184, August 2011.

[14] Ernst Ulrich von Weizsäcker, Amory B. Lovins and L. Hunter Lovins, "Factor Four: doubling wealth, halving resource use — the new report to the Club of Rome", Earthscan, United Kingdom.

[15] Ernst Ulrich von Weizsäcker, et al., *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, 2011.

[16] J. Cullen and J. Allwood, "Theoretical efficiency limits for energy conversion devices", *Energy*, vol. 35, No. 5, pp. 2059-2069, 2010.

illustrates what could be done, if all organizational, socioeconomic and political limits were overcome worldwide.[17]

Patterns of technology flows and transfer

15. Today's patterns of technology flows and transfer differ greatly from those in 1992, when technology flows were mainly between developed countries and the challenge was to promote greater technology transfer to developing countries. While these flows are still very important, clean technology flows among technology-intensive developing countries and from these countries to developed countries have grown faster, but the participation of the poorest and smaller economies is negligible.

16. Not only the overall magnitude, but also the nature of cross-border technology flows has changed. Technology flows are increasingly embedded in global trade and foreign direct investment (FDI) flows, thus forming part of international production systems, even though there are significant regional differences. In terms of the manufacturing and export of clean technology, several developing countries have become world leaders, and some are also emerging as the most important users. However, the majority of developing countries continue to face significant technology gaps and barriers to access.

17. South-South clean technology transfer has become increasingly important. Highly publicized examples include ceramic cookstoves, biogas digesters, cement board and jatropha biofuel, and a range of Chinese and Indian FDI activities in Africa. Yet, a number of policies continue to constrain South-South technology transfer. A recent survey found tariff and non-tariff (equivalent) barriers in large developing countries for solar photovoltaic products to range from 12 to 18 per cent and 41 to 63 per cent, respectively (see also table 1).

Table 1
World leaders in selected climate-relevant technologies

	World leaders	
Technology	*Production and exports*	*Technology use*
Ethanol (from sugar cane)	Brazil	United States of America, Brazil
Biodiesel (from jatropha)	India	India, Indonesia, European Union
Wind energy	China, India	China, Germany
Solar photovoltaic	China	Germany
Compact fluorescent lamps	China, Indonesia	European Union
Solar water heaters	Mexico	China
Coal gasification	China	China, United States of America

[17] The most ambitious global sustainable development scenarios (e.g., scenario B1 of the Intergovernmental Panel on Climate Change) show pathways towards a "factor 3" improvement.

Technology	World leaders	
	Production and exports	*Technology use*
Heat pumps	China	Switzerland, European Union
Hybrid fuel vehicles	Japan	United States of America, European Union, Japan
Wood waste use	Sweden	Sweden

Source: Thomas L. Brewer, "Climate change technology transfer: a new paradigm and policy agenda", *Climate Policy*, vol. 8, pp. 516-526.

Research, development and demonstration

18. Mirroring the changing patterns of technology flows, research, development and demonstration stocks and flows have changed, illustrating a much more important role for technology-intensive developing countries. According to the World Bank and the UNESCO Institute for Statistics, overall investment in research and development as a share of gross domestic product (GDP) in middle- and low-income countries doubled from 0.5 to 1 per cent between 1996 and 2007, whereas in high-income countries it remained fairly stable, at a rate of between 2.2 and 2.4 per cent over the same period. Anecdotal evidence suggests that this share has remained at much lower levels in the poorest and/or most vulnerable countries. For example, it was about 0.1 per cent of GDP in the Caribbean region.[18]

19. Today's level of public spending for energy-related research and development in developed countries is still below that of the 1970s and early 1980s, even though overall research, development and demonstration budgets have doubled since the 1980s.[19] Public spending on research, development and demonstration of nuclear, fusion, fossil fuels and renewable energy technologies is lower in each case than in 1980. Investment in energy research, development and demonstration in Brazil, the Russian Federation, India, Mexico, China and South Africa amounted to $19 billion, which is more than the total investment in all 28 developed member States of the International Energy Agency combined ($12.7 billion).[20] This challenges the conventional wisdom that most new technologies are invented in developed countries and transferred to developing countries. Energy research, development and demonstration investments in Brazil, Russian Federation, India, China and South Africa (BRICS) focus on fossil fuel and nuclear energy, with renewables and energy efficiency underrepresented.

Innovation drivers

20. Technology convergence and underpinning technologies have been key drivers of innovation, especially in the past 20 years. This implies that specialization in one technology cluster, without skills in other clusters, is not sufficient. As a result, many new cooperation initiatives have emerged. However, smaller, poorer

[18] See A/65/115, para. 56.

[19] Gregory F. Nemet, Daniel M. Kammen, "U.S. energy research and development: declining investment, increasing need, and the feasibility of expansion", *Energy Policy*, vol. 35, No. 1, pp. 746-755.

[20] In public-private partnerships.

economies, and small- and medium-sized enterprises everywhere, have weak bargaining positions. While in the past many would have argued that research, development and demonstration would be of relatively little importance to poorer economies, this is less and less the case, in view of the internationalization of research, development and demonstration and the need to bridge large technology gaps through local adaptation.

Patents and licensing

21. The rise of strategic patenting and a series of legislative changes to expand monopoly rights has led to a very complex system of patents, which is increasingly geared to support the rights of incumbent large firms over new, smaller, innovative firms. Arguably, the system in many countries has moved from its original objective of stimulating innovation through the provision of incentives to innovators, to preventing new domestic and foreign market entrants, an increasing number of which are from developing countries. Some characterize the intellectual property rights system and its enforcement in some countries as excessive.[21] Against this background and related public criticism, some patent offices are exploring ways to improve patent quality over quantity.[22]

22. Over the past four decades, patent filings surged during two periods: from 1983 to 1990, and from 1995 to 2007. The growth in worldwide filings in the second surge was higher than in the first one. Japanese applicants were the main source of growth in filings during the first period. In the second surge period, applicants from the United States of America filed the most patent applications, followed by China, the Republic of Korea and Japan. In a matter of only a few years, several technology-intensive developing countries have created patent offices and experienced a fast growth in patent filings.[23] China's patent office is soon expected to become the world's largest, in terms of the number of filings.

23. Patenting rates for clean energy technologies have increased faster than for other sectors, at a rate of about 20 per cent per year since the adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, in 1997. Japan, the United States of America, Germany, the Republic of Korea, the United Kingdom of Great Britain and Northern Ireland and France account for almost 80 per cent of all patent applications in clean energy technology. Japan, the Republic of Korea and the United States accounted for two thirds of solar energy patent applications, while Japan accounted for the majority of patent applications in fuel cell technology. Some large developing economies are rapidly emerging as leaders in clean technology patents in their own right. India features within the top

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[21] There is a large body of literature suggesting an increasingly "excessive" nature of intellectual property rights systems since the 1990s. Examples include: (a) National Research Council, *Global dimensions of intellectual property rights in science and technology*, National Academy Press, Washington, D.C. (1993); (b) N. P. Louwaars et al., *Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries*, World Bank (2005); (c) Annette Kur and Marianne Levin, *Intellectual Property Rights in a Fair World Trade System — Proposals for Reform of TRIPS*, Edward Elgar Publishing, United Kingdom of Great Britain and Northern Ireland and United States of America, 2011.

[22] European Patent Office, *Quality over quantity: on course to raise the bar*, available from www.epo.org/about-us/office/annual-report/2008/focus.html.

[23] WIPO, *World Intellectual Property Indicators 2011*, Geneva.

five countries for solar photovoltaic patents, while Brazil and Mexico share the top two positions in hydro/marine patents.[24]

24. Web-based technologies have made new forms of science and technology collaboration possible. In particular, free and open-source collaborations and solutions have emerged, which are viewed by some as alternative forms to the conventional intellectual property rights systems of patents and copyrights, whereas others have emphasized their complementarity.[5]

25. A recent survey[24] found relatively low levels of out-licensing of clean technology towards developing countries. Scientific infrastructure, human capital, favourable market conditions and investment climate were considered more important than protection of intellectual property rights in the country of the licensee (in the case of developing countries, see table 2). The willingness to out-license was found to be much higher than the actual level of licensing.[25] In responding to the survey, 70 per cent of participants said they were prepared to offer more flexible terms when licensing to developing countries with limited financial capacity. Most respondents favoured collaborative research and development activities, patent out-licensing and joint ventures over patent pooling and cross-licensing.

Table 2
Importance of decision factors for licensing agreements with recipients in developing countries
(Percentage of survey respondents)

	Protection of intellectual property rights	*Scientific capabilities and infrastructure*	*Favourable market conditions*	*Favourable investment climate*
Not a factor	18	13	16	15
A basic precondition for doing business, but not a driving factor	28	37	26	27
Significantly attractive condition, would encourage negotiation	29	37	44	42
Compelling reason towards an agreement	25	13	14	16

Source: United Nations Environment Programme (UNEP), European Patent Office and International Centre for Trade and Sustainable Development, *Patents and clean energy: bridging the gap between evidence and policy* (2010).

B. Institutional landscape: international institutions, instruments and commitments

26. The institutional landscape has also changed significantly since 1992, including in terms of institutions in the field of research, development and

[24] United Nations Environment Programme, European Patent Office and International Centre for Trade and Sustainable Development, *Patents and clean energy: bridging the gap between evidence and policy*, 2010.

[25] In the survey mentioned above, 66 per cent of respondents were private firms (47 per cent of which are multinationals), and 34 per cent were academic institutions, governmental bodies, national research institutes, and other consortia of research bodies.

demonstration, policy instruments, support mechanisms of the United Nations system, international commitments and international law.

Capacity-building

27. Over the past 20 years, a system of capacity-building mechanisms for technology and sustainable development has emerged that is increasingly fragmented, including within the United Nations system. A recent survey of activities within the United Nations system[26] illustrates the range of capacity-building activities, which remain largely uncoordinated and ad hoc in terms of objective, content and country coverage. There is no global framework, agreement, assessment or monitoring mechanism for science and technology for sustainable development.

Research, development and demonstration collaboration networks

28. The global research, development and demonstration network of clean technology cooperation has become almost universal, whereas, in 1992, it involved essentially only developed countries. Today, entities in 182 Member States participate in some form of international clean technology cooperation, with potential knowledge flows among all of these. However, the structures of technology cooperation networks differ greatly between technology clusters, reflecting national policy priorities, resource endowments and political considerations. One example, the global technology cooperation network on bioenergy, is shown in figure 2 (below). A number of multilateral frameworks (e.g., the framework research programmes in the European Union), and bilateral frameworks (e.g., on biofuels, between Brazil and the United States of America) have been opened to external participants, including from developing countries. Open collaboration provides new opportunities to poorer countries and improves the efficiency of global cooperation in research, development and demonstration of clean technology. Making most future technology cooperation frameworks "open" might prove the cheapest option for improving research, development and demonstration, to the benefit of all.

Market instruments

29. In line with a general trend, today's technology policy in many countries emphasizes market and price instruments as levers of choice, with much less focus on technology mandates and standards than in the past. Various forms of taxation, subsidies, feed-in tariffs and permit trading systems have been introduced to stimulate green technology. For example, government support for renewables amounted to $57 billion in 2009 and the amount is expected to quadruple in the next 20 years.[27] Oil price spikes, high petrol taxes, subsidies and permit trading schemes are experiments that provide insight into the limitations of technology policy approaches based on price incentives alone. In most countries, carbon tax equivalents of petrol taxes are much higher than carbon prices generally considered necessary from a climate change perspective, but to date, only regulatory measures have had a significant impact on passenger car efficiency/emissions.

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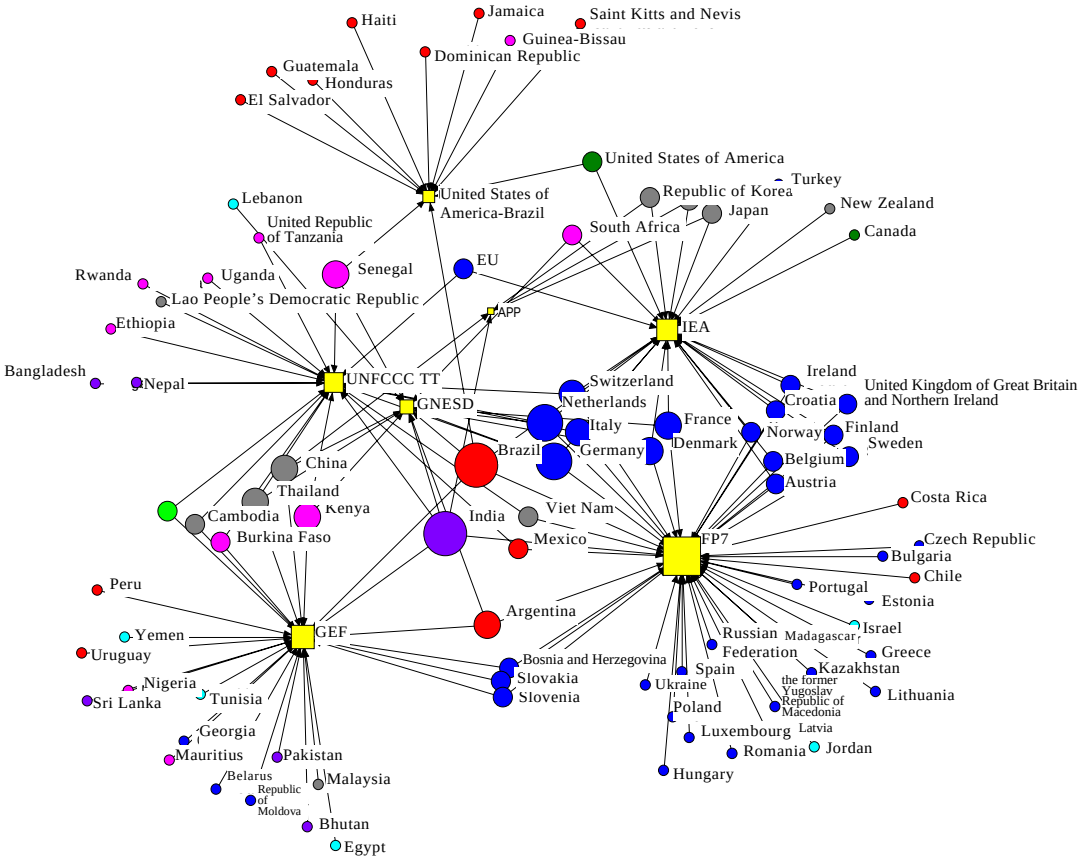
[26] Department of Economic and Social Affairs and United Nations Industrial Development Organization, "Technology development and transfer for climate change: a survey of activities by United Nations system organizations" (working paper, 2010).

[27] International Energy Agency and the Organization for Economic Cooperation and Development, *World Energy Outlook 2010*, Paris.

Figure 2
Participation network in technology cooperation on bioenergy



Notes: squares: cooperation frameworks; circles: participating countries; circle size: number of participations. APP: Asia-Pacific Partnership on Clean Development and Climate; EU: European Union; FP7: seventh Framework Programme of the European Union; GEF: Global Environment Facility; GNESD: Global Network on Energy for Sustainable Development; IEA: International Energy Agency; UNFCCC TT: United Nations Framework Convention on Climate Change technology transfer framework.
Source: Department of Economic and Social Affairs, background paper, 2011.

Technology commitments in resolutions of the United Nations

30. In preparation for the United Nations Conference on Sustainable Development, the Department of Economic and Social Affairs reviewed the global commitments on science and technology for sustainable development. Only one quarter of these commitments specifically address environmentally sound technologies.

31. Commitments agreed within the context of the United Nations over the past 20 years have typically followed a technology-centric perspective, which aims to facilitate technology transfer, in particular from developed to developing countries, for which it is considered crucial to raise financial resources and build capacity (see e.g., Rio principles 7 and 9).

32. In Agenda 21, technology was referred to more than any other issue. It is prominent in every single chapter, totalling 691 references, and chapters 16, 31, 34

and 35 are dedicated to science and technology. Technology-relevant commitments were of a rather general nature and their scope was wide. The most relevant references for a technology facilitation mechanism are those relating to building technology capacity; the creation of international information systems; regional and international clearing houses to facilitate partnerships; networks of technology research centres and technology assessment centres; long-term collaborative arrangements between enterprises of developed and developing countries, multinationals, and for joint ventures between suppliers and recipients of technologies; as well as transfer of patents and licences on non-commercial terms to developing countries.

33. Adopted in 2002, the Johannesburg Plan of Implementation contained 140 references to science or technology. It did not include any chapter specifically focusing on technology, but it was highlighted in a chapter on the means of implementation. It restates many of the technology commitments contained in Agenda 21. It elaborated on technology transfer; access to global research and development programmes and publicly funded research and development; networks of centres of excellence; collaboration between scientists and policymakers; assessment models; and information and communications technology.

34. In 2003 and 2005, the World Summit on the Information Society adopted principles and an action plan to bring 50 per cent of the world's population online by 2015.

35. The 2005 World Summit Outcome [28] contains a section on science and technology for development, which emphasizes the importance of access to and the development, transfer and diffusion of technologies to developing countries, as well as supporting greater efforts to develop renewable sources of energy.

36. In 2010, the General Assembly, in its resolution 65/1, entitled "Keeping the promise: united to achieve the Millennium Development Goals", resolved to "promote the development and dissemination of appropriate, affordable and sustainable technology and the transfer of such technologies on mutually agreed terms".

37. The outcome document of the United Nations Conference on Sustainable Development, adopted on 22 June 2012, contains 12 paragraphs that focus on science and technology for sustainable development. They address clean technology transfer and diffusion (paras. 269, 270 and 273), research, development and demonstration and the science-policy interface (paras. 274-276), capacity-building and stakeholder participation (paras. 160, 217, 272 and 278) and the policy environment (paras. 72 and 271).

38. Resolutions of the Economic and Social Council on science and technology for development (e.g., 2009/8, 2010/3 and 2012/6), which arise from recommendations of the Commission on Science and Technology for Development, are relevant and fully in line with the present report. To date, the Commission has focused mainly on technology and development policies rather than their sustainable development aspects.

[28] See General Assembly resolution 60/1.

39. The regional commissions and specialized organizations of the United Nations, such as the International Maritime Organization, have adopted a large number of resolutions on specific technology sectors, which provide more detailed guidance.

40. In the review by the Department of Economic and Social Affairs of the delivery of global commitments on science and technology for sustainable development, it was observed that progress towards the agreed objectives had been better in the areas of technology transfer, mandates and market incentives, than in research, development and demonstration and knowledge-sharing. While progress has been fairly good in many areas, some glaring gaps remain, especially with regard to the poorest countries. At the same time, the overall progress of technology has been insufficient to set the world on a sustainable path. This implies both an implementation gap and the need for more ambitious technology-related sustainable development goals.

Technology transfer provisions in international agreements

41. There are many technology provisions in international agreements, conventions and protocols, especially in the areas of environmental, health and safety technologies, including the following:

- Convention on the Transboundary Effects of Industrial Accidents
- Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution
- Protocol on Persistent Organic Pollutants to the Convention on Long-range Transboundary Air Pollution
- Protocol on Heavy Metals to the Convention on Long-range Transboundary Air Pollution
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- Convention on Biological Diversity
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity
- Convention on Nuclear Safety
- Convention on the Law of the Sea
- Vienna Convention for the Protection of the Ozone Layer
- Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer on Substances that Deplete the Ozone Layer
- United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
- International Undertaking on Plant Genetic Resources
- International Treaty on Plant Genetic Resources for Food and Agriculture

- United Nations Framework Convention on Climate Change
- Kyoto Protocol to the United Nations Framework Convention on Climate Change

42. The impact of these agreements on technology transfer has been mixed. For example, the Montreal Protocol has been hailed as a great success in terms of its impact on technology transfer, whereas views are divided about the impact of the United Nations Framework Convention on Climate Change. The Framework Convention commits Parties to "promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes" (art. 4). The clean development mechanism, as outlined in the Kyoto Protocol, was expected to promote technology transfer to developing countries. It was estimated that 26 per cent of the projects in relation to the clean development mechanism involved at least some kind of technology transfer, most of which involved the transfer of hardware, but with technological learning and capability-building restricted to operation and maintenance. In reality, only 0.6 per cent of projects involved technology transfer in the full sense that the host country entity was involved in adapting or improving upon an imported technology, or developed the technology in collaboration with some foreign entity.[29] The future Climate Technology Centre and Network, as established by the Conference of the Parties to the Framework Convention, is expected to promote technology transfer on a larger scale.

Agreement on Trade-Related Aspects of Intellectual Property Rights

43. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), which is the most comprehensive international treaty on intellectual property rights, has frequently been invoked in debates on the practical impact of those rights in promoting or constraining innovation in clean technologies. Three broad views are expressed in this debate: a sense that the existing system, while far from perfect, has worked reasonably well; a critical view that calls for patents to be excluded or revoked on certain technologies; and a view that specific interventions are needed, similar to text adopted by the Ministerial Conference of the World Trade Organization (WTO) in 2001, regarding access to medicines, in the Doha Declaration on the TRIPS Agreement and Public Health,. Others have pointed out that the TRIPS Agreement already allows for considerable flexibility in the use of compulsory licences and other forms of exception and limitation that provides a broad policy space for technology mechanisms.

44. In WTO, within the Council for TRIPS and the Working Group on Transfer of Technology, there has been a long-running debate over technology transfer and the patent system. It relates to implementation of article 66.2 of the Agreement, which requires developed countries to provide incentives to entities located in their territories in order to promote and encourage the transfer of technology to the least developed countries. Current debates about technology transfer and the environment therefore raise the question of whether this is just another intellectual property and

[29] Kasturi Das, "Technology transfer under the clean development mechanism: an empirical study of 1000 CDM projects", *The Governance of Clean Development*, Working Paper Series, No. 14, Economic and Social Research Council and University of East Anglia, July 2011, available from www.indiaenvironmentportal.org.in/files/file/gcd_workingpaper014.pdf.

technology transfer debate, or whether environmentally sound technologies present distinctive challenges.

C. Lessons learned for technology facilitation

45. It follows that there is a need for a technology mechanism that can accelerate technology progress on a global scale and that is commensurate with the sustainable development challenge. Whatever the international community decides, its actions must make sense. It is a paradox of our times that we have failed to make use of our far greater scientific and technological possibilities and global wealth to effectively solve global sustainable development challenges. This is even more striking in the light of certain sectors and parts of the world where we have made astounding progress.

46. A number of lessons learned have become apparent. To be effective, a technology facilitation mechanism needs to:

(a) Address gaps throughout the full technology cycle, from research to development, demonstration, market formation and diffusion;

(b) Address these gaps in all countries, poor and rich;

(c) Provide special support to the least developed countries, and other poorer, smaller, or especially vulnerable countries, which have been increasingly marginalized despite the development success of other countries;

(d) Promote partnerships to reduce poverty, by enabling the poorest to contribute to knowledge and technology development;

(e) Foster a truly global, cooperative undertaking that engages all interested Governments and major groups, including the private sector;

(f) Be practical and flexible in order to quickly adjust to new challenges and opportunities;

(g) Take national action at the sector and cluster levels, but monitor progress against global, cross-sectoral, technology-related sustainable development goals;

(h) Take action across sectors and countries to address issues related to technology convergence and underpinning technologies;

(i) Greatly improve technology transfer, including between developing countries;

(j) Pragmatically address intellectual property rights constraints for technology transfer, wherever they exist, by exploring innovative voluntary approaches;

(k) Promote voluntary technology assessment through a global network;

(l) Build and greatly expand open international networks of collaboration in research, development and demonstration that allow for the participation of all countries, including the poorest;

(m) Better coordinate capacity-building work by the United Nations through partnerships to achieve truly global reach;

(n) Build partnerships to better coordinate and support the implementation of technology-related international commitments, agreements and conventions.

III. Proposals for improved technology facilitation for sustainable development

47. Solutions suggested in debates in the United Nations on technology for sustainable development typically include: (a) strengthening international cooperation to close implementation gaps in terms of capacity, funds, technology and political commitment; (b) promoting "big push" technology transfer, including hardware, to developing countries; (c) building indigenous capacity and providing equitable access to overcome technology gaps; and (d) promoting partnerships with or solutions by the private sector and non-governmental organizations, supported by further privatization, liberalization and trade. The proposals for a technology facilitation mechanism are also grounded in one or a combination of these perspectives.

A. Institutional proposals for improved technology facilitation

48. In the present report, the following proposals were taken into account: (a) inputs from 22 organizations of the United Nations system; (b) proposals by organizations of the United Nations system and intergovernmental organizations, Member States and major groups, contained in official submissions for the preparatory process of the United Nations Conference on Sustainable Development;[1] and (c) proposals arising from internationally agreed technology commitments, such as those contained in Agenda 21, the Johannesburg Plan of Implementation and the outcome document of the Conference. Official submissions to the Conference were included, since it was shown that those submissions focused primarily on the issues and commitments where insufficient progress had been made since 1992.[30]

49. While hundreds of institutional proposals for improved technology facilitation have been made in the past 20 years, they can be summarized in 48 proposals, only 3 of which focus on bridging the gaps from development to demonstration and market formation (see table 3, below). The overwhelming majority of proposals address either research and development or the transition from market formation to diffusion.

50. For all technology stages, proposals were made for funding mechanisms, programmes and partnerships. Legal and regulatory proposals focused on the market formation to diffusion stage. It should also be noted that the proposals serve a limited set of 10 primary objectives: knowledge-sharing, strengthening research, development and demonstration, technology transfer, business incubation, reducing risk, reducing intellectual property rights constraints, technology information, technology assessment, public participation and coordination. Interestingly, this is largely in line with the technology transfer framework of the Expert Group on Technology Transfer, established at the eighth Conference of the Parties to the Framework Convention, which consists of: technology needs and needs assessments,

[30] Of the 31 proposals, 15 are "new" suggestions, in the sense that, at present, there are no agreed international commitments.

technology information, enabling environments, capacity-building, mechanisms and cross-cutting issues.[31]

51. The sum of proposals listed in table 3 calls for a global technology facilitation mechanism (or technology sharing facility, clearing house, or partnership) consisting of the following:

(a) A global network, mechanism, or partnership, together with a technology development fund, in order to strengthen global research, development and demonstration cooperation, technology transfer and participation of developing countries;

(b) A global network of national business incubators, together with support programmes and technology prizes;

(c) A global clean technology venture capital fund, and sharing pools/funds related to intellectual property;

(d) A global network of technology transfer and information mechanisms, based on existing global and regional centres, online platforms, clearing houses, international conventions with technology provisions and economic partnership agreements;

(e) Public-private partnerships on collaborative intellectual property systems and licensing;

(f) A network of capacity development programmes and knowledge platforms within the United Nations system, to promote clean technology transfer, diffusion and public participation;

(g) An international network of technology assessment centres and/or national and global advisory groups on technology assessment and ethics;

(h) An independent advisory team (or dialogue mechanism) within the United Nations, composed of experts and stakeholders, possibly drawing on a large pool of experts;

(i) A management and coordination structure within the United Nations, including regional and subregional cooperative mechanisms and national coordination units.

52. It needs to be emphasized that the proposals listed in table 3 complement each other. If undertaken in a coordinated fashion, important synergies are expected, despite the differences in the proposers' perspectives on technology and sustainable development and their rather different priorities.

[31] Expert Group on Technology Transfer, "Five years of work", available from unfccc.int/resource/docs/publications/egtt_eng.pdf.

Table 3
Institutional proposals for improved technology facilitation

Stages	*Objective*	*Means*	*Institutional proposal*	*By*	*When*	*Source*
Research to development (to demonstration)	Knowledge-sharing	Partnership	Global mechanism for research cooperation on sustainable development by 2013	European Union	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Agenda 21, Johannesburg Plan of Implementation
		Programme	National research and education networks, including national science, technology and innovation observatories	Economic and Social Commission for Western Asia	Inputs for A/67/348	Submission
				Economic and Social Council	2012	Economic and Social Council resolution 2012/6
	Strengthen research, development and demonstration	Fund	Global network of regional science foundations, with technology development fund or funding mechanism to enable participation of developing countries in international research and development projects	Brookings Institution	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Department of Economic and Social Affairs (2008)
				Department of Economic and Social Affairs, Economic and Social Commission for Asia and the Pacific	Inputs for A/67/348	
		Partnership	Global research and development alliance on key technologies, with collaborative regional networks of research centres and partnerships	General Assembly	Rio/Johannesburg Plan of Implementation	
				Economic Commission for Africa, Department of Economic and Social Affairs	Inputs for A/67/348	Agenda 21, Johannesburg Plan of Implementation, Department of Economic and Social Affairs (2008)
		Legal	International, regulatory body on technology development	Kazakhstan	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
	Technology transfer	Fund	Publicly supported centres for technology development and transfer	Department of Economic and Social Affairs	Inputs for A/67/348	Department of Economic and Social Affairs (2008)

Stages	*Objective*	*Means*	*Institutional proposal*	*By*	*When*	*Source*
Development to demonstration	Business incubation	Partnership	Network of national business incubators, with programme on technology incubators	United Nations Educational, Scientific and Cultural Organization	Inputs for A/67/348	
				Brookings Institution	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
		Fund	Technology prizes	Department of Economic and Social Affairs	Inputs for A/67/348	Department of Economic and Social Affairs (2008)
Demonstration to market formation	Reduce risk	Fund	Global clean technology venture capital fund (a risk capital fund)	Department of Economic and Social Affairs	Inputs for A/67/348	Department of Economic and Social Affairs (2008)
			Intellectual property sharing pool or fund	Brookings Institution	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	
Market formation to diffusion	Technology transfer	Fund	Technology Mechanism of the United Nations Framework Convention on Climate Change (Technology Executive Committee and Climate Technology Centre and Network)	United Nations Framework Convention on Climate Change, Economic Commission for Latin America and the Caribbean, United Nations Office for Project Services, United Nations Capital Development Fund, United Nations Development Programme	Inputs for A/67/348	United Nations Framework Convention on Climate Change
			Technology transfer fund, loan and grant programmes		Inputs for A/67/348	Submission
		Programme	Online technology transfer facilitation mechanism (Technology4sme.net) or platform (planned by the Republic of Korea)	Economic and Social Commission for Asia and the Pacific, United Nations Educational, Scientific and Cultural Organization	Inputs for A/67/348	
			Regional technology centres (Economic and Social Commission for Western Asia and Economic and Social Commission for Asia and the Pacific)	Economic and Social Commission for Western Asia, Economic and Social Commission for Asia and the Pacific	Inputs for A/67/348	Submission
		Legal	Environmental and other conventions with technology transfer commitments	Economic Commission for Europe, International Maritime Organization	Inputs for A/67/348	Conventions

Stages	*Objective*	*Means*	*Institutional proposal*	*By*	*When*	*Source*
Market formation to diffusion			Economic partnership agreements on green technology transfer and deployment (including sustainable energy trade agreement)	India, International Centre for Trade and Sustainable Development	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
	Reduce intellectual property rights constraints	Partnership	Improved licensing systems: voluntary patent pools, Eco-Patent Commons, blue skies proposal of the European Patent Office, and other collaborative intellectual property mechanisms, including open-source and general public licences	Economic Commission for Europe, Organization for Economic Cooperation and Development	Outcome document (General Assembly resolution 66/288)	Submission
				Department of Economic and Social Affairs	Inputs for A/67/348	Department of Economic and Social Affairs (2008)
	Technology information	Programme	Network of clearing houses of technology information, including renewable energy technology banks	Economic and Social Commission for Asia and the Pacific	Inputs for A/67/348	Agenda 21
				General Assembly	United Nations Conference on Environment and Development	
	Knowledge-sharing	Programme	United Nations capacity development programmes, including network of knowledge platforms (based on the investment and technology promotion offices, national cleaner production centres, network for resource efficient and cleaner production, international technology centres and climate technology centres of the United Nations Industrial Development Organization) (considering spider-web, public-private structure)	United Nations Industrial Development Organization, World Intellectual Property Organization, United Nations Development Programme	Inputs for A/67/348	Submission
			Public-private knowledge sharing infrastructure	Economic Commission for Europe, Organization for Economic Cooperation and Development	Outcome document (General Assembly resolution 66/288)	Submission
	Public participation	Legal	Committee on technological diffusion and conservation to promote public participation and technology diversification/ diffusion	Economic and Social Commission for Western Asia Technology Centre	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission

Stages	*Objective*	*Means*	*Institutional proposal*	*By*	*When*	*Source*
Market formation to diffusion	Technology assessment	Legal	Intergovernmental mechanism for impact assessment of new technologies (e.g., through an institutional convention)	Action Group on Erosion, Technology and Concentration, Annual Conference of the Department of Public Information for Non-Governmental Organizations, Asia-Pacific Research Network	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
		Expert advice	Global advisory committee for the socioeconomic and ecological evaluation of new technologies	Action Group on Erosion, Technology and Concentration	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
			National advisory groups on technology ethics	General Assembly	United Nations Conference on Environment and Development	Agenda 21
		Partnership	International network of technology assessment centres	General Assembly	United Nations Conference on Environment and Development	Agenda 21
Across (almost) all stages	Technology facilitation	Partnership	Global technology mechanism (or technology sharing facility, or technology clearing house, or global green innovation and technology partnership) to facilitate technology transfer and sharing	Group of 77, Belarus, Plurinational State of Bolivia, United Nations Environment Programme, Asia-Pacific Youth (major group), International Centre for Trade and Sustainable Development	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Agenda 21
			Identify options for a facilitation mechanism that promotes the development, transfer and dissemination of clean and environmentally sound technologies (for consideration by the General Assembly)	General Assembly	Outcome document (General Assembly resolution 66/288)	General Assembly resolution 66/288, paragraph 273
	Knowledge-sharing	Programme	Support mechanism for capacity-building and funding	European Union, Economic Commission for Europe	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Agenda 21, Johannesburg Plan of Implementation
				Economic Commission for Africa	Inputs for A/67/348	
			Research capacity and outreach unit to monitor, forge partnerships and facilitating technology transfer	Economic Commission for Latin America and the Caribbean	Inputs for A/67/348	Submission

Stages	*Objective*	*Means*	*Institutional proposal*	*By*	*When*	*Source*
Across (almost) all stages		Expert advice	United Nations independent advisory body (including gender advisory board)	Economic Commission for Africa, United Nations Entity for Gender Equality and the Empowerment of Women	Inputs for A/67/348	Submission
				Economic and Social Commission for Western Asia	Inputs for A/67/348	Submission
			Sectoral, intergovernmental or expert forums and dialogue mechanisms (e.g., Intergovernmental Panel on Sustainable Development)	Indonesia, Stakeholder Forum, Children and youth (major group)	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Agenda 21, Johannesburg Plan of Implementation
			Implementation through resource pool of experts from partner institutions (including women scientists)	United Nations Environment Programme, United Nations Entity for Gender Equality and the Empowerment of Women	Inputs for A/67/348	Submission
	Public participation	Partnership	Multi-stakeholder Steering Committee (Members States, private sector, research communities, international organizations) with inter-agency secretariat support	International Telecommunication Union	Inputs for A/67/348	Submission
		Legal	Consider a global version of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention)	Pardee Center	Preparatory process for the United Nations Conference on Sustainable Development (2011-2012)	Submission
	Coordination	Partnership	Core United Nations structure to manage and coordinate activities	United Nations Environment Programme	Inputs for A/67/348	Submission
			Regional and subregional cooperative mechanisms (with regional steering committees)	General Assembly	Rio/Johannesburg Plan of Implementation	Agenda 21, Johannesburg Plan of Implementation
		Programme	Coordination unit in national Government (focal point)	Economic Commission for Latin America and the Caribbean, United Nations Environment Programme	Inputs for A/67/348	Submission

B. Functions, format and working methods

53. Hundreds of functions have been suggested for the technology facilitation mechanism, which can be summarized in 124 functions (see sustainabledevelopment.un.org). Of the above-mentioned functions, 50 were concerned with knowledge-sharing, 16 with strengthening research and development, 22 focus directly on technology transfer, 17 on technology goals and mandates, and 19 on policy environment and financing. The suggested functions covered actions across all technology stages, including research, development, demonstration, market formation and diffusion. Functions to support capacity-building, technology access, technology transfer and diffusion, funding and technology goals and mandates were much emphasized.

54. In their inputs for the report, organizations within the United Nations system suggested their own working methods (see table 4) and their own areas of work as high priority areas or sectors for the technology facilitation mechanism (see table 5). However, when all inputs are combined, the resulting lists are much in line with the areas highlighted in the outcome document of the United Nations Conference on Sustainable Development.

Table 4
List of working methods and format, as proposed by United Nations organizations

Type	*Means*	*Working methods and format*
Capacity-building	General	(New) capacity-building programmes
	Training	Training of professionals, workshops, training materials and toolkits
	Awareness	Outreach and awareness activities, especially for end users
Networking	Intergovernmental dialogue	Intergovernmental or expert dialogue in specific sectors, including regional cooperation
		Annual information sharing event during sessions of the Commission on Sustainable Development or of the high-level forum of the General Assembly
	Networks	Regional network of centres of excellence, partnerships and hubs
		Networks of a scientific, regulatory or technical nature
		Collaborating centres in academia, and international laboratories
	Information and communications technology platforms	Online knowledge platform (national, regional and global)
		Online technology transfer facilitation mechanism
		Regional information systems for resource mapping

Type	*Means*	*Working methods and format*
Other technical cooperation	Projects	Demonstration and pilot projects (including under regional initiatives and management plans)
		United Nations Development Assistance Frameworks and South-South cooperation
	Funds	Technology development fund
		Small loan and grants, including concessional loans and risk-capital grants
	Advisory services	Scoping mission, advice, consultation
		Supporting technology incubators
		Intermediary services
		Implementation through a resource pool of experts
Policy analysis and regulation	Analytical studies	Country reviews and profiles
		Coordinated research programmes
		Technology transfer and efficiency performance criteria and impact indicators
		Identification of good practices
		Monitoring of geographical representation and gender balance
	Instruments and regulation	Regulation, mandatory requirements, standardization and intellectual property rights
		Market-based mechanisms
		National focal point system

Table 5
Priority areas for the technology facilitation mechanism, as proposed by United Nations organizations

Scope	*Priority technology areas*
General	All technologies (beyond scope of existing instruments)
	Publicly owned or publicly funded technologies
	University-industry-government technologies
	Public participation
	Gender

Scope	*Priority technology areas*
Health and safety	Public health (neglected tropical diseases, malaria, tuberculosis)
	Industrial safety
	Disaster risk reduction
Environment	Sustainable procurement
	Environmentally sound technologies and production
	Low carbon technologies
	Air pollution (including ozone)
	Environmental monitoring and assessment
	Green economy
Energy	(Clean and/or renewable) energy
	Access to modern, clean energy services
	Energy efficiency and conservation (including in transport sector)
Infrastructure	Sustainable infrastructure and transport
	Water
	Waste management
	Green buildings
	Information and communications technologies
Resources	Oceans and marine technology
	Agriculture and food security
	Forests

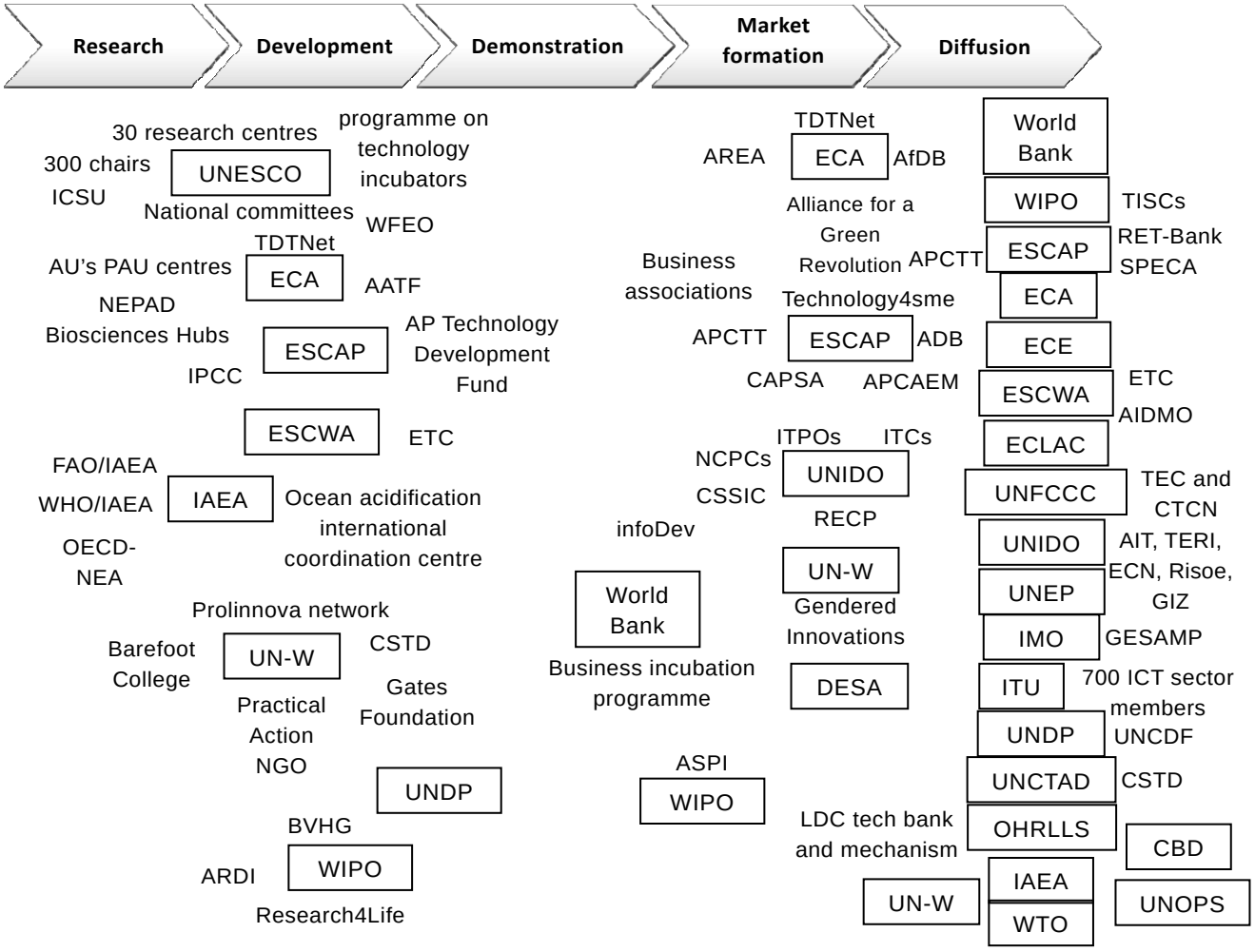
C. Contributions from the United Nations and partnerships

55. At present, a large number of partnerships, programmes, projects and instruments are managed by United Nations organizations. Most of them focus on a specific sector or particular region, and a majority of them address the final stages of the technology life cycle, from market formation to diffusion, primarily aiming to facilitate technology transfer, investment or capacity-building (see figure 3, below).

56. In the absence of an effective coordination mechanism, coordination between United Nations organizations occurs primarily on an informal level. Hence, a global technology facilitation mechanism that builds on this work and reaps synergies through networking and partnerships appears to be a promising, effective intervention.

57. In their inputs for this report, many organizations detailed the contributions that they could offer for a future technology facilitation mechanism and the most important partners they would like to see involved. Most of the pledged contributions represent, in essence, a scaling up (geographically or financially) and sharing of their existing initiatives. There appears to be minimal overlap, with most contributions focusing on further diffusion and technology transfer, and little to support the link between demonstration and market formation, as shown in figure 3.

Figure 3
Overview of United Nations contributions (boxes) and selected partnerships (without boxes)



Abbreviations: AATF, African Agriculture Technology Foundation; ADB, Asian Development Bank; AfDB, African Development Bank; AIDMO, Arab Industrial Development and Mining Organization; AIT, Asian Institute of Technology; Alliance for a Green Revolution: Alliance for a Green Revolution in Africa; AP, Asia-Pacific; APCAEM, United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery; APCTT, Asian and Pacific Centre for Transfer of Technology; ARDI, Access to Research for Development and Innovation programme; AREA, African Renewable Energy Alliance; ASPI, Access to Specialized Patent Information programme; AU's PAU centres, Pan African University centres of the African Union; BVHG, BIO Ventures for Global Health; CAPSA, Centre for Alleviation of Poverty through Sustainable Agriculture; CBD, Convention on Biological Diversity; CSSIC, Centres for South-South Industrial Cooperation; CSTD, Commission on Science and Technology for Development; CTCN, Climate Technology Centre and Network of the Framework Convention; DESA, Department of Economic and Social Affairs; ECA, Economic Commission for Africa; ECE, Economic Commission for Europe;

ECLAC, Economic Commission for Latin America and the Caribbean; ECN, Energy Research Centre (the Netherlands) (Energieonderzoek Centrum Nederland); ESCAP, Economic and Social Commission for Asia and the Pacific; ESCWA, Economic and Social Commission for Western Asia; ETC, Technology Centre of the Economic and Social Commission for Western Asia; FAO, Food and Agriculture Organization of the United Nations; Gates Foundation, Bill and Melinda Gates Foundation; GESAMP, Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection; GIZ, Deutsche Gesellschaft für Internationale Zusammenarbeit; IAEA, International Atomic Energy Agency; ICSU, International Council for Science; IMO, International Maritime Organization; infoDev, infoDev programme of the World Bank; IPCC, Intergovernmental Panel on Climate Change; ITCs, international technology centres; ITPOs, investment and technology promotion offices; ITU, International Telecommunication Union; LDC tech bank and mechanism: technology bank and mechanism for the least developed countries; NCPCs, national cleaner production centres; NEPAD, New Partnership for Africa's Development; NGO, non-governmental organization; OECD-NEA, Nuclear Energy Agency of the Organization for Economic Cooperation and Development; OHRLLS, Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States; RECP, network for resource efficiency and cleaner production; RET-Bank, renewable energy technology bank of the Asian and Pacific Centre for Transfer of Technology; Risoe, United Nations Environment Programme Risoe Centre on Energy, Climate and Sustainable Development (Denmark); SPECA, United Nations Special Programme for the Economies of Central Asia; TDTNet, African Technology Development and Transfer Network; TEC, Technology Executive Committee of the Framework Convention; Technology4sme, web-based technology transfer facilitation mechanism of the Asian and Pacific Centre for Transfer of Technology (Technology4sme.net); TERI, the Energy and Resources Institute (India); TISCs, technology and innovation support centres; UNCDF, United Nations Capital Development Fund; UNCTAD, United Nations Conference on Trade and Development; UNDP, United Nations Development Programme; UNEP, United Nations Environment Programme; UNESCO, United Nations Educational, Scientific and Cultural Organization; UNFCCC, United Nations Framework Convention on Climate Change; UNIDO, United Nations Industrial Development Organization; UNOPS, United Nations Office for Project Services; UN-W, United Nations Entity for Gender Equality and the Empowerment of Women; WFEO, World Federation of Engineering Organizations; WHO, World Health Organization; WIPO, World Intellectual Property Organization.

Support for research, development and demonstration

58. The Economic Commission for Africa (ECA) offered support through its initiatives, networks and partners, in particular the regional coordination system mechanisms; biosciences hubs of the New Partnership for Africa's Development; the centres of excellence of the African Network for Drugs and Diagnostics Innovation; the African Technology Development and Transfer Network; Pan African University centres of the African Union; African and United Nations clusters on science and technology; and the African Agriculture Technology Foundation.

59. The Economic and Social Commission for Western Asia (ESCWA) emphasized the role of its technology centre, which is establishing national observatories for sciences, technology and innovation.

60. The United Nations Educational, Scientific and Cultural Organization (UNESCO) offered its existing programme and institutional support, including on marine technology transfer. More than 30 research centres affiliated with UNESCO; 300 Chairs appointed by UNESCO; national committees; and the programme on technology incubators could be mobilized as partners. The International Council for Science (ICSU) and the World Federation of Engineering Organizations were also considered essential partners.

61. The International Atomic Energy Agency (IAEA) offered its expertise in nuclear energy and nuclear applications in many sectors. Suggested partners include laboratories, ministries and individual experts; the collaborations between the Food and Agriculture Organization of the United Nations (FAO) and IAEA, and IAEA and the World Health Organization (WHO); the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD); and the recently launched Ocean Acidification International Coordination Centre of IAEA.

62. The United Nations Entity for Gender Equality and the Empowerment of Women (UN-Women) would help to ensure that gender equality considerations and commitments are considered, including in terms of education and dialogue mechanisms. Suggested partners include UNESCO, networks of women scientists, Barefoot College, the Gender Advisory Board of the Commission on Science and Technology for Development, the Bill and Melinda Gates Foundation, and the non-governmental organizations Practical Action and Prolinnova.

63. The Economic and Social Commission for Asia and the Pacific (ESCAP) reported on its proposal for an Asia-Pacific technology development fund.

Market formation and diffusion

64. The Economic Commission for Africa offered the support of its initiatives and networks. Suggested partners include the African Technology Development and Transfer Network, the Alliance for a Green Revolution in Africa, the African Renewable Energy Alliance, regional coordination mechanisms and the African Development Bank.

65. The Economic and Social Commission for Asia and the Pacific suggested expanding the web-based technology transfer facilitation mechanism (available from www.technology4sme.net) of the Asian and Pacific Centre for Transfer of Technology, and involving the United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery and the Centre for Alleviation of Poverty through Sustainable Agriculture. Suggested partners include experts from the Intergovernmental Panel on Climate Change, United Nations country teams, national agencies, business associations, the Asian Development Bank and financial institutions.

66. The United Nations Industrial Development Organization suggested its knowledge platforms as operational elements of the technology facilitation mechanism, including its investment and technology promotion offices; national cleaner production centres; its network for resource efficient and cleaner production; international technology centres, centres for South-South industrial cooperation; and its Institute for Capacity Development. Suggested partners include the United Nations Environment Programme (UNEP), Governments, industry associations and university institutes.

67. The United Nations Entity for Gender Equality and the Empowerment of Women advocated for investment in technology and the development of environmentally sound technologies that would benefit women and girls, especially in rural areas. Suggested partners include the project on Gendered Innovations.

Further diffusion

68. The Economic and Social Commission for Asia and the Pacific is building a renewable energy technology bank through its Asian and Pacific Centre for Transfer of Technology. That Centre also hosts the Renewable Energy Cooperation-Network for the Asia-Pacific, and ESCAP entities include its intergovernmental mechanism on energy cooperation in North-East Asia, and among its partnerships are the Seoul Initiative Network on Green Growth, and a clean technology project with the United Nations Special Programme for the Economies of Central Asia.

69. the Technology Centre at ESCWA could contribute to the facilitation mechanism by conducting analysis, technical cooperation and partnerships. Suggested partners include United Nations country teams, national agencies, the Arab Industrial Development and Mining Organization, business associations, regional financial institutions and El Hassan Science City.

70. The secretariat of the Framework Convention, UNIDO and UNEP suggested contributions from the Technology Executive Committee of the Framework Convention and the future Climate Technology Centre and Network. Partners might include the Asian Institute of Technology, the Bariloche Foundation, the Council for Scientific and Industrial Research (South Africa), the Energy and Resources Institute (India), Environnement et Développement du Tiers Monde, the Tropical Agricultural Research and Higher Education Centre (Costa Rica), the World Agroforestry Centre, Deutsche Gesellschaft für Internationale Zusammenarbeit, the Energy Research Centre (the Netherlands), the National Renewable Energy Laboratory (United States of America) and UNEP Risoe Centre on Energy, Climate and Sustainable Development (Denmark).

71. The Economic Commission for Europe offered to conduct its environmental performance reviews worldwide, upon request, and to share its open-source guidance, guidelines and checklists. Suggested partners were collaborators in implementation of ECE conventions.

72. The Economic Commission for Latin America and the Caribbean (ECLAC) offered technical support for the mechanism, including in terms of performance management, policy analysis, training and platforms for information and communication technologies (e.g., the Small Island Developing States Network) to capture indigenous experiences and monitor technology impacts. Suggested partners include the Caribbean Community (CARICOM); Brazil; the University of the West Indies; the Caribbean Telecommunications Union; the Caribbean Knowledge and Learning Network; ministries of energy, education and science and technology; solid waste management entities; chambers of commerce; and the Caribbean Development Bank.

73. The International Maritime Organization (IMO) highlighted its project on Building Partnerships to Assist Developing Countries to Reduce the Transfer of Harmful Aquatic Organisms in Ships' Ballast Water (GloBallast Partnerships) and its partnership with the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection through a ballast water working group, and suggested working with current IMO partners.

74. The United Nations Environment Programme (UNEP) highlighted its role as implementing agency of the Multilateral Fund for the Implementation of the Montreal Protocol. UNEP and UNIDO offered their global network of 42 national cleaner production centres, the Green Industry Platform, a technology needs assessment project for the Global Environment Facility (GEF) and sectoral initiatives to phase out inefficient technologies (e.g., en.lighten initiative).

75. The International Telecommunication Union (ITU) offered to contribute to a knowledge-sharing platform, mobilize technology experts and ITU sector members, showcase applications, promote standardization, and support multi-stakeholder initiatives. Suggested partners include companies and technology developers, industry associations, 700 information and communications technology sector

members, 40 academic institutions, and the Broadband Commission for Digital Development, established by ITU and UNESCO.

76. The World Intellectual Property Organization (WIPO) offered to provide support for access to technology information, including through its PatentScope search service, patent landscape reports, its Access to Specialized Patent Information and Access to Research for Development and Innovation programmes, the Sustainable Technology Marketplace of WIPO (WIPO Green), and technology and innovation support centres. It would provide training and tools on intellectual property assets management and legislation and continue to provide information and statistics relevant to intellectual property. Suggested partners include United Nations organizations, GEF, the Climate Technology Centre and Network of the Framework Convention, the Global Compact Office, the infoDev programme of the World Bank on climate innovation centres, BIO Ventures for Global Health and Research4Life.

77. The United Nations Capital Development Fund offered support through its Clean Start programme on energy access in Asia and Africa. Suggested partners include the business support service providers, industry associations, carbon finance brokers and institutions in financing, training, market and technology research.

78. The United Nations Office for Project Services (UNOPS) offered its initiatives on low carbon infrastructure and sustainable procurement, including a loan scheme related to the clean development mechanism and a small grants programme. Suggested partners include United Nations organizations, academia, private companies and non-governmental organizations.

79. The United Nations Development Programme (UNDP) offered its support in terms of advisory services, capacity-building, stakeholder participation, policy development, tools and best practices. Suggested partners include the Green Growth Knowledge Platform, the United Nations Development Group, the resident coordinator system, the Climate Technology Centre and Network and the Environment Management Group.

80. The Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States is following up to paragraph 14 of General Assembly resolution 66/213 to undertake a joint gap and capacity analysis by 2013, with the aim of establishing a technology bank and mechanism for the least developed countries.

81. The United Nations Conference on Trade and Development (UNCTAD) offered cooperation from the Commission on Science and Technology for Development, which has examined a number of priority themes that are closely related to the development, diffusion and transfer of environmentally sound technologies. The Commission would continue to provide a platform to share good practice cases, with a view to identifying gaps and needs, as well as effective policy options.

82. The World Bank offered infoDev as a partner to provide advice on technology transfer, notably in the fields of business incubation and technology-based solutions for climate change mitigation and adaptation.

D. Technology-related sustainable development goals

83. A preference for technology-related sustainable development goals and/or targets is apparent from the submissions. Any future global technology facilitation mechanism should have some role in suggesting, setting, monitoring and facilitating the achievement of such goals. No single submission suggested a consolidated list of global technology goals, however, when all submissions where compiled, the outline presented in table 6 could be defined: goals need to ensure that technology progress makes sense globally, that the need for equity is fulfilled, and that the institutions are prepared for the challenge.

Table 6
Potential areas to be considered for technology goals

Principle	*Potential goal*	*Elaboration on potential targets*
It needs to make sense globally	Global technology performance improvement by a "factor 4"	This goal might be elaborated in the form of eco-efficiency targets for 2030 and 2050, for example: • Increase global resource and energy efficiency by a "factor 4" by 2050. This might mean doubling the level of energy services, while halving primary energy and resource use and overall pollution • Issue-specific technology performance targets for 2030: reduce energy and resource/materials intensity by at least 40 per cent and double the use of wastewater treatment and solid waste management • Issue-specific technology performance targets for 2020: increase water efficiency in agriculture and energy, as well as food supply-chain efficiency, by 20 per cent
Need for equity	Universal access to sustainable technology	This goal might be elaborated in the form of universal access targets in such areas as modern, clean and affordable energy and transport services; clean water, sanitation and wastewater treatment; recycling and solid waste management; and modern information and communications technologies, by 2030
Institutions need to be prepared for the challenge	Global green innovation system for sustainable development	This goal might be elaborated in the form of institutional and inputs targets by 2030, for example: • Global research, development and demonstration cooperation system that is open for participation by entities from all countries • Global intellectual property rights system that promotes technology development, innovation, access and transfer. It would value quality over quantity and support new forms of licensing, voluntary patent pools, and free and open-source collaboration • Combined public and private investment of at least 2 per cent of gross domestic product in research, development and demonstration in all countries, and at least 3 per cent in technologically advanced economies • Publicly funded technology, scientific discoveries and creative works made freely available for sustainable development

IV. Recommendations

84. **A global technology facilitation mechanism is needed, and to be effective, it must draw upon lessons learned as guiding principles.**

85. **The analysis contained in the present report leaves no doubt that there is a need for a global technology facilitation mechanism under the auspices of the United Nations. An initial set of 14 lessons learned are proposed in the report (para. 46), which could serve as general guiding criteria for future deliberations on the details of a mechanism.**

Recommended elements of the technology facilitation mechanism

86. **Essential elements of the global technology facilitation mechanism can be derived from the proposals contained in section III of the report. In paragraph 51, key elements of a mechanism are outlined, drawing on hundreds of institutional proposals. Ideally, the technology facilitation mechanism would follow the structure illustrated in figure 4:**

(a) **The mechanism should be either part of or under intergovernmental direction of the high-level political forum, in order to ensure global coordination. In the latter case, it could be envisaged as a voluntary partnership;**

(b) **The management and coordination structure within the United Nations would consist of secretariat functions, provided by the Department of Economic and Social Affairs, to support the mechanism and the forum at the global level, regional and subregional cooperative mechanisms led by the regional commissions, and national coordination units led by the offices of the United Nations resident coordinators and of the organizations of the United Nations system with a national presence. Close cooperation with the entire United Nations system (including through UN-Energy and UN-Water) and with the advisory groups to the Secretary-General will be essential;**

(c) **The United Nations Conference on Trade and Development should continue to service the Commission on Science and Technology for Development. The Commission should be encouraged to monitor and recommend actions to the high-level political forum and technology facilitation mechanism;**

(d) **The technology facilitation mechanism would suggest overall technology-related sustainable development goals and promote four types of global and regional networks (initially based on existing institutions): networks of science foundations; networks of business incubators; networks of policy, intellectual property and organizations that aim to reduce and share risk; and networks of technology transfer mechanisms and related instruments:**

(i) **The global network of science foundations would support priority-setting, research funding, international exchange and cooperation. It would link academia, public and private research and development centres, laboratories and research and development programmes. The global network (or partnership), ideally supported by technology development funds, would aim to strengthen global cooperation in research, development and demonstration, technology transfer and the participation of developing countries in research, development and demonstration programmes; possible models include the National Science**

Foundation (United States of America), the public-private partnership model applied to vaccines and drugs for neglected tropical diseases, the Consultative Group on International Agricultural Research, the former programme of the European Union for advanced communications technologies and the Baltic Sea Innovation Network Centres project;

(ii) **The global network of national business incubators would support business plans and product development, build capacity for production skills and provide seed money. The network would link entrepreneurs and start-ups, pro-poor community enterprises, and various United Nations and non-United Nations support programmes. The network could also institute technology prizes for the demonstration of technologies with great sustainable development impact. Possible models include the World Bank climate innovation centres, the Centre for Innovation, Entrepreneurship and Technology (Brazil) and the Centre for Innovation, Incubation and Entrepreneurship (India);**

(iii) **The global network of policy, intellectual property and organizations that aim to reduce and share risk would aim to provide support for the acquisition and sharing of intellectual property, risk guarantees, equity/debt instruments and venture capital. The network would link public-private and philanthropic partnerships on collaborative intellectual property systems and licensing, organizations providing risk capital and, ideally, a global venture capital fund.** [32] **It might also involve an international network of technology assessment centres or relevant advisory groups, in order to provide policymakers with advice. Possible models include existing venture capital funds, the Green Climate Fund private sector facility, the South-South Global Assets and Technology Exchange System, the Pool for open innovation against neglected tropical diseases, the Eco-Patent Commons of the World Business Council for Sustainable Development, and the Re:Search Open Innovation Platform and the Sustainable Technology Marketplace of WIPO;**

(iv) **The global network of technology transfer and information mechanisms would aim to promote investment and technology transfer, by promoting partnerships among existing global and regional centres, online technology information platforms, clearing houses, technology instruments of international agreements, relevant economic partnership agreements, international financial institutions and technology funds. It would also forge a global network of United Nations capacity development programmes and knowledge platforms, to promote clean technology transfer, diffusion and public participation. Essential parts of this network would be the future Climate Technology Centre and Network of the Framework Convention, as well as the future technology bank/supporting mechanism for the least developed countries called for by the General Assembly in its resolution 66/213. Possible models include the web-based technology transfer facilitation mechanism of the Asian and Pacific Centre for Transfer of Technology, the technology centres of the United Nations Industrial Development Organization, the green revolution model of**

[32] See also Ghosh et al, "A partnership for a decarbonized energy future", *World Affairs: The Journal of International Issues*, vol. 10, No. 1, 2006.

publicly funded centres, and the Climate Technology Centre and Network, which is under development.

Recommended way forward

87. **The Secretary-General recommends the immediate constitution of an intergovernmental preparatory working group, serviced by the Department of Economic and Social Affairs, and supported by a pool of experts, in order to work out institutional details, with a view to achieving an operational technology facilitation mechanism, before the end of 2013, that would report to the high-level political forum.**

Figure 4

Recommended technology facilitation mechanism and its interlinkages with the United Nations system and non-United Nations partners