UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

UNCTAD

Science, Technology & Innovation Policy Review

Islamic Republic of Iran

UNITED NATIONS
New York and Geneva, 2016

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Two dots (..) indicate that data are not available or are not separately reported. Use of a dash (-) between dates representing years (e.g. 2008-2010) signifies the full period involved, including the beginning and end years.

Reference to "dollars" ($) means United States dollars, unless otherwise indicated.

Details and percentages in tables do not necessarily add to totals because of rounding.

UNITED NATIONS PUBLICATION
UNCTAD/DTL/STICT/2016/3

ACKNOWLEDGEMENTS

The Science, Technology and Innovation Policy (STIP) Review of the Islamic Republic of Iran was prepared under the direct supervision of Angel Gonzalez Sanz, Head of the Science, Technology and ICT Branch (UNCTAD). The preparation of the Review was coordinated by Michael Lim (UNCTAD). Background reports were prepared by Martin Schaaper of the UNESCO Institute of Statistics (for STI indicators), Thomas Andersson, Chairman of the International Organisation for Knowledge Economy and Enterprise Development (for the national innovation system), Eva Dantas, consultant and associate fellow at the Science Policy Research Unit (SPRU), University of Sussex (for oil and gas) and Kathryn Stokes, consultant (for biotechnology). Mesut Saygali (UNCTAD) participated in the second field mission and helped with the preparation of the chapter on STI indicators. The collaboration of the UNESCO Institute for statistics on this project is gratefully acknowledged.

UNCTAD worked closely with the Vice-Presidency for Science & Technology (VPST) of Iran in the preparation of this Review, and the STIP Review would not have been possible without their collaboration. Dr. Mehdi Mohammadi, faculty member at the University of Tehran, was the coordinator of the STI Policy Review for the VPST. UNCTAD thanks the staff of VPST for their valuable support to this project.

The Review benefited greatly from comments and suggestions provided by many people in Iran. Numerous people in Iran, including government officials, university and research institute staff, private sector representatives and others gave generously of their time and insights to the research team involved in the drafting of the Review. All of these contributors are gratefully acknowledged.

The manuscript was copy edited externally by Praveen Bhalla and typeset externally by Laurence Duchemin. Nadège Hadjemian (UNCTAD) designed the cover.

EXECUTIVE SUMMARY

The Islamic Republic of Iran has made significant advances in research, higher education and technology since 1990. It has a vast wealth of oil and gas (O&G) reserves, estimated as the 4th and the 2nd largest in the world, respectively, as well as significant minerals and other natural resources. Despite this, it has managed to avoid the so-called "natural resource curse". The industrial sector has grown both in scope and diversity in recent decades, making Iran the most economically diversified economy, with the lowest dependence on O&G incomes, compared with other oil-rich countries in the region. During the past two decades, Iran has committed itself to the development of a dynamic national innovation system (NIS) and has been moving steadily towards a knowledge- and innovation-based economy. The period of international sanctions strengthened its resolve to achieve this goal. As a result of this commitment, the country's human resource base is now impressive: it has a large number of well-educated, trained and energetic Iranians both at home and among the diaspora living abroad as scientists, entrepreneurs and business people. At present, Iran is seeking to reinforce its productive capacity, encourage international collaboration to exchange technology and know-how, and engage more actively in innovative activities to foster economic growth and sustainable development.

UNCTAD collaborated with Iran in the preparation of an STI Policy Review in 2005 – an opportune time of policy reform, when its policymakers showed a growing interest in science, technology and innovation. It marked the start of a transition away from a strong but narrow focus on science policy. The STIP Review examined Iran's NIS, along with its oil, gas and petrochemical industries and biopharmaceuticals. Even at that time, it observed that the national development policy was aiming to shift the country from a natural-resource-based economy to a more knowledge-based one. Policymakers recognized the need for economic diversification away from the predominant O&G industry through a process of industrialization, using O&G revenues to fill the financing and foreign exchange gaps. The development strategy remained largely focused on self-reliance, although it was moving towards a more outward and export-oriented approach. Most of the issues and challenges raised in the 2005 Review have been dealt with through different policy measures and initiatives. The current STIP Review can be considered, to some extent, as a neutral and unbiased assessment of the effectiveness of government policies with regard to STI development and a pointer to the way ahead.

There have been a number of improvements in Iran's NIS during the period 2005–2015, in scientific research and publishing, higher education, exports, and ICT infrastructure. Iran's global rank in scientific publications improved from 34th in 2005 to 16th in 2015. Even though the country has not managed to massively increase research and development (R&D), research activities are emerging in new areas, including nanotechnology, biotechnology and renewable energy. In tertiary education, the number of graduate engineering students has increased, with Iran ranking second globally in terms of the number of engineering graduates per capita (according to the Global Innovation Index 2016 Report). As a result of the law for supporting knowledge-based firms (KBFs), which was ratified in 2010, 2,732 KBFs were benefiting from its financial and non-financial facilities as on October 2016. These firms accounted for a total of 70,000 employees and $6.6 billion in annual turnover. The drive for diversification through knowledge-intensive activities has led to an eightfold increase in knowledge-intensive exports. ICT infrastructure has also improved with respect to mobile phone penetration (from 12 per cent in 2005 to 93 per cent in 2015) and Internet users (from 8 per cent in 2005 to 44 per cent in 2015). Despite policy several actions, ICT infrastructure still requires higher investment to facilitate e-commerce and e-government, and to improve ICT services and make them more efficient for businesses.

Regarding structural and institutional changes in the NIS, a number of new policymaking institutions have been created over the past decade. The establishment of the Vice Presidency for S&T in 2007 and its 16 affiliated technology councils, as well as the Innovation and Prosperity Fund in 2011, are among the major institutional changes. In addition, new, supportive policies have been ratified and implemented (for example, with regard to KBFs), and other instruments and mechanisms have been created or expanded (such as incubators, S&T parks, S&T special districts, research and technology funds and venture capital funds). Since 2005, policies and initiatives have led to the emergence and reinforcement of technology- and innovation-intensive entities, such as new technology-based

firms, start-ups and KBFs. Finally, since 2013, there have been major changes in the macroeconomic environment, including growth of the services sector, control of the inflation rate and macroeconomic stabilization efforts.

Compared to the situation during the previous STIP Review, Iran has faced severely tightened international sanctions. The sanctions had been in place since 1980, but became much more extensive in 2008, and effectively excluded Iran from the international payments system. They restricted imports of some technologies and isolated the country from global collaboration. Sanctions have had multiple macro effects besides limiting international transactions. In particular, they sparked a drive for STI development and created support for a push to adopt an indigenous development approach in the country. The challenges created by sanctions mustered a remarkable and widely shared commitment to build a comprehensive and dynamic innovation system and a knowledge-based economy.

This Review identifies three waves of STI policy development in Iran since the 1990s. The first wave focusing on developing higher education started in 1990. A second wave focusing on developing research and technology (including emerging technologies and their required infrastructure) started in 2000. The third wave marking a transition towards an innovation and knowledge-based economy started in 2010. Among the outcomes of the third wave, the large pool of young, educated and skilled labour and growing research capacity have emerged as the country's most important assets today. They now need to be fully harnessed for rapid industrialization and the transition to a knowledge-based economy. The main question is how to ensure that these assets make positive economic, social and environmental impacts and contribute to sustainable development.

The "Resilient Economy" policy, which came into effect in 2014, can be seen as a pragmatic one aimed at managing international linkages and STI development under constrained circumstances in a way that strengthens national economic resilience and ensures the maximum realization of potential benefits from international trade and investment linkages.

Some of the main institutions in the innovation system retain a focus on production, without due adequate consideration to the critical role that the development of innovation capacity must play in the ability of firms and industries to compete in the domestic market or to export abroad once Iran reintegrates into the global economy. This reintegration is in progress, with Iran considering accession to the World Trade Organization (WTO). The bodies with authority over the economy, such as the Supreme Economy Council, the Ministry of Economic Affairs and Finance, and even the Chamber of Commerce, need to give greater emphasis to enhancing STI capacity as a basis for building a competitive economy in the coming years.

Overall, despite the significant progress made, Iran faces a range of challenges in several areas, including improving the business environment, modernizing an ageing infrastructure (particularly in energy and transport), stabilizing inflation, stimulating economic growth, creating jobs and raising gross domestic product per capita. Considering Iran's sizeable infrastructure in ICT, transport and power, as well as the potential effects of large-scale urbanization (with around 73 per cent of the population living in urban areas) and a large domestic market, efforts should be directed at increasing productivity through STI and leveraging the highly skilled workforce more effectively.

A new approach based on Iran's reintegration into the global economy will be confronted with a complex mix of opportunities and challenges. Iran has good potential to develop strong STI capacity and leverage it to support sustainable development. To realize this potential, policy reforms are needed. This Review proposes some major recommendations to enhance the country's STI policy efforts. These recommendations include measures to strengthen the governance of the innovation system as well as address specific policy issues considered barriers to STI development.

- **Ensure greater coherence between STI policy and other key areas of National Policy in order to increase the positive economic impacts of STI.** Diverse policy areas need to be better aligned to strengthen support for innovation, encompassing wider framework conditions as well as the mechanisms at the core of the NIS so that it has a greater impact on economic growth and sustainable development. There is an obvious need for industrial policy and STI policy to be closely linked. Coherence is also important between STI policy and FDI, trade, education, financial, competition and SME/entrepreneurship policies. Macroeconomic policies should crucially aim at maintaining economic stability and creating a pro-growth environment. The need for policy coherence also applies at the sub-national level.

- **Restructure the division of functions and responsibilities for STI governance.** Some overlaps have been observed among the key bodies that play a role in STI policymaking, design and implementation. It is advisable to devise a holistic plan to create a clear division of STI functions and responsibilities among different STI policy bodies, with clearly specified mandates. In addition, new measures, such as venture capital development, are important for promoting innovation and supporting entrepreneurship. There needs to be a change in mindsets so that all major players have a common understanding and appreciation of the role of STI and STI policy. Efforts should be made to change the traditionally dominant approach to innovation involving a linear, science-push one, to more of an innovation systems approach.
- **Establish a short- to medium-term target for an attainable level of R&D spending with a focus on promoting and providing incentives for the business sector.** In any country that invests extensively in R&D, the bulk of it is undertaken by the private sector. Hardly any government in the world invests more than 1 per cent of GDP in R&D, and part of that is used as fiscal incentives to encourage R&D investment by private companies. It is therefore recommended that Iran adjust its existing target of public spending on R&D to 1 per cent of GDP, along with a target of 1.5 per cent of GDP to be spent by the private sector. The resulting aggregate target of 2.5 per cent of GDP for R&D spending is a realistic level that could be attainable through serious effort. The focus on achieving the R&D targets should be accompanied by policy attention to promoting continued investments in further strengthening design and engineering capacity.
- **Make funding of universities, research and technology organizations performance-related by introducing R&D "project" or "mission" funding schemes targeting prioritized areas.** Iran should revise the current structure of research budgets of universities and public research organizations that is on a non-competitive basis and not conditional on performance. A centralized budget allocation system implemented through a national fund, such as the Iranian National Science Foundation, should use performance criteria in determining the extent of support to universities and public research organizations, giving priority to areas of high social and economic interest. Eligibility for funding should also be based on criteria that promote stronger linkages within the innovation system.
- **Modify the approach to evaluation and policy learning with a view to strengthening policy experimentation.** Evaluating innovation should give less weight to measuring delivery versus planned objectives. Instead, it should focus more on economic, social and environmental outcomes and impacts, evaluating the unexpected, taking direct as well as indirect impacts into account and helping to design a more effective innovation system as a whole.
- **Adopt a comprehensive strategy for attracting and benefiting from FDI as well as other external sources of funding, implementing policies and creating conditions that promote linkages, technology flows and technological learning.** Realizing the potential benefits from foreign direct investment is not automatic; it requires appropriate policies and measures, and creating the right conditions, including improving the absorptive capacity of local firms. Policymakers will need to move swiftly to take advantage of post-sanctions foreign investors interest, targeting foreign investors in industries and activities of high national priority, and promoting FDI that can help create local linkages and contribute to developing/upgrading local skills, knowledge and technological learning. Formulating an appropriate policy framework for foreign investment is therefore important. Policies on technology transfer and local content, such as the Technology Annex and the Policy on Maximum Utilization of Local Capacity, should be implemented in a pragmatic and adequately flexible manner to realize the benefits from FDI. At the same time, it is important to ensure that investments in high priority areas are not deterred by imposing unrealistic requirements and targets that will be difficult to meet in the near term.
- **Improve the credibility and usefulness of the IPR system through its comprehensive, gradual improvement, encompassing the entire IPR life cycle, for the purpose of maximizing its relevance to the innovation system.** The Iranian Parliament is currently considering reform of the IPR law. In moving forward, Iran's IPR legislation needs to be revised to ensure maximum relevance for innovation. This requires institutional backing from Parliament and key decision-makers to ensure that the full cycle, spanning all stages of the IPR process – from patent application to dispute resolution and rights enforcement, as well as awareness-raising, training and professional support – operates effectively and all elements of the cycle are properly aligned. The

issue of copyright protection will also need to be addressed as the IPR system is improved. Starting planning for this transition may become critical if Iran is to accede to the WTO.

- **Promote the goal of a knowledge-based economy across traditional industrial sectors, with continued policy support for start-ups and new growth areas, including through professional business services and an upgraded innovation and entrepreneurship ecosystem.** Iran's large traditional and mature industries are impeded by an ageing and underperforming infrastructure, which needs major upgrading and expansion over the next decade. Mature firms in established industries need incentives to invest more in innovation. Simultaneously, policymakers should continue to foster the rise of new KBFs, new activities and new industries. The existing support programme for KBFs contains a well-designed package of instruments to identify and nurture a vibrant community of young firms with high-growth potential. In addition, the Government needs to facilitate the establishment of professional business service providers capable of assisting start-ups and young growth-oriented companies in areas such as strategy, registration, funding, marketing, IPRs, healthy information exchange and negotiations. It should also encourage active engagement by venture capital firms.

Iran's biotechnology innovation system: Main conclusions and recommendations

Biotechnology in Iran dates back to the 1920s when the Pasteur and Razi Institutes started to produce vaccines. It entered the modern biotechnology era two decades ago with a focus on supply-side policies such as the establishment of new research centres, the development of many related disciplines in universities, and the introduction of new supporting laws, which led to the growth of 302 biotech KBFs. Despite significant progress in biotechnology in recent years, there are a number of challenges that need to be tackled through appropriate policy initiatives. These challenges include inadequate demand-side policies, inefficiency of IPR enforcement, inadequate access to financial resources and FDI, and inadequate commercialization processes. The following recommendations seek to help overcome these challenges:

- **Improve financing for biotechnology.** Iran should develop additional effective financing mechanisms for funding biotech development, including measures to develop a domestic venture capital market and to attract international venture capital.
- **Enhance collaboration between biotech KBFs and mature firms.** Efforts should be made to intensify competition and provide incentives to induce mature firms to become more involved in R&D activities and new product development, which will increase opportunities for collaboration with KBFs through the creation of supply chain linkages, joint R&D projects and participation in acquisitions.
- **Strengthen international collaboration on biotechnology and local biotech firms' access to international markets.** Improving access of local firms to international markets will require improved marketing, branding, skills in international negotiation and the creation of distribution networks by providing local firms with appropriate education and training, empowerment and consultancy services.
- **Improve the biotech accreditation system by enhancing laboratory and testing equipment and facilities.** Biotech accreditation bodies, biotech testing and certification systems need to be established or improved to ensure that the biotech products produced in Iran meet the quality requirements and other standards necessary for entering the local market and/or export markets.
- **Enhance local content policies as well as public procurement in favour of biotech innovations.** Public procurement could be better leveraged to encourage innovation by local firms, particularly in bio-agriculture and health.
- **Strengthen balanced applications of biotechnology in its four main subsectors: health, industry, agriculture and the environment.** Policies and actions are needed aimed at unlocking the full potential of biotechnology application in a balanced manner to help address health, industrial agricultural and environmental challenges in Iran.

Iran's oil and gas innovation system: Main conclusions and recommendations

Iran's oil and gas (O&G) industries date back to the early twentieth century, making them the oldest in West Asia. In 2015, the O&G sector accounted for around 20 per cent of GDP. Based on both achievements and challenges in the sector, the following actions and initiatives are proposed:

- **Promote collaborative learning in the O&G innovation system combined with strategies for building local capabilities.** Policymakers, executive officers and firms' managers should give due importance to engaging actively with technology and promoting technological learning for technological catch-up, as discussed in the Review. Innovation requires not only R&D, but also engineering and design capabilities, in particular. There is a need for collaboration both among domestic actors and between them and foreign firms. For policymaking, interactive learning is a key process that must be enabled through the design of appropriate mechanisms.
- **Promote supplier development, including through MNE-local firm linkages.** Supplier development and local linkages can be supported through suitable local content requirements and a technology strategy designed specifically for the O&G sector.
- **Develop public procurement instruments and shape the financial institutions and tools needed to support both supply and demand.** There should be a supportive financial system which provides three kinds of financial services: venture capital and angel investors, special organizations for funding projects, and mechanisms to cover risks and uncertainties (such as insurance).
- **Restructure the institutional set-up of the O&G sector, and foster the development of knowledge linkages and flows between S&T organizations and companies:** It would be advisable to improve horizontal coordination among the key O&G policymaking bodies, and to change the mind-set of some policymakers to adopt an *innovation systems* approach to innovation policy. In addition, there should be an increase in the participation of the productive sector in high-level decision-making for both strategic priority-setting and programme design.

To sum up, it is important to devise a policy mix for the O&G innovation system that responds to the differing demands for knowledge-oriented linkages of various types of firms. SOEs and large engineering, procurement and construction firms should participate actively in technology development. The Ministry of Petroleum and its affiliated companies should feel as responsible for technology development in the O&G sector as they are for production in that sector. It should be noted that such efforts are in motion in a limited number of divisions in that Ministry, but they need to be adopted more broadly. Furthermore, suitable local content policies should be designed and implemented in the sector in order to enhance technological collaboration between local firms and international companies, and foster the development of technological capabilities in local firms.

An overall conclusion of this Review is that Iran possesses significant assets in terms of a strong human resources base and research and technology capabilities. These assets are key prerequisites for the country's transition to a knowledge- and innovation-based economy. It is a time of great opportunity and critical decisions for national policymakers in Iran. Decisive policy initiatives and actions are needed to fully utilize these assets to boost economic growth and sustainable development. These efforts will require action by both the public and private sectors.

Decisions made in the near future may determine what path the country will pursue for many years to come. As Iran's international trade and investment relations move towards normalization, policymakers should consider mobilizing the revenues from oil, gas and minerals for investment in industrial upgrading and modernization of the infrastructure. They should also focus on fostering efforts aimed at achieving greater technological and innovation capabilities needed to drive truly sustainable growth and development in the country over the long term. This means redoubling current efforts to shift from a natural-resource-based economy towards a more knowledge- and innovation-based one. It also requires mainstreaming innovation into the development policy mix and including it in the agenda of key public and private sector institutions.

Science, Technology and Innovation in Iran at a glance

Enrolment in and graduation from tertiary education in Iran

	2005-2006	2012-2013
Students	2,389,867	4,367,901
Graduates	340,246	718,801
PhD Students	19,237	58,683

Scientific publications

	2005	2011	2015
Iran's share in scientific publications in West Asia	14.8 %	32.4 %	28.6 %
Rank in West Asia	3	1	1
Iran's share in scientific publications in the world	0.4 %	1.5 %	1.5 %
Rank in the world	34	17	16

Gender balance in higher education

47% 53%

2013-2014
High level of gender equality in both secondary and tertiary education compared to other countries in West Asia

Number of universities in Iran

Public universities	154
Public medical universities	58
Islamic Azad University	567
Private universities	354

Knowledge-based firms

52 (2014) → 2732 (2016)

Number of supported KBFs has increased from 52 in March 2014 to 2732 as of October 2016. They account for around 70,000 jobs and $6.6 billion in revenue.

Number of S&T parks in Iran
1 (2002) → 39 (2016)

Number of Incubators in Iran
136 (2013) → 170 (2016)

Companies located in S&T parks and incubators

2012	2518
2013	3000
2014	3400
2015	3650

Innovation and Prosperity Fund

1380 approved projects — $280 million total support

Technology-based exports ($ billions)

High- and medium high- tech exports

1.5 (2004) → 7 (2009) → 12.1 (2014)

Knowledge-based products exported by S&T parks and incubators ($ millions)

2012	0.7
2013	14.1
2014	49.6
2015	50.6