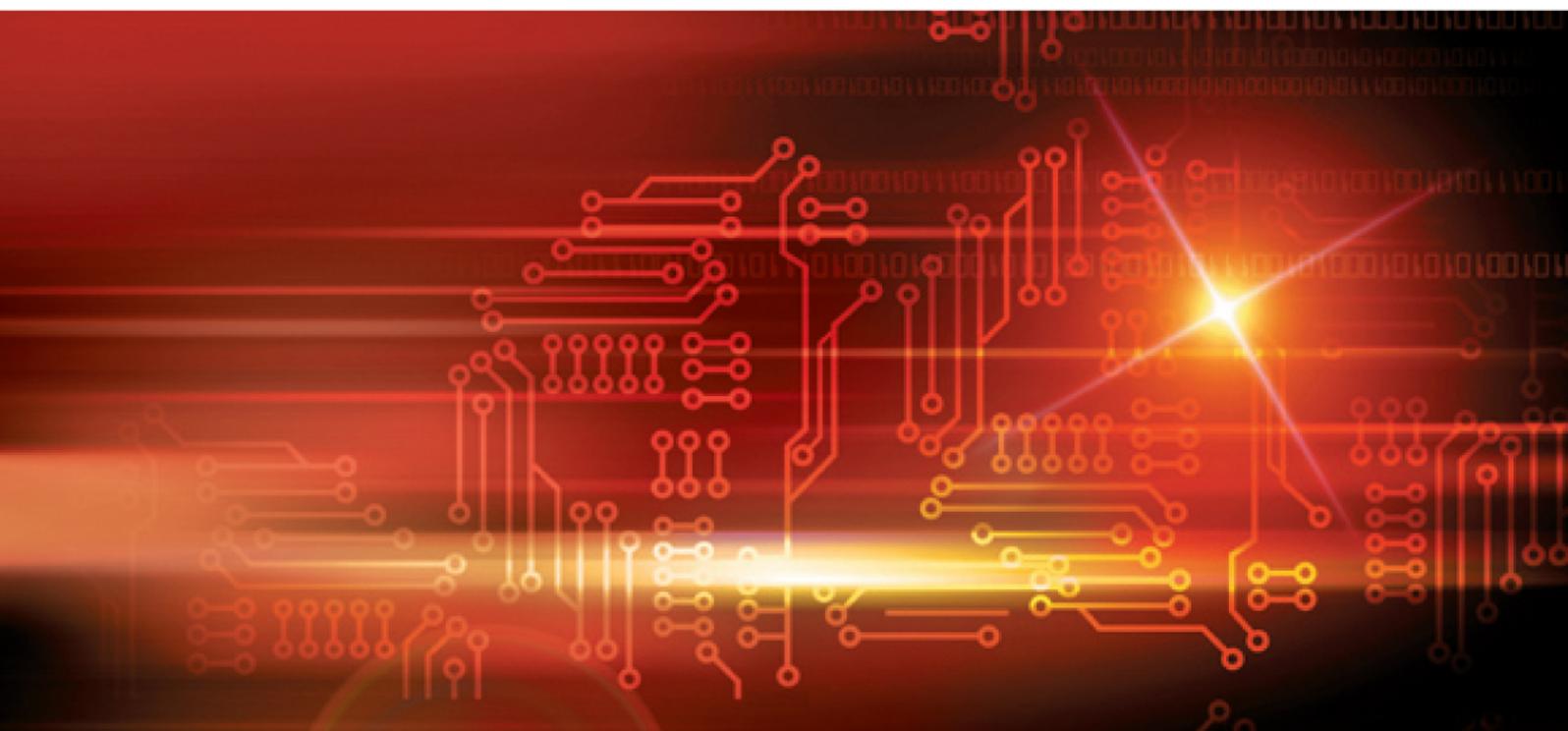


Science, Technology and Innovation Policy (STIP)

Review of Angola



UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Science, Technology and Innovation Policy (STIP)

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STIP Review of Angola

FOREWORD

As the lead agency within the United Nations system for science and technology as part of its work on trade and development, UNCTAD is pleased to publish the *STIP Review of Angola*. The latest in the STIP series, it strengthens UNCTAD's support in country-level mechanisms, including within the framework of the Millennium Development Goals as called for by its Panel of Eminent Persons. We in UNCTAD believe that technology is a crucial element for enhancing the growth prospects of developing countries and is a necessary precondition for overcoming poverty and marginalization. In spite of increasing global commitment to address this issue, the technology gap among and within nations continues to widen. The present work contributes to the global knowledge and experience in identifying policies and measures for integrating technology into national development strategies and in maximizing their impact towards the achievement of the MDGs, as well as in building innovation capabilities, developing absorptive capacity and infrastructure for technology transfer, and applying ICTs to development. We actively sought the views of stakeholders across the board in producing this work, including government officials and development partners, foreign investors and local entrepreneurs, NGOs and academe. I would like to thank all those who have contributed to it in one way or another.

The signing of the 2002 Peace Accords has heralded double-digit economic growth in Angola, underpinned largely by the country's rich natural resources. Inasmuch as Government is the principal actor in both economic and social scenes at this time, the review focuses on the technology needs of the main ministries and proposes innovative measures for creating additional value-added in their service delivery and organizational dynamics. While national research and development capacity was critical not only in agriculture and health but also in the nascent private sector, the review stresses that it should be development-oriented rather than research-centered. In addition to the two platform technologies it proposes to support Angola's current economic and social growth, i.e. ICTs and energy, it offers sector-specific and cross-cutting measures to create an environment conducive to innovation and growth. Foremost among these is strengthening human capital.

Angola has the resources and potential to become an economic engine in the sub-region. Its success will not only serve as an example for countries emerging from conflict but also as a stabilizing factor in the geopolitical dynamics in the region. We are therefore proud and honored to be of service to the Government of Angola in its peace-building and reconstruction efforts.

Dr. Supachai Panitchpakdi
Secretary-General of UNCTAD

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ABSTRACT

Prepared at the request of the government of Angola, this paper pinpoints the key areas in the national landscape wherein science and technology could play a catalytic role in stimulating economic growth and improving public service delivery. It proposes platform technologies that provide maximum impact across both public and private sectors activities and development; and offers options for promoting science and technology as well as fostering innovation in key growth areas such as education and enterprise development.

Earlier STIP reviews carried out by UNCTAD confirms the catalytic and reinforcing role of science and technology in the development process. The recommendations made in the present review are underpinned by the national innovation system theory, which posits that innovation and technology development are results of a complex set of relationships among actors in the system, which includes enterprises, universities and government research institutes. While assessing the structures of the principal sectors involved and the dynamics among them, the analysis of the present review has been primarily confined to areas where science, technology and innovation could make the most impact.

In a post-conflict country engaged in massive reconstruction and heavily dependent on natural resources, as is the case of Angola, the public sector constitutes the principal source of activity and employment. The review addresses both the present urgency to improve of basic public services and the need to build human capacity and technological facilities in order to ensure sustained economic growth. It proposes STI-related, sector-specific recommendations for the key public sectors such as education, agriculture and health, and well as across-the-board measures to ensure synergy and coordination, as well as regulations and measures for creating a regulatory framework and business environment that are conducive to innovation. The review identifies ICT and energy supply as platform technologies that should be solidly in place in order to support and promote STI growth in other areas. Through effective use of science and technology, underpinned by a strengthening culture of innovation and innovativeness, the review argues that Angola could become an economic engine and food basket of the region.

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ABBREVIATIONS

AIA	Angolan Industrial Association
ANIP	National Agency on Private Investment
ARIPO	African Regional Intellectual Property Organization
AU	African Union
CCIA	Chamber of Commerce and Industry of Angola
CNRF	National Centre for Phytogenetic Resources
CNTI	National Commission on Information Technology
ECP	Strategy to Combat Poverty
ENCTA	Angolan National Company of Post Office and Telegraph
ENDIAMA	National Diamonds Company of Angola
ENE	National Electric Company
EPTEL	Public Telecommunications Company
FAO	Food and Agriculture Organization
FDES	Economic and Social Development Fund
FDI	Foreign Direct Investment
GARE	Entrepreneurial Restructuring Programme
GDP	Gross Domestic Product
GNI	Gross National Income
IANORQ	Angolan Institute for Standardization and Quality
ICT	Information and communication technologies
IDA	Institute of Agrarian Development
IDIA	Institute of Industrial Development of Angola
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IIA	Angolan Institute of Agronomy
IIV	Institute of Veterinary Research
INACOM	Angolan National Institute of Communications
INAFOP	National Institute for Employment and Professional Training
INAPEM	National Institute to Support Small and Medium Enterprises
INCOM	National Institute of Communications
IPR	Intellectual Property Rights
ISO	International Standards Organization
IT	Information Technologies
ITU	International Telecommunications Union
LDC	Least Developed Countries
LNG	Liquefied natural gas
MAPESS	Ministry of Public Administration, Employment & Social Security
MDG	Millennium Development Goals
MED	Ministry of Education
MINADER	Ministry of Agriculture and Rural Development
MINCIT	Ministry of Science and Technology
MIND	Ministry of Industry
MINEA	Ministry of Energy and Water

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NEPAD	New Partnership for Africa's Development
NGOs	Non-governmental organizations
OAPI	Organisation Africaine de la Propriétés Intellectuelles
ODA	Official development assistance
PATIA	Programme for Industrial Technology Upgrade
PIP	Public Investment Programme
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
R&D	Research and Development
SADC	Southern African Development Community
SME	Small and Medium Enterprises
Sonangol	Sociedade Nacional de Combustíveis de Angola
STI	Science, technology and innovation
TRIPS	Trade-Related Intellectual Property Rights
UAN	Universidade Agostinho Neto
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WFP	World Food Programme
WHO/DOTS	World Health Organization/Directly Observed Therapy-Short course
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

Angola has achieved much in the five years since the 2002 Peace Accord. The climate of détente between the rival parties has paved the way for a national reconstruction that encompasses physical infrastructure, economic consolidation and human capital. The financial stabilization measures adopted earlier have come to fruition, with GDP growing at double-digit rates, inflation tamed and fiscal balance restored. On the social development front, significant gains have been made in education even while improvements have yet to be seen in other key areas. Furthermore, the Government has taken steps to improve and strengthen the delivery of basic social services and utilities.

However, as noted in the 2007 LDC report, economic growth and social development are not likely to be sustained in the absence of technological learning and innovation capacity-building. Indeed science and technology has of late featured prominently in the agenda of regional bodies such as NEPAD, SADC and AU. Undertaken at the request of the Government of Angola, the present Review seeks to pinpoint bottlenecks in the structural, institutional, and financial policies, measures and strategies that hinder and obstructs these processes. It subsequently proposes options for the Government to consider in ensuring a science, technology and innovation (STI) component in its policies for institution-strengthening and human capital building.

Chapter 1 provides an overview of the economic structure and human development in Angola, as well as key policies and programmes. With export earnings buoyed by record high petroleum prices, Angola's GDP per capita growth rate in 2006 was almost three times the sub-Saharan Africa average. Its GNI per capita and economic vulnerability indices were such that, were it not for the criteria on human assets, it would have been graduated from the LDC classification. The wide disparity between the rosy macroeconomics and living conditions was confirmed in the Human Development Report 2006 which ranks Angola 125th in terms of GDP per capita, but 161st of 177 countries in Human Development Index (HDI). The Government's post-war action plan as articulated in its *Strategy to Combat Poverty (ECP)* focuses on rebuilding the physical and social infrastructure, but does not contain any explicit role for science and technology. At the 2005 MDG Review, universal education was the only one of the 8 goals considered most likely to be met by 2015.

Chapter 2 indicates that despite the prevailing post-conflict difficulties, capacity-building is taking place in key areas. It argues that STI-building policies and measures should already be in place as Government shifts its focus from post-conflict reconstruction to national development, and that institutional arrangements should be made in order to ensure a central and continuing role of science and technology in the development process.

Chapter 3 shows that current industrial policy and measures need to be strengthened in order to promote technological learning at the enterprise level. Furthermore, agriculture R&D must be revitalized to ensure food security, contain rural-urban migration and diversify the export base. The health system and delivery mechanism are currently so fragmented that opportunities for programme synergies and technological learning are often lost. Options proposed are tailored to the specific needs and weaknesses of the sector, and range from improved coordination, adequate funding, better training, to effective incentives to more targetted policies.

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Chapter 4 highlights two infrastructure elements critical to national development, one selected for its forward-looking dimension and the other for its importance to everyday life. Angola's IT strategy is frontier-pushing and as such is faced with both structural and human resource challenges. Its very implementation, however, could serve as a learning experience for the country at large even as it stimulates and reinforces growth in key engine sectors such as industry, education and health. On the other hand, country-wide, reliable energy supply would not become reality without technological upgrading and capacity-building. As well, new renewable energy technologies should be considered as supplementary sources.

Chapter 5 examines the four key determinants of STI: education and training; R&D capacity; financing; and STI-related policies and measures. It suggests that a survey of skill needs to provide a basis for the design of curriculum and vocational training as well as for building linkages between research programmes and industrial needs. It also explores financing mechanisms and provides options for building STI policies and measures.

Chapter 6 argues that as a cross-cutting tool for development, science and technology (S&T) should be the underpinning tool for all development programmes and service delivery systems. Furthermore, innovation (I) and the capacity to innovate should be promoted in order to ensure the sustainability of technological learning and, by extension, socio-economic development. The Ministry of Science and Technology should be provided with the resources necessary to coordinate the science, technology and innovation (STI) components of the different ministries, to oversee inter-ministerial synergies in this area, and to ensure the continuing growth and contribution of STI to Angola's national development.

Angola has responded to the immediate post-conflict challenge with heavy investment to address structural and human capital bottlenecks in food sufficiency, health, education and infrastructure, notably in transportation and power supply. The agricultural sector for instance would be revitalized to ensure food security, to combat entrenched poverty, and to stabilize displaced persons who have been resettled in the rural areas. For the longer term, it has initiated steps to strengthen its economic base and diversify its export structure. With a correct mix of policies and measures, Angola can and must move up the chain of commodity exports and into the global network of manufacturing. It is hoped that the present review will contribute towards generating the political will to place science and technology at the front and center of its drive towards progress and development.

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Chapter 1: Overview

Angola is in the process of a massive reconstruction of both its physical infrastructure as well as its human capital. While progress has not been uniformly satisfactory at all fronts, the areas where spectacular advances have been made could be expected to drive growth in the lagging areas. Fuelled mainly by its petroleum and minerals exports, the drive towards economic and social development is very dynamic. This chapter provides an overview of the current economic and human development situation in Angola, and outlines the key policies that have so far been formulated to guide reconstruction and development.

1.1 The growth and structure of the economy

Angola embarked on a system of centralized economic and political management after its 1975 independence from Portugal. The transition to a market economy was initiated in 1987 with an ambitious reform program¹ aimed at stabilizing the economy, securing fiscal discipline, fostering private sector growth, and dismantling the system of price fixing.² However, progress has been slow, and only during the early 2000s did the Government finally succeed in curbing inflation and stabilizing the economy. During the 27-year period of civil conflict following independence, the economy suffered greatly with high negative GDP per capita growth rates until 1993 and triple-digit inflation until the early 2000s. However, since the establishment of peaceful conditions, tentatively at first during the mid-nineties and more decisively since the 2002 Peace Accords, the economy has been expanding rapidly, as shown in table 1.1.

Table 1.1 Overall growth of the Angolan economy

	<i>actual</i>		<i>forecast</i>		
	2004	2005	2006	2007	2008
GDP growth rate	11.2	20.6	19.5	31.2	15.9
Petrol sector growth	13.1	26.0	21.2	33.6	13.4
Non-petrol sectors growth	9.0	14.1	17.2	27.9	19.5
Inflation	31.1	18.5	10.0	10.0	8.0

Sources: National Institute of Statistics, Ministry of Planning, General Programme of the Government for the Biennium 2007-2008.

The post-war reform programme has included setting up a unified budget, a single Treasury account, and an online system tracking the flow of funds between the Treasury, the Banco Nacional de Angola (BNA, the central bank) and the Banco de Poupança e Crédito, which operates the budget. The Ministry of Finance plans to replace the ineffective bi-annual public investment programmes with a medium-term economic framework aimed at long-term rather than annual fiscal targets. There is still room for work, particularly in strengthening co-ordination between the current and capital budgets, as well as improving budgetary planning to reconcile ambitious spending targets with the government's weak absorptive capacity.

¹ SEF, *Programa de Saneamento Economico e Financeiro*

² World Bank (2006)

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Extremely favourable external market conditions have enabled Angola to consolidate its transition from a centrally-planned to a market economy. Furthermore, runaway inflation was brought under control with more rigorous monetary and exchange rate policies. Annual inflation rates during the conflict routinely exceeded 100%; by the end of 2005, the rate had fallen to 18.5% and expected to fall further to 10% in 2006. The Government has now achieved better control of its finances, a vast improvement after the large fiscal deficits in the 1990s. The average annual growth rate, estimated at 10% between 2002 and 2004, has risen to over 20% in 2005 and expected to peak at over 30% in 2007. Fiscal balance has been restored from a deficit of 7.8% in 2003 to a surplus of 0.6% in 2004. By 2005, the surplus was estimated at 7 percent of GDP.³ The country's reserves grew from one month of imports in 2003 to 2.4 months in 2004. Also, Angola's GDP per capita growth rate is high: 11.4% in 2006, compared to an average of 5.9% in lower middle income countries generally, and 3.1% in sub-Saharan Africa.⁴

Table 1.2 Composition of GDP, 2004-2006

	2004	2005	2006*
Agriculture, Forestry & Fisheries	8.6	7.2	8.6
Petroleum	54.7	62.9	57.0
Diamonds	5.2	4.3	2.3
Manufacturing	4.0	3.6	4.6
Electricity	0.0	0.0	0.4
Construction	3.8	3.1	5.1
Banking and commerce	15.9	13.4	13.6
Other services	7.7	6.3	8.4
Taxes and duties	0.1	0.0	0.1

Source: National Institute of Statistics, Ministry of Planning

(* estimated)

Prior to independence, agricultural exports were the cornerstone of the Angolan economy. The structure of the economy shifted substantially after 1973 as the minerals and service sectors increased their share in GDP. Angola is currently the second largest oil producer in Africa. Petroleum production accounts for around 60% of GDP (see Table 1.2), 90% of country's export revenues and 90% of government earnings. Estimated reserves have quadrupled between 1995 and 2005; by 2008 production is expected to reach 2 million barrels per day from 1.4 million in 2005. About half of total output is from offshore sources. The volatility of the petroleum markets is an on-going concern for the Government, given the country's high dependence on oil. On the other hand, there are concerns over the environmental impact of oil exploration and extraction activities, particularly, the effect of offshore activities on the fishing industry. In view of these threats, the uncertain sustainability of the price level and stock, as well as the fact that the industry does not generate significant local employment, the need to diversify the economy has been explicitly highlighted in the Government's plan for 2007-2008.

In comparison to the petroleum sector which has been buoyed by surging oil prices, it would appear in table 1.2 that the GDP shares of other sectors has been stagnating or declining.

³ This windfall, however, could be partly attributed to the skyrocketing oil revenues of US\$10.6 bn., almost double from the previous year.

⁴ IDA (2007) Interim Strategy Note for the Republic of Angola.

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These data actually mask promising growth in certain sectors that are undergoing reconstruction and recovery, as shown on table 1.3.⁵

Table 1.3 Growth rates (%) by sector, 2005 and 2006

	Oil and Gas	Diamonds and other minerals	Agriculture	Fisheries	Manufacturing	Public Works and Construction	Energy and Water	Trade and services
2005	26.00	16.20	17.00	-16.30	24.90	16.90	19.30	8.50
2006	21.20	41.70	-12.30	5.00	30.70	66.20	28.30	15.80

Source: Government of Angola (2006) General Programme of the Government for the Biennium 2007-2008

Diamonds and other mining activities have also grown significantly with improved access to mining areas and with restructuring and reorganization. The sector's growth rate of over 16% in 2005 almost tripled to 42% in 2006. Growth is expected to cool down thereafter, despite rich reserves. The sector is rife with informal mining and illegal trafficking of precious stones. Furthermore, it faces the threat of diminishing returns from exploration efforts. To overcome the latter, regulatory weaknesses in mining industry, the lack of geological database, and the absence of qualified personnel need to be addressed.

Growth in manufacturing in 2005 is recorded at 24.9%, and expected to rise over 30% in 2006. In 2005, beverages recorded the highest growth rate, followed by food products. Recovery in this sector continues to be promising, especially with the expected increase in access to finance through public-private partnerships and the creation of the Development Bank of Angola as well as the improved infrastructure and continued growth in domestic markets. However, as the Government noted, growth could be hampered in the long run by a weak workforce and undeveloped entrepreneurship. Continued growth will also hinge on further improvements in transport, communications, energy and water supplies, and the level of success in alleviating poverty.

The electricity sub-sector grew 17.4% in 2005 and is expected to increase to around 28% in 2006, largely as a result of public investment in rehabilitation and new capacity as part of the Public Investment Programme (PIP). There is great potential for expanding capacity, given the extensive untapped hydro resources and the possibility of developing other sources of large-scale capacity, including nuclear energy.⁶ Like manufacturing, the energy sector is presently hampered by dilapidated infrastructure coupled with obsolete technology and a lack of technological capacity to innovate. It sustains high efficiency losses from the dilapidated conditions of the transmission and distribution networks. Further loss is incurred from rampant consumer theft from the grid, despite the heavily subsidized consumer price of electricity. Price distortions in the electricity market are another threat to the development of the sub-sector that has been highlighted by the Government.

⁵ The General Programme of the Government for the Biennium 2007-2008 also provides information on the current situation in each sector, including strengths, weaknesses, opportunities and threats; the subsequent sector summaries are based on this document.

⁶ In June 2007, the National Assembly approved the proposed drafting of new legislation on atomic energy (MINCIT pages on the Government of Angola website)

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Public works and construction are mostly financed from the PIP – US\$ 205.6 million in 2005. The annual overall combined growth rate in these job-generating areas was nearly 17%. Further growth is expected to be boosted by the general economic recovery, the on-going programme of infrastructure reconstruction, and the expected improvements in the capital markets and the new stock exchange. On the other hand, the absence of competition and the distorted prices of construction materials could threaten the sustainability of the sector's growth. As in other sectors, the weak workforce, obsolete technology and low technological capacity have been flagged, along with a lack of manufacturing capacity in building materials.

The agriculture sector is beginning to show the benefits of the resettlement and de-mining programmes. The Government reported a 17% growth rate in agriculture in 2005, but final figures for 2006 are expected to indicate a negative growth rate of over -12%, reflecting the bumper harvest in 2004-5 and less favorable conditions the following year. Rural development continues to face problems ranging from poor accessibility, market distortions, a lack of rural credit, and growing illiteracy. Future development could also be constrained by low levels of private investment.

Fisheries showed negative growth rates in 2005, both in respect of catches (-16.3%) and processing (-2.76%). However, in the first three months of 2006 the fishing industry appeared to recover, registering a 3.4% growth largely attributed to an injection of public investment. Weaknesses in the fishing industry include the lack of port infrastructure and unloading equipment for landed catches, weak capacity for the construction and maintenance of fishing equipment, and insufficient business management skills. There are also concerns about the future levels of fish stocks from over-exploitation of resources, environmental degradation caused by extensive petroleum and gas activities, and climate change.

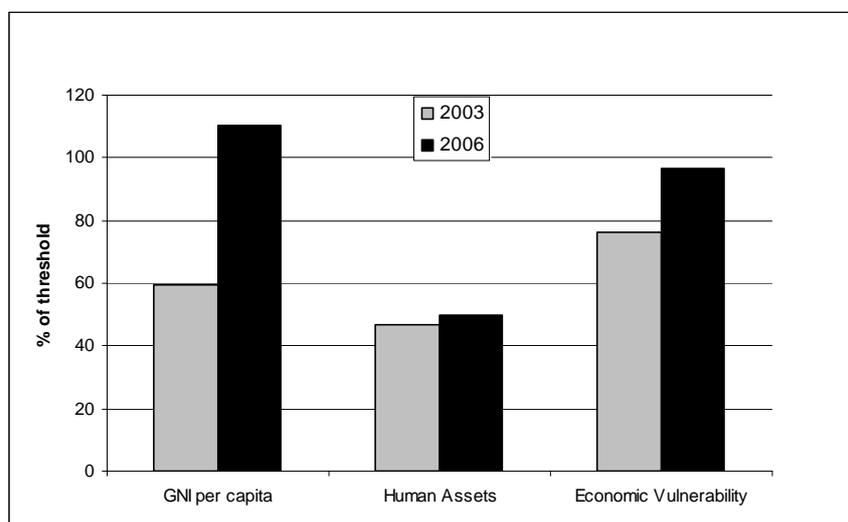
With oil production set to rise strongly against a background of high oil prices, strong economic growth is set to continue, averaging 21.1% in 2008 and 12.9% in 2009. Sustained high government spending and buoyant domestic demand are likely to keep inflation high, averaging 13.2% in 2008 and 14.7% in 2009. The rapid increase in oil exports and high international prices are forecast to keep the current account in surplus, although, owing to rapid real GDP growth, the surplus will fall from an estimated 28.9% in 2007 to 26.3% in 2008 and 19.5% in 2009.

1.2 Human Development

Notwithstanding its rosy macroeconomic performance following the 2002 Peace Accord, Angola is still classified as a Least Developed Country (LDC) for which criteria are GNI per capita, economic vulnerability, and human assets. At the 2006 evaluation exercise, Angola's GNI per capita actually exceeded the threshold and its score on economic vulnerability almost reached it. The marked improvement on these two indicators between 2003 and 2006 is illustrated in figure 1.1. The indicator on human assets, on the other hand, appears to have stagnated.

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Figure 1.1 Angola's rating on the LDC criteria, 2003 and 2006



Sources: UNDP (2003) and UNDP (2006)

Note: UN evaluations in 2003 and 2006 were based on data from 2001 and 2004, respectively.

Human assets are the focus of the joint Government of Angola/UNDP 2005 report on progress towards the Millennium Development Goals (MDG), for which key indicators are shown on table 1.4. The short life expectancy of 42 years has been attributed mainly to the high mortality rate of infants and children under 5 which is estimated at 260 deaths per 1000 live births in 2004 – one of the highest rates in the world. Achieving MDG #4 of a reduction of two-thirds of the 1990 figure of 292 deaths per 1000 live births will be extremely difficult to meet by 2015. The report's outlook on MDG #5 on reducing maternal mortality is similarly pessimistic. The maternal mortality ratio of Angola is one of the world's highest.

In Angola, the main cause of morbidity is malaria, followed by respiratory and diarrhoeal diseases. Together, they account for 70% of morbidity and 60% of mortality.⁷ The prevalence of HIV/AIDS is relatively low, while a conservative 2001 estimate put 7,000 new cases of TB per year.⁸ Malnutrition has been a major contributing factor to child mortality. As the displaced population is resettled, food production and food security has increased. Where an estimated 3.5 million people suffered from food insecurity in 2002, the number was reduced to 1.1 million in 2005 and further to 800,000 people in 2006.⁹

In addition to the successful resettlement programme, the Government had undertaken massive school rebuilding and teacher training. Although serious problems such as shortage of teachers, unaffordable school materials as well as high failure and drop-out rates persist, improvement has been such that the 2005 MDG Report considers the MDG #2 on universal education most likely to be met by 2015. Poor health, malnutrition and illiteracy are elements of

⁷ MOH-coordinated survey of the provinces several years ago, as reported in WHO (2003).

⁸ WHO (2003)

⁹ FAO/WFP (2006)

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the vicious circle with poverty. The following section summarizes the main government policies on poverty alleviation.

Table 1.4 Basic human development indicators

Population (estimated)	16.5 million	<i>Year 2004</i>
Population under 21 years of age (%)	60	<i>2004</i>
Population living below the poverty line (%)	68	<i>2001</i>
Population living in extreme poverty (%)	26	<i>2001</i>
Population with access to a safe water source (%)	68.5	<i>2003</i>
Population with access to improved sanitation (%)	78	<i>2003</i>
Life expectancy at birth	42.4 years	<i>2004</i>
Child mortality (per 1000 children under 5)	260	<i>2006</i>
Infant mortality (per 1000 live births)	154	<i>2006</i>
Maternal mortality rate (deaths per 100,000 live births)	1400 - 1700	<i>2003</i>
Gross primary school enrollment rate	91.1	<i>2003</i>

Source: Government of Angola /UNDP (2005) Angola Millennium Goals Report Summary

1.3 Key policies and programmes for reconstruction and development

In its *Strategy to Combat Poverty* (ECP), released in January 2004, the Government defined its priority areas, among which are rural development and food security; education; health; rehabilitation of basic infrastructure; employment and professional training; governance; and macroeconomic management. Programmes and measures to address each priority area were outlined. Steady progress has been made in some areas such as social reintegration and macroeconomic management. Programmes for political, administrative and judicial reform are on-going.

The rehabilitation of physical infrastructure has been heavily compromised by mine threats. The de-mining process, on the other hand, has been considerably slowed down by the fragile conditions of the road network which cannot support the transport of de-mining equipment. The de-mining of key infrastructures, critical to the pace of rehabilitation and repair of these infrastructures, has had to be carried out manually at a slow rate of around 10 square km per year.¹⁰

¹⁰ CNIDAH (2006) Mine Action in Angola: 2006-2011 Strategic Plan.

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In addition to physical infrastructure, Angola is engaged in improving utilities such as water and energy supply systems, as well as the rehabilitation of basic social services such as schools, health centres and hospitals. These are the key areas for the *Public Investment Programme*, with the reconstruction project also being supported by the recently-created Development Bank of Angola. Budget allocations for key areas of the ECP for the 2007-2008 biennium are shown in table 1.5.

Table 1.5 Public expenditure in key sectors and sub-sectors (% of total public expenditure)

Public works	Energy and water	Basic services	Health	Education	Agriculture & Rural Devpt.	Fisheries
31.19	10.98	11.67	3.04	5.76	2.50	6.44

Source: Government of Angola (2006) General Programme of the Government for the Biennium 2007-2008

Development partners are said to be reviewing their assistance level in light of the high oil revenues on the one hand,¹¹ and the relatively low allocations to health, education and agriculture – the three sectors most critical for achieving the MDGs. For its part, the Government has cited the lack of absorptive capacity in the ministries concerned to execute larger budgets. Already in early 2006, it reported that the implementation of the ECP was being compromised by a shortfall in international aid, weak institutional capacity and inadequate human resources.¹² However, it must also be considered that the ECP, despite certain short timescales for achieving targets, is in reality a long-term framework strategy for overall national reconstruction.

One aspect of the ECP that is especially relevant to the present STIP Review is the absence of any explicit reference to the role of science and technology in achieving its objectives. The 2007 LDC Report notes that this is a common omission in the Poverty Reduction Strategy Papers (PRSPs) of developing countries, and that it reflects the “marginalization of technology policies” in both the old structural adjustment programmes and the PRSP approach that replaced them.¹³ The plans, programmes and mandates of the implementing agencies of the ECP implicitly include STI activities and capacity-building needs, which are taken up in later chapters.

¹¹ Angola's oil production had risen to 1.9m b/d by mid-February 2008 and expected to reach 2m b/d by year end, a little above its 1.95 m b/d OPEC quota. A reprimand from the cartel is unlikely, given that Nigeria is struggling to reach its own production quota. *EIU, March 2008*.

¹² Government of Angola 2006 *Mid-term review of the Brussels program of action – least developed countries*.

¹³ UNCTAD The Least Developed Countries Report 2007: Knowledge, Technological Learning, and Innovation for Development. Geneva.

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Chapter 2: The STI framework

The Government of Angola has time and again evoked the need for STI policies to promote innovation, particularly at the enterprise level. The present chapter seeks to present an overview of the existing framework – or “enabling” – conditions for capacity-building in Angola, and pinpoints areas where government policy might be focused to build capacity for innovation and to stimulate innovative processes.

2.1 Government and STI policy

The Executive branch of the Government consists of the Office of the Prime Minister, 29 central ministries, as well as local administrations in each of the country’s 18 provinces, which consist a total of 163 municipalities and 532 communes. The 2001 decentralization programme has uncovered a number of weaknesses.¹⁴ In addition to the Ministry of Planning’s national planning functions and its National Institute of Statistics, each ministry is equipped with its own services for studies, statistics and planning at sector/sub-sector level. Most have one or more institutes for research and/or development, regulatory organs, as well as special funds for extra-budgetary activities. The Ministry of Finance is charged with the allocation of budgets to ministries, provincial governments, and other public organizations.

For semi-autonomous research/development bodies, this system minimizes the risk that notional allocations for STI capacity-building would be reduced to cover shortfalls in their parent ministries' budget. On the other hand, these type of allocations are basically determined by the negotiating skills of the administrator rather than to an objective needs assessment. The budgetary autonomy of many organizations indicates a problematic discrepancy between policy-making and policy implementation. This concern is not specific to STI, but it is relevant in view of the inherently complex, cross-sectoral nature of STI.

Indeed, STI-related mandates and activities are spread across the different ministries at the central government, local government, and individual organizations' levels. There are several coordinating mechanisms for, or including, STI-related activities. The highest of these is the Council of Ministers, wherein high-level debates on cross-cutting issues are conducted. There are also inter-ministerial committees, councils and commissions, such as the National Commission on Information Technology (CNTI), established to coordinate activities on areas related to information and communication technologies.

2.1.1 *The role of the Ministry of Science and Technology*

The Ministry of Science and Technology (MINCIT)¹⁵ was set up in 1997 with the following statutory responsibilities:

¹⁴ The separation of budgetary allocation and chain of authority from the central government ministries has strained the implementation of national policies. Further, as provincial and municipal authorities are appointed rather than elected, accountability is rather weak. While these concerns are not strictly within the purview of the present Review, implementation problems at the regional and municipal levels may limit the impact of STI policies on broader development objectives.

¹⁵ As set down in the *Estatuto Orgânico do Ministério da Ciência e Tecnologia: Decreto-Lei 15/99*.

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- national policy and planning for science, technology and innovation;
- advisory support and coordination for S&T education, training and research;
- stimulation of incentives for STI, including regulatory and legislative regimes, and an environment for international cooperation; and
- information dissemination and promotional activities to create awareness and build a culture of STI.

In addition, the Minister for Science and Technology chairs a High Board of Science and Technology, which functions are to define policies for scientific research and to evaluate and monitor research projects. The Ministry's organizational structure is shown in Figure 2.1. Like the other sector ministries, MINCIT has its advisory, and technical support divisions, and a Central Executive Service.¹⁶ Its substantive work is carried out by the Central Executive Service, which consists of three Directorates: 1) scientific research, 2) technology development, and 3) training and international cooperation. The Directorate of International Cooperation is charged with activities involving international cooperation and collaboration, including oversight of oversees training and fund-raising. The functions of the first two directorates include, in their respective areas, the collection, analysis and dissemination of information; the organization of conferences and similar events; the organization of professional training; and oversight of project development and implementation. In addition, the Directorate of Scientific Research oversees scholarships for education/training, and the Directorate of Technology Development is responsible for the introduction and/or diffusion of new technologies.

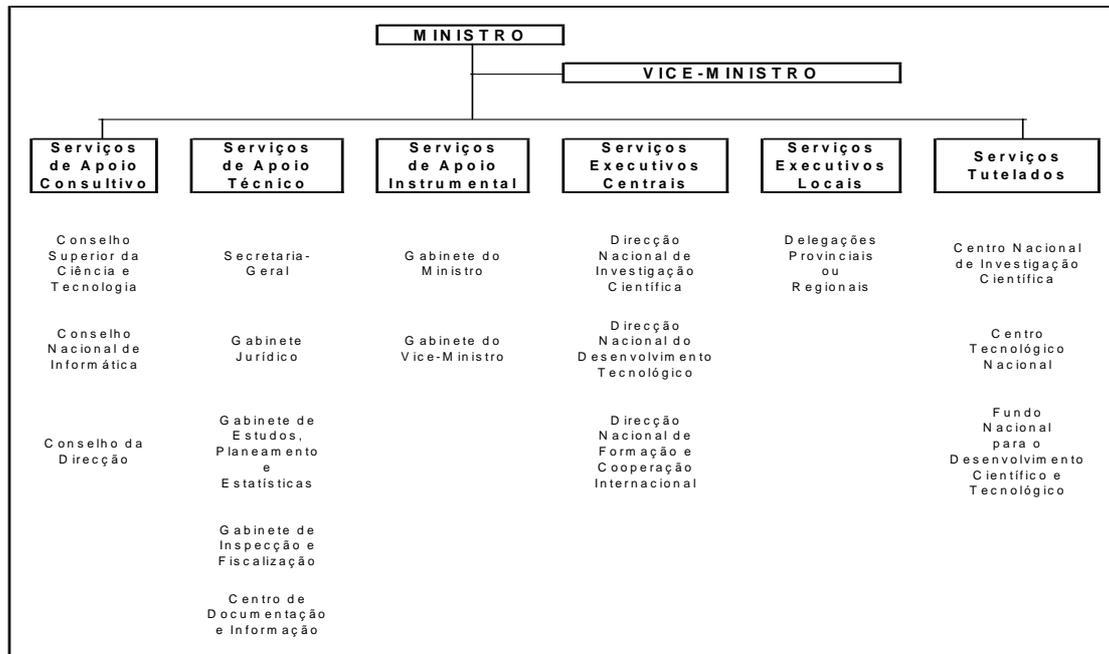
As is often the case in S&T ministries, MINCIT's mandates and its Executive Directorates' programme revolves around science and technology rather than innovation. Up until recently, innovation has been ascribed to industrial policy.¹⁷ Experience has shown however that the of separation of S&T policy from innovation policy engenders the risk of ineffectiveness and even failure in both, while a coordinated approach could lead to a mutually reinforcing growth in both S&T and innovation. On the other hand, whilst policies for most sectors are still being developed in line with the reconstruction blueprint, it is understandable that MINCIT would focus – in the short term – on traditional S&T core policies, particularly on education and research.

¹⁶ The structure of MINCIT is unusual among the central ministries in that it includes a Local Executive Service, comprising provincial delegates who act as local counterparts to the ministry's central executive service.

¹⁷ UNCTAD 2007 LDC Report.

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Figure 2.1 Organigram of the Ministry of Science and Technology



Source: Estatuto Orgânico do Ministério da Ciência e Tecnologia, Decreto-Lei no. 15/99

To date, MINCIT has made significant progress in raising public awareness of the important role of STI in nation-building and in enhancing the contribution of scientific research to socio-economic development. The volume of research output, however, is still relatively low.¹⁸ Very little data, either quantitative or qualitative, exist on which to evaluate the performance of research. Table 2.1 shows performance against two standard research output indicators.

Table 2.1 Output from research in Angola 1995 and 2005

	Per million population	
	1995	2004-5
Scientific and technical journal articles	0.16	0.22
	Average 1993-7	Average 2001-5
Patents granted by USPTO	0.00	0.01

Source: World Bank (2006) *Knowledge for Development: Angola Basic Scorecard*

¹⁸ CESO CI Angola (2005), Teta, P. (2007)

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In 2001, measures were introduced to attract and retain scientists into public research institutions.¹⁹ These provisions, which included special remuneration scales and salary bonuses for publications, have remained largely ineffective as indicated in table 2.1. Moreover, post-graduate training has been neglected and little investment made towards upgrading scientific research.²⁰ The latter has been especially important in constraining the capacity of research institutes and universities. The constraints and motivations of researchers need to be better understood if they are to play a more constructive role in the development process. The on-going study programme commissioned by MINCIT²¹ will hopefully provide useful information and analysis.

2.1.2 National STI Policy

The formulation of a national STI policy is a principal mandate for MINCIT. In order to draw an effective coherent all-encompassing policy, such as required for a key cross-sectoral element for underpinning national development, would require sound statistical data to guide the process. As well, the Ministry needs access to quality and timely information to assess and monitor the policies, capabilities, activities and needs of and across many different sectors. Certain ministries, such as the Ministry of Agriculture and Rural Development, have a sector development policy which includes provisions for STI while others, such as the Ministry of Health, do not have one as yet. An issue to consider is the potential value of a broad STI policy during the current reconstruction phase. The Ministry's planned study programme should provide inputs into the STI policy process, but in the short term, MINCIT might a focus on developing, and coordinating with other Ministries, policies that create an enabling STI environment.

2.2 Towards an enabling environment for STI

This section assesses the key elements of a national innovation framework. One is the general climate for investment and enterprise development, because “the enterprise is the locus of innovation and technological learning”.²² Equally important is the reconstruction and development of the physical infrastructure such as transport, telecommunications, and electricity. Finally, an overall summary of the current status of the education system is presented. These three elements represent primary facets of national development, namely human capital, economic dynamism and physical assets.

2.2.1 Investment Climate and Business Support

To stimulate private sector growth, the privatization of state companies was initiated in 1989 with the establishment of Entrepreneurial Restructuring Programme (GARE) under the Ministry of Industry. This was reinforced with a two-phased privatization program, in

¹⁹ Estatuto da Carreira do Investigador Científico, Decreto 4/01 and Estatuto Remuneratório do Investigador Científico, Decreto 40/01.

²⁰ Teta, P.S. (2007) Scientific Research in Angola. Paper written by the Vice-Minister of MINCIT, available from the Government of Angola website.

²¹ CESO CI ANGOLA (2005) Ciência, Tecnologia e Inovação : Estudo Prospectivo / Plano de Médio Prazo (2007-2012)

²² UNCTAD 2007 LDC Report.

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collaboration with the IMF and the World Bank, during which 1990-2000 phase saw the restructuring and privatization of 409 state companies. Since 2001, another 90 public companies have been privatized. The pace of privatization has slowed considerably following the initial phase.

Apart from the FDI-dominated petroleum and diamond sectors, the private sector is basically underdeveloped. The manufacturing sector, once capable of producing a wide range of export-quality and quantity products, is expected to recover with the implementation of the Plan for Reindustrialization, which features protection of light and consumer industries. Other entities set up to support private sector growth are the National Institute to Support Small and Medium Enterprises (Inapem); the *Guiché Único de Empresa* (a one-stop window to simplify registration of enterprises); and more recently, the National Agency on Private Investment (ANIP). ANIP has been established to facilitate and promote both domestic and foreign private investment in Angola, as well as to identify investment opportunities. It oversees the administrative procedures for establishing and operating a business, and is considered generally efficient.²³ Investment incentives are discussed further in Chapter 3. However, several barriers still need to be overcome, foremost of which are inadequate access to finance, unreliable electricity supply, heavy bureaucratic requirements, and weak transport infrastructure.²⁴

Angola's financial sector has been described as underdeveloped but growing rapidly.²⁵ The activities of most banks, however, are mostly limited to commission-based currency trading and trade finance rather than credit facilities. Thus far, the Government has been the major credit source, with relatively favorable terms, for local businessmen. Furthermore, the Government allocates a portion of the national oil revenues to small and medium-sized enterprises through the Economic and Social Development Fund (FDES)²⁶. Government financing being potentially unsustainable, efforts are needed to expand banking services to include credit facilities, particularly for STI-related activities.

2.2.2 Transport Infrastructure

Only about a tenth of Angola's roads were paved in 2004. Of the 7,953 kilometers of paved road, 88 percent were in "bad" or "very bad" condition.²⁷ City road and traffic conditions are further strained by the influx of migrants from the countryside. All three rail lines face operational difficulties, severely limiting load carriage to and from the coastlines. Port infrastructure also needs to be rehabilitated. A US\$ 226 million program for emergency repair and reconstruction of roads and bridges has led to the reopening of the main arteries. Further, the Government has allocated about US\$ 4 billion for the Angolan Road Institute and the Ministry of Transport and Communications to restore and expand the road and bridge network.

The three main railways linking Angola's key Atlantic ports to the interior are also being rehabilitated. As well, construction is to begin on a fourth line linking Angola to the Namibian railway network while other plans for expansion are being considered. Port facilities provided in

²³ WTO, 2006.

²⁴ Enterprise Surveys (2006) Angola: 2006 Investment Climate Profile.

²⁵ US Embassy, Luanda (2006) Angola: 2006 Investment Climate Statement.

²⁶ The functions of the FDES are to be taken over eventually by the proposed Development Bank of Angola (BDA) when the latter is operational.

²⁷ INEA, 2005.

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Luanda, Namibe and Lobito is due to be expanded when the port in Cabinda becomes fully rehabilitated. There are plans to rehabilitate 32 airports and aerodromes by 2010, beginning with a US\$400m rehabilitation of 25 airports in 2007-08. Work is also continuing on Luanda's new international airport, Transport infrastructure is likely to remain a top national priority although work is expected to slow down as activities move further into the hinterlands where landmines have not been cleared yet. The development of agriculture and the growth of the agro-industrial sector, as well as the achievement of food sufficiency, hinge on a viable road system. At present, it is reported that local products cannot compete with imported foodstuff in Luanda because of the high domestic transport costs.

2.2.3 Telecommunications

The institutional framework for telecommunications was initiated with the establishment of the Ministry of Post Office and Telecommunications in 1997. Two years later, the Government liberalized the sector which ended the monopoly of state-owned Angola Telecom. It also set up the Angolan National Institute of Communications (INACOM) as a regulatory body for the rapidly growing sector. Two state-owned companies continue to operate in the fixed telephony market: the Angolan National Company of Post Office and Telegraph (ENCTA) and Angola Telecom, which consists of the National Company of Telecommunications (Enatel) and the Public Company of Telecommunications (Eptel). As in everywhere else, growth in telephony has been almost entirely in mobile phones.

Against the initial successes in the sector, especially in stimulating competition in the mobile phone area, many weaknesses remain. Infrastructure is still fragile, and the fixed line system is subject to frequent line interferences and interruptions. Internet service provision is relatively expensive; in 2004, the monthly "price basket" in Angola was US\$78.8, compared with a sub-Saharan Africa average of US\$54.8.²⁸ A capping regime was introduced in 2004, overseen by a cross-sector committee (Comité de Preços de Telecomunicações) made up of representatives from the Ministries of Post & Telecommunications, Finance, and Planning, and the industry regulator, INACOM. Also, major investments in fibre optic cables have been negotiated in 2007. The STI aspects of current telecommunications policy and institutional infrastructure are discussed further in chapter 4.

2.2.4 Energy supply

Angola's hydroelectric potential is estimated at 18,000 mw. By the end of the civil war in 2002, Angola had only 205 mw of installed hydroelectric capacity and 412 mw of thermal capacity. Since then a number of power projects have expanded capacity to 1,160 mw in 2007, of which 77% was hydroelectric and 33% diesel-generated. A number of dams have been rebuilt or being rehabilitated. A small amount of electricity is imported from Namibia. The Southern African Development Community (SADC) is promoting the creation of a regional electricity grid, to be led by the South African power utility Eskom. The grid will link the Angolan network to an expanded Inga hydroelectric scheme on the Congo River, which is projected to generate up to 39,000 mw.

²⁸ World Bank estimates.

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Electricity infrastructure in Angola is generally obsolete and/or damaged. Estimates vary from 8% - 20%²⁹ of the population having access to electricity, with the capital Luanda accounting for two-thirds of consumption. The International Energy Agency (IEA) notes that energy development presents a major challenge for the Government, particularly at this time when large-scale reconstruction of physical infrastructure such as road network and transport system and rebuilding of other key sectors such as education and health, are stretching public resources. Grid supply, transmission and distribution are almost entirely state-owned and operated, and therefore depend on public investment.

A national strategy to increase energy production annually by 12% from 2001 to 2006 and 7% thereafter, was taken in 2002. Even with the rehabilitated and hydropower dams, the IEA estimates that supply may still fall short to rising consumption. In Luanda alone, the estimated annual growth in demand is 20%. Recent growth spurts in production holds some promise, as the Ministry of Energy and Water has forecasted increase of production by 30% in 2007. Despite the expanded production capacity, there still remains the poor condition of the grid through which much power is lost in transmission. Power outages are increasingly common, worsened by poor maintenance and below-cost tariff structures. Owing to power cuts, 68% of businesses maintain own generators, the highest recorded rate in Africa.

Unreliable electricity supply is one of the main constraints of other key drivers of development, including manufacturing, commerce, telecommunications, and education. In April 2007, the government announced plans to invest US\$2bn in the energy infrastructure, with a focus on boosting output and strengthening the national grid. The institutional and technological aspects of the energy sub-sector is discussed further in Chapter 4.

2.2.5 Education and literacy

An estimated 1,500 school buildings were destroyed between 1996-1999 alone. Since sixty per cent of Angola's population are children, development must start with the restoration of schools and the improvement of the education programme.³⁰ The Angolan plan to reconstruct the education system has three phases: the emergency phase (2003-2005); the establishment phase (2006-10) and the development phase (2011-2015). The underlying objectives are the rehabilitation of physical infrastructure, human resources and institutional capacity. The plan includes the achievement of universal primary education by 2015 – which means to increase primary school enrolment from an estimated 2.1 million in 2003 to 5 million by 2015.³¹ This is the one area in which Angola seems to be on track to meet the Millennium Development Goal target for universal primary education.

Official data indicate that adult literacy has been rising from 15% in 1975 to 67% in 2007. A ten-year literacy strategy was launched in 2006, with the overall aim of increasing adult literacy to 91%. For this 8,000 new literacy teachers will be recruited to teach over 500,000 students. Between 2002 and 2007, the number of students rose threefold to 5.8m, of which 4.7m were in primary level; the number of teachers from 75,000 to 115,740; and the number of schools from 2,282 to 3,728. Spending on education rose in recent years, reaching 5.6% of budgeted

²⁹ IEA (2006) Angola: towards an energy strategy

³⁰ http://www.unicef.org/infobycountry/angola_27832.html. S. Crowe: Angola: After 30 years of civil war, school reconstruction helps build a bright future. July 2005.

³¹ UNICEF estimate.

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expenditure in 2006. In 2005 10,000 new classrooms were built, and in April 2006 work began on a 15-month project to construct 35 vocational polytechnics and 18 secondary schools with a total capacity for 66,000 students. In addition, the government plans to train 50,000 new teachers and build a further 10,000 classrooms by 2015, with the aim of tripling the number of secondary and tertiary students. In 2006 work began on expanding Luanda's university campus to accommodate 16,000 students. Moreover, private schools and universities have grown since 1991, when the ban on private education was lifted. Education facilities in the rural areas, however, have not benefitted as much growth.

In 2004, new principles of technical-professional education were established, in order to develop technical, administration and management, and agrarian institutes. A variety of appropriate progression routes for children now benefiting from primary education is thereby being established. The development of professional and vocational training is under the overall mandate of the Ministry of Public Administration, Employment and Social Security, with sector ministries being charged with the training institutes related to their specific areas. This approach ensures close linkages between sector needs and training provision.

Through public investments and international cooperation, higher education has been improved and access to it broadened. Publicly-funded but autonomous, the only State university and the main higher education institute in Angola, Universidade Agostinho Neto (UAN), has faculties for engineering, medicine, natural sciences, law, nursing, agrarian sciences, economics and education. It is expanding to new specializations in engineering and studies on phyto-genetics. There are also several private institutions, such as Catholic University of Angola, Lusfada University, Jean Piaget University of Angola, New University of Angola and Private Superior Institute of Angola. Another private university, UTEC, sponsored by the Sonangol oil company, and specializing in science and technology, opened in 2007.³² New private universities have also emerged in response to a growing demand for higher education. Figures on enrollment and graduation could not be found for the newer universities, but the graduation numbers for Agostinho Neto University and the Catholic University of Angola, shown in table 2.2 indicate that science and engineering are not as attractive to university students as, for example, law and business. Given the key role of human capital in the long-term development of STI, the Ministry of Science and Technology might consider developing mechanisms to encourage students into these areas.

The Government of Angola recognizes the important role of education in national development, and the need for a scientific-technical component in the education system. However, the educational reform started in 2001 continues to face significant barriers, including a lack of teaching personnel, overcrowded classrooms, and insufficient learning materials. In terms of higher education, progress is slow in spite of investments and international cooperation to improve access, upgrade conditions and widen the choice of specializations.

³² <http://www.angolapress-angprop.ao>

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Table 2.2 Graduations from Agostinho Neto University and the Catholic University of Angola

<i>Agostinho Neto University</i>	2007			
Medicine (including nursing)	77			
Sciences (natural + agricultural)	163			
Engineering	32			
Law	127			
Economics	141			
Education sciences	90			
Arts and Social Sciences	212			
<i>Catholic University of Angola</i>	2000	2001	2003	2004
Engineering		63		157
Law	159	359		655
Business	96	320		567
Social Sciences			34	72

2.3 Incentives for innovation

The main objective for enterprises to innovate is to maintain and enhance the competitiveness of their outputs. For export-bound outputs, the level and type of innovation is largely determined by external factors, including price competition, consumer preferences, and regulatory requirements in importing countries. Enterprises that produce mainly for small domestic markets --- particularly consumer markets with low purchasing power --- would have less incentive to innovate, especially where there is a lack of effective competition and absence of external pressure for improved product quality. In such a case, government intervention might be warranted. This is especially relevant in Angola at present, as domestic enterprises will soon have to compete with cheap imports from other SADC countries when the country becomes fully integrated into SADC, and domestic markets are opened up. In this section, areas wherein government policy for stimulating innovative activities at the enterprise level are examined.

2.3.1 Intellectual Property Rights (IPRs)

The existence of a strong legal intellectual property (IP) protection is not, in itself, an incentive to innovate. Rather, it is the legal monopoly on the commercial exploitation of a product or process that acts as an incentive, but then only when market conditions are favourable for such exploitation. The relatively small size of Angola's domestic market may not encourage significant local investment in many areas of innovation. A more pressing question might be whether or not the IPR regime is supportive to imported innovations.

There are two legislative regimes covering Intellectual Property Rights (IPRs): the 1992 Industrial Property Law (*Lei da Propriedade Industrial*), which covers patents, trade marks,

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industrial designs, utility models, appellations of origin (geographical indications), and unfair competition; and the 1990 Copyright Law (*Lei dos Direitos de Autor*).³³ Implementation of these laws is under the mandates of, respectively, the Angolan Institute of Industrial Property, a protected agency of the Ministry of Industry, and the National Institute of Cultural Industries/National Directorate of Entertainment and Copyright, in the Ministry of Culture. IP protection for plant varieties has not yet been enacted, although according to a 2005 report, a draft Plant Breeders Rights Law has been drawn up.³⁴

Both IP laws pre-date Angola's accession to the WTO in 1996, which entails compliance with the provisions of the Trade-Related Intellectual Property Rights (TRIPS) Agreement for which deadline for compliance for LDCs has been set for 2013, or 2016 in respect of pharmaceuticals and related processes. To date, Angola has not a party to other international IP conventions. Neither is it a member of ARIPO nor OAPI, the two African IP organizations.

Data on patenting or other IPR-related activities in Angola were not available at the time the present review was taken. While existing laws are generally perceived as weak and/or obsolete,³⁵ there is no evidence that this condition is inhibiting innovation or the acquisition of proprietary technology from abroad. In the latter case, it might be the lack of capacity that is hindering imitation. However, as building technological capacity is an incremental process – for example, in ICTs and software development – IPR protection may need to be strengthened in specific areas in due time. These issues should be considered in amending the existing legislation to conform to the TRIPS provisions.

On the other hand, IPR reform need to take into account that stronger IPR regimes could become a barrier to the acquisition and deployment of proprietary technologies and thus hinder capacity-building. Measures should be taken to ensure that the flexibilities of the TRIPS agreement – especially with regard to compulsory licensing – can be fully utilized where appropriate. Even where conflicts of interest do not arise, capacity to negotiate technology licensing agreements is still essential to ensure that domestic enterprises can access foreign technologies under favourable terms.³⁶

Finally, it must be noted that the existing IP laws still distinguishes between industrial property and copyright regimes, a distinction that is no longer as clear-cut elsewhere. Copyrights, for instance, has expanded beyond artistic creations to include industrially-applicable knowledge. On this basis, and taking into account the country's shortage of qualified and experienced personnel for the revision and implementation of IPR laws, there is a case for unifying all IPR regimes under a single mandate and/or Intellectual Property Office (IPO).

³³ WIPO (2007) Guide to Intellectual Property Worldwide, Country Profiles, Angola Legislative Profile.

³⁴ van der Walt, W.J. (2005) FANRPAN Economic Policy Research Study on Status of Plant Variety Protection in the SADC Region: Country Reports for South Africa, Angola, Malawi, Mozambique, Zambia and Zimbabwe.

³⁵ For example, see van der Walt, W.J. (2005), and Global Economic Forum (2007) The Africa Competitiveness Report 2007. In the latter, Angola ranked 102nd out of 128 countries worldwide in respect of IPR protection; however, the country's ranking in respect of, specifically, Utility Patents was much higher – 72nd out of 102 countries worldwide, and 8th among the 25 African countries included in the rankings.

³⁶ WIPO offer training courses in this area.

2.3.2 *Fiscal and financial incentives*

As mentioned earlier, there are general incentives for business investment in Angola. These include exemptions in most sectors³⁷ from customs duties for 3-6 years, with some types of imports excluded; from industrial tax for 8-15 years; and from capital gains tax for 5-15 years. The exemption period depends on geographic location within the country. There are also “bonus incentives,” such as industrial tax exemptions for the creation of more than 50 full-time jobs, or investment in priority regions. Certain business activities could also be assessed for fiscal purposes as costs rather than investment expenditures, as in the construction of basic infrastructure and housing for workers and their communities, and vocational training.³⁸ Apart from subsidized training, the main incentive to innovate provided by the new customs and investment laws are exemptions on import duties for capital goods.

The Ministry of Industry, in its Programme of Action for the Manufacturing Sector 2007-2008, lists as an objective the development and implementation of financial mechanisms to support national private investment.³⁹ It is not specified whether these mechanisms include innovation-promoting measures such as fiscal incentives or customs duties exemptions for R&D activities and materials. Such mechanisms on their own could foster existing R&D, but are generally insufficient to lead to additional. This mechanism should be integrated into a more comprehensive, cross-sectoral STI-conducive framework to ensure the sustainability and development of STI. Other potential mechanisms through which the Government might consider fostering R&D are discussed further in Chapter 5.

2.3.3 *Standards and quality regulation*

Effective, up-to-date and enforceable standards and quality regulation are important tools to promote technological innovation, especially incremental innovation. They are also critical in building competitiveness in international markets, where the use of standards certification is becoming the norm. Certification systems exist in areas such as environmental management, occupational health and safety, and industrial security, as well as for end-product standards.

The Angolan Institute for Standardization and Quality (IANORQ) was established in 1996. It participates at the International Standards Organization (ISO), in the SADC initiatives on standardization, metrology, and accreditation, and is an affiliate member of the International Electro-Technical Commission. It is likely that standards and quality regulation in Angola will develop in tandem with SADC guidelines. IANORQ is a “protected organization” under the Ministry of Industry. Conceptualizing and implementing standards to improve product quality is listed as one of the Ministry’s specific objectives under their Programme of Action for the Manufacturing Sector 2007-2008.⁴⁰ However, IANORQ may also need to upgrade its testing facilities, inspection and certification to implement new standards regimes.

³⁷ Notably, the minerals sectors. Terms of agreement, including tariffs, are negotiated bilaterally between the Government and the oil company. A new Petroleum Customs Law is being debated (US Dept. of Trade website, July 2007). Oil and mining industries can import equipment duty-free, provided that these are used exclusively for exploration.

³⁸ ANIP (?) Investment Incentives in Angola.

³⁹ Ministry of Industry (MIND) (2006) Programa de Acção do Sector da Indústria Transformadora para o período 2007-2008

⁴⁰ MIND (2006) Programa de Acção do Sector da Indústria Transformadora para o período 2007-2008

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Other regulatory regimes have been established in other ministries. The Ministry of Post and Telecommunications has as its regulatory body the National Institute of Communications (INCOM), which represents Angola at the International Telecommunications Union (ITU). The Ministry of Health is the national representative on the Codex Alimentarius Commission, although recent regulatory capacity in food safety has been built with the support of the Ministry of Agriculture and Rural Development, through the establishment of a new laboratory for food safety testing. However, a new regulatory regime is needed for the approval and registration of pharmaceuticals and, possibly, other therapeutic medical products, not least because it has been found that doctors in Angola may prescribe expensive brand-name drugs simply because the generic versions has not been validated at the national level.

2.3.4 Procurement

Government procurement is a valuable tool for technological capacity-building. In Angola, opportunities for technological learning abound from the large-scale government investment taking place in public works and energy production. However, whilst these investments are supporting the creation of a large number of new – though, temporary – jobs, large-scale projects are put out to foreign contractors, and domestic enterprises are relegated to supporting roles such as supplying basic building materials. The problem of absorptive capacity notwithstanding, policy decision-makers should remain alert to opportunities to negotiate contracts to maximize the potential learning benefits.

2.4 Summary

The overview presented in this chapter indicates nascent capacity-building in key areas, but the framework for integrating STI into the different sectors need to be strengthened. Focus has been wholly on tackling urgent needs, and opportunities for incremental technological learning from these activities themselves have not been fully exploited. Education and training capacity is improving, but the sciences and engineering are neither featured prominently in the curricula nor in students' choice of specialization. There is a gaping lack of STI skills in the labour market, but STI initiatives appear to be limited to technical and vocational training, general investment incentives, and regulatory reforms. The latter appear to have been taken to remove bottlenecks in STI capacity-building, rather than as proactive measures to stimulate it. STI policies that flexible enough to respond to rapidly-changing conditions need to be in place to provide fertile ground for incremental technology learning and subsequently national STI capacity.

The Ministry of Science & Technology is well-placed to formulate and promote such policies. Its role in relation to other sector ministries needs to be more clearly defined. For example, it does not seem to participate in the formulation and implementation of the national regulatory regimes, rather it appears to function as an advisory body to other ministries. This role could be useful if other ministries proactively seek the advice and input of MINCIT for a STI-dimension in their own sectoral policies and programmes, but difficult to carry out if they did not. Another principal statutory role ascribed to MINCIT is to foster STI in the development of a knowledge culture. At this time, no mechanisms have been set up for this function. The limited

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budget of the ministry as well as other constraining factors would limit work in this potentially dynamic area of growth. Under the prevailing conditions, it would seem that MINCIT is confined to the “traditional” S&T policies. A comprehensive review of MINCIT’s mandate, clarification of its roles, and – in the light of these – the allocation of an appropriate budget to execute these programmes, would be useful.

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Chapter 3: STI and Angola's Economic Pillars

In its pre-1975 prime, the Angolan industrial sector centered on petroleum refining and machinery, construction inputs, food processing, electrical products, chemicals, steel, and vehicle assembly. The long-running civil war has left Angola's industrial sector operating at a fraction of pre-war levels, and the economy largely dependent on extractive industries, notably petroleum and diamonds. The present chapter seeks to illustrate that current industrial policy and measures need to be strengthened in order to promote technological learning at the production and enterprise levels, to improve public service delivery, and to enhance national export capacity.

3.1 Industry

The Angolan industry has two main components: minerals and manufacturing. The minerals sectors – primarily, petroleum and diamonds – are both FDI-dominated, with foreign TNCs operating in relative isolation from the rest of the economy, with state-owned Sonangol and Endiama holding major stakes in each sector. In contrast, the manufacturing sector, more damaged during the war than the minerals sectors, is being rebuilt and expanded through new private enterprises, particularly SMEs. This chapter discusses the STI-related policies in both minerals and manufacturing, with emphasis on the latter where policies and mechanisms for promoting and sustaining opportunities for capacity-building are still evolving.

3.1.1 *Petroleum and Gas*

FDI in Angola is concentrated in the petroleum sector. It typifies FDI in African LDCs: geographically concentrated enclaves in extractive sectors with weak linkages to the rest of the economy. Most outputs are exported in raw and unprocessed state. It is heavy on imported equipment, which requires specialized skills to operate, which in turn limits job creation. Due to the low incidence of inter-firm linkages, joint ventures, and labour movement, the contribution of minerals-based FDI to technology transfer and technological learning is generally very low.⁴¹ Improving the absorptive capacity for technological learning on the one hand, and adjusting FDI policies to improve linkages would enhance the participation of foreign firms in the development of the local economy. In Angola, policies to establish channels for knowledge flows have been introduced, thus far with mixed success.

The 100% state-owned national oil company, Sociedade Nacional de Combustíveis de Angola (Sonangol), was set up in 1976 as the sole concessionaire of the Angola oil industry. To gain access to the Angolan oil industry, foreign companies must enter into joint ventures and production-sharing agreements with Sonangol. In addition, Sonangol carries out its own exploration and production activities, and owns a range of subsidiaries. Sonangol is a key stakeholder, with Total and private investors, of a refinery in Luanda. A second refinery in Lobito —known as Sonaref— is being built. As at late 2007, the Japanese government has started discussions with the government with a view to getting involved in the US\$3.5bn Sonaref

⁴¹ UNCTAD 2007 LDC Report.

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project in return for crude supplies. The Government of Angola, through Sonangol, therefore, holds significant authority to increase national technological capacity through FDI in the oil industry. The government has announced plans in late 2007 to reform Sonangol by transferring its quasi-fiscal operations to the finance ministry and the central bank, and its regulatory functions to the petroleum ministry.

The “Angolanization of the Oil Industry” initiative was launched in 1982, with the objective of expanding the presence of national technicians and companies in the oil industry. Decree number 20/82 stipulated that all companies involved in crude oil exploration in the country should contribute to the training of nationals in the sector, and that a fund be created to finance the training of Angolan nationals outside the country. It also included a timetable for the gradual replacement of expatriate workers in national companies with Angolan nationals. However, it has had little impact on employment: only about 1% of total workforce is currently linked to the oil sector. A new Petroleum Activities Law came into force in 2004, which again sets out provisions for local content. The new Law requires companies to include Angolan citizens at all levels, providing that candidates for employment possess the required expertise.⁴² The Government’s targets for local content in this respect are: 100% for unskilled workers, 80% at the mid-level, and 70% for higher level staff. However, the International Energy Agency reported that companies were finding it difficult to recruit skilled local staff. According to a recent Government report, only around 12,000 new jobs have been created in the oil sector in 2005. For a key industry, albeit one generally characterized as being capital-intensive and geographically isolated enclave, this has been considered meagre compared to the over 31,000 in fisheries, and nearly 40,000 in diamond mining.⁴³

A task force has been set up, involving the Ministry of Petroleum, Sonangol, and the other oil companies, to discuss ways through which local content in the industry can be increased. Professional training appears to be a favoured mechanism. The new Law, like the one it replaces, requires foreign oil companies to support the professional education of Angolans.⁴⁴ Foreign oil companies have provided funds for education in the past, and these activities are continuing under the new Law. However, there must be some concern as to whether recruitment of Angolan staff into foreign oil companies will be successful in terms of the accumulation of technological learning at the national level. This depends not only on attracting qualified nationals but also on retaining them. Unless there is evidence of labour mobility, especially amongst skilled personnel, between foreign and domestic enterprises, a refinement of current policy is warranted. At a time when the Government aims to diversify the economy, channelling skilled and highly-educated Angolans into long-term positions in foreign TNCs in the oil industry may not be the best use of scarce human resources.

Most oil companies sponsor social projects as a part of Corporate Social Responsibility programmes, but these have traditionally been *ad hoc*, geographically and institutionally fragmented initiatives. More recently, oil TNCs have formed partnerships with the Government, NGOs, and other organizations, including Sonangol, that have enabled better targeting and coordination of initiatives. One example, outlined in Box 3.1, is the CAE-Apoio Empresarial, a business support centre for SMEs.

⁴² IEA (2006) Angola: towards an energy strategy.

⁴³ Government of Angola (2006) General Programme of the Government for the Biennium 2007-2008

⁴⁴ IEA (2006) Angola: towards an energy strategy.

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Box 3.1 CAE-Apoio Empresarial

CAE-Apoio Empresarial was established with sponsorship by Sonangol in cooperation with BP, Chevron, Esso and Total, and is managed by Citizens Development Corps, a US-based nongovernmental organization. The centre offers small and medium-sized Angolan companies training in quality, bidding, and securing and managing contracts in the oil sector. The centre currently services more than 300 enterprises. CAE has helped 15 Angolan firms secure contracts worth a total of around \$1.25 million, to provide the oil industry with goods such as pumps, overalls and stationery, and services such as cleaning and catering.

More recently, in March 2007, the Government announced a US\$ 50 billion investment into the oil sector over the next five years. The investment will be made in various areas in the sector, such as environmental protection, construction of infrastructure and oil installations. It is expected to open new business opportunities for national suppliers and service providers, as well as in the establishment of oil infrastructures, manufacture of equipment and maintenance operations. These initiatives are buoyed by the new law (decree 20/82) which requires foreign oil companies to purchase Angolan goods and services wherever quality is comparable with imported alternatives, and where the price is no more than 10% higher.⁴⁵

From this broad overview, it emerges that the promotion of inter-firm linkages in supply chains is likely to make the best contribution to building technological capabilities in Angola. In respect of education, training and recruitment of Angolans, there is a case for reviewing alternative options to build technical and managerial skills related to the oil industry for the national benefit. Policies that would encourage the mobility of personnel between TNCs and Angolan business activities, perhaps through internships, or short-term contracts, should be considered.

New enterprise opportunities may, in the longer term, emerge from the nascent gas industry. The IEA (2006) reported that “almost all” gas reserves and production are associated with oil activities, and that up to 80% of this is flared at present. Some gas is liquified off-shore and directly exported as LNG. However, the Government of Angola has introduced legislation to phase out flaring by 2010, and, as a result, there is a proposal to build a liquification plant on-shore in Soyo. Under the proposal, Sonangol, the sole concessionaire for gas and oil, would operate the plant as a joint venture with Chevron.

3.1.2 Diamonds and other minerals

The relatively small and declining share of diamonds in GDP (table 1.2) obscures the fact that it nevertheless accounts for the second largest percentage of export revenues. Angola is the world’s fourth largest producer of rough diamonds. Its diamond reserves were estimated in 2000 at 40 million carats in alluvial deposits, and 50 million carats in kimberlite pipes, which are just now beginning to be exploited.⁴⁶ In 2005, diamonds accounted for 6% of total exports, and nearly

⁴⁵ IEA (2006) Angola: towards an energy strategy.

⁴⁶ World Bank’s Angola Economic Memorandum (2006)

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300 new licenses were issued in 2004-5.⁴⁷ Angola is also rich in other minerals, such as marble, granite, iron ore, gold, phosphates, manganese, copper, lead, zinc, tin, tungsten, vanadium, titanium, chrome, beryllium, kaolin, quartz, gypsum, and uranium deposits.

The National Diamonds Company of Angola (ENDIAMA) was established in 1981. It operates under the guidelines set up in the Strategy for the Development of the Diamond Sub-Sector, which is programmed up to 2010. Like Sonangol in the oil sub-sector, ENDIAMA is responsible for mining licenses in the country and, through joint ventures, has stakes in all the country's diamond mines. The company set up a new subsidiary, ENDIAMA Prospecting and Production, in 2003, to carry out its own prospecting, research and mining activities. The company also has an information system facility, SIDIAMA, which compiles mining geology data. In 2005, the company set up Angola Diamond Polishing. State-owned SODIAM (The Diamond Marketing Company) is ENDIAMA's trading arm; it has offices in major diamond centres around the world.

Sodiam reported sales of 9.447m carats of diamonds in 2006, comprising 8.267m carats from official mines and 1.18m carats from informal mines. This represents a 22% rise in production from 2005, bringing the total value of diamond sales to US\$1.2bn. Illegal mining, presumably by artisanal miners operating in the diamond zones of the extreme east and north-east of the country, is estimated to have cost Sodiam US\$380m in 2006. Endiama plans to boost production to 17-19m carats by 2010, when a number of new diamond projects are expected to reach full production.

Another successful initiative was Kimberley Process, concluded in 2003, to introduce a national certification system for diamonds. Technological learning in the diamond mining sub-sector is accruing, but it appears to be entirely within the ENDIAMA group. Whilst the company has stated commitments to building "know how" through training of its work force and contributing to sustainable development, the company itself is building new capacity along the value chain through existing and newly-established subsidiaries, and has created new jobs. However, these government-backed initiatives may actually be marginalizing private small and medium scale mining enterprises.⁴⁸ There is concern that technical change might be slowed by a lack of competition in the sub-sector. It has been reported that the foreign mining companies allege that SODIAM pays below market prices for rough stones, and that ENDIAMA is reluctant to enter into joint ventures for mining development.⁴⁹

The African Growth and Opportunity Act Competitiveness Report (2005) urges that attention be also given to other minerals, such as marble, granite, iron ore, gold, phosphates, manganese, copper, lead, zinc, tin, tungsten, vanadium, titanium, chrome, beryllium, kaolin, quartz, gypsum, and uranium deposits. War had interrupted process of acquiring modern technologies in mining exploration and in geological surveys. In conjunction with building survey capabilities and data, known reserves might be reviewed. In some cases, known deposits were at one time considered to be economically unfeasible targets for exploitation. Now, given the development of mining technologies over the past decades, these may be worth reconsideration. Investments in R&D, within or coordinated by the Ministry of Geology and

⁴⁷ AfDB/OECD (2006) African Economic Outlook.

⁴⁸ Whilst one of the reasons for the certification system was to discourage informal activities and illegal trading, it may also act as a barrier to legitimate development.

⁴⁹ Ayalan-Metser, T. & Lieberman, R. (2007) Angola marks record production in 2006. In Mining Diamond News.

Mines, in surveys, both geological and evaluation of available extraction and processing technologies, may be warranted.

3.1.3 Manufacturing

The once-thriving manufacturing sector in Angola is only now beginning to recover from the ravages of war. Existing firms are predominantly engaged in light industry, including food and beverage production and textiles. It has only been in the past two or three years that overseas investors have begun to show interest in the sector.⁵⁰ The potential growth in the food and beverage processing industries will, to a large extent, depend on a revival in agricultural production and fisheries, which together account for less than 10% of GDP. There is a great deal of potential to increase these sectors' shares of GDP in the future, as the process of de-mining the countryside progresses and the country's transport infrastructure is improved.

3.1.3.1 Industrial Strategy

Industrial policy in manufacturing is guided by the national *Strategy for the Reindustrialization of Angola (Estratégia de Reindustrialização de Angola)*. Its key objective is to ensure that the country's manufactures are competitive by the time that Angola is fully integrated into SADC.⁵¹ The strategy's guiding principle is that the private sector should be the driving force in the country's industrial development. To this end, a key objective is to attract not only external capital funding but also acquire technology, markets, research and capacity-building activities. The strategy also identifies the development of agriculture, cattle-breeding and fisheries, and their integration with manufacturing as fundamental to the revival of the industrial sector.

The strategy rests on four priority areas: meeting basic needs and generating more jobs, particularly in labour-intensive primary products sectors; building the capacity for import substitution; gaining comparative advantage in certain exports; and constructing upstream and downstream industrial facilities for chemicals, aluminium, LNG, methanol, ammonia and fertilizers.

Another important feature of the strategy is the establishment of industrial development poles: in Luanda, which has 75% of the country's existing industrial capacity and the largest share of domestic markets, Benguela – close to the port of Lobito – and Cabinda, for its proximity to areas where the potential of natural gas is being developed.

3.1.3.2 Current policy and implementation mechanisms

While the industrial strategy is now midway in its 2001-2012 planning period, the Ministry's Programme of Action for the period 2007-2008 lays out a set of general and specific objectives. These include the continuation of support mechanisms for setting up and nurturing new enterprises; for coordinating business strategies; for encouraging private investment; and for implementing financial instruments to promote domestic investment. During this period, the

⁵⁰ AfDB/OECD (2006)

⁵¹ MIND (2005) *Estratégia de Reindustrialização de Angola* and opportunities for investment. It is noted that, according to the Government of Angola's General Programme of the Government for the biennium 2007-2008, integration into SADC is seen as both an opportunity and a threat (Government of Angola 2006). The opportunity is access to a market of nearly 200 million (MIND 2005); the threat is that, unless Angola's products are competitive, the country could be flooded with imports from other countries in the region.

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principal focus of action was to be the implementation of measures for the horizontal development of industry in food, construction materials, rubber products, packaging, small parts, small-scale agricultural equipment, as well as repair and maintenance operations.

In tandem with the Industrialization Strategy's three geographical poles for development, current policy focuses on the establishment of Industrial Growth Points. Recently approved is the Capanda Industrial Growth Point Development Plan, a public-private partnership with a total investment of US \$ 900 million to set up and develop an agro-industrial centre for soya and cassava processing as well as alcohol production. The 8-year development plan will be managed by the Capanda Development Society, an autonomous organization set up with public funds.

Technological development is one of the development plan's general objectives, but the only specific technology-related items in its Programme of Action are the design and implementation of norms on quality standards, and the programme to build human capital. The General Programme of the Government for the biennium 2007-8 highlights the low levels of qualification of workers as a key weakness in the sector, and the Ministry is directly addressing this problem through its own Centres of Professional Training.⁵² At present, there are four centres. They offer courses ranging from metallurgy for technicians and operators, industrial baking, and basic mechanics course for machine operators and industrial maintenance workers to basic administration. Three of the training centres are in Luanda province, the fourth being located in Huambo. Two offer English language training.

Professional and vocational training is a prerequisite to building technological capacity. In Angola, there is a general shortfall in human resource development at these levels, particularly in the sciences and engineering. However, from interviews carried out during the Review process and from university statistics, it is evident that science and engineering degrees are not as popular with students as, for example, law and business. Policies and measures to build human capital in the sciences, technology and engineering are largely the province of the Ministry of Education and, to a lesser extent, the Ministry of Science and Technology. A collaborative approach for building a critical mass of scientists and engineers at the national level is being proposed.

The Ministry of Industry (MIND) has a mandate to “promote industrial innovation, scientific research and technological development” and to build capacity to “select, acquire, adapt and diffuse industrial technologies”.⁵³ To address the first part of this mandate, the Program for Industrial Technology Upgrade (PATIA – Programa de actualização Tecnológica da Industria de Angola) was established to reverse technological decline. It aims to build partnerships between domestic manufacturing enterprises and foreign supplier firms that operate in Angola.⁵⁴ In addition, the Industrial Development Institute of Angola (IDIA), a protected organization under the Ministry, is responsible for, *inter alia*, technical studies and promotional activities, such as trade fairs, to support productivity-enhancing technological innovation. These types of activities support MIND's policy objective of selecting and acquiring industrial technology. The MINCIT/Directorate of Technology Development has a parallel mandate, and the synergies between the two bodies might be enhanced through a joint programme of activities. The participation of existing business and investment associations such as the Angolan Industrial

⁵² MIND (2007) *Centros de Formação Profissional*

⁵³ Translation from the original Portuguese. From the MIND webpages on the Government of Angola Portal at URL: www.angola-portal.ao

⁵⁴ <http://angolaembaixada.org/pt>

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Association (AIA), ANIP, and the Chamber of Commerce and Industry (CCIA) could be sought for certain activities. For example, progressively less “packaged” forms of imported technology as a medium- to long-term industrial objective. Capacity-building toward this objective could include licensing negotiation training⁵⁵ for business managers as well as in researching and identifying appropriately-packaged technologies. This requires on the part of training organizers familiarity with the business and production sectors, their structures and dynamics, technological levels and absorptive capacities of the human capital. Another area to explore would be opportunities for import-substituting enterprises.⁵⁶

3.1.3.3 The need for policy innovation in technological development

The mechanisms discussed earlier are but some of the elements needed for successful technology acquisition. The ability within new and rehabilitated enterprises to operate, adapt, maintain and diffuse industrial technology is also essential. The role of “tacit knowledge”⁵⁷ in technological capacity-building in assimilating new technologies is another important element.

The global pool of experience on intervention mechanisms to address deficits in tacit knowledge is still limited. However, certain measures might be taken to ensure its development. For instance, in-house training and apprenticeship schemes have proven to nurture tacit knowledge among new employees. Where new enterprises are starting up with limited experience of modern industrial technology, the firm’s stock of tacit knowledge is likely to be low. MIND, IDIA and MINCIT might collaborate to develop mechanisms to identify, monitor and address areas of production where lack of tacit knowledge is constraining the absorption of new industrial technologies. Another measure would be an “industrial mentoring” scheme for the industrial growth points, particularly at the production and production management levels. Expatriate “mentors” could be contracted⁵⁸ to observe production processes and practices of various firms in their area of expertise, and provide recommendations specific to the plants, business concern as well as to the sector at large. Similar provisions could also be included in FDI agreements and technology purchases, coupled with training that focuses on the transfer of standardization information about a given technology. Further provisions might be made to attract experienced professionals who are recently-retired or are considering a “career break”.⁵⁹

To be effective, policies to promote and facilitate the development of domestic markets for technological services should be a long-term strategy.⁶⁰ In Angola, the Ministry of Industry and other agencies have already adopted this principle, especially in terms of production of

⁵⁵ WIPO offers courses in this area.

⁵⁶ For example, there is a large potential market in SADC for solar-powered mobile phone chargers (and, in future, solar-powered mobile phones, which are still not yet very technologically efficient): is there potential for adding value in Angola through in-country assembly, and/or local manufacture of the plastic casings? (In this specific example, there may not be enough commercial incentive, as the retail price of these chargers in Europe is falling very rapidly.)

⁵⁷ Tacit knowledge is a consolidation of knowledge formally-acquired through education and training, and the skills and know-how gained in working with the technologies. Tacit knowledge cannot be codified in instruction manuals. Its acquisition is an incremental long-term learning process, determined by the increasing complexity of the technology. Unfortunately, intervention mechanisms to address deficits in tacit knowledge in “catching up” contexts, either at firm or government policy level, have as yet not been well-developed.

⁵⁸ For, say, 6 months – 2 years depending on the size and needs of the industrial growth point.

⁵⁹ This is an increasing phenomenon in some industrialized countries where there is high fluidity in job markets: individuals chose to take a year or two out of their career to do something “different” to broaden their life experience. Language training in Portuguese, as part of the mentor’s package of benefits, would enable such a scheme to extend beyond Portuguese-speaking countries.

⁶⁰ UNCTAD 2007 LDC Report.

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intermediate goods. Other measures for facilitating learning and the diffusion of knowledge in the productive sectors, including engineering firms, business consultancies and machinery producers, might also be considered.

Another, and perhaps more important, aspect of technological learning is in-firm R&D. Evidence have shown that “some R&D is needed just for efficient absorption” in addition to fiscal and other incentives to encourage the large initial investment for setting up R&D, especially in SMEs. In Taiwan (Province of China), where industrial growth was largely driven by SMEs, the Government used a range of mechanisms to promote industrial R&D in strategic areas. These included funds for venture capital; interest-free loans to match the firm's investment in R&D, as well as grants for certain categories of projects; requirement for larger firms to re-invest a portion of sales revenue into R&D; and public-private research consortia to develop key technologies.⁶¹

At this point in its reconstruction programme, the Government of Angola might wish to consider the last mechanism for developing national research capacity. This would ensure a research programme that is structurally linked and substantively responsive to the changing needs of the industrial sector.

The Ministry's broad strategy for enterprise creation has two distinct strands: the support of individual enterprises in priority areas of production, and the establishment of industrial clusters in selected geographical locations. The strands have the common key objective of building capacity along value chains. The integration of enterprises into existing and emerging supply chains has significant potential to stimulate both technical and techno-managerial innovation as well as learning through producer-supplier links. In addition to the underlying strategy of positioning the private sector at the forefront of industrial development, further specific interventions to encourage investment in innovation are needed. In one study of African clusters, it was found that those that failed to continuously learn were “trapped in a pattern of poor markets, low-quality products and a lack of imagination”.⁶² In view of the perceived weakness of enterprise management and lack of strategic business skills in the sector⁶³ and the poor functioning of domestic consumer markets, establishing improved product and process quality standards may be necessary for achieving the Ministry's objectives.

Furthermore, there are general risks associated with innovation which entrepreneurs take into account. Foremost is the uncertainty about the scale and lead time for benefits to materialize, particularly where such benefits are dependent on complementary investments and on other agents. On major development projects, the Government of Angola has taken measures to cushion the risks. An example is its large-scale projects undertaken. Another are the credit schemes set up for SMEs. However, to ensure the sustainability of initiatives to stimulate innovation in the manufacturing sector, mechanisms are needed to consolidate and perpetuate the process of incremental absorptive capacity, as well as to stimulate capacity-building to adapt, improve, and diffuse existing technologies.

⁶¹ UNCTAD (2003) Investment and Technology Policies for Competitiveness.

⁶² UNCTAD 2007 LDC Report.

⁶³ General Programme of the Government for the Biennium 2007-2008

3.1.4 Summary

In the mineral sector, acquiring local technological capabilities through existing operations and through appraisal of survey and exploration technologies can enable local capacity in a domain hitherto the preserve of overseas corporations. In addition to job creation potential, there are growth opportunities for local consultancy and services firms. In the longer term, local mining enterprises could also develop services for export.

MIND's strategy and policy objectives are aimed at opportunities for enterprise development, and are built on Angola's industrial tradition in food and beverage self-sufficiency. Establishing growth development points through public-private partnerships in strategic locations and equipping these with adequate infrastructure appears to be the way forward towards rebuilding industrial dynamism. In addition to the industrial policy and mechanisms to foster enterprise development, interventions need to be timely, complementary and responsive to the changing needs and capacity of firms in the value chain. Overall, in manufacturing, absorptive capacity-building is still in the early stages, and the levels of capacity vary widely among firms.

Current industrial policy is rather weak in the area of technological development. MIND's programme for the current biennium includes as objective the implementation of regulatory reforms, which could act as an incentive for firms to upgrade their production processes and management in order to enhance quality and norms. However, measures and mechanisms to promote technological learning within enterprises are lacking. Government investment in this area, preferably through public-private initiatives, is warranted, especially in areas which are dominated by SMEs, for which the inability to invest in firm-level R&D is a serious constraint to the development of innovative capacity.

3.2 Agriculture

Angola has three agricultural zones. The humid tropical lowlands in the northern provinces produces cassava as the major crop, supplemented with beans, maize, sweet potato and groundnuts. In the dry regions of the south, millet and sorghum are the dominant crops and cattle are raised in natural pasture. The main staple in the central highlands is maize, together with beans, cassava and groundnuts. The central highlands has been the tradition bread basket of Angola, and is still home to the larger proportion of the rural population. However, it is now the poorest area of the country. The return of internally-displaced people to the rural areas has led to increased small-scale crops production.⁶⁴ The International Fund for Agricultural Development (IFAD) estimates that four out of five Angolan farmers are subsistence farmers. Productivity is very low, as land is labored manually with little or no fertilizers and pesticides. The same plot of land is cultivated continuously without fallow periods. Only around 18% of farmers produce some surplus, and only 2% are commercial producers with a paid workforce.⁶⁵ Recovery and growth in the agriculture sector is still severely constrained by the degradation of physical and

⁶⁴ The agro-pastoralist production systems in the south of Angola were less affected by the war and the resulting demographic upheavals: most of the internally-displace people are, therefore, returning to areas where crops are dominant in agricultural production.

⁶⁵ IFAD (2005)

institutional rural infrastructure and by the presence of landmines. Farmers' access to both credit and inputs is severely limited. Further, much of the traditional farming knowledge has been lost as a result of urban exodus during the conflict.

Even as Angola has been dependant on food imports for the past thirty years and on food aid since 1990,⁶⁶ a recent mission of the Food and Agriculture Organization of the United Nations (FAO) and the World Food Programme (WFP) found that food security in most regions is improving rapidly. An estimated 90% of the resettled population are engaged in agricultural production.⁶⁷ The mission estimated that 800,000 people would require both food and non-food assistance such as planting materials and other farm inputs during 2006/7. This is a significant reduction on the 1.9 million people requiring such assistance in 2003, and the 1.4 million in 2004.⁶⁸

Angola's potential for becoming once again a major food producer in the region could be realized through an appropriate mix of policies and measures, including the adoption of mature food production technologies and farming techniques. This chapter focuses on crop agriculture because of its importance in achieving food security, re-establishing livelihoods for resettled population, and providing inputs into the nascent food processing industry.

3.2.1 *The policy framework*

The Ministry of Agriculture and Rural Development (MINADER) has three executive directorates: agriculture and forestry, rural development, and agricultural engineering.⁶⁹ In addition, it has the Technical Services, which carried out planning (including studies and statistics), inspection, and food security. The food security unit monitors food security, markets and prices, and has a rapid alert function. Other development functions, including R&D, are carried out by “protected services” of the Ministry.

One of the Ministry's most recent policy document for the sector⁷⁰ is aimed at developing and modernizing the agriculture sector, with a view to increasing agricultural production and competitiveness, and to improving the economic and social status of the rural population. Specifically, its main objectives include: upgrading the qualifications of human resources through professional and vocational training; extending the areas of cultivation under irrigation; improving the market efficiency for agricultural and forestry products through better access routes between areas of production and large centres of population; involving farmers in the process of formulating policies for agricultural production, processing and commercialization; reducing the role of the State through a progressive and orderly transfer of its functions to agricultural associations and intermediate organizations; and developing research and experimental capacities, and enhancing technology diffusion channels in the different agricultural sub-sectors.

Subsequent articles of the policy document outline plans for: agricultural business development at all levels: family, SMEs, and large-scale, with family-owned and operated enterprises having priority to government support; sustainable use and management of resources,

⁶⁶ International Fund for Agricultural Development (2005)

⁶⁷ FAO/WFP (2006) FAO/WFP Crop and Food Supply Assessment Mission to Angola, July 2006.

⁶⁸ FAO/WFP (2006)

⁶⁹ Including Hydrological Engineering.

⁷⁰ MINADER (2005) Lei de Base do Desenvolvimento Agrário 15/05 December 2005.

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especially water and biodiversity; incentives to increase productivity through innovation and use of modern technology; promotion and monitoring of food safety in both products and production processes; restructuring and improved functioning of agricultural markets; improved infrastructure for agricultural production, processing and commercialization, as well as enhanced synergy among agro-industrial businesses along the value chain; and regulation and revival of agricultural markets, preferably with the participation of risk capital.

Law no. 15/05's objectives reflect a systemic, demand-driven and enterprise-oriented approach to agricultural development. It includes substantial technology content, and implies innovative institutional reforms. However, it is essentially a framework document of aspirations, objectives and principles. Under Article 10, responsibility for the creation of mechanisms to implement the policies and programmes of the Government is delegated to the relevant competent authorities.⁷¹ Other detailed measures and mechanisms are specified in the articles of the document, which outline policies for specific areas: supporting incomes, interventions in neglected geographic zones, and agricultural research. One example in the policy to support incomes is remuneration for environmental services to agriculturalists who adopt environmentally-friendly technologies, systems and activities.

Article 33 of the Law outlines an agricultural research policy, in recognition of the fundamental importance of research to agricultural development.⁷² Its only specific measure to be implemented is the development of an agricultural information system. The remainder of the article establishes key guiding principles for research, among which is that it should provide realistic solutions to current agriculture problems. Solutions should be sustainable, innovative and competitive, and should generate sources of income for related sectors.⁷³ Research activities should cover basic and applied research including experimental development, and should be programmed and carried out in close consultation with agro-industrial enterprises and other agricultural organizations. This participatory approach to designing research activities is reinforced with a clause of the article, which specifies that agriculturalists and their representative organizations should participate in decision-making with the agricultural research organizations.

Although a principle in modern agricultural development, participatory decision-making is rather difficult to implement. Agricultural research, particularly in areas dominated by traditional farmers, tends to be supply-driven. It is characterized by weak linkages between the researchers and the farming communities.⁷⁴ Its results and findings conveyed to farmers through the formal channels of extension services or other intermediate organizations. Implementation of Law 15/05's objectives implies a re-orientation of agricultural development in general, and agricultural R&D in particular, towards demand-driven innovation. This may require a change in professional culture in the implementing agencies.

At the national level, most of the responsibility for coordinating and executing plans to implement MINADER's policies and strategies lies with the development institutes, which are semi-autonomous "protected services". Other protected services are R&D institutes, and special

⁷¹ These would include the "protected" organizations under MINADER, particularly the Institute for Agricultural Development (IDA), and the provincial and municipal authorities.

⁷² MINADER (2005) Lei 15/05 op cit.

⁷³ This last objective appears to relate to the Article's special mention of research relevant to the agro-food industry.

⁷⁴ Clark, N. (2002) Innovation systems, institutional change and the new knowledge market: implications for third world agricultural development. In *Economics of Innovation and New Technology*, Vol. 11, No.s 4-5.

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funding bodies to mobilize funding to support the diffusion of both traditional and modern technical knowledge and artifacts. The protected services are shown in table 3.1.

Table 3.1 Protected Services of the Ministry of Agriculture and Rural Development

DEVELOPMENT	R&D
Institute of Agrarian Development (IDA)	Institute of Agronomic Research (IIA)
Cabinets of Agrarian Development (GDA)	Institute of Veterinary Research (IIV)
National Cereals Institute (INCER)	FUNDS
National Coffee Institute (INCA)	Agrarian Development Fund (FADA)
National Seed Services (SENSE)	Coffee Development Fund (FDCA)
Veterinary Services (SV)	
Institute of Forestry Development (IDF)	

Source: MINADER website <http://www.minader.gov.ao>

3.2.2 Agricultural research and development

The two main research institutes in MINADER are the *Instituto Agronomico de Angola* (IAA) for crops, and the Instituto de Investigação Veterinária (IIV) for veterinary research, both of which report to the Institute of Agrarian Development (IDA).

The IIV is based in Luanda, with research stations and veterinary laboratories in key livestock producing regions. In 2003, the institute's personnel numbered 460, of whom 30 had graduate or postgraduate degrees. Recruitment of qualified staff has been constrained by unattractive salary scales and obsolete inadequate laboratory facilities.⁷⁵ The institute's 2003 budget was taken up entirely by salaries (58%) and operational costs (42%). The institute's priority research areas during that period were: livestock biotechnology, nutrition and feedstocks, draught animals, epidemiological studies on animal diseases, and quality control on animal products and derivatives. Animal improvement was particularly highlighted as a priority, and this is still an important area, with animal breeding being one of the areas targeted for government investment incentives.

There is a wide range of potential consumers for livestock research in Angola: commercial ranchers for cattle, subsistence crops producers for draught animals, small-scale farmers for livestock, and agro-pastoralists. At present, the institute does not have sufficient capacity to address all their diverse needs, but future work programmes might be expanded beyond backyard husbandry towards commercial-level livestock production. The latter category

⁷⁵ MINADER/FAO (2003)

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is more likely to attract capital into the sector, generate revenues and jobs, as well as provide another source of knowledge and experience.

The IAA is headquartered in Huambo in the Central Highlands. Its network of experimental stations, damaged or neglected during the conflict years, is now being rehabilitated. The Institute reports to the Agricultural Development Institute (IDA) in Luanda, and works closely with the Agostinho Neto University's Faculty of Agricultural Sciences, which is also located in Huambo.⁷⁶ Its staff of 174, which includes 107 technicians, is rotated across the headquarters and 10 experimental stations. However, it has been noted that the remote location of the stations and the lack of rural infrastructure has made it difficult for the institute to attract and retain qualified and experienced personnel.⁷⁷

The Institute's research agenda includes improved crop varieties, pest control, fertilizer use, information systems and databases, as well as water supply management. Supplies of improved varieties seed and other planting material are critical to increase yields of major food crops, particularly in the central highlands where food insecurity is most serious. However, data collected in 2003 indicated that plant breeding activities were allocated only 10% of the IAA's budget: allocations to specific crop categories are shown in table 3.2. Most of the work being undertaken in the breeding programmes is evaluation and on-farm testing of both local and imported crop lines.⁷⁸ Its impact on crop production, at both local and national levels, has been considered negligible. It would appear that the institute's resources are far from sufficient to adequately address its mandate and carry out its work programmes.

Current budget figures were not available at the time of the STIP Review mission to Angola, but a MINADER/FAO report from 2003 indicates that salaries and operational costs accounted for nearly 95% of the institute's budget that year. This situation is not uncommon in agricultural R&D in sub-Saharan Africa. Also in 2003, the institute's plant breeders were asked to rank the major factors limiting their programmes. The results are shown in table 3.3.

Table 3.2 Distribution of IIA resources by crop category (2003)

	Per cent
Maize	35
Oilseeds	10
Roots and tubers	20
Other grain legumes	20
Vegetables and fruits	10

⁷⁶ IFAD (2005) and Matos (2005)

⁷⁷ Interview with Dr. Antonio do Vale of the IAA, November 2006. A 2003 MINADER/FAO report indicates that IIA total staff in that year numbered 935, including 490 support workers, 350 basic technicians, 58 middle-level technicians, 14 graduate researchers, and a further 23 researchers with postgraduate qualifications (including 10 PhDs).

⁷⁸ Matos (2005) Report on Plant Breeding and Biotechnology Capacity Survey: Angola. According to the report, between 70-80% of plant breeding resources are devoted to this area of work, except in respect of maize, where 50% of resources are used in germplasm enhancement and line development.

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Others	5
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Source: Matos (2005)

Table 3.3 Factors limiting the success of plant breeding programmes at IIA (2003)

1	Not enough plant breeders per crop
2	Lack of funds for field and laboratory experiments
3	Linguistic limits to literature
4	Lack of participatory approach in plant breeding programme
5	Obsolete and inadequate laboratory facilities

Source: Matos (2005).

These same factors have also been pinpointed in the MINADER/FAO report for that year. A key objective of the IAA at the time of the MINADER/FAO study has been to increase the number of varieties per species released. The achievement of this objective has been blocked by human resources, laboratory facilities, and access to knowledge. It is interesting to note that the breeders themselves identified a lack of understanding of participatory techniques as a barrier to success. This indicates an evolving process of researchers' professional practices. The MINADER/FAO report – which compared data in 2003 with that of a 1996 study – found that, in 1996, a lack of tradition in dealing directly with the problems and concerns of peasant farmers was a problem at the Institute, but that this was not a key issue in 2003. These indications are very encouraging in respect of MINADER's new policy.

Another objective noted in the MINADER/FAO study was to ensure that technologies were diffused from IAA. This has traditionally depended on the strengths and weaknesses of public sector agricultural extension services.

3.2.3 Agricultural extension

The Agricultural Development Institute (IDA - *Instituto de Desenvolvimento Agrário*) is the coordinating body for smallholder issues as well as for rural extension services. Agricultural extension activities in local areas are carried out by 13 Agrarian Development Stations (EDAs) and 7 Agrarian Development Cabinets (GDAs) across 7 different provinces. All the EDAs and GDAs come under the authority of the relevant Provincial Governments, specifically MINADER's Provincial Directorates.⁷⁹ Existing extension services are generally perceived as inadequate conduits for disseminating new ideas and practices. The extension system is vastly

⁷⁹ Government of Angola (2005) Support to NEPAD-CAADP Implementation: National Medium Term Investment Programme.

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under-funded, and has little presence and no influence. Moreover, staff has little interaction with smallholders, and has few links with other organizations.⁸⁰

Given its structural and capacity shortfalls, the institute works directly in collaboration with donors and NGOs to disseminate improved seeds. The role of NGOs in rural development has been officially recognized as “crucial”, especially where their activities were coordinated with the Government and donors.⁸¹ MINADER actively seeks involvement through counterpart focal points and contributions to technical cooperation projects, including technical studies. However, relatively unattractive civil service scales have been cited as limiting effective ministry participation and has been the cause of concerns for the “migration” of skilled staff to better-paid positions in partner organizations.

In the new Law on agricultural development, principles and objectives for agricultural extension are notably absent. It could be argued that, where agricultural R&D is participatory and demand-driven, the conventional role of extension services would become redundant. However, the diffusion of new techniques and materials to a large numbers of geographically dispersed small-scale farmers still requires significant human resources and organizational capacity. In the short- to medium-term, NGOs and donor agencies are still likely to play an important role. But if the Law’s objectives are to be achieved in the longer-term, new approaches to technology diffusion will be needed. A starting point for the design of extension mechanisms might be Uganda’s *Plan for the Modernization of Agriculture*, which provides for a replacement of public delivery of extension services with private, “demand-driven, farmer-led” delivery.⁸² Another mechanism which might be deployed is strengthening the role of local suppliers of agricultural inputs, particularly seed suppliers.

3.2.4 *Private enterprise development*

The closure of most parastatal companies that were set up after independence to provide inputs and technical support has led to a growth in private sector activities – especially, SMEs – in the supply of inputs to the main agricultural centres. However, the production and multiplication of adequate supplies of certified seed and other planting materials remains a major problem. This has, in fact, been identified as a priority objective for agriculture under the proposed World Bank’s Multisector Recovery Project (EMRP) for 2004-2007.⁸³ At present, much of the national seed supply is imported from foreign companies, including the Botswanian subsidiary of the Zimbabwean seed firm Seed Co. The entry of companies like Seed Co into Angola has led to the enactment of the Seed Law in 2005, which seeks to ensure quality through certification.

Quality assurance regulations are being expanded under the 2005 policy for agricultural development.⁸⁴ The policy includes provisions to introduce quality standards and certification for food products, with the view to safe-guarding public health, cultural values, natural resources, as well as optimizing the economic potential of the agricultural produce. Certification systems for

⁸⁰ IFAD (2005)

⁸¹ Government of Angola (2005) NEPAD Medium-term support programme...

⁸² Omamo, S.W. & Naseem, A. (2005) Agricultural Science and Technology Policy for Growth and Poverty Reduction. ISNAR Discussion Paper No. 3.

⁸³ Government of Angola (2005) NEPAD Medium-term support programme.....

⁸⁴ MINADER (2005) Lei 15/05 op cit.

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products and services are being planned. To this end, a new laboratory for the analysis of agro-food products was set up at MINADER's central laboratory.

It would seem that in the immediate future, the agricultural system in Angola will be based on small-scale farming, modernized and organized to produce surplus for agro-processing. Becoming more market-oriented, the agricultural system would also see the gradual withdrawal of state intervention. In this light, one of the key issues to be addressed will be the generation and diffusion of agricultural innovations from domestic R&D. In Angola, as elsewhere in Africa, spending on agricultural R&D is very low. Privatizing certain agricultural research services, made more attractive with an expanded agro-industry, might be an option for the Government to consider, especially at a time of declining overseas assistance to agricultural research in Africa.⁸⁵ On the other hand, it should be noted that a re-orientation of national agricultural research capacity towards areas with high profit potential, such as post-harvest storage and food processing, could be detrimental to small-scale farmers.⁸⁶ A regulatory framework that ensures the integration of small-scale farmers in the rural development and modernization processes would help resolve this conflict of interests.

3.2.5 Summary

Agricultural policy under Law 15/05 presents a long-term vision of the agriculture sector. The current priorities of agricultural research at the IAA are the needs of small-scale, subsistence farmers in food insecure areas. In order to achieve the vision behind Law 15/05, the institute should expand its programme to include traditional cash crops such as coffee or cotton.⁸⁷ as well as food processing. Indeed, some initiatives have already been undertaken in this direction. One of these is the establishment of a food testing laboratory under MINADER. The fruition of these initiatives is, like the rest of the sector, dependent on an enhanced IAA capacity to carry out its mandates. Given the severe shortage of qualified researchers in Angola, and the low budget devoted to agricultural research, the future implementation of the objectives of Law 15/05 raises some questions about the future direction and resource levels of agricultural R&D.

An issue that might be considered is the division of R&D areas of coverage between MINADER and MIND, especially in the growing food and beverage industries. A multi-stakeholder "foresight" exercise might also be carried out. This would facilitate long-term planning for agricultural R&D, from a more effective curricula for the education system to a more user- and market-responsive R&D programmes. It should also be noted that the government is keen to develop the agro-industrial sector, starting with the 2007 construction of the US\$900m Capanda Agro-Industrial Complex.

The underlying hindrance to the pursuit of IAA mandates, and by extension the Angolan vision of modern agriculture, is the lack of financial resources. This situation has been translated in practical terms into: a lack of human resources, especially plant breeders; inadequate

⁸⁵ Pardey, P., Beitema, N., Dehmer, S., & Wood, S. (2006) *Agricultural Research: A growing global divide?* Washington D.C. IFPRI.

⁸⁶ A 2003 study (Chema, Gilbert & Roseboom), of several countries in sub-Saharan Africa pointed out that partial privatization of agricultural firms had further marginalized subsistence farmers and livestock keepers.

⁸⁷ Although a project to revitalize coffee production is on-going, sponsored by the Government and the Common Fund for Commodities, in collaboration with the International Coffee Organization, and executed by MINADER's National Coffee Institute of Angola. (ICO 2005: Summary Report on mission findings: Pilot Rehabilitation of neglected coffee plantations into small family production units in Angola.

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laboratory facilities to allow for modern techniques; and deficient funding to carry out R&D activities. Investment in the expansion and upgrading of laboratories should be a priority, and future budgets should include provisions for operating costs and research-related expenses. The lack of human resources is the most difficult issue to address. The IAA should be asked to identify and prioritize its staffing needs, taking into account the level of skills needed for different tasks. It should also consider the different options for concentrating resources on fewer priorities. In the shorter term, agricultural R&D must be focused on the achievement of the Millennium Development Goal No. 1 on eradicating extreme poverty and hunger.

In addition to the food production, Angola's agriculture also has a nascent biofuels industry. This sector received a boost with a recent agreement between Sonangol, Brazil's Odebrecht and an Angolan oil company, Damer, to set up a new biofuel company, Biocom. This will involve an investment of US\$200m in a 30,000-ha sugarcane plantation, which will annually produce 150m tonnes of sugar, enough to make 50m cubic litres of alcohol and produce 140 mw of power. Given the country's abundance of agricultural land, it has been estimated that by 2050 Angola could annually produce 6 exajoules of biofuel, the equivalent of 2.7m b/d of oil, which is well in excess of the country's current crude output.

The capacity to absorb, adapt and diffuse new technology has been proven in one or two fields within agriculture. There is, however, still much more to be done to extend this capacity throughout the sector. Rural markets are starting to function in some areas, and seed supply through small-scale suppliers is increasing even while seed certification has been introduced to ensure quality. The research culture at the IAA is increasingly open to participatory approach and to meeting the needs of subsistence farmers. The short-term obstacle in respect of poverty alleviation is one of scale. NGOs have a vital role to play, and for the short-term at least, the Government might consider contracting certain services such as extension work to NGOs already in the field. This stop-gap measure should not, in any case, replace the need for long-term investment in education and training. Therefore, until this vision is more clearly articulated, a short-term generalized, rather than long-term specialized, approach would be appropriate.

3.3 Health

About 80% of health care facilities have been destroyed during the conflict. A large proportion of medical staff moved to Luanda or other major provincial capitals for safety.⁸⁸ It is believed that only around 30% of the population is covered by the present health care system,⁸⁹ further exacerbated by the enormous differences in the health delivery gaps among provinces.⁹⁰ A recent report characterized the health system by “a lack of qualified and motivated health staff outside the capital, poor drug and medical supply and management systems, and a weak primary healthcare network”.⁹¹ The resource needs of the health service are immense, and international cooperation and assistance have thus far played a significant role in meeting them. It should be

⁸⁸ President's Malaria Initiative (PMI) 2007 Malaria Operational Plan – Year Two (FY07): Angola, and WHO (2003) Country Cooperation Strategy: Angola. The latter report indicates that, in 2001, over 70% of the country's 656 MDs were based in Luanda. In the same report, the estimated figure for the proportion of destroyed healthcare facilities was given as 65%.

⁸⁹ President's Malaria Initiative (PMI) 2007 Malaria Operational Plan – Year Two (FY07): Angola

⁹⁰ For example, in 2001, Cabinda had one health centre for every 9,400 people: in contrast, Bié – one of the poorest areas – had 460,000 people for each health centre. (WHO 2003) op cit.

⁹¹ PMI (2007) Malaria Operational Plan.

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noted that three out of the eight MDGs are health-related: the fourth on the reduction of child mortality, the fifth on improving maternal health and the sixth on combating HIV/AIDS, malaria and other diseases.

3.3.1 Health policies and programmes

Articulation of an integrated national health policy has been problematic, and at the time of the review team's mission to Angola, there was no (published) overall sector policy. The health-related Millennium Development Goals, the health-related objectives outlined in the ECP, and the various on-going targeted health programmes and action plans in the country, define – in effect – the policy objectives in the health sector.

The ECP for the period up to 2006 identified programme objectives for health, with a focus on target diseases and vulnerable groups, as shown in table 3.4.

Table 3.4 ECP Health Priorities

Primary healthcare	HIV/AIDS	Malaria	TB	Maternal & Child health	Polio, measles, etc
Diagnostics					
Drugs					
Vaccination programmes					
Management and administration (local)					
Training					

Source: ECP (2004)

Explicitly mentioned under the health objective are effective coordinating mechanisms, non-duplication of efforts and complementary interventions between government organizations, the private sector, NGOs, and international agencies. The Fundo de Apoio Social (FAS – Social Support Fund) is used to facilitate the construction and rehabilitation of health centres, together with local resources and businesses.⁹²

There is, implicit in the ECP and explicit in current healthcare plans, a particular focus on the three major diseases that are targeted for special attention in the Millennium Development Goals: HIV/AIDS, malaria, and tuberculosis. The Ministry of Health, supported by funding from the World Bank, has established a HIV/AIDS/STI, Malaria and Tuberculosis Control Project. Since its incidence in Angola is relatively low, HIV/AIDS is not discussed further.

3.3.1.1 Malaria

Around 3.5m Angolans are affected by malaria each year, causing 13,700 deaths in 2005. The death rate fell to 7,700 in 2006, as a result of spraying programmes and the distribution of

⁹² Ministry of Planning (2004) *Estratégia de Combate à Pobreza*.

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anti-malarial nets. The government aims to cut the number of malaria cases by three-quarters by 2012, and to eliminate the disease as a public health problem by 2030. The Roll Back Malaria campaign is the guiding force of Angola's strategy to tackle malaria. It is also a participating country of the President's Malaria Initiative (PMI), a programme led by USAID, in cooperation with the Global Fund, the Roll Back Malaria Partnership, the World Bank Malaria Booster Program, the private sector, and NGOs. At an October 2007 malaria forum in Seattle, experts urged that preventive measures and treatment must be incorporated into the broader national programme of improving the overall public health and health care delivery systems in order to ensure long-term success.

3.3.1.2 Tuberculosis

Angola's National TB Prevention and Control Program (NTP) was set up in 1981, but its efforts were severely constrained by the conflict. It is now strengthened with support from various international and bilateral programmes, and many NGOs. The World Bank, the Global Fund and the WHO are key partners in this drive. The World Bank's \$20 million programme and the Global Fund's \$11 million initiative are both aimed to combat HIV/AIDS and TB. The number of TB cases in Angola in 2004 was reported to be over 40,000,⁹³ but actual cases may be more because of inadequate diagnostic facilities in the provinces. The NTP plan to strengthen TB detection and treatment is expected to double the estimates in some regions. Some progress has been made in extending treatment coverage with WHO/DOTS (Directly Observed Therapy, Short-Course) – up from 43% to 56% between 2002 and 2004 – but the success rate for treatment has remained static (68%-70%)⁹⁴. Default rates remain high at 23%.

Priorities for the current TB Strategic Plan for 2003-07 are the expansion of DOTS and adaptation of this programme to HIV and related drugs resistance; a standardized information system for detection and treatment; community involvement in social education; and the reinforcement of partnerships so that strategies are implemented effectively.⁹⁵ USAID has been supporting capacity-building in the TB programme, including training, improvement of laboratory facilities, and technical advice to the Ministry of Health on laboratory diagnosis and clinical treatment.⁹⁶

3.3.1.3 Other serious diseases

Trypanosomiasis had been practically eradicated in Angola by 1960, but the disease surfaced again during the long period of civil conflict. The Strategic Plan for 2002-2005 to eradicate the disease had charged the Instituto de Controlo e Combate das Tripanossomíases (ICCT), a protected institute under the Ministry of Health, as the focal agency for action, but the ICCT ran into serious operational difficulty in fulfilling its functions. In 2005, the Government reported that the presence of the vector (tsetse fly) in 14 of the 18 provinces. Preventive measures are critical in tackling sleeping disease since at its later-stage, the only drug treatment has potentially severe and sometimes fatal side effects. But because the ICCT's mobile units are virtually non-operational, no preventive measures are in effect.

⁹³ USAID (2006) citing the WHO.

⁹⁴ variously reported in USAID (2006) and Millennium Development Goals Summary Report 2005.

⁹⁵ Millennium Development Goals summary report (2005)

⁹⁶ USAID (2006) Tuberculosis profile.

Measles, polio, tetanus and other vaccine-preventable diseases are targeted under the Government's Programa Alargado de Vacinação (PAV) which seeks to improve primary health care, build capacity of health workers in pediatric and maternity units, implement a system of integrated epidemic monitoring, and procurement of vaccines. The Government pointed out that whilst the 2004 outbreak of the hemorrhagic disease Marburg received prompt international intervention to halt its spread, response to other epidemics such as cholera has been inadequate.

3.3.1.4 Maternal and child health

With no marked improvement between 2001 and 2003 in child mortality, MDGs #4 and #5 on reducing child mortality and improving maternal health are unlikely to be met by 2015.⁹⁷ The implementation of the Integrated Management of Childhood Illnesses has been slowed by lack of financial resources.⁹⁸ The National Strategic Plan for Reproductive Health 2002-2006 subsequently called upon UN agencies and bilateral donors for assistance. The more recent Strategic Plan for the Accelerated Reduction of Maternal and Child Mortality (2004-2008) directs basic health packages – for example, drug treatments, vaccinations, nutritional supplements, oral rehydration therapy – to the immediate cause of morbidity rather than on underlying causes such as poverty and environmental conditions. The strategy aims for universal coverage through three delivery mechanisms: the fixed healthcare network, including NGOs and church-sponsored health services; mobile health units; and, community-based activities.

The MDG report identifies financial resources as the main constraint to the full implementation of the strategy. Even with adequate financing, there are doubts over the capacity of the existing system to absorb both financial and technical assistance.

3.3.2 Programme coordination and systemic efficiency

The various health strategies, plans, programmes and coordination mechanisms outlined in this chapter – as well as others not mentioned⁹⁹ – is evidence of a fragmented health system. Despite the institutional mechanisms set up to facilitate coordination among the various activities and partner agencies, the WHO reports that coordination remains the key problem. Part of the blame could be laid on the partner agencies themselves, which have been known to compete for leadership and visibility.¹⁰⁰ However, there still remain the inherent difficulties in coordinating activities within the existing context for the Ministry of Health to resolve.

The UNDP has suggested that coordinating mechanisms on specific themes be established, perhaps under the Ministry of Planning to alleviate the burden on the Ministry of Health. An STI-based mapping tool could be set up by disease and by regions. Figure 3.1 illustrates a basic framework for analysis of a problem-based health innovation system, with malaria as example. The analysis of “capacity” to deliver interventions could be based on the identification and evaluation of: 1) the elements constituting each pole of the framework; 2) the inter-relationships of the elements within each pole; and 3) the linkages among the key elements of different poles. This methodology helps to identify programme weaknesses and to guide

⁹⁷ MDG Summary Report (2005)

⁹⁸ Ministry of Health (2004) Strategic Plan for the Accelerated Reduction of Maternal and Child Mortality in Angola 2004-2008.

⁹⁹ Including, for example, the Humanitarian Sub-Group for Health and Nutrition – part of the national Aid Coordination Technical Unit – a multi-stakeholder group chaired by the Ministry of Health (WHO 2003)

¹⁰⁰ WHO (2003)

policy planning for the health sector, both within the Ministry of Health as well as health-related policies in other ministries, such as Energy and Water, Public Works, Environment and Urbanization, and Education, as well as provincial and municipal health authorities.

Whilst there are many potential contributions that could be made to the MDGs through STI initiatives, these need to be selected to target areas that are not being addressed adequately by current activities, and for which existing capacity could be mobilized. Further, given the scarcity of skilled human resources, STI recommendations need to take into account the longer-term usefulness of the skills and expertise that are needed to address short-term problems. Another objective of STI policy should be to build on innovations that are being generated through existing programmes, particularly technologies brought into Angola through donor activities.

Given the general shortfall in the health network, it is important that duplication of activities is avoided; that potential synergies in programme needs and activities are utilized and optimized; and that gaps and barriers to absorptive capacity are addressed.

3.3.3 Building capacity to absorb and build on imported knowledge

A significant amount of embodied medical technology, skills and expertise is being brought into the country as part of international cooperation to tackle key diseases. In order to optimize learning benefits and ensure sustainability, Angola's innovation system needs to build complementary capacity to assess and build on imported technologies. Table 3.5 shows that the types of knowledge being transferred into the country generally meet needs as identified in complementary capacity to assess and build on imported technologies. Table 3.5 shows that the types of knowledge being transferred into the country generally meet needs as identified in official health programmes. The problem is not so much the relevance but the shortfall in quantity, for which the Government has stressed the need to expand existing programmes. Various reports and strategy documents also highlight more complex systemic problems in absorptive capacity, such as weaknesses in the pharmaceutical management system which constrain the distribution of essential drugs. A national "stock-taking" of existing capacity and gaps is important, but even this faces major obstacles.

The key barriers to a viable strategy and effective national health policy appear to be a lack of health statistics and information; a shortage of medical, technical and support personnel; the Ministry of Health's constrained ability to implement national strategies and policies. The latter is critical, given that a large bulk of funding for health in Angola is channelled outside the Government¹⁰¹, via international agencies and NGOs. Other barriers are systemic, such as the budgetary autonomy of provincial health administrations for which funding is derived directly from the Ministry of Finance; and weak management, particularly at the provincial level.¹⁰²

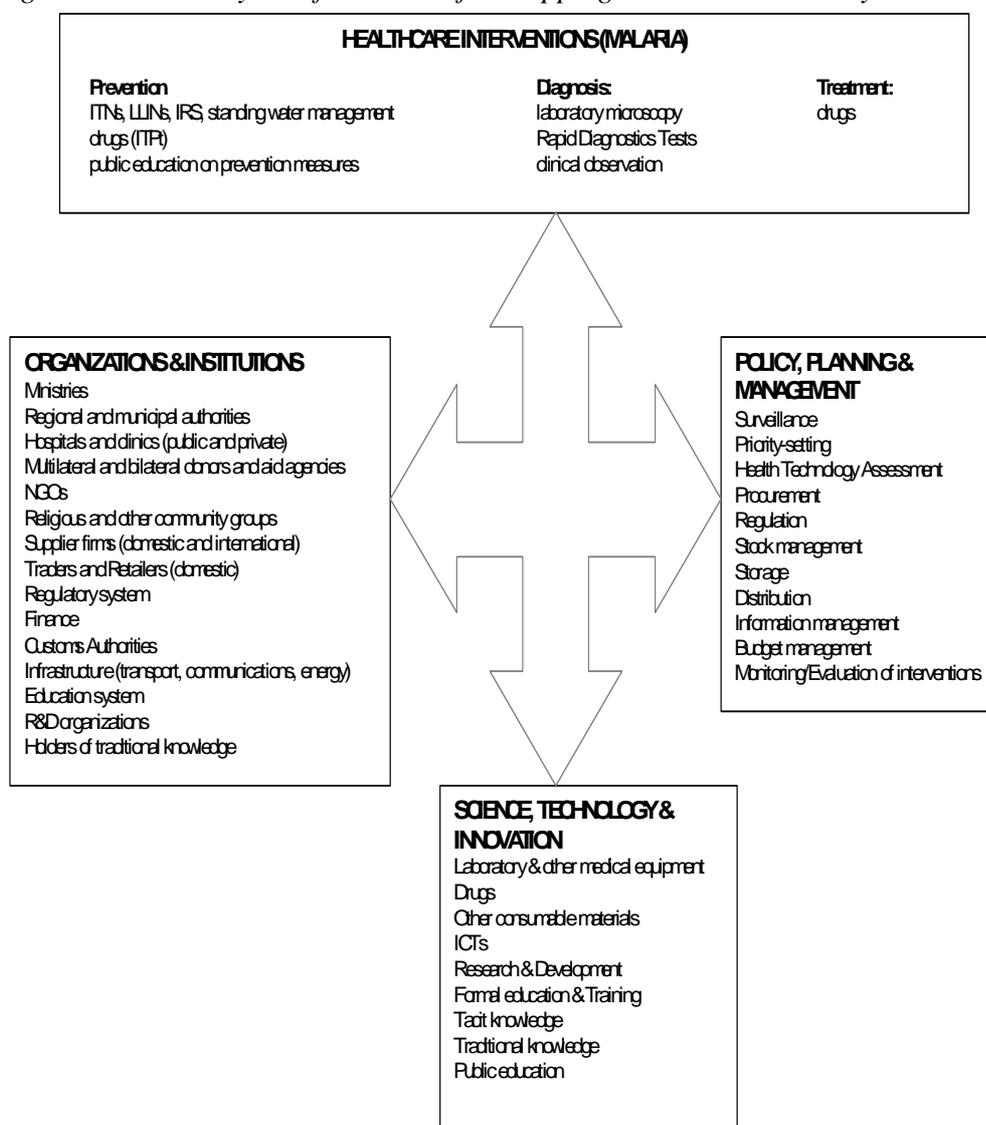
It can be concluded that existing donor activities are still primarily humanitarian, although there are efforts to build sustainability through training programmes and expanding laboratory facilities. Resources to build absorptive capacity are scarce and therefore need to be targeted to specific key areas. S&T contribution would be optimal in the areas of information systems, epidemiology, and laboratory diagnostics.

¹⁰¹ Fustukian, S. (2004) Review of health service delivery in Angola. DFID Health Systems Resource Centre.

¹⁰² WHO (2003)

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Figure 3.1 An analytical framework for mapping health innovation systems



Source: adapted from Stokes, K (2006)

A weak information system, combined with a lack of epidemiological data and surveillance facilities, makes it difficult to gauge and monitor public health. A 2006 UNAIDS country report on Angola, for instance, highlights the difficulty in monitoring trends due to the “limited information on HIV seroprevalence” in the country, and particularly notes the lack of surveillance of women attending antenatal clinics.¹⁰³ Donor support has been given for a

¹⁰³ UNAIDS (2007) Angola: country situation analysis.

Demographic and Health Survey in 2006, for which results could be used in health sector planning. Local capacity to carry out and continue surveillance activities should be a priority, as well as epidemiological surveys and laboratory facilities for diagnosis.

Current activities under the CNTI's ISAP to support information management and deploy ICTs in healthcare delivery are particularly relevant for strengthening the health system. However, to collate and analyze this information, complementary capacities in statistical analysis, policy, and health economics need to be built. Building "generic" capacity in health information, epidemiology and diagnostics is fundamental in a functional and effective health system. Technical assistance in training national counterparts, expanding laboratory facilities, and diffusing diagnostics techniques and materials as part of on-going programmes contribute both to achievement of the three health-related MDG targets, and to longer-term development.

3.3.4 *Building capacity to innovate*

In order to better diffuse improved medical technologies and techniques into the health system, medical personal must be trained and re-trained on a regular basis. Parallel efforts might also be made to evaluate the feasibility of integrating indigenous knowledge and actors into the mainstream health delivery system. This could provide fertile areas for building new capacity both within the formal education system, but also at the community level. Bringing traditional health remedies into mainstream healthcare is an important area of STI opportunity in biodiversity-rich countries such as Angola. In fact, phytomedicine is already gaining ground in Angola, even as 2001-2010 has been declared as the "Decade of African Traditional Medicine" by African governments.¹⁰⁴ Of course remedies need to be evaluated for efficacy and safety before they could be approved for use, and traditional healers need to be aware of modern alternatives, and to know when to refer cases to mainstream medicine.¹⁰⁵ Therefore, research that aims to evaluate the potential of traditional knowledge, whilst assuring the intellectual property of the healers, would be another potential area of capacity-building in health research.

The population at large need to be mobilized in addressing the environmental causes of key diseases. Preventive measures such as vector control, improved sanitation, and nutritional security, already identified as priorities in health and related policies and programmes, must be promoted. Mobile health units, proposed under the Strategic Plan for the Accelerated Reduction of Maternal and Child Mortality, may have a crucial role to play in this campaign. Table 3.5 above also shows simple low-cost interventions that have proven effective. Public awareness could also be raised on the effect of indoor air pollution, such as from indoor wood cooking with inadequate ventilation, to the incidence of respiratory diseases especially among children. It is perhaps in these preventive measures that are outside the strict boundaries of the health sector that innovative efforts could best be directed to support the MDGs.

At the science-intensive end of the knowledge spectrum, capacity-building efforts need to take on long-term perspective beyond 2015. The revival of typanosomiasis has led the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases

¹⁰⁴ Kamau, E. & Oloo, A.J. (2006) Developing Traditional Medicine to Roll Back Malaria in Africa. In African Health Monitor, January-June 2006.

¹⁰⁵ Kamau, E. & Oloo, A.J. (2006) op cit.

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Table 3.5 Imported knowledge and priority needs

Imported knowledge	Identified key areas of need
<i>Hard technologies (products)</i>	
laboratories equipped for microscopy diagnosis	Laboratories
bio-molecular reference laboratory (planned)	
Vaccines	supplies of vaccines
anti-retrovirals	continuous supplies of anti-retrovirals
anti-malarials	supplies of anti-malarials
DOTS package (antibiotics + technique)	expansion of DOTS programme
	Drugs to treat trypanosomiasis
Rapid Diagnostic Tests	diagnosis capacity
ITN and LLINs	expansion of anti-vector measures
Insecticides (for Indoor Residual Spraying)	
	distribution of insect traps (trypanosomiasis)
	expansion and rehabilitation of sanitation units
<i>Techniques</i>	
Microscopy diagnosis	capacity for laboratory diagnosis
surveillance, monitoring and evaluation	surveillance, monitoring
	epidemic control and alert response mechanisms
	information systems
<i>Skills training</i>	
health management advice and training	Training
laboratory technicians training	Training
doctors and nurses training	Training
	Public and social education at community level

(TDR) to recommend long-term measures for its control.¹⁰⁶ Despite rapid progress in its treatment and control, malaria needs continued close surveillance as called for at the October 2007 global forum on malaria. Building research capacity to improve public health should prioritize capacity-building in general skills with wide applications, such as advanced techniques in molecular biology, which are more useful than specializations of particular diseases, parasites or vectors. The capacity of the labour market to absorb highly-trained scientists¹⁰⁷ should also be a consideration.

3.3.5 Summary

The impact of science and technology on the health sector cannot be underestimated. Reduction of the global health burden is, to a large extent, dependent on scientific and technological innovations. In a country like Angola, where public health is relatively poor, S&T has a critical role. Scientific knowledge and technology that could prevent, cure or eradicate key diseases already exist, and there is a willingness on the part of the international community and the Government of Angola to invest time, money and effort in the diffusion of health-related innovations. The availability of S&T is therefore not so much the problem as the weak absorptive capacity. While the civil conflict had caused massive destruction to the physical infrastructure and serious disruption to medical personnel formation and retention, the current fragmented activities and institutions present another systemic barrier to long-term STI development.

There is an absolute and urgent need for a cohesive, long-term strategy to strengthen the public health system in Angola. The WHO recommends a clear definition of priorities and a “stock-taking” of existing capacity. A starting point might be the identification and mapping of the “innovation system” that is being implicitly built through the various national and technical assistance programmes. At present, external organizations are the main agents of innovation through, for instance, the procurement of drugs, diagnostics and other health products, as well as in upgrading laboratory capacity. However, these activities tend to be disease-specific and the delivery fragmented. Without a coordinating mechanism, opportunities for incremental learning and for building institutional knowledge are lost. As in many other developing countries, in Angola “policies treat science and technology as exogenous variables to the improvement of health.”¹⁰⁸ Identification of capacity-building needs to absorb and build on new knowledge and linkages is essential in order to integrate STI into long-term health policy in Angola, and ensure that health care provision is closely linked to local innovative capacity.

¹⁰⁶ TDR (2002) Strategic Direction for Research: African Trypanosomiasis.

¹⁰⁷ Such as the case of Brazil-trained Angolan researchers unable to find employment upon repatriation, as reported in SciDevNet (2007) *Brazil to boost health research capacity in Angola*.

¹⁰⁸ Mugabe (2005) Health Innovation Systems in Developing Countries.

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Chapter 4: STI and the Platform Technologies

Angola's development policies for revitalizing the industrial sector, modernizing agriculture, and improving public health service depend on an efficient infrastructure support. Transport infrastructure is, at present, the key recipient for public works. Substantial investments are also being made in two other key infrastructure, energy and communications. The earlier assessments on the manufacturing, agriculture and health sectors demonstrate the importance of ICTs and energy to those sectors' development. Both ICTs and energy are technology-intensive, and their impacts are pervasive across all sectors. Therefore, development in these key platform technologies can either drive or constrain the growth of other sectors of the economy.

4.1 Information and Communications Technologies (ICTs)

ICTs facilitate knowledge creation and diffusion in innovative societies. An essential pre-requisition for an Angolan Information Society is a modern telecommunications sector and as described in Chapter 2, much has been achieved in this direction. Table 4.1 shows the rapid ICTs development under a government strategy of widening participation and increasing competition.

Table 4.1 ICTs development against key indicators, per 1000 population

	Angola 2000	Angola 2004	Sub-Saharan Africa Average 2004
Telephone line subscribers (fixed + mobile)	8	60	103
<i>fixed line</i>	6	7	17
<i>Mobile</i>	2	53	86
Internet users	1	14	15
Personal computers	1	4	12

Source: World Bank (2006) *ICT at a glance: Angola*

4.1.1 STI in telecommunications

Competition between private Unitel and state operator Angola Telecom (through Movitel, its subsidiary) – which had the monopoly in the area – has widened the network and led to the diffusion of new technology, with the use both of GSM (by Unitel) and CDMA (by Angola Telecom). The largest company, Angola Telecom, covers all provinces of Angola and offers a range services from VSAT, Inmarsat, telex to the Internet. Recently, this state operator announced an expansion of lines – including about 14,000 more lines in the province of Huíla by 2008 – and improvement of services. Since 2004, new operators have entered the market, such as

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Mercury – a Sonangol subsidiary – and Nexus. Technologies like WiMax, Vector Signal Analyzer (Vsat), Internet and “Fixed Wireless Access” have been implemented.

It would appear that the sector has rapidly growing absorptive capacity and that it is enterprise-oriented. It has benefited from large-scale government investment in physical infrastructure. In addition, protected institutes under the Ministry of Post and Telecommunications carry out research and vocational training. The Instituto de Meteorologia e Geofísica (INAMET) is responsible for national activities and international cooperation in areas of meteorology, geophysics and astronomy that are relevant to the sector.¹⁰⁹ The Instituto de Telecomunicações (ITEL) is responsible for technical professional training in telecommunications, under the joint mandate of the Ministry of Post and Telecommunications and the Ministry of Public Administration, Employment and Social Security, the latter having overall responsibility for vocational and professional training in Angola. Current government policy is directed towards a controlled, supported growth. The capacity to generate incremental knowledge in telecommunications enterprises is a critical next step. In this situation, price-capping mechanisms and other government interventions need to be balanced with the need to encourage enterprise-level investment in the search, selection, acquisition, and adaptation of new technologies.

4.1.2 Information Technology

The National Commission on Information Technology (CNTI) is a cross-sector coordinating body set up to drive national efforts to build an Angolan “information society”. It was established in 2000, and chaired by the Vice-Minister for Science & Technology. CNTI has adopted, and is now implementing, a national strategy and action plan for the first ten years, up to 2010. The “Strategy for developing information technologies in Angola 2000-2010”¹¹⁰ lays out a comprehensive set of programmes, principles and objectives for the development and deployment of IT capabilities. The strategy itself is based on a “national system of innovation” approach as illustrated in box 4.1, which maps out key elements of the strategy.

The strategy is wide-ranging in scope and objectives, and goes beyond the traditional boundaries of S&T policy of the education and research systems. With market stimulation as a key objective, it uses government procurement as a “kick-start” mechanism for private enterprise participation. Government and other state organizations are installing IT systems. In 2007 the CNTI inaugurated the government portal¹¹¹ for which main objective was to promote transparency and improve service delivery. The portal would bring all government public information and services under the same platform and make them available to citizens via the Internet. Angolans can make appointments with government officials; and download useful documents and forms such as passport applications. They can also find information on government programmes and send their views and comments to the government, and a government portal has been set up and has become partially operational. It has been awarded the

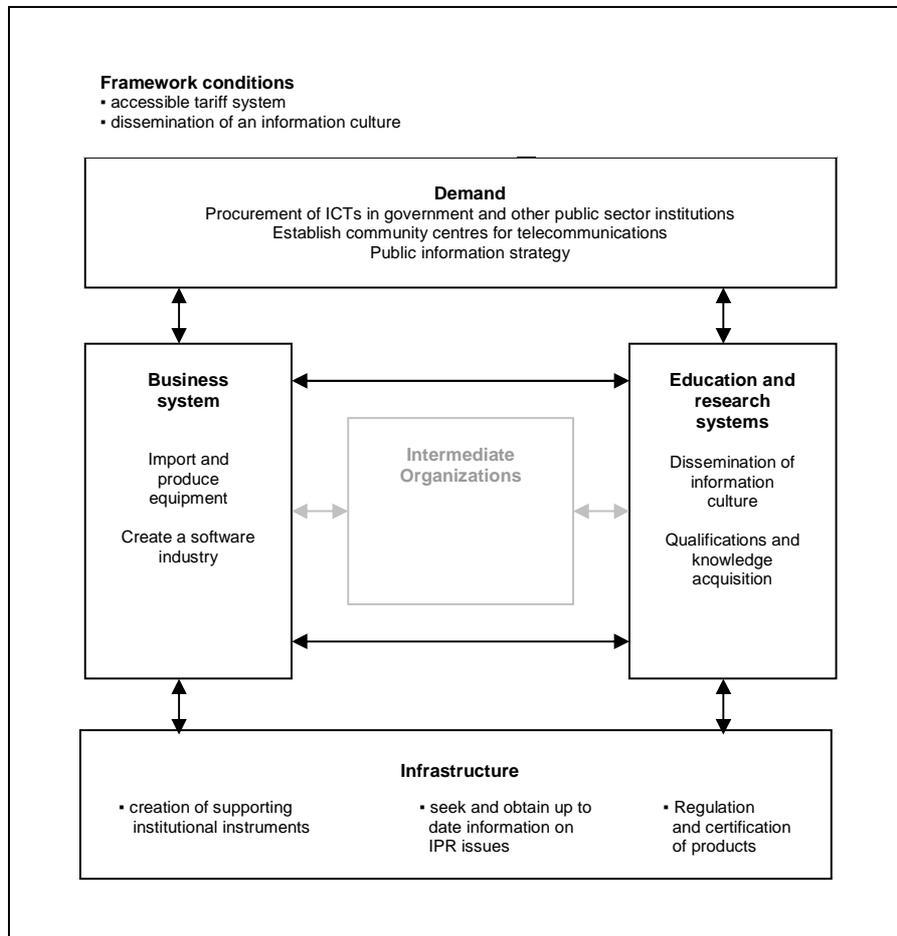
¹⁰⁹ Government of Angola (1998) Ministério dos Correios e Telecomunicações Decreto-Lei 2/98.

¹¹⁰ “Estratégia para o desenvolvimento das tecnologias de informação em Angola 2000-2010”. At URL: <<http://mirror.undp.org/angola/estrategica%20tecnologias.htm>>. Accessed January 2007.

¹¹¹ <http://www.governo.gov.ao>

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Box 4.1 An innovation system view of Angola's IT strategy



top prize in the 2007 ECA-sponsored Technology In Government in Africa (TIGA) awards on Information and Communication Technologies (ICTs) with the project "Government's Portal", in the category of better public services to citizens and communities through the ICTs.¹¹²

That none of the key elements of the strategy calls for the use or establishment of intermediate organizations to act as conduits of information or new knowledge indicates an efficient approach to long-term market-driven sustainability. This is, of course, easier in a technology-based rather than science-intensive area. Achievements of certain objectives will be prerequisite or mutually reinforcing for the success of others; on the other hand, others will need to be addressed independently. Also designed along an integrated systems approach, the Information Society Action Plan (ISAP) 2006-2011 has been adopted to complement the strategy. Table 4.2 summarizes the main components – or “pillars” – of the Plan. It is too early to

¹¹² <http://unpan1.un.org/intradoc/groups/public/documents/UNPAN/UNPAN027888.pdf>

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assess the performance of the ISAP projects at the present time. The ongoing infrastructure reconstruction will also inevitably cause bottlenecks to ICTs growth.

Educational reform of technical institutes, international forums such as the Angola IT Forum 2006, and international cooperation are initiatives that facilitate IT development and diffusion. In order to sustain this growth, parallel efforts must be made in capacity-building in areas from services to engineering maintenance of infrastructure and installations, training for

Table 4.2 *Summary of the Information Society Action Plan*

CONTENT PILLARS	KEY PROJECT COMPONENTS AND OBJECTIVES
Digital infrastructure	Development of communications infrastructure, including a national plan for internet accessibility
Development oriented government	Electronic Government Action Plan, to modernize the administration systems and train staff
Building competencies	Training and education to use, and using, ICTS in the education system, and training for business and administrators
Building a competitive economy	Stimulation of a dynamic ICT sector, promotion of E-commerce, introduction of an “Agritech” programme for rural development
Healthcare improvement	Improvement of knowledge flows within the National Health system, and development of Telemedicine, a Health Call Centre, and an internet-based Health Portal
Supporting Sustainable Development	Establishing community centres with ICTs (ANGONET program), building information systems for environmental management, and urban and rural planning, and the promotion of ICTs accessibility for women
<i>Context pillars</i>	
Policy and regulatory framework	Consolidate and coordinate existing policies and monitoring information, update and integrate the legislative framework for ICTs, initiated a national awareness campaign
Organizational capacity	Formalize political support for existing plans, build a centralized coordinating body for the development of ICTs, and mobilize civil society’s participation in development
Financing	Establishing a financing model for ICTs, including programs on investment and sustainability
Monitoring and evaluation	Establishing an observation system and producing statistical reports

Source: CNTI (2005).¹¹³

¹¹³ Comissão Nacional das Tecnologias da Informação (2005) Angola : An emerging digital player.

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advisory and training services for technologies in use (including Fixed Wireless Access, Internet, VSAT, ADSL and GSM), software maintenance and development, and Internet service provision. At present, these services are mostly undertaken by international experts. Some of these areas offer good opportunities for government-assisted enterprise development, particularly for engineers and new engineering and technical graduates.

An important next stage in the ISAP is the digitalization of key institutions such as universities, industries, libraries, banks, museums, geological and meteorological services, and health services. The process will involve all ministries, agencies and institutions, especially the National Commission on Information Technologies (CNTI), and will be monitored under the ISAP's tenth "pillar". The monitoring framework set up under the ISAP has four components: technological infrastructure, public services, public administration, and citizenship (participation). These components are designed to allow early identification of weak performance and systemic bottlenecks and barriers.

4.1.3 Summary

Angola's IT strategy is frontier-pushing relative to the other programmes. It faces numerous challenges in its implementation, including significant structural barriers. Human skills and expertise have to be built, and the diffusion of ICTs will depend heavily on reliable electricity supply. Further, much of the growth has thus far been in the Luanda area. Indeed, the city's telephony and Wireless Internet System has been a priority project under the current ISAP (CNTI 2005). Implementing the ISAP outside the capital city to regions where the physical, institutional and cultural infrastructure is more problematic, will be likely at a slower rate than achieved so far.

Finally, there are two areas of opportunity which must be flagged for exploiting the growth in telecommunications and IT for the benefit of broader STI-related development. First is that the accumulation of knowledge and skills in technology licensing could be applied to other emerging sectors. The second is the potential to develop manufacturing capacity in telecoms-related products, as mentioned in Chapter 4. These two areas warrant further discussion among the private sector, the CNTI, and the Ministries of Post and Telecommunications, and of Industry.

4.2 Energy Supply

The Ministry of Energy and Water (MINEA) is charged with the production, transmission and distribution of electricity, with the Ministry of Finance setting tariffs and subsidies. The three main grids and some of the smaller, isolated grids are under the state-owned utility Empresa Nacional de Electricidade (ENE), which is also responsible for distribution outside the capital city. Distribution within Luanda is under another state-owned utility, Empresa de Distribuição de Electricidade (EDEL), which purchases electricity from ENE. A regulator for the sector, Instituto Regulador de Sector Eléctrico (IRSE) was established in 2002 but has been unable to start operations due to difficulties in filling its Commission.¹¹⁴ In some areas not served by the

¹¹⁴ IEA 2006

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national grid system, municipal authorities operate their own generation and distribution systems. The power regulator, Instituto Regulador do Sector Eléctrico, estimates that only 30% of the population has access to electricity.

4.2.1 Strategic development of the sub-sector

Current policy is articulated in the Government's *Strategy for the Development of the Electricity Sector of Angola*. The Strategy, formulated in 2002 with a proviso for an annual review, is made up of a short-term rehabilitation plan and a long-term development strategy. The rehabilitation plan has a five-year timeframe and focussed on the repair to existing infrastructure.¹¹⁵ For longer-term development, the strategy includes the expansion of the sector to meet economic and social needs, the promotion of private investment and local participation, and the reform of pricing policy to reflect real cost.

Reform in the sector implies the dismantling of the state monopoly and, subsequently the unbundling of ENE's functions. Regulatory measures complemented with a system of incentive would foster conditions to encourage competition among distributors, foster private investment and set a balance between cost and quality of services.¹¹⁶

4.2.2 The current policy programme

However, these principles are still on paper; plans to implement the long-term development strategy are only just beginning to emerge. The 2007-2008 biennium programme reflect the Strategy's long-term principles, but programme for implementation is still unclear.

As of 2006, the IEA reported that the main option for privatization of ENE was to split the organization into smaller entities, with ENE retaining responsibility for transmission. The 2007-2008 programme alludes to the creation of a large-scale national grid. This would connect and integrate the three main grids, link Angola to other countries in Central and West Africa, and provide additional distribution facilities closer to potential consumers.¹¹⁷ The programme's objectives also include the promotion and development of renewable and alternative energy sources that are small-scale and independent such as: solar panels, mini- and micro- hydro, wind, and biomass. The nature and range of opportunities for private investors are still unclear.

Tariff reform is a critical point for attracting private investment into the sector, and is a difficult and sensitive issue to address.¹¹⁸ In any case, it has been stated that the new tariff framework should ensure that operating costs would be fully covered, investment costs at least partly covered, and that the interests of vulnerable populations would be protected.¹¹⁹ However, the programme does not set out any policies or mechanisms to achieve the stated objectives. Another consideration to take into account is the current levels of non-payment of electricity charges, and the potential for this to be exacerbated by increased tariffs. A solution could be the use of pre-payment meters, which has been successfully introduced in other countries such as

¹¹⁵ Though the start date is not clear – the IEA report assumes that the plan covers the period 2002-2007.

¹¹⁶ IEA 2006

¹¹⁷ Ministry of Energy and Water (2007) Programa Sectorial 2007-2008.

¹¹⁸ The IEA study and a World Bank consultancy report both highlight the need for phasing out subsidies, but do not make any firm recommendations. (IEA 2006, and Silva, E. 2005 Assessing the impacts of phasing out utility price subsidies. World Bank, Angola)

¹¹⁹ Ministry of Energy and Water (2007) Programa Sectorial 2007-2008.

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India.¹²⁰ Tariff reform in public electricity supply also needs to correspond to diesel pricing to avoid an increase in the use of diesel-fueled generators.

Another major difficulty, for both planning and investment promotion, including tariff design, is the lack of adequate and up to date statistics on all aspects of energy production, supply and demand. These statistics are necessary for effective management and planning. Data collection and compilation need to be integrated into the operation. As a first time, the metering system¹²¹ might be improved.

4.2.3 *STI planning for energy development*

The rehabilitation and construction of dams, as well as the improvement of the national grid feature prominently in the current efforts to keep up with the rapidly growing demand for energy. Angola has also been engaged in developing more sustainable, alternative energy sources, such as small-scale hydro, wind and solar.¹²² Biomass from agricultural byproducts and municipal waste also has potential, although it requires for the stations to be in proximity to sources of inputs to minimize transport costs. This may be worth considering where long-term planning includes modernizing or constructing new sanitation and waste management installations. In order to promote rural development, energy supply might have to be decentralized to cover the vast hinterlands. Small, stand-alone units might be considered as a viable alternative to building a nation-wide grid network.

Another key element to consider is consumption efficiency. Optimizing energy use is not only economical to both the end user and the country at large, it also enables the system to meet energy demands which would otherwise not be serviced. The Government might consider introducing energy efficiency standards and regulations on appliances and manufacturing technologies, for example. Further, if ENE is to relinquish some of its responsibility for electricity generation, it could focus future efforts on reducing transmission losses, especially technical losses, which are estimated to be around 18%.¹²³

Lack of information and skilled personnel were identified by the IEA as two major barriers to the implementation of energy development plans. The current programme provides a vision of a national electrification plan in which rural and peri-urban areas are the priority. Indeed, a Rural Electrification Plan has already been drafted. However, as the IEA report concludes, until clear-cut strategies and action plans are officially adopted, the uncertainty over investment opportunities in energy development has been a deterrent in the entry of interested parties into the sector. Also, until clear strategies are established, the potential contribution of STI to energy development cannot be realistically assessed. Information systems and other technologies, such as utility metering, are indispensable for management and planning purposes.

¹²⁰ <http://www.iea.org/textbase/pm/?mode=pm&id=3607&action=detail>

¹²¹ IEA 2006

¹²² IEA, Angola: Towards an Energy Strategy, 2006.

¹²³ IEA, 2006.

4.2.4 *Alternative sources of energy*

Pending the results of an ongoing feasibility study, three new dams on the Kwanza River could be operational as early as 2013-14. Angola's hydroelectric potential is 18,000 mw, but the current installed capacity is only 790 mw, of which 85% is hydroelectric and the rest thermal.

With the National Assembly's 2007 adoption of a new law on atomic energy, initially intended to regulate the importation and use of medical radiation equipment, the field has been opened for a civilian nuclear energy programme. Such a programme has been reported to be under bilateral discussion with China.

Box 4.2.1 Comparative lessons on Solar PV in Kenya and Zimbabwe

The introduction of PV systems into rural areas in different countries has had mixed success. In Kenya, for example, the small solar power industry is thriving. By 2001, solar power firms in Kenya were installing around 20,000 systems each year. Growth has been driven solely by consumer demand, with neither government intervention nor donor assistance. The rural middle classes form 60% of the consumer base. High growth in sales led to the development of a network of installers, suppliers of equipment and parts, and after-sales services. Demand from lower income groups is growing, although there have been problems with system specifications and quality of the cheaper, low-output models. International agencies (e.g., World Bank and UNDP) have supported an initiative to address these problems, and to provide financing schemes for low-income households.

This contrasts with other early efforts to deploy household PV systems in Zimbabwe, under a GEF-funded demonstration project during the 1990s. Zimbabwe already had a small solar industry, but the project failed to meet many of its objectives. Cost was subsidized by project-specific customs exemptions on imported parts and an unsustainable revolving credit facility with preferential interest rates, but these measures failed to attract the target market of low-income rural households. The small, geographically-dispersed potential market for household PV systems encouraged enterprise and expertise in PV, which had been created by the project to serve rural areas, to concentrate in the capital, leaving the rural customers without local support. Further, a large proportion of the systems broke down even during the period of the project (7 years) due to failure or incompatibility of the components.

Sources: Ndlovu (1998) The GEF PV Solar project in Zimbabwe – an appropriate yet ineffective RET dissemination approach? Renewable Energy for Development, vol. 11, no. 1; Muluguetta et al (2000) Photovoltaics in Zimbabwe: lessons from the GEF Solar Project. Energy Policy, Vol. 28; Stokes, K. (1998) interviews with solar firms from Kenya and Zimbabwe, Harare, October 1998.

The only small-scale renewable energy source being developed is solar photovoltaic (PV) power. The IEA reports that there is, as yet, no clear strategy for the deployment of solar technology, although a press release in December 2005 announced that the MINEA planned to launch a 15-year solar PV programme in 1300 villages the following year.¹²⁴ It is a stand-alone, low maintenance device, and may be the only way to bring quality-of-life improvements to rural communities in remote locations. In Angola, where diesel fuel to power autonomous generators is subsidized, but in short supply in rural areas, solar PV could be deployed to replace diesel generators, or as a supplement to reduce diesel consumption. The IEA recommends that the Government consider solar energy to provide rural services “as part of a clear strategy” and “with

¹²⁴ Angola Press (2005) Found at URL: www.angolapress-angop.ao/noticia.asp?ID=400125, May 2007.

specific attention to local conditions.” This last cautious qualification is important. The EIA further reports that pilot projects have been carried out in household solar PV, and that British Petroleum (BP) has installed solar PV systems in two schools in Luanda and in a number of clinics. There has also been some private uptake of PV systems imported from Namibia.

However, there have been problems reported from pilot projects, including lack of maintenance, vandalism, and abandonment of systems, attributed in the IEA report to a “lack of local ownership.”¹²⁵ The key point emerging is that solar PV systems are not simply “plug in and play” technologies. They require supporting mechanisms for quality control, maintenance and, in some case, financing. Most of all, they must meet local conditions and needs. Box 4.2.1 summarizes two case studies that contrast a successful demand-driven approach to a supply-driven, top-down project approach.

If the national energy strategy is to include solar PV capacity, the initial capacity-building process might be initiated in urban, rather than rural, areas where electricity supply is available but unreliable. This would provide sufficient demand to encourage enterprise growth which could spill-over to into the neighbouring rural areas. The EIA reports that the Ministry of Environment and Urbanization is considering the use of solar PV for niche applications in urban centres. In the long-term, household and small enterprise solar PV might also be considered in respect of the future potential for micro-generation for regional or local grid electricity. Where initiatives are planned to update and replace existing metering systems, this future potential might be factored in to meter design.

A “systems” approach is needed to evaluate the introduction of small-scale renewable energy sources. The integration of a policy for renewables at the national level should not seek to “pick winners” from the range of technologies available, but rather, facilitate a demand-driven approach through, for instance, participatory technology assessments at the local level; identification of the most appropriate technologies, including hybrid systems. Equally important are components from international, regional and domestic sources, information dissemination, and institutional reforms to support the diffusion of the technologies.

4.2.5 *Summary*

Reports from other sectors indicate that unavailability and unreliability electricity supply is a key bottleneck to progress. Clarity in the Government’s long-term overall strategy and plans for the energy sector must be in place to pinpoint new areas of technological development and to attract private foreign investment, particularly under the Build-Operate-Transfer (BOT) approach. Energy policy objectives – for example, for the development of renewable energy sources and rural electrification – can be achieved more effectively without the present climate of uncertainty.

A key problem for energy management and planning is the lack of information. Improved metering system and the expertise to analyze and utilize information are needed to address this problem. MINEA has established a general technical training programme, but there is also a need for energy engineers, statisticians, analysts and managers. Further, in order to attract the best and brightest students onto training courses or degree programmes in energy engineering, an promising career path must be opened as an incentive.

¹²⁵ EIA (2006)

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Because of the electricity sub-sector's weak absorptive capacity, the potential benefits of technological learning from contractors and imported technology would be limited. Further, until the conditions in which opportunities for technological development become clear, building human and institutional capacity is likely to be problematic, which in turn will hinder the development of new energy technologies. Human resource capacity-building efforts are, at present, best directed to information management, planning, and engineering. Finally, it is recommended that absorptive capacity for renewable technologies be assessed using a participatory approach, as a guide to future planning and as a mechanism to attract private – and ideally, local – investment.

Chapter 5: Key challenges for STI policy

An integral part of the rebuilding drive has been the focus on “building capacity to build capacity” in areas ranging from training teachers and researchers, supporting new enterprises, providing physical infrastructure, as well as adjusting policies and action plans. In the area of science, technology and innovation, there are four key elements that present the most significant challenges in capacity building. These are education and training, R&D capacity, financing, and policy formulation.

5.1 Education and training

Angola has made major investments to rehabilitate and construct schools and to train teachers, and has consequently been on track to achieving MDG No. 2 on universal primary education. School enrollment rose by 20% in 2005, but it should be noted that the rates of failure and drop-out at the primary level are relatively high. The issues of education quality, progression routes, and employment opportunities therefore need to be addressed at policy level.

Recent statistics from the National Institute for Employment and Professional Training (INAFOP)¹²⁶ indicate that employers are demanding higher educational qualifications even for unspecialized or semi-skilled positions.¹²⁷ Jobs that required no formal schooling fell from 38.5% of jobs in 2003 to 27.5% in 2004, while jobs requiring primary education rose from 22% to 30%. Analysts see this as “tenuous but potentially important signs of structural improvement” in the labour market, although only 0.4% of total job offers required a high school diploma.¹²⁸ As experienced in Thailand,¹²⁹ neglect of secondary and technical education could lead to a serious bottleneck in the process of structural change. Rising educational qualifications for job entries and evolving job market needs should therefore be factored into education planning, as well as adequate secondary and technical training facilities to meet future labour market needs and to accommodate rising number of students. To this end, the Government has already undertaken measures to expand middle-level training through polytechnics and agricultural schools.¹³⁰

To a large degree, improving the quality of education hinges on attracting competent teachers, enhancing teacher training, providing adequate school facilities and updating pedagogical materials. Building an STI system in particular, and preparing for a future “knowledge society” in general, require innovation-oriented curricula, which in turn implies the development of pedagogy and modern teaching methods with both national and global perspectives. In addition, educational facilities, especially adequately equipped laboratories, are needed. Primary and secondary level curricula and pedagogy should be built around a vision of a citizenry that is literate and numerate; scientifically and technologically aware; competent in the

¹²⁶ An institute of the Ministry of Public Administration, Labour and Social Security, which bases its job market analysis on data gathered from employment centres across the country.

¹²⁷ Center for Scientific Studies and Research (CEIC), Catholic University of Angola (2005)

¹²⁸ CEIC (2005) *ibid.*

¹²⁹ UNCTAD (2003)

¹³⁰ Ministry of Education (2007) *País ganha mais nove Institutos Médios*. Notice on Government of Angola portal, 17/4/2007.

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use of IT, at least at a basic level; dedicated to the principles of sustainable development; innovative and entrepreneurial. In short, full participants in the global information society.

INAFOP statistics do not cover employment opportunities for graduates. It can, however, be inferred that there is an acute shortage of managerial and technical personnel in sectors that require a high degree of STI competencies. Further, the sector analyses presented in earlier chapters indicate that there are shortfalls in the number of doctors and other medical personnel, engineers of all types including IT, agricultural scientists, statisticians, and policy analysts. Except for the medical personnel, no projections seem to have been made on the number and skill levels of graduates and post-graduates needed to meet current and future employment demands. A comprehensive analysis and foresight exercise need to be made in order to better prepare human capital for the rapidly changing needs of a growing Angolan economy and its evolving society.

Provision for higher education is expanding rapidly, notably through the establishment of private universities. Business, management, economics and law appear to be the preferred field of study among students,¹³¹ compared to the sciences and engineering. This suggests either less promising career paths for scientists and engineers and/or, the educational experience – in terms of curriculum, facilities, faculties, student lifestyle – in these branches is unattractive. In either case, new approaches must be found to make the sciences and engineering attractive as academic options. Experience in other countries has shown that incentives in the form of subsidized fees and/or higher scholarship allowances, combined with attractive career prospects, are effective incentives. Among these could be a placement for a work-internship within an establishment as part of the academic programme to expose students to actual uses of S&T and at the same time to help build their cv for future employment. While the effectiveness of the educational system and training programmes determine the capacity of its graduates to contribute to technological development, diploma requirements should not be so overloaded with unnecessary courses that they become unattainable. A recent positive change in Angola has been the introduction of 3-year basic degree programmes as alternatives to the standard 5-year combined 1st degree and masters.

In addition, new programmes and specialization might be introduced to reflect the changing needs of the employment market as well as national development priorities. Combined degree programmes are another option: for example, engineering and management, mathematics and statistics, science and law, IT and marketing. At the postgraduate level, distance learning could be facilitated with local ICT facilities and evening classes opened to enable full-time employed professionals to pursue further degrees. Additionally, short courses leading to diplomas in specializations such as research methodologies and laboratory techniques might be offered. Another area which needs expansion is linguistics, preferably English as most scientific and technological literature, training courses abroad, as well as international linkages are mostly in this language.

Whilst the Ministry of Education is the lead ministry for the education system and complemented by the Ministry of Public Administration, Labour and Social Security in the area

¹³¹ Based on: INHEA (2003) Angola Higher Education Profile, Education Africa Portal (2007) Angola, the web pages of Agostinho Neto University and the Catholic University of Angola, together with interviews of the STIP mission to Angola (November 2006).

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of vocational and professional training schemes, the Ministry of Science & Technology has a special mandate to promote postgraduate education, including the selection of candidates for government-funded overseas study. To ensure returns for this heavy public investment, areas of specialization need to correspond directly to existing knowledge and professional gaps.¹³² In addition to formal measures to ensure repatriation, incentives such as attractive career opportunities might be offered, as well as business incubation facilities for those venturing into entrepreneurship. While counter-arguments have been advanced in favor of the brain drain, including remittances and other benefits from nationals working abroad, these are often not applicable in countries at the initial phase of nation-building as Angola today.

An effective national innovation system will thrive only within an environment wherein STI is promoted both from the supply and demand sides, as represented by the mutually reinforcing relationship of technological capacity and entrepreneurship. Both technological capacity and entrepreneurship should therefore be inculcated into the education system, from primary level upwards.¹³³ Technical and vocational branches should be made as attractive and as respectable as academic degrees, while the latter should be oriented towards real-world issues. A comprehensive analysis of present and future skills needs of industry and public services might be made in order to identify and prioritize areas of specialization. The results could serve as the basis for educational reform, and built into curriculum design for strengthening human capital.

5.2 Building R&D capacity

In most countries, the main objective of S&T policy is to allocate resources to the national R&D system. It is the R&D system, its programme orientation and operational effectiveness, determines to a large extent the country's capacity for technological development. In industrialized countries, a "national R&D system" includes a substantial input from the private sector. In Angola¹³⁴ as in most sub-Saharan African countries, where the private sector is either FDI-dominated and/or local industry relatively weak, this participatory approach is not operational. The Government of Angola might consider measures and incentives to encourage private sector R&D, as proposed earlier in Chapter 3 on the manufacturing section. These might include expansion of business support services, fiscal and financial incentives as well as public-private sector partnerships to facilitate initial establishment of R&D functions within enterprises,

¹³² The INHEA study, for instance, points out that investment in scientific research has been low while government-commissioned research in social and human sciences had been along Marxist lines. Besides researchers, entrepreneurship could also be encouraged.

¹³³ See, for instance, the conclusions of workshop 1: Entrepreneurship in Primary Education of the final proceedings of the European Commission's Entrepreneurship Education in Europe: *Fostering Entrepreneurial Mindsets through Education and Learning* OSLO, 26 - 27 OCTOBER 2006 (<http://ec.europa.eu>). Also (<http://www.divainternational.ch/spip.php?article33>) article in Diva International website on the value of. On the value of technical and vocational educational and training (TVET), upon which countries such as Germany and South Korea have built successful industries. An increasing number of developing countries have adopted TVET into youth employment programmes. As well, policy-makers in many LDCs, particularly in Africa, are now convinced that equipping youth people with TVET skills linked with entrepreneurship training would, in the absence of wage employment, enable communities them to set up businesses that provide services to their communities and stimulate local economy. In rural communities, it would enable them to add value to agricultural products and traditional arts and crafts, and help contain rural-urban migration. In countries emerging from conflict, former militia members can be mobilized into national reconstruction activities that impact "on the job" TVET.

¹³⁴ CESO CI ANGOLA (2005) *Ciência, Tecnologia e Inovação : Estudo Prospectivo / Plano de Médio Prazo (2007-2012)*.

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centralized facilities for clusters such as the industrial growth points, and mechanisms that enable personnel mobility between public and private sectors.

Public sector R&D generally has two broad functions: to meet the needs and demands of technology end-users; and to build research capacity to keep up with new developments at the global level. Angola being in the process of reconstruction and development, its technology needs would be best addressed with carefully selected mature technologies. Local testing, adaptation and incremental improvements may still be necessary. Universities are best placed to undertake these functions, leaving public sector research institutes to focus on applied R&D, and on optimizing the socio-economic impact of research results.¹³⁵

The boundary between public sector research institutes and universities have become increasingly porous, in part because in lead technologies such as ICTs and biotechnology, scientific research and technology development are themselves rather fluid. However, the traditional ivory-tower mindset still seems to be prevalent, particularly among senior scientific researchers. The legislation recently introduced in Angola provides for salary bonuses to encourage scientific research. The 2005 CESO CI Angola report, however, noted the lack of diffusion of the results from existing research activities. The present STIP review is of the similar conclusion, but notes that some innovations are being diffused to farmers and livestock-keepers by the agricultural research organizations. These may not be the latest technology nor cutting-edge science, but they make a valuable contribution towards socio-economic development. Yet under the terms of the present scientific research incentives, the agricultural researchers who are responsible for these contributions would not be rewarded as well as scientists would be for publications. Gearing the incentives scheme for scientific researchers as set up by the Government more towards the diffusion of new and improved products and processes, rather than publications in scientific journals might help break this mindset, and bring about a more results-oriented generation of scientists and researchers.

At present, the only university with research facilities is the Agostinho Neto University. Its has two main research projects, namely 1) the Laboratório de Engenharia da Separação, da Reacção Química e do Ambiente, including 2 basic research projects, 3 doctoral theses and 6 masters' (licenciatura) theses; and 2) the Centro Nacional de Recursos Fitogenéticos (CNRF), where the 2003 opening of a new molecular biology laboratory has enabled research to be carried out to characterize indigenous plant resources;

In addition, the Herbário de Luanda has a mandate to identify and carry out taxonomy studies of local plant resources, partly to determine their potential as food source, medicines, and industrial inputs, and also to contribute to the country's inventory of plant resources. This highlights a third role of public R&D, which is to inventory national biological resources. This function is of particular importance in Angola, which covers a vast territory of varied climate and rich biodiversity. Safeguarding and maintaining these resources, and data thereof, have been seriously compromised during the conflict years. There is urgent need for information to guide the management, policies and measures for a sustainable natural resources. Government research

¹³⁵ It has been generally noted that most public R&D systems in the sub-Saharan region have had limited contribution on socio-economic development. Few research results, for instance, are commercially viable. See, for example, Nath & Mrinalini 1996, Hamel 2000, Adeboye 2000, Asiedu 2000.

institutes in Angola have a specific remit to compile data for national databases, including geological surveys, fish stocks, as well as flora and fauna inventories.

The different objectives for national R&D therefore need to be identified, prioritized and pursued accordingly. Where R&D is intended to provide new products and processes, further policy intervention to facilitate diffusion may be required in certain areas, owing to a lack of market at the domestic and international levels, particularly for innovations for which demand still have to be created; insufficient resources to acquire IP protection; inadequate facilities to scale-up, test, and/or market innovations.

Strong linkages need to be forged between innovators and end-users. Groups such as business and farmers' associations, community organizations, and local NGOs might be recruited as an alternative or a supplement to expanding government "bridging" services, particularly in cases where specialized problems could be addressed in the short or medium term. Information dissemination and training components within existing technology transfer institutions may have strengthened. A full review of possible technology diffusion mechanisms might be included within the CESO CI ANGOLA 2007-2012 exercise, taking into account the roles of producer associations, rural administrative functions, and locally-based NGOs.

Furthermore, the formulation of R&D programme of work might be open to discussion among stakeholders to ensure, among others, that upstream competencies are built and downstream demands are met. The role of academia and within it the faculties and research institutes might be better defined. As well mechanisms might be set up to foster personnel mobility between sectors, facilitate study leaves and promote continuing learning.

5.3 Finance

Financing mechanisms for enterprise development and large-scale government investment in infrastructure and reconstruction open important opportunities for building STI capacity, especially where specific measures are in place to ensure technological learning. However, policies and funding mechanisms that target specific STI capacity-building activities have thus far been confined to education and training. These measures could be expanded to other areas, such as innovation within SMEs, R&D capacity in the public S&T institutions, and diffusion of renewable energy technologies.

5.3.1 *Bridging the "funding gap" for innovation at the enterprise level*

First, it is useful to highlight the three main causes of the "funding gap" – essentially, the lack of access to capital – for innovation in SMEs, particularly new enterprises in developing countries.¹³⁶ These are: the high transaction costs relative to small-scale financing; the combined high risk factors of both technology development projects and small-scale operations; and, "informational asymmetries" between entrepreneurs and potential investors.

Financial incentives for technological capacity-building within enterprises are common in both industrialized and newly-industrialized countries. Certain NICs, notably the Republic of

¹³⁶ InfoDev (2006) Scaling up innovation and entrepreneurship in developing countries: the role of private sector finance.

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Korea, have made large-scale investments in venture capital institutions, while Taiwan Province of China established investment funds earmarked for SMEs in the 1980s. Nicaragua has taken the lead among developing countries in establishing an Innovation Fund which subsidizes between 60% and 80% of the cost of SME investment. Other provisions to address the problem of high transaction costs and collateral requirements include government credit subsidies and credit guarantees schemes. As well, mechanisms such as direct grants and fiscal allowances, as discussed in Chapter 1, have been used to ease the burden of R&D expenditure at the enterprise level.

The final obstacle to financing for innovation at the enterprise level, that of “informational asymmetries,” was illustrated in Chapter 2 in the lack of special terms for technology-specific loans in the Angolan banking sector and in government-supported programmes for STI capacity-building in SMEs. Neutrality as the guiding principle in government financing of enterprise-level innovation would discourage rent-seeking behaviour and minimize artificial distortions between and within sectors.”¹³⁷ The 2007 LDC Report reiterates this principle by stressing the importance of government financing mechanisms that are “based on competitions,” technologically oriented and underpinned by an overall objective of sustainability.¹³⁸ However, setting standard criteria for funding, such as “technological and commercial viability” and “proven business record,”¹³⁹ may not be feasible in Angola at this time when most enterprises are at the start-up stage. A case-by-case funding review mechanism, taking into account the different types of capacity-building needed in different productive sectors, might be more appropriate. Indeed, establishing a viable government financing mechanism for innovation is a complex process at both the policy and implementation levels. To ensure effectiveness, it would need to be continuously monitored and adjusted as the need arises.

Another source of funding for enterprise-centred innovation and technological capacity-building is equity financing from “angel investors” – successful entrepreneurs who contribute not only funds but also expertise to ease newcomers into the industry. “Angel investors” are common in the USA and in parts of Europe, but the concept is still novel in many developing countries.¹⁴⁰ Probably more viable for Angola as an example would be China's success in tapping into the investment force of its communities abroad. A campaign could be mounted to attract expatriate Angolans seeking investment opportunities in Angola, or those wishing to establish residency in Angola. This is an area where ANIP might take special interest.

Finally, the potential that official development assistance (ODA) has in promoting developing enterprise-based STI cannot be underestimated. This is an area which has been largely neglected, particularly in LDCs. ODA could be directed toward activities such as enterprise-based training activities and building business linkages, as well as to “mentoring” schemes in the manufacturing sector as described in Chapter 3, and enterprise-based R&D with potentially significant social returns, such as food safety and nutritional enhancement.

STI capacity-building in agricultural enterprises is another important area for development partners to consider. The successful adaptation of more advanced technologies for

¹³⁷ Goldberg, I. et al (2006) Public Financial Support for Commercial Innovation.

¹³⁸ UNCTAD 2007 LDC Report.

¹³⁹ Goldberg, et al (2006) op cit.

¹⁴⁰ Goldberg et al (2006) op cit.

indigenous ones has been more elusive in this sector than in others. Reasons for failure vary, from unbridgeable disparity in levels of technological sophistication and skills, to risk aversion especially among small-scale and subsistence farmers. Modernization of the agricultural sector could provide the opportunity for mutual learning between researchers and users, and the potential for hybridization of traditional and modern scientific and technical knowledge. On-farm research is already carried out in the public sector R&D system, but it is reported that financial resources are not available to expand this work.

5.3.2 Financing public sector R&D

As noted in Chapter 3 on agriculture, current funding levels barely cover the salaries and running costs in key research institutes, leaving little or nothing for R&D projects. This situation lends to disproportionate reliance on donor support for R&D activities, which potentially leave the programme vulnerable to competing and sometimes conflicting interests.

Where innovation and the underpinning S&T activities are demand-driven, certain areas of public sector R&D may be financed by end users. For example, as commercial agriculture expands, producer associations could fund their own R&D. In a situation of predominantly family-owned farms and small-scale enterprises, R&D and its related costs would be out of end-users' range. A well-mounted public information drive might be carried out to raise awareness of the need and benefits of demand-driven, user-oriented R&D. Levying of even a small fee might help establish a sense of community ownership and heighten drive for its success. It would help foster a research culture that is focused on applied R&D to meet user demands. As pointed out earlier, measures should also be taken to protect the interests of end users who are unable to pay.

Another suggested measure is the allocation of funding on a competitive basis, as is practiced for government-supported R&D in the private sector in many industrialized countries. More than a standard set of criteria or even the intrinsic value of the research programme, the key factor would be whether or not it addresses identified priorities. It could therefore be regarded as government-contracted R&D, and to an extent, implies a certain degree of subjective judgment. It might be useful to focus on areas of broad applications, such as software development, irradiation technology for use in agriculture, health and manufacturing, advanced diagnostics techniques, and/or composite materials. Funding might also be made available for trials and pilot projects of experimental development, as well as for centralized facilities where high-value equipment could be leased by different research projects.

The 2007 LDC Report advocates an increase in ODA for agricultural research, noting that least developed countries, especially in Africa, need a Green Revolution to boost food production capacity. This would require a significant escalation of R&D funding for agriculture. The report also calls for support of enterprise-based learning in business firms and farms. In Angola, where donors are shifting from emergency humanitarian assistance towards longer-term development programmes, this would be an opportune period to draw development partners into areas of growth, such as private enterprises, scaling up and/or diffusing innovations, R&D capacity through education and training, and epidemiological research.

5.3.3 *Funding for energy technologies: a special case*

The energy sector has not generated much interest among investors, possibly because of the uncertainty generated by the anticipated tariff reform on the sector. Thus far, public funding for the electricity sub-sector has been targeted at infrastructure rehabilitation and reconstruction, with a few ad hoc initiatives to develop and diffuse new technologies for energy production or energy efficiency. Combined with the disincentives for private sector investment, this situation leaves longer-term STI needs without sufficient resources. The development of renewable energy technologies and/or energy efficiency technologies might be covered under the general Innovation Fund proposed earlier in this chapter.

Opportunities to raise new funds through levies on production or consumption of oil could be explored further. Options include a levy on oil production to fund the development of renewable energy; access to new technology and technical assistance from oil companies; and a small levy on petrol prices to raise finance for energy technology development.¹⁴¹ However, it should be noted that funding raised through levies should be ring-fenced and carefully managed to maintain the credibility of the mechanism. Another potential source of funding for Angola as a signatory to the Kyoto Protocol, is the Clean Development Mechanism.¹⁴²

5.4 Building STI policy capacity

Some of the challenges for STI policy in Angola are technical in nature, such as the need for complementary skills in building information systems and adequate laboratory facilities. Others are more systemic, including mechanisms to bring stakeholders together in problem definition and solution assessment, and to plan STI capacity-building.

5.4.1 *Information Systems*

Lack of statistics and complementary data has been a serious handicap in both service delivery and programme planning across sectors, including energy, agriculture, health, fisheries, and mining. ICTs as the backbone of an efficient information system have been rightfully introduced into public service. In addition to hardware and software skills directly associated with information management, specialized skills and technologies should be upgraded as well. In health, for example, these will include laboratory facilities, trained epidemiologists, and health economists. In energy, new metering systems are required not only for billing purposes but also to generate statistics on level of usage, peak hours and district differences. Other sectors need expertise and data on for instance, oceanography, mining geology, GIS, remote sensing, taxonomy, and mathematical modeling to formulate more effective work programmes. These needs could be identified at the sector level, and fed into a centralized needs assessment unit to optimize synergies and prioritize skills and technologies needs.

¹⁴¹ In Ghana since the 1980s, for example, it was set at 0.3% of the pump prices for petrol and diesel fuel. UNDP/EC (1999) *Energy as a tool for sustainable development for African, Caribbean and Pacific Countries*.

¹⁴² Although funding under this mechanism would be on an individual project basis, and would therefore leave less potential for fitting in with broader government planning than a national fund.

5.4.2 *STI policy on research and analysis*

Whilst baseline data and other statistics are essential for planning, they can only serve as guides in formulating specific STI policy measures and mechanisms. For each STI-related objective in each specific sector, there is a wide range of technologies to choose from, each requiring different sets of “innovation system” capabilities in terms of institutional mechanisms and human resources. STI to meet short-term MDG objectives have to be both effective and sustainable beyond 2015. The evaluation and comparison of alternative STI interventions require in-depth, sector-specific analysis. Building capacity in various technology assessment methods, including forecasting and participatory priority-setting, is another key STI challenge.

Angola at its present state of reconstruction is faced with diverse and urgent needs. Priority-setting and implementation programming are indispensable if risks of failure are to be minimized. The national Poverty Reduction Strategy has been initially criticized on this basis: it identified but did not prioritize vast range of needs. In many countries, it is primarily lack of public funding that constrains across-the-board initiatives to address key needs. In Angola, the more constraining factor is general lack of absorptive capacity in key sectors. In any case, resource scarcity – whether financial, human-related, institutional, or infrastructural – has to be taken into account when assessing needs and their STI solutions. Existing resources should figure in the recommendations, complemented by new players, resources, skills and technologies. As well, areas of synergy should be identified and optimized with new work linkages, including the role of the private sector.

5.4.3 *The “innovation systems” approach to policy-making*

None of the sectors included in this review – agriculture, health, environmental health, and energy - has as yet exhibited any discernible “innovation systems”. These areas are, like the rest of the country, still under reconstruction. The overall status of STI in each sector is unclear due to lack of information, and initiatives appear to be mostly *ad hoc* and fragmented. A major challenge facing Angola as it graduates from post-conflict emergency reconstruction is to direct policy and planning towards long-term system-building, while being flexible to adjust policies, legislation and regulation in response to emerging problems and bottlenecks to progress. In this regard, the development and implementation strategy for ICTs provide a basis for decision-making.

The development of generic – or, platform – technologies does not logically fall under the remit of traditional sector-based ministries or other administrative bodies. In Angola, ICTs are being developed and deployed by a cross-sectoral Commission, headed by the Ministry of Science and Technology. The strategy developed is based on an innovation systems approach. Rather than the conventional “science and technology” elements of ICTs, this approach takes into account the complementary development activities needed across the political, social and economic landscape.

The rationale behind promoting an interlinked ICTs “innovation system” is clear-cut. However, the barriers to progress are likely to be related to the timescales for implementing the

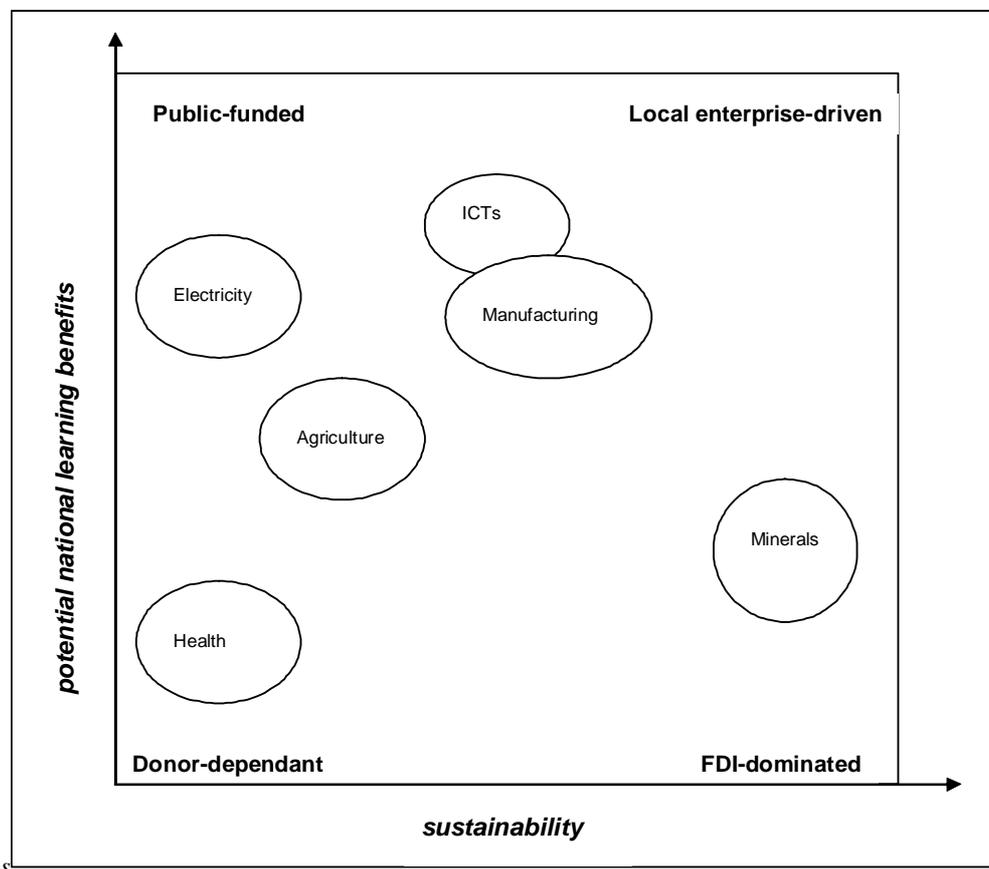
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activities and interventions identified in the strategy and the recent Action Plan. Bottlenecks, such as inadequate human resource capital and unreliable electricity supply are long-term problems that have to be resolved, and these will probably hinder the achievement of other, shorter-term, objectives. The implementation of the ICTs strategy will generate experience and learning, not least in the area of STI policy. Through the Commission, these can be integrated across ministries and other government bodies, and serve as a blueprint for other sector-specific STI policy formulation, especially in other platform technologies as biotechnology and composite materials, but also in key sectors such as energy, agriculture, and health.

Chapter 6: Summary and key recommendations

A national innovation system might be described as comprising a dynamically-linked set of elements for which technology acquisition is a mutually reinforcing function. In Angola's current reconstruction, it is still too early to expect a perfectly functioning national innovation system to have emerged in the process of institutional capacity-building. This concluding chapter summarizes STI policies, institutions and existing STI capacity in the various elements of the system, and identifies current or potential weakness of the linkages among them, with the purpose of contributing towards the emergence of a solid national innovation system that will underpin the sustainability of Angola's socioeconomic development.

Figure 6.1 Current and future potential STI capacity in selected sectors



6.1 Sector summaries of STI capacity

Figure 6.1.1 illustrates the overall picture of the key sectors in respect of their current potential for building national STI capacity, and the long-term sustainability of current STI development. Sector-specific options for stimulating innovation have been proposed in the

preceding chapters. The present chapter proposes short-term actions to address policy gaps and bottlenecks.

6.1.1 Oil and diamonds

As shown in Figure 6.1, the mineral sector is FDI-dominated enclaves with high level of STI development but low potential for national learning benefits. The task of STI policies in this sector is to leverage as much learning benefits as possible from FDI. These could be channeled through forward and backward linkages in value chains, employment at managerial level, joint ventures, and on-site training. Some mechanisms are already in place to facilitate learning through these channels, but their impact on the wider economy has yet to be seen. Sonangol and Endiama have, through joint ventures, the expertise to evaluate existing knowledge transfer mechanisms and the bargaining power to leverage increased national learning benefits.

For example, training provision has largely amounted to monetary contributions of oil companies to formal education. More might be achieved through the actual participation of oil company personnel in local education and training, and through temporary internships for students in secondary technical and tertiary education. It would be useful to carry out an evaluation of existing knowledge flows from FDI, with the participation of Sonangol and Endiama if possible, with a view to reorienting or enhancing mechanisms to ensure that learning benefits can be captured at the national level.

6.1.2 Manufacturing

The strategy for the reindustrialization of Angola currently deploys a range of policies and mechanisms to promote and support enterprise development. Manufacturing is predominantly led by local enterprises, although the sector is beginning to attract overseas investment. It is still dependent on substantial government support for building absorptive capacity for STI and therefore it has yet to achieve long-term sustainability. There is high potential for learning in the sector, but current policies are not specific enough on mechanisms to promote STI capacity-building. More use could be made of the regulatory system to encourage technological upgrading while new policies are needed to facilitate enterprise-based learning.

The Ministry of Industry and the Ministry of Science and Technology should collaborate to devise mechanisms for facilitating enterprise-based learning, and to develop regulatory regimes that are conducive to innovation.

6.1.3 Agriculture

While there are small pockets of STI capacity in the agriculture sector, there is no vehicle for systematic accumulation of learning and diffusion of knowledge. Scaling-up learning benefits is constrained by lack of human resources, inadequate funding, as well as competing priorities. The structure of the productive system, which is dominated by subsistence farming, necessitates dependence on government support and ODA, which tends to constrain the sustainability of STI development.

Current policy reflects a long-term vision of agricultural development that is based on three levels of production: family-owned, small-scale commercial, and industrial-scale enterprise. Whilst a key objective of the policy is to focus government support on the needs of family farms, the STI provisions fall short of reiterating this commitment at the levels of both policy and practice. STI activities in agriculture are at present concentrated on alleviating food security problems through the provision of inputs to increase productivity. In the longer term, building capacity for agricultural R&D and other STI activities is constrained by a lack of clarity in the current policy. In particular, there is no specific action plan for bridging the transition from the current food sufficiency drive to industrial food production.

The Ministry of Agriculture and Rural Development, in cooperation with the Ministry of Science and Technology as well as with other relevant ministries, local authorities, development partners, and producer groups, should consider carrying out a foresight exercise in respect of the long-term development of STI in agriculture.

6.1.4 Health

STI in health is almost completely ODA-dependent. Generally STI capacity-building is taking place, but is largely incidental through programmes targeted to specific diseases. There is no clear policy for STI, and coordination of STI-related activities among the multitude of projects and programmes is lacking. As a result, the opportunity for building on and around existing learning benefits accruing from these projects and programmes is severely wasted. Long-term planning for STI needs, especially after 2015 when the current donor contribution and importation of health technologies are expected to slow down, does not seem to be a priority.

The Ministry of Health might consider prioritize its system-wide coordination in programme delivery and evaluation. Other relevant ministries, particularly those responsible for areas related to environmental health such as sanitation, water supply and education, could collaborate with MINCIT in identifying common grounds for action with differentiated approaches. These might include community innovations in improving environmental health, activities to support synergies between traditional and modern medicine, and capacity building in science-intensive areas such as diagnostics.

6.1.5 Energy

Policy in the electricity sub-sector is geared towards reconstruction of infrastructure and increased supply of grid electricity. Large-scale public investment in these areas offers high potential to accrue learning benefits, but this has been largely constrained by a lack of absorptive capacity. Increasing absorptive capacity is to a large extent dependent on new local investments, but there are few incentives for such investments, which has been deterred by the prevailing uncertainty surrounding the sector. In particular, subsidies for electricity and diesel fuel, and the state monopoly had dampened investment in renewable energy technologies and energy efficiency. It is recognized at the national level that sector reform is necessary in the longer-term, but policy mechanisms to implement reforms are as yet not well-articulated. Whilst this situation continues, the role of STI policy is necessarily limited. Evaluation of potential new

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technologies is needed, but neither the state electricity companies nor potential private investors have an incentive to carry out such activities.

MINCIT and the Ministry of Education may well be best placed to build general capacity in energy engineering through the education system. Technology assessment projects could also be undertaken as, for example, dissertation projects towards a doctorate degree, or as joint exercises with development partners.

6.1.6 ICTs

As noted earlier, STI policies for the development and diffusion of ICTs are very well-articulated. The strategy and action plan developed by the CNTI could be used as a blueprint policy-making in other areas, even while the monitoring and evaluation activities are likely to result in significant STI policy learning. Government procurement as a mechanism to “kick-start” the development of enterprises in ICTs has the dual benefit of upgrading public sector administrative capacity. Implementation of a system-wide strategy will continue to face bottlenecks; at present, electricity supply and human skills and expertise are chief amongst these. The long-term sustainability of learning in ICTs depends on timely interventions to overcome implementation problems, systemic bottlenecks, the expansion of absorptive capacity, and the strengthening of the demand for technology.

6.2 STI policies

STI and related policies and initiatives in Angola that have been analyzed for the STIP review reflect the Government’s recognition that:

- There is a need to diversify the economy, involving a shift in the allocation of resources into sectors such as agriculture and manufacturing;
- Innovation should be demand-driven and that development of capacity in STI and in private sector development should be mutually responsive and supportive;
- Improvements are needed in the functioning of the country’s innovation system and in its building blocks to achieve these aims.

Implementation of these policies is well underway in some areas, particularly with regard to creating a conducive framework for an effective innovation system. These include the rebuilding of physical infrastructure, the expansion of basic education, financing and business support schemes for SMEs, and regulatory reforms. The establishment of financing mechanisms for industrial growth clusters and for selected types of businesses – notably, food and beverage processing, and enterprises along the value chains of existing industries – is commensurate with STI and related development policy objectives. Further, the use of government procurement as a mechanism to stimulate the development and diffusion of information technologies is well-conceived. However, it would seem that opportunities to stimulate innovation through regulatory regimes are generally overlooked; regulations appear to be modified reactively – that is, in response to the development of bottlenecks in particular areas – rather than pro-actively.

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In other areas, policies are under-developed in terms of STI objectives, and/or implementation mechanisms. This is the case particularly in the electricity sub-sector, health, and – to a lesser extent – manufacturing and agriculture. In agriculture, the most recent policy document has too many objectives, but does not take into account its limited resources. Policies in the manufacturing sector are perhaps more realistic and robust, although specific STI measures and mechanisms cover only on vocational training and on standards and norms, to the neglect of measures to build innovative capacity at the enterprise level.

There is, as yet, no clear national STI strategy. Indeed, this STIP review is aimed at contributing towards the development of a national strategy. However, where sector policies are not yet sufficiently well-defined to identify STI needs – together with appropriate development timescales – a realistic national STI strategy may be difficult to develop. In particular, demand-driven innovation is difficult to plan for whilst the local private sector is still in the early stages of development. On the other hand, it might be useful to articulate a general framework and set of guiding principles for STI development in, for example, financing, education and training, and building R&D capacity.¹⁴³ This might serve as a guide for the formulation of more detailed policies, implementation mechanisms, and timescales at sector level, and for other cross-cutting issues and technology areas.

Recommendation: A national framework strategy for STI development might be devised to establish general principles for the formulation of STI policies in key sector and cross-sectoral policies, in line with the NSI approach.

6.3 Policy coordination and priority-setting

Experience has shown that STI capacity has often been a marginal component of national development strategies because market demand has either not been factored in or been miscalculated in the formulation of policies, programmes and projects. Equally important in formulating S&T policies are factors that cause market failures. In Angola, these relate mainly to infrastructure, capacity-building in emerging generic technologies, and urgent poverty-alleviation measures. In addition, measures should be taken to build a “technology culture” to stimulate demand for STI in the longer term, and to promote skills and expertise to search, select, acquire, adapt and deploy technologies from outside the country.

Another risk that should be avoided is spreading STI resources too thinly to be fully effective, especially during the on-going reconstruction phase. Therefore, time should be taken to identify and prioritize STI needs at both the national and sector levels, to evaluate the existing innovation system's capacity to meet those needs, to set up complementary measures to address un-met needs, and to establish guidelines for monitoring and evaluating the newly setup system.

Improvement in the civil service has been noted in a number of donor reviews. Momentum should be maintained to build and strengthen capacity across all ministries to formulate and implement effective STI policies. This could be done through policy training, through practical monitoring and evaluation studies, and particularly, through inter-ministerial coordination and collaboration in STI policy planning and implementation strategies.

¹⁴³ In fact, there appears to be a broad trend in Angola to develop framework policies as a first step – the ECP published in 2004 is one example.

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Recommendation: A two-tiered inter-ministerial STI coordinating mechanism, consisting of:

- a high-level Council, preferably attached to the Office of the President, to oversee national STI priorities and technological development;
- an STI Working Group consisting of STI focal points from each ministry, chaired and coordinated by MINCIT, to facilitate stakeholder dialogue to identify demand for innovation and ensure synergies in STI activities.

In addition, a “multi-stakeholder task force” approach should be adopted to tackle emerging problems and bottlenecks in the NSI – these ad hoc bodies would be established through the high-level Council.

6.4 The role of the Ministry of Science and Technology

MINCIT’s role and mandates are too broad and warrant some review and clarification, particularly with regard to overlapping ministerial mandates. The establishment of ministry liaison officers to work directly with MINCIT, as recommended in the previous section of this chapter, might be considered to resolve this issue. MINCIT’s human resource and funding capacity need strengthening to play an effective advisory and coordinating role in the development of a national innovation system, in particular in the formation of a “technology culture” for a “knowledge society”. This implies close work with other ministries as well as provincial and municipal authorities on numerous development areas, including education, community development, and local infrastructure.

At present, MINCIT seems to have contracted its activities to the boundaries of traditional S&T policy, which emphasizes science more than technology and innovation, and tends to focus particularly on postgraduate education and research. Innovation is particularly neglected in the structure and mandates of the Executive Directorates of the ministry. MINCIT has a pivotal role to play in building a knowledge society from the bottom upwards – that is, stimulating and building on the innovative capacity and entrepreneurship of the whole population to meet social and job-related needs, rather than concentrating efforts on increasing the levels of expertise amongst a highly-educated minority.

MINCIT needs to explore its role and the structure of the Executive Directorates in respect of contributing to national innovative capacity more fully and creatively, and this might help in the future formulation of specific policies and initiatives to address its very broad mandate.

Recommendation: The Ministry of Science and Technology might, in conjunction with the Ministry of Planning and other relevant ministries, review its role and mandates, giving particular attention to its role in promoting innovation at the national, sectoral, sub-sectoral and local levels.

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Republic of Angola

Ministry of Science and Technology

Round Table Discussion of the STIP Review Draft,
prepared by the Government of Angola/Ministry of Science and Technology

Annex I

On 6 May 2008, the Ministry of Science and Technology organized a round table discussion in Luanda on the draft Science, Technology and Innovation Policy (STIP) Review of Angola. Participation at the event was approximately 80, representing government agencies, public and private universities, colleges, research and development institutions, the private sector, and non-governmental organizations (NGOs). The purpose of the discussion was two-fold: to disseminate the findings and recommendations of the review on the one hand, and to invite the views and opinions of the participants on the other. The Government of Angola was represented by Deputy Prime Minister Mr. Aguinaldo Jaime and Minister of Science and Technology Mr. João Baptista Ngandajina; the United Nations Development Programme (UNDP) was represented by the Country Director and Resident Representative a.i. Mrs. Gita Honwana Welch; and UNCTAD was represented by Ms. Menelea Masin.

The UNDP Resident Representative said that the review – requested by the Government of Angola to UNCTAD with support from UNDP – aimed to analyse and determine the effectiveness of the systems and structures of science and technology in order to identify strengths and weaknesses, and at the same time the opportunities, challenges and threats, both in the country and abroad. It will enable the formulation of strategies to ensure that science, technology and innovation (STI) play a crucial role in social- economic development in Angola. The objective of the round table was discussed, emphasizing in particular the importance of policies on STI to Angola. The importance of STI for development, and the mistrust often found in the use of new technologies, was also highlighted. Also discussed were the challenges of developing countries for competitiveness, hence the importance of training of scientists, the use of science and technologies for sustainable development and the particular importance of biotechnology.

The Deputy Prime Minister praised the initiative of the Ministry of Science and Technology in requesting UNCTAD to undertake the study. With the significant progress in economic reforms in the country, he said that the use of scientific and technological knowledge

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could help improve the indicators of human development in Angola and win the battle against hunger and poverty. He emphasized that the battle to overcome that situation would be won by those who seriously invested in the use of STI. The Government would review the major recommendations of this round table to transform the study into strategies for political STI to Angola.

The discussions of the review opened with the presentation of the working document by the UNCTAD representative. Her presentation covered the concepts and theories underlying the work and its findings regarding the *de facto* policy on STI. She discussed the capacity for technology acquisition and innovation, as well as what and how the national innovation system is and could become in Angola. Other topics included in her presentation were the education system and the training of engineers, scientists and technicians, as well as the instruments of science policy, their administration and national capabilities that were required to ensure successful technology acquisition.

Participants expressed appreciation for the efforts put into the preparation of the study. They were convinced that the excellent work would lead to national strategies for the development of STI in Angola. Some of the important points of the ensuing round table discussion were:

- (a) To achieve the objectives set out in the review, particularly achieving sustaining development, it was essential to strengthen human resources and institutions;
- (b) Without competent and capable human resources, a national STI system would not be viable. There was therefore an urgent need for training programmes, which would include new fields such as vocational education, in order to meet the changing needs of the country. Measures should be taken to ensure the continuity and direction of training, as well as its relevance and efficiency;
- (c) Investment in higher education, as well as in technical schools and primary education, should be increased. Within this context, the MINCIT (the Ministry of Education) and MAPESS (the Department of Higher Education), whose mandate covered education, training, scientific and technological knowledge, had a particular role to play in creating the best conditions for developing and implementing strategies towards this end;
- (d) Education reform should be undertaken, in particular the strengthening the teaching of science and entrepreneurship, in view of the important link between educated minds and the capacities for research, invention, innovation, for adaptation to progress, for solving technological problems, as well as for enhancing life itself;
- (e) Attention was needed at the national level to science in general, and in technology and innovation and research and development in particular;
- (f) The importance of indicators and statistics of science and technology should not be overlooked;
- (g) The context of development, particularly the economy, should be the driving force in the pursuit of STI;
- (h) Political will and commitment must be secured and maintained to build national capacity in STI;
- (i) The political instruments for creating an STI framework must be fully harnessed in order to bring about a knowledge-based society and technology-based industrial sector;

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- (j) The effectiveness and efficiency of managing the various instruments, in particular the role of MINCIT, coordination among ministries and sectors, as well as cooperation with international scientific entities, was largely influenced by:
 - Research institutions and funding mechanisms;
 - Guidelines and policies on STI; and
 - Capacity for technology acquisition of key sectors;
- (k) The areas and focus of research should reflect the changing needs of the economy and society;
- (l) Entry points for technological upgrading must be identified and prioritized;
- (m) The choice and selection of technologies must be rationalized in terms of immediate need and optimum impact;
- (n) Research and development activities in universities must be linked more closely with private sector needs. Mechanisms for funding as well as for vetting project proposals should be set up to ensure applicability and marketability, promote excellence and diffuse results. Some suggested areas of research include alternative energy sources, environmental science, soil conditions and water management;
- (o) Entrepreneurial initiative and innovation, particularly through national and international networking, should be promoted;
- (p) As it emerges, the National System of Innovation should be used to support the development of national STI capacity, in terms of training human capital and managing financial and materials resources, promoting national and international networks and partnerships between public and private sectors;
- (q) Measures should be taken to enhance research and development capacity, notably by:
 - Facilitating the acquisition of new technologies for the creation, modernization and strengthening of State-owned companies and public research institutions;
 - Providing facilities to commercialize research and development findings; and
 - Strengthening institutional knowledge on rules and procedures relating to intellectual property, patent registration, as well as marketing of products and processes developed by research centres, universities and enterprises;
- (r) An effective and efficient STI system, based on a network of public and private institutions, should be established to sustain an increasingly competitive and productive economy;
- (s) Research and development should be directly linked to economic and social goals and objectives, and should in turn be supported with enabling environments and facilities, such as networks of technology and innovation centres, in an integrated technology park/incubator for business as well as appropriate incentives for innovation;
- (t) To strengthen the information society, information and communication technologies (ICTs) and related technologies should be taken into account;
- (u) The role of MINCIT should be clarified and strengthened, given the potential of STI in national development. Specifically, it should be charged with a national STI as a tool to support the development of national STI capability, and provided with adequate human, financial and material resources to carry out its objectives;
- (v) An effective and efficient STI system, based on a network of public and private institutions and aimed at creating a competitive and productive economy, should be established;
- (w) Measures should be taken to carry out STI-related international and regional programmes, specifically:

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- Ensuring sustainable development through natural sciences and engineering:
 - Promote research and capacity-building on natural resources management;
 - Strengthen human and institutional STI capacities, with emphasis on basic science and engineering;
 - Raise public awareness on the role of STI in national development;
 - Build capacities for natural disaster warning networks for disaster response.
- Meeting new social and ethical challenges through social and human sciences:
 - Adopt a set of principles and standards on scientific and technological development;
 - Foster the linkages between research and policies to social change.

Recommendations

The discussion also offered recommendations for national action and for improving the impact of the STIP exercise, such as:

- (a) Need to correct inaccuracies and update data;
- (b) Highlight the need for new technologies in rural development;
- (c) Include other aspects of environmental problems beyond those related to agriculture, such as conservation of biodiversity, climate change and the national legislation and standards on the environment;
- (d) Emphasize educational reform, particularly the role of higher education and STI-related activities of the universities aimed at solving social problems such as waste management, recycling, etc.;
- (e) Promote research into the recovery of solid waste through recovery and recycling;
- (f) Exploit traditional knowledge, in particular on the medicinal uses of plants;
- (g) Promote innovation and entrepreneurship in education system;
- (h) Strengthen the role of MINCIT, especially with regards to the relationship and coordination with other ministries;
- (i) Set up a support fund for the financing of STI actions;
- (j) Establish a plan for training technicians to support interim research and development activities;
- (k) Foster and create synergies between industry, universities and research and development centres;
- (l) Promote development of science parks and incubators of enterprises;
- (m) Encourage scientific and academic mobility for teachers, researchers, technicians and students;
- (n) Create centres of excellence and national, regional, and subregional research and development networks;
- (o) Establish a mechanism to encourage the return of scientists trained abroad;
- (p) Promote incentives for scientific and technological production;
- (q) Promote the training of scientific journalists;
- (r) Promote principles, laws and ethical standards in scientific and technological development;
- (s) Apply science and technology to rural development and to the solving of urban problems (sanitation, etc.);
- (t) Promote a culture for the rehabilitation and maintenance of scientific equipment and machines;

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- (u) Create a glossary of symbols, abbreviations, definitions and a list of reference literature.

Initiatives taken by the Government of Angola on key areas of the STIP Review

On section 3.1, on Petroleum and gas

- Decree No. 48/06 of 1 September that sets the rules and procedures for public tenders for the National CTM, for all national or foreign entities with a proven reputation of expertise and/or financial capability who wish to be associated with the national concession for the execution of oil operations, and the entities that buy goods and services contracted for the execution of petroleum operations This activity also aims to promote the integration of domestic companies in the oil industry;
- Executive Decree No. 7/88, 26 March on the Information System for Petroleum Operations (SOIP) implementing a standard system for the reporting of oil activity which standardizes the format, content and frequency of accounting and financial information to be provided to the concessionary by the operational oil companies under the terms of the relevant contracts relative to all concession operations in the country;
- Data bank sector. Already under way, in partnership with the Government of Norway, a data base project which allows for the teaching entity of the sector to completely manage, online and in real time, all activities and operations which take place across the country and abroad;
- National plan of contingencies, with regards to prevention of oil spills, coordinated by the Ministry of Petroleum;
- TradeJango is a service that brings together suppliers of goods and services with the oil companies through an electronic spreadsheet;
- Project “paenal” on the construction of facilities and modules for platforms in the shipyard of Porto Amboim/South Kwanza;
- Sonamet (shipyards of Lobito/Benguela) construction of steel structures for oil platforms and facilities;
- Petromar (shipyards in Soyo and Luanda) construction and maintenance of platform and oil facilities both on and offshore;
- Angoflex (shipyards in Ambriz) for manufacture of flexible pipes and pipelines for oil operations;
- Review of decree 20/82. These are amendments to the old law and not a new law as noted on page 40;
- The SONAREF project. Sonangol is the sole investor and seeks to increase the production of refined oil products in the country;
- Regulations on the safety of the petroleum sector under law 10/04 of 12 November is aimed at ensuring the safety of petroleum operations in accordance with national standards of health, hygiene and safety, and also those internationally accepted by the oil industry.

On agriculture and rural development

The Programme of Extension and Rural Development (PERD) was officially launched in 2005 in the municipality of Andulo, province of Bié. Its functions include providing support the farmers’ associations and organizations, enhancing the roles of EDA and the Provincial Departments of the Investment and Development Authority (IDA), increasing the productivity of rural communities, and improving social services.

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The objectives of the programme are to contribute towards (a) food security and poverty reduction; (b) the integration of rural communities in the economic and social development of the country; (c) the organization of production in rural communities; (d) increased productivity of family agribusiness; and (e) improving conditions and quality of life in rural communities.

In the first year of operation, 2005/06, PERD activities were focused on the supply of agricultural inputs and equipment, in the preparation of land and technical assistance to producers. On the institutional front, the programme focused on the training and certification of technicians, rehabilitation and furnishing of the EDAs, establishing partnerships with NGOs and other institutions, dissemination and advertising of the programme, support to the organization, strengthening of farmers associations and agricultural cooperatives, and support to the commercialization of agricultural products. During this period, the PERD served 618,859 families, representing 77 per cent of the originally envisaged aim. Under the existing contract with the company MECANAGRO EP, 22,000 acres of land were prepared, accounting for 87 per cent of the target area.

On potential and opportunities

By far the major potential of Angola lies in its huge, natural resources base. Both land and water are abundant. The domestic market, currently dependent on food imports, offers vast opportunities for local produce to take over, while the relatively high revenues from oil concessions offer the opportunity to finance rural development, through the National Fund for Development.

Agriculture is predominantly non-irrigated. Water resources locations do not match the areas where water is needed for agriculture, livestock and domestic use. However, there are a large number of potential locations to establish reservoirs and other water regulation structures.

Urbanism and environment

The environmental policy in Angola has undergone a remarkable dynamics since 1998, when the National Assembly adopted the Basic Law on the Environment [Lei de Bases do Ambiente (LBA)]. The Basic Law was soon followed with supplementary legislative and regulatory measures. Government programmes for the biennia 2005-2006 and 2007-2008 feature environment-related items. Additionally, the profile of chemical products of the country was established and the development of the national framework for biosafety was initiated.

Strategies and Plans for the Environment

Under the target “Ensure Environmental Sustainability” of the Millennium Development Goals (MDGs), however, the Government has adopted two objectives: (a) to integrate into the policies and programmes the principles of sustainable development and reverse loss of natural resources; and (b) to halve, by 2015, the proportion of people without sustainable access to safe drinking water.

A National Programme for Environmental Management (NPEM) has been drafted. It will represent the first instrument for environmental policy in Angola. The intervention strategy

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incorporated in the NPEM is all-inclusive and covers major environmental issues. It should be mentioned that the Constitution of Angola, under the section on Fundamental Rights and Duties, grants the right of all citizens to live in a healthy and non-polluted environment, the State being responsible for “taking the necessary measures to protect the environment and the national species of flora and fauna throughout the national territory and maintain ecological balance” (article 24).

Angola is a signatory to the Convention on Biological Diversity; the Cartagena Protocol on Biosafety; the Convention on International Trade in Endangered Species of Wild Fauna and Flora; the United Nations Convention to Combat Desertification; the United Nations Convention Framework on Climate Changes; the Vienna Convention for the Protection of the Ozone Layer; the Protocol of Montreal to substances that deplete the Ozone Layer; and the Kyoto Protocol on climate change.

Luanda, 12 May 2008.

Annex II

Presentation at the eleventh session of the
United Nations Commission on Science and Technology for Development
Geneva, 29 May 2008

The present review was presented and discussed at the United Nations Commission on Science and Technology for Development on 29 May 2008. The national delegation was headed by the Deputy Prime Minister of Angola. Invited speakers included the permanent representatives of Brazil, Nigeria and Portugal to the United Nations Office at Geneva. The United Nations Development Programme (UNDP) in Angola was represented by its country director and resident representative. Interventions were also heard from representatives of the Global Alliance for Information and Communication Technology (ICT) for Development (GAID), the International Telecommunication Union (ITU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

The presentation was chaired by Lesotho's Minister of Communications, Science and Technology, in his capacity as Vice-chair of the commission's bureau. He pointed out that while the role of science, technology and innovation (STI) in the development process was already unanimously recognized, the process of integrating those essential ingredients into the national development framework remained ambiguous for many developing countries. Yet without an effective STI framework, countries would be unable to meet the increasing challenges brought about by globalization, trade liberalization and the emergence of knowledge-based industries. The Minister said that the continuous quest for improvements had led to urgent reliance on scientific and technological innovation, necessitating constant adjustments to policies and practices at both the enterprise and government levels. Through its Science, Technology and Innovation Policy (STIP) Reviews, UNCTAD aimed at helping developing countries formulate and hone their policies and institutions in order to bring about technological growth, capacity-building and innovation. He said that the presentation of the STIP Review of Angola was an occasion for sharing experiences, learning different options for enhancing STI growth, knowing development partners and agencies which were actively assisting countries in this area and being briefed on South-South cooperation in technological advancement.

Describing the state and outlook of post-war Angola, the Deputy Prime Minister said that the next development priority after infrastructure reconstruction, which was reaching completion, was the diversification of the economic base. Placing non-mineral enterprises at the front and centre of this strategy, he said the country had also embarked on a campaign to attract foreign direct investment (FDI). While technology and knowledge might be expected from FDI, measures should also be taken to ensure that there was national capacity to avail and adapt these. He also spoke of Angola's efforts to meet the Millennium Development Goals (MDGs), which the application of modern technologies and knowledge could manifestly help. Clearly, there was urgent need to ensure that the national science and technology framework met with the changing direction and pace of development. He welcomed the present review as an instrument for

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assessing the STI needs of Angola and as a guide for building an effective national STI framework.

The UNCTAD secretariat underlined the Government of Angola's political will and commitment to development, as demonstrated in its initiative to request the present review. Also highlighted was the progress made in the education sector, in which the Government had in addition astutely made massive investment in infrastructure. It was pointed out these two attributes, education and infrastructure, were mutually reinforcing with national STI capacity. Furthermore, the cross-cutting role of STI necessitated cooperation and coordination among the principal sectors and actors. The review's findings and recommendations centered on strengthening existing mechanisms for planning and coordinating STI-related activities and programme components of the different ministries. The role and function of the Ministry of Science and Technology should be more clearly defined for it to take on the function of overseeing the technological growth and innovative development of Angola. Finally, UNCTAD pointed out that the STIP Review was not a single event, but the beginning of a process for building a functioning and effective STI framework.

The pivotal and underpinning role of STI in the development process was confirmed by subsequent discussants. The representative of Brazil pointed out Angola's huge potential in agriculture, which could only be realized through a well-planned, long-term strategy encompassing human, economic and environmental dimensions. The representative of Nigeria evoked his country's historical solidarity with Angola and cited their two countries' common challenge of managing their petroleum fossil endowments. While the Nigerian experience in the petroleum sector could be useful to Angola, it was important that other sectors such as agriculture be developed as well. The growing presence of Portuguese firms in Angola could play a role in Angola's technological and innovative development, as suggested by the representative of Portugal, who had recently completed a four-year term as his country's ambassador to Angola. The level of technology introduced should be consistent with the absorption capacity and operating conditions. The brain-drain phenomenon, which affected not only Angola but other developing countries as well, should be addressed to help developing countries retain their human capital. The representatives of Brazil, Nigeria and Portugal commended the Government of Angola for its initiative in requesting a thorough review of its STI policies, assured their respective countries' continuing support and cooperation, and expressed confidence in its sustained growth and progress.

The UNDP country director in Angola provided the main points brought up at the round table discussion earlier in the month in the capital. She was confident that the findings and recommendations of the review would lead to a coherent and effective national STI strategy. Citing the importance of ICT in the knowledge society, the executive director of GAID commended Angola for the comprehensive approach and realistic timetable of its ICT strategy. This opinion was seconded by the deputy director of ITU, who also said that STI was key to the reconstruction and sustainable development of Angola. The representative of UNESCO pointed out that her agency had an agreement with the African Union to undertake STIP Reviews in African countries, and it had already completed a number of them.

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The ensuing discussion from the floor included the delegations from China, Lesotho, South Africa, Sudan, the United States and Austria. They unanimously supported the STIP Reviews exercise, and encouraged UNCTAD to pursue the series. A number of issues were suggested for inclusion in future reviews, such as gender and brain drain. The representative of the World Intellectual Property Organization (WIPO) spoke of his agency's work on intellectual property, as it affected STI and the transfer of technology.

UNCTAD assured the commission of its commitment to continue with the STIP Review series in line with the outcomes of UNCTAD XII. Thanking the commission and UNCTAD, the Deputy Prime Minister of Angola said that, in spite of the challenges his country faced, there was reason for optimism. In her concluding statement, the Acting Deputy Secretary-General of UNCTAD reiterated the importance of STI as a strategic tool for development, not only for more advanced countries but for all developing countries. She assured the Government of Angola of UNCTAD's continuing support in their development efforts, including in the field of STI.

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