

4.3 ENERGY, OIL & GAS, AND MINING

4.3.1 Energy

1. Overview

Energy sector plays an essential role in achieving social, economic, and environmental objectives for the realization of sustainable development. It is also one of the major contributors toward the national economy. At the same time, access to sustainable energy is a main prerequisite for improving the living standards of the people.

Access to energy services in rural areas will raise new opportunities for income generating activities; it will increase agricultural productivity, improve social services in the area of health and education, reduce work load, provide the basis for better communication and information, and lead to a better quality of life – hence reducing the pressure and need for migration to urban centres.

Energy sector in Timor-Leste depends on non-renewable energy. It is important to take alternative energy into account, since it could reduce the country's dependence on oil and gas resources and create environmentally clean energy. The development of alternative energy can be done by promoting energy conservation and sustainable energy. The potential for energy sources and their production are as follows:

- a) Bayu-Undan is the only oil and gas field currently in production, contributing revenues to the Petroleum Fund. It has estimated reserves of about 800 million barrels oil and natural gas of 12 trillion cubic feet (TCF).
- b) The potential Greater Sunrise field contains conservatively proven reserves of 7.7 TCF of natural gas and 299 million barrels of condensate.
- c) Eni, an Italian Oil Company, has confirmed that the Kitan-1 exploration probe, drilled in Block 06-105 in the joint petroleum development area between Timor-Leste and Australia, has hit oil. Indications are flowed 6,100 barrels per day of oil.

The Program of the IV Constitutional Government envisages a clear energy policy that will harmonize the various market interests from a competitiveness viewpoint while paying proper regard to the quality of the environment, thus avoiding a disorderly industrialization devoid of adequate regulations.

The use of alternative energy sources is meant for reducing the use of oil fuels that have become increasingly expensive and the supply has continued to decrease. As alternative energy sources, natural gas and renewable energy sources, such as geothermal energy, hydro-power, nuclear energy, solar energy, wind energy, fuel cell energy and bio-mass can be used.

As a country that is blessed with an abundance of natural wealth, Timor-Leste has substantial and a diversity of energy sources, but their production has not yet been optimal.

- a) *Wind power:* Based on studies in West Timor, wind power is considered unfeasible to be built in coastal areas, but suitable for mountainous areas and highlands. This type of power plant can be used in the dry season around the month of April to October since it is windy season, and during the rainy season, the power generation can be replaced by using hydro power plants. Potential locations for wind power are in Ira Lalaro and Foho Bagarkoholau, ten kilometres south of Dili.
- b) *Solar power:* Solar power offers good potential for off-grid electrification in Timor-Leste. Considering the low population densities in the rural areas in Timor-Leste, solar home systems would be a lower-cost electrification option compared to grid extension for small hamlets in households remote from the grid where the main necessity is only for lighting. A typical solar home system involving a 50 peak watt (WP) panel would be sufficient to provide electricity for a daily average consumption of 150 Watt-hours; that is, a 25 watt load for 6 hours per day. Such a system would be sufficient to produce enough electricity for lighting, radio, and television for a small household. In order to make the cost of solar home system more affordable to the rural households, capital subsidies would be required.

- c) *Mini- and Micro-hydro:* Mini and Micro-hydro have a significant and continuing role in rural electrification in a number of isolated locations with mountainous terrain and high rainfall. In these areas where grid connection would not occur, micro-hydro can serve as an alternative for mini grid development. Due to the steep topography of the country, there are quite a few opportunities to build artificial reservoirs, and most are 'run of river' type, involving small diversions, after which the water will be returned back to the stream. As yet, there are no existing mini- or micro-hydro installations in Timor-Leste.

Possible domestic alternatives to imported oil would be a large hydropower project, of which feasibility study has been conducted on the onshore oil and gas, and resulted in a prospective socio-economic venture. On a smaller scale, over 30 gas seeps and some other renewable resources have been identified. On the downside, the development of the large scale hydropower project and the onshore oil and gas would require significant financial commitments and an establishment of legal and regulatory arrangements, such that the development of such projects is not possible in the short to medium term. In the interim, harvesting of gas offers a more sensible prospect of a much cheaper power supply to some rural population centres; especially those in close proximity to the gas seeps.

With regards to the data on energy sector, there is no energy balance data available (consumption of kerosene, electricity, diesel, LPG, fuel-wood, etc), biomass potential largely unknown, hydropower potential insufficiently mapped and measured, and current status of deployment and operating conditions of solar electric systems not fully monitored.

In addition, energy uses in rural areas very elementary (mainly in the domestic sector for cooking/lighting, not for productive purposes), while around more than 90% of all energy demand is being covered by fuel-wood – mainly for cooking, baking and water heating.

2. Problems and Constraints

- d) Unavailability of legal and regulatory framework in energy sector;
- e) Lack of relevant and accurate data on renewable energy sources;

- f) Lack of institutional and personnel capacity to undertake wide range of tasks, limited number of staff;
- g) Projects are not well prepared and have already faced several problems during implementation stage.

3. Analysis

- a) The main energy source used by most of the population of Timor-Leste is fuel-wood. This has partly contributed to the damage of Timor-Leste's forests while other sources of energy (solar, biogas and gas) are widely available in Timor-Leste;
- b) Timor-Leste has abundant sources of primary energy of various kinds. However, the locations of these energy sources are far-off from the demand. Thus, exploitation of that energy source requires energy infrastructure to convert and transmit to the end users;
- c) The development of energy resources can be linked with area development by means of integrated approach, such as improvements of agriculture sector, small businesses, health and education;
- d) Solar energy can be used for basic domestic energy needs (lighting/communication) and for health/education sectors and water pumping, particularly in rural and remote areas where electricity grid is unavailable.

4. Target

- a) Reduce the average amount of fuel-wood used for cooking in private households by introducing fuel substitution and supporting the use of energy-efficient stoves;
- b) Base the future electricity generation for rural areas of Timor-Leste mainly on indigenous renewable energy sources, such as hydropower, solar-energy and organic material (biogas).

5. Policy Direction

- a) **Intensifying the search for energy sources**, through a more active encouragement of more intensive and continuous searches for new

reserves of energy, mainly crude oil and gas, and by reserving and utilizing natural resources for surveys of new reserves, such as the use of the reforestation fund in the forestry sector. The efforts for finding energy sources are mainly carried out in regions that have never before been surveyed, while for areas that have already been indicated as having reserves, efforts must be made to enhance their status from having probable reserves to proven reserves.

- b) **The policy to diversify energy** is directed at the diversification of renewable as well as non-renewable energy utilization, so as to attain the optimal regional/national energy supply, through other alternative energy sources; solar energy in households, micro-hydro energy in the industrial sector; and by analyzing and promoting alternative energies such as wind energy and bio-fuel.
- c) **Conserving energy** is to be applied to all phases of utilization, starting from the supply of energy resources to the final utilization phase so as to ensure that the interest of future generations is maintained. The conservation effort is implemented from two aspects, namely the resources (upstream) aspect, and the final utilization (downstream) aspect. Upstream conservation refers to efforts for conserving energy resources, the utilization of which is based on enhancing the value added and maintaining the interest of future generations, so that energy resources can be utilized for the longest possible period, while downstream conservation is implemented by enhancing the efficiency of utilizing energy infrastructure and of consuming final energy in all sectors.
- d) **Policies to manage the environment** are pursued by taking into consideration all phases of energy development, starting from the exploration and exploitation of energy resources to the utilization of final energy through the use of energy that does not pollute the environment and through the use of environment friendly technology. It is necessary to increase the use of energy that has a low pollution impact, such as lead (Pb) free gasoline. The transportation sector must gradually reduce gas emissions, such as CO, HO, and NO. For industries, the policy is directed at reducing and controlling gas emissions.

6. Program

- a) Formulation of policies and regulations in energy sector;
- b) Capacity building of energy institution and personnel;
- c) Installation of solar panels in selected rural area/sucos;
- d) Conversion of fuel wood to other energy sources, started with introduction of energy-efficient stoves in the urban areas;
- e) Implement biogas energy program in selected sucos.

4.3.2 Oil & Gas

1. Overview

a) Introduction

Timor-Leste is an emerging oil and gas country in South East Asia. With reserves of oil about 800 million barrels and natural gas of 12 trillion cubic feet (TCF) while the number of population is about 1 million, Timor-Leste is a quite rich country in the region in terms of oil and gas reserves per capita. However, since it is a quite new industry in the country, and the nation had just got its independence in 2002, oil and gas sector has not contributed significant impact to Timor-Leste's economic development.

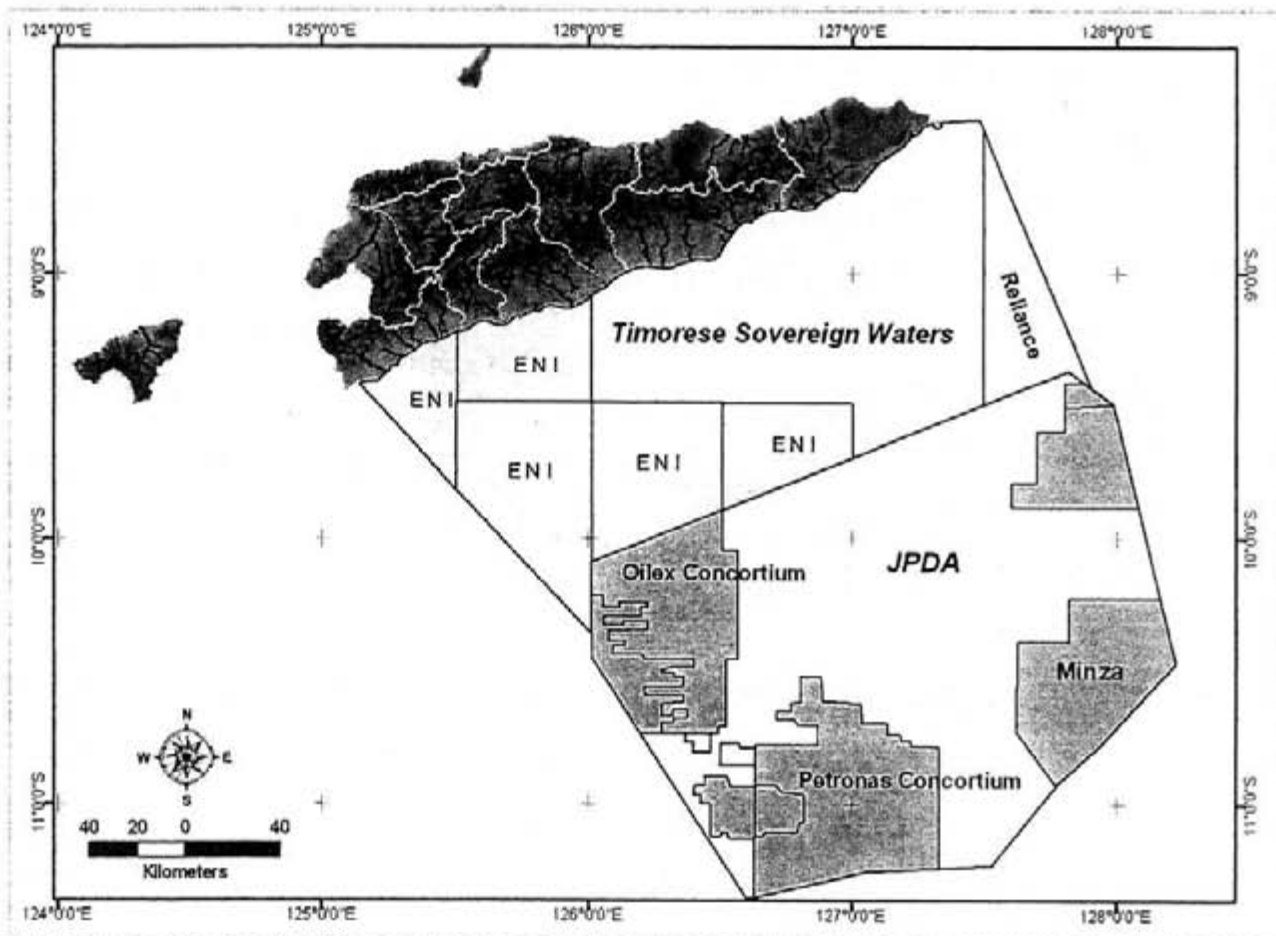
Even though Timor-Leste is a new comer in the world's petroleum industry community, the new nation has already established sound basis and framework required to develop a modern (transparent, competitive and responsible) petroleum industry. Among the Laws that has been established are Law No. 13 Year 2005 on Petroleum Act and Law No. 9 Year 2005 on Petroleum Fund.

Based on the established Petroleum Act 13/2005, the government of Timor-Leste had developed a model for Production Sharing Contract then moved forward in 2005-2006 to offer 11 Petroleum Working Areas (A-K) to parties having interests to explore and exploit Timor-Leste's oil and gas upstream potentials.

Most of the Timor-Leste's oil and gas deposits currently are located off-shores. The main off-shore deposits lie off the south coast in the Timor Sea in the Joint Petroleum Development Area (JPDA). The JPDA is located in the Timor Sea, the centre of which is approximately 500 km northwest of Darwin and 220 km southeast of Suai, Timor-Leste, in an area defined in the Timor Sea Treaty between Timor-Leste and Australia.

Bayu-Undan is the only oil and gas field currently in production. The Bayu-Undan field was discovered in 1995, contains proven reserves of 4 TCF of natural gas of and 500 million barrels of condensate and other Liquid Petroleum Gases (LPG).

Figure 4.12 - Off-Shores Exploration Sites



The facilities in Bayu-Undan exploration site consist of an unmanned Wellhead Platform (WP1) of more than 1,300 tonnes, linked with sub-sea pipeline to a Drilling and Production Platform (DPP) of more than 14,000 tonnes, in turn bridge-linked to Compression, Utilities and Quarters Platform (CUQ) of more than 10,000 tonnes and a remote flare tripod. The DPP, CUQ and the two bridges are collectively known as Central Processing Platform (CPP). The CPP is linked through sub-

sea pipeline to a Floating Storage and Offloading Facility (FSO) called “Liberdade” which is the first built combined condensate/LPG storage vessel.

Bayu-Undan is operated by US-based Conoco-Phillips, and commenced its full commercial production in 2004. Bayu-Undan has produced liquids (condensate, propane and butane) at an average of 107,000 – 110,000 bbl/d since the start up of production in July 2004. Gas exports commenced in March 2005 are channelled through pipeline from Bayu-Undan to Liquefied Natural Gas (LNG) plant in Darwin, Australia, where the products exported serving East Asian markets.

A major gas project still in the appraisal phase, following the Certain Maritime Arrangements in the Timor Sea (CMATS) Treaty in 02/2007, is the Greater Sunrise (GS) gas field. The field is 20.1% located inside the JPDA area and the remaining 79.9% lies outside of the JPDA. The GS field contains conservatively proven reserves of 7.7 TCF of natural gas and 299 million barrels of condensate. According to the Timor Sea Treaty, Timor-Leste and Australia will have a revenue share of 90:10 only from the exploration of the portion of GS field within the JPDA.

In 2005, Timor-Leste issued its Petroleum Act. The purpose of the Act is to provide maximum benefit to Timor-Leste and its people from its petroleum resources by creating a regulatory regime that allows petroleum companies to develop these petroleum resources.

The Act empowers the Ministry to authorize petroleum companies to explore for and develop Timor-Leste’s petroleum resources.

Also in 2005, Timor-Leste established a Petroleum Fund (Law No. 9 Year 2005) to adopt sound management arrangements for its petroleum revenues. The establishment of the Fund was assisted by the government of Norway and The World Bank. The revenues from the exploitation of oil and gas (currently the country’s take from the oil and gas exploration and production contracts) are not transferred or can be used directly by the government (in the State Budget) – as many other oil producing countries do – but it is collected first and invested in investment market in the USA. In 2007, more than \$100 million has

been accumulated monthly to the Petroleum Fund, bringing the total assets to \$2.1 billion by the end of 2007 (over 450% of non-oil GDP). A part of the money pooled in the Fund can be contributed to the State Budget (Annual Government Budget).

In 2008, Timor-Leste issued Decree-Law No. 20/2008 on National Petroleum Authority. According to the Law, the National Petroleum Authority has the task to establish and supervise compliance with the enacted rules and regulations covering the exploration, development, production, transportation and distribution of petroleum and natural gas resources. Given the wide task and responsibility of the Authority, however, so far, as the petroleum industry is still young and the Authority is still a new created one, it has not carried out well all the tasks and responsibilities stipulated by the Law.

Following its exploitation, oil and gas sector have grown to become a major export earnings of Timor-Leste, passing other sectors of the economy which have not been well-developed. The revenues from exploiting oil and gas also serve as the principal source for Timor-Leste's government budget. In terms of Income per Capita, since 2004 the Oil GNI Per Capita has passed Non-Oil GDP Per Capita and currently stands at about 3 times larger.

In addition to oil and gas reserves mostly found off-shores, Timor-Leste also has several on-shores oil seep and gas seep, but most of them to this point have not been well-developed as fuel.

Even though Timor-Leste has emerged as an oil and gas producing country, the entire production of oil and gas of the country is not used within Timor-Leste's territory. All of the oil and gas produced in Bayu-Undan are currently intended for exports, whereas the oil is picked up and transported using oil tankers to export destinations, while natural gas is transported through pipeline to Darwin LNG Plant in Australia.

To meet the domestic demand for (oil-based) fuels, Timor-Leste relies on fuels import, mostly supplied by PERTAMINA (Indonesian oil and gas company) that operates oil products storages and limited distribution facilities in Timor-Leste. So far, Pertamina is the primary supplier of

fuels for the UN mission, Timor-Leste's electric company (EDTL) and the general public. Pertamina supplies Timor-Leste market with some 30,000 kL per year of premium gasoline, diesel oil, kerosene, and aviation turbo. The company also serves as the price leader in Timor-Leste oil products market.

To date, there is no oil refinery operating in Timor-Leste. As the country start producing crude oil and domestic demand for oil base fuels growing (including to fuel the country' electricity, where its electrification ratio is among the lowest in South-East Asia), it would makes sense for Timor-Leste to consider of building an oil refinery in its territory, with a capacity that could meet domestic demand for oil products.

As with oil, natural gas currently produced in Timor-Leste are exported and processed into LNG (and LPG) in a foreign country. The growing question and debate in Timor-Leste at the moment is whether the upcoming natural gas production and processing (from the Greater Sunrise areas) would follow the previous model (Bayu-Undan) or whether Timor-Leste has to make a new decision on this issue, for instance by requiring the companies to build gas processing plants (or even LNG liquefaction plants) in on-shore Timor-Leste.

In 2008, Timor-Leste established its National Petroleum Authority (Decree-Law 20/2008), which mainly has regulatory functions in the Timor-Leste oil and gas industry.

To date, a National Petroleum Company as commonly established by other developing-oil producing nation, has not been established in Timor-Leste. There is also no National Petroleum Training Centre and Research Institute operating in Timor-Leste to support its petroleum industry development.

b) Regulation

Among the relevant regulations concerning Timor-Leste's oil and gas industry development are:

- i) Art. 139 Constitution of RDTL, mentioning that
 - The resources of the soil, the subsoil, the territorial waters, the continental shelf and the exclusive economic zone, which are essential to the economy, shall be owned by the State and shall be used in a fair and equitable manner in accordance with national interests;
 - The conditions for the exploitation of the natural resources referred to in item 1 above should lend themselves to the establishment of mandatory financial reserves, in accordance with the law; and
 - The exploitation of the natural resources shall preserve the ecological balance and prevent destruction of ecosystems.
- ii) Law 4/2003 on Petroleum Development of Timor Sea (Tax Stability);
- iii) Law 9/2005 on Petroleum Fund
- iv) Law 13/2005 on Petroleum Act
- v) Decree-Law 7/2005 on Public Tenders in Respect of Petroleum Contract Awards
- vi) Decree-Law 20/2008 on National Petroleum Authority

c) Institutional

The major government agencies responsible for oil and gas industry management in Timor-Leste are:

- i) Secretary of State for Natural Resources under Prime Minister (SoSNR) is responsible for the design, execution, coordination and assessment of the policy defined and approved by the Council of Ministers for the areas of mineral and natural resources, including oil and gas, as well as the activities of the mining, petroleum and chemical industries.
- ii) National Petroleum Authority; has the task to establish and supervise compliance with the enacted rules and regulations covering the exploration, development, production, transportation and distribution of petroleum and natural gas resources.

d) Program/Projects

Currently, the Secretary of State for Natural Resources are carrying out studies and doing capacity building activities relevant for oil and gas development in Timor-Leste. Among the activities are

- i) Scholarships for Studies in Natural Resources;
- ii) Study and research on the option of Timor-Leste being the basis for the pipeline and Central LNG from the Greater Sunrise; and
- iii) Study on the development of the Supply Base in Suai (southern part of Timor-Leste).

Several bilateral and multilateral agencies, such as the government of Norway and The World Bank are helping Timor-Leste in developing and carrying out capacity building program, mainly training activities, for Timor-Leste.

e) Problems and Constraints

Problems/constraints in Timor-Leste's oil and gas development basically lie on the short of experiences Timor-Leste has made in managing its oil and gas resources. Human resources and institutions' capacities are still not adequate to cope with modern oil and gas industry management.

2. Analysis

A SWOT analysis was employed for Timor-Leste oil and gas industry in order to gain insight for strategic planning of the country's oil and industry. The analysis was divided into two parts: the internal analysis (that consists of strength and weakness factors) and the external one (that consists of opportunity and threat).

a) Part 1 - Internal Analysis

i) Strength

- Timor-Leste has significant oil and gas reserves; in terms of reserves per capita they are comparable to that of Indonesia and Malaysia, which are the major oil and gas producing countries in the region.

- The government of Timor-Leste has a strong commitment to develop oil and gas sector, and has put them as high priority in its development planning policies.
- Timor-Leste has gained experiences in developing and managing oil and gas exploration and exploitation, and learning from the experiences they have made.
- There have been good institutions and regulation dealing with oil and gas industry management established in Timor-Leste (The Petroleum Fund, The National Petroleum Act, etc.). These institutions can be expanded with new functions if deemed necessary.
- There is growing demand for the use of both oil and gas in Timor-Leste domestic market and strong interest to develop the domestic capability in managing oil and gas industry.
- As the oil and gas infrastructure in Timor-Leste is still limited, there is still large room and opportunity to develop oil and gas infrastructures in Timor-Leste.

ii) Weakness

- Although possessing considerable oil and gas reserves, domestic capabilities (human resources and institutions) to manage oil and gas industry are still limited and need to be improved.
- Timor-Leste's experience in managing oil and gas industry is still short and not adequate enough.
- Coordination and cooperation with other sectors related to the development of oil and gas industry is still poor and need to be improved.
- Timor-Leste is tied with several oil and gas agreements which some of them are complicated and need long time to improve them to make it in favours for Timor-Leste.
- The domestic oil and gas industry in Timor-Leste is so far still viewed as merely a source of revenues, not as major supplier of fuel to secure the domestic energy demand and to fuel the economy as a whole.

b) Part 2 - External Analysis

i) Opportunity

- Asian region, where Timor-Leste is located, is economically the most growing region where energy (including oil and gas) demand is growing very fast, which means that demand for Timor-Leste oil and gas can also be high.
- Timor-Leste is surrounded by neighbouring countries which have quite long experiences in managing oil and gas industry (Indonesia, Malaysia, Australia, etc.), with which Timor-Leste might develop cooperation in building its oil and gas industries.
- Timor-Leste may be able to gain lessons from other countries' previous experiences in managing oil and gas industry, and should not waste its time and efforts to start its industry from scratch.

ii) Threat

- As international demand for oil and specially natural gas is fast increasing, competition among oil and gas producers would be even tighter, which means that Timor-Leste's position as a new comer could be relatively weak.
- Timor-Leste could be targeted as a 'victim' or an outlet for disposing old non-appropriate oil and gas technology by more advanced oil and gas countries, especially those which are shifting from their aged technologies.

3. Strategy

Timor-Leste has basically established some sound policies needed to develop a modern (competitive, transparent and responsibly) petroleum industry. However, due to its young status both as a nation and as an oil and gas producing country, the policies have yet to be well-implemented.

What is strategically important for Timor-Leste petroleum industry development in the middle term would be, firstly, to increase Timor-Leste's independency in managing its oil and gas industry by developing its human

resources, and secondly, to reduce Timor-Leste's high dependency on fuel imports.

It is necessary to stress that the goals for developing petroleum industry for a nation not merely as source of revenues but also as sources of fuels to secure the domestic energy needs.

Based on the understanding of Timor-Leste oil and gas industry current situation and the analysis carried in the previous section, there is a growing need to establish strategic programs necessary to develop Timor-Leste oil and gas industry in the middle to long term, so that the industry could be able to contribute a larger share to the Timor-Leste economy and development plan.

- a) **Strengthen national capacity** in managing oil and gas industry will be the centre of the strategic program. This program must be implemented through several capacity building activities targeted to the current officers and institutions in the oil and gas industry management. In addition, it is very important to train a large number of young Timor-Leste natives so that they could gain oil and gas skills and knowledge (geology, petroleum and chemical engineering, petroleum finance and management, etc.) including by means of sending them to post-graduate studies in well-established oil and gas institutions in foreign countries such as Indonesia, Malaysia, Australia and other more developed nations.
- b) Prepare a **Logistic Base** (in south part of Timor-Leste) to support oil and gas exploration and exploitation activities conducted in Timor-Leste's off-shores. The Logistic Base should meet a world-class standard to attract international oil and companies **working** in Timor-Leste (at least it must be comparable to the similar facility available in Northwest Australia). A simple approach is by inviting the oil and gas contractors currently working in Timor-Leste to prepare a logistic base in Timor-Leste's onshore, while the government provides a certain area dedicated for the logistic base.
- c) Establish a **National Petroleum Company** with main task to develop the country's oil and gas resources through direct involvement in all of the oil and gas business chain. The future National Petroleum Company can

be developed from the current National Petroleum Authority then be separated as it getting larger and more independent.

- d) The establishment of National Petroleum Company should then be complemented by establishing a **Petroleum Training Centre and Research Institute**.
- e) **Develop capacities in upstream business**, by increasing the involvement of national entities or government-owned contractors in upstream activities, starting even from simple activities (i.e., internship for Timorese in companies currently working as PSC-contractors with Timor-Leste, procuring simple materials, etc.). Later, assessment of the Petroleum Systems in Timor-Leste and offshore areas should also be done by Timorese. Timor-Leste should also prepare their own capacities/capabilities in this respect so that they will be ready to take a larger role in the future and even take part in as a major player as the current up-stream agreements expired.
- f) **Develop Downstream Infrastructure** to secure the domestic demand for oil-based fuels and petrochemical products. The major programs on this issue would be to build a new (mini) **oil refinery** located in Timor-Leste on-shore and to prepare a **Supply Base** for fuels in order to enlarge domestic network for distributing oil-base fuels and other petrochemical products. The crude oil to the planned refinery should be supplied primarily from Timor-Leste *own* production, in which Timor-Leste should develop a working concept of Domestic Supply Obligation to its future oil and gas production contracts. The domestic oil refinery would be beneficial for Timor-Leste not only because it would produce fuels, but also other products (asphalts, LPG, etc.) that are also needed to support the country's development. An appropriate LNG Plant should also be built in Timor-Leste to serve domestic market with a cleaner and cheaper energy source.
- g) **Prepare national capacity to develop LNG Plant in Timor-Leste**. Building LNG Plant in on-shore Timor-Leste – in response to the development of Greater Sunrise oil and gas working areas – would be more beneficial for the country and could produce larger multiplier effects than to export the raw gas and process them in a foreign

country LNG Plant. However, it should be noted that LNG Plant is a very capital-intensive industry and the decision to build LNG Plant must be made in a very careful and prudent way. Timor-Leste might start building the LNG Plant after establishing its National Petroleum Company. Given that there are already some world-class LNG Plants operating in the surrounding neighbouring countries (Bontang of Indonesia, Bintulu of PETRONAS, etc.), in building LNG industry and set the necessary consortium, it is very important for Timor-Leste to choose experienced and trusted partners.

- h) **Oil and gas used by Timorese in Timor-Leste domestic market.** Timor-Leste should not only be concerned with the fact that revenues from their oil and gas exploration are transferred to the established Petroleum Fund, but they also need to promote the use in its own *domestic* market, which would effectively reducing the county's dependency on fuel imports all at once. The gas in particular should also be developed so that in the middle term it could replace diesel-fired electricity plants which currently play as the only alternative for generating electricity in Timor-Leste. Timor-Leste should develop an initial oil and gas infrastructure plan for domestic market supply purpose.
- i) Put all the programs into a **master plan for oil and gas development** and develop **investment schemes** that meet the program requirements would serve as key factor for the success of Timor-Leste's oil and gas industry strategic program. It should be kept in mind as well that the finance for almost all of the oil and gas development would be borne by private sectors; hence, the government's share would be mostly in the provision of good investment climate. It is necessary for the government to prepare "public-private partnership" schemes suitable for the development of Timor-Leste oil and gas.

We propose major activities for oil and gas development from 2010-2020 as shown in the following table:

Table 19. Major activities for oil and gas development 2010-2014

4.3.3 Mining

1. Overview

The most significant conclusion arising from the publication is that Timor-Leste does have mineral potential and that some of that potential will almost certainly attract foreign mining companies. The most attractive potential of Timor-Leste is in base metals, mainly copper, and associated gold and silver. Chromites and vein-type gold represent other exploration targets in which the private sector will be interested. There might also be interest in the clay mineral potential, in phosphoresces as well as in marble and other stone resources. Some of these resources may represent targets for domestic investment.

The mineral resources, with which Timor-Leste is endowed, are waiting to be developed in an environmentally friendly manner for the greater economic and social good of the people of this newly independent nation. The major metallic minerals in Timor-Leste are gold, copper, silver, manganese, although further investigations are needed to determine the size as well as their vertical and lateral distribution. Gold is found as alluvial deposit probably derived from quartz veins in the crystalline schist of (Aileu Formation). It can also be found as epithermal mineralization such as the ones found in Atauro Island. Nearby islands such as Wetar, Flores, and Sumba islands of the Republic of Indonesia have produced gold deposit in a highly economic quantity.

In Timor-Leste, the known occurrences of these precious minerals are mostly concentrated along the northern coastal area and middle part of the country associated with the thrust sheets. The copper-gold-silver occurrences associated with ophiolite suites resembling Cyprus type volcanogenic deposits have been reported from Ossu (Viqueque district), Ossuala (Baucau district), Manatuto and Lautem districts. The Cyprus type volcanogenic massive sulphides are usually between 500,000 to a few million tonnes in size or larger (UN ESCAP-report, 2003). Therefore it is worth exploring such potential.

The Government policy on the natural and mineral resources is clear; that is: to explore and develop with sound mining practice for the benefit of people

of Timor-Leste with special attention given to the environmental protection, and in a sustainable manner. In line with this spirit, the draft mining legislation, which is now in the government circulation for approval, has, indeed, in one hand emphasized the importance of environmental protection and sustainable mining operation through the establishment of structures to support them. In the other hand, the formation of infrastructure, institution and human resources capacity building are needed to create and promote a good business environment that encourages private investment.

Mineral indication and occurrences based on the UN ESCAP-report, 2003, are as follows.

a) Copper

The mineralization occurs as sulphides vein lets containing chalcopyrite and pyrite in the ultra basic units, with extensive serpentinites alteration and with evidence of intrusive diorite/diabase.

In Ossuala area (Baucau district) sampling by Allied Mining Company (Wittouck, 1937 in Bambang, 2003) indicates grade values of 10% Cu, 3 g/t Au and 170 g/t Ag.

b) Gold

The gold mineralization has been observed in several forms as quartz, quartz-calcite and calcite veins hosted by shale/slate or schist. The veins are commonly pyritized and mineralized with gold. In Hilimanu area the mineralization occurs in the metamorphosed igneous rock. The mineralization is associated with quartz vein (0.5 – 12 m wide) containing chalcopyrite, limonite and chalcedony. Some samples indicate an average grade of 0.5 g/t Au and 50 g/t Ag.

c) Chromite

The chromite deposits have been reported from Baucau, Hilimanu (Manatuto district) and Manufahi districts. The deposits were found as primary mineralization in the serpentinites hosts. There has two mineralization type i.e; Schlieren and Podiform chromite. The podiform chromite in the Manatuto districts is similar to chromite mineralization

in allochthon ophiolite bodies found in the Circum Pacific belt in the Philippines, New Caledonia and Kalimantan, Indonesia. The quality of the chromites is good, with grades between 36% and 51% Cr₂O₃. As far as the grades are concerned, 80% of the world's major deposits have an average between 33% and 52% Cr₂O₃.

d) Manganese

The manganese deposits were discovered in several places such as Vemasse, Talamata, Venilale (Baucau district), Uato-Carbau (Viqueque district). The deposits are interbedded form within red shale and associated with the limestones of the Bobonaro Formation. The manganese deposits mainly composed of pyrolusite mineral with the grade range between 84 – 94.5% MnO₂.

e) Phosphate

The deposits are located in Daemena, Abo (Quelicae-Baucau district), and Laleia (Manatuto district). The phosphate deposits occurs in the unconsolidated gravel - boulder material which similar age to the Ainaro Gravel. Analysis result of the samples taken from Abo area has revealed the significant assay ranging from 9.97 % to 21.55% P₂O₅. The best assay was recorded from Japan Development Consultant showing 31% P₂O₅.

f) Bentonnesite

Bentonnesite-clay deposit is partly bedded of the clay-stones of Bobonaro Formation and located at Venilale (Baucau district), Bobonaro (Bobonaro district). In Mulia-Quelica village (Baucau district), the swelling value was recorded between 371 up to 1829 x dry volume. Mineral reserve has been estimated to be approximately of 115,570,000 cubic meters (around 6 X 6 km²).

g) Marble

The deposits have been recorded at Cablaci-Same (Manufahi district), Lacro (Manatuto district) and Builale (Viqueque district). In Lacro, the gross mineral reserved is thought to be at least 5.000.000 cubic meters.

h) Gypsum

The gypsum deposit was found to be associated with clay-stones of the Bobonaro Formation. The deposit is located at Laleia-Obrato (Manatuto district). Result from the test pitting investigated area of 50 has revealed the mineral reserved to be approximately of 400 tones.

River valleys throughout the country contain a wide range of sand and gravel deposits some of which have already been used for building and construction industries. There is also a wide variety of building stoniness such as granite, andesitic, basalt and gabbroic that could provide valuable sources of rock fill, aggregate and road materials. Andesitic are especially suitable for use in breakwater for harbour protection and for stabilizing seabed pipeline and make ideal material for railway ballast, road metal and high strength concrete.

2. Problems and Constraints

- a) Unavailability of legal and regulatory framework on mining sector;
- b) The lack of data and information constrains the ability to develop the potential of mining industry;
- c) Limited infrastructure to facilitate the development of mining industry;
- d) Inadequate local human resources in the mining sector.

3. Analysis

The analysis was divided into two parts: the internal analysis (that consist of strength and weakness factors) and the external one (that consist of opportunity and threat).

a) Internal Analysis

i) Strength:

- Have a lot of mining resources type, some of which are already being explored.

ii) Weakness:

- Limitation of power stations to generate electricity and requirement to access good road;
- Inadequate human resources both in public and private sectors.

b) External Analysis

i) Opportunity :

- Timor-Leste has a good access to both Australian and Indonesian markets;
- Greater economic multiplier effect;
- Increase economic growth;
- Increased national government revenues;
- Develop mining industry to create jobs especially for youth;
- Private sector to play a stronger role in the economy.

ii) Threat

- Limitation at infrastructure will constrain investment at mining sector;
- Loss of confidence in financial institutions and inadequate banking infrastructure;
- The rights and responsibilities relating to acquisition of land and resettlement.

4. Target

- a) Establishment of a database on mining;
- b) Formulation of legal and regulatory framework as a tools of mining industry;
- c) Management and utilization of its natural resources to support economic growth and improved community welfare.

5. Program

- a) Conducting survey and mapping of the mining resources in all districts in order to get indicative potential resources;

- b) Designing policies and establishing national sustainable management mechanisms that will allow for an effective oversight, regulation and control of the sector by the Government;
- c) Capacity building for mining institution and personnel.