Sunrise LNG in Timor-Leste

Dreams, Realities and Challenges

A report by

La'o Hamutuk
Timor-Leste Institute for Reconstruction Monitoring and Analysis

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February 2008

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Authorship

This report is the collective effort of La'o Hamutuk's Natural Resources Team, with assistance from a number of other knowledgeable people. Two technical contributors, Guillermo Franco[1] (engineering, risk and environmental impact) and Martin E. Sandbu[2] (social and economic development) joined us in Timor-Leste for some of the research and assisted greatly in writing and reviewing the report. From La'o Hamutuk's staff collective, Guteriano Neves, Charles Scheiner and Santina Soares worked on the entire report, and were joined by Tibor van Staveren and Viriato Seac during editing and finalization. Emma Conlan, formerly with Oxfam Australia in Timor-Leste, assisted with the executive summary and final edits. Although this report is the accumulation of the contributions, expertise and research of each of the authors and contributors, responsibility for its contents, conclusions and recommendations rests with La'o Hamutuk.

La'o Hamutuk (*Walking Together* in English), also known as the Timor-Leste Institute for Reconstruction Monitoring and Analysis, is a seven-year-old Timor-Leste non-governmental organization that monitors, analyzes and reports on the principal international institutions present in Timor-Leste as they relate to the physical, economic, and social reconstruction and development of the country. La'o Hamutuk believes that the people of Timor-Leste must be the ultimate decision-makers in this process and that this process should be democratic and transparent. La'o Hamutuk is an independent organization and works to facilitate effective Timorese participation, to improve communication between the international community and Timorese society, to provide resources on alternative development models, and to facilitate links between Timorese groups and groups abroad. For the last five years, La'o Hamutuk has been the leading force in civil society on many aspects of Timor-Leste's petroleum development, including boundary negotiations with Australia, regulating the offshore upstream industry, developing petroleum legislation and managing petroleum revenues. La'o Hamutuk also participates in international networks on these issues, and is publishing this report to share our knowledge and experience with a broad range of Timorese citizens, leaders and organizations.

We have published this report to help Timor-Leste complete and improve legal and other mechanisms to develop an LNG plant and to manage our non-renewable natural resources well. Many of its findings are also relevant to other major industrial facilities. These are large and complex topics, and we hope that the many sources we have drawn upon can provide insights and references for further studies and implementation.

Cover photo: Young people listen in as the Chefe de Aldeia of Com learns about the proposed LNG project from La'o Hamutuk researchers and shares his thoughts about how this project could benefit the people of his area.

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Acknowledgments

La'o Hamutuk would like to acknowledge the people who helped research and write this report. Many others also supported our efforts, and we apologize to anyone we have left out.

Timor-Leste Government officials: Angelo de Almeida (Tax Commissioner), João Baptista Freitas Alves, (Secretary of State for Environment), Maria José Campos (TSDA Legal Officer), Jacinta Correia da Costa (Judge of Court of Appeals), Joao Gomes da Cunha (Coordinator for Environmental Policy), Amandio Gusmão Soares (Director of Petroleum and Gas), Cristino Gusmão (Director of Macroeconomic, Ministry of Finance), Manuel de Lemos (Director of Timor Sea Office), Francisco da Costa Monteiro (advisor to the President on oil and gas), Alfredo Pires (Secretary of State for Natural Resources), Francisco do Rosario (Director of Disaster Management), Pedro Xavier de Sousa (Director of Land and Property, Ministry of Justice), Jose Teixeira (Minister of Natural Resources, Minerals and Energy Policy), and Carlos Ximenes (Director of Environment).

Local leaders: Estevão de Carvalho (Viqueque District Development Officer), Horacio da Costa (Director of Education for Lautem District), Lino Ferreira (Lautem District Development Officer), Arlinda Mendes (Deputy District Administrator of Lautem), Mateus Soares (Liurai of Viqueque), Carolino Ximenes (Chefe do Suco) of Lore and the Chefe do Aldeia of Com.

Friends and colleagues from civil society organizations, who served on the Advisory Committee for this project and were generous with their time and suggestions: Deometrio Amaral (Director of Haburas Foundation), Mario de Araùjo (Oxfam Australia), Maria Dias (Prontu Atu Servi Clinic), Thomas Freitas (Luta Hamutuk), Nivio Oliveira (Verupupuk), Flavia Salsinha (FOKUPERS), Helio Dias da Silva (Mata Dalan Institute), Justino da Silva (NGO Forum) and Julino Ximenes (HAK Association).

International advisors to Timor-Leste's government: Hermes da Rosa Correia Barros, Havard Holterud and Rob Steele (taxes), Anne-Lene Midseim and Roger White (oil and gas), Vasco Leitão (environment), Cathy Molnar (National Parks) and Alistair Watson (petroleum taxation).

In addition, we received invaluable support and information from Joseph Bell, Michelle Bologna, Bjørn Brandtzæg, Christian Brütt (Project Manager, Knabe Ingenieure), Ian Gary, Francis Ghesquiere, Brigham Golden, Gary Gray and Amanda Whyte (Woodside Petroleum), Ruth Greenspan Bell, Gavin Hayman and Sarah Wykes (Global Witness), Rui Hanjam, Morten Lund Hoffman, Anton Hove, John Imle, Akshay Jashnani, Johanna Johannson, Erling Kvadsheim, Esperanza Martinez (Oilwatch), Geoff McKee, Charles McPherson and Mr. Ramos (World Bank), Jim Mellor, John M. Miller, Shirley Neff, Liv Marte Nordhaug, Henry Thompson, Andrew de Sousa, Tone Sørgård, Andrea Woodhouse and Geir Ytreland.

We would like to express our deep gratitude to Oxfam Australia and CAFOD who provided funding for this project, especially to Keryn Clark and Emma Conlan. We are grateful for the three foundations which support La'o Hamutuk's overall work on natural resources and other issues: HIVOS, Trocaire and Development and Peace. Without their confidence, we would not have been able to undertake this project. We also appreciate the patience shown by our colleagues at La'o Hamutuk and by our families as we deferred other responsibilities to focus on this report.

This report was printed by Sylvia Printing in Dili, Timor-Leste.

Dili, January 2008

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La'o Hamutuk Natural Resources Team

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Executive Summary

Petroleum will be the most important factor in Timor-Leste's economy and government budget for the foreseeable future. Revenues from oil and gas already comprise 50% of the country's Gross National Income (GNI) and supply more than 90% of its government revenues. To date, this is entirely from offshore, upstream development, with downstream processing done in other countries. It is the hope of many Timorese, including the Timor-Leste government, that Timor-Leste will soon receive revenues from downstream (refining, processing and gas liquefaction). The most likely near-term possibility for this is an undersea pipeline from the Greater Sunrise gas field to the shore of Timor-Leste, with a Liquefied Natural Gas (LNG) liquefaction plant and tanker port to process the gas and ship it overseas.

People are imagining the wonderful things that will happen if the pipeline comes onshore in Timor-Leste: it will stimulate local economic development, spin off to boost the local and national economy, and create employment opportunities for Timorese workers. However those dreams and expectations will be difficult to realize in Timor-Leste in the current context of the new nation.

The government's Petroleum Act and Petroleum Fund Act set out a legal framework outlining the transparent and prudent management of petroleum revenue and currently Timor-Leste has more than one billion U.S. dollars in the Federal Reserve Bank of the United States. Despite this, over half of the population continues to live in poverty, unemployment is widespread, infrastructure is weak, trust in security has broken and the laws that should protect human rights, land, economy and environment are not yet in place. The causes of these problems – fragility and inexperience of state institutions, lack of human resources, inability to execute the budget – must be overcome before a project like the Sunrise LNG plant can be used safely and effectively to benefit current and future generations.

The research

In February 2006, La'o Hamutuk began to research the implications of the development of an LNG processing plant in Timor-Leste. The research was conducted over four months and involved interviews with communities, traditional and local government leaders, oil companies and key government and civil society players in the petroleum sector. With the assistance of outside technical and economics experts, we reviewed relevant documents to conduct an environmental and social analysis of the proposed project, learning from similar projects in other countries, and their people's experiences with oil and gas development. During late 2006 and 2007, there were many changes both in Timor-Leste and in the worldwide gas industry, and we continued to research and update our findings through the end of 2007.

The purpose of this report is to explore the benefits and costs, the risks and opportunities that a pipeline and LNG plant could bring to Timor-Leste, so that our citizens and leaders will be better informed as they consider whether such development would be beneficial for the country. We tried to identify specific actions to maximize benefits and minimize risks to ensure that Timor-Leste gains more from this project than it will lose. We do not attempt to predict what the development decision will be. Rather, we hypothesize that Australia, Timor-Leste, and the companies decide to build a pipeline to Timor-Leste and an on-shore LNG plant on the south coast. If this were to happen, Timor-Leste's people need to know the advantages and disadvantages of such a project, and our government needs to take actions now to maximize the gains and minimize the dangers.

In order to make this report useful and understandable by people with limited technical knowledge of the oil and gas industry, we have included an extensive glossary of technical and economic terms used in this report in Appendix 7.

Findings and recommendations

The consequences of landing natural gas and constructing and operating a gas liquefaction and LNG shipping facility in Timor-Leste depend largely on a number of factors. Firstly, to land natural gas from the Greater Sunrise field in Timor-Leste, the government will have to secure the agreement of Australia's government and the Sunrise joint venture companies, and find companies that are willing and able to construct, operate, and responsibly decommission the pipeline and LNG facility.

In a best case scenario, such a plant could provide employment and training to Timorese employees, boost the economy of the country and the region where it is located, and provide increased tax revenues for the government, which can in turn be used for the benefit of all Timor-Leste's people. However, the outcome could also be much bleaker. The facility could become an *enclave*, physically situated on the coast of Timor-Leste, but with few or no jobs for Timorese citizens, no money going into the local community, and indeed no integration at all with the rest of society— neither economically, socially, or in terms of infrastructure such as road connections. In short, it could be "in" Timor-Leste, but not "with" Timor-Leste. The worst scenario is a plant that displaces the local population, impinges on their sacred places and harms the natural environment, and is staffed by foreigners who live in self-contained living quarters near the plant, without any positive interaction with the rest of the country. It is easy to see that this would cause deep grievances and frustrations in a population that is already struggling with poverty and a history of colonialism and violence.

Which scenario prevails will depend on the actions of all parties involved in preparing for the arrival of the pipeline, plant, and port; during the construction of the facilities; and throughout the life of the project. The government, petroleum companies, local authorities, local communities, traditional leaders, and civil society, including non-governmental organizations and individual Timorese citizens will each have a role in this. To ensure that this project maximally benefits the people of Timor-Leste, and that the negative impacts are minimized, we must all be prepared for the opportunities and challenges that an LNG project will bring.

Dreams, expectations and realities

Timor-Leste's people have high expectations that petroleum revenue will improve their lives and that the processing of petroleum will provide them with employment opportunities, attract local economic development and extract investment. In informal and formal discussions with communities, people expressed their hopes that petroleum revenues should be used for national development: improving agriculture, improving the health system, improving the quality of education, and improving the infrastructure so their children can go to school, receive adequate health care, have access to media and have better opportunities than they themselves had.

However, if we look around the world, petroleum development is often not a blessing, but a curse. The global record shows that many countries rich in petroleum wealth are low in Human Development index, have high poverty levels, authoritarian systems, environmental degradation, militarism, human rights violations and corruption. Although oil can bring money, it also brings problems. In countries like Timor-Leste, where our economy and government are dependent on petroleum income (90% of GDP and 95% of government revenues come from oil and gas), these dangers are even harder to avoid. It is critical to manage both the money and the industry well, and good models are hard to find.

Timor-Leste's leaders have often stated their commitment to learn from the experiences of other countries to avoid the "resource curse." However, this commitment needs to be more than only a political statement, and should be implemented in laws and regulations, and with strong public institutions. So far, the Government appears to have been successful in petroleum development, by establishing some basic legal foundations, However it is too early to be know if such steps will ensure prosperity for future generations of Timorese and much work is still to be done in order to realize the dreams and expectations. Since the Government has committed to bringing the pipeline onshore to Timor-Leste, there are several steps which should be taken now:

1. Timorese people must be well-informed about the government's plans for LNG development. Communities should be told of the risks associated with the development as well as the benefits and consultation should be held to ensure the informed voice of Timorese women and men is represented in decisions. Local people should be given the chance to choose what is best for them.
2. A legal foundation should be in place which incorporates; respecting land rights, assessing and protecting the environment, guaranteeing sacred places, managing pollution and disasters, enforcing transparency and public consultation, safeguarding workers' rights and safety, and preventing conflicts of interests. More than five years after independence, Timor-Leste has not enacted laws to ensure the above, and without them we are vulnerable to violations of our rights. In addition to passing the laws, enforcement and monitoring systems and personnel must be in place. Sanctions must be severe enough to ensure companies comply by these laws, and a judicial system must have the capacity to fairly and expeditiously resolve any disputes or violations.

3. The Government must initiate programs to equip Timorese people to undertake higher-skilled jobs in the companies involved in the LNG project, as well for those who will regulate it on behalf of the Government. Training, scholarships, apprenticeships, and education should begin at the pre-secondary level to prepare people for work in petroleum and related industries. The sooner and better this is done, the more Timorese will get jobs that would otherwise go to foreigners. The Government should require companies to hire and train Timorese workers and facilitate the flow of information on recruitment, so that companies can find the people they need for positions and people have information to apply for the jobs that they are qualified for.
4. We can avoid the worst by being ready. The hydrochloric acid leak at the port in April 2007 clearly illustrated how unprepared Timor-Leste is to handle even a simple accident contained to central Dili. The recently repaired Motale'e bridge to Beaçu (see Appendix 6) exemplifies how difficult it is for us to maintain and repair even simple infrastructure. With a major industrial facility like an LNG plant, the infrastructure needs are far more complex and critical; the consequences of a badly-handled accident would be much more devastating. To respond adequately Timor-Leste needs developed planning, procedures, interagency coordination, emergency medical response, communications and deployment systems which can deal with the worst that could happen.
5. In order to maximize spin-off benefits, the LNG project needs to be integrated into local economic development plans. The plant requires water and electricity, for which it has to build its own supplies, and the construction of these facilities could also benefit the community, either by utilizing the contractors who build the plant infrastructure to build infrastructure for the country at the same time, or by constructing roads, docks, generators or similar infrastructure to serve both the plant and the local population. In order to ensure maximum and sustainable spin-off benefits, the Government must conduct specific, far-sighted planning, as well as stimulate and develop the capacity of local businesses.

La'o Hamutuk believes that it would be to Timor-Leste's advantage to extend the period of Sunrise production by reducing the rate at which gas is extracted and liquefied. Timor-Leste will get more spin-offs from operating than from construction, and a longer project lifetime allows for more "Timorization." Timor-Leste would also benefit if the project started later, giving us more time to prepare to receive its benefits.

Fiscal and economic issues

An LNG plant could potentially be of major fiscal and economic benefit for Timor-Leste. In addition to significant downstream tax revenues and some employment, we could receive secondary economic effects in local and national business booms through sub-contracts for construction, and a general increase in economic activity. However, under the current circumstances, Timor-Leste will not gain as much as many people are expecting. The project runs a risk of becoming an enclave, with no spin-off benefits to Timor-Leste, and therefore several measures are needed to maximize fiscal and economic impact:

Recommendations

1. Downstream tax revenues could be as much as four billion dollars over the lifetime of the project under the current tax laws, the most important being a 30% corporate income tax. A reduction of this tax to 10%, as currently proposed, would mean a huge (approximately 2 billion dollars) loss in revenues, and we recommend that the government reconsider the implications the proposed tax reform would have on a project of this scale and any other future projects.
2. The Government should integrate the LNG project with local economic development plans. Feasibility studies should be conducted on using electricity from the plant's power generator for the national grid, and whether the construction dock can be adapted to become a commercial port. These studies need to be translated into a concrete plan with budget allocation, to be implemented by relevant ministries. These measures will not only serve the plant, but will also boost economic development in the south coast region.
3. The Government should increase efforts to develop the local private sector. This should include provision of subsidies and loans (for instance through a special investment fund for small Timorese businesses to establish and develop business activities), an increase in business information and development services as well as training in project acquisition and management (with special attention to construction and hospitality services). The juridical and social security of the private sector should be improved requiring a review of Investment Law, Land and Property Law. This should include incentives for setting up local

businesses and the promotion of the creation of cooperatives through the establishment of a Cooperative Supporting Institution.

4. Contracts, laws and other policies should encourage the oil companies to give preference to sourcing workers, products and services from Timor-Leste, in general terms, increasing local content. For instance, a requirement could be that local content steadily increases over the operational period of the project, reaching 85% or more after 20 years. Both the Government and companies should establish coordination mechanisms to promote local content before the project begins to ensure that such objectives are met.

Employment

Employment opportunities created by an LNG plant could assist Timorese people in shifting from subsistence agricultural work into more lucrative agricultural production and stimulate employment in other sectors including manufacturing and public sector projects such as health, education and infrastructure. This would serve to stimulate the economy and develop corporate and individual skills for Timorese people.

However the dreams of many people that bringing the pipeline to Timor-Leste will provide job opportunities for many Timorese workers may be illusory as most of the well-paying jobs require a level of technical expertise that currently doesn't exist in Timor-Leste. During the two to four year construction phase, there will be opportunities for short-term work for local people, but during the following 40 years of operation, the plant will require very few people, mostly with specialized skills. Indirect employment opportunities through demand for goods and services would also be limited by the localized demand for these goods and services and the localized current capacity to meet this demand. As Timor-Leste has experienced under UNTAET administration, a high international presence does not ensure economic growth if wages are spent overseas and products consumed are imported. In addition, Timor-Leste's current labor laws do not ensure the rights and protection of those employed to adequately protect workers from exploitation.

Whether Timorese get jobs at the LNG plant will depend very much on the training policies the government manages to implement before the construction period, as well as the extent to which contractors are required to utilize local resources. Ideally, the expertise of foreign contractors should be used not just to construct the facility but also to train local workers, and this could be made part of company contractual requirements.

Recommendations

5. The government and companies should identify the specific job skills required for a LNG project – from construction through to decommissioning – and begin to prepare now. The development of Timorese skills should include local education, providing scholarships, on-the-job training and internships. The government should increase investment in technical education and training, encourage local educational institutions to expand on relevant subjects, and give scholarships for Timorese in specific areas of mechanical and civil engineering and the hospitality and services industry.
6. To increase Timorese employment over the multi-generational lifetime of the project, the Government needs to improve vocational education in Timor-Leste, including a review and reorientation of the technical and vocational education curriculum to enable adequate and flexible response to demand, and an increase in the quality of teaching in existing schools. Furthermore, the existing engineering faculty within the national and private universities in Timor-Leste should receive significant assistance to increase capacity, quality and facilities to anticipate the project's needs.
7. To protect those who will be employed by the project, the Labor Code and other Health and Safety Regulations should be revised to clearly stipulate regulations related to working hours and shifts, secondary benefits, health and safety measures, working in hazardous environments, as well as regulations related to injuries and death. The Government must have effective mechanisms to enforce, regulate and arbitrate labor laws and disputes.

Social and cultural issues

Although the project promises positive effects, it also carries risks of negatively affecting Timor-Leste's people. A national-interest endeavor, such as the LNG project, endangers local community land rights, threatens livelihoods of communities, and could destroy existing sacred places and infrastructure reflecting traditional

values of the community. A huge influx of foreign workers further threatens local economies such as fisheries and agriculture, and could increase the vulnerability of women, elders, and children.

Women in Timor-Leste stand to gain less from the positive impacts of possible LNG development and suffer more from the negative. Timorese women play a crucial role in the economic and social management of the family and comprise a significant proportion of subsistence farmers. Although women's rights as equal to men are enshrined in the constitution, women continue to face challenges in accessing these rights including limited rights to land tenure, livelihoods, health services, and education.

Recommendations

8. Land and property rights must be clarified, with recognition of individual and collective ownership over land and traditional systems of tenure. If the project requires land from individual or community owners, or negatively impact on their livelihoods, the Government should have in place an effective, transparent and adequate compensation system. This requires revisions of Land and Property Law and regulations on protected areas. Any decision for a plant location should be preceded by a coordinated assessment, of local social and cultural traditions, sacred places, land and water use and other related factors, with concrete recommendations to mitigate the project's negative impact. This assessment should have extensive involvement of local civil society and be part of the formal Environmental Impact Assessment discussed below.
9. Company contractual requirements should include mechanisms to resolve disputes that may arise due to the influx of foreign workers with a priority to respect local values and customs as well as the obligation to obey national judiciary law and respect Timor-Leste's courts and arbitration procedures. To minimize conflicts between the community and foreign workers, and to channel community voices and facilitate dispute resolutions, a coordination mechanism should be established which includes representatives from the company, workers, government, and civil society.
10. All institutions, bodies, and committees should take special consideration of gender issues, so as not to perpetuate discrimination against and the victimization of women. This ranges from women-focused business training and scholarship preferences, to mechanisms to avoid wage differentiation and sexual exploitation of women. All assessment teams, coordination teams and liaison teams, at all levels and stages, must be engendered.

Environmental issues

An LNG Project will introduce many new environmental problems. The project could double Timor-Leste's carbon dioxide emissions to the atmosphere and will generate significant amounts of polluting materials, such as hydrogen sulfide, oils, garbage, sanitary water, and other waste.

Although an LNG plant would be less harmful to the environment than a processing plant for oil or coal, pollution impacts of the plant include the release of increased greenhouse emissions from burning gas, possible methane leakages and waste discharge polluting Timor's oceans and rivers. The RDTL has drafted a Protection Control Law which would mitigate the risk of pollution through the issuing of licenses requiring companies to conduct Environmental Management Plans however to date; this legislation has not been passed.

In addition to pollution, LNG development will also impact on the environmental stocks present in Timor. Use of land and waters for construction, operation and the needs of an influx of laborers will lead to the loss of vegetation cover and habitats for animals. The associated increase in demand for water can also reduce the water table, leading to the degradation of environmental resources for future generations of Timorese.

Recommendations

11. The Government should revise the Law on Environmental Impact Assessment and, related to this, develop proper guidelines for conduct of an EIA for an industrial project. An EIA should include a detailed Environment Management Plan spelling out pollution management and mitigation, disaster management plans, and detailed mechanisms for minimizing negative cultural and social impacts. To enable proper evaluation of a submitted EIA, the Government should establish a joint coordination mechanism among ministries and departments, increase capacity of these departments, and include non-governmental

recognized expertise (both national and international). The Environmental Impact Assessment process should include informed local consultation and consent, as well as the opportunity for civil society organizations and local community leaders to give input to and modify the Management Plan.

12. A Pollution Control law should specify limits to pollutants, including CO_2 and other greenhouse gases, chemicals which affect sea, ground water and soil quality, as well as issues like flaring and noise pollution. The law needs to be detailed on requirements for waste disposal and treatment of various types of waste, so that regulatory and monitoring bodies can enforce it, and public and private waste disposal and treatment facilities can be developed.

13. A base law on the environment, incorporating pollution control and environmental impact assessment laws should also define conditions for decommissioning of projects and constructions after their operational period has ended, to ensure that Timor-Leste is not left with toxic materials or dangerous structures after the company leaves. Plans on decommissioning should be part of the contract and the EIA.

14. Each law developed should spell out or refer to specific sanctions and/or penalties and the legal processes of conduct if regulations are violated, which are severe enough to compel compliance. Contractual agreements should exist stipulating that the operating companies obey these laws. It is therefore necessary that laws and regulations are in place before the onset of the project, and that Timor-Leste has the personnel and the mechanisms necessary to identify violations and expeditiously enforce the law.

Chapter 1. Dreams and expectations

Is something confusing?

Many technical, financial legal and historical terms in this report are explained in the Glossary in Appendix 7.

Timor-Leste's people have high expectations that oil and gas revenues will improve their lives, including social services, and that processing petroleum will provide jobs, support our local economies and attract foreign investment. Community people described their hopes that petroleum revenues can advance national development, improving agriculture and infrastructure. They also hope that their children will be able to go to good schools and enjoy quality health care, and have access to efficient communication and news from around the country and the world to improve their lives (see Appendix 6). Timor-Leste's first Constitutional Government underlined these expectations and promised to achieve this vision within the National Development Plan. [72][3] By the year 2020, according to this plan, Timor-Leste will be a prosperous society with adequate food, shelter, clothing etc. Our people will be literate, educated and have many skills. We will have good access to health care and an improved standard of living. Our public institutions will be transparent, operating under the rule of law. We will use our natural resources sustainably, with the income fairly distributed, and everyone will be able to participate in economic, social and political development.

During 2007, the people of Timor-Leste elected a new President and Parliament. The new Government, like the previous ones, is working to bring the Sunrise gas pipeline to Timor-Leste. They see this as an integral part of their campaign to develop Timor-Leste's economy with foreign investment and to optimize the benefits for Timor-Leste's people from our oil and gas resources. It is too soon to know all the details of this effort, let alone how successful it will be, but the tantalizing vision of a pipeline which will replace poverty with prosperity is shared by people and communities throughout Timor-Leste.

Box 1. Dreams and fantasies

"A pipeline to Timor from the Sunrise field with a Liquefied Natural Gas (LNG) export industry built on the north side of the island would generate huge additional economic benefits as a result of fixed direct investment. The quantification of these downstream benefits has been studied in detail by the Northern Territory government. Timor-Leste must strive to achieve these downstream benefits for her people, following the example set by the Northern Territory government. A Northern Territory government spokesman has said that if all Timor Sea gas came ashore to Darwin it would create directly and indirectly 12,000 jobs for Australians."

Geoffrey A. McKee, petroleum analyst, March 28, 2005 [54]

"The AMP Government is ready to bring the pipeline from Greater Sunrise to Timor-Leste … because thousands of Timorese youth are unemployed … and Timor-Leste needs it to create job opportunities for other sectors to help develop Timor-Leste."

Timor-Leste Prime Minister Xanana Gusmão, 17 September 2007 [98]

"There is not one person in Timor-Leste who doesn't want the pipeline to come here …, and this new government, particularly my department, will work hard to secure the pipeline to Timor-Leste."

RDTL Secretary of State for Natural Resources Alfredo Pires, 20 September 2007 [67]

"A pipeline and LNG to Timor-Leste will create 40,000 job opportunities for Timorese workers."

RDTL Minister of Economy and Development João Goncalves, 1 October 2007 [100]

"The pipeline to Timor-Leste will create 10,000 job opportunities for Timorese."

RDTL Secretary of State for Natural Resources Alfredo Pires, 15 October 2007

"There is no doubt that with the establishment of a LNG plant on Timor-Leste soil, this will automatically drive an extraordinary business boom into the East Timor economy. In context of macro-economic performance, the LNG plant will tackle and address the massive unemployment issue by creating directly manner approximately 20,000 jobs throughout different stages of construction of the plant, - indirectly, thousands of other associated jobs … needed to meet the expected mass demands at the LNG plant."

-- Vicente Mau Bocy, 22 October 2007 [52]

[3] Numbers in [square brackets] refer to the alphabetical list of references and sources in Appendix 8.

Thoughts from across the Timor Sea

"Sunrise gas onshore will create thousands of extra jobs for Australians, and will increase GDP by A$15 billion."

Northern Territory Chief Minister Clare Martin, 22 July 2002 [59]

"The [Northern] Territory Government is committed to bringing gas onshore from the Sunrise project, and will continue to work with the project proponents to develop a viable customer base for Sunrise gas onshore. This is the best way to maximize employment and local business opportunities."

Dr. Chris Burns, Northern Territories' Minister for Environment and Heritage, 28 March 2003 [90]

"The next major hurdle for the Greater Sunrise is East Timor's insistence that any LNG plant supplied by Greater Sunrise gas be built within its borders. Woodside has said consistently that while transporting gas by pipeline from the reservoirs to East Timor is technically feasible, it is commercially unattractive."

Nigel Wilson, The Australian Business, 12 February 2007 [120]

Darwin will not be in the running to process gas from the Greater Sunrise field until East Timor makes its own proposal for an onshore LNG plant. Mr. Macfarlane says the gas field's proponents have promised to give East Timor a fair hearing. "Once they are satisfied with the outcome of those discussions as to where the gas will be processed, then I think you'll see that project proceed."

Australian Federal Resources Minister Ian Macfarlane, 30 May 2007 [1]

People hope that the revenue from oil will make it possible to turn these dreams into reality. They hope that foreign oil companies, invited by the Government to extract Timor-Leste's oil and gas, will provide employment for local people, buy local agricultural and other products, rent their land and houses, and use hotels and restaurants owned and managed by the local community. Many people hope to share in the process of this development – selling their labor, goods and services. We don't want to be like other countries, where oil funds the government or a few corrupt individuals, but the people get almost nothing.

Everybody in Timor-Leste wants our natural resources to give us the means to improve people's health and reduce poverty. Our Government and other executive institutions have the responsibility to utilize these resources to achieve these dreams. One mechanism for doing this is the Petroleum Fund, which means to manage the revenue to benefit both current and future generations. Another process, perhaps more important in planning for two generations from now, when all Timor-Leste's oil and gas will have been sold, is to use petroleum extraction and processing to develop the businesses, skills, education and experience necessary for strong, multi-sectoral, sustainable development. According to Secretary of State Alfredo Pires, "Oil is a motor for development of Timor-Leste … with oil revenues we will improve the non-oil sector such as tourism and other industries … so that by the time the oil resources are exhausted, Timor-Leste's economic development is stable." [67]

1.1. Realities

If we look around the world, petroleum development is often not a blessing, but a curse. [44] The global record shows that many countries rich in petroleum wealth score low in the UNDP Human Development Index, have high poverty levels, authoritarian systems, environmental degradation, militarism, human rights violations and corruption. Although oil can bring money, it also brings problems. In countries like Timor-Leste, where our economy and government are dependent on petroleum income (the majority of our national economy and more than 90% government revenues come from oil and gas), these dangers are even harder to avoid. It is critical to manage both the money and the industry well, and good models are hard to find.

Timor-Leste's leaders have often stated their commitment to learn from the experiences of other countries to avoid the "resource curse." However, this commitment needs to be more than only a political statement, but should be enshrined in laws and regulations and implemented with strong public institutions.

So far, the Government appears to have succeeded in petroleum development, but this is very narrow and based on only six years of Timor-Leste's independence. Achievements so far don't guarantee a prosperous and successful future, although they have begun to establish some basic legal foundations for Timor-Leste.

1.2. Greater Sunrise

The oil and gas resources in the Timor Sea have been disputed for more than three decades, since the Portuguese colonial period. Many actors have played roles in the Timor Sea process, such as international oil companies and foreign countries. Appendix 1 contains a description of Timor-Leste's petroleum resources, and a detailed chronology of relevant events is in Appendix 2. A glossary of technical and other relevant terms is in Appendix 7.

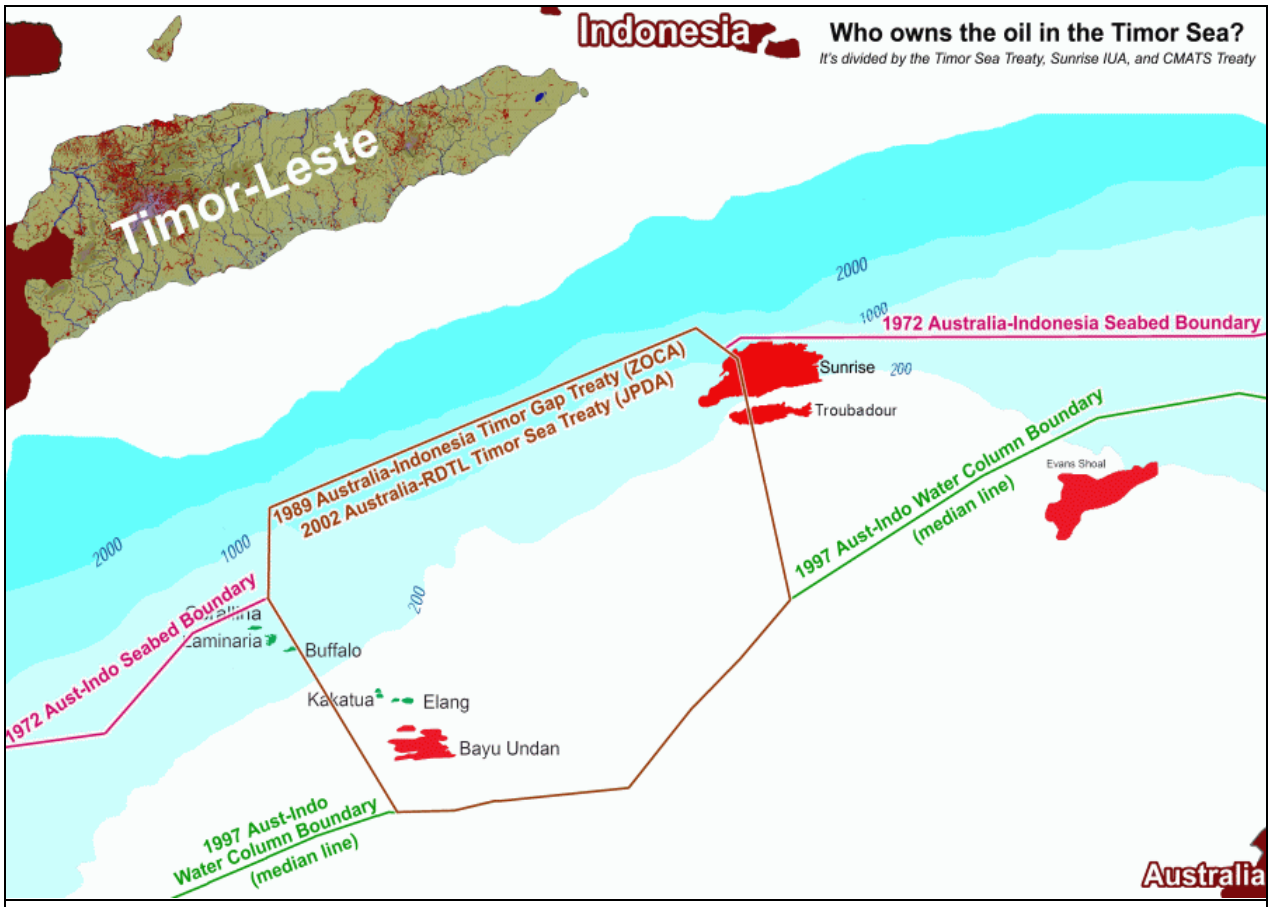


Figure 1. Map showing major oil (green) and gas (red) fields, boundary agreements and revenue-sharing zones in Timor-Leste's part of the Timor Sea. See Figure 26 for a map of all fields in the area, and Figure 28 for a more detailed map of the Greater Sunrise field. [45]

Greater Sunrise, which includes the Sunrise and Troubadour fields, was discovered in 1974. It is the largest field in the area claimed by both Australia and Timor-Leste, estimated to contain 300 million barrels of light oil (condensate and LPG) and 8.3 trillion cubic feet (tcf) of natural gas (see Table 14 in Appendix 3). Approximately one-fifth of Greater Sunrise lies within the Joint Petroleum Development Area established by the 2002 Timor Sea Treaty and administered by the Timor-Leste/Australia Timor Sea Designated Authority (TSDA), while the remainder lies in territory claimed by both countries and occupied by Australia, although it is all closer to Timor-Leste.

Woodside Petroleum has been exploring the Greater Sunrise field since before Indonesia invaded Timor-Leste in 1975. The terms of their contracts with Australia and the TSDA were negotiated with Australia and Indonesia in the mid-1990s, without Timor-Leste involvement. Under Annex F of the 2002 Timor Sea Treaty, Timor-Leste agreed to continue those terms, and the CMATS and IUA treaties ratified in 2006 provide the legal and fiscal certainty that Woodside and its partners require to proceed with development. Although Woodside is the operator of Greater Sunrise, it owns only 33.44% of the unitized project, with other shares held by ConocoPhillips (30%), Shell (25.56%) and Osaka Gas (10%).

According to the 2002 Timor Sea Treaty, the 2003 International Unitization Agreement, and the 2006 Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS), Timor-Leste and Australia will each receive 50% of

upstream revenues from Greater Sunrise, but where the gas will be piped for downstream processing (liquefaction) has not yet been decided.

Long-term petroleum prices are impossible to predict accurately, but we (see Fiscal Effects discussion in Chapter 4) estimate that the government of Timor-Leste could receive $10-16 billion in total from natural gas from the Greater Sunrise field over the next 40-50 years. Australia will receive as much or more. Although the Sunrise field was discovered decades ago, its development has been stalled for the last few years due to the boundary dispute (see Chronology, Appendix 2). Sunrise operator Woodside Petroleum suspended all work on the project in late 2004, although engineering studies resumed in 2007 following the ratification of the CMATS Treaty.

1.3. The pipeline debate

The natural gas in the Greater Sunrise field provides income only when it is delivered to customers who will pay for it. As it is stranded gas, it needs to be liquefied and shipped on tankers to buyers in other countries. This liquefaction process requires a major industrial facility, which could be built in Timor-Leste or Australia, and will be connected to the Greater Sunrise field through an undersea gas pipeline.

All of Timor-Leste's governments, including Prime Ministers Mari Alkatiri, José Ramos-Horta and Xanana Gusmão, repeatedly stated their commitment to bring the pipeline to Timor-Leste if such a project would be good for the citizens of this country. As time goes on, our leaders promise larger and larger benefits from the project, and our people expect that the pipeline will greatly boost Timor-Leste's economy and development, creating job opportunities for tens of thousands of Timor-Leste people. They hope that building an LNG plant and LNG tanker port here will enable Timor-Leste to do more than simply sell unprocessed oil and gas, but also build up our industrial capacity. Our leaders and our citizens see obtaining the pipeline and LNG plant as a vital component of our National Interest.

However, both the Australian Government and Woodside have long advocated that the pipeline should go to Australia, rather than to Timor-Leste for technical, financial and political reasons. To pressure Timor-Leste's government to give up its maritime boundary rights, Woodside often claimed that a "market window" for Sunrise LNG was about to close, and that if the project wasn't developed quickly it might not happen at all. But more recently, it has become clear that LNG will be a "sellers market" for decades to come, and that the value and marketability of the gas will continue to increase over time.

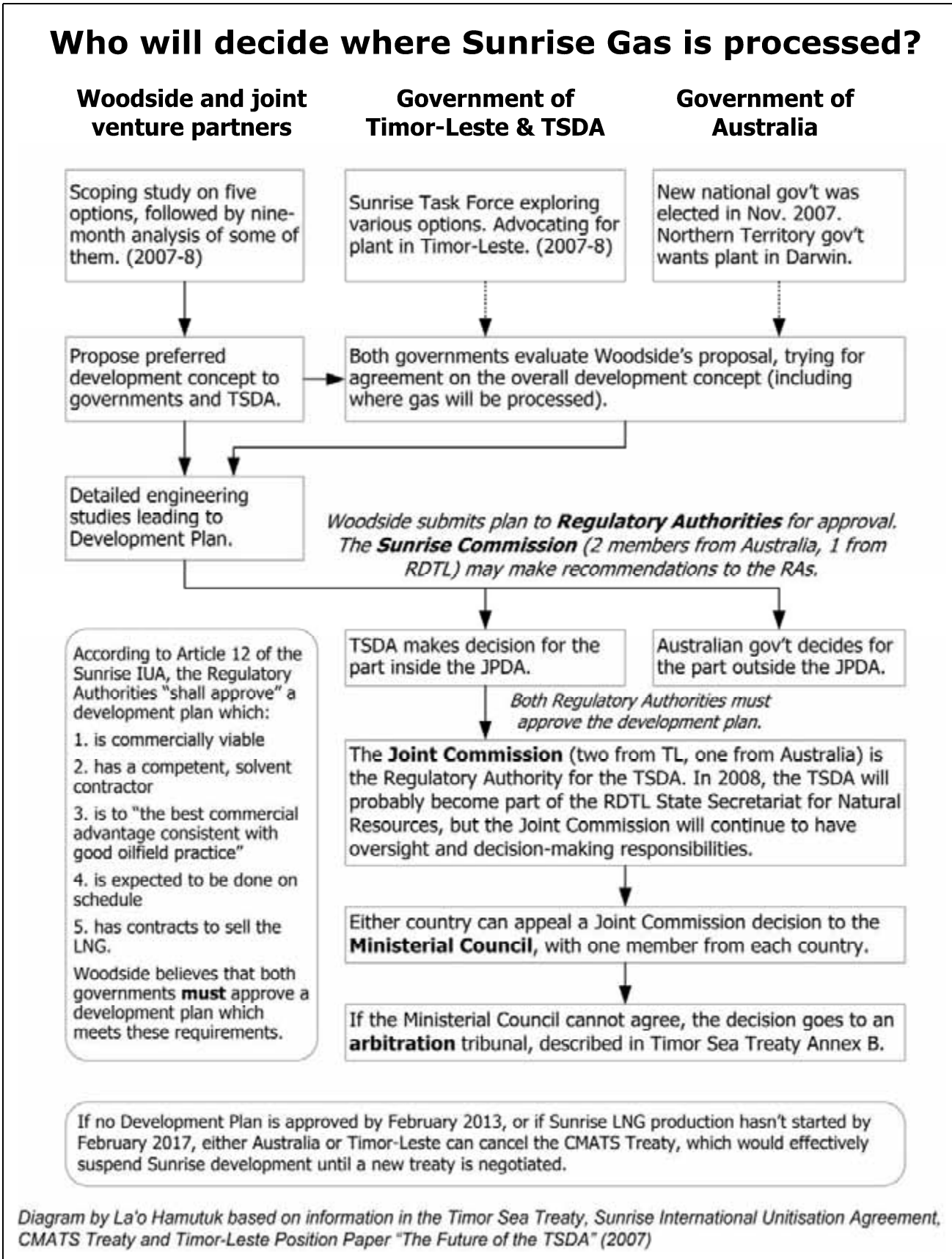


Figure 2. How the Sunrise development decision will be made. [81]

Woodside's proposed development plan will be based on their commercial interests, rather than moral issues. However, the leaders of Timor-Leste have stated their commitment to bring the pipeline onshore to Timor-Leste, and called on the company to respect Timor-Leste's wishes.

Woodside has described five options:

1. Transporting the gas to Australia and processing it at an existing or new LNG plant in Darwin.
2. Processing the gas at sea at a floating LNG plant; this would be the first such plant in the world
3. Transporting the gas to Timor-Leste and processing it at a new LNG plant in Timor-Leste.
4. A "gravity-based structure" anchored to the seabed in shallow water.
5. Another "gravity-based" design, with LNG storage tanks on the sea floor.

La'o Hamutuk has suggested that a sixth option be considered:

6. Wait to develop Greater Sunrise until Bayu-Undan revenues are no longer sufficient to meet Timor-Leste's needs, about 10 years from now. [46], [94]

If the project goes ahead expeditiously, concept selection will be probably be in 2008, the development plan could be in approved in 2009 and gas production could begin in 2013. However, it would be better for Timor-Leste if the project started later, for reasons explained in Chapter 9.1.

Ongoing public discussions seem to focus the commercial interests of the international oil companies, rather than Timor-Leste's rights. Although the LNG Plant will benefit Timor-Leste's economy, it also brings risks. Timor-Leste's people should consider more than just getting jobs and economic gains from this huge project, but also hot to protect our land, healthy environment, and the right to participate in the development process. Even if the country as a whole benefits, local communities could lose.

The purpose of this report is to explore the benefits and costs, the risks and opportunities that a pipeline and LNG plant could bring to Timor-Leste, and to encourage every citizen to think hard about whether it will be good for our country, and what we have to do to ensure that Timor-Leste gains more from this project than we will lose. We do not attempt to predict what the development decision will be. Rather, we hypothesize that Australia, Timor-Leste and the companies agree to build a pipeline to Timor-Leste and an on-shore LNG plant on our south coast. If that were to happen, Timor-Leste's people need to know the benefits and risks of such a project, and our government needs to take actions now to maximize the gains and minimize the dangers.

Chapter 2. Choices for development

In this study, we investigate the possible positive and negative consequences for Timor-Leste's development of a decision to build a pipeline/LNG project for Greater Sunrise in Timor-Leste, and what Timor-Leste should do to maximize the positive and minimize the negative. Before presenting our analysis, we explain what we mean by "development," as this word is used in different senses by different people. The vision for Timor-Leste described above suggests that the notion of development is complex, involving many different aspects of both goals and the process to achieve them.

We wish to emphasize that a commonly used measure of development, the Gross Domestic Product (GDP) *per capita,* is inadequate to evaluate what is good for our people. Dollars are important as a means to development in a broader sense, but they are not sufficient. Material wealth is, after all, at best a means for achieving good lives, and does not in itself constitute well-being or development. GDP/capita, moreover, does not capture enough of the essential information about poverty or prosperity.

In particular, it does not say anything about how GDP and wealth are distributed among the population. If GDP/capita goes up while most people remain poor, we would not say development has progressed—in fact, we could say that it has declined, because the inequality of such a change would make lives worse for the majority of people, even though a small elite does very well. An adequate view of development must also look at who becomes more prosperous, and if higher incomes are equitably distributed. In petroleum-dependent countries, where large amounts of money sometimes flow to only a few individuals amid a destitute population, it is particularly important to make sure that economic growth benefits everyone, to avoid alienation and social jealousy. Timor-Leste's 2006 crisis is a small taste of what can result from social and economic inequality.

Petroleum revenues in most cases flow to the government, not to the people. It will take competent and conscientious leadership, a well-functioning democratic system, experienced and responsible civil servants and an engaged citizenry to ensure that the government uses these revenues effectively to benefit the entire population, both in the short term and with a view toward future generations. This generation may transform all of Timor-Leste's petroleum wealth into dollars, but if the dollars are not saved, invested in our people, or used to strengthen other productive sectors of our economy, future generations may have nothing.

Development, then, means not just owning more things and having higher incomes, but that people's lives actually become better. This broader view of development is recognized in some measures of development such as the Human Development Index (HDI), which takes into account lifespan and education as well as economic wealth.[4] In the broadest sense, *human* development includes access to health care and education, security, and the ability to function well in a society whose culture can add meaning to people's lives. That takes more than mere prosperity (and may not even require more than modest prosperity). It requires the general realization of and respect for the rights of the entire people, protection of the environment, and participation of the public. A true development process enhances the control people have over their lives, especially those who are traditionally disenfranchised: The poor, minorities, and women. This requires both that the process of sustainable economic growth respects people's rights, and that a society in which those rights are fulfilled itself be seen as one of the goals of development.

Box 2. Kerala's development experience

The Indian state of Kerala illustrates how several human development goals can be achieved even without much economic growth. Kerala's around 32 million inhabitants had a Net Domestic Product per capita of around US$530 in 2003 (calculated at market exchange rates). Yet Kerala has succeeded in lowering mortality rates and raising life expectancy to developed-country levels (the infant mortality rate is 11 per thousand live births; life expectancy at birth is 76 years for women and 71 years for men). Its literacy rate is 91%. [27] The experience of Kerala shows that it is possible to secure important aspects of human development even without material prosperity. These successes have been attributed to Kerala's long tradition for the public provision of widespread education, as well as a culture favoring strong rights for women, including in education and inheritance. [95]

[4] The view of development that underpins the United Nation Development Program's Human Development Index and Human Development Reports is described at http://hdr.undp.org/hd/. Timor-Leste ranks 150 in HDI among 177 countries rated in 2007. [107]

Measures like GDP and HDI are insufficient to describe human development in Timor-Leste. For a society which lived through centuries of colonization, decades of military occupation and repeated trauma, personal and psychological security are very important. Timorese have to feel safe living in their homes and be able to travel around the country without fear. To overcome past repression, people must feel free to express themselves, talk to their friends and their leaders, elect their government, and take ownership of their state and their country. Our 24 years of struggle was not only to achieve an independent state, but also for the freedom of the people – and the state is responsible to protect the people's human, economic, and psychological rights.

If material wealth is to make people's lives go better, something else is also required: A social setting in which meaningful lives can be lived. The change from a traditional society based on subsistence agriculture to a more productive economy with its division of labor and larger industrial and service sectors is traumatic. Experience shows that this process has deep and painful implications, often uprooting old ways of life and placing people in new and disorienting social relationships. As traditional cultures are disrupted, social and family networks can be damaged, leaving many people disconnected from their roots, resulting in violence and substance abuse. While change is always challenging, we must not blithely accept threats to the traditional cultural context as "growing pains," but rather avoid them where possible, and minimize and mitigate the unavoidable negative impacts of development, "modernization" and economic growth. Again, this means that an evaluation of projects from the point of view of development must not simply look at the economic gains and losses, but also take into account non-economic costs and benefits.

A successful development process requires the actors to pursue many goals and values at the same time, trying to balance them in the best possible way. There are many actors, each with their own interests, which will often come into conflict. It is critical, and difficult, to ensure that development decisions balance these competing goals, so as to serve the broader population and not only those who expect to receive a particular benefit (such as employment) or suffer a specific loss (such as loss of their land). However, the rights of individuals must also be protected and weighed against those of the community and the nation. Transparency of information, fully informed public consent and pluralistic democratic decision-making processes are essential to resolving these potential conflicts. Understanding this means accepting that there can be real trade-offs between the goals, say, of prosperity, respecting and fulfilling rights, and preserving of valuable cultural and social worlds.

In good situations, these values will be aligned. In bad ones, difficult choices will have to be made. But it is never a good idea to pretend that only one thing matters and that trade-offs do not exist. Our goal in this study is to survey the possible consequences a specific development project—the proposed pipeline/gas liquefaction plant—might have, in all of these dimensions of development. Whether they will conflict with each other will depend in part on how well each actor prepares for the challenges the project will bring up. Our aim is to provide a first inventory of what these challenges might be, and thereby contribute to solving them.

2.1. The "petro-state" predicament

The Timorese people's optimism upon restoring independence in 2002 has so far not been rewarded with prosperity. The country has mostly stagnated economically, if not regressed, in the last few years.[35],[80] Nevertheless, the government receives large and growing revenues from the petroleum sector. Timor-Leste has established a successful Petroleum Fund, which has so far accumulated more than two billion dollars from petroleum operations in the Timor Sea. Timor-Leste is endowed with large reserves of this valuable resource (see Chapter 9. Fulfilling the dream), and is working to develop more fields than those already in operation.

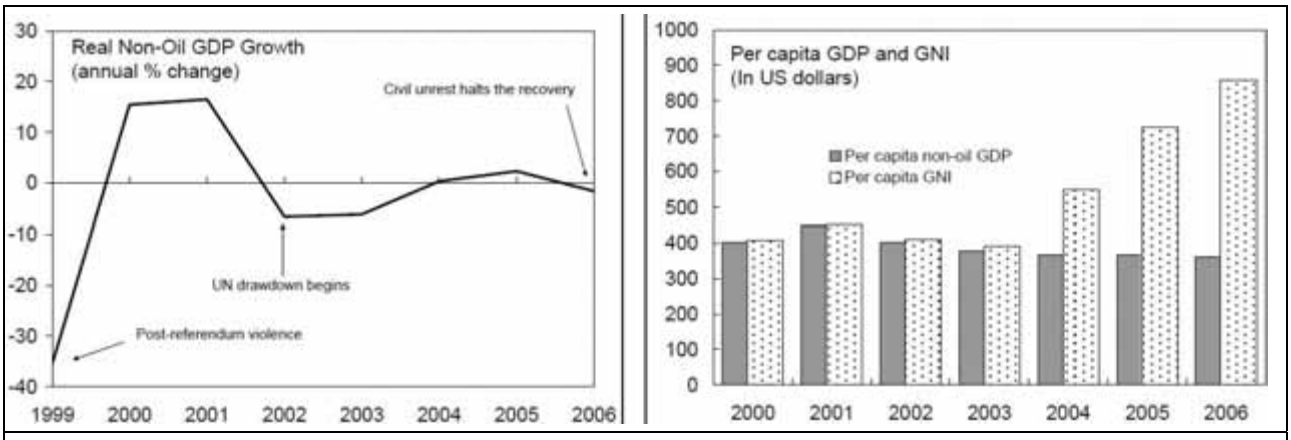


Figure 3. Non-oil GDP growth and non-oil per capita GDP in Timor-Leste. The Gross National Income (GNI) has been growing since 2004 because of oil income. [35]

Petroleum, however, also comprises one of the country's greatest challenges. International experience shows us that succeeding with petroleum is very hard. Rather than being a blessing, oil and gas wealth is almost always a curse for poor countries. People in most resource-rich low-income countries with a lot of oil, gas or mineral resources, are *worse* off than similar countries which don't have such natural resources.

Petroleum brings money, but as we emphasized above, money is not the same as development. In many petroleum-rich countries the revenues from natural resource exploitation has been extremely unequally distributed. Not only that, the desire to capture the cash from the natural resource has often led to war, violations of human rights, and local communities being uprooted. Petroleum development damages both the local and planetary environments, and these costs must be balanced against the financial and developmental gains. In Third World countries, such development also brings a clash of cultures and a local window into global economic injustice, as highly-paid foreign workers and executives come into contact with a local population unaccustomed to their priorities and values. Dili has experienced this on a small scale over the last few years, with the influx of highly-paid foreign UN staff and international advisors. But the culture of oil workers is different – they are less knowledgeable and caring about the people, culture or development of the countries they are working in.

Box 3. The curse of natural resources

Finding oil or gold is often thought to be the end to economic problems. In reality, for many countries, oil, gas, and mineral wealth has been a curse rather than a blessing. Many studies show that in comparison with similar countries that have few natural resources, natural resource-rich countries suffer in many ways: Lower economic growth, less democracy, and higher risk of violent conflict. In addition, the non-natural resource part of the economy typically does not develop alongside the resource sector, so when the resource is depleted, the wealth it generated proves unsustainable. There are several reasons for this "paradox of plenty." One is that with large natural resource sectors, scarce resources are devoted to natural resource extraction and the influx of foreign exchange drives prices up. These effects make other exporting sectors, such as manufacturing, less competitive. Another reason for the underperformance of resource-rich countries is that "money for nothing" creates perverse incentives. People who have a chance of securing a share of the money will work to achieve that instead of engaging in money-making activities that are truly productive and meet people's needs. In inexperienced and understaffed bureaucracies, moreover, the influx of large amounts of money with few controls encourages corruption, relieves the pressure for sound management of public funds, and creates rewards for undermining the rule of law.

The presence of petroleum or mineral resources can also be a cause for conflict and war. In our own neighborhood, we have seen this both within one country (Aceh, Indonesia or Bougainville, Papua New Guinea) and by encouraging foreign occupation (as in Timor-Leste in 1975, West Papua since 1963, or Iraq today). Domestic political instability, corruption, and conflict between communities or economic classes also often results from the "resource curse."[5]

Until today, all of Timor-Leste's experience with the petroleum industry has been with offshore upstream extraction, out of sight in the middle of the ocean. The potential risks from onshore and downstream projects are much larger, but our people have never seen such things. Our

[5] La'o Hamutuk's *OilWeb* CD-ROM contains many articles, analyses and case histories about different examples and manifestations of the Resource Curse. See also "Untapped: The Scramble for Africa's Oil" [25]

regulators have no experience with such projects, so we do not yet have the legal frameworks, administrative systems, and ongoing supervision mechanisms they will require.

So far, Timor-Leste has not suffered the worst consequences petroleum revenues have caused in other countries. Hopefully, they will benefit future generations of Timorese, since they have not been stolen or squandered. But neither have these revenues made much improvement on the lives of the present generation. And other countries' experience with the "natural resource curse" should caution us against thinking that petroleum will magically solve the challenges of development. Timor-Leste must not be content to simply receive payments for a depletable natural resource taken out of our ground. All development policies, and in particular those relating to petroleum exploitation, should aim to develop a more diversified productive base in the domestic economy, as well trying to reach the broader development goals described above.

Although nearly all Timor-Leste politicians and citizens want the Sunrise LNG plant to come here, there is a significant chance that their hopes will not come true, and the gas will be piped to Australia or processed at sea. Even if this happens, nearly all of the information and recommendations discussed in this report are still relevant and important. They would apply to any large industrial project, and to any on-shore petroleum activities. Timor-Leste will need practical, realistic, forward-looking policies and mechanisms to develop our economy, safeguard our environment, and protect our people's rights from any project or industry, and virtually all entail the kinds of opportunities and risks that this report discusses in relation to Sunrise natural gas.

2.2. The proposed project

The pipeline/gas liquefaction project we examine in this report would be another step along a development path based on natural resource exploitation. While it therefore contributes to the risks we described above, it also carries the promise of large revenues for oil companies and the government, with smaller amounts injected into the local economy. The project is a proposal for processing natural gas from the Greater Sunrise field in the Timor Sea. A problem for Timor-Leste's natural gas production is that our country is located far from the potential customers—large countries that need more gas for their energy needs than they produce themselves. In the Pacific, the most important importer of gas is Japan, but China and India's imports are likely to continue to grow. These markets are too far away to build pipelines from the Timor Sea. Nor is natural gas in its normal state a liquid that can be transported on tanker ships, unlike oil.

Box 4. What is LNG?

LNG stands for Liquefied Natural Gas. It is produced by compressing and cooling natural gas to very low temperatures of about -160°C (-260°F). Natural gas is a combustible gas consisting mainly of methane (over 80% in volume) with varying quantities of ethane, propane, butane, nitrogen, and helium. It occurs naturally in the earth and frequently with other petroleum fuels. Its principal uses are for fuel and for the production of chemical products such as fertilizers and plastics. In liquid state, natural gas occupies a volume about 600 times smaller than in gas state. Liquefying it makes it possible to transport it across great distances by ship or truck, allowing it to be extracted from countries that have natural gas resources and sold in countries that need it for their consumption.

In other gas fields in the same situation, the solution has been *liquefied natural gas* (LNG). By cooling the gas down to very low temperatures (around minus 160 degrees Celsius), natural gas becomes liquid and takes up much less space than at normal temperatures. (See Box 4.) In this state, it can be transported on special tanker ships, much like oil. The gas from Timor-Leste's Bayu-Undan field is piped to Darwin in Australia, and liquefied there before it is shipped to Japan.

The world market for LNG is new and growing rapidly. The map and table below show the international LNG trade, which totaled 211 billion cubic meters (7.45 trillion cubic feet, about the same as the contents of the Greater Sunrise field) during 2006. This is about 7% of all natural gas used globally during the year; the remaining 93% was transported by pipeline to the end user. Of the natural gas used worldwide, 15.4% was used in the Asia-Pacific region (dark green on the map below), and gas consumption in the region increases about 7% every year.

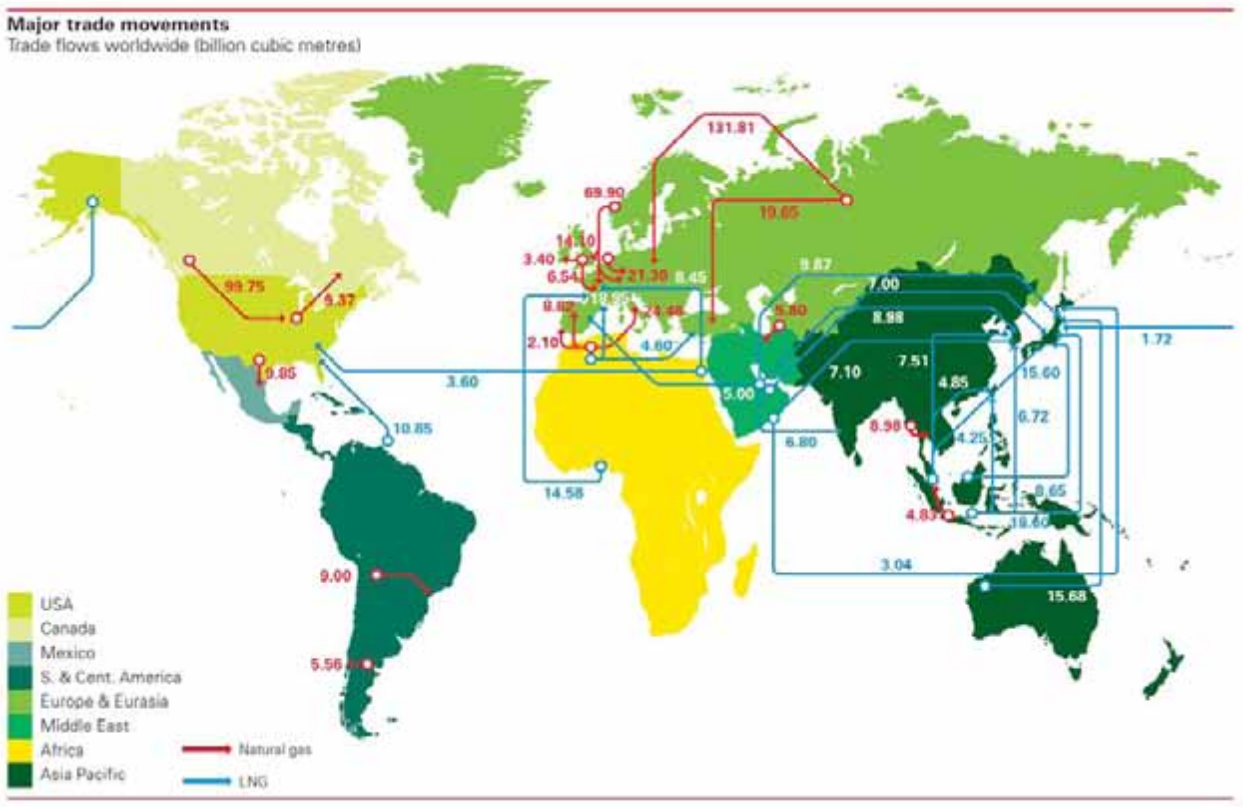


Figure 4. Major LNG trade movements, diagram from BP Statistical Review of World Energy, 2007. [14], p.31

Trade movements 2006 – liquefied natural gas
Billion cubic metres

To	From: USA	Trinidad & Tobago	Oman	Qatar	UAE	Algeria	Egypt	Libya	Nigeria	Australia	Brunei	Indonesia	Malaysia	Total imports
North America														
USA	–	10.85	–	–	–	0.49	3.60	–	1.62	–	–	–	–	**16.56**
Mexico	–	0.16	–	0.08	–	–	0.16	–	0.54	–	–	–	–	**0.94**
S. & Cent. America														
Dominican Republic	–	0.25	–	–	–	–	–	–	–	–	–	–	–	**0.25**
Puerto Rico	–	0.72	–	–	–	–	–	–	–	–	–	–	–	**0.72**
Europe														
Belgium	–	0.16	–	0.36	–	3.35	0.25	–	0.16	–	–	–	–	**4.28**
France	–	–	–	–	–	7.35	2.30	–	4.23	–	–	–	–	**13.88**
Greece	–	–	–	–	–	0.45	0.04	–	–	–	–	–	–	**0.49**
Italy	–	–	–	–	–	3.00	0.10	–	–	–	–	–	–	**3.10**
Portugal	–	–	–	–	–	–	–	–	1.97	–	–	–	–	**1.97**
Spain	–	3.00	1.00	5.00	–	2.80	4.80	0.72	7.10	–	–	–	–	**24.42**
Turkey	–	–	–	–	–	4.60	–	–	1.12	–	–	–	–	**5.72**
United Kingdom	–	0.60	–	–	–	2.00	0.96	–	–	–	–	–	–	**3.56**
Asia Pacific														
China	–	–	–	–	–	–	–	–	–	1.00	–	–	–	**1.00**
India	–	–	0.24	6.80	0.08	0.08	0.55	–	0.08	0.08	–	–	0.08	**7.99**
Japan	1.72	0.44	3.04	9.87	7.00	0.24	0.80	–	0.22	15.68	8.65	18.60	15.60	**81.86**
South Korea	–	0.07	7.10	8.98	–	0.32	1.25	–	0.16	0.87	1.16	6.72	7.51	**34.14**
Taiwan	–	–	0.16	–	–	–	0.16	–	0.38	0.40	–	4.25	4.85	**10.20**
TOTAL EXPORTS	**1.72**	**16.25**	**11.54**	**31.09**	**7.08**	**24.68**	**14.97**	**0.72**	**17.58**	**18.03**	**9.81**	**29.57**	**28.04**	**211.08**

Source: Cedigaz (provisional).

Table 1. Major LNG trade movements 2006, from BP Statistical Review of World Energy, 2007. [14], p.30

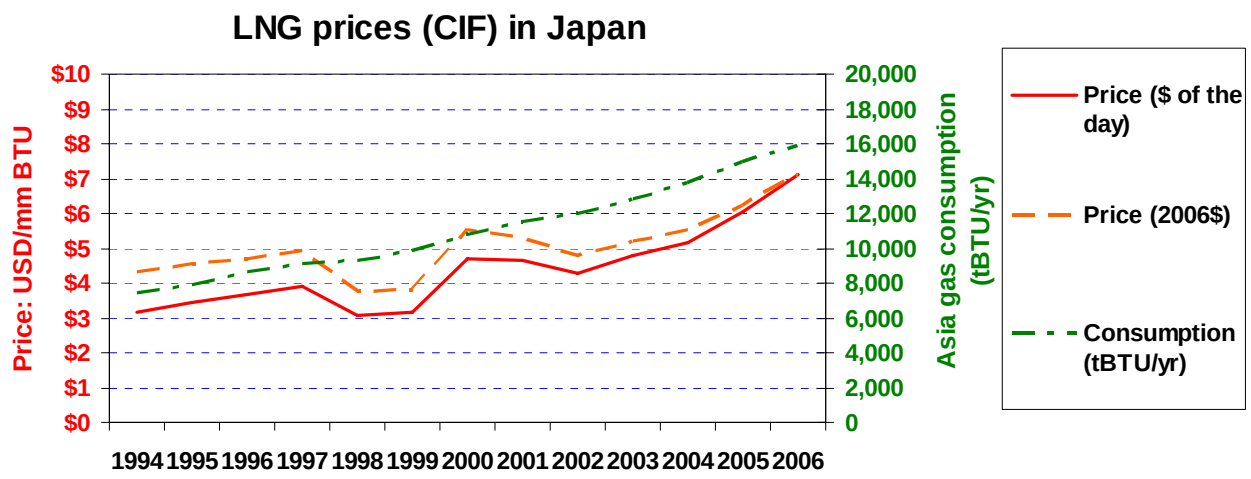


Figure 5. LNG prices in Japan (solid and dashed lines, left scale) and Asia-Pacific usage (dotted line, right scale) have grown significantly in recent years and are likely to continue to increase, with demand growing faster than supply. Prices include cost, insurance and freight.
Data from BP Statistical Review of World Energy, 2007. [14]

Chapter 3. The plant

This section describes the processes that take place at the LNG plant and the major technical requirements to site the facility. At the end of Chapter 6, which discusses environmental and safety concerns, we describe the current status of disaster preparedness in Timor-Leste.

Figure 6. The Darwin LNG plant which processes gas from Bayu-Undan. [18] The jetty to the LNG tanker is 1.3 km long.

3.1. The LNG plant and its processes

The LNG plant envisioned for Timor-Leste is a liquefaction plant, a facility that will receive the natural gas from the Greater Sunrise undersea reservoir through a long undersea pipeline, and lower its temperature to liquefy it for storage and later shipping to overseas customers. The plant is constructed as one or more processing "trains" which receive the gas, filter and cool it, and store the liquid in a tank until a tanker ship picks it up. Many plants are first constructed as a single train, with additional trains being added later to increase the processing capacity as additional gas reserves come on line.

The process at the liquefaction plant can be divided into three main areas: feed gas preparation, fractionation, and liquefaction. This description of these processes follows Alexander S. Adorjan's explanations. [5]

Feed gas preparation

The liquefaction cycle for natural gas requires cooling it to about -160°C. Therefore, the incoming gas needs to be cleaned of substances that could freeze at these temperatures and cause plugging in the equipment. These components are typically water vapor (H_2O), carbon dioxide (CO_2), and higher-level hydrocarbons, which may be commercially useful in themselves. Hydrogen sulfide (H_2S) is removed for safety reasons while traces of

mercury are also removed to avoid corrosion in the equipment.[6] The operations needed involve refrigeration, absorption, and adsorption processes, and must be engineered to match the particular composition of the natural gas from Greater Sunrise. The feed gas preparation operation is cheap in terms of the relative cost of the equipment (for instance, acid gas removal equipment may constitute only 5% of the plant capital cost), but this process requires a lot of energy. Removal of 5% CO_2 from the feed gas can consume more than 25% of the energy of the total plant.

In the case of the Wickham Point facility that liquefies processes Bayu-Undan gas in Darwin [66], an aqueous, organic, amine bath is used to remove CO_2, small quantities of H_2S and other sulfur components. These components, usually referred to as acid gas, are later removed from the amine solution in a stripper. Water is removed in this facility partly in the first phase of gas chilling which condenses some of the water and, subsequently, in a three-bed molecular sieve that removes the rest of the water vapor. The traces of mercury are removed through two beds of activated carbon.

In addition, nitrogen gas, although not a contaminant, is removed from the gas when its content is higher than 0.5% because it depresses the heating value of the final natural gas product, it reduces the boiling point of the feed gas, and its presence increases the occurrence of rollover in storage tanks and vessels.

Fractionation

Higher-level hydrocarbons are removed in the Liquefied Petroleum Gas (LPG) fractionation process. This part of the plant may cost about 3% but requires about 10% of the total energy. Since LPG is a marketable by-product of the LNG plant, fractionation is an important factor in the overall plant economy. It could be done at sea or in the LNG plant itself, as described in Box 5.

Liquefaction

In the liquefaction cycle, the heat is removed from the natural gas in four distinct stages: cooling and condensation, expansion and flashing, evaporation, and compression. The efficiency of the liquefaction process can be improved by using multi-stage refrigeration, either with the cascade cycle (see Figure 7) or the mixed-refrigerant cycle. In the first method, the liquefaction involves refrigerants such as butane, propane, ethane, methane, nitrogen, or their mixtures. The gas is thus cooled in successive steps. It is a rather costly cycle depending on the number of stages with a compressor, heat exchanger, storage tank and other components required for each stage of the cycle. Although both systems provide similar efficiencies, the mixed-refrigerant cycle requires a lower initial investment. In that process, the working fluid is expanded at different pressure levels and the liquid and gas are separated after each expansion. The gas is then compressed while the liquid passes onto the next refrigeration stage.

Box 5. Liquids from Sunrise

In addition to its natural gas, the Greater Sunrise field contains approximately 300 million barrels of liquid petroleum products, mostly condensate and other light hydrocarbon fractions which can be refined and sold as oil or LPG. Over the life of the field, this could generate billions of dollars of additional upstream revenues to Timor-Leste. Downstream processing for liquids is less capital-intensive and less profitable than LNG; although bringing them onshore to Timor-Leste could supply fuel to local consumers.

The Bayu-Undan method of refining the liquids on a platform at the field and selling them from a Floating Storage Offloading vessel may be difficult because Sunrise lies in deeper water than Bayu-Undan [114], although Woodside has suggested this as one option. [96] The Snøhvit model of sending liquids and gas together in a single multi-phase pipeline to an on-shore refinery is unworkable because the pipeline length and depth are too great. Consequently, a separate liquids pipeline is required, either to a mid-sea platform in shallower waters than the Sunrise field (15-60 km away), or to run alongside the gas pipeline to the same location as the LNG plant. Further discussion of Sunrise liquids is beyond the scope of this report, and they are not included in our calculations of fiscal benefits from the LNG plant.

The power for all of these operations can be provided by steam turbines, gas turbines, combined gas and steam turbines, or electric motors. Steam turbines are typically more flexible and have a characteristic thermal

[6] Woodside estimates that the Sunrise reservoir fluids contain an average of 5 mol% CO_2 and 10 mg/m^3 total sulfur. [116]

efficiency of 25%. Gas turbines have higher efficiencies of about 30-35%, although they are less flexible than steam turbines in regard to power control. Gas turbines are also more sensitive to changes in ambient temperatures.

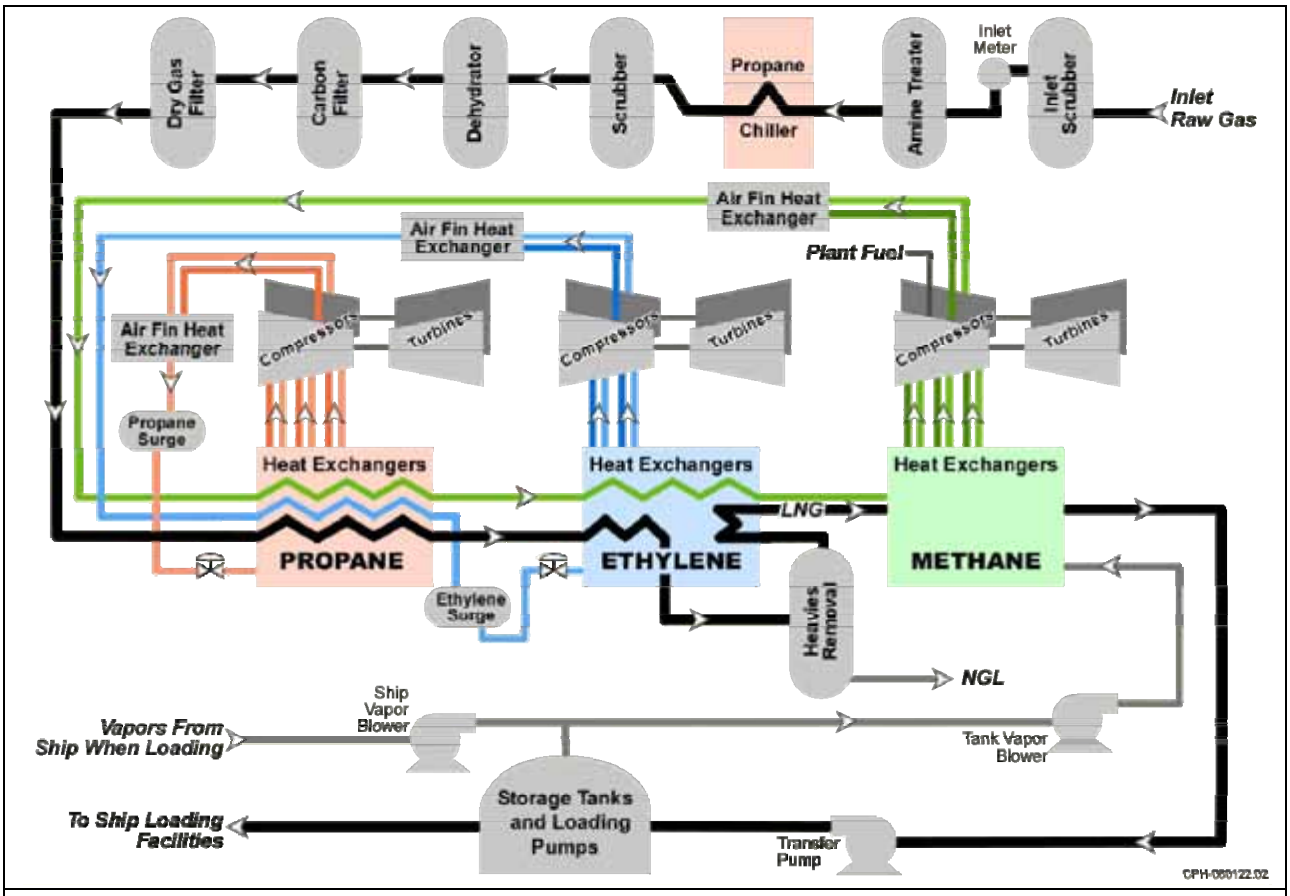


Figure 7. The ConocoPhillips Optimized Cascade LNG Process showing the gas treatment phase (top, starting from the right), and the liquefaction cycle with three cascaded refrigerants (propane, ethylene, and methane). The compressors are driven by gas turbines and the heat removal is accomplished through air fin heat exchangers rather than by cooling towers, reducing the need for cooling water. [18]

Storage tanks

Once the liquefaction process is completed, the LNG is stored in double-walled containment tanks. These tanks are especially designed and cooled to contain the liquefied gas until it is loaded into tankers. Tank designs typically use a double container system which consists of an inner 9%-nickel steel tank and an outer steel or concrete tank [5] (see Figure 8). The space between the two tanks is filled with a thermal insulator (perlite). The bottom of the tank is heated to avoid freezing the soil below. If the tanks are partially buried below grade, the walls are also heated.

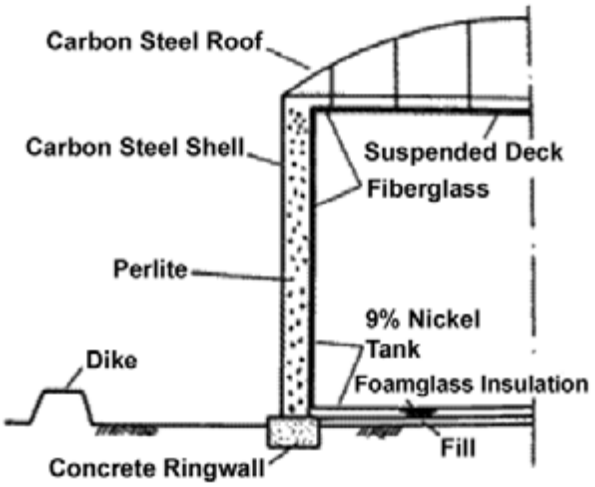


Figure 8. Typical cross-section of an LNG storage tank [5], consisting of two cylinders, an outer concrete or steel shell and an inner nickel lining cylinder. The dike around the tank helps to control leaks. About 78% of LNG worldwide is stored in conventional LNG tanks.

Figure 9. Standing nearly 47 m high, the LNG storage tank in Darwin can store 188,000 m³ of gas. [13]

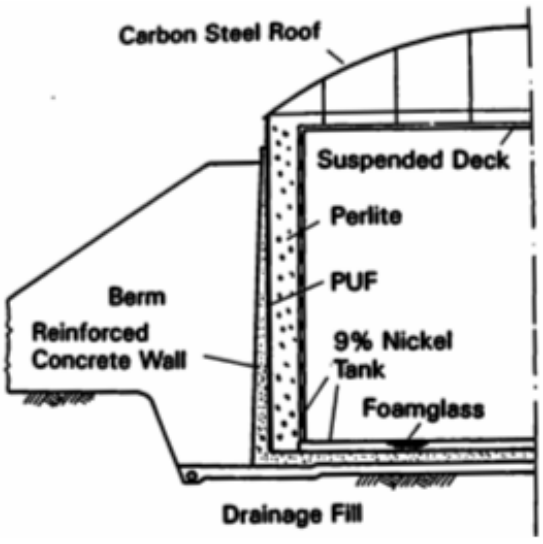


Figure 10. The tank design used by Woodside at its Northwest Shelf Project, Australia. The outer wall is concrete, not carbon steel as in Figure 8, and the tank is partly buried in the ground. [5]

A dock is also necessary to transport the LNG from the storage tanks to the LNG tankers. The characteristics of this facility will be briefly described in the following "Siting the plant" section due to the importance of navigational access in siting the facility.

The plant will have its own electric generating facility, as it needs power in larger and more reliable amounts than the EDTL grid can supply. This generator could increase environmental pollution, depending on the fuel used. It could also be designed to produce more power than the plant requires, thereby servicing nearby communities.

3.2. Siting the plant

South of the island of Timor, between the shoreline and the location of the gas reserves of Greater Sunrise, the bottom of the sea displays a great depression (an underwater valley) more than 3,000 meters deep in places. This formation is known as the Timor Trough and it was formed as a consequence of the collision of the tectonic plates containing Australia and Asia. The southbound drifting Eurasian plate is colliding with the Indian-Australian plate in the Banda Sea north of Timor island. This collision has folded the Australian plate, thereby forming the Timor Trough and Timor island itself, which is part of the Banda Orogen.[7] This process has also fractured the Australian plate along a number of small fault lines in the Timor Sea. The formation of the island of Timor was studied by Audley-Charles [12] and others, although many of the aspects of this geological history still pose unresolved enigmas.

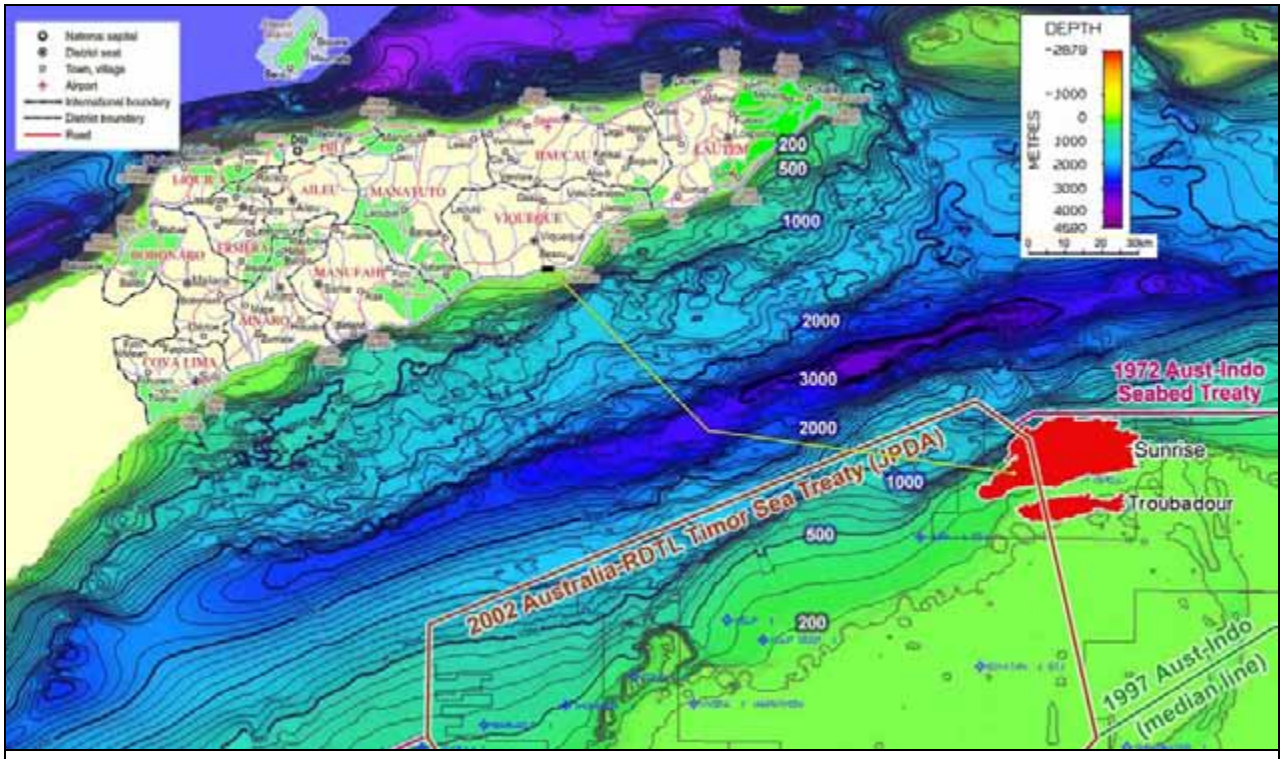


Figure 11. Bathymetry (sea depths) between Greater Sunrise (red) and Timor-Leste. The yellow line is one possible pipeline route, although both Betano and Beaçu are under consideration. The route shown avoids the deepest part of the Timor Trough and the steepest slopes off Beaçu and Betano, although the undersea terrain is irregular and unstable along the entire north side of the Trough.

Adapted from a slide from Nick Hoffman's presentation at Dili LNG Round Table on Greater Sunrise LNG [33], with additional information from other sources. The bathymetry data contain some artifacts (such as west and south of Jaco Island), as a detailed survey has not yet been conducted.

Several challenges need to be resolved to find a suitable site for the LNG plant in Timor-Leste:

1. *Pipeline route*: The gas extracted from Greater Sunrise will be transported to the coast of Timor through an undersea pipeline. This presents a challenge due to the depths of the Timor Trough. As a pipeline goes deeper, it must be designed to handle increased pressure, thereby adding to its complexity and costs. The route and landing site therefore are tradeoffs between minimizing the pipeline length while avoiding the deepest parts of the trough, as well as avoiding areas where the seabed is prone to landslides, seismic activity or other instability. The RDTL government's development team [82] and others believe that the pipeline could cross the Trough in water shallower than 3,000 m, although the exact route and depth will depend on detailed bathymetric studies which have yet to be done.

[7] The crash between these plates results in an "orogen" which is a mountainous formation generated from tectonic processes. Timor-Leste is technically a part of the "Banda Orogen," the formation created when the Australian Plate buckled as a consequence of the tectonic clash.

2. *Land*: The plant, depending on the size and number of the trains, requires about 1-2 km² of level ground to fit in all the machinery, storage tanks, power generator and other necessary equipment (see Figure 12). The plant needs to be located on the coast to minimize the transport distance of the gas from the underwater reservoir and to minimize the transport distance for the LNG to the tanker ships. Therefore, the chosen site will need to be a coastal location with enough space available and as free as possible of hills and other irregularities that would require the removal of large amounts of earth, transportation, and filling activities, thus increasing the cost of construction.
3. *Soils*: The coastal site needs soils capable of supporting heavy equipment and loads for a long time without significant settlements and deformations. Clays (limestones), which are common on Timor-Leste's south coast, are typically unsuitable for this type of construction due to their water content, which leaks out slowly upon application of heavy loads, causing the ground to settle. This is dangerous since a differential settlement in the ground can stress the concrete structures and could crack the LNG containment structures. In general, sands are preferable for heavy structures since settling happens quickly and differential deformations are less probable. Clays, if unavoidable, typically increase the cost of construction due to the application of pre-loading necessary to minimize long-term settlement. If erosion is of concern in the specific spot, harbor engineers will have to protect the shore with rock, and the plant designers must ensure that erosion does not jeopardize the plant structure or ancillary facilities.
4. *Navigational access*: The site will need to be reachable by LNG tankers whose lengths may approach 300 m with a draught of about 10-15 m. The plant needs to be thus located in waters that are relatively calm and navigable by large vessels, with little other marine traffic. Ideally, the site should display a natural bathymetry that minimizes the need for major dredging, which is costly and environmentally disruptive. A jetty will be constructed to transport the LNG from the storage tanks to the LNG tankers.
5. *Natural hazards*: Earthquakes, cyclones, storms, floods or tsunamis impose severe loads on infrastructure. Due to the sensitivity of the LNG and associated chemicals that are stored and manipulated in the LNG processing facility, it is important to choose a site which is not likely to experience extreme geophysical events. These events can damage the containment facilities, inducing leaks and spills of hazardous substances. Leaks and spills of LNG can lead to dangerous situations, as will be described in Section 6.2. Timor-Leste is in a seismically active zone due to the Indian-Australian and Eurasian tectonic plates moving abut seven cm closer to each other every year. [6]
6. *Respect existing situations and activities*: The site must avoid damaging areas which are or should be protected or sensitive for environmental, cultural or economic reasons. In addition, it should minimize disruption and displacement of existing communities, both where they live and where they farm. See Figure 14.
7. *Accessible by local population:* To maximize local employment and spin-off benefits for Timor-Leste's people, the plant location needs the ability to be well-connected with transportation and population centers.

A location has not been decided, and several technical studies should be conducted prior to this decision. [82]

Figure 12 (left). Disturbance envelope of the proposed 10 million tons per year (mtpa) LNG facility at Wickham Point in Darwin, Australia (adapted from [66]).

Figure 13. Satellite photo of Darwin LNG plant under construction.

3.3. Construction

As explained before, an LNG plant is a complex structure with many interdependent parts. A typical construction phase of a LNG plant will involve major engineering projects in two phases, and several sub-phases, needing three to six years:

1. Preparation of the land area at the LNG plant site
2. Transportation, mobilization and installation of mobile camps
   Construction of processing, tank storage and work areas
   Construction of port facilities and testing of systems and equipment

Building an LNG plant on the south coast of Timor-Leste will require constructing various supporting infrastructure. Works related to the construction of the plant itself and this infrastructure will start at different times and last different periods, with some overlapping with others. It is possible, however, to indicate several main categories with an indicative list of works, outlined below and summarized in Table 2. Specialized companies are usually sub-contracted do perform various works and services, such as dredging and other marine works. Also, some items will be built mostly on-site while others, such as gas-turbine electricity generators and major components of the LNG process, will be shipped in ready-made and be assembled at the site.

Table 2: Summary of phases of LNG plant construction

Site preparation	• access roads • construction camp and temporary facilities[8] • clearing, leveling and excavation • electricity (and its related fuel storage) • water (and its related water treatment and storage) • concrete batching plants • settling and slab construction • construction dock
Secondary plant facilities	• heliport and/or airstrip • gas-turbine electricity generator • warehouses and laboratory • administration building • permanent housing • staff amenities • sewerage and waste treatment facilities
Processing modules construction and assembly	• feed gas receiving area, liquid separation, gas metering and pressure reduction • safety systems and ground flares • acid gas removal • gas dehydration and carbon adsorption units • refrigeration and liquefaction machinery • LNG, LPG and residual NGL storage tanks • refrigerant storage • ship loading pumps and piping
Ship docking facilities	• channel dredging and other marine works • piled concrete breakwater protecting shore • jetty, platforms, trestle, tanker berth • loading arms, utility dock • tug boat berths (possibly at construction dock)

[8] This can include site construction offices, field offices, warehouses, freight forwarding office, customs office, materials yard, vehicle and equipment repair shops, parking areas, medical facilities, toilets, waste collection facilities, firefighting and other emergency equipment storage, catering services, temporary accommodations, etc. These facilities will be built at different times and places; as construction progresses certain facilities will contract, expand or eventually become permanent.

The plant site will approximately occupy 1-2 km^2 of land when built closely together and will be close to the shore, but sufficiently elevated to avoid flooding of the site. Clearing the site of vegetation and commencing initial leveling can be done with typical earthmoving machinery, which can be transported to the site either by road on flatbed trucks or landed by barge. Earthworks could total over 2 million cubic meters in volume. For comparison, preliminary calculations for the expanded Darwin LNG plant, which will be capable of processing 10 mtpa, estimated 1,600,000 m^3 of "cut" and 1,000,000 of "fill" earthworks (cutting down hilly areas and filling up lower areas; this is more or less a simultaneous process). [66]

During meetings between La'o Hamutuk and staff and advisors of the Ministry of Natural Resources in 2006 [82], government technical consultants expressed their preference to transport all machinery and supplies by sea with barges, thus avoiding the reconstruction of the road infrastructure in Timor-Leste. However, if the road system were improved, access roads could link the plant site to the Timor-Leste road network providing opportunities for local sourcing of personnel, construction equipment and materials, as well as using Dili airport and seaport facilities. Still, a good north-south road connection will not fulfill all needs, and it will be necessary to build a construction dock as early as possible to allow for heavier machinery as well as shipping of pre-manufactured processing modules and probably personnel. It may be possible to engineer this construction dock and shipping lanes to serve as a commercial port, which would extend its functionality beyond servicing the LNG plant, but proper needs and risk assessments must be carried out (see Chapter 6).

A typical construction dock consists of a T-shape structure extending from the coast into water, usually constructed with rockfill and armor stone in combination with steel plate and steel pile reinforcement and a concrete deck. Specific design requirements depend heavily on type of shoreline and coastal depths. For comparison, the Darwin LNG plant possesses a construction dock with a 20 m wide groin (the vertical bit of the T) extending 570 m from the plant site into the sea and ending up in a rectangular dock (the horizontal bit of the T) measuring 30 m by 50 m. (See Figure 12.) Additionally, a berthing pocket measuring 40 m by 200 m and an approach channel measuring 70 m by 1,000 m were dredged. Approximately 675,000 m^3 of landfill and 135,000 m^3 of armor stone were used, with the landfill coming from site leveling works, and 145,000 m^3 of dredge spoil was created. A construction dock will need its own environmental impact assessment, to be packaged independently or jointly with the LNG project.

Out of safety concerns, LNG tanker loading facilities are kept separate from other docks, necessitating construction of a second jetty structure, or perhaps a y-split structure. However, LNG loading facilities usually extend further into the sea to because LNG cargo ships require greater depth (a typical tanker will have a capacity greater than 100,000 m^3), and berthing pockets and the approach channel are larger and deeper. Tankers also need a vessel turning basin perhaps 600 m in diameter. The loading facility needs some specialized pipeline-to-ship connection machinery. The marine works for both the construction and tanker docks could be done by the same company.

LNG plants incorporate their own power generating stations because they need large quantities of electricity, which could be done through using some of the gas to fuel electricity generators. However, the construction phase will already require electricity[9] which will have to be provided initially by a diesel generator and accompanying fuel storage tanks on-site or through direct linking to the local electricity grid. The latter option requires sufficient preparation to provide enough electricity and to guarantee a continuous supply. LNG plants require water for operating (cooling process, cleansing gas of polluting agents, fire prevention, etc.), and therefore require a sufficient, guaranteed water supply. Water will also be required for initial construction, mainly cement works, and for consumption throughout all phases, requiring early establishment of water supply and treatment[10]. Construction and operation of this scale will also require well-functioning communications, including independent emergency fall-back systems. Likewise, an early installment of facilities for concrete batching can significantly increase speed of works and avoid unnecessary delays.

[9] For comparison: the Darwin LNG plant was supplied with four megawatts (peak rate) of power during the construction phase, although most of its energy needs during operation are supplied by gas turbines. [66]

[10] For comparison: the Darwin LNG plant was supplied with 80 m^3/hour (peak rate) of water. [66]

Figure 14. The southeast coast of Timor-Leste is the likely location of an LNG plant to process Sunrise gas. Red dots are concentrations of residences, of which there are few near the sea. The red area around Loré (including light red offshore area) is Parque Nacional Nino Konis Santana, and the pink areas around Uato Carabau, Natarbora and Laclubar are protected [110] or identified as having high conservation values. [103] Map by La'o Hamutuk based on information from the National Census (altitudes and population distribution) [85], the UN (roads, towns, rivers and boundaries) [109], BirdLife International (protected areas) [103], RDTL National Parks Directorate (Konis Santana National Park) [75], and Nick Hoffman (sea depths) [33].

One important factor of construction work is the relative remoteness from populated areas, necessitating fairly early building of sufficient accommodation for the construction workforce (which could be over 1000 workers at later peak periods).During construction of the Darwin LNG plant, similar numbers of workers were accommodated in Darwin. Only 25% of the workers came from the Darwin area and probably had their own accommodation. Building housing for the others could require extra site clearance, or another designated area, to accommodate close to a thousand people. (Employment is discussed at length in Chapter 5.)

Secondary plant facilities will support the technical and mechanical operation of the plant. Many temporary facilities from the initial construction camp will be transformed into or replaced by permanent facilities. Although many facilities will be more or less standard (there really are not many ways one can build a warehouse), some buildings, such as a laboratory, have a more specialized function requiring more international content.

The main electricity generator for the plant deserves special mention. A pipeline and liquefaction complex consumes a large amount of energy. Given the undeveloped system of electricity generation in Timor-Leste, the LNG plant will have to be self-sufficient in energy, using some of the feed gas to fuel a power station located within the plant. The energy needs of the liquefaction process will require a capacity on the order of several hundred MW. For comparison, the power plant at Snøhvit LNG has a generating capacity of 225 MW, and the facility consumes an additional 45 MW from the main electricity grid. [97] It is likely that an LNG plant in Timor-Leste will have even larger energy needs than this, given the possibly larger rate of production, the higher ambient temperature, and the longer pipeline[11]. Gas turbines could provide much of the power needed to run the plant either directly or through electricity.

While such generating capacities are far beyond anything currently available in Timor-Leste, they are standard in the world of heavy engineering. Thus one could straightforwardly install a turbine with a capacity around 400

[11] The RDTL government has planned to provide electricity to 80% of all households in Timor-Leste by 2025, which will require 110 megawatts of generating capacity. This is triple Timor-Leste's current capacity but less than half what the LNG plant would require. [4]

MW, which comes as standardized products from manufacturers. Purchasing and installing such a generator might cost around US$400 million, according to one engineer familiar with LNG projects. [34] It would be possible to build a gas-fuelled power station with sufficient generating capacity not just to power the pipeline and liquefaction plant, but produce additional electricity for domestic use (although, of course, this requires appropriate transmission lines and infrastructure as well as a thorough consideration of all safety concerns). The power plant could be built at the same time as the pipeline and be ready to produce energy as soon as the pipeline was connected and the upstream facilities were producing gas, which could be before the LNG plant was ready or even under construction.

Another aspect of construction work is the generation of waste. This initially includes vegetation during site clearing, but soon diversifies into building materials, domestic garbage, sanitary wastewater, drums and containers, spent oils, paint and hazardous materials, which require proper waste collection and disposal systems. The composition of construction waste differs from waste generated during operation of the plant, but general methods of waste management are similar. Although many other LNG plants are built where there is sufficient existing waste management capacity to sub-contract waste disposal to third party companies. However, mechanisms such as general landfill, high temperature burning, recycling, or sequestration and permanent isolation from the environment will need to be established from scratch in the south of Timor-Leste.

3.4. Decommissioning

After all gas fields have been used up resources are exhausted and no feed gas is available for the LNG plant, it will be shut down and decommissioned. In the case of a "special purpose company" as discussed during the April 2007 roundtable discussion [17], the trustees could be mandated to sell the plant to Timor-Leste "as is" for a fixed price. This could be useful if additional natural gas fields are found in Timor-Leste.

Box 6. Texaco's toxic legacy in Ecuador

The U.S. company Texaco began operating oil wells and pipelines in Ecuador's Amazon region in 1964, and their operations dumped and leaked 18 billion gallons of poisonous petroleum waste and destroying indigenous communities and rainforest areas. As public and legal pressure grew, Texaco abandoned Ecuador in 1992, transferring their remaining operations to the Petroecuador national oil company. Texaco has since been absorbed by Chevron, but the toxic waste they generated continues to kill people and damage the environment, and to be the subject of lawsuits and campaigning in both Ecuador and the United States. See http://www.chevrontoxico.com/ for more information.

In the case the plant should be removed, normal practice dictates that plant equipment and piping should be purged of hydrocarbons and all other chemicals and materials with possible toxic effects. Plant and office equipment could be sold where possible unless the facility is sold as is. Equipment that cannot be sold should be disassembled and sold as scrap or disposed of in accordance with regulatory guidelines (which should be in place at the start of the project to have any jurisprudential weight). Regulations in Timorese law will define exactly how decommissioning should take place, and, although it seems far away, the government needs to consider now the implications of decommissioning a plant of this magnitude.

The Timor-Leste Petroleum Act [74] passed in 2005 requires companies decommissioning exploration and extraction facilities "to clean up the Authorised Area and make it good and safe, and to protect the environment," and stronger legislation needs to be passed for downstream and other large industrial projects on Timor-Leste's land. An LNG plant here will be a greenfield project (a project built on previously undeveloped land), so Timor-Leste law should require that the site be returned to its natural state, and that all waste and materials be removed or permanently and safely isolated from the environment. Generally, decommissioning means that after a long and stable period of minimum employment, there will be a minor spike in employment related to deconstruction and landscaping.

Chapter 4. In Timor-Leste or For Timor-Leste?

What will be the results if we bring natural gas to Timor-Leste and construct and operate a gas liquefaction and LNG shipping facility here? As this section explains, the answer is "it depends." To land natural gas from the Greater Sunrise field in Timor-Leste, the government will have to secure the agreement of Australia's government and the Sunrise joint venture companies (see Figure 2) and find companies that can construct, operate, and responsibly decommission the pipeline and LNG facility. If things go well, such a plant could provide employment and training to Timorese workers, boost the economy of the country and the region where it is located, and provide tax revenues for the government, which can in turn be used for the benefit of all Timor-Leste's people.

But the situation could be much bleaker. The facility could become an *enclave*, physically situated on the coast of Timor-Leste, but with few or no jobs for Timorese citizens, no money going into the local community, and indeed no integration at all with the rest of society—neither economically, socially, or in terms of infrastructure such as road connections. In short, it could be "in" Timor-Leste, but not "for" Timor-Leste. The worst scenario is a plant that displaces the local population, impinges on their sacred places, and harms the natural environment, and is staffed by foreigners who live in self-contained housing with no positive interactions with the rest of the country. It is easy to see that this would cause deep grievances and frustrations among people who are already struggling with poverty and a history of colonialism and war.

Box 7. Nigeria would be better off without oil and gas

Nigeria is well-endowed with natural resources, and was expected to be the economic tiger in Africa when it achieved independence 50 years ago. However, a corrupt military regime took power and supported the oil companies' interests. Nigeria, the world's sixth-largest oil exporter, has the economic capacity to make its citizens wealthy through transparent and accountable government and social investment. However, kidnapping, embezzlement, trafficking, bribery, collusion, nepotism and corruption have become deeply embedded.

Government policies that prioritize interests of foreign oil companies exacerbate the suffering of the people. Government is eager to maximize its revenues, the benefits to a few rich officials, and the profits of companies like ENI, Chevron and Shell. They fail to develop facilities or invest in their people, and the companies dominate politics, economy, and social and cultural life.

This policy directly impacts the community: gas explosions from leaking pipelines, burning coconut plantations, provoking ethnic conflict, and polluting residential and agricultural land, lakes and the sea. The ongoing violence in the Niger Delta region reflects these injustices, but the government uses the military to protect company facilities from the community. For example, the military repressed nonviolent activists, leading to the execution of Ken Saro-Wiwa from the Movement for the Survival of the Ogoni People.

Leaking pipelines demonstrate that the government has no power to compel the responsible companies to obey their contracts; the government covers up for the companies and denies the complaints of local communities. One community leader told us that "we would be happier if this country never had any oil and gas."

By Julino Ximenes da Silva, HAK Association [43]

Which scenario prevails will depend on the actions of everyone involved—the government, the petroleum companies, local authorities, local communities, traditional leaders, civil society and non-governmental organizations, and individual Timorese citizens—in preparing for the arrival of the pipeline, plant, and port; during the construction of the facilities; and throughout the life of the project. To maximize the benefits to the people of Timor-Leste and minimize the negative impacts, we all must prepare ourselves and each other for the opportunities and challenges that an LNG project will bring.

This report surveys these opportunities and challenges. They include the effects on the national and local economy (see Local economic activity below); the creation of jobs and infrastructure (Chapter 5); the project's impact on the surrounding social and natural environment (Chapter 6); the effects on women and local communities (Chapter 7); and the consequences of an LNG project in Timor-Leste on the country's domestic and international political situation (Chapter 8).

Box 8. Timika, West Papua

The U.S. company Freeport MacMoRan has been mining copper and gold in Timika, West Papua, since 1967. Freeport's operations have repeatedly violated community rights (damaging subsistence and livelihoods, destruction of rainforest including hunting grounds and farmed areas), cultural rights (destruction of a mountain and other spiritually significant sites), human rights (torture, rape, indiscriminate and extrajudicial killings, disappearances, arbitrary detention, surveillance and intimidation, employment discrimination, and severe restrictions on freedom of movement). [2], [26]

4.1. Economic consequences of an LNG facility

The lack of economic growth since the restoration of independence has disappointed many Timorese people, especially those who still suffer from poverty and unemployment. While the government has received billions of dollars from offshore petroleum, the non-oil economy has stagnated. It is not surprising that in discussions of the potential LNG project, most of the attention has focused on how it improve economic conditions. In this section, we discuss what economic effects an LNG plant could have and what is needed to ensure that they are as positive as possible. We start by looking at the potential for an LNG plant stimulating the national and local economy, rather than becoming an isolated enclave with no linkages to benefit the population. We then consider the amount of money the government could receive in tax revenue from the LNG project.

Local economic activity

There are great expectations that the LNG project will boost economic activity in Timor-Leste as a whole, particularly in the region where the facility is located. Virtually all the local administrators and elected and traditional leaders interviewed for this report expressed this hope. Most of all, people think that the project will create employment for the local population, either directly in constructing the plant and port complex, or indirectly through the increased demand for local goods and services that the project would spur. Since jobs are the first concern for many people, we address this topic in the next chapter, including how many and what kinds of jobs may be created. This section gives an overview of the possible consequences for parts of the local and national economy.

The first potential boost to the national economy would come in the construction phase. The construction of gas pipelines and liquefaction plants constitute enormous undertakings costing several billion dollars. How much of this will enter Timor-Leste's economy and provide livelihoods for Timorese? Given the current state of development in Timor-Leste, virtually all of the materials and components required for the construction are likely to be produced abroad and shipped to the site, so any demand for local economic activity would have to come not from manufacturing but from the construction process itself, which has a slightly better chance of providing jobs for Timorese workers.

The construction process will involve purchases of at least three classes of goods and services. First, there is the construction work itself. Currently, no Timorese construction companies can provide more than very basic construction, and certainly most of the highly skill-intensive tasks will be carried out by foreigners. However, local companies may be able to gain subcontracts for certain low-skilled tasks, such as the administrative buildings for the plant, housing for workers and other ancillary facilities and infrastructure. Similarly, Timorese individuals may be hired by foreign contractors for lower-skill tasks, and a select few may secure higher-skilled jobs.

In addition to the construction services themselves, a range of other services will be needed during construction. These include security, drivers, transport, hospitality (food and housing), infrastructure, and clerical work. While these comprise a small part of the construction costs, they could provide a much-needed boost to the local economy. So would the demand for goods like food and basic construction materials, which will be required throughout the construction period. Again, the extent to which these ancillary services and consumer and producer goods will be sourced locally, depends both on the ability of the local market to supply them and the willingness of the contractors to purchase them locally rather than ship them in from abroad. This in turn will depend on the quality available, the ease with which the goods and services can be procured locally, and incentives for or requirements on the contractors. Again, policies are necessary to help local producers and service providers know which goods and services would be demanded, and provide training to prepare for that demand. In parallel, the infrastructure must be developed that would reduce the cost of buying locally, for example by improving the road connections between the site of the LNG facility and where the goods and services would be produced. The government and contractors would have to work closely with local authorities. Further, contractors and subcontractors should be required to source a high (but realistically feasible) proportion of their required ancillary goods and services locally. Note that these different policies—of improving the quality, quantity and access of the supply, and of requiring contractors to avail themselves of that supply—are highly interdependent. The contractors, for example, could be required to help upgrade the road connections between the construction site and nearby towns, so that food for the construction workers could be purchased without prohibitive transport costs.

It seems inevitable that only a very small fraction of construction expenditures will be spent in Timor-Leste. In absolute numbers, however, they could still be significant. As our spreadsheet model (see http://www.laohamutuk.org/Oil/LNG/FiscalBenefits.xls) shows, if Timor-Leste secured 10% of the construction expenditures for Timorese workers or producers, that could amount to $100 million over a four-year construction period, or perhaps 7-8% of non-oil GDP.[12] Achieving this will require judicious design and implementation of policies by the central and local governments, as well as cooperation from the contractors. Significant benefits can be reaped if the right preparations are made, as is shown by the experience of Trinidad and Tobago, where $235 million of the total of $1.3 billion spent to build the recently completed Train 4 was contracted locally. [11] Although Trinidad and Tobago is economically more developed than Timor-Leste, this high local content results from a concerted government policy.

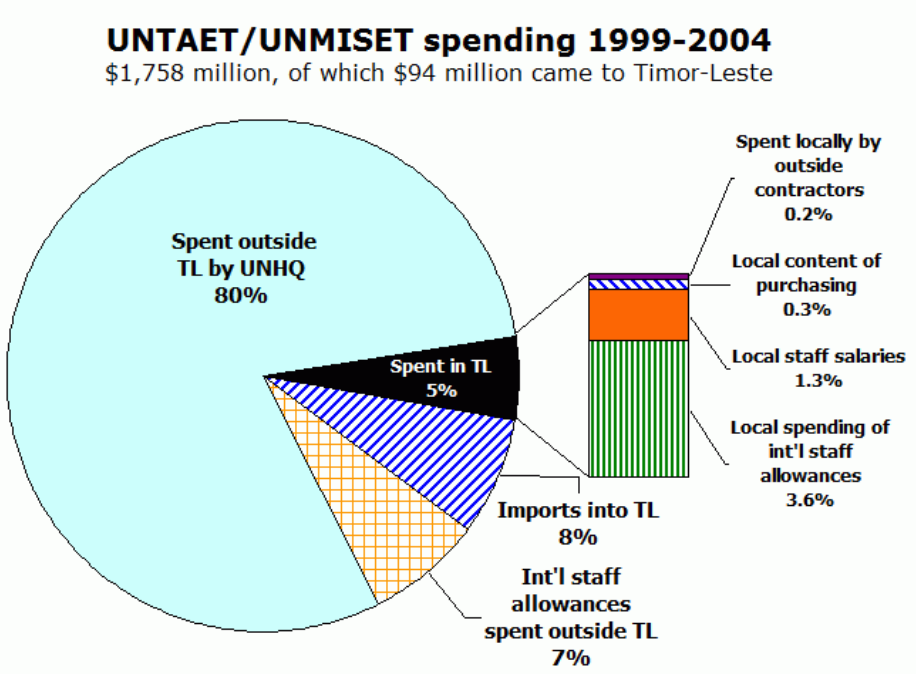
After the construction period, the benefits of the LNG facility to the domestic economy will be small. Indeed it is entirely possible for the LNG plant to be almost entirely self-sufficient. Unless measures are taken to integrate the plant with the rest of the country, it could operate as an enclave, which would pump in gas, ship in necessary supplies, and ship out LNG, with few local employees and no linkages to the rest of the economy. While this scenario is not unavoidable, it is unfortunately a common pattern for the petroleum industry in poor countries. The authorities of Timor-Leste, the companies that operate the LNG plant and the local population face a difficult challenge in seeking to maximize the integration of the facility with the local and national economy. This can be measured by calculating the proportion of yearly operating expenses spent locally, as well as what that money is spent on. Our calculations estimate annual operating expenses of around $100 million, but only a small fraction of that is likely to enter the Timorese economy. There are two channels for this integration: Salaries paid to Timorese residents (and in

Box 9. Local economic impact of UNTAET and UNMISET

Timor-Leste has already experienced a large international project in our country, and we can explore how much of the money spent entered the local economy. From 1999 to 2004, the UNTAET and UNMISET missions spent more than $1.7 billion, approximately one-third of the capital investment required to build an LNG plant.

Nearly 95% of the money spent on UN Missions did not come into the local economy. Local contracts and services were minimal, because Timor-Leste does not yet have a diversified economy with local manufacturers who can supply the needs of an international project. Local salaries constituted slightly over 1% of UN spending. Salaries for international staff were paid overseas, and staffers received allowances for local expenses. Surveys indicate that they typically spent half of their allowances on housing and a quarter on food.

About 5% of the five-year budget over the duration of UNTAET and UNMISET was spent locally. In comparison, over 80% was spent on military contingents, international civilian salaries, IT and communications infrastructure, and air transportation.



In comparison with LNG plant construction, the UN spent a much larger part on personnel and local activities, since the major components of the plant will be built outside Timor-Leste and shipped here.

Information from Economic Impact of Peacekeeping; Interim Report Phase I, by Peace Dividend Trust, April 2005. [64]

[12] By comparison, this is about three times Timor-Leste's entire non-oil export income, which is almost all from coffee.

particular those paid to Timorese nationals, since non-nationals will spend some of their income in their home countries or elsewhere), and purchases of locally sourced supplies. The bulk of the operating expenses, however, will go to purchases from abroad (of supplies such as mechanical parts or chemicals and other inputs into the liquefaction process, as well as specialized services for high-tech repairs and maintenance), and to a lesser extent, to remuneration to non-residents (such as foreign experts or expatriate staff on short-term assignments).

This observation for the construction phase also applies to the operations phase, although the much longer duration of the operations phase provides more opportunities for training local workers and developing local subcontractors. The most accessible way of integrating the facility with the local economy is through the employment of Timorese for tasks such as low-skill maintenance and cleaning, cooking, and security. With adequate preparation and training policies, coupled with realistic requirements on the companies, a few Timorese may also be employed at higher skill levels. It should be a goal for the government and the companies to steadily increase the proportion of Timorese employees at the facility over the lifetime of the project. We discuss the prospects for employment in more detail in Chapter 5.

The other connection the facility could have with the local economy is through locally sourced supplies. In addition to high-tech equipment and production inputs that would have to be procured from abroad, the facility would have a demand for goods that could be purchased locally. The most obvious is food, but this could include simple manufactures such as furniture. In the absence of government policy to discourage it, the facility always has the option of importing such supplies directly from abroad, so the right incentives need to be set up to maximize the share of local content—which again requires the right combination of facilitation from the government (in particular the relevant district administration, but also national policies), contractual requirements on the companies, and an efficient flow of communication about the nature of the goods and services required by the facility. The success of local content provision in the operations phase will be affected by how well local economy is integrated with the construction process. If during construction, roads and other infrastructure have been developed so as to connect the facility with local economic activity, it will be much easier to avoid the enclave problem once operations start. A further point is that one must pay attention not only to the quantity of locally sourced supplies, but also to their quality. Diversified economic development in Timor-Leste requires the growth of continuously higher-value-added productive activities, and local content policies should be designed with that goal in mind. While it must be the responsibility of local business to develop product of higher quality and higher value added (which can therefore command a higher price), the government can take steps to facilitate such a shift, and local content rules can be designed so as to secure a market for such products.

We must emphasize, however, that all this potential will not be realized by itself. It needs a combination of earnest effort from the companies (in their willingness to help promote local content), the national government (through wise polices implementing well-targeted regulation and incentives for the companies), and local government, communities and civil society organizations. Without this, the enclave model is very likely to be the reality of an LNG plant in Timor-Leste.

One of the simplest ways the plant can support the local economy is for Timorese businesses and people to provide food and housing for international plant workers. The Government, local communities and companies should work together to help Timorese companies start and grow so that the international companies and their workers can rent and buy housing, hotel rooms, restaurant food and groceries which are locally staffed and produced. This can include local content purchasing requirements, financing, teaching people how to start and run businesses, etc.

4.2. Fiscal effects: Government's tax revenues

The most obvious advantage of processing natural gas in Timor-Leste is the *fiscal benefit*. The fiscal benefit is the revenue that Timor-Leste's government will receive from the profits of the LNG facility, as well any taxes flowing from the jobs and economic activity the LNG facility may spur, in construction and during operation. We cannot predict the precise amount of these revenues, since they depend both on how much it would cost to build the pipeline and LNG facility, and on the future price of LNG. In addition, the LNG industry has recently seen rapidly increasing construction costs (see Box 12).

We present some very tentative estimates for several scenarios below, which should be taken with a great deal of caution. Before making a decision about whether to try to locate an LNG facility in Timor-Leste, the government must prepare more accurate and detailed estimates of the fiscal effects. However, even the most expert consultants and thorough data and methodology cannot predict LNG prices over the decades this project will be in operation or construction costs five years from now, so any estimate will be very approximate.

Box 10. "Upstream" and "downstream" project

Petroleum projects are often divided into "upstream" and "downstream" parts. The upstream project extracts the oil and gas from the ground or the seabed, while the downstream project includes everything that transports the raw petroleum, processes it, and brings it to market. In the case of Sunrise, the upstream project will be the facilities that pump the gas up from the seabed under the Greater Sunrise field. The downstream project will be the pipeline and the liquefaction plant the cools the gas and ships it off in tankers.

Even if the upstream and the downstream project are developed and managed by the same companies, the tax authorities will treat them as separate projects, because different tax rules apply to upstream and downstream activities. The upstream project will sell the gas to the downstream project, even if both projects belong to the same company. This is to make sure that profits at each level are calculated and taxed as the tax rules intend, and to prevent the companies from shifting profits to the level with the lowest taxes.

It is clear that any consideration of the fiscal benefits from such a project must include the possible tax effects on the *upstream* project as well (see Box 10). This is because what happens downstream will affect how much money the upstream project receives from the gas it sells *downstream* (the "netback price"), and that in turn affects company revenues, profits and tax revenues to Timor-Leste (through the JPDA and through Australia's payments to Timor-Leste under CMATS) and Australia (directly and through the JPDA). There are several reasons why the increased tax revenue Timor-Leste's government would receive from locating the LNG project here could be offset by reduced tax revenues from the Sunrise Unitized Area. The Australian government and Woodside have argued that it would cost more to build the LNG facility in Timor-Leste relative to the main alternative, which is either to expand the existing LNG facility in Wickham Point in Darwin or build a new plant on the Australian coast.[13] The pipeline route to Timor-Leste would have to traverse the deep Timor Trough, and could therefore be more expensive, even though Sunrise is much closer to Timor-Leste than to Australia. It is also possible that construction costs may be higher in Timor-Leste because of the lack of infrastructure, local contractors and skilled personnel. On the other hand, Timor-Leste could be a cheaper place to construct the LNG plant, as a pipeline crossing the Timor Trough may be cheaper because of the shorter distance. Moreover, modular construction methods that would not be used in Australia could be used in Timor-Leste, making the plant cheaper as well.

Another concern is that even if the Timor-Leste option is not more expensive than the alternative, the netback price paid for the gas could be lower, since Timor-Leste's limited experience with self-government and stability may cause customers for the LNG to worry about possible supply disruption. This in turn could motivate them to bargain for a price discount to compensate for their additional risk exposure -- even if it is merely a perceived, not a real risk.

It is impossible to know how these variables will play out. In what follows, we consider five scenarios and two variations to derive some very simplified estimates of Timor-Leste's tax revenues depending on where the downstream facility is located.[14] In the first scenario, the Timor-Leste and Australia options can be done at the same "moderate" cost. In Scenarios 2 and 2a, the options are again equally costly, but more expensive than in Scenario 1. The next two scenarios we examine how fiscal revenues depend on the location of the plant if the construction costs are higher in one country than in another. Scenario 3 compares a moderate Timor-Leste option with an expensive Australia option, and Scenario 4 looks at the opposite. In Scenario 5, we go back to both options having the same moderate cost, but we see what happens if the Timor-Leste option receives a 10% lower LNG price because customers perceive it to be more risky. It is important to note that we are not

[13] Other possibilities include floating plants and plants anchored to the seabed, but these are opposed by both Timor-Leste and Australia. Woodside is also not enthusiastic about untested mid-sea technology, although it continues to consider the floating option at the time of writing. This report compares the two onshore alternatives.

[14] The assumptions and calculations are explained in Appendix 3, and can be examined in the spreadsheets available at http://www.laohamutuk.org/Oil/LNG/FiscalBenefits.xls.

suggesting which of these assumptions are correct. The scenarios simply make it possible to compare possible outcomes under different assumptions.

The fiscal consequences of the downstream project depend very much on how the Timor-Leste government decides to tax it. Will it apply the normal domestic tax rules, or will it design a special tax system for the LNG plant? This could be an issue of negotiation between Timor-Leste and the oil companies. The government has not said anything about its plans, and we do not try to guess. The best we can do is to assume that the normal domestic tax laws will apply, and make our estimates based on that. In addition, in September 2007 the government proposed new domestic tax rules (see Box 11), and their effect on revenues is shown in Scenario 1a.

Box 11. Proposed tax "reform"

In September 2007, the Government proposed a major tax reform which they hope to enact by January 2008. [79] This would have a major impact on Timor-Leste's tax revenue from a Sunrise LNG plant. For example, in our Scenario 1, the total fiscal revenue from the downstream project would fall from over $3.6 billion to about $1.1 billion – more than two-thirds less! Similar reductions would happen in the other scenarios with the LNG plant built in Timor-Leste. The scenarios in this chapter assume the current tax rules, as the current proposals may be modified or not even enacted, or a special tax law could be passed for the LNG plant. We have included Scenario 1a, which is the same as Scenario 1 with the new tax laws applied. Our modeling spreadsheet includes estimates with the current and the new tax rules, which show that the actual tax take would be significantly less if the new rules are enacted as proposed.

We discuss here the high-price scenarios, which assume a sales price for LNG of $7.50/MM BTU (about $44/BOE), based on the futures prices for natural gas at the NYMEX commodity exchange during 2006-2007. The low-price scenarios in the spreadsheet use a price of $3.50/MM BTU ($21/BOE). These show qualitatively similar results but are not shown as tables in this report. The other assumptions are explained in detail in Appendix 3.

The tax revenue from the downstream project can be divided into three main sources, as detailed in the spreadsheet accompanying this report. We have ignored indirect taxes (sales taxes), as these make little difference and would be too speculative to guess.

1. Tax from the project itself. Once operations start, the income from the processing is liable to Timor-Leste's general profit (income) tax at 30% after deductions, which in our Scenario 1 amounts to about $3.4 billion.
2. Timor-Leste's tax regime imposes a "withholding tax" on the purchase of "construction services" from residents at the low rates of 2-4%, and mandates the withholding of income tax at 20% for non-residents. Since a sizeable part of the construction costs of the LNG facility will be salaries and other compensation, this creates a large tax base for the country during the construction of the plant, which we estimate to generate $136 million in taxes for the government in Scenario 1.
3. The incomes of those people locally employed during operation, and any money expended on locally sourced supply will enter the domestic economy and generate wage and income taxes during the operations phase. In Scenario 1, these are about $99 million over the life of the project.

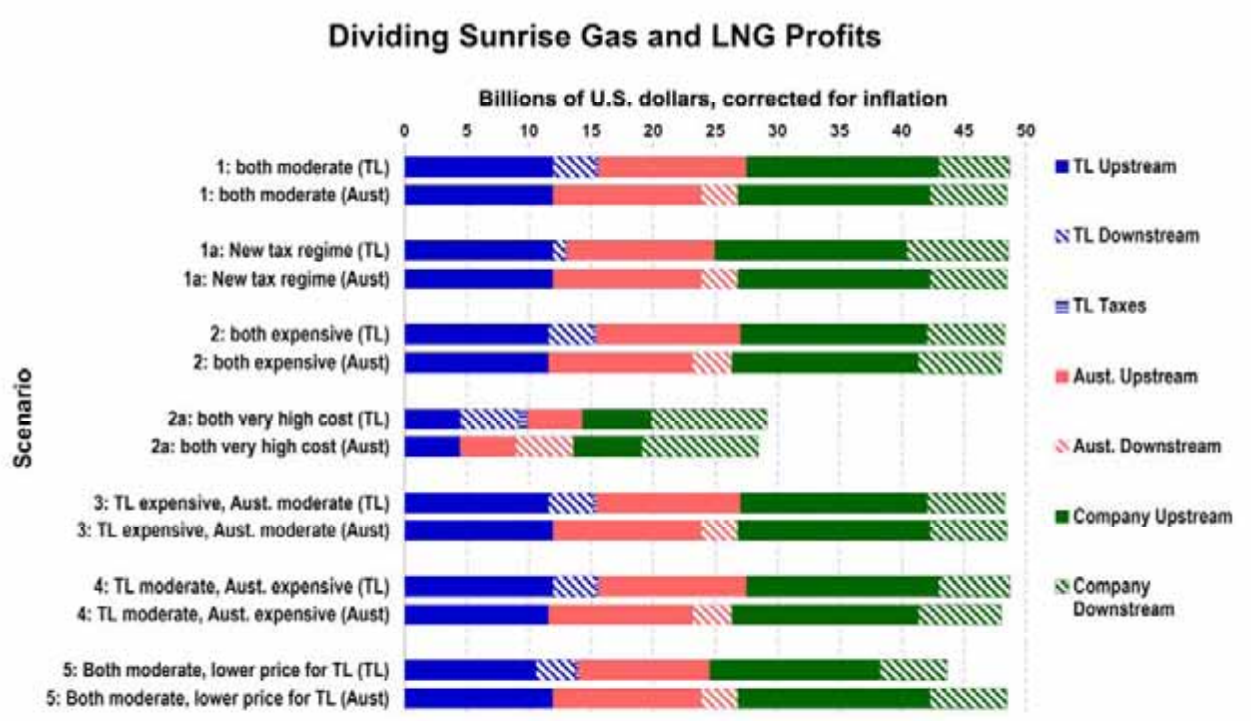


Figure 15. How the profits and taxes from the Sunrise LNG project (upstream and downstream, not including liquids, after paying construction, debt service and operating costs) would be allocated among Timor-Leste (blue), Australia (pink) and the oil companies (green) for each scenario described below. Diagonal hatching is for downstream revenues, solid is for upstream, and horizontal strips are the small amount of secondary Timor-Leste taxes. The upper bar for each scenario is if the pipeline comes to Timor-Leste, and the lower one is if it goes to Australia.

Scenario 1. Base case

Table 3 below first includes our estimate of fiscal revenues to Timor-Leste over the lifetime of the project from the two plant locations under Scenario 1. The key figures show that even if the plant is built in Timor-Leste, about three-fourths of the revenues to the government of Timor-Leste (around $11.9 billion of a total $15.6 billion in Scenario 1) would come from the *upstream* Sunrise project, not from the pipeline/LNG plant facility. Notwithstanding, the potential tax revenues from the downstream facilities are also very large: on the order of $3.4 billion just from the plant itself (undiscounted except for inflation-adjustment), or an average of around $100 million per year. Income and withholding taxes discussed about would add about $235 million over the project's lifetime. If the downstream facilities are located in Australia, but are otherwise identical from the perspective of project profitability, downstream tax revenue for Timor-Leste vanishes, as the downstream facilities become part of the domestic Australian tax base. Still, the upstream revenues would remain unchanged, at almost $12 billion over the projected period of Sunrise production.

All taxes from the downstream project would be lost to Timor-Leste if the liquefaction plant is located outside Timor-Leste's tax jurisdiction. Instead, the downstream project's profits would be shared between the companies and Australia. Our approximations of Australia's company tax regime project that Australia will receive almost $3 billion more if the LNG plant comes to Australia than if it comes to Timor-Leste. The companies may also make more money with the Australian option, since taxes under Australian taxation rules are lighter than under current Timor-Leste laws. Some RDTL advisors suggest giving special tax incentives to make the project happen; which would also reduce tax revenues.

All figures in the tables below are in millions of U.S. dollars, except for LNG sales prices, which are in dollars per million BTU.

Table 3. Scenario 1: Base case	Location of LNG plant			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price Freight on Board (F.O.B.)	$7.50		$7.50	
Total fixed costs of downstream project	$2,075		$2,075	
Net pre-tax income (total downstream net revenue)	**$9,137**		**$9,137**	
Net post-tax income: Downstream private profits	$5,732	62.7%	$6,183	67.7%
Timor-Leste take of downstream net revenue	**$3,405**	**37.3%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$235**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$2,954	32.3%
Upstream project (after CMATS redistribution)**:**				
Netback price to upstream project (real)	$5.26		$5.26	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$39,322**		**$39,322**	
Net post-tax income: Upstream private profits	$15,458	39.3%	$15,458	39.3%
Timor-Leste take of upstream profit	**$11,932**	**30.3%**	**$11,932**	**30.3%**
Australia take of upstream profit	**$11,932**	**30.3%**	**$11,932**	**30.3%**
Totals for project				
Net total pre-tax income	$48,459		$48,459	
Total Timor-Leste take of project profit	**$15,338**	**31.7%**	**$11,932**	**24.6%**
Total Australia take of project profit	$11,932	24.6%	$14,887	30.7%
Upstream private profit	$21,189	43.7%	$21,640	44.7%
Other Timor-Leste tax revenue	**$235**		**$0**	
Total Timor-Leste tax revenue	**$15,573**		**$11,932**	

Scenario 1a. New tax regime

As discussed in Box 11 above, Timor-Leste is considering major tax reform which would significantly reduce the fiscal benefits from an LNG plant in our territory. The following figures are is the same as the base case in Scenario 1, with the proposed new taxes applied. It is clear that the fiscal benefits for Timor-Leste are significantly less, and the companies' profits are correspondingly larger.

Table 4. Scenario 1a: New tax regime	Location of LNG plant			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$7.50		$7.50	
Total fixed costs of downstream project	$2,075		$2,075	
Net pre-tax income (total downstream net revenue)	**$9,137**		**$9,137**	
Net post-tax income: Downstream private profits	$8,155	89.3%	$6,182	67.7%
Timor-Leste take of downstream net revenue	**$981**	**10.7%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	$109		$0	
Australia take of downstream net revenue	$0	0.0%	$2,954	32.3%
Upstream project:				
Netback price to upstream project (real)	$5.26		$5.26	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$39,322**		**$39,322**	
Net post-tax income: Upstream private profits	$15,457	39.3%	$15,457	39.3%
Timor-Leste take of upstream profit	**$11,932**	**30.3%**	**$11,932**	**30.3%**
Australia take of upstream profit	**$11,932**	**30.3%**	**$11,932**	**30.3%**

Totals for project				
Net total pre-tax income	$48,459		$48,459	
Total Timor-Leste take of project profit	**$12,914**	**26.6%**	**$11,932**	**24.6%**
Total Australia take of project profit	$11,932	24.6%	$14,887	30.7%
Upstream private profit	$23,612	48.7%	$21,640	44.7%
Other Timor-Leste tax revenue	**$109**		**$0.00**	
Total Timor-Leste tax revenue	**$13,023**		**$11,932**	

Scenario 2. Higher construction costs for both options

Scenario 2 projects the same figures for a somewhat more costly LNG plant and pipeline. Our scenario amounts to 20% higher construction costs for the LNG plant and a 36% more expensive pipeline, an increase of $465 million over Scenario 1 assumptions for a 5.3 mtpa plant (for details about the cost assumptions, please see Appendix 3). The table shows that as long as the costs are the same in both locations, similar results hold in Scenario 2 as in Scenario 1.

Table 5. Scenario 2: Both options "expensive"	**Location of LNG plant**			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$7.50		$7.50	
Total fixed costs of downstream project	$2,540		$2,540	
Net pre-tax income (total downstream net revenue)	**$9,816**		**$9,816**	
Net post-tax income: Downstream private profits	$6,240	63.6%	$6,640	67.6%
Timor-Leste take of downstream net revenue	**$3,576**	**36.4%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$269**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$3,176	32.4%
Upstream project:				
Netback price to upstream project (real)	$5.13		$5.13	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$38,178**		**$38,178**	
Net post-tax income: Upstream private profits	$15,004	39.3%	$15,004	39.3%
Timor-Leste take of upstream profit	**$11,587**	**30.3%**	**$11,587**	**30.3%**
Australia take of upstream profit	**$11,587**	**30.3%**	**$11,587**	**30.3%**
Totals for project				
Net total pre-tax income	$47,994		$47,994	
Total Timor-Leste take of project profit	**$15,163**	**31.6%**	**$11,587**	**24.1%**
Total Australia take of project profit	$11,587	24.1%	$14,763	30.8%
Upstream private profit	$21,244	44.3%	$21,644	45.1%
Other Timor-Leste tax revenue	**$269**		**$0**	
Total Timor-Leste tax revenue	**$15,432**		**$11,587**	

Scenario 2a. Very high costs for both options

Recently, construction costs of LNG plants have been skyrocketing, as explained in Box 12. Although we believe it is unlikely that costs will remain this high for very long, we calculated a scenario with extremely high costs. The following results if exploration, construction, operating and decommissioning costs for both upstream and downstream are three times as high as in the base case described in Scenario 1. The project is still profitable for the companies, but both governments' revenues are significantly reduced.

Box 12. Capital costs rising

In recent years, the cost of constructing LNG plants has been rising very rapidly, because a lot of countries currently want to build LNG plants. Only a few large companies are capable of doing it, and their resources are stretched. Raw materials have also become expensive. For example, a year or two ago, the commonly quoted cost of building a liquefaction "train" was $200 per ton-per-year capacity, but now prices of $600 per ton-per-year are seen. [48]

Our estimates assume costs around the levels that were expected before these recent increases. This is because these costs are not caused by fundamental physical or technological challenges, which have not changed in two years. Rather, they arise from tight conditions in the specialized engineering and construction market. Over the long term, as the construction industry expands its capacity (or fewer countries want to build LNG plants at the same time) we expect these prices to come back down to earlier levels. Additionally, Timor-Leste need not be in a hurry to build this plant (see Chapter 9.1) – this report argues that it takes time to prepare the public sector, private firms, civil society, and the population at large for the construction. And in any case, the government may not spend most of the revenues from Sunrise as they come in, because of the Petroleum Fund. So our estimates apply to a case where the government times the project wisely, including waiting until construction costs fall.

Nevertheless, we include one calculation based on much higher costs as Scenario 2a. When we assume that costs are three times higher than what we think is possible in the long term, total revenues obviously fall. But the qualitative conclusions in our main text which compare the two locations for the liquefaction plant are not changed much with higher costs. This is not surprising, since high construction costs would apply wherever the plant is built.

Table 6. Scenario 2a: Very high costs

	Location of LNG plant			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$7.50		$7.50	
Total fixed costs of downstream project	$6,225		$6,225	
Net pre-tax income (total downstream net revenue)	**$13,976**		**$13,976**	
Net post-tax income: Downstream private profits	$9,316	66.7%	$9,362	67.0%
Timor-Leste take of downstream net revenue	**$4,660**	**33.3%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$705**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$4,614	33.0%
Upstream project:				
Netback price to upstream project (real)	$3.70		$5.13	
Total fixed costs of upstream project	$4,350		$1,450	
Net pre-tax income of upstream project	**$14,460**		**$38,178**	
Net post-tax income: Upstream private profits	$5,491	38.0%	$5,491	38.0%
Timor-Leste take of upstream profit	**$4,485**	**31.0%**	**$4,485**	**31.0%**
Australia take of upstream profit	**$4,485**	**31.0%**	**$4,485**	**31.0%**
Totals for project				
Net total pre-tax income	$28,436		$28,436	
Total Timor-Leste take of project profit	**$9,145**	**32.2%**	**$4,485**	**15.8%**
Total Australia take of project profit	$4,485	15.8%	$9,098	32.0%
Upstream private profit	$14,807	52.1%	$14,853	52.2%
Other Timor-Leste tax revenue	**$705**		**$0**	
Total Timor-Leste tax revenue	**$9,850**		**$4,485**	

Scenario 3. Timor-Leste more expensive

The comparisons in Scenarios 1 and 2 do not consider how the location of the downstream project might affect the upstream project if the Timor-Leste and the Australia option are *not* equally costly. Since we have assumed until now that the two downstream alternatives are financially identical, the netback price to the upstream is the same under both scenarios. This is an unrealistic assumption. We now look at two other scenarios in which building the downstream facilities in Timor-Leste costs more money (Scenario 3) or less money (Scenario 4) than building them in Australia (and therefore causes a lower or higher netback price, affecting the profitability of the upstream project). In Scenario 3 we compare an expensive Timor-Leste option with a moderate Australia option, as some argue that it would be more expensive to build a pipeline and a liquefaction plant in Timor-Leste.

In this scenario, the Timor-Leste option of course produces a lower overall net income for the whole value chain (reduced by $465 million for a 5.3 mtpa plant). In other words, locating the plant in Timor-Leste creates a slightly smaller "pie" to divide among the three parties: Timor-Leste, Australia and the companies. This loss is absorbed by the upstream level through a lower netback price. In fact it is more than absorbed. The rules guarantee a certain pre-tax rate of return to the downstream project, so that higher costs means more profit is allocated to the downstream to compensate. As a result, profits in the downstream project are *higher* in the high-cost option, whereas profits in the upstream project are *lower* by about $1,150 million – more than the extra cost. So all three parties lose at the upstream level with the more expensive option compared to the moderate option. The governments each get about $350 million less upstream tax revenue, while the companies get $450 million less.

The table also shows, however, that this effect is swamped by the zero-sum game over how the "pie" is divided. It is particularly significant where the downstream profits are taxed: Timor-Leste or Australia. At more than $9 billion, these profits are much bigger than the difference in construction costs. Therefore, Timor-Leste would get significantly higher government revenues with the more expensive plant in its territory than with the cheaper plant in Australia. Its projected tax revenues from the downstream amount to more than $3.8 billion, while its tax revenues from the upstream (due to lower overall profitability) only fall by about $350 million, leading to a net gain of about $3.5 billion. This is the *additional* tax revenue that we estimate Timor-Leste could gain from locating the plant in its territory rather than in Australia, *even* if that would come with higher costs of construction. Partly, this effect is because higher costs of construction (but also higher natural gas prices) are passed on to the upstream project through the lower netback price, and since tax revenues from the upstream project are shared equally with Australia, Timor-Leste's government only bears part of the loss.[15] But mostly, the gain comes from the advantage of having the downstream project be part of Timor-Leste's tax base, just as in Scenarios 1 and 2 where the cost was the same in both locations.

The other zero-sum game over who gets what share of the financial "pie" is between the companies and the governments. In Scenario 3, the companies get about the same amount of downstream profits in both the Australia and Timor-Leste locations. At the upstream level, however, they get less if the more expensive construction option is chosen, and would therefore be likely to favor the Australian location in this scenario.

[15] By the same token, downstream taxes are much less sensitive to oil and gas price fluctuations than are upstream taxes, provided prices stay high enough to make both downstream and upstream projects sufficiently attractive to investors.

Table 7. Scenario 3: Timor-Leste "expensive," Australia "moderate"	Location of LNG plant			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$7.50		$7.50	
Total fixed costs of downstream project	$2,540		$2,075	
Net pre-tax income (total downstream net revenue)	**$9,816**		**$9,137**	
Net post-tax income: Downstream private profits	$6,240	63.6%	$6,183	67.7%
Timor-Leste take of downstream net revenue	**$3,576**	**36.4%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$269**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$2,954	32.3%
Upstream project:				
Netback price to upstream project (real)	$5.13		$5.26	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$38,178**		**$39,322**	
Net post-tax income: Upstream private profits	$15,004	39.3%	$15,458	39.3%
Timor-Leste take of upstream profit	**$11,587**	**30.3%**	**$11,932**	**30.3%**
Australia take of upstream profit	**$11,587**	**30.3%**	**$11,932**	**30.3%**
Totals for project				
Net total pre-tax income	$47,994		$48,459	
Total Timor-Leste take of project profit	**$15,163**	**31.6%**	**$11,932**	**24.6%**
Total Australia take of project profit	$11,587	24.1%	$14,887	30.7%
Upstream private profit	$21,244	44.3%	$21,640	44.7%
Other Timor-Leste tax revenue	**$269**		**$0**	
Total Timor-Leste tax revenue	**$15,432**		**$11,932**	

Scenario 4. Australia more expensive

Other observers (e.g. Imle [36], Lucon [49]) think that it would be cheaper to build the downstream project in Timor-Leste, as the pipeline would be shorter. We examine this possibility in Scenario 4. Here the Australia option is $465 million more expensive than the Timor-Leste option. At the upstream level, the difference between the two options is symmetrical to Scenario 3; here the Timor-Leste location generates the higher netback price and a larger "pie" to split. This means that Timor-Leste's tax revenues from the downstream project would be boosted by a gain at the upstream level (relative to choosing the more expensive plant in Australia). In this scenario, Timor-Leste's government would receive around $4 billion more if the plant were located in Timor-Leste than in Australia. But again, most of this gain is zero-sum: Australia would receive at least $2.8 billion less (not counting the taxes on employees and suppliers to the plant). The companies would also do better with the Australia option—in this case because Australia's company taxation is lighter than Timor-Leste's, at least under the current Timorese tax rules (but see Box 11).

Table 8. Scenario 4: Timor-Leste "moderate," Australia "expensive"	**Location of LNG plant**			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$7.50		$7.50	
Total fixed costs of downstream project	$2,075		$2,540	
Net pre-tax income (total downstream net revenue)	**$9,137**		**$9,816**	
Net post-tax income: Downstream private profits	$5,732	62.7%	$6,640	67.6%
Timor-Leste take of downstream net revenue	**$3,405**	**37.3%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$235**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$3,176	32.4%
Upstream project:				
Netback price to upstream project (real)	$5.26		$5.13	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$39,322**		**$38,178**	
Net post-tax income: Upstream private profits	$15,458	39.3%	$15,004	39.3%
Timor-Leste take of upstream profit	**$11,932**	**30.3%**	**$11,587**	**30.3%**
Australia take of upstream profit	**$11,932**	**30.3%**	**$11,587**	**30.3%**
Totals for project				
Net total pre-tax income	$48,459		$47,994	
Total Timor-Leste take of project profit	**$15,338**	**31.7%**	**$11,587**	**24.1%**
Total Australia take of project profit	$11,932	24.6%	$14,763	30.8%
Upstream private profit	$21,189	43.7%	$21,644	45.1%
Other Timor-Leste tax revenue	**$235**		**$0**	
Total Timor-Leste tax revenue	**$15,573**		**$11,587**	

Scenario 5. Risk discount in Timor-Leste

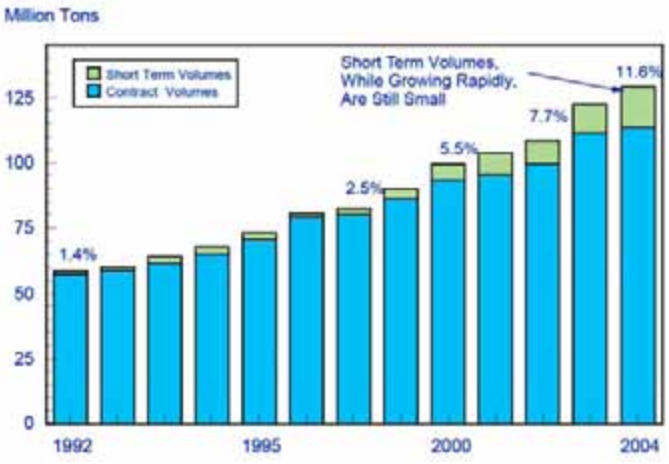
As explained before, another reason locating the downstream in Timor-Leste may be less profitable than the alternatives is that the revenues may be lower, even if the costs are not higher. The reason is that with perceived political instability in Timor-Leste, the buyers of the LNG may worry about the possibility of supply interruptions. Even a record of many years of peace and stability may leave lingering doubts in the minds of purchasers, who may therefore demand a "risk discount" in their purchasing contracts. We examine this hypothesis in Scenario 5.

The size of such a risk discount would depend on many factors, including the perceived prospects for political stability in Timor-Leste when the contract is negotiated, but also the bargaining skills of the LNG plant and the customer, the availability to the customer of other supply options, and whether a larger and deeper spot market in LNG develops (see Box 13). All we can do is run our projections with a guess at a risk discount. We use 10%, which would be a large discount, cutting the F.O.B. price from $7.50 to $6.75/MM BTU (or from $3.50/MM BTU to $3.15/MM BTU in the low-price scenarios; the effects are similar). We use the moderate cost assumptions, so that Scenario 5 is identical to Scenario 1 except that the LNG fetches a 10% lower price in the Timor-Leste option.

As before, locating the downstream facilities in Timor-Leste brings with it the usual income taxes. But the lower price that the LNG can fetch in Scenario 5 also significantly reduces the netback price and therefore the profitability of the upstream project. Indeed in this comparison, the Timor-Leste option generates aggregate upstream profits that are $4.5 billion lower than the Australian option. This hurts Timor-Leste's tax revenues from Sunrise upstream exploitation activities, which are about $1.35 billion lower than if the plant were built in Australia, under these assumptions. This goes a long way to cancel out Timor-Leste's gain in tax revenues from the downstream project, although Timor-Leste's government finances still gain — about $2 billion — from getting the plant rather than agreeing to locate the plant in Australia and benefiting from a higher netback price. However, the large upstream loss would be shared by Australia and by the companies, who would therefore likely put a lot of pressure on Timor-Leste to acquiesce in locating the downstream facilities in Australia. If the proposed tax rules are enacted (see Box 11 and Scenario 1a), then the taxes to Timor-Leste's government from the LNG plant would be too small too compensate for a large reduction in its share of upstream profits.

Box 13. LNG spot markets

Most LNG is traded under long-term contracts, where one export liquefaction plant agrees with one or several customers to provide large and steady amounts of LNG for many years. The prices are determined separately for each such contract, depending on the negotiation between the LNG plant and the customer, and are often defined by formulas that link them to the oil price. This is different from the market for oil, which has a "spot market" and a "futures market." In these markets, sellers and buyers can trade smaller quantities and agree to single trades at a time (either immediately—spot markets—or at a defined date in the future—future markets), so that oil tankers can be sent to where the demand is highest at any given time, rather than be committed to a long-term trading relationship. A small spot market is developing for LNG as well, and this trend seems likely to continue. Jensen shows that almost 12% of LNG traded in 2004 was sold under short-term contracts, rather than long-term relationships [39]:



The Sunrise International Unitisation Agreement (IUA) requires long-term sales contracts for at least some of the Sunrise gas before a development plan can be approved (see Figure 2). However, if a full-fledged LNG spot market develops, that would be an advantage to Timor-Leste, since it would alleviate the problem of perceived risks of supply disruption that would lead customers to try to negotiate a price discount. In a spot market, Timor-Leste could always sell its LNG at the prevailing market price, making it easier to resist customers' requests for discounts.

Table 9. Scenario 5: Both "moderate," lower LNG price for Timor-Leste	Location of LNG plant			
Downstream project:	**Timor-Leste**		**Australia**	
LNG sales price F.O.B.	$6.85		$7.50	
Total fixed costs of downstream project	$2,075		$2,075	
Net pre-tax income (total downstream net revenue)	**$8,555**		**$9,137**	
Net post-tax income: Downstream private profits	$5,396	63.1%	$6,183	67.7%
Timor-Leste take of downstream net revenue	**$3,159**	**36.9%**	**$0**	**0.0%**
Other Timor-Leste tax revenue	**$235**		**$0**	
Australia take of downstream net revenue	$0	0.0%	$2,954	32.3%
Upstream project:				
Netback price to upstream project (real)	$4.74		$5.26	
Total fixed costs of upstream project	$1,450		$1,450	
Net pre-tax income of upstream project	**$34,837**		**$39,322**	
Net post-tax income: Upstream private profits	$13,680	39.3%	$15,458	39.3%
Timor-Leste take of upstream profit	**$10,579**	**30.4%**	**$11,932**	**30.3%**
Australia take of upstream profit	**$10,579**	**30.4%**	**$11,932**	**30.3%**
Totals for project				
Net total pre-tax income	$43,392		$48,459	
Total Timor-Leste take of project profit	**$13,738**	**31.7%**	**$11,932**	**24.6%**
Total Australia take of project profit	$10,579	24.4%	$14,887	30.7%
Upstream private profit	$19,075	44.0%	$21,640	44.7%
Other Timor-Leste tax revenue	**$235**		**$0**	
Total Timor-Leste tax revenue	**$13,973**		**$11,932**	

Conclusion

It is important to understand the limitations of this analysis. Firstly, it is based on very uncertain estimates of the revenues from and costs of the Sunrise upstream and downstream developments. The scenarios are only educated guesses, meant more to convey qualitative judgments than precise quantitative projections. Secondly, the scenarios discussed above (except Scenario 1a) assume that Timor-Leste's general domestic taxation regime in its current incarnation will apply to a downstream project located in Timor-Leste. But that taxation regime is not particularly attractive to investors, who may bargain with the government to secure more favorable tax treatment. Note that the IUA envisages (and these calculations assume) that the downstream project will earn a nominal 10.5% internal rate of return *before* taxes, the most important of which is the 30% income tax (under current tax rules; see Box 11). That leaves a very low after-tax return for private investors, who may choose not to invest in a Timor-Leste LNG project if they have lower-risk projects with similar or higher returns available to them. In other words, to attract investors who can finance such a multi-billion-dollar investment, the government may be obliged to grant special tax benefits. This would change the fiscal benefits in the above scenarios in the predictable way: the tax benefits from locating the downstream project in Timor-Leste would be smaller, and would not weigh up as much for falls in upstream tax revenues caused by possible higher downstream project costs (Scenario 3) or risk discounts (Scenario 5).

On the other hand, we have not included other possible revenues to the state from locating the downstream project in Timor-Leste. One obvious source of additional revenues would be land rent: since the Constitution prohibits foreigners from owning land, a liquefaction facility would likely need to lease land from the government. The Law on Leases of Government Land (Law No. 1/2003) provides legal tools for securing both the rent on the land and the maintenance of the natural environment (see Chapter 6). Leases of up to 50 years are available for major commercial and industrial uses, with provision for special cases for longer periods, as would likely be required for an LNG facility.

Keeping these qualifications in mind, we may draw some tentative conclusions regarding the fiscal consequences of the decision about where to locate the pipeline and liquefaction facilities:

1. The downstream taxes are much smaller than the upstream taxes, but they are still economically very significant.
2. All other things being equal (in particular the sales price of LNG and the costs of building and operating the pipeline and plant), the government of Timor-Leste would stand to receive large tax revenues from locating the downstream facilities in Timorese territory. This conclusion depends on the tax regime to which the pipeline and plant owners are subjected.
3. Timor-Leste would benefit fiscally from locating the downstream facilities in its territory even if it entailed considerably higher costs of downstream construction and processing.
4. Timor-Leste would benefit fiscally from locating the downstream facilities in its territory even if this entailed a small risk discount on the sales price of LNG to the customer, but if the risk discount becomes substantial; the benefit diminishes. In the tentative projections presented here, a risk discount of about 10% of the F.O.B. price of LNG still yields significant fiscal benefits to Timor-Leste from getting the plant, provided current taxation rules apply.
5. A more lenient tax regime for the downstream facilities than current domestic taxation law would correspondingly reduce the fiscal benefits to Timor-Leste of locating the project in its territory.

Chapter 5. Employment and infrastructure

As stated above, local leaders hope and expect that many jobs will result from an LNG plant in Timor-Leste. The national government is similarly aware of the acute need for employment if living standards and economic productivity are to increase. The great majority of Timor-Leste's citizens live from subsistence agriculture at very low productivity. Any substantive growth in per capita incomes in the non-oil part of Timor-Leste's economy will involve people moving from subsistence agriculture into higher value-added activities, such as more productive agriculture for local or export markets, manufacturing, or public sector activities (health, education, and infrastructure). More productive forms of agriculture would be possible in combination with lower transport costs (in both money and time) to bring products to market, but in addition, growth in the non-farming private sector will likely be needed for people to move out of subsistence farming. Indeed the private non-farming sector already generates more of Timor-Leste's Gross Domestic Product than the agricultural sector, in spite of the latter employing many times more people. [89]

This means that jobs created by an LNG project could help Timor-Leste people move from agricultural work to other sectors, which the government is hoping will provide economic growth in Timor-Leste's non-oil GDP. [88, pages 21-27] In addition to providing jobs and developing individual capacities, the construction and operation of an LNG plant can provide the impetus and start-up funding for small businesses of various kinds, as subcontractors for goods or services to the LNG project. This would develop corporate capacity as well as individual skills, and could be extremely valuable as Timor-Leste diversifies its economy in the future.

What employment effects, then, ought we to expect? As Chapter 3 suggests, there are three ways in which an LNG plant might increase employment. The first is during construction, where a large number of workers are needed, but for a short amount of time. The second is during operation—that is, the workers who run and manage the plant and provide necessary support services. Finally, if there is an increase in demand for local or national goods and services—we discussed above which sectors could potentially benefit—this would translate into increased employment in those sectors. Examples include hotels, restaurants, office supply and operations, printing, security, low-skill construction, cleaning, waste disposal, road-building, and dredging.

Primary effects

Construction

The construction of an LNG plant takes three to six years. At the peak, more than one thousand workers may be needed, but many for less than a year. The Snøhvit LNG project in Norway, constructed between 2002 and 2007, employed around 1,800 during the peak period of construction (see Figure 16). The Wickham Point LNG project in Darwin, which liquefies natural gas from the Bayu-Undan field in the JPDA, projected a peak of near 1,200 jobs for a single five million tons per annum (mtpa) liquefaction train, and near 1,600 for staggered construction of two 5-mtpa trains (over a three-year period for each train; see Figure 17 and [66]). The expansion of Atlantic LNG in Trinidad and Tobago, which involved adding a new 5.2-mtpa liquefaction train, storage tank, and jetty to the existing capacity of 9.6 mtpa, was reported in December 2005 to have logged more than 14 million worker-hours, with the storage tank still to be built. At 2,000 hours/year, this corresponds to 7,000 worker-years; the workforce peaked at 3,500. [10] Trinidad and Tobago has more workers than the other two examples; this may be partly caused by contractors' economizing on labor in countries with high labor costs, as well as the higher productivity of labor in developed countries reducing the amount of manpower needed for a given task. Therefore, the construction of an LNG facility in Timor-Leste could tend towards the higher end of the range.

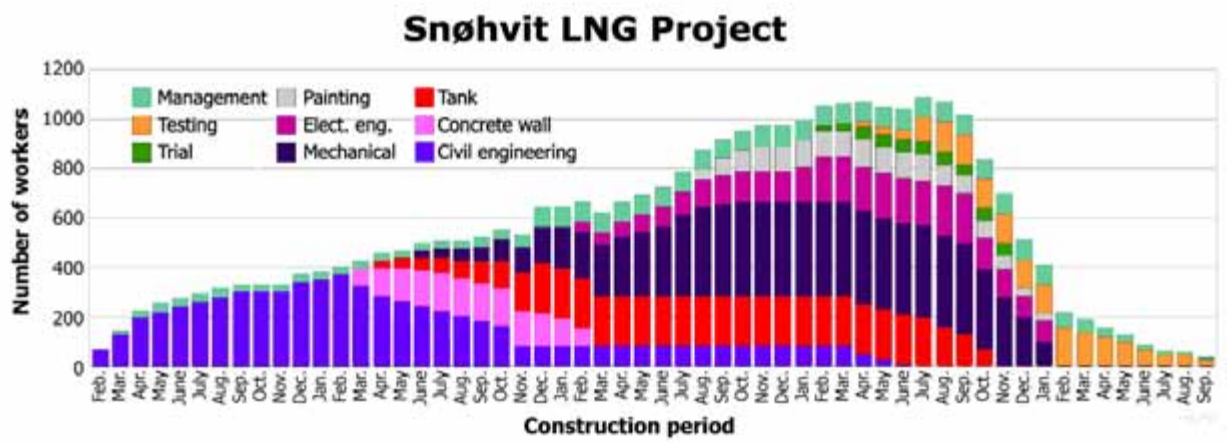


Figure 16. The estimated number of workers at the construction site month-by-month during the construction of the Snøhvit LNG plant at Melkøya in Norway. The lower-skill jobs are denoted by pink (concrete wall construction) and grey (painting) bars. The graph shows the number of people estimated to be working at any one time, so that when we count workers from all shifts, the number of jobs could reach 1,800 in the peak months. [97]

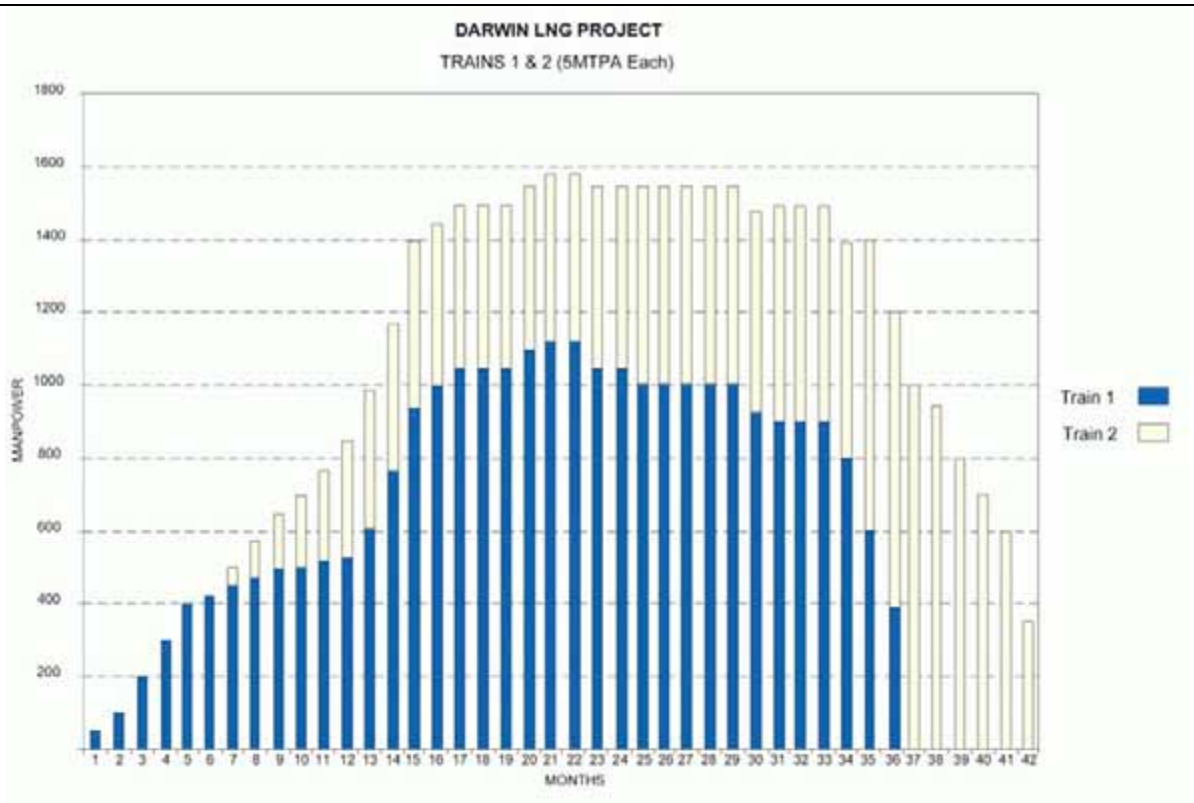


Figure 17. Projected employment during the construction of two LNG trains at the LNG plant in Darwin, Australia. Only one has been built to date. [66]

As these cases illustrate, the construction of an LNG facility employs a large number of people for a short period of time. This presents an opportunity as well as a challenge. Even short-term work would be welcome by many Timorese, yet it is not certain how many of the construction jobs would go to Timorese workers. Many of these are high-skilled jobs that require extensive training, and the short period of construction does not allow time to learn high-skilled jobs. This includes not only engineering and management positions, but also skill-intensive manual work like specialized welding. Furthermore, no Timorese company would be able to supply manpower at this scale, whereas the world's large construction companies are used to bringing in thousands of foreign workers to construction sites for short periods. For these reasons, the contractors for the construction job may find it easier to build a construction camp to house the workers they need, whom they would bring in

from countries like the Philippines. To increase the number of Timorese employees, the contractors should be required to recruit locally and to prepare skilled Timorese workers before construction starts. If plant construction doesn't begin until it is needed to replace Bayu-Undan gas (about 2015, see Chapter 9.1 and Figure 25), this would allow more time for future workers to receive training and on-the-job experience, especially if the RDTL Government and oil companies work together.

We make recommendations for how to prepare for this challenge in Chapter 9**.** Even with the best preparation, however, the bulk of the work will be done by people from abroad. In Darwin, where the skill levels are relatively high, only 25% of the construction workforce was projected to be obtained locally. [66] Similarly, at Snøhvit, from the total construction work, only about 800 worker-years would be sourced locally.

Operations

The number of operating personnel is much lower than the number of workers needed for construction. Gas liquefaction is an extremely capital-intensive activity—very little labor is involved in the process once construction is completed. So during normal operations, the LNG facility will not employ many people, about 40 permanent personnel per mtpa capacity.

If a Timor-Leste LNG facility is built with a capacity of five to seven mtpa, we may therefore expect 200-350 permanent jobs. Most of these jobs, however, require very high skill levels, as they involve manipulating advanced technological equipment. Very few Timorese as yet possess such skills, and most do not even have the education level that would enable them to train for the specific requirements of LNG plant operation. If an LNG plant were to open today, hardly any of the skilled positions would be given to Timorese citizens initially, although the three decades of plant operation provides enough time for people to enter relevant professions and gain the required skills and experience, provided that the companies and the government provide the necessary support. There are nevertheless jobs that will require less skill, such as cleaning and simple maintenance tasks, security, catering, and secretarial services, which could more easily be filled by Timorese citizens.

Box 14. Permanent jobs at other LNG plants

Darwin LNG in Australia (3.2 mtpa) was projected to have 120 permanent jobs.

Snøhvit LNG in Norway (4.1 mtpa) estimates 180 permanent personnel will be employed. Of these, 70-80 jobs involve maintenance and clerical work and ten are for remote operation of offshore seabed drills, not for the liquefaction plant.

Atlantic LNG in Trinidad and Tobago has increased its permanent employment from 120 in 1999 for its first train (three mtpa), to 600 with four trains (for a total of 14.8 mtpa) by the end of 2005.

To maximize the number of permanent jobs held by Timorese, the operator of the LNG plant must be required and given incentives to employ Timorese nationals. This can be promoted through different methods, from tax subsidies to outright quotas. To maximize national employment, the appropriate government authorities must develop local content and national employment policies *in advance* of signing contracts, as well as the capacity to facilitate and monitor the implementation of the commitments made my the operator. The operator must try to employ as many locals as possible, and indeed the government should make sure to award the right to develop and run the LNG plant to companies who are genuinely concerned about local content.

At present, Timor-Leste has no legislation or model for a contract governing a downstream project. However, the production-sharing contracts (PSCs) for the upstream operations of Bayu-Undan, as well as the Model PSC for future upstream petroleum projects in Timor-Leste, require operators to give preference to employing Timor-Leste nationals. Although the Sunrise upstream PSCs have not been made public, we hope that they contain a similar provision, and it must also be included in contracts for future downstream projects in Timor-Leste. The contractual requirement for training is less clear, although this would also be essential in order to increase the number of qualified Timor-Leste citizens.

Secondary effects

An LNG facility on Timor-Leste's coast may increase employment through its demand for goods and services in the local community (see Local economic activity above) and the "multiplier effect" of that demand. The demand will in the first instance be for the goods and services immediately useful to the plant and those who

work there. This includes for example food products for the catering, hospitality services like hotels and restaurants for those workers who are not native to the area (which will be virtually all), driving and other transport services, and simple mechanical repairs. If the local economy manages to absorb this spending (that is, to supply the goods and services in demand), many people employed in these activities will see their incomes rise and/or become more secure. That will in turn create spin-off effects on other sectors in the economy as these people spend their higher incomes on goods and services *they* need, and so on.

How many such jobs would there be? It is limited both by the demand side and on the supply side: On the demand side, there is only so much extra demand the injection of purchasing power from the LNG plant can generate. On the supply side, the ability to meet the demand and jobs being create is constrained by, again, the skills in the population (for example in providing international-standard hotel services), but also by the lack of good distribution networks, both physical (roads and other transport infrastructure) and logistical (such as the ability to guarantee regular and high-quality deliveries of food products to the plant).

In the Norwegian case, the number of jobs created in the local community is estimated to be about the same as the number directly employed at the facility [97], although some of these jobs also require high skill levels. Again, as long as the local population lacks skills and experience, the more technical auxiliary jobs will not be given to Timorese.

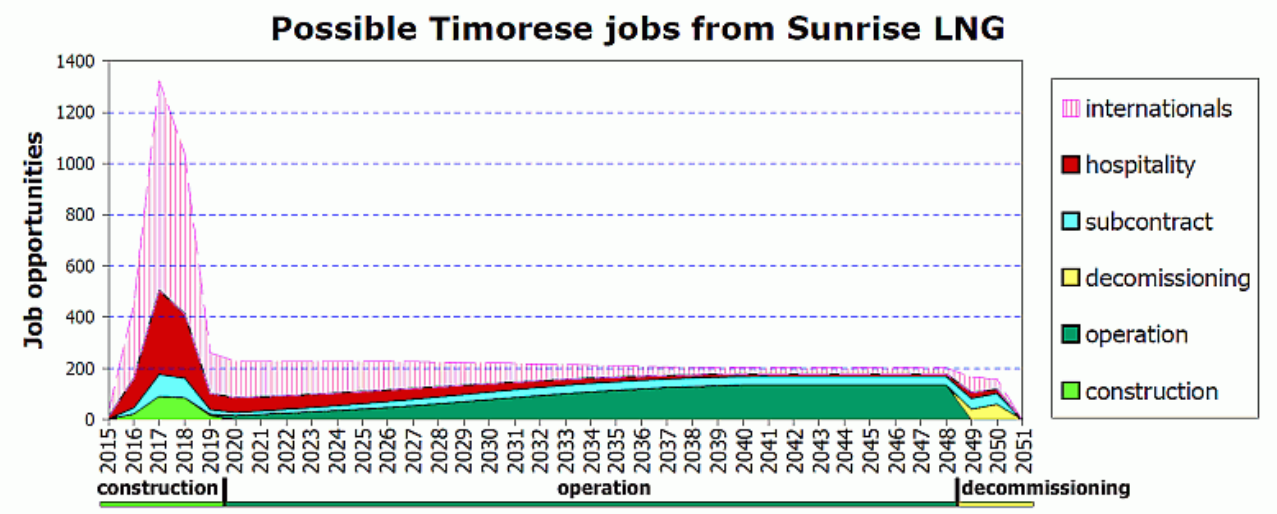


Figure 18. Very approximate estimate of the numbers of jobs for Timorese and international workers in Timor-Leste over the lifetime of a 5.3 mtpa Sunrise LNG plant. These include workers at the plant, those providing food and housing (hospitality) for international workers and local businesses which receive subcontracts, but does not include follow-on industries that could develop from the LNG plant.[16]

5.1. Development linkages and the national infrastructure

As the previous two subsections suggest, the degree to which an LNG facility can be integrated into the national economy partly depends on how much Timor-Leste's human capacity and physical infrastructure enable such integration. This subsection addresses how the construction and operation of an LNG plant can be managed to help develop both of these conditions, so that the facility will be drawn into the local economy as much as possible. These ideas are merely illustrative, and we encourage the central government, district administrations and local community leaders to be creative in addressing this challenge.

[16] This graph illustrates how jobs would be allocated if the recommendations in this report regarding education and local content are implemented, and if the numbers in the text are accurate. It assumes four local hospitality jobs for every ten international workers.

Building Timorese expertise

Very few Timorese have the skills to perform the more advanced jobs that an LNG facility requires.[17] There are at least three reasons, however, why it is realistic to develop a pool of Timorese with such skills. First, it can be done in time to be useful for the project. If some of the most talented Timorese high-school graduates are given strong post-secondary education in mathematics, physics, engineering, and languages, they can then be trained for the jobs available at the facility and be fully qualified within six or seven years. Since construction may take four years, and that the start of construction will not take place for several years, there is time to do this if one starts today, and even more time if the project is postponed. Second, the LNG facility will operate for many decades. Even if no Timorese are employed in high-skilled jobs at the start of operations, that can be achieved in the medium term. Finally, it has been done elsewhere. Both Qatar[18] and Trinidad and Tobago,[19] for example, have policies to increase the proportion of nationals employed at their LNG facilities.

Such training can to a large extent be provided by the companies operating the plant. But the government will also have to ensure that skilled trainees are available. One way of doing this, in addition to improving the schools overall, is to make Timorese preparation for technical employment a national priority. One could imagine how the lure of a technical position at the LNG plant would motivate many secondary school students to study hard—for example, scholarships for engineering studies could be made available to high school students who perform best in an annual national competition. Certainly the government will have to provide resources to schools so that they can fulfill the promise, but this suggestion indicates one way to produce qualified Timorese workers within eight years.

Improving local schools and universities is a long-term process. Government should make an effort to increase teaching quality and knowledge by hiring experienced foreign teachers and lecturers, who have had access to a wider range of experience and information than most local professors. The Portuguese and Brazilian vocational training schools are good initiatives, but local schools and higher education institutions should be enabled too.

With the right preparation on the educational front, the operating company could be required to steadily increase the percentage of Timorese workers, and to devise practical training programs for qualified Timorese. This would give Timor-Leste an economic and human asset that would both spread the benefits more widely than an enclave facility and last long after the gas wells at Greater Sunrise have run dry. If Timor-Leste complements its facilities with a competent workforce, it could become an attractive location for liquefying other gas reserves from the region even after the Sunrise project is completed—becoming a regional LNG hub. Several undeveloped gas fields, including Abadi, Evans Shoal and Caldita, are close enough to Sunrise or to Timor-Leste to make it plausible to process their gas in a Timor-Leste LNG plant. (see Appendix 1.)

Currently, unemployment is very high, and there are not many jobs available. In addition, few people of Timor-Leste have had access to higher education. Article 50.1 of the Constitution promises every Timorese woman and man the right and the duty to work in his or her freely chosen profession. However, the country has much work to do before we can enjoy this right, including developing a strong legal framework. UNTAET Regulation 2002/5 is still Timor-Leste's labor code, but it does not effectively guarantee people's right to employment. During the last five years, the Ministry of Labor and Solidarity did not effectively implement its responsibility to match jobseekers with employers, and the new government has removed the mandate for labor from this ministry, assigning it to the State Secretariat for Vocational Training and Employment.

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[17] By way of illustration, in September 2007 the incoming Secretary of State for Natural Resources estimated that he needs 100 technically skilled people to work in his Secretariat, but that only twenty qualified Timorese were available, although more than 80 others are currently studying abroad in relevant fields. [67]

[18] RasGas, the company that runs the Ras Laffan LNG facility in Qatar, reported at the end of 2004 that 53.1% of its employees were Qatari nationals, and 27.9% of them held permanent positions. This is ahead of the schedule set by their long-term "Quality Qatarization" strategic plan and program. [71]

[19] Trinidad and Tobago's "Vision 2020" is that "By the year 2020, Trinidad and Tobago will be a united, resilient, productive, innovative and prosperous nation with a disciplined, caring, fun-loving society, comprising healthy, happy and well-educated people and built on the enduring attributes of self-reliance, respect, equity and integrity." Sectoral subcommittees have explored how to accomplish this, and the Energy Subcommittee's report discusses how employment and local subcontractors can benefit from the LNG industry. [28]

Harnessing the construction phase

The jobs available during construction will use a variety of skills, from very basic to more complex. Those who receive training or jobs during the construction phase may find the experience helpful in getting jobs in future construction projects in Timor-Leste or abroad. The operation phase of the plant requires only a few hundred employees, with specific education and training. Hardly any Timorese will get these jobs during early years of plant operation, unless a great effort is undertaken to empower people with the necessary skills.

Efforts to avoid the enclave problem should begin at the start of planning for construction. Timor-Leste should promote positive side benefits for itself from the construction at every opportunity. As we discuss elsewhere in this report, the construction phase will only last a few years and could significantly intrude into the local human and natural environment. It does, however, also lend itself to benefits that can be harnessed with proper planning. For the duration of the construction process, Timor-Leste will have in its territory a large quantity of two resources it is sorely lacking: The physical machinery and inputs for heavy infrastructure construction; and the human skills required to employ them. It would be a terrible waste not to make maximal use of these resources to advance Timor-Leste's development. There are two main ways to harness them:

First, in addition to constructing the pipeline/LNG facility itself, the contractors could be employed for other infrastructure development. To some extent, this could be infrastructure that supports the facility, such as upgrading the roads to the nearest large towns (making it possible for staff to live there and for local supplies to be transported efficiently) and improving air transport, communications, water and electricity for the plant, the workers, and, most importantly, people who live in the region. But more extensively, the presence of capable contractors could be used to carry out infrastructure projects only peripherally related to the LNG facility itself. The degree to which this should be financed through the LNG project itself would have to be negotiated, but clearly it could be a requirement for subcontractors that they should stay in the country after completing the LNG plant (or arrive earlier) so as to carry out other projects within their capacity, while receiving adequate compensation. Furthermore, it is important that any such additional infrastructure contracts be completely transparent and fairly priced. This means that non-LNG infrastructure work should be under separate contracts from work on the LNG plant, and should be carried out on competitive commercial terms to avoid incentives for corruption.

We observe that infrastructure investments in Timor-Leste have often been delayed by governmental difficulties with disbursing funds and managing projects, rather than by a lack of money. It seems quite feasible, therefore, to pay foreign contractors to do more work than just building the LNG plant. For example, contractors will be building ports for construction and for LNG tankers, they could also be contracted to upgrade the commercial port in Dili or elsewhere. Similarly, the company contracted to set up the power station at the liquefaction facility could also be hired to build smaller power stations elsewhere in the country. These examples are merely illustrative. The main point is that the construction of a pipeline/LNG complex should not be treated separately from the general infrastructure development in the country; rather, it should be integrated into a national master plan for infrastructure.

The second way in which the presence of experienced contractors can be harnessed for Timor-Leste's development is through training and skills transfer. As a capable construction sector will remain crucial for Timor-Leste's future, training programs should be an integral part of the large-scale construction of the LNG plant. If contractors and subcontractors were required to train a certain number of local workers before undertaking their construction project, the skills of the Timorese construction workforce would receive a valuable boost. This would also make subcontractors more willing to hire local workers for their construction jobs, as they would have trained them—contractors could even be required to employ the best of those they train, which would give them a strong incentive to provide quality training. Appropriate design of training requirement policies could, therefore, create a virtuous cycle of mutually enforcing incentives.

Incorporating the facility into the national infrastructure

We have already mentioned how the road access to the facility will determine the extent to which the staff are present in the local communities and nearby towns, rather than being helicoptered in from abroad and living in isolation from the rest of the country. Better roads will also make it easier for Timorese people and products to access the plant site, increasing the possibilities for Timorese goods and services to be purchased, sub-contracted

or hired as part of the project. By the same token, a complementary approach to avoiding the enclave problem is to find ways to physically integrate the pipeline/LNG complex into the rest of Timor-Leste's infrastructure. Here we address some possibilities for linking the physical plant with the general economic infrastructure. These are illustrative examples rather than outright recommendations; our general point is that if an LNG facility is built, it should be planned with a view to making it a connected part of the national infrastructure and not just a stand-alone project.

Linking the pipeline/LNG facility to Timor-Leste's domestic energy infrastructure

Considerable economies of scale could be reaped by designing the power plant to also provide power to the domestic grid, relative to building an entirely separate power plant for that purpose, not to mention that the contractors would already be in place to build the plant. What this would require is serious advance planning to prepare the building and upgrading of the electricity grid, so that it is ready to be connected to the power plant when power becomes available.

Another way to connect the LNG facility with domestic energy infrastructure would be to make use of a small portion of the feeder gas from Greater Sunrise for household fuel needs. Diverting a very small share of the gas before liquefaction would be sufficient to provide households in the region a steady source of household fuel — which would reduce pressures for deforestation and indoor air pollution from firewood — at least for the duration of Sunrise production. Again, this would require detailed advance planning so that a gas distribution network can be built to be ready for when the gas starts to flow. Another option would be to bottle a small portion of the natural gas or liquid petroleum products from Sunrise (which is estimated to contain around 300 million barrels of condensate) for household fuel use, replacing wood and LPG currently imported from Indonesia.

Expanding the scope of the LNG tanker port

The pipeline/LNG complex will include a construction dock and a port for LNG tankers, where the liquefied gas will be pumped from storage tanks to cryogenic containers on large tankers, which ship the LNG to regasification plants in customer countries. This will be have to be a deep-water port where the LNG tankers can moor (Snøhvit LNG, for example, assumes a required harbor depth of about 16.2 meters below lowest astronomical tide). As with power generation, economies of scale will be gained if the LNG harbor can also include a commercial port. The construction of the LNG plant should be planned, to the greatest degree possible, with a view to the total infrastructure development of Timor-Leste.

Developing auxiliary industries

The infrastructure and material resources involved with an LNG facility could spur the development of other businesses. In Darwin, for example, the Bayu-Undan plant is stimulating the creation of a factory which will produce Australia's entire need for helium. [58] Some have suggested that natural gas could be the feedstock for a fertilizer factory in Timor-Leste [17], and other chemical industries could convert natural gas to liquid fuels. More concrete or visionary illustrations are beyond the scope of this report, but they should be considered early in the project's planning stages.

Conclusion

How many Timorese get jobs at the LNG plant will depend very much on the training policies the government implements before construction starts, as well as the extent to which contractors are required to include local content. Ideally, the expertise of foreign contractors should be used not just to construct the facility but also to train local workers, and this could be made part of the requirement for being allowed to build. The Production Sharing Contracts (PSCs) that apply to Timor-Leste's upstream petroleum projects (the 2005 Model PSC for future upstream projects including those licensed in June 2006, and the Bayu-Undan PSC; for Sunrise, neither government nor the companies have made the PSC public) are not sufficient in that regard. They do require contractors to give preference to local job seekers and locally sourced goods and services provided they are

competitive, but they demand little in the way of training or otherwise creating a competitive supply of skilled workers, goods or services in Timor-Leste.[20]

Article 18 of the Sunrise International Unitization Agreement (IUA) gives employment and training preference inside the Unit Area to nationals or permanent residents of both countries, but says nothing about downstream facilities.

The new Government in Timor-Leste is discussing a Petroleum Optimization Law, which will revise the draft regulation on Local Content Policy, a mechanism to encourage companies to use local workers and suppliers of goods and services to help strengthen Timor-Leste's economy. The Government is also providing scholarships for Timorese to study in relevant fields, and considering requiring contractors to implement a Social Responsibility Concept – which will require them to do more for Timorese development than existing contracts and laws. [67] As this regulation is finalized, it needs to consider how a project like the Sunrise LNG plant can best be used to help develop other sectors of our economy.

Box 15. Local content with ENI

ENI, a large Italian oil company, was awarded offshore exploration contracts in RDTL's exclusive maritime area in 2006. ENI has opened an office in Dili, as its initial step to implement its $9.6 million commitment to Local Content. ENI explained that they want to support capacity-building for the Timorese (training, education and internships), provide goods and services, support infrastructure, and technology transfer. ENI is approaching community-based organizations and local NGOs and soliciting proposals to receive funding from the company (although if ENI finds oil or gas some or all of this will be recovered from revenues paid to the government of Timor-Leste). ENI claims that this spending will provide opportunities for Timorese businesses and people to participate in their exploration program in sustainable and economic ways. [41]

[20] The Model PSC says (article 5.4): "Each Contractor shall comply with the proposals which accompanied its application under Article 13 of the Act for this Agreement in respect of training, employment and the acquisition of goods and services, and otherwise shall:

(a) give preference to the acquisition of goods and services from persons based in Timor-Leste, provided they are offered on competitive terms and conditions;

(b) with due regard to occupational health and safety requirements, give preference in employment in Petroleum Operations to nationals of Timor-Leste."

The Bayu-Undan PSC says (section 5.2): "The contract operator … shall …

(h) give preference to goods and services which are produced in Australia or Timor-Leste, or provided by subcontractors operating out of Australia or Timor-Leste, provided they are offered on competitive terms and conditions compared with those available from other countries

(i) give preference to the employment of Timor-Leste nationals and permanent residents, having due regard to safe and efficient activities, and good oilfield practice."

Chapter 6. Impact on the social and natural environment

"Impact" is understood here as an alteration that may be positive, neutral, or negative depending on whether the change that it produces is considered beneficial, of no importance or detrimental to the social and natural environment. An appropriate impact assessment requires baseline studies that describe the local conditions prior to construction of the infrastructure and an accurate knowledge of the extension and characteristics of the infrastructure planned. At this time, there are few if any baseline studies of the environment in Timor-Leste [7], and a precise characterization of the infrastructure is also unavailable. [82]

This discussion is based on previous environmental impact assessments of similar infrastructure in other parts of the world, on interviews carried out with government and civil society in Timor-Leste, and on the observations obtained during a four-day field trip (see report, Appendix 6). We can only discuss qualitative considerations related to the LNG plant in Timor-Leste. The environmental impact assessments used here as illustrations are the 2003 environmental impact assessment for the LNG export project in Pampa Melchorita, Peru [65], and the 2002 Public Environmental Report Draft for the expansion of the LNG processing facility in Darwin, Australia. [66]

After a brief introduction to environmental impact assessment, we will analyze the main conclusions of these two works. We will extrapolate from these reports to identify specific impacts that might be expected from the construction and operation of an LNG processing facility in Timor-Leste. In this discussion we will also highlight issues of special concern in the current regulatory context.

Box 16. Timor-Leste and international environmental conventions

Timor-Leste has moved beyond the Constitutional commitment to protect the environment and use resources sustainably, beginning to integrate these principles into policies. We have signed and ratified three international conventions on preserving the natural environment: the United Nations Convention to Combat Desertification (UNCCD; August 2003), the UN Framework Convention on Climate Change (UNFCCC; Oct. 2006) and the UN Convention on Biodiversity (UNCBD; Oct. 2006). These are known as the Rio conventions, and signatories are obligated to integrate principles of sustainable development and global environmental management into their national development priorities and programs. In late 2007, Timor-Leste signed the Kyoto Protocol to the UNFCCC, expressing its commitment to reduce global climate change (see Box 18).

However, Timor-Leste does not yet have any "specific legislation that gives effect to the objectives and principles of the conventions, although there are already several pieces of legislation that deal with various issues that are closely related with the conventions." Many laws now in force are from Indonesia or UNTAET, and are sometimes inconsistent. Although some laws have been updated or newly drafted, many of these are still not operational because they have not been enacted. This is partly because we lack relevant expertise: "Another capacity need at the individual level is that the ministers and other top decision makers often have insufficient knowledge of the sector they are running." [78]

The current government remains committed to "promote the environmental area as an essential, integral and indispensable driver in the strategy of medium/long term development." [87] However, the previous government's Ministry of Development and Environment has been dissolved, and environmental issues are now handled through the National Directorate for Environmental Services (DNSMA) in the State Secretariat for Environment under the Ministry of Economy and Development, which could reduce its priority and coordination with development projects.

An LNG plant is a large industrial facility operating in a coastal environment as described in Chapter 3. Some degree of impact on the environment is inevitable from the construction and operation of the facility, . The objective of the environmental impact assessment is to identify the likely impacts and evaluate, quantitatively when possible, their extent and gravity. This assessment can then be used to mitigate these impacts in as far as is possible or, if they are found to be altogether undesirable, to alter or cancel the project. How the environmental impacts assessment can influence a project of this magnitude has been recently illustrated by the Gorgon LNG project in Australia, which will be larger than the Sunrise LNG plant (see Box 17).

Box 17. Gorgon vs. the environment

In June 2006, the Environmental Protection Agency of Western Australia recommended that the state government reject the Gorgon LNG project, proposed to process natural gas on Barrow Island, a protected natural reserve. In addition to other impacts, the alteration of the local population of flatback turtles was deemed so great [51] that the project deserved rejection from the highest environmental authority. In October 2007, the Commonwealth Government overrode the objections of environmental experts and the State government, and has allowed the project to proceed. with more strict environmental safeguards than originally planned.

Most Timorese people make their living in agriculture. They use land not only to live on, but also for farming, as the source for their livelihood, and as part of their traditional spirituality. The LNG plant will have a huge impact on community rights to land. Many people could be displaced and lose the sources of their livelihood, because their land is taken away to build the plant and associated infrastructure. Their farmland could be polluted, or their sources of water could be diverted or contaminated by project activities.

Many Timorese, who live in rural areas, believe that specific places and objects have supernatural value and powers. Timorese protect those places from misuse and destruction through traditional methods, such as Tara Bandu. Some of these areas should not be interfered with at all, while others can be used in a sustainable way with permission from appropriate local spiritual leaders. Such places can exist anywhere, in or near communities of people. A huge industrial project like an LNG plant could threaten sacred places, infrastructure and existing communities who are living on or near the desired project site. International companies and workers, as well as Dili-based government officials and advisors, need to safeguard against violating our traditional beliefs, which are fundamental to Timorese culture.

Timor-Leste has yet to enact laws or implement regulations for working conditions, health and safety. UNTAET Regulation 2002/05, the Labor Code for Timor-Leste, is the only non-Indonesian labor law at this time, and it does not regulate health and safety. This Labor Code creates a National Labor Board with the mandate to provide independent advice on occupational safety and health matters as well as programs on vocational training and skills development, grant exemptions, set minimum wages and other related functions. However, the Board has not been established. The Occupational Health and Safety Law was drafted in 2004, but has not yet been enacted. The Government hasn't released the draft, so we are unable to determine how adequate it will be when and if it becomes law. Furthermore, labor regulation has been moved from the former Ministry of Labor and Solidarity to the State Secretariat for Vocational Training and Employment. We are concerned that the Secretariat does not have sufficient power to ensure that working conditions at an LNG plant site are safe, that workers are fairly trained and compensated, and that their rights will be respected.

Box 18. Sunrise will add to global climate change

At present, Timor-Leste's impact on global climate change is very small. The fossil fuels used here release about 150,000 metric tons of carbon dioxide (CO_2) into the atmosphere each year[21], but Greater Sunrise will change that. Processing 5.3 mtpa of gas would produce about four million tons of CO_2 annually at the LNG plant (reference [60], page 10), mostly from generating electricity and removing waste from the feed gas. If this is vented into the atmosphere, it would multiply Timor-Leste's contribution to the greenhouse effect by thirty times. An environmentally responsible facility like Snøhvit in Norway pumps waste CO_2 back into the ground so that it doesn't damage the climate. Gorgon (see Box 17) also does this, but the Darwin LNG plant releases it into the atmosphere.

Sunrise operator Woodside Petroleum "is committed to minimising greenhouse gas emissions from the company's production of energy products while remaining globally competitive" [123], but the company has not said what it will do with CO_2 produced by a Sunrise LNG plant.

Burning the gas from Sunrise will release an additional fifteen million tons of CO_2 into the atmosphere every year. However, Timor-Leste has little influence over what the overseas buyer does with the combustion products of the gas after it has been sold. Timor-Leste signed the Kyoto Protocol in 2007, and this commitment should be carried through while considering designs for the Sunrise LNG plant, wherever it is built.

Methane (CH_4), the principal component of LNG and natural gas, is 23 times more destructive of the atmosphere than CO_2, so it is important to avoid leaking or spilling it from the wells, pipeline or LNG plant.

6.1. Environmental footprint of an LNG plant

Activities related to processing gas and loading it onto LNG tankers affect the land, air and sea environments. Typically, an LNG processing plant will have a significant impact on the social and natural environment during its several years of construction, which involves a large workforce and heavy machinery. Once the facility is operational, impacts might be less severe but will be continuous. Some impacts will therefore happen just once and others repeatedly or over a period of decades. Some might have a lasting impact on the environment and some might be temporary. It is hard to evaluate the severity of these impacts since many of them are uncertain or hard to measure. This results in many impacts measured on very

[21] Calculation by La'o Hamutuk based on RDTL imports of $35.1 million worth of fuels during 2005, of which 74% was diesel and 12% petrol. [86] This is consistent with the UNDP estimate of 0.2 million tons CO_2 per year from Timor-Leste. [107]

subjective scales that depend heavily on who is carrying out the analysis. Therefore, it is desirable to compare assessments carried out by different groups. Ultimately, qualitative and approximate quantitative analysis tools make it possible to rank the impacts according to a scale of severity.

For instance, after consideration of the local conditions, the environmental impact assessment for the Pampa Melchorita facility [65], a 4.4 mtpa LNG export plant in Peru, concluded that none of the expected impacts would have a highly negative effect on the social and natural environment.[22] As positive impacts it listed increased tax revenues, increase in demand of goods and services, and increase in employment (see Box 19). These positive impacts are also the main drivers for construction of a similar facility in Timor-Leste, as was discussed in Chapter 4 and Chapter 5, although the non-fiscal benefits are likely to be significantly smaller for Timor-Leste than for Peru, even with a concerted effort to maximize them.

Box 19. EIA for Pampa Melchorita LNG facility, Peru

The Environmental Impact Assessment for the Pampa Melchorita LNG export facility, carried out by Golder Associates Peru S.A. [65], details six phases in construction and six phases in operation and dismantling. In these 12 phases, 22 potential impacts were identified and ranked as positive, neutral, slightly negative, moderately negative, or highly negative. Below is a simplified presentation of these results. The six phases of construction have been condensed into a single construction phase and the six phases of operation and dismantling have been similarly condensed into a single phase of operation. Three of the 22 impacts were considered positive during both construction and operation phases, none were ranked as highly negative, and the remainder was tagged either moderately (M) or slightly (S) negative. The impacts are tagged with a "P" referring to the case of Pampa Melchorita for later reference.

POSITIVE IMPACTS	**CONSTRUCTION**	**OPERATION**
P-1 Increase in tax revenues	YES	YES
P-2 Increase in demands of goods and services	YES	YES
P-3 Increase in employment	YES	YES
NEGATIVE IMPACTS	**CONSTRUCTION**	**OPERATION**
P-4 Alteration of air quality	M	S
P-5 Increase in noise levels	M	S
P-6 Increase in turbidity of sea water	M	S
P-7 Change in sea and river water quality and quantity	S	S
P-8 Alteration of soil structure	S	S
P-9 Alteration of soil quality	S	S
P-10 Alteration of geomorphology	M	S
P-11 Alteration of beach morphology	S	M
P-12 Loss of terrestrial vegetal cover	M	S
P-13 Alteration of composition of sea communities	M	S
P-14 Changes in fish catch	M	S
P-15 Reduction in marine fauna	S	S
P-16 Change of the demographic composition	M	S
P-17 Alteration of local traditions	S	-
P-18 General nuisances for population	M	S
P-19 Traffic interruption	M	-
P-20 Restrictions for traditional fishing access	M	M
P-21 Reduced revenues in traditional fisheries	S	M
P-22 Destruction of archaeological patrimony	S	-

For comparison, we also looked at the 2002 Public Environmental Report Draft [66] for the Darwin LNG facility in Australia. It details environmental and social "benefits" and "costs" related to a proposed 10 mtpa plant (capable of processing gas from Bayu Undan, Greater Sunrise or other nearby gas fields in the Timor Sea).

[22] La'o Hamutuk does not claim that the Pampa Melchorita study, undertaken by proponents of a project which was strongly opposed by some local communities, is unbiased. Rather, we offer it to illustrate some of the issues that should be examined in an Environmental Impact Assessment.

Box 20. EIA for Darwin liquefied natural gas plant, Australia

The Public Environmental Report (PER), prepared in 2002 by URS Australia Pty Ltd, for a Wickham Point Darwin 10 mtpa LNG Facility [66] was based on earlier (1996) plans and their environmental assessment documents related to a 3 mtpa LNG facility. These earlier plans and documents were approved in 1998, but construction was deferred "due to global economic issues." [66] These documents already discussed environmental impact related to a later possible expansion to 9 mtpa, which was noted by the licensing authorities but not yet approved at that time. The later plans for 10 MTPA, which showed relative reduction in negative impact compared to the earlier proposed 9 mtpa, were approved and an Exceptional Development Permit was granted in 2002. This permit itself was later amended in several steps to reflect the reduction in size to a 3.2 mtpa facility, which began construction in 2003 and operation in 2006.

POSITIVE IMPACTS
D-1 New sources of energy; production of LNG for industrial and domestic use
D-2 Financial contributions to Australia and East Timor governments from Timor Sea gas reserves
D-3 Contributions from export earnings, income sharing, taxes, salaries and purchases
D-4 LNG Promotion reduces greenhouse gas emissions in accordance with Kyoto Protocol[23]
D-5 Significant training and employment opportunities
D-6 Supply of infrastructure for future Timor Sea developments, economic diversification
D-7 Commitment to sustainable development in consultation with community
D-8 Expansion of reservation rainforest through purchase for conservation
D-9 No ecological threats and minimal and manageable environmental risks.[24]
NEGATIVE IMPACTS
D-10 Alteration of a wilderness island into an industrial plant site
D-11 Loss of dry rainforest and associated fauna that is of conservation value
D-12 Modification of inter-tidal pavement and sand flat near jetty and dock structures
D-13 Loss and disturbance of archaeological sites
D-14 Increased traffic, service and accommodation demand during construction
D-15 Restricted public access to industrial facility and dock structures
D-16 Possibly modified flight paths
D-17 High volume discharge of CO_2 into the atmosphere
D-18 Low volume discharge of atmospheric emissions of Nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter of size 10 (PM10)
D-19 Low volume discharges of hazardous and non-hazardous wastes to onshore sites

These likely impacts foreseen for the LNG facilities of Pampa Melchorita and Darwin can be grouped into broader categories:

1. Social, cultural, and economic impacts
2. Pollution and wastes
3. Loss of environmental stocks

[23] Greenhouse gas emissions are less than if oil or coal were used to provide the energy which will be generated from LNG; the project itself adds to greenhouse gas emissions.

[24] La'o Hamutuk does not believe that the absence of threats or risks is a positive impact. The EIA should describe the effects of building the project. If it were not built, this would also not have threats or risks.

These categories help us to conceptualize the main concerns for Timor-Leste if such a facility is to be built here. Extrapolating on the basis of Timor-Leste's specific situation and research and interviews carried out in Timor-Leste, La'o Hamutuk has identified several concerns to be addressed prior to the construction of this facility and which should be monitored in detail. This list include both expected "negative" impacts and potential "positive" impacts. The construction of this facility offers some opportunities from which the Timorese people can benefit, if the construction and operation process are carried out in a manner that aims to build on its natural and social environment. We list them here and discuss them in the following paragraphs.

Table 10. Categories of environmental and social impacts

IMPACT CATEGORY	CHARACTER	CONCERNS IN TIMOR-LESTE
1. Social, cultural, and economic	positive	1. Increased government revenues 2. Employment opportunities 3. Provide stimulus for local businesses 4. Energy source
	negative	5. Shrinkage of traditional economies, including loss of land and fishing and agricultural areas. 6. Loss of archaeological patrimony 7. Demographic pressure, including displacement, disruption of communities, impact of foreign workers.
2. Pollution and wastes	positive	8. Low CO_2 emission energy source (in comparison with coal or oil which the LNG would replace)
	negative	9. Increased greenhouse emissions, from burning gas, possible leakage of methane, and CO_2 extracted with the gas. 10. Wastes and discharges
3. Loss of environmental stocks	positive	11. Establishment of protected land (the Darwin plant traded its land use for a separate protected area. Timor-Leste does not yet have such a scheme, but it could be beneficial.)
	negative	12. Loss of vegetable cover 13. Loss of fauna and habitats 14. Increased demand for process water, which may impact on water table used by local communities

Social, cultural, and economic impacts

The construction and operation of the LNG plant has the potential to bring significant revenues and opportunities into the country. Revenues can originate through taxation of many of the activities, not only the processing of the gas, but also purchases and services rendered. Given the current level of development in

Timor-Leste it is unlikely, however, that Timor-Leste suppliers or workers will receive significant money from direct purchases of goods or services, as these goods and services are likely to be imported. These transactions can nevertheless be taxed by Timor-Leste, thus producing revenues. A more in-depth analysis of the revenues that the Timorese government can expect from the country's LNG aspirations can be found in Chapter 4, and a more detailed analysis of primary and secondary employment benefits is in Chapter 5.

The construction of the LNG plant will include building an electric power plant to supply energy for the plant processes. Constructing a larger or additional power plant could supply energy to the nation or to nearby communities. This would be a positive impact for the region neighboring the LNG facility, providing electricity with low environmental impact. Electricity production with natural gas could offset environmental concerns that have been raised regarding other major power enterprises such as the Iralalaro project. [115] To the knowledge of this team, however, this possibility remains unaddressed and thus the availability of energy for Timor-Leste resulting from the LNG endeavor cannot be counted on.

The implementation of the LNG processing plant in Timor-Leste will have some negative impacts on traditional economies such as fisheries and agriculture. These impacts might be small in comparison to the project's benefits for the nation, but will have major effects on the lives of those directly involved. They should be analyzed, and the people whose livelihoods are affected need to be compensated or given alternative employment opportunities. Especially during construction time, the site of the plant will experience significant demographic pressure due to the large number of workers. These changes in the local demographics need to be assessed and the potentially negative impacts such as prostitution and violence, curbed. Finally, construction of the facility might produce losses in the archaeological patrimony that is scarcely known at this point in Timor-Leste. Base studies as to the archaeological wealth and *lulik*[25] of the site that is ultimately selected need to be undergone prior to the beginning of the construction phase. This patrimony is designated protected in Timor-Leste by UNTAET Regulation 2000/19 on (Protected Places) [110], but the regulation is vague as to which areas are protected or what activities are prohibited in these areas.

Throughout the twentieth century, massive numbers of people in many countries were displaced to make way for large industrial or infrastructure projects, often with disastrous effects on their lives. In recent years, society has recognized that these people's rights must be respected, and a consensus is emerging around a standard that people forced to move should be better off after relocation than before. This is a complex area, and conventional methods which assign little value to "unimproved" land which is used sustainably or traditionally, while providing much more compensation to richer people who built expensive houses, should not be unthinkingly applied in Timor-Leste.

Pollution and wastes

Due to a variety of factors, Timor-Leste's environmental laws are still not in place, and currently Indonesian laws from 1999 apply. Current schedules hope to enact the Base Law for Environment (which encompasses the Pollution and Hazardous Waste Law [76] and the Law on Environmental Impact Assessment [77]) by the end of 2008. Under this law draft, the potential polluter, a person or an industry, requires a license to emit discharges to the atmosphere, land or waters of Timor-Leste that are noxious or poisonous, harmful to humans, animals or vegetation, or that are offensive to the human senses. It is ultimately the Directorate for Environmental Services (DNSMA) within the State Secretariat for Environment that is responsible to grant and regulate such licenses. Discharges described here should be carefully regulated. In order to receive the license, the project proposal needs to be accompanied by an Environmental Management Plan that describes the extent of the polluting activities and how their effects will be minimized, in all stages of the polluter's life-cycle (construction, operation, as well as decommissioning).

In this regard, the wastes expected during the construction and operation phases need to be considered. The Public Environmental Report Draft for the Darwin facility expansion [66] lists types of waste expected to result from construction and suggests ways to decrease damage to the environment. Table 11 below lists these types, together with information about Timor-Leste's capacity to deal with similar issues.

[25] *Lulik* is a traditional, animist belief that certain places and objects are spiritually meaningful, often embodying ancestors. Any use of such places requires permission from the appropriate leaders, and some should not be disturbed at all.

Cleared vegetation: "Mangroves and other trees or plants that are removed during the construction phase should not be burnt but stockpiled and used for environmental rehabilitation. This material can be re-spread in previously cleared areas or it can be chipped and used as mulch for landscaping of the facility's grounds." [66]

Spent oils and lubricants, and domestic garbage: The Darwin analysis [66] suggests that a commercial waste management contractor assume responsibility to dispose of hazardous materials in accordance with appropriate legislation. The DNSMA should dictate the appropriate method of disposal for spent oils, garbage and sanitary water. Currently, regulation of these wastes would be limited to the Draft on Pollution Control. [76] Due to the incipient development of environmental legislation in Timor-Leste and to the absence of locally operating waste management contractors with the required expertise, special attention should be directed to this topic, either by building the required capacity to handle the disposal of these materials locally or to monitor an external contractor. Garbage handling is a serious unresolved problem in Timor-Leste, which must be dealt with even without the additional burdens of the LNG facility. Therefore, significant capacity will have to be developed on site to handle the disposal of garbage.

Domestic/Sanitary Wastewater: Typically, run-off from clean areas in an LNG facility is directly discharged into the harbor waters. The rest, as discussed in the Darwin Environmental Report [66], should be treated and used for irrigation and landscaping. This report makes an exception for the water used for hydro-testing during construction, which will be released into the harbor containing chemicals needed for the testing process. The capacity for treating sanitary water is not extended in Timor-Leste and it will not be possible, in the short term, to subcontract this disposal to local industry. Regarding the water used for hydro-testing, studies should be conducted to ensure that chemicals are not released into the harbor if they could threaten the marine environment, or ensuring that mitigation measures are well in place, according to the Pollution Control Law.

Construction Materials: Disposal at approved location and/or collected in a suitable disposal area for recycling purposes. In the absence of appropriate landfills for disposal of construction materials, an appropriate site would have to be identified. The creation of a new landfill will require its own environmental impact statement, if it is not included in the LNG project. This will then fall within the dictates of the Environmental Impact Assessment Legislation [77] which was re-drafted in 2006. Care must also be taken about pollutants which may leach out of the landfill over time, making sure that they do not enter into the environment.

Hazardous Materials: primary contractor and subcontractors are responsible for on-site handling, required paperwork, and subsequent off-site disposal to facilities in accordance with appropriate legislation. There is currently no local capacity in Timor-Leste to identify, contain, and dispose hazardous materials that will be used during the construction phase. These activities might be subcontracted to internationally operating companies under license from the State Secretariat for Environment, if the Pollution Control Law draft is enacted.

Other Materials: As byproducts of the LNG, the plant will have to dispose of other wastes, particularly carbon dioxide (CO_2) and hydrogen sulfide (H_2S). Although the Darwin plant dumps their CO_2 into the atmosphere, more responsible operators (such as Snøhvit in Norway) keep it out of the environment by pumping it back underground. Timor-Leste should also do this, as responsible global citizens (see Box 18). Other pollutants, such as emissions from the power plant, should also be handled using the best available practices.

The amounts of these wastes generated by an LNG processing facility in the post-construction, operational phase will depend upon the technology used and upon the number of trains. These are the estimates for the Darwin 10 mtpa project [66]:

Table 11: Waste expected from Darwin LNG construction and operation

Solid Waste	Tons/Year	Treatment and disposal
Waste lubricating oils	16	Removed from the site by waste management contractors and disposed. A standardized practice is transportation to a lime kiln. Two companies have extensive experience in disposal of petroleum industry wastes.
Spent oils	1.5	Removed from the site by waste management contractors and disposed. A standardized practice is transportation to a lime kiln.

Cellulose	2	Removed from the site by waste management contractors and disposed in landfill, after appropriate testing and provision of test results to appropriate regulatory bodies.
Biological sludge	5	Removed from the site by waste management contractors and disposed of at local sewage treatment plants in accordance with regulatory requirements.
Inorganic sludge	0.4	Removed from the site by waste management contractors, de-watered when appropriate, tested as required and disposed in landfill.
Oily sludge	60	Removed from the site by waste management contractors and disposed. A standardized practice is transportation to a lime kiln. Darwin based waste management companies have facilities to dewater oily sludge.
Spent solvents	0.2	Removed from the site by waste management contractors and disposed. A standardized practice is transportation to a lime kiln.
Ceramic balls	5.5	Removed from the site by waste management contractors and disposed in landfill, after appropriate testing and provision of test results to appropriate regulatory bodies.
Molecular sieve waste	72	Removed from the site by waste management contractors and disposed in landfill, after appropriate testing and provision of test results to appropriate regulatory bodies.
Trash	80	Removed from the site by waste management contractors and disposed in landfill
Liquid Waste		
Treated Water Effluent	96,725	Treated and mostly used for irrigation and landscaping of premises
Atmospheric Emissions		
Particulates	537	Monitored, reported on, and released into atmosphere according to permit
SO_2	130	
NO_X	6,152	
CO	1,942	
CO_2	4,559,940	
TOC/CH_4	464	Burnt in incinerator and transformed into CO_2

Loss of environmental stocks

Clearing the area for construction of the facility will involve loss of vegetable cover and, subsequently, might endanger the habitat of animal species. UNTAET Regulation 2000/19 on Protected Places [110] protects animal and vegetable species. Once several sites have been chosen as appropriate for the conception of the plant, a base line study needs to be done to determine the local species and the impact that the construction of the proposed facility might entail. According to HABURAS, a local environmental NGO, the existing information regarding the distribution of fauna and flora in the island of Timor is lacking in detail. [7] There is also disagreement as to the exact boundaries of the protected areas, which include areas already used by people.

Indonesian and UNTAET legislation applies when not overridden by other Timorese legislation. In regard to the marine environment, Section 3 of UNTAET Regulation 2000/19 specifically includes as endangered species crocodiles, sea tortoises, sea turtles, and marine mammals such as bottlenose dolphins, whales and dugongs, in addition to those listed in the Convention on International Trade in Endangered Species. Those species and their habitats shall be protected in Timor-Leste and their destruction prohibited. Sections 4 and 5 of this

regulation also prohibit the destruction, removal, damaging, or pollution of coral reefs, wetlands and mangroves. Marine habitats are susceptible to disruption from the sea operations related to the LNG export, especially the frequent navigation of large tankers in addition to construction and the operations of dredging and of maintenance of the waterways.

The pristine environment of Timor-Leste is likely to suffer comparable losses to Darwin. However, since the land and marine environment of the island have not been surveyed in depth, the potential impact on sea species cannot be projected at this point. It is important to note, nevertheless, that judging from the Australian experience, a potential important loss to the marine fauna could justify alterations in the project and ultimately rejection of the enterprise, if it is deemed too disadvantageous by the Timorese people.

In July 2007, the RDTL Council of Ministers approved Government Resolution 8/2007 to create the joint terrestrial-marine Nino Konis Santana National Park at the eastern tip of Timor-Leste to protect terrestrial and marine natural and cultural values (see map, Figure 14). This incorporates three 'Protected Wild Areas' listed in existing Regulation 19/2000 [110] which named fifteen such areas, including several on the south coast (see Figure 14). This list is a step toward developing comprehensive Protected Area policies (scheduled to begin in early 2008) which will refine and add to the previous list and provide comprehensive guidance regarding management, prohibitions, regulation and enforcement. It seems obvious that major industrial facilities like an LNG plant should not be allowed in protected areas, and we hope that the legislation to be adopted next year will be clear, workable and enforced to ensure that such a facility does not destroying irreplaceable environmental, cultural, socio-economic or historical heritage.

The not-yet-enacted Law on Environmental Impact Assessment will regulate the environmental impact assessment process for infrastructure projects. [77] The current draft would define the LNG project as category "A," requiring an Environmental Impact Statement and an Environmental Management Plan, which are jointly referred to as an Environmental Impact Assessment. Infrastructure projects in close proximity to an Environmentally Sensitive Area (as defined in the draft), involve hazardous or dangerous chemicals, are related to petroleum, petrochemicals or hydrocarbons, or are major government infrastructure projects will be ranked as category "A." This draft would rate the LNG plant as category "A," requiring a full fledged EIA.

The aim of this discussion has been to illustrate that the LNG project will involve significant positive and negative impacts to the social and natural environment. Pampa Melchorita and Darwin provide examples of some impacts which may apply in Timor-Leste, although these will depend on the natural and social circumstances of the country as well as on the characteristics and location of the final plant design.

The economic and development benefits come together with consequences that can be detrimental to the marine, land, and atmospheric environments, as well as affecting the economic, cultural and traditional heritage of local communities. Whether the positive outcomes offset these costs to Timor-Leste can be predicted more accurately only after the project is defined – and the actual effects will not be completely known until they have already happened.

However, attention has been drawn to two important facts:

1. At present, Timor-Leste does not have the bodies, regulations and experience necessary to plan, monitor and regulate industrial activities to prevent, scrutinize and minimize the negative impacts. Most of the laws critical to ensuring the protection of Timor's natural and social environment are still in draft, and many of the necessary services, such as waste management, are not available locally.
2. There are very few base line studies describing the natural and archaeological wealth of Timor-Leste. In the absence of these studies, it is difficult to assess the potential losses in such an industrial endeavor and the extension of these losses will not be known.

Whether this situation represents an impediment for development or an opportunity for growth and capacity building depends upon a plethora of circumstances and choices. In Chapter 9, we discuss choices that must be made soon to ensure that the LNG enterprise is good for the people of Timor-Leste.

6.2. Potential hazards

LNG processing is commonly believed to be less dangerous than other hydrocarbon processing technologies. [30] However, accidents have occurred in the past and continue to occur, both during construction and during operation. These accidents have usually not affected people or property outside the facility's boundaries (see Appendix 5 for a discussion of LNG technological risk).

Although the risks associated with handling LNG may be less well-known, the plant will also involve a number of other dangerous petroleum components and other substances during construction, operation and transport, including natural gas (before liquefaction), LPG, condensate, tanker and generator fuels, other industrial chemicals, plant by-products, waste from all processes, and waste stored in landfills. The risks of accidents, fires and pollution from these materials are better known and must also be considered. For example, LPG and condensate are much more dangerous than LNG with regard to fires and explosions. Any gas that is liquefied by pressure can, upon rupture of the containing vessel, experience a boiling liquid expanding vapor explosion. [117]

One of the well known problems of LNG storage tanks is the possibility of the liquid withdrawal lines in the bottom of the tank freezing and leaking (this occurred in the Das Island incident in the United Arab Emirates in 1978). For that reason, modern tanks are designed with withdrawal lines suspended from the roof. Zip-failure is another well known problem that involves the structural failure of the tank due to freezing-induced brittleness of the inner tank steel. Although the industry considers all modern tanks to be safe, underground double-containment tanks are the safest design. See Figure 10 for examples of tank designs.

Box 21. Boiling liquid expanding vapor explosion, rapid phase transition, and pool fires

Gasses that are liquefied through pressure can start boiling violently when that pressure is taken away. For instance, if a pressurized container with LPG is ruptured pressure is initially taken away causing the liquid to start boiling violently, which rapidly releases large amounts of vapor causing extremely high pressure resulting in an explosion. This is called BLEVE, an acronym for boiling liquid expanding vapor explosion. The gas does not need to be flammable for this type of explosion. However, if the substance involved is flammable, it is likely that the resulting cloud of the substance will ignite after the bleve has occurred, forming a fireball and possibly a fuel-air explosion, also termed a vapor cloud explosion (VCE).

LNG is liquefied by cooling it below its boiling point (-160°C) while maintaining atmospheric pressure, and therefore a bleve cannot occur. The evaporation rate of the LNG depends on the material on which it is spilled, this material acting as a source of heat. For instance, soil provides heat when LNG is spilled on it but, as the gas evaporates, the soil freezes and reduces its capacity to transmit heat to the LNG pool thus reducing the evaporation speed. Spills on water evaporate faster due to the basically unbounded capacity of the sea to provide heat to the LNG pool with a practically constant evaporation rate. If a large quantity of LNG is immersed rapidly in a hot fluid like the sea (which is 180°C hotter), it reaches its superheat limit very quickly and can experience a Rapid Phase Transition (RPT) consisting of the explosive and spontaneous vaporization of the LNG. The release of energy is due to the sudden phase change from liquid to gas and it can result in a damaging explosion (see Figure 20). The created vapor – 600 times bigger in volume as compared to its liquid and still cold enough to cause cryogenic injuries – is dispersed in the atmosphere and travels with the wind (see Figure 19) creating elongated clouds that hug the ground when still cold. If the concentration of methane in the air is between 5% and 15% of volume, the gas mixture becomes flammable. If the vapor cloud within these concentrations of methane comes in contact with an ignition source or with extreme heat sources, it can ignite and produce a fire (see Figure 20) or even a vapor cloud explosion (see Figure 23). Even if this ignition happens far away from the spill, the fire can propagate backwards towards the source causing a ferocious fire directly above a pool of spilled LNG (see Figure 22). The fire spreads as the pool spreads and the heat radiation is so great that it can seriously injure and damage people and property even two kilometers from the fire. [22] The fire, which burns more violently than oil or gasoline fires, cannot be extinguished and the gas needs to be consumed before the fire goes out. Pool fires are the most serious hazards. [30]

LNG vapor clouds do not usually detonate unless they are in a confined situation due to walls, buildings or other obstacles. However, depending on the mix of vapor and air (at high hydrocarbon levels), these clouds can explode even in unconfined conditions (see Figure 23).

Figure 19. Experiments to contain a dispersing natural gas cloud with a physical barrier (Falcon LNG vapor barrier experiments, Nevada Test Site 1987, from [41]).

Figure 20. Ignited LNG vapor cloud from [69].

Figure 21. DOE's Burro experiments with LNG vapor dispersion, where Rapid Phase Transition shows explosive behavior. [41]

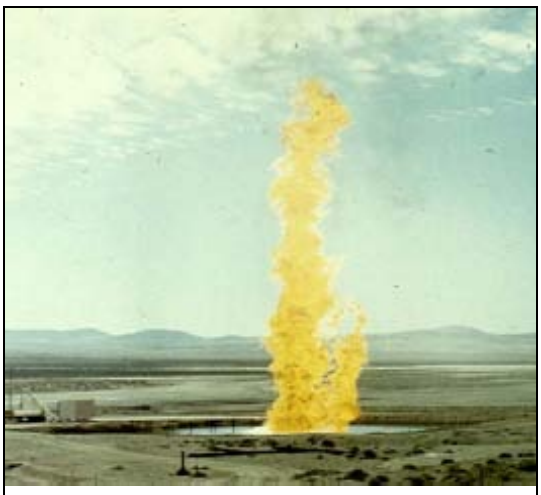

Figure 22. Pool fire experiments from [69]. The fire is shown in its initial phase.

Figure 23. Detonation of an LNG vapor and air mixture from [69].

Cryogenic contact injuries can occur if people are exposed to LNG due to its low temperature. However, most of the risk related to LNG processing is due to the rapid conversion of the liquefied natural gas into its gaseous form if not properly maintained at temperatures lower than -160°C. This situation can arise in cases of leaks and spills from pipes and valves within the facility, from storage tanks, or from LNG tankers. These spills can occur on land or on sea. LNG tanker ships have had a good safety record, but a tanker accident could have very serious consequences, especially if a large amount of LNG is released onto the sea surface. This can cause a "flameless explosion" from rapid evaporation of LNG on the ocean, forming pieces of ice and gas clouds followed by combustion and explosions. Such explosions could destroy everything alive within 10 km. But even if vaporization takes place at a less than explosive rate, the vapor could still ignite and produce a fire. In Timor-Leste's monsoonal climate, there can be months with no rain, which increases the likelihood that the fire can spread to dry vegetation. [61]

In order to assess the risks posed by LNG spills, an analysis needs to be carried out that addresses the evaporation speeds of the LNG depending on whether the spill occurs on land or sea, the wind influence on the vapor dispersion, and the existence of ignition sources. This helps predict exposure to potential fires and design measures to prevent them. The principal issues of LNG fire protection are extinguishing the fire, controlling and reducing the rate of burning, reducing the rate of thermal radiation from the fire, suppressing unignited LNG vapor cloud formation, and protecting surrounding structures and equipment.

LNG processing operations have a good safety record to date and handling natural gas poses, in general, milder hazards than handling most other petroleum products. Nevertheless, it is significantly more dangerous than industries Timor-Leste has experience with, such as coffee production, water distribution and diesel electric generation. Contingency plans need to be set in place for the eventuality of severe accidents. The operator must develop emergency response plans to control accidents at the source and to minimize their consequences at their onset. The people of Timor-Leste should, nevertheless, consider the possibility that the processing facility personnel might be unable to contain the impact of a severe accident to the plant's boundaries, in which case, a community emergency response plan needs to be in place. Currently, the capacity of Timor-Leste to control an industrial accident is severely deficient or nonexistent, partly because the country has no prior experience with large industrial operations. RDTL Petroleum officials [82] suggested that Australia's emergency response capability might be invoked in the event of a major industrial accident. This choice, unconfirmed at this point, entails significant dependency upon Timor-Leste's neighbor and involves additional uncertainty in the promptness of the response since distance, politics and international relations will be involved.

In parallel, and not directly related to the LNG enterprise, Timor-Leste is developing a disaster management plan to be able to respond to earthquakes, floods and other potential natural catastrophes. This plan should also be useful for responding to industrial accidents or fires. The current draft of the National Disaster Risk Management Plan [84] is a comprehensive document that discusses the needs for a risk management plan, briefly assesses the hazards that affect Timor-Leste, and details a workable mechanism to manage multiple risks that includes disaster preparedness, emergency response, and, to a more limited extent, rehabilitation and recovery. Parts of this plan are well designed and correspond to the highest standards of the United Nations International Strategy for Disaster Reduction (UNISDR) and other relevant agencies, but more work on them is needed to better integrate research institutions and coordination efforts between the National Disaster Management Office (NDMO) and other departments, including Environmental Services.

The document was developed by the NDMO while it was part of the Civil Protection Directorate in the Ministry of Interior. In the new Government structure, the NDMO has been moved to the Ministry of Social Solidarity and its State Secretariat for Social Assistance and Natural Disasters. We are concerned that this could indicate reduced attention to human-caused disasters (since they are not "natural," a concern that was confirmed by the NDMO director). Furthermore, the hydrochloric acid spill in Dili harbor in April 2007 (see Box 22) dramatizes the gap between well-written plans and their implementation during actual accidents. Significant additional time, work, and personnel are required to implement these plans so that Timor-Leste will be prepared to handle future disasters.

Annex 3 of the draft [84] lists the issues and capacities necessary for the risk management plan to meet the desired standards expressed in the same document. Out of 30 elements that concern risk management and need attention, 19 are nonexistent and have not been addressed at all, ten are labeled as "limited" or "weak," and only one is listed as "Available." This element is the linkages to avoid duplication with existing NGOs that participate in risk reduction activities, so this activity has little to do with capacity in Timor-Leste. These comments should

not be interpreted as criticism but rather as a warning that the country is not prepared at this point to respond to serious or even mild emergencies. Therefore, if the LNG infrastructure is to be built on Timorese territory an enormous effort should be carried out in parallel to stock up the local community with educational material and technical capacity to respond to eventualities that include violent fire and chemical and industrial spills. These efforts should include providing the local communities with capacity to regularly monitor the safety precautions at the plant site.

During our field visit to Lautem and Viqueque in May 2006, the authors observed the limited capability of the local community and administration to carry out a reasonable management of their infrastructure and to respond to relatively small scale incidents, like the partial collapse of the road of Viqueque to Beaçu, caused by river erosion of the toe of the embankment (see Appendix 6).

Box 22. Hydrochloric acid spill in Dili Port

On 16 April 2007, a ship heading from Indonesia to Australia discovered an acid leak onboard and consequently requested emergency docking clearance in Dili, where a leaking container was off-loaded. In the port offloading area, a gaseous substance was spraying out of the container, creating irritating fumes and puddles of liquid that flowed into the sea. The shipping bill specified that the substance was 22,000 liters of 33% hydrochloric acid, but this could not be confirmed because suitable sampling equipment was unavailable. By this time, many organizations and departments were involved, including the National Disaster Management Office; Ministry of Public Works, Transport and Communications; Ministry of Labor and Community Reinsertion; Ministry of Health; Ministry of Development and Environment; UNMIT, UNDP, UN Office for Coordination of Humanitarian Affairs (OCHA), WHO, and IOM. The Australian Defense Force component of ISF was able to contain and seal some leaks, but the container was in such bad shape that new leaks continued to appear. The leaks also formed an acid vapor cloud, and created a risk of a much bigger spill which would have severely impacted the local community.

OCHA, with help from the UNEP Regional Office and the German Federal Agency for Technical Relief (THW), established communications with chemical experts in the German BASF Chemical Company who recommended several mitigation/management measures and personal protection guidance, including the evacuation of the surrounding area. An evacuation site and transport were prepared for the population within 250 meters. While some people in the area evacuated, the IDPs in the Jardim camp defied the evacuation request, believing that it was a ploy to get them out permanently. Information also spread that fish caught in Dili harbor could be contaminated, causing many Dili residents to refuse to eat fish for several days, although this advice was quickly reversed.

The Timor-Leste government requested assistance from Australia, and members of the Queensland Fire and Rescue Service arrived in Dili on 17 April with proper equipment for testing around the exclusion zone and assessing danger levels. Recommended approaches were to neutralize the acid with the only available neutralizing agent available in Timor: cement dust and seawater.

The incident demonstrated that Timorese capacity to manage a disaster was very limited, without adequate technical expertise, although commendable coordination was conducted by the many agencies involved.

6.3. Risk analysis

This section of the report is a brief summary of the main concepts in LNG risk assessment. The risk analysis process depends heavily on site-specific information on environmental conditions, such as wind and sea currents, the existence of populations and forests in potentially vulnerable areas, and on the choice of the technology. Since, at this point, the site has not been selected and the environmental data available in Timor-Leste are scarce, this part of the report points to potential critical studies that should be carried out in the near term, in parallel or before other activities in the planning process.

As part of the risk assessment process, it is customary to develop an "event tree" that describes the possible paths that can lead to a potentially threatening event. By analyzing each of the elements in the event tree, it is possible to calculate or to obtain estimates for the probabilities of occurrence and consequences of each step, to ultimately obtain the risk quantification. See Appendix 5.

As interest in the transportation and processing of LNG has grown in recent years, so has the concern about potential hazards presented by these activities. A variety of agencies in the United States have commissioned studies to address the quantification and mitigation of the risks posed by LNG processing. The Sandia National Laboratories LNG Spill on Water Risk Assessment [31] is one such study.

Risk analysis process for an LNG spill on water

Earlier we discussed that the potential threats of LNG processing mainly originate from spills of LNG at sea and on land. Evaporation of spills on land happens at a much slower rate than spills on water because soil is a much poorer thermal conductor. Therefore, LNG spills on water will evaporate faster and steadily, potentially

creating larger vapor clouds at a faster rate, which in turn, constitute a hazard if ignited. In the United States, LNG spills on land are regulated through articles DOT 49 CFR 193 and NFPA 59A but so far there are no regulations with respect to spills on water.

According to the Sandia study, six main damaging events can result from an LNG spill: injuries from asphyxiation, cryogenic burns and structural damage, combustion and thermal damage, LNG fireballs, LNG and air explosions, and Rapid Phase Transitions (RPT). Pool sizes can range from 150 m in diameter for small, accidental spills to several hundred meters for large, intentional spills. [31] High thermal hazards from fire are expected to occur within approximately 250-500 m from the origin of the spill. Major injuries and significant structural damage are possible in this zone. The extent of damage will depend on the spill size, and the dispersion from wind, waves and currents. People, major commercial and industrial areas or other critical infrastructure elements (such as chemical plants, refineries, bridges and tunnels), or national icons located within portions of this zone could be seriously affected. With increasing distance, hazards and thermal impacts become less dangerous, but for a large spill minor injuries and damage are still possible at 1,600 m. If the vapor cloud disperses considerably before being ignited, distances up to 2,500 m are possible, and hazards are much greater.

Risk management

Given the technical descriptions of the hazards obtained through the modeling of the spill event, three zones of security are proposed in the Sandia report [31] with varying risk mitigation requirements:

Zone 1: Areas where the LNG shipments transit narrow harbors or channels or come within 250 m of people and major infrastructure. For Timor-Leste. this should include the existence of rich environmental ecosystems, such as the Lore Reserve which is a coastal forest. Thermal radiation poses a severe hazard within this zone and can cause significant damage to people, infrastructure and the natural environment, including coral reefs and fishing grounds. Risk management needs to address vapor dispersion and fire hazards.

Zone 2: Areas in which LNG shipments occur in broader channels or large outer harbors, or within 250-750 m of major critical infrastructure or settlements. Hazards are less severe within this zone and risk mitigation should, like in zone 1, be focused on vapor dispersion and fire hazards.

Zone 3: Areas where LNG shipments and deliveries occur beyond 750 m from major infrastructure and settlements, or in large bays or open water. Thermal radiation in these areas poses minimal risk to public safety and property. Risk mitigation should concentrate on vapor cloud dispersion.

Appendix 5 lists several prevention and mitigation techniques that might be deemed necessary or that might be recommended depending on the threat level. Some are easier to implement than others and Timor-Leste should develop a specific study to select some of these procedures, or variations thereof, to reduce risk with the available resources.

Relevance to Timor-Leste

General knowledge about the hazards that this infrastructure and the LNG traffic entails should guide the site selection process or, at least, play a role in addition to the engineering technical requirements (see Chapter 3). After the site is chosen, a thorough risk analysis should be conducted. For the case of Timor-Leste, the following points should be carefully considered:

Risk assessment guidelines: The Timor-Leste facility should include a risk assessment and mitigation study in line with other facilities around the world. Regardless of the company or consultants that carry out this work, the most up-to-date version of the risk assessment guidelines by the Sandia National Laboratories [31] should be taken into account, in addition to other methodologies that might be used to corroborate or to expand the results.

Hazards for the environment and settlements: The site selected for Timor's LNG processing facilities will be on the south coast, and nearby natural ecosystems will be within zones 1 or 2, as defined above. If this is the case, special attention needs to be paid to the hazard of vapor clouds and ulterior ignition. This hazard poses high risk of fires with the consequent damage to the environment and nearby settlements, especially during the dry

season. Of most concern, however, is the limited capacity of Timor-Leste to control a fire of the proportions that an LNG incident could trigger.

Education and information of stakeholders: All stakeholders, especially nearby residents, need to be consulted, informed, and considered in the decision making process involving risk, mitigation and disaster prevention. In order for this dialog to occur under fair circumstances, the local population needs to be thoroughly educated as to the dangers that the LNG processing facility poses. These hazards need to be assessed and properly communicated, without alarming the population, but with a thorough treatment of the causes, the risks, and the prevention and mitigation measures. If the consequences of a potential fire or of thermal radiation extend beyond the limits of the LNG processing facility, the people of Timor-Leste need to have the training, preparedness, and resources to act appropriately to control the impact and to protect their lives and property. Considering the current state of development of coastal rural communities in Timor-Leste (see Appendix 6), this task requires enormous efforts by the government and plant operator.

Preparation and prior studies: In order to assess site-specific conditions that play a significant role in risk assessment, Timor-Leste must begin to gather data as soon as the site for the LNG facility is chosen. These studies will be necessary to conduct the risk assessment but also for the environmental impact assessment. Indeed, these two studies are interdependent. Ultimately, a description of sea currents, waves, wind, natural ecosystems, water availability, etc. will enormously contribute to the design process of the LNG facility. Some of these studies are important on their own, for instance the environmental stock assessment. Data on wind speed and direction is important to assess the consequences of potential LNG spills. This work should start as early as possible, and it will be very helpful to Timor-Leste's development, regardless of its LNG ambitions.

Legal considerations: In the United States and elsewhere, many of the mitigation strategies, in order to be successful, rely on the support by legislation and from international treaties. Timor-Leste needs to develop similar legislation and make sure that it is properly enforced. This will guarantee that LNG traffic and handling is carried out appropriately. Unless Timor-Leste advanced its legislation and enforcement, the risk is high that LNG shipment and activities will be conducted with lesser standards, which might lead to threatening circumstances for people and property.

Chapter 7. Effects on women

Women in Timor-Leste, like women everywhere, fill important roles in the family, society and nation building. In countries like Timor-Leste, women often have to work hard to sustain their families. During the resistance, their involvement in the long struggle for national liberation showed great courage, and today they have to struggle for their own economic and political liberation.

Article 17 of the Timor-Leste constitution states that women and men shall have the same rights and duties in all areas of life: family, cultural, social, political and economic. This is to guarantee women's rights in economic activities, their political, social and cultural rights, and it also means that every person is entitled to equal protection of their human rights and security.

The women we interviewed during our field visits stressed how important development is for this country. They have high expectations that bringing the LNG plant to Timor-Leste, especially to their communities, will benefit them economically. They don't yet know the other ways their lives will be affected by the LNG plant or by oil and gas development. They described how the expect the plant to increase their families' incomes by selling their agriculture products and handicrafts, renting places for foreigners to stay, and working with the company or in support facilities. However, they need information about other impacts from the processes of construction and operation, and what the government and the companies will do to minimize risks and enable women to participate fully.

This part of this report will describe how the LNG development could impact negatively on women's lives in Timor-Leste, especially in the area of development, unless the government and companies give this serious consideration. In many natural-resource-rich countries, women and children suffer from mining and petroleum operations because the government and companies give less attention to their needs and don't respect the rights of women and others who are powerless and voiceless.

In this context, we will discuss some social problems which could affect women's lives if an LNG plant is built, and will offer some proposals about actions the government and the companies can take to prevent these problems from arising.

Land rights and displacement of women

In Timor-Leste, most land in rural areas is still considered traditional land because few people have legal documents to prove formal ownership. One government official told us that if the government needs land to build a project for the national interest, then local people should move to allow this to happen [19]; and most people we interviewed agreed.

Current ideas for land compensation would pay more to rich people than to poor ones. For instance, if people have built an expensive house, they will receive more than those whose house is made from local materials. In Timor-Leste's situation, many people's houses are made from grass, often rebuilt every few years – but the land is still their home. If land is primarily used for agriculture, it is considered less valuable than land with buildings on it, even if it is their only source of income. Compensation based on market value is problematic as land in remote rural areas often has a low market value (nobody with money is interested in it), even though it is essential to the lives of people who live there.

Timor-Leste's predominant patrilineal land tenure system discriminates against women (although in a few communities like Manatuto, women also can inherit land along with their brothers). Consequently, women's access to land rights is usually limited and conditional. Conversely, in the few areas where a matrilineal system operates, men have limited and conditional access to land. [20] Therefore, in most cases, women do not participate in decisions on selling land nor benefit from compensation for land sales. As Timor-Leste does not yet have a formal law on restitution and hence there is no mechanism for legal recourse, women could be deprived of participation in compensation for land sold to make way for the LNG facility.

Traditionally, one of the responsibilities of women is to collect clean water for cooking, drinking, washing and other purposes. However, a large construction project or facility like an LNG Plant could deprive communities

of their sources of water, or could use a lot of water, draining streams and water table and forcing women to walk further to collect water.

Many women still depend on natural products for health care because they cannot access the hospital, so they rely on local materials for traditional medicine. People's economic survival depends on farming.

If a large construction project is built, it may destroy the local environment, and women may lose their sources of medicine, food and income. If they are relocated, it will be difficult for women to adapt and survive. Women in many resource-rich countries have suffered from this situation. For instance, in India mining has displaced women and medicinal plants are lost due to forest destruction, leaving women without a health support system. Often the women are too poor to buy medical services and medicines (if available), but the company will not pay for their medical expenses. [50]

It is possible to do development well, if the developers take great efforts to make sure the project will benefit the local people and the country. If the LNG Plant is built in Timor-Leste, the government should guarantee displaced people's rights, requiring the companies to pay sufficient compensation to protect the community, and to pay particular attention to possible impact on women and children who live in the area of the facility.

Women and economic activities

Since the majority of Timor-Leste's population is women, they play very important roles in the family and society. Because our infrastructure is not developed, women have to walk far carrying their produce to sell it for very low prices in the market. During the rainy season, the products often become wet and cannot be sold. Women usually have to walk for long distances to gather firewood or fetch water. They spend a large portion of each day doing this work, so they don't have much time or opportunity to develop their capacity for other kinds of work and roles in society. Women hope that if the LNG plant is built in their area, they will benefit from new or improved facilities such as roads, bridges and public transport.

As discussed in Chapter 5, the LNG facility could improve the infrastructure in Timor-Leste which will help women to participate in economic activities. However, women will need training, micro credit and other support to benefit from economic activities made possible by an LNG project. There should be a mechanism to guarantee that women will benefit from the construction and the development.

Women's voices

Timor-Leste's has been independent since May 2002, and our Constitution guarantees women's right to participate in politics. Timor-Leste has more women political leaders — government officials and members of Parliament — than most other developing countries. However, traditionally women's political status remains very weak, and often depends on their husband, father and brothers. Especially in rural areas where the LNG plant will be built, women are often excluded from decisions which will have major effects on their lives. Many rural women have very low educational levels; most of them are illiterate. This is because parents with limited resources often give lower priority for girls to attend school, discrimination reinforced by the strong traditional structure and patriarchal system. We are concerned that women may not be effectively involved in debates about how the LNG project will relate to the community, and that they will not receive adequate benefits – essential compensation, education and health care facilities. In Timor-Leste's patriarchal system, consultation usually involves only men. If women do participate, it is often just to prepare food for the men who will negotiate for the companies and government. Women are often excluded from the process, or put in support roles, because the men consider them to have low education, limited knowledge and little courage.

For example, the World Bank and the Timor-Leste Ministry of Natural Resources, Mineral and Energy Policy are developing a Resettlement Policy Framework for the Gas Seep Harvesting Project planned for Aliambata. [83] The Framework says that the project will pay particular attention to the needs of vulnerable groups among those who will be displaced, especially those below the poverty line, the elderly, women, children, and ethnic

minorities.[26] However, the consultation process in the area was very limited. There was only one woman among the people selected to speak, and even she does not live in the area of the project.

To break this pattern, the government and company must involve women in the processes of community consultation and negotiation and bargaining, while providing sufficient information for the women to contribute effectively to these important stages. We believe that women's participation is essential because only they possess certain information and priorities; they must be empowered and given a critical role. Since men often dominate in mixed groups, we encourage government to hold separate consultations with women only, so that they have the chance to talk to government directly. The information thus gained could help allocate funds or priorities to provide education and otherwise enable women and girls to participate more fully in such processes.

Health care

In many resource rich-countries, communities are tremendously damaged by oil and gas exploitation in their environment. The average woman in Timor-Leste will have seven or eight children, and health is a critical issue for them.

Timor-Leste does not have enough health facilities, especially in rural areas and for people who are too poor to purchase medical treatment. As we discuss in Chapter 3, an LNG plant is a large industrial facility that operates in a coastal environment. Construction and operation will have major impacts, including some which are not anticipated. Major disruption or contamination of air quality, noise, seas, rivers, soil and ground water often accompany such facilities.

Box 23. An indigenous woman from the Ecuadorian Amazon living close to an oil exploitation area:

"Our environment and farmland were contaminated by oil, we can't use the land for farming anymore. My sister was dying because of cancer, no sufficient medical facility was available, and we did not have enough money to go to the hospital. Our children could not study or sleep because of the noise from the company every day and night. We are women; we have to take care of the children." [62]

Most people in rural Timor-Leste earn their livelihoods from farming. The water which they use for cooking and drinking comes directly from the ground. Their domestic animals usually eat grass from the area where they live and drink the water from a nearby stream. If the LNG plant is built in Timor-Leste, and if it releases toxic pollutants by low-level leakage, "normal" emissions, or accident, it could cause long-term poisoning of farmland or water. This would be devastating for the entire community which depends on land and water; their animals will die from drinking contaminated water, and their crops will be inedible. Contamination is especially dangerous for pregnant women and children, who are the most vulnerable. If they can't get clean water for drinking and cooking, they will suffer many diseases.

These situations are very burdensome for women, and this burden affects the entire society. The government and companies must find ways to prevent this from happening in our country. We should learn from other countries' experiences and manage our natural resources properly for the well-being of all people: women, men and children.

Prostitution, trafficking and domestic violence

Prostitution is not accepted by Timorese society, and women are always the victims. However, Timorese men sometimes use prostitutes, taking advantage of women who need money and have fewer opportunities for legitimate jobs than men do. Women and girls become involved in prostitution for many reasons, including economic need, as well as the social disruption and disparities of wealth inherent when different cultures come together. During construction and operation of the LNG plant, hundreds of foreign workers, mostly men, will come to our communities. This could lead to prostitution, as highly-paid men far from home seek sexual gratification while impoverished local women, with their lives disrupted by the plant, accept their money in

[26] The Resettlement Policy Framework for the Aliambata Gas Seep Harvesting Project only applies to that project, but it gives an indication of how future processes for other gas-related projects might be undertaken.

return for sexual favors. Prostitution will also increase HIV/AIDS in the community,[27] and prostitutes are most likely to suffer from this illness.

Currently, there are also some problems with trafficking of women and children in Timor-Leste. We are concerned that if the LNG plant is built in Timor-Leste, the resulting social disruption and influx of foreigners on short-term contracts could lead to increases in trafficking of women and children.

Domestic violence is high in Timor-Leste, although society usually considers domestic violence to be a family problem. Women and children are the most common victims. Because men are considered the heads of the family, with power and responsibility, they often hit their wives, children and other family members when they get drunk. The construction of an LNG Plant in Timor-Leste could also increase domestic violence, because some men will have opportunities for jobs, interacting with foreign workers who may bring drugs and alcohol. Other Timorese men, frustrated that they cannot get a job with the company, could vent their anger on their families. If the plant requires families to relocate or change their way of living, domestic violence also will worsen because of the increased stress.

Women and children are usually told to be silent when they experience domestic violence. If they bring it up, they do not get much support from their community, or even their families. Many women in rural areas use traditional methods to deal with domestic violence and sexual violence, even though these are crimes, and these traditional processes often produce unsatisfactory results for the women victims. [63, pages 59 and 66] The traditional justice mechanism used by most communities to deal with their conflict is called "Tesi Lia"/resolving problems, and the traditional leader who serves as an arbitrator is called "Lia Nain."

We recommend that the government establish a legal mechanism to assist women in rural areas where the LNG Plant will be built to access justice, as well as a process for alternative dispute resolution which can provide a just solution in domestic violence cases. In addition, gender equality should be integrated into curricula, the law on domestic violence should be approved, and men should be educated through seminars and training.

Women's access to justice

When rights are violated or disputes arise, women and other disenfranchised people rely on the court system to protect their interests against powerful forces. But women often cannot get adequate legal assistance or even information about their rights and legal processes. Against a company of a government, women are sometimes afraid to bring a legal case because they feel powerless. Often, they cannot afford to hire legal counsel or even to travel to the court. In many cases, the only support for victims of crimes against women are women's organizations, whose female staff may provide legal assistance to some vulnerable women. Therefore, the larger (male) community assumes that only women need to support women, and most women do not receive the information they need.

Cases related to women are often not brought to the court, but dealt with within their families. According to International Rescue Committee research on gender based violence, only 3% of women ask the police for assistance, 9% try to forget the problem, 32% resolve it within the family, 51% of women felt that the best way to cope was with support from their family and 5% went to traditional justice. [99, page 13]

Even when people decide to go to the police or court, the judicial system process is very slow. According to the Judicial System Monitoring Program which monitored Dili District Court for two months during 2004, 55% of the scheduled criminal hearings were related to women (as victims, no women were perpetrators), and most of them were for sexual violence. Only 16% of these hearings actually took place, and the court failed to deliver any decisions. None of the domestic violence cases reported to the Vulnerable Persons Unit during that time were scheduled for court hearings, and there was no significant progress in other cases involving women victims. [40, page 4]

[27] According to Timor-Leste Vice Minister for Health Madalena Hanjam in October 2007, 43 Timor-Leste people are known to have been infected with HIV/AIDS, of whom 11 have died.

Timor-Leste has only four district courts, which often are not functional. The LNG plant will be quite far from any of the courts, making it difficult for women to travel there. The judicial system in Timor-Leste is still very weak. Therefore it is important to establish a legal mechanism – information and support center, as well as courts – near the project which can be accessed by women and others who are directly affected by the project.

Employment and training

While Timorese women are increasingly taking on traditionally male roles like earning money to support their families, men rarely reciprocate by taking on female roles, such as sharing child-care or domestic responsibilities. In addition, Timorese society has often prioritized educating men over women, and education itself often reinforces gender-based role models. Furthermore, many professions are seen as "male," such as mechanics, carpentry and construction. This results in fewer women in technical trades or in higher-paying skilled positions.

Although policies, development programs, and training in Timor-Leste could be said to be largely gender neutral and in theory do not discriminate between the sexes, they are also gender blind, meaning that they do not sufficiently consider the specific circumstances of women. Simply allocating a set number of training places for women is not enough. To allow training and development programs to become more open to women's participation they should be short and recurrent, because many women have little time to spare or are not accustomed to sitting in a classroom. They should be locally based, with child-care and transport available. Timing should also be flexible to fit in with women's existing workloads.

Training for women and others could include trades and business management, which would help empower them to benefit directly and indirectly from the development of the LNG plant. In addition, child care, micro-credit, cooperatives, community organizations, and other mechanisms can provide necessary support for women and small businesses to receive a share of the benefits of LNG development.

Also, dissemination of information on training and business opportunities should be extended and take into account the specific problems women face. Furthermore, increased training opportunities need to be enhanced with increased access to small grants or loans. More targeted support by the government is needed. For example, the Women's Business Council of the Philippines, set up by and for women, received significant initial support from the Philippine government Department of Trade and Industry. [108]

Within the LNG project, strong commitment from government and project developers can help overcome the obstacles facing women. From the beginning, extra attention should be given to training women for jobs in the project, in the local school and university systems, as well as in scholarships for study abroad and training given by the government or companies. Recruitment and hiring processes should make extra efforts to locate capable women, so that the promise of Timor-Leste Constitution Article 16 (equality and non-discrimination) and Article 17 (equality between women and men) can be fulfilled.

Chapter 8. International and domestic politics

Our analysis so far has mainly focused on the social, economic and environmental advantages and disadvantages of a pipeline/LNG complex in Timor-Leste. This section addresses the political effects of such a project. Building a pipeline and gas liquefaction plant will have important implications for political and power relationships within Timor-Leste and between Timor-Leste and other countries. Predicting these consequences is speculative, and the points we raise are neither unavoidable nor exhaustive. As each political actor in Timor-Leste decides whether this LNG project is a good idea, he or she should consider how it will influence both Timor-Leste's domestic interests and its foreign standing.

In other petroleum-exporting developing countries, the money and critical decisions involved in petroleum exploitation often bring conflict and corruption. Many believe, for example, that Australia approved Indonesia's invasion of Timor-Leste in 1975 in part because Canberra believed it would be easier to negotiate a deal over Timor Sea oil with Indonesia than with an independent Timor-Leste.[28] In our neighbors – Aceh, Bougainville and West Papua (see Box 8 above) – exploitation of oil and mineral resources has also brought war, human rights violations, and other violence.

In addition, the profits and revenues from petroleum development are so huge that improper expenditures of tens of millions of dollars or more are hardly noticed. From Suharto to the Shah of Iran, from Nigeria's Sani Abacha to Iraq's Saddam Hussein, dictators have taken power to obtain oil's huge profits, and used them for personal gain, to maintain control, and to finance repression. Timor-Leste will require leaders of exceptional integrity and consistent laws for transparency and accountability to resist corruption and bribery. Even in rich, democratic countries, corruption is widespread in the oil industry: Thanks to an error in contract negotiation, many U.S. oil companies are currently depriving the U.S. government of billions of dollars in natural gas royalties. In the last four years, the top executives of companies with the highest reputation – Statoil and Shell – have been forced to resign because of improper practices.

Box 24. Power corrupts

In 2006, *The New York Times* revealed that the Bush administration had failed to collect billions of dollars from companies drilling for oil and gas in federal waters through a mistake in offshore leases that allows companies to escape an estimated $10 billion in royalties. In addition, leases were signed at royalty rates far below current global norms. Future royalty rates were raised somewhat in 2007, but past leases are still in effect. [8], [9]

Statoil CEO Olav Fjell and Chairman Leif Terje Løddesøl were forced to resign in September 2003 because of allegations that the company had violated Norwegian law by paying bribes to Iranian officials. [6]

Shell CEO Sir Philip Watts was forced to resign in March 2004 after regulators caught the company systematically overstating its reserves for many years. Watts received a million pounds in severance pay and was subsequently investigated by U.K. and U.S. authorities, although no charges were brought. [101], [119]

Timor-Leste has fortunately resisted these levels of corruption and violence since 1999, but there is no reason to believe that we are immune to such temptations. As petroleum processing and extraction move onshore, the decisions become more complex and the benefits of shortcuts and favoritism become larger than when they were out of sight in the Timor Sea. Timor-Leste's 2005 petroleum legislation[29] provides some protection against corruption and human rights violations, but it may not be strong enough to safeguard our people, our political system and our environment. Before a LNG facility or other large petroleum project is built on our land, we need to have a system that not only is better than current worldwide practice, but that will actually be effective.

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[28] One reason this belief is widespread is the cable sent from Australian Ambassador to Indonesia Richard Woolcott to Canberra on 17 August 1975: "… I wonder whether the Department [of Foreign Affairs] has ascertained the interest of the Department of Minerals and Energy in the Timor situation. It would seem to me that this Department might well have an interest in closing the present gap in the agreed sea border and this could be much more readily negotiated with Indonesia than with Portugal or independent Portuguese Timor. I know I am recommending a pragmatic rather than a principled stand but that is what national interest and foreign policy is all about." [56]

[29] The 2005 Petroleum Act [74] applies to newer upstream projects but not to Sunrise, as the Sunrise production-sharing contract was signed before Timor-Leste became independent in 2002 and was exempted from subsequent legislation by the Timor Sea Treaty. A downstream project like the LNG plant would have to obey other Timor-Leste laws, which are not yet written.

Citizens and decision-makers must also understand the effects that developing an on-shore LNG facility could have on the domestic politics of Timor-Leste. We will look at a few political challenges which often accompany large infrastructure projects in other countries. Nobody can tell for certain whether these would in fact materialize, but there is a risk (and there could of course also be others).

Alienation of local communities

Regional rivalries could emerge concerning the siting of the plant. Our field trip to Lautem and Viqueque showed that even with little knowledge about what an LNG facility would involve, local leaders are eager for it to come to Timor-Leste and to their district in particular. There is an almost universal perception that the effects will be positive, especially in terms of providing jobs and incomes to local residents, but also as an important national symbol. As plans advance, different regions might see each other as competitors for a desirable project. At the same time, there could be local advocacy against having the plant built in a particular community. When local residents become aware of the social and environmental costs of the plant (including the likely need to relocate an entire community from the chosen site), every district may want the plant, but no *aldeias* or *sucos* do — the "Not In My Back Yard" syndrome. Although policy-making in Timor-Leste is quite centralized, this creates the prospect of regional loyalties becoming more important. Once the plant site is chosen, moreover, any environmental degradation, accidents, or social problems between the construction crews or plant staff and the local population will foment anger and frustration that can turn to insecurity or violence if the grievances are not properly addressed, as examples such as Nigeria's Niger Delta region (see Box 7 above) show.

Militarization

Oil, gas and mining operations are often accompanied by militarization and human right abuses. The companies require security for their facilities, and they often use armed guards to ensure that they can operate safely and without unexpected interruptions, employing military, police, civilian staff or private security companies to protect themselves from people they perceive as hostile.

In Timor-Leste's current uncertain security situation, many people feel that their freedom of movement is restricted by the deployed international and Timorese security forces. Our people have had long experience with the oppressive Indonesian military, which causes them to be afraid of men with guns.

Timor-Leste's perceived instability may motivate the operators of the LNG plant to hire local people and private security to protect their operations. Foreign governments could also decide to provide security for foreign investments, as has happened in Colombia, where the U.S. government used the war against drugs as a reason to provide $98 million to train and equip Colombian soldiers to protect an Occidental Petroleum pipeline. [16]

West Papua has become world-famous because civilian and military security personnel abuse the local population while protecting Freeport MacMoRan's copper and gold mining operations (see Box 8 and reference [26]). In other resource rich countries, such as Ecuador, Bougainville, Nigeria and the USA, oil and mining companies have been in conflict with indigenous people for decades. Timor-Leste needs to carefully consider how we can avoid repeating those experiences, which will be especially difficult because our police, military and private security companies are inexperienced and have limited understanding of international human rights standards.

This problem has become more recognized internationally, and the United States, Britain and other governments and extractive industries have developed a set of *Voluntary Principles on Security and Human Rights*. [112] In addition to preventing conflict by developing good relations between the facility and the local community, international companies operating large facilities here should be required to follow these Principles.

Displacement

Throughout the twentieth century, massive numbers of people in many countries were displaced to make way for large industrial or infrastructure projects, often with disastrous effects on their lives. In recent years, society has recognized that these people's rights must be respected, and a consensus is emerging around a standard that people forced to move should be better off after relocation than before. This is a complex topic, and

conventional methods assign little value to "unimproved" land which is used sustainably or traditionally, while providing much more compensation to richer people who built expensive houses. This valuation would be unjust in Timor-Leste's society and should not be unthinkingly applied here.

Secondary economic benefits

One of the main arguments for bringing Sunrise gas to Timor-Leste is the possibility of "spin-off" effects for local economic development. As we discussed in Chapter 5, this will require the central and district government to work together with the companies to maximize the share of local content in employment and supplies. Experience from other countries, however, suggests that promoting local content can easily lead to corruption and cronyism. Legally-mandated local content is often under the control of government officials who may be tempted to influence the allocation of contracts according to their private interests rather than the common good. Even the mere perception of corrupt behavior is damaging to the trust between the government and the governed, and so this risk should be very clearly taken into account from the earliest stages of planning for the project. The history of politics in Timor-Leste since independence is permeated with unsubstantiated allegations and unverified denials, with government officials employing criminal defamation charges to fend off their critics. If a multi-billion dollar LNG project is to be carried out, its managers and decision-makers must find a way to change this pattern.

We have already warned in this report that without careful preparation, the non-fiscal benefits of a pipeline/LNG facility will prove elusive. People have great expectations that a facility will spur economic development in their area, and if these are disappointed the results could be devastating. *In extremis*, such frustrations fuel violent conflict. The tragic situation in many oil-rich countries reflects in great part the offensive physical juxtaposition of continuing poverty with extractive industry facilities whose benefits are not enjoyed by the population that suffers the negative effects of the infrastructure.

On the international level, it is important to note that any development option for Sunrise must be approved by both Timor-Leste and Australia, and by the private companies, led by Woodside (see Figure 2). Our fiscal estimates in Chapter 4 showed that, other things being equal, Timor-Leste's government would benefit in fiscal terms from the downstream project being located in Timor-Leste. Australia, by comparison, stands to benefit more from a downstream project located in their tax jurisdiction. In other words, supposing that the profitability of the downstream project would be the same in the two countries, the decision where to locate it amounts to a zero-sum-game between the two countries. On the same assumption, the developer of the downstream project would seek to build in the jurisdiction that both offered the lowest taxes (or highest subsidies) and the most secure and stable conditions for profitable operation. It is likely that Timor-Leste will be perceived as worse on both of those dimensions, especially if current tax laws are applied.

If we consider, as some claim, that the downstream project would be less profitable if built in Timor-Leste — either because of higher construction costs or because of a lower risk-adjusted LNG sales price — the conflicts of interests are even more stark. As we explained in Chapter 4, Timor-Leste could still benefit in fiscal terms, because the loss would be passed on to the upstream project. That means, however, that Australia would not only lose the tax revenue from the LNG plant, but would also receive less from the upstream project. Similarly, the upstream private contractors would reap lower profits if a less-than-maximally profitable downstream development is chosen, since this will lead to a lower netback price to the upstream. Australia and the companies will need to be persuaded that the non-fiscal benefits to Timor-Leste from building the plant here outweigh whatever tax revenues and profits they might lose, and Timor-Leste will be under pressure to compensate them for conceding that income. Similarly, if the plant is built in Australia, Timor-Leste should insist on compensation for lost revenue and development opportunities, which could be cash payments and/or opportunities for training, employment and subcontracting.

These conflicts of interest mean that it will be difficult for all parties to agree on how to develop Sunrise. We expect that both the upstream contractors and the Australian government will push for a downstream solution in Australia. Australia may well link this issue to other negotiations with Timor-Leste, such as other Timor Sea questions, Australian influence over Timor-Leste security policies, or Australia's military presence in Timor-Leste. Potential downstream contractors will likely seek tax concessions from both countries, making them bid against each other to offer the most profitable arrangement to the companies. When evaluating the prospect of a pipeline/LNG project, therefore, Timor-Leste must determine how much it is willing to concede to achieve an

agreement on the downstream project, or alternatively, whether it should use the LNG questions as a bargaining chip to improve its standing in other matters to be negotiated with Australia. Timor-Leste could also negotiate compensation from the companies in return for approving their preferred development plan outside Timor-Leste.

If the RDTL government achieves its policy goal of building an LNG facility in Timor-Leste, this will have another large effect on the country's international political situation. It will make Timor-Leste a more integral part of the international energy supply chain, significantly increasing energy-importing countries' concern about political or other instability that may interrupt the delivery of LNG. The countries that will buy Timor-Leste's LNG – perhaps Japan, China, Korea, USA or India – would be the most concerned. More indirectly, any disruption in Timor-Leste could potentially effect gas markets in general, at least insofar as a global LNG spot market continues to develop (see Box 13).

Countries concerned about energy supplies may therefore pay particular attention to Timor-Leste, which could on balance be beneficial or nefarious. The increased importance of Timor-Leste in global energy politics could be harnessed by a wise foreign policy. However, it may also encourage a more intrusive attitude vis-à-vis Timorese politics in reaction to real or imagined threats to stability or to policies perceived to increase the risk to LNG production and exports. We are not making judgments on these questions, but simply highlight them as important topics to consider while deciding about the LNG facility.

Chapter 9. Fulfilling the dream

Timor-Leste's people have high hopes and grand dreams about oil development for our young nation. We imagine that a pipeline to Timor-Leste will bring far more than natural gas: it will stimulate economic growth, create employment opportunities for Timorese workers, spin off money into our local and national economy, and show the world we are a modern, industrial, independent nation. We heard these expectations from officials and citizens in Dili, and from local people throughout Lautem and Viqueque.

However these dreams will be difficult to realize. Political stability in our new nation is fragile, law enforcement mechanisms and practices are weak, and the institutions of our state are inexperienced and incomplete. Many of the necessary laws to protect our human rights, land, economy, and environment have not been passed. People in local communities do not yet have much information about the Sunrise LNG plant, even as of our national leaders are unrealistic about the benefits and dismissive of the dangers. The "resource curse" that afflicts many other countries can also happen here.

The humanitarian and political crisis which began in April 2006 demonstrates how challenging it is to use Timor-Leste's petroleum wealth to benefit our people. Even though the Petroleum Act [74] and Petroleum Fund Act [73] require transparency and promote wise revenue management and Timor-Leste has saved two billion U.S. dollars in the Federal Reserve Bank, poverty is endemic, unemployment is widespread, infrastructure is limited and deteriorating, and many of our population are not confident of their security and do not trust public officials. The causes of these problems – fragility and inexperience of state institutions, lack of human resources, inability to implement government programs – must be overcome before a project like the Sunrise LNG plant can safely and effectively benefit current and future generations. Before companies will invest billions of dollars in a plant on our shores, they, their customers and our people must be confident that the facility will operate harmoniously for three decades or more.

The vision that bringing the pipeline to Timor-Leste will provide many jobs for Timorese workers may be an illusion. The oil industry is global, powerful and high-technology, and most of its high-paying jobs require many years of education and experience. During the two to four year construction phase, there will be opportunities for short-term work for local people, but during the following decades of operation, the plant will require only approximately 200 people, mostly with specialized skills. If Timorese workers are to fill these positions, we must plan and prepare long in advance.

We all must work hard to come up with ways to fulfill these dreams. Since the Government as committed to bring the pipeline onshore to Timor-Leste, there are several steps which should be taken now:

1. Timorese people must be well-informed about the government's plans for LNG development. Communities should be told of the risks associated with the development as well as the benefits, and consultation should be held to ensure the informed voices of Timorese women and men are represented in decisions. Local people should be given the chance to choose what is best for them.
2. A legal foundation should be in place which incorporates respecting land rights, assessing and protecting the environment, guaranteeing sacred places, managing pollution and disasters, enforcing transparency and public consultation, safeguarding workers' rights and safety, and preventing conflicts of interests. More than five years after independence, Timor-Leste has not enacted laws to ensure the above, and without them we are vulnerable to violations of our rights. In addition to passing the laws, enforcement and monitoring systems and personnel must operational. Sanctions for violations must be severe enough to ensure that companies comply with these laws, and a judicial system must have the capacity to fairly and expeditiously resolve any disputes or violations.
3. The Government must initiate programs to equip Timorese people to undertake higher-skilled jobs in the companies involved in the LNG project, as well for those who will manage and regulate the project on behalf of the Government. Training, scholarships, apprenticeships, and education should begin at the pre-secondary level to prepare people for work in petroleum and related industries. The better this is done, the more Timorese will get jobs that would otherwise go to foreigners. The Government should require companies to hire and train Timorese workers and facilitate the flow of information on recruitment, so that companies can find the people they need for positions and people have information to apply for the jobs that they are qualified for.

4. We can avoid the worst by being ready. The hydrochloric acid leak in April 2007 illustrated that Timor-Leste is not prepared to handle even a simple accident in our capital. The recently repaired bridge to Beaçu (see Appendix 6) exemplifies how difficult it is for us to maintain and repair even simple infrastructure. With a major industrial facility like an LNG plant, the infrastructure needs are far more complex and critical; the consequences of a badly-handled accident would be much more devastating. Before undertaking such a project, Timor-Leste needs developed planning, procedures, interagency coordination, emergency medical response, communications and deployment systems which can deal with the worst that could happen.
5. In order to maximize spin-off benefits, the LNG project needs to be integrated into local economic development plans. The plant requires water and electricity, for which it has to build its own supplies, and the construction of these facilities could also benefit the community, either by utilizing the contractors who build the plant infrastructure to build infrastructure for the country at the same time, or by constructing roads, docks, generators or similar infrastructure to serve both the plant and the local population. In order to ensure maximum and sustainable spin-off benefits, the Government must conduct specific, far-sighted planning, as well as stimulate and develop the capacity of local businesses.

9.1. When should Sunrise development begin?

As La'o Hamutuk recommended in our "Case for Saving Sunrise" paper [94], Timor-Leste would gain by extending the period of Sunrise production by starting later and reducing the rate at which gas is extracted and liquefied. Timor-Leste will benefit more extensively from operating than from construction, and a longer project lifetime allows for more Timorization. A single 3.5 mtpa train, with a smaller-diameter pipeline, would be less costly to build than the 5.3 or 7 mtpa plant capacities that have been suggested. Timor-Leste would also benefit more if the project started later, giving us more time to prepare to receive its benefits. Although these options may be less preferable for the companies, they would be better for Timor-Leste's people.

At present, the Estimated Sustainable Income (ESI) to Timor-Leste from oil and gas projects under contract (primarily Bayu-Undan) is about $300 million per year, as described in the Petroleum Fund Act. [73] The ESI will increase to about $550 million/year when a Sunrise Development Plan is agreed, as the anticipated Sunrise revenues will then be included. If that Plan includes an LNG plant in Timor-Leste, the annual ESI would be about $625 million. All of these numbers are far beyond the capacity of the Government to execute programs responsibly, and the amount actually spent over the next several years is likely to be considerably less than the ESI. As the following two graphs show, the income Timor-Leste receives from Bayu-Undan alone is far above the ESI for the next decade, and Greater Sunrise will provide additional income for another couple of decades.

However, if Greater Sunrise is developed as quickly as possible (see Figure 24), its revenues will overlap those from Bayu-Undan, creating a revenue peak which will be deposited into the Petroleum Fund. In this case, Sunrise revenues will stop when the gas is exhausted, about 35 years from now. Figure 25 shows an alternative, delaying the start of construction until 2015, with production starting in 2020. In addition to providing six more years of income, this delay would have several advantages for Timor-Leste:

1. It would allow more time to train our workforce and develop secondary businesses, increasing the share of revenues which would come into our economy.
2. It gives time to develop, pass, implement and gain experience with environmental laws and other legal prerequisites for a successful LNG project.
3. It gives our administrators and regulators more time to develop their capacities and experience, so that they are better able to ensure that the project serves Timor-Leste's interests.
4. It allows us to take advantage of improvements in rapidly-developing LNG and deep water pipeline technology.
5. It will probably result in less expensive construction and higher revenues, as current very high construction costs (see Box 12) are likely to drop after a few years.
6. It is likely to result in increased income, as the sales price of oil and gas is almost certain to go up over the long term.

7. Finally, if development is delayed Timor-Leste could request renegotiation of the CMATS treaty, allowing us to achieve our right to a maritime boundary and secure a greater share of our natural resource entitlement.

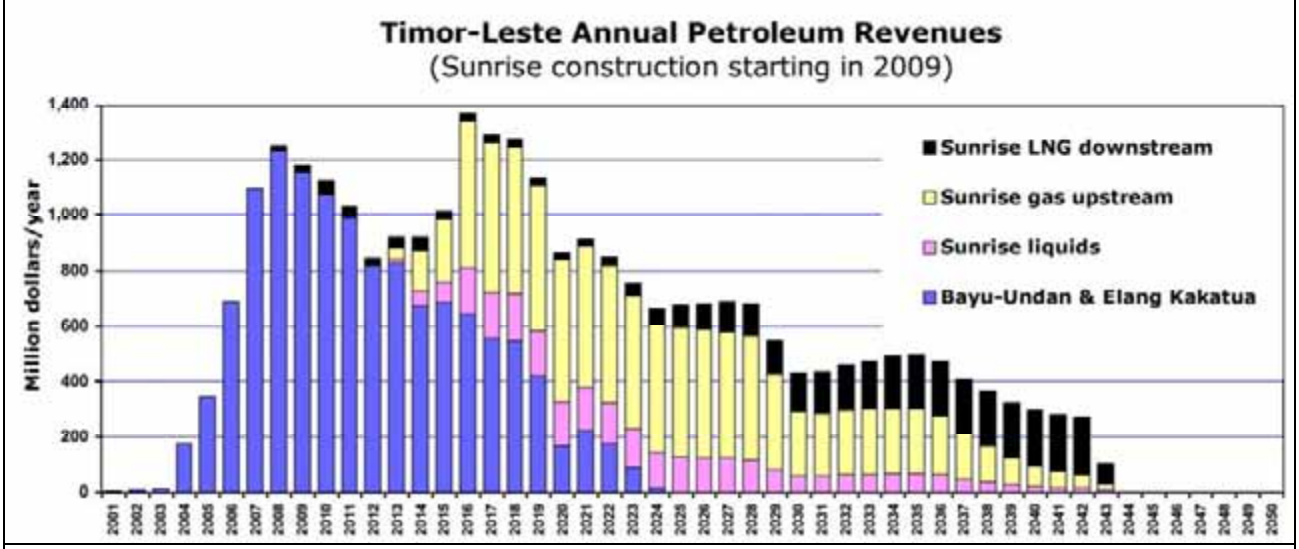

Figure 24. A qualitative approximation of the revenues Timor-Leste will receive each year from the Bayu-Undan and Greater Sunrise fields if Sunrise construction starts in 2009 and production in 2013, which would be the fastest possible. This graph should be considered as a general illustration only, since the numbers depend on future oil prices and other factors which are impossible to predict with any accuracy.[30]

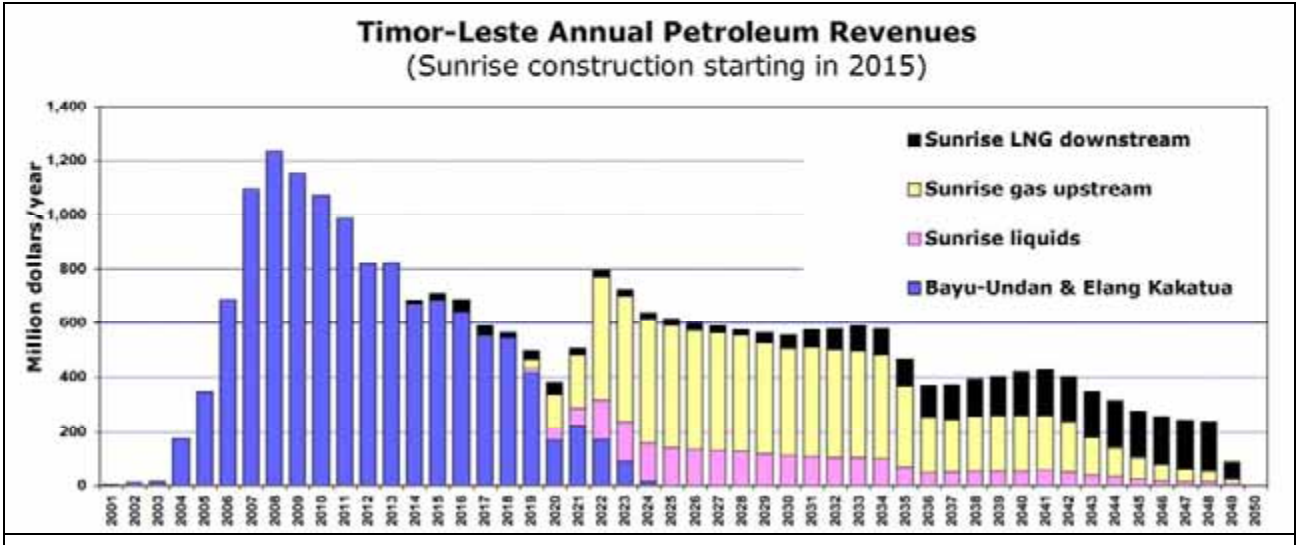

Figure 25. This graph uses the same assumptions as the previous one, except that Sunrise construction starts in 2015 and production in 2019.

[30] In these two graphs, revenues for Sunrise gas upstream and downstream are based on prices and other assumptions similar to Scenario 1 in Chapter 4.2 (see also Appendix 3). They are corrected for inflation, assuming a 2.6% annual rate. For illustrative purposes, we have included estimated revenues from Sunrise liquids (see Box 5) and Bayu-Undan adapted from information used by the Government of Timor-Leste. However, we have assumed a lower inflation rate and somewhat higher oil prices than the very conservative government estimates in order to more closely approximate actual revenues and make projections from two sources more consistent. References [80], [113], [125].

9.2. Recommendations

As stated above, these recommendations must be implemented now, even before a development plan is agreed to and contract negotiations begin. They should be done in consultation with civil society and other relevant stake holders. Carrying out these recommendations will help ensure that our government and people are prepared to host such a project, and that we have time to develop the mechanisms to carry them out. A firm legal framework will also provide assurance to the companies that the rules will not be changed in the midst of the project.

Putting these recommendations into practice will be good for Timor-Leste even if the Sunrise pipeline goes elsewhere. Most of them will be relevant to any large or industrial project, to increasing the range of jobs available to our workers, and to protecting the rights of our communities and vulnerable groups. Whether or not Timor-Leste receives the Sunrise LNG plant, we will benefit if discussions of this project stimulate our leaders and citizens to think and act seriously and concretely about the future.

Fiscal and economic issues

An LNG plant could potentially be of major fiscal and economic benefit to Timor-Leste. In addition to significant downstream tax revenues and some employment, we could receive secondary economic effects such as local and national business booms through sub-contracts for construction, and a general increase in economic activity. However, under the current circumstances and recently proposed legislation, Timor-Leste will gain less than many people are expecting. The project runs a risk of becoming an enclave, with no spin-off benefits to Timor-Leste, and therefore several measures are needed to maximize fiscal and economic impact:

1. Downstream tax revenues could be as much as four billion dollars over the lifetime of the project under the current tax laws, the most important being a 30% corporate income tax. A reduction of this tax to 10%, as currently proposed, would mean a huge (approximately 2 billion dollars) loss in revenues, and we recommend that the government reconsider the implications the proposed tax reform would have on a project of this scale and any other future projects.
2. The Government should integrate the LNG project with local economic development plans. Feasibility studies should be conducted on using electricity from the plant's power generator for the national grid, and whether the construction dock can be adapted to become a commercial port. These studies need to be translated into a concrete plan with budget allocation, to be implemented by relevant ministries. These measures will not only serve the plant, but will also boost economic development in the south coast region.
3. The Government should increase efforts to develop the local private sector. This should include provision of subsidies and loans (e.g. through a special investment fund for small Timorese businesses to establish and develop business activities), an increase in business information and development services as well as training in project acquisition and management (with special attention to construction and hospitality services). The juridical and social security of the private sector should be improved requiring a review of Investment Law and the Land and Property Law. This should include incentives for setting up local businesses and the promotion of the creation of cooperatives through the establishment of a Cooperative Supporting Institution.
4. Contracts, laws and other arrangements should encourage the oil companies to give preference to sourcing workers, products and services from Timor-Leste, in general terms, increasing local content. For instance, a requirement could be that local content steadily increases over the operational period of the project, reaching 85% or more after 20 years. Both the Government and the companies should establish coordination mechanisms to promote local content before the project begins to ensure that such objectives are met.

Maximizing employment benefits

Many of the dreams currently being discussed for the LNG Plant revolve around the job opportunities which will be presented in the building and operation of this facility. Although these are fewer than some believe, Timor-Leste workers could receive a significant number of positions if proper preparation and legislation are undertaken. If not, low-paid cleaners and maids will receive the crumbs from higher-paid foreign workers.

5. The Government and companies should identify the specific job skills required for an LNG project – from construction through to decommissioning – and begin to prepare now. The development of Timorese skills should include local education, providing scholarships, on-the-job training and internships. Government should increase investment in technical education and training, encourage local educational institutions to expand on relevant subjects, and give scholarships for Timorese in specific areas of mechanical and civil engineering and the hospitality and services industry.
6. To increase Timorese employment over the multi-generational lifetime of the project, the Government needs to improve vocational education in Timor-Leste, including a review and reorientation of the technical and vocational education curriculum to enable adequate and flexible response to demand, and increase the quality of teaching in existing schools. Furthermore, the existing engineering faculty within the National University and private universities in Timor-Leste should receive significant assistance to increase capacity, quality and facilities to anticipate the project's needs.
7. To protect those who will be employed by the project, the Labor Code and other Health and Safety Regulations should be revised to clearly stipulate regulations related to working hours and shifts, secondary benefits, health and safety measures, working in hazardous environments, as well as regulations related to injuries and death. The Government must have effective mechanisms to enforce, regulate and arbitrate labor laws and disputes.

Social and cultural issues

Although the project promises positive effects, it also carries risks of negatively affecting Timor-Leste's people. Most land in rural areas is still considered traditional land because few people have legal documents to prove formal ownership. A national-interest endeavor, such as the LNG project, endangers local community land rights, threatens livelihoods of communities, and could destroy existing sacred places and infrastructure reflecting traditional values of the community. A huge influx of foreign workers further threatens local economies such as fisheries and agriculture, and could increase the vulnerability of women, elders, and children. Timor-Leste is currently unprepared to prevent these effects, and important steps need to be taken:

8. Land and property rights must be clarified, with recognition of individual and collective ownership over land and traditional systems of tenure. If the project requires land from individual or community owners, or will negatively impact on their livelihoods, the Government should have in place an effective, transparent and adequate compensation system. This requires revisions of the Land and Property Law and regulations on protected areas. Any decision for a plant location should be preceded by a coordinated assessment, of local social and cultural traditions, sacred places, land and water use and other related factors, with concrete recommendations to mitigate the project's negative impact. This assessment should have extensive involvement of local civil society and be part of the formal Environmental Impact Assessment discussed below.
9. Company contractual requirements should include mechanisms to mitigate adverse effects and resolve disputes that may arise due to the influx of foreign workers, with a priority to respect local values and customs as well as the obligation to obey national judiciary law and respect Timor-Leste's courts and arbitration procedures. To minimize conflicts between the community and foreign workers, and to channel community voices and facilitate dispute resolution, a coordination mechanism should be established which includes representatives the company, workers, government, and civil society.
10. All institutions, bodies and committees should take special consideration of gender issues, so as not to perpetuate discrimination against and the victimization of women. This ranges from women-focused business training and scholarship preferences, to mechanisms to avoid wage differentiation and sexual exploitation of women. All assessment teams, coordination teams and liaison teams, at all levels and stages, must include women as well as men.

Environmental issues

An LNG Project will introduce many new environmental problems. The project could double Timor-Leste's carbon dioxide emissions to the atmosphere and will generate significant amounts of polluting materials, such as hydrogen sulfide, oils, garbage, sanitary water, and other waste. Timor-Leste currently has insufficient laws or

capacity to regulate, monitor and control waste generation and pollution of this scale, and many important steps need to be taken:

11. The Government should revise the Law on Environmental Impact Assessment and, related to this, develop proper guidelines for conduct of an EIA for an industrial project. An EIA should include a detailed Environment Management Plan spelling out pollution management and mitigation, disaster management plans, and detailed mechanisms for minimizing negative cultural and social impacts. To enable proper evaluation of a submitted EIA, the Government should establish a joint coordination mechanism among ministries and departments, increase capacity of these departments, and include recognized expertise from national and international non-governmental organizations. The Environmental Impact Assessment process should include informed local consultation and consent, as well as the opportunity for civil society organizations and local community leaders to give input to and modify the Management Plan.
12. A Pollution Control law should specify limits to pollutants, including CO_2 and other greenhouse gases, chemicals which affect sea, ground water and soil quality, as well as issues like flaring and noise pollution. The law needs to be detailed on requirements for waste disposal and treatment of various types of waste, so that regulatory and monitoring bodies can enforce it, and public and private waste disposal and treatment facilities can be developed.
13. A base law on the environment, incorporating pollution control and environmental impact assessment laws should also define conditions for decommissioning of projects and constructions when their operational period has ended, to ensure that Timor-Leste is not left with toxic materials or dangerous structures after the company leaves. Plans on decommissioning should be part of the contract and the EIA, although they could be written to enable Timor-Leste to revise its decommissioning requirements during the course of the project.
14. Each law developed should spell out or refer to sanctions and/or penalties which are severe enough to compel compliance. Contractual agreements should stipulate that the operating companies obey these laws. It is therefore necessary that laws and regulations are in place before the onset of the project, and that Timor-Leste has the personnel and the mechanisms necessary to identify violations and expeditiously enforce the law.

Appendix 1. Oil and gas in and near Timor-Leste

Large deposits of oil and natural gas under the Timor Sea, in Timor-Leste's territory as well as that of neighboring Australia and Indonesia, have been explored for more than forty years. Many of the offshore fields are in formerly disputed territory; Figure 26 and Table 12 list the major known fields which should belong to Timor-Leste under current international legal principles.

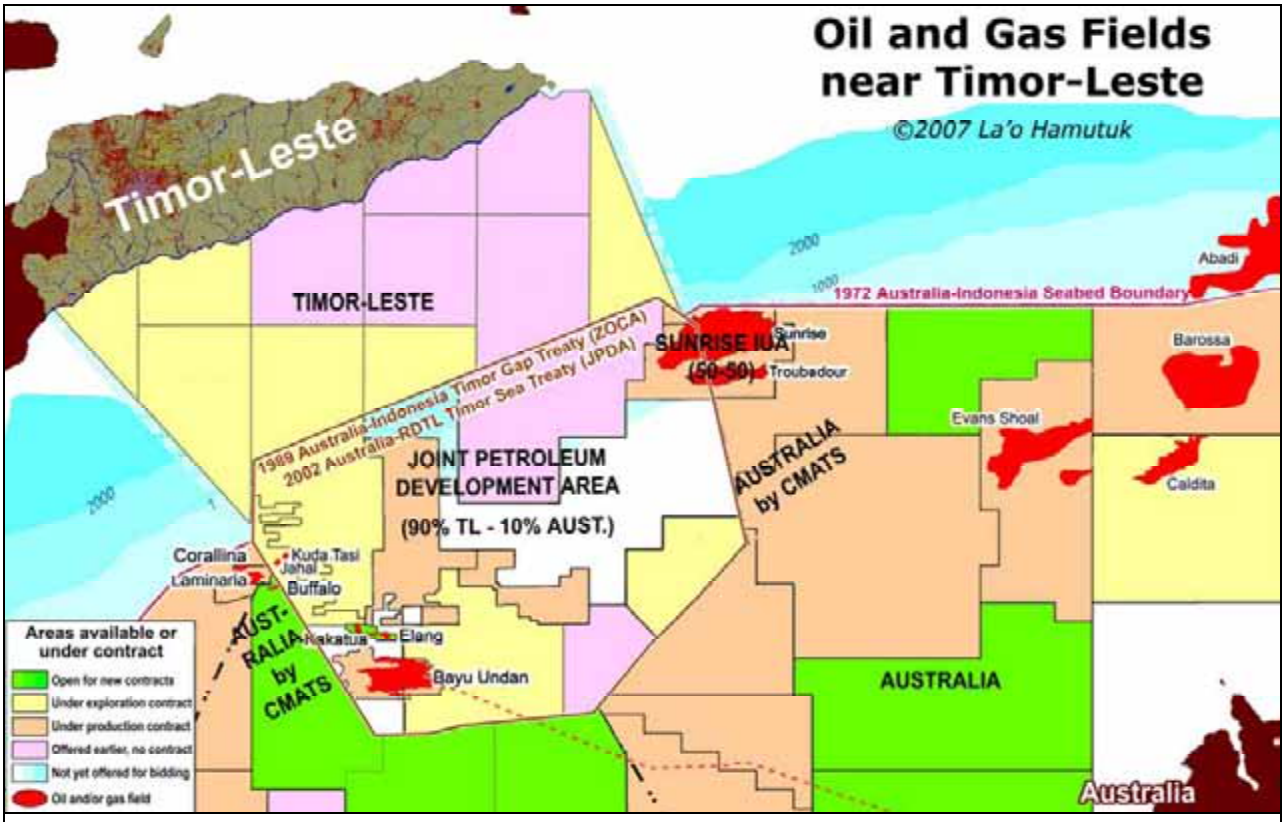

Figure 26. Offshore oil and gas fields (red), areas under contract (tan and yellow), and areas currently (green) or previously (pink) available for bidding in and near Timor-Leste's territory.

During 2006, new exploration contracts were signed for areas in the Joint Petroleum Development Area (JPDA) and in Timor-Leste's exclusive maritime territory. Timor-Leste also has deposits under its land, including oil and gas seeps which were collected during Portuguese times, but none of these are currently in production. Onshore natural gas could also be processed at an LNG plant built for Greater Sunrise, but it is likely to be much less than what is contained in offshore fields.

Table 12. Offshore oil and gas fields closer to Timor-Leste than to any other country

Name of field Operator	Location	%TL under treaties Upstream / downstream for gas projects; oil is upstream only.	Status	Total oil reserve (P50 est.) million barrels	Total gas reserve (P50 est.) trillion cubic feet	Oil produced through Sept. 2007 million barrels	Gas produced through Sept. 2007 trillion cubic feet
Greater Sunrise Woodside	20% in JPDA, shared under CMATS.	50% / not yet decided	Production will start after the Development Plan is decided by all parties, perhaps as early as 2012.	300	8.3	0	0
Bayu-Undan Conoco-Phillips	JPDA	90% / 0	Began oil production in 2004 and gas production in 2006. This field provides nearly all of Timor-Leste's current petroleum revenues.	400	3.4	81 ref.[92]	0.2 ref.[92]

Buffalo* Nexen (was BHP)	JPDA	90%	In production 1999-2004, now decommissioned.	16	0	16	0
Elang-Kakatua* Conoco-Phillips (until July 2007)	JPDA	90%	In production from 1998 until July 2007, the TSDA is looking for a new operator as ConocoPhillips is no longer interested.	32.7 ref.[102]	0	31.3 ref.[102]	0
Laminaria-Corallina Woodside	Just outside JPDA, disputed until 2006 when Timor-Leste ceded it to Australia in CMATS.	0%	Began production in 1999. Australia has received $1.5 billion in revenues.	210	0	183 ref.[124]	0
TOTAL		**61%**		**959**	**11.7**	**311**	**0.2**
* These fields started production during the Indonesian occupation. Their ownership has changed twice since 1999.							

In 1991, Indonesia and Australia awarded the first exploration contracts for Timor-Leste's resources, which they divided according to the illegal Timor Gap Treaty. The companies eager for this stolen oil included Royal Dutch Shell, Woodside Petroleum Ltd. (which later became Woodside Australian Energy), Santos and Phillips Petroleum (later ConocoPhillips), all of whom are still exploring and exploiting Timor-Leste's maritime petroleum resources. ConocoPhillips' small Elang-Kakatua oil field was the first. Discovered in 1994, it began making money for Indonesia and Australia in July 1998, and, nearly exhausted, stopped operation nine years later. (For a chronology of these and related events, see Appendix 2.)

The largest field entirely in the JPDA is the Bayu-Undan oil and gas field – 400 million barrels of condensate (liquids) and 3.4 trillion cubic feet of gas. ConocoPhillips and its partners began developing this field in the late 1990s, while it was still stolen territory. Bayu-Undan offshore development continued without interruption during Timor-Leste's popular consultation, subsequent destruction, and UN transitional government. Liquids production started in 2004. Since 2006, natural gas has been sent by pipeline to Darwin, giving Australia most of the jobs and all the downstream revenues. The gas is liquefied there and shipped to Japan. Production will peak around 2010, and the field will be exhausted by 2024. The project comprises 58% of Timor-Leste's Gross National Income (GNI), and supplies more than 90% of government income. [80]

From 1999 through September 2007, Australia has taken in more than US$1.5 billion[31] from Laminaria-Corallina, an oil field much closer to Timor-Leste. This field, just outside the JPDA and claimed by both countries, is nearly exhausted. Timor-Leste has protested the theft of its resources, but Australia is adamant and Timor-Leste yielded in the 2006 Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS). [45]

Greater Sunrise, including the Sunrise and Troubadour fields, is the largest deposit in the area. According to the Timor Sea Treaty, 20.1% of Greater Sunrise lies inside the JPDA and 79.9% is outside, in contested waters where Timor-Leste consented to Australian control in CMATS. Woodside has long had a contract to develop Sunrise, but suspended work in 2004 and resumed in 2007, after Australia and Timor-Leste agreed on the ownership and revenue-sharing for the field. Upstream (extraction) revenues will be shared 50/50 between the two countries, but downstream revenue division will depend on where the LNG plant is built.

Timor-Leste, Indonesia and Australia each hope that an LNG plant in their territory could become a regional "hub," processing gas from several fields. In addition to Bayu-Undan and Sunrise, four other offshore fields may be developed within 5-10 years (see Figure 26.) The Australian company Santos has licenses and is drilling exploratory wells in Evans Shoal (estimated to contain 6.6 tcf of gas), Caldita and Barossa in Australian territory, while the Japanese company Inpex has a license for Abadi (5.0 tcf), just across the border in Indonesia. Any or all of these could be profitable to process at an LNG plant in Timor-Leste, provided that the companies and the countries where the fields are located are persuaded that this is an economically and politically attractive option.

[31] Calculated by La'o Hamutuk based on sales and tax information in Woodside's filings with the Australian Stock Exchange. [124] See http://www.laohamutuk.org/Oil/Boundary/laminaria_revenues.htm.

Appendix 2. History of Sunrise developments

The history of Greater Sunrise, and the dispute over who owns it, goes back more than thirty years. This chronology lists the major events, but does not try to explain the context or more details. More information is available on La'o Hamutuk's OilWeb CD-ROM and website (http://www.laohamutuk.org/Oil/OilIndex.html).

1970-1998

1970-1973 — Australia and Indonesia begin negotiations on seabed boundaries, ignoring Portuguese objections that the seabed should be demarcated halfway between the coasts of Timor and Australia. Australia and Indonesia sign treaties "Establishing Certain Seabed Boundaries" on 18 May 1971 and 9 October 1972, which come into effect in November 1973. These treaties are based on the continental shelf principle, which is biased in favor of Australia. Because Portugal did not participate, the other two countries could not complete the line between Portuguese Timor and Australia, creating the "Timor Gap." See Figure 1.

1974 — Troubadour and Sunrise oil and gas fields discovered, collectively called Greater Sunrise. Woodside drills a test well Troubadour-1, with additional wells at Sunrise in 1975. See Figure 28 below.

7 December 1975 — Indonesia invades Portuguese Timor (Timor-Leste).

1979 — Australia accords legal *de jure* recognition to Indonesia's annexation so it can negotiate with Jakarta about a maritime boundary to close the Timor Gap. Over the next ten years, Australia and Indonesia hold more than a dozen negotiating rounds. Although the countries cannot agree on a seabed boundary, they eventually reach an arrangement to share oil revenues.

11 December 1989 — Australia and Indonesia sign the Timor Gap Treaty. The treaty establishes a Zone of Cooperation (ZOC) between Timor-Leste and Australia (later called the JPDA), north of the median line. It provides for Indonesia-Australia joint exploration of the illegally occupied territory, with revenues shared 50/50. The treaty is ratified and takes effect on 9 February 1991.

Figure 27. Foreign ministers Gareth Evans and Ali Alatas toast the signing of the Timor Gap Treaty while flying over the Timor Sea.

11 December 1991 — Australia and Indonesia award production sharing contracts to Phillips Petroleum (which later became ConocoPhillips), Royal Dutch Shell, Woodside Australian Energy (later called Woodside Petroleum) and other companies to explore and exploit resources in the Timor Gap Zone of Cooperation.

1995-1996 — Australia and Indonesia issue Production Sharing Contracts 95-19 and 96-20 for the part of Greater Sunrise inside the Zone of Cooperation (JPDA) to the Northern Australia Gas Venture (Woodside and Shell). Australia also issues contracts NT/P55 and NT/RL2 for the portion of Greater Sunrise east of the JPDA.

August 1995 — Sunrise appraisal well drilled at Loxton Shoals, with a total of seven wells drilled by 1998.

1999-2001

30 August 1999 — Timor-Leste's people vote overwhelmingly to reject integration with Indonesia.

10 February 2000 Australia and UNTAET sign an interim Memorandum of Understanding, to continue the 1989 Australia-Indonesia Timor Gap Treaty terms but replace Indonesia with Timor-Leste. These agreements specify a 50/50 division between Australia and Timor-Leste of oil and gas production from the Joint Petroleum Development Area (called the Zone of Cooperation under the Timor Gap Treaty).

July-Sept. 2000 Woodside, Shell and partners undertake an extensive 3D seismic exploration of Greater Sunrise.

October 2000 UNTAET begins negotiations with Australia for a longer-duration agreement over division of Timor Sea resources, but not about maritime boundaries or the EEZ. In April 2001 Australia reiterates that it will not discuss formal maritime boundaries in the Timor Sea.

5 July 2001 UNTAET and Mari Alkatiri sign the Timor Sea Arrangement with Australia. Under this Arrangement, which replaces the February 2000 MOU, Timor-Leste will receive 90% and Australia 10% of upstream oil and gas revenues from the JPDA. The JPDA inherits the ZOC from the 1989 Timor Gap Treaty, altering only the division of revenues. Greater Sunrise is deemed to lie 20% in the JPDA and 80% in Australian territory.

2002

21 Mar 2002 Australia secretly withdraws from international processes for resolving maritime boundary disputes under the Law of the Sea (UNCLOS) and the International Court of Justice. In addition to demonstrating that Canberra knows its legal arguments are weak, this action prevents Timor-Leste from bringing the dispute to an impartial third-party arbiter, forcing it to rely on inherently unequal negotiations.

19 May 2002 Timor-Leste civil society groups and opposition political parties protest the imminent signing of the Timor Sea Treaty between Timor-Leste Prime Minister Mari Alkatiri and Australian Prime Minister John Howard. The 2006 CMATS treaty applies Timor-Leste laws (there were none) and Australian laws from this date to legitimize Australia's exploitation of contested areas.

19-20 May 2002 (midnight): The Democratic Republic of Timor-Leste becomes an independent nation.

20 May 2002 Timor-Leste and Australia Prime Ministers sign the Timor Sea Treaty (TST) to replace the 2001 Arrangement. The substance of that Arrangement is continued, "without prejudice" to a future maritime boundary settlement which would replace the treaty. Both Governments promise to conclude a Sunrise Unitisation Agreement by the end of 2002.

19 July 2002 The first round of negotiations between Timor-Leste and Australia on a Sunrise International Unitization Agreement (IUA) concludes with both parties pledging to reach agreement by the end of 2002. The IUA will define how the Greater Sunrise field, with about 9 trillion cubic feet of natural gas will be divided. Australia (then expected to receive 82% of Sunrise upstream revenues) places a high priority on reaching this agreement so that the Sunrise project can proceed.

24 August 2002 Timor-Leste passes a maritime boundary law based on UNCLOS principles, claiming an Exclusive Economic Zone for 200 miles off Timor-Leste's coasts. The law is retroactive to 20 May 2002.

20 September 2002 Australia awards an exploration contract for a disputed area partly on Timor-Leste's side of the median line. Similar contracts, protested by Timor-Leste, are awarded in April 2003 and February 2004.

3 October 2002 Timor-Leste Prime Minister Mari Alkatiri writes Australian PM John Howard to propose initial discussions on maritime boundaries. A month later, Howard replies that Australia "is willing to commence discussions" after the Timor Sea Treaty is in force and the Sunrise IUA "has been completed." On 18 November Alkatiri writes back that he sees no reason why "completion of these interim arrangements" is necessary before boundary talks start, and asks for a "swift timetable" for boundary discussions.

October 2002 Sunrise unitization agreement talks continue. Australia and Woodside want to link this agreement to the ratification of the Timor Sea Treaty, thereby holding the Bayu-Undan project (which primarily benefits Timor-Leste) hostage to Timor-Leste's concession of most of the revenues from the larger Sunrise project to Australia.

27 November 2002 Australian Foreign Minister Alexander Downer, after an acrimonious meeting with Mari Alkatiri in Dili, says that Australia may not ratify the Timor Sea Treaty until February 2003 or later, violating both governments' commitments to complete ratification in 2002. The oil companies say that the delay could endanger arrangements to sell gas from Bayu-Undan and Sunrise, adding to pressure on Timor-Leste's government to promptly accept Sunrise unitization terms which unfairly benefit Australia, rather than insisting that the maritime boundaries be negotiated.

6 December 2002 Sunrise partners Woodside, ConocoPhillips, Shell and Osaka Gas announce the indefinite delay of the Sunrise project, claiming that neither the floating LNG processing plant nor the pipeline to Darwin is economically viable. Many see this as a tactic to pressure Timor-Leste to accept Australia's wishes on Sunrise.

17 December 2002 Timor-Leste's Parliament ratifies the Timor Sea Treaty.

2003

26 January 2003 The East Timor *Action* Network (ETAN) demonstrates in Washington to demand that Australia abide by international law. This is the first of many such demonstrations around the world over the next 2½ years.

1 February 2003 Australia, rejecting Timor-Leste's refusal to concede sovereignty over the part of Greater Sunrise which lies outside the JPDA, says its Parliament will not ratify the Timor Sea Treaty until Timor-Leste gives in and signs Australia's proposed version of the Sunrise International Unitization Agreement.

4 March 2003 Having received no response to his 18 November 2002 letter requesting boundary negotiations, Mari Alkatiri writes to John Howard that the TST will soon be in force and the IUA is being submitted to the RDTL Council of Ministers. He asks for an "early indication of a date" on which permanent boundary "discussions might begin, and a date by which you consider those discussions might result in a permanent boundary delimitation." Howard replies five months later, indicating a willingness to begin talking about boundaries, with no timetable.

6 March 2003 Australia and Timor-Leste sign the International Unitization Agreement (IUA) for Greater Sunrise.

6 March 2003 The Australian Parliament ratifies the Timor Sea Treaty. Green Senator Bob Brown is expelled for accusing John Howard of "blackmail" by delaying ratification until after Timor-Leste signs the IUA.

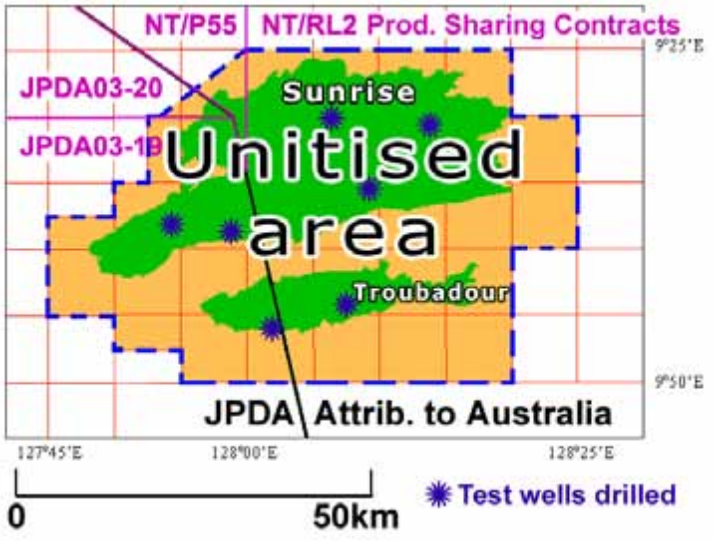

Figure 28. Sunrise Unit Area defined by the IUA (tan, with dashed blue border), showing fields (green), production-sharing contracts (purple) and test wells (blue). The black line divides the Joint Petroleum Development Area (left) from the area attributed to Australia.

2 April 2003 The Timor Sea Treaty enters into force, establishing the bi-national Timor Sea Designated Authority (TSDA) to manage projects in the joint development area. It will expire in 30 years, or when maritime boundaries are established, whichever comes first.

May 2003 Production-sharing contracts are signed between the TSDA and the Sunrise Joint Venture to replace those signed during the Indonesian occupation. Contracts JPDA 03-19 and JPDA 03-20 continue the terms of the 1995-6 contracts, as provided by Annex F of the Timor Sea Treaty, and are retroactive to 20 May 2002. The Sunrise Joint Venture currently includes Woodside (Operator, with a 33.44% share), ConocoPhillips (30%), Shell (26.56%) and Osaka Gas (10%).

12 November 2003 Negotiators from Timor-Leste and Australia meet in Darwin for the first "scoping session" of maritime boundary negotiations. Timor-Leste's government expresses unhappiness after the talks.

2004

January 2004 The Government of Timor-Leste lobbies Woodside and Australia to bring Sunrise Gas to Timor-Leste, persuading Woodside to do a feasibility study on this option. Woodside undertakes the study (see August 2004 below), while continuing to threaten that a "market window" for Sunrise LNG will close unless development begins quickly.

29 March 2004 Australia ratifies the Sunrise IUA.

April 2004 New campaigns to protest Australia's theft of Timor-Leste's resources are launched on both sides of the Timor Sea: the Timor Sea Justice Campaign in Australia and the Movement Against the Occupation of the Timor Sea in Timor-Leste. Large protests are held in Dili.

19-22 April 2004 The first substantive round of boundary talks take place in Dili, with little results.

11 August 2004 Foreign Ministers José Ramos-Horta and Alexander Downer meet in Canberra, suggesting a "creative solution" to the boundary dispute, where Australia would provide a larger share of revenue from disputed areas to Timor-Leste, while Timor-Leste would agree to forego a permanent maritime boundary at least until the petroleum is exhausted. Three more rounds of negotiations took place from August to October, without reaching an agreement.

August 2004 Woodside presents its "Pipeline Feasibility Study Report" to the TSDA and Timor-Leste government, concluding that a pipe from Sunrise to Timor is less financially attractive than one to Darwin. Timor-Leste hires an independent expert to review the study, and Woodside incorporates some of their suggestions. However, the expert's final review in January 2005 says that the Woodside study is still not an objective comparison of project costs. [49]

17 November 2004 Woodside suspends work on Greater Sunrise due to the failure of the governments to provide legal and regulatory certainty.

2005

7-9 March 2005 Australian and RDTL negotiators meet in Canberra. The following month they meet in Dili, with demonstrations across Australia. A third meeting is held 11-13 May in Sydney.

September 2005 Timor-Leste and Australia agree on the details of a Petroleum Mining Code for the JPDA, which must be formally approved before a licensing round for new JPDA areas scheduled for early 2006 can be conducted.

29 November 2005 Australian and RDTL technical delegations meet in Darwin, reaching an agreement which is not made public.

2006

12 January 2006 Australia and RDTL sign the Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS) in Sydney. The CMATS treaty package includes the 2003 IUA.

28 February 2006 Australia approves the JPDA Petroleum Mining Code, enabling the TSDA bidding round to proceed.

May 2006 The Timor Sea Designated Authority holds a bidding round for exploration of new areas in the Joint Development Area of the Timor Sea. Four contracts were awarded on 16 August.

12 October 2006 Australia and East Timor sign Security Arrangement on Joint Petroleum Area.

2007

7 February 2007 Australia tables the CMATS Treaty in its Parliament.

20 February 2007 Timor-Leste's Parliament ratifies the CMATS Treaty and Sunrise IUA.

22 February 2007 Australian Foreign Minister Alexander Downer invokes the "national interest exemption" to enable the CMATS treaty to enter into force the following day, without a Parliamentary waiting period or ratification.

February 2007 until today: Woodside resumes engineering work on Greater Sunrise, re-processing seismic data, opening a Dili office, discussing with both governments, looking for customers and exploring development concepts. They hope to have a development concept approved by the regulators in 2008.

August 2007 The new government in Timor-Leste maintains the previous government's objective of landing Sunrise gas in Timor-Leste and continues to gather information.

November 2007 Australia elects a new government, but their position on Sunrise LNG is not yet clear.

2008

February 2008 Woodside presents its suggestions for Sunrise LNG development options to the TSDA and the Government of Timor-Leste.

Appendix 3. Fiscal effects

As the main text explains, the effect on net revenues to Timor-Leste's government of where the LNG plant is located will depend on the effect of that decision on the sales price of the LNG it produces and on the cost of constructing the pipeline and liquefaction plant. It is also determined by the tax schedules that would apply to upstream and downstream projects. This appendix describes the assumptions on which the estimates presented in the main text are based. The calculations themselves can be inspected (and other assumptions attempted) in the spreadsheet accompanying this report, available at http://www.laohamutuk.org/Oil/LNG/FiscalBenefits.xls.

The upstream revenue to Timor-Leste's government can be divided into three components. According to the IUA, Sunrise is shared by Australia and JPDA in the proportion 79.9%-20.1%. Timor-Leste's first source of revenue from Sunrise is its 90% share of JPDA's take of profits in its part of Sunrise as given by the Sunrise Production Sharing Contract (PSC). Secondly, Timor-Leste imposes income taxes on its share of the JPDA share (90% of 20.1%) of the upstream companies' income after they have shared production with JPDA. Finally, the CMATS Treaty provides that Australia should make transfers to Timor-Leste in the amount necessary to equalize the two governments' revenues from the upstream project.

The downstream revenue to Timor-Leste can be divided into two components. The first consists of income taxes on the LNG plant itself. The second consists of various withholding or wage taxes on money that is spent by the LNG plant—on salaries or locally sourced supplies—but these taxes are not paid by the plant, but rather by those who receive them (we call these "Other Timor-Leste taxes" in the tables). We have not attempted to estimate any multiplier effects in the local economy—we only estimate the number of jobs and the magnitude of purchases that the LNG plant itself may be expected to carry out. We have also left out any revenues from import duties or other indirect taxes, as we cannot confidently estimate what they might be, and they would in any case be too small to affect our overall analysis.

We have attempted to model upstream and downstream aggregate cash flows, upstream revenues for Timor-Leste, Australia and the companies, and downstream revenues for Timor-Leste and the companies if the LNG plant comes to Timor-Leste. We have also tried to compare the two land-based options for the LNG plant and the pipeline (Timor-Leste and Australia), but it is beyond the scope of this report to model the domestic Australian taxes (including taxes paid by people and businesses employed by or supplying the LNG plant) if the LNG facility is in Australia. In the comparisons, we therefore restrict ourselves to reporting total downstream project revenues (company profits plus taxes paid by the project) for the Australian option, and have made the simplifying assumption that Australia's tax revenues from the downstream project are just the flat 30% company tax applied to the total profits.

We would like to emphasize that the numbers used here are often quite tentative. Estimates of costs and revenues in a large petroleum project are necessarily marred by uncertainty, and we have not had access to more than easily available public information regarding the prospects of Sunrise. Further, the overlapping legal and taxation regimes that results from the Indonesian occupation and the UN Transitional Administration, as well as the complicated situation in the Timor Sea, make it very difficult to be certain of the exact tax and profit-sharing rules that would apply to the project. We therefore caution readers to double-check our numbers before making use of our results.

All monetary values are denominated in United States dollars. Totals over time are given in 2006 net present values, discounting only by the inflation rate, not by any further discount rate.

Different petroleum products are quantified in different units. Natural gas is usually measured by volume (in cubic feet or cubic meters) but priced by energy units (measured in British thermal units); LNG is measured in metric tons; and crude oil and other condensates in barrels. Different types of petroleum can be compared by their energy content, which is measured in barrels of oil equivalent.

Table 13. Approximate conversion factors

Natural gas (NG) and liquefied natural gas (LNG)	To: billion cubic meters NG	billion cubic feet NG	million tons oil equivalent	million tons LNG	trillion British thermal units	million barrels oil equivalent
From	**Multiply by**					
1 billion cubic meters NG	1	35.3	0.90	0.73	36	6.29
1 billion cubic feet NG	0.028	1	0.026	0.021	1.03	0.18
1 million tons oil equivalent	1.111	39.2	1	0.805	40.4	7.33
1 million tons LNG	1.38	48.7	1.23	1	52.0	8.68
1 trillion British thermal units (BTU)	0.028	0.98	0.025	0.02	1	0.17
1 million barrels oil equivalent	0.16	5.61	0.14	0.12	5.8	1

Source: BP Statistical Review of World Energy, June 2007 [14]

Our different scenarios are explained in the Fiscal Effects section of Chapter 4. In the following tables, we give details of how we have chosen the different parameters. As explained in Box 12, costs in liquefaction plant and pipeline construction have recently escalated strongly. In our scenarios, we use what we believe were reasonable price estimates before these increases. We still think these costs estimates are plausible in the long term, given that the current high prices are driven by particularly tight market conditions, rather than physical or technological constraints. For completeness, however, we also provide calculations for cost parameters three times as large as what we use in the baseline moderate scenarios.

Furthermore, our scenarios assume that any downstream project in Timor-Leste would be subject to the domestic taxation system at the time of writing. As explained in Box 11, however, a reform proposal for domestic taxes is currently being considered by the Timor-Leste government.[79] We therefore also include in the spreadsheet additional calculations using the new proposed tax rates, one example of which is in Scenario 1a. Note that the tax reform does not make a difference to the upstream project.

Table 14. Main assumptions (in "Assumptions and Results" worksheet)

Line	Quantity	Explanation of assumption
2	Sunrise reserves	Public estimates have varied from 7.68 trillion cubic feet (tcf) to more than 9 tcf. Privately, Timor-Leste government officials have expressed their belief that Sunrise may contain more than 11 tcf. We have conservatively used an estimate of 8.35 tcf from the middle of the range of publicized figures. The real figure is likely to be higher if gas prices remain at high levels, since that would make it economical to use more expensive technology to recover more gas. There are also 300 million barrels of condensate (see Box 5). We do not calculate the economic effect of condensate production, as condensate can be exported directly from the offshore facilities, regardless of where the LNG plant is located. So condensate production does not affect the comparison between different solutions for the liquefaction process.
3	Upstream exploration costs	Woodside reports having spent about US$185 million (Australian $250 million) on prospecting and other preparation for Sunrise so far. We assume that the total exploration and other preparatory costs may come to US$300 million in total, slightly higher than McKee's estimate. [53] While this figure is a very rough estimate, it has little effect on the calculations.

4	Upstream construction costs	ACIL Consulting [3] assumes total upstream investments of US$1,150 million (Australian $1,500 million) for a 5 mtpa-capacity extraction facility and US$1,500 million (Australian $2,000 million) for a 6.6 mtpa-capacity facility. Our assumptions for LNG production capacity and feed gas lost to electricity consumption in the liquefaction process (see below) suggest the higher end of the range. Given our assumptions for exploration (see above) and decommissioning costs (see below) for the upstream project, we calculate that the remaining offshore facilities will cost US$1 billion. For simplicity, we assume that construction costs are borne through the first four years of the project (so we ignore construction expansions after production has commenced). This simplification does not significantly affect the results. It does, however, mean that our costs are classified somewhat differently from what may be found in other industry calculations. "Upstream construction costs" includes costs that have to be expended before production can start. "Upstream operating costs," below, includes what economists refer to as *variable* costs, meaning all those costs that depend on production volume. This last item may include construction, for example when a new well is drilled after production has started. This partitioning of cost may make our "construction costs" seem lower than other estimates of "capital expenditures," whereas our "operating costs" may seem similarly higher than other estimates of "operating expenditures." We advise readers who compare our costs with other sources to keep this in mind, and to look at *total* costs to get a simple comparison of which estimates are more conservative. Note also that this figure for "upstream construction costs" does not include the cost of laying the pipeline, which we attribute to the downstream project.
5	Upstream operating costs	We assume the non-fixed capital costs of gas extraction to be US$0.50/MM BTU, equivalent to US$2.94/BOE. This figure corresponds to the lower end of the estimate range given for exploration *and* production costs in Foss. [24]
6	Upstream decommissioning costs	The U.S. Government provides estimates for decommissioning of petroleum production rigs off the U.S. Pacific Coast. [106] Their numbers suggest that the facilities of the size Woodside [121] envisages at Sunrise (39,400 tons) would cost about US$85 million (in 2004 dollars) to dispose of. Accordingly, we assume upstream decommissioning costs of US$100 million. This can be compared with McKee's estimate of US$150 for the whole production chain (upstream and downstream). [53]
7	Total fixed costs	The sum of exploration, construction, and decommissioning costs.
8	Total per unit produced	Total fixed costs divided by the total quantity of extractable gas, plus the operating costs per unit of gas.
9	Construction period	For simplicity, we assume the same timeline for the construction of both the upstream and downstream facilities, four years. For comparison, the Darwin LNG plant (www.darwinlng.com) was built in less than three years (although the upstream started several years earlier), while Snøhvit LNG took more than five (www.snohvit.com). Atlantic LNG's first train took about three years to construct, and some of the expansion trains even less. [11] It seems reasonable to expect a longer construction time in Timor-Leste since some infrastructure will need to be built before plant construction can begin, and the various components have to be constructed off-site and shipped in. This could take a long time, especially with the long waiting times in today's petroleum-related construction sector, which faces very high demand for exploration and other equipment.
10	Number of years of operation	This is calculated from the amount of feed gas needed for the production of the assumed quantity of LNG and to power the electricity generation plant. We simplify by assuming that full capacity is reached in the first year, and is constant so long as there is gas remaining in the reserves. Including a ramp-up and ramp-down period would not significantly change the results we examine in the report.
11	Yearly LNG output	No decision seems to have made about capacity. Numbers that have been mentioned range from 5 mtpa to 7 mtpa. In our calculations we assume 5.3 mtpa of LNG produced, the quantity proposed by Sunrise operator Woodside in official presentations. [121] Given the assumption that 9% of the feed gas is used to power the liquefaction process (see below), this means a total of 287 bcf of natural gas must be pumped to the LNG plant annually, or 0.78 bcf/day.

12	Percentage of gas liquefied	A liquefaction facility would need to be fully powered by its own power plant to supply the energy needed to pump and liquefy the gas. This plant would consume a share of the gas purchased from the upstream project. The gas consumed in the liquefaction process at Darwin LNG is 7%, and Woodside has projected a 9% figure for Sunrise. [113] We use the 9% assumption in our calculations.
13	Construction costs, pipeline	The feasibility and costs of laying a pipeline from Sunrise to Timor-Leste is a matter of great dispute. While the distance from Sunrise to Timor-Leste is much shorter than to Australia, a pipeline to Timor-Leste would have to cross the Timor Trough with depths down to 3,000 meters. Woodside has dismissed that option and wants the gas from an upstream Sunrise project to be pumped to Australia for processing. Several observers, however, think a pipeline to Timor-Leste could be significantly cheaper than the alternative of a pipeline to Darwin. [53], [36] A study by Intec estimates the cost of a pipeline of sufficient size for a 6 mtpa LNG plant from Bayu-Undan to Timor-Leste's southern coast—a similar distance as that from Sunrise to the coast—to be US$317 million. [37] (They also estimate that a pipeline could be laid to connect Sunrise to Bayu-Undan for $171 million.) On the other hand, an unpublished study by Woodside from 2004 estimates the cost for a Sunrise-Timor-Leste pipeline at $721 million, compared to a pipeline to Darwin for $566 million. Another consultant's study, carried out for the government of Timor-Leste but also not published, criticizes Woodside's numbers and estimates a pipeline to Timor-Leste could be laid for as little as $448 million. [49] This report also suggests that Woodside's estimate for the Darwin option understates the true costs. We are not in a position to make a definitive judgment about what a pipeline would cost. In our comparisons, we use two possible cost levels: $550 million for the "moderate" option and $750 million for the "expensive" option, in line with the lower and upper ends of the range of estimates that have been discussed. In practice, the cost will also depend in part on the capacity of the plant, since that influences the required diameter of the pipeline, but this makes a negligible difference to our results, so we simplify by assuming a fixed cost. We compare the two pipeline options for three assumptions: that they are equally costly, that the Timor-Leste option is the cheaper one, or that the Australia option is the cheaper one.
14	Construction costs, liquefaction plant and associated facilities	Recent literature suggests that a cost of US$250 per tpa capacity is achievable, and even lower costs for expansions of existing projects. As an illustration, train 1 of Atlantic LNG in Trinidad and Tobago was built at less than $200/tpa in 1999 [23]; the Train Four expansion was reported in 2005 to amount toS$1.3 billion for a capacity of 5.2 mtpa. [11] Darwin LNG cost just over US$1bn (Australian $1.4bn) for a nominal capacity of 3.5 mtpa, according to the contractor Bechtel, which amounts to just under $300/tpa (http://www.bechtel.com/darwin_lng.html). It is disputed which of the two onshore options for the LNG plant would be cheaper to construct. A plant in Timor-Leste would be a "greenfield" development, and would perhaps face a higher cost of capital because of a higher perceived risk. In Australia, on the other hand, it might be possible to expand Darwin LNG as a "brownfield" development, but some commentators argue that Australian labor regulations which increase labor cost and hinder the use of modular construction techniques. [36] Even an expanded Darwin LNG plant might not be available to process Sunrise gas, as other nearby gas fields might have a prior claim on the facility, which cannot be expanded beyond 10 mtpa because of site constraints. For our scenarios, we use $250/tpa for the "moderate" assumptions and $300/tpa for the "expensive" assumption. The "very high cost" assumption in Scenario 2a is based on $750/tpa. The assumption that the cost is proportional to capacity is a simplification; in practice, there will be a fixed component to the construction costs due to minimum infrastructure work that has to be done regardless of the capacity. This simplification does not have a significant effect on our results.
15	Total downstream construction costs	The cost of the pipeline plus the cost of the LNG plant.

16	Respective share of materials and labor in construction costs	According to a recent survey, approximately "half of [the cost of a liquefaction plant] is for construction and related costs, 30 percent is for equipment, and 20 percent is for bulk materials." [104] A rule-of-thumb is that roughly 50% of the costs are spent on materials and 50% on actual contractor work, which under current Timor-Leste domestic tax laws is taxed differently from other income. We assume the share of materials to be relatively higher for the pipeline compared to the liquefaction plant, and therefore assume a 60% share of the overall construction costs for materials and the remainder for labor ("construction services.")
17	Construction services	Dollar amount obtained by multiplying the total construction costs by the share of labor in costs. (This spending is subject to a special tax under Timor-Leste's domestic tax regime.)
18	Percentage to Timorese residents	This is a very difficult quantity to estimate, but will by all reasonable assumptions be small, given the poor state of development of industry in Timor-Leste. According to Atlantic LNG's numbers, about 18% of the total construction costs for the Train Four expansion went to Trinidadian firms. In Timor-Leste, virtually none of the materials would be purchased locally, and a significantly lower portion of construction services would be locally sourced than in Trinidad. We assume that 10% of the expenditures on construction services (and none of the materials costs) are spent on Timorese residents. This figure, however, will depend greatly on the considerations examined in Chapter 5.
19	Operating costs per million BTU (MMBTU)	Since the calculations assume that power generation is fueled by feed gas from the Sunrise reserves, we assume a low remaining unit cost of US$.30/MMBTU for the operating expenses of LNG liquefaction (equivalent to about $15 per metric ton of LNG). This brings the total unit cost for the downstream project (including construction costs but excluding power) to about $.80/MMBTU or $40/ton, which is at the lower end of generic estimates (e.g. Foss [24] estimates total liquefaction costs to be in the $.80-$1.20/MMBTU range; EIA [104] cites an estimate of $1.09/MMBTU for a greenfield project of 8 mtpa capacity).
20-22	Share salaries to residents, to non-residents, and to local content supplies.	These are also difficult quantities to estimate, but given the small number of personnel needed for plant operation (see Chapter 5), it is likely that most of the operating costs will involve non-labor costs. While most of the permanent personnel will be Timorese residents under the extant domestic tax laws, some salary costs would be paid to short-term, but high-paid technical experts. We assume the resident salary share of the operating costs to be 5% and the non-resident salary share to be 10%. Of non-labor costs, we also assume that only a small share will be purchased locally, at 10% of the total. Of course all of these figures will depend on the considerations discussed in Chapter 4 and Chapter 5.
23	Decommissioning costs	This is a very uncertain assumption, as costs of disposal would be very sensitive to the kind of environment that would have been affected, and the state to which it would have to be restored. Pipeline removal is very expensive: U.S. Government [106] estimates a cost of more than $100,000 per mile of pipeline for disposal, but also around the same amount per day of on-site operations for retrieval of the pipeline, which can take 5-7 hours for a 120-foot (36-meter) cut. This would amount to some $1.5 million per kilometer of pipeline. We cannot estimate how much of the pipeline would have to be removed, but enough should be removed to remove any hazard to the environment, in particular near the coast. In addition, the processing plant itself would have to be dismantled in a safe way, although many of the port facilities could probably be transferred to other uses. Our calculations assume decommissioning costs for both pipeline and onshore facilities in the amount of US$200 MM, as we do not believe Timor-Leste ought to risk damage to its environment for what would be a relatively small increase in company profit and tax revenues. Nevertheless, we emphasize that these are very uncertain numbers.
24	Total fixed costs	The sum of construction and decommissioning costs.
25	Total costs per unit of gas sold	Total fixed costs divided by the total quantity of LNG sold over the lifetime of the project, plus the downstream operating costs per unit of LNG. This reflects economic unit cost of the downstream operations (not including the upstream costs).

26	Allowed internal rate of return	The IUA sets out principles for determining the price at which petroleum is sold by the upstream to the downstream project (the netback price). The price has to be based on arm's-length principles, which means a price that would be agreed if the upstream and downstream projects were run by different companies not trying to collude. What this price might be is a matter of speculation, but the IUA provides a rule for the downstream project's internal rate of return (IRR) in the absence of arm's-length transactions (for example if some of companies from the Sunrise consortium are also involved in the downstream project). The posited IRR is set to 10.5% for a land-based LNG plant. We use this to calculate how the netback price will be set. Note that the IUA formulation is vague on whether the 10.5% is a real or a nominal rate of return. An advisor to the Timor-Leste government informs us that it should be a nominal rate of return, which would make the project much less attractive to investors if the world returned to a high-inflation (or even moderate inflation) environment. In such a situation, the netback price would likely be renegotiated, and the IUA explicitly provides for this possibility. We therefore simply assume a constant low inflation rate of 2.6% (the difference between inflation-adjusted and non-adjusted U.S. Treasury bonds at the time of writing), and expect that any significant change in the inflation rate would cause the nominal IRR to be renegotiated to maintain the same real (post-inflation) IRR.
27-28	LNG sales price	For convenience, the spreadsheet also reports the corresponding price per barrel of oil equivalent, using energy content to calculate the equivalent price. In our high-price scenarios, we use US$7.50/MMBTU, equivalent to about $45/barrel of oil equivalent. This is somewhat lower than the longest-term future price contracts traded on the NYMEX commodity exchange, which captures the commodity's markets average guess at the future price. The average price of all future natural gas contracts traded on NYMEX—monthly contracts from December 2007 through December 2012—was US$8.35 on 2 November 2007. The average price for the 12 contracts for 2008 delivery was $8.54, and the average price for the 12 contracts for 2012 delivery was $7.96. At these price levels, our assumed LNG sales price therefore allows for shipping and regasification costs. We note that these prices are historically high (see Figure 5). The average spot price for natural gas in the U.S. was US$5.76 during 2001-2005 and $3.28 in the 1996-2000 period (in 2005 dollars, calculated from the IMF's International Financial Statistics). It is notoriously difficult to predict energy prices, but we cannot rule out that in the long term, they will return to the very low levels of the late 1990s. We therefore also include a set of low-price scenarios, where we assume a natural gas price of $3.50/MMBTU, equivalent to about $21/barrel of oil equivalent.
29	Inflation rate	We assume a 2.6% inflation rate, the difference between yields on U.S. Treasury 30-year bonds with and without inflation indexation at the time of writing. (http://www.bloomberg.com/markets/rates/index.html quotes yields of 1.98% versus 4.62% on 2 November 2007.)
30	Long-term borrowing rate for augmentation	This is the base rate for the "augmentation rates" that Australian petroleum taxation adds to capital and operating costs. We assume a real interest rate of 5%, so that the long-term borrowing rate is 5% plus the rate of inflation. For Australian petroleum taxation, see http://www.ato.gov.au/large/pathway.asp?pc=001/009/029&cy=1.

Table 15. Upstream assumptions (in "Upstream" worksheet)

Line	Quantity	Explanation of assumption
13	Quantity of gas purchased by the downstream project	Given by the assumptions of yearly output and liquefaction energy consumption.
14	Price of gas purchased by the downstream project	The netback price, calculated to satisfy the required IRR.

20-25	Upstream costs	The rates for the upstream exploration, construction and operating costs are explained in Table 14 "Main Assumptions." We assume very simple time profiles for exploration and construction, with equal exploration costs over two years, and a ramped-up four-year construction period. While not quite realistic, this makes no difference to our analysis.
26-27	Upstream project net cash flow and IRR	The difference between gas sales revenues and upstream costs, and the resulting IRR from that cash flow (a measure of profitability).
29-53	JPDA production sharing rules	As per production-sharing contract terms preserved under Annex F of the Timor Sea Treaty. The PSC for Sunrise has not been made public, but the relevant terms have been communicated to us.
39	Share of capital costs in construction	We assume that a large part of construction costs will be for equipment and materials rather than labor, and set this to 75%.
57-71	Australian take of JPDA share	From Australian tax rules. Note that the Petroleum Resource Rent Tax (PRRT) does not apply to Australia's share of JPDA revenues. [113]
74-91	Timor-Leste take of JPDA share	Preserved Indonesian income tax rules. We approximate the depreciation rules with 20-year straight-line depreciation.
94-123	Australia's (non-JPDA) share of upstream cash flow	Australian tax rules, including 40% Petroleum Resource Rent Tax.
152-154	CMATS redistribution	CMATS provides for a transfer from Australia to Timor-Leste of the amount that would equalize the revenues the two governments receive from the upstream Sunrise project.

Table 16. Downstream assumptions (in "Downstream" worksheet)

Line	Quantity	Explanation of assumption
10-11	Inflation and real cost factors	The inflation factor is calculated by compounding the assumed constant rate of inflation inputted into the Main Assumptions sheet. In our scenarios, we assume that the natural gas price is constant over time in real terms (that is, it just increases by the rate of inflation in nominal terms). For the convenience of users, however, we include a line where users may experiment with assumptions of increasing or decreasing *real* natural gas prices. The real rate of increase should be inputted in the first (left-most) cell of line 11 (to do this, the user must "unprotect" the sheet in the Excel "Tools" menu).
13-16	Construction and operating costs	See the assumptions for the costs in Table 14 "Main Assumptions." For the time profile of cost, we posit a simple ramped-up time profile with peak construction activity in the third year.
18-23	Sales of LNG and purchases of feed gas	See the assumptions in Table 14 "Main Assumptions." The netback price for purchases of feed gas (line 19) is calculated in lines 26-52. Line 23 adjusts the assumed natural gas price by the inflation factor (from line 10) and the real natural gas price change factor (line 11). We assume the latter to be constant in our scenarios.
26-52	Calculation of netback price	Based on formula in IUA Annex 6. Lines 27-31 give the decomposition of costs as is Annex 6. Lines 34-38 give the same costs discounted at the required IRR (given in Main Assumptions). Line 40 repeats the cost of gas purchased, while line 42 gives the net cash flow for the downstream project (line 23 minus line 31 minus line 40). Line 43 gives the same number in constant (year 0) dollars, *i.e.* adjusted for inflation. The actual IRRs for that cash flow (nominal and real) are given in lines 45-46, as a check that the calculated netback price produces the right IRR. The netback price is calculated by rearranging the formula in Annex 6 as follows: $$0 = \sum_{t=0}^{T} \frac{VDP_t - ECC_t - OC_t - CDC_t - PV \times QH_t}{(1+r)^t}$$ $$PV = \frac{\sum_{t=0}^{T} \frac{VDP_t - ECC_t - OC_t - CDC_t}{(1+r)^t}}{\sum_{t=0}^{T} \frac{QH_t}{(1+r)^t}} = \frac{\text{line 48}}{\text{line 49}}$$ where VDP is the total market value of the LNG (line 27), ECC expenditures for capital costs (line 28), OC operating costs (line 29), CDC costs for decommissioning (line 30), and QH the quantity of gas purchased (line 18). The resulting netback price is given in line 50. Note that this is a fixed nominal price, whose real value will change with inflation. For comparison with the LNG sales price, it is more informative to look at the real (year 0) price, which is given by the net present value of the money paid to the upstream by the downstream project for the feed gas (line 20) divided by the total quantity of gas bought (line 18). This figure is given in lines 51 and 52.

54-106	Taxes to Timor-Leste	As explained in Chapter 4.2, we calculate downstream tax revenue to Timor-Leste according to the current regime of business taxation. The estimates assume that the regime will not change, and in particular that no tax incentives are given in order to attract the project to Timor-Leste. We assume that construction costs are evenly distributed into the two depreciation categories of "buildings" and "machinery." When contractors have the choice between depreciation methods, we assume they choose the one that maximizes their IRR. The assumptions on the share of construction and operating costs going to local content are given in Table Main Assumptions. Finally, we assume that 50% of local supply purchases indirectly accrue to wages to residents. Note that we are ignoring indirect taxes (customs duties and excise taxes) as we cannot confidently predict how these will apply to the LNG plant. In a separate sheet, "Downstream (new tax regime)," we model the downstream tax revenues to Timor-Leste that would result if the tax reforms under consideration by the government at the time of writing (see Box 11) are enacted as they are currently proposed. We have included this for completeness, but underline that we have not been able to thoroughly research these rates, and based these estimates simply on short publications by the government. [79] The calculations are in lines 56-90, and also ignore indirect taxes.
111-124	Approximation of downstream taxes to Australia	We use the model of Australian taxation of Australia's share of JPDA revenues as a simple approximation of company taxation and depreciation rules that might apply to an Australian LNG plant. These figures should be seen as very approximate, as it is beyond the scope of this report to do an in-depth analysis of Australia's domestic taxation. The sheet "Downstream (new tax regime)" reproduces the same estimates in lines 95-108.

Appendix 4. History of accidents in the LNG industry

1944	Cleveland, Ohio, USA	At the peak-shaving plant a tank failed and spilled its contents into the street and storm sewer system. The resulting explosion and fire killed 128 people. The tank was built with a steel alloy that had low-nickel content, which made the alloy brittle when exposed to the extreme cold of LNG.
1964	Arzew, Algeria	During loading operations, lightning struck the forward vent riser of the Methane Progress and ignited vapor which was being routinely vented through the ship venting system. A similar event happened early in 1965 while the vessel was at sea shortly after leaving Arzew. In both cases, the flame was quickly extinguished by purging with nitrogen through a connection to the riser.
1965	Jules Verne Spill, Arzew, Algeria	LNG liquid spill caused by overflowing of a cargo tank that resulted in the fracture of the cover plating of the tank and adjacent deck plating.
1965	Methane Princess Spill	LNG discharging arms were disconnected prematurely before the lines had been completely drained, causing LNG liquid to pass through a partially opened valve and onto a stainless steel drip pan placed underneath the arms. This caused a star-shaped fracture to appear in the deck plating in spite of the application of seawater.
1969	Portland, Oregon, USA	An explosion occurred in an LNG tank under construction. No LNG had ever been introduced into the tank. The cause of the accident was attributed to the accidental removal of blinds from natural gas pipelines which were connected to the tank. This led to the flow of natural gas into the tank while it was being constructed.
1971	La Spezia, Italy	This accident was caused by "rollover" where two layers of LNG with different densities and heat content form. The sudden mixing of these two layers results in the release of large volumes of vapor. In this case, about 2,000 tons of LNG vapor discharged from the tank safety valves and vents over a period of a few hours, damaging the roof of the tank.
1972	Montreal, Quebec, Canada	A back flow of natural gas from the compressor to the nitrogen line occurred during defrosting operations at an LNG liquefaction and peak shaving plant in Montreal East. The valves on the nitrogen were not closed after completing the operation. This caused over-pressurization of the compressor and the natural gas entered the control room (where operators were allowed to smoke) through the nitrogen header. An explosion occurred when an operator tried to light a cigarette.
1973	Staten Island, NY, USA	In February 1973, a fire started while repairing the interior of an empty storage tank at Staten Island. The resulting increase in pressure inside the tank was so fast that the concrete dome on the tank lifted and then collapsed down inside the tank killing the 37 construction workers inside.
1974	Massachusetts Barge Spill, USA	After a power failure and the automatic closure of the main liquid line valves, 40 gallons of LNG leaked as it was being loaded on a barge. The LNG leaked from a one-inch nitrogen-purge globe valve on the vessel's liquid header, causing several fractures to the deck plates.
1977	Aquarius Spill, Bontang, Indonesia	During the filling of a cargo tank, LNG overflowed through the vent mast serving that tank. The incident may have been caused by difficulties in the liquid level gauge system. The high-level alarm had been placed in the override mode to eliminate nuisance alarms.
1978	Das Island, U.A.E.	An accident occurred due to the failure of a bottom pipe connection of an LNG tank. The tank had a double wall (a 9% nickel steel inner wall and a carbon steel outer wall). Vapor from the outer shell of the tank formed a large heavier-than-air cloud which did not ignite.

1979	Mostafa Ben Bouliad Spill, USA	While discharging cargo at Cove Point, Maryland, a check valve in the piping system of the vessel failed releasing a small quantity of LNG. This resulted in minor fractures of the deck plating.
1979	Cove Point, Maryland, USA	In October 1979, a natural gas leak at Cove Point caused an explosion killing one plant employee and seriously injuring another and causing about $3 million in damages.
1983	Bontang, Indonesia	A rupture in an LNG plant occurred as a result of over-pressurization of the heat exchanger caused by a closed valve on a blow-down line. The exchanger was designed to operate at 25.5 psig. When the gas pressure reached 500 psig, the exchanger failed and the explosion occurred.
1987	Mercury, Nevada, USA	In August 1987 an accidental ignition of an LNG vapor cloud occurred at the U.S. Department of Energy Nevada Test Site during large-scale tests involving spills of LNG. The cloud was accidentally ignited and damaged and propelled polyurethane pipe insulation outside the fence.
2003	Bintulu, Malaysia	A major fire occurred in the exhaust system of the propane gas turbine in the first train (Train Number 7) of the MLNG Tiga project at the Petronas' LNG Complex.
2004	Skikda, Algeria	A steam boiler that was part of an LNG production plant exploded, triggering a second, more massive vapor-cloud explosion and fire. The explosions and fire destroyed a portion of the LNG plant and caused 27 deaths, 74 injuries, and material damage outside the plant's boundaries.
2004	Ghislenghien, Belgium	A pipeline carrying natural gas from the Belgian port of Zeebrugge to northern France exploded, resulting in 23 known fatalities. The cause of the incident is still under investigation but it appears that a contractor accidentally damaged the pipe.
2004	Trinidad & Tobago	In June 2004, workers were evacuated after a gas turbine at Atlantic LNG's Train 3 (Trinidad & Tobago) facility exploded.
2005	District Heights, Maryland, USA	A Washington Gas Company-sponsored study released in July 2005 pointed to subtle molecular differences in the imported liquefied natural gas the utility began using in August 2003 as the cause of a house explosion in March 2003.
2005	Nigeria	A 28-inch LNG underground pipeline exploded in Nigeria and the resulting fire engulfed an estimated 27 square kilometers.

References: [15], [38], [118]

Appendix 5. Risk analysis

Risk is defined in the Sandia National Laboratories *LNG Spill on Water Risk Assessment* as "the potential for suffering harm or loss and [it] is often quantified as the product of the probability of occurrence of a threatening event times the system vulnerability to that event and the consequences of that event." [31] Mathematically, it is typically expressed as:

$$Risk = P_t \cdot P_s \cdot C$$

where P_t stands for the probability of the specific threat occurring, P_s is the probability of the system failing under that threat –or vulnerability– and C represents the consequences expressed in terms of loss of life or money.

Here, we follow the study for one type of accident -- LNG spills on water -- by Sandia National Laboratories [31] to point out how risk is taken into account and what conclusions were reached in that report. The steps in LNG spill risk assessment are summarized as follows:

1. Evaluate the potential for a breach or loss of LNG from a ship
2. Establish the potential damage to a cargo tank or other system from these events and the potential spills that could occur
3. Estimate the volume and rate of a potential LNG spill based on the dimensions and location of the breach, properties, and characteristics of the LNG, ship construction and design, and environmental conditions (e.g. wind, waves, currents, etc.)
4. Estimate the dispersion, volatilization, and potential hazards of a spill based on physical and environmental conditions; and
5. When necessary, identify prevention and mitigation strategies to meet risk management goals.

Figure 29, from the Sandia report, shows the event tree of LNG spills at sea that can lead to threatening situations.

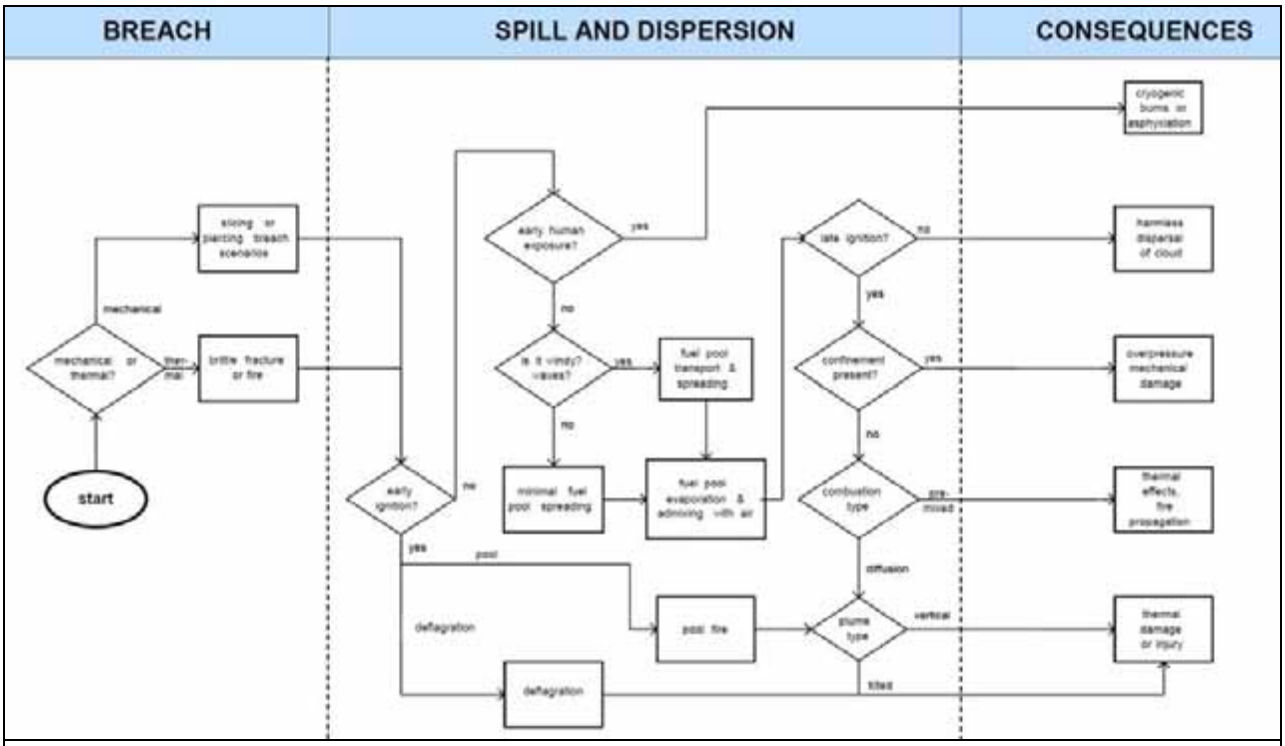

Figure 29. Potential sequences of events following a breach of an LNG cargo tank. [31]

According to the Sandia study, six main damaging events can occur as a consequence of an LNG spill, namely injuries from asphyxiation, cryogenic burns and structural damage, combustion and thermal damage, LNG fireballs, LNG and air explosions, and Rapid Phase Transitions (RPT). The four existing models of spill dispersion and ignition analyzed by the Sandia report ([47], [21], [68], and [111]) yield substantial differences in their estimates of thermal damage and there are some disparities in the treatment of meteorological conditions. There is, therefore, high uncertainty in the results. Moreover, no probabilities of occurrence of triggering events are assumed. Indeed, the existing models assume that the event has a 1.0 probability of occurrence. These studies are not probabilistic but analyze a "worse case" scenario or a consequence-based scenario. In order to accurately carry out economically-conscious risk mitigation procedures, these probabilities need to be taken into account. There is very limited experience with large-scale LNG spills, and it is basically impossible to estimate realistic probabilities of occurrence for many of the steps involved in the event tree.

The problem of the uncertainty of hazards estimates is addressed by the independent analysis presented in the Sandia report [31] which uses state-of-the-art modeling tools to calculate the damage potential from LNG spills on water in order to arrive at the classification of hazard depending on the distance to the potential spill:

1. Pool sizes can range from 150 m in diameter for small, accidental spills to several hundred meters for large, intentional spills. High thermal hazards from fire are expected to occur within approximately 250-500 m from the origin of the spill. Major injuries and significant structural damage are possible in this zone. The extent of damage will depend on the spill size, and the dispersion from wind, waves and currents. People, major commercial and industrial areas or other critical infrastructure elements, such as chemical plants, refineries, bridges or tunnels, or national icons located within portions of this zone could be seriously affected.
2. Hazards and thermal impacts transitions to lower levels with increasing distance from the origin of the spill. Some potential for injuries and property damage can still occur in portions of this zone, but this will vary based on the spill size, distance from the spill, and site-specific conditions. For small spills, the hazards transition quickly to lower hazards levels.
3. Beyond approximately 750 m for small accidental spills and 1,600 m for large spills, the impacts on public safety should generally be low for most of the potential spills. Hazards will vary but minor injuries and minor property damage are most likely at these distances. Increased injury and property damage would be possible if vapor dispersion occurred and a vapor cloud was not ignited until after reaching this distance. Distances of dispersion as high as 2,500 m are possible.

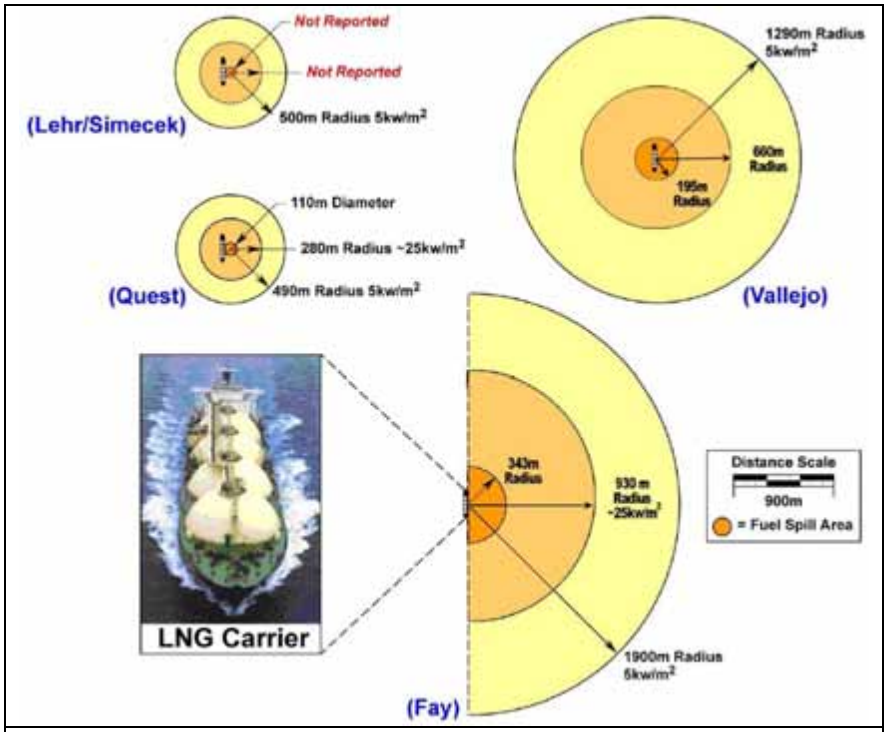

Figure 30. Different areas of thermal radiation threat predicted by the four different models. [30]

Given the technical descriptions of the hazards obtained through the modeling of the spill event, three zones of security are proposed in the Sandia report [31] with varying degrees of risk mitigation intensity, as discussed in Chapter 6.3.

In order to carry out the necessary risk management process, the Sandia report lists the following critical steps:

1. Characterize assets: The context of the LNG facility including location, site-specific conditions, and nominal operations need to be identified. These must collect information on the type and proximity of neighbors, the environmental conditions, and the nominal operation conditions.
2. Identify potential threats: Accidental and intentional events need to be considered.
3. Determine risk management goals and consequence levels: Set goals with regard to property damage and injury, loss of service, and economic loss.
4. Define safeguards and risk management system elements: Prevention and mitigation considerations and protective designs.
5. Analyze system and assess risks: The risk management goals need to be compared to the consequence levels. An event tree needs to be identified for the site-specific conditions and its consequences evaluated.
6. Assess risk prevention and mitigation techniques: If the potential hazards exceed the consequence and mitigation goals, then an enhanced risk mitigation strategy needs to be developed.

Table 17 lists several prevention and mitigation techniques that could be necessary or recommended depending on the threat level. Some are easier to implement than others, and Timor-Leste should develop a specific study to select some of these procedures, or variations thereof, to reduce risk with the available resources.

Table 17. Prevention and mitigation measures identified by the Sandia report. [31]

PREVENTION	MITIGATION
ISOLATION	RECOVERY OPERATIONS
• physical separation (distance) • physical barriers • keep-out or exclusion zones (buffers) • interrupted operations (aircraft, bridge traffic)	• plans in place & current • equipment & people in place & ready • drills • evacuation plans
VOID SPACES WITH INERT GAS	MAINTAIN MOBILITY (tanker + towing)
INERTING OF VOID SPACES	LIMIT SPILL AMOUNTS & RATES
VARIED TIMES OF OPERATIONS	SECURITY EMERGENCY RESPONSE FORCES
INTELLIGENCE	FIRE-FIGHTING CAPABILITIES
• communication links in place & ready • timely updates • interagency communication links	• leak detectors • deluge systems • radiant barriers (high-pressure high-density foam systems) • backup fire fighting capabilities
INCREASED MOBILITY (tugs)	REDUNDANT MOORING & OFFLOADING CAPABILITIES
ARMED SECURITY ESCORT (boat, aircraft or on-board)	OFFSHORE MOORING & OFFLOADING CAPABILITIES
SWEEPS (divers, sonar, U.S.C.G. boarding)	SPEED LIMITS
SURVEILLANCE (on-ship, on-land, underwater & aerial)	CRYOGENICALLY-HARDENED VESSEL
EMPLOYEE BACKGROUND CHECKS	SHIP ARMOR, ENERGY-ABSORBING BLANKETS
TANKER ACCESS CONTROL PROGRAM	MISSILE DEFENSE SYSTEM
STORM PREDICTION & AVOIDANCE PLANS	REDUNDANT CONTROL SYSTEMS
SAFETY INTERLOCKS	BACKUP FUEL SOURCE (oil)

Appendix 6. Field visit report

In May 2006, La'o Hamutuk's research team visited several areas under consideration as possible sites for an LNG plant. Political and security unrest had displaced many people within Dili and to outlying areas. However, everything seemed peaceful when we visited Lautem and Viqueque districts, with no obvious signs of refugees from Dili and no shortages of supplies. We were the only clients at every hotel and restaurant we went to.

At that time, we were informed that Com, Lore, Beaçu, Betano and Suai had been studied as possible sites for the LNG processing facility in Timor-Leste, although La'o Hamutuk was not able to see to any of these reports. La'o Hamutuk visited Com and Lore to conduct a brief visual inspection and meet with local leaders. We also met with district officials in Los Palos and Viqueque. We were not able to conduct our planned visit to Beaçu because the bridge was out.

In the 18 months since our visit, the political situation in Timor-Leste has changed, and further consultation should be done to assess the current mood of people in areas where the plant may be sited. However, most of the observations discussed below, especially regarding awareness of the scale and implications of this project, lack of readiness to participate in its economic benefits, and limitations of infrastructure and disaster management are still valid.

Com is located in a natural bay on the north coast of Timor island, which is characterized by the calmer waters of the Banda Sea or Tasi Feto (see Figure 31). Siting the plant in Com, while providing great navigational access and a good mooring point at an existing port, involves a longer pipeline that would have to either go around or cross Timor Island on surface or through a tunnel through Lautem district. If Com itself were to be chosen for the site, a small but thriving community with tourism potential and with a soon-to-be-repaired and operating port would have to be displaced. Building the plant eastwards of Com is impeded by hills, leaving the flat lands west of Com as a possibility. In July 2006, Com and all land to its east were designated as part of the Nino Konis Santana National Park (see Figure 14).

Figure 31. The port of Com in a natural bay on the northeast coast of the island of Timor. A small community is slowly developing an incipient tourist business in the region.

Lore, on the other hand, provides a mooring point on the rougher waters of the Timor Sea or Tasi Mane (see Figure 32). The town of Lore and the beach visited during the field trip are included in the Lore Reserve, a natural protected environment listed in the appendix schedule of UNTAET regulation 2000/19 on protected places, under point (k) [110], and as part of the new National Park. A location on the southern coast would shorten the length of the gas pipeline and avoid the problem of crossing the island. However, the optimal landing site for the pipeline will also depend on detailed bathymetry which has not yet been conducted. (See Chapter 3 for a discussion of the LNG plant location requirements). Discussions with José Teixeira's team at the Ministry of Natural Resources [82] indicate that in mid-2006 the Government was also considering south coast locations near Betano (Manufahi) or Suai (Cova Lima), regions that this team was not able to visit. Other officials indicate that minimizing the pipeline length is one of the most important factors, lending weight to a more easterly site (closer to Sunrise) such as Beaçu.

Figure 32. A location near Lore on the southeastern coast of the island of Timor, with a rich vegetation cover and within the Lore Reserve, a pristine and little surveyed natural environment, one of the few virgin forests remaining in the region.

On 16 May 2006, the team found the road from Viqueque to Beaçu on the southern coast to be impassable due to an almost complete collapse of the road embankment (see Figure 33) of the Motale'e bridge. The design of the bridge, built ten years ago during Indonesian times, displayed insufficiently extended flanges, thus providing inappropriate containment for the soil behind the bridge south support wall. Erosion of the river bend at the embankment toe combined with inadequate drainage caused the road to collapse, which was reduced to a section of about 1.5m in width. Small vendors congregated at the bridge waiting to catch a ride with vans that venture through the remaining gap when the soil is dry. Local officials had informed authorities in Dili about this several weeks earlier and were waiting for a response, since there was no local capacity to repair the road.

Figure 33. Collapse of the road embankment. The structural remains show a lack of transition slab, an insufficient flange length, inappropriate drainage, and poor embankment erosion protection at its base by the river. A temporary repair was made five months after the bridge collapsed, slightly widening the roadway so that four-wheeled vehicles could cross. It took another year, until October 2007, before the national government permanently repaired the bridge.

This incident exemplifies both the fragile state of the Timorese civil infrastructure and the limited local and national capacity to respond to natural disasters, industrial accidents, or infrastructural failure.

During the trip, we observed that the rural road network is very deficient. It is also unlikely that it will have been improved significantly by the time plant construction starts. At least at the beginning of the works, major operations of loading and unloading will have to be carried out from the sea or by helicopter, and thus the roads will not be necessary for the construction phase. [82] Any benefit that might derive from an improved road network will be delayed until the roads are necessary for the operation of the plant.

It quickly became clear that an LNG plant along the coastal areas visited would severely disrupt the rich and beautiful natural environment of Timor-Leste. Since most of the natural environment has not been properly surveyed [7], the implementation of the LNG plant could inflict some valuable but unknown losses. This suggests that prior to the selection of the site, an in-depth environmental base line study should be carried out to find out the elements at risk to help select the most appropriate site and establish an effective environmental management plan.

During our visit, the La'o Hamutuk team interviewed District Administrators and other officials, Chefes de Suco and Aldeia, traditional leaders, and civil society organizations. A list of those interviewed is in the acknowledgements. Based on these discussions, we observed the following:

1. The people of Timor-Leste hold great hopes for this development opportunity. Community leaders are willing to relocate their communities if necessary for this chance to improve their economy, even if they may lose their homes, sacred sites and agricultural land, although they expect that the Government will compensate them fairly and find new places where they can continue their activities. There is enormous pride in Timor-Leste and in what the country can do and there is a sense of unity and readiness to work and collaborate for the national interest.
2. On the other hand, many people are unaware of the how large this project will be, or the number of highly paid jobs and services it will involve. They anticipate that their community will only get some unskilled jobs (cleaners, security) and a few buyers for local products. This can be dangerous, as people may not get more than they ask for. Local businesses do not currently have the human resources or financial capacity to receive significant benefits from this project.
3. The trust in the national leadership opens the way for local people to be manipulated, and avoids responsibility at the district or community level to protect or serve the people. For example, Viqueque district officials didn't want to admit their frustration with Dili not responding to their requests to fix the Motale'e Bridge.
4. The social willingness and strength is counterbalanced by an enormous gap in the skills of the workforce and state of the infrastructure. At present, local people would only be able to perform very basic jobs, such as simple construction, catering and hospitality. Women hope to benefit from this project by opening restaurants or working as cooks, and they are ready to learn how to cook food that foreigners want. However, long-term, highly-paid international workers will expect a higher standard of food and lodging than tourists who come for a night or two. Local businesses and workers in this sector will need extensive training and financial support to develop to the point where they can receive significant income from this aspect of the project.
5. Every person we interviewed was eager for the LNG Plant to come to their community, even though they have little understanding of the scale and impact of the project. They expect that it will provide some jobs for them, and that foreign workers will buy their local products. At present, few local consumers have money to buy their local products, and farmers are looking for new markets. Improvements in local infrastructure, especially in roads that would allow local produce to be transported to urban markets, would also be welcome. This can reduce the burden on women who usually carry their produce on foot to sell it in the districts.
6. There is a complete lack of preparedness for contingencies. A large industrial facility will pose risks to workers, adjacent communities and the natural environment. At this moment, however, it would be impossible to handle even modest emergencies at a local level, and with great difficulty at the national level. The local community and the country would have to rely on facility personnel to contain accidents. Should the plant fail to handle the emergency, the country would depend on foreign assistance, and the delay caused in the process could have dire consequences for human life and the environment.
7. Public officials we met with were open about how little information they have received on oil-related issues and the LNG plant, and did not try to pretend that they knew more. They are eager to receive information

from any sources, in addition to the government. Chefes do suco and aldeia also would be grateful for basic information on oil and gas exploration and exploitation, as well as all other aspects of such a project.

8. District and community officials have almost no information regarding the government's development plans. Most people interviewed had not heard of the possible LNG project, and those who had, had only heard of the topic tangentially, possessed no specific information, and had heard only about positive aspects of petroleum development. They were unaware of the potential negative impacts of such a project, and therefore unable to reach informed opinions. Some of the local leaders said they were not asked about development itself, but only given information about what is going to happen. The substitution of socialization for consultation has already been accepted by some local leaders, which can lead to serious long-term consequences if projects have other effects than were explained, or if people feel excluded or alienated from projects in their neighborhood.

9. We found a great disconnect between the information available to national authorities in the capital and to those in the districts. Information channels need to be put in place in order to ensure participation in a development enterprise that needs to be a joint effort between the government, the developers, and local communities. For public consultation to be meaningful, widespread and in-depth education must be provided, preferably by someone independent of the government.

10. Many local community people have accepted the conventional view of compensation for people who have to relocate, placing a high value on money spent (such as building an expensive house) and a low value on labor and materials invested, or on land used for farming. This means that rich people may get more compensation than poor ones, and that those who lose "only" farmland or fishing areas will get very little. In addition, conflicts could arise if the Government decides to give compensation related to traditionally owned land. The Liurai usually has title to more land than the common people, but the land actually belongs to the entire community, so it is important to consult with the entire population.

Appendix 7. Glossary

Absorption	The physical or sometimes chemical bonding of small particles or molecules within an absorption agent, which could be a solid or fluid. The bonding is generally strong. For example, dry cement absorbs water, causing the cement to set. The term is also often used in biological processes, such as the absorption of oxygen in blood.
Acid gas	Gas that readily transforms into an acid. For example, H_2S and SO_2 gases are transformed in the presence of oxygen and water into sulfuric acid. When this happens in the atmosphere it can result in acid rain, which has had disastrous results on Scandinavian and Canadian pine forests.
Activated carbon	Also called activated charcoal or activated coal, usually derived from charcoal. It has an exceptionally high surface area, due to its highly porous nature, and is therefore a very effective adsorption agent.
Adsorption	The physical bonding of small particles or molecules to the surface areas of an adsorption agent, another material which is usually a solid. Adsorption bonding is generally weaker than absorption. See also activated carbon and molecular sieve.
Amine bath (aqueous, organic)	A solution of organic compounds with chemical groups containing nitrogen as the central atom. An amine bath can help to "wash" natural gas of contaminants like carbon dioxide and hydrogen sulfide. Often used are: monoethanolamine (MEA), diglycolamine (DGA), diethanolamine (DEA), diisopropanolamine (DIPA) and methyldiethanolamine (MDEA).
Aqueous	Water-based. An aqueous solution is something dissolved in water.
Arbitration	A method of resolving disputes where a third party, such as a jointly-agreed panel, makes a decision. The two disputing parties agree in advance to accept the arbitrator's decision. If the parties cannot agree on an arbitrator, he/she could be appointed by an impartial agency.
Archaeological patrimony	Ancient socially or culturally significant objects, including art, tools and/or structures, that could help to understand how earlier societies lived. The pyramids of Egypt and the rock paintings at Ile Kere Kere (Lautem district) are examples. Many countries protect their archaeological patrimony from being destroyed by development.
Asphyxiation	Suffocating, a situation in which a person or animal, cannot get enough oxygen from the air. Asphyxiation can occur in closed spaces where air is displaced or not renewed, or near fires, which consume oxygen.
Atlantic LNG	An LNG project in Trinidad and Tobago, and the company which operates it. The company began to liquefy natural gas for export in 1999 with a single 'train' or liquefaction unit, and currently has four trains with a capacity of 14.6 mtpa, employing about 400 people.
Atmospheric emission	Release of tiny particles or gases into the air, one form of pollution.
Audit	An examination of financial records or analysis carried out by an expert (auditor) who is independent of the people who prepared the records. The auditor certifies that the records are accurate, and reports on any inconsistencies or differences from accepted accounting practices. Audits can be internal (done by the agency which prepared the records) or external (done by someone from outside the agency). Audit reports are often made public.

Banking and Payments Authority (BPA)	The Central Bank of Timor-Leste;, a semi-independent government agency which is responsible for managing Government assets and regulating the banking sector. The BPA also manages investments and operations of the Petroleum Fund, reporting on its activities.
Barrel (of oil)	A standard measure of oil, 42 U.S. gallons or 159 liters.
Barrel of oil equivalent (BOE)	A unit to describe the amount of energy produced by burning petroleum or natural gas, the same as from burning one barrel of oil. This unit makes it possible to compare reserves of different fuels in familiar crude oil terms. One trillion cubic feet (tcf) of natural gas is approximately 180 million BOE (mmboe).
Bathymetry	The study of underwater depths, such as of the ocean floor. A bathymetric map usually shows floor relief or terrain as contour lines, and may additionally provide surface navigational information.
Bayu-Undan	A large oil and gas field in the JPDA, exploited by ConocoPhillips; it began oil production in 2004 and gas production in 2006. This field provides nearly all of Timor-Leste's current petroleum revenues.
Bn	Billion (1,000,000,000)
British thermal unit (BTU)	A measure of energy. One Barrel of Oil Equivalent (BOE) is equal to about 5,800 BTU.
Carbon Dioxide (CO_2)	A chemical compound consisting of one carbon atom and two oxygen atoms, It is a gas at standard temperature and pressure, and is produced by burning wood, petroleum or natural gas. Although CO_2 is not toxic, large amounts of it released into the atmosphere are altering the global climate. (see also: greenhouse gas).
CMATS	The Treaty on Certain Maritime Arrangements in the Timor Sea, signed between Australia and Timor-Leste on 12 January 2006 to allocate upstream revenues from Greater Sunrise areas while deferring maritime boundary discussions.
Condensate	Light oil (sometimes called "natural gasoline") which forms the heaviest component of natural gas. It is found in many natural gas fields including Bayu-Undan and Sunrise. Condensate can be extracted and used as liquid fuel or for petrochemicals without the refining process required for heavier crude oil. Condensate can be processed at sea and loaded onto ships for transport to customers. Its market value is similar to crude oil, higher than gas.
ConocoPhillips	The sixth largest oil company in the world, based in Texas, USA, with more than 38,000 employees and operating in more than 40 countries. The 2002 merger of Phillips Petroleum (long involved in the Timor Sea) and Conoco created ConocoPhillips, the operator and majority owner of Elang-Kakatua and Bayu-Undan in the JPDA, and also owns 30% of Greater Sunrise.
Contaminant	An unwanted substance in a mixture which could damage or reduce the value of the main component, such as an impurity. For example, in an LNG plant mercury is a contaminant as it speeds corrosion of processing equipment. When disposed of improperly, mercury can become a dangerous environmental pollutant, killing fish or causing them to be poisonous to people or animals which eat them.

Continental shelf principle	A now-outdated way to define maritime boundaries between two nearby countries, based on the depth of the water between them. Water less than 200 meters deep (the "continental shelf") was seen as the natural extension of the country's land territory. The 1972 Australia-Indonesia seabed boundary treaty, which followed the deepest water between the two countries, was based on this principle. Many geologists see Timor-Leste as part of the Australian continental shelf, with no continental shelf boundary between the two countries. Since the 1982 United Nations Convention on the Law of the Sea, this principle has been replaced by the median line principle, which is based on distance from the coastlines.
Cryogenic burns	Cold contact burns or frostbite, caused by very cold gases and liquids, such as LNG, coming. Skin may become inflamed and painful, and parts of the skin and underlying tissue may die.
Cubic foot	The volume occupied by a cube measuring 1 foot (30.5 cm) in length, height and width. 1 cubic foot is 0.028 cubic meters, and 1 cubic meter is 35.71 cubic feet.
Darwin LNG plant	See Wickham Point.
Decommissioning	The process of shutting down and disposing of a facility after its operations are finished. Many places are now requiring that the site be restored to the conditions existing before the construction of the plant, and that all waste and materials be removed or permanently isolated from the environment. Normally, the initial site license includes decommissioning requirements, and the company must guarantee that decommissioning will be carried out as promised.
Demographic pressure	Impact on the environment by a growing number of human inhabitants, which may use all available resources. Although overpopulation is usually assessed by comparing the number of people with available renewable resources such as food and water, demographic pressure captures additional aspects of quality of life, such as crime, health, employment, and conflict.
Disaster preparedness	Planning and preparation in advance to reduce the effects of natural and/or man-made disasters. This involves prediction and (where possible) prevention, public information systems, and the legislation, agencies, personnel and equipment to minimize the negative impact on vulnerable populations.
Downstream	The refining or liquefaction part of the petroleum process, transforming crude oil or gas as pumped out of the ground (upstream) into a form that can be transported and sold to customers.
Downstream project	The facilities that refine or process petroleum from the raw material extracted by the upstream project, such as an LNG plant or an oil refinery.
Ecosystem	A natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all the non-living physical factors of the local environment. The ecosystem concept illustrates that living organisms are continually interacting with and affecting other nearby organisms in a complex system of inter-relationships.
Enclave	An area surrounded by a different area, and isolated from it, such as of Timor-Leste's Oecussi district, which is surrounded by Indonesia. The concept is used to describe all kinds of systems within another system, but functioning independent from it. An LNG plant or Special Economic Zone which has minimal relationships with the surrounding area could be considered an enclave.

Environmental degradation	The deterioration of the environment through pollution or depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife.
Environmental Impact Assessment (EIA)	The technical and legal process of defining how the environment would be affected by a proposed development and of determining the significance, risks and consequences of the potential impacts. The EIA process, which can be conducted by the developer or government and usually includes public consultation and comment, often results in recommendations for ways to reduce negative impacts. It can be the basis for an Environmental Management Plan.
Environmental Impact Statement (EIS)	A document detailing key elements of a development proposal, a detailed description of the current social, economic, cultural and natural environment, and a determination of potential impacts of the proposed project on this environment.
Environmental Management Plan	A set of documents outlining measures and actions to avoid or mitigate impact of a development proposal on various aspects of a given social, economic, cultural and natural environment. The project operator write the Environmental Management Plan, which is approved by regulatory authorities, and the operator is required to follow it.
Estimated Sustainable Income (ESI)	A projection of the amount of money that can be withdrawn every year from the Petroleum Fund each year for the indefinite future. The ESI is calculated by adding the value of the money in the Petroleum Fund and the petroleum reserves still in the ground (only those with an approved development plan are counted) and estimating how much interest will be earned by investing that amount.
Exclusive Economic Zone (EEZ)	An area of the sea and seabed adjoining a country's land territory where the country has rights to exploit and sell the resources in and under the water. Under UNCLOS, the EEZ usually extends 200 nautical miles (330 km) from the shore. When two countries are less than 400 miles apart, a process of negotiation, litigation and/or arbitration can decide the boundary between the EEZ, which is usually along the median line, halfway between the coastlines.
Exploitation	The process of extracting oil and gas from the ground, processing it and selling it. Also called production.
Exploration	The process of geological analysis, seismic testing, and testing wells to locate, identify and estimate the size of underground or undersea oil and gas deposits.
F.O.B.	"Free on board" denotes a price paid for a product that does not include shipment to the customer. (e.g. the price an LNG customer might pay to a Timor-Leste LNG plant when the customer takes the responsibility for shipping the LNG to their intended markets.)
Federal Reserve Bank of New York	Part of the Federal Reserve system which serves as the central bank of the United States. The Timor-Leste Petroleum Fund is deposited in this bank, which is the equivalent of lending the money to the United States Government.
Feed gas	Gas coming into an LNG plant from an underground or undersea field, through a pipeline. The first step in a plant is removing contaminants, so that the gas can be liquefied.

First Tranche Petroleum (FTP) revenues	A percentage of the money received for selling petroleum, paid as a royalty to the government(s) from whose territory the petroleum was extracted, beginning from the start of petroleum production. This is one of several sources of government revenue from petroleum development; larger amounts can be earned from profit oil and taxes.
Fiscal year	A twelve-month period used for budgeting and financial management purposes, which may or may not be the same as the calendar year. Timor-Leste's fiscal year ran from 1 July to 30 June until 2007; beginning in 2008 it will be January to December.
Flaring	The burning of gases (including natural gas) into the atmosphere to dispose of waste. In an LNG plant, some processes which may require flaring include: plant upsets, which interrupt processing and generate gases; commissioning and start-up processing; and loading of LNG tanker vessels when LNG cannot be kept at low enough temperatures to maintain its liquid state.
Floating Storage Offloading (FSO) facility	A floating facility (ship) to perform separation, stabilization and subsequent loading of liquid petroleum products, including condensates found together with natural gas. Such a facility is generally built close to the offshore wellhead platform and used to enable "clean" gas to be transferred to an onshore LNG plant.
Fractionation	A separation process in which a mixture of chemical compounds is divided up into some of its components (fractions), enabling grouping of compounds according to their chemical and physical characteristics. A common process in oil refineries is fractional distillation, which groups compounds according to their boiling points.
Geomorphology	The study of landforms, including their origin and evolution, and the processes that shape them. Geomorphologists seek to understand landform history and dynamics, and predict future changes through a combination of field observation, physical experiment, and numerical modeling.
Global climate change	Changes in temperature, humidity or other characteristics of the earth's atmosphere over time ranging from decades to millions of years, caused by processes internal to the earth (e.g. volcanoes), external forces (e.g. sunlight intensity), or human activities. In recent years, "climate change" usually refers to warming of the atmosphere as a result of human-generated emissions of greenhouse gases such as carbon dioxide.
Government bond	A type of investment which involves lending money to a government. Bonds can be short or long term, and can return fixed interest rates or fluctuate over time in response to market forces.
Gravity-based structure (GBS)	A support structure held in place by gravity, often in the middle of the sea. A GBS intended for offshore oil platforms is constructed of steel reinforced concrete, with tanks or cells which can be used to control the buoyancy of the finished GBS. When completed, it is towed to the intended location and sunk. The platform structure which a GBS supports is called the topside.
Greater Sunrise	The largest known oil and gas reserve under Timor-Leste's part of the Timor Sea, including the Sunrise, Sunset and Troubadour fields.
Greenhouse effect; greenhouse gases	The process in which the earth receives more energy input from the sun than it re-radiates back into space, causing warming of the atmosphere, oceans and the planet's surface. It results from changes in the content of the upper atmosphere, which causes it to reflect infrared (heat) radiation emitted by the earth's surface back to earth, rather than send it back into space. Certain gases, including carbon dioxide and methane, strongly add to the greenhouse effect and are therefore called greenhouse gases.

Groin	A man-made structure, made from wood, concrete, or piles of rock, extending from the shore. One purpose can be limiting or preventing sediment transport, and is therefore a form of erosion control. Another purpose is permanent (land) access to deeper parts of water, as is the case with the groins built for the Darwin LNG plant.
Gross Domestic Product (GDP)	An indication of the size of an economy and defined as the total market value of all final goods and services produced within a country in a given year. This production is basically measured by looking at expenditure - the summing of all personal spending of households, investment spending of households and companies, and spending by government - and adjusting this sum for spending on imported and exported goods. This total amount, when divided by the population, gives an indication of average individual income. A different measure, Gross Domestic Income (GDI), uses income, including returns on investment, to come to an overall indication of economic activity.
Gross National Income (GNI)	An indication of the size of an economy and defined as the total amount produced by the nationals of the country (GDP is the amount produced within the country), plus income received from other countries (interest, dividends), as well as income earned by companies and individuals abroad, after subtracting similar payments made to other countries. GDP and GDI are chiefly concerned with the region where economic activity takes place, while GNI looks at a region's "nationals" and who "owns" the production. In the case of Timor-Leste, GNI is significantly higher than GDP because income from offshore oil is included in GNI calculations.
Human Development Index (HDI)	The Human Development Index (HDI) combines measurements of life expectancy, literacy, education (enrollment), and standard of living (GDP) UNDP calculates this index for all countries to produce a "development" ranking of countries. See http://hdr.undp.org/hd/ for the view of development that underpins the United Nation Development Program's Human Development Index and Human Development Reports. In 2007, Timor-Leste's HDI was 0.514, ranking 150th of 177 countries rated.
Hydrocarbon	A chemical compound consisting mainly of carbon and hydrogen, such as oil, natural gas, or many petroleum products. The majority of hydrocarbons found naturally occur in crude oil, which itself originates from dead plants and animals buried millions of years ago.
Internal Rate of Return (IRR)	A measure of how profitable investments in a project are. Technically, it is the discount rate that makes the net present value of a cash flow over time equal to zero. More informally, it is the highest interest rate at which you could afford to borrow all the capital needed for the project and still break even.
International Court of Justice (ICJ)	A court in The Hague, Netherlands, where national governments can bring civil cases against one another. The ICJ has often served as a mediator or arbitrator in maritime boundary disputes. In March 2002, Australia gave notice that it would no longer accept ICJ or UNCLOS processes for arbitrating maritime boundaries.
International Unitization Agreement (IUA)	An agreement between two countries to develop a petroleum field or fields that crosses a boundary as a single entity, applying a single system of laws, taxes, environmental standards, safety codes, labor rules, etc. to that field. As gas and oil will flow underground, a single field is usually developed as one project, and it would be impractical for different regulations to apply on different sides of an imaginary line in the middle of the sea. Timor-Leste and Australia signed an IUA for Greater Sunrise in March 2003, but it was not ratified in Timor-Leste and only came into effect with the CMATS Treaty in February 2007.

Inter-tidal pavement	That area of the sea bottom between the highest and lowest sea levels caused by tides.
Investment	Financial investment is lending money to a government or company (such as by depositing in a bank or purchasing a stock or bond), in order to receive a return on investment (interest or dividends). For some investments, the value of the principal (the amount invested) may also increase or decrease over time. It is also possible to invest in the human or physical capital of a country, such as through education, preventive health care or infrastructure, but the Timor-Leste Petroleum Fund is restricted to financial investments. When an oil company undertakes a large project such as an LNG plant, the investment to construct the project could come from the company's own cash reserves or from outside investors who will be repaid from the plant's profits.
Investment Advisory Board (IAB)	Advises the Ministry of Planning and Finance regarding investment policies for the Petroleum Fund.
Iralalaro project	A proposed hydroelectric project using water from the Iralalaro Lake in Timor-Leste's first national park to generate power. It involves the diversion of the entire flow of the Irasiquero River away from its sinkhole at Mainina into a tunnel drilled under the Paitchau Mountains. The tunnel would feed water to generators at sea level on the south coast, involving a fall drop of about 300 meters.
Joint Petroleum Development Area (JPDA)	An area of the Timor Sea between Timor-Leste and Australia, but closer to Timor-Leste. This was defined first in the 1989 Timor Gap Treaty as Zone of Cooperation Area A, and re-established by the 2002 Timor Sea Treaty. It is now jointly developed by Timor-Leste and Australia, with Timor- Leste receiving 90% of the government revenues from upstream production. The JPDA includes the Bayu-Undan and Elang-Kakatua gas and oil fields, and about 20% of the Greater Sunrise field.
Joint venture	A coalition of corporations, in which several companies own shares in a single project or business. All Timor Sea petroleum projects are being developed by joint ventures, which have signed exploration and production sharing contracts with governments or bi-national agencies (such as the TSDA).
Judicial system	The system of courts which administer justice in the name of the sovereign or state, and a mechanism for the resolution of disputes. The term is also used to refer collectively to the judges, magistrates and other adjudicators who form the core of a judiciary, as well as the support personnel who keep the system running.
Land tenure system	The legal regime in which land is owned by an individual or group, who is said to "hold" the land. With origins in classical systems of lords owning the land and tenants holding parts of it, whereby tenants often had obligations to the lord, it now refers to the modern relationship of various parties and land which is held under a lease.
Landfill	Also known as a dump or tip, is a site for the disposal of waste materials by burial and is both the oldest and most common form of waste treatment. A landfill also may refer to ground that has been filled in with soil and rocks instead of waste materials, so that it can be used for a specific purpose, such as for building houses. Materials which contain poisons or other environmental destructive chemicals should not be disposed of in landfills, as they could leak out into nearby water or soil.

Lateral boundaries	The definition of which territory belongs to Timor-Leste and which to Australia in areas east and west of the JPDA. These have not been established, but would be significantly wider than the JPDA according to current international legal principles. The JPDA's edges were set by Indonesia and Australia in 1972 and 1989, without participation from Portugal or Timor-Leste. Under CMATS, Timor-Leste has conceded Australia's right to extract petroleum from these previously disputed areas.
Liquefaction (Liquification)	The process of transforming natural gas to a liquid state (LNG) for loading onto ships. This is done in a large factory and requires cooling to -160°C.
Liquefied Petroleum Gas (LPG)	Propane and butane; see natural gas liquids. LPGs are commonly used as a household fuel for cooking or heating.
LNG (Liquefied Natural Gas)	In order to transport natural gas by ship, it must be cooled from its natural gaseous state to be a liquid, so that it requires much less space. LNG is almost 100% methane. See Liquefaction.
Local content (Timor-Leste content)	The proportion of economic activities by foreign companies in Timor-Leste that enters into the Timor-Leste economy. This includes hiring local workers and buying goods and services from local suppliers. See *La'o Hamutuk Bulletin* of September 2007.
Maritime Commission	Created by CMATS, with equal representation from Timor-Leste and Australia. This Commission will review and consult on issues of environment, security, resource management, and maritime boundary status, but has no authority to negotiate or determine maritime boundaries or make major project decisions.
Market window	A time-limited opportunity to produce and sell something in a profitable or commercially interesting way.
Matrilineal system	A family structure based on the relationships between female ancestors and descendants. It often refers to a system of inheritance from mother to daughter. See also patriarchy.
Median line principle	The currently accepted legal method for settling a maritime boundary when two countries' Exclusive Economic Zones overlap. As established by the UNCLOS and many ICJ decisions, the boundary should be drawn halfway between the coastlines of the two countries.
Metric ton	A measurement of mass equal to 1,000 kilograms.
Mm	Million (1,000,000).
Modernization	Social evolution theories traditionally see modernization as the process of "lifting" civilization to higher levels of development, in which more modern states would be wealthier and more powerful, and their citizens freer and having a higher standard of living. In this view, modernization is interchangeable with development, and every more modern approach as preferable to the approach already in place. This view is criticized for of giving preference to Western patterns of modernization or development and not paying enough attention to indigenous circumstances or qualities which cannot be measured in money.
Molecular sieve	A material containing tiny pores of uniform size that is used to adsorb gases and liquids. Molecules that are small enough pass through the pores and are adsorbed, while bigger molecules are not.
MTPA or mtpa	Million (metric) tons per year—a measure of rate of LNG production.

Natural gas	A petroleum resource found underground in a gaseous state, consisting primarily of methane and ethane, with smaller amounts of heavier hydrocarbons. It is often distributed as a gas by pipeline (usually after removal of the heavier hydrocarbons), but can be liquefied into LNG for storage or transport by ship. Most of Timor-Leste's undersea petroleum is natural gas.
Natural gas liquids (NGL)	The heavier components of natural gas extracted by cooling, and consisting of LPG (propane and butane) and condensate (pentanes and heavier hydrocarbons).
Natural resources	Naturally occurring substances that are considered valuable in their relatively unmodified (natural) form. A substance is generally considered a natural resource when the primary activities associated with it are extraction and purification, as opposed to creation. Thus, mining, petroleum extraction, fishing, hunting, and forestry are generally considered natural-resource industries, while agriculture is not.
Net Domestic Product	NDP equals GDP minus depreciation (the loss of value of a product over time). This is an estimate of how much the country has to spend to maintain the current GDP.
Netback price	The price the upstream project receives for the gas it extracts and sells; see Box 10.
Non-renewable Resource	A natural resource, such as petroleum, which is not replaced as it is used and will eventually run out. This is different from a renewable resource, such as water or fish, which can replenish itself if properly managed. Conversion of a non-renewable resource to cash is also called an extractive industry.
Operator	An oil company that is part of a joint venture (often the largest shareholder) and takes responsibility for exploration, drilling, construction and operation of processing facilities. However, all joint venture partners usually make major decisions together, each having a vote in proportion to their share. ConocoPhillips and Woodside Petroleum are the operators of Bayu-Undan and Greater Sunrise respectively.
Osaka Gas	A gas company based in Osaka, Japan. Together with Woodside Petroleum, Shell and ConocoPhillips it is a joint venture partner for the Sunrise development project.
P50	The mid-range estimate of the amount of oil and gas contained in a reserve, also called "proved plus probable" or 2P Other estimates are P90 ("proved" or 1P) and P10 ("possible" or 3P). A P50 estimate means there is a 50% probability that the reserve will contain at least this amount.
Paradox of plenty	Also termed the "resource curse," this refers to the paradox that countries with an abundance of natural resources tend to have less economic growth than countries without these natural resources. This happens for many different reasons, including a decline in the competitiveness of other economic sectors, volatility of revenues from the natural resource sector, and government mismanagement or political corruption, provoked by the inflows of easy windfalls from the resource sector.
Patriarchy	The structuring of society on the basis of family units, in which fathers have primary responsibility for the welfare of these units. The concept of patriarchy is often used to refer to the expectation that men take primary responsibility for the welfare of the community as a whole, acting as representatives via public office.
Patrilineal	See Matrilineal system.

Peak-shaving	A method commonly used by plants with additional electricity generating capacities. It allows securing of electrical energy at the lowest possible rate through buying of electricity from others when rates are low and manufacturing power internally when rates are high. LNG plants, in this way, buy power from a local grid as well as generate power themselves. The incentive to do the latter depends on costs of buying power and losses incurred by using up gas that could be sold.
Petroleum	A naturally-occurring liquid or gaseous hydrocarbon, resulting from decomposition of living material from millions of years ago. The word often refers to unrefined oil as opposed to gas, another chief product, although petroleum itself is a mixture of liquid and gaseous hydrocarbons.
Petroleum Act	Enacted by Timor-Leste in July 2005, this law defines the relationship between the Timor-Leste government and companies which carry out petroleum exploration and extraction in the country's land and sea territory, spelling out the contract system, the companies' fiscal, environmental and other responsibilities, labor and procurement practices, etc. The Petroleum Act governs upstream activities only, and would not apply to an LNG plant. See reference [74] for the text and history of this law.
Petroleum Fund	A fund established by Timor-Leste law in September 2005, that saves and invests government revenues from petroleum, including royalties and taxes. It is managed by the Banking and Payments Authority. The Petroleum Fund is a mechanism for making petroleum income more consistent and predictable from year to year, and for saving some of the revenue for the time when all Timor-Leste's oil and gas have been extracted. See reference [73]. Additional information on the Fund's operation, including a link to the text of the law, is available at http://www.laohamutuk.org/Oil/PetFund/05PFIndex.htm.
Petroleum Fund Act	The law defining how the Government manages petroleum-related income using the Petroleum Fund, setting guidelines on how much can be spent each year to balance the needs of current and future generations. See reference [73].
Petroleum Fund Consultative Council (PFCC)	An advisory body which includes former Government leaders and representatives of various sectors of society. It provides advice to the Parliament concerning the Petroleum Fund before Parliament makes any decisions about withdrawing money from the Fund.
Petroleum Mining Code (PMC)	A law adopted by the TSDA in 2005 to govern petroleum activities in new areas of the JPDA. The Bayu-Undan, Elang-Kakatua and Greater Sunrise fields, already under contract, are covered by a previous interim code. The PMC will apply to areas which are contracted from 2006 on. Australia withheld approval of the PMC to pressure Timor-Leste to sign the CMATS Treaty, but approved it in February 2006. Available at http://www.laohamutuk.org/Oil/PetRegime/JPDA%20PMC%208-05.pdf
Phillips Petroleum	See ConocoPhillips.
Principal	An amount of money used for investment, on which interest is paid.
Production Sharing Contract (PSC)	A contract between one or more oil companies (see joint venture) and a governmental body to explore for and develop petroleum resources in a defined area and to sell the petroleum found there. Under the PSC arrangement, the government owns the underground petroleum resources, not the oil companies. The companies act as "contractors" to the government, being paid for their services with a share of production. Australia, UNTAET, and now Timor-Leste have promised the oil companies that PSCs signed during the Indonesian occupation will be honored even if territory or revenue is reassigned.

Profit oil (Also called second tranche petroleum)	Once oil companies have sold enough petroleum to recover their investment in a particular project, a share of additional sales are paid to the government(s) from whose territory the petroleum was taken. This is called profit oil, and is in addition to FTP that is paid from the beginning of production. The companies also pay income or corporate tax on their net profits, after subtracting operating expenses.
Ratification	The act of giving official sanction, usually by multiple sub-national entities, to a formal document such as a law, treaty or constitution. Generally, a treaty does not come into force until it has been ratified by Parliament.
Refrigeration	The process of removing heat from an enclosed space or from a substance, for the primary purpose of lowering the temperature and then maintaining that lower temperature. Its most common applications are household refrigerators and air conditioning units. As refrigeration technology developed into the generation of extreme low temperatures, anything below -180°C is commonly referred to as cryogenics.
Resource curse	See Paradox of Plenty
Revenues	Also referred to as "turnover," a financial term for the amount of money received in a given time period. For a company this is mostly from sales of products and/or services to customers. For individuals, the equivalent term is income. For government, it refers to the gross proceeds received from taxes, fees, royalties, etc.
Risk discount or Risk premium	An adjustment in price in order to sell or buy a good or service whose quantity, quality, or delivery is subject to risk. For example, if LNG from Timor-Leste is perceived to be more likely to have its supply interrupted than LNG from Australia, a customer may insist on paying a lower price for Timor-Leste LNG.
Rollover	A large and sudden release of vapor from LNG due to the initial forming of two separate layers with different densities and heat content in a single container, which start mixing rapidly.
Royal Dutch Shell	A multinational oil company of British and Dutch origins. It is one of the largest private sector corporations in the world (2006 revenues were $318.8 billion and profits $26 billion), operating in over 140 countries. The company's main business is exploration and production, processing, transportation and marketing of hydrocarbons (oil and gas). Shell also has a significant petrochemicals business, and an embryonic renewable energy sector developing wind, hydrogen and solar power opportunities. It owns 34% of Woodside Petroleum and is a joint venture partner in Sunrise.
Rule of law	In its most basic form, the principle that no one is above the written law and there is equality of all before the law. The most important application of the rule of law is the safeguard against arbitrary governance, whether by a totalitarian leader or by mob rule, as it enforces a government to adhere to established procedural steps to retain legitimacy and legality. The concept of "rule of law" per se says nothing of the "justness" of the laws themselves, but simply how the legal system upholds the law.
Sand flat	A nearly flat sandy coastal area alternately covered and exposed by the tides, with no vegetation.

Seabed boundary treaty	Signed between Australia and Indonesia in 1972. This treaty draws a boundary between the two countries' seabed (ocean floor) resource entitlements, following the continental shelf principle of drawing the line through the Timor Trough, the deepest water between the two countries. Portugal, which was then administering Timor-Leste, refused to participate in the negotiations, so there is a gap in the line off the coast of Timor-Leste.
Shell	See Royal Dutch Shell
Snøhvit (Snow White) LNG project	A 4.3 mtpa LNG plant in northern Norway and operated by Statoil, exploiting the resources of three gas fields in the Barents Sea; Snøhvit, Albatross and Askeladd. The plant is built on a small island, Melkøya, and, due to its isolated nature, nearly all construction work was done in other places.
Stranded gas	A natural gas field that has been discovered, but remains unusable for physical or economic reasons, often because there is no pipeline connecting it with potential customers. LNG is one way to bring stranded gas to market.
Stripper	A device used to "strip" unwanted contaminants from a liquid. In the case of LNG, nitrogen rich vapor is stripped from partially liquefied gas, and carbon dioxide and other contaminants from the amine baths.
Sunrise Commission	Established by the IUA, the Sunrise Commission has two members appointed by Australia and one by Timor- Leste. This Commission will coordinate the work of the Australian government and the Timor Sea Designated Authority (TSDA) regarding exploration and exploitation of petroleum in the Sunrise Unit Area. If there is a disagreement which cannot be resolved by the regulatory authorities or the Sunrise Commission, it can be referred to arbitration.
Sunrise field	See Greater Sunrise
Sunrise task force	A task force set up by the Alkatiri government to conduct preliminary studies on the possibility of processing Sunrise gas in Timor-Leste. It has been re-created by the current AMP government.
Sustainable development	Development that fulfills human needs while maintaining the quality of the natural environment indefinitely. It does not focus only on environmental issues, but takes into account economic and social issues as well. The UN World Commission on Environment and Development calls it development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs."
Tara bandu or tarabandu	Tara Bandu refers to traditional Timorese customs that regulate the relationship between humans and the environment surrounding them. For example, it can determine the times when it is forbidden to fell trees, or to pick and collect the produce from plants in certain places that are considered to be sacred or from which many people derive their means of existence. In essence, it is a traditional livelihoods regulatory system that takes into account sustainable development.
Tcf	Trillion cubic feet—a measure of quantity of natural gas. See also: cubic foot
Tectonic plates	The outermost part of the Earth's interior is made up of two layers: the top layer is mostly solid and rigid. Below it are parts that, although solid, can flow like a liquid on geological time scales. Due to this liquid, flowing nature of the inner part the outer part endures stress causing it to break-up into several tectonic plates, large areas of the earth's surface. These plates can flow alongside each other, can move apart, or can crush into one another. Timor island was formed through a collision between the Eurasian plate with the Australian plate, folding the latter near the colliding area.

Thermal efficiency	A performance measure of a thermal device such as an internal combustion engine or a boiler. The input to the device is heat, or the heat-content of a fuel that is consumed. The desired output is mechanical work, or heat, or possibly both. The thermal efficiency of an electric generator based on gas turbines, as often used in LNG plants, compares (electric) energy produced with energy produced if the gas was burned normally.
Timor Gap Treaty	Signed between Australia and Indonesia in 1989 to allow the two countries to explore for petroleum in illegally-occupied Timor-Leste seabed territory, with a 40-year term. This treaty closed the Timor Gap in the 1972 Australia-Indonesia seabed boundary line by defining a Zone of Cooperation, later called the Joint Petroleum Development Area (JPDA). The Timor Gap Treaty became meaningless in October 1999, when Indonesia gave up its claim to Timor-Leste.
Timor Sea Designated Authority (TSDA)	A bi-national Australia/Timor-Leste government agency established by the 2002 Timor Sea Treaty to regulate petroleum projects within the Joint Petroleum Development Area (JPDA) of the Timor Sea, including the Bayu-Undan oil and gas field (in production since 2004), part of the larger Greater Sunrise field (which could begin production in about five years), and the smaller Elang-Kakatua oil field (in production 1998-2007, now depleted). The TSDA is two-thirds controlled by Timor-Leste and acts like a government for purposes of contracting with and managing oil company operations in the JPDA.
Timor Sea Treaty	Signed between Timor-Leste and Australia on 20 May 2002, the treaty came into force on 2 April 2003. It continues the JPDA defined in the Timor Gap Treaty, but replaces Indonesia with Timor-Leste and allocates 90% of JPDA government revenues to Timor-Leste. The Timor Sea Treaty had an original duration of 30 years from 2003, but it was extended by the CMATS Treaty to 50 years from 2007.
Trafficking in human beings	The recruitment, transportation, transfer, harboring or receipt of people for the purpose of exploitation. Trafficking involves illicit means such as threat and deception, and targets vulnerable groups. Examples of exploitation are forcing people into prostitution, forced labor or services, slavery, illegal child adoption, or the removal of organs.
Troubadour Field	See Greater Sunrise
Turbidity	The cloudiness or haziness of a fluid or gas caused by tiny particles in it, similar to smoke in air. Turbidity in open water is often caused by waste or sediments resulting from waste disposal. In water high turbidity can increase viral and bacterial matter, as it attaches to the particles, and it can disrupt marine ecosystems.
United Nations Convention on the Law of the Sea (UNCLOS)	Signed in 1982, and adopted by most countries in the world, it entered into force in 1994. This treaty defines laws for many issues relating to the sea, including Exclusive Economic Zones and procedures for establishing maritime boundaries according to median line principles. It also includes a process for resolving disputes, both in court and by arbitration, from which Australia withdrew in March 2002. Indonesia ratified UNCLOS in 1986 and Australia in 1994. Timor-Leste has not yet signed or ratified UNCLOS.
Unitized, Unitization, Unit Area	See International Unitization Agreement.

Upstream	The part of the petroleum process that involves finding and getting the gas or crude oil out of the ground or the seabed and into a pipeline or ship for further downstream processing. This is defined in CMATS as "petroleum activities and facilities before the valuation point" defined in the Sunrise IUA.
Valuation point	The point of the first commercial sale of petroleum extracted from the Sunrise field, which is when natural gas enters a pipeline which leaves the Unit Area. For other marketable components, such as crude oil, condensate, liquefied petroleum gas (LPG, propane), it represents the first sale of the component. (See IUA Articles 1(h), 1(i) and 1(t)).
Water column	Resources contained on the surface and within the water of the sea, including fish and dissolved minerals, but not including the seabed underneath. In 1997, Australia and Indonesia signed a treaty drawing a boundary between their water column resources (fish, etc.). CMATS defines Timor-Leste's rights to water column resources within the JPDA, and Australia's rights south of it, but leaves the water column rights in lateral areas unresolved.
Wickham Point	A peninsula in Darwin Harbor, in Australia's Northern Territory, formerly an environmental sanctuary. A large part of the protected area has been given up to construct a LNG plant, which is named after the area but also known as the Darwin LNG plant. This plant processes natural gas from Bayu-Undan, but could be expanded to also handle gas from other fields.
Woodside (formerly called Woodside Petroleum or Woodside Australian Energy)	Australia's largest gas producer (although, with 2,900 employees, much smaller than international oil companies), operator of the Sunrise, Laminaria-Corallina and Kuda Tasi/Jahal fields. Woodside is 34% owned by Shell, the second largest oil company in the world.
Zip failure	The cracking of joined metal, especially welding joints, due to extreme cold.
Zone of Cooperation (ZOC)	A portion of the Timor Sea between Australia and Timor-Leste, but closer to Timor-Leste. This was created by Australia and Indonesia in the 1989 Timor Gap Treaty as a way to share petroleum revenues, since they could not agree on their maritime boundary. Its central portion - Area A - became the Joint Petroleum Development Area (JPDA) under the Timor Sea Treaty.

Appendix 8. References

More information, background, supporting documents, etc. are available on the La'o Hamutuk website http://www.laohamutuk.org and on the OilWeb CD-ROM published by La'o Hamutuk.

The following is an alphabetical list (by author) which includes the documents referenced in the text of this report [indicated in square brackets at the point of reference] as well as a few other materials which provide relevant information. For most of them, we were able to obtain electronic copies, which are included in the CD-ROM edition of this report (available from La'o Hamutuk); some are also on OilWeb. They are also linked from the website version, at http://www.laohamutuk.org/Oil/LNG/Refs/app8.htm. All materials are in English except where otherwise noted.

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