APPENDIX

Oil Storage Infrastructure in Myanmar

This appendix provides more detailed information on the oil-storage infrastructure of Myanmar. In preparing an effective oil-stockpiling development plan, understanding domestic oil infrastructure such as tank storage locations and their capacities is very important. Collecting accurate statistics is also based on correct information of oil storage infrastructure. Myanmar is one of the few ASEAN countries that is currently working to develop a comprehensive oil-supply security plan, and precise information of the country's oil-storage infrastructure would assist such development efforts. The country is also in the process of developing a system for collecting and managing energy-related statistics. Infrastructure information would also be a useful reference in the development of this system. Based on this consideration, this appendix aims to provide the latest oil-storage infrastructure information as of March 2015.

A-1. Oil-Storage Facilities in Myanmar

A-1-1.Oil-stockpile situation in Myanmar

As elaborated in 2-10, Myanmar does not have any oil-stockpile strategy yet, and its oil is stored in storage facilities as feedstock for refineries and petrochemical complexes. The Myanmar government established the NEMC, a new organisation responsible for formulating energy policy and plans, in 2013. According to the interview conducted with officers in the Ministry of Energy in 2014, the NEMC specified in the draft of the Energy Security Plan that 30 days of net imports will be held in 2020, 45 days of net imports will be held in 2045, and 90 days reserve will be held in 2050. Currently, the Ministry of Energy is responsible for oil stocks. However, the NEMC will assume this responsibility in the near future. Oil-storage facilities will be reported in the following subsections because there are no stockpile plans and facilities in Myanmar as explained earlier.

A-1-2. Oil refineries

Myanmar has three refineries in operation—Thanlyin, Chauk, and Thanbayakan (Mann)—with a refining capacity of 51,000 b/d in total (Asia Development Bank, 2012). Table A-1-1 summarises information on the three refineries and Figure 2.1 shows their locations. As shown in Table A-1-1, the refineries are old and the operating percentages are low, ranging from 33 percent to 57 percent. The refineries use a blend of domestic crude oil from onshore fields (heavy sweet crude oil) and condensates from the Yetagun offshore gas field. Detailed information will be described in the following sections.

Furthermore, Myanmar plans to build several new refineries to meet domestic demand as well as to export larger volumes of diesel. Future plans on refineries will be described in a later section.

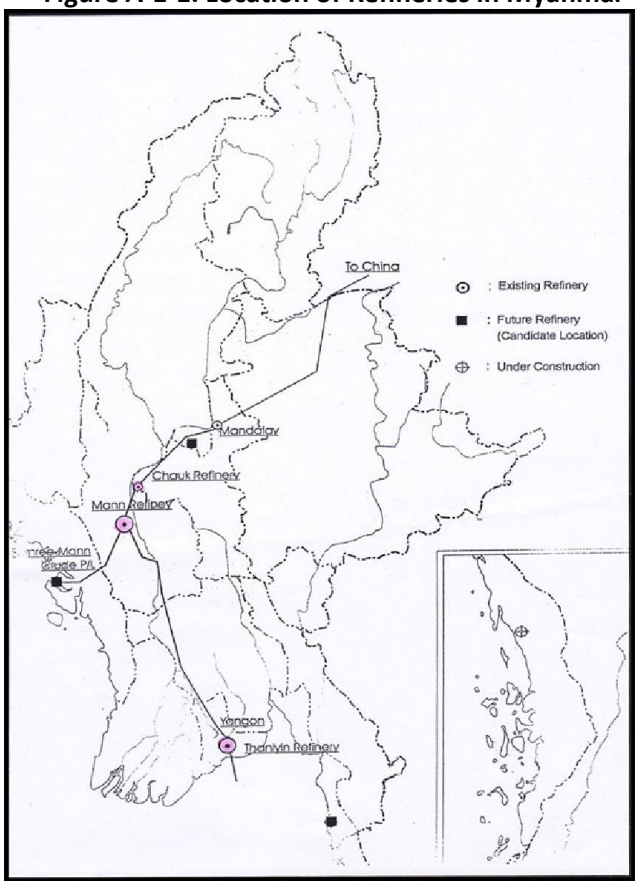
Table A-1-1. Summary of Operating Refineries in Myanmar

No.	Name	Location	Design Capacity [kb/day]	Acutual Capacity [kb/day]	Percent of Design Capacity [%]	Start Year	Operator	Ownership [%]
1	Thanlyin Refinery	Thalnyin, Yangon	20	11	57	1963	MPE	100
2	Chauk Refinery	Chauk, Magway	6.0	2.0	33	1954	MPE	100
3	Thanbayakan Refinery	Minhla, Magway	25	8.6	34	1982	MPE	100

MPE: Myanmar Petrochemical Enterprise

Source: Asia Development Bank (2012) and Myanmar Immortal Trading (n.d).

Figure A-1-1. Location of Refineries in Myanmar



Source: Project Monitor News Bureau (n.d.)

(1) Thanlyin Refinery

The Thanlyin Refinery is located on the bank of the Bago River, 14 km from Yangon, Thanlyin Township. It is the largest and also one of the oldest refineries in Myanmar (Myanmar Petrochemical Enterprise, 2012 and The World Bank, 2012). Though the design capacity of the refinery is 20,000 BPSD, the actual production is approximately half of the design capacity as shown in Table A.1.

Table A-1-2 summarises the main units of the Thanlyin Refinery and Figure A-1-2 shows a block flow diagram of the refinery (ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1992). Crude oil was used as a feedstock when the refinery started its operation. The feedstock, however, was changed to the condensate from Yetagun in 2002. Therefore, the Delayed Coker Plant was shut down in 2002 while the Bitumen Plant was shut down in 2007. The Crude Oil Distillation Unit B and Unit C were renovated in 1997 (Unit B) and 2007 (Unit B and Unit C) to enhance the performance of the refinery.

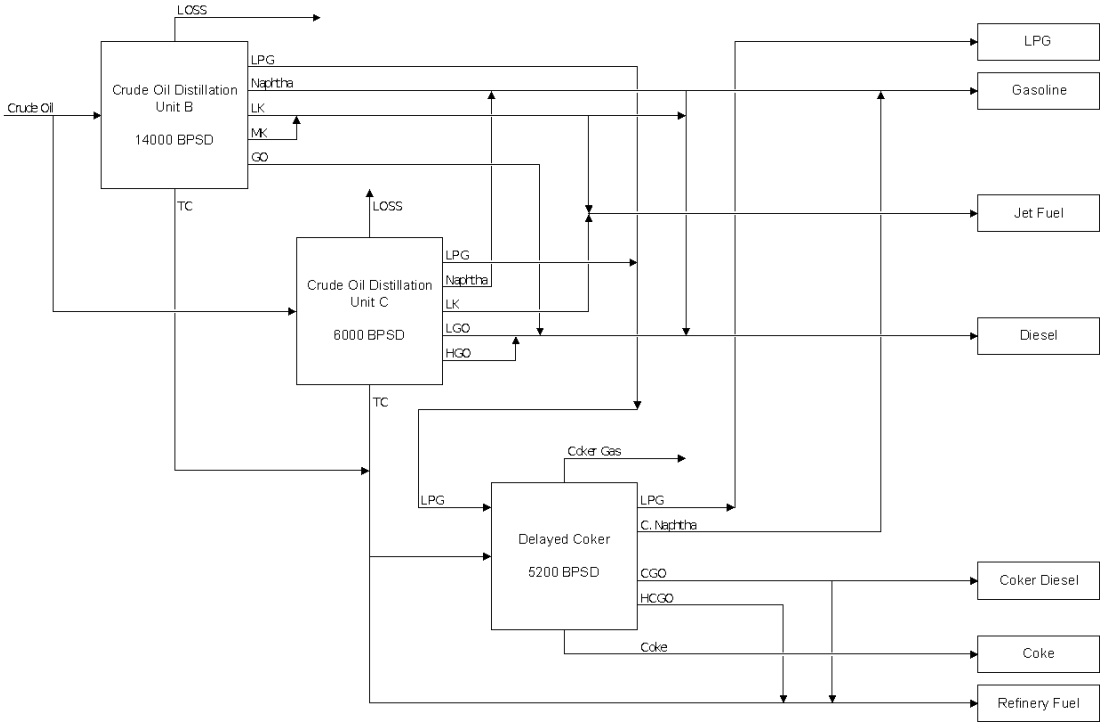
Table A-1-2. Main Units of the Thanlyin Refinery

Name	Design Capacity	Contractor	Year
Crude Oil Distillation Unit B	14,000 BPSD	Foster Wheeler	1962
Crude Oil Distillation Unit C	6,000 BPSD	Mitsubishi Heavy Industries	1980
Delayed Coker Plant	5,200 BPSD	Mitsubishi Heavy Industries	1982
Special Boiling Point Solvent Plant	1,400 BPSD	APV Mitchell Ltd.	1973
Bitumen Plant	400 t/day	Nichimen Company	1999
Candle Factory	1.5 t/day	N/A	1963
6 MW Electricity Generation Plant	6 MW	Mitsubishi Heavy Industries	1980
4.5 MW Electricity Generation Plant	4.5 MW	Angelique International Co. Ltd.	2007

Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1992.

The Thanlyin Refinery has tank farms and offsite facilities including 54 storage tanks and five berth marine terminals. Table A-1-3 summarises the information about the storage tanks installed around the Thanlyin Refinery. Thanlyin Refinery has intermediate tanks associated with the main units such as the Crude Oil Distillation Unit, the Delayed Coker Plant, and the Special Boiling Point Solvent Plant in addition to storage tanks for crude oil and products.

Figure A-1-2. Block Flow Diagram of the Thanlyin Refinery



Source: Asian Development Bank (2012a).

Table A-1-3. Storage Tanks Installed around the Thanlyin Refinery

Description	Quantity of Tanks	Capacity
Crude Oil/Condensate	12	29.6×10^6 gal
Motor Gasoline	14	21.8×10^6 gal
Aviation Turbine Fuel	3	4.45×10^6 gal
Diesel Oil	11	17.1×10^6 gal
Topped Crude	3	1.33×10^6 gal
Fumace Oil	3	2.43×10^6 gal
LPG	8	5.55×10^3 t

Source: The World Bank, 1992.

(2) Chauk Refinery

Chauk Refinery is located in Magway division. It is the smallest refinery of the three refineries in Myanmar operated by MPE and its design capacity is 6,000 BPSD (Myanmar Immortal Trading Co., Ltd., n.d.). Several small jetties are built on the Irrawaddy River, and two small storage tank farms are located near the jetties and the refinery.

The Chauk Refinery refines crude oil produced from the Chauk-Lonywa oilfield found in 1902. It includes a topping and vacuum unit with 6,000 BPSD as design capacity and a wax plant producing 1,500 tons per month (Aung Kyaw Htoo, 2014; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1985). From 1979 to 1980, vacuum residue was reclaimed from open pit storage where it has accumulated since start-up and sold as heavy petroleum oil. Paraffin wax is produced using a chill process. However, the sharp decline in production in the period 1982–1983 points to difficulties in repairing the wax plant (Daw Hla Kyi, 2006). The actual refining capacity of the refinery is approximately 38 percent because it is difficult to transport crude oil to the refinery and products from the refinery due to the limitations imposed by its location.

(3) Thanbayakan Refinery (Mann Refinery)

The Thanbayakan Refinery, located in Magway division 500 km from Yangon, is the newest refinery. Oilfields here are scattered within a 10 km to 20 km radius from the refinery and the oil produced from these fields constitutes the major feedstock of the refinery. Although the design capacity of the refinery is 25,000 BPSD, the actual

production is less than half of the design capacity as shown in Table A-1-1.

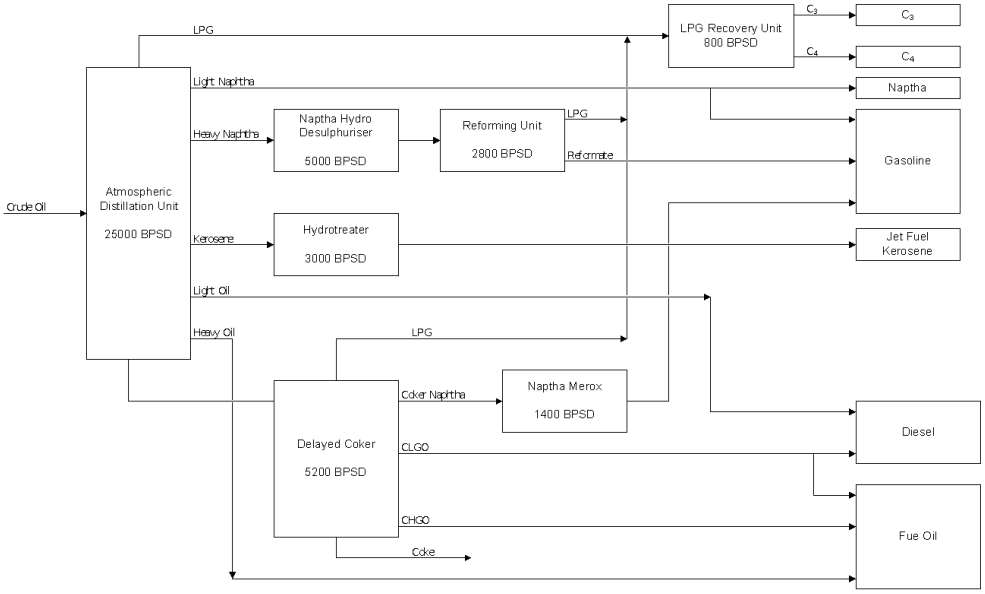
Table A-1-4 summarises the main units of the Thanbayakan Refinery and Figure A-1-3 shows a block flow diagram of it (ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015). The refinery has a 25,000 BPSD Crude Oil Distillation Unit; a 2,800 BPSD Semi-regenerative Catalytic Reformer; a 5,200 BPSD Delayed Coker; a Kerosene Hydrodesulphurisation unit (3,800 BPSD); an LPG Recovery (Merox treating) unit; and a Naphtha Merox treating unit. The LPG Separation Plant at Thanbayakan has a design treating capacity of 24 million cubic feet per day (MMCFD) of wet natural gas and a design production capacity of 60 t/d of propane and 55 t/d of butane. Crude oil is transported from local oilfields through pipelines that are 10 inches in diameter (Mann, Htauk Shabin, and Kanni) and by barge (Ye-Nan-Chaung, Kyauk-Kwet, Nyaung-Don, Kwai Ma, and Nga-Bat-Chaung). Yetagun condensate from the Yetagun offshore oilfield is also processed in response to demand.

Table A-1-4. Main Units of the Thanbayakan Refinery

Name	Design Capacity	Contractor	Year
Crude Oil Distillation Unit	25,000 BPSD	Mitsubishi Heavy Industries	1982
Naphtha Hydro Desulphuriser	5,000 BPSD	Mitsubishi Heavy Industries	1982
Reforming Unit	2,800 BPSD	Mitsubishi Heavy Industries	1982
Hydrotreater	3,000 BPSD	Mitsubishi Heavy Industries	1982
Delayed Coker	5,200 BPSD	Mitsubishi Heavy Industries	1982
LPG Recovery Unit	800 BPSD	N/A	1982
Naphtha Merox	1400 BPSD	N/A	1982
Fouling Water Stripper	15.2 t/h	N/A	1982

Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015.

Figure A-1-3. Block Flow Diagram of the Thanbayakan Refinery



Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015.

A-1-3. Pipelines

(1) Domestic Pipelines

There are three crude oil pipelines in Myanmar as of 2014 (Japan Petroleum Energy Center, 2011). Table A-1-5 gives details of these three domestic crude oil pipelines. All pipelines are owned and operated by Myanma Oil and Gas Enterprise. It would be easy to assume that there are oil-storage tanks at the origin and the destination in each pipeline. We, however, could not obtain any detailed information on these storage tanks.

Table A-1-5. Domestic Crude Oil Pipelines in Myanmar

Name of Pipeline	From	To	Start Year	Length [km]	Diameter [inch]	Company
Mann-Thinlyin Pipeline	Mann field	Thinlyin	1979	449.8	10	MOGE
Letpando-A yadaw Pipeline	Letpando	Ayadaw	1998	75.7	8 , 6	MOGE
Thargyitaung-Kamma Pipeline 1	Thargyitaung	Kamma	2001	9.9	10	MOGE

Source: Japan Petroleum Energy Center, 2011.

(2) International Pipelines

China National Petroleum Corporation (CNPC) built and will operate the Myanmar–China oil pipeline which bypasses the sea route via the Malacca Strait. This pipeline and a companion natural-gas pipeline transport hydrocarbons from the Bay of Bengal across Myanmar to southwestern China (Hilton, 2013).

Figure A-1-4 shows the planned route of the Myanmar–China gas and oil pipelines (Wikipedia, n.d.) and Table A-1-6 gives details of these pipelines. The gas and oil pipelines run in parallel and start near Kyaukphyu, run through Mandalay, Lashio, and Muse in Myanmar before entering China at the border city of Ruili in Yunnan province. The gas pipeline, the maximum capacity of which is 12 billion cubic metres/year, will carry natural gas from Myanmar's offshore A-1 and A-3 blocks. This pipeline runs further from Kunming to Guizhou and Guangxi in China and is 2,806 km long in total. The oil pipeline, the maximum capacity of which is 0.24 million bbl/year, will transport crude oil carried by tankers from the Middle East. Therefore, a large oil-import port and storage tanks will also be built as an input point of this oil pipeline. The port can receive vessels up to 300,000 deadweight tonnage (DWT) and has storage capacity of 1.2 million cubic metres. This pipeline, which eventually terminates in Kunming, capital of Yunnan Province, has a total length of 771 km (The Associated Press, 2013). The total estimated project costs are US$1.04 billion for the gas pipeline and US$1.5 billion for the oil pipeline (Hilton 2013).

Construction of the Myanmar–China oil pipeline and gas pipeline started in June 2010. In June 2013, the CNPC announced that the Myanmar section of the gas pipeline was complete and ready for testing while the oil pipeline was 94 percent complete [28]. In January 2015, Myanmar officially opened a deep-sea port off its western coast and started trial operation (China Harbour Engineering Company).

Figure A-1-4. Planned Route of the Myanmar–China Gas and Oil Pipelines

Source: Wikipedia, n.d.

Table A-1-6. Myanmar–China Gas and Oil Pipelines

Name of Pipeline	From	To	Start Year	Length [km]	Diameter [inch]	Owners	Operator	CAPEX [billion USD]
Myanmar-China gas pipeline	Kyaukphyu	Guizhou and Guangxi	2013	792	40	CNPC (50.9%) MOGE(49.1%)	CNPC	1.04
Myanmar-China oil pipeline	Kyaukphyu	Kunming	2015	2806	32	CNPC (50.9%) MOGE(49.1%)	CNPC	1.50

Source: Japan Petroleum Energy Center (2011), Hilton (2013), The Associated Press (2013) and China Harbour Engineering Company.

To be exact, the port and storage tanks are located on the Madae Island. As reported by the Associated Press, China Harbour Engineering Company, and Tank Storage Magazine, there are 12 storage tanks at the port and the capacity of each tank is 100,000 cubic metres.

Myanmar is supposed to receive US$13 million per year and a toll fee of the pipeline (US$1/tonne) from the CNPC (Aung Kyaw Htoo, 2014). In addition, the construction of a new refinery is planned in the greater Mandalay area with feedstock to come from a branch line from this pipeline. Future refinery plans are described in detail in a later section.

A-1-4. Storage tank terminals

(1) Fuel Terminals

Figure 2.11 shows the location of storage terminals and ports in Myanmar. There is little information on the storage terminals in Myanmar. Therefore, the fuel storage network in Myanmar is expected to be inadequate.

i) Terminals Owned by State-Owned Companies

As shown in Table A-1-7, a total of seven fuel terminals are owned by state-owned companies such as the MPPE and MPE (Japan Petroleum Energy Center, 2011).

Table A-1-7. Fuel Terminals Owned by State-Owned Companies in Myanmar

Name	Type	Location	Division	Capacity [m^3]	Company
Taungdwingyi Terminal	Fuel Terminal Grade (A)	Taungdwingyi	Magwe	---	MPPE
Chauk Terminal	Fuel Terminal Grade (A)	Chauk	Magwe	---	MPPE
Mandalay Terminal	Fuel Terminal Grade (B)	Mandalay	Mandalay	---	MPPE
Popaywa Terminal	Fuel Terminal Grade (C)	Popaywa	Mandalay	---	MPPE
Bassein Storage Terminal	---	Bassein	Ayeyarwady	946	MPPE
Moulmein Storage terminal	---	Moulmein	Mon State	2,271	MPPE
Thanlyin refinery Storage Terminal	---	Thanlyin	Yangon	875,538	MPE

Source: Japan Petroleum Energy Center, 2011.

ii) Terminals Majority-Owned by Chinese State-Owned Company

NPC, a Chinese state-owned oil and gas company, has a large fuel terminal in Kyaukphyu. This terminal has 10 storage tanks with a capacity of 100,000 cubic metres/tank (in total 1.2×10^6 cubic metres). The engineering, procurement, and construction (EPC) contractor for this oil terminal and channel-dredging project was China Harbour Engineering Company Ltd and the storage tanks were built by China Huanqui

Contracting & Engineering (China Harbour Engineering Company, n.d.; Oil & Gas Technology, 2013 and Tank Storage Magazine, 2013). Table A-1-8 summarises information on the fuel terminal in Kyaukphyu.

Table A-1-8. Fuel Terminal Majority-Owned by the CNPC in Myanmar

Terminal	Location	Start Year	Operator	Owner	Tank Capacity [m^3/tank]	Numbet of Tanks [tank]	Total Capacity [m^3]	Stored Products
CNPC Kyaukpyu Terminal	Kyaukphyu	2015	CNPC	CNPC (50.9%) MOGE (49.1%)	100,000	12	1,200,000	Crude Oil

Source: Japan Petroleum Energy Center (2011); China Harbour Engineering Company (n.d.) and Tank Storage Magazine (2013).

Figure A-1-5. Storage Tanks at the CNPC's Fuel Terminal in Kyaukphyu

Source: Tank Storage Magazine (2014).

iii) Terminals Owned by Private Companies in Yangon

As summarised in Table A-1-9, there is one fuel terminal project under construction which will be owned and operated by Guangdong Zhenrong Energy Co., Ltd at Yangon port. In addition to the Guangdong Zhenrong Terminal, a plan for another fuel terminal called the Vitol Yangon Storage Terminal has been announced and has received approval from the Myanmar Port Authority. However, little information is available on the current situation regarding the Vitol Yangon Storage Terminal.

Table A-1-9. Fuel Terminals Owned by Private Companies in Yangon

Terminal	Location	(Planned) Start Year	Operator	Owner	Tank Capacity [m^3/tank]	Numbet of Tanks [tank]	Total Capacity [m^3]	Stored Products	Status
Yangon Oil Terminal	Yangon	2018	Guangdong Zhenrong	Guangdong Zhenrong (100%)	---	---	100,000	Refined Products	under construction
Vitol Yangon Storage Terminal	Yangon	---	Vitol Tank Terminals International BV	Vitol Tank Terminals International BV	---	---	---	---	approved

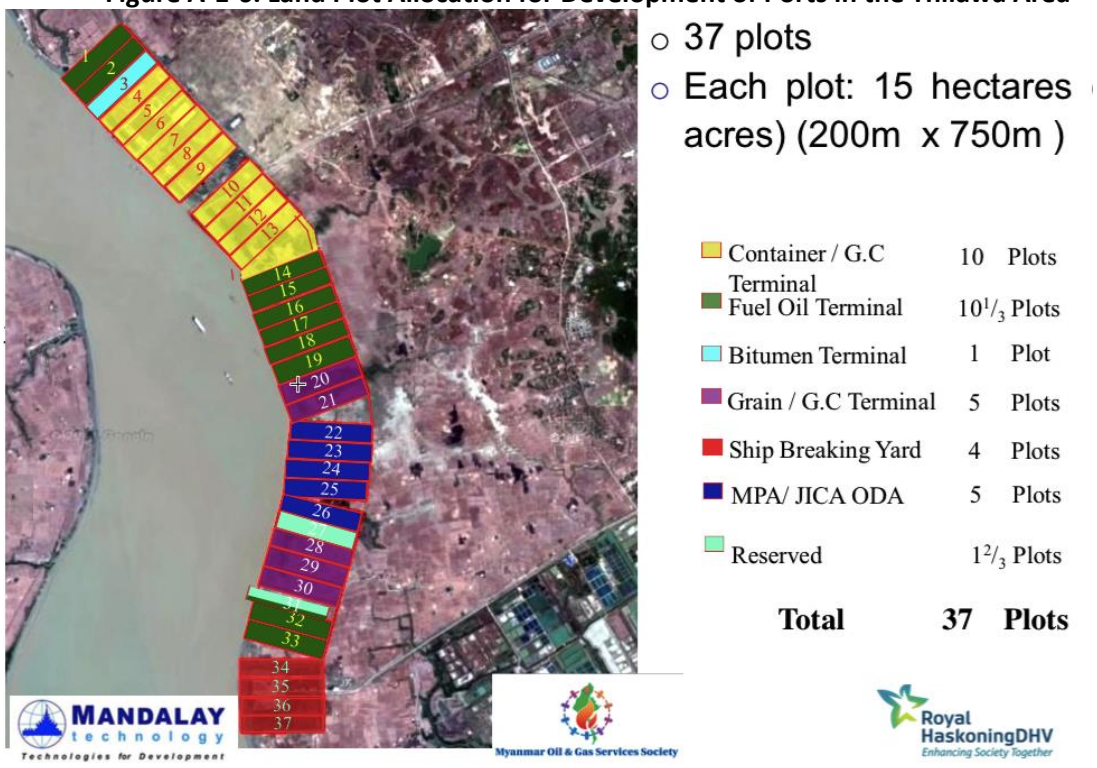
Source: Aung Kyaw Htoo (2014), Japan Petroleum Energy Center (2011) and Zaw Naing (2014).

iv) Terminals Owned by Private Companies in Thilawa

The construction of fuel terminals has been planned to in concert with the expansion of Thilawa port. As shown in Figure A-1-6, there are 37 allocated plots and the area of each plot is approximately 24 acres (200 metres by 750 metres). As of 2014, approximately 10 plots were planned to be used for fuel oil terminals. The construction of some of these terminals had been finished and they were in operation.

Table A-1-10 summarises information on fuel terminals. Detailed information on the fuel terminals in operation will be described in this section and information on the planned terminals will be described in a later section.

Figure A-1-6. Land Plot Allocation for Development of Ports in the Thilawa Area



Source: APEX Gas & Oil Public Company Limited.

Table A-1-10 Fuel Terminals Owned by Private Companies in Thilawa

Terminal	(Planned) Start Year	Operator	Owner	Tank Capacity [m^3/tank]	Numbet of Tanks [tank]	Total Capacity [m^3]	Stored Products	Status	Plot No.
Great Petroleum Terminal	2013	APEX Gas & Oil Public Company Limited	APEX Gas & Oil Public Company Limited (100%)	5,000 15,000	2 1	25,000	Gasoil and Gasoline	in operation	1, 2(B)
Myat Myittar Mon Petroleum Terminal	---	Myat Myittar Mon	Myat Myittar Mon	380 2,000	2 2	4,760	Gasoil and Gasoline	in operation	1, 2(A)
Asia World Petroleum Terminal	---	Asia World	Asia World	7,600 15,200	4 2	60,800	---	in operation	17, 18 (A)
Great Petroleum Terminal Expansion	2015	APEX Gas & Oil Public Company Limited	APEX Gas & Oil Public Company Limited (100%)	---	---	50,000	Gasoline	under construction	1, 2(B)
Puma energy Thilawa storage terminal	2015	Puma Energy	Puma Energy (80%) Asian Sun Group Company Limited (20%)	---	---	88,000	bitumen and petroleum products	under construction	3
Thyuriya Energy Thilawa SEZ Storage Terminal	2016	Thyuriya Energy Depot Management Ltd	Dagon Group of Companies (100%)	---	---	74,560	Diesel and Octane	under construction	17, 18
Denko oil storage terminal	---	Denko Trading Company	Denko Trading Company	---	---	---	---	approved	17, 18 (B)
Padauk Shwe War Port and Petroleum Storage Terminal	---	Padauk Shwe War Port and Petroleum	Padauk Shwe War Port and Petroleum	3,800 5,700	2 1	13,300	---	approved	33
International Group of Entrepreneur Storage Terminal	---	International Group of Entrepreneur	International Group of Entrepreneur	380 380 7,600	2 2 2	9,120	---	approved	31, 32 (B)
Green Asia Services Storage Terminal	---	Green Asia Services	Green Asia Services	---	---	---	---	approved	---
Max Myanmar and Elite Petrochemical StorageTerminal	---	Max Myanmar and Elite Petrochemical	Max Myanmar and Elite Petrochemical	20,000 8,700 15,200 7,600	4 4 2 3	168,000	---	approved	15, 16 (A, B) 15, 16 (A, B) 15, 16 (C) 15, 16 (C)
Kaung Myanmar Aung Shipping Storage Terminal	---	Kaung Myanmar Aung Shipping	Kaung Myanmar Aung Shipping	5,700 160	2 1	---	---	approved	31, 32 (C)
Shwe Taung Energy Services Storage Terminal	---	Shwe Taung Energy Services	Shwe Taung Energy Services	4200 8400	2 1	16,800	---	approved	1, 2(C)

Source: Japan Petroleum Energy Center (2011), U Aung Khine Htun (2012), APEX Gas & Oil Public Company Limited and opencorporates APEX Gas & Oil Public Co., ltd (Public).

Great Petroleum Terminal : (Japan Petroleum Energy Center (2011), opencorporates APEX Gas & Oil Public Co., ltd (Public) and opencorporates Myat Myittar Mon Co., Ltd.)

- Plot No.: No. 1 and 2 (B) (see Figure A-1-13 for an aerial view of the area)
  - ✓ Sharing Plots No.1 and No. 2 with Myat Myittar Mon Company Limited and Shwe Taung Company Limited
- Operator: APEX Gas & Oil Public Company Limited
- Ownership: APEX Gas & Oil Public Company Limited (100%)
- Tank capacity and number of tanks:
  - ✓ 1 million gallon/tank × 2 tanks (approximately 5,000 m^3/tank × 2 tanks)
  - ✓ 3 million gallon/tank × 1 tank (approximately 15,000 m^3/tank × 1 tank)
  - ✓ Expanding to 10 storage tanks with a total capacity of 75,000 m^3 for Gasoline

APEX Gas & Oil Public Company Limited was incorporated on 16 January 2013 with registration No. 4334 and established the Great Petroleum Terminal. The Great Petroleum Terminal is the first standard private petroleum terminal in Myanmar certified in accordance with ISO 9001-2008.

The terminal operates a full range of storage tank services, gasoil (diesel), gasoline (mogas 92/95, etc.) and terminal-related logistics services for both local and import/export use. Moreover, gasoil and gasoline are provided to their 19 filling stations and more than 30 of their partners' filling stations.

As shown in Figure A-1-13, there are 11 tanks built in plots No. 1 and No. 2. It is difficult to identify which tanks belong to Great Petroleum Terminal. However, three tanks located at plot No. 2 are assumed to be those used for Great Petroleum Terminal according to the information on sizes and the total number of tanks.

Myat Myittar Mon Terminal (Japan Petroleum Energy Center (2011), opencorporates Asia World Co., Ltd.)

- Plot No.: No. 1 and 2 (A) (see Figure A-1-13 for an aerial view of the area)
  - ✓ Sharing Plots No.1 and No. 2 with APEX Gas & Oil Public Company Limited and Shwe Taung Company Limited
- Operator: Myat Myittar Mon Company Limited
- Ownership: Myat Myittar Mon Company Limited
- Tank capacity and number of tanks
  - ✓ 0.5 million gallon/tank × 2 tanks (approximately 2,000 m^3/tank × 2 tanks)
  - ✓ 0.1 million gallon/tank × 2 tank (approximately 380 m^3/tank × 1 tank)

Myat Myittar Mon Company Limited was incorporated on 3 April 2000 with registration No. 14 and established the Myat Myittar Mon Petroleum Terminal in Thilawa. The terminal is in operation using the four tanks listed above and Myat Myittar Mon is building additional four storage tanks in the terminal.

It is difficult to identify which tanks shown in Figure A-1-13 belong to the Myat Myittar Mon Petroleum Terminal. However, four small tanks located at Plot No. 1 are assumed to be those used for the Myat Myittar Mon Petroleum Terminal considering the tank capacity and the number of tanks.

Asia World Petroleum Terminal: (Japan Petroleum Energy Center (2011), opencorporates Asia World Co., Ltd., Asia World Co., Ltd. Opencorporates Green Asia Services Co., Ltd, Kudo (2005))

- Plot No.: No. 17 and 18 (A) (see Figure A-1-14 for an aerial view of the area)
  - ✓ Sharing Plots No.17 and No. 18 with Denko Petrochemical Company Limited and Thyuriya Energy Depot Management Company Limited

- Operator: Asia World Company Limited
  - ✓ Green Asia Services Company Limited, which is a group company of Asia World may be an operator of this terminal.
- Ownership: Asia World Company Limited
  - ✓ Green Asia Services Company Limited, which is a group company of Asia World may be a one of the owners of this terminal.
- Tank capacity and number of tanks
  - ✓ 2 million gallon/tank × 4 tanks (approximately 7,600 m^3/tank × 4 tanks)
  - ✓ 4 million gallon/tank × 2 tanks (approximately 15,200 m^3/tank × 2 tanks)

Asia World Company Limited was incorporated on 5 June 1992 with registration No. 120 and established the Asia World Company Petroleum Terminal in Thilawa. The terminal is in operation using the six tanks listed above.

It is difficult to identify with certainty which tanks shown in Figure A-1-14 belong to the Asia World Company Petroleum Terminal. However, four smaller tanks and two larger tanks located at plot No. 18 are assumed to be those used for the Asia World Company Petroleum Terminal considering the tank capacity and the number of tanks.

(2) Sub-Fuel Terminals

As described in section 2.4.1(a), MPPE and MPE own and operate seven storage terminals through their subsidiaries. MPPE also established 25 sub-fuel terminals, 10 aviation distribution facilities to supply aviation fuels, and 271 fuel filling stations and one LPG filling station (Japan Petroleum Energy Center (2011), AsiaTradeHub.com, Myanmar Port Authority)

Table A-1-11 summarises information on the sub-fuel terminals in Myanmar owned and operated by the MPPE.

Table A-1-11. Sub-Fuel Terminals in Myanmar

Name	Type	Location	Division	Company
Myeik Terminal	Depot Grade (A)	Myeik	Tanintharyi	MPPE
Dawei Terminal	Depot Grade (A)	Dawei	Tanintharyi	MPPE
Mawlamyine	Depot Grade (A)	Mawlamyine	Mon	MPPE
Pyinywa/Labuta	Depot Grade (A)	Pyinywa/Labuta	Ayeyarwady	MPPE
Sittwe Terminal	Depot Grade (A)	Sittwe	Rakhine	MPPE
Pyay Terminal	Depot Grade (A)	Pyay	Bago	MPPE
Hsihseng Terminal	Depot Grade (A)	Hsihseng	Shan	MPPE
Myaung Terminal	Depot Grade (A)	Myaung	Sagaing	MPPE
Kawthoung Terminal	Depot Grade (B)	Kawthoung	Tanintharyi	MPPE
Thaton Terminal	Depot Grade (B)	Thaton	Mon	MPPE
Hinthada Terminal	Depot Grade (B)	Hinthada	Ayeyarwady	MPPE
Kyaiklat Terminal	Depot Grade (B)	Kyaiklat	Ayeyarwady	MPPE
Thandwe Terminal	Depot Grade (B)	Thandwe	Rakhine	MPPE
Sinbaungwe Terminal	Depot Grade (B)	Sinbaungwe	Magwe	MPPE
Pyinmana Terminal	Depot Grade (B)	Pyinmana	Mandalay	MPPE
Thazi Terminal	Depot Grade (B)	Thazi	Mandalay	MPPE
Pakokku Terminal	Depot Grade (B)	Pakokku	Magwe	MPPE
Kengtung Terminal	Depot Grade (B)	Kengtung	Shan	MPPE
Konkyan/Launtkai	Depot Grade (B)	Konkyan/Launtkai	Shan	MPPE
Kutkai Terminal	Depot Grade (B)	Kutkai	Shan	MPPE
Larshio Terminal	Depot Grade (B)	Larshio	Shan	MPPE
Myitkyina Terminal	Depot Grade (B)	Myitkyina	Kachin	MPPE
Bhamo Terminal	Depot Grade (B)	Bhamo	Kachin	MPPE
Mawlaik Terminal	Depot Grade (B)	Mawlaik	Sagaing	MPPE
Monywa Terminal	Depot Grade (B)	Monywa	Sagaing	MPPE

Source: Japan Petroleum Energy Center (2011).

A-2. Existing Infrastructure Related to Oil Storage in Myanmar

A-2-1. Pipelines

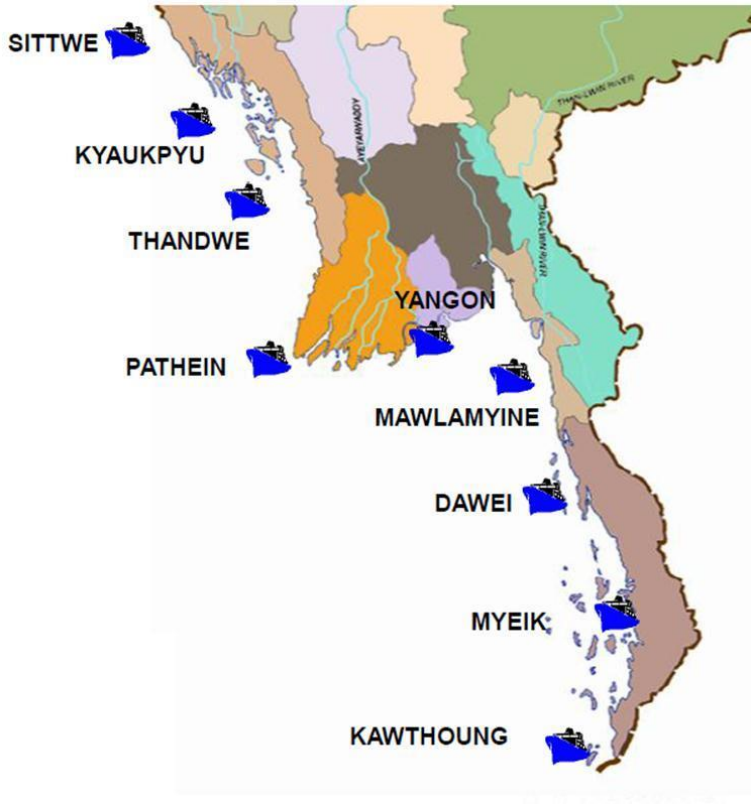
Refer to section A-1-3 for information on existing domestic and international pipelines in Myanmar.

A-2-2. Ports

Figure A-2-1 shows the location of the main ports in Myanmar. Yangon Port is an international port and Sittwe, Pathein, Mawlamyine, and Myeik Ports are international exporting ports. Kyaukphyu, Thandwe, Dawei Ports are mainly for domestic coastal traffic. Kawthaung Port, a domestic coastal port has been used for domestic coastal

traffic as well as an exporting port mainly for exports destined for Thailand. Myanmar Port Authority is responsible for these coastal ports (Japan International Freight Forwarders Association, 2012 and Captain Aung Khin Myint, 2014).

Figure A-2-1. Location of Ports in Myanmar [46]



Source: Asian Development Bank (2012b).

The ports in Yangon (including Thilawa), Kyauphyu, and Dawei are expected to be important for transporting crude petroleum and petroleum products because deep-sea berths are being, or will be, built at these ports.

(1) Port of Yangon

The Port of Yangon is the premier port in Myanmar and handles about 90 percent of the country's exports and imports, which amounted to 12 million tons of import and export freight in 2011. The Port of Yangon is the only port in Myanmar that handles both export and import shipments. This port is located along the Yangon River, which is 30 km inland from the sea and close to Yangon City (Japan International Freight Forwarders

Association, 2012; Captain Aung Khin Myint, 2014; Aung Min Han, 2013).

Access to the Port of Yangon is limited to vessels of around 12,000 DWT to 15,000 DWT because of the shallow draft leading to the port (Figure A-2-2) (APEX Gas & Oil Public Company Limited; Japan International Freight Forwarders Association, 2012; Captain Aung Khin Myint, 2014; Aung Min Han, 2013 and Ports.com). Additional government-owned terminals for petroleum products and other commodities are in the same port area (Japan International Freight Forwarders Association, 2012).

Table A-2-1 summarises the facilities of international wharves at the Port of Yangon. Other basic information on the port is summarised as follows (APEX Gas & Oil Public Company Limited; ADB, 2012b; Aung Min Han, 2013; Ports.com and Aung Min & Kudo, 2012).

- Tidal Range: 5.85 m (at spring tide) – 2.55 m (at neap tide)
- Current Velocity: 4–6 kt
- Waves:
  - ✓ Do not do not hinder marine operations
  - ✓ Seldom rough with less than 2 m wave-height
- Vessel Size: LOA 167 m, Draft 9 m, 15,000 DWT
- Depth:
  - ✓ Anchorage depth: 6.4 m–7.6 m
  - ✓ Cargo pier depth: 6.4 m–7.6 m
  - ✓ Oil terminal depth: 7.1 m–9.1 m
- Dry dock: Small
- Harbour size: Small
- Railway size: Medium
- Harbour type: River Natural
- Max size: Up to 500 feet in length
- Repairs: Limited

Crude oil and diesel fuel are currently imported in large crude carriers in volumes of 6,000,000 bbl. These carriers are moored at the mouth of the Yangon River. Due to the low draft and sandbars along the river, the crude has to be transported to the refinery using shuttle tankers with a capacity of 6,000 bbl. As a result, it takes nearly 14 days to clear a tanker. To overcome this problem Myanmar's Ministry of Energy is currently seeking to utilise a Single Buoy Mooring (SBM) at the mouth of the river and then to lay a pipeline from the SBM to the Thanlyin Refinery.

Figure A-2-2. Location of Terminals and Inland Container Depots at Yangon Inner Harbour

Source: APEX Gas & Oil Public Company Limited.

Table A-2-1. Facilities of International Wharves at the Port of Yangon

No.	Name	Type of Terminal	Quay Length [m] each	Quay Length [m] sub total	Apron Width [m]	Vessel DWT [DWT]	Back Up Area [acre]
1	SPW (1)	GC	137		12.2	15,000	
2	SPW (2)	GC	137		12.2	15,000	
3	SPW (3)	GC	137		12.2	15,000	
4	SPW (4)	GC	137	1040	12.2	15,000	38
5	SPW (5)	GC	168		15.2	15,000	
6	SPW (6)	GC	162		15.2	15,000	
7	SPW (7)	GC	162		15.2	15,000	
8	BSW (1)	GC/ Container	137		15.2	15,000	
9	BSW (2)	GC/ Container	137	457	15.2	15,000	24
10	BSW (3)	GC/ Container	183		30.0	15,000	
11	AWPT (1)	GC/ Container	198		30.5	15,000	
12	AWPT (2)	GC/Container	156	614	19.5	15,000	30
13	AWPT (3)	GC/ Container	260		30.5	15,000	
14	MIP (1)	GC/ Container	155	310	18.0	12,000	17
15	MIP (2)	GC/ Container	155		18.0	12,000	
16	HOB	Edible Oil	120		15.0	5,000	
17	HPT (2)	Edible Oil	213	546	30.0	15,000	---
18	HPT (3)	Edible Oil	213		30.0	15,000	

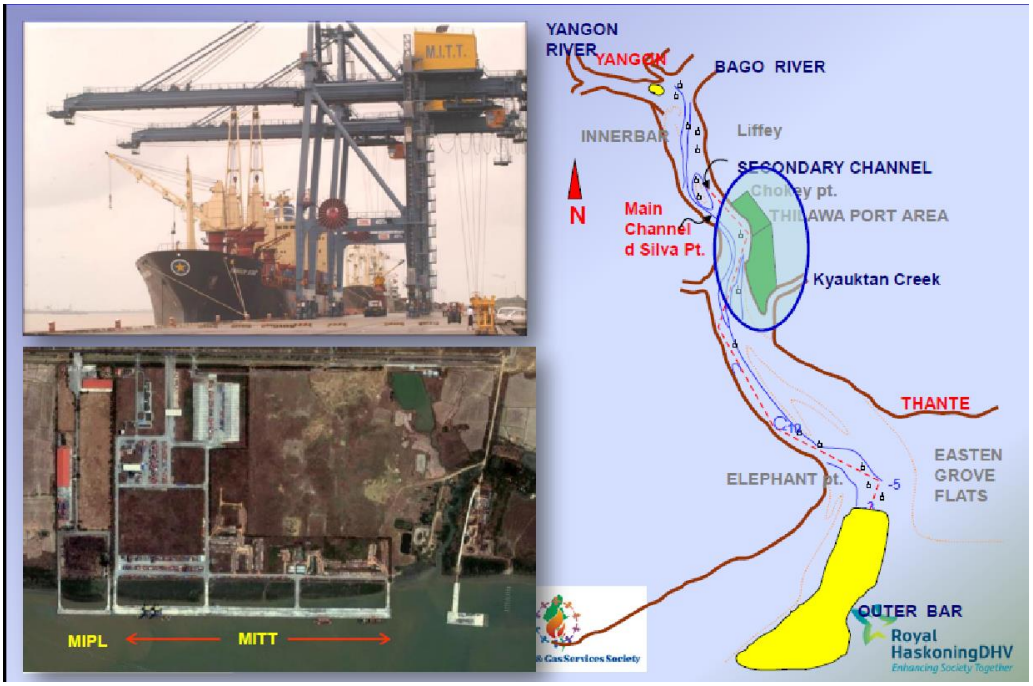
Source: Aung Min Han (2013).

(2) Thilawa Port

Yangon port now includes the new port area at Thilawa called Myanmar International Terminals Thilawa (MITT), about 20 km downstream of Yangon. This is a private sector investment developed and operated by Hutchison Port Holdings (HPH) of

Hong Kong, China. The new port has rail access, provides some 1,000 m of wharf, and handles container and general cargo. It offers a deeper draft than Yangon—10 m compared with Yangon's 7 m. As a consequence, it can handle larger vessels, including cruise ships (Japan International Freight Forwarders Association, 2012 and Captain Aung Khin Myint, 2014). Figure A-2-3 shows the location of terminals at Thilawa Port and Table 3.1 summarises the facilities of the international wharves at Thilawa Port.

Figure A-2-3. Location of Terminals at Thilawa Port



Source: APEX Gas & Oil Public Company Limited.

Table A-2-2. Facilities of International Wharves at Thilawa Port

No.	Name	Type of Terminal	Quay Length [m] each	Quay Length [m] sub total	Apron Width [m]	Vessel DWT [DWT]	Back Up Area [acre]
1	MITT (1)	GC	200		30.0	20,000	
2	MITT (2)	GC	200		30.0	20,000	
3	MITT (3)	GC	200	1,000	30.0	20,000	185
4	MITT (4)	GC	200		30.0	20,000	
5	MITT (5)	GC	200		30.0	20,000	
6	MIPL	GC / Liquid Bulk	200	200	17.0	20,000	37

Source: Aung Min Han (2013).

Thilawa Port is currently under development for expansion as described in section A-1-4. As shown in Figure A-1-12, there are 37 plots available; however, they are very small and currently being bought in groups by construction companies and investors. The plot land owners are not all looking to give up the plots they own at the port entirely but are looking for financial partners to construct facilities on them so that they may benefit in the future when the port is completed and established in the market, according to the report by Claira Lloyd (Italian-Thai Development Public Company Limited, 2014).

(3) Dawei Small Port and Deep-Sea Port

The Dawei deep-sea port development was planned as a part of the Dawei Special Economic Zone (SEZ) Development Project. Figure A-2-4 shows a Perspective View of the Planned Dawei SEZ. Dawei SEZ Development consists of the following development (in full phase) (Italian-Thai Development Public Company Limited, 2013).

- Deep-sea port
- Industrial-estate heavy industries such as steel mill, oil refinery, petrochemical complex, fertiliser plant, ship building and maintenance services facilities, power plants, and other utilities service businesses
- Cross-border road and rail link with connecting oil and gas pipelines and transmission lines from the Dawei SEZ to the Myanmar–Thailand border
- Township for residential and commercial development

In order to start the Dawei SEZ Project, an initial-phase development will first be implemented. The expected concession agreements signing date was in February 2015. The initial-phase project, along with the associated infrastructure will be divided into four phases of industrial-estate development totalling an industrial estate area of 28 square km or 21 square km of saleable industrial estate land. The development period for the initial-phase project will total eight years with the commercial operation date expected in mid-2016 with a land lease period of 50 + 25 years (Italian-Thai Development Public Company Limited, 2013).

Figure A-2-4. Perspective View of the Planned Dawei Special Economic Zone

Source: Kruewan (2014).

i) Small Port

Small-port development as part of the initial phase was partially completed as of December 2014. The authors participated in an infrastructure mission hosted by the Japan External Trade Organization (JETRO) in 2014 and had an opportunity to visit the Dawei SEZ project site. Only the 1st Jetty Berth, however, had been completed when the authors visited the Dawei SEZ. This port will be the logistics base for the light- and medium-industry estate, which will be developed adjacent to the port.

Figure A-2-5 shows the planned perspective and isometric view of the small port at Dawei SEZ and the actual berth of the small port. Basic information on the small port based on the information provided by the Italian–Thai Development Public Company Limited (ITD), the Thai developer on this project, is as follows:

- Jetty Berth
  - ✓ 1st Berth (Completed) : 100 m length jetty berth
    - Overall length is 150 m
    - 13,000 DWT multipurpose vessel (approximately 400 twenty-foot equivalent unit [TEU]) with an estimated capacity of 330,000 tonnes per annum (TPA)
  - ✓ 2nd Berth (future expansion): 150 m length jetty berth

- Overall length is 180 m
- 25,000 DWT multipurpose vessel (approximately 400 TEU) with estimate

● Depth

✓Approach Channel: 8 m

✓Anchorage Area: 7 m

● Other planned facilities:

✓There are also plans to provide cargo operation and ship operation facilities in the future according to demand.

✓An LNG terminal will be developed within two years. LNG is to be used as fuel for the power plant which supplies electricity to the Dawei SEZ.

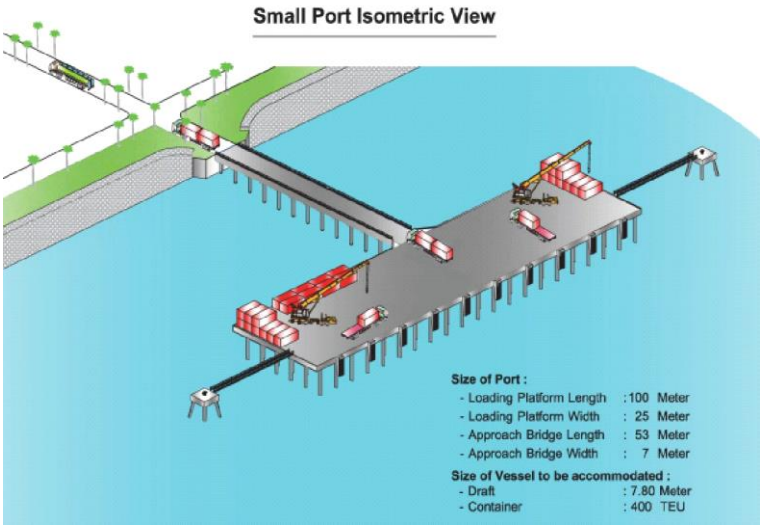
- Shell is involved in the development of the LNG terminal.
- Most of the participants in the JETRO Infrastructure Mission expressed doubts regarding the feasibility of building the LNG terminal within two years.

Source: Italian-Thai Development Public Company Limited, 2013; Kurewan, 2014 and Kimura &Umezaki, 2010).

Figure A-2-5. Small Port at the Dawei Special Economic Zone

(a) Perspective View of the Planned Small Port

(b) Isometric View of the Planned Small Port



(c) Photograph Taken at the Berth of the Small Port

Source: Authors.

ii) Deep-Sea Port

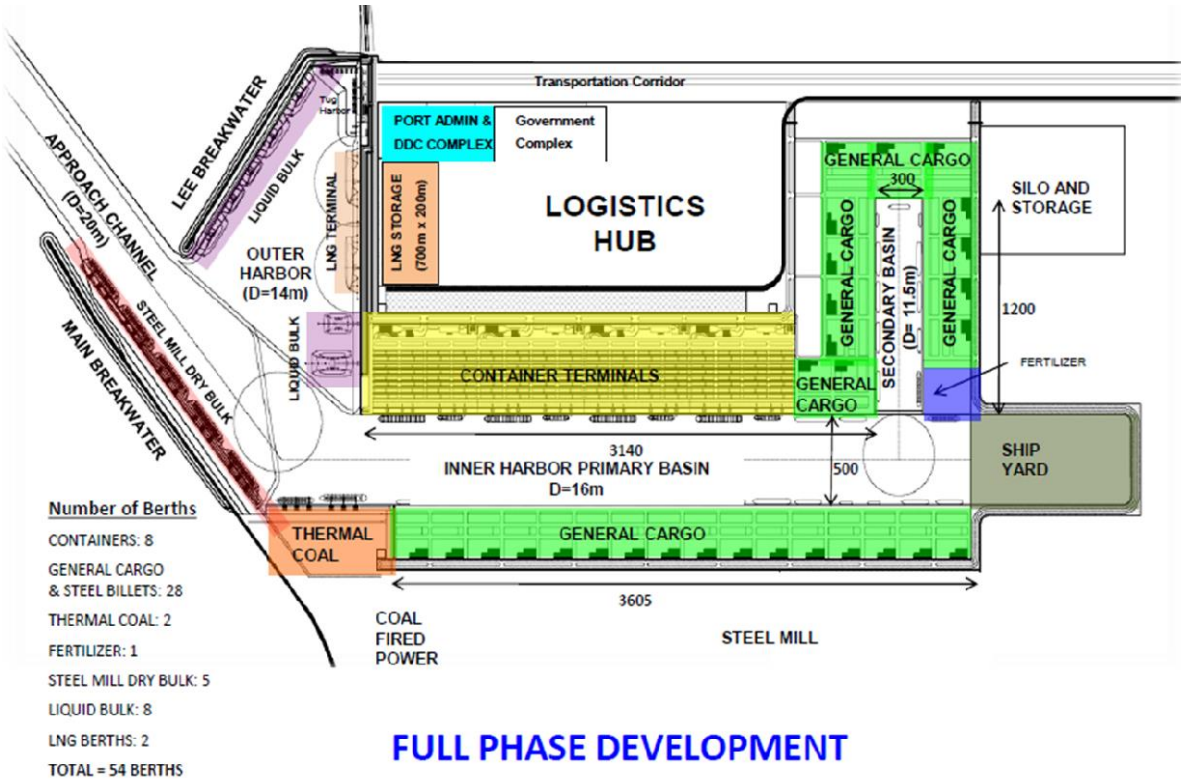
Figure A-2-6 shows the current plan for a deep-sea port at the Dawei SEZ. Originally, two deep-sea ports were to be developed. However, only one deep-sea port will now be developed according to the current development plan. The outer harbour is designed with container terminals and berths for liquid and dry bulk cargo while the inner harbour will contain general cargo-handling facilities. As shown in Figure A-2-7, the current status of the deep-sea port development project is still in the land-preparation stage and it seems that it will require much time to complete development and start commercial operation.

Italian–Thai Development Public Company Limited provided the following basic

information on the deep-sea port (Llyod, 2014; Italian-Thai Development Public Company Limited, 2013; Kurewan, 2014 and Kimura & Umezaki, 2010).

- Total area: 1,000 ha
- Estimated capacity at full phase: 287 × 10^6 t and 5× 10^6 TEU
  - ✓ General cargo: 50 × 10^6 t (approximately)
  - ✓ Chemical and petrochemical: 35 × 10^6 t
  - ✓ Crude oil: 36 × 10^6 t
- Estimated Project Cost: US$2.4 million for full phase
- Vessel size: up to 300,000 DWT
- Number of berths: 54
  - ✓ Containers: 8
  - ✓ General cargo and steel billets: 28
  - ✓ Thermal Coal: 2
  - ✓ Fertiliser: 1
  - ✓ Steel mill dry bulk: 5
  - ✓ Liquid bulk: 8
  - ✓ LNG: 2
- Quay Length: 8.7 km
- Depth
  - ✓ Approach channel: 20 m
  - ✓ Inner harbour primary basin: 16 m
- Breakwaters (3.7 km) and revetment
- Tug harbour and vessel traffic management and navigation aids

Figure A-2-6. Layout Plan of the Deep-Sea Port at the Dawei Special Economic Zone [55]



Source: Kruewan (2014).

Figure A-2-7. Current Situation at Deep-Sea Port Basin Area

Source: Authors.

(4) Kyaukphyu Deep-Sea Port

Myanma Oil and Gas Enterprise and CNPC have been jointly operating the tanker port on Made Island for the Myanmar–China crude oil pipeline. The tanker port is 480 m long and can accommodate 300,000 DWT vessels. This would also provide easier access to the markets of Africa, the Middle East, and Europe for Chinese manufacturers through Myanmar. Construction on the workboat wharf and other necessary structures started in November 2009 (Myanmar News Agency, 2015). Myanmar has officially opened a deep-sea port off its western coast and started trial operation in January 2015 (China Harbour Engineering Company). Basic information on the deep-sea port is as follows: [48]–[50]:

- Vessel size: up to 300,000 DWT
- Number of berths: 5
- Quay Length: 480 m (tanker ports)
- Depth: 25 m
- Loading: 4 sets of DN400 hydraulically actuated marine arms,
  ✓ maximum unloading rate: 12,000 m^3/h

Source: Captain Aung Khin Myint, 2014; Aung Min Han, 2013 and Ports.com.

Figure A-2-8. Aerial view of Kyaukphyu Deep-Sea Port

Source: Myanmar News Agency (2015).

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