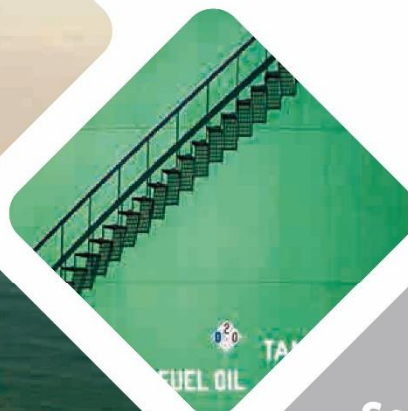APEC Oil and Gas Security Studies

Oil Supply Security and Emergency Policy in the APEC Region

APERC
Asia Pacific Energy Research Centre

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Oil Supply Security and Emergency Policy in the APEC Region

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November 2015

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Asia Pacific Energy Research Centre

FOREWORD

During the 11th APEC Energy Ministersø Meeting (EMM11) held in Beijing, China on 2nd September 2014, the Ministers issued instructions to the Energy Working Group (EWG). This includes an instruction to Asia Pacific Energy Research Centre (APERC) to continue its cooperation on emergency response so as to improve the capacity building in oil and gas emergency response in APEC region.

Following this instruction, APERC has started implementing the Oil and Gas Security Initiative (OGSI) in November 2014. One of the three overarching pillars of the OGSI is the publication of the Oil and Gas Security Studies (OGSS).

The OGSS serves as a useful publication to APEC economies by having access to developments and issues on oil and gas security, and information on individual economyøs policies related to oil and gas security including responses to emergency situation.   The research studies included in OGSS will help encourage the APEC economies to review and revisit their respective policies, plans, programmes and measures on oil and gas security, and may probably help them adopt appropriate approaches to handling possible supply shortage or supply emergencies in the future.

I would like to thank the contributors to the OGSS for the time they have spent doing research works. May I however highlight that the independent research project contents herein reflect only the respective authorsø view and not necessarily APERCøs and might change in the future depending on unexpected external events or changes in the oil and gas and policy agendas of particular economies or countries.

I do hope that the OGSS will serve its purpose especially to the policy makers in APEC in addressing the oil and gas security issues in the region.

Takato OJIMI

President

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Acknowledgements

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Abbreviation and Acronyms

Abbreviation

AAGR	average annual growth rate
Ktoe	kilotonnes of oil equivalent
Km^2	square kilometres
MMbbl/d	million barrels per day
Mtoe	million tonnes of oil equivalent
'000bbl/d	thousand barrels per day
PPP	purchasing power parity
TOE	tonnes of oil equivalent
USD	US Dollar

Acronyms

ACE	ASEAN Centre for Energy
APEC	Asia Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
APSA	ASEAN Petroleum Security Agreement
ASCOPE	ASEAN Council on Petroleum
ASEAN	Association of Southeast Asian Nations
CERM	Coordinated Emergency Response Measure
DIARIO	DiarioOficial De La Federacion
DOE	Department of Energy
EA	Emergencies Act
ECTF	Inter-Agency Energy Contingency Task Force
EDMC	Energy Data and Modelling Center
EDPMO	Energy Department at the Prime Minister Office
EERC	Energy Emergency Response Centre
EGAT	Electricity Generating Authority
EIA	Energy Information Administration
EMSD	Electrical and Mechanical Services Department
EMERCOM	Ministry of Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters
ENB	Environment Bureau
EPCA	Energy Policy and Conservation Act

ERA	Emergency Response Assessment
ERE	Emergency Response Simulation Exercise
ERIA	Economic Research Institute for ASEAN and East Asia
ESAB	Energy Supplies Allocation Board
ESEA	Energy Supplies Emergency Act
FEC	Final Energy Consumption
FED	Final Energy Demand
GDP	Gross Domestic Product
HHI	Herfindahl-Hisrchman Index
IEA	International Energy Agency
IEEJ	Institute of Energy Economics Japan
IEP	International Energy Program
JOGMEC	Japan Oil and Gas and Metals National Association
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MBIE	Ministry of Business, Innovation and Employment
MCDEM	Ministry of Civil Defense and Emergency Management
MEMR	Ministry of Energy Mineral Resources
METI	Minister of Economy, Trade and Industry
MINEM	Ministry of Energy and Mines
MIR	Minimum Inventory Requirement
MOE	Ministry of Energy
MOEA	Ministry of Economic Affairs
MOIT	Ministry of Industry and Trade
MOJ	Ministry of Justice
MOTIE	Ministry of Trade, Industry and Energy
NEA	National Energy Administration
NEC	National Energy Council
NDMC	National Disaster Management Centre
NDRC	National Development and Reform Commission
NESO	National Emergency Strategic Organization
NORC	National Oil Reserve Center
NOSEC	National Oil Supplies Emergency Committee
OCCO	Oil Conservation and Control Ordinance
OGJ	Oil and Gas Journal
OGSN	Oil and Gas Security Network
ONEMI	National Emergency Office

OPEC	Organization of Petroleum-Exporting Countries
OSRM	Oil Stockpiling Roadmap
PDR	Petroleum Demand Restraint
PECR	Philippine Energy Contracting Round
PES	Primary Energy Supply
PMO	Prime Minister's Office
PRIDE	Personal Readiness is Drawdown Excellence
PTT	Petroleum Authority of Thailand
RAHS	Risk Assessment Horizon Scanning
SEC	Superintendency of Electricity and Fuels
SENER	Secretaria de Energia
SPR	Strategic Petroleum Reserves
TPEC	Total Primary Energy Consumption
TPES	Total Primary Energy Supply
UAE	United Arab Emirates
US	United States

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Overview and Executive Summary

The APEC region contributes significantly to global economy with about 50.0 percent share to total world GDP *(World Bank, World Development Indicators)*. Such large contribution is translated to 60.0 percent of global energy demand as the region is a host to world's largest energy consumers ó China, the United States, Russia and Japan *(Energy Working Group & BP Statistics)*. Final energy demand of the region from 1990 to 2012 grew by 1.8 percent at average annual rate. On the other hand, final energy intensity (or energy use per unit of GDP) in 2012 as shown in *Figure 2*, on the average, was at 84.6 toe/million USD GDP (2010 USD). Half of the APEC economies demonstrated above APEC average final energy intensity. In 2013, the region's energy demand reached 5,100 Mtoe and it is projected to increase at 1.1 percent annually until 2040 *(Draft APEC Energy Outlook, 6th Edition)*.

Oil consumption of the region has also been growing, though its share to total primary energy supply (TPES) already declined over the years *(Figure 2)*. Oil share to TPES decelerated from 34.0 percent in 1990 to 28.0 percent in 2012. However, in absolute terms, oil demand steadily increased annually at 1.1 percent. Total oil demand in 2012 stood at 48,793 thousand barrels per day (‑000bbl/d), of which about one-third was gasoline fuel, while diesel fuel accounted for 25.0 percent of total *(Figure 3)*. The United States was the largest oil consuming economy in the region with 35.0 percent share to total, followed by China with 20.0 percent share. As in the other parts of the world, transportation sector drives APEC's oil demand (about 55% in 2012).

Figure 1. Final Energy Intensity, 2012

Economy	FED (TOE)/Million USD GDP (2010USD)
CDA	146.60
RUS	146.30
VN	126.30
PRC	119.40
ROK	104.40
THA	102.60
PNG	94.70
NZ	92.80
US	91.50
AUS	87.00
CT	83.10
MAS	78.80
INA	74.50
CHL	71.50
JPN	70.70
BD	65.30
MEX	62.30
PE	50.65
RP	42.20
SIN	41.18
HON	25.40
APEC Ave.	84.63
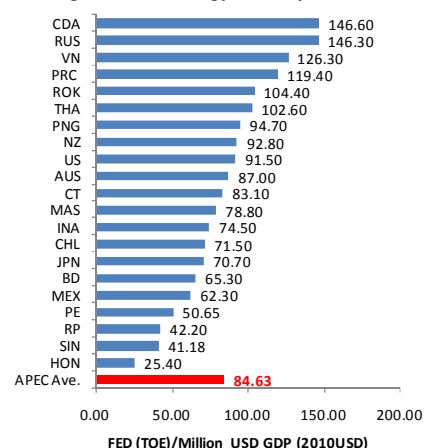
Source: EDMC-IEEJ

Figure 2. APEC Total Primary Energy Supply
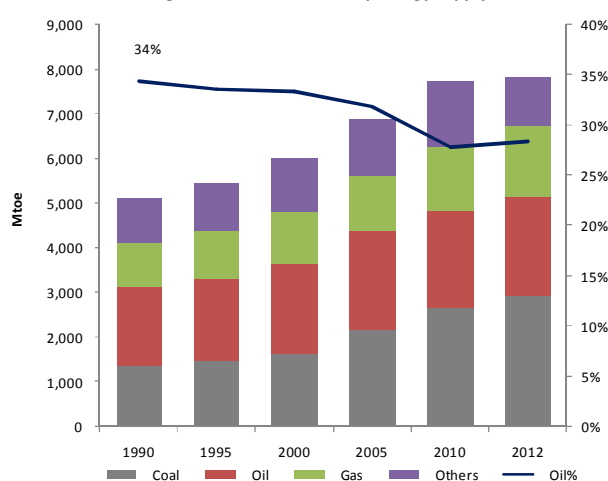
Source: APERC

Figure 3. APEC Oil Demand by Product ('000bbl/d), 2012

Others, 13,386 (27%)
Gasoline, 15,951 (33%)
LPG, 4,967 (10%)
Fuel Oil, 2,049 (4%)
Diesel 12,440 (25%)
48,793
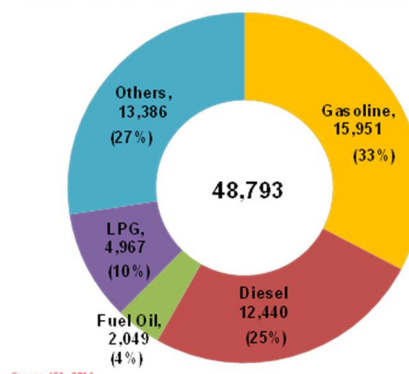
Source: IEA, 2014

Oil intensity varies over APEC economies mainly because of each member's industry structure. APEC average oil intensity was registered at 39.5 toe/million USD GDP (2010 GDP) in 2012 with Hong Kong displayed the lowest intensity of 9.0 toe/million USD GDP, while Papua New Guinea had the highest *(Figure 4)*. Oil intensities tend to be high in economies with heavy industries and to some extent with relatively high dependency on oil.On the other hand, APEC average share of oil to TPES was 38.0 percent of the total. China recorded the lowest share of oil to TPES at 17.0 percent, and Papua New Guinea obtained the highest. Seven (7) economies had higher share of oil above the region's average *(Figure 5)*.

Figure 4. APEC Oil Intensity, 2012
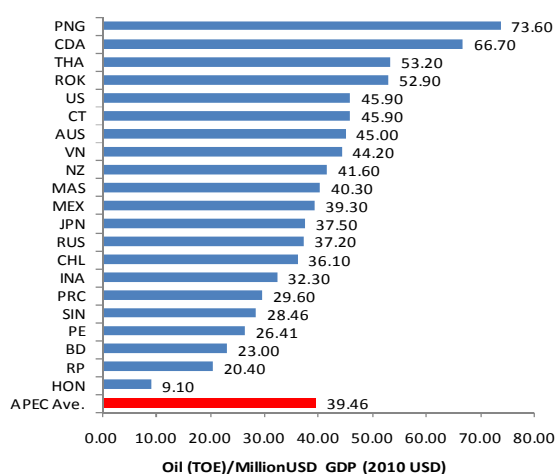
Figure 5. APEC Oil Share to TPES (%), 2012
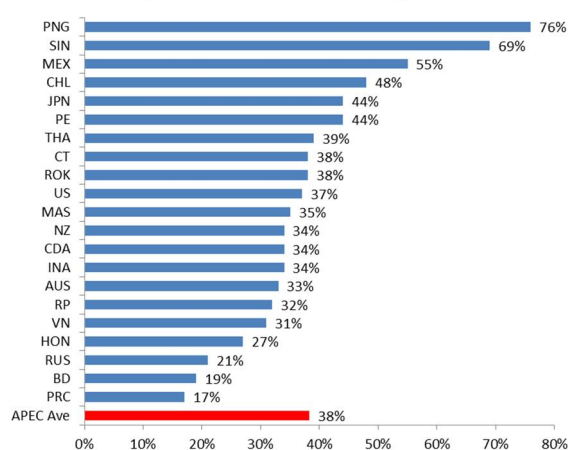
Oil will remain as the second largest energy source for APEC region growing at 1.0 percent until 2040. Its share to TPES will slightly fall by 3.0 percentage points, from 28.0 percent in 2013 to 25.0 percent in 2040 *(Figure 6)*. Much of the growth in oil demand will come from Southeast Asian economies, with consumption expected to expand by 3.0 percent annually. Diesel and gasoline will continue to be the primary driving force to increase the regional oil consumption *(Figure 7)*. About 60.0 percent of oil demand growth will come from gasoline and diesel *(Draft APEC Energy Outlook, 6th Edition)*.

Figure 6. APEC Total Primary Energy Supply (Outlook)
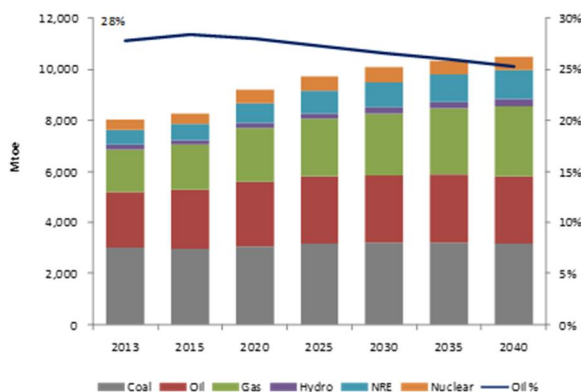
Figure 7. APEC Oil Demand by Product (2013-2040)
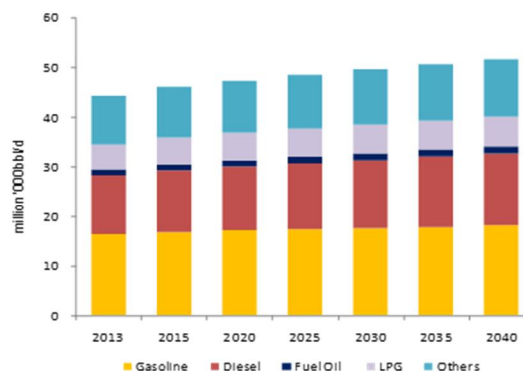
The region is also characterized by member economies that are top world oil producers. In 2013, five (5) of the APEC members were on the top 10 world oil producers ó Russia, the United States, China, Canada and Mexico ó with combined share of almost 40.0 percent of total world oil production *(BP statistics)*. In the last 5 years (2008-2012), total crude oil production in the region increased at average annual rate of 2.2 percent.   Among the oil producing economies, the United States exhibited   the highest growth rate of 7.0 percent compared with others.   The United States is seen to boost its crude oil production from shale and other tight formations.   In 2014, the United States production expanded by 2,000 thousand barrels per day (ó000bbl/d) of additional crude oil *(U.S. Energy Information Administration)*.   With maturing oil fields, production from other member economies only increased at a slower rate.

Nonetheless, the region is also net oil importers with 16 of the member economies are dependent on imports to meet their domestic oil requirements.   Some members have even 100.0 percent import dependency on crude oil, while others economies have limited refinery capacity to produce oil products, and thus relied on product imports to augment supply.

Figure 8. Oil Import Dependency (Total Oil Supply) (%), 2012

Economy	%
CT	100%
SIN	100%
ROK	100%
HKC	100%
JPN	100%
CHL	98%
RP	95%
THA	70%
NZ	68%
PNG	59%
PRC	53%
US	53%
AUS	51%
INA	42%
PE	30%
VN	15%
APEC Ave.	30%
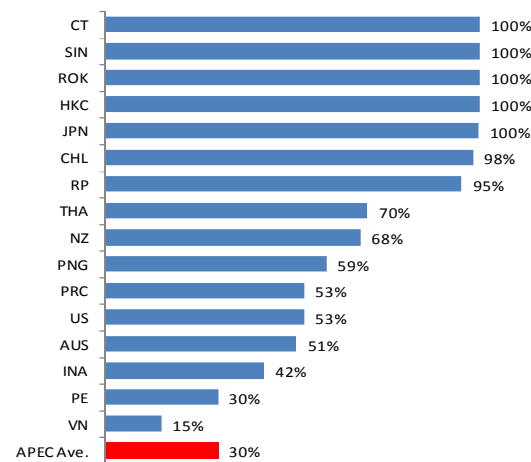
Source: IEA, 2014

Figure 9. APEC Region Crude Oil Imports by Regional Sources, 2012/2013

Others, 7.0%
Africa, 9%
APEC, 22%
Other Asia and Pacific, 0.5%
Other Americas, 9%
Middle East, 48%
Europe & Former Soviet Union (exclude Russia), 4%
HHI = 0.30 (Moderate Low -Concentration)

Source: EIA and EDMC-IEEJ

Note: Brunei, Hong Kong, Mexico , Russiaq and Vietnam have no crude oil imports. PNG was not included due to non-availability of data
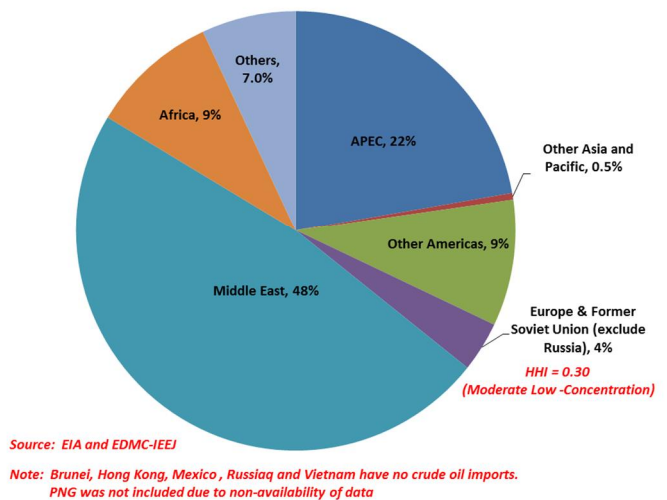
On the average, the regionós total oil import dependency in 2012 was about 30.0 percent. Viet Nam, a crude oil producer, had the lowest import dependency at 15.0 percent of total oil supply.   The United States is expected to have lower oil import dependency in coming years with growing domestic production.   Seven economies were highly dependent on oil imports with 95.0 to 100.0 percent of total oil supply sourced from overseas *(Figure 8)*.   Almost 50.0 percent of crude oil import came from the Middle East and 22.0 percent was sourced within the APEC region *(Figure 9)*.

Based on Herfindahl-Hisrchman Index (HHI) [1], regional sources of crude oil imports for the total APEC region may be considered as moderate-low concentration with 0.30 HHI. On per economy, the United States has the most diversified regional sources of crude oil imports, followed by Canada and Indonesia. Chile had a highly concentrated regional source of crude oil imports with HHI of 0.83. Other economies with high concentration of regional import sources were Korea, Japan, Chinese Taipei, Peru and the Philippines *(Figure 10)*.

Figure 10. Herfindahl Hisrchman Index (HHI), 2012/2013
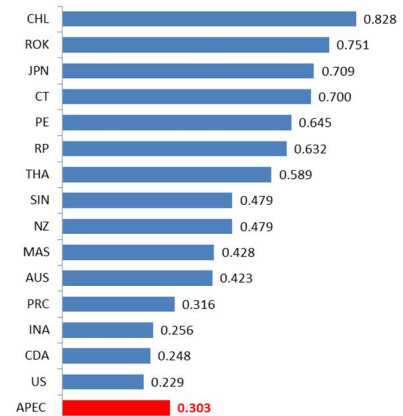
As APEC's oil demand continues to grow, the region is becoming the center of international oil trade. Oil import growth in the region slowed down, which to some extent offset by the decline in the U.S. imports due to surge in its production starting in 2012 *(Figure 11)*. Oil export in the region was seen growing more rapidly than import, with exports escalating at annual growth rate of 6.0 percent compared with only 4.0 percent in imports *(Figure 12) (BP Statistics)*.

Figure 11. Oil Imports by Asia-Pacfic and Its Share

Figure 12. Oil Exports by Asia-Pacfic and Its Share
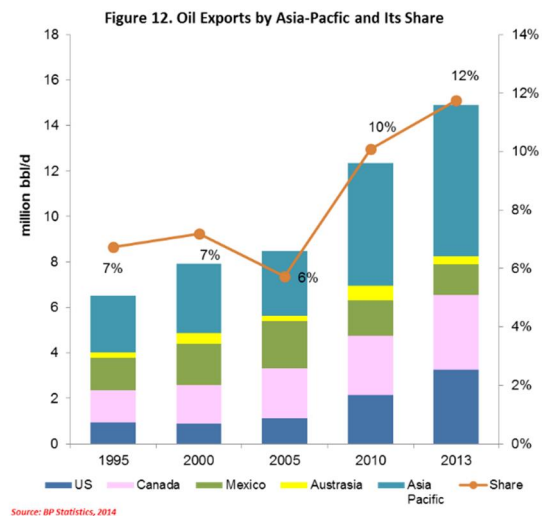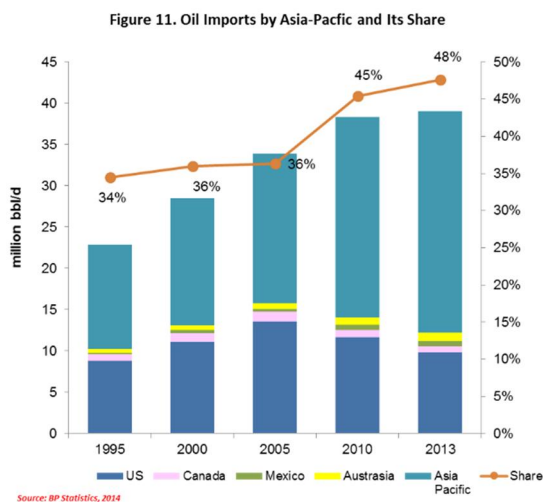
Looking at the oil refining capacity in the region, about 3,500,000 bbl/d will be added up to 2019 *(source: IEA Medium-Term Oil Market Report 2015)*. Bulk of the refinery capacity additions in the region will be in Asia, mostly coming from China with more than 2,000,000 bbl/d of total capacity is planned to be put up. China and the United States have the largest refinery capacities in the region with combined share of almost 60.0 percent of total capacity.

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[1] *HHI is an economic concept applied to assess market share. For this study, HHI is used to measure the concentration of regional import sources per economy. However, the HHI was modified for this analysis such that the range (index) of high concentration was adjusted from its original >0.25 to >0.60. Higher HHI means high concentration to one or few sources. Below 0.20 HHI is considered low concentration, 0.21-0.40 is moderate- low concentration, 0.41-0.60 mid-concentration, 0.61-.80 is moderate-high concentration and 0.81 and above is high concentration.*

Some economies have excess refinery capacity in 2014 such as China, Korea, Russia, Singapore and Chinese Taipei.   Brunei Darussalam is expected to have a surplus capacity with the coming of new refinery facility by 2018.   At 85.0 percent operating capacity, refinery output can meet more than 80.0 percent of oil demand in the region until 2040 *(Figure 13)*.

Figure 13. Oil Demand and Refinery Capacity
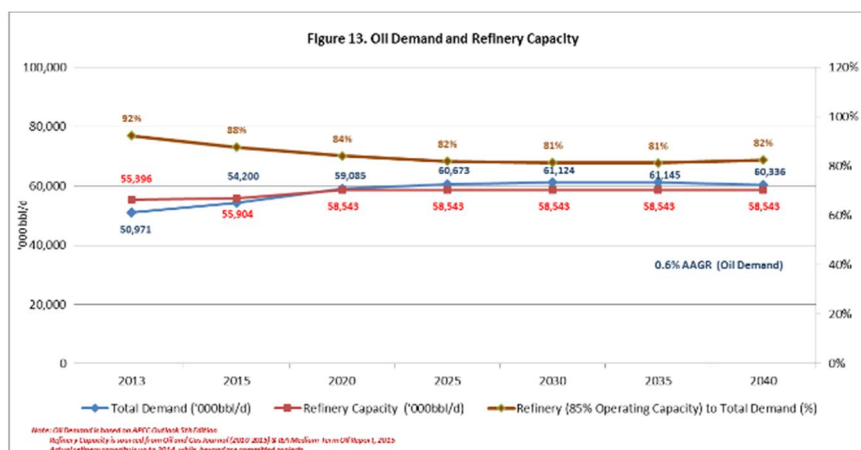
The APEC region has put utmost concern on energy security as espoused in the Energy Security Initiative (ESI).   The ESI sets forth short- and long-term measures to address supply disruptions and emergencies, and other energy security challenges confronting the region.   Part of the short-term measures is for member economies to have supply emergency mechanisms and contingency plans in place.   Further, the 10th Energy Ministers' Meeting (EMM) issued the St. Petersburg Declaration on energy security in June 2012 and called for enhanced concerted actions on various energy security issues in the region, which include improving response to oil and gas emergency situations.   The establishment of National Emergency Strategic Organization (NESO) is an important component of supply emergency mechanism to ensure coordinated action of emergency responses.

All economies have identified and established a NESO or similar entity responsible for handling emergency situation.   The 7 APEC member economies (Australia, Canada, Japan, Korea, New Zealand and the United States) are covered under the International Energy Agency (IEA) ó International Energy Program (IEP) being also member countries of IEA.   The IEP is a joint strategy to deal with oil security issues on an international scale.   In the IEA framework, a NESO must be created with the primary responsibility of preparing and implementing national emergency measures, which in the case of the member IEA-APEC economies delegated to a particular government ministry or agency *(IEA, 2007)*. The non-IEA member economies have also identified a particular government agency/institution responsible to handle energy supply emergencies.   Some of them have even created a special committee or task force to address emergency situations.

Criteria for emergency have been defined in most APEC economies, specifically those members with regional oil supply security agreement like IEA and under the ASEAN Petroleum Security Agreement (APSA). Aside from the criteria for emergency set under regional agreements, some economies have also formulated their respective definition of emergency situation based on domestic policies, contingency plans and supply requirements. No clear information on the definition of emergency for those economies that have not entered into any regional oil supply agreement.

Table 1. Oil Supply Security Policy[2]

Economy	NESO	Criteria of Emergency	Emergency Policy	Regional Oil Security Policy	Oil Stockpiling	Emergency Exercise
Australia	✓	✓	✓	✓	✓	✓
Brunei	✓	✓	✓	✓	✓	✓
Canada	✓	✓	✓	✓	✓	✓
Chile	✓	✓	✓	x	✓	✓
China	✓	No Information	✓	x	✓	✓
Hong Kong	✓	No Information	✓	x	✓	x
Indonesia	✓	✓	✓	✓	✓	✓
Japan	✓	✓	✓	✓	✓	✓
Korea	✓	✓	✓	✓	✓	✓
Malaysia	✓	✓	✓	✓	No Information	✓
Mexico	✓	No Information	✓	x	No Information	x
New Zealand	✓	✓	✓	✓	✓	✓
PNG	✓	x	x	x	No Information	x
Peru	✓	No Information	No Information	x	✓	x
Philippines	✓	✓	✓	✓	✓	✓
Russia	✓	No Information	✓	x	No Information	x
Singapore	✓	✓	✓	✓	✓	✓
Chinese Taipei	✓	✓	✓	x	✓	x
Thailand	✓	✓	✓	✓	✓	✓
United States	✓	✓	✓	✓	✓	✓
Viet Nam	✓	✓	✓	✓	✓	✓

Almost all APEC economies have put in place emergency policy framework governing energy supply crisis stiuations. Some have existing procedure and coordination arrangements among relevant government agencies and institutions tasked to deal with emergency situation including the implementation of response measures. Such framework is more evident in IEA-APEC economies and some economies in the Southeast Asian region. Meanwhile, other economies are starting to develop their own framework to address emergency situation.

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[2] *Check (✓) means existing, while x implies non-existing*

Table 2. Summary of Indicators

Economy	Oil Share to TPES (%)	Oil Import Dependency (Total Oil Supply) (%)	Crude Oil Import Sources HHI (0 – 1.0)	Oil Intensity (FED) (toe/million USD)	Regional Agreement	Oil Stockpiling (Days)[1]
Australia	33	51	0.42	45.00	IEA	52/d of net imports
Brunei	19	Negative Dependency	No Crude Oil Imports	23.00	APSA	31/d of oil demand (industry)
Canada	34	Negative Dependency	0.25	66.70	IEA	53/d of oil demand (industry)
Chile	48	98	0.83	36.10	None	25/d of sales
China	17	53	0.32	29.60	None	30-60 of domestic demand
Hong Kong	27	100	No Crude Oil Imports	9.10	None	30/d of retained imports
Indonesia	34	42	0.26	32.30	APSA	22/d of domestic demand
Japan	44	100	0.71	37.50	IEA	151/d of net imports
Korea	38	100	0.75	52.90	IEA	233/d of net imports
Malaysia	35	Negative Dependency	0.43	40.30	APSA	No Information
Mexico	55	Negative Dependency	No Crude Oil Imports	39.30	None	No Information
New Zealand	34	68	0.48	41.60	IEA	96/d of net imports
PNG	76	59	No Information	73.60	None	No Information
Peru	44	30	0.65	26.41	None	15/d of domestic supply
Philippines	32	95	0.63	20.40	APSA	30/d for refiners & 15/d for marketers
Russia	17	Negative Dependency	No Crude Oil Imports	37.20	None	No Information
Singapore	69	100	0.48	28.46	APSA	50/d (refiners); 90/d (power generation)
Chinese Taipei	38	100	0.70	45.90	None	90/d of net imports
Thailand	39	70	0.59	53.20	APSA	50/d of domestic demand
United States	37	53	0.23	45.90	IEA	251/d of net imports
Viet Nam	31	15	No Crude Oil Imports	44.20	APSA	47/d of domestic demand

Only 13 economies have entered into regional oil security policy agreement ó 6 economies under IEA-IEP and 7 economies covered by APSA (Brunei Darussalam, Indonesia, Malaysia, Philippines Singapore, Thailand and Viet Nam). Only 7 out of 10 ASEAN countries are APEC member economies. Under IEA policy, all members are committed to undertake joint measures in the event of supply emergencies, and agreed to share information, coordinate their energy policies, as well as cooperate in the development rational energy programmes. Each IEA member is likewise required to contribute in collective action based on its assessed share to total IEA oil

consumption.   Holding of oil stocks equivalent to 90 days of prior year's net imports is also set as an obligation for IEA members (IEA, 2014).

Table 3. Composite Index[3]

Economy	Oil Share to TPES	Oil Import Dependency	HHI	Oil Intensity (FED)	Regional Agreement[4]	Oil Stockpiling[5]	Composite Index
Australia	0.33	0.51	0.42	0.56	0.00	0.82	**0.43**
Brunei	0.19	0.00	0.00	0.22	0.50	0.82	**0.32**
Canada	0.34	0.00	0.25	0.89	0.00	0.55	**0.29**
Chile	0.48	0.98	0.83	0.42	1.00	0.88	**0.79**
China	0.17	0.53	0.32	0.32	1.00	0.82	**0.57**
Hong Kong	0.27	1.00	0.00	0.00	1.00	0.82	**0.62**
Indonesia	0.34	0.42	0.26	0.36	0.50	0.92	**0.50**
Japan	0.44	1.00	0.71	0.44	0.00	0.00	**0.40**
Korea	0.38	1.00	0.75	0.68	0.00	0.00	**0.42**
Malaysia	0.35	0.00	0.43	0.48	0.50	No Information	**0.33**
Mexico	0.55	0.00	0.00	0.47	1.00	No Information	**0.46**
New Zealand	0.34	0.68	0.48	0.50	0.00	0.24	**0.35**
PNG	0.76	0.59	No Information	1.00	1.00	No Information	**0.84**
Peru	0.44	0.30	0.65	0.27	1.00	1.00	**0.64**
Philippines	0.32	0.95	0.63	0.44	0.50	0.87	**0.63**
Russia	0.17	0.00	0.00	0.44	1.00	No Information	**0.36**
Singapore	0.69	1.00	0.48	0.30	0.50	0.51	**0.62**
Chinese Taipei	0.38	1.00	0.70	0.57	1.00	0.14	**0.63**
Thailand	0.39	0.70	0.59	0.68	0.50	0.59	**0.56**
United States	0.37	0.53	0.23	0.57	0.00	0.08	**0.28**
Viet Nam	0.31	0.15	0.00	0.54	0.50	0.62	**0.37**

Impacts of Oil Supply Disruption:	
Large	0.81 & above
Moderate large	0.61-0.80
Medium	0.41-0.60
Moderate low	0.21-0.40
Low	below 0.20

On the other hand, the APSA–Coordinated Emergency Response Measure (CERM) stipulates that all member states are endeavoured to supply petroleum to the ASEAN Member State in Distress at an aggregate amount equal to 10.0 percent of the Normal Domestic Requirement of the said member state for a continuous period of at least 30 days.   However, the member state in distress must first implement short-term measures to reduce oil demand before requesting assistance under CERM *(ASCOPE)*.

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[3] *Weight applied per category: Oil Share to TPES (20%); Oil Import Dependency (20%); HHI (10%), Oil Intensity (10%); Regional Agreement (20%); and, Oil Stockpiling (20%).   For some economies lacking information/data on specific category, weights for categories were adjusted. Dimension Index methodology was used to compute some of the index.*

[4] *Index for Regional Agreement is 0.00 for IEA, 0.50 for APSA and 1.0 for those economies without regional oil supply agreement.   It is assumed the 0.00 index for IEA means low impact of oil supply disruption as the agreement is already being implemented. Meanwhile, 0.50 index for APSA means having medium impact of oil supply disruption as the agreement is not yet fully implemented and tested.   The 1.0 index for the other economies means large impact as no regional agreements may be tapped during oil supply disruptions.*

[5] *Oil stockpiling was converted based on domestic demand, such that stockholding equivalent to days of net imports was translated to days of domestic demand (net import per day * no. of days of stockholding based on net imports / domesctic demand per day).*

Majority of the economies have established oil stockholding policy either strategic oil stockpiling (emergency) held by government or private sector or both with operational stocks from industry, or minimum obligatory stockholding to industry or commercial stockholding held by industry. Other economies with no strategic oil stockpiling have commercially driven operational stocks, while some having minimum inventory imposed to industry for commercial purpose. As of December 2014, about 5 economies held 90 days and above oil stock levels, namely: Chinese Taipei, Japan, Korea, New Zealand, and the United States based on net imports. Others have below 40 days oil stocks like in the case of Chile, Hong Kong and the Philippines, among others, based on sales, supply requirement or domestic consumption. Some oil producing economies like Canada has only industry oil stocks for commercial purpose, while Indonesia has obligatory operational stocks for industry.

China is building up its oil stockpiling facilities for crude oil with a goal to establishing strategic oil stockholding equivalent to 90 days of net imports, while Thailand is looking at expanding its oil stockholding to 90 days of domestic consumption. On the other hand, under the National Stockpile Master Plan approved in 2009, Viet Nam is proposing to hold oil stocks equivalent to 90 days of net imports or 60 days of domestic consumption. To date, such has not yet been realized.

Assessment on vulnerability of APEC economies to impacts of oil supply disruption based on 6 categories and classified into 5 levels of indicators *(in Tables 2 and 3)* revealed that exposure to oil supply disruptions per economy varies per category. However, the region is seen more susceptible to oil supply crisis on categories relating to oil stockpiling, oil import dependency, oil intensity and regional oil security policy agreement as more economies obtained larger indices. In particular, Asian economies tend to have greater exposure to impacts of oil supply crisis having larger indices on three or more categories. Based on composite index, the United States received the lowest index, thus has the lowest exposure or impact to oil supply disruption among the APEC economies. Canada followed next having the second lowest index. Meanwhile, Papua New Guinea and Chile have the highest indices therefore more vulnerable to large impacts of supply emergency situations or disruptions. About 13 economies have medium to large impacts to oil supply disruptions having an index of 0.41 and above.

Policy and Regional Cooperation Implications

▪ Development of oil security and emergency response varies over APEC economies. The IEA approach on obligatory cooperation framework may be difficult for APEC region as some economies have limited resources and facilities to implement for instance 90 days of strategic oil stockholding. Likewise, due to limited funds, governments could not provide any financial support to private oil companies to bear a portion of the cost on establishing strategic oil stockholding.

  However, there are a number of cooperation opportunities that exist among APEC economies. A roadmap on possible joint oil stockpiling could be considered with economies sharing the cost of stockholding, which could be entered into through government-to-government and business-to-business agreement, or government-to-business agreement. A joint stockpiling may reduce the burden of some economies with limited financial resources and available facilities to put up strategic oil stockholding.

▪ As oil trading activities expand in the APEC region, further facilitation of trade and investments could also enhance oil supply security. It may be noted that APEC sources around 22.0 percent of crude oil imports within the region as a number of member economies are crude oil producers. Further, there exists surplus refinery capacity in some economies, which could make up for shortage of capacity in other economies. This would also avoid or defer investment in refining capacity by facilitating and carrying out trade of oil products between and among APEC economies. During supply disruption, affected economies could tap excess refinery capacity of other economies by sourcing or importing a portion of their oil products requirements, or increase their importation from these economies to fill the supply gap.

▪ Conduct of oil emergency exercise is also seen important to be undertaken on a regular basis be it by individual economy or by region to operationalize and improve existing oil supply security and emergency framework developed by member economies. Emergency exercise may aid economies to enhance procedural and institutional arrangements and response measures, which could possibly include even regional responses.

▪ Establishment of a Regional Framework on Oil Supply Security should also be look upon, either through inter-framework collaboration with IEA-APEC economies and ASEAN-APEC economies, or formulating a separate framework taking into account salient provisions in

both IEA-International Energy Program and the ASEAN Petroleum Security Agreement. A framework on oil supply security is necessary to include the other 8 economies not covered by any regional oil security agreements.

The framework may setforth both short- and long-term cooperation such as regional supply emergency policy and emergency preparedness, the conduct of regular supply emergency exercise, building of joint stockpiling, facilitation of oil trade, and measures to lower oil intensity, among others.

However, it is of great challenge for the APEC Leaders and Energy Ministers on how APEC could enhance inter-framework collaboration on regional oil supply security.
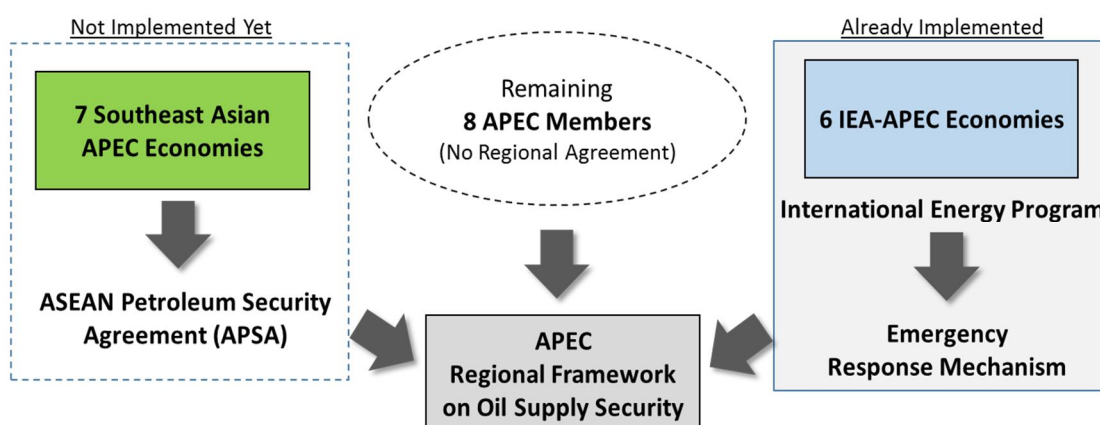
Oil Supply Security and Emergency Policy by APEC Member Economy

AUSTRALIA

Socio-Economic Overview

Table 1.1 Socio-Economic Profile, 2012

Land Area km^2	7,692,024
Population (million)	22.72
GDP (USD Billion, 2010 Price & PPP)	911.78
GDP per Capita	40,124

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Australia is the sixth largest economy in terms of land area in the world occupying 7.7 million square kilometres total land area. In 2012, the economy's population was almost 23 million and growing at an average annual growth rate (AAGR) of 1.7 percent in the last 5 years (2008-2012). In the same year, the economy's GDP was recorded at USD 911.78 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 2.4 percent. Meanwhile, GDP per capita posted a modest growth of 0.7 percent average annual rate (last 5 years) reaching USD 40,124 in 2012 (APERC, 2015a & EDMC, 2014).

Figure 1.1 GDP and GDP Per Capita
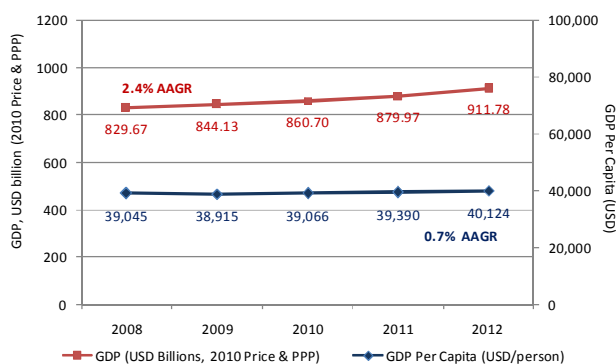
Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Figure 1.2 Total Primary Energy Supply
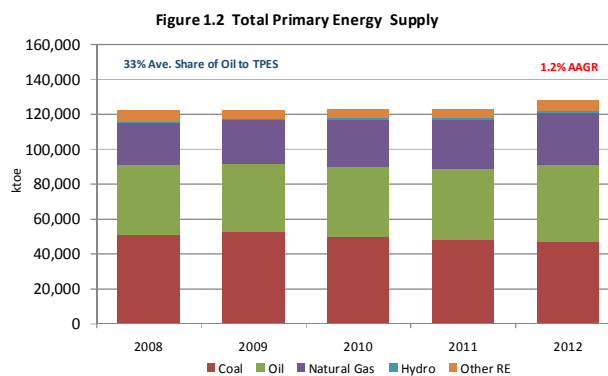
Source: IEA 2014

Australia's primary energy supply stood at 128.27 million tonnes of oil equivalent (Mtoe) in 2012 registering an AAGR of 1.2 percent over the last 5 years with oil as one of the major energy resources posting an average share of 33.0 percent, next to coal (with an average share of 40.0 percent). Meanwhile, natural gas provided 21.0 percent average share and renewable energy contributed 5.0 percent for the same period. Australia is a net importer of crude oil and refined products. Imports of crude oil as refinery feedstock are expected to decrease in the future in line with declining domestic refining capacity, which will be offset by increasing imports of oil products.

In terms of final energy demand, the economy consumed 79.36 Mtoe in 2012 exhibiting 1.0 percent AAGR in the last 5 years. Average share of oil to total final energy demand was recorded at 51.0 percent, followed by electricity and natural gas with 23.0 percent and 16.0 percent shares, respectively.

Figure 1.5 Final Energy and Oil Demand Per Capita

Figure 1.3 Final Energy Demand (Fuel)
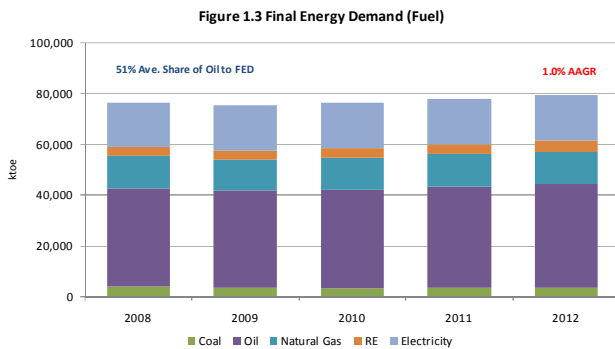
Among the sectors, the transport sector is the largest energy consuming sector using up about 40.0 percent, on the average, of the final energy demand, and growing at AAGR of 1.6 percent. Industry sector is the second largest with 30.0 percent average share, while residential sectorconsumed 13.0 percent of the total (IEA, 2014).

When it comes to energy intensity, the economy achieved improvement (decline) of 5.2 percent from 91.8 toe/million USD GDP in 2008 to 87.0 toe/million USD GDP in 2012 of energy demand. On the other hand, oil intensity declined by 3.5 percent, which was recorded at 45.0 toe/million USD GDP in 2012 from 46.6 toe/million USD GDP in 2008. Such changes could be attributed to energy efficiency and structural effect ó shift to less energy-intensive sectors such as commercial and services (EDMC, 2013).

Figure 1.4 Final Energy Demand (Sector)

Figure 1.6 Final Energy and Oil Demand Intensity

Oil Supply and Demand

b) *Energy per Capita and Energy Intensity*

Australiaøs energy and oil per capita had been relatively stable over the last 5 years exhibiting 3.5 tonnes of oil equivalent (toe)/person and 1.8 toe/person, respectively.
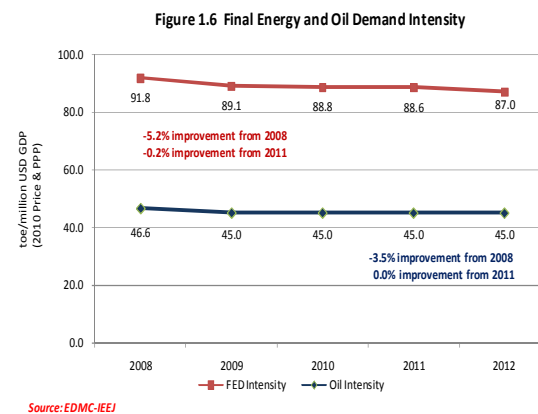
a) *Crude oil Production and Imports*

Since 2000, Australiaøs oil production has been declining but is expected to be offset

by developments of smaller production fields in the coming years (EIA, 2014). From 2008-2012, crude oil production had demonstrated a declining rate of 0.8 percent average annual, while crude imports increased by 3.4 percent annually within the same period (IEA, 2014). As such, the economy's import dependency went up from 28.0 percent

Figure 1.7 Crude Oil Supply

Source: IEA 2014
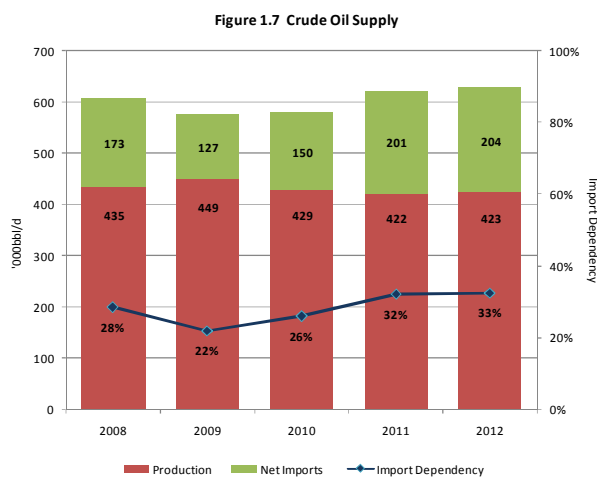
in 2008 to 33.0 percent in 2012. As regards the regional sources of crude oil importation, the economy relied almost 60.0 percent of its imports from the APEC region, particularly from Malaysia, Indonesia and Viet Nam. Other regional sources are Middle East and Africa providing around 20.0 percent each for

Figure 1.8 Australia Crude Oil Imports by Sources, 2012

HHI = 0.42
(Mid-Concentration)

Source: IEEJ-EDMC, 2012
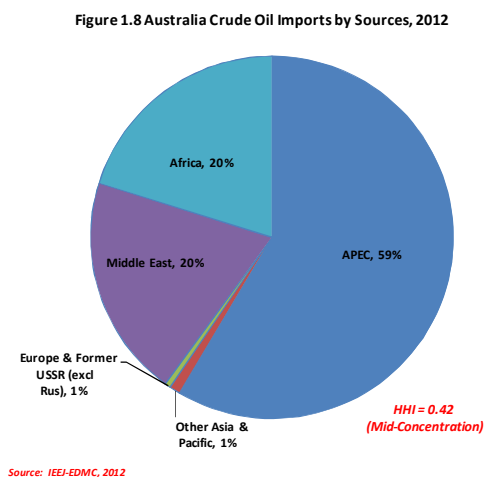
the economy's import requirements. Based on Herfindahl-Hirshman Index (HHI), the import sources (by regional sources) may be considered as mid-concentration with HHI value of 0.42.

b) Oil Products

Australia's refinery production had decreased by 2.0 percent AAGR with net import escalating annually by 10.0 percent in the last 5 years. This resulted in increased import dependency from 22.0 percent in 2008 to 31.0 percent in 2012. Almost half of the petroleum product imports were sourced from Singapore, while the remaining was mostly coming from Japan and Korea (EIA, 2014).

Table 1.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	855	846	823	847	790
Net Imports	217	257	263	245	317
Others *	-121	-180	-147	-127	-104
Net Supply	951	924	938	965	1,003
Demand	951	924	938	965	1,003
Gasoline	344	332	326	325	354
Diesel Oil	338	336	354	367	388
Fuel Oil	25	20	20	20	19
LPG	72	73	70	69	60
Other Petroleum Products	172	163	167	185	182
Import Dependency	**22%**	**25%**	**26%**	**24%**	**31%**

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

Total oil demand grew annually by 1.3 percent, on the average, with diesel oil and gasoline as the most consumed fuels exhibiting average shares of 37.0 and 35.0 percent, respectively.

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Diesel oil was growing at a faster average annual rate of 3.5 percent.

Table 1.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	72	67	75	73	83
Transport	635	626	629	642	666
Residential	9	9	9	9	9
Commercial	13	14	14	14	14
Agri & Fishery	41	40	41	43	42
Electricity	24	17	15	15	16
Others	157	151	155	170	172
Total Consumption	**951**	**924**	**938**	**965**	**1,003**

Others include non-energy, own-use and losses
Source: IEA 2014

Around 67.0 percent of total oil demand was consumed by the transport sector, while industry sector only demanded an averageshareof 7.8 percent of the total. Oil demand of the transport sector was expanding by 1.2 percent annually. Non-energy uses for oil accounted for 16.8 percent average share (IEA, 2014).

The total oil supply had increased on an average rate of 3.5 percent per year, for the period 2008 to 2012. However, local oil production had shown a reduction of 0.8 percent per year being compensated by increase of net imports, around 7.5 percent annually, to meet domestic requirement. This resulted in increased import dependency of the economy from 42.0 percent in 2008 to 51.0 percent in 2012.

c) *Oil Demand Outlook and Refinery Capacity*

Australiaøs oil demand is projected to increase at AAGR of 0.5 percent until 2040 (APERC,

Figure 1.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014
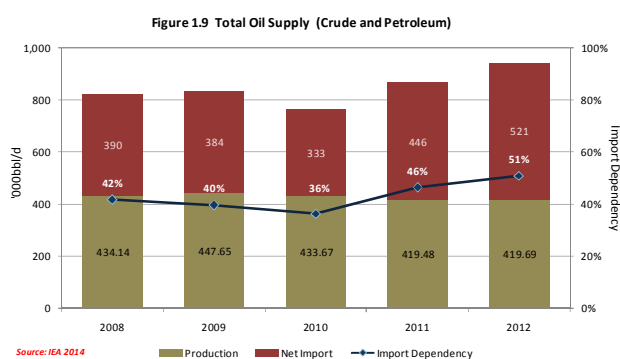
2015). In 2013, the economyøs refinery capacity of 674 thousand barrels per day (õ000bbl/d) could still meet up to 50.0 percent of its domestic oil demand based on 85.0 percent operating capacity. However, with the expected retirement of refineries in 2015, domestic refinery production could only meet about 31.0 percent of oil demand requirement of the economy until 2040 if no new additional refinery capacity will be built within this period.

Figure 1.10 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook , 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Oil Supply Security Policy

Table 1.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Department of Industry and Science, as the agency responsible for supervising the energy sector portfolio, serves as the permanent core of NESO. Being the permanent core of NESO, the Minister for Industry and Science has the responsibility to coordinate emergency responses during a national oil supply disruption. In the event of major oil supply disruption affecting more than one territorial jurisdiction, the said permanent core will be expanded to cover the National Oil Supplies Emergency Committee (NOSEC). NOSEC is composed of state and territory governments, industry players and the Australian Institute of Petroleum (IEA, 2014a).

b) Criteria of Emergency

Initially, the IEA Agreement on International Energy Program (IEP) defined emergency as an oil supply disruption involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. With development in oil markets, such has also been evolved providing greater flexibility in determination of emergency situation including when and how to implement emergency measures (IEA, 2007). Likewise, the IEA's Initial Contingency Response Plan is oriented to a process of market assessment to judge whether there is an emergency situation or not. On the other hand, under the Australia's National Plan, a disruption is assessed by volume and duration to define whether or not an emergency will be declared accordingly (OGSN, 2015).

c) Emergency Policy

In case of emergency, the Minister of Industry and Science will convene the NOSEC to assess the extent and degree of oil supply emergency and possible responses measures. Consultation will also be done with other relevant government agencies including the Department ofthe Prime Minister and Cabinet, the Department of Foreign Affairs and Trade, the Treasury and the Office of National Assessments. With recommendation by the Minister of Industry and Science, the Governor-General of Australia may declare a national emergency under the Australian government's Liquid Fuel Emergency Act of 1984 (IEA, 2014a).

d) Strategic Oil Stockholding

Australia has no public stocks to maintain and no minimum stockholding requirement imposed on oil companies. The economy has only commercially driven stockholdings for domestic oil supply from the industry (IEA, 2014a). As of December 2014, the economy's stock level was 52 days of net imports (IEA, 2014b).

e) Regional Oil Security Policy

As a regulation under IEA policy, all members are committed to taking joint measures in the event of oil supply emergencies. IEA members agreed to share energy information, coordinate their energy policies and cooperate in the development of rational energy programmes. Each of the 29 IEA member countries is also required to hold oil stocks equivalent to 90 days of its prior year's net

imports. A member country is also required to contribute to collective action based on its share in total IEA oil consumption (IEA, 2007).

f) *Emergency Exercise Activity*

As an IEA member country, Australia participates in emergency response exercisesregularlyconducted every two (2) years by IEA. Australia also conducts a national emergency exerciseon an annual basis through the NOSEC (OGSN, 2015).

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BRUNEI DARUSSALAM

Socio-Economic Overview

Table 2.1 Socio-Economic Profile, 2012

Land Area km^2	5,765
Population (million)	0.41
GDP (USD Billion, 2010 Price & PPP)	28.97
GDP per Capita	70,284

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Brunei Darussalam is a small economy with population of approximately 410,000 in 2012. It covers a total land area of 5,765 square kilometres and is bordered on the north by the South China Sea and on all other sides by the Malaysian state of Sarawak. Although the economyøs GDP in 2012 reached USD 28.97 billion (USD 2010 Price & PPP) with an average annual growth rate (AAGR) of 1.3 percent over 2008-2012, GDP per capita slightly declined from USD 70,957 in 2008 to USD 70,284 in 2012, exhibiting a 5-year AAGR of negative 0.2 percent (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Brunei Darussalam is dominated mostly by natural gas and oil, owing to the fact that the economy is endowed with hydrocarbons. These resources are the major sources of the economyøs export earnings and greatly contribute to its GDP. Natural gas accounted for 81.0 percent of the total primary energy supply, while oil accounted for an average share of 18.7 percent during the period 2008-2012. The economy is a net exporter of oil and natural gas. Meanwhile, renewable energy resourcesspecifically solar photovoltaic, which the economy started utilizing since 2011, represents merely less than 0.1 percent.

Figure 2.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 2.2 Total Primary Energy Supply
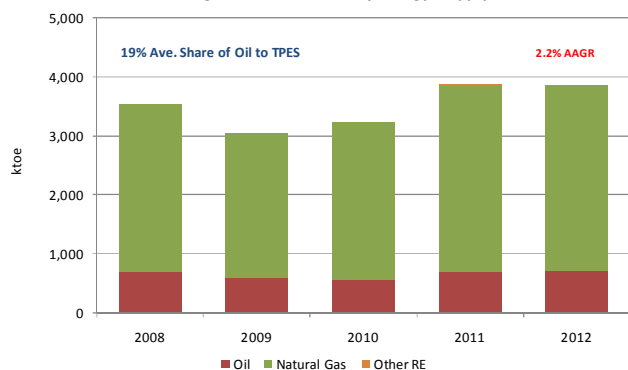
Source: IEA 2014

Brunei Darussalam's final energy demand grew at 5.6 percent, on average, in the last 5 years (2008-2012). Oil demand consistently increased during the period, reaching 666 thousand tonnes of oil equivalent (ktoe) in 2012, although its share had declined recently due to natural gas expansion. Natural gas demand increased substantially since 2010 when the first petrochemical plant (a methanol

Figure 2.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 2.4 Final Energy Demand (Sector)

Source: IEA 2014

production plant) constructed at the Sungai Liang Industrial Park was successfully commissioned. The economy intends to utilize natural gas to develop domestic petrochemicals and energy-intensive industries. The downstream development strategy of the economy explains a structural change of its final energy demand by sector since 2010. Increasing natural gas use as feedstock contributes to expanding share of non-energy (APERC, 2015a). Meanwhile, transport sector in which oil is consumed substantially grew at AAGR of 4.4 percent.

b) Energy per Capita and Energy Intensity

Brunei Darussalam's final energy demand per capita had increased since 2010 after a significant decline in 2009 due to a decrease in natural gas demand. Final energy demand per capita was registered at 3.0 toe/person on the average. Meanwhile, oil demand per capita had almost levelled off over 2008-2012 period showing an average of 1.5 toe/person.

Final energy demand intensity and oil demand intensity climbed up during the 5-year period, 18.2 percent and 19.3 percent, respectively. The increase in final energy demand intensity was attributed to sharp increase of natural gas consumption (EDMC, 2013).

Figure 2.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 2.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

Oil Supply and Demand

a) Crude oil Production and Imports

Brunei Darussalam is 100.0 percent self-sufficient on crude oil resource with annual production of 150 thousand barrels per day (‑000bbl/d) in 2012, about 96.0 percent of which was exported. Main destinations of crude oil were Korea, the ASEAN economies, Australia, India, China, New Zealand and Japan (APERC, 2015a). However, crude oil production level had been stagnant in recent years largely because most of the economy's oil fields are considered mature. Therefore, it seems necessary for the economy to implement advanced recovery methods such as enhanced oil recovery to rejuvenate maturing oil and gas fields.

Figure 2.7 Crude Oil Supply
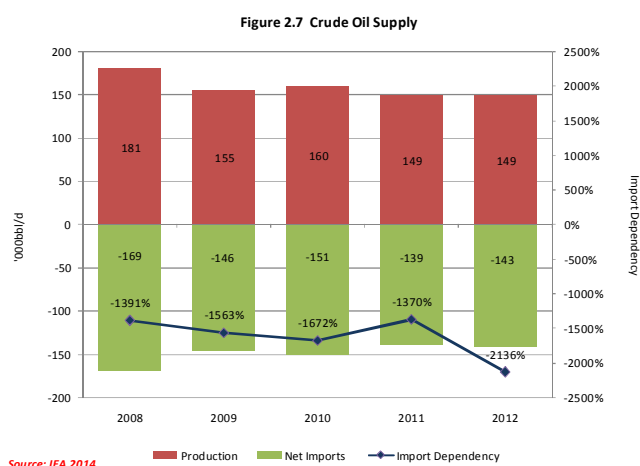
b) Oil Products

While refinery production had decreased, demand for petroleum products had increased, which resulted in increased oil import dependency. Brunei Darussalam needs to import petroleum products due to the limited capacity of 8,600 bbl/d of the sole Seria

refinery. However, the demand and supply imbalance of petroleum products may be redressed in the future because of the construction of a refinery and aromatics cracker plant projects with a capacity of 170,000 bbl/d in Pulau Muara Besar Island by the Chinese petrochemical firm, the Zhejiang Hengyi Group Co. Ltd. The new refinery facility is expected to start operations in 2018 (APERC, 2015a).

Table 2.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	15.9	14.8	14.1	13.1	9.3
Net Imports	1.0	2.0	3.0	5.1	7.8
Others *	-3.5	-3.5	-3.9	-4.1	-2.9
Net Supply	13.4	13.3	13.1	14.0	14.2
Demand	13.5	13.4	13.3	14.2	15.1
Gasoline	5.5	5.6	5.8	6.1	6.6
Diesel Oil	4.5	4.8	5.3	6.3	6.6
Fuel Oil	-	-	-	-	-
LPG	0.5	0.5	0.5	0.5	0.5
Other Petroleum Products	2.9	2.4	1.6	1.3	1.4
Import Dependency	8%	15%	22%	36%	54%

* *include stock change, international marine & aviation and statistical difference*

The transport is the largest oil consuming sector, accounting for annual average share of 65.0 percent of total oil demand, followed by the industry sector with 20.9 percent share. Gasoline and diesel are the dominant oil productsdemanded by the economy constituting about 80.0 percent of total oil consumption. Diesel demand grew faster at AAGR of 9.8 percent than that of gasoline of 4.5 percent over 2008-2012.

Although Brunei is a net exporter of crude oil, the economy also relies on petroleum product imports due to limited refinery capacity. With this, total import dependency (crude and petroleum products), though negative, increased the dependency level from negative 1,788 percent in 2008 to negative 1,196 percent.

Figure 2.9 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

0.6 percent (APERC, 2015). With the entry of new refinery facility in 2018, the economy will have excess refining capacity with a ratio to total domestic oil demand of about 900 percent. However, this will depend if the refinery construction project is carried out successfully and a new refinery commences operation as planned. At 85.0 percent operating capacity, refinery capacity (considering the new refinery facility) can meet more than 800 percent of domestic oil demand.

Table 2.3 Oil Consumption ('000bbl/d)					
	2008	**2009**	**2010**	**2011**	**2012**
Industry	1.5	2.9	3.1	3.3	3.8
Transport	8.4	8.4	8.8	9.5	10.0
Residential	0.6	0.6	0.5	0.5	0.5
Commercial	-	-	-	-	-
Agri &Fishery	-	-	-	-	-
Electricity	0.2	0.2	0.2	0.2	0.2
Others	2.8	1.3	0.7	0.7	0.6
Total Consumption	**13.5**	**13.4**	**13.3**	**14.2**	**15.1**

Others include non-energy, own-use and losses
Source: IEA 2014
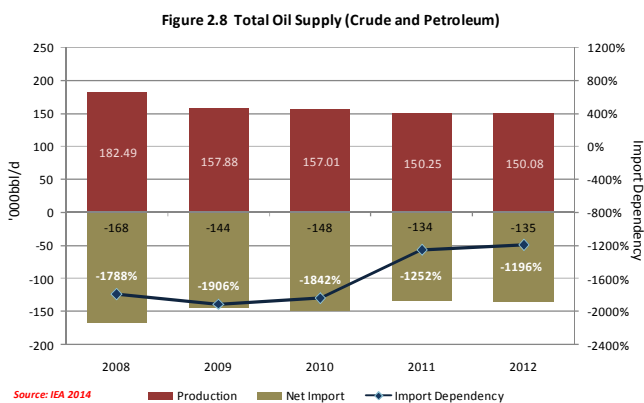
Oil Supply Security Policy

Table 2.4 Policy Overview		
The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

Figure 2.8 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

c) Oil Demand Outlook and Refinery Capacity

Oil demand of Brunei Darussalam is estimated to reach 179,000 bbl/d in 2040 with AAGR of

The Brunei government will lead a national response to emergencies of all kinds including those affecting oil and gas emergencies.

The Energy Department under the Prime Minister Office (EDPMO) serves as the regulator for oil and gas and the lead governmental body responsible for dealing with oil supply disruptions, while the National Disaster Management Centreøs (NDMC) will be the coordinating agency for disaster relief (APERC, 2015a).

b) Criteria of Emergency

Brunei is one of the 10 member states of the Association of Southeast Asian Nations (ASEAN). Under the ASEAN Petroleum Security Agreement (APSA), critical oil supply shortage is defined as the situation when a member state is experiencing a shortfall of at least 10.0 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. APSA was first signed in 1986 and updated in 2009 during the ASEAN Foreign Ministersø Meeting held in Thailand. The revised APSA was fully ratified by all 10 ASEAN Member States and took effect in March 2013 (ASCOPE, 2009).

c) Emergency Policy

In case of emergency, the government has mandatory right to purchase and control all crude and oil product stocks held by the industry (IEA, 2014a).

d) Strategic Oil Stockholding

Brunei Darussalam has the Energy Contingency Plan for Refined Petroleum Product Imports which sets an obligatory level of stockholding at 31 days for industry. The emergency stock is called Country Wide Stock (IEA, 2014a).

During the 5th ASEAN+3 (China, Japan and Korea) Energy Ministers Meeting in 2008 in Thailand, the Ministers recognized the risks of possible supply disruptions due to highly volatile oil markets. With this, the Ministers saw the necessity to have initiatives on oil stockpiling and supported the efforts of developing an Oil Stockpiling Roadmap (OSRM) to assist ASEAN member states on building up their respective strategic storage (IEA, 2014a).

e) Regional Oil Security Policy

The APSA contains a Coordinated Emergency Response Measure (CERM) provision, which endeavours all member states to supply petroleum to the ASEAN member state in Distress at the aggregate amount equal to 10.0 percent of the Normal Domestic Requirement of the said member state. However, as a requirement, a member state must have implemented short-term measures to reduce demand before seeking assistance under CERM. An APSA Task Force was even created in 2014 to study and review the CERM Operationalization Manual (ASCOPE).

f) Emergency Exercise Activity

Brunei Darussalam participated in APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013 (APERC, 2014).

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24

CANADA

Socio-Economic Overview

Canada is the second largest economy in land area and endowed with rich and diversified natural resources, making it the fifth largest energy producer in the world behind China, USA, Russia and Saudi Arabia. In 2012, the economy's population was more than 34.7 million and growing at an average annual growth rate (AAGR) of 1.1 percent over the last 5 years (2008-2012)

Table 3.1 Socio-Economic Profile, 2012

Land Area km^2	9,984,670
Population (million)	34.75
GDP (USD Billion, 2010 Price & PPP)	1,417.45
GDP per Capita	40,785

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Figure 3.1 GDP and GDP Per Capita
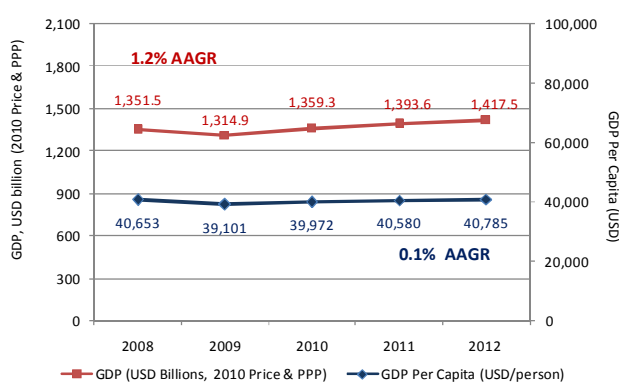
Source: EDMC-IEEJ

In the same year, the economy's GDP was USD 1,417.45 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 1.2 percent. Meanwhile, GDP per capita grew at 0.1 percent average annual rate (last 5 years)

reaching USD 40,785 in 2012(APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Over the last 5 years (2008-2012), oil had been the major energy source for Canada posting an average share of 34.0 percent to the primary energy mix, followed by natural gas with an average share of 32.0 percent. Meanwhile, hydro provided 13.0 percent and nuclear with 10.0 percent average shares for the same period.

Figure 3.2 Total Primary Energy Supply
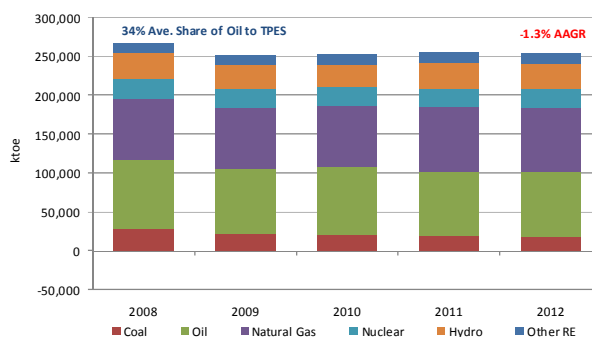
Source: IEA 2014

In terms of final energy demand, the average share of oil was recorded at 45.0 percent followed by natural gas and electricity with

27.0 and 22.0 percent, respectively. The economy's oil consumption had been increasing at AAGR of 0.2 percent in the last 5 years.

Figure 3.3 Final Energy Demand (Fuel)

Source: IEA 2014
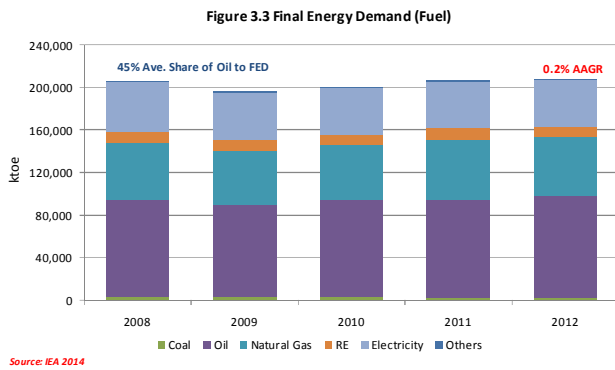
Among the sectors, transport sector was the largest energy consuming sector using up about 29.0 percent, on the average, of the final energy demand, and growing at AAGR of 1.0 percent. Industry sector was the second largest with 28.4 percent average share, while residential sector consumed 15.9 percent of total final energy demand (IEA, 2014).

Figure 3.4 Final Energy Demand (Sector)

Source: IEA 2014
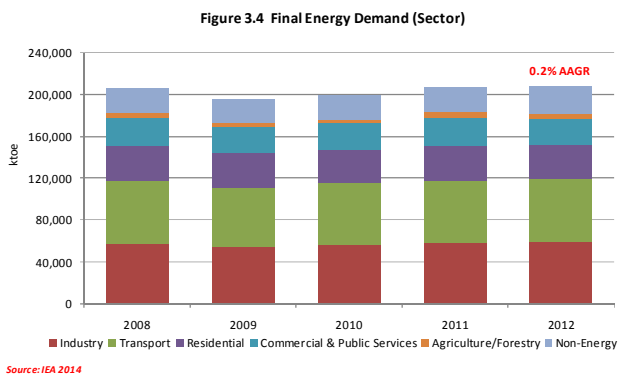
b) Energy per Capita and Energy Intensity

Canada's energy and oil per capita had been relatively stable over the last 5 years exhibiting 6.0 tonnes of oil equivalent (toe)/person and 2.7 toe/person, respectively. When it comes to energy and oil intensities, the economy achieved improvement (decline)

of 3.8 percent from 152.5 toe/million USD GDP in 2008 to 146.6 toe/million USD GDP in 2012 of energy consumption. On the other hand, oil consumption likewise slightly decelerated by 0.9 percent, which was recorded at 66.7 toe/million USD GDP in 2012 from 67.3 toe/million USD GDP in 2008 (APERC, 2015a & EDMC, 2014).

Figure 3.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 3.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ
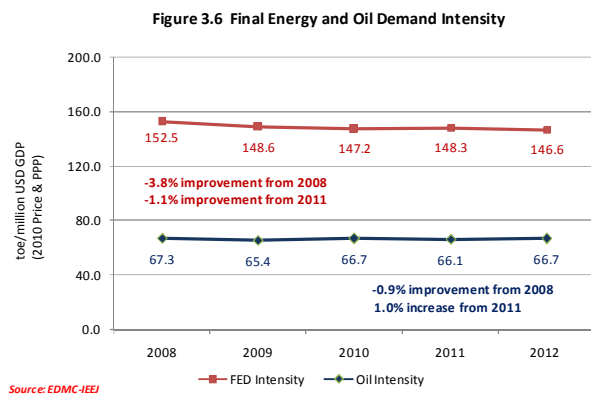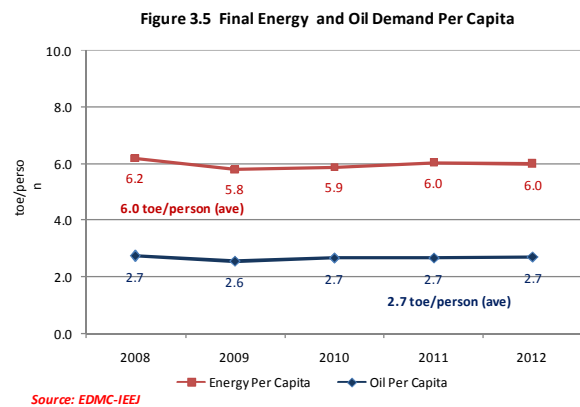
Oil Supply and Demand

a) Crude oil Production and Imports

As of 2013, Canada is the world's 5th largest crude oil producer and significant net exporter of crude oil globally as domestic production far exceeds domestic demand. About 97 percent of the economy's oil export was going to the United States. Canada is the largest

supplier of crude oil to the United States (EIA, 2014).

Oil production is concentrated in the Prairie Provinces (Alberta and Saskatchewan accounted for 76.0% and 14.0% of total, respectively in 2012 and in Newfoundland (6.0% of total). Despite its status as a major oil exporter, Canada still imports significant amount of crude oil (725,000 bbl/d in 2012) to supply some domestic markets, notably Eastern Canada, because of the insufficient infrastructure between the mid-continent oil producing centres and consuming centres in Quebec and the Atlantic provinces.

Figure 3.7 Crude Oil Supply

Source: IEA 2014

In 2012, about 41.0 percent of Canada's domestic refinery demand was sourced overseas, primarily from the US (20%), Iraq (12%) and Saudi Arabia (9%) and Nigeria (7%) (OGSN, 2015).

As regards the regional sources of crude oil imports, the economy relied about 33.0 percent of its imports from the Africa, 23.0 percent from the APEC region, 22.0 percent from the Middle East and Europe and Former USSR Republics providing 20.0 percent. Based on Herfindahl-Hirshman Index (HHI), the regional import sources may be

considered as moderate-low concentration with HHI value of 0.25.

Figure 3.8 Canada Crude Oil Imports by Sources, 2012
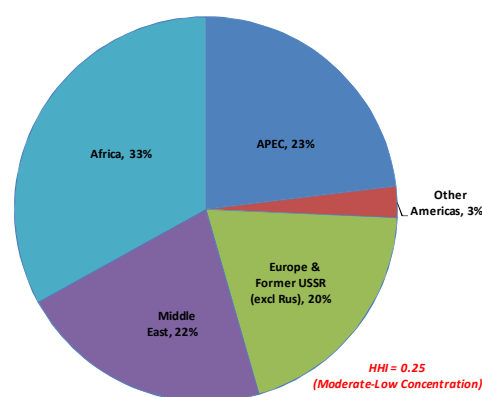
Source: EDMC-IEEJ, 2012

b) Oil Products

Canada's refinery production had increased at AAGR of 1.8 percent with net import decreasing annually by 15.7 percent. This led to a declining import dependency of negative 5.0 percent in 2008 to negative 9.0 percent in 2012. Total oil demand had

Table 3.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	2,467	2,385	2,463	2,417	2,650
Net Imports	-127	-185	-204	-87	-227
Others *	33	68	96	43	4
Net Supply	2,373	2,268	2,355	2,373	2,427
Demand	2,373	2,268	2,355	2,373	2,427
Gasoline	737	744	772	764	788
Diesel Oil	579	533	579	606	585
Fuel Oil	93	88	69	53	54
LPG	168	154	152	174	194
Other Petroleum Products	796	749	785	776	805
Import Dependency	-5%	-8%	-9%	-4%	-9%

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

Table 3.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	163	146	155	159	166
Transport	1,204	1,177	1,226	1,230	1,249
Residential	64	61	59	58	54
Commercial	68	59	60	68	69
Agri and Fishery	64	51	60	68	66
Electricity and Heat	28	27	18	14	14
Others	782	746	778	776	810
Total Consumption	**2,373**	**2,268**	**2,355**	**2,373**	**2,427**

Others include non-energy, own-use and losses
Source: IEA 2014

increased a bit by 0.6 percent annually, on the average, with gasoline and diesel oil as the most consumed fuels with both exhibiting average shares of 32.3 percent and 24.4 percent, respectively.

In terms of sectoral consumption, around 50.0 percent of total oil demand was consumed by the transport sector, increasing by 1.0 percent annually. Meanwhile, average consumption of industry and commercial sectors was about 6.7 and 2.7 percent of total, respectively (IEA, 2014).

The increase in local crude oil and refinery production during the last 5 years (2008-2012)

Figure 3.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014
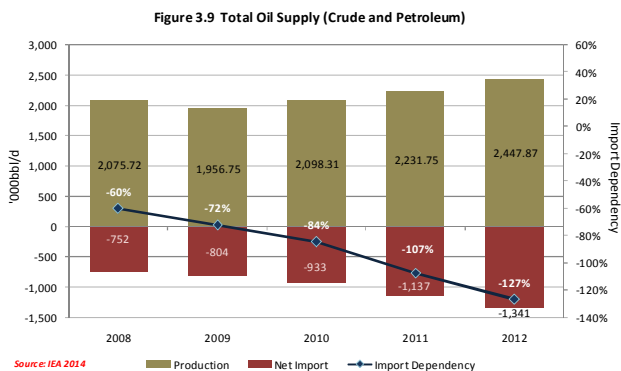
brought net imports to decline by 15.6 percent annually. Such reduced further the economy's import dependency from negative 60.0 percent in 2008 to negative 127 percent in 2012.

c) Oil Demand Outlook and Refinery Capacity

Canada's oil demand is projected to increase at AAGR of 0.1 percent until 2040 (APERC, 2015). With possible additional new refinery capacity of 50,000 bbl/d in 2017, the economy could still meet about 70.0 percent (based on 85.0 percent operating capacity) of its domestic oil demand until 2040.

Figure 3.10 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyod are committed projects
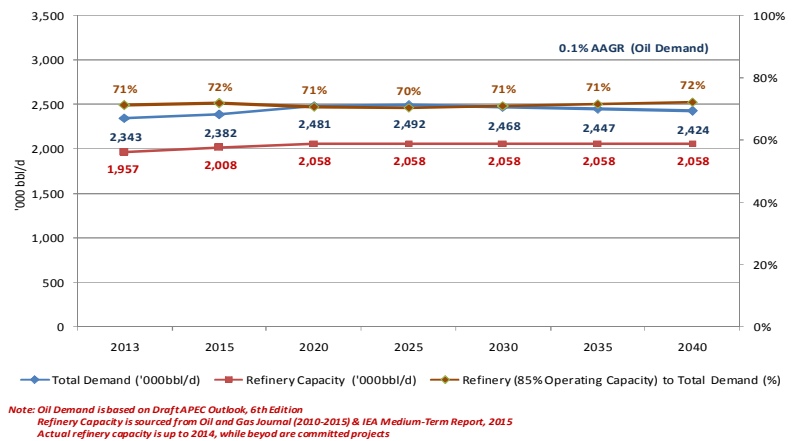
Oil Supply Security Policy

Table 3.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

Provincial governments are responsible for the use, conservation, development and management of resources within their respective territories or boundaries. The federal government is only involved in the management of an energy-related emergency if requested by the provincial government and on cases where more than one province (interprovincial) or national territory is affected, such as energy systems outside provincial boundaries. The federal government through the Energy Supplies Allocation Board (ESAB) decides and organizes ways and measures on how to address national emergency like an oil supply disruption.

In the case of a declared national emergency, the government would invoke provisions either under the Emergencies Act (EA) of 1985 or the Energy Supplies Emergency Act (ESEA) of 1985. The EA provides the federal government the authority to direct disposition of energy commodities. In the event of an energy shortage, it enables the government to initiate and implement a set of emergency orders and regulations and allows for the requisition, use or disposal of property, including energy commodities such as crude oil and refined products (MOJ, 2003). The EA is best used to address a short-term oil emergency.

In the event of an oil supply emergency that is expected to have long-term impacts, the government would invoke provisions under the ESEA. The ESEA provides similar powers as that of EA and allows for the activation of the Energy Supplies Allocation

Board (ESAB), which has the authority to control all aspects of crude oil and petroleum product movements, as well asprovides for the legal instruments to satisfy Canadaøs obligations as member of the IEA (MOJ, 2012). The ESABøs mandate is to provide a means to conserve the supplies of energy within Canada during periods of national emergency caused by shortages or market disturbances affecting the national security, welfare and economic stability of Canada (OGSN, 2015).

b) Criteria of Emergency

The IEA Agreement on International Energy Program (IEP) initially defined emergency as an oil supply disruption involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. However, such definition in the IEP has evolved with the development of oil markets and provided more flexibility in determining emergency situation and response measures (IEA, 2007). Likewise, the IEAøs Initial Contingency Response Plan has considered a process of continuous market assessment to determine if there is imminent emergency situation or not.

Canadaøs federal government would only declare a national emergency in extreme circumstances. Emergency situation is defined as actual oil supply shortages, or market disturbances affecting the national security, welfare and/or economic stability of the economy. When the situation warrants the declaration of emergency, decision will come from the Governor in Council (cabinet) based on the advice from Minister of Natural Resources (OGSN, 2015).

c) Emergency Policy

In the event of an oil supply emergency that is expected to have long-term impacts, the ESEA provides the federal government the authority to direct disposition of energy commodities in the event of an emergency related to energy supplies. In the case of an energy shortage, it enables the government to initiate and implement a set of emergency orders and regulations and allows for the requisition, use or disposal of property, including energy commodities such as crude oil and refined products. It also permits the activation of the ESAB, which has the authority to regulate company stocks. The Board may specify petroleum products which are to be controlled, and set the priorities of use or supply. The Board may likewise regulate the price of electricity to discourage demand on available supplies, regulated and exports of any controlled product; and, restrict the demand of petroleum products or implement rationing of certain products (OGSN, 2015).

d) Strategic Oil Stockholding

Being a net oil exporter, Canada is not subject to the IEA 90-day oil stock obligation and does not hold any public stocks or have a compulsory stockholding obligation on industry (IEA, 2014b). All the economy's oil stocks are industry stocks held for commercial purposes. As of 2013, industry held stock equivalent to around 53 days of oil demand, 65 percent of which was crude and 35 percent products. The economy exports 68 percent of oil produced domestically (OGSN, 2015).

e) Regional Oil Security Policy

All members of the IEA are committed to undertake joint measures in the event of oil supply emergencies. Members have all agreed to share energy information, co-ordinate their energy policies and co-operate in the development of rational energy programmes. Each of the 29 IEA member countries is also required to hold oil stocks equivalent to 90 days of its prior year's net imports. In the case of Canada, despite it is a member of the IEA, it does not hold any bilateral stocks for other IEA member country (IEA, 2014a). However, the economy is obliged to contribute to collective action based on its assessed share intotal IEA oil consumption (IEA, 2007). Further, the economy's obligation to participate in an IEA collective action would be met primarily through demand restraint measures and surge in production (OGSN, 2015).

f) Emergency Exercise Activity

IEA carries out emergency exercises and workshops every two years with the primary aim of reviewing policies and procedures, and assessing decision-making process and readiness to act immediately and effectively (IEA, 2014a)

IEA conducted Emergency Response Reviews in 2009 and 2014.Among the key findings of the reviews were:

- Canada has emergency response policies in place and there remains some uncertainty regarding their potential impact should they be implemented in response to future disruptions; and,

- The federal government should continue to explore appropriate stockholding measures through consultation with industry and IEA Member countries to ensure that the economy is able to effectively participate in future IEA collective actions.

Based on the findings, the federal government is currently working with the IEA and other relevant stakeholders to improve Canada's emergency response capabilities *(OGSN, 2015)*.

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CHILE

Socio-Economic Overview

Chile is located in South America and it shares borders with Peru to the north, Bolivia to the north-east and Argentina to the west.

Table 4.1 Socio-Economic Profile, 2012

Land Area km^2	756,102
Population (million)	17.46
GDP (USD Billion, 2010 Price & PPP)	348.82
GDP per Capita	19,973

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

In 2012, the economy's population was around 17 million and growing at an average annual growth rate (AAGR) of 0.9 percent in the last 5 years (2008-2012). For the same period, the economy's GDP was USD 348.82 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 3.9 percent. On the other hand, GDP per capita grew by 3.0 percent annually reaching USD 19,973 in 2012 (APERC, 2015a & EDMC, 2014).
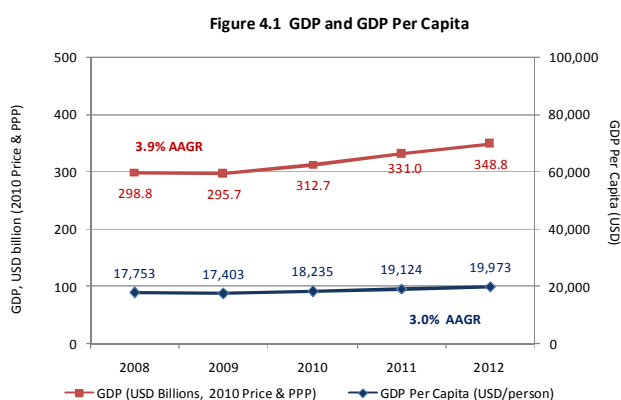
Figure 4.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Oil has been the major fuel for Chile over the last 5 years (2008-2012), posting an average share of 49.0 percent to the primary energy mix, followed by renewable energy sources with an average share of 25.0 percent. Coal provided 15.0 percent while natural gas with 11.0 percent average shares for the same period.

Figure 4.2 Total Primary Energy Supply
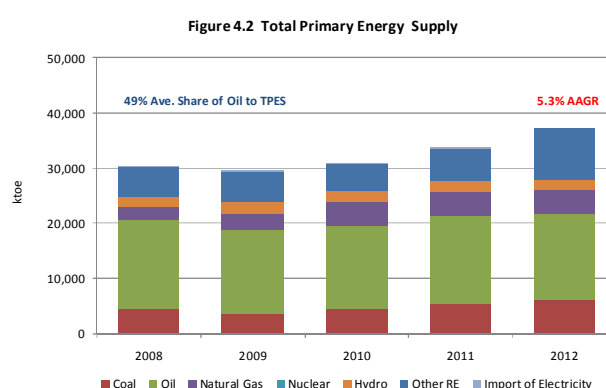
Source: IEA 2014

In final energy demand, the average share of oil was recorded at 51.0 percent, while renewable energy and electricity both with 20.0 percent average shares. The economy's

oil consumption had increased at AAGR of 2.2 percent in the last 5 years.

Figure 4.3 Final Energy Demand (Fuel)

51% Ave. Share of Oil to FED   2.5% AAGR

Coal   Oil   Natural Gas   RE   Electricity   Others

Source: IEA 2014
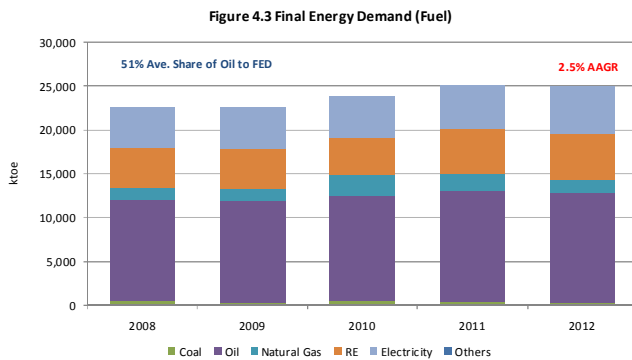
By sectoral consumption, the industry is the largest energy consuming sector with an average share of 37.1 percent of final energy demand. The sector's energy demand grew annually 1.8 percent. Transport sector posted the second largest with 30.1 percent average share, while residential sector consumed 22.7 percent oftotal final energy demand (IEA, 2014).

Figure 4.4 Final Energy Demand (Sector)

2.5% AAGR

Industry   Transport   Residential   Commercial & Public Services   Agriculture/Forestry   Non-Energy

Source: IEA 2014
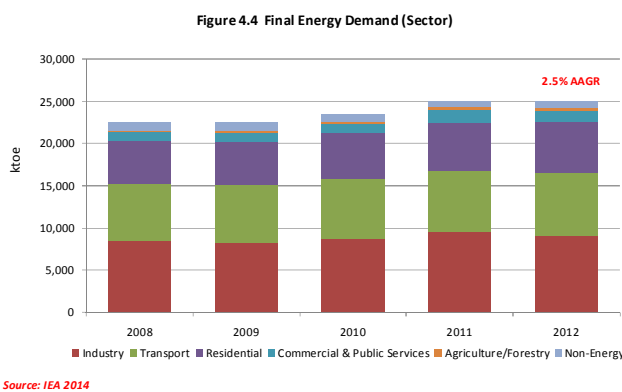
b) Energy per Capita and Energy Intensity

Chile's energy and oil per capita had been relatively stable over the last 5 years exhibiting an average of 1.4 tonnes of oil equivalent (toe)/person and 0.7 toe/person, respectively. As regards to energy intensity, the economy has showed improvement (decline) of 5.3 percent from 75.5 toe/million

USD GDP in 2008 to 71.5 toe/million USD GDP in 2012 of energy consumption. Oil intensity likewise declined by 6.4 percent, which was recorded at 36.1 toe/million USD GDP in 2012 from 38.6 toe/million USD GDP in 2008 (EDMC, 2013).

Figure 4.5 Final Energy and Oil Demand Per Capita

1.4 toe/person (ave)

0.7 toe/person (ave)

Energy Per Capita   Oil Per Capita

Source: EDMC-IEEJ

Figure 4.6 Final Energy and Oil Demand Intensity

-5.3% improvement from 2008
-5.5% improvement from 2011

-6.4% improvement from 2008
-6.3% improvement from 2011

FED Intensity   Oil Intensity

Source: EDMC-IEEJ
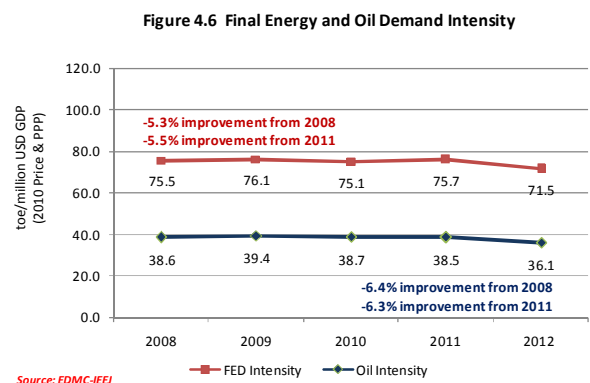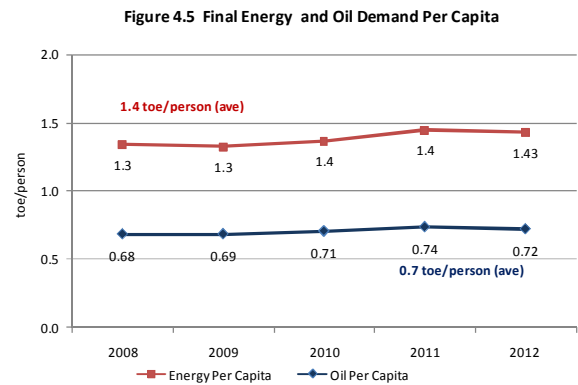
Oil Supply and Demand

a) Crude oil Production and Imports

Chile's crude oil production had increased in the last 5 years (2008-2012) with an AAGR of 23.0 percent. This resulted in decrease in crude oil imports by about 4.1 percent annually. With this, the economy's import dependency went down from 99.0 percent in 2008 to 97.0 percent in 2012.

With regard to regional sources of crude oil imports, the economy relied about 91.0 percent of its imports from the other American countries, specifically from Brazil (48%), Argentina (18%), Columbia (16%) and Ecuador (14%) (EIA, 2015). The APEC

Figure 4.7 Crude Oil Supply
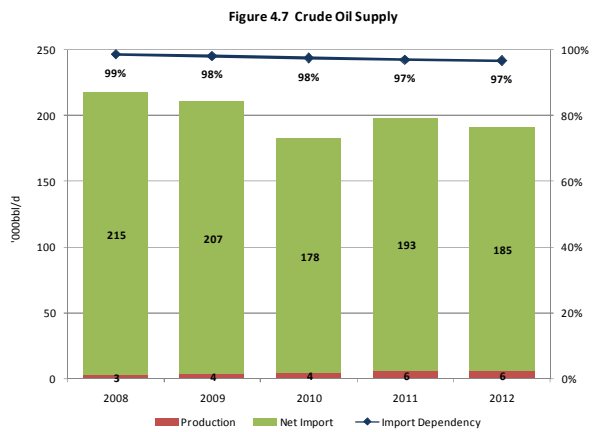
region represents 6.0 percent of Chilean oil imports. Based on Herfindahl-Hirshman Index (HHI), the regional import sources may be considered as high concentration with HHI value of 0.83.

Figure 4.8 Chile Crude Oil Imports by Sources, 2012
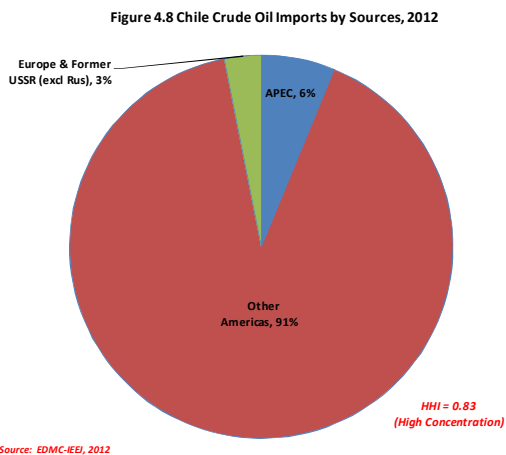
b) Oil Products

Chile's refinery production had declined at an average of 5.3 percent annually, which caused net import to rise yearly by 0.6 percent. This intensified the economy's import

dependency to 49.0 percent in 2012 from 45.0 percent in 2008.

Table 4.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	213	194	168	169	171
Net Imports	147	128	147	148	150
Others *	-24	-3	-11	-6	-6
Net Supply	335	320	305	312	315
Demand	335	320	305	312	315
Gasoline	57	62	69	64	65
Diesel Oil	173	159	146	158	157
Fuel Oil	28	20	22	23	22
LPG	45	50	45	43	46
Other Petroleum Products	32	29	23	24	24
Import Dependency	**45%**	**43%**	**50%**	**49%**	**49%**

* include stock change, international marine & aviation and statistical difference

Total oil demand was declining by 1.5 percent per annum, on the average. Diesel oil and gasoline were the most consumed oil products with both exhibiting average shares of 50.0 percent and 20.0 percent, respectively. Gasoline oil was growing at a faster average

Table 4.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	68	66	63	66	59
Transport	145	147	153	155	159
Residential	28	30	29	31	31
Commercial	8	8	11	15	12
Agri and Fishery	3	3	5	7	6
Electricity	56	42	28	22	29
Others	27	25	16	15	19
Total Consumption	**335**	**320**	**305**	**312**	**315**

Others include non-energy, own-use and losses

annual rate of 3.4 percent. Large portion of Chile's imports of oil products came from the United States (EIA, 2015).

In terms of sectoral demand, around 48.0 percent of total oil demand in 2012 was consumed by the transport sector, while industry sector demanded at an annual average of 20.0 percent of the total. Oil demand of the transport sector was expanding by 2.3 percent annually in the last 5 years.

Looking at total oil supply (crude and oil products), total net import in the last 5 years had reduced, from 355,000 bbl/d in 2008 to about 327,000 bbl/d in 2012, which could be attributed to slight increase in domestic crude oil production. However, this had marginal effect on the import dependency indicator, reducing from 99.0 percent in 2008 to 98.0 percent in 2012 (IEA, 2014).

Figure 4.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014
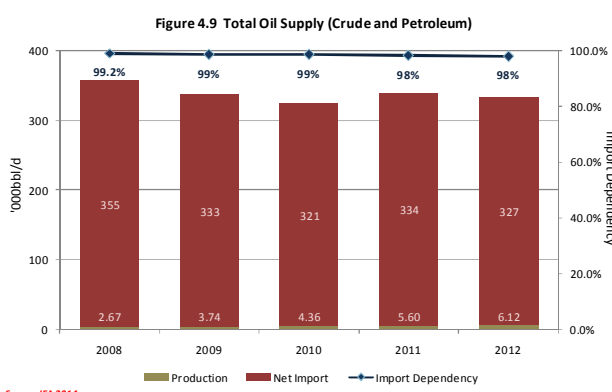
c) Oil Demand Outlook and Refinery Capacity

Chile's oil demand is projected to increase at AAGR of 1.7 percent until 2040 (APERC, 2015). In 2013, the economy's refinery capacity of 227,000 bbl/d, based on 85.0

percent operating capacity, could still meet about 55.0 percent of its domestic oil demand. However, refinery production share to total demand decreases to 37.0 percent in 2040 if no additional capacity comes in within the outlook period.

Figure 4.10 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects
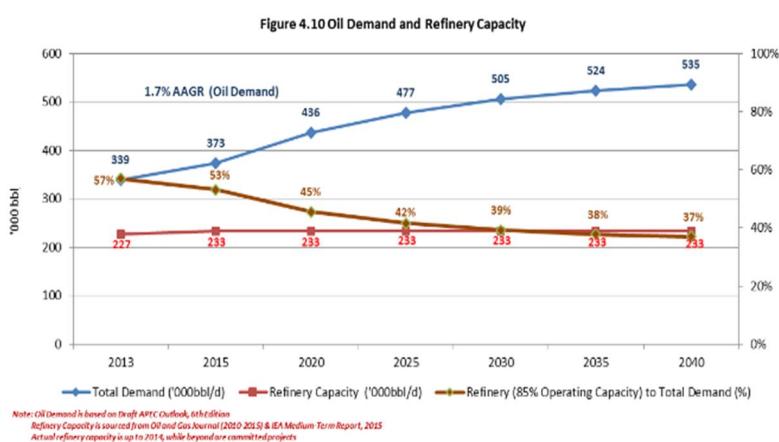
Oil Supply Security Policy

Table 4.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☒ None	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

In 2014, Chile established the Energy Sectoral Committee for Emergency Operations (COSE) as part of the National Committee for Emergency Operations (COE). The main task of COSE is to coordinate with COE, public organizations, private companies and other sectoral authorities involved and/or affected by energy emergency situation and address such

event. The committee will formulate and implement measures to confront supply disruption and reduce the negative effects to the economy (MOE, 2014).

Prior to creating COSE, the National Emergency Office (ONEMI) under the Ministry of the Interior and Public Security served as the lead agencyin coordinating both public and private sectorsø actions to address all kinds of emergencies. The Superintendency of Electricity and Fuels (SEC) of the Ministry of Energy has also its own emergency plan that could be activated during disturbances in normal operation of the energy markets (IEA, 2014).

b) Criteria of Emergency

The current definition of oil emergency is based on level of economyøs oil supply stocks. There are three (3) classifications developed in assessing critical supply, namely: normal status is when oil supply is over 25 days of operational stocks; alert status is when oil the level of stocks is between 15 to 25 days; and, serious status if less than 15 days (IEA, 2014).

c) Emergency Policy

In case of emergency, several measures are identified such as fuel switching, demand restraint, and lowering specification for fuels like gasoline and diesel to expand sources of fuels from overseas refineries producing lower grades fuels. It was however recognized that to fully implement demand restraint, a law must be enacted to address legal and administrative barriers of said measure (IEA, 2014).

d) Strategic Oil Stockholding

Chile has no strategic oil stocks. However, the government imposes obligatory stocks to oil industry participants, equivalent to 25 days of their sales based on the past six (6) months sales or average imports if such are for their own consumption (IEA, 2014).

e) Regional Oil Security Policy

Chile has no regional oil security policy. Nonetheless, Chile is a candidate member country of IEA, and once acceded, the economy will be covered by IEA Agreement on International Energy Program (IEP).

f) Emergency Exercise Activity

Since 2011, Chile has been conducting oil emergency simulation exercises on an annual basis. Said exercise is being participated in by the Superintendence of Electricity and Fuels, energy companies and other public institutions such as the National Emergency Office (ONEMI). In 2012, emergency exercise was jointly done with IEA. Likewise, an Emergency Response Assessment (ERA) was conducted by IEA in 2011 (IEA, 2012).

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CHINA

China is located in northeast Asia and bordered by the East China Sea, the Yellow Sea and the South China Sea with a total land area of about 9.6 million square kilometres. It has a diverse landscapes consisting of mountains, plateaus, plains, deserts and river basins.

Table 5.1 Socio-Economic Profile, 2012

Land Area km^2	9,572,900
Population (million)	1,350.70
GDP (USD Billion, 2010 Price & PPP)	14,248.86
GDP per Capita	10,549

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

In 2012, the economy's population was 1.35 billion and growing at an average annual growth rate (AAGR) of 0.5 percent in the last 5 years (2008-2012). During the same period, the economy's GDP was recorded at USD 14,248.9 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 9.1 percent. Meanwhile, GDP per capita has been growing at an annual average rate of 8.6 percent (last 5

years) reaching USD 10,549 in 2012(APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Although coal is the dominant energy source in China, accounting an average share of 68.0 percent of the economy's total primary energy supply mix from 2008-2012, oil is also considered as one of the major fuels contributing an average share of 17.0 percent for the same period. Meanwhile, renewable energy had an average share of 11.0 percent, natural gas with 4.0 percent, and nuclear energy sources with 1.0 percent. The economy is a net importer of crude oil which is seen to escalate to meet the growing demand.

Figure 5.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 5.2 Total Primary Energy Supply
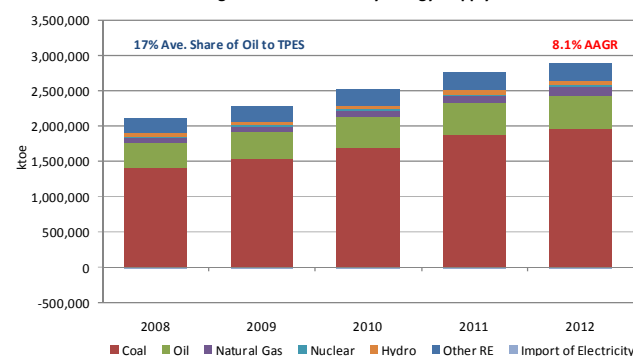
Source: IEA 2014

In terms of final energy demand, the average share of coal was recorded at 35.0 percent followed by oil (24.0 percent), electricity (19.0 percent), renewable energy (14.0 percent), and natural gas (4.0 percent). The economy's oil consumption had been increasing at AAGR of 5.6 percent in the last 5 years.

Figure 5.3 Final Energy Demand (Fuel)

Figure 5.4 Final Energy Demand (Sector)
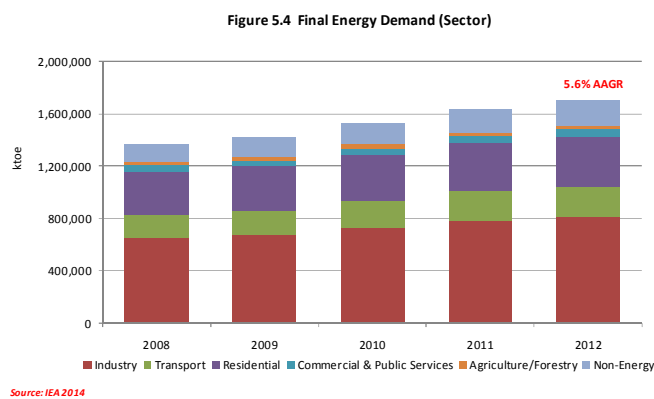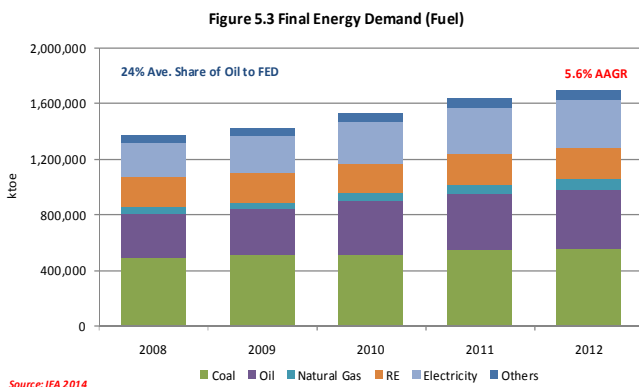
For the economic sectors, the industry sector used up almost 50.0 percent, on the average, of the final energy demand, and growing at AAGR of 5.6 percent. Residential is the second largest consuming sector with 23.0 percent average share, while transport sector consumed 13.0 percent of the total final energy demand. Transport energy demand expanded about 9.0 percent annually. Non-energy sector also consumed 11.0 percent

of the final energy and displayed 8.0 percent annual growth rate (IEA, 2014).

b) Energy per Capita and Energy Intensity

China's energy and oil per capita had steadily increased over the last 5 years exhibiting an annual average of 1.1 tonnes of oil equivalent (toe)/person and 0.3 toe/person, respectively. On the other hand, despite 5.6 percent increase in the final energy demand, the economy achieved improvement (decline) in energy intensity level of 12.4 percent from 136.4 toe/million USD GDP in 2008 to 119.4 toe/million USD GDP in 2012 of energy consumption. Similarly, oil intensity also declined by 6.9 percent, which was recorded at 29.6 toe/million USD GDP in 2012 from 31.8 toe/million in 2008. Such changes could be attributed to energy efficiency and structural

Figure 5.5 Final Energy and Oil Demand Per Capita

Figure 5.6 Final Energy and Oil Demand Intensity
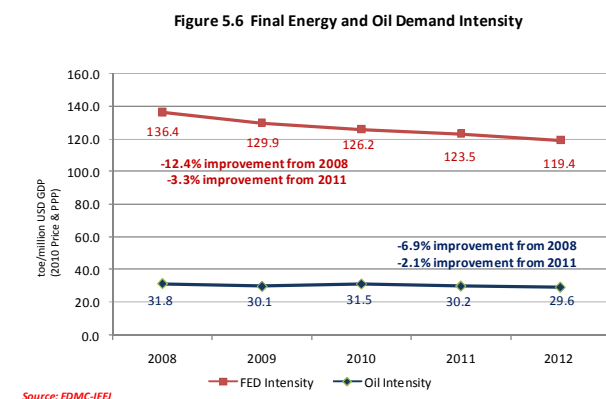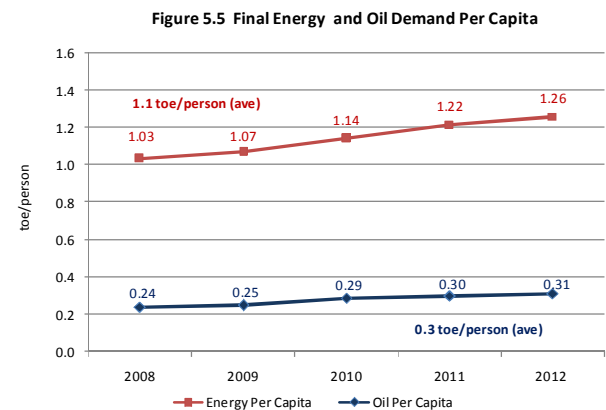
effect ó shift to less energy-intensive sectors, where the major contributor is from industry sectors (EDMC, 2013).

a) Crude oil Production and Imports

Figure 5.7 Crude Oil Supply

Source: IEA 2014

China is the fourth largest producer of crude oil in the world. However, the economy has been a net importer of crude oil since 1996 *(IEA, 2014b)*. The economy's crude oil production demonstrated an increasing rate of 2.2 percent annual average from 2008-2012, while crude net imports increased much faster by 11.4 percent annually within the same period. As such, the economy's import dependency

Figure 5.8 China Crude Oil Imports by Sources, 2013

HHI = 0.32
(Moderate-Low Concentration)
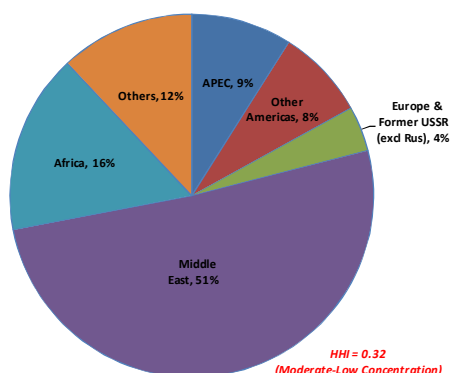
Source: EIA-China Overview, Feb. 2014

went up from 49.0 percent in 2008 to 58.0 percent in 2012.

As for the regional sources of crude oil imports, the economy relied about 51.0 percent of its imports from Middle East. Other sources of crude include Africa (16.0 percent), APEC region (9.0 percent), America (8.0 percent), and Europe & Former USSR (4.0 percent). Based on Herfindahl-Hirshman Index (HHI), the regional import sources may be considered as moderate-low concentration with HHI value of 0.32.

b) Oil Products

China's refinery production exhibited an average annual increase of 7.7 percent, thus decreasing net import by 1.6 percent. Such brought down import dependency from 7.0 percent in 2008 to 5.0 percent in 2012. Meanwhile, total oil demand grew annually by 6.9 percent, on the average, with diesel oil and other petroleum products (non-energy) as the

Table 5.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	7,300	7,886	8,941	9,277	9,840
Net Imports	530	409	392	496	496
Others *	-359	-599	-493	-478	-576
Net Supply	7,471	7,695	8,840	9,295	9,760
Demand	7,471	7,695	8,840	9,295	9,760
Gasoline	1,472	1,479	1,712	1,811	1,950
Diesel Oil	2,773	2,860	3,229	3,457	3,519
Fuel Oil	471	392	347	292	264
LPG	808	823	836	896	918
Other Petroleum Products	1,946	2,140	2,716	2,839	3,109
Import Dependency	7%	5%	4%	5%	5%

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

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most consumed fuels with average shares of about 36.8 percent and 29.4 percent, respectively. Such demand translated to growing annual average rates of 6.1 percent for diesel oil and 12.4 percent for other petroleum product. Fuel oil demand recorded a decline of 13.5 percent annually, on the average.

Among the sectors, transport consumed about 47.1 percent, on the average, of total oil demand during the last 5 years. Followed next

registered 10.0 percent annual growth rate, lower by 1.0 percent in crude oil.

Figure 5.9 Total Oil Supply (Crude and Petroleum)

Table 5.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	984	983	1,251	1,183	1,252
Transport	3,413	3,547	4,152	4,486	4,711
Residential	624	646	644	715	734
Commercial	237	252	282	308	359
Agri & Fishery	270	279	294	312	328
Electricity and Heat	126	85	84	53	50
Others	1,817	1,904	2,133	2,236	2,326
Total Consumption	**7,471**	**7,695**	**8,840**	**9,295**	**9,760**

Others include non-energy, own-use and losses

is non-energy with 19.0 percent of total, industry with 13.1 percent, and residential with 7.8 percent. The rest of the sectors consumed less than 4.0 percent of the total oil demand. Oil demand of both transport and non-energy were expanding by 8.0 percent annually.

Assessing overall oil supply (crude oil and petroleum products), the economy's import dependency reduced to 55.0 percent compared with dependency level in crude oil as petroleum products net imports declined. Total net imports

c) Oil Demand Outlook and Refinery Capacity

China's oil demand is projected to increase at AAGR of 1.7 percent until 2040 (APERC, 2015). With refinery capacity of 13,520 thousand barrels per day ('000bbl/d) in 2013, the economy provided more than 100.0 percent of its domestic oil demand. Despite the planned refinery capacity additions of around 2,000,000 bbl/d until 2018, the economy's refinery capacity could only cover up to 80.0 percent (based on 85.0 percent operating capacity) of its escalating oil demand by 2040 if no other capacity expansion will be added (IEA, 2015).
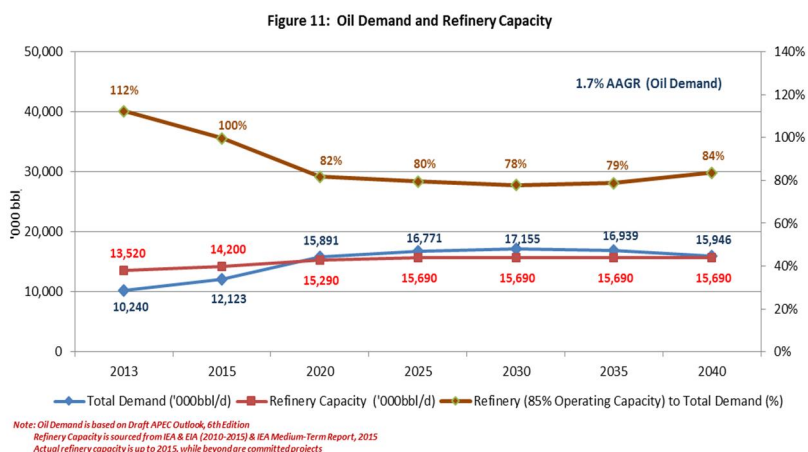
Figure 11: Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from IEA & EIA (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2015, while beyond are committed projects

Oil Supply Security Policy

Table 5.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	No Information	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☒ None	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The State Council has the authority and final decision during emergency situation including releases of Strategic Petroleum Reserves (SPR). Said Council is composed of premier, vice-premiers, state councilors and ministers. Based on the State Council's decisions orders, the National Development and Reform Commission (NDRC), and the National Energy Administration (NEA) together with the Ministry of Finance will cooperate to carry out such decisions/orders.

The NDRC is in charge of conducting assessment of energy supply and demand, coordinating relevant significant issues, arranging urgent allocation of important energy supplies (i.e. oil, gas, coal and electricity), as well as putting forward any arrangements on important emergency supply reservation and the use of Strategic Petroleum Reserves (SPR). Under the guidance of the NDRC, the NEA undertakes the responsibility of managing SPR including operation regulations and security inspection. On the other hand, the National Oil Reserve Center (NORC), which is under the supervision of NEA, is responsible for the construction of SPR and procurement of oil (IEA, 2014a)

b) Criteria of Emergency

China has no specific criteria for emergency. However, SPR may be ordered for releases when there are significant changes in oil market supply and sudden incidents happened.

c) Emergency Policy

In case of emergency, the NEA will seek approval from the State Council on the plan for emergency oil reserves releases. Upon approval of the Council, NEA will undertake the measure in coordination with the NDRC and other relevant agencies like ministries and national oil companies (IEA, 2014a).

d) Strategic Oil Stockholding

In 2003, China started to build stockpiling facilities for crude oil storage. From 103 million barrels in strategic crude oil storage capacity in 2009 in four (4) sites, the economy intends to build more storage capacity to reach at least 500 million barrels by 2020 (EIA, 2014). The economy's goal is to hold strategic reserves equivalent to 90 days of net imports by 2020. The government has also a plan to put petroleum product reserves.

A minimum stockholding obligation on industry as part of the National Petroleum Reserve is still under considering. It is proposed that the National Petroleum Reserves be composed of government stocks and obligatory industry stocks, and will include both crude oil and products (IEA, 2014a).

e) Regional Oil Security Policy

China has not engaged in any regional oil security policy. However, the economy has

been participating in IEA activities such as the Emergency Response Simulation Exercise (ERE) (IEA, 2012).

f) Emergency Exercise Activity

China has been actively taking part in the international and regional emergency exercise activity. China participated in the IEA Emergency Response Simulation Exercise together with other countries in 2002, 2004, 2008, 2010, and 2011IEA, 2012). In January 2015, the IEA held the first ERE in China (IEA, 2015a).

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HONG KONG, CHINA

Socio-Economic Overview

Hong Kong, China is a special administrative region of the People's Republic of China with a land area of about 1.1 thousand square kilometres. It is a world class financial, trading and business centre of almost 7.2 million people located at the south-eastern tip of China and the population was growing at an average annual growth rate (AAGR) of 0.7 percent in the last 5 years (2008-2012).

Table 6.1 Socio-Economic Profile, 2012

Land Area km^2	1,104
Population (million)	7.15
GDP (USD Billion, 2010 Price & PPP)	352.75
GDP per Capita	49,303

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

In 2012, the economy's GDP was recorded at USD 352.7billion (USD 2010 Price & PPP), registering a 5-year (2008-2012) AAGR of 2.6

percent. For the same period, GDP per capita grew an annual average rate of 1.9 percent reaching USD 49,303 in 2012, among the highest in the APEC economies (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Hong Kong, China has no natural resources and thus almost all its energy demand is met by imports. Among the imported energy source, coal maintained the highest share to the total primary energy supply mix registering an average share of about 50.0 percent in the last 5 years. Oil is also a significant source, posting an average share of 27.0 percent, followed by natural gas with 18.0 percent, and renewable energy with 1.0 percent.

Figure 6.1 GDP and GDP Per Capita
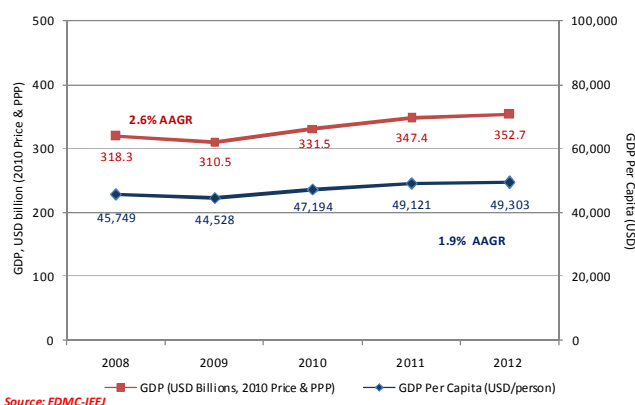
Source: EDMC-IEEJ

Figure 6.2 Total Primary Energy Supply

Source: IEA 2014

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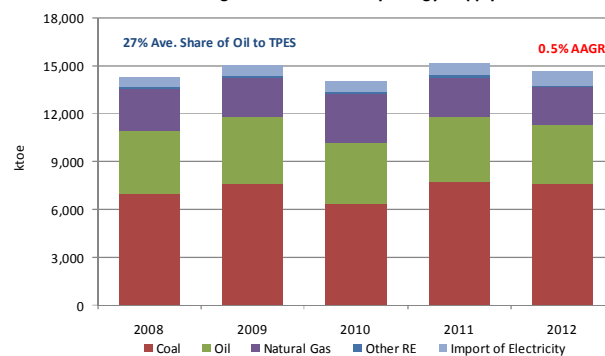
With regard to final energy demand, the average share of electricity was recorded at 41.0 percent followed by oil (38.0 percent), coal (14.0 percent), natural gas (7.0 percent), and renewable (1.0 percent). The economy's oil consumption demonstrated average annual increase of 0.6 percent in the last 5 years.

Among the sectors, the commercial and public services is the largest energy consuming sector utilizing about 31.0 percent, on the average, of the final energy demand, and growing at AAGR of 0.9 percent. Industry sector is the second largest with 25.0 percent average share, while transport sector consumed 24.0 percent of total final energy demand (IEA, 2014).

respectively, on the average. Meanwhile, the economy's energy intensity has showed improvement (decline) by 2.3 percent, from 26.0 toe/million USD GDP in 2008 to 25.4 toe/million USD GDP in 2012 of energy consumption. Oil consumption likewise declined by 7.1 percent for the same period, which was recorded at 9.1 toe/million in 2012 from 9.8 toe/million USD GDP in 2008 (EDMC, 2013). Such improvement could be attributed to various policies being implemented in Hong Kong on energy efficiency, such as the mandatory energy efficiency labelling scheme, building energy efficiency Ordinance, building energy efficiency funding schemes and district cooling system (APERC, 2015a).

Figure 6.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 6.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ
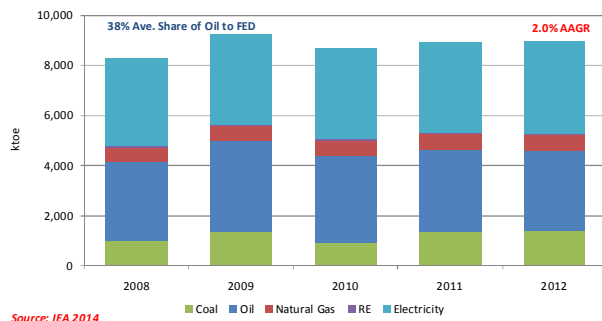
Figure 6.4 Final Energy Demand (Sector)

Source: IEA 2014
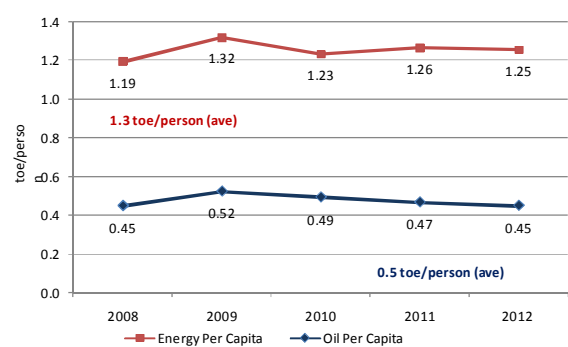
Figure 6.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

b) Energy per Capita and Energy Intensity

Hong Kong's energy and oil per capita somehow were stable over the last 5 years (2008-2012) exhibiting 1.3 tonnes of oil equivalent (toe)/person and 0.5 toe/person,
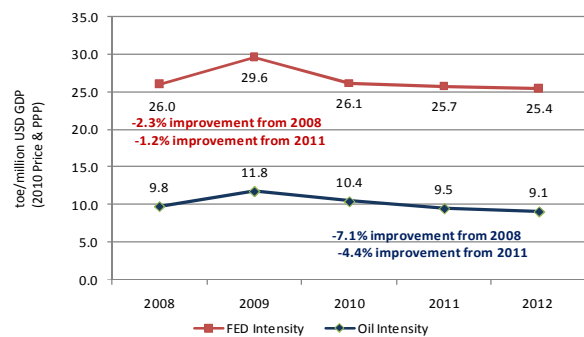
Oil Supply and Demand

a) Crude oil Production and Imports

The absence of oil refinery in Hong Kong has made the economy 100.0 percent dependent on petroleum imports.

b) Oil Products

For sectoral demand, around 64.3 percent of total oil demand was consumed by the transport sector, followed by the industry sector with 17.2 percent. On the other hand, non-energy (Others) application for oil used up 12.2 percent of total, commercial with 4.3 percent, and residential with 0.4 percent. Such demand in the transport sector translated to an annual average growth rate of 3.6 percent (IEA, 2014).

Table 6.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	-	-	-	-	-
Net Imports	319	390	436	389	359
Others *	-249	-308	-359	-315	-284
Net Supply	70	82	77	74	75
Demand	70	82	77	74	75
Gasoline	8	9	9	10	10
Diesel Oil	31	47	42	40	39
Fuel Oil	7	1	0	0	3
LPG	16	16	14	14	14
Other Petroleum Products	8	10	11	10	9
Import Dependency	100%	100%	100%	100%	100%

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

Table 6.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	16	14	12	12	11
Transport	42	54	50	49	48
Residential	0	0	0	0	0
Commercial	4	3	3	3	3
Agri and Fishery	-	-	-	-	-
Electricity	1	1	1	1	4
Others	8	9	11	9	9
Total Consumption	70	82	7	74	75

Others include non-energy, own-use and losses
Source: IEA 2014

All oil products were imported with net imports increasing by 3.0 percent per year. Total oil demand grew annually by 1.8 percent, on the average, with diesel oil as the most consumed fuels with average shares of about 52.2 percent and growing at a faster average annual rate of 5.8 percent.

c) Oil Demand Outlook and Refinery Capacity

Figure 6.7 Oil Demand and Refinery Capacity
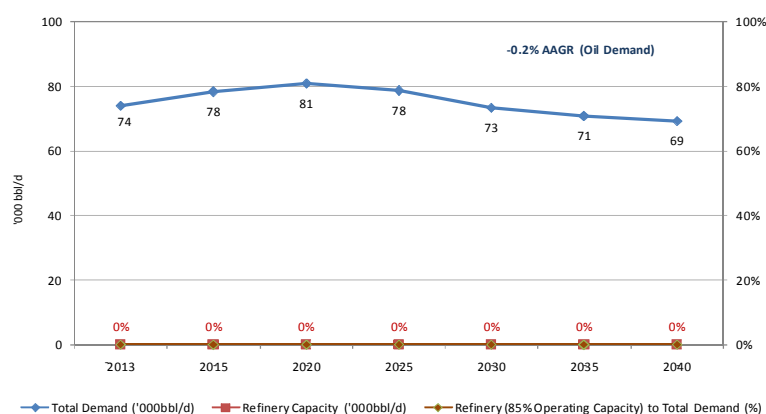
Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015

Hong Kongøs oil demand is projected to slightly decrease until 2040 with average annual rate of negative 0.2 percent (APERC, 2015). In order to fulfil its oil demand, the economy will still rely 100.0 percent on petroleum products imports.

Oil Supply Security Policy

Table 6.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	No Information	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
No Information	☒ None	☒ None

a) National Emergency Strategic Organization (Institutional Framework)

By virtue of Oil (Conservation and Control) Ordinance which was enacted in 1979, the Electrical and Mechanical Services Department (EMSD) is the responsible organization to handle oil supply emergency, to regulate or prohibit the storage, supply, acquisition, disposal or consumption of oil (ENB). Since mid-2000, the jurisdiction on oil conservation and control has been transferred to EMSD (EMSD).

The Chief Executive of Hong Kong (Head of the Hong Kong Special Administrative Region) appoints the Director of Oil Supplies with the primary authority to ensuring oil conservation and control (OCCO).

b) Criteria of Emergency

Although Oil Conservation and Control Ordinance already exist, Hong Kong has not defined any criteria for determining emergency oil supply situation.

c) Emergency Policy

In case of emergency, the EMSD or the Director of Oil Supplies has the power to require, restrict or prohibit the supply of oil to any persons, and undertake requisition of stocks holdings, if necessary. The Chief Executive may also order to regulate use of vehicles on roads and the use of aircraft, vessels, trains and trams (OCCO).

d) Strategic Oil Stockholding

After the oil crisis in 1970øs, the economy has put in place legislative and administrative arrangements to deal with any oil supply disruption. These include voluntary code of practice between oil companies and Towngas in 1982, whereby both are required to maintain strategic reserves of gas oil and naphtha in the amount equivalent to 30 days of retained imports during the previous calendar year (ENB).

The economy has not entered into regional oil security policy or agreement. Likewise, the economy has no known emergency response simulation exercise being undertaken or conducted in the past.

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INDONESIA

Indonesia is a large archipelago consisting of 17,508 islands and with total land area of 1.9 million square kilometres (24.5 percent of its territory). The economy's population was the fourth largest at 246.9 million in 2012.

Table 7.1 Socio-Economic Profile, 2012

Land Area km^2	1,904,569
Population (million)	246.86
GDP (USD Billion, 2010 Price & PPP)	2,143.88
GDP per Capita	8,684

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Indonesia's GDP averaged had been growing at an average annual growth rate (AAGR) of 5.9 percent over the period 2008-2012, reaching USD 2,143.9 billion (USD 2010 Price & PPP) in 2012. Similarly, the average annual growth rate of GDP per capita was robust at 4.5 percent in 5-year period (APERC, 2015a & EDMC, 2014).

Figure 7.1 GDP and GDP Per Capita
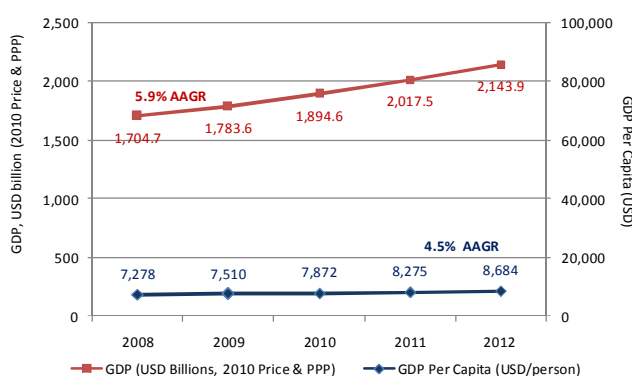
Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Indonesia's total primary energy supply (TPES) was 213,587 kilotonnes of oil equivalent (ktoe) in 2012 and grew at 3.4 percent annually, on the average, from 2008 to 2012. Oil had been dominant in the TPES with 34.4 percent average share, followed by renewable energy (34%), natural gas (17%) and coal (14%). Oil demonstrated the fastestgrowth rate of 5.0 annually in the last 5 years. The economy is endowed with natural resources including oil, natural gas, and coal, which makes the economy a net exporter of energy resources.

Figure 7.2 Total Primary Energy Supply
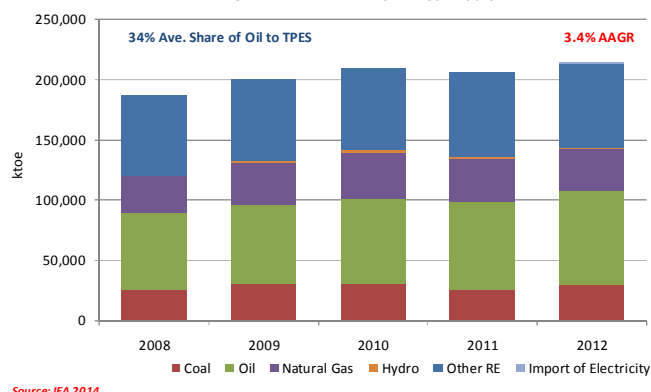
Source: IEA 2014

Oil accounted for 43.4 percentshare of the final energy demand in 2012, an increase from 37.9 percent in 2008, whereas coal share declined by 5.6 percent to 2.9 percent in 2012.

Natural gas registered the fastest annual growth rate of 9.0 percent over 2008-2012 although its share was still around 11.0 percentof total in 2012.

By sectoral energy demand, the residential sector exhibited the largest share of 37.0 percent, on the average, and grew annually at 1.0 percent in 5-year period (2008-2012). On the other hand, the transport sector had the fastest AAGR of 12.3 percent during the same period. The industry sector showed a declining energy demand of about 2.0 percent annually (IEA, 2014).

decline of about 9.0 percent, from 82.0 toe/million USD GDP in 2008 to 74.5 toe/million USD GDP in 2012. This indicates the economyøs energy intensity had improved over the last 5 years (2008-2012), which can be attributed to enhanced programs on energy efficiency and conservation being carried out by the Indonesian government. However, oil demand intensity increased from 31.1 toe/million USD GDP in 2008 to 32.3 toe/million USD GDP in 2012, which was mostly driven by increasing oil consumption in the transport sector (APERC, 2015a).

Figure 7.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 7.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 7.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

Figure 7.4 Final Energy Demand (Sector)

Source: IEA 2014

b) Energy per Capita and Energy Intensity

Both final energy demand and oil demand per capita had been in increasing trends since 2008, reaching 0.65 toe/person and 0.28 toe/person in 2012, respectively, on the average. As to energy intensity, the economy recorded a

Oil Supply and Demand

a) Crude oil Production and Imports

In 2009, Indonesia suspended its membership to the Organization of Petroleum Exporting

Countries (OPEC) due to declining crude oil production and higher oil demand, which resulted in increasing petroleum imports. Indonesia is expected to rejoin OPEC in December 2015 (EIA, 2015).

Figure 7.7 Crude Oil Supply
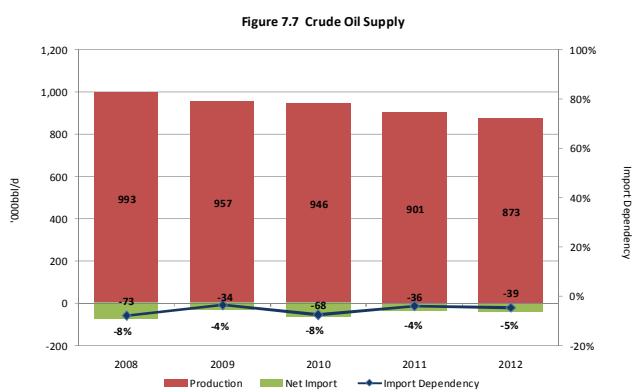
Indonesia's crude oil production continued to decline in the last 5 years (2008-2012), around 3.0 percent average annual reduction rate. Decreasing oil production has made the economy to secure a portion of its crude oil requirements overseas. Indonesia's crude oil import origins were diversified, with 35.0 percent share from the Middle East as the largest supplier. Bulk of imports from the Middle East came from Saudi Arabia (EIA, 2015). Other trading partners of Indonesia include Africa (19.0 percent), Other Asia and Pacific (15.0 percent) and the APEC region

Figure 7.8 Indonesia Crude Oil Imports by Sources, 2013

HHI = 0.26
(Moderate-Low Concentration)
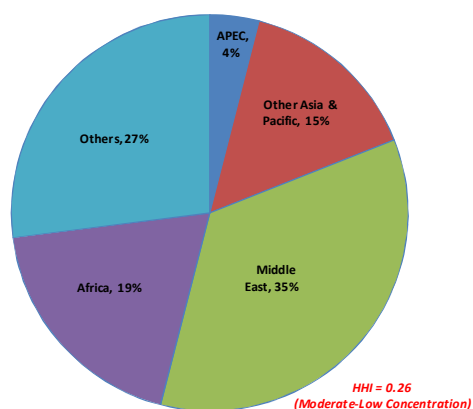
(4.0 percent). With Herfindahl-Hirshman Index value of 0.26, the import regional sources may be considered as moderate-low concentration.

b) Oil Products

Stagnant refinery production has raised petroleum product imports, consequently having the economy to become more dependent on imported petroleum products. Over the last 5 years, diesel oil and gasoline were the major fuels used in Indonesia, accounting for 37.6 percent and 30.8 percent, respectively. Liquefied petroleum gas (LPG)

Table 7.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	1,024	1,079	1,016	1,031	1,053
Net Imports	350	347	480	551	665
Others *	18	12	52	66	0
Net Supply	1,393	1,438	1,548	1,647	1,718
Demand	1,393	1,438	1,548	1,647	1,718
Gasoline	397	435	469	520	576
Diesel Oil	501	531	600	625	662
Fuel Oil	106	100	100	90	82
LPG	67	103	136	157	182
Other Petroleum Products	323	269	243	256	216
Import Dependency	26%	24%	32%	35%	39%

* include stock change, international marine & aviation and statistical difference

recorded the fastest growth rate of 28.5 percent over 2008-2012 due to the government's kerosene-to-LPG conversion program implemented in 2007 although its share was only 11.9 percent of total oil demand in 2012.

Table 7.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	178	184	214	183	168
Transport	616	699	791	860	962
Residential	180	173	175	178	196
Commercial	26	25	24	21	21
Agri and Fishery	52	58	61	51	52
Electricity	203	169	169	207	185
Others	139	131	115	147	133
Total Consumption	**1,393**	**1,438**	**1,548**	**1,647**	**1,718**

Others include non-energy, own-use and losses
Source: IEA 2014

Driven by increasing number of vehicles, the transport sector grew at 11.8 percent annually on average in 5-year period and expanded its share substantially from 44.2 percent in 2008 to 56.0 percent in 2012. All other sectors demonstrated a marginal or negative growth in recent years.

Total oil supply had demonstrated increasing rate of 4.4 percent average annual in the period 2008-2012. However, since domestic crude oil production continued to decline, and with almost stagnant refinery production, which was not sufficient to meet domestic oil demand, the economy had increased its dependency on oil import. This brought the economy's oil import dependency from 22.0 percent in 2008 to 42.0 percent in 2012, up by 20.0 percentage points.

c) Oil Demand Outlook and Refinery Capacity

Indonesia's oil demand is projected to reach 3,935 thousand barrels per day ('000 bbl/d) in 2040 with an AAGR of 3.3percent (APEC, 2015). In 2013, about 63.0 percent of total demand can still be provided by the existing refineries based on 85.0 percent operating capacity. However, with no refinery capacity additions coming in throughout 2040, this indicates that merely 27.0 percent of the total oil demand would be met by domestic refinery productions.

Figure 7.10 Oil Demand and Refinery Capacity
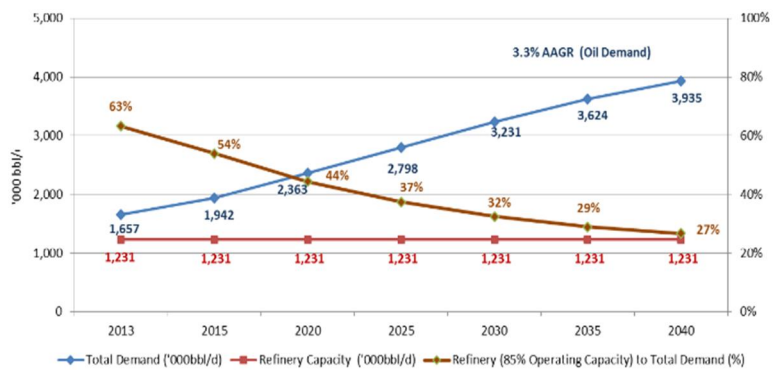
Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & Ministry of Energy & Mineral Resources
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 7.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy

Table 7.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The National Energy Council (NEC) under the Ministry of Energy Mineral Resources (MEMR) is the responsible body for coordinating emergency response in the event of an oil supply disruption. NEC has responsibilities to identify and formulate measures to addressing energy crises and emergency situations. NEC is now preparing guidelines in dealing with energy emergencies including provision on the type, amount, volume and location of strategic oil reserves (OGSN, 2015).

b) Criteria of Emergency

Indonesia, being a member state of ASEAN, could use the ASEAN Petroleum Security Agreement (APSA) definition of oil emergency, which is situation when a member is experiencing a shortfall of at least 10 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. APSA was first signed in 1986 and updated in 2009. The revised APSA was fully ratified and took effect in March 2013 (ASCOPE, 2009).

c) Emergency Policy

In case of emergency, the Fuel Distribution System could be activated by the government to ensure supply availability in disrupted areas. Although the government has no legal authority to enforce the system to industry, such is part of requirements needed to be carried out by industry to maintain its oil business licence (IEA, 2014b).

However, several measures are being identified and considered for implementation during future emergency situation such as release of energy buffer reserves, increase of energy imports, export restrictions, demand restraint measures, and fuel switching, among others (IEA, 2014a).

d) Strategic Oil Stockholding

Oil companies authorized by the government and PERTAMINA (the National Oil Company) are obliged to maintain 22 days of operational oil stock based on domestic oil consumption (IEA, 2014b). The NEC is planning to strengthen national stockpiling system by creating a national energy reserve system classified as follows:

- Energy Strategic Reserves consisting of energy resources to be held and regulated to ensure long-term supply security;
- Energy Buffer Reserves are considered public emergency stocks to be held by the government (based on Law 30/2007), which will be used only for emergency. Under this, it is being proposed to hold 30 days of net imports; and,
- Operational Reserves are provided by the industry composed of Pertamina holding 21-23 days of stocks and private companies 21 days of operational stocks *(IEA, 2014a)*.

e) Regional Oil Security Policy

Under APSA, all members are endeavoured to supply petroleum to the ASEAN Member State in Distress at an aggregate amount equal to 10 percent of the Normal Domestic Requirement of the said member state as

contained in the Coordinated Emergency Response Measure (CERM). However, a member state is required to implement short-term measure to reduce demand prior to requesting assistance under CERM. The APSA Task Force is currently reviewing the CERM Operationalization Manual (ASCOPE).

f) Emergency Exercise Activity

Indonesia participated in APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013 and conducted its own emergency exercises under the APEC on Oil and Gas Security Exercise: Indonesia Exercise in 2013 (APERC, 2014).

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JAPAN

Socio-Economic Overview

Table 8.1 Socio-Economic Profile, 2012

Land Area km^2	377,930
Population (million)	127.56
GDP (USD Billion, 2010 Price & PPP)	4,365.36
GDP per Capita	34,222

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Located in East Asia, Japan consists of several islands, the largest of which are Honshu, Hokkaido, Kyushu and Shikoku. Japanøs total land area is 377,930 square kilometres and mostly covered with mountains and thickly forests. In the face of the aging society, Japanøs population had flattened out already and reduced slightly to 127.56 million in 2012. The economy had struggled to achieve a positive economic growth in recent years ó its GDP of USD 4,365.4 billion (USD 2010 Price & PPP) in 2012 was slightly lower than that of 2008. Accordingly, a per capita income displayed average annual growth rate (AAGR) of negative 0.01 percent over 2008-2012 (APERC, 2015a & EDMC, 2014).

Figure 8.1 GDP and GDP Per Capita
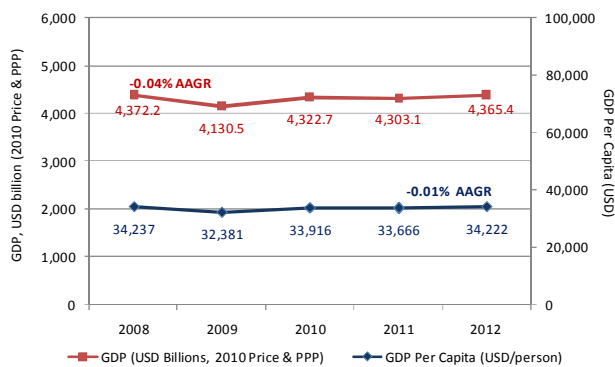
Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Total primary energy supply of Japan declined at 2.2 percent AAGR between 2008 and 2012. While oil has consistently been dominant over the 5-year period, its share had gradually reduced in the primary energy mix until 2010, but went up again as oil helped to make up for the loss of nuclear power in 2011 with other fossil fuels, especially natural gas. With very limited natural resources, Japan is heavily dependent on imports of all fossil fuels (IEA, 2014).

Figure 8.2 Total Primary Energy Supply

Source: IEA 20.
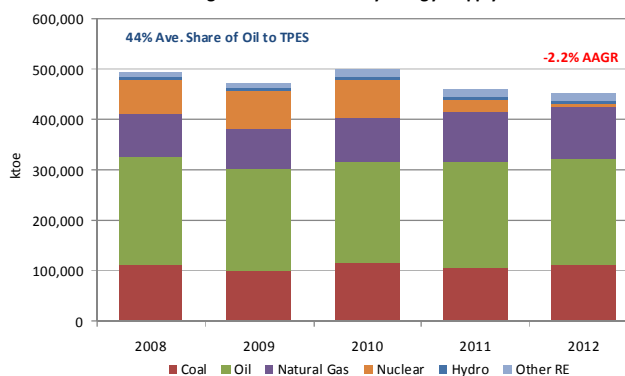
Among the fuels used in final energy demand, oil maintained more than half of total in 5-year period. Nevertheless, the AAGR of negative 1.0 percent for oil demand revealed a faster

reduction compared to that of the total final energy demand at negative 0.6 percent AAGR. Instead, natural gas indicated a modest growth of 1.7 percent per annum on the average.

By sector, no significant change was observed in terms of share of the final energy demand throughout the 5-year period. All sectors, except non-energy uses, demonstrated negative growth rates of 1.1 percent for both transport and commercial and public services sectors, while other sectors (industry, agriculture and residential sectors) exhibited negative growth rates ranging from 0.2 percent to 0.8 percent (IEA, 2014).

Figure 8.3 Final Energy Demand (Fuel)

54% Ave. Share of Oil to FED

-0.6% AAGR

Coal Oil Natural Gas RE Electricity

Source: IEA 2014

Figure 8.4 Final Energy Demand (Sector)

-0.6% AAGR

Industry Transport Residential Commercial & Public Services Agriculture/Forestry Non-Energy

Source: IEA 2014
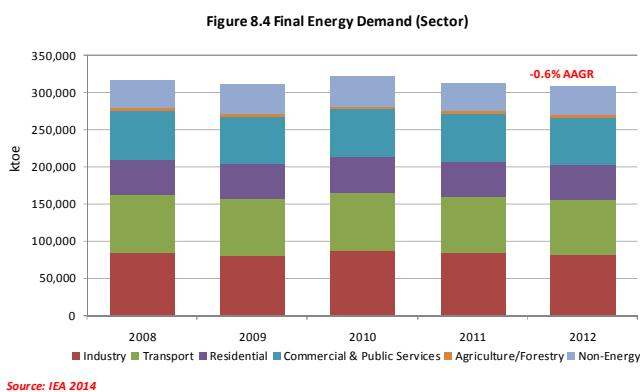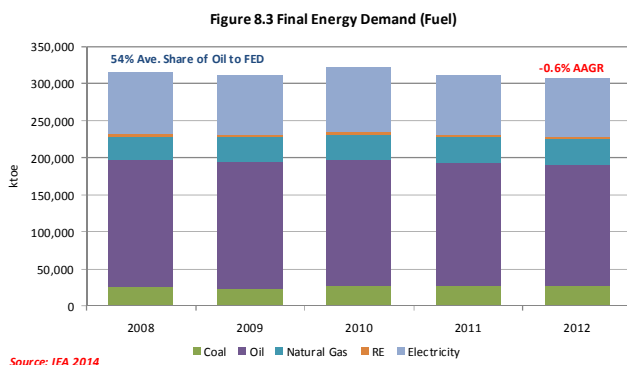
b) *Energy per Capita and Energy Intensity*

Japan's final energy demand and oil demand per capita in 2012 marginally declined compared with 2008 levels. Meanwhile, the energy intensity of final energy demand improved by 2.7% from 72.7 tonnes of oil

Figure 8.5 Final Energy and Oil Demand Per Capita

2.5 toe/person (ave)

1.3 toe/person (ave)

Energy Per Capita Oil Per Capita

Source: EDMC-IEEJ

Figure 8.6 Final Energy and Oil Demand Intensity

-5.4% improvement from 2008
-1.8% improvement from 2011

-8.0% improvement from 2008
-2.4% improvement from 2011

FED Intensity Oil Intensity

Source: EDMC-IEEJ
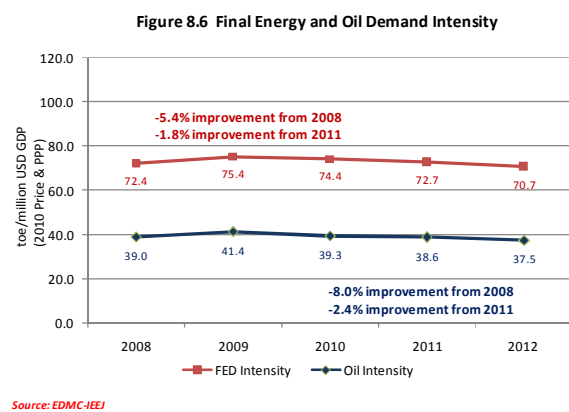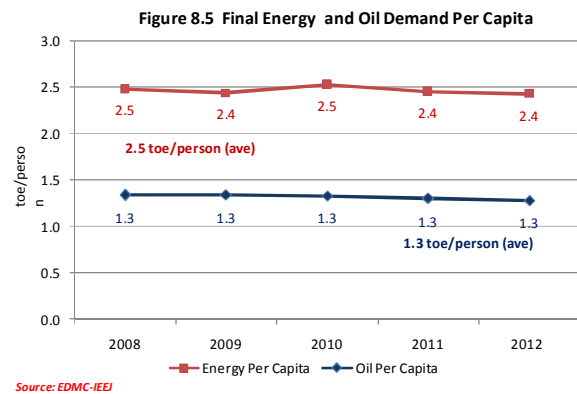
equivalent (toe)/million USD GDP in 2011 to 70.7 toe/million USD GDP in 2012, mainly owing to improvement of the industry sector with 4.1 percent improvement, followed by transport with 3.0 percent. Similarly, oil intensity also registered 2.9 percent improvement from 2011 level of 38.6 toe/million USD GDP to 37.5 percent toe/million USD GDP in 2012 (EDMC, 2013).

Oil Supply and Demand

a) *Crude oil Production and Imports*

With limited indigenous energy sources, Japan imports almost its entire oil requirement making oil import dependency at 100.0 percent level. Oil production in Japan only represents about 0.14 percent of total crude supply. Majority of the imports (83.0 percent

Figure 8.7 Crude Oil Supply

Source: IEA 2014
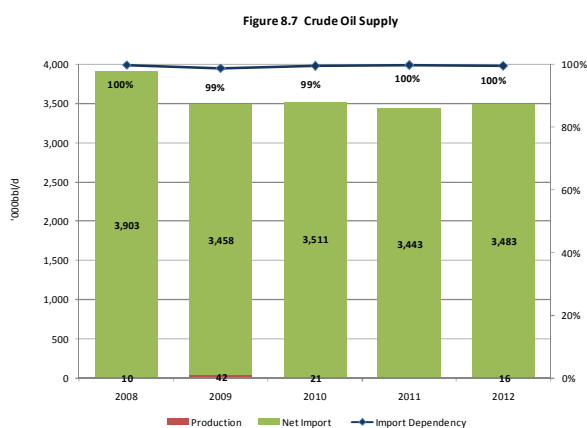
in 2013) came from the Middle East, specifically from Saudi Arabia with 30.4 percent share of total and United Arab Emirates (UAE) with 22.5 percent. Other Middle East import sources were Iran, Qatar and Kuwait (METI, 2013). With Herfindahl-Hirshman Index value of 0.67, the regional import sources may be considered as moderate-high concentration.

Figure 8.8 Japan Crude Oil Imports by Sources, 2013

HHI = 0.70
(Moderate-High Concentration)

Source: METI, 2013
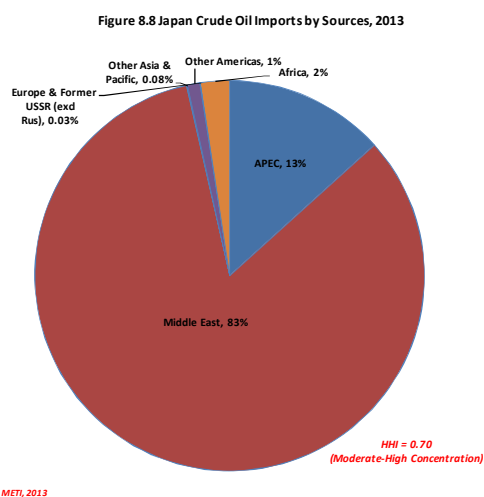
b) Oil Products

Japan's net imports of petroleum products in 2012 was 1,011 thousand barrels per day (‒000 bbl/d), about 1.5 times higher than in 2008 due to continuous reduction of

refinery production. As a result, import dependency rose from 16.0 percent in 2008 to 24.0percent in 2012. While gasoline had been dominant and managed to maintain its share around 24.8 percent over 2008-2012, its demand had gradually declined.   On the other hand, demand for diesel decreased faster at 2.3 percent annually on the average.

Table 8.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	3,887	3,742	3,712	3,491	3,476
Net Imports	685	694	777	945	1,011
Others *	-300	-228	-302	-227	-257
Net Supply	4,272	4,207	4,187	4,209	4,230
Demand	4,272	4,207	4,187	4,209	4,230
Gasoline	1,047	1,049	1,060	1,042	1,028
Diesel Oil	901	843	840	831	820
Fuel Oil	429	325	317	423	475
LPG	447	462	435	451	449
Other Petroleum Products	1,447	1,527	1,536	1,461	1,457
Import Dependency	**16%**	**16%**	**18%**	**22%**	**24%**

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

Table 8.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	455	476	459	461	430
Transport	1,702	1,667	1,683	1,654	1,628
Residential	333	323	346	324	320
Commercial	434	396	354	387	377
Agri and Fishery	69	68	68	67	68
Electricity	260	166	171	277	353
Others	1,019	1,112	1,106	1,039	1,053
Total Consumption	**4,272**	**4,207**	**4,187**	**4,209**	**4,230**

Others include non-energy, own-use and losses
Source: IEA 2014

58

Oil demand of all sectors except non-energy uses had been on the wane from 2008 to 2012. Share of each sector had stayed almost same. Only electricity and non-energy uses for oil slightly expanded its share with 8.0 and 0.8 percent AAGR percent in 2008 to 2012.

Overall, Japanøs total oil import dependency (crude and petroleum) still remained at 100.0 percent as domestic crude oil resource is limited and with 100.0 percent of crude oil being used by refineries is primary sourced out from other countries (IEA, 2014).

raised to 13.0 percent of total distillation capacity.

Figure 8.10 Oil Demand and Refinery Capacity

Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 8.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy

Table 1.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

c) Oil Demand Outlook and Refinery Capacity

Japanøs oil demand is estimated to decrease by 1.4 percent from 2013 to 2040 (APERC, 2015). Based on assumption that no refinery capacity would be added in the future and eight (8) refineries are expected to retire until 2017, declining oil demand would make a ratio of refinery capacity to total demand to move upward. In fact, the major Japanese petroleum companies are required to reduce their refining capacity to comply with the law on the Promotion of the Use of Non-fossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers. The law stipulates that heavy oil cracking unit capacity of petroleum companies should be

a) National Emergency Strategic Organization (Institutional Framework)

The Petroleum Refining and Reserve Division of the Natural Resources and Fuel Department is designated as the secretariat and part of the core of the Japanese National Emergency Strategy Organisation (NESO). Cooperation and coordination with relevant ministries and concerned industries will be done during supply emergency situation. The Petroleum Refining and Reserve Division will coordinate the releases of public oil stocks during supply disruption with Japan Oil, Gas and Metals National Association (JOGMEC) in case of reducing the industry obligation (IEA, 2014a).

b) Criteria of Emergency

Initially, the IEA Agreement on International Energy Program (IEP) defined emergency as an oil supply disruption involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. However, such definition under the IEP has evolved with the development of oil markets and provided flexibility in making a decision on when to activate emergency response measure basedon the results of impact analyses and market assessment (IEA, 2007). Further, the IEAøs Initial Contingency Response Plan has considered a process of continuous market assessment to determine if there is imminent emergency situation or not.

c) Emergency Policy

Under the Oil Stockpiling Stock Act of 1975, the Oil Stockpiling Act allows the Minister of Economy, Trade and Industry (METI) to decide when and how to release government stocks during supply emergency situation, including lowering the industryøs oil stocks obligation(IEA, 2014a).

After the 2011 earthquake which resulted in shortage of oil products, Japan implemented some improvements obligating oil companies to jointly prepare emergency oil supply cooperation plan to address supply shortfall in the event of a disaster and to ensure continuous supply of oil products.

d) Strategic Oil Stockholding

Japan meets its stockholding obligation to the IEA by having public Strategic Petroleum Reserves (SPR) and placing a minimum stockholding obligation to industry.

JOGMEC is the agency in charge of managing public stocks under the Oil Stockpiling Act, which is mostly consisted of crude. However, the public stocks have been expanded to cover refined products, namely: gasoline, kerosene, fuel oil and diesel oil. On the other hand, 70-90 days of average daily imports, sales or refined production from the previous 12 months must be held by refineries, specified distributors and importers, and 70 days of the stockholding for industry (IEA, 2014a). As of December 2014, the oil stock level was 151 days of net imports (IEA, 2014c).

In the Oil Stockpiling Act Amendment in 2012, the mobilization requirements were amended to allow releases of oil stocks and liquefied petroleum products not only to address a shortage of oil supply from overseas, but also inthe event of supply shortage in Japan due to a disaster (METI, 2012).

Further, Japan signed agreements with oil-producing countries such as Saudi Arabia and United Arab Emirates that involved leasing crude oil storage from these countries. The lease agreement is about three (3) years to store 6.3 million barrels for each of these producers. With this agreement, Japan has a priority to purchase the oil in the event of a serious supply disruption (EIA, 2015).

e) Regional Oil Security Policy

As a matter of IEA regulation and policy, all members have commitments to conduct joint measures in the event of oil supply emergencies. During emergencies, IEA members agreed to share energy information, coordinate their energy policies and cooperate in the development of rational energy programmes. The economy is likewise

obliged to contribute to collective action based on its assessed share in total IEA oil consumption (IEA, 2007). Further, IEA member country is required to hold oil stocks equivalent to 90 days of its prior year's net imports (IEA, 2014a).

f) *Emergency Exercise Activity*

IEA undertakes emergency exercises and workshops every two years. Such activities are aimed at reviewing policies and procedures including decision-making process and readiness to act immediately and effectively to supply emergencies (IEA, 2014a).

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KOREA

Socio-Economic Overview

Table 9.1 Socio-Economic Profile, 2012

Land Area km^2	100,210
Population (million)	50.00
GDP (USD Billion, 2010 Price & PPP)	1,594.28
GDP per Capita	31,883

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

The Republic of Korea is located in Northeast Asia between China and Japan. It has an area of 100,210 square kilometres and a population of around 50 million people as of 2012.

Korea's population density is very high, with an average of more than 500 people per square kilometre.

Korea has been one of the Asia's fastest-growing and most dynamic economies. In 2012, Korea's GDP reached USD 1,594.3 billion (USD 2010 Price & PPP), averaging 3.3 percent annual growth rate over 2008-2012. Similarly, GDP per capita registered an average annual growth rate (AAGR) of 2.7 percent during the same 5-year period (APERC, 2015a & EDMC, 2014).
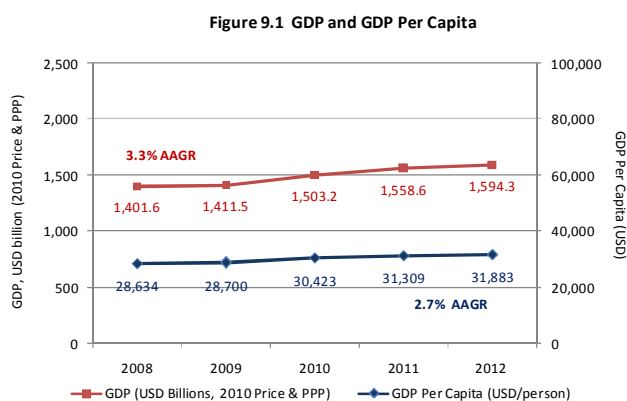
Figure 9.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Total primary energy supply (TPES) in Korea had steadily increased with the AAGR of 3.8 percent in 5-year period (2008-2012). Although oil had maintained the largest share throughout the period (38%), the AAGR of oil at 2.1 percent was slower than the other fuels such as coal at 5.2 percent and natural gas at 9.0 percent, which resulted in a gradual decreased share of oil in the TPES. Korea is a net energy importer as the economy has few indigenous resources including crude oil (IEA, 2014).

Figure 9.2 Total Primary Energy Supply
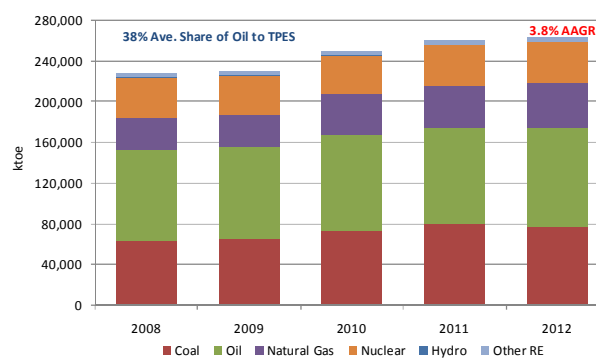
Source: IEA 2014

Oil had been dominant in final energy demand with 52.1 percent share over 5-year period (2008-2012), followed by electricity (24.3 percent), natural gas (12.9 percent), and coal (6.1 percent). Natural gas demand had increased substantially with the AAGR of 6.8 percent as the economy's policy measures supported its use in order to reduce oil dependency.

By sector, the industry sector maintained the largest share although its demand had weakened since the late 1990s. Meanwhile, non-energy consumption such as petrochemical feedstock increased substantially with the AAGR of 5.8 percent and its share had expanded almost as large as that of the industry sector (IEA, 2014).

b) Energy per Capita and Energy Intensity

Final energy demand per capita slightly increased from 3.0 tonnes of oil equivalent (toe)/person in 2008 to 3.3 toe/person in 2012 whereas oil demand per capita had stayed almost the same. While an improvement in the final energy and oil demand intensity can be observed over the last 5 years, energy intensity of final energy demand in 2012 increased by about 0.7 percent to 104.4 toe/million USD GDP (2010 Price & PPP) compared to the 2011 level. This is because energy intensity reduction achieved by the industry sector was offset by increased intensity of the transport and other sectors. Similarly, such increase was reflected in oil intensity with an increase of 0.5 percent from 52.7 toe/million USD GDP in 2011 to 52.9 toe/million USD GDP in 2012 (EDMC, 2013).

Figure 9.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 9.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 9.4 Final Energy Demand (Sector)

Source: IEA 2014

Figure 9.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ
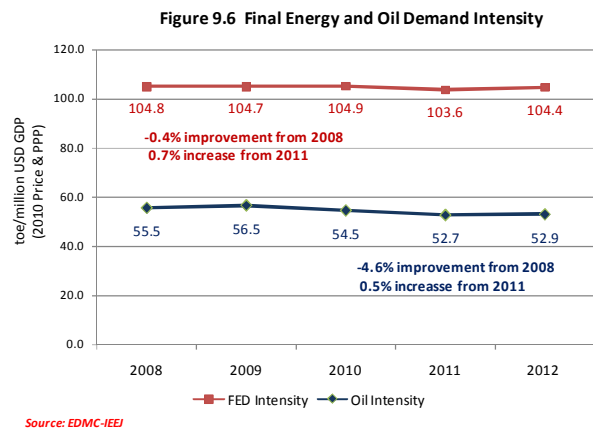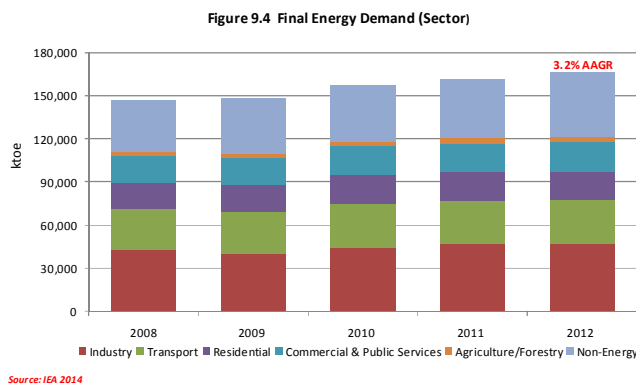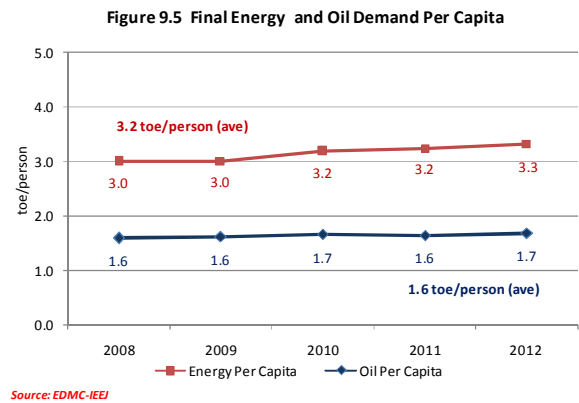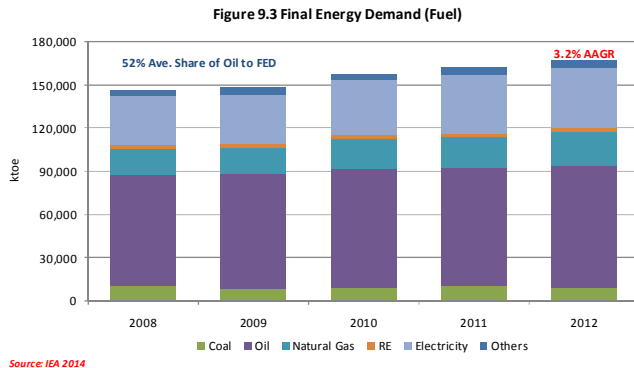
Oil Supply and Demand

a) Crude oil Production and Imports

Korea has very limited oil resources and thus dependent on oil imports. The economy's crude oil import had augmented with AAGR of 2.5 percent between 2008 to 2012. The economy was the 5th largest importer of crude oil in the world. About 86.0 percent of Korea's crude oil imports came from the Middle East in 2013, which resulted in Herfindahl-Hirshman Index (HHI) value of 0.75 indicating a moderate-high concentration of regional import sources. Saudi Arabia has been the primary source of crude imports accounting for 34.0 percent of the total (EIA, 2014).   To reduce reliance on Middle East crude, the economy had

implemented measures such as subsidies for transportation costs for non-Middle East crude imports and tax rebates, which are expected to help the refiners to diversify crude oil origins.

b) Oil Products

Table 9.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	2,474	2,409	2,489	2,631	2,728
Net Imports	-243	-119	-107	-297	-295
Others *	-241	-239	-278	-242	-270
Net Supply	1,990	2,050	2,103	2,092	2,163
Demand	1,990	2,050	2,103	2,092	2,163
Gasoline	183	191	200	202	201
Diesel Oil	375	370	380	376	389
Fuel Oil	188	189	180	139	134
LPG	306	306	305	292	270
Other Petroleum Products	939	995	1,038	1,083	1,169
Import Dependency	-12%	-6%	-5%	-14%	-13%

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

Korea's refinery production had increased with an AAGR of 2.5 percent in 5-year period (2008-2012) and remains as a net exporter of petroleum products. Gasoline maintained its share of 9.4 percent with an AAGR of 2.3 percent. On the other hand, diesel oil registered a modest annual growth rate of 1.0 percent on average, losing its share from 19.0 percent in 2008 to 18.0 percent in 2012. Demand for other products, such as naphtha which are used as petrochemical feedstock, obtained substantial increase during the same period.   Accordingly, by sector, the

Figure 9.7 Crude Oil Supply

Source: IEA 2014

Figure 9.8 Korea Crude Oil Imports by Sources, 2013

HHI = 0.75
(Moderate-High Concentration)

Source: EIA-Korea Overview, Apr. 2014

non-energy (Others) used up nearly half of oil demand in 2012.

Although Korea remains a net export of petroleum products with its robust refinery capacity having three (3) of 10 largest oil refinery in the world, total import dependency (crude and petroleum products) still at 100.0 percent level given very limited domestic crude oil resources (IEA,

Figure 9.10 Oil Demand and Refinery Capacity
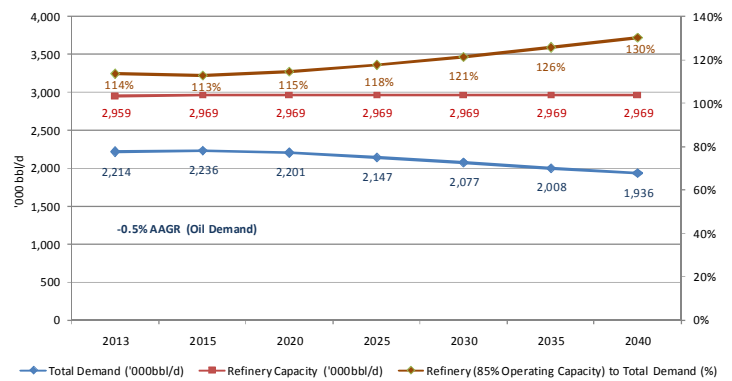
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015

Table 9.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	131	119	122	108	89
Transport	643	650	659	647	660
Residential	73	69	69	74	67
Commercial	84	85	86	75	70
Agri and Fishery	38	41	44	39	39
Electricity	49	65	60	45	68
Others	972	1,022	1,062	1,104	1,171
Total Consumption	**1,990**	**2,050**	**2,103**	**2,092**	**2,163**

Others include non-energy, own-use and losses
Source: IEA 2014

2014).

Source: IEA 2014

c) Oil Demand Outlook and Refinery Capacity

Korea's oil demand is estimated to level off towards 2040 with negative AAGR of 0.5 percent (APEC, 2015). Although there is no

refinery capacity addition assumed during the outlook period, the economy is likely to have surplus refinery products until 2040 because of its declining oil demand. The economy has the 6th largest refinery capacity in the world (EIA, 2014).

Oil Supply Security Policy

Table 1.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Energy and Resource Policy Division and the Petroleum Division of the Ministry of Trade, Industry and Energy (MOTIE) function as the core body of Korea's National Emergency Strategy Organisation (NESO). During oil supply emergency, MOTIE sets up the Petroleum Supply and Demand Committee and the Energy Emergency Response Centre

(EERC). Said Committee is tasked to formulate a response plan identifying the measures or actions to be carried out to address the supply emergency situation. On the other hand, the Centre will be implementing the response measures as contained in the response plan including the monitoring of oil supply and demand (IEA, 2014a). Likewise, MOTIE will have to establish a Task Force composed of Supply Response Team, Price Response Team and Situation Analysis Team for the implementation of response measures (OGSN, 2015).

b) Criteria of Emergency

Being a member country of the International Energy Agency (IEA), the agreement on International Energy Program (IEP) initially defined emergency as an oil supply disruption involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. However, the said definition has changed as oil markets evolved, which now providing more flexibility in determining emergency situation and response measures (IEA, 2007). The conduct of market assessment is now being undertaken as the basis for declaration of emergency oil supply situation, as well as when to implement emergency response measures.

c) Emergency Policy

Several laws, such as the Petroleum and Petroleum-Alternative Business Act, the Energy Act and the Energy Use Rationalization Act, authorized the Minister of MOTIE to establish an energy supply and demand plan and the implementation of potential emergency response measures to include oil stock release, lowering of the level of compulsory stockholding obligation on industry and demand restraint (IEA, 2014a).

d) Strategic Oil Stockholding

Korea meets its stockholding obligation to the IEA by holding government stocks and by placing a minimum stockholding obligation on industry. Crude refiners are obliged to hold at least 40 days of stocks, in either crude or products (excluding naphtha), based on a 12-month average of their previous year's sales. Product importers, LPG importers and petrochemical companies are also required to hold at least 30 days of stocks based on their domestic sales. As of December 2014, the oil stock level was 233 days of net imports (IEA, 214b).

e) Regional Oil Security Policy

As part of IEA policy, all members have commitments to hold joint measures in the event of oil supply emergencies. IEA members have agreed, among others, to share energy information, coordinate their energy policies and cooperate in the development of rational energy programmes. IEA membersare also required to hold oil stocks equivalent to 90 days of its prior year's net imports (IEA, 2014a). Further, each member must also contribute to collective action based on its assessed share in total IEA oil consumption (IEA, 2007).

f) Emergency Exercise Activity

As a member country of IEA, Korea participates in emergency exercises and workshops being held every two years by IEA. The main objective of these activities is to review policies and procedure, assess decision-making process and the preparedness to respond immediately and effectively to oil supply emergencies (IEA, 2014a).

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MALAYSIA

Malaysia is located in Southeast Asia with a land area of 330,803 square kilometres covering the states in Peninsula Malaysia, the Federal Territories of Kuala Lumpur Putrajaya, and Labuan, and Sabah and Sarawak on the island of Borneo.

Table 10.1 Socio-Economic Profile, 2012

Land Area km^2	330,803
Population (million)	29.24
GDP (USD Billion, 2010 Price & PPP)	627.94
GDP per Capita	21,476

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

The economy's population increased at 1.74 percent average annual growth rate (AAGR) over 2008-2012, reaching 29.24 million in 2012. Malaysia had demonstrated a robust economic growth, its GDP registered USD 627.9 billion (2010 Price & PPP) in 2012, growing at 4.1 percent per annum during the same period (APERC, 2015a & EDMC, 2014).
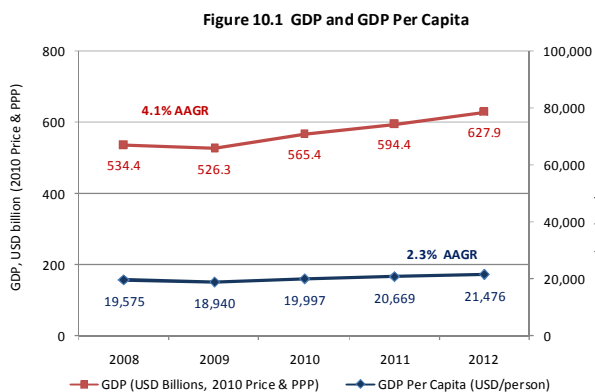
Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Malaysia's total primary energy supply in 2012 was 81,234 kilotonnes of oil equivalent (ktoe) with a modest growth rate of 1.5 percent per annum over 2008-2012. Natural gas contributed the largest share although it had declined by 9.0 percentage points to 40.0 percent in 2012 compared to 2008. Oil, the second dominant fuel, increased annually by 3.1 percent during the same period. Supported by the government policy of emphasizing fuel diversification, coal registered the fastest AAGR of 13.6 percent in the last 5 years,

Figure 10.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 10.2 Total Primary Energy Supply
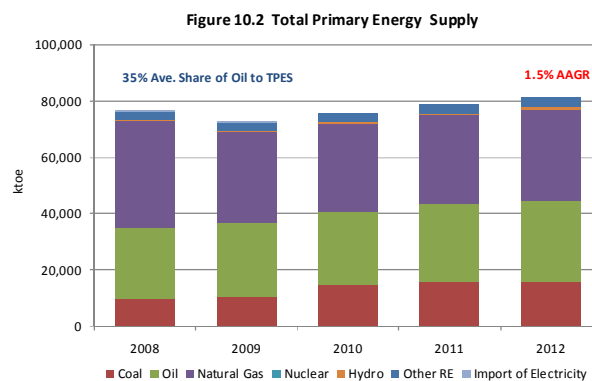
Source: IEA 2014

largely due to expanded use for power generation. Malaysia is endowed with both conventional and renewable energy resources.

In final energy demand, oil had been dominant throughout the period with more than 50.0 percent share to total and displayed annual growth rate of 2.7 percent. Recorded the fastest AAGR of 6.8 percent, electricity demand surpassed natural gas in 2009 and continued to occupy the second largest share since then.

By sector, energy demand reduction of the industry sector by 7.0 percent annually was offset by substantial expansion of non-energy use in recent years. Non-energy use demand demonstrated a robust annual growth rate of 34.0 percent in the last 5 years. Energy demand in the transport sector marginally increased at an AAGR of 0.6 percent although the sector's share to total final energy demand

remained at around 30.0 percent (IEA, 2014).

b) Energy per Capita and Energy Intensity

Final energy demand and oil per capita had been stagnant over the 5-year period. On the other hand, final energy demand intensity fell substantially, showing 7.0 percent improvement between 2008 and 2012. The industry sector's energy intensity reduction seemed to have contributed much of the improvement, which was probably a result of the increasing use of more efficient equipment and machineries for manufacturing and production. Oil demand intensity likewise showed 5.4 percent improvement (EDMC, 2013).

Figure 10.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 10.3 Final Energy Demand (Fuel)
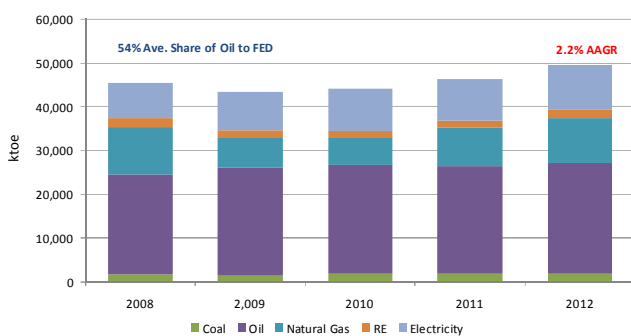
Source: IEA 2014

Figure 10.4 Final Energy Demand (Sector)

Source: IEA 2014
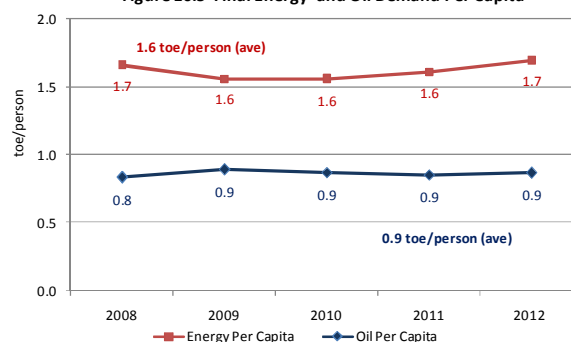
Figure 10.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

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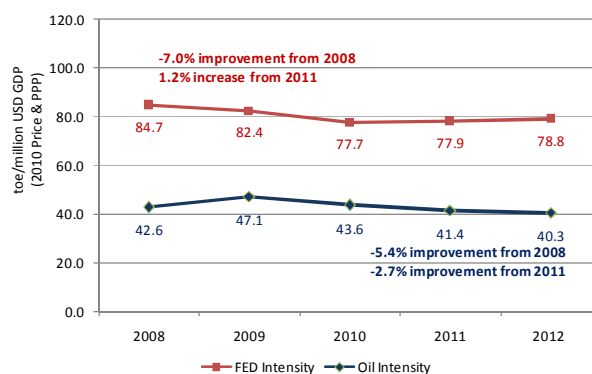
Oil Supply and Demand

a) Crude oil Production and Imports

Malaysia is the second largest oil producer in Southeast Asia. However, the economyøs crude oil production had experienced a declining trend, from 693,000 bbl/d in 2008 to 607,000 bbl/d in 2012, which was mainly caused by maturing fields. To reverse the production reduction, Malaysia has tried to utilize enhanced oil recovery technology, to develop marginal fields, and to attract new investment (EIA, 2014). A combination of the economyøs domestic oil demand increase and oil production decrease resulted in oil export reductions.

The economy relied on the Middle East for more than half of crude oil imports. Other sources of crude oil include Other America (19.0 percent), APEC region (16.0 percent) and Africa (5.0 percent). Herfindahl-Hirshman Index value of 0.43 indicates that the regional import sources could be considered as mid-concentration.

b) Oil Products

Malaysia turned to be a net importer of petroleum products in 2010 to meet the growing domestic demand. Gasoline and diesel made up about two-thirds of domestic demand of petroleum products in 2012. However, both fuelsø demand had not grown much in the last 5 years.

Figure 10.7 Crude Oil Supply

Source: IEA 2014
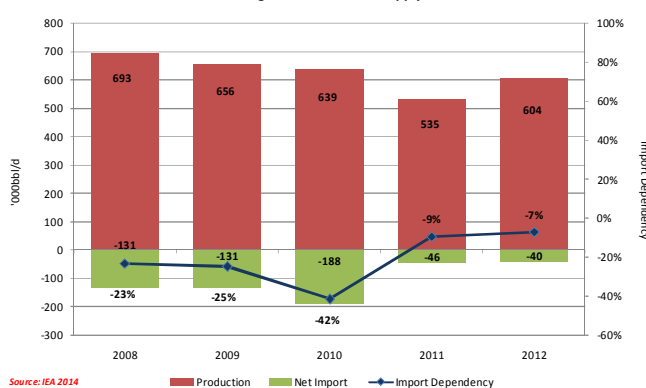
Figure 10.8 Malaysia Crude Oil Imports by Sources, 2012

HHI = 0.43
(Mid-Concentration)

Source: EDMC-IEEJ, 2012

Table 10.2 Oil Products Supply and Demand ('000bbl/d)					
	2008	**2009**	**2010**	**2011**	**2012**
Refinery Production	647	626	569	578	679
Net Imports	-49	-15	63	76	27
Others *	-59	-5	-41	-39	-57
Net Supply	539	606	591	615	649
Demand	539	606	591	615	649
Gasoline	206	204	222	190	207
Diesel Oil	195	190	184	201	196
Fuel Oil	44	27	11	28	24
LPG	47	80	93	92	92
Other Petroleum Products	48	105	80	105	129
Import Dependency	-9%	-2%	11%	13%	4%

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

Meanwhile, demand for LPG and other petroleum products such as naphtha had increased substantially which were primarily used for petrochemical feedstock.

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Table 10.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	105	89	59	43	64
Transport	312	305	317	313	315
Residential	32	24	23	25	23
Commercial	22	28	32	28	25
Agri and Fishery	5	4	21	18	21
Electricity	11	18	15	43	27
Others	51	138	124	146	174
Total Consumption	**539**	**606**	**591**	**615**	**649**

Others include non-energy, own-use and losses
Source: IEA 2014

In oil demand by sector, transport had been the largest consuming sector with more than 50.0 percent to total final energy demand in the last 5 years. However, the sector's oil demand had only increased annually at 0.2 percent. Oil demand for non-energy use increased about 4.5 folds compared to 2008. On the other hand, oil demand of the industry sector dropped significantly by 12.0 percent.

Looking at total oil supply (crude and petroleum products), the economy's import dependency had been gradually going up with continued reduction in crude oil

production and increase imports of refined products. From negative 48.0 percent in 2008, dependency level went up steadily to negative 8.0 percent as net imports became positive in 2011.

b) Oil Demand Outlook and Refinery Capacity

Malaysia's oil demand is projected to grow at 1.7 percent per annum until 2040 (APEC, 2015). Although new refinery with a capacity of 300,000 bbl/d is expected to commence operation in 2019 under the state-owned PETRONAS's project called Refinery and Petrochemical Integrated Development (RAPID), the economy's refinery production is likely to meet domestic demand in 2020, but will eventually decline with increasing oil demand afterward.

Figure 10.10 Oil Demand and Refinery Capacity
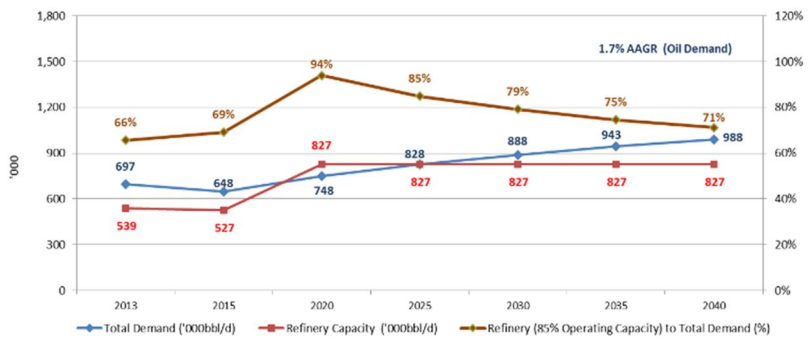
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 10.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy

Table 10.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☒ None	☑ Exist	☑ Exist

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a) National Emergency Strategic Organization (Institutional Framework)

The National Security Council of the Prime Minister's Department is the agency that has responsibility for dealing with oil supply emergencies. The government may also direct all relevant agencies during energy crisis to assess and prepare report on the impact of emerging situation. Among agencies to be involved are PETRONAS, a state-owned oil company, the Economic Planning Unit of the Prime Minister's Department, the Ministry of Energy, Green Technology and Water, and the Ministry of International Trade and Industry. Each of these agencies has significant role to undertake during oil supply emergencies (APERC, 2014).

b) Criteria of Emergency

As a member state of ASEAN, Malaysia may use the definition of supply emergency as stipulated in the ASEAN Petroleum Security Agreement (APSA), which is a situation when a member is experiencing a shortfall of at least 10.0 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. The updated APSA, which was first signed in 1986, is fully ratified by ASEAN members and took effect in March 2013 (ASCOPE, 2009).

c) Emergency Policy

In case of emergency, the Prime Minister could issue direction on the operations of PETRONAS (National Oil Company) including full control over the company's stock.

PETRONAS may be directed to ensure that enough supply for domestic use is available before exporting. Production may also be increased to the extent allowed under the õNational Depletion Policyö of the government to offset the supply shortfall (APERC, 2014).

d) Strategic Oil Stockholding

Malaysia does not hold emergency oil stock nor has existing policy on oil reserves. However, Malaysia has a plan to become a regional oil trading and storage hub by increasing its refining and storage capacities (EIA, 2014).

e) Regional Oil Security Policy

Under the APSA Coordinated Emergency Response Measure (CERM), all members are endeavoured to supply petroleum to the ASEAN Member State in Distress at an aggregate amount equal to 10 percent of the Normal Domestic Requirement of the said member state. However, a member state is required to implement short-term measure to reduce demand prior to requesting assistance under CERM. An APSA Task Force was created to review the CERM Operationalization Manual (ASCOPE).

f) Emergency Exercise Activity

Malaysia participated in the APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013 conducted by the Asia Pacific Energy Research Centre (APERC) in collaboration with other international

organizations like IEA, Economic Research Institute for ASEAN and East Asia (ERIA), ASEAN Centre for Energy (ACE), and ASEAN Council on Petroleum (ASCOPE) (APERC, 2014).

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MEXICO

Socio-Economic Overview

Mexico is a federal republic located in North America, bordered by the United States to the north, by Belize and Guatemala to the South and by the Atlantic and Pacific Oceans. Mexico has an approximate land area of 2.0 million square kilometres rich in biodiversity and natural resources that include oil and gas.

Table 11.1 Socio-Economic Profile, 2012

Land Area km^2	1,964,375
Population (million)	120.85
GDP (USD Billion, 2010 Price & PPP)	1,878.21
GDP per Capita	15,542

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

In 2012, the economy's population was 120 million and growing at an average annual growth rate (AAGR) of 1.25 percent in the last 5 years (2008-2012). During the same period, the economy's GDP was USD 1,878.21 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 2.0 percent. Meanwhile, GDP per capita grewby 0.8 percent average annual rate

(last 5 years) reaching USD 15,542 in 2012(APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Over the last 5 years (2008-2012), oil had been the major energy source for Mexico posting an average share of 55.0 percent to primary energy mix with an AAGR of 1.0 percent, followed by natural gas with an average share of 29.0 percent. Renewable energy (Hydro and Other RE) and coal provided 10.0 percent and 5.0 percent average shares, respectively, for the same period.

In terms of final energy demand, average share of oil was recorded at 65.0 percent, while electricity had 16.0 percent and natural gas with 11.0 percent average share. The

Figure 11.1 GDP and GDP Per Capita
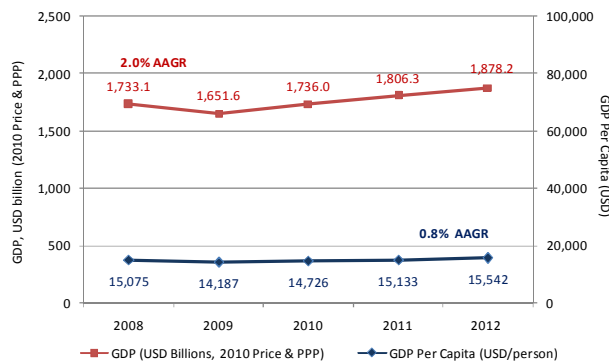
Source: EDMC-IEEJ

Figure 11.2 Total Primary Energy Supply
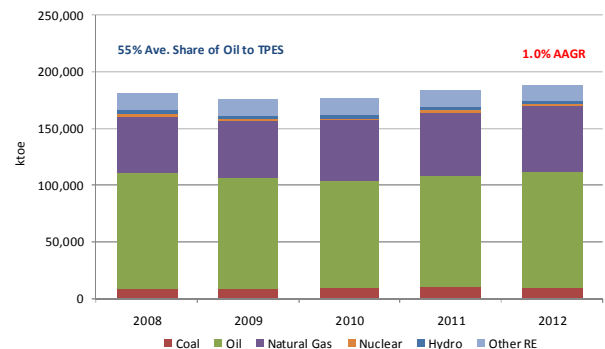
Source: IEA 2014

economy's energy consumption had been increasing at AAGR of 0.4 percent in the last 5 years.

Among the sectors, transport sector remained the largest energy consuming sector of the economy utilizing 45.2 percent, on the average, of the final energy demand, and growing at AAGR of 0.3 percent. Industry sector posted second with 24.6 percent average share, while residential sector consumed 15.7 percent of the total final energy demand (IEA, 2014).

Figure 11.3 Final Energy Demand (Fuel)

65% Ave. Share of Oil to FED

0.4% AAGR

Source: IEA 2014

Figure 11.4 Final Energy Demand (Sector)

0.4% AAGR

Source: IEA 2014
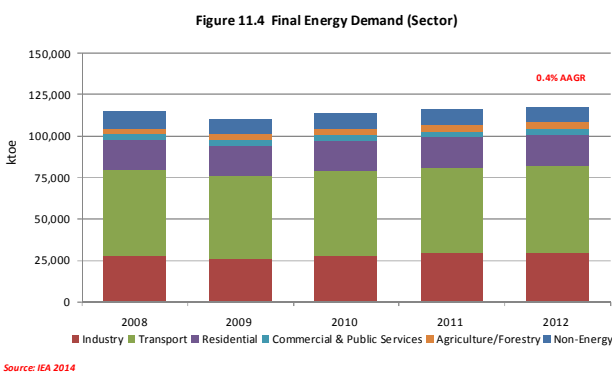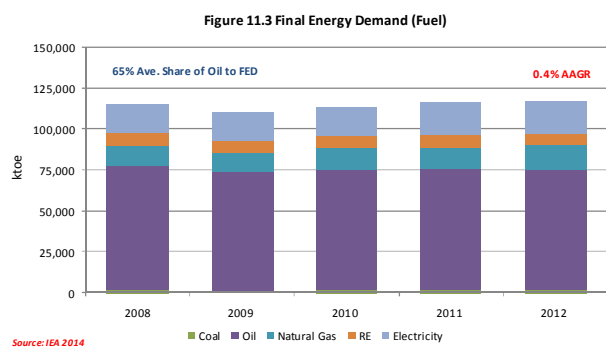
b) Energy per Capita and Energy Intensity

Mexico's energy and oil per capita had been relatively stable over the last 5 years exhibiting 1.0 tonnes of oil equivalent (toe)/person and 0.6 toe/person, respectively. As for the final energy demand intensity, an improvement (decline) of 6.2 percent was observed for the same period, from 66.4

toe/million USD GDP in 2008 to 62.3 toe/million USD GDP in 2012 of energy consumption. This can be attributed to the reduced consumption of the transport sector. Similarly with oil intensity, it had a descending trend of 10.4 percent, which was recorded at 39.3 toe/million USD GDP in 2012 from 43.9 toe/million USD GDP in 2008 (EDMC, 2013).

Figure 11.5 Final Energy and Oil Demand Per Capita

1.0 toe/person (ave)

0.6 toe/person (ave)

Source: EDMC-IEEJ

Figure 11.6 Final Energy and Oil Demand Intensity

-6.2% improvement from 2008
-3.1% improvement from 2011

-10.4% improvement from 2008
-4.0% improvement from 2011

Source: EDMC-IEEJ
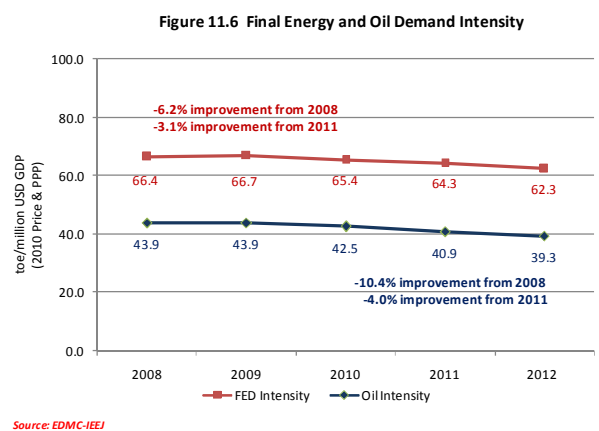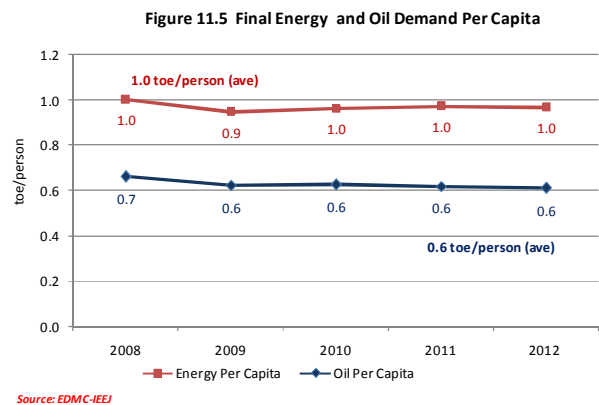
Oil Supply and Demand

a) Crude oil Production and Imports

Mexico is a net crude oil exporter with about half of its total domestic crude oil production is sent overseas, mainly to the United States. Mexico is the third largest oil supplier after Canada and Saudi Arabia to the United States

Figure 11.7 Crude Oil Supply
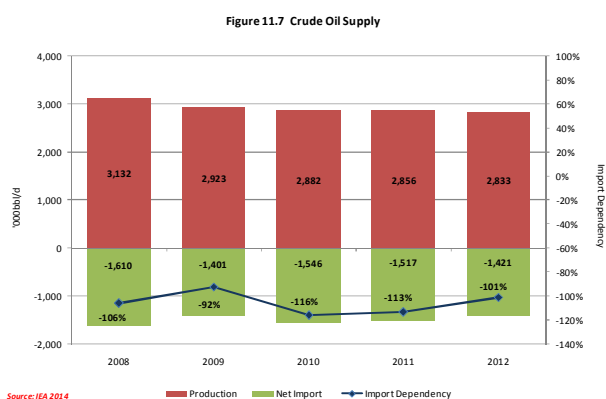
(EIA, 2015). The economyøs crude oil production is more than enough to cover the domestic demand and its export obligations to other countries, thus, the economy has not relied on oil supply imports.

However, crude oil production in the last 5 years was decreasing by about 2.4 percent per year which likewise resulted in decline of the economyøs oil exports by an average of 2.9 percent annually. Oil exports represented an average of 51.0 percent of the annual production during 2008 to 2012. In 2014, economyøs crude oil production was at the lowest since 1986 with production accounted for only 2,400 thousand barrels per day (–000bbl/d) (EIA, 2015).

b) Oil Products

In spite of total distillation capacity (about 1.7 million bbl/d of crude oil) of the existing six (6) oil refineries in Mexico, this still not sufficient to meet the domestic market demand for oil products. This made the economy a net importer of refined products in the last 5 years (2008-2012). Net petroleum imports for the period were escalating annually by 5.2 percent thereby keeping import dependency around 22 percent in 2008 to 27 percent in 2012. Total oil demand decreased annually by 0.7

percent, on the average, with gasoline and diesel oil as the most consumed fuels both exhibiting average shares of 39.8 percent and 19.9 percent, respectively.

Among the economic sectors, around 55.4 percent of the total oil demand, on the average, was consumed by the transport sector, and increasing by 0.2 percent annually from 2008

Table 11.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	133	121	117	116	118
Transport	1,168	1,139	1,168	1,173	1,179
Residential	215	206	210	208	210
Commercial	47	45	47	47	47
Agri and Fishery	57	59	58	60	64
Electricity	189	181	168	189	201
Others	348	322	316	326	275
Total Consumption	**2,157**	**2,073**	**2,084**	**2,119**	**2,093**

Others include non-energy, own-use and losses
Source: IEA 2014

Table 11.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	1,807	1,861	1,777	1,680	1,687
Net Imports	473	359	494	552	579
Others *	-124	-147	-187	-113	-173
Net Supply	2,157	2,073	2,084	2,119	2,093
Demand	2,157	2,073	2,084	2,119	2,093
Gasoline	836	833	843	841	838
Diesel Oil	420	403	419	430	425
Fuel Oil	252	234	212	229	233
LPG	328	316	322	319	314
Other Petroleum Products	321	287	288	300	283
Import Dependency	**22%**	**17%**	**23%**	**26%**	**27%**

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

to 2012. Meanwhile, industry and residential sectors had average oil consumption of around 5.7 and 10.9 percent of total, respectively (IEA, 2014).

Mexico's total oil supply (crude and petroleum) posted a nil growth of only 0.3 percent annually. With declining crude oil production and rising petroleum products imports, overall import dependency had been increasing (though still negative) during the 5-year period.

Figure 11.9 Oil Demand and Refinery Capacity

0.6% AAGR (Oil Demand)

Total Demand: 2,307 (2013), 2,438 (2015), 2,567 (2020), 2,696 (2025), 2,725 (2030), 2,723 (2035), 2,685 (2040)

Refinery Capacity: 1,690 (2013), 1,690 (2015), 1,730 (2020), 1,730 (2025), 1,730 (2030), 1,730 (2035), 1,730 (2040)

Refinery (85% Operating Capacity) to Total Demand: 62% (2013), 59% (2015), 57% (2020), 55% (2025), 54% (2030), 54% (2035), 55% (2040)

— Total Demand ('000bbl/d) — Refinery Capacity ('000bbl/d) — Refinery (85% Operating Capacity) to Total Demand (%)

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Sener, Mexico (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 11.8 Total Oil Supply (Crude and Petroleum)

Production: 3,144.80 (2008), 2,929.93 (2009), 2,900.18 (2010), 2,861.77 (2011), 2,854.52 (2012)

Net Import: -1,137 (2008), -1,050 (2009), -1,060 (2010), -973 (2011), -850 (2012)

Import Dependency: -65% (2008), -61% (2009), -65% (2010), -59% (2011), -50% (2012)

Production   Net Import   — Import Dependency

Source: IEA 2014

c) Oil Demand Outlook and Refinery Capacity

Mexico's oil demand is projected to increase at AAGR of 0.6 percent until 2040 (APEC, 2015). In 2013, the economy's refinery capacity of 1,690,000 bbl/d could still meet about 62.0 percent of its domestic oil demand based on 85.0 percent operating capacity. However, despite the expected increase in refinery capacity of 2.4 percent in 2019, domestic refinery production could only meet about 55.0 percent of oil demand requirement of the economy until 2040 if no additional refinery capacity will be put within that period.

Oil Supply Security Policy

Table 11.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	No Information	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☒ None	☒ None	☒ None

Mexico has not established any National Emergency Strategic Organization. However, under the Energy Reform and the framework provided by the New Energy Law, the National Energy Secretary (SENER) will be the one in charge in organizing energy resources during emergency (Diario, 2014).

The economy does not clearly define what constitutes energy supply emergency. The occurrence of a natural disaster, war and/or threat to the natural security and economy are considered emergencies that have impacts on national energy supply security. The new Hydrocarbon Law of 2014 considers that SENER has the option to expropriate or to

occupy oil producer fields, refineries and oil storage installations under an emergency.

Strategic stockpiling policy has not yet considered at the moment, but may be defined by SENER in the future.

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NEW ZEALAND

Table 12.1 Socio-Economic Profile, 2012

Land Area km^2	269,652
Population (million)	4.43
GDP (USD Billion, 2010 Price & PPP)	138.82
GDP per Capita	31,315

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

New Zealand is an island economy in the South Pacific, occupying a total land area of about 269,000 km^2. In 2012, the economy registered a total population of 4.4 million, which was growing at an average annual growth rate (AAGR) of 0.95 percent in the last 5 years (2008-2012). In the same year, the economy's GDP reached USD 138.82 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 1.6 percent.

New Zealand is a mature economy with a per capita GDP of USD 31,315 (USD 2010 Price & PPP) per person with modest annual growth rate 0.6 percent in the last 5 years. The per capita GDP is below the average of the OECD member economies (APERC, 2015a & EDMC, 2014).
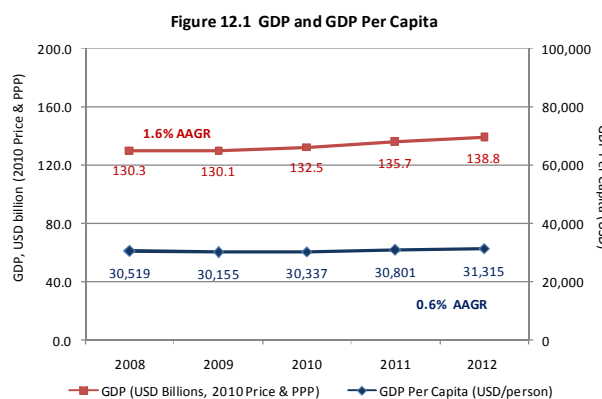
Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

New Zealand's primary energy supply reached 18,961 thousand tonnes of oil equivalent (Ktoe) in 2012 expanding annually, on the average, by 2.2 percent over the last 5 years. Oil contributed the largest share, about 34.2 percent (average share) of total primary energy supply. On the other hand, renewable energy resources (hydro and other RE) provided an aggregate average share of 37.7 percent, natural gas 20.0 percent and coal 9.0 percent. Among the energy resources, renewable energy (other RE excluding hydro) grew annually, on the average, by 8.4 percent in the

Figure 12.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 12.2 Total Primary Energy Supply
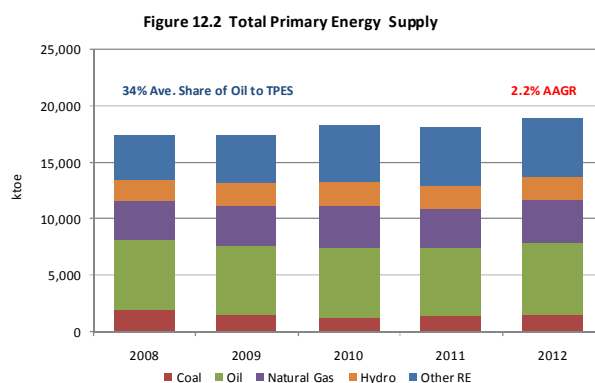
Source: IEA 2014

last 5 years, followed by gas with 2.8 percent annual growth rate. Oil only registered less than 1.0 percentAAGR.

The economy consumed 12.879 Ktoe in 2012 from 12,666 Mtoe in 2008 translating to nil growth of 0.4 percent annually in the last 5 years. Average share of oil to total final energy demand stood at 46.1 percent, followed by electricity with 26.2 percent and natural gas with 13.2 percent.

On a per sector basis, the transport sector remained the largest energy consuming sector with 36.1 percent average share to total final energy demand. However, the transport sector energy consumption gradually declined in the last 5 years by 0.7 percent annually. Industry sector consumed about 30.8 percent, on average, while residential sector accounted for 11.6 percent of the total (IEA, 2014).
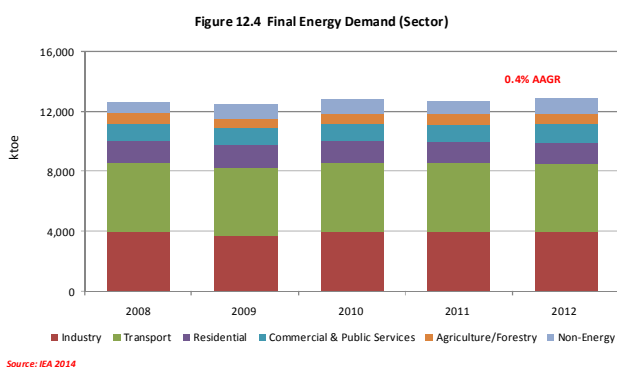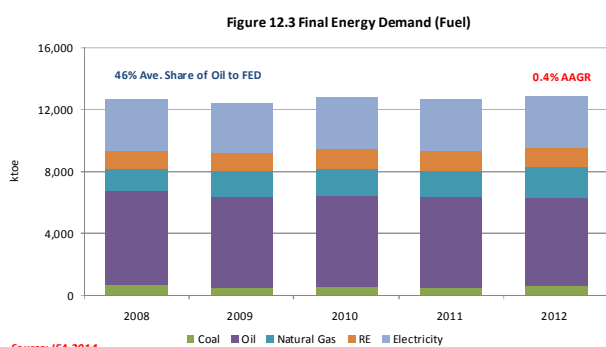
b) *Energy per Capita and Energy Intensity*

New Zealandøs energy and oil per capita over the last 5 years were relatively constant exhibiting 2.9 tonnes of oil equivalent (toe)/person and 1.3 toe/person, respectively. As for energy intensity, the economy was able to realize improvement (decline) of 4.6 percent from 97.2 toe/million USD GDP in 2008 to 92.8 toe/million USD GDP in 2012 of energy consumption. Similarly, oil consumption decreased by 10.8 percent, from 46.6 toe/million USD GDP in 2008 to 41.6 toe/million USD GDP in 2012. The improvements in both energy and oil intensities could be translated to reduction of consumption from transport and industry sectors (APERC, 2015a & EDMC, 2014).

Figure 12.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 12.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 12.4 Final Energy Demand (Sector)

Source: IEA 2014

Figure 12.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ
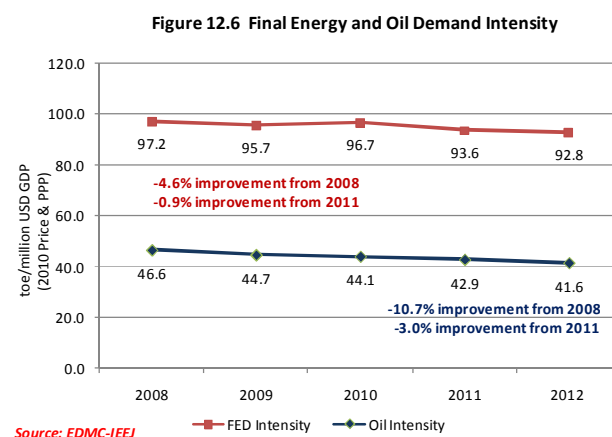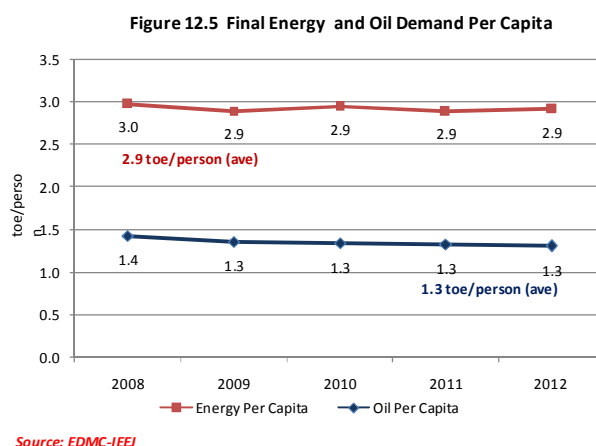
Oil Supply and Demand

a) Crude oil Production and Imports

As New Zealand's crude oil production was declining at annual rate of 9.1 percent (2008-2012). As such, crude oil imports grew by 3.8 percent annually with declining exports (-8.4percent AAGR). As a result, the economy's dependency on imports increased from 45 percent in 2008 to 68 percent in 2012. More than half of the imports was sourced from the Middle East (53.0 percent) with 15.0 percent coming from Saudi Arabia. The APEC region accounted for 44.0 percent, specifically from Southeast Asian economies (Brunei, Malaysia and Indonesia) (EDMC, 2013). Based on Herfindahl-Hirshman Index (HHI), the oil import sources may be considered as mid-concentration with HHI value of 0.48.

b) Oil Products

As economy's refinery production increased by 2.4 percent annually, its net import slid down by 7.4 percent. Such resulted in decreased import dependency from 33 percent in 2008 to 25 percent in 2012.

The economy's total oil demand fell at AAGR of 1.3 percent. Gasoline and diesel oil as the most consumed fuels accounting for average shares of about 42.1 percent and 38.4 percent, respectively. All fuels posted negative growth rates in the last 5 years with largest decline observed for fuel oil and other petroleum products for non-energy uses.

Figure 12.7 Crude Oil Supply

Source: Ministry of Business, Innovation and Employment

Figure 12.8 New Zealand Crude Oil Imports by Sources, 2012

HHI = 0.48 (Mid-Concentration)

Source: EDMC-IEEJ, 2012

Table 12.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	117	114	120	124	129
Net Imports	46	46	36	35	34
Others *	-22	-24	-20	-24	-29
Net Supply	141	135	135	135	134
Demand	141	135	135	135	134
Gasoline	59	58	58	56	56
Diesel Oil	54	51	51	52	53
Fuel Oil	1	1	0	1	1
LPG	6	6	5	5	5
Other Petroleum Products	21	20	21	21	18
Import Dependency	**33%**	**33%**	**27%**	**27%**	**25%**

*** *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

In terms of sectoral demand, the transport sector utilized around   74.1   percent, on the

Table 12.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	10	9	8	7	8
Transport	103	101	101	100	100
Residential	2	2	2	2	2
Commercial	3	2	3	3	3
Agri and Fishery	9	8	8	9	9
Electricity	1	0	-	-	0
Others	14	13	14	13	12
Total Consumption	**141**	**135**	**135**	**135**	**134**

Others include non-energy, own-use and losses
Source: IEA 2014

average, of total oil demand. However, the sector's oil demand had reduced a bit by 0.8 percent annually in the last 5 years. Only residential and commercial sectors registered increasinggrowth rates among the sectors with 3.5 percent and 0.2 percent, respectively (EIA, 2014).

The economy's total oil supply (crude and refinery) had been decreasing by 0.6 percent annually, on the average, in the last 5 years as oil demand declined in the same period. Despite of lower supply requirement and expanding refinery production, import dependency (total supply) still at 68.0 percent in 2012 from 55.0 percent

Figure 12.9 Total Oil Supply (Crude and Petroleum)
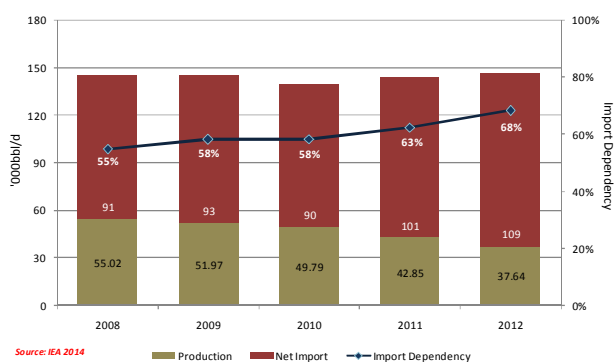
Source: IEA 2014

in 2008 due to the large reduction in domestic crude oil production.

c) Oil Demand Outlook and Refinery Capacity

New Zealand's oil demand is projected to increase at AAGR of 0.6 percent until 2040 (APERC, 2015). With refinery capacity of 107,000 bbl/d in 2013, the economy could provide up to 65.0 percent of its domestic oil demand based on 85.0 percent operating capacity. With no additional capacity foreseen to be in place until 2040, the economy's refinery capacity could only cover up to 55.0 percent of its increasing oil demand.

Figure 12.10 Oil Demand and Refinery Capacity
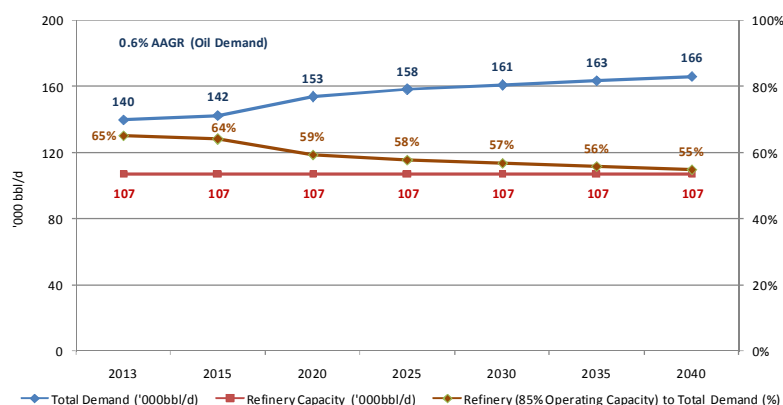
Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Oil Supply Security Policy

Table 12.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Ministry of Business, Innovation and Employment (MBIE) is responsible for policy related to oil supply security. In the event of an international disruption, MBIE would chair the national emergency strategy organisation (NESO) and take the lead in developing a plan of action. MBIE is working closely with the the Ministry of Civil Defense and Emergency Management (MCDEM) in charge of civil contingency planning and coordination with local authorities for domestic events atthe local and regional level (IEA, 2014a).

b) Criteria of Emergency

As an IEA member country, emergency situation based on IEA-International Energy Program is initially defined as an oil supply involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. Said definition of emergency has changed with the developments in oil markets, and now with more flexibility in deciding emergency situation and implementing response measures (IEA, 2007). The IEAøs Initial Contingency Response Plan has likewise suggested a thorough market assessment process in determining emergency situation.

c) Emergency Policy

In case of emergency, NESO will take necessary measures such as drawdown of stock based on the International Energy Agreement Act of 1976 or implement demand restrain in accordance with Petroleum Demand Restraint (PDR) Act of 1981, which also deals with supply distribution issues. Demand restrain measures are used as the last resort (IEA, 2014 and OGSN, 2015).

d) Strategic Oil Stockholding

New Zealand, as an IEA member, maintains stocks of at least 90 days of net imports. The government does not place a minimum stockholding obligation on industry but procures sufficient reserve stocks to maintain the target level. All government-procured stocks are currently held in other IEA member countries in the form of ÷oil ticketsø (options to purchase specified volumes of oil or oil products). In 2014, the oil stock level was an average 96 days of net imports, of which about 13 days was held in other countries via tickets (OGSN, 2015).

e) Regional Oil Security Policy

All IEA member countries are committed to taking joint measures in the event of oil supply emergencies. IEA members agreed to share energy information, coordinate their energy policies and cooperate in the development of rational energy programmes. Each member is also required to hold oil stocks equivalent to 90 days of its prior yearøs net imports. Also as part of IEA collective action, the economy is required to contribute based on assessed share in total IEA oil consumption (IEA, 2007).

f) Emergency Exercise Activity

IEA emergency exercises and workshops are conducted every two years. These activities

are intended to assess policies and procedures, decision-making process, and readiness to quickly respond to emergency situation in effective manner (IEA, 2014a).

New Zealand is in the process of completing a NESO handbook and plans an emergency test exercise when this is completed (OGSN, 2015).

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PAPUA NEW GUINEA

Socio-Economic Overview

Table 13.1 Socio-Economic Profile, 2012

Land Area km²	462,840
Population (million)	7.17
GDP (USD Billion, 2010 Price & PPP)	16.74
GDP per Capita	2,336

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Papua New Guinea is situated in the southwest of the Pacific Ocean, with a population of more than 7 million, spread across a total land area of 462,840 km². The economy's GDP in 2012 was recorded at USD 16.7 billion (USD 2010 Price & PPP), which exhibited a robust growth rate of 7.6 percent on average annual (last 5 years). For the same period, GDP per capita also posteda strong growth of 5.2 percent reaching USD 2,336 in 2012(APERC, 2015a & EDMC, 2014).

Figure 13.1 GDP and GDP Per Capita
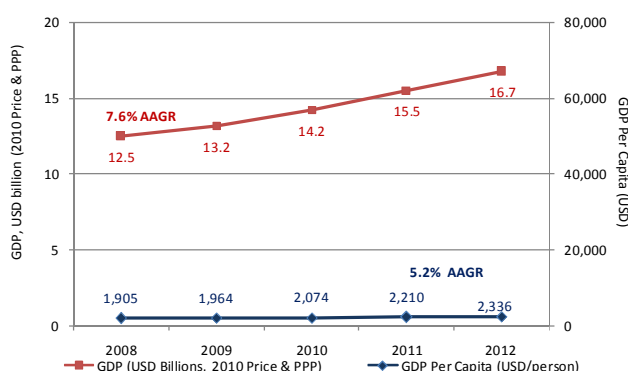
Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Papua New Guinea's primary energy supply in 2012 reached 2,502 thousand tonnes of oil equivalent (Ktoe) in 2012, which recorded an average growth of 4.3 percent per annum in the last 5 years. Oil contributed bulk of energy supply for the economy with an average share of 75.9 percent to the primary energy mix. Renewable energy resources provided 18.5 percent average share, while natural gas 5.6 percent. As domestic production of crude oil had gradually declined, the economy's oil imports increased over the last 5 years.

As for final energy demand, the economy consumed 1,586 ktoe in 2012 posting an AARG of 5.2 percent for the period

Figure 13.2 Total Primary Energy Supply
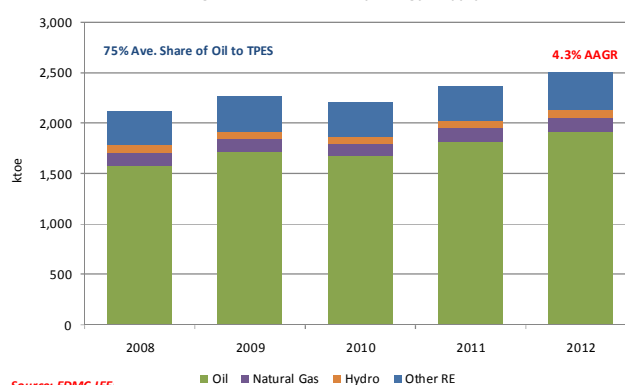
Source: EDMC-IEEJ

2008-2012. Oil consumption was about 77.8 percent, on the average, of the final energy demand, with an annual growth of 5.2 percent. Electricity consumption was about 22.2 percent of total.

As for sectoral consumption, the industry sector exhibited the largest energy consumption utilizing about 52.0 percent, on the average, of the total final energy demand. The transport sector followed next with 30.9 percent average share, and demonstrated the fastest growth rate of 6.2 percent annually (IEA, 2014).

energy intensity with 8.8 percent reduction from 103.9 toe/million USD GDP in 2008 to 94.7 toe/million USD GDP in 2012. The improvement could be attributed largely to industry sector energy consumption reduction. Similarly, oil intensity decreased by 8.7 from 80.7 toe/million USD GDP in 2008 to 73.6 toe/million USD GDP in 2012 (APERC, 2015a & EDMC, 2014).

Figure 13.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 13.3 Final Energy Demand (Fuel)

Source: EDMC-IEEJ
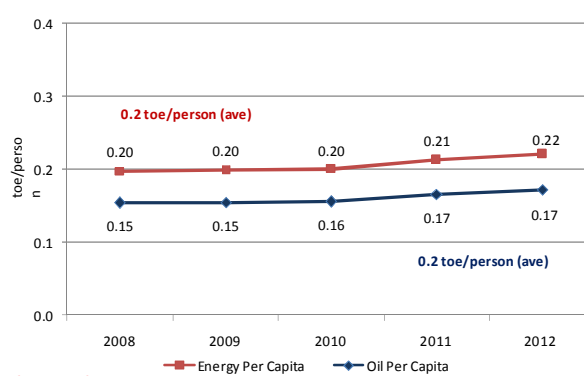
Figure 13.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

Figure 13.4 Final Energy Demand (Sector)

Source: EDMC-IEEJ

Oil Supply and Demand

b) Energy per Capita and Energy Intensity

Papua New Guinea's energy and oil per capita stood at 0.2 tonnes of oil equivalent (toe)/person and 0.17 toe/personin 2012, respectively. On the other hand, the economy was able to achieve improvement in
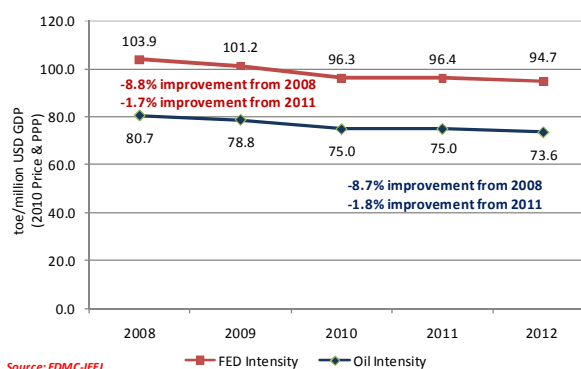
a) Crude oil Production and Imports

Papua New Guinea is also a producer of crude oil with production capacity of 14 thousand barrels/day (‑000bbl/d) in 2012. However, as the oil producing fields are maturing, the

economy is facing a declining in oil production (OGSN, 2015). In the last 5 years, crude oil production dropped annually by 22.8 percent, which resulted in decreased exports by 22.0 percent and increased imports by 6.3 percent (per year). The economyøs import dependency level went up drastically from negative 142 percent in 2008 to 33 percent in 2012.

Figure 13.7 Crude Oil Supply

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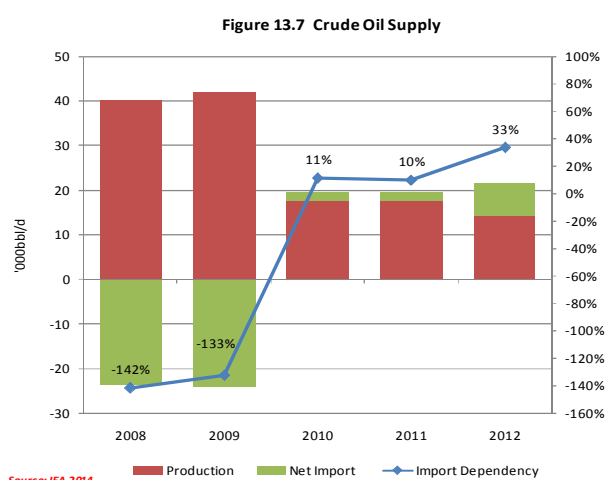
b) Oil Products

Papua New Guineaøs refinery production grew annually at an average rate of 7.5 percent, which resulted in minimum increase in net import of 0.7 percent annually over the last 5 years. Hence, import dependency on petroleum products dwindled from 48 percent in 2008 to 41 percent in 2012. Diesel oil and fuel oil were the most consumed fuels with both contributing average shares of about 58.4 percent and 26.9 percent, respectively. Diesel oil displayed the fastest increase in oil consumption at annual rate of 6.5 percent, which is primarily used in transport and electricity generation sectors.

Table 13.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	17	17	20	20	23
Net Imports	15	17	14	17	16
Others *	-0	-0	0	0	0
Net Supply	32	35	33	37	39
Demand	41	44	42	48	50
Gasoline	2	2	2	3	3
Diesel Oil	23	25	25	28	30
Fuel Oil	11	12	11	13	13
LPG	1	1	1	1	1
Other Petroleum Products	3	4	3	4	4
Import Dependency	**48%**	**50%**	**41%**	**47%**	**41%**

* *include stock change, international marine & aviation and statistical difference*

Table 13.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	9	10	10	11	12
Transport	8	9	9	10	11
Residential	-	-	-	-	-
Commercial	-	-	-	-	-
Agri and Fishery	-	-	-	-	-
Electricity	9	10	9	11	11
Others	14	15	14	16	17
Total Consumption	**41**	**44**	**42**	**48**	**50**

Others include non-energy, own-use and losses

Among the sector, about 34.3 percent of the total demand was consumed for non-energy uses, whilethe Industry sector utilized around 22.9 percent. Oil demand in the transport and electricity sectors were likewise recorded at

20.8 and 22.1 percent average shares of total demand. Industry, transport and electricity sectors all posted around 6.0 percent annual growth on oil consumption in 5-year period.

The economy's total oil supply (crude oil and petroleum products) increased substantially at an average annual rate of 3.9 percent between 2008 and 2012 caused by large growth in oil demand. Over the same period, oil production had significantly declined at an average rate of 22.3 percent, which was not sufficient to meet domestic refinery demand, thus, resulted in import dependency level to increase to 59.0 percent in 2012

Figure 13.9 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 13.8 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014
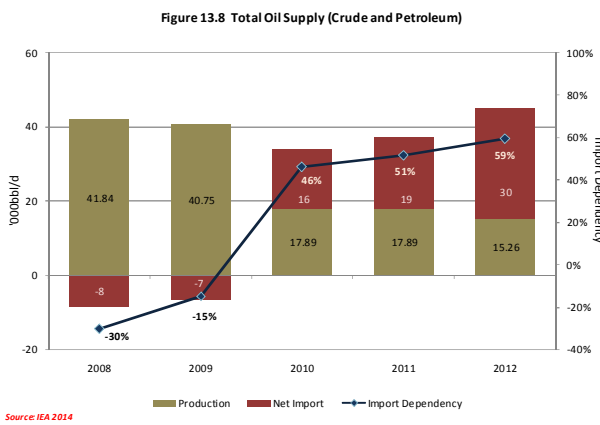
c) Oil Demand Outlook and Refinery Capacity

Papua New Guinea's oil demand is expected to grow at 2.4 percent AAGR until 2040 (APERC, 2015). In 2013, the economy's refinery capacity stood at 33,000 bbl/d, which was about 71.0 percent of its domestic oil demand based on 85.0 percent operating capacity. If no additional new refinery
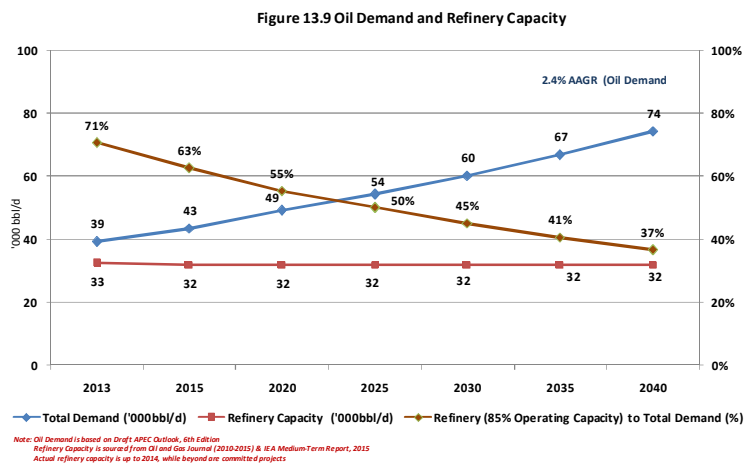
capacity will be put in place within that period, total refining capacity will only be about 37.0 percent of domestic oil demand in 2040.

Oil Supply Security Policy

Table 13.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☒ None	☒ None
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☒ None	☒ None	☒ None

The Prime Minister's Office and the National Executive Council (NEC) will implement measures to deal with oil crisis or emergency. The NEC is a government decision making body, which is composed of members from all ministries. The NEC has the power to demand for actions even without legislation, as well as can propose new legislation to be passed by Parliament (PMO).

Currently, Papua New Guinea has no oil supply security policy at the moment in place. However, a draft Energy Policy (including oil and gas) has been drafted and being circulated to concerned government agencies for inputs

and comments before deliberation of the parliament. The economy is cognizant of the importance of energy security policy within the APEC region.

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http://www.officeofprimeminister.com/#!departments-and-devisions/cpu1

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PERU

Socio-Economic Overview

Table 14.1 Socio-Economic Profile, 2012

Land Area km²	1,285,216
Population (million)	29.99
GDP (USD Billion, 2010 Price & PPP)	320.94
GDP per Capita	10,702

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Peru is located in South America, bordered by the Pacific Ocean, Chile to the south, Ecuador and Colombia to the north, and Brazil and Bolivia to the east. Peru is one of two APEC economies in Latin America located on the Pacific coast of South America (the other is Chile). With a land area of 1.3 million square kilometres, Peru has three main geographical regions: the Costa to the west, the Sierra (Andes mountains), and the Selva, covered by the Amazon rainforest. The economy is divided into 25 Regional Governments and one (1) Constitutional Province (administrative regions).

The economy's population in 2012 was almost 30 million and growing at an average annual growth rate (AAGR) of 1.17 percent in the last 5 years (2008-2012). In the same year, the economy's GDP was USD 320.94 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 5.4 percent. Meanwhile, GDP per capita grewby 4.2 percent average annual rate (last 5 years) reaching USD 10,702 in 2012(APERC, 2015a & EDMC, 2014).
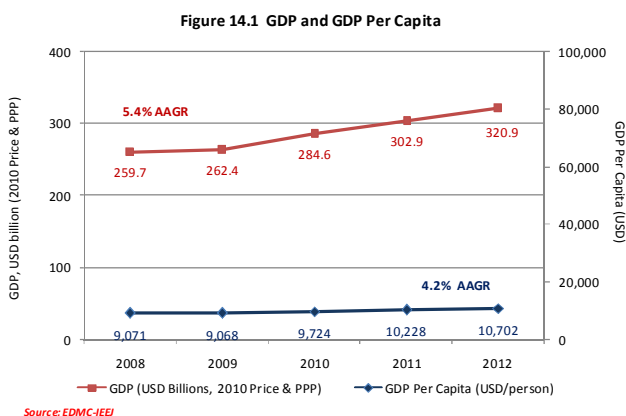
Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Peru's total primary energy supply in 2012 was 21,703 kilotonnes of oil equivalent (ktoe), which demonstrated an AAGR of 9.6 percent for the period 2008-2012. Consistently, oil provided majority of the economy's energy requirement, with 44.3 percent average share. The robust increase in the primary energy

Figure 14.1 GDP and GDP Per Capita

5.4% AAGR — 259.7, 262.4, 284.6, 302.9, 320.9
4.2% AAGR — 9,071, 9,068, 9,724, 10,228, 10,702

Source: EDMC-IEEJ

Figure 14.2 Total Primary Energy Supply

44% Ave. Share of Oil to TPES   9.6% AAGR

Coal   Oil   Natural Gas   Hydro   Other RE

Source: IEA 2014

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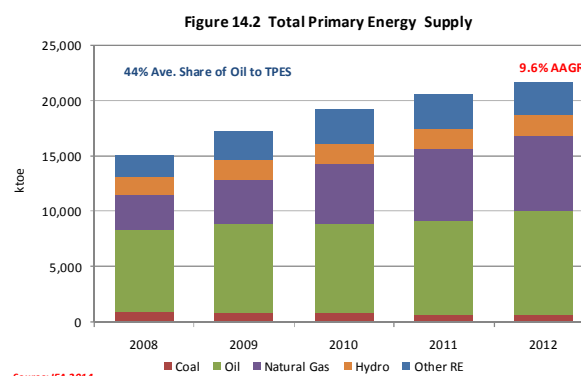
supply can also be translated to the growth observed in the production of natural gas and its liquids. From merely 21.6 percent share in 2008 to about 31.4 percent in 2012, this exhibited the fastest growth of 20.4 percent among the energy sources. Renewable energy provided 23.0 percent, of which hydro contributed 9.4 percent average share to total energy supply for the same period.

In terms of final energy demand, 6.5 percent growth, on the average was recorded for the last 5 years, from 12,641 ktoe in 2008 to 16,255 ktoe in 2012. Accordingly, oil dominated more than half of the total energy consumption in 5-year period, with 53.0 percent annual average share. Electricity made up 19.3percent of total energy demand, while renewables, natural gas and coal accounted for the remaining with 16.5, 7.5 and 4.1 percent shares, respectively.

Among the economic sectors, transport sector is the largest energy consuming sector using up about 37.9 percent, on the average, of the final energy demand, and growing at AAGR of 8.5 percent. Industry sector is the second largest with 28.0 percent average share, while residential sector consumed 23.8 percent of total (IEA, 2014).

b) Energy per Capita and Energy Intensity

Peruøs energy and oil demand per capita has been growing since 2008 until 2012. In the last 5 years, Peru had presented an average energy per capita of 0.5 tonnes of oil equivalent (toe)/person and 0.3 toe/person in Oil per Capita.

Meanwhile, Peruøs energy demand intensity had increased from 2008 level by 4.0 percent, but with observed reduction of 2.7 percent

Figure 14.3 Final Energy Demand (Fuel)
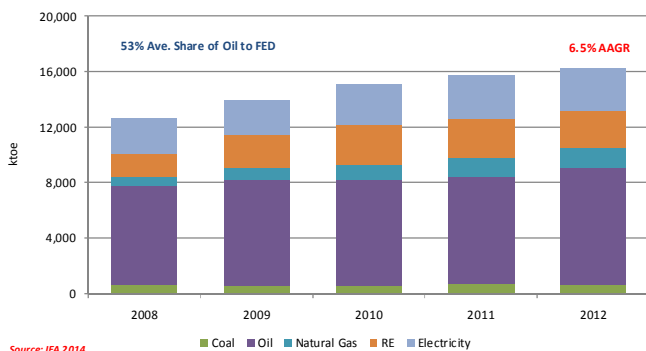
Source: IEA 2014

Figure 14.4 Final Energy Demand (Sector)

Source: IEA 2014

Figure 14.5 Final Energy and Oil Demand Per Capita
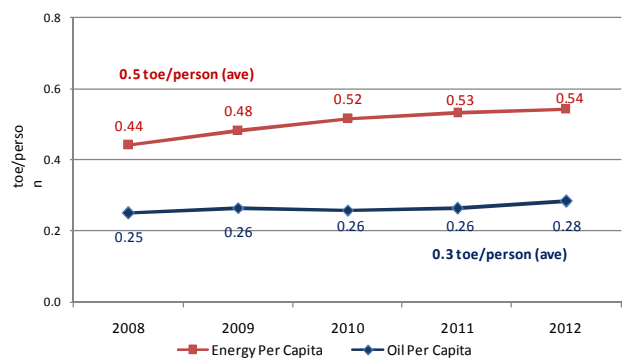
Source: EDMC-IEEJ

Figure 14.6 Final Energy and Oil Demand Intensity
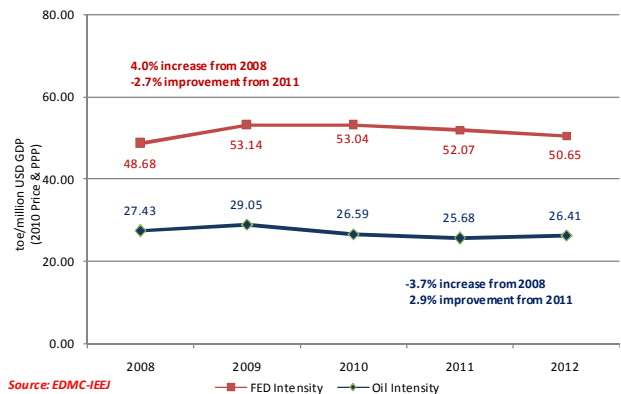
Source: EDMC-IEEJ

from 2011 level of 52.07 toe/million USD GDP to 50.65 toe/million USD GDP in 2012. On the other hand, oil intensity likewise declined by 3.7percent, which was recorded at 26.41 toe/million USD GDP in 2012 from 27.43 toe/million USD GDP in 2008(APERC, 2015a & EDMC, 2014).

Oil Supply and Demand

a) Crude oil Production and Imports

Figure 14.7 Crude Oil Supply

Source: IEA 2014

Although Peru has the seventh-largest crude oil reserves in Central and South America, its crude oil production has been declining since the mid-1990s (EIA, 2015). However, the economyøs crude oil production was

Figure 14.8 Peru Crude Oil Imports by Sources, 2013

Others, 3%
Africa, 19%
Other Americas, 78%

Source: Ministry of Energy and Mines

intensified in the last 5 years (2008-2012), represented by an increase of 1.1 percent annually, on the average, from 99,000 bbl/day in 2008 to about 110,000 bbl/day in 2012. As such, the economyøs import dependency declined from 45.0 percent in 2008 to 41.0 percent in 2012. Most of the economyøs crude imports came from America (78.0%), Africa (19.0%) and other regions (3.0%). Based on Herfindahl-Hirshman Index (HHI), the import sources may be considered as moderate-high concentration with HHI value of 0.64 (MINEM, 2013).

b) Oil Products

Table 14.2 Oil Products Supply and Demand ('000bbl/d)					
	2008	**2009**	**2010**	**2011**	**2012**
Refinery Production	225	246	256	245	242
Net Imports	-20	-47	-48	-26	-32
Others *	-27	-11	-16	-19	-2
Net Supply	177	188	192	199	208
Demand	177	188	192	199	208
Gasoline	25	29	32	31	31
Diesel Oil	86	88	94	97	96
Fuel Oil	24	23	14	16	12
LPG	33	36	40	45	49
Other Petroleum Products	8	11	12	10	20
Import Dependency	**-11%**	**-25%**	**-25%**	**-13%**	**-15%**

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

Peruøs refinery production grew annually at average annual of 1.9 percent with net import decreasing by 12.3 percent annually. This

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Table 14.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	31	33	27	29	30
Transport	97	104	112	116	119
Residential	21	22	21	22	23
Commercial	1	2	4	4	5
Agri and Fishery	4	4	2	3	3
Electricity	12	10	12	13	7
Others	11	13	14	13	21
Total Consumption	**177**	**188**	**192**	**199**	**208**

Others include non-energy, own-use and losses
Source: IEA 2014

resulted in decreasing further import dependency for refined petroleum products from around negative 11.0 percent in 2008 to negative 15.0 percent in 2012.

Total oil demand grew annually by 4.1 percent, on the average, with diesel oil and LPG as the most consumed fuels with both exhibiting average shares of 47.9 percent and 21.0 percent, respectively. LPG was growing at a faster average annual rate of 10.0 percent, annually. On the other hand, around 56.7 percent of total oil demand was consumed by the transport sector, while

industry sector demanded at an annual average of 15.5 percent of the total. Oil demand of the transport sector was expanding by 5.3 percent annually. The total oil supply (crude and petroleum products) had increased in an average rate of 3.8 percent per year for the period 2008-2012. Despite the reduction in annual oil imports and the increase in annual oil production, the requirement to cover local oil stocks had increased the dependency ratio from 23.0 percent in 2008 to 30.0 percent in 2012.

c) Oil Demand Outlook and Refinery Capacity

Peru's oil demand is projected to increase at AAGR of 4.3 percent until 2040 (APERC,

Figure 14.10 Oil Demand and Refinery Capacity
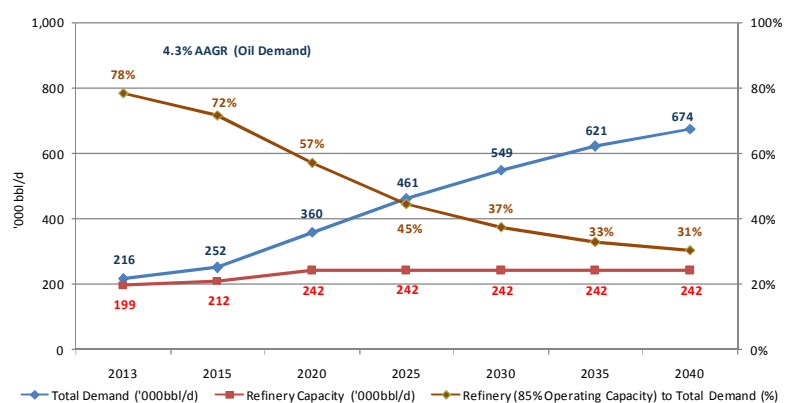
Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

2015). In 2013, the economy's refinery capacity of 199,000 bbl/d will cover 78.0 percent of its domestic oil demand based on 85.0 percent operating capacity. However, despite the expected increase in refinery capacity of 21.6 percent in 2019, domestic refinery production could meet about 31.0 percent of oil demand requirement of the economy until 2040 if no additional refinery capacity will come in during the outlook period.

Figure 14.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy

Table 14.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	No Information	No Information
Strategic Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☒ None	☒ None	☒ None

The Ministry of Energy and Mines (MINEM) is the agency responsible for managing the energy and mining sectors in Peru, and also in charge of overseeing the distribution of energy. It was created to formulate and evaluate policies on sustaining development and environmental matters relating to energy and mining, as well as the rational use of natural resources. Although it is not explicitly described, said entity may also take the lead during oil supply emergency being the policy regulatory body on energy.

Peru has no clear criteria and definition of oil emergency situation, as well as emergency policy and mechanism. Only gas supply has emergency mechanism stipulated in the Supreme Decree No. 050-2012-EM. Further, the economy even formulated a contingency plan, risk study and priority in the allocation of natural gas (OGSN, 2015).

Peru has no strategic stockpiling policy, and only implements operational stocks, which should be not less than 15 days of domestic supply. The economy has no known regional oil security policy engagement, and oil emergency exercise activity.

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PHILIPPINES

Socio-Economic Overview

Table 15.1 Socio-Economic Profile, 2012

Land Area km^2	300,000
Population (million)	96.71
GDP (USD Billion, 2010 Price & PPP)	569.52
GDP per Capita	5,889

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

The Philippines is an archipelago consisting of 7,107 islands and covers a total land area of 300,000 square kilometres. It is located in the South eastern part of Asia and bordered by the Philippine Sea on the east, South China Sea on the west, the Luzon Strait on the north, and the Celebes Sea on the south.

The economyøs total population in 2012 reached 96.71 million, a 1.7 percent increase from the previous year. Driven by strong performance of the service and industry sectors, the Philippine economy demonstrated robust growth with average annual growth rate (AAGR) of 4.8 percent, reaching a GDP of USD 569.5 billion (USD 2010 Price and PPP) in 2012. Per capita GDP had also increased
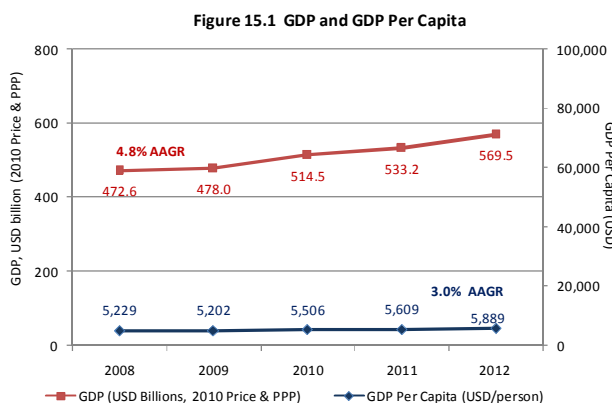
steadily at 3.0 percent of the AAGR over 2008-2012 (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Total primary energy supply (TPES) of the Philippines showed a modest growth rate of 1.5 percent per annum in 5-year period (2008-2012). In terms of share of energy resources to TPES, renewable energy, most of which are geothermal and biomass, contributed about 40.0 percent to total in 2012, followed by oil (32.2 percent) and coal (18.8 percent). Coal registered the fastest AAGR of

Figure 15.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 15.2 Total Primary Energy Supply

Source: IEA 2014

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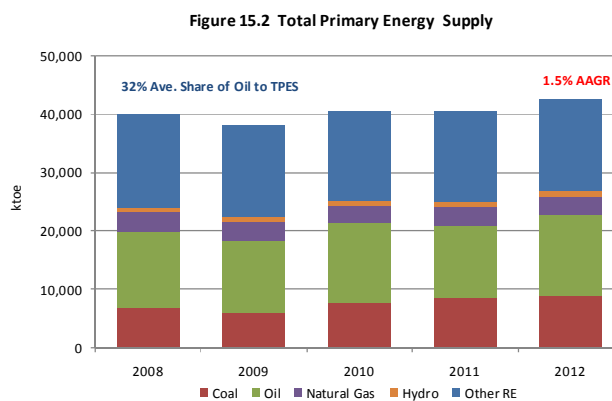
6.4 percent in the last 5 years due to increased use for power generation.

On the other hand, final energy demand grew by 1.9 percent annually. Oil was the most consumed fuel, nearly half of total energy demand over 2008-2012, and accelerating at 2.1 percent annual average higher than final energy demand growth rate. Renewable (biomass) and Electricity made up the rest, 24.0 percent and 20.0 percent shares, respectively.

Among the sectors, the transport accounted as the largest consumer of final energy demand with 34.8 percent average share and expanding at an annual rate of 3.1 percent during the 5-year period. Demand of commercial and public services sector recorded the fastest AAGR of 8.4 percent which was attributed to

increased demand for diesel and electricity (IEA, 2014).

b) Energy per Capita and Energy Intensity

No significant change was observed in both final energy and oil demand per capita. On the other hand, final energy intensity in 2012 decelerated by 10.5 percent from the 2008 level. Among the sectors, the industry sector registered the largest reduction in energy intensity at 20.3 percent from 2008. Such drop in energy use may be credited to the application of a more energy-efficienct production processes and technologies. The transport sector also helped energy intensity to be lowered as a number of vehicle owners have become judicious in fuel use and adopted more fuel efficient vehicle to save expenditure for petroleum products. Oil intensity also

Figure 15.3 Final Energy Demand (Fuel)

48% Ave. Share of Oil to FED

1.9% AAGR

Coal   Oil   Natural Gas   RE   Electricity

Source: IEA 2014

Figure 15.4 Final Energy Demand (Sector)

1.9% AAGR

Industry   Transport   Residential   Commercial & Public services   Agriculture/Forestry   Non-Energy

Source: IEA 2014

Figure 15.5 Final Energy and Oil Demand Per Capita

0.4 toe/person (ave)

0.25   0.25   0.25   0.25   0.25

0.12   0.12   0.12   0.12   0.12

0.3 toe/person (ave)

Energy Per Capita   Oil Per Capita

Source: EDMC-IEEJ

Figure 15.6 Final Energy and Oil Demand Intensity

47.2   47.6   46.1   44.3   42.2

-10.5% improvement from 2008
-4.7% improvement from 2011

22.6   23.3   22.3   21.2   20.4

-9.8% improvement from 2008
-3.9% improvement from 2011

FED Intensity   Oil Intensity

Source: EDMC-IEEJ

went down by 9.8 percent from its 2008 level (APERC, 2015a & EDMC, 2014).

Oil Supply and Demand

a) Crude oil Production and Imports

Figure 15.7 Crude Oil Supply

Source: IEA 2014

The Philippines has limited oil resources and only produced a small volume of crude oil. With this, the economy is heavily dependent on crude oil imports to meet its refinery demand with dependency level of about 90.0 percent. In 2014, the government invited potential investors for 11 oil and gas exploration blocks through the Philippine Energy Contracting Round (PECR). Said exploration bid round could push oil

Figure 15.8 Philippines Crude Oil Imports by Sources, 2013

HHI = 0.63
(Moderate-High Concentration)
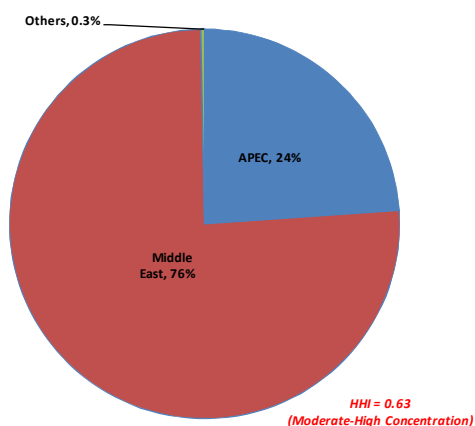
Source: Oil Supply & Demand Report 2013, DOE-Philippines

production up to 39,000 barrels per day by 2019 (EIA, 2014).

Bulk of crude imports in 2013 was sourced from the Middle East around 76.0 percent, while the APEC region made up the rest. About 40.0 percent of crude oil from Middle East came from Saudi Arabia while remaining was sourced from UAE and Qatar. On the other hand, the primary importer of crude oil to the Philippines in the APEC region was Russia, which provided around 18.0 percent of the total imports *(DOE, 2014)*. Based on Herfindahl-Hirshman Index, regional import sources could be considered as moderate-high concentration with HHI value of 0.63.

b) Oil Products

Table 15.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	185	151	179	190	170
Net Imports	106	140	132	106	142
Others *	-33	-21	-28	-28	-35
Net Supply	258	271	283	268	277
Demand	258	271	283	268	277
Gasoline	64	66	68	67	69
Diesel Oil	109	116	121	120	125
Fuel Oil	40	38	44	30	30
LPG	34	37	37	37	37
Other Petroleum Products	11	13	12	14	16
Import Dependency	38%	53%	46%	39%	50%

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

Since petroleum products production was not enough to meet the growing domestic demand, the Philippines also heavily relied on petroleum product imports, thus the economy's import dependency level hovered around 50.0 percent over 2008-2012. Diesel was the most consumed product with an average share of 43.6 percent, followed by gasoline with 24.7 percent.

Figure 15.9 Total Oil Supply (Crude and Petroleum)
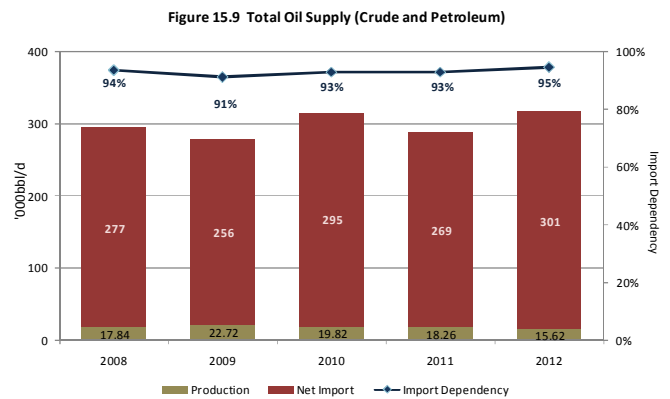
Table 15.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	31	27	28	27	26
Transport	158	166	169	167	174
Residential	27	29	28	28	28
Commercial	12	19	21	22	22
Agri and Fishery	5	4	4	4	4
Electricity	20	22	28	15	18
Others	4	4	4	4	6
Total Consumption	**258**	**271**	**283**	**268**	**277**

Others include non-energy, own-use and losses
Source: IEA 2014

By sector utilization, the transport sector used 62.9 percent of total petroleum products demand in 2012. The commercial sector accounted for merely 7.9 percent of demand in the same year, but presented the robust AAGR of 15.7 percent in 5-year period.

As the Philippines has limited crude oil production and also dependent on petroleum products imports, the economy's import dependency level for total oil supply (crude and petroleum products) was around 95.0 percent in 2012. The economy's total oil supply

requirement had been growing at 1.3 percent annual average in the last 5 years.

c) Oil Demand Outlook and Refinery Capacity

The Philippines' oil demand is projected to increase from 286,000 bbl/d in 2013 to 651,000 bbl/d in 2040, accelerating at a rate of 3.1 percent per annum (APERC, 2015). The existing refinery capacity of 284,000 bbl/d in 2013 was able to meet 85.0 percent of the total oil demand (based on 85.0 percent operating capacity). However, if no new refinery capacity is added until 2040, share of domestic refinery production to meet oil demand is likely to continue to fall to reach only about 37.0 percent in 2040.
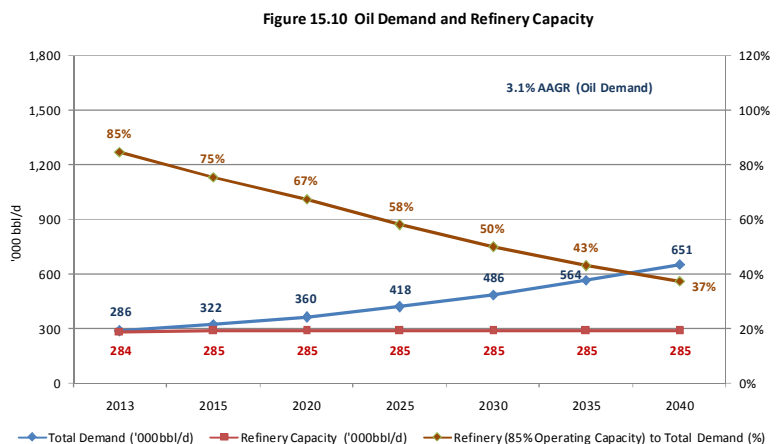
Figure 15.10 Oil Demand and Refinery Capacity

Oil Supply Security Policy

Table 15.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Department of Energy (DOE) as the lead agency of the Inter-Agency Energy Contingency Task Force (ECTF) is the main government body responsible for dealing with oil supply disruptions. The Task Force is composed of other relevant government agencies such as the Department of Trade and Industry, Department of Transportation and Communication and the National Security Council. The ECTF is tasked to update overall action plan for oil supply emergencies; implement efficient and equitable distribution of oil; and, implement allocation and rationing at local levels.

The DOE was established in 1992 through a Republic Act with the primary functions of formulating energy policies for the economy prepare, integrate, coordinate, supervise and control all plans, programs, projects and activities of the Government relative to energy exploration, development, utilization, distribution and conservation. Other duties of the DOE include examining appropriate minimum inventory to be held by the oil companies based on Executive Order issued by the President of the Philippines in 2002, as well as monitoring such inventory level.

b) Criteria of Emergency

The Philippines is a member state of the Association of Southeast Asian Nations (ASEAN). Based on definition of ASEAN Petroleum Security Agreement (APSA), critical shortage is defined as the situation when a member economy is experiencing a shortfall of at least 10 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. The APSA was updated and ratified, which took effect in March 2013 (ASCOPE, 2009).

The Philippines has also a set of criteria for determining emergency as contained in the Oil Contingency Plan formulated in 2002. The criteria for emergency are based on different scenarios of inventory levels shortfall in crude oil supply. Other trigger point of emergency situation is soaring oil price as an offshoot of difficulty in supply (OGSN, 2015).

c) Emergency Policy

In case of emergency, the President of the Philippines upon determination and recommendation of the DOE that circumstances warrant for the declaration of emergency will issue an Executive Order to that effect to include the activation of ECTF to implement the oil contingency plan according to scenario levels (OGSN, 2015).

The oil contingency plan will be activated by the government to implement potential measures. The contingency plan outlines several measures to be implemented based on emergency scenarios. The guiding principles of the plan include:

- Priority in the allocation of petroleum products shall be given to vital and strategies in the event of supply disruptions; and,
- Associated effects on domestic socio-political stability arising from energy interruptions shall be addressed immediately by agencies concerned together with National Security and Public Safety organizations.

d) Strategic Oil Stockholding

The Philippines has no strategic oil stockpiling. However, the government is enforcing a minimum inventory requirement (MIR) for oil companies. The MIR imposes total in-country stocks of crude and finished products equivalent to 30 days or refiners, while an equivalent of 15 days in-country stock is required for the bulk marketers and 7 days for the LPG players. Usually, oil companies maintain more than the required minimum level of inventory (DOE, 2014a). In 2013, total inventory level stood at 38 days supply equivalent, consisted of 31 days for crude oil and products in country stocks and 7 days in-transit (DOE, 2014).

e) Regional Oil Security Policy

Under APSA, all member states are endeavoured to supply petroleum to the ASEAN Member State in Distress at an aggregate amount equal to 10 percent of the Normal Domestic Requirement of the said member state. Such provision is contained in the APSA-Coordinated Emergency Response Measure (CERM). It is also specified that a member state should have put in place measures to reduce demand as a requirement to seek assistance under CERM. Currently, the APSA Task Force is studying and reviewing CERM Operationalization Manual (ASCOPE).

Likewise, the economy has entered into several Memoranda of Understanding (MOU) with Russia, Iran, Indonesia and India on oil supply.

f) Emergency Exercise Activity

The Philippines participated in the APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise conducted in 2013 in Bangkok, Thailand. Said emergency exercise activity was undertaken by the Asia Pacific Energy Research Centre (APERC) in collaboration with other international organizations like IEA, Economic Research Institute for ASEAN and East Asia (ERIA), ASEAN Centre for Energy (ACE), and ASEAN Council on Petroleum (ASCOPE) (APERC, 2014).

The Philippines is scheduled to hold its own oil and gas emergency exercise scheduled in 2015 under the APEC energy cooperation.

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RUSSIA

Socio-Economic Overview	

Table 16.1 Socio-Economic Profile, 2012

Land Area km²	17,098,242
Population (million)	143.18
GDP (USD Billion, 2010 Price & PPP)	3,154.27
GDP per Capita	22,030

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

The Russian Federation is the largest economy in the world with a total land area of about 17 million square kilometres, and the only APEC economy situated in Europe and Asia continents.

The economy's population stood at 143.18 million in 2012 posting a minimal average annual growth rate (AAGR) of 0.21 percent in the last 5 years (2008-2012). In the same period, the economy's GDP grew at AAGR of 1.0 percent registering USD 3,154 Billion (USD 2010 Price & PPP) in 2012. Meanwhile, GDP per capita had improved by 0.7 percent annually in the last 5 years reaching USD 22,030 per person (APERC, 2015a & EDMC, 2014).

Energy Profile	

a) Total Primary Energy Supply and Final Energy Demand

Russia's primary energy supply grew annually by 2.4 percent over the last 5 years, which stood at 756.59 million tonnes of oil equivalent (Mtoe) in 2012. Oil has been the second major energy resources of the economy with an average share of 21.2 percent, next to natural gas which provided more than half to primary energy supply. Coal contributed an average share of 16.4 percent, nuclear with 6.3 percent and renewable energy with 3.1 percent share.

The economy's crude oil resources in so-called traditional oil producing regions are said to be gradually depleting with more than 50.0 percent of the recoverable resources (economically) has been extracted. However, the remaining resources, which are more

Figure 16.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 16.2 Total Primary Energy Supply
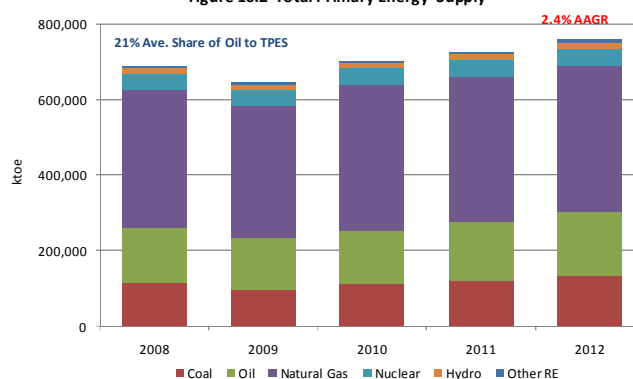
Source: IEA 2014

complex to recover, have been steadily growing.

In 2012, the economy's total final energy demand was 461,342 ktoe, registering an AAGR of 1.5 percent in the last 5 years. By fuel source, natural gas and oil were the most consumed fuels accounting for average shares of 30.4 percent and 24.8 percent, respectively. On the other hand, electricity was about 14.0 percent, on the average, and coal 3.9 percent of total. Considering the extreme cold climate, demand for space heating was also large about a quarter of total.

By sector, industry had been the largest consuming sector accounting for 28.8 percent average share of the final energy demand in the last 5 years. The sector likewise demonstrated the fastest growth rate among the sectors increasing by 3.8 percent annually as traditional energy-intensive industrial structure is one of the main drivers of economic development. Followed next is residential (25.4 percent average shares) and transport (21.5 percent average share) (IEA, 2014).

b) *Energy per Capita and Energy Intensity*

Russia's energy per capita was 3.1 tonnes of oil equivalent (toe)/person on the average, which had been stable over the last 5 years. On the other hand, oil per capita increased slightly from 0.75 toe/person in 2008 to 0.82 toe/person in 2012.

As for energy intensity, the economy was able to realize improvement in 2011 with a decline of 2.7 percent in energy consumption from 150.4 toe/million USD GDP in 2011 to 146.3 toe/million USD GDP in 2012. Meanwhile,

Figure 16.3 Final Energy Demand (Fuel)

Figure 16.5 Final Energy and Oil Demand Per Capita

Figure 16.4 Final Energy Demand (Sector)

Figure 16.6 Final Energy and Oil Demand Intensity
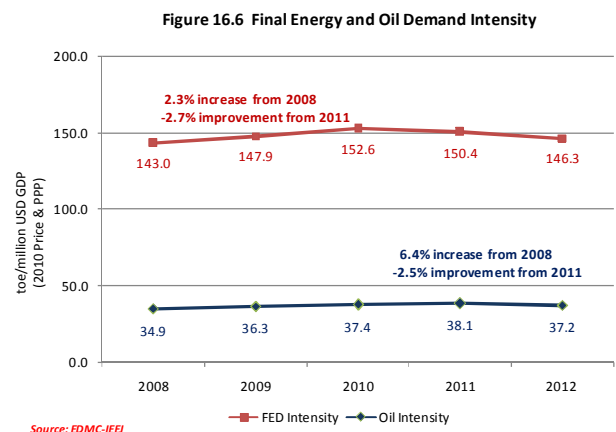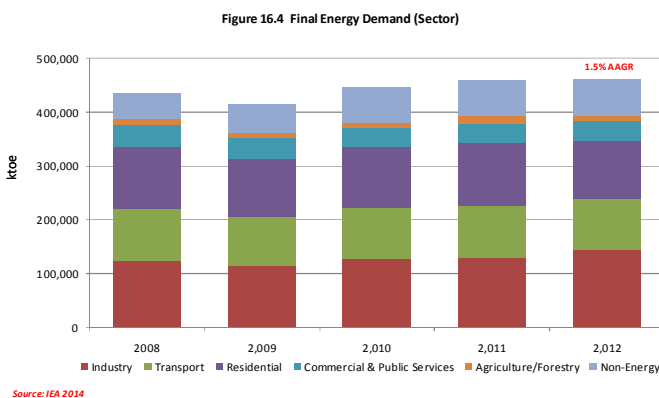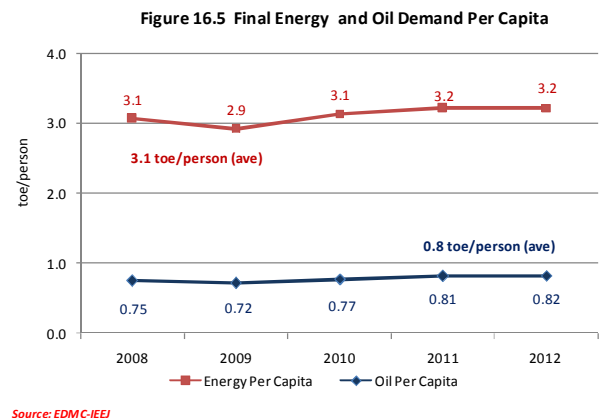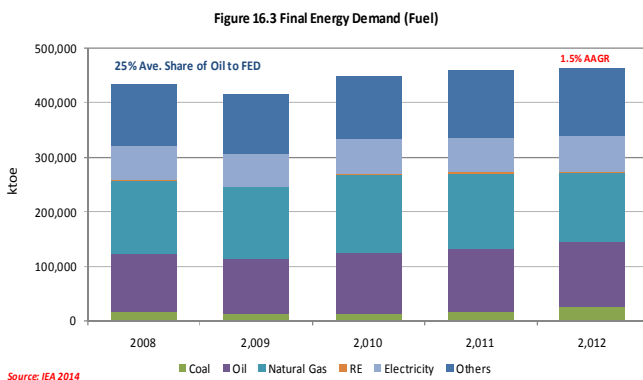
oil intensity also improved by 2.5 percent from 2011 level of 38.1 toe/million USD GDP to 37.2 toe/million USD GDP in 2012. Such demonstrated improvements in energy and oil intensities, particularly from 2011 levels, could be attributed to the new measures to improve energy efficiency in existing industries, increased share of less-energy intensive services, and on the efforts to enhancing efficiency in heat supply to the residential and commercial sectors (APERC, 2015a & EDMC, 2014).

Oil Supply and Demand

a) Crude oil Production and Imports

Russia is the second top world crude oil producer with 10,104 thousand barrels/day (‒000bbl/d) capacity in 2012, which steadily increased annually by 1.5 percent in the last 5 years. In 2013, the economy's production reached 10,425,000 bbl/d. The economy is a major oil exporter with bulk of the exports is directed towards western and eastern Europe, while the other export routes are headed to regional markets such as the APEC region. China, Korea, Japan and the United States are
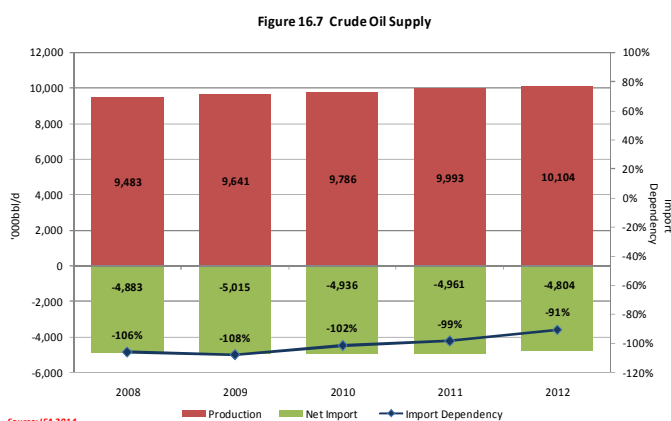
the major export destinations of the economy's oil in the APEC region (EIA, 2015).

b) Oil Products

Table 16.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	4,726	4,724	5,131	5,129	5,498
Net Imports	-1,879	-1,971	-2,124	-1,943	-2,047
Others *	42	49	-48	29	-196
Net Supply	2,890	2,801	2,959	3,215	3,254
Demand	2,890	2,801	2,959	3,215	3,254
Gasoline	772	765	815	825	857
Diesel Oil	651	580	573	627	558
Fuel Oil	252	249	214	305	313
LPG	338	373	365	413	437
Other Petroleum Products	876	835	992	1,044	1,088
Import Dependency	**-69%**	**-75%**	**-75%**	**-65%**	**-63%**

* *include stock change, international marine & aviation and statistical difference*
Source: IEA 2014

Russia's refinery production had expanded at AAGR of 3.9 percent (2008-2012) with exports growing by 2.2 percent annually. The economy's total oil demand increased annually by 3.0 percent, on the average. Other petroleum products (Naphtha, Lubricants, and Bitumen, etc.) used as feedstock in petrochemical industry were the most consumed fuel with an average share of 31.9 percent. Gasoline followed next with an average share of 26.7 percent and diesel oil with 19.9 percent. Among the fuels, LPG demonstrated a faster growth rate of 6.6 percent annually.

Figure 16.7 Crude Oil Supply

Source: IEA 2014

Table 16.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	296	233	231	207	234
Transport	1,220	1,226	1,259	1,324	1,314
Residential	202	127	134	166	183
Commercial	45	35	36	54	47
Agri and Fishery	107	78	77	98	79
Electricity and Heat	204	207	176	276	280
Others	816	895	1,047	1,091	1,117
Total Consumption	**2,890**	**2,801**	**2,959**	**3,215**	**3,254**

Others include non-energy, own-use and losses
Source: IEA 2014

Figure 16.8 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

By sectoral demand, about half of the total oil demand was consumed by the transport sector, while industry and residential sectors only cornered 8.0 percent and 5.4 percent average shares, respectively, of total. The transport sector oil consumption was increasing at 1.9 percent annually. Oil demand for non-energy uses accounted for 24.0 percent average share.

Although Russia is both net exporter of crude oil and petroleum product, import dependency of the economy for total oil supply (crude and petroleum products) had increased, from negative 287 percent in 2010 to negative 229 percent in 2012. This can be translated to decreased net import of about 2.0 percent from 2010 to 2012.

c) Oil Demand Outlook and Refinery Capacity

Russia's oil demand is expected to display a nil annual growth rate of 0.6 percent until 2040 (APERC, 2015).   In 2013, the economy's refinery capacity stood at 5,500,000 bbl/d, which was about 141.0 percent of its domestic oil demand (based on 85.0 percent operating capacity). New refinery is expected to be put up bringing in additional capacity of 70,000 bbl/d, which will increase the economy's total refining capacity to 5,570,000 bbl/d.

Figure 16.9 Oil Demand and Refinery Capacity
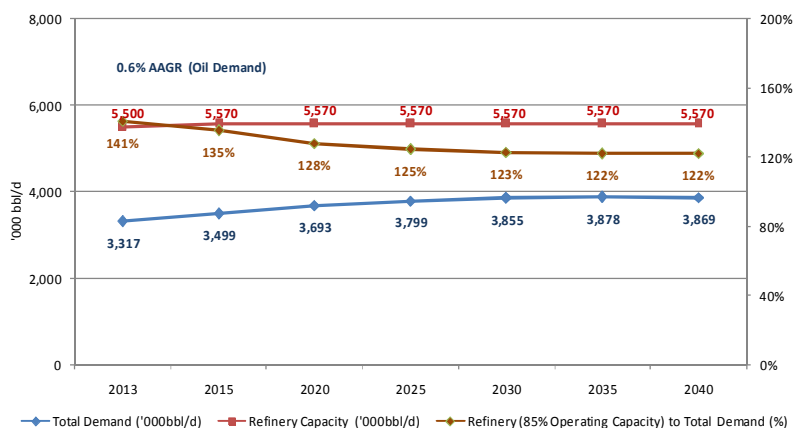
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Oil Supply Security Policy

Table 16.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	No Information	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
No Information	☒ None	☒ None

The Ministry of Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM of Russia) is the main body responsible for dealing with oil disruptions. Said Ministry, upon agreement with the federal executive authorities, shall put forward its proposals to the Government of the Russian Federation within a 6-month period concerning devolving to the federal executive authorities the functions related to protection of population and territories against emergencies (Russia, 2003).

Russia has yet to define the criteria for declaring emergency situation. However, in case of emergency, EMERCON of Russian will arrange and execute the activities related to elimination of emergencies. EMERCON shall use the channels and facilities of the uniform telecommunication network according to the established procedure to control the forces of the unified state system for prevention and elimination of emergency situations (Russia, 2003).

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SINGAPORE

Socio-Economic Overview

Table 17.1 Socio-Economic Profile, 2012

Land Area km^2	714.3
Population (million)	5.31
GDP (USD Billion, 2010 Price & PPP)	388.72
GDP per Capita	73,172

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Singapore is situated south of the Malaysia Peninsula between the Strait of Malacca and the South China Sea with a total land area of 714.3 square kilometres. Its population was about 5.31 million in 2012 and growing with an average annual rate of 2.4 percent.

Despite its small land area and population, the economy is one of the most highly industrialised and urbanized economies in Southeast Asia. Singapore GDP reached USD 388.7 billion and per capita of USD 73,172 (USD 2010 Price and PPP) in 2012 and had enjoyed robust economic growth with the average annual growth rate (AAGR) of 5.6 percent between 2008 and 2012 (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Singapore's total primary energy supply (TPES) in 2012 had increased marginally compared to 2008 level with an AAGR of 0.6 percent over 2008-2012. Oil remained as the economy's primary energy source, accounting for about 68.7 percent during the period to meet the international transport such as international marine bunkers and international aviation bunkers because Singapore has been growing as a regional petroleum hub and supplier of equipment for the oil and gas industry. Natural gas followed next as it was used for approximately 80.0 percent of the economy's power generation.

The economy's final energy demand increased substantially with AAGR of 8.0 percent over 2008-2012. Oil had hovered around 70.0

Figure 17.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 17.2 Total Primary Energy Supply

Source: IEA 201

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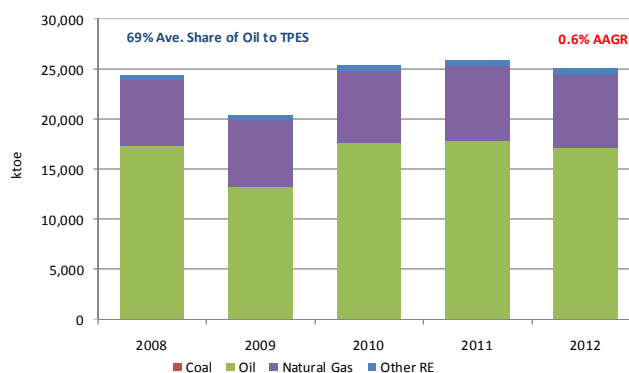
percent of such demand, leaving the rest for electricity and natural gas.

The largest share of the final energy demand by sector was 37.8 percent for non-energy use in 2012 because Singapore had grown as one of the leading economies in the petrochemical industry in the world. The industry sector, especially manufacturing industry, came next with a share of 32.3 percent (IEA, 2014).

Figure 17.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 17.4 Final Energy Demand (Sector)

Source: IEA 2014
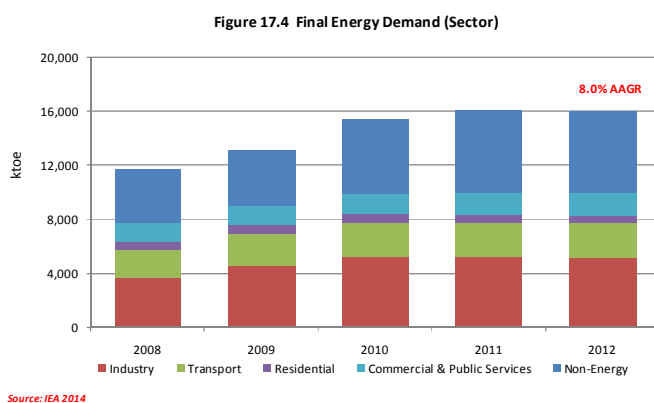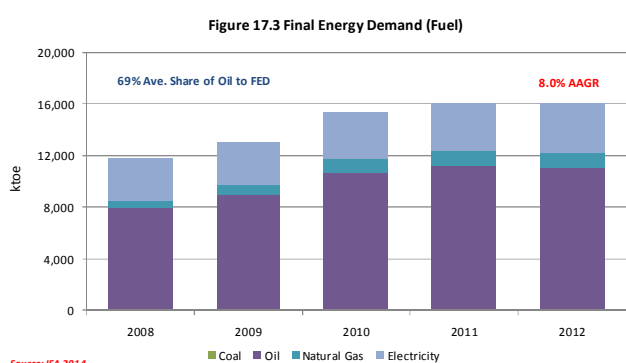
b) *Energy per Capita and Energy Intensity*

Final energy demand and oil per capita had increased at almost same level, from 2.4 toe/person in 2008 to 3.0 toe/person in 2012 (final energy) and 1.64 toe/person to 2.08 toe/person (oil).

On the other hand, improvement in final energy intensity was only realized from 2011

level, registering energy intensity reduction of 3.0 percent which was contributed both by industry and transport sectors. Same trend of intensity improvement was observed for oil, accounting 3.8 percent reduction from 2011 level. Such progress can be attributed to the measures being adopted by the economy to improve its energy efficiency and reduce the energy use of various sectors of its economy. The economyøs efforts to reduce its energy intensity began in 2009 by targeting 35.0 percent reductions by 2035 when APECøs target then was 25 percent by 2030. The economy has enhanced its efforts to meet APECøs more ambitious target of 45.0 percent intensity reduction by 2035 as set by the APEC leaders in 2011 (APERC, 2015a & EDMC, 2014).

Figure 17.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

Figure 17.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Oil Supply and Demand

a) Crude oil Production and Imports

Figure 17.7 Crude Oil Supply
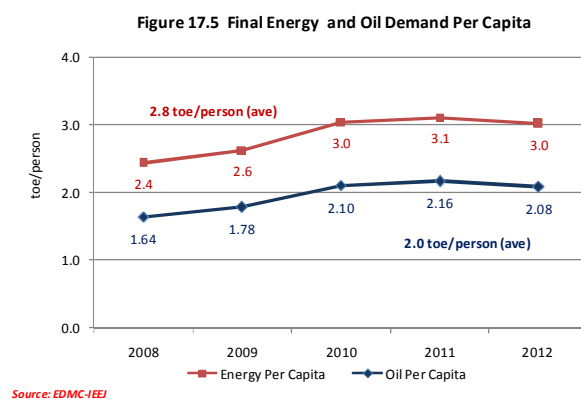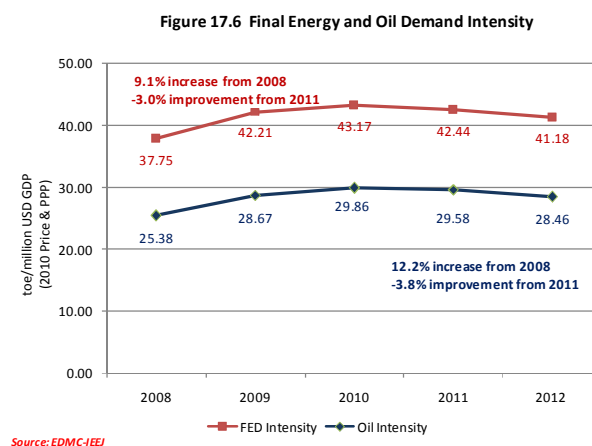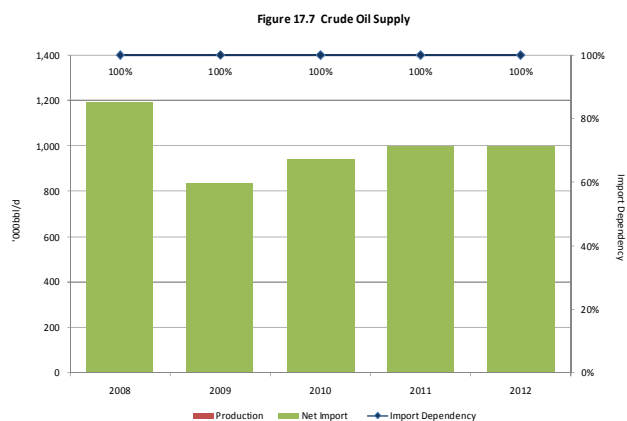
With negligible indigenous energy resource, Singapore relies almost entirely on energy imports to meet its domestic energy needs. Regardless of net import volume of crude oil, its import dependency had stayed 100.0 percent. In 2012, 60.0 percent of oil was imported from the Middle East, with Saudi Arabia and UAE contributing an aggregate share of more than 40.0 percent of total. Herfindahl-Hirshman Index value of 0.48 indicates that the regional import sources could be said as mid-concentration.

Figure 17.8 Singapore Crude Oil Imports by Sources, 2012

HHI = 0.48
(Mid-Concentration)
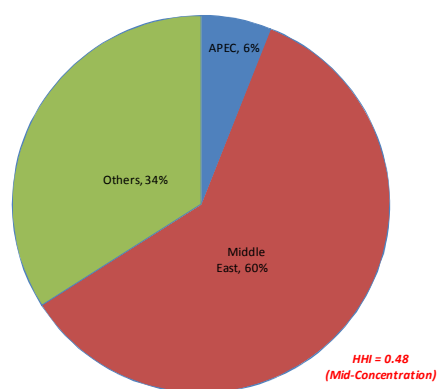
b) Oil Products

Having large refinery capacity, Singapore is one of the top ten exporters of refined oil products in Asia. About 70.0 percent of the economy's refinery output is intended for exports. More than half of economy's exports are going to Malaysia, Indonesia and Australia (EIA, 2013).

Other petroleum products like naphtha used as feedstock for the petrochemical industry grew faster at 9.1 percent per annum over 2008-2012 than the total at 5.6 percent. Fuel oil was the second most consumed fuel in Singapore although its share narrowed down by 5.5 percent from 2008 to 2012.

Table 17.2 Oil Products Supply and Demand ('000bbl/d)					
	2008	2009	2010	2011	2012
Refinery Production	1,253	827	916	979	1,010
Net Imports	-114	191	229	228	197
Others *	-882	-755	-831	-874	-888
Net Supply	258	263	314	334	320
Demand	258	263	314	334	320
Gasoline	21	20	21	21	21
Diesel Oil	34	39	43	41	39
Fuel Oil	49	43	51	54	43
LPG	3	5	4	4	4
Other Petroleum Products	151	155	195	214	213
Import Dependency	-29%	81%	73%	69%	58%

*include stock change, international marine & aviation and statistical difference

As the petrochemical industry is one of the major contributors to the economy, oil demand from 'Others' sector demonstrated a significant increase, from 143,000 bbl/d in 2008 to 188,000 bbl/d in 2012, which

registered an AAGR of 7.0 percent during the 5-year period. Among the sectors, however, the industry sector recorded the fastest growth rate of 9.0 percent in the last 5 years.

Despite being an exporter of petroleum products, import dependency for total oil supply (crude oil and petroleum products) remained at 100.0 percent during the 5-year period. This was also due to increased imports of refined products starting 2010.

Table 17.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	39	53	58	57	56
Transport	44	48	50	50	50
Residential	1	1	1	1	1
Commercial	2	3	3	2	2
Agri and Fishery	-	-	-	-	-
Electricity	28	26	5	35	25
Others	143	133	168	189	188
Total Consumption	**258**	**263**	**314**	**334**	**320**

Others include non-energy, own-use and losses
Source: IEA 2014
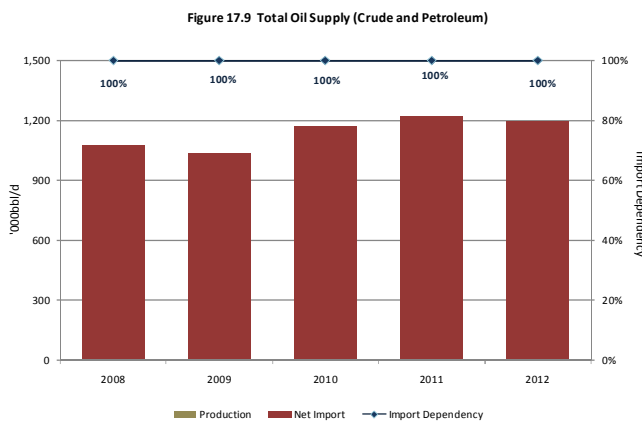
Figure 17.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

c) Oil Demand Outlook and Refinery Capacity

Figure 17.10 Oil Demand and Refinery Capacity
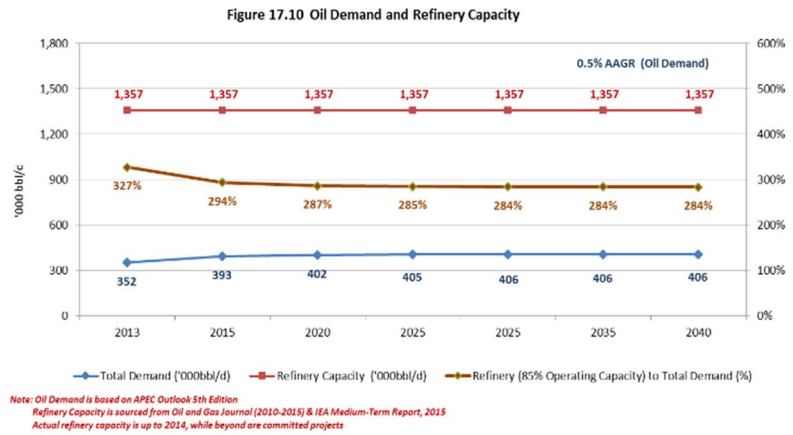
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Singapore's oil demand is projected to reach 452,000 bbl/d in 2040, posting a minimal growth of 0.5 percent per annum over the outlook period (APERC, 2015). Existing refinery capacity of 1,357,000 bbl/d that is assumed to stay the same would still be almost 300.0 percent of projected oil demand (based on 85.0 operating capacity). Therefore, the economy has huge surplus of domestic refining capacity to meet local oil demand and its exports obligation.

Oil Supply Security Policy

Table 1.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Risk Assessment Horizon Scanning (RAHS) Programme Office is the agency in

charge of regularly monitoring real-time security developments, which include imminent oil supply emergencies. Depending on the risk level of oil supply emergency, an Inter-agency Government Committee will be convened to manage and address the emergency situation (OGSN, 2015).

b) Criteria of Emergency

Based on definition of ASEAN Petroleum Security Agreement (APSA), critical shortage is defined as the situation when a member economy is experiencing a shortfall of at least 10 percent of the Normal Domestic Requirement for a continuous period of at least 30 days (ASCOPE, 2009).

c) Emergency Policy

In case of emergency, the government will monitor the real-time security development, through various entities such as the Risk Assessment Horizon Scanning Programme Office. The Inter-agency Government Committee will implement appropriate measures to deal with oil supply emergency and to ensure continued supply to meet domestic demand. As a measure for oil supply emergency, power generation companies are required to maintain a stockpile of fuel oil and diesel based on Energy market Authorityøs license requirement (APERC, 2014).

d) Strategic Oil Stockholding

Singapore has no mandatory stockholding for refineries or private oil companies. The obligatory crude oil stockpiling was terminated back in 1983. However, refineries are maintaining operational stocks estimated to be around 50 days. Only power generating companies are required to hold fuel stocks as reserved fuels equivalent to 90 days to ensure continuous supply power in the event of any supply emergency (IEA, 2014a).

e) Regional Oil Security Policy

The Coordinated Emergency Response Measure (CERM) provision of the APSA agreement endeavours all members to supply petroleum to the ASEAN Member State in Distress at the aggregate amount equal to 10percent of the Normal Domestic Requirement of the said member state. It is a requirement, however, that a member state should implement short-term measures to reduce demand before requesting assistance under CERM. The Operationalization Manual for CERM is now being reviewed and studied by the APSA Task Force for its effective implementation during oil supply emergency (ASCOPE).

f) Emergency Exercise Activity

Singapore was among the ASEAN members who participated in the APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013. The emergency exercise was conducted by Asia Pacific Energy Research Centre (APERC) in collaboration with other international organizations like IEA (APERC, 2014).

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CHINESE TAIPEI

Socio-Economic Overview33

Table 18.1 Socio-Economic Profile, 2012

Land Area km^2	36,193
Population (million)	23.32
GDP (USD Billion, 2010 Price & PPP)	784.73
GDP per Capita	33,656

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Chinese Taipei, located 160 kilometres off the south-eastern coast of China has a land area of about 36 thousand square kilometres. The economyøs population in 2012 was 23 million and growing at an average annual growth rate (AAGR) of 0.3 percent in the last 5 years (2008-2012). In the same year, the economyøs GDP was recorded at USD 784.7 billion (USD 2010 Price & PPP) exhibiting a 5-year AAGR of 3.6 percent. Meanwhile, GDP per capita had also grown at 3.2 percent average annual rate (last 5 years) reaching USD 33,656 per person in 2012 (APERC, 2015a & EDMC, 2014).

Figure 18.1 GDP and GDP Per Capita
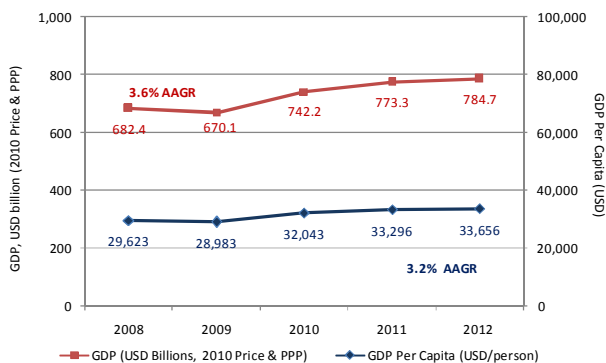
Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. Its energy supply structure is highly dependent on fossil fuels such as coal, oil and naturalgas (APERC, 2015a). In the last 5 years (2008-2012), oil and coal were the dominant energy sources of the economy, posting annual average shares of 38.5 and 37.9 percent respectively, of primary energy mix. Likewise, natural gas provided 11.5 percent average share, while nuclear posted 10.2 percent and renewable energy 2.0 percent for the same period. The economy is a net importer of crude oil and is expected to increase with increasing demand.

Figure 18.2 Total Primary Energy Supply

Source: IEA 2014

116
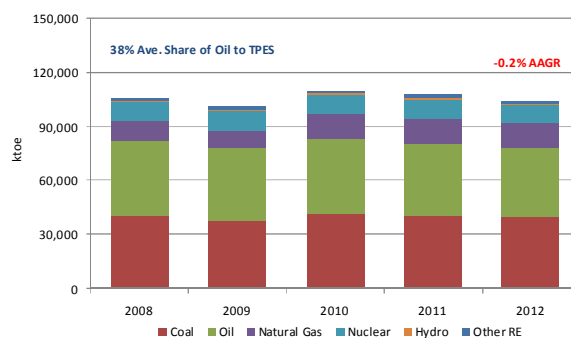
In terms of final energy demand, average share of oil was recorded at 57.1 percent, followed by electricity (28.5 percent), coal (10.8 percent), and natural gas (3.2 percent). The economy's oil consumption had been increasing at AAGR of 0.7 percent in the last 5 years.

Among the sectors, the industry sector is the largest energy consuming sector utilizing about 33.5 percent, on the average, of final energy demand. The sector had been growing at AAGR of 1.3 percent annually in 5-year period. Non-energy was the second largest with 32.6 percent average share, while transport sector consumed 18.5 percent of total (IEA, 2014).

b) *Energy per Capita and Energy Intensity*

Chinese Taipei's energy and oil per capita had been increasing over the last 5 years exhibiting 2.8 tonnes of oil equivalent (toe)/person and 1.6 toe/person, respectively. Meanwhile, the economy to achieve improvement in energy intensity with a reduction of 10.4 percent in energy consumption from 92.7 toe/million USD GDP in 2008 to 83.1 toe/million USD GDP in 2012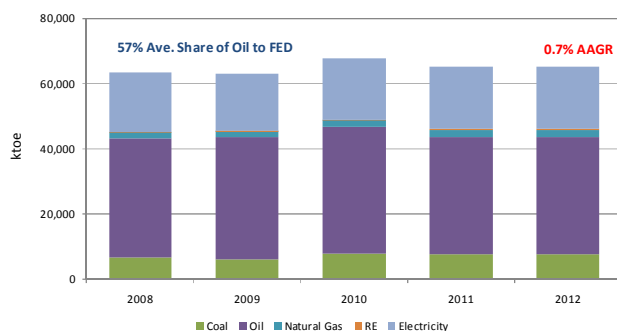. Oil consumption likewise declined significantly by 14.8 percent, which was recorded at 45.9 toe/million in 2012 from 53.8 toe/million USD GDP in 2008. Such significant changes could be attributed to energy efficiency and structural effect ó shift to less energy-intensive sectors mainly from industry and also from the contribution of transport sector (EDMC, 2013).

Figure 18.3 Final Energy Demand (Fue
57% Ave. Share of Oil to FED   0.7% AAGR
Source: IEA 2014

Figure 18.4 Final Energy Demand (Sector)
0.7% AAGR
Source: IEA 2014

Figure 18.5 Final Energy and Oil Demand Per Capita
2.8 toe/person (ave)
2.7   2.7   2.9   2.8   2.8
1.6 toe/person (ave)
1.59   1.62   1.68   1.55   1.54
Source: EDMC-IEEJ
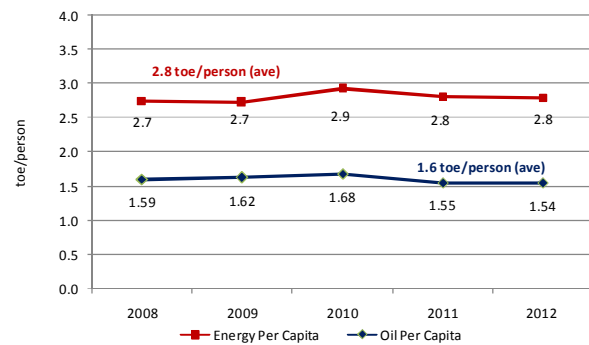
Figure 18.6 Final Energy and Oil Demand Intensity
92.7   93.8   91.2   84.4   83.1
-10.4% improvement from 2008
-1.6% improvement from 2011
53.8   55.9   52.3   46.5   45.9
-14.8% improvement from 2008
-1.4% improvement from 2011
Source: EDMC-IEEJ
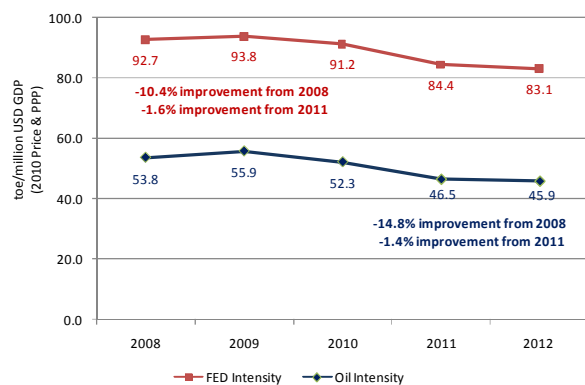
Oil Supply and Demand

a) Crude oil Production and Imports

Figure 18.7 Crude Oil Supply
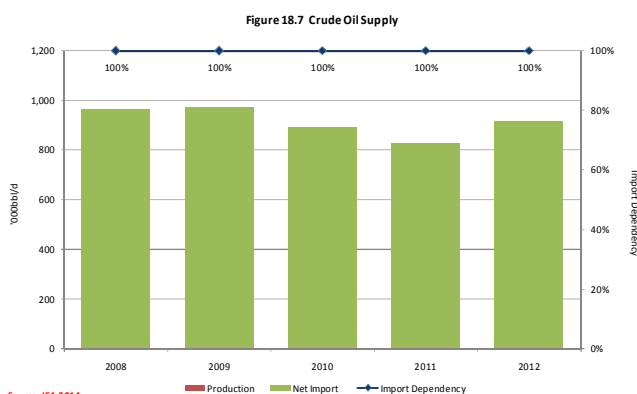
The lack of domestic energy and mineral has forced Chinese Taipei to import nearly all of its crude oil requirements. Considering that Chinese Taipei's energy supply structure is highly dependent on fossil fuels such as coal, oil and natural gas, has made the economy 100.0 percent crude oil import dependent. The Middle East represents its major supplier, accounting for 82.7 percent of total oil imports. Other regional sources are Africa (12.1 percent), APEC region (3.7 percent), and Other Asia and the Pacific (1.5 percent). Based on Herfindahl-Hirshman Index (HHI), the import regional sources may be considered

Figure 18.8 Chinese Taipei Crude Oil Imports by Sources, 2013

HHI = 0.70
(Moderate-High Concentration)
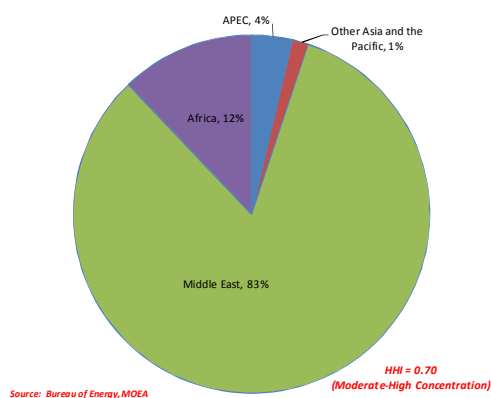
moderate-high concentration with HHI value of 0.70.

b) Oil Products

Chinese Taipei is also an exporter of petroleum products. However, refinery production had remained constant in the past 5 years. The economy registered a negative net import of 19 thousand barrels per day ('000bbl/d) in 2012, which was higher compared to 2008 level. This resulted in decreased import dependency, from negative 1.0 percent in 2008 to negative 2.0 percent in 2012. Total petroleum demand decreased annually by 1.2 percent, on the average. Other petroleum products used for non-energy was the most consumed fuels with average aggregate share of about 50.5 percent.

Table 18.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	1,024	1,065	989	907	1,001
Net Imports	-11	-59	78	77	-19
Others *	-60	-55	-77	-72	-72
Net Supply	952	951	989	913	909
Demand	952	951	989	913	909
Gasoline	177	180	182	183	179
Diesel Oil	99	93	98	100	99
Fuel Oil	135	108	117	103	86
LPG	82	85	78	80	71
Other Petroleum Products	460	484	515	448	474
Import Dependency	-1%	-6%	8%	8%	-2%

***** *include stock change, international marine & aviation and statistical difference*

More than half of total oil demand was consumed by non-energy sector, followed by transport (28.1 percent). Oil demand of

Table 18.3 Oil Consumption ('000bbl/d)

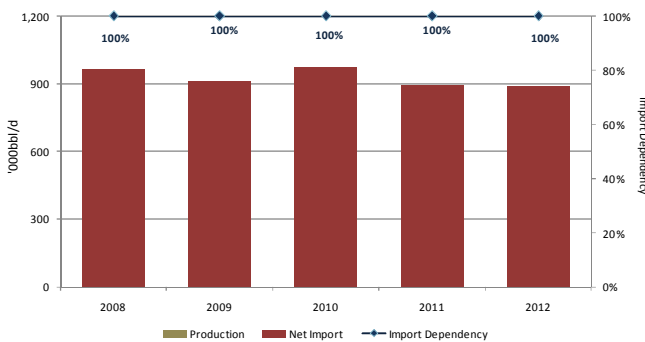|	2008	2009	2010	2011	2012
Industry	79	71	73	64	54
Transport	258	261	269	271	265
Residential	37	37	36	35	34
Commercial	21	20	19	18	17
Agri and Fishery	9	7	6	6	7
Electricity and Heat	57	35	44	39	32
Others	491	521	542	479	500
Total Consumption	**952**	**951**	**989**	**913**	**909**

Others include non-energy, own-use and losses
Source: IEA 2014

non-energy and transport sectors was expanding less than 1.0 percent, while the other fuels displayed negative growth rates. Around 40.0 percent of petroleum product imports (excluding LPG) in 2013 was primary sourced from Malaysia (43.0%), Singapore (30.0%) and Indonesia (20.0%). Meanwhile, the economy obtained more than 80.0 percent of LPG imports from the Middle East (BOE-MOEA, 2013).

Despite the 2.0 percent decreased in net import during the period 2008 to 2012 for crude oil and refined products, the import

requirement to meet domestic oil demand still remained at 100.0 percent.

c) Oil Demand Outlook and Refinery Capacity

Chinese Taipei's oil demand is projected to decrease at AAGR of 0.3 percent in the future (2013-2040) (APERC, 2015). In 2013, the economy's refinery capacity of 1,310,000 bbl/d could still meet about 119.0 percent of its domestic oil demand based on 85.0 percent operating capacity. Since oil demand is projected to be declining trend, domestic refinery production still could meet about 124.0 percent of oil demand in 2040.

Figure 18.10 Oil Demand and Refinery Capacity

Note: Oil Demand is based on Draft APEC Outlook, 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Figure 18.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy		

Table 1.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☒ None	☒ None

As stipulated in the Petroleum Administration Act of 2001, the Ministry of Economic Affairs (MOEA) is the responsible organization to handle oil supply disruptions being the head or lead agency of the Central Competent Authority. In Measure Governing Oil in Emergency Management, which is instituted under the provision of the Petroleum Administration Act, the Central Competent Authority, headed by the Minister of MOEA, shall establish the Council Oil in Emergency Management before implementation of the said emergency management. The Director of the Council is the Minister of MOEA and members are composed of vice-ministers of the different government agencies including representatives from oil refinery and scholars or professionals. The Council's missions are to propose the enforcement period of the Measure Governing Oil in Emergency Management, and the division of the work, regarding the preceding measure, of the agencies concerned (MOJ, 2009).

b) *Criteria of Emergency*

The Measure Governing Oil in Emergency Management defines emergency as situations of deficient oil resources and acute fluctuation of oil price that could influence domestic oil supply or affect national security, which may be determined by the Central Competent Authority. Such situations may warrant enforcement of the Emergency Management through oil control, quotas, price limits and adjustment, appropriation and operational measures of oil stockpile to be announced by the central competent authority upon approval

of the Executive Yuan. The Executive Yuan is the executive branch of the government, headed by the premier, who is appointed by the president.

c) *Emergency Policy*

In case of emergency, the Central Competent Authority may impose the necessary measures, which include restriction on oil export, stocks holdings, adjusting refined and imported oil types and quantity, implementing restrictions on oil distribution and selling, and setting up the maximum of oil prices (OGSN, 2015).

The government-owned strategic petroleum reserves could also be released in two (2) ways: (1) Through open public bid; and, (2) Sell in the market by authorized oil businesses with the price assigned by the Central Competent Authority.

d) *Strategic Oil Stockholding*

Even not being a member country of IEA, Chinese Taipei follows the IEA 90-day Strategic Petroleum Reserves obligation (EWG, 2011). The strategic reserves are classified into:

- Public reserves, which should be not less than 30 days; and
- Industry reserves (oil refiners and importers), which should not be less than 60 days *(OGSN, 2015)*.

e) Regional Oil Security Policy

Chinese Taipei has not entered into any regional oil security policy, nor engaged in regional cooperation agreement on oil supply.

f) Emergency Exercise Activity

To date, Chinese Taipei has no known any emergency exercise activity conducted, nor participated in any joint emergency response simulation exercises.

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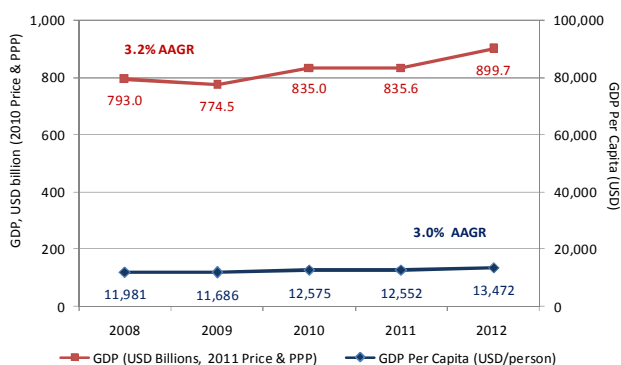
THAILAND

Socio-Economic Overview

Table 19.1 Socio-Economic Profile, 2012

Land Area km^2	513,120
Population (million)	66.79
GDP (USD Billion, 2010 Price & PPP)	899.70
GDP per Capita	13,472

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Thailand covers an area of 513,120 square kilometres and shares borders with Malaysia to the south and with Myanmar, the Lao People's Democratic Republic and Cambodia to the north and east. Its population was 66.79 million in 2012 with a modest average annual growth rate (AAGR) of 0.23 percent between 2008 and 2012. While Thailand's GDP robustly increased to USD 899.7 billion (USD 2010 Price and PPP) in 2012, 7.7 percent up from 2011 level, its AAGR in the 5-year period was relatively slower at 3.2 percent. Similarly, GDP per capita posted an annual increase of 3.0 percent, on the average, reaching 13,472 USD/person in 2012 (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

Thailand's total primary energy supply (TPES) grew at 4.1 percent per annum over 2008-2012, keeping a share of each fuel almost same. Accounting for the largest share of 38.5 percentduring the period, oil demonstrated the faster AAGR of 5.0 percent than that of TPES. Natural gas on which the economy heavily relies for power generation came next in terms of share at 27.5 percent and renewable energy, mostly biomass, followed with a share of around 20.0 percent. Hydro exhibited annual growth rate of 5.3 percent during the 5-year period. The economy has indigenous energy resources but is highly dependent on energy imports (IEA, 2014).

Figure 19.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

Figure 19.2 Total Primary Energy Supply

Source: IEA 2014

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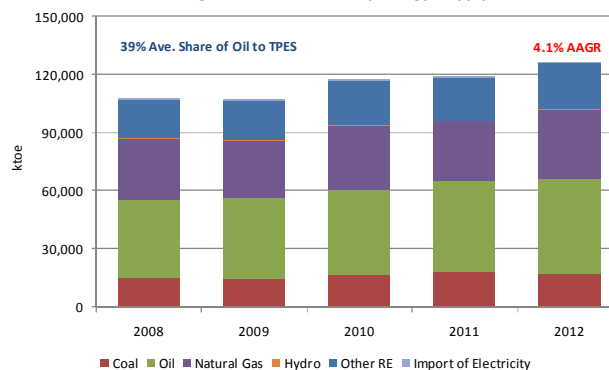
Final energy demand of Thailand also robustly increased with AAGR of 5.7 percent in the past 5 years. By fuel, oil had been dominant with an average share of 51.9 percent, followed by renewable energy (17.0 percent), of which biomass was mainly used in industry and residential sectors. Natural gas registered a significant AAGR of 20.5 percent despite having the smallest share to total.

Figure 19.3 Final Energy Demand (Fuel)

Source: IEA 2014

The industry and transport sectors constituted more than half of the final energy demand in 2012, 31.6 percent and 23.6 percent, respectively. On the other hand, non-energy sector registered the fastest AAGR of 10.9 percent among the sectors.

Figure 19.4 Final Energy Demand (Sector)

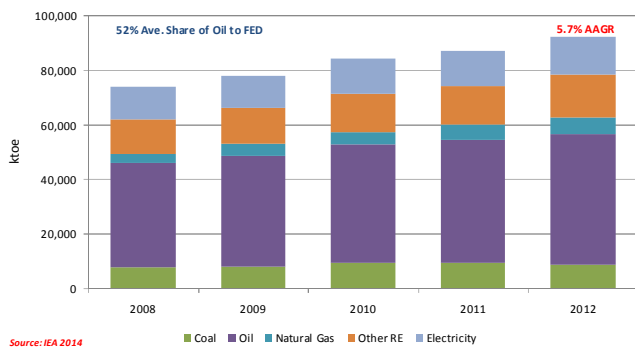*Source: IEA 2014*
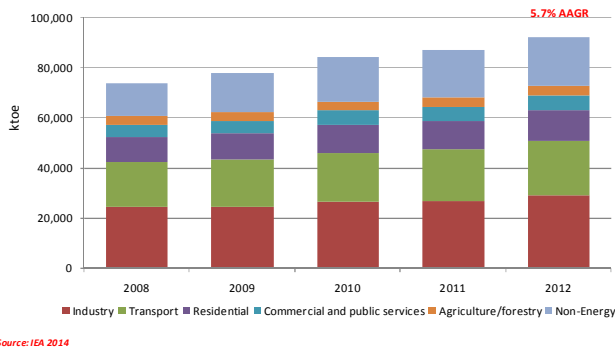
b) *Energy per Capita and Energy Intensity*

Final energy demand grew much faster than the population in the five years (2008-2012),

which consequently made both final energy demand per capita and oil demand per capita to go up continuously. On the other hand, the energy intensity of final energy demand increased by 10.2 percent from 2008 to 2012, largely owing commercial and residential sectors, with an increase of 15.0 percent. This implies that Thailand may need to strengthen measures to improve energy efficiency in other sector.   Similarly, oil intensity was also in the same upward trend as the final energy demand (APERC, 2015a & EDMC, 2014).

Figure 19.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 19.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

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Oil Supply and Demand

a) *Crude oil Production and Imports*

Having minimal oil and gas resources, Thailand is highly dependent on crude oil

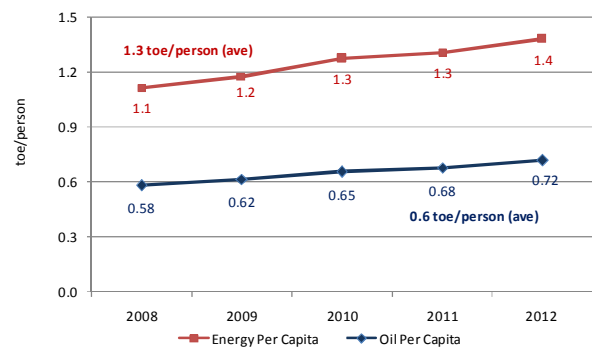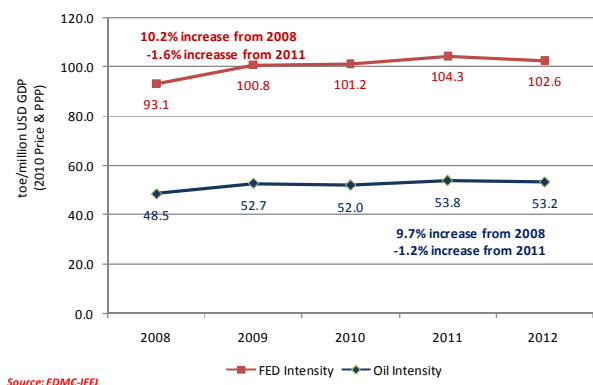imports which resulted in import dependency of around 77.0 percent between 2008 and 2012. Bulk of oil imports were sourced from the Middle East with 75.0 percent share to total imports. UAE was the main contributor of Middle East crude oil imports providing 41.0 percent to total, followed by Saudi Arabia with 18.0 percent share. The APEC region also contributed 17.0 percent to oil imports, mostly coming from Australia, Indonesia, Malaysia and Russia (MOE). With Herfindahl-Hirshman Index (HHI) value of 0.48, it indicates that the economy's regional import sources could be said as mid-concentration.
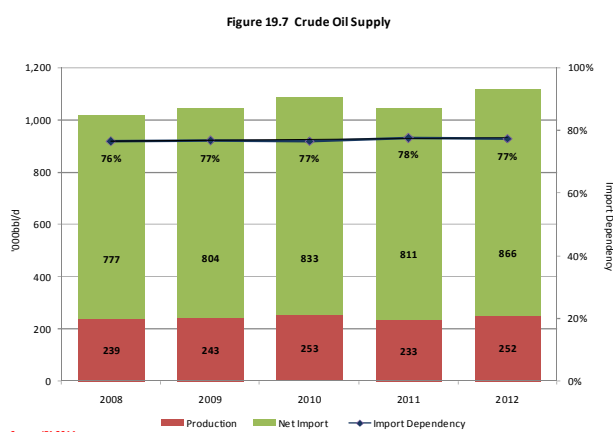

Figure 19.7 Crude Oil Supply

Source: IEA 2014

Figure 19.8 Thailand Oil Imports by Sources, 2013

HHI = 0.58
(Mid-Concentration)

Source: Ministry of Energy, Thailand
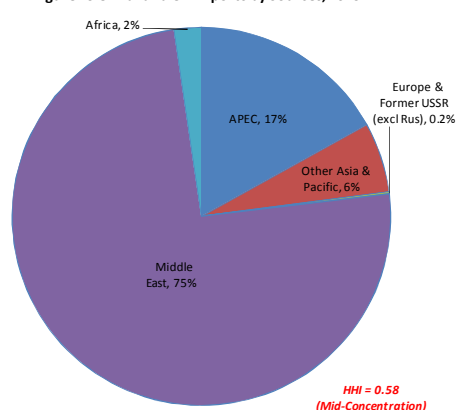
b) Oil Products

Thailand is a net exporter of petroleum products. However, demand for petroleum products grew faster at 6.5 percent per annum

between 2008 and 2012 than that of refinery production at 4.9 percent. To make up for the gap, petroleum products imports substantially increased, which resulted in increasing the economy's import dependency level, from negative 19.0 percent in 2008 to negative 13.0 percent in 2012. Among the fuels, diesel was the most consumed fuel, about 2.9 times higher than gasoline demand due to the significant number of diesel light vehicles in the economy.

Table 19.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	1,226	1,295	1,342	1,378	1,483
Net Imports	-175	-191	-164	-137	-163
Others *	-112	-103	-101	-108	-111
Net Supply	939	1,002	1,077	1,133	1,210
Demand	939	1,002	1,077	1,133	1,210
Gasoline	119	124	122	120	126
Diesel Oil	310	321	323	341	366
Fuel Oil	28	21	21	24	27
LPG	180	196	225	259	278
Others Petroleum Products	303	340	387	389	412
Import Dependency	**-19%**	**-19%**	**-15%**	**-12%**	**-13%**

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

The transport sector continued to be dominant but its share had been gradually taken by non-energy sector over 2008-2012 period. The non-energy sector demanded 40.0 percent of total final energy demand, higher than transport demand share of 34.0 percent. The remaining was used by other sectors (industry, residential, commercial, agriculture and electricity sectors) with each having less than 10.0 percent share to total. Compared to the

Table 19.3 Oil Consumption ('000bbl/d)

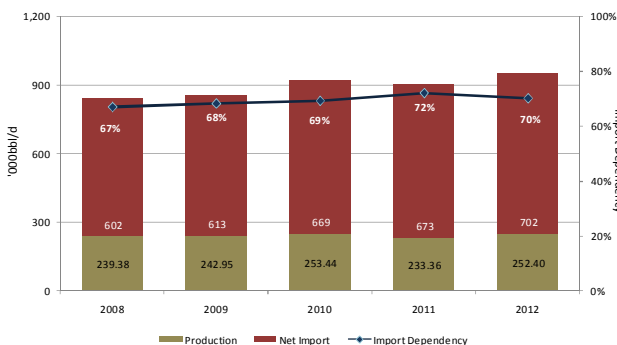|	2008	2009	2010	2011	2012
Industry	67	62	66	67	85
Transport	366	379	379	396	410
Residential	52	56	53	65	77
Commercial	28	28	38	35	38
Agri and Fishery	71	70	71	76	78
Electricity	7	3	5	8	10
Others	348	405	465	486	512
Total Consumption	**939**	**1,002**	**1,077**	**1,133**	**1,210**

Others include non-energy, own-use and losses
Source: IEA 2014

transport sector's AAGR of 2.9 percent during the 5-year period, the non-energy sector demonstrated an annual growth rate of 10.1 percent. The industry sector posted a 6.1 percent growth rate, residential sector with 10.4 percent and commercial sector with 7.6 percent.

The economy's import dependency for total oil supply (crude oil and petroleum products) consistently increased during the 5-year period posting 70.0 percent dependency level. Such could be attributed to expanding petroleum products imports with 34.0 percent annual growth rate compared with export

growth rate of only 5.0 percent. Total oil supply requirement of the economy grew at an AAGR of 3.9 percent.

c) Oil Demand Outlook and Refinery Capacity

Thailand's oil demand is projected to increase to 2,528 thousand barrels per day (000bbl/d) by 2040 with an AAGR of 2.5 percent (APERC, 2015). Thailand has the second largest refining capacity in Southeast Asia, next to Singapore (EIA, 2014). If no additional refinery capacity will be added after 2015, the ratio of refinery production that would be able to meet domestic oil demand is likely to decrease from 76.0 percent in 2013 to 39.0 percent in 2040 based on operating capacity of 85.0 percent.

Figure 19.10 Oil Demand and Refinery Capacity
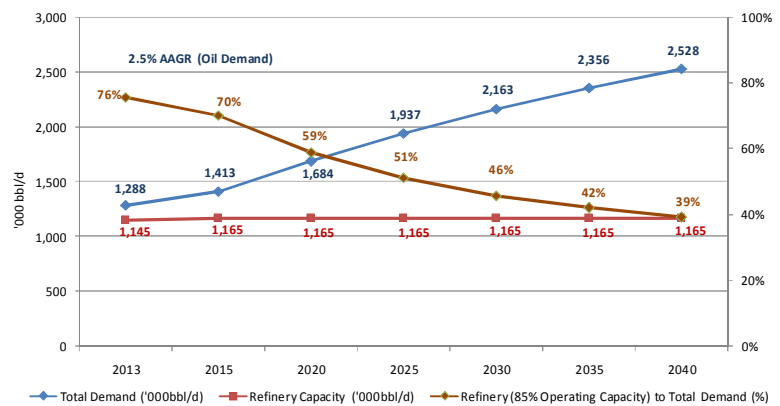
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Ministry of Energy Thailand (2007-2013) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2013, while beyond are committed projects

Figure 19.9 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

Oil Supply Security Policy

Table 19.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

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a) National Emergency Strategic Organization (Institutional Framework)

The Ministry of Energy chairs the National Emergency Strategy Organization (NESO). NESO is a working group consisting of representatives from different departments under the Ministry of Energy including the Office of Permanent Secretary and other concerned organizations such as the Petroleum Authority of Thailand–Public Company Limited (PTT) and the Electricity Generating Authority of Thailand (EGAT) (OGSN, 2015). The Office of Permanent Secretary serves as the secretariat of NESO (APERC, 2014).

b) Criteria of Emergency

As a member state of ASEAN, Thailand can make use of definition or criteria of emergency as set forth in the ASEAN Petroleum Security Agreement (APSA), which is a situation when a member is experiencing a shortfall of at least 10 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. APSA was updated and fully ratified by ASEAN members, which took effect in March 2013 (ASCOPE, 2009).

c) Emergency Policy

In the event of emergency, the Ministry of Energy will call a meeting with the NESO for the implementation of response measures to address the emergency situation. Following laws will be enforced by the Ministry of Energy:

- Fuel Trade Act B.E. 2543 (2000) is a regulation governing trade of fuel for

prevention and remedy of fuel supply shortage; and,
- Emergency Decree on Remedy and Prevention of Shortage of Fuel Oil B.E. 2516 (1973).

Among the measures that could be implemented during supply emergency are restricting crude oil and oil products exports, and drawdowning of legal government-controlled oil stocks (APERC, 2014).

d) Strategic Oil Stockholding

Based on amendments of the Fuel Trade Act of 2000, refineries are required to hold 6.0 percent of their annual sales of crude oil and oil products, while retailers and importers are obliged to have stockholding equivalent to 6.0 percent of crude oil and 12.0 percent of oil products. The stockholding levels must be at least 43 days of domestic consumption, and operational stocks should be around 5 to 7 days. Overall, total oil stocks should be 50 days of domestic consumption (OGSN, 2015). The Thai government is intending to increase oil stockholding up to 90 days of domestic consumption (IEA, 2014a).

e) Regional Oil Security Policy

In the APSA Coordinated Emergency Response Measure (CERM), all members are endeavoured to supply petroleum to the ASEAN Member State in Distress at the aggregate amount equal to 10 percent of the Normal Domestic Requirement of the said member state.As a requirement for assistance, a member state should have implemented

short-term measures to reduce demand. The CERM Operationalization Manual is under review by the APSA Task Force for its effective implementation during energy supply crisis (ASCOPE).

f) *Emergency Exercise Activity*

Since 2010, Thailand has been conducting annual emergency response exercise. The 6th emergency response exercise was held in March 2015(OGSN, 2015). Thailand also participated in Emergency Response Exercises with IEA in 2009 and APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013.

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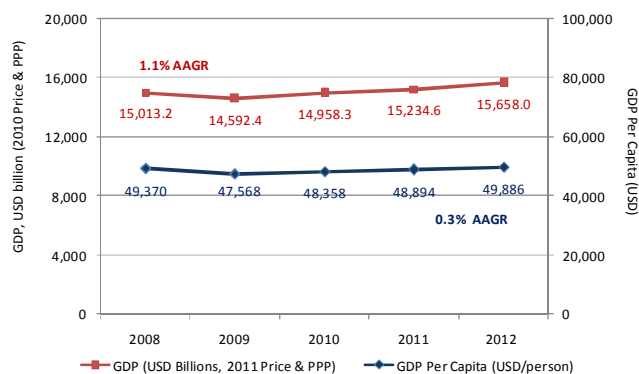
UNITED STATES

Socio-Economic Overview

Table 20.1 Socio-Economic Profile, 2012

Land Area km^2	9,826,675
Population (million)	313.87
GDP (USD Billion, 2010 Price & PPP)	15,657.97
GDP per Capita	49,886

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

The United States (US) has a total land area of 9.8 million square kilometres and is located between Canada and Mexico. Its population demonstrated a modest growth rate at 0.79 percent per annum over 2008-2012, reaching about 313.87 million in 2012. The US economy, the largest in the world, recorded a GDP of USD 15.7 trillion (USD 2010 Price and PPP) in 2012 with an average annual growth rate (AAGR) of 1.1 percent during the 5-year period. Correspondingly, GDP per capita posted an AAGR of 0.3 percent over the 5-year period reaching 49,886 USD per person in 2012 (APERC, 2015a & EDMC, 2014).

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

The U.S.'s total primary energy supply (TPES) had waned with a negative AAGR of 1.5 percent over 2008-2012, posting 2,140.62 million tonnes of oil equivalent (Mtoe) in 2012, 6.0 percent lower than 2008 level. Despite its dominant position, oil had slowed down, which also showed negative AAGR of 2.3 percent. Natural gas had grown by 2.4 percent per annum and taken up coal's share gradually due to rapid production of unconventional gas.

Figure 20.2 Total Primary Energy Supply
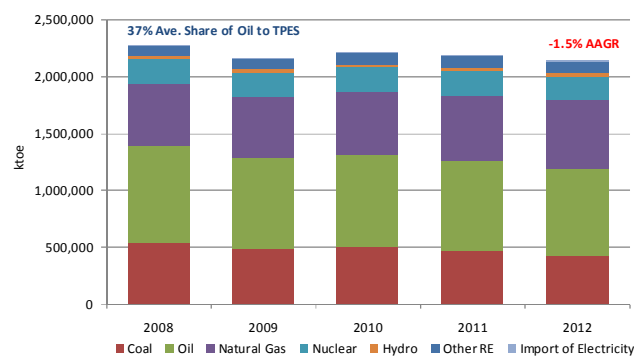
Source: IEA 2014

Final energy demand in the U.S. also indicated a negative AAGR of 1.6 percent over 2008-2012. Each fuel's share had remained almost same during the period. In 2012, oil

Figure 20.1 GDP and GDP Per Capita

Source: EDMC-IEEJ

accounted for 50.2 percent of final energy demand, followed by electricity (22.4 percent) and natural gas (20.7 percent). Only renewable energy, mainly biofuels, recorded positive AAGR of 0.5 percent.

Figure 20.3 Final Energy Demand (Fuel)

By sector, the transport sector accounted for 40.0 percent share, on the average, of final energy demand. However, the sector displayed negative AAGR of 0.2 percent, which among the sector was the least. All sectors demonstrated negative AAGR over 2008-2012. On the other hand, non-energy sector decreased at the fastest rate of 6.8 percent per annum (IEA, 2014).
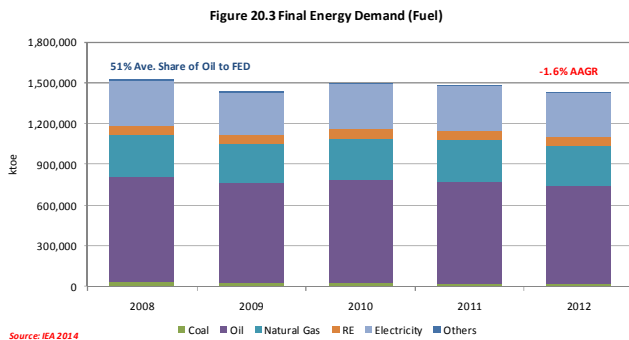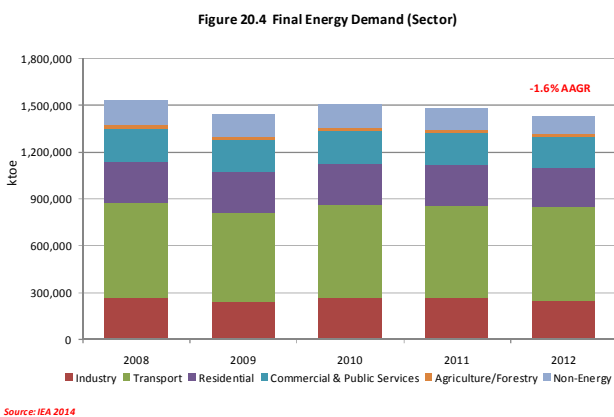
Figure 20.4 Final Energy Demand (Sector)

b) *Energy per Capita and Energy Intensity*

Both final energy demand per capita and oil demand per capita decreased over 2008-2012 period, the former attained 4.6 toe/person and the latter 2.3 toe/person in 2012. Similarly, the

energy intensity of final energy demand and oil demand for 2012 substantially improved by 9.9 percent and 11.4 percent, respectively, compared with 2008 levels. Final energy demand intensity improved across all sectors between 2008 and 2012. The intensity improved most in residential and commercial sectors with an aggregate of 13.6 percent reduction, followed by the industry sector at 12.6 percent and the transport sector at 4.7 percent over the same period (APERC, 2015a & EDMC, 2014).

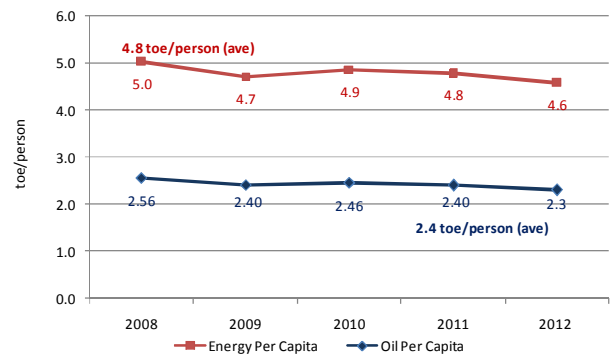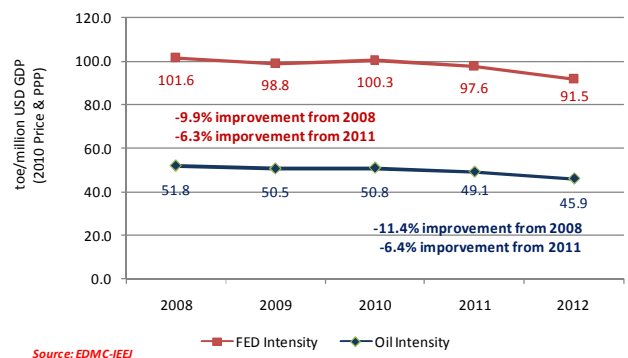**Figure 20.5 Final Energy and Oil Demand Per Capita**
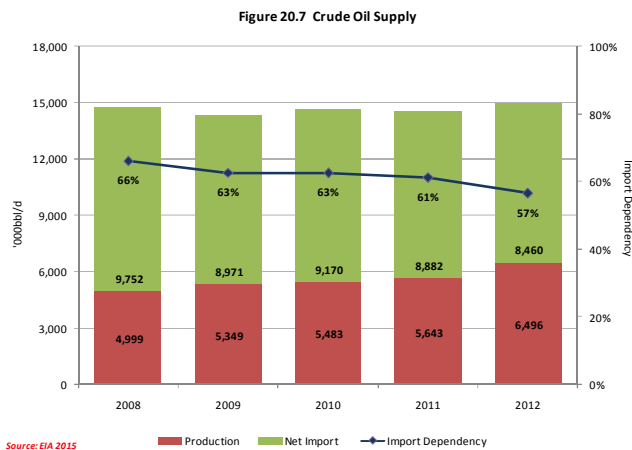
Figure 20.6 Final Energy and Oil Demand Intensity
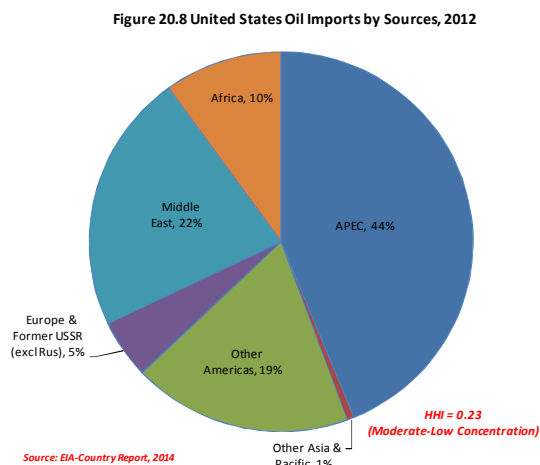
Oil Supply and Demand

a) *Crude oil Production and Imports*

The U.S.'s crude oil production increased largely from 4,999,000 bbl/d in 2008 to

6,496,000 bbl/d in 2012 demonstrating an AAGR of 6.8 percent. Much of the increase in crude oil production came from shale and other tight (very low permeability) formations. Production was further expanded in 2014 by more than 2,000,000 bbl/d (EIA, 2015).

came from the APEC region, mostly provided by Canada and Mexico.On the other hand, the primary source of Middle East crude imports was Saudi Arabia. The Herfindahl-Hirshman Index (HHI) value of 0.23 indicates that the import sources may be considered as moderate-low concentration.

Figure 20.7 Crude Oil Supply

The substantial increase in production resulted in declining net crude oil imports with negative AAGR of 3.5 percent. Such reduction is translated to a constant drop in crude oil import dependency over 2008-2012 period, which could be seen to continue to slide down in the coming years due to decreasing crude oil imports (EIA, 2015a). The U.S. oil import sources by region were diversified relative to other economies. About 44.0 percent of the crude oil imports

b) Oil Products

The U.S. has become a net exporter of petroleum products since 2010 and continuously expanding its exports from then on. Most of the increase of the US exports of petroleum products was attributable mainly to stagnant domestic oil demand, increased crude oil production, refineries operating at high levels. Petroleum product demand all decreased over 2008-2012.

Table 20.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	19,781	19,110	19,908	20,288	19,439
Net Imports	389	21	-234	-871	-1,167
Others *	-1,068	-990	-955	-937	-712
Net Supply	19,102	18,140	18,718	18,479	17,559
Demand	19,102	18,140	18,718	18,479	17,559
Gasoline	8,946	8,767	8,973	8,746	8,462
Diesel Oil	3,949	3,604	3,778	3,762	3,719
Fuel Oil	264	200	196	154	177
LPG	1,512	1,430	1,491	1,518	1,494
Other Petroleum Products	4,430	4,139	4,281	4,300	3,707
Import Dependency	**2%**	**0%**	**-1%**	**-5%**	**-7%**

* include stock change, international marine & aviation and statistical difference

Figure 20.8 United States Oil Imports by Sources, 2012

HHI = 0.23
(Moderate-Low Concentration)

Table 20.3 Oil Consumption ('000bbl/d)

	2008	2009	2010	2011	2012
Industry	655	576	628	632	420
Transport	12,677	12,087	12,452	12,265	12,382
Residential	555	529	511	482	814
Commercial	292	334	324	304	334
Agri and Fishery	328	304	336	312	311
Electricity and Heat	140	114	105	71	59
Others	4,455	4,197	4,363	4,413	3,238
Total Consumption	**19,102**	**18,140**	**18,718**	**18,479**	**17,559**

*Others include non-energy, own-use and losses*
Source: IEA 2014

Gasoline was still the most consumed fuel, accounting for about half of the demand for petroleum products. Diesel oil and other petroleum products (non-energy uses) registered average shares of around 20.0 percent to total.

Demand in the transport sector, which dominated around three-fourth of total displayed a relatively small reduction with AAGR of negative 0.6 percent. Unlike other sectors, only the residential sector revealed a jump in demand in 2012, which was explained by an increased use of LPG (propane) for heating.

With increased production of crude oil and exports of petroleum products, the U.S. import dependency for total oil supply (crude oil and petroleum) went down from 67.0 percent in 2008 to 51.0 percent in 2012, decreasing at AAGR of 7.4 percent. In 2014, import dependency level

fell significantly as total net imports decreased by 2 million bbl/d (EIA, 2015b).

Figure 20.9. Total Oil Supply (Crude and Petroleum

Source: EIA
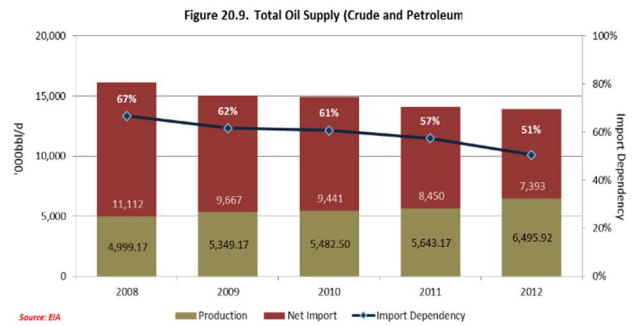
c) Oil Demand Outlook and Refinery Capacity

The United States' oil demand is projected to reach a peak in 2020 and will continue to decline until 2040 with an AAGR of negative 0.3 percent (APERC, 2015). Despite the decreasing oil demand towards 2040, refinery capacity is likely to be maintained at same level (IEA, 2015 & OGJ). That is, domestic refinery production capacity would be able to satisfy oil demand (theoretically) until 2040. However, it may be noted that refinery capacity utilization rate in 2012 was about 89.0 percent of the nameplate capacity.

Figure 20.10 Oil Demand and Refinery Capacity
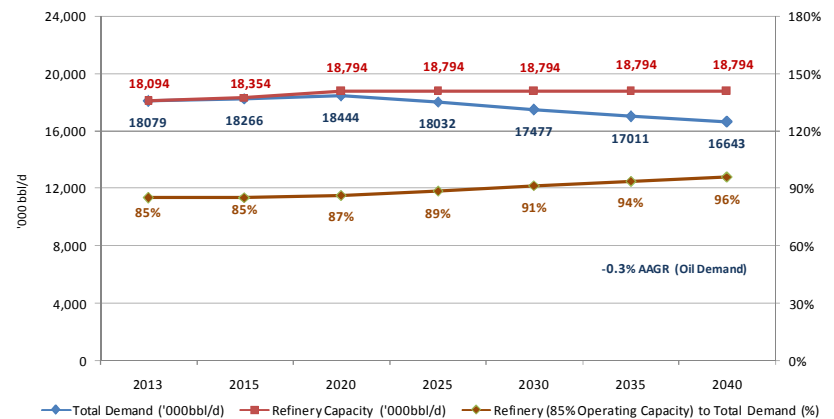
Note: Oil Demand is based on APEC Outlook 5th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Oil Supply Security Policy		

Table 20.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The US Department of Energy (DOE) also acts as the National Emergency Strategy Organisation (NESO) with the primary functions and responsibilities of initiating and facilitating a coordinated response to an oil supply disruption. NESO has established two (2) teams to undertake responses to oil supply disruption, namely: the Executive Team and the Crisis Assessment Team. The Crisis Management assesses the emergency situation and provides responses measures and options to be recommended to the Executive Team. On the other hand, the Executive Team evaluates the findings of the Crisis Management Team and coordinates the responses of concerned departments or organizations. The Executive Team is composed of the Secretary and Deputy Secretary of the Department of Energy, and Senior Management of the Office of Policy and International Affairs, the Energy Information Agency (EIA) and SPR. The Secretary of Energy has the responsibility to submit the recommended measures to the U.S. President (IEA, 2014a).

b) Criteria of Emergency

Initially, the IEA Agreement on International Energy Program (IEP) defined emergency as an oil supply disruption involving a loss of 7% or more of normal oil supply, either for the IEA as a whole or any individual member country. However, as oil markets developed together with improved measures to responding to any supply disruptions, the determination of supply disruption event may now depend on detailed impact assessment, which is being used as the basis for decision on how and when to activate emergency measures (IEA, 2007). The IEA's Initial Contingency Response Plan has proposed for the conduct of a continuous process of market assessment to determine emergency situation. The U.S. defines emergency as a "severe petroleum supply interruption" involving:

- A petroleum supply emergency of significant scope and duration;
- A severe increase in the price of petroleum products; and,
- Major adverse impact on the national economy *(OGSN, 2015)*.

c) Emergency Policy

Upon determination of emergency situation by President of the U.S., drawdown of Strategic Petroleum Reserves (SPR) is authorized through the Energy Policy and Conservation Act (EPCA, P.L. 94-163) of 1975. In the event of international interruption, the President may release certain volume of crude oil, while some statutory limitations would apply in the case of national interruption. The EPCA was amendment in 1990 for the primary purpose of providing an SPR

drawdown with less rigid determination and even without having to declare severe supply disruption (CRS, 2012).

There are two (2) circumstances to trigger the drawdown of SPR. First, drawdown is conducted to meet the economy's obligation in the IEA collective action. Second, the SPR can be used to address a severe petroleum supply interruptions that involve greater supply shortfall, sharp increase in petroleum products and expected impact to the national economy (OGSN, 2015).

d) Strategic Oil Stockholding

United States meets its IEA stockholding obligation of 90 days of imports covered by government emergency stocks in the SPR. Industry also holds substantial oil stocks for commercial purposes (OSGN, 2015). The declined net imports due to increased domestic products resulted in the decreased amount of required oil stocks to meet IEA obligation (IEA, 2014a).

e) Regional Oil Security Policy

As a regulation of IEA, all members are committed to take part in joint measures during event of oil supply emergencies. IEA members have all agreed to share energy information, coordinate their energy policies and cooperate in the development of rational energy programmes. Each IEA member is required to contribute to collective action based on its assessed share in total IEA oil consumption (IEA, 2007).

f) Emergency Exerciser Activity

As a member economy of IEA, emergency response exercise is conducted regularly every 2 years by IEA (IEA, 2014b). Aside from IEA emergency exercise activity, the U.S. also conducts SPR Eagle Exercises, which is an organization-wide disruption simulation, and the Personal Readiness Is Drawdown Excellence (P.R.I.D.E.) program (OGSN, 2015).

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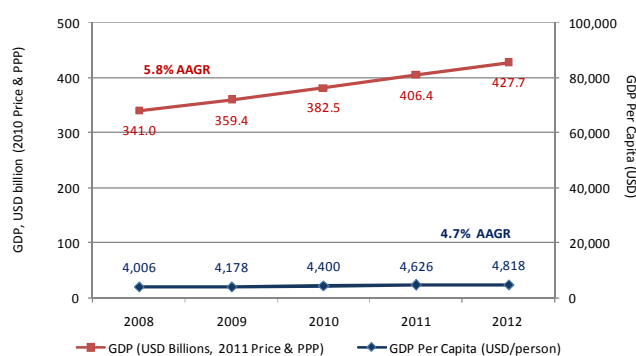
VIET NAM

Socio-Economic Overview

Table 21.1 Socio-Economic Profile, 2012

Land Area km^2	333,972
Population (million)	88.77
GDP (USD Billion, 2010 Price & PPP)	427.68
GDP per Capita	4,818

Source: APERC-APEC Energy Overview, 2014 & EDMC-IEEJ

Viet Nam has an area of 333 972 square kilometres and shares borders with Cambodia and Laos to the west and China to the north. The economy's population reached 88.77 million in 2012 with the average annual growth rate (AAGR) of 1.06 percent between 2008 to 2012. Viet Nam attained a robust economic growth in 2012 with 5.8 percent increase in its GDP and 4.7 percent in GDP per capita per annum on average over 2008-2012 period. An open socialist-oriented market economy and progressive industrialization had enabled the economy to sustain such strong economic growth (APERC, 2015a & EDMC, 2014).

Figure 21.1 GDP and GDP Per Capita


Source: EDMC-IEEJ

Energy Profile

a) Total Primary Energy Supply and Final Energy Demand

For the last 5 years (2008-2012), Viet Nam's total primary energy supply (TPES) grew at 7.3 percent per annum reaching 64,854 kilotonnes of oil equivalent (ktoe) in 2012. Among the fossil fuels which remained the major energy sources, oil had a significant growth rate of 10.6 percent per annum during the 5-year period. Hydro registered the fastest AAGR at 19.7 percent over the same period, as a result of doubling installed hydropower capacity from 6.0 GW to 12.6 GW. Endowed with diverse fossil energy resources such as oil, natural gas and coal, as well as renewable

Figure 21.2 Total Primary Energy Supply

Source: IEA 2014

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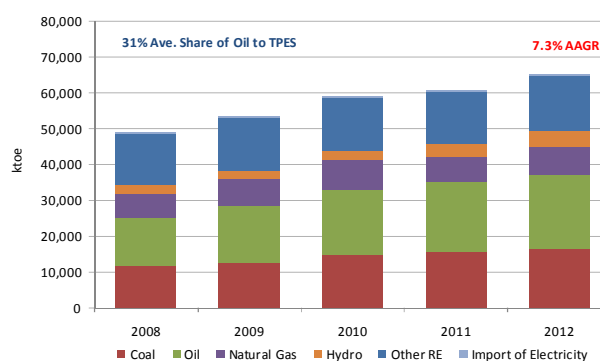
sources, the economy has been a net energy exporter since 1990, exporting mainly crude oil and coal, and being self-sufficient in natural gas.

In final energy demand, oil demonstrated the AAGR at 9.7 percent over 2008-2012 higher than that of the total at 6.8 percent. Electricity demand recorded the fastest AAGR at 12.7 percent during the same period. Oil posted an average share of 34.0 percent share to total final energy.

By sector, the industry sector had accounted for the largest share with 36.5 percent, on the average, in the last 5 years. Although the residential sector consumed the second largest energy, its share had declined gradually due to its slower annual growth rate of 2.9 percent. The transport and the non-energy sectors both achieved higher AAGR compared to that of the total, 9.4 percent and 24.5 percent, respectively (IEA, 2014).
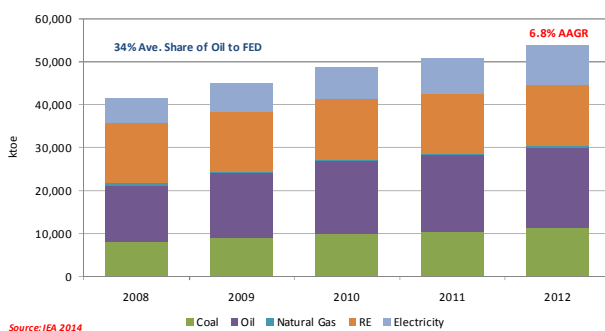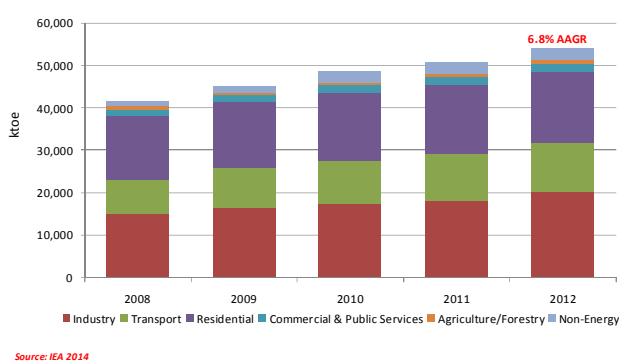
b) Energy per Capita and Energy Intensity

Final energy demand per capita marginally increased from 0.5 toe/person in 2008 to 0.6 toe/person in 2012, while oil demand per capita also went up to 0.21 toe/person in 2012 from 0.15 toe/person in 2008. On the other hand, Viet Nam's oil demand intensity in 2012 accelerated by 15.4 percent compared with 2008 level, which was higher than the total final energy demand intensity increase of 3.7 percent. The increase in energy intensity was triggered by the growth in transport sector energy demand consumption, followed by the industry sector.

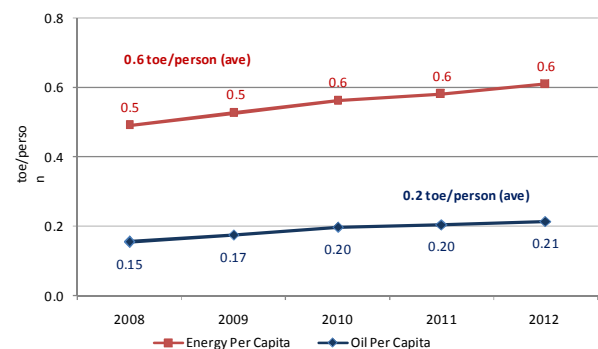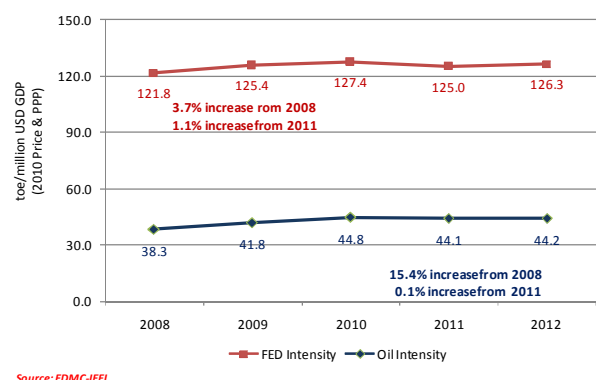Figure 21.5 Final Energy and Oil Demand Per Capita

Source: EDMC-IEEJ

Figure 21.6 Final Energy and Oil Demand Intensity

Source: EDMC-IEEJ

Figure 21.3 Final Energy Demand (Fuel)

Source: IEA 2014

Figure 21.4 Final Energy Demand (Sector)

Source: IEA 2014

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Oil Supply and Demand

a) Crude oil Production and Imports

Crude oil production that had been on the wane after reaching a peak in 2004 but revived in recent years due to commencement of oil production from newly developed fields. Viet Nam is a net crude oil exporter and all crude oil was exported before 2009. Since the Dung Quat refinery (140,000 bbl per day (bbl/d), the first refinery in Viet Nam, started operation in 2009, crude oil available for exports declined (EIA, 2014). However, the economy still exhibited negative import dependency, which was about 115 percent

Figure 21.7 Crude Oil Supply

Source: IEA 2014
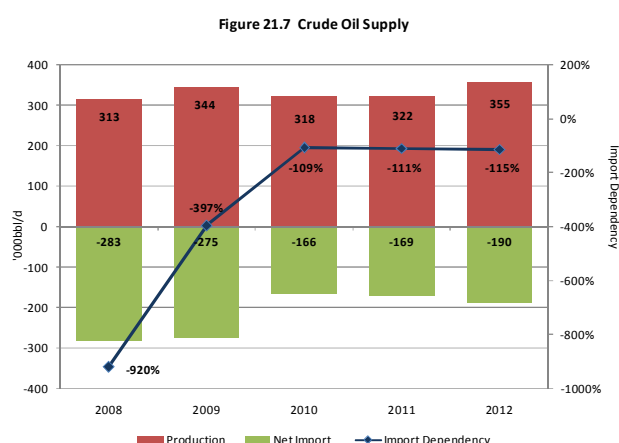
in 2012.

b) Oil Products

Although a net exporter of crude oil, Viet Nam was totally dependent on imported petroleum products until 2009 when its first refinery started its operation. Since then, refinery production had increased by an AAGR of 96.7 percent, while petroleum products imports had shown a downward trend. With this, import

dependency for petroleum products went down from 96.0 percent in 2008 to 54.0 percent in 2012. Diesel oil and gasoline were the two (2) most consumed fuels, mainly driven by rapid increase of vehicle ownership after 2000.

Table 21.2 Oil Products Supply and Demand ('000bbl/d)

	2008	2009	2010	2011	2012
Refinery Production	11	45	142	143	157
Net Imports	294	280	231	258	230
Others *	-13	9	13	2	37
Net Supply	292	334	385	403	424
Demand	292	334	385	403	424
Gasoline	84	99	110	117	123
Diesel Oil	128	144	151	158	166
Fuel Oil	26	28	32	34	35
LPG	33	40	45	48	50
Others Petroleum Products	21	24	47	47	49
Import Dependency	96%	84%	60%	64%	54%

* include stock change, international marine & aviation and statistical difference
Source: IEA 2014

Total oil demand of the economy accelerated at 9.8 percent annually. The transport sector had dominated oil demand with 59.0 percent average share from 2008-2012, and expanding annually at 9.6 percent rate. Demand from the non-energy sector also soared since 2010 with average share of 10.0 percent, and growing annually at a rate of 25.0 percent. The residential sector also posted higher growth rate of 10.0 percent in the last 5 years. Other sectors had demonstrated slower growth rate compared to total, i.e., industry, commercial, and the agricultural and fishery sectors.
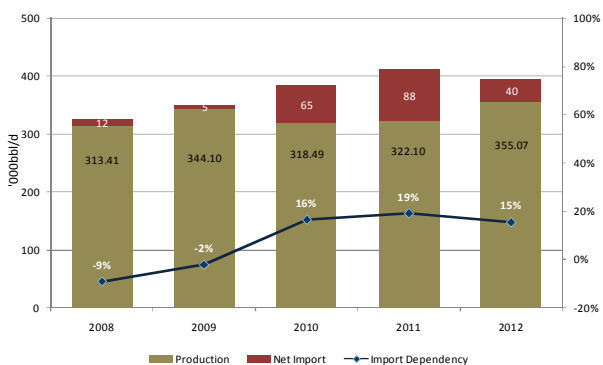
Table 21.3 Oil Consumption ('000bbl/d)					
	2008	**2009**	**2010**	**2011**	**2012**
Industry	41	45	44	47	49
Transport	171	205	220	234	246
Residential	21	25	28	29	31
Commercial	18	18	19	20	21
Agri and Fishery	11	11	11	11	12
Electricity	11	12	22	20	21
Others	17	19	42	41	43
Total Consumption	**292**	**334**	**385**	**403**	**424**

Others include non-energy, own-use and losses
Source: IEA 2014

The milestone in the refinery production contributed to increased supply of oil in Viet Nam which recorded huge annual growth rate in the last 5 years. With this, a decline in import dependency for total oil supply (crude oil and petroleum products) can be observed from 19.0 percent in 2011 to 15.0 percent in 2012.

an AAGR of 5.9 percent (APERC, 2015). Despite the assumption that Nghi Son refinery with capacity of 200,000 bbl/d will be built and to start operation in 2017, refinery capacity would still not enough to meet domestic oil demand throughout 2040. With foreseen increasing demand, only 17.0 percent of the total demand will be served by the existing refinery by 2040. Hence, the Viet Nam government has included in its master plan the refinery development up to 2025 the construction of four (4) refinery projects, such as Dung Quat expansion, Nghi Son, Vung Ro, and Long Son. In addition, the Victory-Nhon

Figure 21.9 Oil Demand and Refinery Capacity
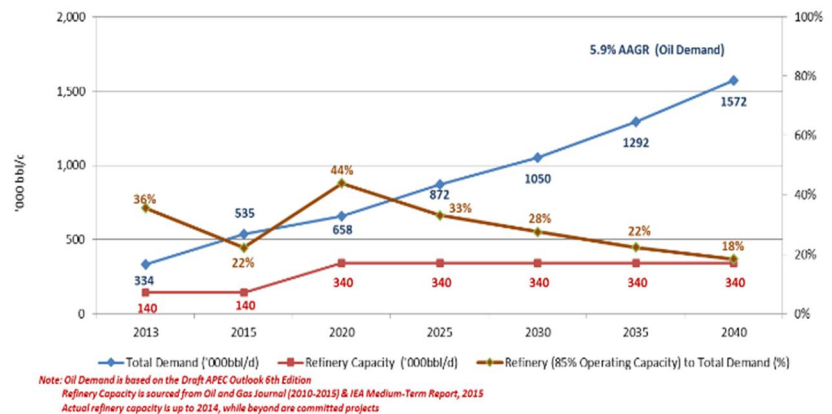
Note: Oil Demand is based on the Draft APEC Outlook 6th Edition
Refinery Capacity is sourced from Oil and Gas Journal (2010-2015) & IEA Medium-Term Report, 2015
Actual refinery capacity is up to 2014, while beyond are committed projects

Hoi petrochemical and refinery of the Petroleum Authority of Thailand (PTT) is currently under consideration. Once these refineries will be built as planned, it is expected that domestic refinery production capacity would be strengthened (APERC, 2015a).

Figure 21.8 Total Oil Supply (Crude and Petroleum)

Source: IEA 2014

c) Oil Demand Outlook and Refinery Capacity

Viet Nam's oil demand is projected to increase about 4.7 fold in the future (2013-2040) with

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Oil Supply Security Policy		

Table 21.4 Policy Overview

The National Strategic Organization (NESO)	Criteria of Emergency	Emergency Policy
☑ Exist	☑ Exist	☑ Exist
Strategic Oil Stockholding	Regional Oil Security Policy	Emergency Exercise Activity
☑ Exist	☑ Exist	☑ Exist

a) National Emergency Strategic Organization (Institutional Framework)

The Ministry of Industry and Trade (MOIT) is the leading government body responsible for dealing with oil supply disruptions. The MOIT chairs the Committee on the State Management of Domestic Markets, which is composed of other relevant government agencies such as the Ministry of Industry and Trade and Ministry of Finance (OSGN, 2015). The MOIT reports to the Prime Minister on emergency situation. Based on the report and recommendations from the Committee, the Prime Minister will instruct concerned ministries to handle the emergency situation. On the other hand, the MOIT will be in charge of giving directives to the enterprises for the implementation of required measures to deal with the emergency (APERC, 2014).

b) Criteria of Emergency

Based on definition of ASEAN Petroleum Security Agreement (APSA), critical shortage is defined as the situation when a member economy is experiencing a shortfall of at least 10 percent of the Normal Domestic Requirement for a continuous period of at least 30 days. APSA has been updated and ratified

by ASEAN members. The updated APSA took effect in March 2013 (ASCOPE, 2009).

c) Emergency Policy

In case of emergency, the Committee of the State Management of Domestic Markets will be convened to make recommendations to the Prime Minister on possible emergency measures. Based on the directives from the Prime Minister, relevant ministries will immediately carry out the measures. Collection of information and processing, response plan, as well as notices to the public will be properly assigned according to the functions of the ministries and even enterprise, which all activities will be coordinated (APERC, 2014).

d) Strategic Oil Stockholding

Viet Nam held 47 days of oil stocks in 2013, which include 30 days of commercial stocks and 10 days of national products stocks, based on domestic consumption. The Prime Minister approved the National Stockpile Master Plan in 2009, which proposes to hold oil stocks equivalent to 90 days of net imports or 60 days of domestic consumption by 2015. The target oil stockholding would necessitate increasing the commercial stocks to 40 days through expanding operational stocks and also by having crude oil stocks (IEA, 2014a).

e) Regional Oil Security Policy

In the APSA-Coordinated Emergency Response Measure (CERM), all ASEAN member states are endeavoured to supply petroleum to a Member State in Distress at an aggregate amount equal to 10 percent of the

Normal Domestic Requirement of the said member state. Measures to reduce demand are being required to be implemented by a member state before seeking assistance under CERM. The CERM Operationalization Manual is being reviewed by the APSA Task Force, which was created for such purpose (ASCOPE).

f) Emergency Exercise Activity

Viet Nam holds emergency exercise activity by enterprise, local authority and state organization (OSGN, 2015). The economy likewise participated in APEC Oil and Gas Security Exercise: Joint Southeast Asian Exercise in 2013, which was organized by the Asia Pacific Energy Research Centre (APERC).

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