



Green Economy Guideline Manual

2014



**Oil, Gas &
Petrochemical**





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Foreword

Malaysia's commitment to sustainable development is articulated through its national development plans including the "Tenth Malaysia Plan, The New Economic Model" which underlines the long term development framework for Malaysia. At the Earth Summit in 1992, Malaysia pledged to keep at least 50% of its land area as forest cover, and has maintained its commitment with forest cover in 2012 being at 56.4% of total land area.



Leaders of governments at the United Nations Conference on Sustainable Development (Rio+20, Rio de Janeiro, 2012) resolved to act on addressing challenges in achieving sustainable development through the development of 'Green Economy' in their countries. The Government of Malaysia at Rio+20 reaffirmed its commitment to sustainable development, and its voluntary reduction commitment (announced at the 15th meeting of Conference of Parties, Copenhagen, 2009) of greenhouse gas emissions intensity of GDP by up to 40% by 2020, compared to 2005 levels. Our Prime Minister has also launched our Low Carbon Society Blueprint (at the 18th meeting of Conference of Parties, Doha, 2012) as our commitment to building a green economy at Iskandar Malaysia (IM).

Climate change is no longer a myth but a reality that affects all of us. The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) has stated that an increase of 0.85°C in the global average surface temperature could wreak havoc upon our environment. Earlier in 2014, Malaysia experienced one of its worst dry spells, triggering the Malaysian cabinet to consider calling a state of emergency in 15 areas in Malaysia that had not experienced rainfall in more than 20 days.

We have developed this Green Economy guidelines (GEG) manual which provides a checklist for businesses to address areas of procurement, operations and supply chain management in order to minimize impact on the environment. The development of

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these guidelines included consultations with ministries and government agencies, business associations, local bodies, international agencies and IRDA's own business teams.

The goal of the GEG manual is to help businesses and industries to study, evaluate, adopt and inculcate environmentally sustainable economic behavior leading to building a prosperous, resilient, robust and globally competitive green economy in Iskandar. This is in line with IRDA's vision of becoming a "Strong and Sustainable Metropolis of International Standing". The LCS Blueprint has 3 main themes - Green Economy, Green Community and Green Environment. This manual is an output of the first theme and focuses on the oil, gas, & petrochemical industry.

We hope businesses in Iskandar in the oil, gas, & petrochemical industry will find these guidelines relevant and useful in evaluating and adopting more innovative and sustainable practices, contributing to Green Economy in Iskandar.

In closing, I would like to thank and congratulate all parties involved in the production of this manual. I would also like to make a special mention of the advice and support given by the Working Group to the IRDA team and consultant Ernst & Young's Climate Change and Sustainability Services team in putting together this manual.

Y. Bhg. Datuk Ismail Ibrahim
Chief Executive IRDA

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Glossary

AFV	Alternative Fuelled Vehicles
BEMS	Building Energy Management Systems
CAGR	Compound Annual Growth Rate
CFL	Compact Fluorescent Lighting
CHP	Combined Heat and Power
CNG	Compressed natural gas
E&P	Exploration and Production
EN	European Standard
EPA	Environment Protection Agency
ESG	Environmental, social and governance
G&P	Gas & Power
GBI	Green Building Index
GDP	Gross Domestic Product
GPP	Government Green Procurement
GHG	Greenhouse Gases
HRV	Heat Recovery Ventilation
HVAC	Heating, ventilation and air-conditioning
ICT	Information and communications technology
IM	Iskandar Malaysia
IRDA	Iskandar Regional Development Authority
KeTTHA	Malaysia Ministry of Energy, Green Technology and Water
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
LEP	Light-emitting plasma
LPG	Liquefied petroleum gas
PPP	Public-Private Partnerships
VOC	Volatile organic compound

Oil, Gas & Petrochemical

1. Industry Overview

The oil, gas & petrochemical industry comprises of exploration, extraction, refining, transportation and production of petroleum products. This guideline draws specific attention to mid-stream operation, which involves storage and transportation, and downstream operation, which includes refining and processing. Within the industry, the petrochemical sector will be reviewed in depth because Iskandar Malaysia (IM) is a key regional petrochemical hub due to availability of feedstock at competitive prices. The petrochemical sector is expected to grow a further RM217 billion in the next decade (Iskandar Regional Development Authority, 2011). As a regional hub of a rapidly growing sector, the environmental footprint from this sector is set to increase correspondingly.

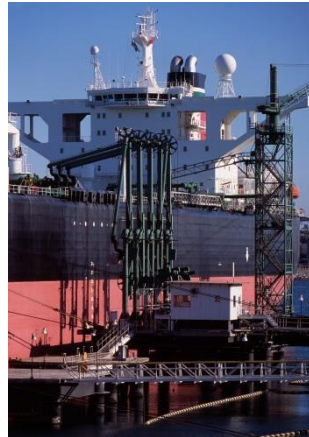


Image 1: Oil tanker berthing

The oil & gas sector contributes

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approximately 3.5% of global Gross Domestic Product (GDP) (World Bank, 2014). Oil production and consumption have continuously been increasing since 2010, at Compound Annual Growth Rate (CAGR) 1.7% and 1.3% respectively (BMI, 2014).

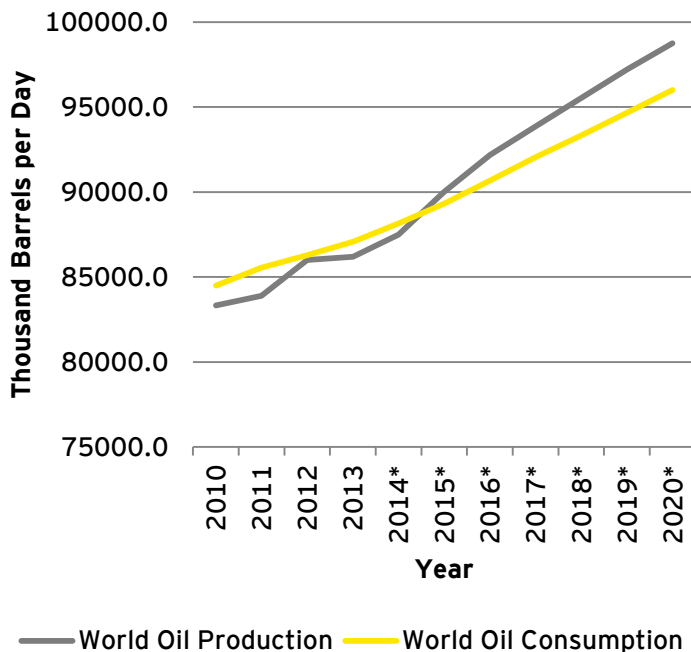
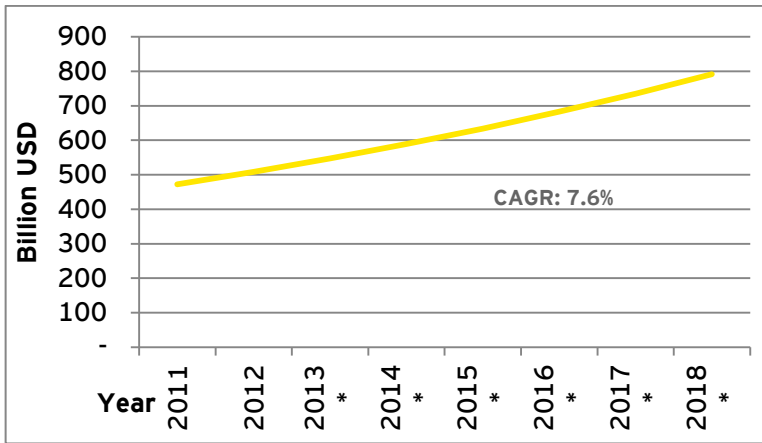


Figure 1: World Oil Production and Consumption (BMI, 2014)

The global oil & gas market was valued at USD2,848

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billion in 2012 and is expected to expand by approximately 30% to USD3,699 billion in 2015. The global petrochemicals market was valued at USD472.06 billion in 2011 and is expected to reach USD791.05 billion by 2018, expanding at a CAGR of 7.6% from 2011 to 2018.



**Figure 2: Global Market Value of Petrochemical Industry
(Transparency Market Research, 2012)**

Downstream operations incorporate production and processing of products derived from crude oil, whereas the petrochemical sector is involved in the manufacturing of petroleum-based products. Globally, the petrochemical sector accounts for approximately 0.7% of GDP,

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demonstrating its significant role in the world economy (World Bank, 2014); (Transparency Market Research, 2012)

Global petrochemicals consumption was 436.86 million tonnes in 2011 and is expected to reach 627.51 million tonnes by 2018, growing at a CAGR of 5.4% from 2012 to 2018 (Transparency Market Research, 2012). Production capacity of ethylene, which is the most common petrochemical class, is expected to expand from 4Mt in 2012 to 5.2Mt in 2017 (Mitsubishi Chemical Holdings, 2014). Following this current trend, energy use and GHG emissions will increase accordingly with increases in production and consumption.

IM aims to be the world class oil, gas and petrochemical destination by attracting high value-added activities. The Iskandar Regional Development Authority (IRDA) continues to attract businesses by developing industry-specific cluster with an integrated supply chain to reduce infrastructure costs and also by increasing access to international market. Already, the IM complex sees the entry of relevant businesses into two of its largest industrial estates, the Tanjung Langsat Industrial complex and Pasir Gudang Industrial Park. Their strategic position

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to the government-backed Pengerang Refinery and Petrochemicals Integrated Development enable businesses to capitalize on available experts and also infrastructure nearby. Furthermore, the presence of Johor Port and Tanjung Langsat Port in Pasir Gudang complex and Tanjung Langsat complex respectively ensures access to logistics, shipping and also market. As such, IM is growing steadily to becoming key hub for industry players as evident from the growing committed investment into the region (Figure 3).

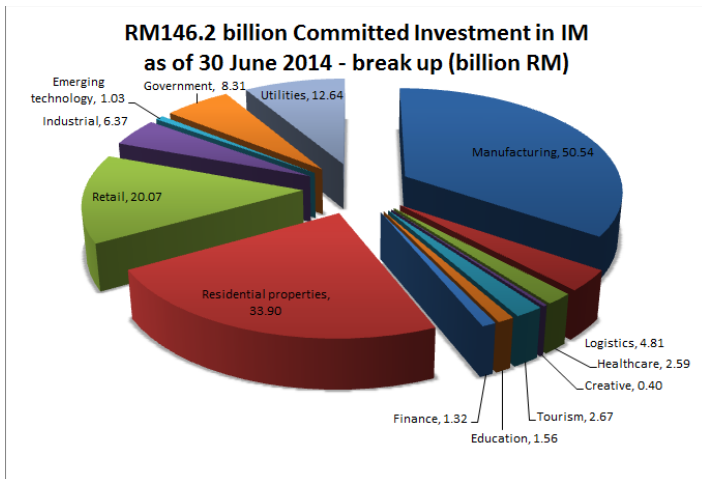


Figure 3: Cumulative Committed Investment in IM (Low & Kasmuri, 2014)

1.1 Environmental Impacts

Environmental issues associated with mid-stream operation in the oil, gas & petrochemical industry includes air pollution, wastewater and hazardous waste and these concerns are attracting interest not only from industries but government as well. High profile incidents, such as the North Dakota train derailment and Jilin chemical plant explosion, have highlighted the environmental risks posed to all aspects of the value chain.

The petrochemical sector is one of the most energy intensive industry sectors in the world, accounting for 10% of total worldwide final energy consumption (IEA, 2013) and 30% of the total industrial energy use worldwide (IEA, 2009). Consequently, greenhouse gases (GHG) emissions from the sector account for up to 7% of the global GHG emissions and 18% of the direct industrial emissions (1.24 GtCO₂) (IEA, 2013).

Given the current industry trend, additional actions will need to be taken to mitigate issues related to pollution, energy use and GHG emissions of the industry over the medium to long term. In order to identify green growth (“greening”) opportunities in the sector, this guideline

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concentrates on identifying and prioritizing greening options that are pursued by leading oil, gas & petrochemical companies.

Company	Sales in billion USD	Key Green Initiatives
BASF SE	101.7	<ul style="list-style-type: none">• Aims to have energy management in Germany certified by 2015• Discloses GHG emissions through CDP• Adopts the use of additives in engines to decrease GHG emissions
The Dow Chemical Co.	57.1	<ul style="list-style-type: none">• Aims to reduce energy intensity by 25% in 2015, based on 2005 level• Committed to publish product safety assessments for all products by 2015
Saudi Basic Industries Corp.	50.4	<ul style="list-style-type: none">• Established environmental performance targets in GHG, water, energy and material loss• Includes sustainability element in its Key Performance Indicator

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Mitsubishi Chemical Holdings Corp.	33.9	<ul style="list-style-type: none"> • Complies with Global Reporting Initiative on sustainability reporting • Has ISO 14001 certification for 97% of its production sites
DuPont	35.7	<ul style="list-style-type: none"> • Promoting innovation to promote sustainable growth • Sharing of surplus heat from plant activities to power homes
Formosa Petrochemical Corp.	31.1	<ul style="list-style-type: none"> • Invested USD247 million on water saving projects, saving 10.25 million tonnes of water annually • Invested USD278 million on energy conservation projects, reducing 7.8 million tonnes of CO₂ emissions
Lotte Chemical (Titan Petchem Sdn Bhd)	15.9	<ul style="list-style-type: none"> • First in the petrochemical industry in 2010 to implement an SAP-integrated to monitor and manage GHG emissions and energy

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Hitachi Chemical	4.85	<ul style="list-style-type: none">• Green Curtain Project to reduce CO₂ emissions from savings in energy use for HVAC
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Table 1: Top participants by sales (Factiva, 2014)

2. Identifying Green Opportunities

2.1. Areas for intervention

A typical oil, gas & petrochemical industry value chain is divided into upstream, mid-stream and downstream processes. While the manufacture of petrochemicals is related to downstream operations, manufacturers are also involved in the transportation and storage of raw materials (mid-stream). Petrochemical companies, therefore, influence both mid- and down-stream activities, resulting in several areas for greening.

GHG emissions from transportation contribute a small percentage (18.2%) in the share of total emissions (BASF, 2013). However, accidents in the



Image 2: Oil storage terminals

mid-stream operations are not infrequent. From August 2013 to January 2014, there were five major transport-related accidents in North America alone (Vartabedian,

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2014). The impact of these accidents is far reaching. Oil spills are known to decimate habitats because oil persists in the environment and is generally toxic to animals and plants. The North Dakota derailment spilled crude oil that caused USD6 million in damages (Vartabedian, 2014). The National Wildlife Federation has estimated the costs of environmental clean-up cost for the BP Gulf of Mexico spill would amount to USD14 billion (CBS News, 2014). This is further compounded by a loss by more than 40% in share value in the aftermath of the spill (Calkins & Fisk, 2014). These financial setbacks alone make it clear that risks involved in the industry have to be carefully managed.

Oil storage terminals are not major consumers of energy or GHG emissions. Nevertheless, risks associated with volatile organic compound (VOC) leaks, wastewater, hazardous materials and wastes should be mitigated in order to promote environmental sustainability in the sector. Taking VOC as an example, the US Environmental Protection Agency estimates that 40,000 tonnes of VOCs are emitted annually from petroleum refineries alone. This amount is in addition to the estimated 70,367 tonnes of VOC that leaks in operation (Environmental Protection Agency, n.d.). As a known ozone-depleting chemical group, the environmental impact of VOC in the atmosphere will

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affect the health and well-being of the general public and community in the proximity of the plant.

Chemical conversion in the petrochemical industry involves numerous processes, which comprises of steam systems (steam generation and distribution, power generation, compressors, process heating, cooling and refrigeration, and machine drive (IFC, 2007)Energy use is the highest in steam systems, with 37% of the on-site energy use (US Department of Energy, 2006). It is also estimated that electricity makes up to 92% of the total energy used, with fuel and steam making up the remainder (Worrell & Galitsky, 2005).

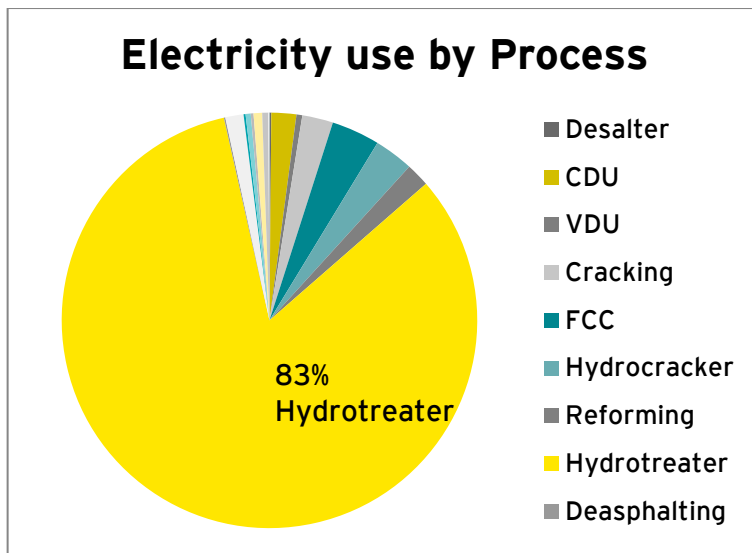


Figure 4: Electricity use by process

To address the environmental issues associated with the industry, interventions could be affected in the following areas:

Mid-Stream	Downstream
<ul style="list-style-type: none"> • Transportation • Oil Storage Terminals 	<ul style="list-style-type: none"> • Refining • Energy use in processing operations <ul style="list-style-type: none"> - Chemical Conversion - Facilities

Table 2: Intervention to address environmental issues

2.2. Potential Options

Analysis of potential impacts and measures pursued by leading corporations in the sector suggest a range of options to be implemented in order to mitigate the environmental issues identified in the previous section. Potential actions are summarized as follows:

Areas	Aspects
Facility Efficiency	HVAC efficiency Lighting efficiency
Waste Management	Reduce, reuse, and recycle Innovation in packaging

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Transportation, distribution and logistics	Modal shift
Oil Storage Terminal	Mitigating air emissions Mitigating waste water Mitigating hazardous materials and oil
Refining	Mitigating air emissions Mitigating waste water Mitigating hazardous materials and oil
Chemical conversion	Improving steam systems
Monitoring & Reporting	Environmental Management System

Table 3: Potential Options

3. Recommended Actions for Strategic Direction and KPIs

3.1. Facility Efficiency

Improving facility efficiency can be achieved by implementing a range of technologies, from improved heating, ventilation and air-conditioning (HVAC), lighting efficiency, monitoring (enabled by Building Energy Management Systems and Smart Metering) to implementing sustainable building designs.

3.1.1. HVAC Efficiency

Action: Installing efficient HVAC systems

According to Carbon Trust, a 1°C decrease in internal building temperature results in 10% energy consumption savings which would automatically lead to decrease in GHG emissions (CarbonTrust, 2002). Recommended actions that can improve energy efficiency include (University of Twente, Unilever, 2013):

- Insulation: If some rooms are too hot or too cold, inadequate air sealing or insufficient insulation could be the cause. Cavity wall insulation is used

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to reduce heat loss by filling the air space with material that inhibits heat transfer. It is often used in doors, which are the primary culprits of air leaks in the building. Adding additional insulation (double-glazing) around the interior of the building and installing air curtains will also contribute to reducing energy usage.

- Infrared assessment: To identify areas of energy wastage, infrared imaging is a valued tool in identifying problems related to energy loss, inadequate insulation, inefficient HVAC systems, radiant heating, water damage on roofs, and much more. Conducting an infrared inspection on leak tightness and coldness infiltration can detect potential areas for additional insulation. Professional energy auditors can be employed to carry out this process.
- Heat Recovery Ventilation (HRV): HRV is an energy recovery ventilation system which uses heat exchangers to heat or cool incoming fresh air, recapturing 60% - 80% of the conditioned temperatures that would otherwise be lost. Instead of opening a window for ventilation, the

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HRV system is able to provide fresh air without any heat loss or gain. In climates such as Malaysia with warm, humid weather, HRVs can also remove humidity before it enters the air ducts to keep the interior comfortable and prevent the HVAC system from having to work harder. These products can be purchased from major retailers in Malaysia such as Carrier and Honeywell.

- Alarm for warehouse doors: Alarms of annunciators indicate when doors are open and prevent unwanted heat loss or gain. This simple yet efficient measure has proven to be very cost effective in many cases.
- Green façade and roofs: Vegetation or plant cover on roofs over a water-proof membrane is known to reduce building heating and cooling needs. In addition, it can retain rainwater for other uses if an efficient drainage system is installed. This measure qualifies for Leadership in Energy and Environmental Design (LEED) points.

Hitachi Chemical Group (Hitachi Chemical, 2014)

Making use of curtain-like vines to manage heating and ventilation of facilities

Since 2006, Hitachi Chemical has been adopting the Green Curtain Project in reducing its GHG footprint from its facility. The project encourages employees to dress office windows with climbing-plants. The plants help to cool the building by mitigating the heating effects of direct sunlight as well as plant transpiration. Hitachi Chemical suggests that the project has helped to reduce CO₂ emissions through savings in electricity consumption. The project is so successful that since 2011, the entire Hitachi Group companies have replicated the Green Curtain Project.

Action: Maintaining efficient HVAC systems

Dirt and neglect are the top causes of heating and cooling system inefficiency and failure. It is important to have a qualified technician perform regular maintenance on the HVAC system every year. Maintenance activities include (US EPA, 2009):

- Lubricate moving parts. Electrical devices that lack lubrication can cause friction in motors and increase the amount of electricity consumption. Lack of lubrication can also cause equipment to wear out more quickly, requiring more frequent

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repairs or replacements.

- Check the condensate drain in the air-conditioner. If plugged, stagnant water in the drain may damage the house, affect indoor humidity levels, and breed bacteria and mold.
- Inspect, clean, or change the air filter in your central air conditioner. A contractor can demonstrate how to do this for company maintenance staff to do so on a more regular basis.
- Clean the air-conditioner blower components and coils. Proper airflow over the coils allows your system to run efficiently, reducing energy costs and lengthening equipment lifespan.
- Check the central air conditioner refrigerant charge and adjust it if necessary to ensure it meets manufacturer specifications. Too much or too little refrigerant charge can damage the compressor, reducing the shelf life and increasing costs.

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Action: Glazing

Transparent and clear glass panes used in buildings are prone to increase the heat gain inside buildings and hence additional air conditioning (higher capital and operating costs) becomes necessary. Proper selection of glazing properties helps improving energy efficiency in buildings as a good glazing will reduce solar heat gain from both direct and diffuse solar radiation (BSEEP, 2013). Better glazing efficiencies can be achieved by taking into consideration the following key factors (and other considerations as deemed appropriate for the building)

- Choosing the glazing with appropriate visible light transmission, low solar heat gain coefficient
- Single and double glazing low-E value coatings
- Reduction of glazing area, where possible

Action: Wall Insulation

Malaysia has a mild climate with outdoor dry bulb temperatures reaching 26.9°C during day time and 24°C during night time. Heat is both conducted from the outside into the building and as well as from inside of the building to the outside. While the impact of insulation on building

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energy reduction may not be very significant, the effect on reduction in peak cooling load is certain. A feasibility study on the economics of insulation materials should be done before embarking on the installation of insulation systems (BSEEP, 2013).

Action: Roof Insulation

Energy efficiency brought about by different types of roofs varies for each type, operating hours and the space immediately below the roof. Ideally an insulated roof during day time to prevent heat gain and non-insulated roof during night time to cool the building would be the most appropriate one for Malaysian climate.

However, business needs (office / hospital / warehouse / cold storage), occupant comfort, wind velocity, rains, etc. are the key decisive factors in determining the roof type and materials used. In

P&G (Cocking, 2011)

P&G implemented green office design in its new South and East Africa head office. The office comes with double glazed panels for insulation, wing walls as shades, roof-top garden and grey glass vision panel to deflect heat, while leaving the east-west facades with minimal glazing to exploit natural lighting. All these improvements cut energy consumption by 30%.

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a simulation study carried out while developing the *Building Energy Efficiency Technical Guideline for Passive Design (2013)* suggests that provision of 25mm of insulation provided maximum incremental savings. Keeping in mind that electricity tariffs in Malaysia are bound to increase with time, businesses need to evaluate the energy consumption, return on investment, business needs of roof insulation and proceed accordingly.

Action: Zoning and Infiltration control

Zoning is the process of positioning air-conditioned spaces in a building in a coherent fashion such that wastage of conditioned air is minimized. In general it is done by locating rooms according to the leakage flow of air-conditioned air from the coldest room will benefit other spaces before it completely escapes out of the building.

Zoning the most air-conditioned areas at the core of the buildings surrounded by comparatively lesser air-conditioned areas, optimizing window areas, converting glazed areas to opaque, etc. are among the widely practiced techniques to achieve energy efficiency.

Infiltration is the process of out-door air entering the air-conditioned space introducing sensible and latent

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(moisture) heat into the building, which increases the energy requirements. Sealing cracks in walls, window panes, controlling window / door operation with sensors, door pumps, air curtains could be adopted to minimize infiltration losses. Please refer the *Building Energy Efficiency Technical Guideline for Passive Design (2013)* for case studies on various scenarios of simulation conducted for more information on avoiding infiltration losses.

3.1.2. Lighting Efficiency

Action: Daylight harvesting

Malaysia being located close to the equator, with lesser seasonal variation has reliable day light available for about ten hours a day. Natural daylight harvesting is amongst the most efficient method to improve energy efficiency in buildings because diffused light is not much affected by the sun appearing in the sky/hiding behind the clouds. To achieve better utilization of daylight harvesting, appropriate tropical climate daylight harvesting techniques need to be deployed to gain the optimum benefits.

- Utilizing daylight to combine with artificial

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lighting is a simple, efficient way to reduce lighting.

- Analyzing the location, layout and orientation of windows (west / east), Incorporating skylights into roofing and utilizing transparent weather-resistant material that can maximize natural light passage is one of the key measures to maximize use of daylight.
- Skylights that can be operated to open and close can additionally lead to savings in energy used for ventilation or cooling.
- Solar heat gain minimization, glare protection, deep daylight penetration, uniform daylight distribution, etc., needs to be investigated thoroughly, and addressed before implementation of a well-designed daylight harvesting system to optimize performance.

Action: Switching to energy-efficiency lighting

**Chevron Gas Station,
Concord, California
(CREE, 2013)**

Jadwinder Singh had rigorous zoning and energy-saving mandates to follow as a Chevron franchise owner. He replaced the station's lighting of 250-watt metal halide fixtures to LED. Not only did he enjoy 64% energy savings, the gas station had better visibility, up to four miles away from the highway, drawing more customers.

In 2010, the British Broadcasting Corporation carried out a quantitative energy analysis and identified solid-state light-emitting plasma (LEP), light-emitting diode (LED) and fluorescent lighting as the most energy-efficient sources without compromising on performance (BBC, 2011).

LED is one of today's most energy-efficient and rapidly-developing lighting technologies. LEDs are "directional" light sources, which mean they emit light in a specific direction unlike traditional light sources which emit light and heat in all directions. For this reason, LED lighting is able to use light and energy more efficiently in many applications. Residential LEDs use at least 75% less energy, and last 25 times longer, than incandescent

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lighting (US Department of Energy, 2014).

As a cheaper alternative, high efficiency Compact Fluorescent Lighting (CFL) consumes only 25% of the energy of an incandescent bulb and lasts nine times as long, or up to 7 years (Tufts University, 2014). Aside from its lower cost, CFL bulbs are known to be versatile. They can be applied nearly anywhere where incandescent lights are used, and are particularly suitable for area lighting.



Figure 5: Comparison of Lighting Types

Action: Optimizing lighting performance

Many minor steps can be taken to improve lighting performance. For example, regular cleaning of light bulbs can also improve energy efficiency, as two years' worth of accumulated dust can reduce luminosity by as much as 50%

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and increase operating costs by 15% (Carbon Trust, 2007).

Utilizing daylight in combination with artificial lighting is another simple yet efficient way to reduce energy costs. Analyzing the location, layout and orientation of windows (west / east) can maximize the natural light passage.

To supplement this, motion sensors can also help to optimize lighting usage in a facility. Sensors switch off lights when an area is not occupied, and may also dim lights according to the required output (University of Twente, Unilever, 2013).

Action: Shades

Shades are primarily used to reduce solar heat gain, widely practiced across the world and Malaysia as well. External shades are being replaced by advancements in glazing technologies and internal shades are still the most economical solution (but with regular maintenance / replacement). Different types of horizontal and vertical shades are utilized; however thermal comforts, brightness control, glare protection, privacy, view out, and durability are the key factors that need to be considered before the installation of shades. Please refer the *Building Energy Efficiency Technical Guideline for Passive Design (2013)*

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for more information on application of shades, various pros and cons.

Action: Applying for building certifications

Industry associations can play a vital role in providing guidelines and standards on building energy measures. In Malaysia, companies can consider applying for the Green Building Index (GBI), which assesses new and existing buildings for their environmental performance according to a range of key criteria.

IM has set out in its Green Building Road Map to utilize the GBI as a rating tool for buildings in the region to promote sustainability in the built environment. In July 2013, a luxury condominium in IM, Molek Pine 4, became the second residential project in the country to achieve the highest GBI rating.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Energy savings from measures to increase efficiency	Higher	Easy

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Cost savings from measures to increase efficiency	Higher	Easy
Amount and % of reduction in carbon emissions in weight	Higher	Moderate
Building certifications (e.g. GBI)	Lower	Moderate

In this section, this guideline provides measures to reduce energy consumption in facilities and to lower GHG emissions. Areas to target are HVAC and lighting, where most of the energy is consumed.

Facility efficiency is principal to a green economy, and this is acknowledged by both the Malaysian Federal government as well as IM. Malaysia follows the Low Carbon Cities Framework & Assessment System, developed by the **Ministry of Energy, Green Technology and Water (KeTTHA)**, which recommends specific carbon reduction solutions in buildings and infrastructure. Malaysia has also launched the **GBI** to rate commercial and residential buildings. Both buyers and builders of green buildings stand to benefit from this scheme. Some of the

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benefits that businesses could enjoy include:

- Investment Tax Allowance for purchase of Green Technology Equipment
Businesses could receive tax allowance of up to 100% of qualifying capital expenditure in relation to approved green technology projects or acquisition of green asset
- Income Tax Exemption on the use of Green Technology Services and System
Businesses could receive tax exemption of up to 100% for a period of 5 years in respect of the use and provision of green technology services and systems

More information on incentives can be found at GBI website, KeTTHA website and Malaysia Budget 2015 speech by YAB Dato' Sri Mohd Najib Tun Abdul Razak. Relevant website links can be found at the end of the manual.

IM aims to be an internationally recognized sustainable metropolis, and has imposed a building rating system alongside GBI for their new developments to identify and monitor building sustainability. Businesses should refer to

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IRDA's Low Carbon Society Blueprint and Actions for a Low Carbon Future that promote adoption of green building designs and features. Some of the benefits that businesses stand to receive from the policies include:

- An adjustment to tax rate on fixed asset tax
- Tax incentives on green development
- Low interest loans for energy-efficient building projects
- Subsidy for adopting photovoltaic power (Iskandar Regional Development Authority, 2014)

More information on incentives available from IRDA can be found at www.irda.com.my.

3.2. Waste Management

A waste management plan with specific targets, strategies and initiatives helps businesses to minimize waste that goes to landfill, increase recycling and re-use, and eventually lower environmental impact. In line with IRDA's waste management blueprint, businesses should focus on:

- Applying the waste management hierarchy (eliminate, reduce, reuse, recycle, disposal),
- Raising public awareness on the importance of waste minimization and recycling through Public-Private Partnerships (PPP), and

Shell (Royal Dutch Shell, 2014)

In 2013, Shell invested in resources to dismantle its indefatigable gas field in the southern North Sea. With the help of environmental services company, Shell reused and recycled 98.9% of the material. Materials from the platforms were processed for recycling, while wood was sent to pulping and crushed concrete was used as construction aggregate.

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- Consider investing in sustainable technologies to manage solid waste.

Action: Reducing material volume of packaging

P&G Packaging Reduction (P&G, 2014)

P&G targets to reduce packaging by 20% per consumer use by 2020. Several changes P&G have made are to use more of recycled PET and paperboard and to pack goods more densely for transportation.

There are a variety of estimates available on the weight of packaging, which is typically put at around 5% of the total weight of goods shipments (WEF, 2009). The carbon abatement of eliminating packaging is significant in the

production phase of the lifecycle - at up to 125 MtCO_{2e} per year globally (WEF, 2009).

Action: Using innovation as an engine for sustainable business growth

Innovation in the oil, gas and petrochemical industry has been known as one of the key engines that promotes the industry's growth. Industry leaders invest heavily in research and development to fuel more innovation that leads to improving operational efficiency, safety and

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reducing costs (Lloyd's Register Energy, 2014). This is proven by the huge investment commitment by the respective sectors in industry.

The oil & gas sector is projected to increase investment in R&D by a further 10% in the next two years. Some sectors are even estimated to invest even further given the current trend. The Gulf Petrochemicals & Chemicals Association reports that it has seen a 30% growth in the R&D spending by its companies, from USD266 million in 2011 to USD380 million in 2012 (GPCA, 2014). This growth is significant because during the same period, the global R&D spending was growing at only 10%.

DuPont (Du Pont, n.d.)

Promoting innovation to promote sustainable growth

DuPont creates the Sustainable Growth Excellence Awards to recognize employees who excel in championing sustainable business growth in DuPont's businesses. Among the many innovations, one stand-out innovation is in the packaging sector. DuPont developed a new packaging technology, the Dual Compartment Pouch MixPack, which is particularly useful for food storage. Ingredients for mixing, such as water and milk formula, can be stored separately within the pouch until before consumption. A simple pressure to the pouch will burst the special seal separating the two compartments and allow ingredients to mix, all while the pouch is not opened. The benefit of this lightweight design is not only cost savings from transportation and energy, but also in delivering essential nutrition to children in remote areas, where a "no-waste" mentality is encouraged. The pouch can be recycled into purses to put small change, for instance.

Key Performance Index

Performance Index	Objective	Ease of implementation
Waste reduction	Higher	Moderate
Tons of total waste output	Lower	Moderate
Waste intensity (kg per unit of goods)	Lower	Moderate

Total amount of recycled materials by weight (kg)	Lower	Easy
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Malaysia has a National Strategic Plan for Solid Waste Management that emphasizes the 3R's- Reduce, Reuse and Recycle and can be found on the Ministry of Housing and Local Government's webpage, www.kpkt.com.my. The Government of Malaysia seeks to transform the recycling industry into a remanufacturing industry, especially the automotive industry, to improve the life cycle of products and materials.

Businesses can also look into **IRDA's** Integrated Solid Waste Management Blueprint in order to adopt initiatives to improve waste management. The blueprint consists of strategies that are in line with international leading practices and the National Strategic Plan for Solid Waste Management and has been developed to be more relevant to IM. In addition, the blueprint has also listed waste facilities in IRDA that will make business operations at IM more sustainable and green.

More information on waste management can be found at www.irda.com.my

3.3. Transportation, Logistics & Distribution

Various modes of transport are used for distribution of oil and gas. However, different modes have different GHG emissions intensities (Figure 6). While shifting from ground transport (long-haul trucks) to rail can improve fuel usage and reduce GHG emissions, pipelines offer even better opportunities.

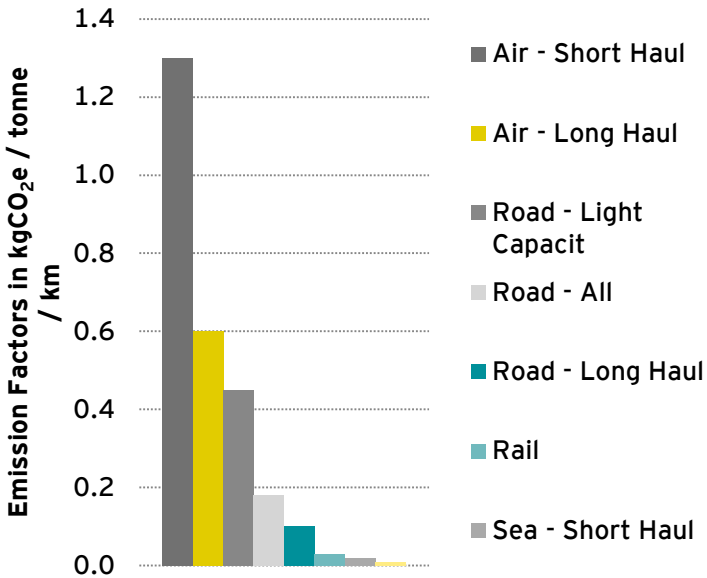


Figure 6: Emission Assessed in terms of emissions intensity per tonne-km (WEF, 2009)

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Action: Utilizing pipelines

Pipeline transportation comprises “long distance, inter and intrastate transmissions systems and the local or regional gathering systems which aggregate production for delivery into the common carrier transmission system” (API, 2013).



Image 3: Pipeline

Pipeline is arguably the safest option amongst all other energy transportation mode. In 2012 alone, 99% of crude oil, natural gas and petroleum products were transported safely to destinations (AOPL, 2014). Pipelines can mitigate risks posed by accidents, especially during maritime

Sabir (Sabir, 2013)

Sabir, a major chemical manufacture and distribution company that produces petrochemical products is reducing their reliance on trucks and gradually shifting to rail and pipeline, to increase safety of supply chain and to reduce emissions. An East-West rail link in Saudi Arabia replaced 200,000 truck shipments. Furthermore, by shifting their supply chain to pipeline transport, they have reduced GHG emissions by 1,670 MtCO₂ per annum.

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transportation. Off-shore oil spills, as seen from the Deepwater Horizon accident in the Gulf of Mexico and the Exxon Valdez accident, severely damaged not only the environment but also the respective company's reputation and share values. Pipelines are the least-cost option in terms of fuel usage, offering half or one-third of fuel costs compared with shipping and rail (EIA, 2012). Also, emission intensity of pipelines is the lowest amongst all other modes of transport.

Route optimization and increasing utilization of Alternative Fuelled Vehicles (AFVs) can mitigate the impacts posed by fuel usage and GHG emissions. However, the share of road transport is minimal in the mid-stream value chain, due to characteristics of the material being handled and risk of spills cannot be minimized from ground transport.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Proportion of material sourced by rail to ground transport	Higher	Moderate
Proportion of material sourced by pipeline to rail transport	Higher	Moderate
Proportion of materials sourced by pipelines	Higher	Moderate

3.4. Oil Storage Terminals: Pollution Prevention Measures

Pollution prevention measures, in response to mitigating air emissions, wastewater and hazardous waste should be implemented in oil storage terminals to reduce risk exposure to leaks. The actions outlined in this section applies to petroleum storage terminals receiving and dispatching crude oil, gasoline, compressed natural gas

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(CNG), liquefied petroleum gas (LPG), aviation gas, middle distillates and specialty products from pipelines, tankers, railway and trucks for commercial distribution (IFC, 2007).

3.4.1. Air Emissions

VOCs emitted into the atmosphere during oil and petroleum product storage poses significant threat not only to the environment but to businesses as well. Evaporative losses can result from operation (such as filling, additive blending, withdrawal and loading / unloading) and storage (leaks from seals and weak connections between equipment). The following actions can reduce the possibility of these losses which can be applied to most fuel storage tanks.

Action: Reducing operation losses

Maintaining high and stable tank pressure can reduce the amount of air being lost to the atmosphere during filling and withdrawing. This can be enabled by implementing vapour balancing between the tank being filled and emptied (vapour displaced during filling is transferred to the tank being emptied), using gasoline supply / return systems, vapour recovery hoses and installing pressurized

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tanks, which have minimal evaporative or operation losses.

Action: Reducing storage losses

Storage losses can be reduced by reflective colour paints that can minimize heat absorption for gasoline, ethanol and methanol and can keep tank pressure and vapour space stable. Installation of fixed roof tanks, floating roof tanks and variable vapour space tanks can be an efficient low-cost option for industries to reduce evaporation losses, where physical fittings such as rim seals can minimize loss of VOCs.

Action: Conducting regular monitoring and maintenance

Tanks should be inspected regularly and monitored in terms of pressure and emission / leaks from pipes, valves and seals to identify areas of vulnerability. Setting up a procedure for periodic monitoring and educating workers is essential.

Action: Adopting secondary emission controls

Where vapour emissions can significantly affect air quality, installing measures such as recovery units, vapour condensing, combustion and recovery units, and catalytic oxidisers can mitigate atmospheric impacts from oil

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storage terminals as losses from oil storage terminals significantly affect not only the company itself but also the environment.

3.4.2. Wastewater

Wastewater from oil storage terminals include process wastewater, which consists of tank bottom water and stormwater, from leaks and spills. It is critical to effectively manage, prevent and control wastewater in order to mitigate environmental impacts to biodiversity, water quality and even human health, considering oil content.

Action: Establishing controls and procedures

Spill prevention measures and controls along with secondary containment procedures such as collection ponds to minimize oil contaminated stormwater run-off are key areas for control. In the case of stormwater run-offs, rainfall, run-off area, geographical location and possible areas of impact should be analysed.

Action: Conducting tank maintenance

Condensation of moisture from tank vapour, rainwater infiltration and leaks contribute to tank bottom water. Maintenance in tanks in terms of roofs and seals should be

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considered and use of domes on top of roof tanks can lower the possibility of rainwater penetration.

3.4.3. Hazardous materials and oil

Petronas (Petronas, 2014)

Petronas bans and controls the use of environmentally hazardous substances. Selected ozone-depleting substances are completely banned, while persistent organic pollutants are minimized.

There are possibilities of leaks during storage and transfer of oil, especially in pipes, hoses and during loading and unloading. These leaks increase risk of fire and explosions due to flammable nature of the materials.

Action: Meeting international standards for design

International standards such as API 620, 650 and European Standard (EN) 12285-2:2005 include fire and overfill protection and measures to prevent electrostatic charge from building up. The standards call for secondary containment should be installed such as double bottom and wall containment, installation of asphalt or concrete in the areas vulnerable to spills and leaks (areas for loading

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and unloading, pipes, pumps).

Action: Inspecting tanks and operations

Tanks should undergo continuous monitoring and maintenance and operations such as loading and unloading should be conducted by properly trained personnel. There should be a specific prevention and control plan, which comprises of different scenarios. Employees are required to be informed and educated about the controls to be followed.

Businesses can refer to the *Green Technology Master Plan* by KeTTHA as an effort to reduce pollution. The Green Technology Master Plan consists of several financing schemes including the Green Technology Financing Scheme. The government has allocated RM1.5 billion to support producers or users of green technology. With the adoption of green technology, businesses could reduce the amount of pollutions emitted from their operations.

More information on incentives available can be found at www.gtfs.my

3.5. Refining: Pollution Prevention Measures

Similar to the oil storage terminals, pollution prevention measures including procedures to mitigate air emissions, wastewater and hazardous waste should also be implemented in refining, in order to reduce risk exposure to leaks and spills. The actions outlined in this section apply to refining processing operations from oil to finished liquid products (IFC, 2007).

3.5.1. Air Emissions

Air emissions can be divided into exhaust and fugitive gases where venting and flaring ensures exhaust and flue gases are effectively disposed. Fugitive gases are released during operation and storage in tanks.

Action: Increase venting and flaring efficiency

Venting is a controlled release of hydrocarbon gases into the natural environment, while flaring is one process that burns these released gases. Pollution prevention measures related to gas flaring are: minimize source gas where possible; maximize combustion efficiency by controlling air / fuel / steam flow mix; minimize risk of blow-out by considering exit velocity; reduce flaring from purges and

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pilots by installation of purge gas reduction devices, inert purge gas, soft seat valve technology; flare gas metering for monitoring purpose(IFC, 2007).

ExxonMobil (ExxonMobil, 2013)

ExxonMobil is aiming to reduce emissions by efficiently managing flaring and venting. In 2012, flaring at ExxonMobil averaged 361 million cubic feet per day which was a decrease of 14% from 2011 and 60% when compared to 2006.

Action: Reducing fugitive emissions by minimizing leaks

Fugitive emissions are associated with vents, valves, flanges, connections, floating roof storage tanks seals and compressor seals. The emission comprises of hydrogen, methane, VOCs and other inorganic gases. To prevent and control these emissions, identifying streams or equipment that are leaking or likely to leak should be acknowledged and monitored through technological measures such as vapour detection equipment. Appropriate measures for seals, valves and packaging should be selected to minimize gas leaks and fugitive emissions.

ExxonMobil (Gulf Times, 2014)

ExxonMobil won the “Innovation Award” for HSE Excellence in Qatar. ExxonMobil has been exemplary in upholding operational health and safety by utilizing its own Remote Gas Detection System. The system autonomously scans for hydrocarbon emissions and identifies leaks that can be repaired.

3.5.2. Wastewater

Industrial process water, which includes sour water, generated from desalting, vacuum distillation, pre-treating, coking, hydrodesulphurization, hydrocracking, catalytic cracking and thermal cracking.

Action: Establishing controls and procedures

Prevention and control should be carried out through regular inspections, maintenance and establishment of response plans. Construction of wastewater and hazardous material storage basins can be an example of control, where wastewater can be prevented from infiltrating into soil and groundwater.

3.5.3. Hazardous Materials

Significant number of hazardous materials is used in petroleum refining. Recommendations are similar to the actions outlined for **Storage Terminals**.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Air emission levels	Low	Difficult
Number of significant leaks or spills occurred	Low	Easy
Percentage of content loss from leaks	Low	Mode
Monitoring / maintenance frequency	High	Easy
Number of education / training sessions held on control and maintenance	High	Easy

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Industries can mitigate pollution risks associated with storage by adopting prevention and monitoring measures. Continuous monitoring is essential to minimize the impact and employees should be trained and educated regarding maintenance on a regular basis.

Businesses can refer to the *Green Technology Master Plan* by KeTTHA as an effort to reduce pollutions. The *Green Technology Master Plan* consists of several financing schemes GTFS. The government has allocated RM1.5 billion to support producers or users of green technology. With the adoption of green technology, businesses could reduce the amount of pollutions emitted from their operations.

More information on incentives available can be found at www.gtfs.my

3.6. Chemical Conversion: Improving Steam Systems

Steam supply includes generation from boilers and Combined Heat and Power (CHP). CHPs are widely adopted within the petrochemical industry players in the industry. Energy use can be reduced from steam supply in boilers in a number of ways outlined by the following

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actions (Neelis, 2008)**Action: Improving process control in boilers**

ExxonMobil (IAC, 2006)

ExxonMobil's Mary Ann, US, facility installs flue gas mixture monitoring equipment. The installation has a payback of 0.6 years on average and resulted in annual energy consumption of 170TBtu and fuel savings of 3%.

This action aims to monitor optimum oxygen levels in the combustion zone. Using an optimal mixture of carbon monoxide and oxygen readings, it is possible to optimize fuel and air mixture for combustion, which can enhance

energy efficiency.

Action: Improving insulation and maintenance of boilers

These measures ensure that boilers are operating at their peak performance with less power and heat requirement. Energy savings from insulation is estimated to be approximately between 6% to 26% when installed with heater circuit controls (Neelis, 2008). Without proper maintenance, condensate return systems and burners may get out of adjustment or wear out. This reduces efficiency by approximately 20% to 30% over 2 to 3 years (US EPA,

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2001). Potential energy savings from maintenance is around 10% (US EPA, 2001).

Action: Installing CHP

An option adopted by petrochemical industries are CHPs, as it provides opportunities in utilizing fuel for power generation and capturing heat to produce steam. A CHP is more energy efficient than a conventional power plant as it takes advantages of losses by reutilizing waste heat.

These cogeneration plants are a popular option for major petrochemical producers, including BASF and ExxonMobil. BASF in Lampertheim, Germany, for instance, has reduced carbon emissions by 14,000 metric tonnes per year, where heat is recaptured from power production to be reutilized for steam (BASF, 2013). ExxonMobil also reuses heat for refining and chemical processing operations, with approximately 5,300MW capacity in more than 100 installations at 30 locations around the globe (ExxonMobil, 2013).

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Action: Utilizing efficient steam distribution

Efficiency can also be enhanced in the areas of distribution process of steam, where leaks should be minimized, measured and insulated throughout. Leak repairs provide 3%-5% fuel savings with a payback period of approximately 0.4 years and insulation measures offer 3%-13% fuel savings with 1.1 years of payback (IAC, 2006). Leaks should be monitored throughout and maintained with regular inspection.

The US Environment Protection Agency (EPA) assessment program for steam system energy saving has identified repairing leaks and failed steam traps as key areas of intervention (US EPA, 2007). Steam leak management and insulation improvement have been identified as near term options for Dow Chemical, where steam leak management resulted in annual energy cost savings of up to 451,100 MMBtu or USD3.3 million. A comprehensive improvement in steam trap program and enhanced leak repair program, could potentially offer savings of USD1.9 million with annual natural gas savings of 272,000 MMBtu with 6 weeks being the payback period (US EPA, 2007)

Key Performance Index

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Key Performance Index	Objective	Ease of implementation
Energy use from steam generation	Lower	Moderate
Emissions from steam generation	Lower	Higher
Improvement in energy use / emission through maintenance	Higher	Higher
Improvement in energy use / emission from insulation	Higher	Higher
Improvement in energy use / emission from minimizing leaks	Higher	Higher
Monitoring / maintenance frequency	Higher	Easy

As steam generation accounts for significant amount of energy use in chemical processing, the area should be targeted through measures outlined above. All the actions may be explored and studied in detail as they pose viable

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investment opportunities for petrochemical industries.

Businesses can refer to the *National Renewable Energy Policy & Action Plan 2009* and *National Renewable Energy Act 2011* in order to improve on low carbon energy production. The **Malaysian Investment Development Authority** has made available incentives to businesses that produce electricity, steam, chilled water and heat through renewable sources.

- Income tax exemption of 100% of statutory income for 10 years for pioneer businesses
- Investment tax allowance of 100% on the qualifying capital expenditure incurred within the period of five years for existing businesses (Malaysian Investment Development Authority, 2013)

Coupled with **IRDA's** incentives to adopt green manufacturing practices as prescribed in the Low Carbon Cities Policy, IRDA has made it favorable for oil & gas businesses to improve on their steam generation and consumption.

More information on incentives available can be found at

www.irda.com.my and www.mida.gov.my.

3.7. Water Management

Water availability is increasingly becoming a global issue. The United Nations Environment Program has identified water shortage as one of two major environmental issues that the globe is facing today (Monash University Malaysia, 2014). Water-rich Malaysia, too, is not impervious to this impact of climate change on water security. The *New Straits Times* has reported that the Klang Valley water rationing in June 2014 has affected 3 million consumers. This incident is not localized either; other areas, such as Gombak, Kuala Lumpur and Petaling, were faced with the same predicament.

Businesses should play key role in conserving water because water scarcity directly affects their operations. During Malaysia's water crisis in early 2014, *Bloomberg* has reported that Malaysia's Top Glove Corporation had expected a cost increase as much as 10 times due to water shortages. *Bloomberg* has also found that another electrical products company in Malaysia had lost a RM40 million order due to uncertainty in water supplies.

As it is, Malaysia registers as one of the high water

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consuming populations in the region. At an individual level, *Business Insider Malaysia* has estimated that Malaysians use 226 litres per person per day. This is significantly higher than Singaporeans, who register 154 litres per person per day, and Thais, who register 90 litres per person per day. Malaysians need to reduce their water intensity level by 37% to achieve the recommended 165 litres per person per day. One of the reasons to explain this water intensity level is the low to free water tariffs that create a wasteful habit. This habit could translate into increased wastages in work environment as well. Not only do businesses suffer from paying additional costs, the sheer volume of water consumed by industries exponentially worsen the situation, leading to accelerated water scarcity.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Water intensity	Lower	Easy

3.8. Equipment Usage

Action: Install energy-efficient equipment

Energy-efficient equipment contributes significantly to the

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cost-savings in business operations. As explained above, energy-efficient equipment, such as HVAC equipment and servers, stands to reduce energy consumption to a large extent. This energy savings definitely translates into cost savings for businesses.

However, energy-efficient equipment is not limited to only instruments like

HVAC equipment and servers.

Significant energy consuming

equipment such as escalators,

elevators, motors

and pumps are

also potential

areas for cost-

savings.

Example of energy-efficient escalator

Hitachi's VX Series escalators have automatic switch-off system that switches itself off when not in use. It also has a load detection system that promptly adjusts its conveyor speed to optimize usage. The combined energy-saving features enable the escalator to register up to 48% in energy savings when compared to conventional escalators (Hitachi, 2014)

There are many

ways to identify energy-efficient equipment in the market.

One of the easiest ways is to look for energy-efficient marker in the equipment, such as the ENERGY STAR tick

marks. Energy-saving certifications, such as ENERGY

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STAR, assure consumers of the energy efficiency of the product. However, consumers should still conduct due diligence on the value proposition and energy savings of equipment before any purchase.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Energy consumption from equipment use	Lower	Easy
% of equipment with energy saving certifications (e.g. from ENERGY STAR)	Higher	Easy

3.9. Monitoring & Reporting

Action: Development/Adoption of green technologies

The information and communications technology (ICT)-enabling effect involves the introduction or improvement of ICT to reduce environmental impact and/or greenhouse

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gas emissions. For instance, the development of video conferencing has reduced the need for corporate air travel as meetings can be done through video conferences. An analysis by Global e-Sustainability Initiative found that ICT is crucial to mitigating climate change and could enable emissions reductions of 7.8Gt CO₂e, or 15% of GHG emissions (GeSI, 2008). Adopting and developing ICT can help with environmental initiatives and cutting costs.

Action: Create a 'carbon budget' during monthly/annual strategic meetings

Companies can create a carbon budget to ensure that they meet carbon emissions targets. This sets a goal for their employees as well as discloses the company's interest in reducing emissions. A detailed carbon budget comes with a clear emissions reduction plan for the long-term which can provide direction/guidelines for staff. A carbon budget sets short-term emissions goals and allows for frequent monitoring and review compared to an emissions target over a period (Gilbert & Recce, 2006).

Action: Monitoring usage

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A Building Energy Management Systems (BEMS) is a computer-controlled automation system which aims to create the safest, most comfortable environment possible at the lowest possible cost. On average, BEMS save about 10% of overall annual building energy consumption, and more than half of all buildings in the US larger than 100,000 square feet have one (Brambley, 2005). This is achieved through:

- Building system automation: This can be done according to time, type of day, or environmental conditions. For example, BEMS can control lighting to avoid unnecessary use of energy outside normal working hours or when ambient daylight levels are

ExxonMobil (Emerson Climate, n.d.)

ExxonMobil installed a climate monitoring system in its 500-strong stores in the US. The system logs the temperature and humidity and regulates the temperature inside the stores. As a result, ExxonMobil saw 10% reduction in annual electrical energy consumption, saving on average USD3,050 per store annually.

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adequate (Sustainable Energy Authority of Ireland, 2014).

- Provide energy monitoring and management information. BEMS provides users with easily available data on energy flows, consumption, trends and overall building performance. Companies such as Siemens even have professionals at their operations center to evaluate the data collected and create comprehensive reports to identify ways to improve energy usage and achieve additional savings.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Number of records of energy consumption	Higher	Moderate

3.10. Educating and Training Employees

Employees are the drivers of businesses on the ground. A well-intentioned environmental strategy from the management without the support of the employees to implement it correctly would subvert the effectiveness of the strategy. Similarly, eco-friendly equipment in the hands of an untrained employee will be ineffective. Hence, it is essential to have an educated and trained workforce that shares the management's concerns and ambitions to build a green and sustainable business.

Businesses should embark on strategic programs and initiatives to build on their capacity for improving environmental performance. Activities to educate and train the company's employees on environmental issues, such as climate change, could motivate employees to be more involved and committed to greening the company and thereby contributing to green economy in IM. For example, an understanding of the deleterious health effects of GHG enables employees to support the management's goal to reduce GHG emissions. Employees could become more dedicated and actively participate in sustainable development activities realizing that their

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welfare is directly affected by such emissions.

It is essential for employees to be made aware that they too have an impact on the environment. Firms could introduce a system that reveals to employees their impact on the environment. For instance, Woh Hup Pte Ltd in Singapore has implemented an environmental management system that monitors on a daily basis the energy, water and generated by the company. These figures are on display in prominently visible areas, such as lift lobbies and pantries, so that employees are reminded of their daily environmental footprint. Individual electric meters were also issued to staff to monitor personal electrical consumption per day. In this manner, employees could relate to their environmental performance, monitoring in real time the impact of their consumption or savings.

Employees could also participate in seminars and conferences as a way for sharing and learning opportunities. For instance, Universiti Utara Malaysia organized the International Conference on Management and Business Sustainability in 18-19 August 2014 that aimed to facilitate exchange of ideas to attain sustainability through business transformation (Universiti

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Utara Malaysia, 2014). Alternatively, business owners could conduct in-house training with the assistance of IRDA's environment team or other experts such as the Malaysian Green Technology Corporation to customize training specifically to business operations.

Ultimately, businesses should aim to have a workforce educated and trained in sustainability topics as a matter of business strategy. With adequate awareness and training, employees would be better equipped to contribute to developing successful solutions. Finally, businesses are the beneficiaries of the cost-savings and subsequent profits generated by such an environmentally-conscious workforce.

Key Performance Index

Key Performance Index	Objective	Ease of implementation
Number of hours of sustainability training per employee	Higher	Easy
Number of training sessions organized by company	Higher	Easy

3.11 Compliance to Local Regulations

As a commercial entity present in Malaysia, businesses should as a first and essential requirement abide by the rules and regulations of the country. Compliance to regulations is a non-negotiable requirement before businesses can fully benefit from this guideline to further improve on the sustainability and green initiatives of business operations.

Malaysia has numerous prevailing national standards and also international standards that businesses are encouraged to adopt. Compliance to authorized standards acknowledged by the Malaysian government is complementary to the recommended actions proposed in this manual. Some examples of recommended standards that businesses are encouraged to comply with are the MS1525, ISO14001, ISO18001 and ISO50001. In addition, businesses can also look to have their products certified MyHijau and disclose their GHG emissions performance through MYCarbon reporting.

The MS1525 is a code of practice pertaining to energy efficiency and use of renewable energy for non-residential buildings. Developed by the Department of Standards,

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Malaysia, this code primarily focuses on energy efficiency in buildings. In general, the code distinguishes between passive measures and active measures that building owners could adopt. Passive measures consist of recommendations relating to architectural and passive design strategies and the building envelope. Active measures correspond with lighting, power and distribution, air conditioning and mechanical ventilation and energy management systems. The adoption of the recommendations in MS1525 would help businesses to eventually reduce energy consumption and minimize use of non-renewable energy sources while maintaining a safe, healthy and comfortable environment for building occupants.

Businesses may also adopt the international standards from the International Standard Organization (ISO) as an alternative to the Malaysian Standards. The ISO is not only an independent non-governmental membership organization; it is also the world's largest voluntary developer of international standards, covering more than 19,500 standards across all industries. Common ISO standards that businesses adopt are the ISO 14000 (environmental management), ISO 18000 (occupational health and safety) and ISO 50001 (energy management

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system). This manual encourages business to consult and consider the ISO standards in addition to the Malaysian Standards.

Moreover, businesses with green features built into their products can look to be certified under MyHijau for enhanced consumer confidence and to demonstrate their commitment to sustainable development. The MyHijau Mark is an internationally-recognized environmental and ecological label. Products labelled MyHijau can be featured in the MyHijau directory which helps businesses to promote their environmentally-friendly goods (Malaysia Green Technology Corporation, 2013).

Businesses could also seek disclose their GHG emissions performance through MYCarbon. The Ministry of Natural Resources and Environment Malaysia has instituted the MYCarbon Programme, which acts as the National Corporate GHG Reporting Programme for Malaysia. The advantage of engaging in a reporting exercise includes creating the awareness in business owners of the importance of measuring and reporting on emissions. This could also eventually lead to efforts put into management of the measureables, such as GHG emissions or energy use,

creating better products, services and operations.

3.12. Case Study

3.12.1. BASF (BASF, 2013)

BASF is a leading chemical manufacturing company with numerous product lines including petrochemical products. In 2013, BASF's petrochemical line generated approximately USD10.5 billion in sales. BASF also has strong presence in Asia Pacific, particularly in Kuantan, Malaysia, due to its close collaboration with PETRONAS.

Not only is BASF very successful in generating revenue from its operations, BASF achieves it with environmental protection in mind. This commitment echoes BASF's corporate purpose which is to "create chemistry for a sustainable future." Evidently, BASF adopts many exemplary practices that make its operations more sustainable.

BASF identifies potential areas for greening by conducting materiality analysis. The outcome of the analysis enables BASF to concentrate its greening efforts on impactful areas, which BASF has identified to be (a) production, (b) transportation, (c) customers and (d) suppliers. In these

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four areas, BASF works towards achieving sustainability in energy and climate through attaining reduction in GHG emissions. BASF aims to reduce specific GHG emissions per metric ton of sales product by 40% compared with 2002 baseline.

a. Production

BASF sources its energy for its production facilities mainly from gas-based CHP. Natural gas has a 90% utilization rate for fuel so it is significantly cleaner than conventional power plant. In addition, the CHP plant recycles heat to produce steam that is necessary for plant operations. In all, 70% of BASF's energy needs are met by gas-based CHP plants.

BASF adopts the Verbund system in its facilities. In Kuantan, BASF operates 13 production facilities covering 1.5 km² connected by a total of 450 km of pipelines. The Verbund system essentially links the production plants, energy flows and infrastructure to achieve energy-efficiency. By-products of one plant are used as starting material by another. As a result, BASF saves in logistics and transportation costs. Moreover, less energy is consumed because fewer chemical conversion steps

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become necessary. In total, BASF prevents 6.1 million tonnes of GHG emissions through the use of Verbund system to regulate power, heat and steam. The system is so effective that BASF plans to have its Germany's energy management system certified DIN EN ISO 50001.

b. Transportation



Image 4: Container facility

BASF adopts several approaches in greening its transportation operations. Firstly, it chooses strategically

located storage area and secondly by utilizing inter-modal transportation terminal.

BASF's facility at Ludwigshafen, Germany, is the world's largest chemical complex. It has 160 production facilities spanning 10km². In this complex, BASF has to organize its logistics operations sensibly due to its sheer size. Adopting the most modern technology to monitor storage and movement and positioning the logistics centre with direct access to the highway, BASF optimizes inventory storage and dispatch. As a result, it relieves nearby towns

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from 25,000 trucks passing each year.

Transportation of BASF's products from production facilities also makes use of inter-modal transportation terminal. BASF recognizes the financial and environmental benefits of combining modes of transportation. Train transport reduces GHG emissions by 65% compared to trucks. As a result, BASF dispatches its products with trucks from production plant to the rail station for a change over to rail freight. In Ludwigshafen alone, the intermodal transportation that BASF utilizes prevents 60,000 tonnes of GHG emissions annually.

c. Customers

BASF achieves more GHG emissions reduction from customers by providing them with products that help to reduce emissions. BASF invests a third of its annual research spending, amounting USD825 million in 2013, in research and development of innovative products.

One of the products that have made its environmental mark is the Neopor insulation material for buildings. The insulation material helps save 387,000 heating oil annually. This is a 145 tonnes of emissions difference for a single-family house annually. In 2013, 246 million tonnes

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of CO₂ emissions are being prevented due to the use of BASF's environmentally-friendly innovations.

d. Suppliers

BASF is committed to be responsible for the environment and the community. It has a Supplier Code of Conduct that governs the standards on human rights, labour as well as use of renewable resources for its suppliers. To help the suppliers achieve BASF's target, it also has the BASF Eco-Efficiency Program that educates and train suppliers on sustainability issues. This program has resulted in 70,000 tonnes of GHG emissions prevented from BASF's Mexico suppliers since 2008.

3.11.2. PETRONAS

Petroliam Nasional Berhad (PETRONAS) is committed to conducting its business in responsible ways to promote environmental sustainability. It has begun disclosing its efforts in greening its operations since 2007. As an oil, gas & petrochemical industry leader in the region, Petronas focuses its environmental strategies on (a) climate change, (b) water, (c) waste minimization and (d) biodiversity.

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a. Climate change

PETRONAS' operations inevitably contribute to the climate change phenomena through GHG emissions from its operations. In response to their impacts, PETRONAS endeavours to track and monitor its GHG emissions so that it can manage and mitigate negative effects of GHG.

PETRONAS strengthens its environmental governance through extensive discussions with the Corporate Sustainability Council to assess the carbon commitments of the group. Moreover, PETRONAS revised its PETRONAS Technical Standards on GHG monitoring, reporting and verification in order to beef up data quality. The revised standards are more in line with IPIECA's reporting standards. As part of improvements in climate change monitoring, PETRONAS also established GHG and Energy Data Management and even more specifically, the GHG Reference Manuals for the Exploration and Production (E&P), Gas and Power (G&P) and Downstream Businesses.

These improvements in reporting enable PETRONAS to quantify its emissions more accurately and identify areas to work on. In 2012, PETRONAS emitted 44 million tonnes of CO₂e from all its operations, including its shipping

company, MISC Berhad.

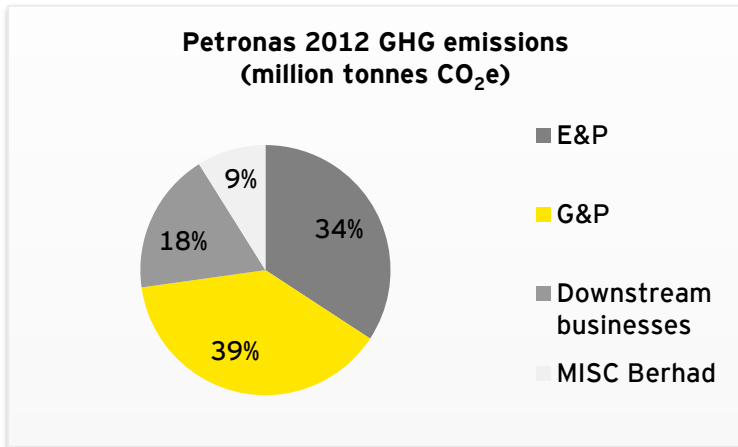


Figure 7: Petronas 2012 GHG emissions



Image 5: Suria KLCC shopping mall roof top (Alexander, 2012)

The emissions figure represents an 8% increase in total GHG emissions from 2011. A more

accurate emissions

monitoring and also the company's aggressive exploration in 2012 could account for the increase in emissions: the

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E&P business received RM27 billion in investments in 2012, as compared to RM21 billion in 2011 (Petronas, 2012; Petronas, 2013)

With the GHG emissions on the increase, PETRONAS has set plans to reduce its emissions. One of the initiatives that PETRONAS has implemented is the reduction and recovery of flare in G&P. PETRONAS LNG Complex in Bintulu, Sarawak has implemented this initiative and has seen total flared gas reduction of 109,860 tonnes of CO₂e accumulatively from 2010 - 2012.

PETRONAS has also collaborated with other organizations to promote green practices and mitigate effects to climate change. PETRONAS worked with Suria KLCC to launch the solar photovoltaic technology for Suria KLCC's shopping mall. The technology supplies 30% of the shopping mall's energy needs and avoid 360 tonnes of CO₂ annually. Moreover, PETRONAS' Solaris Putra and Solaris Serdang have also had their stations fitted with solar panels, LED light fittings, Energy Management System and rain water harvesting system.

Other energy efficiency improvement initiatives have also enabled PETRONAS to achieve more than 1,186,517 GJ

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of energy savings cumulatively.

b. Water

Fresh water is used extensively in an oil and gas operations. PETRONAS constantly monitors its water use and has a dedicated water accounting methodology that is constantly revised to meet international standards. Prior to any utilization, PETRONAS invariably conducts water availability risk assessment for its locations.

In order to reduce demand for fresh water, PETRONAS conducts audits and feasibility studies to assess water supply and consumption patterns. PETRONAS also adopts the reverse osmosis technology to recover water. All these water monitoring and reduction schemes have seen PETRONAS save 518,400 million cubic meters of fresh water.

c. Waste minimization

PETRONAS intensively promotes the 3R principle in waste: reduce, reuse and recycle. PETRONAS has a thorough Environmental Impact Assessment that explores waste management options in its facility. This assessment is carried out from the design stages to the engineering

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stages in order to reduce waste starting from the front-end. Furthermore, PETRONAS has implemented waste minimization practices at its facilities in Malaysia since 2010. This practice has particularly seen a reduction in hazardous material disposal.

d. Biodiversity

All these initiatives to green the operations will ultimately result in a better environment and one of beneficiaries of these initiatives is the biodiversity. PETRONAS establishes its *ecoCare* programme together with the Malaysian Nature Society and the community to conserve mangroves. PETRONAS reforest and rehabilitate sensitive ecosystems along Kertih River, which is near PETRONAS Chemical Group's facilities. As a result, more than 11,000 square meters of mangrove forest have been replanted with more than 6,600 mangrove seedlings from 2005 - 2012.

4. Social Responsibility

The promotion of sustainable business practices, respect for labour and human rights and transparency through disclosure are increasingly expected from responsible businesses. Democratic freedoms, ethical behaviour and good governance, the rule of law, property rights and a thriving civil society create fertile conditions for private sector led growth. The absence of such safeguards takes individuals out of markets, reduces innovation, restricts access to opportunity and drives political instability and conflict.

Forbes has reported that human capital is an increasingly scarce resource in a global economy. It is deemed by many experts as the most important segment of a business' value chain. In the war for talent, companies with excellent human rights track record are consistently ranked high on Employer Branding surveys. This helps in attracting and retaining this key resource, contributing to lower rates of staff turnover and higher productivity, and increasing employee motivation.

Businesses should also note that institutional investors, pension funds and equity firms are increasingly taking

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ethical factors such as human rights into account in their investment decisions. More than 1,260 signatories with USD45 trillion Assets under Management have adopted the UN Principles for Responsible Investment (www.unpri.org), including the Harvard University Endowment. This represents an opportunity for businesses to highlight their human rights credentials in an increasingly enlightened and cautious market.

4.1. Human rights, labour standards and ethical behaviour

Respect for human rights is no longer a good to have but a prerogative of every aspiring country. Businesses that neglect human rights are also liable to boycotts, litigations and backlash by increasingly vocal and militant stakeholders. As reported by *Business Insider*, multinational corporations like Nike have been accused of exploiting low cost labour and have faced public pressure to introduce better working conditions and a minimum wage (Nisen, 2013). Businesses cannot ignore the impact that NGOs, civil society and social media can effect. Instead of being reactive, businesses should anticipate any

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aspects of their operations that may infringe on human rights and proactively work towards avoidance of such violations.

In line with the principles outlined by the United Nations Global Compact (www.unglobalcompact.org) and the International Labour Organization (www.ilo.org), IRDA fully supports international standards for human rights, enshrined in the charter of Ministry of Human Resources (www.mohr.gov.my).

International labour standards are aimed at promoting opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity. In today's globalized economy, international labour standards are essential components in the international framework for ensuring that the growth of the global economy provides benefits to all.

Malaysia too believes that everyone is entitled to their inalienable rights to invest, live, work, worship and play with dignity and respect. This is in accordance with IRDA's vision of building a "Strong and Sustainable Metropolis of International Standing".

Outlined below are the UN Global Compact principles for

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businesses to support and enact within their sphere of influence, applying the following 10 core values in areas of human rights, labour standards, the environment and anti-corruption.

Human Rights

- Principle 1: Businesses should support and respect the protection of human rights (enshrined in the Malaysian constitution, please refer to <http://www1.umn.edu/humanrts/research/malaysia-constitution.pdf>);
- Principle 2: ensure that they are not complicit in human rights abuses across their supply chain.

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Labour

- Principle 3: Businesses should uphold the freedom of association and recognise the right of employees to collective bargaining;
- Principle 4: remove all forms of forced and compulsory labour;
- Principle 5: abolish the use of child labour; and
- Principle 6: eliminate all forms of discrimination in hiring and employment practices

Environment

- Principle 7: Businesses should adopt a precautionary approach to environmental issues;
- Principle 8: undertake initiatives to incorporate greater environmental stewardship in its operations; and
- Principle 9: encourage the development and diffusion of environmentally friendly

Anti-Corruption

- Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery.

IRDA strongly encourages businesses to consider this important aspect and take an enlightened approach to adopt the framework in everyday business decisions and practices.

Key office holders should come together to formulate a human rights policy for the business to comply with and make it publicly accessible on mediums such as websites or on the annual report. Top management and HR professionals should take a proactive approach in educating every employee to abide by the values defined in the human rights policy.

4.2. Disclosure Requirements

Sustainability disclosure is the act of communicating organizational performance on financial, environmental, social and governance (ESG) activities. It is practiced by many leading businesses to communicate their ESG

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progress to stakeholders and lend credibility to their commitments to sustainable development.

Across the globe, more enlightened stakeholders are raising concerns over businesses' non-financial performance and are demanding them to disclose their ESG performance with greater transparency and detail. In certain regions, such sustainability disclosure is a legal requirement. With effect from 31 December 2007, companies listed in Bursa Malaysia are required to include a description of the corporate social responsibility activities or a statement to that effect in their annual reporting (Listing Requirements of Bursa Malaysia Appendix 9C, Part A, Paragraph 29). Bursa Malaysia supports businesses by providing training for companies and offers guidance for sustainability reporting (Sustainable Stock Exchange Initiative, 2013).

Many businesses are accustomed to file mandatory sustainability disclosures such as annual reports and quarterly 10-Qs or in the form of non-financial reports such as pollutant and emissions reports for those in heavy industries. There are also established voluntary disclosure frameworks such as Global Reporting Initiative and the Carbon Disclosure Project which businesses adopt in their

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corporate social responsibility or sustainability reports. There is also a trend of companies aligning financial and non-financial information in a single integrated report.

For businesses that are in their nascent stage of reporting their ESG impacts, they can get in touch with IRDA to learn more on disclosure requirements and report information on the basic triple bottom line performance. This ensures that the disclosed information is complete, consistent, useful and reliable.

The business expression, “If you can measure it, you can manage it” holds true. The process of developing a sustainability disclosure unlocks opportunities for a business to gain insights into its operations and supply chain, identify and mitigate risks and uncover potential cost savings and growth. Businesses that regularly publish sustainability disclosures are recognised on established indices such as the Dow Jones Sustainability Index and FTSE4Good. Businesses that disclose ESG performance not only receive tangible and intangible benefits as mentioned, but also pave the way for a greener economy in Iskandar.

To achieve a more sustainable oil, gas & petrochemical

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sector, we have identified the following indices that businesses should monitor:

- Initiatives and targets for environmental performance;
- Direct and indirect energy consumption
- Energy saved due to conservation and efficiency improvements;
- Initiatives to reduce indirect energy consumption and reductions achieved;
- Total direct and indirect GHG emissions;
- Initiatives to reduce GHG emissions and reductions achieved;
- Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation;
- Initiatives to improve public awareness on climate change issues

Requirements outlined above are based on the Key Performance Indices indicated in the above sections and

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aligned with the Global Reporting Initiative indicators.

4.3. Responsible Procurement

Responsible Procurement ensures that business commitment to good corporate responsibility is reflected in how they select and work with suppliers. Responsible businesses encourage other companies that they do business with to meet the standards of ethics, business integrity and environmental practice expected of them. This would include adherence to high standards on Health & Safety, Fair Business Practices, Environmental Protection, Human Rights, and Local Community Development.

Businesses need to develop a model to bring about meaningful change within the supply chain by way of identifying gaps in suppliers' ethical business practices, and collaborating with them to develop tangible improvements.

Internationally, leading countries have also embarked on sustainable procurement guidelines across their ministries to ensure that labour rights and environmental concerns are respected. Recognizing the importance of Government Green Procurement (GGP), the Malaysian government has

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taken initial steps to boost demand for green products and services.

As the long-term action plan laid out for Malaysia intends for GGP to be implemented at all levels of government by 2020, this sets an exemplary model for private sector companies to follow suit and enjoy potential business opportunities.

Common products which companies and organizations have adopted green procurement policies for include recycled paper, renewable energy sources, VOC-free paints and adhesives, etc. Businesses can also cascade their procurement policy to suppliers/contractors to achieve a widespread effect of green procurement.

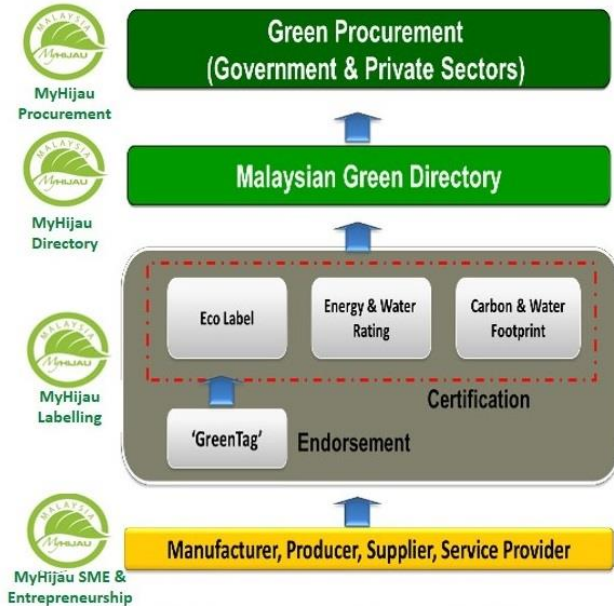


Figure 9: Malaysia Government Green Procurement (Greentech Malaysia, 2013)

Leading firms are conducting life-cycle assessments to identify materials in their products that may pose significant environmental, health and safety risks. With this information, firms can re-design their products to prevent or mitigate such risks, which forms a logical part of effective supply chain management practices. Companies operating in IM could strive to have at least 10% of their purchases in the initial years, and move towards

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100% green procurement in the years to come.

A series of case studies that describe how organizations from different countries have approached the verification of social criteria at various stages of the tender process is available at this link: <http://www.sustainable-procurement.org/resources/tools-and-guidance/>. Each study looks into how the compliance of direct suppliers is monitored and how this applies to the rest of the supply chain. Procurement professionals and other key stakeholders could learn from the experiences of their counterparts to develop or improve their systems.

Another similar report that provides an overview of responsible procurement in the private sector globally is *Green Purchasing: The New Growth Frontier* by the International Green Purchasing Network (http://www.igpn.org/DL/Green_Purchasing_The_New_Growth_Frontier.pdf).

The ideas generated and lessons learnt from these cases can provide additional incentives and tools for other companies to further advance their environmental purchasing policies.

5. Conclusion

Companies operating in the mid and downstream of the oil and gas value chain are major polluters and energy consumers. This guideline has outlined potential actions that can be undertaken by industries, in order to mitigate environmental impacts and the key performance indicators to monitor its progress. Actions required in the sector not only comprise of technological measures and upgrades but also calls for continuous monitoring and assessment.

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Useful Links

Bursa Malaysia regulations on sustainability disclosures

http://www.bursamalaysia.com/misc/system/assets/5949/regulation_rules_main_market_bm_mainchapter9.pdf

Green Building Index

www.greenbuildingindex.org

Iskandar Regional Development Authority

www.irda.com.my

Low Carbon Cities Framework and Assessment

<http://esci-ksp.org/wp/wp-content/uploads/2012/04/Low-Carbon-Cities-Framework-and-Assessment-System.pdf>

Low Carbon Society Blueprint

http://2050.nies.go.jp/cop/cop18/SPM_LCS%20Blueprint_Iskandar%20Malaysia.pdf

Ministry of Energy, Green Technology and Water

www.kettha.gov.my

The 2015 Budget Speech

<http://www.thestar.com.my/News/Nation/2014/10/10/Budget-2015-full-speech-text/>

Key Industry Contacts

Department of Environment (DoE)

www.doe.gov.my

Ministry of Energy, Green Technology and Water (KeTTHA)

www.kettha.gov.my

Land Public Transport Commission (LPTC)

www.lptc.gov.my

Malaysian Industrial Development Authority (MIDA)

www.mida.gov.my

Ministry of Transport (MOT) Ministry of International Trade
and Industry (MITI)

www.miti.gov.my

Ministry of Transport (MOT)

www.mot.gov.my

Ministry of Natural Resources and Environment (NRE)

www.nre.gov.my

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Your business may face new regulatory requirements and rising stakeholder concerns. There may be opportunities for cost reduction and revenue generation. Embedding a sustainable approach into core business activities could be a complex transformation to create long-term shareholder value.

The industry and countries in which you operate as well as your extended business relationships introduce specific challenges, responsibilities and opportunities.

Our global, multidisciplinary team combines our experience in assurance, tax, transactions and advisory services with climate change and sustainability knowledge and experience in your industry. You'll receive tailored service supported by global methodologies to address issues relating to your specific needs. Wherever you are in the world, EY can provide the right professionals to support you in reaching your sustainability goals.

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About IRDA

The Iskandar Regional Development Authority (IRDA) is a Malaysian Federal Government statutory body tasked with the objective of regulating and driving various stakeholders in both public and private sector towards realizing the vision of developing Iskandar Malaysia into a strong and sustainable metropolis of international standing

The Division provides strategic advice on environmental planning, development and management, carries out research and works in partnership with external agencies to promote a green growth economy for Iskandar Malaysia. In addition, the Division builds capacity, collaborates to integrate Climate Change programmes, statutory requirements related to the environment and supports green growth aligned to national commitments.

For further details, please contact the Head of Environment Division, IRDA.





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