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***Title of Paper***

# THE JOURNEY OF THE DEVELOPMENT OF SYSTEM OF ENVIRONMENTAL-ECONOMIC ACCOUNTING (SEEA) PHYSICAL SUPPLY AND USE TABLE (PSUT) – ENERGY ACCOUNT, 2010 IN MALAYSIA (MySEEA PSUT-ENERGY)

**Abstract**

The SEEA Central Framework 2012 was adopted as the first international standard for environmental-economic accounting by the United Nations Statistical Commission, at its 43rd Session in 2012. United Nations Statistical Division (UNSD) has encouraged countries to implement this framework. In addition, SEEA-Energy, SEEA Water, SEEA Agriculture, Forestry & Fisheries and SEEA Ecosystem were published by UNSD to provide compilers and analysts with agreed concepts, definitions, classifications and tables for related accounts.

This paper presents Malaysia's experience in the compilation of MySEEA PSUT-Energy 2010. This account was prepared to fulfil the National Petroleum Policy and National Energy Policy in Malaysia. MySEEA PSUT-Energy would also be a valuable tool to monitor sustainable energy use to support growth (Chapter 7-Focus area E: 11th Malaysia Plan) as well as in measuring achievement of Sustainable Development Goals (SDGs) under Goal 7-Affordable and clean energy.

The top-down approach has been used for the compilation of MySEEA PSUT-Energy where the aggregated data from National Energy Balance 2010 was used as control values to estimate the details energy use by sectors and household. Meanwhile, Economic Census 2010 and Input-Output Tables 2010 were used as its structure. The results indicate that for 2010, natural inputs in Malaysia were dominated by natural gas and crude oil. Mining & quarrying industry was the biggest energy supplier followed by manufacturing and services. Meanwhile, the largest domestic users of energy products were manufacturing, services and households. In term of energy intensity among industries, the manufacturing industry is the

most energy intensive within the Malaysian economy, followed by services and mining & quarrying while agriculture, forestry & fishing and construction are non-energy intensive.

Some challenges faced during the compilation include human resources and technical knowledge. With the support given by UNSD through training, workshop, assessment and consultation these challenges was resolved.

Keyword: System of Environmental-Economic Accounting, SEEA, Energy Account

## I. Contents

I. Contents ..... 3
II. Introduction ..... 4
III. The Journey of the Development of MySEEA PSUT-Energy ..... 6
A. Environmental Accounting ..... 6
1. The System of Environmental-Economic Accounting (SEEA) ..... 6
2. Benefits of SEEA ..... 8
3. The Development of SEEA Account by National Statistical Office (NSO) ..... 8
B. The Development of SEEA in Malaysia (MySEEA PSUT-Energy) ..... 9
1. A Brief History of MySEEA PSUT-Energy ..... 9
2. Scope, Coverage and Classification of MySEEA PSUT-Energy ..... 12
3. Framework of MySEEA PSUT-Energy ..... 12
4. Data Sources ..... 14
5. Compilation of MySEEA PSUT-Energy ..... 17
6. Results and Application of MySEEA PSUT-Energy ..... 22
C. Issues, Challenges and Critical Success Factors ..... 25
1. Issues and Challenges ..... 25
2. Critical Success Factors ..... 26
IV. Conclusion ..... 28
V. References ..... 29

## II. Introduction

Environment is a topic debated everywhere around the globe for its importance, complexities and approaches taken. It is widely recognised that the beginning of public awareness on global environmental problems was in 1972, when the United Nations Conference on the Human Environment took place in Stockholm to discuss the state of the global environment. Consequently, many events related to the environment were held to address global awareness and among major agendas were the Rio Summit 1992, Kyoto Declaration 1997, Earth Summit 2002, Rio+20 in 2012 and the Sustainable Development Goals (SDGs) under 2030 Agenda which is not only focusing on eradicating poverty but also addressing the issue on tackling of climate change (UN, 2015).

Malaysia participates actively in various environmental initiatives to contribute towards sustainable development. Several measures were undertaken as part of commitments and initiatives in Malaysia towards the environment such as the National Policy on the Environment 2002, National Policy on Climate Change 2010, National Petroleum Policy 1975, National Green Technology Policy 2009 and the Eleventh Malaysia Plan (2016-2020). Efforts towards environmental-economic sustainability are also supported by the existing laws and regulations. In addition, Research and Development (R&D) activities towards the environment by various agencies and researchers in Malaysia are not only large in quantity but also growing recently. Among the areas that have been studied include valuation of natural resources (see Kamri, 2013; Abdullah et al., 2015), solid waste management (Pek and Jamal, 2011), environmental impact of economic activities (Harrigan, 2000; Bohari, 2015) and evaluation of river water quality (Lee et al., 2017).

However, all the above mentioned studies are designed for a specific purpose and they do not integrate in an economy-wide framework. Thus, there is a high demand from stakeholders for statistics that could accurately inform societies about climate change in terms of emissions, occurrence, impacts, mitigation and adaptation, so that policymaking and monitoring can be more effective and evidence-based (UN Economic and Sosial Council, 2015) .

In response to this demand, the Department Statistics of Malaysia (DOSM) has taken an initiative to compile the MySEEA PSUT-Energy, 2010. The compilation of this account will provide the information on supply and demand of energy such as the use of renewable energy sources and non-renewable, an increase in productivity and energy efficiency for sustainable development in Malaysia. MySEEA PSUT-Energy would also be a valuable tool to monitor energy security & sustainability as stated in the 11th Malaysia Plan under Chapter 6 Focus area B: Adopting the sustainable consumption and production concept and Chapter 7, Focus area E: Encouraging sustainable energy use to support growth. Furthermore, MySEEA PSUT-Energy can be used in measuring achievement for Sustainable Development Goals (SDGs) under Goal 7-Affordable and clean energy.

This paper is structured in five parts, each of the chapters is comprised of sub topic. Part II contains an introduction and the description of the development of MySEEA PSUT-Energy is explained in Part III. Conclusion and references are included in the final section of part IV and V respectively.

# III. The Journey of the Development of MySEEA PSUT-Energy

## A. Environmental Accounting

In economic activity, both production and consumption are interrelated to the environment. The economy will depend on the resources from the environment as raw materials to produce goods and services in the economy in which the environmental resources are often exploited. As a result it would hamper future production and affects our ecosystems.

At the same time, economic activities will generate residuals in the form of waste, emissions to air and water, pollution and degradation to the resources that will pressure and change the environmental state. Thus, the environmental account is needed to measure and monitor the contribution of the environment to the economy and the impact of the economy on the environment (Eurostat, 2016).

### 1. The System of Environmental-Economic Accounting (SEEA)

The SEEA 2012 Central Framework (SEEA CF) is a multipurpose conceptual framework that describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets (UN et al., 2012). The SEEA CF 2012 was adopted as an international standard for environmental-economic accounting by the United Nations Statistical Commission at its forty-third session in March 2012[1].

[1] See *Official Records of the Economic and Social Council, 2012, supplement No. 4* (E/2012/24), chap. I.B decision 43/105, para. (c).

The SEEA CF applies the accounting concepts, structures, rules and principles of the System of National Accounts (SNA). The SEEA CF comprises the following types of tables and accounts[2]:

*First:* **Supply and Use Tables.** It shows flow of the natural input, products and residuals. Types of accounts covered are energy, water, materials and emissions to air, water and solid waste.

*Second:* **Asset Accounts.** It shows the stock of environmental assets at the beginning and at the end of each accounting period and the changes in the stock. Types of accounts are mineral & energy, land, soil, timber, aquatic, other biological and water resources.

*Third:* **Functional Accounts**. It records transactions and other information about the economic activities undertaken for environmental purposes, e.g. the Environmental Protection Expenditure Account (EPEA) and statistics on the Environmental Goods and Services Sector (EGSS).

*Fourth:* **A Sequence of Economic Accounts.** It highlights depletion-adjusted economic aggregates.

There are other documents as a subsystem to SEEA CF 2012 such as SEEA-Energy, SEEA-Water, SEEA-Experimental Ecosystem Accounting and SEEA-Agriculture, Forestry and Fisheries (draft). SEEA-Energy focuses on energy and it organises and integrates the information on the various energy-related

[2] Refer to SEEA CF 2012, chap. 2 (para. 2.26-2.29)

stocks and flows of the economy and the environment in a series of tables and accounts.

## 2. Benefits of SEEA

SEEA provides an integrated framework between environment and national accounts information in more coherent and consistent way. It can be used to analyse the impact of economic policies on the environment and also with the social aspect of sustainable development (Eurostat, 2016). Oosterhuis et al., (2016) highlights the usefulness of SEEA as a powerful statistical tool in providing a quantitative basis for policy design, including productivity analysis and natural resource management. Furthermore, Schenau (2009) claim: The SEEA is very useful to assess the interrelationships between the economy and climate change in the Netherlands as well as in identifying the driving forces, the pressures, the impacts and responses affecting the climate change. On top of that, SEEA is an important statistical framework for monitoring the SDGs in an integrated way. The use of an established statistical standard such as the SEEA in the definition and measurement of SDG indicators will promote international comparability and consistency across countries (UNSD, 2015).

## 3. The Development of SEEA Account by National Statistical Office (NSO)

The development of SEEA has begun in the early 1990s (Joy E. Hecht, 2004). Developed countries such as Australia, Canada, Denmark, Norway and the Netherlands produced a number of SEEA account i.e. energy, water, minerals, land account and etc. according to their priority. Within the ASEAN countries, Indonesia and the Philippines have focused on ecosystem account.

On the other hand, Malaysia has taken an initiative to develop a PSUT-Energy account.

## B. The Development of SEEA in Malaysia (MySEEA PSUT-Energy)

### 1. A Brief History of MySEEA PSUT-Energy

Discussion and investigation on the implementation of the SEEA in Malaysia initially arose in the context of parliamentary discussion in 2010 on the measurement of Malaysia's green GDP. However, the initial investigation did not lead to the development of any specific accounts in the DOSM.

At the beginning of 2012, the initial study of SEEA was reinvigorated in the Agriculture and Environment Statistics Division, DOSM. As the SEEA CF 2012 had not yet been released, the SEEA-2003 was used as a starting point in this study. The study focused on the potential of the SEEA framework to provide integrated information linked to input-output tables.

By using a starting point of integrated analysis through environmentally-extended input-output tables with environment statistics, DOSM has approached SEEA implementation in a manner rather unlike most countries whose efforts have tended to focus initially on the development of individual accounts for energy, water or timber resources, before considering integration with the national accounts. At the same time, the approach bears similarity in intent to the NAMEA (National Accounting Matrix with Environmental Accounts) approach initiated in the Netherlands in the 1990s.

In 2013, United Nations Statistics Division (UNSD) revised the SEEA 2003 manual to come out with the SEEA CF 2012. Thus, to understand the connections between the SEEA-2003 and SEEA CF 2012 concepts, DOSM has invited UNSD to organise courses on the SEEA in Malaysia.

The first sub-regional course on the SEEA was held by DOSM in Malaysia from 23-27 September 2013 in collaboration with the United Nations Statistical Institute for Asia and the Pacific (UN SIAP), UNSD and United Nations Economic Social Commission for Asia Pacific (UN ESCAP). There are 23 participants from DOSM and various agencies and seven participants from the Philippines, Viet Nam, Indonesia and Cambodia.

Following that, the assessment mission on SEEA was conducted in DOSM by UN ESCAP and UNSD on 31 September – 1 October 2013. The awareness workshop on SEEA was organised on 3 April 2014 to the relevant agencies. The SEEA diagnostic tool has been used by agencies to identify a priority accounts that will be developed. The recommendation from the assessment mission and workshop has been presented to various agencies at the Main User Committee (MUC) meeting on 9 July 2014 chaired by the Economic Planning Unit (EPU). The committee has agreed with the compilation of SEEA Energy for the period of 2014-2016.

From 2014 until 2016, DOSM has worked on the compilation of MySEEA PSUT-Energy based on SEEA CF 2012, SEEA-Energy (draft version) and International Recommendations for Energy Statistics (IRES). To support the

work, DOSM has set up two Technical Working Group (TWG) i.e. Inter Division TWG and Inter Agency TWG involves the Energy Commission, EPU and the Department of Mineral & Geosciences.

To further enhance knowledge and understanding on the compilation of energy account, DOSM has sent representatives to UNSD's for Pilot Training of Trainers for the World Implementation of SEEA CF 2012 on 7–10 July 2014 and 23–26 February 2016. An attachment programme in Australia Bureau of Statistics (ABS) was also been conducted from 15–17 December 2014. Besides that, DOSM has been invited to attend the experts meeting at the London Group and UNCEEA to share and discuss issues on the development of SEEA in Malaysia.

On 19-23 September 2016, the UNSD has conducted another Assessment Mission for the project "Supporting Member States in Developing and Strengthening Environmental-Economic Accounting for Improved Monitoring of Sustainable Development in Malaysia". Following the session, UNSD has appointed an expert from Statistics Denmark to provide technical assistance to review MySEEA PSUT-Energy and provides suggestions to improve and disseminate the account. The expert mission was held on 24-27 January 2017 and the finding of MySEEA PSUT-Energy was presented to the MUC on 22 February 2017. Report of MySEEA PSUT-Energy will be published in limited circulation for relevant stakeholder.

## 2. Scope, Coverage and Classification of MySEEA PSUT-Energy

Concept, classification, definition and framework of MySEEA PSUT- Energy account are based on the international standards of SEEA CF 2012, SEEA-Energy and IRES. The scope and coverage of this account followed the residence principle as applied in SNA.

Energy products classification is based on the Standard International Energy Product Classification (SIEC) which was adopted by the UNSD and the International Energy Agency. The physical unit used in this compilation of account is kilo tonnes of oil equivalent (KTOE). Data in physical unit (barrel, metric tan, gallons, etc.) in this compilation are converted using the same conversion factors in NEB. As for the industry classification, it is based on the Malaysian Standard Industrial Classification (MSIC) 2008. The sectors/economic units of MySEEA PSUT-energy are as follows:

Sectors/economic units

i. Agriculture;
ii. Mining & quarrying;
iii. Manufacturing;
iv. Construction;
v. Services (includes transport & utilities industry);
vi. Households; and
vii. Rest of the world (ROW)-imports and exports.

## 3. Framework of MySEEA PSUT-Energy

In this framework, physical flows are recorded by compiling supply and use tables known as PSUT.

**Figure 1: General structure of the PSUT-Energy**

| SUPPLY | Industries | Households | Accumulation | Rest of the World | Environment | Total |
|---|---|---|---|---|---|---|
| Energy from natural input | | | | | Energy inputs from the environment | Total supply of energy from natural inputs |
| Energy product | Output | | | Imports | | Total supply of energy products |
| Energy Residual (Conversion Losses) | Energy residuals generated by industry | Energy residuals generated by household consumption | Energy residuals from accumulation | Energy residuals received from the rest of the world | Energy residuals recovered from the environment | Total supply of energy residuals |

| USE | Industries | Households | Accumulation | Rest of the World | Environment | Total |
|---|---|---|---|---|---|---|
| Energy from natural input | Extraction of energy from natural input | | | | | Total use of energy from natural inputs |
| Energy product | Intermediate consumption | Household consumption | Changes in inventories | Exports | | Total use of energy products |
| Energy Residual (Conversion Losses) | Collection & treatment of energy residuals | | Accumulation of energy residuals | Energy residuals sent to the rest of the world | Energy residual flows direct to environment | Total use of energy residuals |

According to (UN et al., 2012), the definitions of the energy flow in the SEEA CF 2012 are as below:

a) **Energy from natural inputs:** Comprises flows of energy from the removal and capture of energy from the environment by resident economic units. These include energy from mineral & energy resources, and inputs from renewable energy sources. In MySEEA PSUT-Energy, natural inputs cover crude oil, natural gas, coal & coke and hydro power.

b) **Energy products:** Products that are used as a source of energy. Consist of (i) fuels that are produced by an economic unit (including households) and are used as sources of energy; (ii) electricity that is generated by an

economic unit (including households); and (iii) heat that is generated and sold to the third parties by an economic unit. Some energy products may be used for non-energy purposes. Energy products which cover in MySEEA PSUT-Energy are natural gas, LNG, crude oil, petroleum products[3], coal & coke, electricity and others[4].

c) **Energy residuals/conversion losses:** Consists of energy losses, other energy residuals (primarily heat generated when end users use energy products for energy purposes) and other residuals. Energy losses are grouped into 4 groups [5] : losses during extraction, losses during distribution, losses during storage and losses during transformation. Other residuals refer to solid or fluid waste that is used for the generation of energy and residuals from end-use for non-energy purposes.

## 4. Data Sources

The data sources were obtained from a wide range of sources both DOSM and other agencies. The reference year used is 2010 since most of the main data sources such as Economic Census and Input-Output Tables are available in 2010. The data sources used in this project describe briefly as below:

i. **National Energy Balance (NEB) 2010**

NEB report is an annual statistical publication for physical energy supply and demand in Malaysia published by the Energy Commission. NEB is

[3] Petroleum products included in the NEB are petrol, diesel, fuel oil, LPG, Kerosine, ATF & AV Gas.
[4] Refer to additive which is used as refinery intake.
[5] Refer SEEA CF 2012, chap.3 (para 3.173 - 3.175)

the main source for the compilation of MySEEA PSUT-Energy. It covers three major areas namely the energy supply, transformation and final usage (Energy Commission, 2010).

The main difference between the NEB and the MySEEA PSUT-Energy is the production boundary. The MySEEA PSUT-Energy use the residence principle which includes all the activity based on institution units that are resident of a particular national economic, while NEB follows the territory principle or national territory (UNSD, 2015). The industrial classification in the NEB is modified from ISIC depending on the type of purpose of the unit involved, whereas sectors cover in MySEEA PSUT-Energy are based on MSIC 2008 for industries classification.

ii. **Household Expenditure Survey (HES) 2009/2010**

The HES was conducted twice every five years by DOSM. It covers households in urban and rural areas. Data on expenditure of fuels and lubricant for personal transport, electricity and gas from this survey were used in this compilation.

iii. **Economic Census (EC) 2011 (Reference Year 2010)**

DOSM conducted the EC in every five years and the latest census was 2011 (RY 2010). The EC covers all economic activities in Malaysia. In particular, EC collects some information/data on energy-related expenses of Malaysian business such as purchase of fuels, lubricants

and gas, raw material used in refinery industry and output from refinery industry.

iv. **Petroleum & Natural Gas Statistics 2011 (Reference Year 2010)**

This publication is based on data collected from the Annual Census of Crude Oil & Natural Gas Mining Industry conducted by DOSM and secondary data obtained from oil and gas companies. It consists of information on the production of crude oil, natural gas & petroleum product, imports & exports and etc.

v. **Input-Output (I-O) Tables, Malaysia 2010**

The I-O Tables were compiled every five years by DOSM to provide the structure of the Malaysian economy by industry/commodity.

vi. **Malaysian External Trade Statistics 2010**

Malaysian External Trade Statistics 2010 contains statistics of Malaysia's merchandise trade pertaining to imports and exports (including re-exports) by sections, divisions & groups of commodity, country of origin and destination. The imports and exports of petroleum products, natural gas, crude oil and LNG data from this statistics are used for the MySEEA PSUT-Energy compilation.

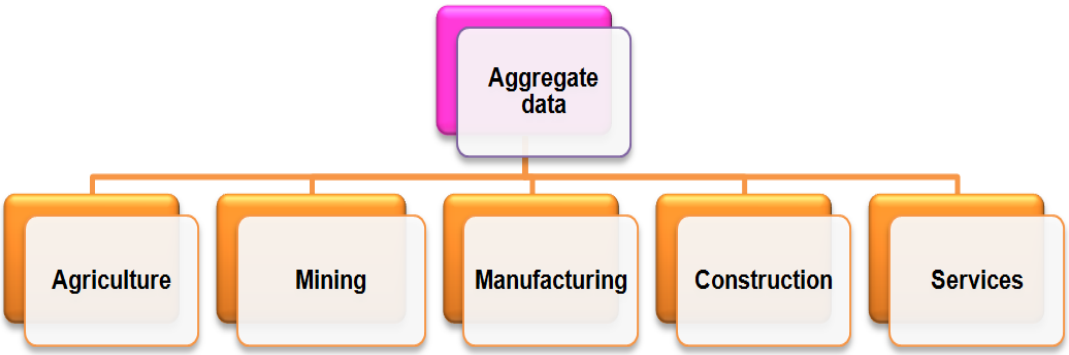
vii. **Journals and selected NSO reports**

Scientific journal articles and reports from agencies as well as other NSOs are referred in order to gather facts and figures for the compilation of MySEEA PSUT-Energy.

## 5. Compilation of MySEEA PSUT-Energy

Top-down approach is used for the compilation of MySEEA PSUT-Energy. The following figure illustrates the method.

**Figure 2: the top-down approach method**




Aggregate data from NEB was used as control values to estimate the details sectors in MySEEA PSUT-Energy.

a) Constructing Supply Table

NEB 2010

| Energy Source | Energy products E1 | E2 | E3 | … | Total |
|---|---|---|---|---|---|
| PRIMARY SUPPLY | | | | | |
| 1. Primary Production | | | | | |
| 2. Gas Flaring Reinjection & Use | | | | | |
| 3. Imports | | | | | |
| 4. Exports | | | | | |
| 5. Bunkers | | | | | |
| 6. Stock Change | | | | | |
| 7. Statistical Discrepancy | | | | | |
| **8. Primary Supply** | | | | | |
| TRANSFORMATION | | | | | |
| 9. Gas Plants | | | | | |
| 9.1 LNG | | | | | |
| 9.2 MDS | | | | | |
| 9.3 GPP LPG (3&4/) | | | | | |
| **Subtotal** | | | | | |
| 10. Refineries | | | | | |
| 11. Power Stations & Self-Generation | | | | | |
| 11.1 Hydro Stations | | | | | |
| 11.2 Thermal stations | | | | | |
| 11.3 Self Generation (5/) | | | | | |
| ~~Subtotal~~ | | | | | |
| 12. Losses & Own Use | | | | | |
| 13. Statistical Discrepancy | | | | | |
| **14. Secondary Supply** | | | | | |

net energy transformation

MySEEA PSUT-Energy

| Supply | Industries: Agriculture | Mining | Manufacturing | Construction | Services | Households | Accumulation | Rest of the World | Environment | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Energy from natural input | | | | | | | | | Energy inputs from the environment | Total supply of energy from natural inputs |
| Energy product | - | Output | Output | - | Output | | | Imports | | Total supply of energy products |
| *Conversion losses | Conversion losses generated by industry | | | | | Conversion losses generated by household consumption | Conversion losses from accumulation | Conversion losses received from the rest of the world | Conversion losses recovered from the environment | Total supply of Conversion losses |

*Step 1:* Primary production data from the NEB is reorganising into the energy inputs from the environment by the environment column.

*Step 2:* Net production data (primary production – gas flaring), transformation output and imports from the NEB are allocated to the supply of energy products by mining, manufacturing & services sectors and ROW. At the same time, data from Petroleum & Natural Gas Statistics 2011 and Malaysian External Trade Statistics 2010 are used as a check and balance to the NEB.

*Step 3:* Transformation losses, residual heat losses, losses during extraction that are recorded in the conversion losses of supply table

can be directly obtained from the net energy transformation (conversion loss), losses & own use, final energy consumption and gas flaring in the NEB.

b) Constructing Use Table

NEB 2010

| Energy Source | Energy products E1 | E2 | E3 | ... | Total |
|---|---|---|---|---|---|
| PRIMARY SUPPLY | | | | | |
| 1. Primary Production | | | | | |
| 2. Gas Flaring Reinjection & Use | | | | | |
| 3. Imports | | | | | |
| 4. Exports | | | | | |
| 5. Bunkers | | | | | |
| 6. Stock Change | | | | | |
| 7. Statistical Discrepancy | | | | | |
| **8. Primary Supply** | | | | | |
| TRANSFORMATION | | | | | |
| 9. Gas Plants | | | | | |
| 9.1 LNG | | | | | |
| 9.2 MDS | | | | | |
| 9.3 GPP LPG (3&4/) | | | | | |
| **Subtotal** | | | | | |
| 10. Refineries | | | | | |
| 11. Power Stations & Self-Generation | | | | | |
| 11.1 Hydro Stations | | | | | |
| 11.2 Thermal stations | | | | | |
| 11.3 Self Generation (5/) | | | | | |
| **Subtotal** | | | | | |
| 12. Losses & Own Use | | | | | |
| 13. Statistical Discrepancy | | | | | |
| **14. Secondary Supply** | | | | | |
| FINAL USE | | | | | |
| 15. Residential | | | | | |
| 16. Commercial | | | | | |
| 17. Industrial | | | | | |
| 18. Transport | | | | | |
| 19. Agriculture | | | | | |
| 20. Non-Energy Use | | | | | |
| **21. Total Final Use** | | | | | |

net energy transformation

MySEEA PSUT-Energy

| Use | Industries: Agriculture | Mining | Manufacturing | Construction | Services | Households | Accumulation | Rest of the World | Environment | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Energy from natural input | - | Extraction of energy from natural input | - | - | Extraction of energy from natural input | | | | | Total use of energy from natural inputs |
| Energy product | - | - | Transformation | - | Transformation | Household consumption | Changes in inventories | Exports | | Total use of energy products |
| | End-use | | | | | | | | | |
| *Conversion losses | Collection & treatment of Conversion losses | | | | | | Accumulation of Conversion losses | Conversion losses sent to the rest of the world | Conversion losses flows direct to environment | Total use of Conversion losses |

*Step 1:* By definition all natural inputs supplied by the environment is equal to the use of natural inputs. Data of primary production from NEB is reorganising into natural inputs in the use table according to the extracting industries (mining and services).

*Step 2:* Transformation of energy products, accumulation and exports data can be directly obtained from the transformation inputs, stock

changes and export/bunkering data in the NEB. Data of transformation input in the NEB is organised according to the manufacturing and services sector in MySEEA PSUT-Energy.

*Step 3:* Allocation of transport sector from the NEB to Agriculture, Mining, Manufacturing, Construction, Services sectors and household in MySEEA PSUT-Energy using the consumption of fuel data in the EC 2011 and data on fuels & lubricants expenditure for private transportation from the HES 2009/2010 as a structure.

*Step 4:* Allocation of electrical data from NEB into the mining, manufacturing and construction sectors in MySEEA PSUT-Energy are based on the percentage of electricity purchases in the EC 2011 while, allocation for agriculture and services sector is based on the data from the journal and report study by agency. Allocation of electrical data for household in MySEEA PSUT-Energy is directly obtained from the final use in NEB.

*Step 5*: Data of fuel and gas consumption for commercial and non-energy in final use NEB is reorganised into the services and manufacturing sectors in MySEEA PSUT-Energy.

*Step 6*: By definition, transformation losses, residual heat losses, losses during extraction in the use table are recorded as energy residual flows direct to environment in the environment column.

c) Balancing

All the data in the supply and use tables need to be balanced (balancing) so that the amount of energy supply is equal with the amount of energy use. The new structure of supply and use table in MySEEA PSUT-Energy is compared with the structure of the input-output table 2010.

## 6. Results and Application of MySEEA PSUT-Energy

Table 1 **MySEEA PSUT – Energy Account 2010**

***Kilo Tonne of Oil Equivalent*** **- KTOE**

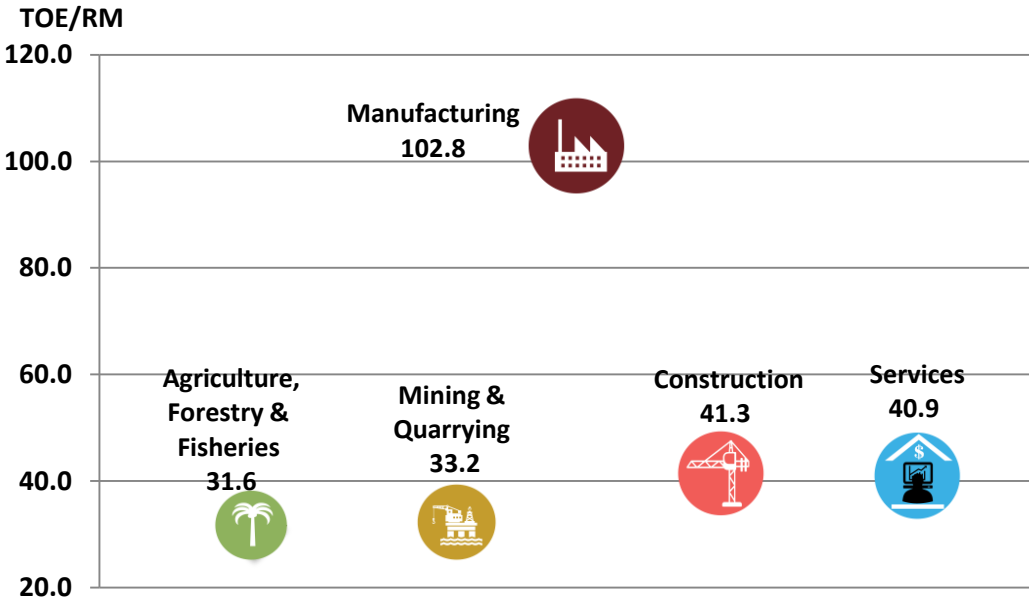
| Item | Total Supply | Domestic Supply | Imports | Total Use | Industry | Household | Change in inventory *(Accumulation)* | Exports |
|---|---|---|---|---|---|---|---|---|
| Total | 201,194 | 160,625 | 40,569 | 201,194 | 132,333 | 9,047 | (359) | 60,171 |
| Crude Oil | 42,370 | 33,136 | 9,235 | 42,370 | 25,358 | - | 337 | 16,676 |
| Natural Gas | 67,688 | 62,165 | 5,523 | 67,688 | 66,266 | 82 | - | 1,340 |
| *Coal & coke* | 14,584 | 1,511 | 13,073 | 14,584 | 14,777 | - | (255) | 62 |
| Liquified Natural Gas | 29,839 | 29,839 | - | 29,839 | - | - | - | 29,839 |
| Petroleum Product | 36,810 | 24,428 | 12,382 | 36,810 | 18,115 | 7,028 | (441) | 12,108 |
| Hydropower | 540 | 540 | - | 540 | 540 | - | - | - |
| Electricity | 9,007 | 9,007 | - | 9,007 | 7,056 | 1,937 | - | 13 |
| Others | 356 | - | 356 | 356 | 222 | - | - | 133 |

**Note:** - **Nil** / blank / no cases

### 6.1 Energy Product Intensity by Sectors

Manufacturing sector was the highest energy intensive in economy with 102.8 ktoe while agriculture, forestry and fisheries was the lowest energy intensive with 31.6 ktoe.

**Chart 1** **Energy Product Intensity 2010: By Sector**

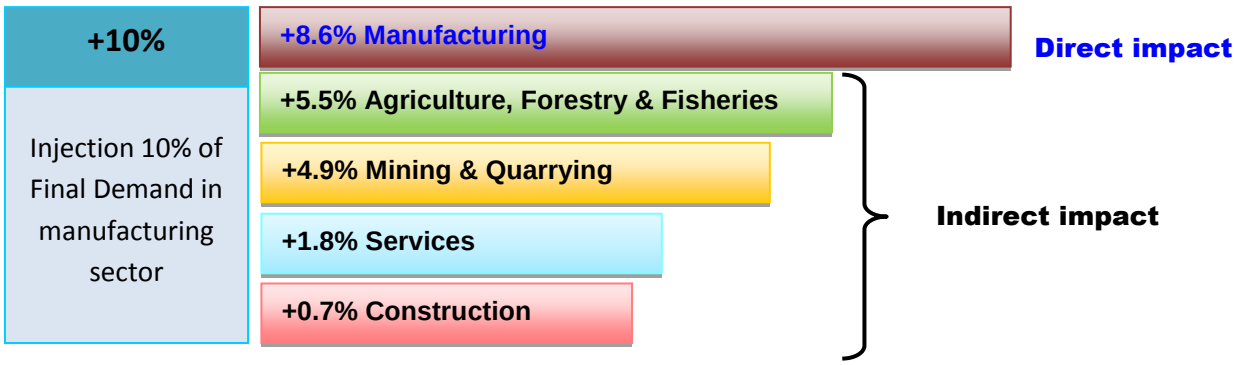



| Item | Agricultre, Forestry & Fisheries | Mining & Quarrying | Manufacturing | Construction | Services |
|---|---|---|---|---|---|
| Final Use of Energy Product (TOE) | 1,291,549 | 1,302,102 | 15,898,917 | 752,205 | 13,182,751 |
| GDP by Kind of Economic Activity at Constant 2000 (RM Million) | 40,916 | 39,270 | 154,640 | 18,220 | 322,611 |
| Energy Intensity (toe/value added) | 31.6 | 33.2 | 102.8 | 41.3 | 40.9 |

## 6.2 Multiplier Impact (direct and indirect) by sector

Carta 2 **Multiplier Impact (direct & indirect) 2010: By Sector**

| Sector | Energy Use (TOE) | New Energy Use (TOE) - by increasing of 10% in Final Demand for the Manufacturing sector | Growth Rate (%) |
|---|---|---|---|
| **Agriculture, Forestry & Fisheries** | 1,291,549 | 1,362,733 | 5.5 |
| **Mining & Quarrying** | 1,302,102 | 1,365,935 | 4.9 |
| **Manufacturing** | 80,982,854 | 87,932,713 | 8.6 |
| **Construction** | 752,205 | 757,348 | 0.7 |
| **Services** | 49,041,751 | 49,910,455 | 1.8 |



## C. Issues, Challenges and Critical Success Factors

### 1. Issues and Challenges

a. Knowledge

The development of MySEEA PSUT-Energy is a complex process and requires a basic knowledge of SNA, deep understanding of economic (input-output) structure and statistical techniques for the estimation, analysis and balancing process. In addition, knowledge in biophysical/environmental subject (energy statistics and energy balance) is also important before SEEA energy account can be constructed.

b. Data

Insufficient of physical energy data/information in Malaysia is the main constraint in constructing the account. Data collection is expensive therefore, for the development of MySEEA PSUT-Energy existing data sources were used. This data are scattered at the various agencies and it is collected based on their needs and the access of data is subject to confidentiality and security act of agencies. Thus, standard metadata is needed for this compilation.

c. Dissemination

Another obstacle or challenge faced by DOSM is to promote the importance/usefulness of MySEEA PSUT-Energy to the stakeholder/agencies as a tool in informing and monitoring various policies implications. Hence, DOSM need to facilitate them with the example on how SEEA can be used to monitor and measure the policy

performance. It requires more complex analysis or modelling techniques on policy instruments in Malaysia.

## 2. Critical Success Factors

a. Commitment from agencies

To make sure the success of SEEA development in Malaysia, strong commitment and cooperation between agencies is the key factor. Continuous support from agencies in engagement and collaboration with DOSM will improve the harmonization of classification, method and quality of data collection.

b. Capacity building

Development of SEEA requires well-trained officers in the fields of economics and environment. Thus, capacity building is another critical part need to be considered. Therefore, continuous trainings/workshop is required to strengthen and to equip the knowledge on SEEA. Attachment of DOSM officer at the international statistical offices of a country who had established SEEA will enable the officer to gain best practise knowledge in understanding of SEEA, data requirement & estimation techniques and application of SEEA for policy analysis. Apart from that, assessment mission and technical assistance from the SEEA expert also helps in provides guidance and advice pertaining to the technical areas and strategies implementation of SEEA Malaysia as well as verifying the account that is being developed based on the international standards.

c. Establishment of official agreements

Establishment of official agreements with relevant agencies on data supply and regulation will allow DOSM to access on relevant administrative datasets from agencies in order to ensure the continuity and sustainability of development of SEEA account in the future. Apart from that, an advisory committee which involved various agencies need to be established for the purpose of verifying the reliability of data as well as to attend the need of the users.

d. Involvement of academia and the NGOs

The development of SEEA not only requires collaboration between the NSOs and agencies but also the involvement of academia whilst Non Governmental Organisations (NGOs) also plays an important role in the successful development of SEEA in Malaysia. Their views and opinion is needed in the compilation of this account to broaden our viewpoints as they look at certain issues from different perspectives[6].

[6] During the compilation of MySEEA PSUT-Energy, technical collaboration between DOSM and University Putra Malaysia has been set up in terms of methodology, data estimation and analysis.

## IV. Conclusion

There is a significant need for an integrated database that provides useful and comprehensive policy analysis. SEEA represents the integrated statistical framework to measure the environment and its relationship with the economy as well as the society.

The compilation of MySEEA PSUT- Energy Account will provide information on supply and demand of energy, an increase in productivity and energy efficiency for sustainable development in Malaysia. MySEEA PSUT-Energy not only provides information on energy flow in Malaysia, but a comprehensive analysis can be carried out to show how much of the energy supplied is exported, and used by households and industries. Such information will help to measure and monitor the energy security in Malaysia. In addition, several important indicators such as energy intensity and multiplier effect also can be directly derived from this account. With such capacity, SEEA can be a useful tool in informing various policy questions particularly on the sustainable development in Malaysia.

Some challenges faced during the compilation of MySEEA PSUT-Energy including knowledge, data and support from agencies. However, with the support given by UNSD through training, workshop, assessment mission and technical assistance these challenges have been resolved.

# V. References

[1] Abdullah, M., Mamat, M.P., Yaacob, M.R., Radam, A. and Fui, L.H. (2015). Estimate the conservation value of biodiversity in national heritage site: a case of Forest Research Institute Malaysia. Procedia Environmental Sciences, 30, 180-185.

[2] Bohari, A.A.M., Skitmore, M., Xia, B., Teo, M., Zhang, X. and Adham, K.N. (2015). The path towards greening the Malaysian construction industry. Renewable and Sustainable Energy Reviews, 52, 1742-1748.

[3] Eurostat (2016). Environmental accounts-establishing the links between the environment and the economy. Available from http://ec.europa.eu/eurostat/statistics-explained/pdfscache/25771.pdf

[4] Energy Commission (2010). National Energy Balance 2010. Available from http://meih.st.gov.my/documents/10620/32f18652-5a27-4a8d-b812-417416191432

[5] Frans Oosterhuis, Stefan van der Esch and Nico Hoogervorst (2016). From statistics to policy-The development and application of environmental statistics and environmental accounts in the Netherlands. Available from www.pbl.nl/en

[6] Harrigan, F. (2000). Macroeconomic income adjustement and tropical forest conservation: a general equilibrium analysis of Malaysia. Journal of Policy Modeling, 22, 491-531.

[7] Joy Hecht (2004). The Evolving System of Integrated Economic and Environmental Accounts, “Encyclopedia of Life Support Systems”. Available from https://www.eolss.net/Sample-Chapters/C13/E1-21-03-04.pdf

[8] Kamri, T. (2013). Willingness to pay for conservation of natural resources in the Gunung Gading National Park, Sarawak. Procedia Social and Behavioral Sciences, 101, 506-515.

[9] Lee, I., Hwang, H., Lee, J., Yu, N., Yun, J. and Kim, H. (2017). Modeling approach to evaluation of envieonmental impacts on river water quality: a case study with Galing River, Kuantan, Pahang, Malaysia. Ecological Modelling. (http://dx.doi.org/10.1016/j.ecolmodel.2017.01.021).

[10] Pek, C-K. and Jamal, O. (2011). A choice experiment analysis for solid waste disposal option: a case study in Malaysia. Journal of Environmental Management, 92, 2993-3001.

[11] Sjoerd Schenau (2009). SEEA as a framework for assessing policy responses to climate change. Available from https://www.researchgate.net/publication/237348885

[12] United Nations (2015). Transforming our World: The 2030 Agenda for Sustainable Development. Available from https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

[13] UN Economic and Sosial Council ( 2015). Report of the Secretary-General: Climate change statistics. Statistical Commission Forty-seventh session E/CN.3/2016/15.

[14] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development and The World Bank (2012). System of Environmental-Economic Accounting (SEEA) – Central Framework. Available from https://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf