NUCLEAR ENERGY IN MALAYSIA: TOWARDS SUSTAINABLE NUCLEAR ENERGY SYSTEMS (NES)

Presented by:
Dr. Noriah Jamal
Malaysian Nuclear Agency (Nuclear Malaysia)
Kajang, Malaysia

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INTRODUCTION TO MALAYSIA

• Total population: 28.3 million (2010)
• Total landmass: 329,847 km²
• Deployment of **nuclear power as an option** for power generation post-2020 is **targeted at Peninsular Malaysia**
Exhibit 7-16
Generation mix in Malaysia

% total GWh

2010
- Coal: 42%
- Gas: 52%
- Hydro: 1%

2015*
- Coal: 43%
- Gas: 40%
- Hydro: 14%
- Renewable Energy: 2%

2020*
- Coal: 53%
- Gas: 29%
- Hydro: 15%
- Renewable Energy: 3%

* Estimated
Source: Energy Commission

5 The HHI target is set at below 0.5 in 2020. A HHI of 0.5 indicates there will be no dependence on any particular fuel while a HHI exceeding 0.5 reflects overdependence on certain fuel resources. The HHI for 2014 is 0.45, which indicates a healthy index.
NUCLEAR ENERGY AS PART OF A NATIONAL ENERGY MIX

MAJOR ENERGY POLICIES IN MALAYSIA

National Petroleum Policy 1975
- To regulate downstream oil & gas industry via the Petroleum Regulations 1974

National Energy Policy 1979
- To ensure adequacy, security and cost-effectiveness of energy supply
- To promote efficient utilization of energy
- To minimize negative environmental impacts in the energy supply chain

National Depletion Policy 1980
- To prolong lifespan of Malaysia’s oil reserves for future security & stability of oil supply

Four-Fuel Diversification Strategy 1981
- To pursue balanced utilization of oil, gas, hydro and coal

Five-Fuel Diversification Strategy 2001
- Renewable Energy included as the “fifth fuel” in energy supply mix

National RE Policy & Action Plan 2009
- To increase RE contribution in the national power generation mix
- To facilitate the growth of the RE industry
- To ensure reasonable RE generation costs
- To conserve the environment for future generations; and
- To enhance awareness on the role and importance of RE

New Energy Policy 2010
- To encapsulates all efforts to ensure economic efficiency, security of supply and meet social as well as environmental objectives

Source: Peninsular Malaysia Electricity Supply Industry Outlook 2013, Energy Commission
NUCLEAR ENERGY AS PART OF A NATIONAL ENERGY MIX

New Energy Policy 2010

New Energy Policy addresses economic efficiency, security of supply and social and environmental objectives

5 PILLARS

1. Energy Pricing
   - Resource Allocation
   - Economic Development path
   - EE & RE Uptake

2. Energy Supply
   - Diversify Supply
   - Alternative Sources
   - New Entrants (NE included)

3. Energy Efficiency
   - Market Competitive
   - Low-carbon Economy

4. Governance
   - Integrated
   - Regulatory consistency
   - Market disciplines

5. Change Management
   - Integrated
   - Sequenced
   - Gradual
   - Social Assistance
NUCLEAR ENERGY AS PART OF A NATIONAL ENERGY MIX

SHARE OF NUCLEAR POWER IN GENERATION MIX

Forecasted Electricity Demand

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak Demand (MW)</th>
<th>Growth (%)</th>
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<tbody>
<tr>
<td>2015</td>
<td>17,697</td>
<td>3.2</td>
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<tr>
<td>2020</td>
<td>20,721</td>
<td>3.0</td>
</tr>
<tr>
<td>2025</td>
<td>22,938</td>
<td>1.8</td>
</tr>
<tr>
<td>2030</td>
<td>24,598</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: Peninsular Malaysia Electricity Supply Industry Outlook 2014, Energy Commission

Nuclear Power: Moving target

Scenario Planning
NUCLEAR ENERGY AS PART OF A NATIONAL ENERGY MIX

MOTIVATION FOR NUCLEAR POWER DEVELOPMENT

- **Long-term energy security**
  - to ensure reliable and secure long term energy supply

- **Diversification of energy resources**
  - reduce overdependence on fossil fuel (natural gas, coal, oil)

- **Depletion of indigenous energy resources**
  - Declining oil and gas production and proven reserve

- **Reduce heavy reliance on imports of coal**
  - Coal is fully procured from the international market - Indonesia (71%), Australia (16%), South Africa (11%), Russia (2%)

- **Reduce green-house-gas (GHG) emission**
  - to achieve 40% reduction in carbon intensity compared to 2005 level by 2020 (achieved 33% under RMK-10)
**NUCLEAR ENERGY SCENARIO AND STRATEGY**

**VISION ON NATIONAL PROSPECTS FOR NUCLEAR ENERGY SIZE AND GROWTH**

### 10th Malaysia Plan (2011-2015)
- To **explore the usage of nuclear power** in order to meet future energy demand and diversify energy mix in Peninsular Malaysia.
- **Feasibility studies, human capital development and public awareness campaign** will be undertaken.

### Economic Transformation Programme (2010-2020)
- Nuclear Power is included as **one of Entry Point Projects (EPP)** under Oil, Gas and Energy sector.
- Initial target: **Twin unit (2 GW) nuclear capacity with first unit commissioned in 2021**.

### 11th Malaysia Plan (2016-2020)
- To **further explore the usage of nuclear power** as an alternative energy resource for Peninsular Malaysia.
- To **build buy-in for the development of nuclear power plants** through effective communications and public awareness programmes and **implementation of NPIDP and NPRIDP**.
Initiatives to Secure and Manage Reliable Energy Supply

Energy security will be enhanced through the development of alternative resources, particularly hydro as well as importation of coal and liquefied natural gas (LNG) by 2015. In the transport sector, blending of bio-fuel will be made mandatory beginning in 2011, further enhancing fuel security. Development of new coal-based plants will be undertaken to ensure security of supply in Peninsular Malaysia. The application of super critical coal technology will be explored to reduce carbon emissions. In addition, the development of nuclear energy as an option for electricity generation will be considered to ensure reliable and cost-effective supply in Peninsular Malaysia. In this regard, efforts will include feasibility studies, human capital development and public awareness campaign.
“A comprehensive and effective communication plan on the sustainable use of energy resources is required to improve public awareness and understanding, and to manage public perception of the subsidy rationalisation programme. This includes communications and public awareness programmes to build buy-in for the development of coal and nuclear power plants required for security of supply, and for consumers to use energy efficiently in homes, schools, and at workplaces. A task force comprising of representatives of the Government, the private sector, and non-government organisations (NGOs) will be formed to ensure coordinated implementation of the plan” (page.7-36)

“The usage of nuclear power as an alternative energy resource will be explored further. In this regard, an independent atomic energy regulatory commission will be established based on a new comprehensive nuclear law for electricity generation.” (page. 7-39)
**STATUS OF FOUR ENABLERS SPECIFIED IN ETP FOR DEPLOYING NUCLEAR ENERGY FOR POWER GENERATION**

**PUBLIC ACCEPTANCE**
- Qualitative & quantitative nation-wide public opinion research;
- Public fora & consultation based on regulations & guidelines;
- Formulation of a 10-Year Comprehensive Communications Plan & Strategies on Nuclear Energy.

**INTERNATIONAL GOVERNANCE**
- New comprehensive nuclear law drafted & includes provisions based on relevant international instruments that will facilitate signing & ratification or accession to international instruments upon enactment of the new law.

**REGULATORY CONTEXT**
- New comprehensive nuclear law & set of subsidiary regulations, guidelines & regulatory guides drafted & reviewed by IAEA;
- New Atomic Energy Regulatory Commission to be established upon enactment of the new comprehensive nuclear law.

**SITE ACQUISITION**
- Site evaluation after Government approval to proceed is obtained, based on results of comprehensive nation-wide public opinion research & consultation on nuclear energy.
To address issues related to nuclear power deployment in the future, such as:

– Energy Planning
– Technology Assessment
– Management of radioactive waste and spent fuel

To keep abreast with global development of NES

To form partnership in the strategic areas related to NES

To establish platform for technology transfer that can contribute to sustainable NES
THORIUM

- **Proliferation Resistance**: 3 times more abundance than uranium, and have all the characteristics for
  - energy efficiency and security - fertile
  - cheaper electricity and minimum nuclear waste (less plutonium)

- **Public concerns and safety issues** –
  - thorium exists in Malaysia in Rare Earth Oxide (REO) waste residue, as well as ex-tin mining tailings
  - resolve the public and safety concerns on thorium by-products (Lynas/ARE issues).
  - built a more sustainable NPP and create safe, clean and good economic REO extraction industries - Economic and Strategic benefits

- Thorium based fuel cycle (including reactors) is currently in the development or R&D stage globally, hence opportunity for Malaysian to join this global venture, including through INPRO

- In practise, a sustainable NPP should still make use of both uranium and thorium, perhaps the way forward

- Participate in INPRO/IAEA activities
THORIUM

- **Long Term Program**: Thorium is a long term program with relatively huge funding, and the outcome may not be achievable within the stipulated time frame. The deliverables should be balanced between short to medium terms and the long terms. Spin-Off projects and deliverables are thus very important, failing which will jeopardise the subsequent project funding.

- **High R&D Investment**: Thorium utilization as fuel in power reactors is also facing global challenge in licensing, requiring huge R&D investments, and industrial acceptance. Malaysia as a small nation and new comer need to fully justify this activities and address the “ROI” appropriately.

- **Capacity Building and TSO Prog**: The Program/Project is also expecting to deliver the desired HRD infrastructure for Nuklear Malaysia to become a TSO for NPP. Thus, a well balanced R&D, Technical Development and Product Commercialization are to be addressed and managed. Stakeholder communication is very essential.
**THORIUM**

<table>
<thead>
<tr>
<th>Subprojects:</th>
<th>Possible Cooperation:</th>
<th>Project Leader:</th>
</tr>
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<tbody>
<tr>
<td>Thorium Resource and Supply</td>
<td>Foreign entities, JMG</td>
<td>Dr. Mohd Azmi B. Ismail</td>
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<tr>
<td>Preliminary Siting Study on Small Modular Reactor (SMR) Using Thorium</td>
<td>UNIMAS</td>
<td>Dr. Kamarudin Samuding</td>
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<tr>
<td>Production of Nuclear-Grade Thorium from Local Sources for Reactor Fuel</td>
<td>Foreign entities, IAEA, JMG</td>
<td>Dr. Meor Yusoff Meor Sulaiman</td>
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<tr>
<td>Development of Radiation Induced Graft Polymerization for Used as Thorium Absorbent</td>
<td>Foreign entities, UTM</td>
<td>Dr. Nor Hasimah Mohamed</td>
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<tr>
<td>Pilot Plant Engineering Development</td>
<td>Foreign entities, IAEA, LabZinc Ipoh, UMP, JMG, MIMOS</td>
<td>Dr. Hasni Hasan</td>
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<td>Characterisation, Extraction and Purification of Rare Earth Elements, Thorium from Malaysian Rare Earth Ores</td>
<td></td>
<td>Prof. Amran bin Abd Majid (UKM)</td>
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<td>Area Monitoring System for Thorium Laboratories and Pilot Plant</td>
<td>MIMOS</td>
<td>Maslina Mohd Ibrahim</td>
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<td>Engineering Software for Radiation Safety Simulation</td>
<td>Foreign entities, IAEA, MIMOS</td>
<td>Shalina Sheik Muhamad</td>
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<tr>
<td>Thorium Reactor Design</td>
<td>Foreign entities</td>
<td>Dr. Muhammad Rawi Bin Mohamed Zin</td>
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</tbody>
</table>
Radioactive waste and spent fuel is an outstanding issue related to nuclear power.

In the light of nuclear power deployment, Malaysia may encountered issues related to radioactive waste and spent fuel in the future.

Prudent management of radioactive waste and spent fuel will pave way for a sustainable NES in the future.

Thus, Malaysia would like to participate in international fora as well as collaborate with international partners to address these issues.
SUMMARY

- Malaysia will further explore the deployment of **nuclear power as an option for electricity generation** post-2020 in Peninsular Malaysia.
- Current status of nuclear power programme is **active without decision**.
- Malaysia would like to explore the option **to use Nuclear Energy System Assessment (NESA)** to assess the sustainability of nuclear power programme in Malaysia holistically.
THANK YOU