CHALLENGES AND PROSPECTS IN ENHANCING MALAYSIA'S ENERGY SECURITY

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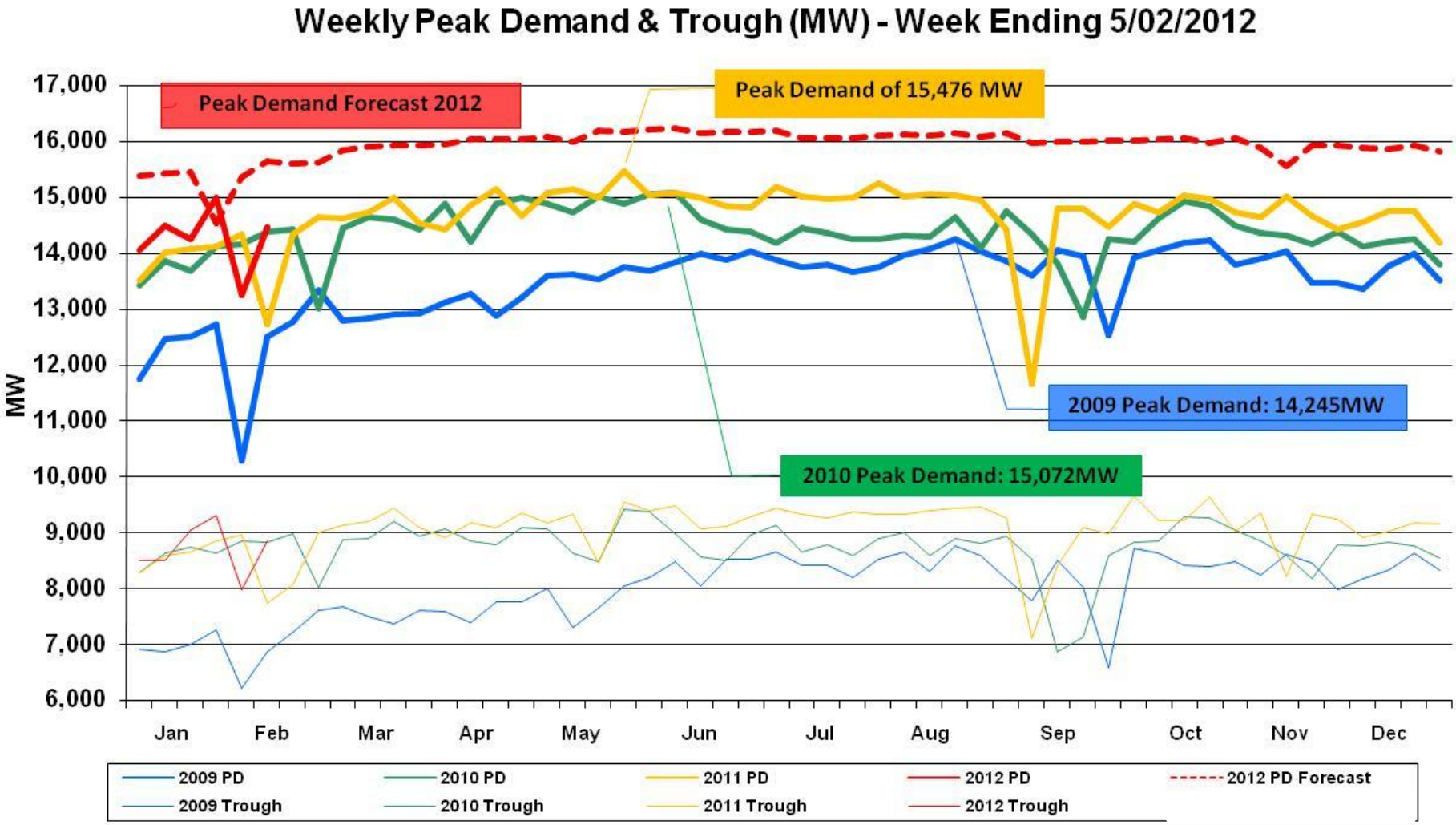
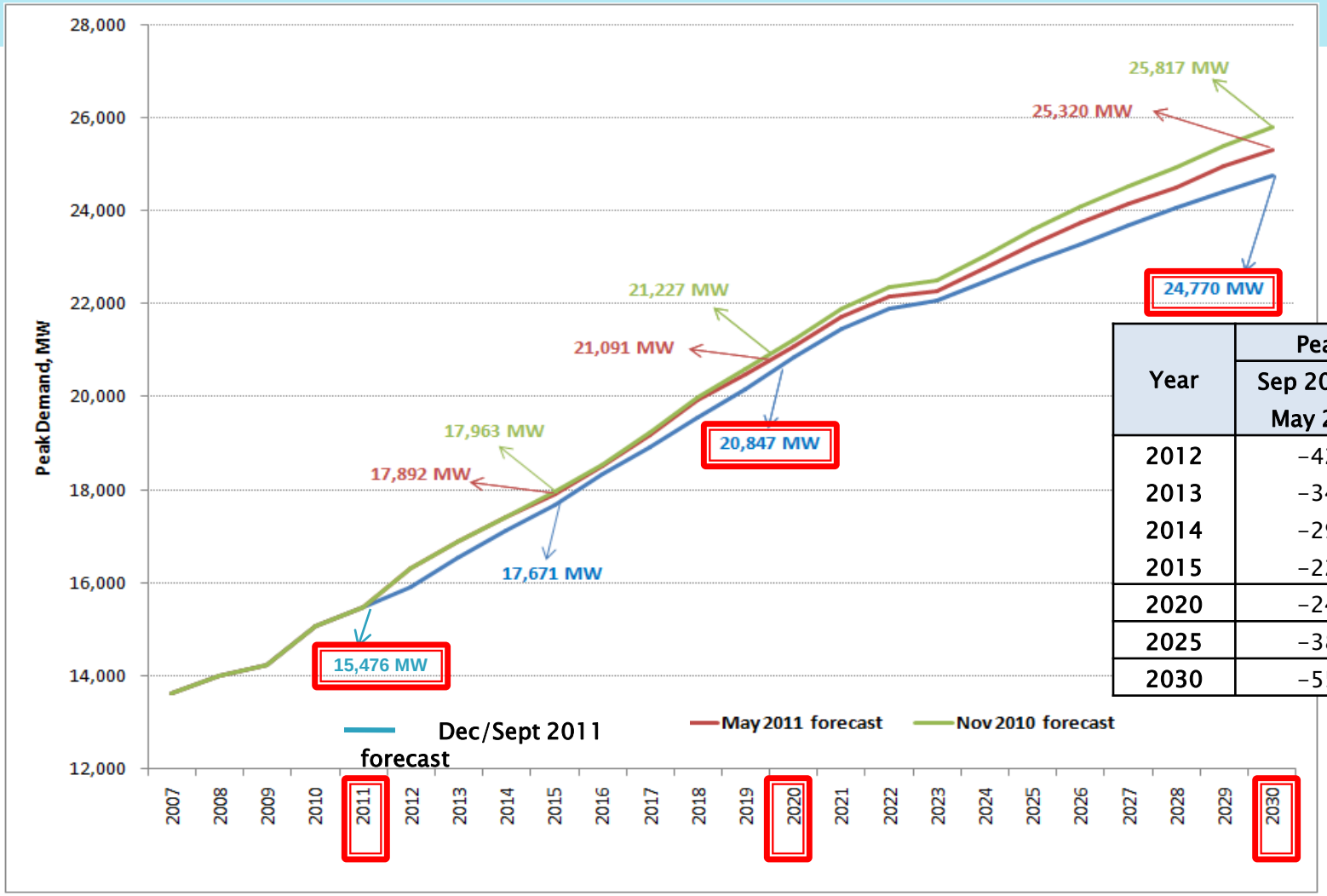
Peninsular Malaysia Electricity Demand – Supply Outlook For 20 Years

Electricity demand is on the rise in 2012



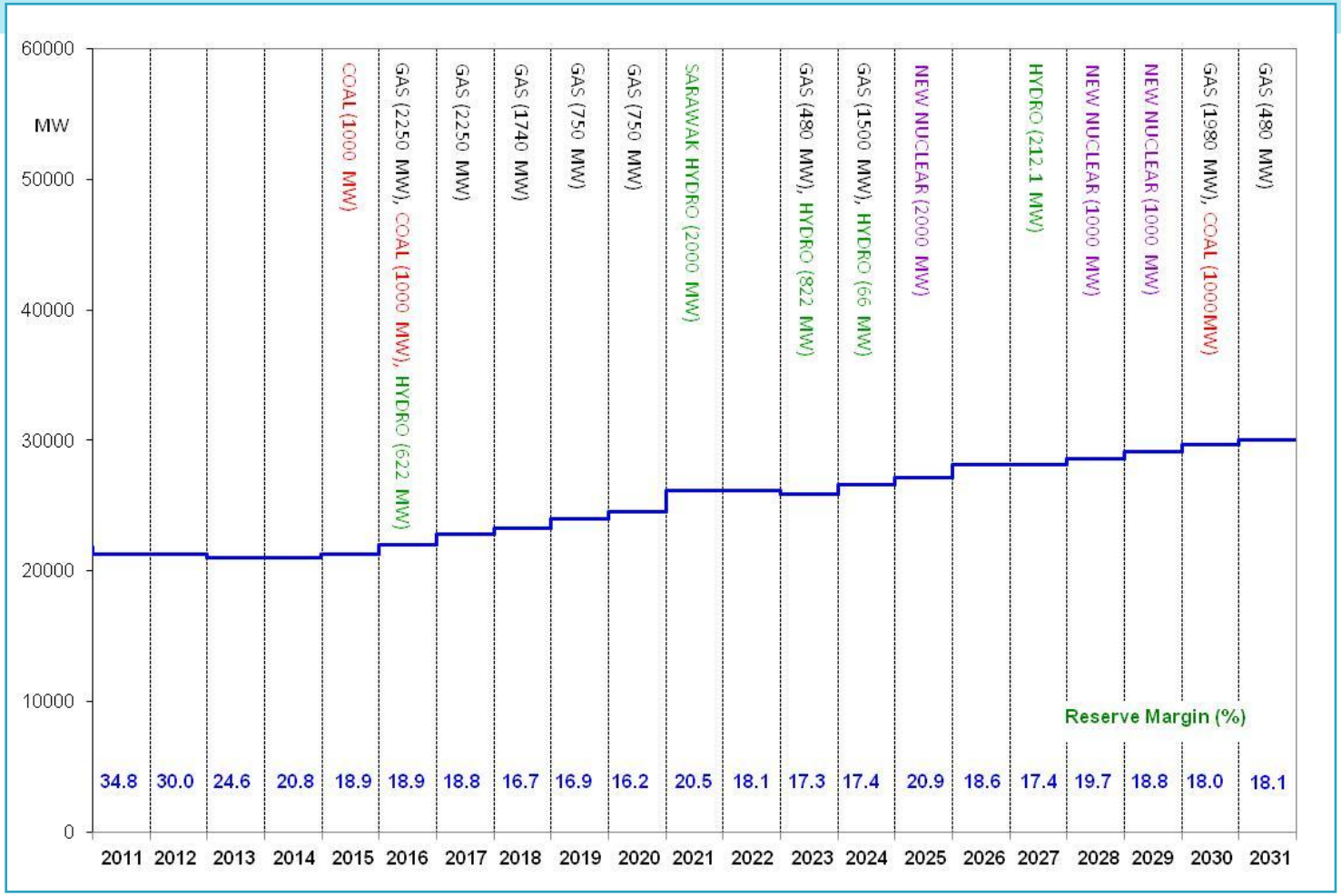
Peak Demand Growth of Around 3% Until 2030



Year	Peak Demand, MW	
	Sep 2011 vs May 2011	Sep 2011 vs Nov 2010
2012	-421	-421
2013	-341	-341
2014	-290	-290
2015	-221	-291
2020	-243	-380
2025	-389	-692
2030	-550	-1,047

Slightly higher growth in the near term (~3.4%) and lower growth projection up until 2030 (~2.5%)

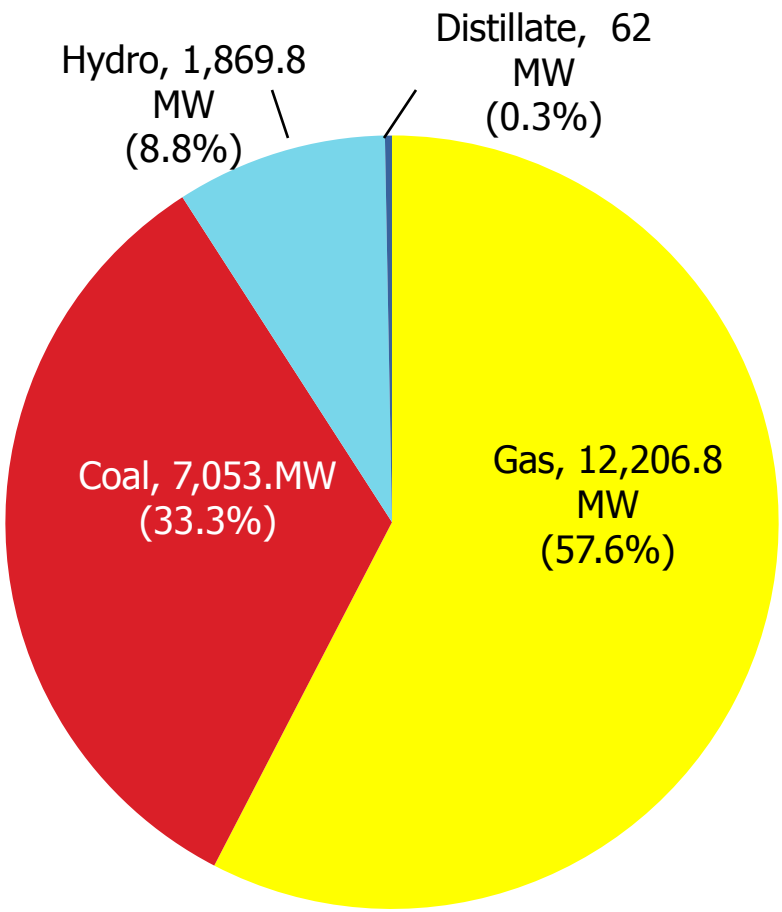
Peninsular Malaysia Electricity Supply – 20 Years Outlook



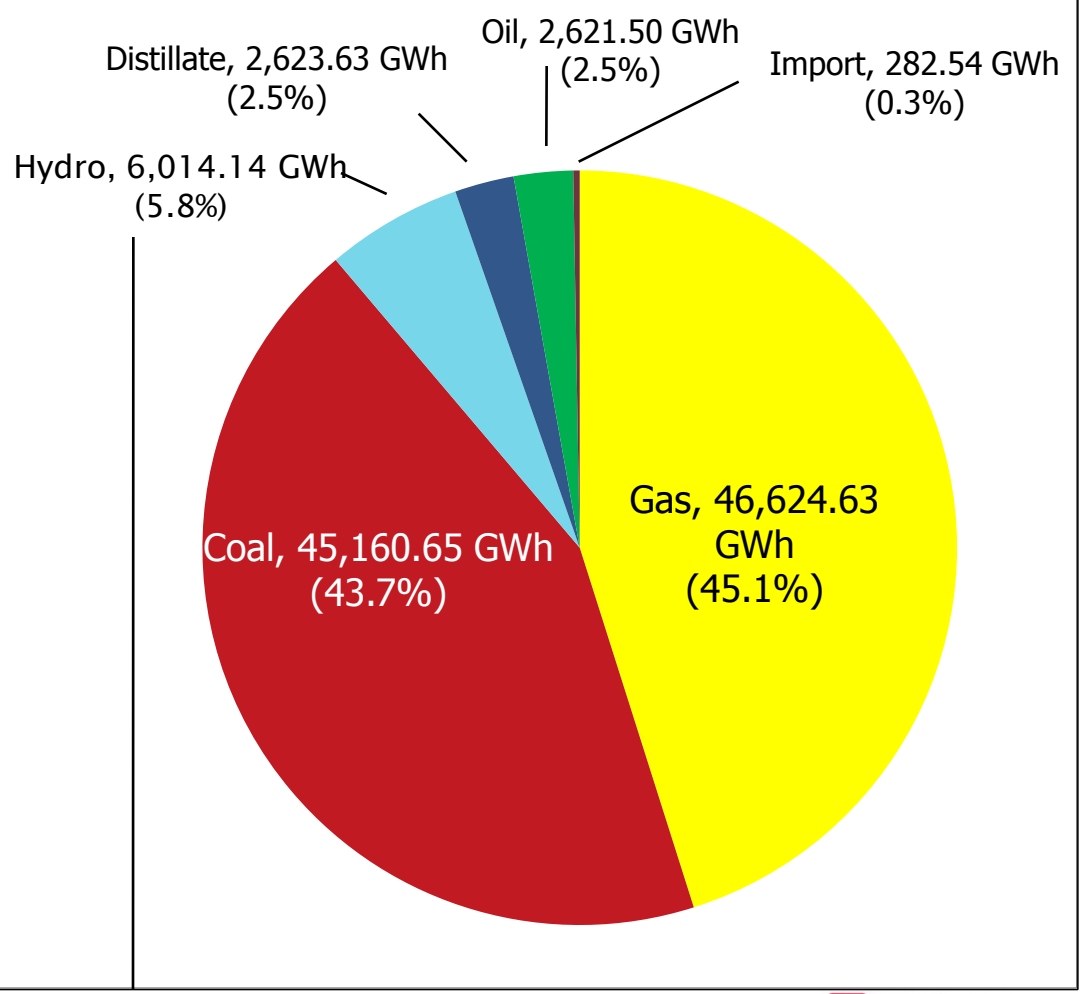
The plant up plan was based on an assumption of 2,000 MW capacity from Sarawak Interconnection in 2021. If this does not materialise, the capacity must be replaced by either coal, nuclear or LNG.

Capacity and Energy Mix 2011

Generation Capacity by Fuel Type



Energy Generated by Fuel Type



Existing Fuel Policies

Policies Governing The Energy Sector

ENERGY RELATED POLICIES

National Energy Policy, 1979
Overall energy policy with broad guidelines on long-term energy objectives and strategies to ensure efficient, secure and environmentally sustainable supplies of energy.

National Green Technology Policy 2010
Green Technology shall be a driver to accelerate the national economy and promote sustainable development.

National Depletion Policy, 1980
aimed at safeguarding the depleting oil reserves.

Four-Fuel Policy, 1981
Oil, Gas, Hydro, Coal

Five-Fuel Policy, 2001
Includes Renewable Energy

The present challenges may require the policies developed previously to be reviewed and revised

Four and Five Fuel Policies Guide Electricity System Planning

Four-Fuel Policy (1981)

- Reduced dependency on oil as fuel for electricity generation. Gas was promoted to replace oil for electricity generation
- 4 sources for electricity generation are oil, gas coal and hydro

Five-Fuel Policy (2001)

- Renewable Energy and Energy Efficiency as the fifth fuel and to further diversify energy base and to create a sustainable energy future.

Fuel Options for Generations - Gas

Gas – The Current Situation

- The power sector (TNB and IPPs) has invested about **RM 30 billion in gas-fired plants**. Total capacity on gas is **12,207 MW**

- The **contracted gas volume** of **1,744 mmscfd** is required for full operation of the gas-fired plants

- However, with the current supply **of gas limited to 1,150 mmscfd**, only limited plants are able to be operated by gas. Supply will be reinstated to 1,350 mmscfd upon commissioning of re-gasification terminal.

Power Sector Gas Supply Agreement Volume		
Plant	**Volume (mmscfd)**	**Signed**
GSP	113	22 September 1993
TNB	500	21 October 1994
PD Power	102	27 May 1994
YTL Paka	118	15 March 1993
YTL PG	59	15 March 1993
Powertek	102	1 March 1994
Segari	161	17 July 1993
Pahlawan	44	30 July 1999
TNB(supp)	150	28 November 2001
GB3	114	6 September 2001
Panglima	118	11 February 2002
TTPC	106	24 January 2002
Prai Power	57	9 April 2002
Total	**1744**	

With numerous curtailments in 2011, gas volume average is reduced to 924 mmscfd, about half than the total requirement

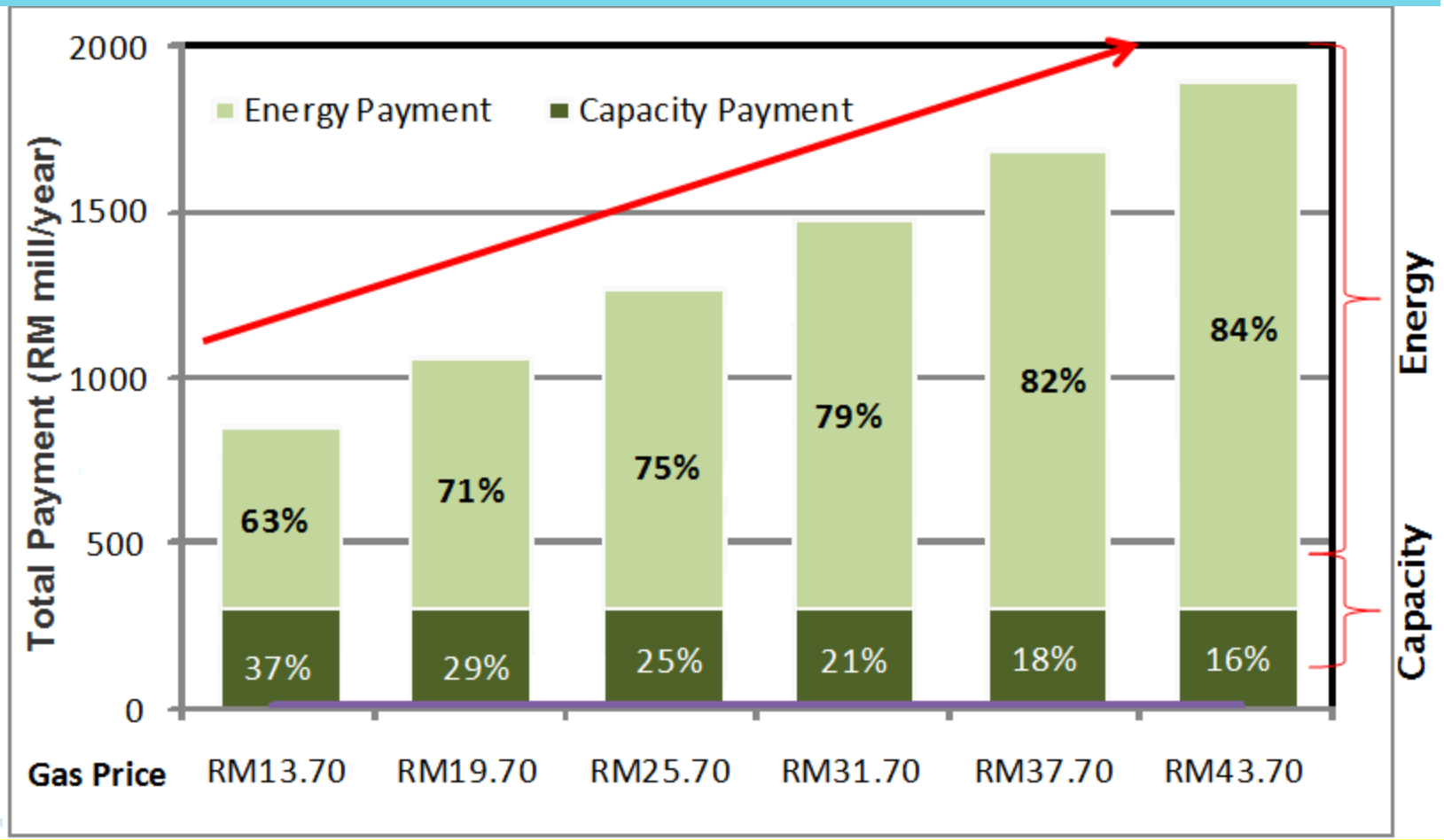
Key Factors in Ensuring Future Gas Supply - *Impact of Gas Price*

- **Market price**
  - **How do we define market price of gas?**
    - Based on a weighted average of all gas sources i.e. domestic, imported via pipeline, LNG
    - Pegged to international indices or competing fuel such as coal
    - The current 'market price' specified in the GSA (pegged to MFO price) which could result in high price
- **Government administrative price**
  - Government to decide on pricing formula
  - Local gas could balance high imported gas price by setting domestic gas price at cost plus level (i.e. as practiced in Thailand, Indonesia, Vietnam)
- **Gas pricing policy**
  - Gas pricing policy has to bring benefit to national economy and ensure security of supply

Absence of a clear gas pricing policy has resulted in weak supply security

Price of Gas Will Determine Energy Mix and Plant-Up Policy

The higher the gas price, the higher the component of the energy payment compared to the capacity payment



New plant up of more efficient plants will reduce consumption of fossil fuels

We need to decide.....

- It is crucial for us to decide on how to move forward, so as to provide clarity for the power industry:-

We could either decide to fix the price of gas now and from thereon the volume to be allocated to the power generation

Or

We could fix the volume to be allocated to the power generation and consequentially the price of gas applicable to the power generation

Key Factors in Ensuring Future Gas Supply - *Commitment of Gas Volume*

- **Policy on Gas Utilization for Power Sector**
  - **Establish a clear fuel generation mix for the medium to long term**
    - To facilitate infrastructure development requirements for upstream (PETRONAS) and downstream (TNB, industrial users) players
- **Gas Volume Commitment**
  - **To determine and commit guaranteed volume**
    - Assist planning for strategic decisions on gas purchasing
    - Assist in planning for local gas utilization (export vs. local use)
  - **Ensure security of supply in the longer term and minimize "uncertainties" in planning for competitive, clean and secure electricity**

Certainty of gas volume will ensure supply security and clear planning for power sector

Gas Pricing for Power Sector -
Pricing Policy Throughout the World

1. Gas-to-gas competition

Gas is priced in open free-market trade on a spot basis or under long-term contracts. *(North America/Europe)*

2. Oil price indexation

Prices are set by formula under long-term contracts, usually of several years duration. *(LNG importers Continental Europe / Asia Pacific)*

3. Bilateral monopoly

The dominant pricing mechanism in interstate gas dealings of the former Soviet Union, in Central and Eastern Europe, and in many immature gas markets with one dominant supplier facing one or two dominant buyers.

4. Netback from final product

Price received by the gas seller reflects the price received by the buyer for this product.

5. Regulation (cost of service)

Prices are approved according to set procedures by a regulatory authority so as to cover supply costs including a reasonable return on investments.

6. Regulation (social/political)

Prices are set and adjusted on an ad hoc basis by the government taking into account of buyers' perceived ability to pay, sellers' perceived costs, and the government's revenue needs.

7. Regulation (below cost)

The government knowingly sets prices below the sum of production and transportation costs as a form of subsidy to the buyers and usually reimburses the seller from the state budget.

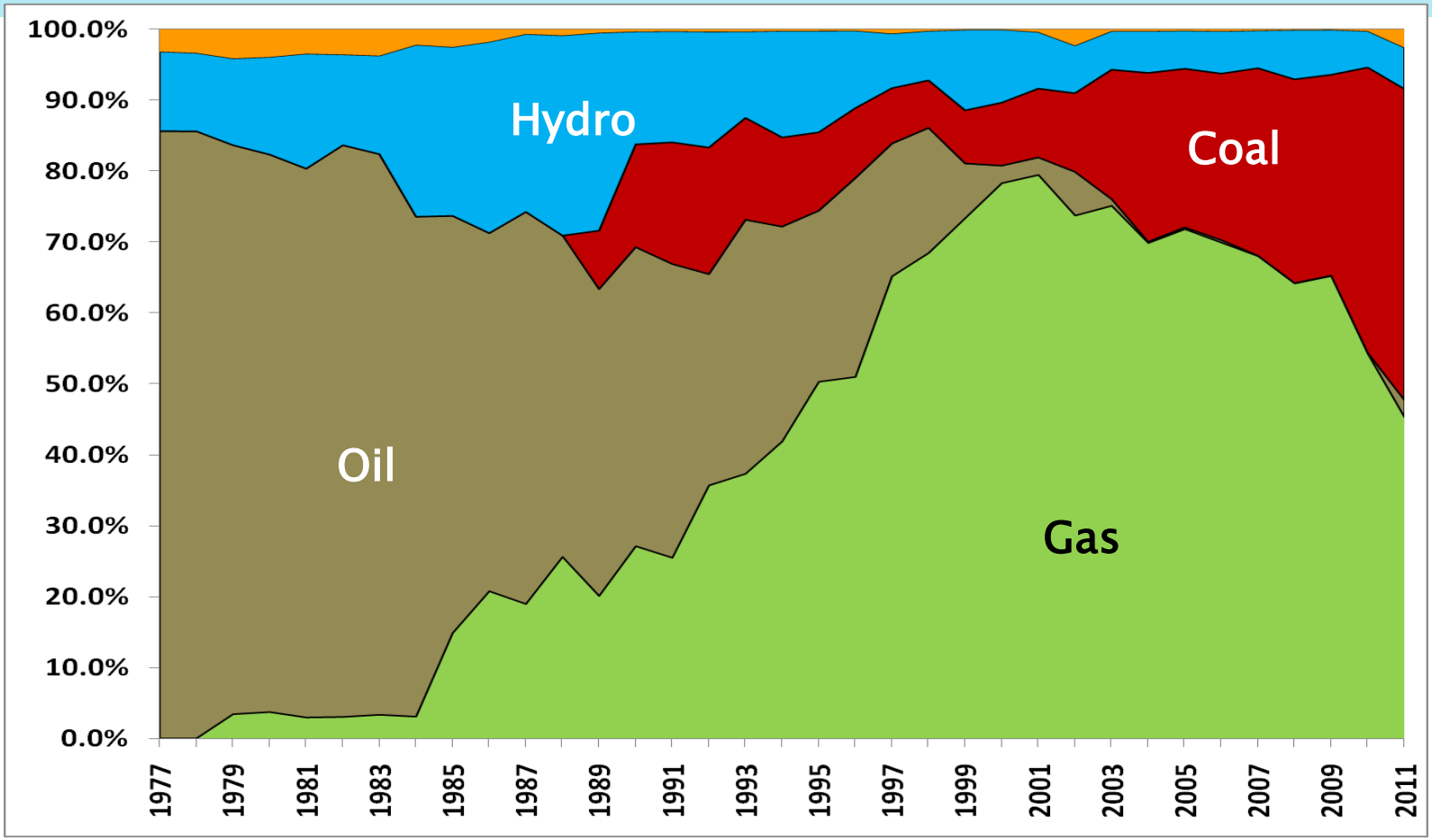
8. No Price

The extreme form of regulation (below costs).

Source: International Gas Union, *Price Formation Mechanisms: 2009 Survey, Table14.1; and IEA, World Energy Outlook 2009, 510*

Which policy is suitable for Malaysia?

Evolution of Generation Mix by Fuel Type

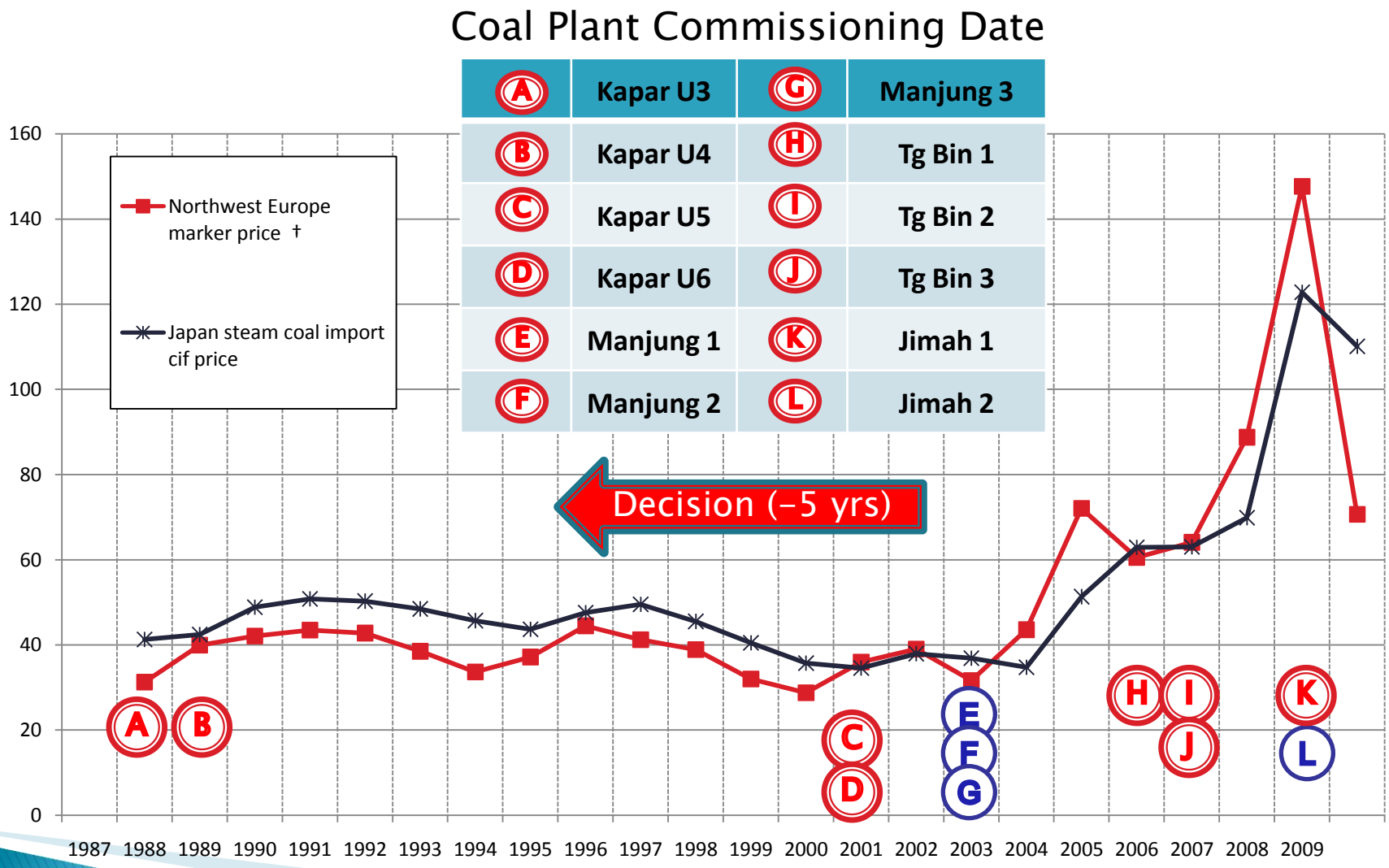


Mainly oil (pre-1980) → **Mainly gas (2000's)** → **Mainly coal (post-2015 ?)**

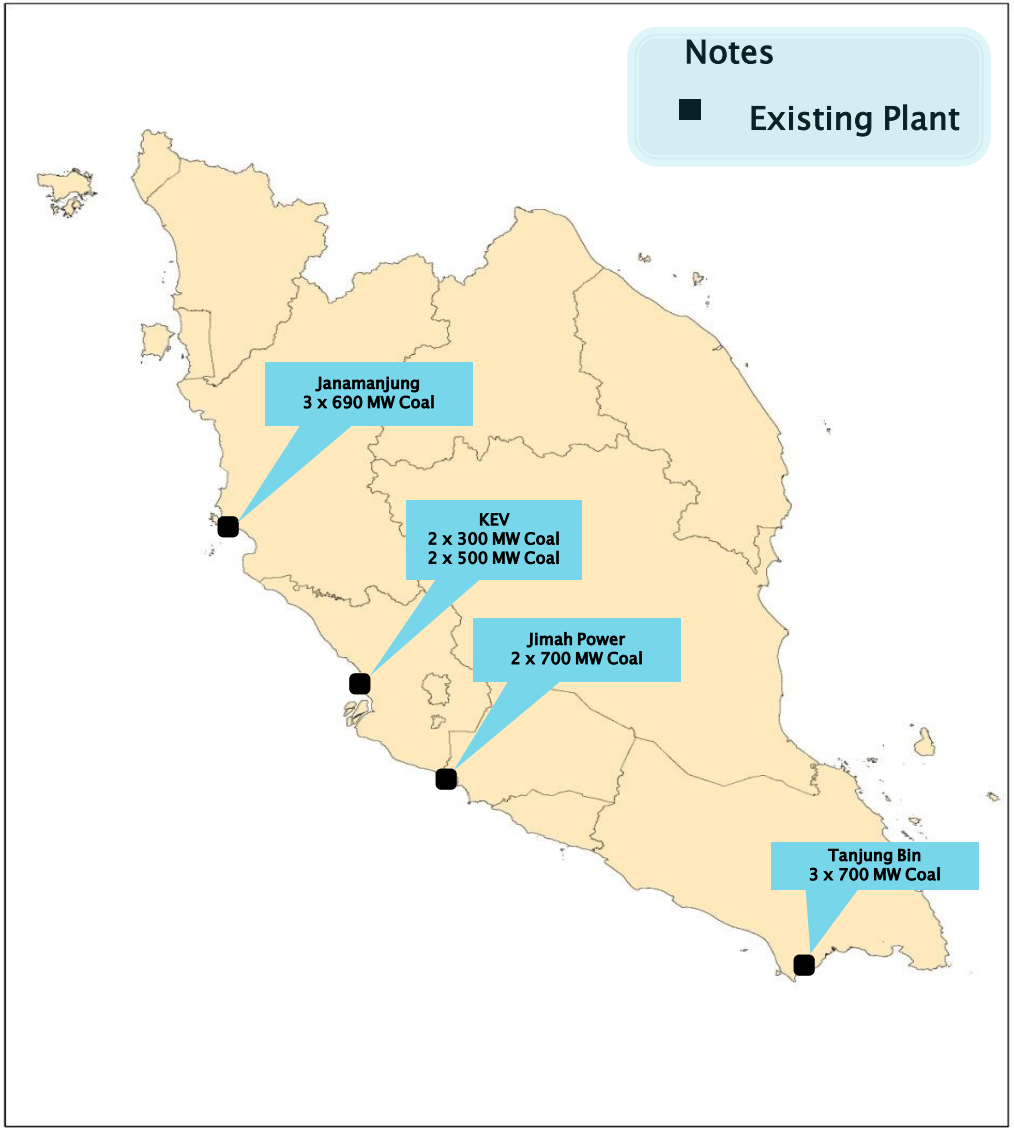
Turning points : oil crisis (1979), discovery of natural gas (1982), gas limitation by PETRONAS (2002), severe gas shortage (2011)

Fuel Options for Generations - Coal

Decision For Coal Plants Was Made When Coal Price Was Low



Greenfield and Brownfield Development For Future Coal Plants



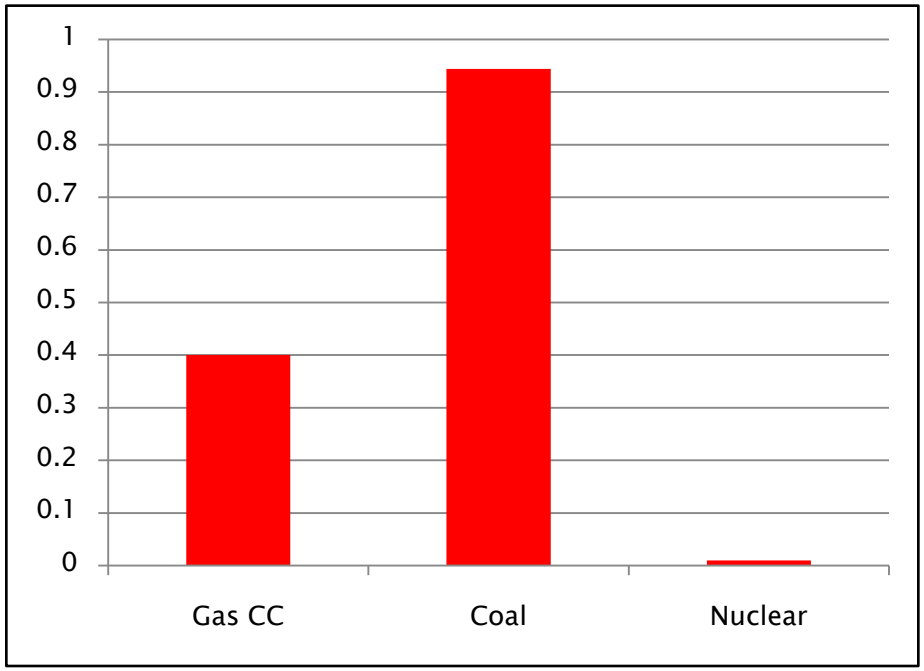
- Sites are available at the existing coal plants (brownfield)
- Greenfield developments are going to be more challenging
- Need to secure additional transmission right of way to the greenfield sites

Greenfield and Brownfield Development For Future Coal Plants

- Copenhagen commitment on carbon emission intensity reduction of 40% by 2020
- Potential international regulation on carbon emission in the future
- Development of new power plants are subjected to stringent Environmental codes and regulations

COP 15

Carbon Emission (tCO_2/MWh)



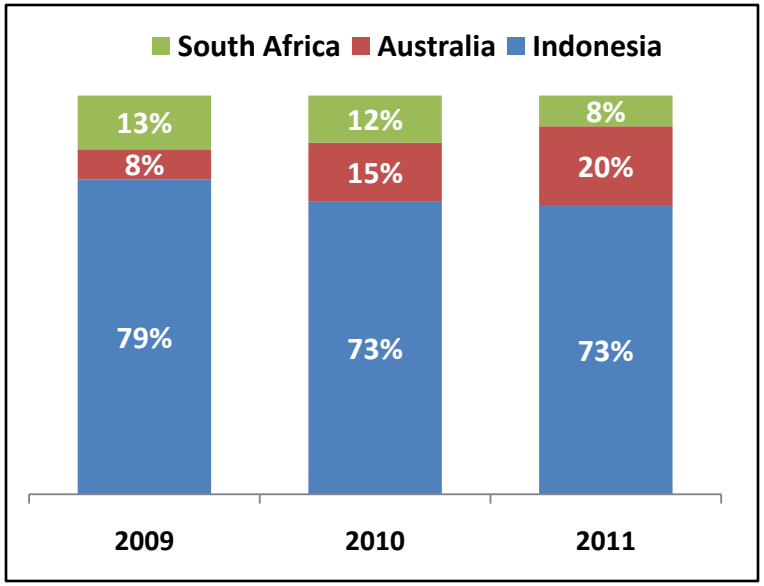
Future generation options must incorporate efficient plants such as supercritical/ultra supercritical boiler.

Coal is Fully Imported

1. Indonesia	
2009	9.4 mil tonnes
2010	12.4 mil tonnes
2011	13.9 mil tonnes

2. Australia	
2009	0.9 mil tonnes
2010	2.5 mil tonnes
2011	3.8 mil tonnes

3. South Africa	
2009	1.6 mil tonnes
2010	2.0 mil tonnes
2011	1.47 mil tonnes



Other countries such as China, India, Japan, Korea are also looking at Indonesia for coal supply.

JakartaGlobe October 14, 2009

Indonesia to Limit Coal Exports As Domestic Demand Grows

The government announced on Wednesday that it would **limit coal exports to 150 million tons** next year to secure national supply as domestic demand from new power plants soars.

Along with increasing coal output, national demand was expanding rapidly, said Bambang Setiawan, director general of coal, minerals and geothermal energy at the Energy and Mineral Resources Ministry.

The situation called for **prioritizing the domestic market**, he said.

“We will try to focus on fulfilling domestic needs first,” Bambang said.

He said an export quota would be imposed after the necessary implementing regulations had been issued.

Also speaking at the conference, Energy Minister Purnomo Yusgiantoro said state power utility PT Perusahaan Listrik Negara would need 75 million tons of coal annually after its planned 35 new coal-fired power plants came onstream as part of the 10,000 MW “fast track” electricity-generation expansion program.

Purnomo said the government would agree to **surplus output being exported after national demand had been met.**

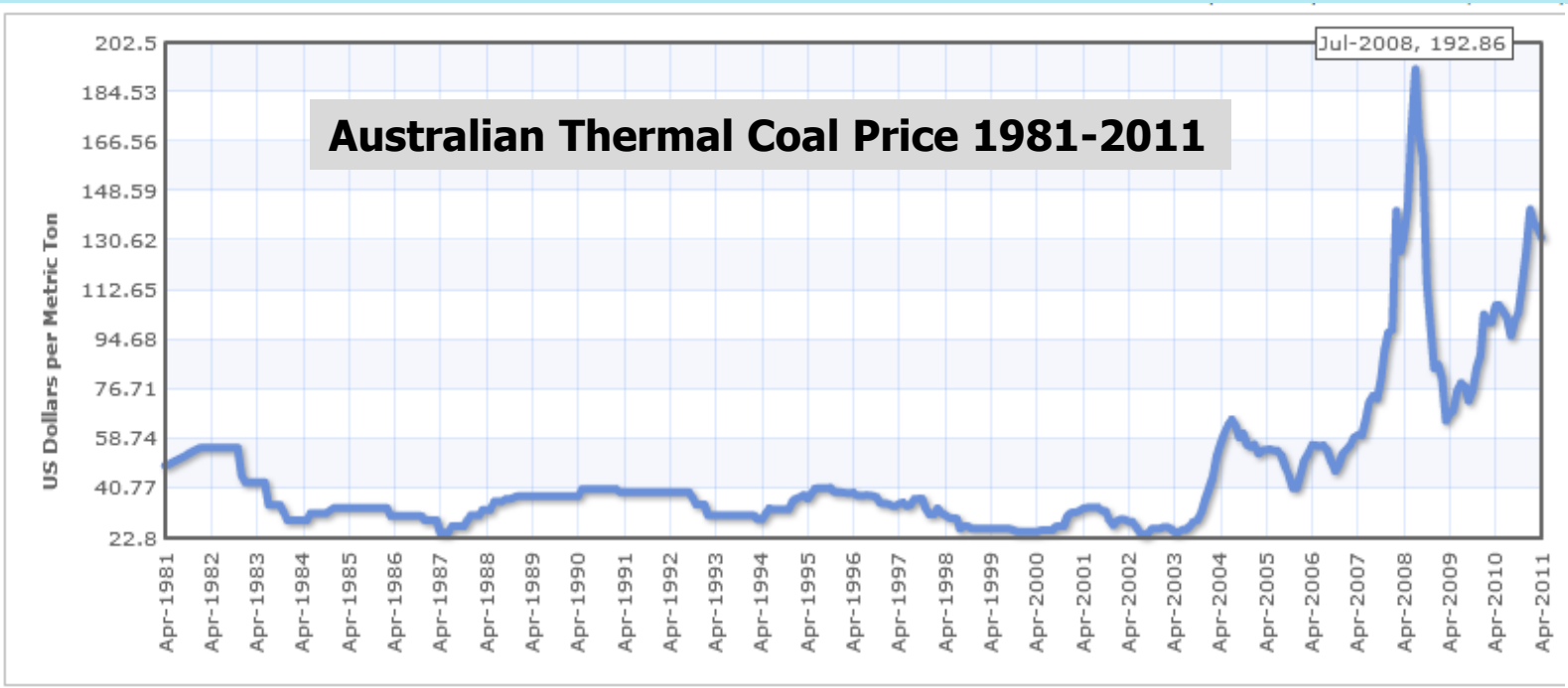
India Policy on Coal

- India has a policy which indicates that local coal is reserved for government companies and local state governments.
- It implies that private sectors will have to resort to imported coal to meet their respective demand (i.e. electricity generation, steel mills, etc).
- This policy can be seen as a mechanism to protect their own natural resources and at the same time provides more competition in global coal market.

"Guidelines to usher in auction of coal blocks have been finalized. But we will retain the policy of reserving coal blocks for government companies and local state governments,"

*- Coal Minister **Sriprakash Jaiswal** (8th July 2011)*

Coal Prices are Subjected to Market Forces



- Coal was stable in terms of price for decades.
- Price started to increase beyond 2003 and has since climbed to new levels due to surge in world demand.
- Volatile, unsettled coal price poses big risk to TNB due to risk of no fuel cost pass through.
- Automatic fuel-cost pass through mechanism is a must to sustain viability of a power company.

Fuel Options for Generations
- Indigenous Hydro

Limited Hydro Potential in Peninsula

- All large hydro potential in Peninsula are utilized except for Lebir and Nenggiri.
- Hydro is very much under the control of the State Governments.
- Developing new hydro projects requires strong support from the State Governments and is not as easy as before.

TERENGGANU
1.Hulu Terengganu; 250MW (2015)

PAHANG
1.Ulu Jelai; 372MW (2016)
2.Tekai; 156MW
3.Telom; 132MW
4.Raub-Bentong; 70MW

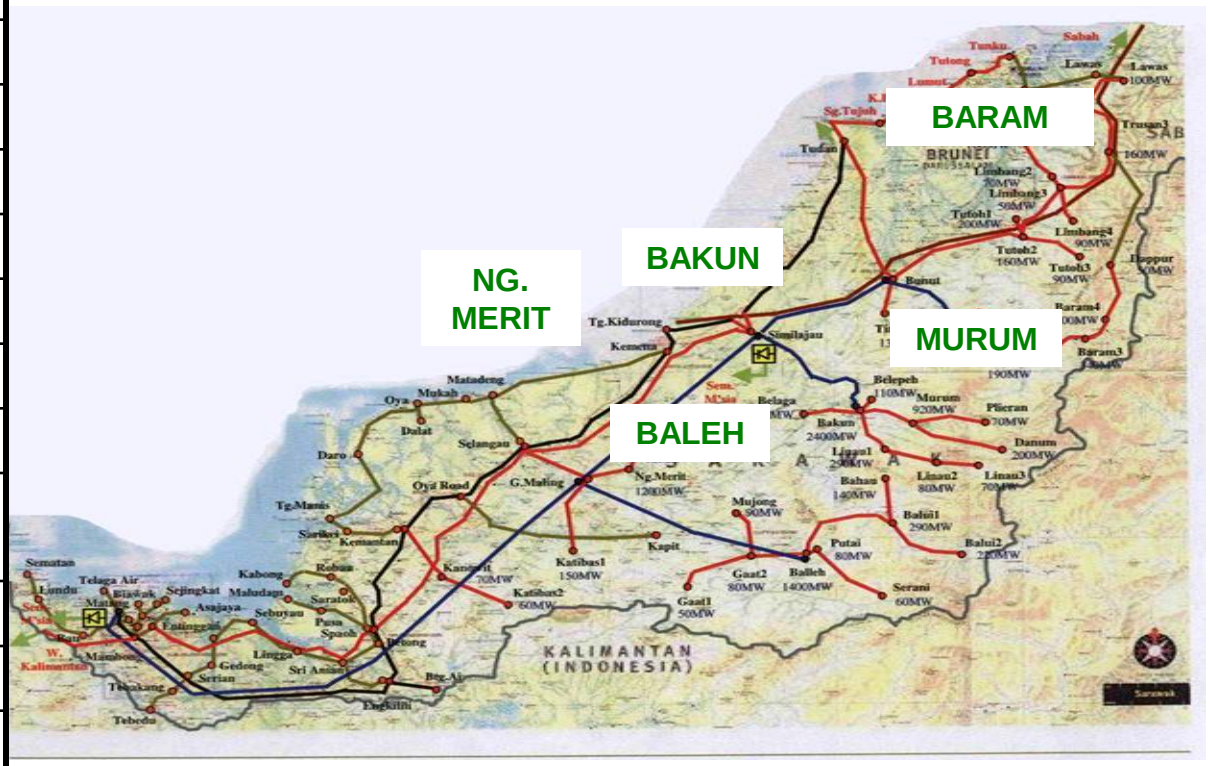
PERAK
1.Sg. Pelus; 35MW
2.Kerian-Selama; 21MW

KELANTAN
1.Lebir (multipurpose); 270MW
2.Nenggiri (multipurpose); 416MW

Total remaining hydro potential in Peninsula is less than 2000 MW, mainly high cost peaking hydro.

Revisited the Sarawak Option – Abundant Hydro and Coal Potential in Sarawak

Generation Source	Capacity (MW)	Available Year
Bakun	2400	2012
Murum	900	2013
Baram	1000	2015
Baleh	1400	2019
Limbang	150	2013
Batang Ai Extension	50	2011
Ng. Merit Coal Plant	600+1200	2013/2015
Mukah Coal Plant Exp.	300	2010
Bintulu CCY	110	2009
Miri CCY	110	2010
Mertjawah, Belepeh, Linau, Tutoh, Ulu Ai & Lawas	1000	2014 -2020



Need to review and reintroduce the subject of importing energy (hydro and coal) from Sarawak to Peninsula.

Fuel Options for Generations - Renewable Energy

RE Is Viable, But Limited

Solar

Potential/Issue
- ~6,500 MW (for 40% buildings)
- Land, cloud, cost

Status
- 1 MW
- MBIPV Projects (SURIA 1000, demo/show case projects etc.)

Biomass

Potential/Issues
- ~1,340 MW by 2030
- Supply security

Status
- 39 MW under construction as of July 2009
- Biogen Project, palm oil waste, other waste (woodchips, paddy husks etc.)

Biogas

Potential
- ~410 MW by 2028

Status
- 4.45 MW under construction as of July 2009
- Palm Oil Mill Effluent (POME), livestock, agro, industrial waste

Mini-Hydro

Potential
- ~490 MW by 2020

Status
- 30.3 MW under construction as of July 2009
- Run-of-river scheme with minimum impounding

Solid Waste

Potential
- ~360 MW by 2022
- ~21,000 tonnes of waste collected every day in M'sia

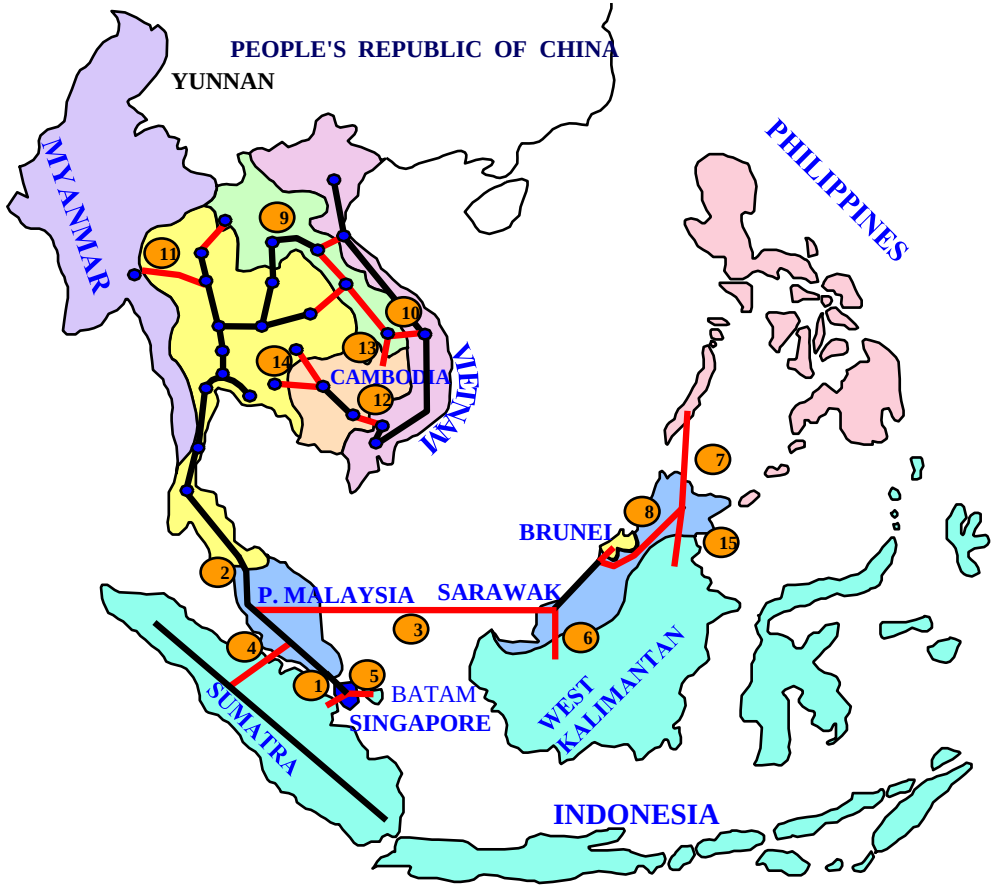
Status
- 5.5 MW commissioned as of August 2009

Renewable Energy Is Not Able to Replace The Dominance of Fossil Fuel.

Source: Ministry of Energy, Green Technology and Water, Energy Commission, MBIPV Project

Options for Generations
- Interconnection with ASEAN Neighbours

ASEAN Power Grid Cross Border - Neighbours



Existing Interconnection

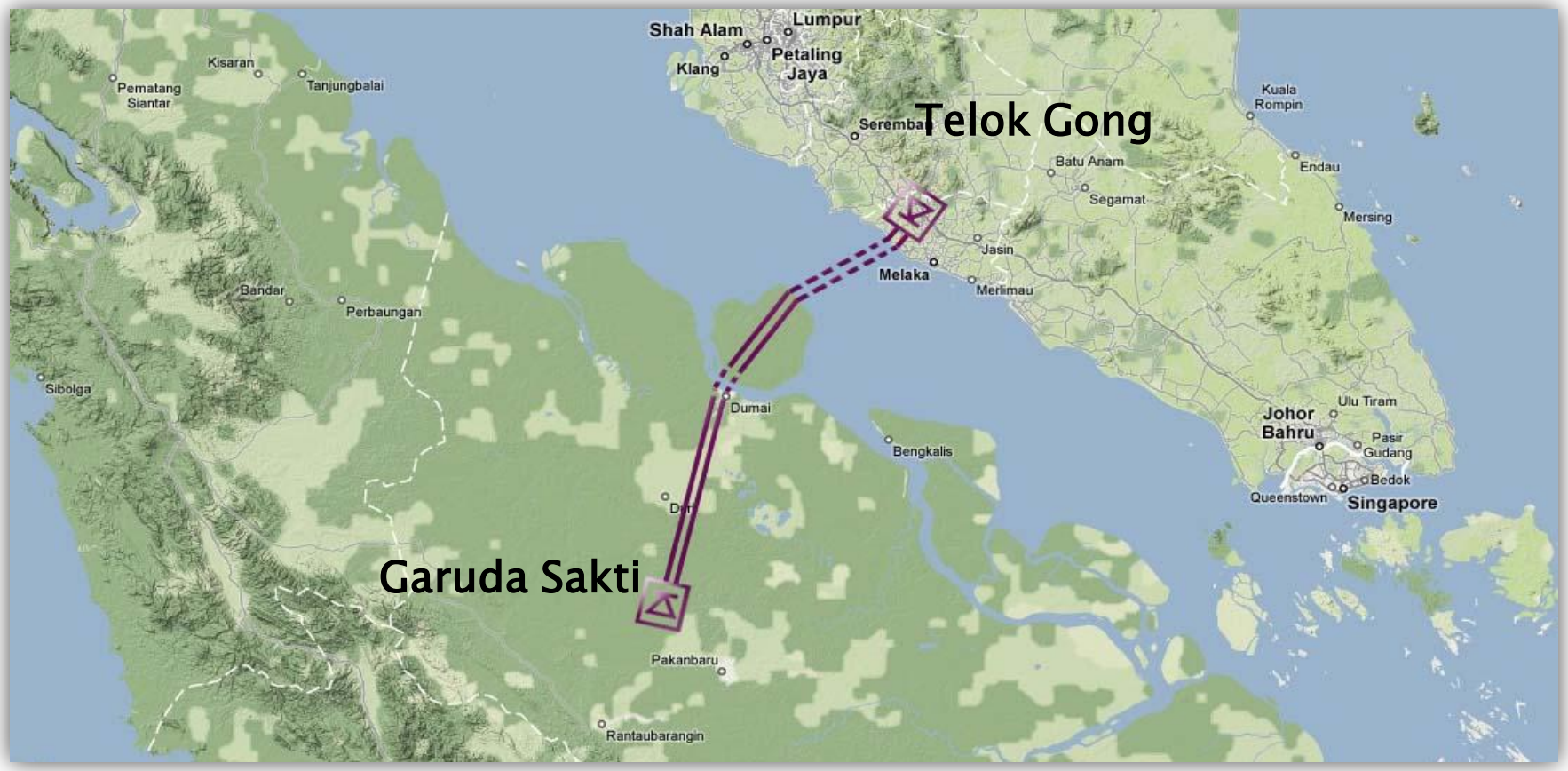
- Peninsular Malaysia –Singapore
- Peninsular Malaysia - Thailand

Possible Interconnection

- Peninsular Malaysia – Sarawak
- Peninsular Malaysia - Sumatera

Sarawak and Sumatera interconnections are viable options to increase energy security.

Sumatera Interconnection May Enhance Energy Security to Peninsula



Sumatera Interconnection is a technically viable option with the potential capacity of at least 600 MW.

Fuel Options for Generations
- The Quest for Nuclear

Making Malaysia 'Nuclear Ready' Is Important

- A lot of countries are having a second look at the nuclear option – Germany, Switzerland, Italy, Thailand, due to the recent incident in Fukushima, Japan
- Others are forging ahead with caution, re-evaluating their existing plants
- Malaysia should continue to be "nuclear ready"
  - Establishment of regulatory framework should not stop
  - Public education to be intensified
  - Feasibility study should proceed
- Construction works will take 5-7 years, the tasks mentioned above are required before we can start construction. Making Malaysia "nuclear ready" is essential
- GO or NO-GO decision can be made when we are "nuclear ready" ~ 2015/2016

Is Fukushima incident a blessing in disguise?
The incident will result in improved design and better safety standard.

Determining The Optimum Fuel Mix

Implications for Malaysia's Long Term Energy Mix (1)

- There is no single 'optimal' long term energy mix target
- Energy mix is actually an output rather than an input.
- The key drivers that will shape peninsula's future energy mix are 5-fold:
  1. Availability and price of 'legacy' domestic natural gas,
  2. Cost, availability and size of development options of Sarawak interconnection,
  3. Cost and availability of nuclear power,
  4. Environmental policy objectives expected over the next decade,
  5. Extent of concern about domestic energy security.

Each area requires supportive policies and regulatory processes to enable appropriate commercial decisions be taken prudently and in a timely manner

- These considerations are critical due to the way in which they influence the optimal mix of future power system investments.

Implications for Malaysia's Long Term Energy Mix (2)

- **Possible future energy mix outcomes depending on time frames and policies**
  1. More coal is required if gas price increases significantly
  2. Less gas and coal are required if resources from Sarawak can be developed earlier
  3. Nuclear development is a very promising option
  4. RE projects are mostly expensive than coal-fired generation and depend almost entirely on policy support (i.e. subsidies)
  5. Demand management and energy efficiency programs can influence future load growth
     - However, they require supportive regulatory arrangements including changes to electricity tariff structures.
- Economic choices for future generation can lead Malaysia into several very different future directions depending on strategic policy preferences.

It is important and timely to consider these policy preferences to ensure that it can properly be reflected in future power sector investment decisions.

Way Forward

Way Forward- Challenges for Prudent Planning (1)

3 main challenges:

1. Establish an overall and sustainable structure for transitioning to move current gas price to market-price,

2. Impact of rising gas price and uncertainty of gas supply towards energy security,

3. Long term impact of generation planning towards greenhouse gas emission
   - To consider coal or future expensive gas to fill the gap until environmentally sustainable options (i.e. hydro and nuclear) can be developed.

Way Forward- Challenges for Prudent Planning (2)

Malaysia's future generation capacity investment choices depend on:

1. Malaysia's overall energy security policy,
2. Malaysia's willingness to rely on imported fuel resources (e.g. Sarawak interconnection) and
3. Malaysia's environmental policy (particularly with regards to greenhouse gas emissions).

Changing power sector gas arrangements to facilitate a more efficient Long Term Energy Mix

4 specific issues must be resolved:

1. A definition of, and mechanism to establish – the market gas price
2. A specification of the quantity of legacy gas that can be used by the power sector
3. An administrative price of legacy gas that is completely separate from the 'market price'
4. A set of arrangement to mange the transition from today's administrative arrangement to the future market-based arrangements.

Developing The Long Term Energy Mix

- As the price of natural gas increases relative to other fuel cost, its role in the overall energy mix will fall
  - Such reliance requires that forward plan take into account the best available information at the time
- Environmental and energy security considerations may not be fully accommodated in a pure 'market-based' planning environment.
- If Malaysia seeks to reduce reliance on imported fuels, it will need to pursue development of energy options:- nuclear power, large-scale hydro, RE, demand-side management and EE initiatives.
  - Nuclear have longer and more complex developmental lead-time

Without active planning and coordinate activities, such options might not otherwise ever be considered practicable.

Closure

Closure

Energy security very much depends on the ability to secure fuel for generating electricity

1. Natural gas is depleting, LNG will be fully imported
2. Coal is fully imported
3. Hydro – Sarawak has a high potential of hydro development
4. Nuclear – Highly dependent on national policy and public acceptance

We need to find the right sustainable and balance energy mix and resources to ensure long term security for the country.

Closure

- Energy supply options must be sustainable, affordable and clean. Hence, it must be a balanced mix of gas, coal, hydro, nuclear and renewable.

- We will be facing tougher time in the future. Peninsular Malaysia is faced with limited and depleting gas resources and increasing reliance on imported coal to meet the country's electricity demand.

- RE, imports from Sarawak together with nuclear in the longer term will reduce the high dependency on gas and coal.

We need to find the right sustainable and balance energy mix and resources to ensure long term security for the country.

Thank You