



NUCLEAR POWER PRE-PROJECT ACTIVITIES IN MALAYSIA

*Fukui International Meeting on Human Resources Development for Nuclear Energy in Asia
Fukui, Japan*

19 & 20 March 2014

1

- **POWER GENERATION IN MALAYSIA**

2

- **POLICY DECISIONS TOWARDS NUCLEAR POWER DEVELOPMENT**

3

- **MNPC'S ROLES AS A NEPIO**

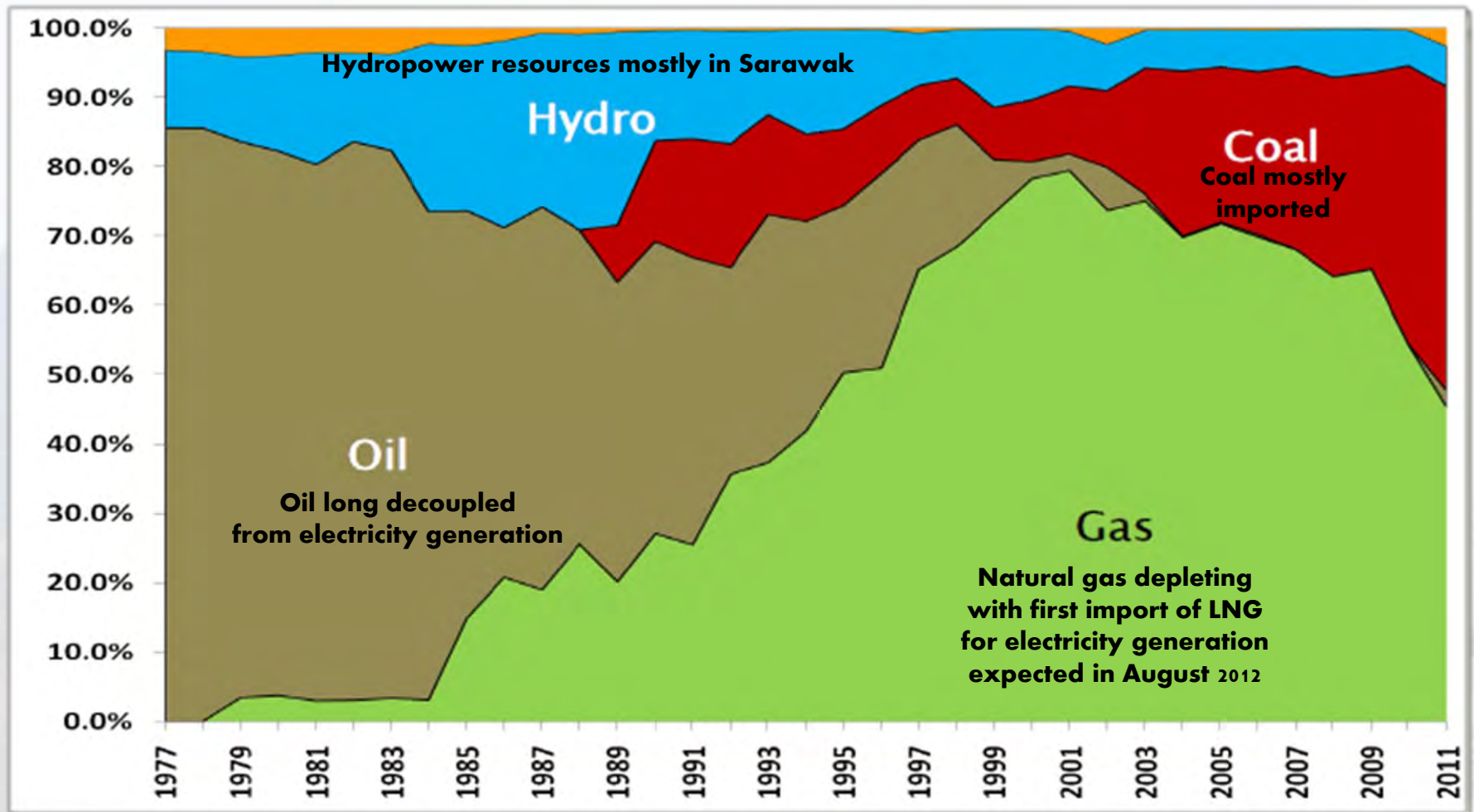
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- **CHALLENGES**

5

- **CONCLUDING REMARKS**

EVOLUTION OF GENERATION MIX BY FUEL TYPE



Mainly oil (pre-1980)



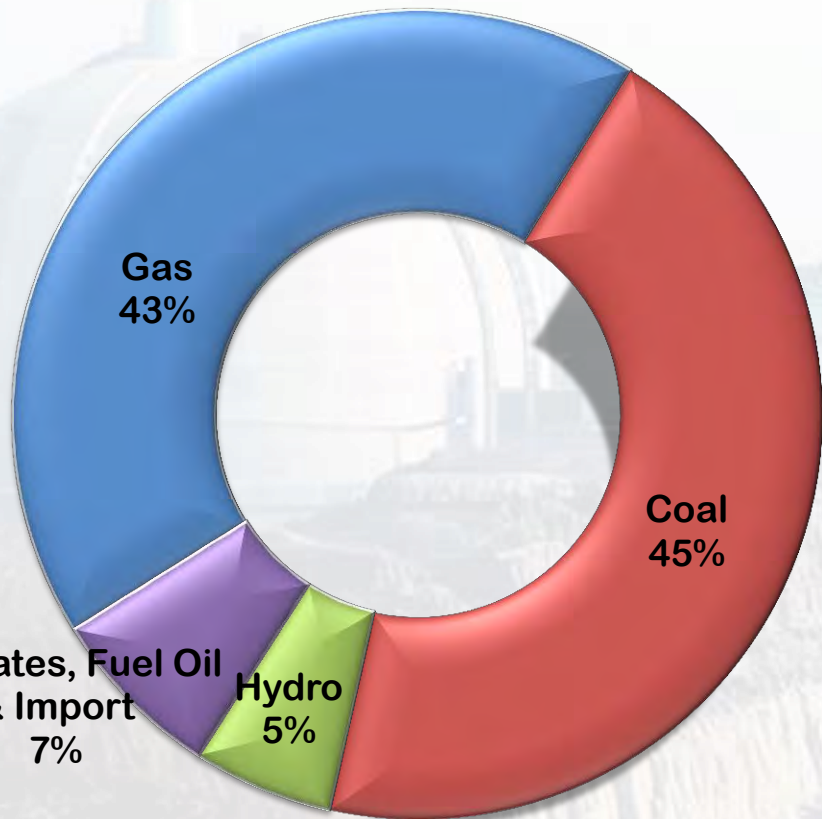
Mainly gas (2000s)



Mainly coal (post -2015?)

CURRENT ENERGY SCENARIO & FUTURE CONCERNS

2011 Generation Mix for Peninsular Malaysia



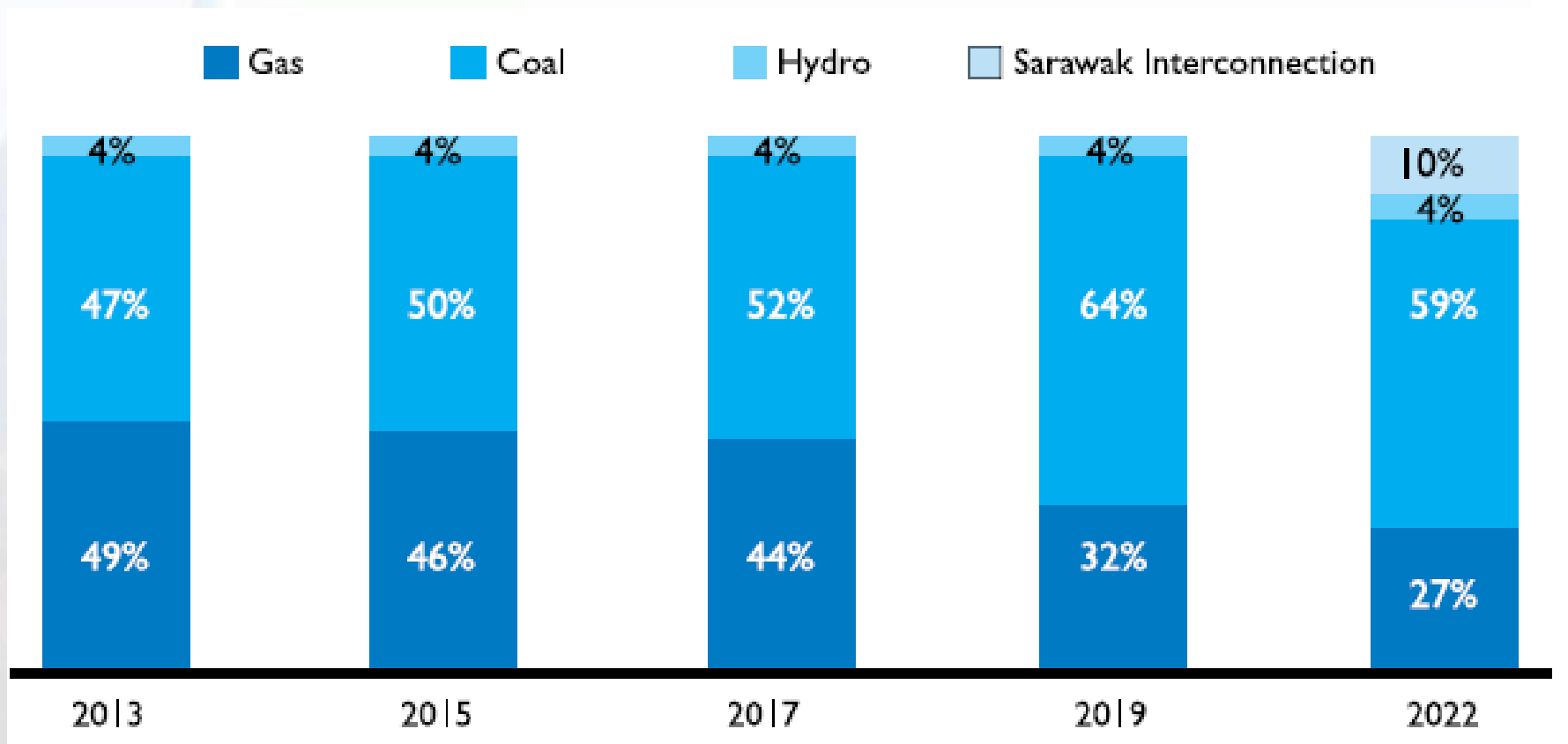
2011 total energy generation: 104,220 GWh

- Fossil fuels currently dominate energy mix (94%). More new coal & gas plants approved in Peninsular Malaysia - COD before 2020, as follows:-

- Prai Gas (H-Class) plant
- Janamanjung Coal 2 x 1000
- Tg Bin Coal 1 x 1000
- Jimah Coal 2 x 1000
(*ultra-super critical coal technology*)

- Electricity generation targets from renewables (solar PV, biomass, biogas & mini-hydro): 2015 = 5%, 2020 = 9%, 2030 = 11%
- Need to diversity for balanced energy mix including exploring the option of using nuclear for power generation post-2020

PENINSULAR MALAYSIA POWER GENERATION MIX UP TO 2022



Source: Energy Commission, *Peninsular Malaysia Electricity Supply Industry Outlook 2013*

POLICY DECISIONS TOWARDS NUCLEAR POWER DEVELOPMENT

7 Jan. 2011: Incorporation of MNPC as NEPIO

10 Dec. 2010: Decision to establish NEPIO



25 Oct. 2010:

Economic Transformation Programme (ETP) launched with nuclear power deployment included

16 July 2010:

Cabinet Decision to adopt National Nuclear Policy

10 June 2010:

New National Energy Policy incorporated in Tenth Malaysia Plan with nuclear energy as longer term option for the Peninsula.

26 June 2009: Nuclear energy adopted as one of fuel options for electricity supply post-2020, especially for the Peninsula;

10 Sept. 2008: Decision to draft National Nuclear Policy

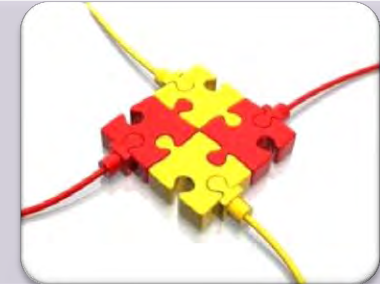
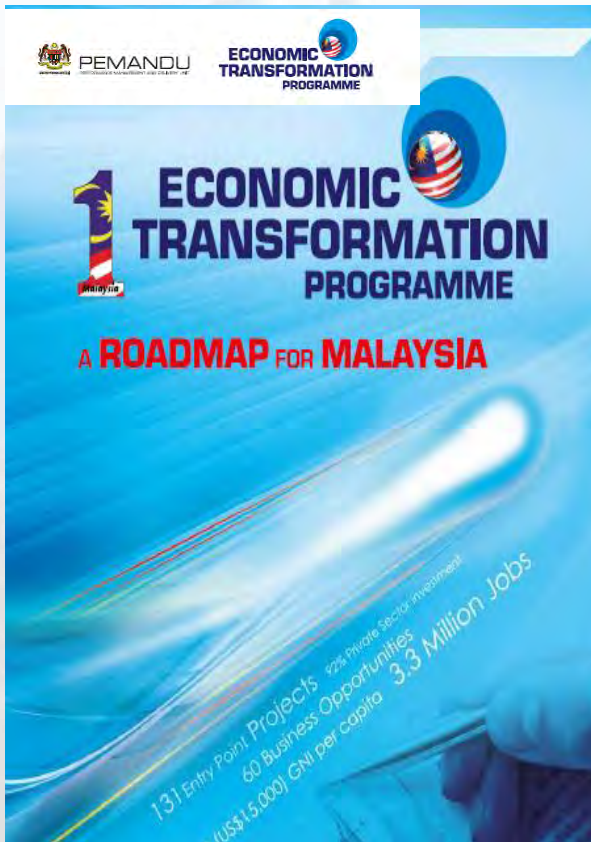
29 Aug. 2008: 2009 Budget in Parliament to explore nuclear energy and formulate new National Energy Policy



ECONOMIC TRANSFORMATION PROGRAMME (1)

A comprehensive effort to transform Malaysia into a high-income nation by 2020

EPP 11: Deploying Nuclear Energy for Power Generation



RATIONALE

Exploring option of deploying nuclear energy to meet future demand and to diversify energy mix for the Peninsular

ACTION

Study possibility of delivering a twin unit nuclear power plant with total capacity of 2000 MW post-2020

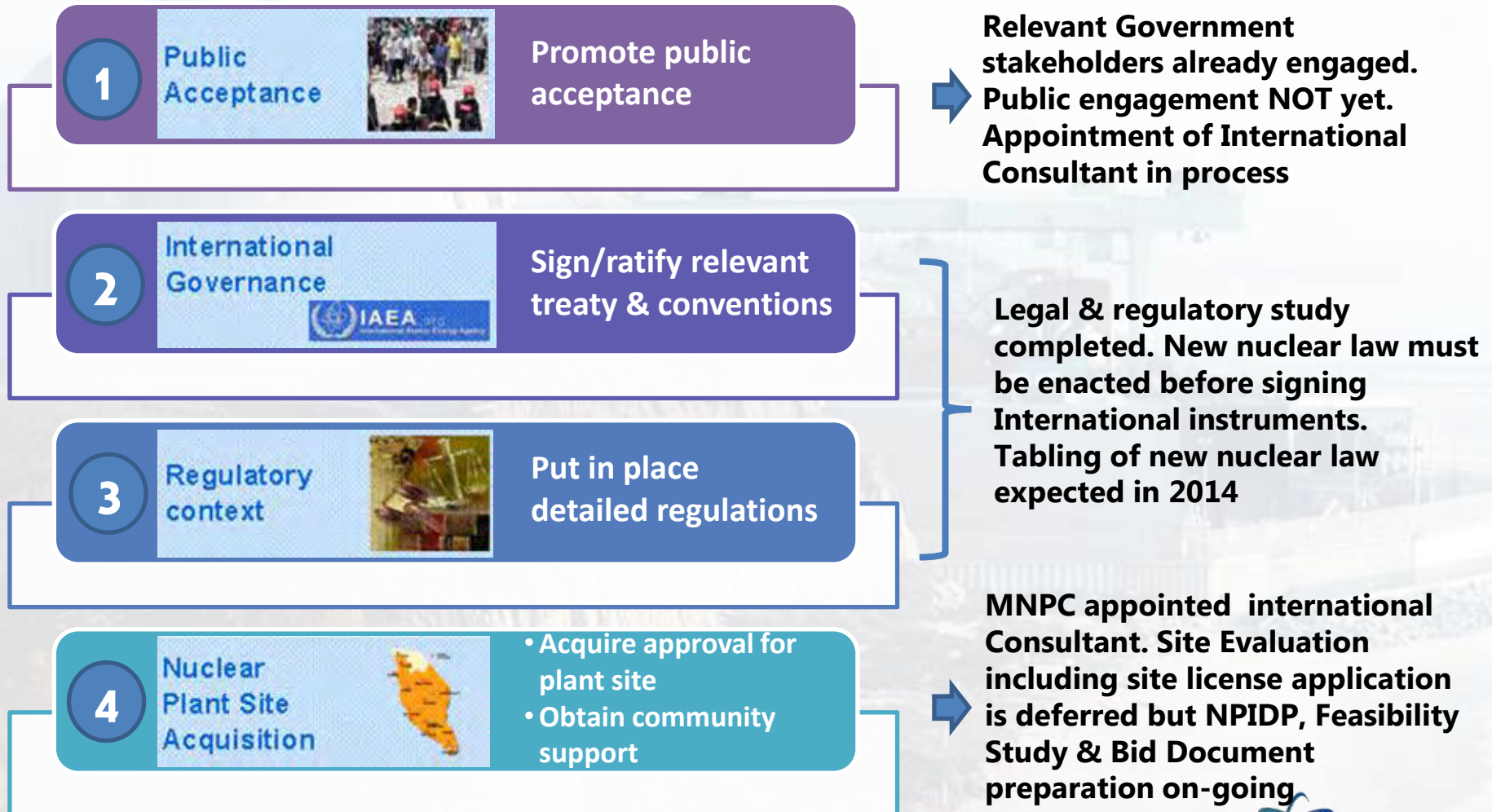
ENABLERS

4 critical path items/enablers must be addressed with highest priority to ensure prompt delivery.

ECONOMIC TRANSFORMATION PROGRAMME (2)

A comprehensive effort to transform Malaysia into a high-income nation by 2020

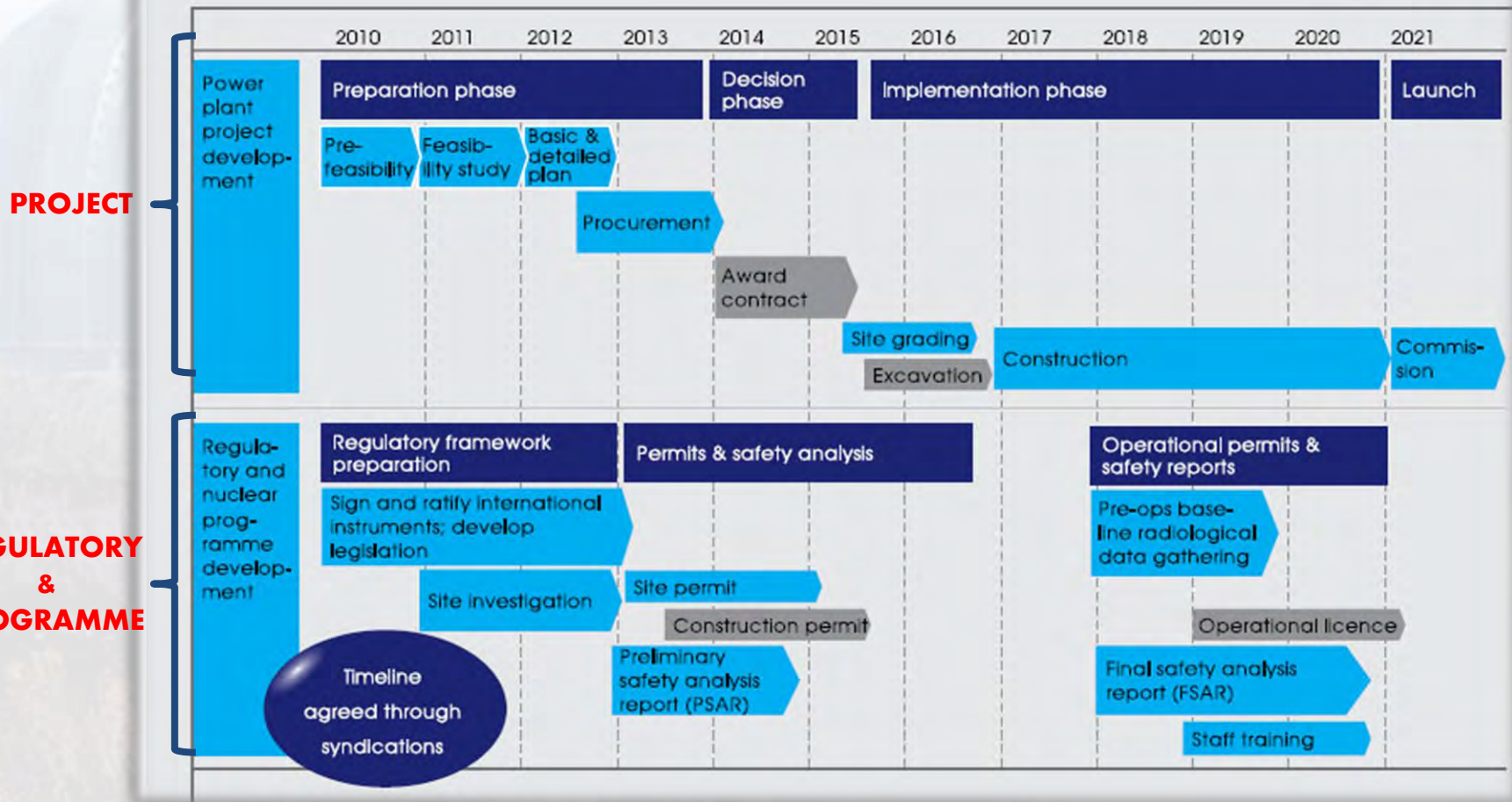
Four (4) critical path items must be addressed with highest priority to ensure prompt delivery, which are:



NUCLEAR TIMELINE IN ETP REPORT

To generate nuclear power by 2021, Government will provide resources to proceed with planned activities

■ Key milestones



MOVING FORWARD: A FULLY DEDICATED NEPIO (1)



Established on 7 January 2011

Registered under Companies Act of Malaysia, and placed under jurisdiction of the Prime Minister's Department, as a new fully dedicated NEPIO

Supersedes 2009 Nuclear Power Development Steering Committee

Officially launched by the Prime Minister to spearhead nuclear power deployment under Economic Transformation Programme (ETP) on 11 January 2011



VISION

Nuclear power for a sustainable high-income economy

MISSION

Establishing a comprehensive groundwork for a successful, sustainable, safe, secure and peaceful national nuclear power programme within time, on budget and in a transparent manner



MOVING FORWARD: A FULLY DEDICATED NEPIO (2)

STRATEGIC OBJECTIVES



To plan, spearhead and coordinate implementation of nuclear energy development programme for Malaysia and to take necessary action to realise development of first nuclear power plant in Malaysia



To ensure development of nuclear infrastructure for the country is in line with International Atomic Energy Agency (IAEA) guidelines covering 19 key infrastructure issues:

- National position
- Nuclear safety
- Management
- Funding & financing
- Legislative framework
- Safeguards
- Regulatory framework
- Radiation protection
- Electrical grid
- **Human resource development**
- Stakeholder involvement
- Site & supporting facilities
- Environmental protection
- Emergency planning
- Security & physical protection
- Nuclear fuel cycle
- Radioactive waste
- Industrial involvement
- Procurement



To identify company or special purpose vehicle (SPV) to be owner and/or operator of nuclear power plant

THE ROLES OF MNPC AS A NEPIO

1

Phase 1 (Pre-Project)

- NEPIO is responsible for most activities.
- Number of staff is relatively small and drawn from various government agencies.
- Much of the actual specialised work is performed by external experts/expert groups.
- Mixture of high-level policy work and detailed feasibility studies.

2

Phase 2 (Project Definition)

- Start of Phase 2 - NEPIO still drives the programme.
- Other key organisations, including the Regulatory Body and the Owner/Operator should be fully established and taking an increasingly active role.
- The core project management team for the plant construction should be in place.
- Recruitment of those Operations staff with long training lead-times should begin.
- End of Phase 2 - NEPIO hands over many of its tasks to the relevant organisations.

3

Phase 3 (Construction)

- Start of Phase 3 - NEPIO will still have an oversight role.
- Owner/Operator will be responsible for management of plant construction and commissioning.
- Regulatory Body will be actively engaged in the plant licensing and overseeing construction, as appropriate.
- Owner/Operator will be actively recruiting and training permanent staff.

ORGANISATION STRUCTURE TO SUIT CURRENT MNPC ACTIVITIES



Additional personnel may be recruited as necessary according to needs and progress of work

RESPONSIBILITIES OF THE CORE UNITS

PROGRAMME DEVELOPMENT UNIT

- Developing the Nuclear Power Infrastructure Development Plan (NPIDP)
- Conducting the self-assessment of IAEA 19 Infrastructure Issues
- Implementing an Integrated Work Plan with the IAEA
- Supporting the human resource capacity development for a domestic nuclear power industry
- Developing strategies for stakeholder engagement & public communications

PROJECT DEVELOPMENT UNIT

- Conducting Site Evaluation Studies (**deferred**)
- Conducting Feasibility Studies
- Developing the Project Bid Documents
- Managing the contract with the Project Development Studies consultant

REGULATORY COORDINATION UNIT

- Developed the Nuclear Power Regulatory Infrastructure Development Plan (NPRIDP) and on-going process to secure NPRIDP approval
- Developed the Atomic Energy Regulatory Bill, new Regulations & Guidelines
- Conducted a Legislation Gap Analysis
- Supporting initiatives for International Legal Instruments
- Completed the Legal & Regulatory Study contract and now, supporting efforts to table new Bill in Parliament

NUCLEAR LEGAL & REGULATORY STUDY

NEW NUCLEAR LAW

- Drafted new comprehensive nuclear law on safety, security & safeguards;
- Formation of a new effectively independent nuclear regulatory body proposed to be Malaysia Atomic Energy Regulatory Commission (MAERC);
- Proposed repeal of the Atomic Energy Licensing Act (Act 304) of 1984.

NPRIDP

- Formulation of Nuclear Power Regulatory Infrastructure Development Plan (NPRIDP) with a comprehensive, clear short and medium term actions, benchmarked against IAEA's 19 Infrastructure Issues, for comprehensive nuclear regulatory development.

LEGISLATION GAP ANALYSIS

- Assessment of laws & subsidiary laws in Malaysia that may be impacted by the proposed new comprehensive nuclear law.

INTERNATIONAL LEGAL INSTRUMENTS

- Identification of international instruments for Malaysia to be a party to, for international confidence-building in nuclear power development.

SUBSIDIARY REGULATIONS & GUIDELINES

- Drafted subsidiary regulations & subsidiary guidelines for the new law.

NUCLEAR POWER INFRASTRUCTURE DEVELOPMENT PLAN (NPIDP), FEASIBILITY STUDY (FS), SITE EVALUATION (SE) & BID DOCUMENTS (BD)

NPIDP

- Formulation of a Nuclear Power Infrastructure Development Plan (NPIDP) based on a comprehensive assessment of national state-of-preparedness on IAEA 19 Infrastructure Issues;
- Formulation of Public Communications Kick-Start Strategy & 10-Year Road-Map on Nuclear Energy.

FEASIBILITY STUDY

- Detailed technical, financial & economic analysis of the viability of nuclear power as part of national energy mix vis-à-vis other sources;
- Identification and/or establishment of a Special Purpose Vehicle (SPV) nuclear power plant owner/operator & its manpower requirements;
- Assessment of sources & methods of nuclear power project financing;
- Recommendations on possible nuclear reactor technologies, plant size, manpower requirements & other main technical features.

SITE EVALUATION

- Shortlisting & detailed evaluation of nuclear power plant candidate sites in accordance with regulatory requirements & guidelines under new law, with Detailed Environmental, Radiological & Social Impact Assessments (DEIA, RIA & SIA).

BID DOCUMENTS

- Recommendations for bidding & contractual approach to nuclear power project implementation;
- Preparation of bid documents & bid evaluation methodologies to invite potential vendors for nuclear power project implementation.

ASSESSMENT OF SOURCES & METHODS OF PROJECT FINANCING IN THE FEASIBILITY STUDY

Bankability Analysis, Funding Plan & Project Capital Structure

Identification of Potential Financing Sources

Financial Model & Sensitivity Analysis

Risk Assessment & Mitigation Strategies

Potential Fiscal Incentives

Owner/Operator Special Purpose Vehicle (SPV) Structuring Options

NUCLEAR POWER INFRASTRUCTURE DEVELOPMENT PLAN (NPIDP)

Legal Framework & Licensing Process

Human Resource Capability Assessment & Development

Industrial Capability Assessment & Development

Nuclear Power Technological Capability Assessment
& Technology Development Road Map

Public Communication Kick-start Strategy On Nuclear Energy

Self-Assessment of IAEA's 19 Infrastructure Issues

- Nuclear HRD development planning is integrated in a Nuclear Power Infrastructure Development Plan (NPIDP) being formulated by MNPC.
- The current status for the nuclear HRD planning for the NPIDP is the distribution of questionnaires for information gathering on the current status of nuclear-related education in local institutions of higher learning, as well as of Malaysians pursuing nuclear-related education in foreign institutions.

NATIONAL NUCLEAR ENGINEERING HIGHER EDUCATION ROAD-MAP

	MILESTONE 1: June 2009 Ready to make a knowledgeable commitment to a nuclear power programme.	MILESTONE 2: 2015 Ready to invite bids for the first nuclear power plant	MILESTONE 3: 2021 Ready to commission and operate the first nuclear power plant	
PHASE 1: 2008 to June 2009 Considerations before a decision to launch a nuclear power programme is taken	PHASE 2: June 2009 to 2015 Preparatory work for construction of a nuclear power plant after a policy decision has been taken	PHASE 3: 2015 to 2021 Activities to implement a first nuclear power plant	POST-2021: Maintenance and continuous infrastructure improvement	

NUCLEAR ENGINEERING HIGHER EDUCATION DEVELOPMENT ROAD-MAP

Commencement of nuclear energy-related subjects under other engineering courses at local universities.	Commencement of nuclear engineering first degree courses in local universities.	Local graduates in nuclear engineering enter the job market during implementation of first nuclear power project.	Sustained output of local nuclear engineering graduates commensurate with demand.
	Conduct of short-term courses on nuclear engineering for engineering professionals from other engineering disciplines in preparation for nuclear power project management & implementation.	Commencement of nuclear engineering post-graduate courses in local universities for sustainable long-term nuclear power-related research & development.	Sustained nuclear power-related local research & development for long-term requirements.
	Development of teaching staff in nuclear engineering through international cooperation.	Development of teaching staff in nuclear engineering from among local graduates.	Sustained output of teaching staff in nuclear engineering from among local graduates.

TERTIARY EDUCATION OF HIGHER LEARNING

Institution	Number
Public :	
Universities	20
Polytechnics	27
Community Colleges	59
Private :	
Universities	24
University Colleges	21
Branch Campus	5
College	416
Total	572

ENGINEERING PROGRAMMES STUDENTS STATISTICS 2010 (UNIVERSITIES)

	Number
Public Universities:	
Intake	20,609
Enrolment	72,676
Graduates	10,249
Private Universities :	
Intake	5,718
Enrolment	39,529
Graduates	3,681

NUCLEAR SCIENCE & TECHNOLOGY EDUCATION & TRAINING

- **Almost all public universities and some private universities offers science, technology & engineering programs**
- **UKM offers nuclear science undergraduate program since 1978**
- **UTM offers medical physics undergraduate program**
- **USM and UM offer postgraduate programs in medical physics**
- **Others offer nuclear Science & Technology as subject in Engineering, Science & Technology and Medical Courses**

NUCLEAR ENGINEERING EDUCATION & TRAINING

- **UTM started to offer Bachelor of Nuclear Engineering program in 2012. Annual intake of about 30 students**
- **UNITEN offer nuclear engineering elective courses to all engineering students in 2009 and plan to offer Nuclear engineering minor in 2014**
- **UIAM plan to offer Bachelor of Engineering (Nuclear & Radiation) in 2014**
- **UTHM plan to offer Master of Nuclear Engineering in collaboration with Malaysian Nuclear Agency (Nuclear Malaysia) as sister campus**
- **MNA collaborates with all universities in Nuclear Engineering Education**
- **In 2012 Ministry of Higher Education commissioned a study on the Roadmap of Nuclear Engineering Education in Malaysia (not yet finalised)**

NATIONAL NUCLEAR ENGINEERING HIGHER EDUCATION ROAD-MAP IN RELATION TO IAEA PHASED-MILESTONES (*proposed*)

	MILESTONE 1: June 2009 Ready to make a knowledgeable commitment to a nuclear power programme.	MILESTONE 2: 2015 Ready to invite bids for the first nuclear power plant	MILESTONE 3: 2021 Ready to commission and operate the first nuclear power plant	
PHASE 1: 2008 to June 2009 Considerations before a decision to launch a nuclear power programme is taken	PHASE 2: June 2009 to 2015 Preparatory work for construction of a NPP after a policy decision has been taken	PHASE 3: 2015 to 2021 . Activities to implement a first nuclear power plant	POST-2021: Maintenance and continuous infrastructure improvement	
NUCLEAR ENGINEERING HIGHER EDUCATION DEVELOPMENT ROAD-MAP				
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	Development of teaching staff in nuclear engineering through international cooperation.	Development of teaching staff in nuclear engineering from among local graduates.	Sustained output of teaching staff in nuclear engineering from among local graduates.	

UTM'S BACHELOR OF ENGINEERING (NUCLEAR) PROGRAMME

- 4-year undergraduate degree program
- 135 credit hours
- Curriculum developed based of IAEA Guidelines and benchmark against other countries
- Stakeholders are engaged in the curriculum development

		COURSES	CREDIT
Y E A R 1	SEMESTER 1		
	SKPN 1243	Introduction to Nuclear Engineering	3
	SSCE 1693	Engineering Mathematics 1	3
	ULAB 1122	Academic English Skills	2
	UHAS 1172	Malaysian Dynamics	2
	SKPG 1243	Statics	3
	SKPN 1113	Modern Physics	3
	Subtotal		16
	SEMESTER 2		
	SSCE 1993	Engineering Mathematics II	3
SKPG 1263	Material Engineering	3	
SKEU 1**3	Electric Circuits and Signals	3	
UICI 1012	TITAS	2	
SKPU 1123	Fluid Mechanics	3	
UKQ ***1	Co-curriculum I	1	
Subtotal		15	

		COURSES	CREDIT
Y E A R 2	SEMESTER 1		
	SSCE 1793	Differential Equations	3
	SCS* 2**3	Programming for Engineers	3
	SKPP 2133	Dynamics	3
	SKPP 2113	Thermodynamics	3
	SKPU 1711	Fluid Mechanics Lab	1
	ULAB 2122	Advanced Academic English Skills	2
	UICI 2022	Science, Technology and Mankind	2
	Subtotal		17
	SEMESTER 2		
SSCE 2193	Engineering Statistics	3	
SKPN 2213	Nuclear Physics	3	
SKPP 1133	Engineering Drawing	3	
SKPN 3173	Engineering Economics & Project Management	3	
SKEU 2**3	Electronic Circuits	3	
U***2**2#	Generic Development or <u>Globalisation</u>	2	
UKQ ***1	Co-curriculum II	1	
Subtotal		18	

UTM'S BACHELOR OF ENGINEERING (NUCLEAR) PROGRAMME

			SEMESTER 1		
Y E A R 3	SSCE 2393	Numerical Methods		3	
	SKEU 2003	Electrical Technology		3	
	SKPN 3113	Nuclear Radiation Protection		3	
	SKPN 3711	Nuclear Physics Lab		1	
	SKPN 3213	Nuclear Reactor Theory		3	
	ULAB 3162	English for Professional Purposes		2	
	SKPU 2711	Thermodynamics & Mechanics of Material Lab		1	
	Subtotal			16	
				SEMESTER 2	
		SKPN 3223	Control and Instrumentation Engineering		3
	UHAS 3012	Entrepreneurship and Enterprise Development		2	
	SKPN 3253	Nuclear Safety, Regulation and Security		3	
	SKPN 3133	Transport Process		3	
	SKPN 3721	Nuclear Reactor Lab		1	
	SKEU 3741	Electrical and Electronic Laboratory		1	
	SKPN 3233	Radiation Detection and Measurement		3	
	SKPN 3915*	Industrial Training (Compulsory)		5	
Subtotal			21		

		COURSES		CREDIT
		SEMESTER 1		
Y E A R 4	U*** 2**2	General Elective		2
	SKPN 4812	Undergraduate Project I		2
	SKPN 4113	Nuclear Fuel Cycle and Waste Management		3
	SKPN 4123	Nuclear Reactor Materials		3
	SKPN 4133	Analytical Radiochemistry		3
	SKPN 4**3	Elective Nuclear I		3
	SKEU 3751	Control and Instrumentation Laboratory		1
	Subtotal			17
		SEMESTER 2		
	SKPN 4824	Undergraduate Project II		4
	SKPN 4834	Nuclear Engineering System and Design		4
	SKPN 4**3	Elective Nuclear II		3
	SKPN 4**3	Elective Nuclear III		3
	SKPN 4611	Nuclear Engineering Professional Practice		1
Subtotal			15	
Total credits			135	

UNITEN'S NUCLEAR ENGINEERING APPROACH

- Established Centre for Nuclear Energy in 2010 as a one stop centre for all nuclear activities
- Began offering common technical elective course – MEHB513 : Introduction to Nuclear Technology in 2009
 - The main objective is create awareness to engineering students
 - Very popular among students with more than 90 enrolments every semester
 - Contents include projects to promote nuclear energy to public

- Projects - Blogs created by students :
 - <http://nuke4malaysia.com/>
 - <http://lensahati.com/nuke/>
 - <http://www.welovenuclear.blogspot.com/>
 - <http://nukeuniten.blogspot.com/>
 - <http://greenenergygisnuclearenergy.blogspot.com/>



- Projects (Current Semester) –
 - Create a logo and corporate video for MNPC and MNS (Malaysia Nuclear Society)
 - Create a TV and print advertisement for nuclear power in Malaysia



UNITEN'S NUCLEAR ENGINEERING APPROACH

- **Proposed BME (Nuclear Engineering) to be offered in 2014 ?**
- **Maintain all the core BME courses (109 credits)**
- **All elective courses are in nuclear (15 credits)**
 - **Intro to Nuclear Engineering**
 - **Reactor Physics**
 - **Reactor Thermal Hydraulics**
 - **Radiation Safety & Waste Management**
 - **Radiation Detection and Nuclear Instrumentation**
- **Additional 3 credits for Nuclear Safety, Security & Safeguard**
- **Final Year Project related to Nuclear (3 credits)**
- **Total 130 credits (8 semesters)**
- **As interim measure all the above courses are offered as technical electives to all engineering students starting 2013**

NUCLEAR HUMAN RESOURCE KEY CHALLENGES

- **Accreditation of the Bachelor of Engineering (Nuclear) :**
 - **Minimum Academic staff Requirements by Engineering Accreditation Council Malaysia (EAC) ~ 8 staff with degree in Nuclear Engineering & 3 professional engineers in nuclear engineering**
- **Academic staff development**
 - **Nuclear Engineering academic qualifications**
 - **Nuclear industrial experience**
- **Teaching infrastructure development**
 - **Collaborations between universities & Nuclear Malaysia**
- **Marketability of Nuclear Engineering graduates**
 - **In the absence of government “go-nuclear” decision**

The Engineering [Accreditation Council](#) (EAC) is a delegated body by the [Board of Engineers](#) Malaysia as the only recognized accrediting body for engineering degree programmes offered in Malaysia. Membership of the EAC comprises five (5) stakeholders namely, the Board of Engineers (BEM) [5-6 representatives], the [Institution of Engineers](#) Malaysia (IEM) [5-6 representatives], Industry Employers [3-4 representatives], Malaysian Qualification Agency (MQA) [1 representative] and the Public Service Department (JPA) [1 representative].

CHALLENGES

CHALLENGE

POTENTIAL RESOLUTION

Public Acceptance



- Promote public acceptance

- Public opinion survey to identify priority segments & concerns
- Awareness projects
- Transparency in project implementation

International Governance



- Sign/ratify relevant treaties & conventions

- Fast-track process and make government priority
- Include Bilateral 123 Agreement

Regulatory context



- Put in place detailed regulations

- Align to international best practices
- Top-down mandate to accelerate process (table comprehensive Nuclear law in 2014)

Nuclear Plant Site Acquisition



- Acquire approval for plant sites
- Obtain public support in locality

- Public information programme
- Option for localities to bid to host nuclear plants as in Japan & Republic of Korea
- Assess site & Apply for Site License

Construction timeline



- Require best-in-class timeline from vendors

- Negotiate with vendors based on timeline
- Avoid FOAKE

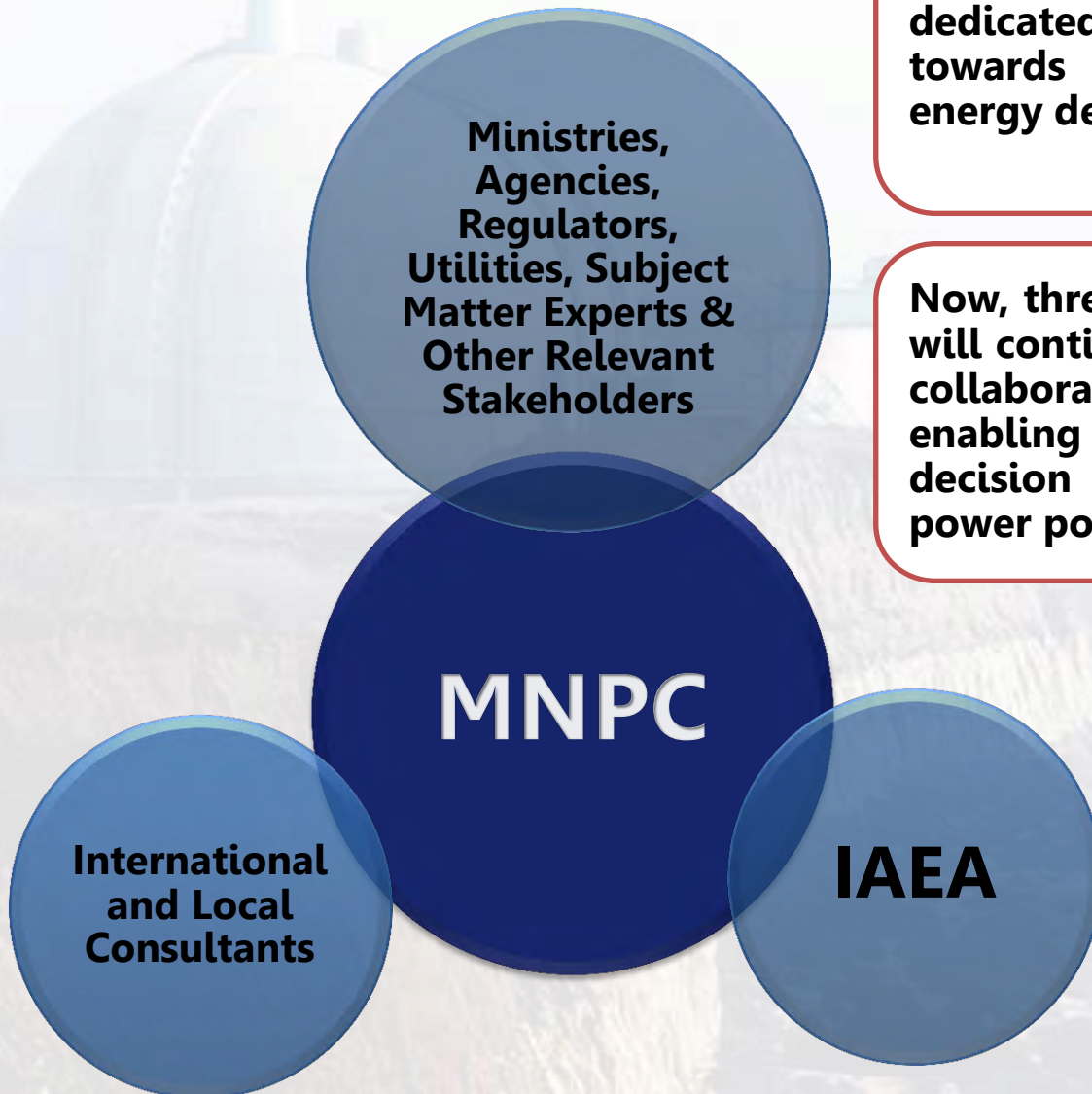
Project Financing



- Obtain low-cost financing

- Combine low-cost & market financing (e.g. sovereign-guaranteed, ECA loans, foreign equity, commercial loans, including Islamic financing)

CONCLUDING REMARKS



The establishment of MNPC as a fully dedicated NEPIO facilitates a focused drive towards the implementation of a nuclear energy development program for Malaysia.

Now, three years after establishment, MNPC will continue to spearhead and coordinate a collaborative national effort towards enabling a well-informed Government decision on the option of using nuclear power post-2020.

Nuclear Power Infrastructure Development Plan (NPIDP) Report which includes HR Development is being prepared by Consultant engaged by MNPC



Thank You

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