

NUCLEAR POWER PROGRAM IN INDONESIA: POTENTIAL AND CHALLENGES

**:IAEA National Workshop on:
Industrial Involvement
Jakarta, 24 – 27 February 2020**

Suparman
Center for Nuclear Energy System Assessment
National Nuclear Energy Agency



- INTRODUCTION
- STATUS OF NPP IN THE WORLD
- PROSPECT AND POTENTIAL OF NUCLEAR ENERGY
- STATUS OF NUCLEAR POWER PROGRAM
- CHALLENGES
- POLICY AND STRATEGY
- FUTURE PLAN

World

- **1956:** NPP (46 MW) put into operation in Calder Hall (Great Britain)
- **1957:** NPP (60 MW) in Shippingport (USA)
- **1969:** NPP in Japan
- **1977:** NPP in South Korea

Russia

- **1954:** the world's first NPP (5 MW) put into operation in Obninsk, Russia



KOREA NPP HISTORY



1970s

Introduction
of Nuclear Power



Construction
of Kori #1 (`71-`78)

1980s

Promotion of
Localization



Establishment of
Localization Plan (`84)

1990s

Technology
Self-reliance



OPR1000
Development (`95)

2000s

Development of
Advanced Reactor

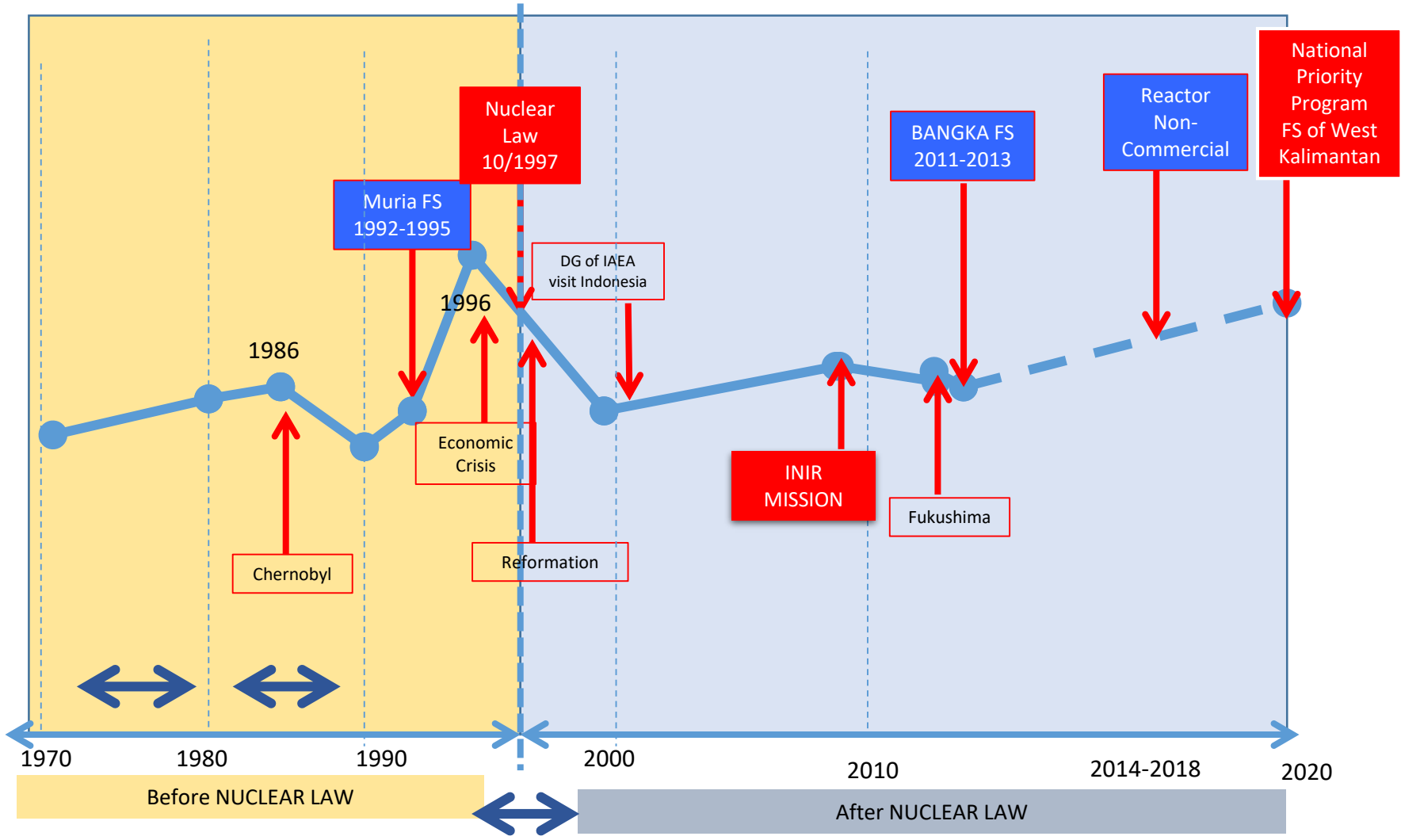


APR1400
Development (`01)

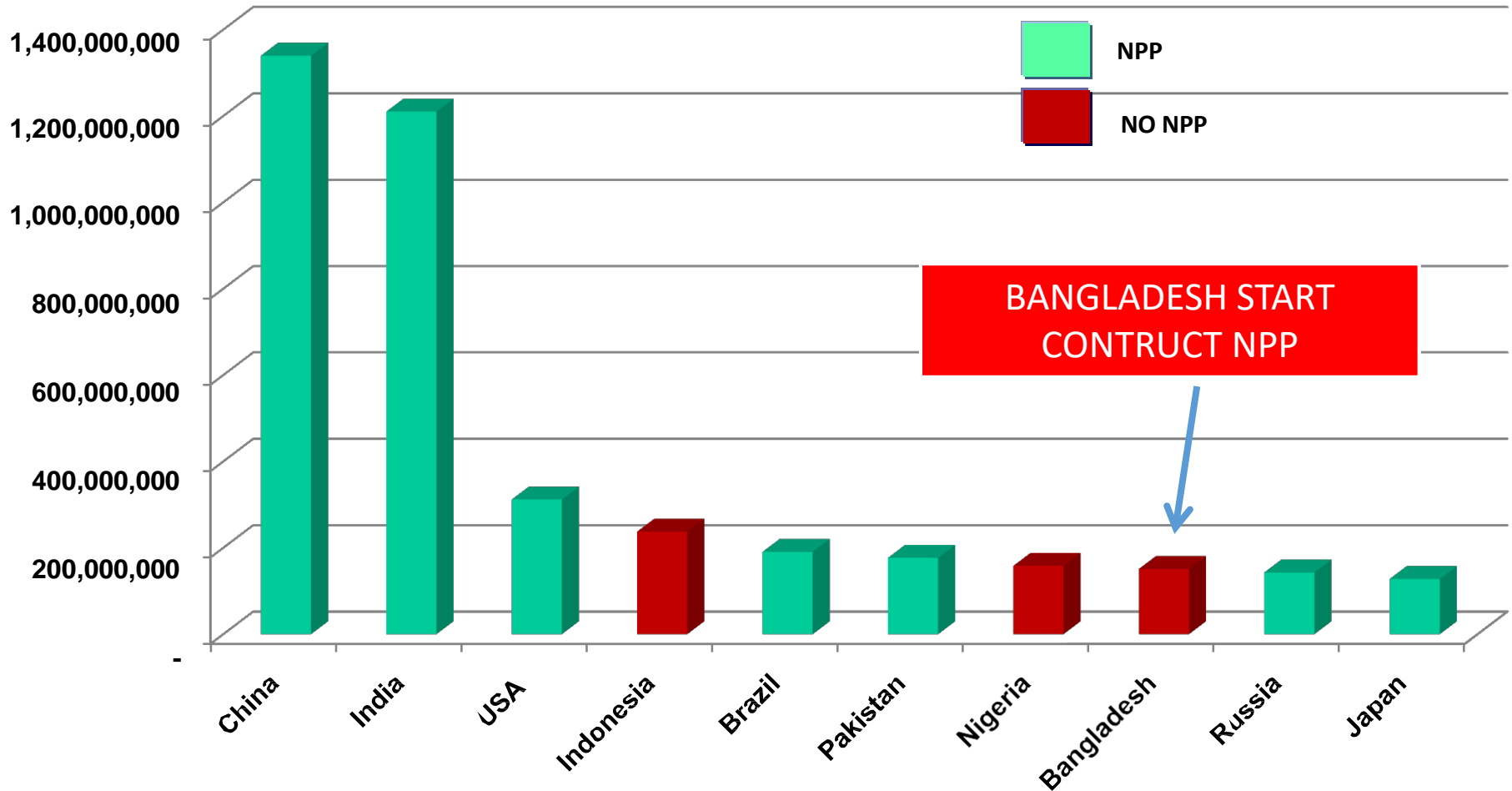
* OPR1000 (Optimized Power Reactor 1,000) is renamed from the former KSNP.

Proprietary DOOSAN

INDONESIA NPP HISTORY



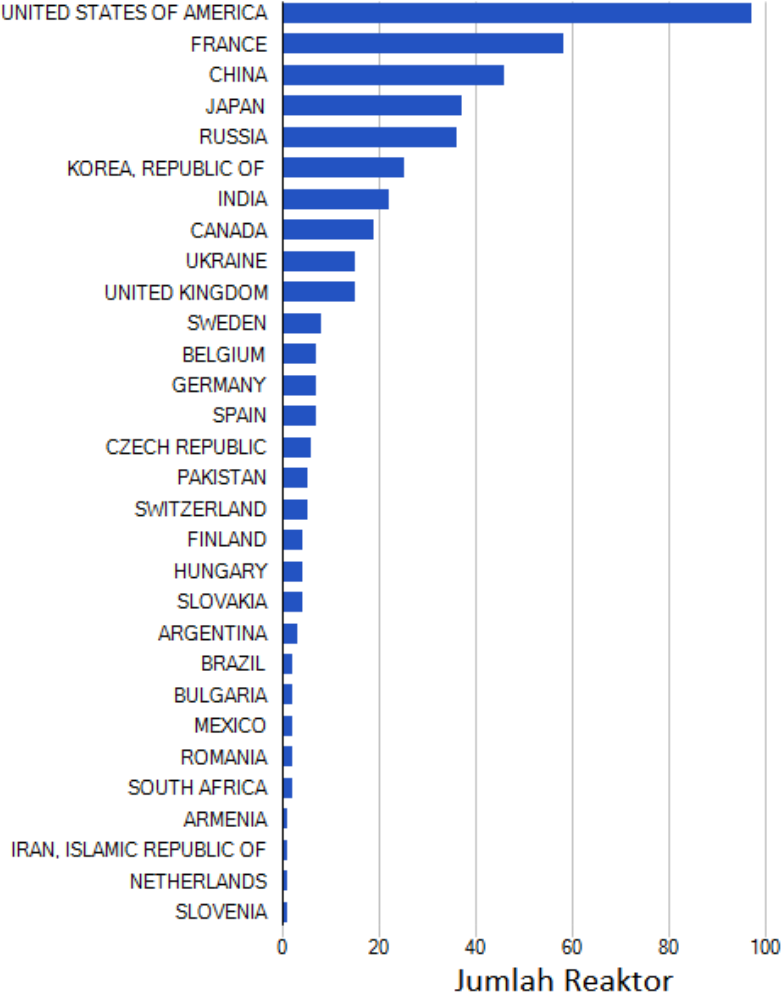
10 DENSELY POPULATED COUNTRY



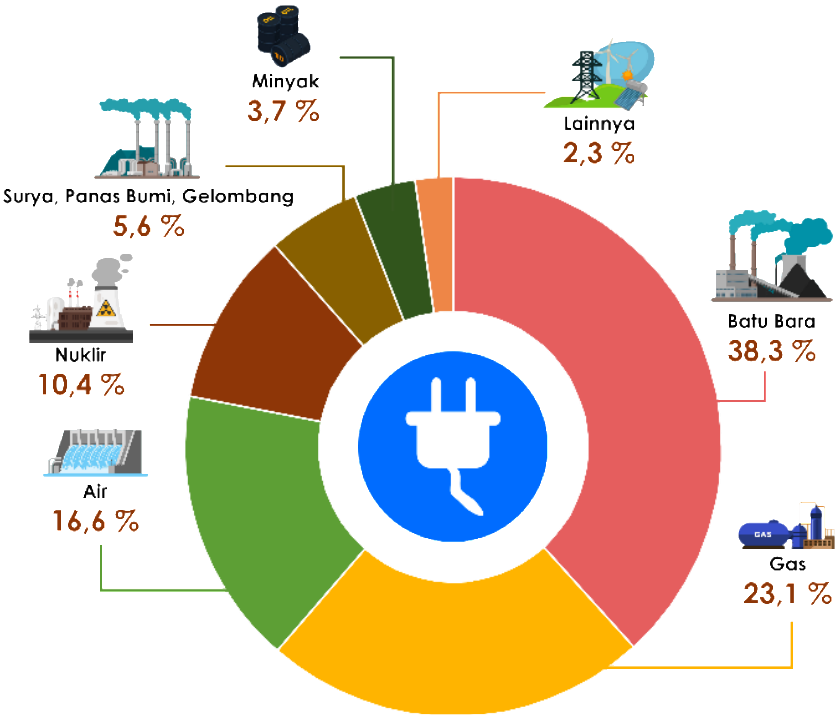
NPP STATUS IN THE WORLD



Jumlah Reaktor: 449 unit

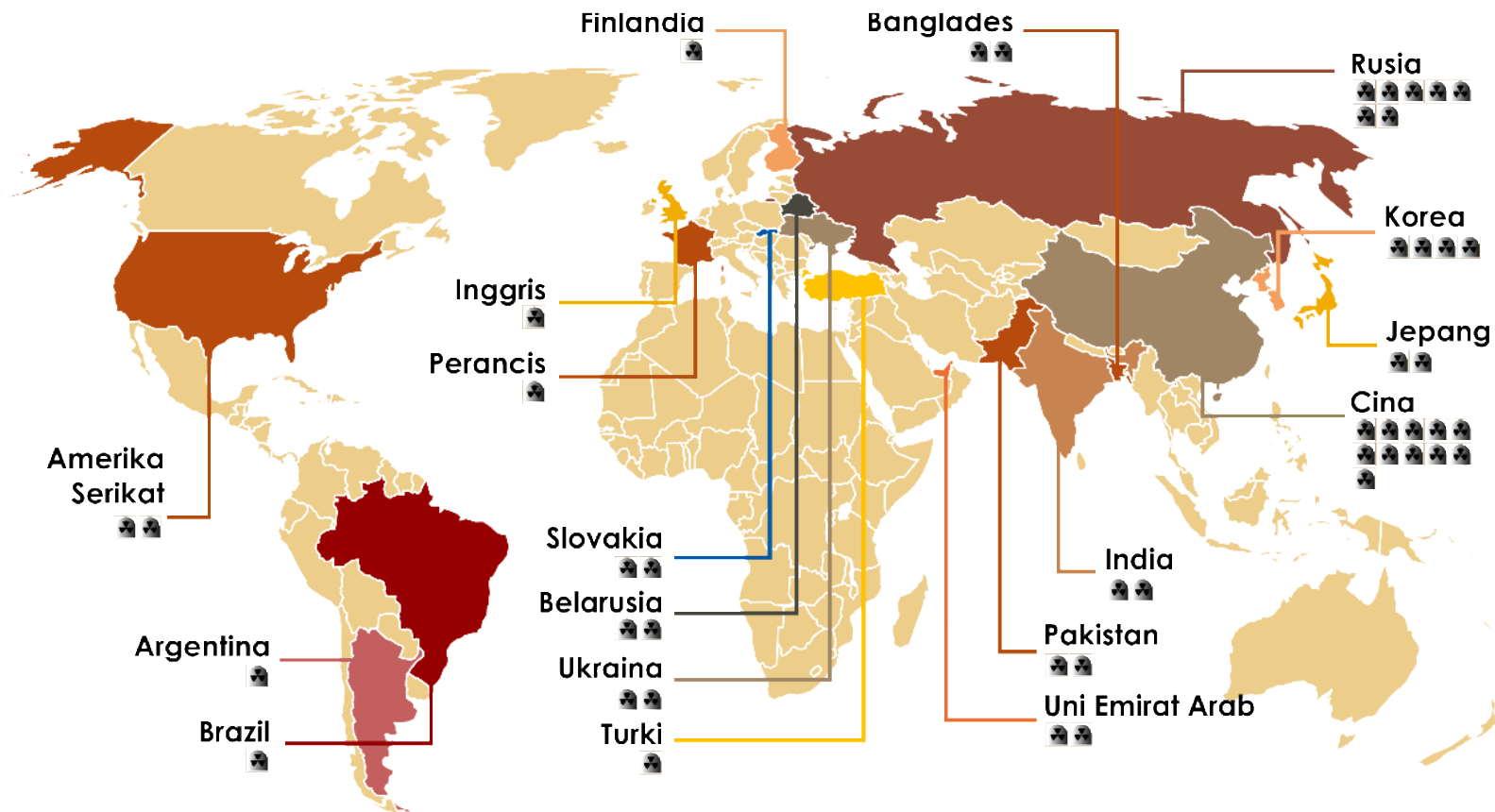


Jumlah Reaktor



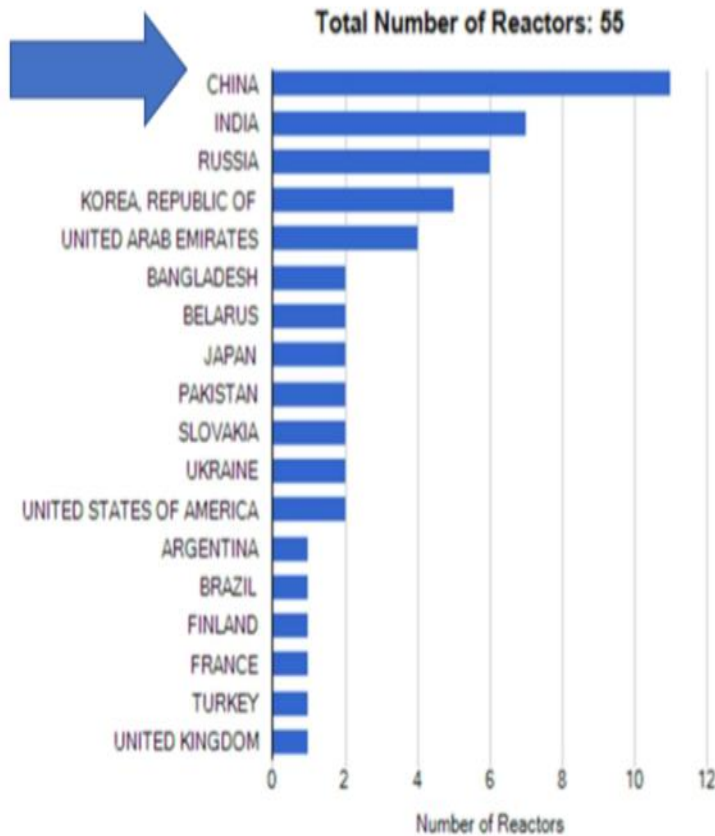
Electricity contribution: 10,4%

UNDER CONSTRUCTION



UNDER CONSTRUCTION

55 nuclear power reactors under construction in 17 countries



Advanced Reactors Newbuild Projects in Embarking Countries – sample:

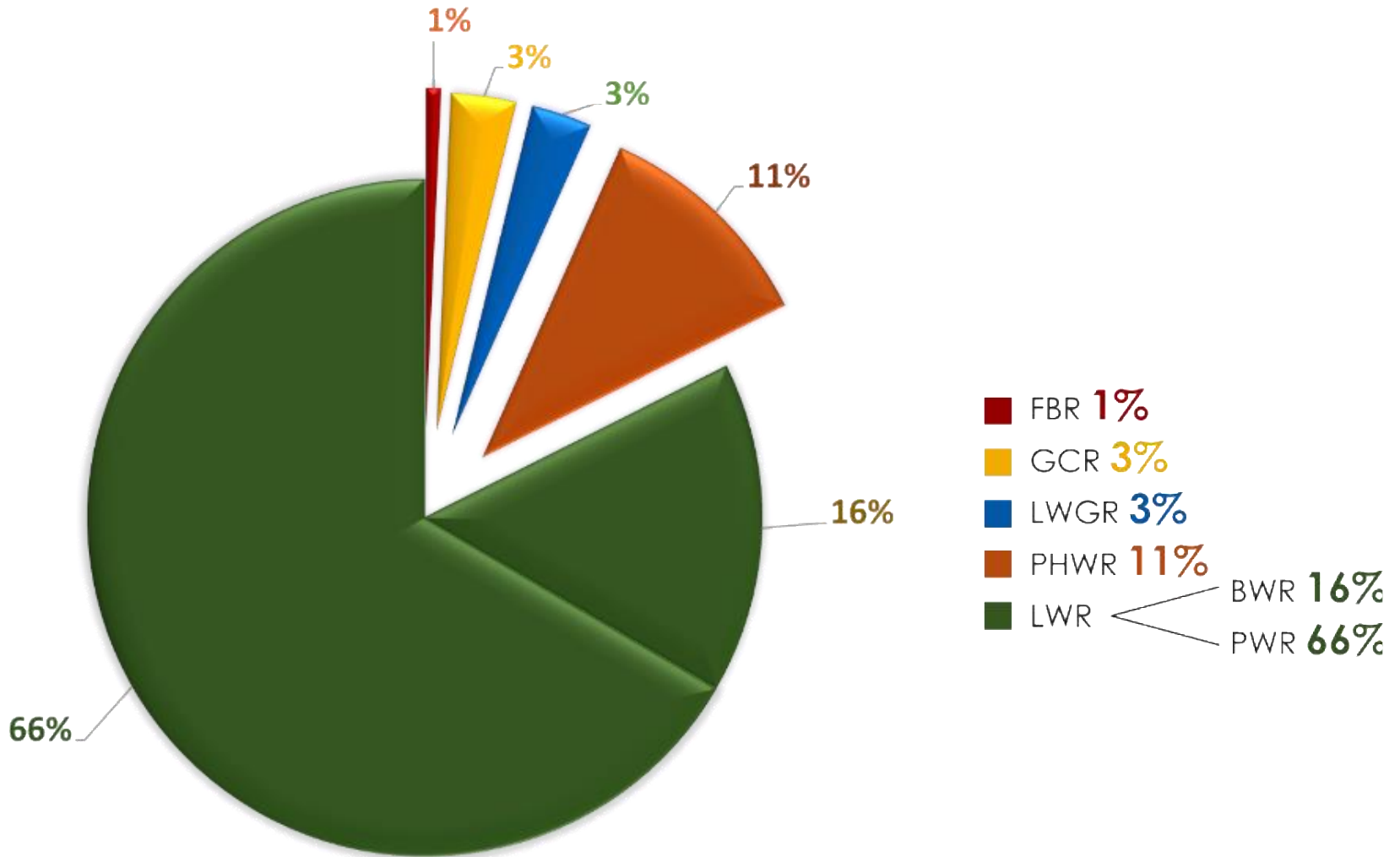
- **UNITED ARAB EMIRATES:** nearly completion of 4 units **APR1400** for Barakah NPP with South Korea
- **BELARUS :** 2 units of **VVER1200** for Ostrovets site with Russian Federation
- **BANGLADESH:** 2 units **VVER1200** for Rooppur NPP with Russian Federation
- **TURKEY:** 2 units of **VVER1200** for Akkuyu NPP with Russian Federation

Next potential embarking countries to build NPP:

- **SAUDI ARABIA:** to invite Bids to vendor countries for the first 2 units, 3 GW(e), targeting 16 GW(e) by 2040
- **EGYPT:** signed agreement with Russian Federation for potential 4 units **VVER1200** for El Dabaa NPP

Source: IAEA Power Reactor Information System (PRIS), 24 April 2019

REACTOR TYPE

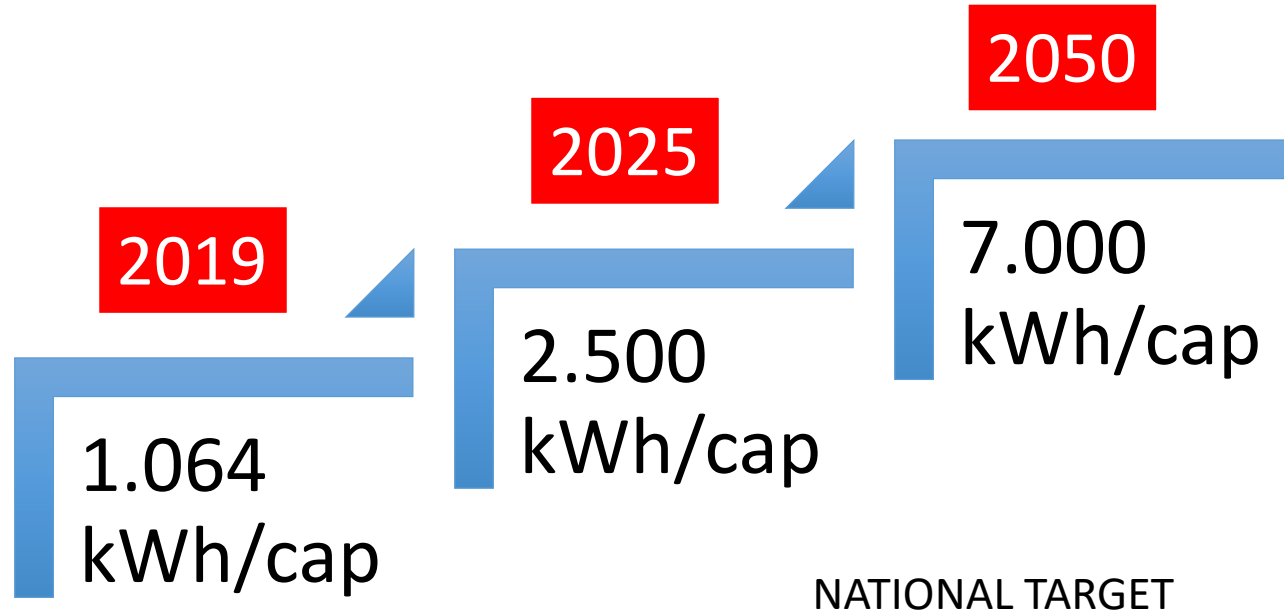


Why we need nuclear?



- Electricity demand increase rapidly
- Economic growth
- The need for a better life
- To support industrialization
- Limited fossil energy resources
- The issue of global warming
- The basic infrastructure (soft and hard) supporting the use of nuclear power plants is largely ready

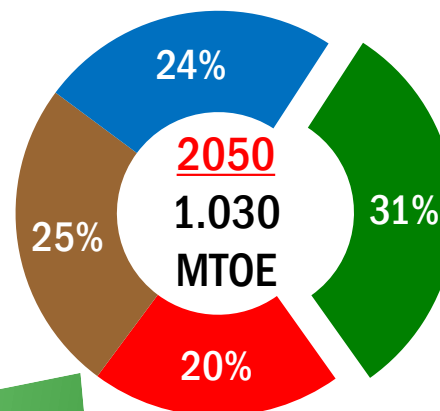
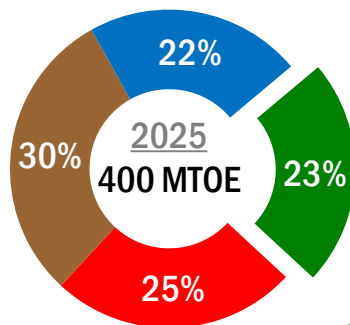
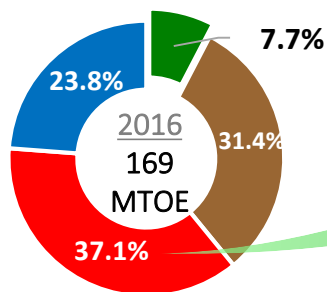
- Electricity per capita: 1064 kWh/cap
- Minimum electricity per capita for developed country: 4.000 kWh/cap



TARGET OF ENERGY MIX



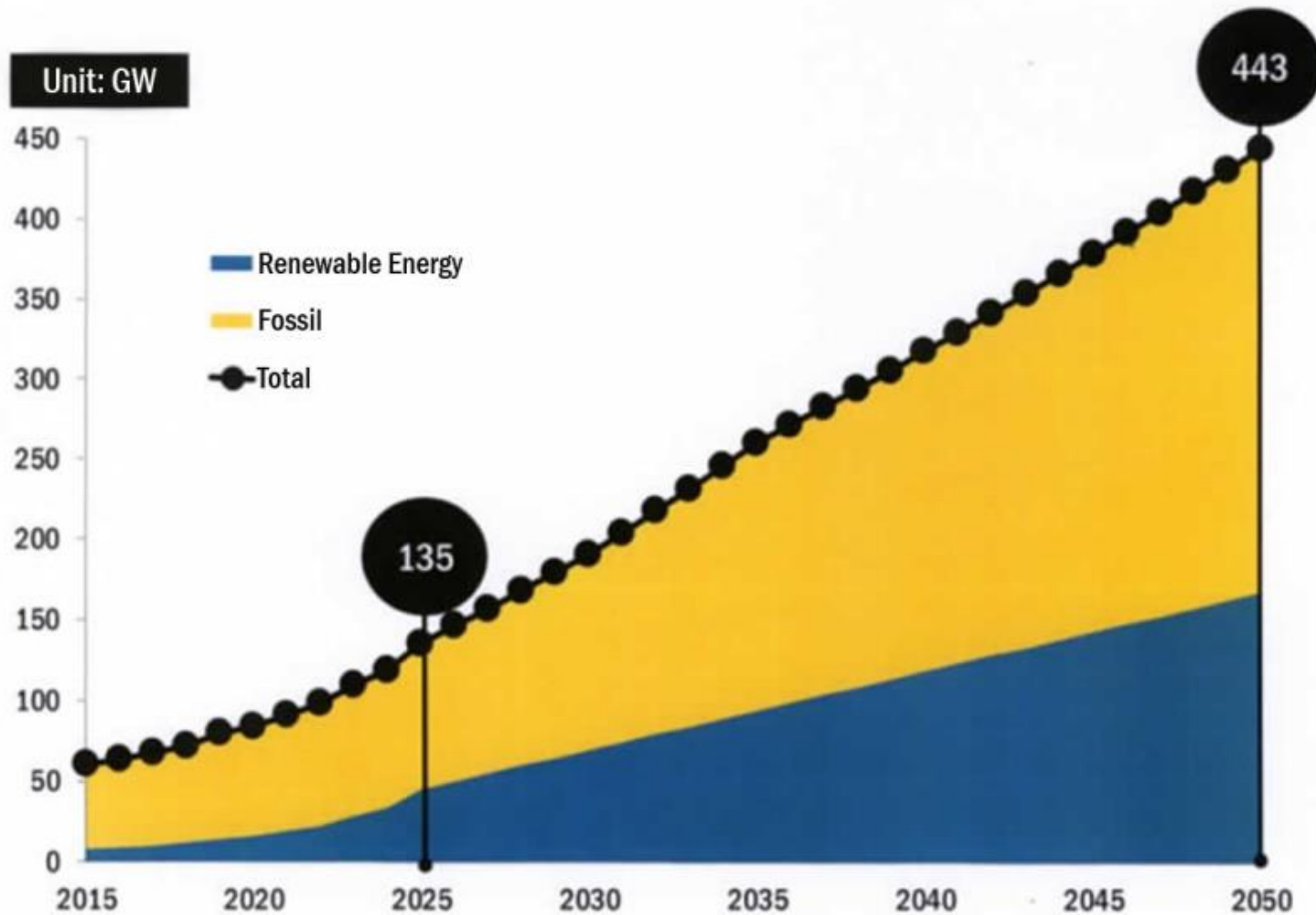
PRESENT CONDITION



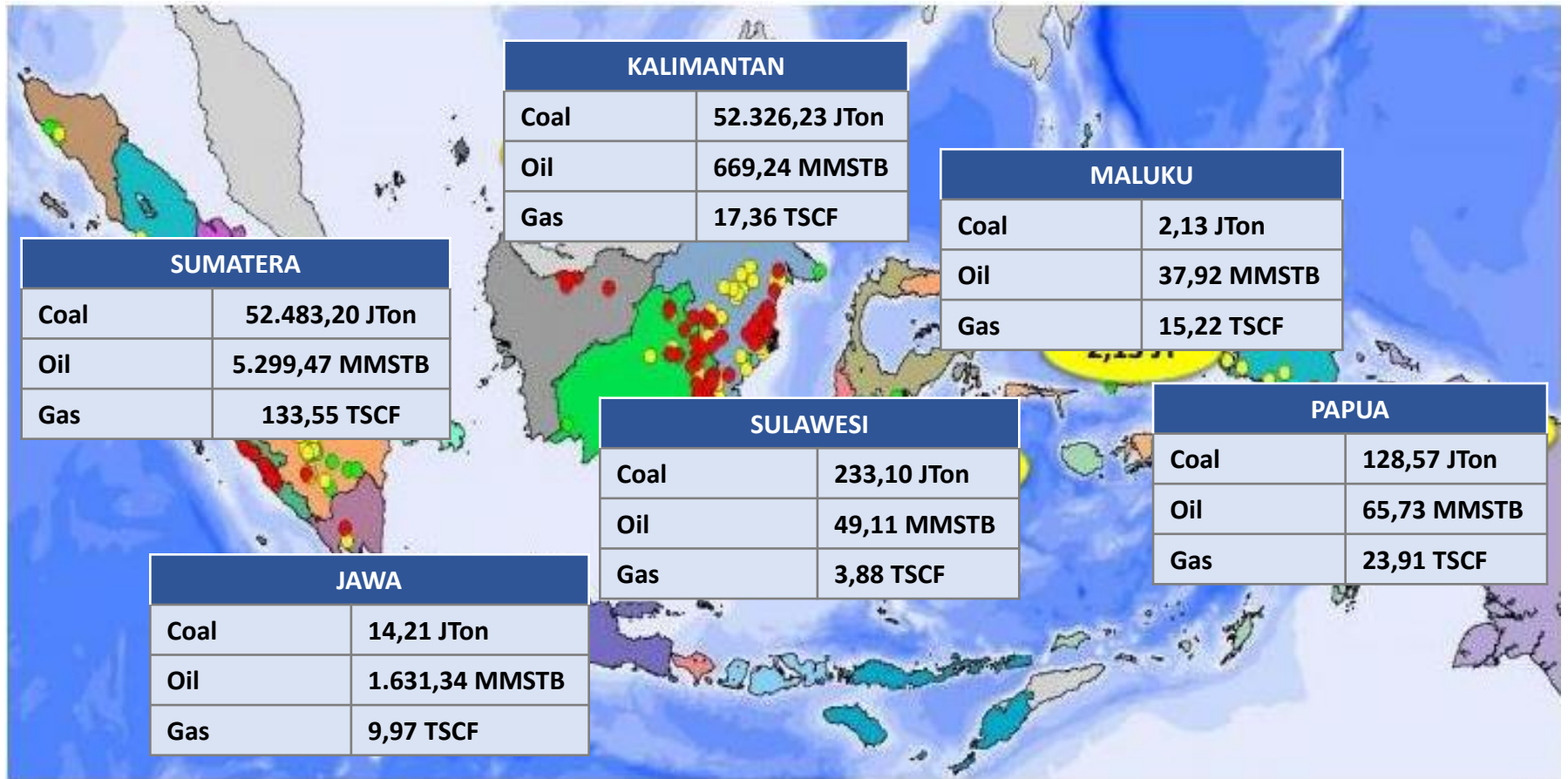
- New and renewable
- Coal
- Oil
- Gas

	2016	2025	2050
Role of energy	Commodity	As development capital	
Renewable mix	7.7%	23%	31%
Energy supply	169 MTOE	400 MTOE	1.021 MTOE
Power plant Capacity	59 GW (EBT 8 GW)	136 GW (EBT > 45 GW)	443 GW (EBT > 167 GW)
Energy elasticity	1	< 1	< 1
Electricity /capita/year	865 kWh	2.500 kWh	7.000 kWh
Electrification Ratio	88%	~100%	~100%

Target of Installed Capacity



FOSIL ENERGY RESOURCES



COAL ~ 50 years, OIL ~ 10-13 years, GAS ~ 30 years

- Indonesia has experiences in build and operate conventional power plants as well as nuclear research reactors:
 - technical personnel,
 - education, training and personnel certifications system,
 - Regulations
- National industry capabilities

- Department of Engineering Physics – Gadjah Mada University: nuclear engineering as major.
- Department of Physics – Bandung Institute of Technology: nuclear engineering as major.
- Nuclear Medical Physics, Department of Physics – University of Indonesia, and other universities.
- Polytechnique Institute of Nuclear Technology – STTN, BATAN.

Consultant	Year	NPP type	Local Content (%)				
			Unit 1&2	Unit 3&4	Unit 5&6	Unit 7&8	Unit 9&10
NewJec	1994	PWR	25	30	35	60	Optimum
MHI-WH	1996	AP600	31	60		-	-
GE	1996	ABWR	26,1	31,4	37,5	60	Optimum
KEPCO	1997	KSNP1000	25	40		60	-
UGM	2004	OPR1000	25	-	-	-	-
KHNP	2006	OPR1000	20	50		70	

National Industry Capability

Condenser



Stationary Blade Rings



LP Outer Casings



Tube's end weld



LP Inner Casings



Generator Casing



Source : PT. Siemens Indonesia
Cilegon Factory

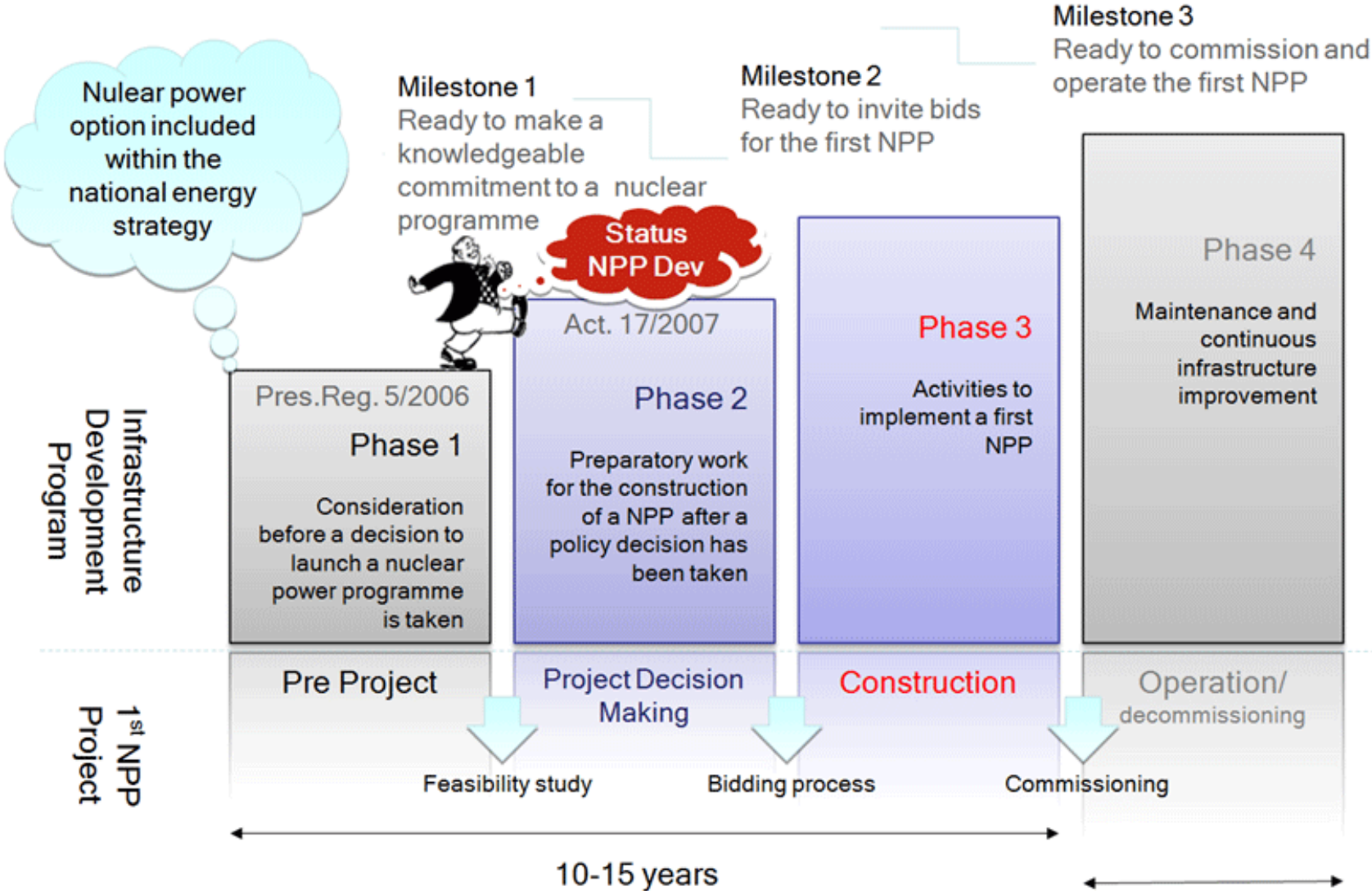
This component for Olkiluoto NPP, Finlandia

Status of National Nuclear Power Infrastructure Development



- BATAN requested the IAEA to perform an **Integrated Nuclear Infrastructure Review (INIR) Mission** under the framework of TC programme (INS/4/037) in a letter dated on 5 August 2009.
- An INIR mission provides an **external peer reviews conducted by the IAEA** in November 23 – 27, 2009
- INIR mission shows that **Indonesia has done extensive preparatory work on most infrastructure issues** that would allow the country to make decision to further consider introduction of nuclear power, i.e. to go from phase 1 to phase 2 in Milestone methodology.

Nuclear infrastructure status



Status of nuclear infrastructure

No.	INFRASTRUCTURE ISSUES	PHASE 1, STATUS
1.	National position	Red
2.	Nuclear Safety	Green
3.	Management	Red
4.	Funding and Financing	Yellow
5.	Legislative Framework	Yellow
6.	Safeguards	Green
7.	Regulatory Framework	Green
8.	Radiation protection	Green
9.	Electrical Grid	Green
10.	Human resources	Green
11.	Stakeholder involvement	Red
12.	Site and supporting facilities	Yellow
13.	Environmental protection	Green
14.	Emergency planning	Green
15.	Security	Green
16.	Nuclear fuel cycle	Green
17.	Radioactive waste	Green
18.	Industrial Involvement	Yellow
19.	Procurement	Green



To be prepared, not available



To be updated/improved



Functional, being implemented, available

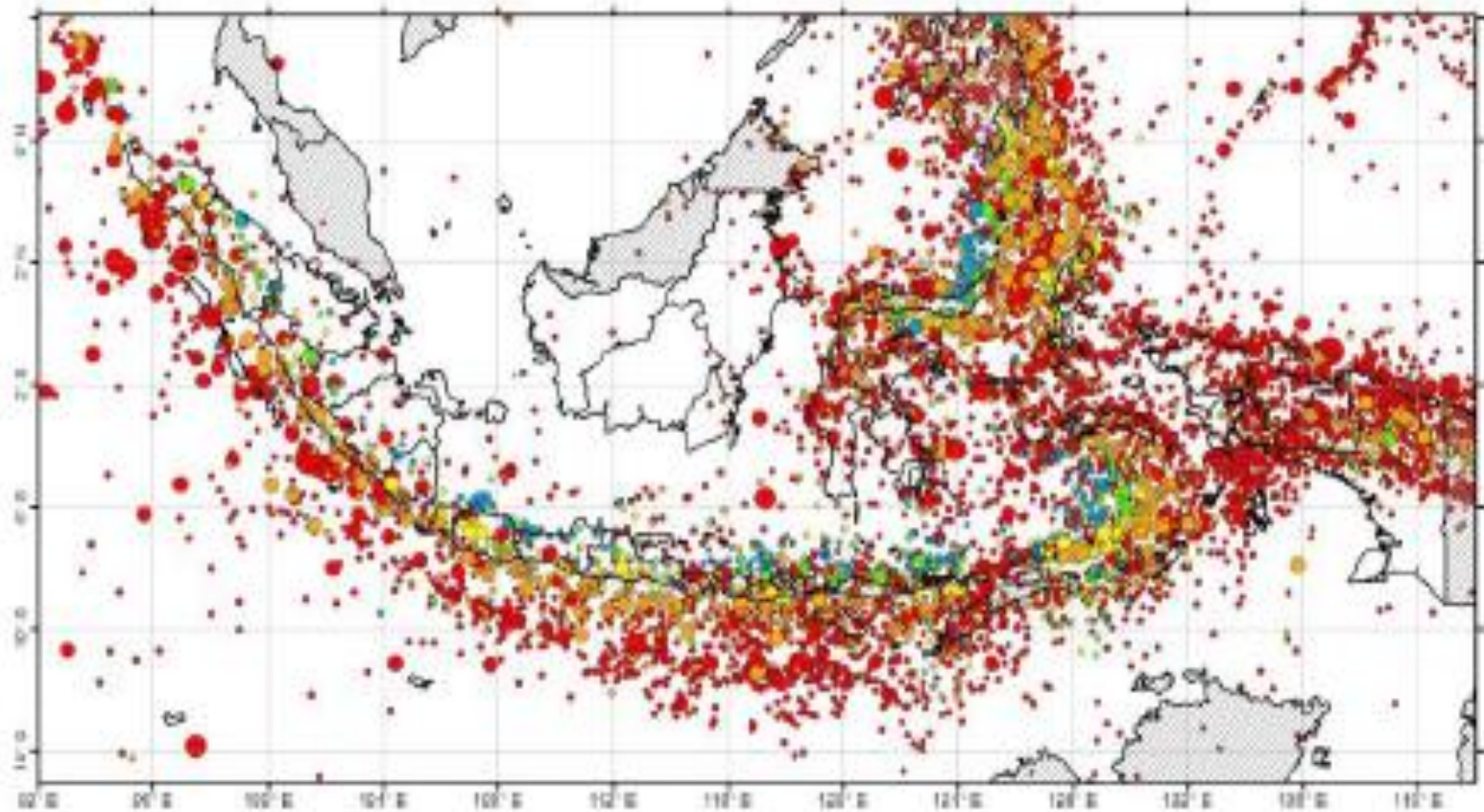
NEPIO not yet established

Site Study for NPP

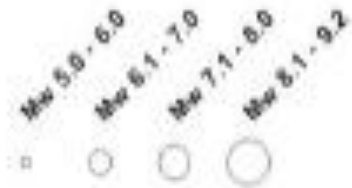
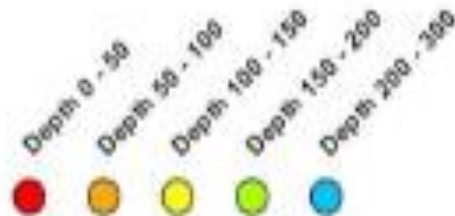


Associated with the preparation of NPP site, there are several locations in Indonesia, which has been identified. The sites are located in the Muria peninsula, Banten, Bangka Island, East Kalimantan, West Kalimantan, Batam and Nusa Tenggara Barat. Bangka candidate site is most ready to be built NPP.

EARTHQUAKE



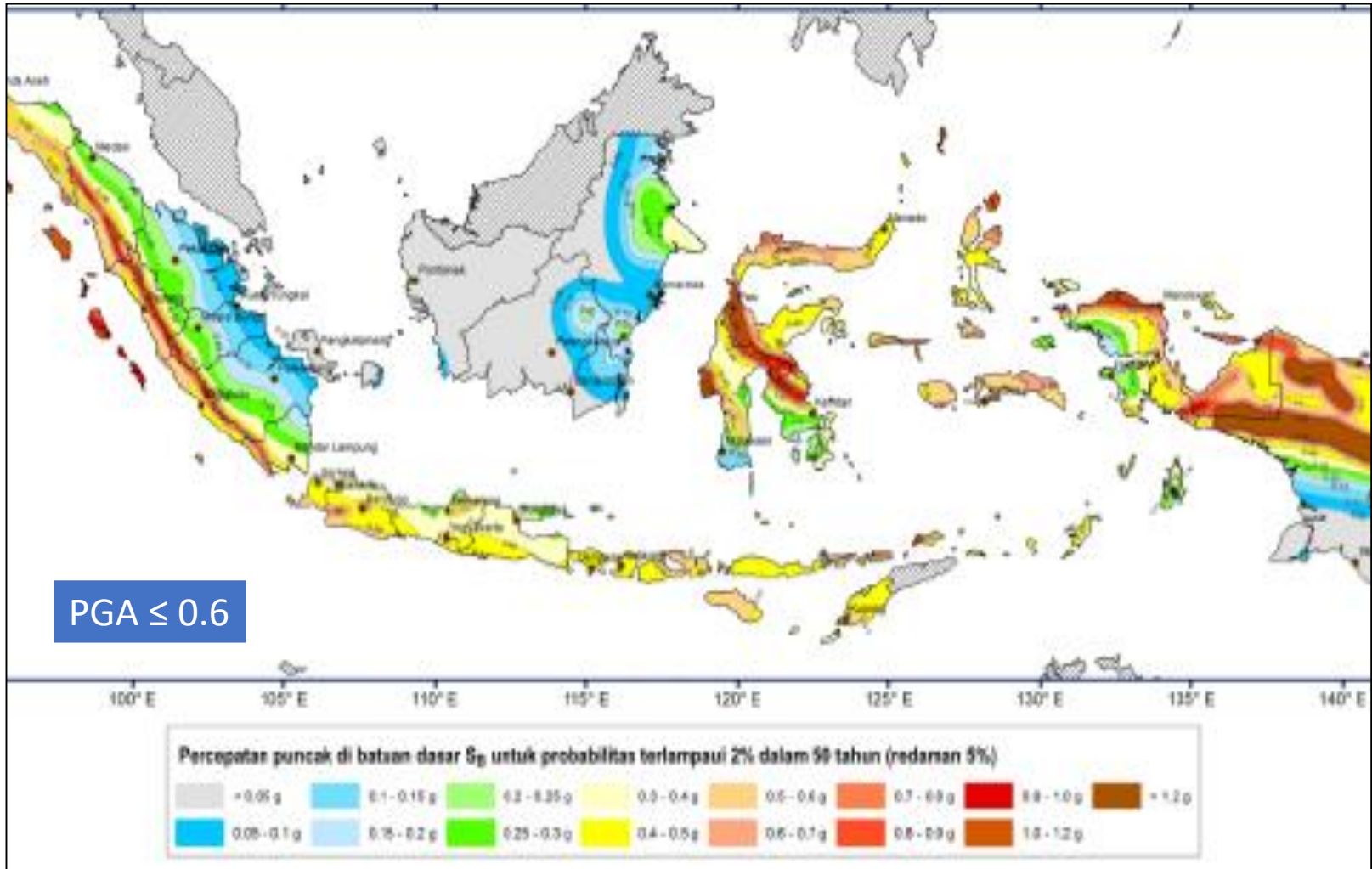
Main shocks



VULCANO



PEAK GROUND ACCELERATION (PGA)



(Masyhur Irsyam, 2010)

- High capital cost of nuclear power plant, less competitive compare conventional power plant
- NPP is **the last option** (Gov. Reg. 79/14)
- NIMBY, NOT IN MY BACKYARD
- NIMET, not in my election territory

Based on the National Energy General Plan, nuclear can be utilized with some criteria such as:

- For fulfilling the needs of growing energy demand by supplying national energy in a large scale
- Reducing carbon emissions
- Economic competitiveness (NPP electricity selling price \leq 7 cent/kWh - the Amount of Cost of Generation Provision (BPP) as basis for Power Purchase Agreement)

PUBLIC ACCEPTANCE ON NPP



- **Annual public opinion** is conducted to measure public acceptance on NPP program;
- The results within **6 years** show **dynamics of acceptance**, especially effected by Fukushima Daiichi accident in **2011**;
- 2016 result showed public confident tends to show **increasing trends** for the last 4 years.

Public Acceptance on NPP Program in Indonesia

Survey period: Nov-Dec 2016
4,000 respondents

77,53%

respondents expressed their **AGREEMENT** to NPP program with the following reasons:



Sustainable Electricity Supply (43,75%)



Lower Electricity Price (41,37%)



Less Emission (19,01%)



Providing employments (new jobs) (35,12%)



National Capability (15,85%)



Technology Transfer (23,90%)



Government Program (14,95%)



Operational Accident Risk (78,10%)
Radioactive Pollution Risk (41,60%)



Radioactive Waste (38,10%)



Human Resources Readiness (21,40%)



Nuclear Proliferation (16,40%)



Other Energy Sources Alternative (15,90%)



High Construction Cost (10,40%)

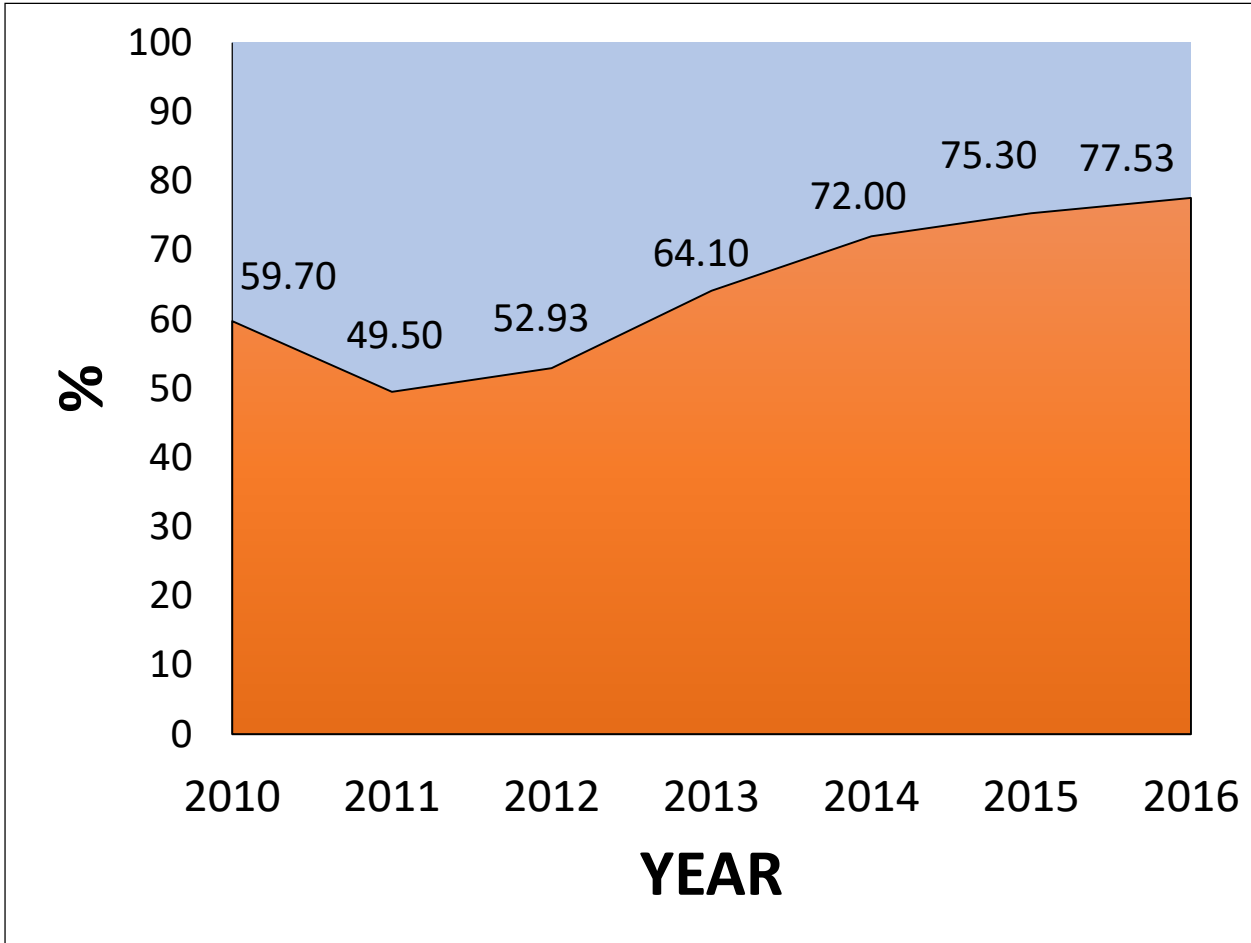
22,47%

expressed their **REFUSAL** to NPP program with the following reasons:

Polling was conducted involving 4.000 respondents, in 34 Provinces nation wide



NOT IN MY BACK YARD (NYMBY)



Site Candidate
Bangka Belitung

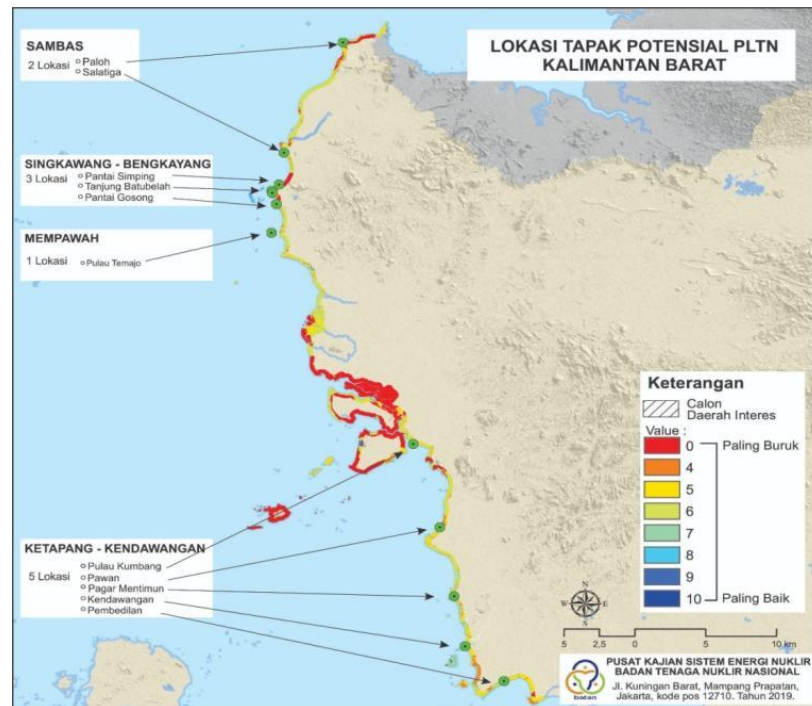
Year	Agree (%)
2011	35
2012	28
2013	42.3
2014	56.5

1. To encourage the local Government **to speak out** more strongly on the need of nuclear energy.
 - East Kalimantan
 - **West Kalimantan**
 - Bangka-Belitung
 - Batam island
 - West Nusa Tenggara
2. To support the Ministry of Energy and Mineral Resources on the **establishment of nuclear energy roadmap**.

3. BATAN's role as promoting organization, **technical supporting organization (TSO)**, and **clearing house**.
4. In cooperation with other stakeholders to initiate the action program on the social, culture, and politics issues.

FUTURE PLAN

- National Priority Research Grant, title: PROTOTYPE OF COMMERCIAL SCALE SMR
- Site: West Kalimantan

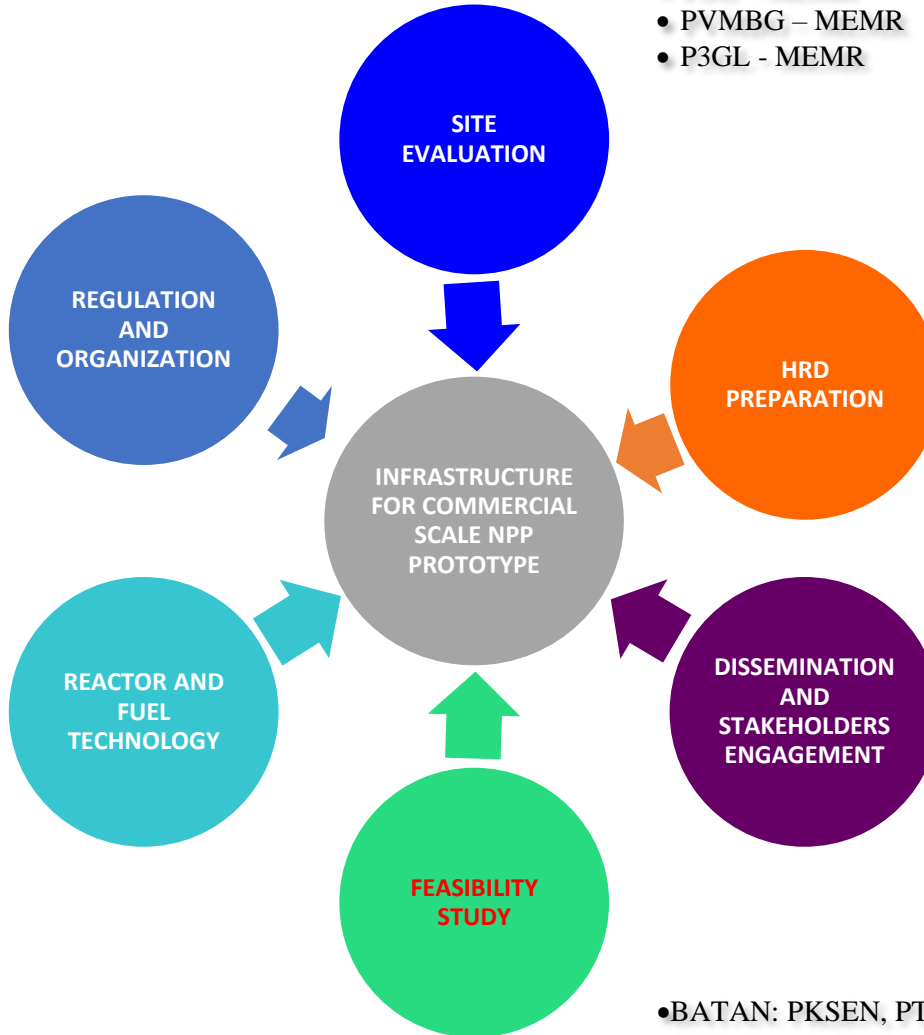


COLLABORATION SCHEME

- BATAN: PKSEN, PTKRN, PTKMR, PPIKSN
- BAPETEN
- BMKG
- PSG – MEMR
- PVMBG – MEMR
- P3GL - MEMR



- BATAN: BHHK
- BAPETEN



- BATAN: PTKRN, PRFN, PTBBN, PTBGN, PTLR, PSMN
- BPPT
- BAPETEN
- INDUSTRY

- BATAN: Pusdiklat, STTN, BSDMO
- UGM, ITB, UNTAN
- West Kalimantan Government

- BATAN: PDK
- West Kalimantan Government
- UNTAN
- LIPI

- BATAN: PKSEN, PTKRN
- PT Indonesia Power
- UGM, ITB, UNTAN
- West Kalimantan Government

- a) To asses NPP technology development on economic and safety aspects
 - a) Encouraging mastery of nuclear power technology in line with the latest developments in nuclear power technology developments in the world
 - b) Building international cooperation related to the study of nuclear power plant development
- Ministry of Research, Technology and Higher Education/BATAN
 - Ministry of Research, Technology and Higher Education/BATAN
 - Ministry of Energy and Mineral Resources

- a) Conduct a multi-criteria analysis of nuclear power plant implementation including: balance of energy supply, reduction of carbon emissions, safety factors and economical aspects by involving various stakeholders
 - b) Prepare a roadmap for nuclear power plant implementation as the last option in national energy development priorities
- Ministry of Energy and Mineral Resources
 - Ministry of Energy and Mineral Resources

The background of the slide is a photograph of a nuclear power plant with two large domes, situated on a beach next to the ocean. The sky is clear and blue. In the bottom left corner, there is a decorative graphic of green bushes and pink flowers.

Terimakasih