Nationally Appropriate Mitigation Actions (NAMAs)
National Integrated Process - Energy Sectors

PECC at 30: New Vision for APEC and Toward Further Regional Economic Cooperation
The 19th PECC GENERAL MEETING
20-22 October 2010, Hotel Okura, Tokyo, Japan

Fourth Session: Climate Change, 21 October 2010

Dr. Hardiv H. Situmeang - Chairman KNI-WEC

Article 3.4 of the Convention

The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programmes, taking into account that economic development is essential for adopting measures to address climate change.

Integration of Climate Change Program into National Development Plan (Programmes)

NATIONALLY APPROPRIATE MITIGATION ACTIONS IN DEVELOPING COUNTRIES

[Its Categories]

Category	Interpretation
1. Unilateral NAMAs	Undertaken by Developing Country Parties by their own: voluntarily, self financing.
2. Supported NAMAs	Supported by direct finance from Developed Country Parties. This agreed emission reductions cannot be used as an offset by Developed Country Parties to fulfill their commitment for their emission reductions.
3. Credited NAMAs	Additional Mitigation actions in Developing Country Parties which can generate credits, and can be used as an offset by Developed Country Parties to fulfill their emission reductions commitment through carbon market or non-market instruments. For instances: (i) Carbon market, such as sectoral crediting, (ii) Non market instrument, such as bilateral arragement.

NATIONALLY APPROPRIATE MITIGATION ACTIONS IN DEVELOPING COUNTRIES

[Indonesia Case]

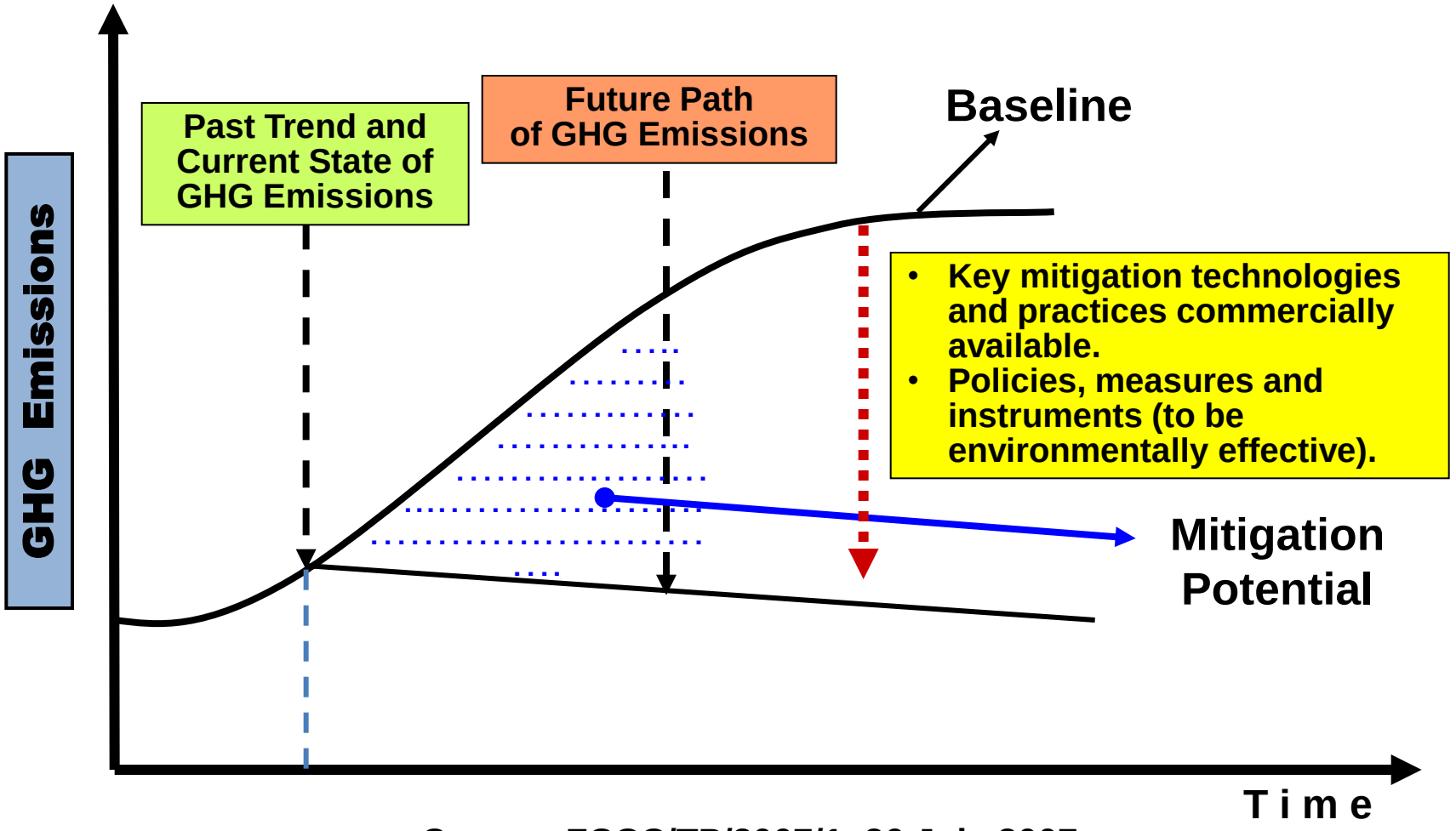
Category	Remarks
1. **Unilateral NAMAs**	Voluntarily, Self financing: 26 % from the National Baseline (Letter 30 January 2010).
2. **Supported NAMAs**	Can be increased up to 41% with International Support (G20 Meeting in Pittsburgh, 2009).
3. **Credited NAMAs** (***These potential possibility need to be confirmed further***)	Additional National Mitigation actions which can generate credits, and can be used as an offset by Developed Country Parties to fulfill their emission reductions commitment through carbon market or non-market instruments. For instances: (i) Carbon market, such as sectoral crediting, (ii) Non market instrument, such as bilateral arragement.

Indonesia Voluntary Mitigation Actions

[Letter to Executive Secretary UNFCCC - 30 January 2010]

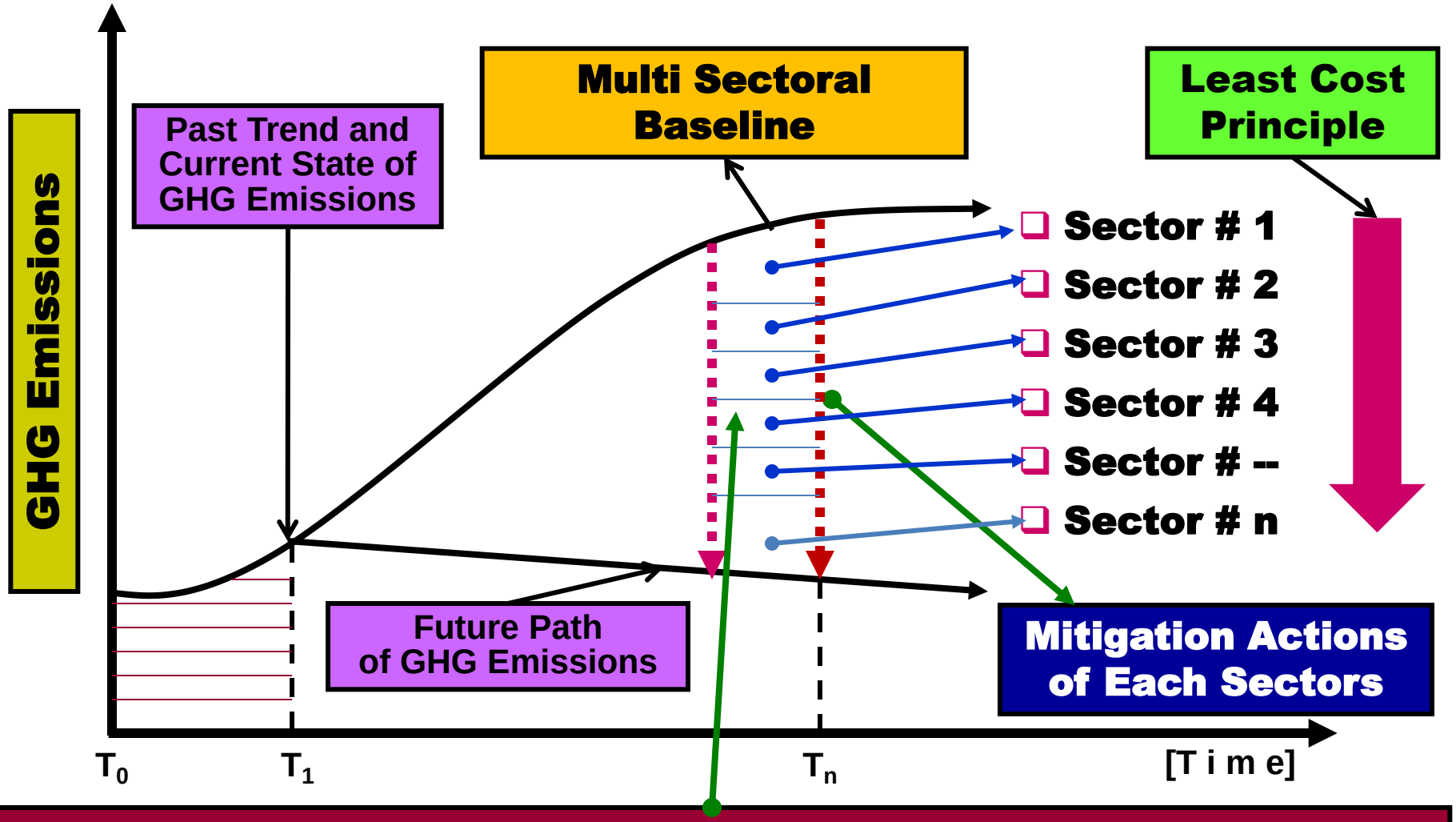
Nationally Appropriate Mitigation Actions	Emission Reduction
The Reduction will be achieved, inter alia, through the following action: 1. Sustainable Peat Land Management 2. Reduction in Rate of Deforestation and Land Degradation 3. Development of Carbon Sequestration Projects in Forestry and Agriculture 4. Promotion of Energy Efficiency 5. Development of Alternative and Renewable Energy Sources 6. Reduction in Solid and Liquid Waste 7. Shifting to Low-Emission Transportation Mode	26 % by 2020

Mitigation Potential for a Specific Period of Time

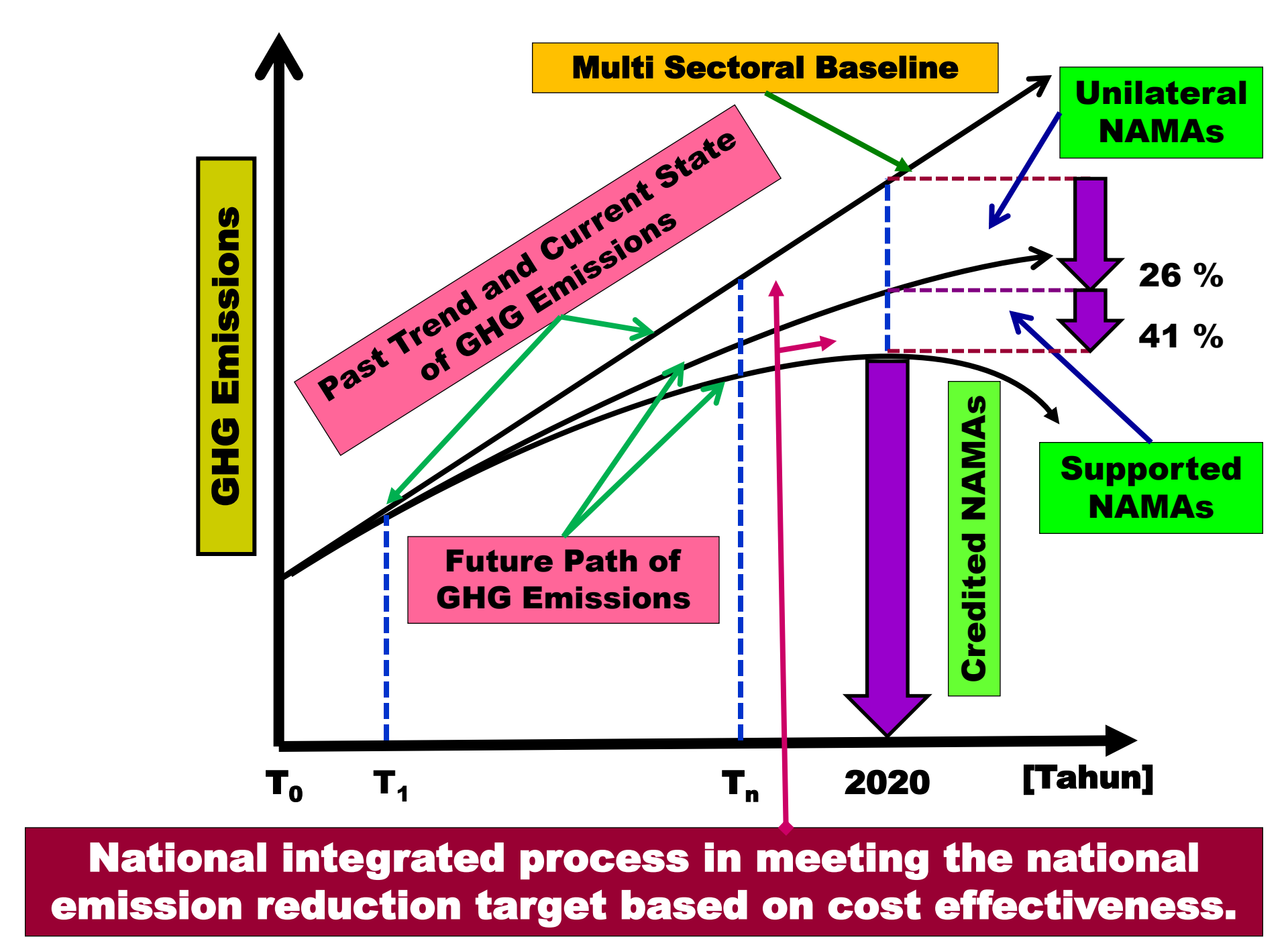


Source: FCCC/TP/2007/1, 26 July 2007.

Future Path of GHG Emissions Reduction
(Multi Sectoral Mitigation Actions)



National integrated process in meeting the national emission reduction target based on cost effectiveness.



National integrated process in meeting the national emission reduction target based on cost effectiveness.

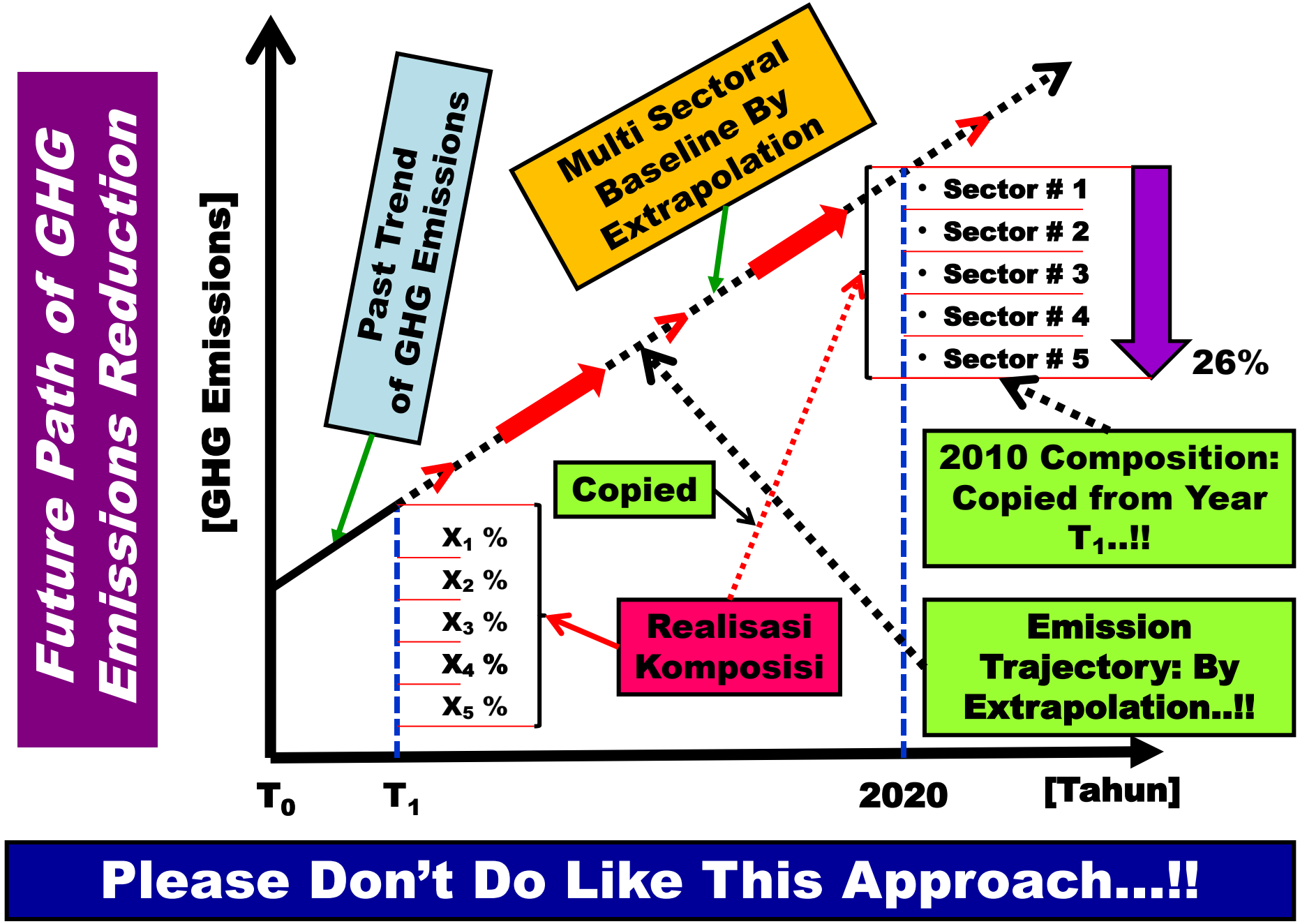
Baseline

A baseline scenario is a plausible and consistent description of how a system might evolve into the future in the absence of explicit new GHG mitigation policies. Baseline scenarios are the counterfactual situations against which mitigation policies and measures will be evaluated.

The baseline is the reference for measurable quantities from which an alternative outcome can be measured, e.g. a non-intervention scenario is used as a reference in the analysis of intervention scenarios which may reflect business-as-usual (BAU) developement, in which the emission reductions are the difference between the baseline and actual performance.

(Example)

A long-term simulation such as, optimization with taking into account uncertainties (probabilistic approach) and others key constraints needs to be done, i.e. particularly in power sector, since its composition should be based on least cost principle which is reflected in the objective function.


Future Path of GHG Emissions Reduction
[GHG Emissions]
Past Trend of GHG Emissions
Multi Sectoral Baseline By Extrapolation
• Sector # 1
• Sector # 2
• Sector # 3
• Sector # 4
• Sector # 5
26%
2010 Composition: Copied from Year T_1..!!
Copied
X_1 %
X_2 %
X_3 %
X_4 %
X_5 %
Realisasi Komposisi
Emission Trajectory: By Extrapolation..!!
T_0
T_1
2020
[Tahun]
Please Don't Do Like This Approach...!!

Future Path of GHG Emissions Reduction

(frequently asked questions)

- BAU is a multi sectoral baseline?
- How to establish a national baseline?
- Base year?
- Identification of potential mitigation actions of each sectors?
- Basis to calculate its emission reductions.
- Selection of mitigation actions of each sectors in meeting the national emission reduction target based on cost effectiveness?
- Estimation of its financing needs and its financing schemes if multi financings are required.
- Is there any external benefits? For instance: Non-GHG benefits. How to determine?
- Development of associated indicators.
- How to establish carbon budget for each sectors?
- Establishment of national emission reduction path, proposed required policies, measures and instruments.
- Required institutions and its national processes.
- Associated MRV: development of National MRV System.

MATRIX OF MITIGATION ACTIONS - Example

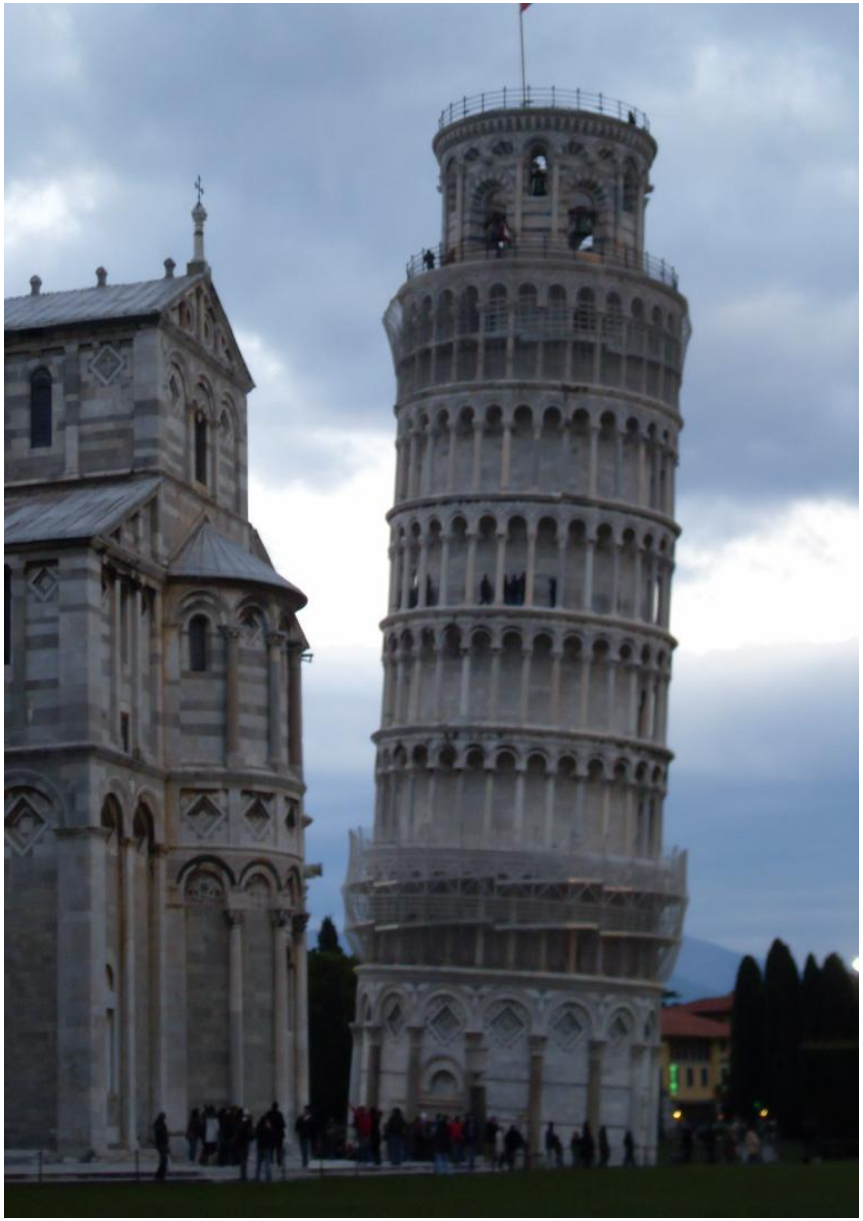
No	Mitigation Actions Scenario xx% Emissions Reduction	Total Mitigation Cost [US$]	Emissions Reduction [Mt CO_2]	Abatement Cost [US$/t$CO_2$]	Required Policy Measures and Instruments	Required Coordination with Sector
1	---xxx---				---zz---	---oo---
2	---xxx---				---zz---	---oo---
(N-1)	---xxx---				---zz---	---oo---
N	---xxx---				---zz---	---oo---
TOTAL		xx,xxx,xxx	x,xxx,xxx	xx.xx	As above	As above

Resume Mitigation Action of Each Scenarios

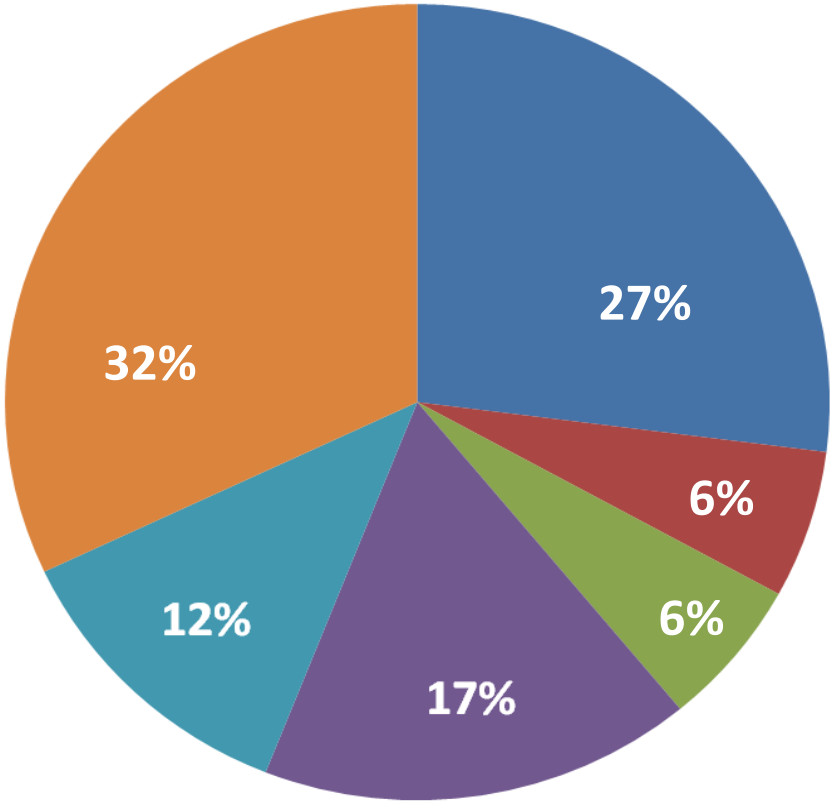
No	Scenarios	Total Mitigation Cost [US$]	Total Emissions Reduction [Mt CO_2]	Abatement Cost [US$/t$CO_2$]	Required Policy Measures and Instruments	Required Coordination with Sector
1	10% Emissions Reduction	xxx,xxx,xxx	xx,xxx,xxx	xx.xx	As proposed	As proposed
2	15% Emissions Reduction	xxx,xxx,xxx	xx,xxx,xxx	xx.xx	As proposed	As proposed
3	20% Emissions Reduction	xxx,xxx,xxx	xx,xxx,xxx	xx.xx	As proposed	As proposed

Future Path of GHG Emissions Reduction

LONG-TERM SIMULATION GHG EMISSIONS REDUCTION OF ENERGY SECTORS



GLOBAL ENERGY RELATED CO_2 EMISSIONS 2005



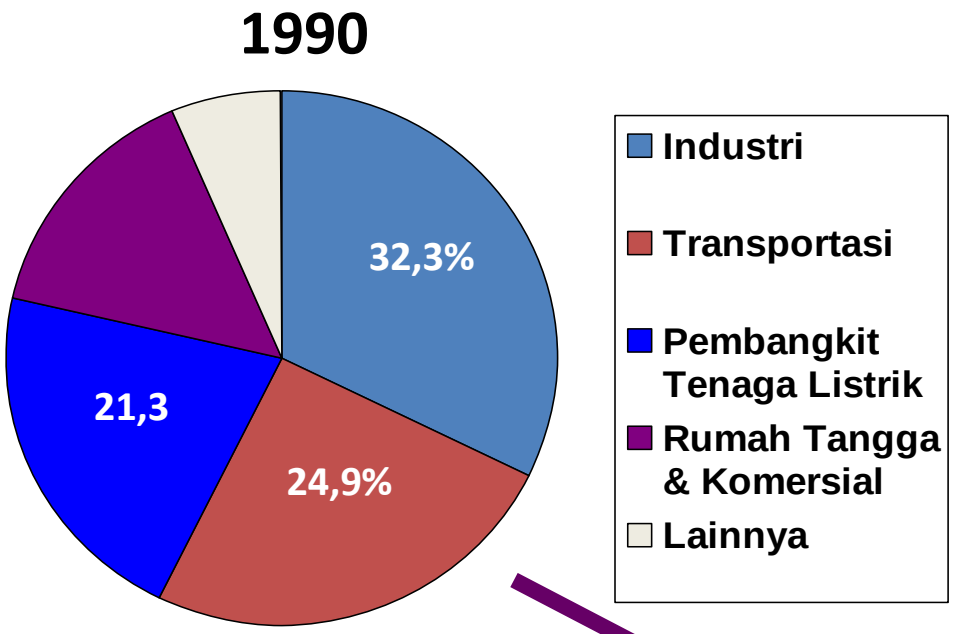
Total 2005 : 27.1 Gt.

- Coal Fired Power
- Iron and Steel
- Cement
- Automobile
- Residential/Commercial
- Others

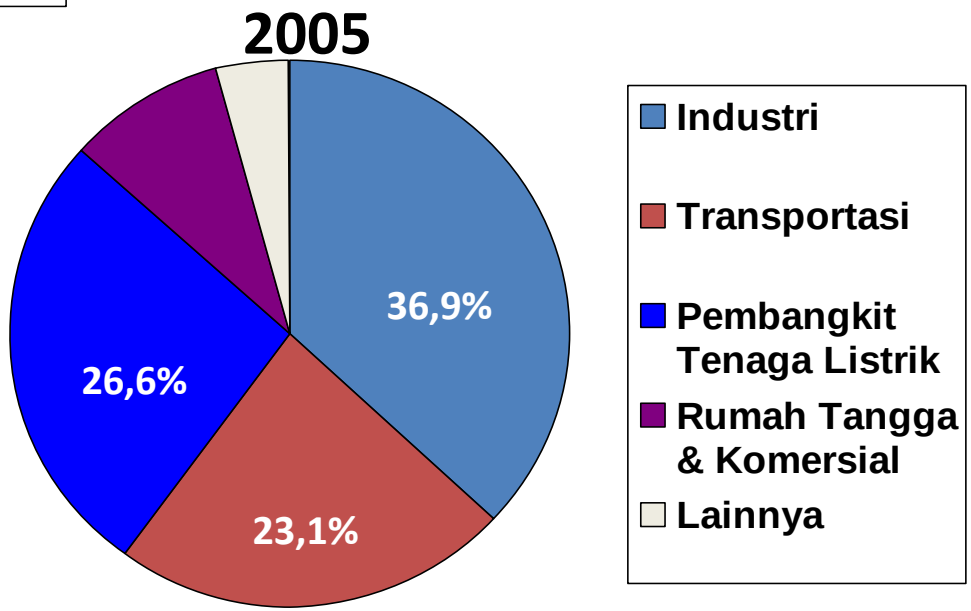
Source: IEA

→ Power: Coal-Fired Power Generation (70% of power sector emissions)
→ Industry: Steel, Cement (50% of industrial sector emissions)
→ Transportation: Road Transportation (70 % of transport sector emissions)

CO_2 EMISSION BY SECTOR



Total: 113.72 Mt

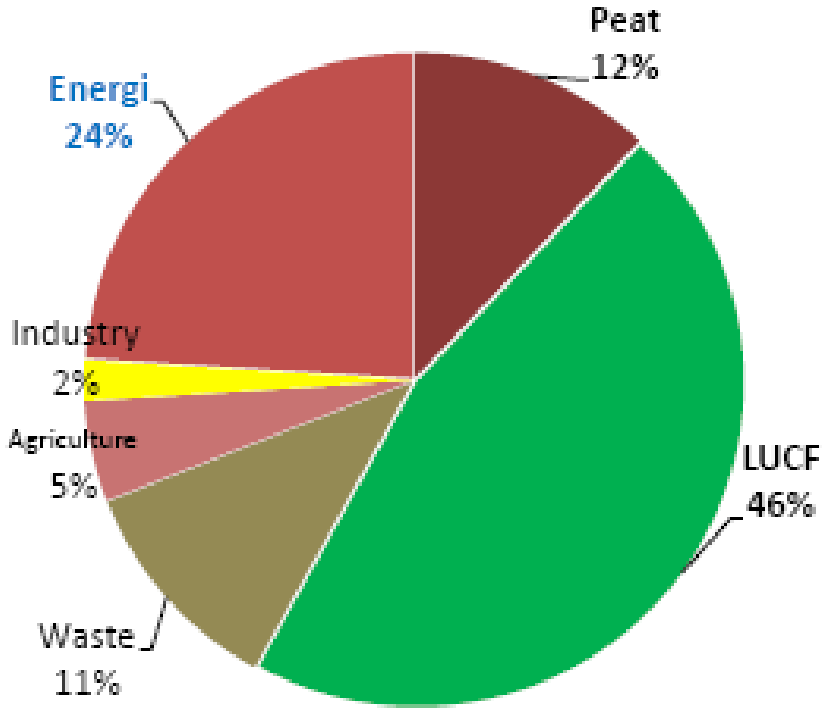


Total: 293.27 Mt

Average Growth around 6.6% per-year.

Source: Handbook of Energy and Economic Statistics of Indonesia 2006.

GHG Emission Sources (2000)



- Main sources of emission: LUCF, Peat land and Energy
- Emission from energy relatively small – but will increase significantly due to the economic growth

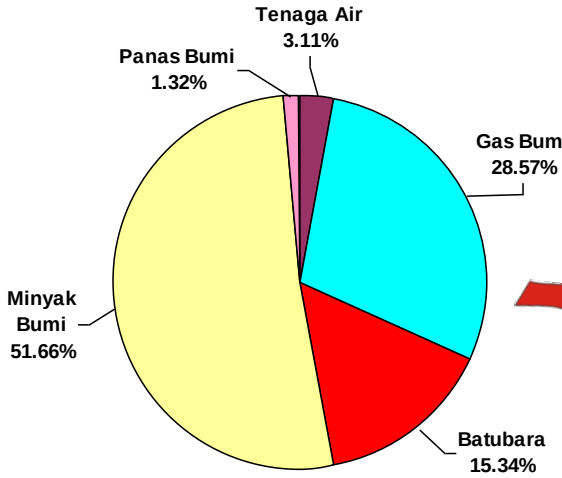
Estimated Total GHG Emission : 1.42 $GTCO_2e$

Source: *Second National Communication* (SNC), 2009

2025 National Energy Mix Target

- Fossil Fuels are still remain dominant source of energy
- Energy Policy is endowment resources driven

PRIMARY ENERGY MIX 2005



National Supply of Primary Energy 2008 (By Type)

- Crude Oil & Fuel Export/Import: 37.01%
- Coal: 23.58%
- Natural Gas & Export/Import (LPG & LNG): 15.71%
- Hydro power: 2.36%
- Geothermal: 1.09%
- Biomass: 20.25%

t_1?

t_2?

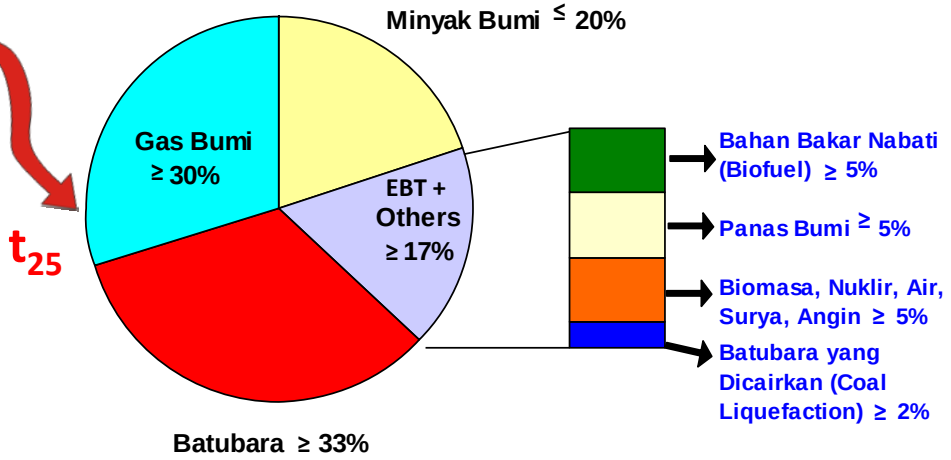
t_3?

Energy Mix Target 2025

- Coal ≥ 33%
- Liquefied Coal ≥ 2%
- Oil ≤ 20%
- Gas ≥ 30%
- Geothermal ≥ 5%
- Biofuel ≥ 5%
- Other Renewable Energy (Biomass, Nuclear, Hydro, Solar, Wind) ≥ 5%

2025 NATIONAL ENERGY MIX TARGET (PERPRES NO. 5/2006)

t_{25}

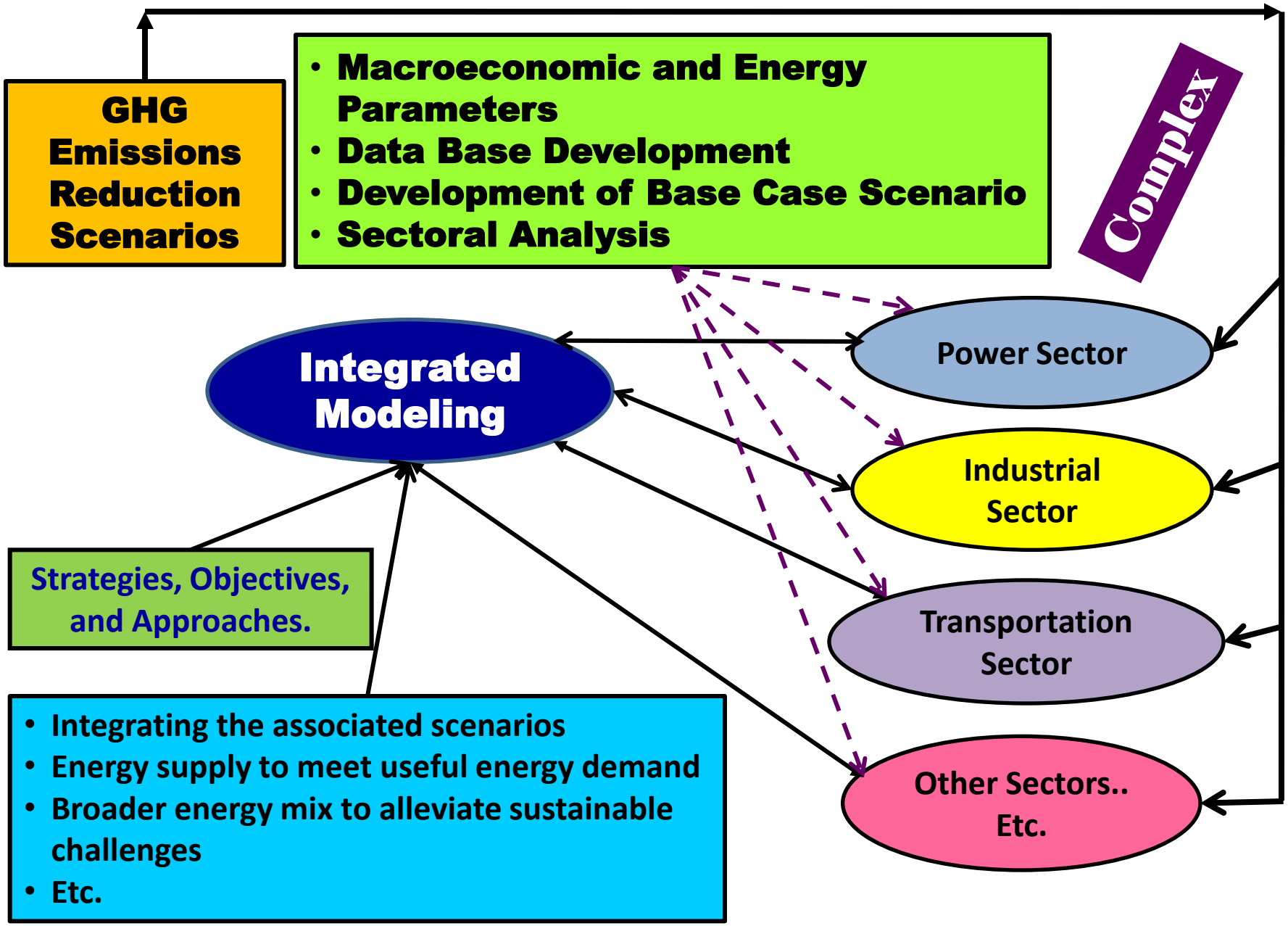


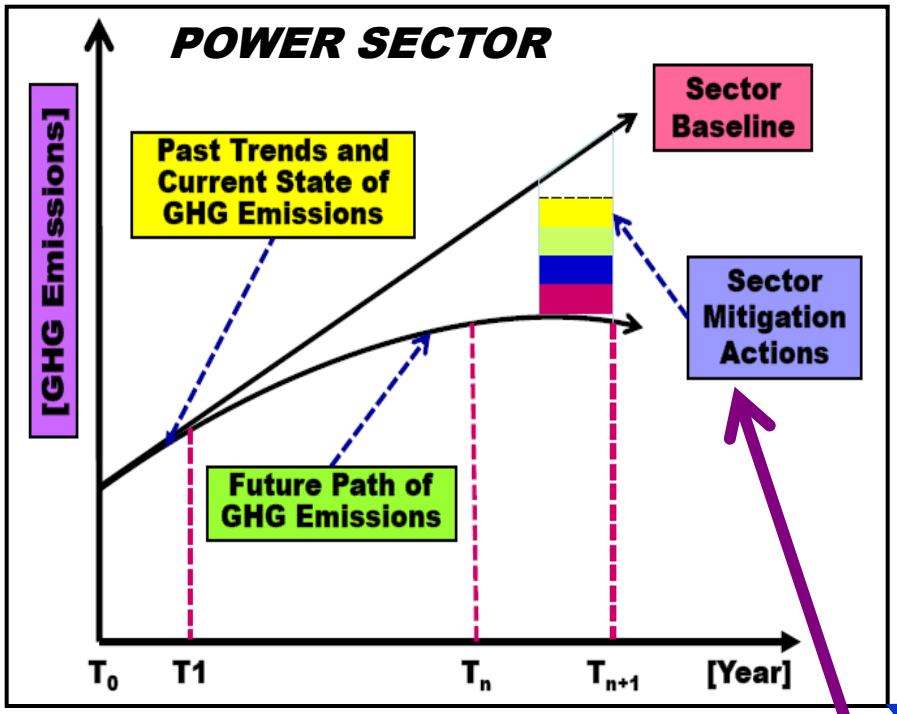
Key Features for Mitigation Assessment

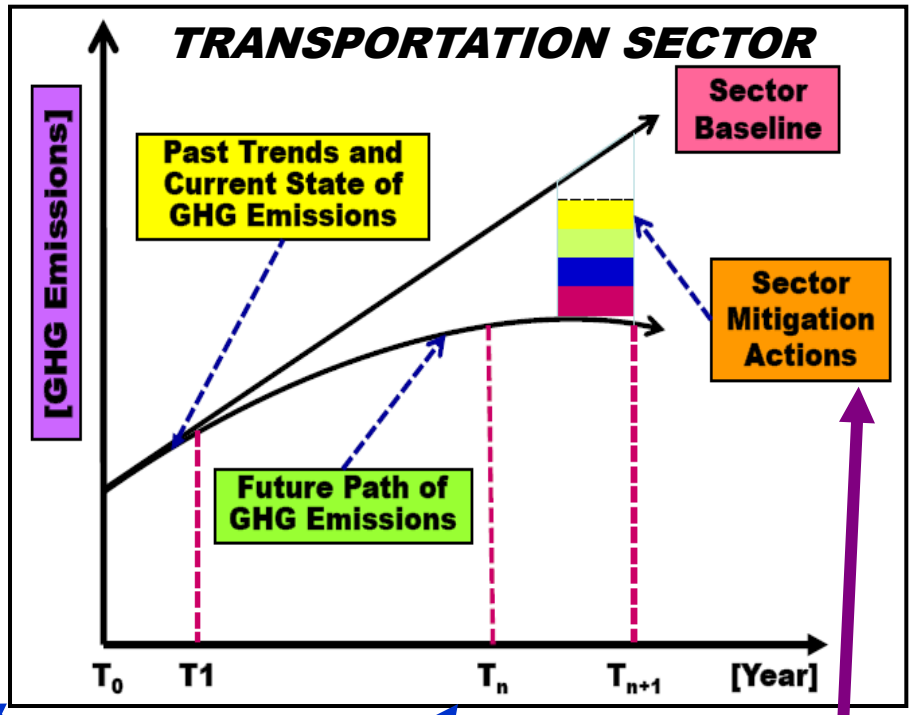
- **Bottom-up models are most useful for studying options that have specific sectoral and technological implications. Most mitigation assessments have been conducted using bottom-up approaches;**
- **Use mathematical programming to identify configurations of energy systems that minimize the total cost of providing energy services;**
- **Select technologies based on their relative costs**
- **Simulate the behaviour of energy consumers and producers under various signals and constraints;**
- **Balance demand and supply and broader energy mix to alleviate sustainable challenges;**
- **Etc..**

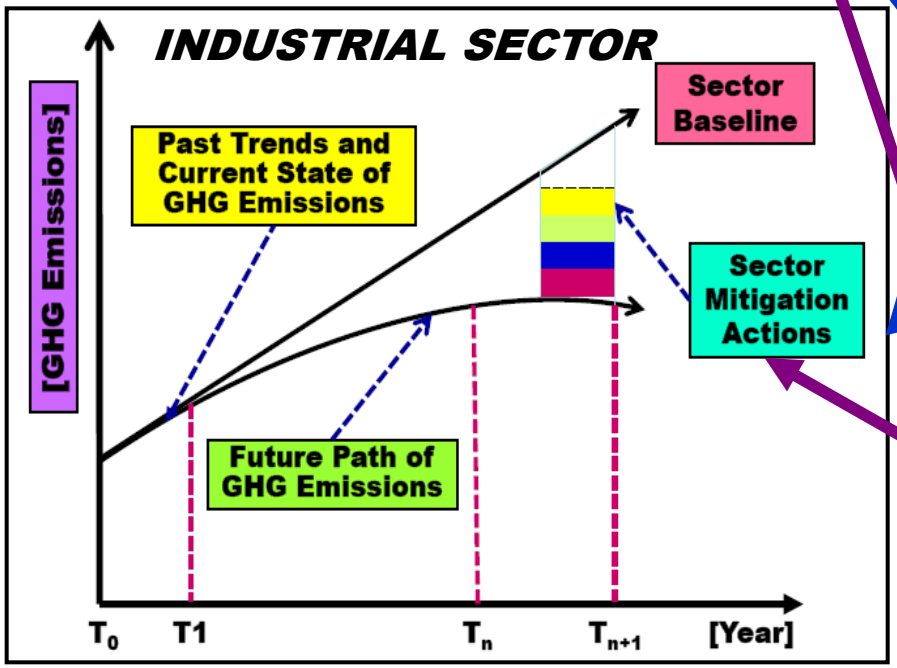
UNFCCC RESOURCE GUIDE. For preparing the NATCOM of Non-Annex I Parties. Module 4, Measures to Mitigate Climate Change.

Integrated Modeling of Energy Sectors









Integrated Modeling

Drive the energy system toward low carbon energy sources, low-carbon and carbon-free energy technologies, greater efficiency in energy production and distribution and in energy use.

Drive the energy system toward low carbon energy sources, low-carbon & carbon-free energy technologies, greater efficiency in energy production & distribution and in energy use.

Transport Sector

- Avoiding
- Shifting
- Improving

Power Sector

- Low-carbon technologies
- Renewables
- Efficiency improvement including in transmission and distribution systems
- Fuel switching
- CCS
- Etc.

Industrial Sector

- Efficiency improvement
- Fuel switching
- Retrofit cleaner production plants and machinery in existing production facilities
- Etc.

Potential Use-Side Interventions

- Energy efficiency for commercial building
- Energy efficiency for residential
- Etc.

WHAT KIND OF MITIGATION ACTION CAN BE IMPLEMENTED IN THE TRANSPORT SECTOR?

Policies that support mitigation actions in the transport sector:

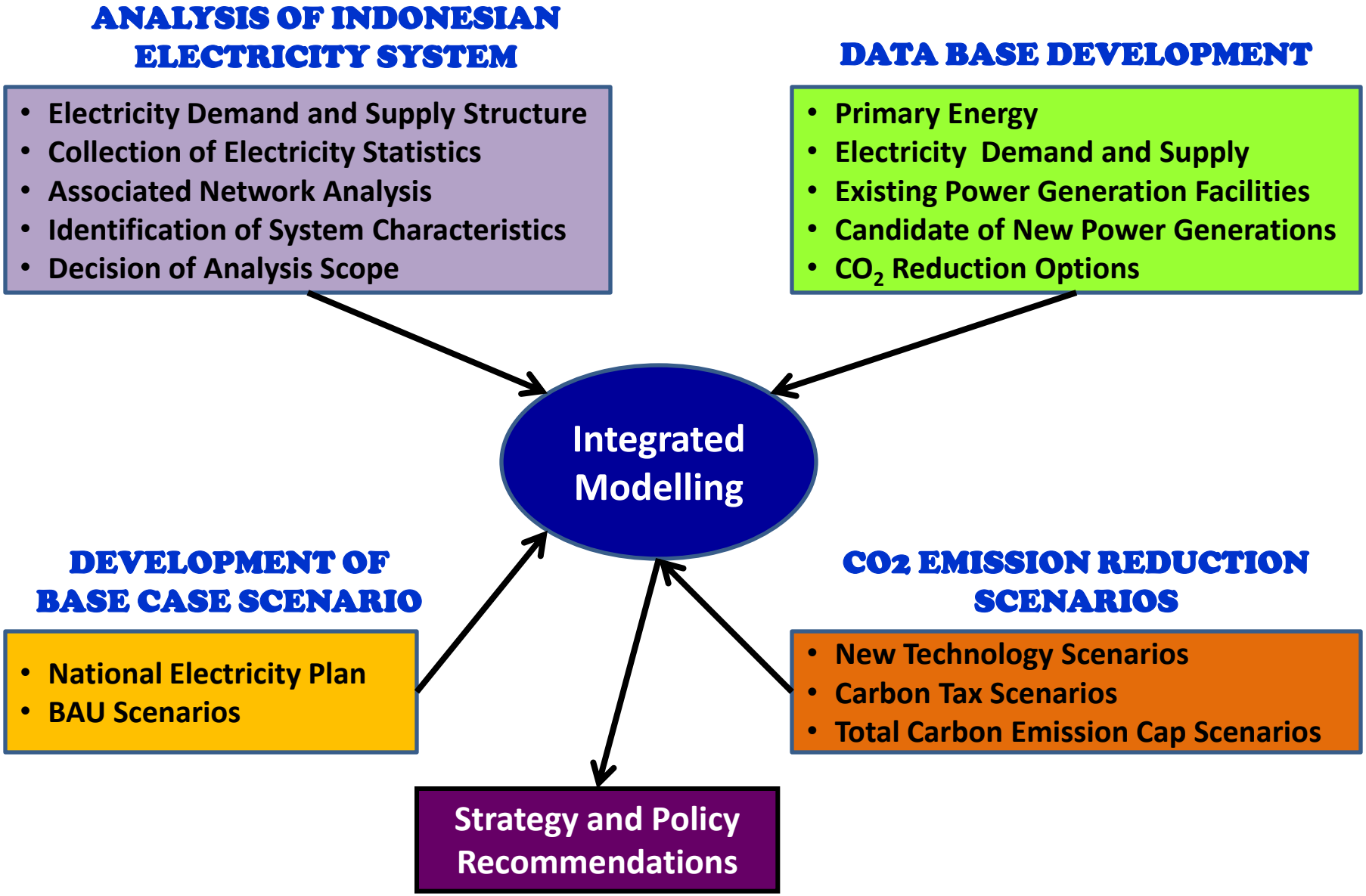
- **Avoiding or reducing trips, e.g. Through the integration of land use and transportation planning,**
- **Shifting to and maintaining the use of "green' modes, such as public transport to and non-motorised transport, and**
- **Improving vehicle and fuel technology of all modes of transport to improve the environmental efficiency from each kilometre travelled.**

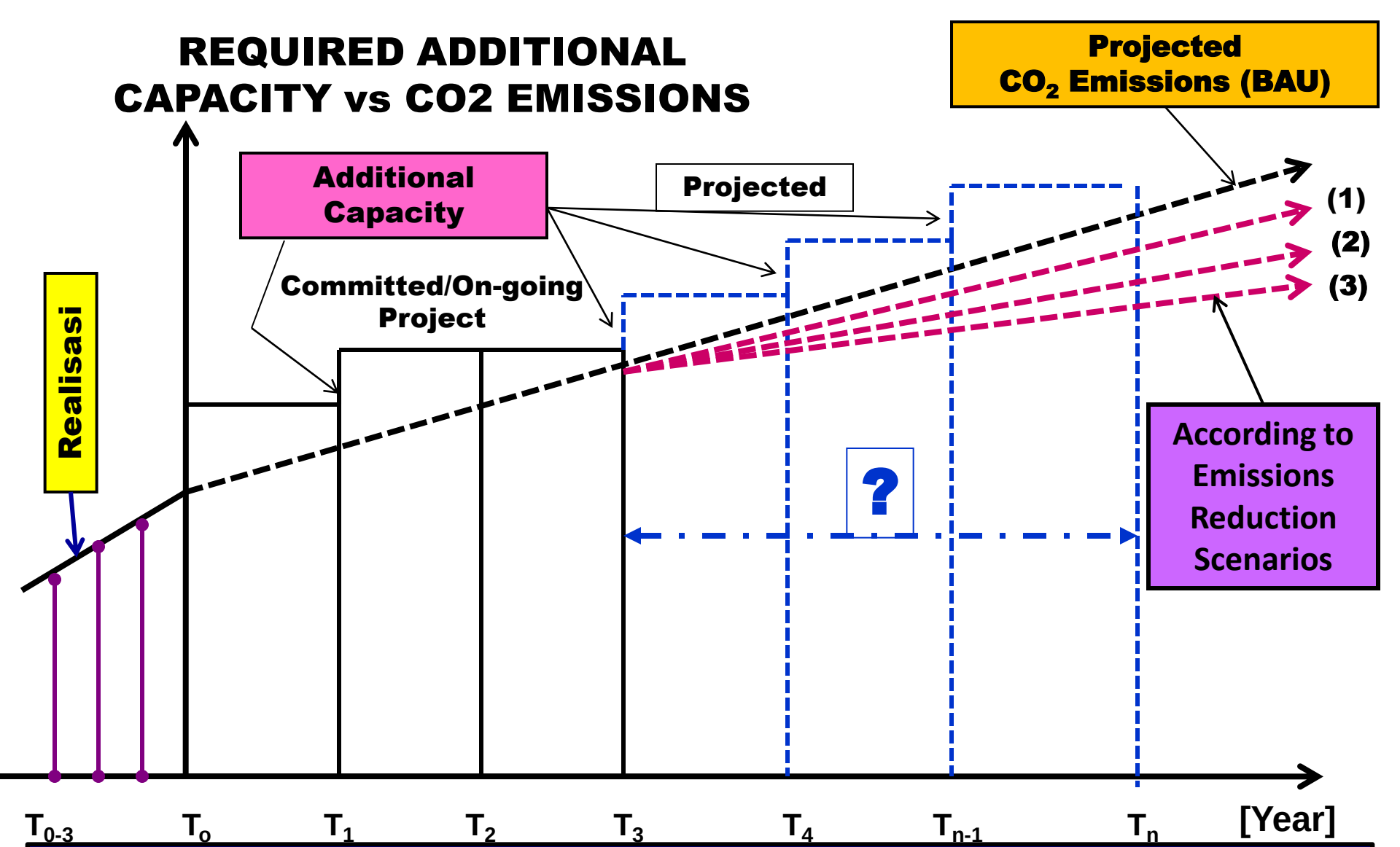
Parties Submissions – Transport Sector under Copenhagen Accord
(GTZ Report February 2010)

Developing country Party	Strategy approach	Infrastructure development/ enhancement					Fiscal incentives	Land use planning	Walking and cycling promotion	Traffic management	Regulatory policy measures	Energy efficiency	No details specified
		Rail/ light rail	Road	Other public transport[4]	Waterborne	Unspecified							
Republic of Armenia	Improve											✓	
Botswana	Shift and improve			✓								✓	
Costa Rica	Not specified												✓
Republic of Congo	Avoid and shift					✓		✓			✓		✓
Ethiopia	Shift	✓											
Indonesia	Shift												
Jordan	Shift and improve	✓			✓		✓				✓	✓	
Macedonia	Shift and improve	✓	✓	✓			✓			✓	✓	✓	
Madagascar	Shift and improve	✓										✓	
Marshall Islands	Shift and improve						✓				✓	✓	
Mexico	Shift and improve	✓	✓	✓							✓		
Mongolia	Improve											✓	
Morocco	Avoid, shift and improve	✓		✓				✓			✓		
Papua New Guinea	Not specified												✓
Sierra Leone	Shift and improve			✓	✓						✓	✓	
Singapore	Shift and improve			✓			✓				✓	✓	

Incorporating Key Mitigation Technologies into Power Sector Development

GHG MITIGATION SIMULATION IN POWER SECTOR INTEGRATED MODELLING





Projected Additional Capacity

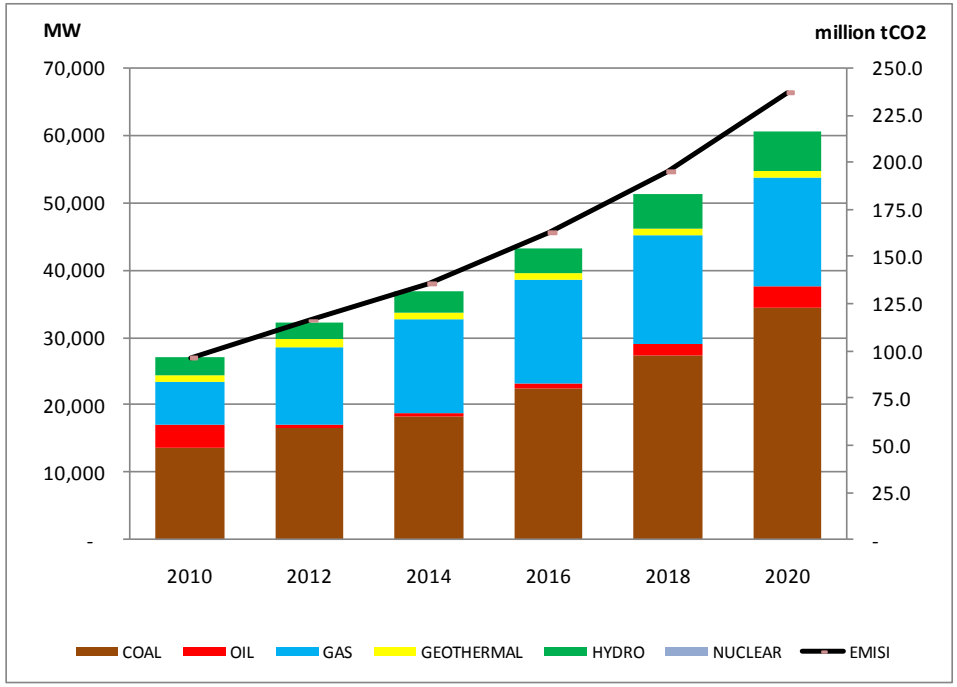
- Scenario: BAU and Least Cost Principle (Cost Effectiveness).
- Key Scenarios, such as: (i) New Technology; (ii) Carbon Values; (iii) Total Carbon Emission Cap (Emissions Reduction) Scenarios.

Java-Bali Power System

Free Optimum/Base-Case Scenario

Development of Base-case Scenario results in :

- **The system needs additional conventional coal-fired (PLTU) power plant of 27,000 MW which represents 72.8% of 60,000 MW total required power generation capacity year 2020.**
- **The required total EPC cost to achieve this base-case scenario is estimated at USD 50.31 billion by 2020.**
- **CO_2 emissions for 2009 – 2020 is accumulated at about 1,796 $MtCO_2$ or about 236.5 $MtCO_2$ in 2020.**



	Unit	2010	2016	2020	Portion (%)
Coal	GWh	84,728	151,929	235,452	72.8
Oil	GWh	206	4	20	0.1
Gas	GWh	30,087	59,029	67,023	20.8
Geothermal	GWh	6,641	8,110	8,110	2.5
Hydro	GWh	7,813	8,893	12,262	3.8
Nuclear	GWh	0	0	0	0
Total Production	GWh	129,475	227,965	322,867	100
Total EPC Cost	Mill. USD	8,047	27,176	50,311	

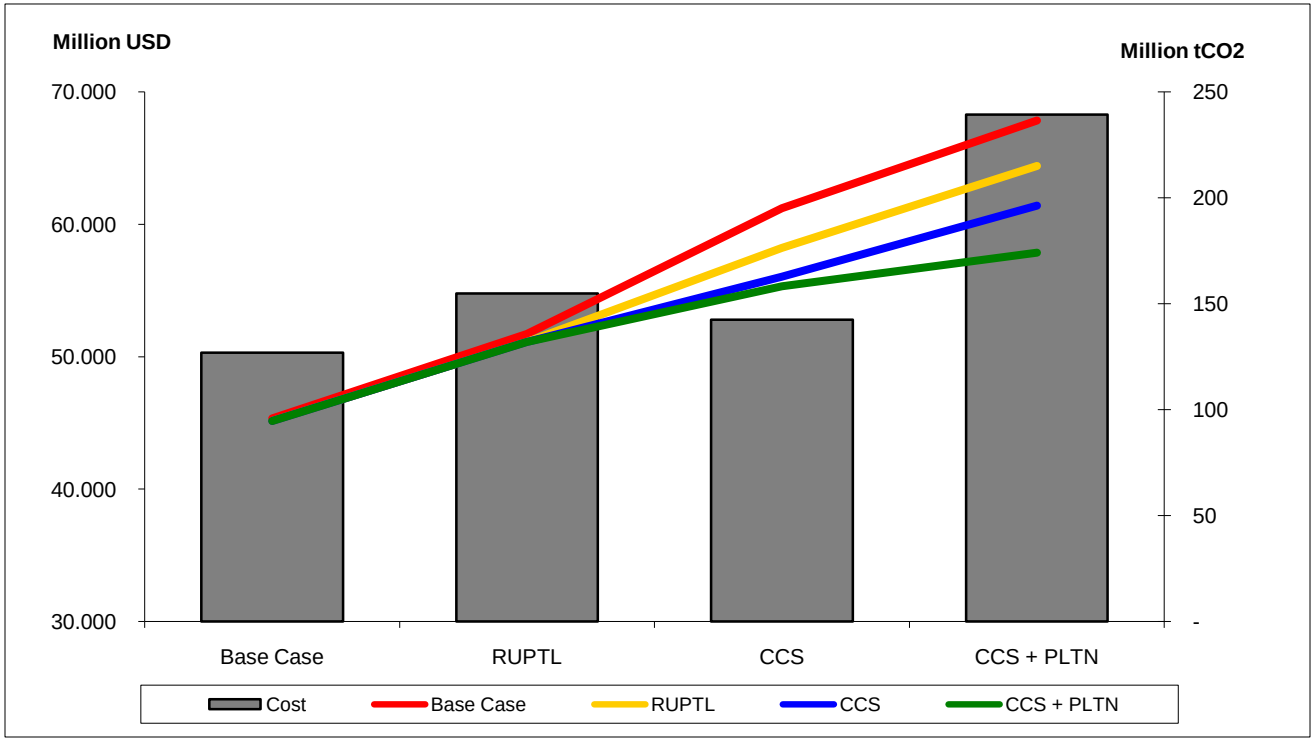
Note: **Total EPC Cost is calculated based on NPV least cost principle**

Source:Simulation results

Java-Bali Power System

Comparison of Emissions Reduction and Investment Cost

- On Base-case scenario, CO_2 emission increase by 185% out of Base-year 2009 or from 83 $MtCO_2$ to become 236.5 $MtCO_2$ in year 2020,
- On RUPTL scenario where the government intervention is counted through the introduction of geothermal and hydropower plants, the emission reduces by 106.21 MtCO2 (5.9%) out of base-case scenario with additional EPC cost required of about USD 4,460 million,
- On New Technology scenario with the introduction of CCS proposed at PLTU Indramayu and PLTGU Muara Tawar, the accumulated CO_2 emission is reduced by 157.9 $MtCO_2$ (8.9%) out of base-case scenario with a total additional EPC cost required at about USD 2,474 million, and
- On the New Technology + 4,000 MW PLTN with the introduction of CCS, accumulated CO_2 emission reduces by 198.4 $MtCO_2$ (11%) out of base-case scenario with the required total additional EPC cost at about USD 17,971 million.



British Embassy
Jakarta

Understanding CCS Potential in Indonesia

1. Introduction.
2. CO_2 Emission Sources in Indonesia: (i) Oil and Gas Industry, and (ii) Power Sector.
3. Capture Technology.
4. Transportation Technology.
5. Methodology for Sites Selection: (i) Non-EOR, and (ii) NOR.
6. Geological Potential Storage .
7. CCS Regulatory Framework and Enabling Policies.
8. Conclusions and Recommendations.

http://www.worldenergy.org/work_programme/technical_programme/technical_committees/cleaner_fossil_fuel_systems/default.asp

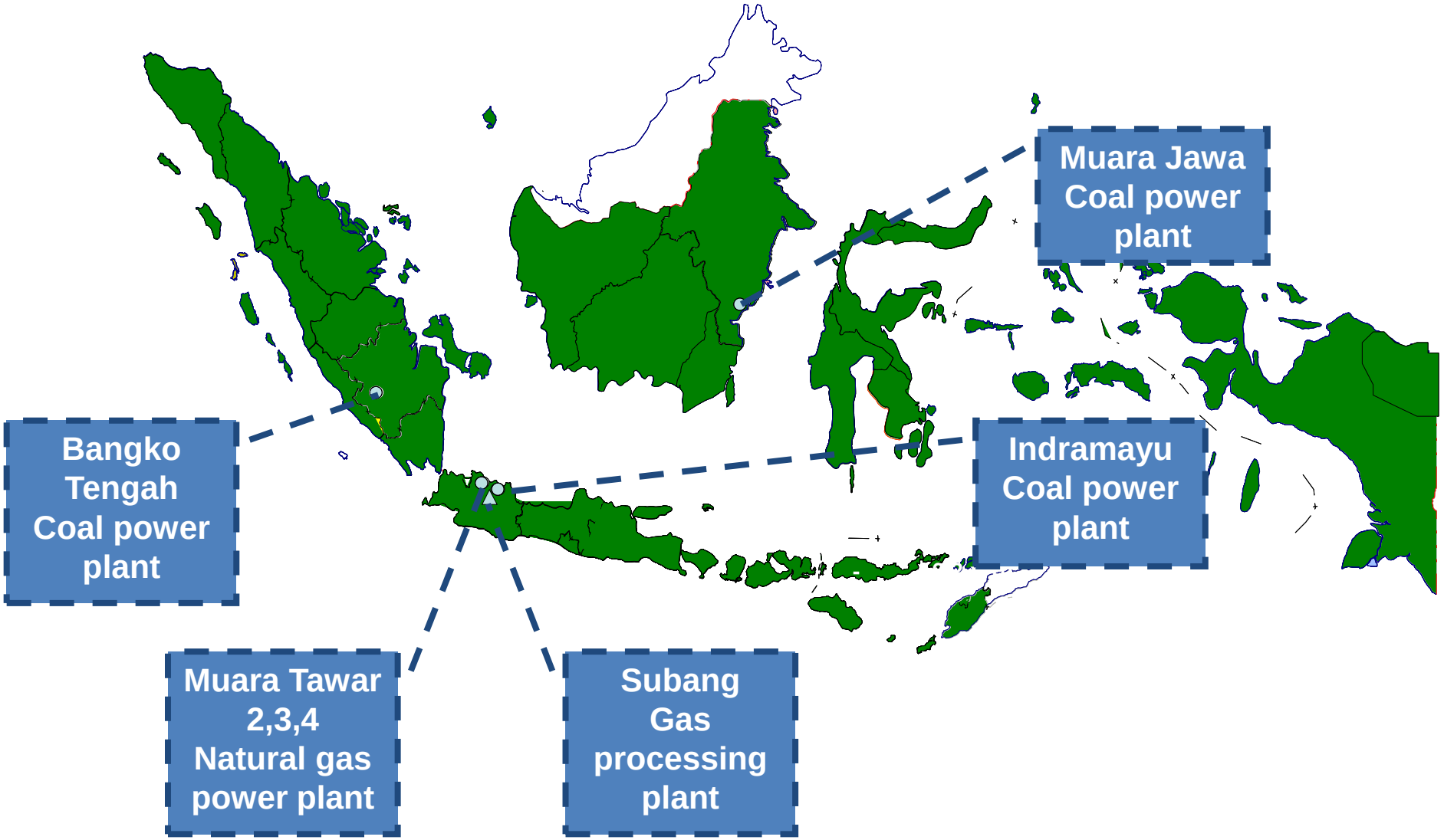
PT PLN (PERSERO)

WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
KOMITE NASIONAL INDONESIA

The Purpose of the Study

- A study into the potential for Indonesia to implement CCS has been undertaken by the CCS Study Working Group. The Working Group comprises the Agency for Oil and Gas Research Development (LEMIGAS) of the Ministry of Energy and Mineral Resources of Indonesia, Indonesian National Committee – World Energy Council (KNI-WEC), PT PLN (Persero) – Indonesia State Electricity Corporation, Ministry of Enviroment of Indonesia, Royal Dutch Shell and UK Embassy.
- The purpose of this study is to develop an understanding of the requirements associated with deploying Carbon Capture and Geological Storage in Indonesia by addressing technical, commercial and regulatory aspects of CCS deployment to further stimulate the on-going dialogue on potential application of such technology in Indonesia.
- This assessment of carbon capture and storage feasibility in Indonesia focuses on a number of factors. These factors include both technical aspects (e.g. geological storage potential, CO_2 capture from industrial sources) and non-technical issues (e.g. regulatory framework on CCS implementation, business opportunity).

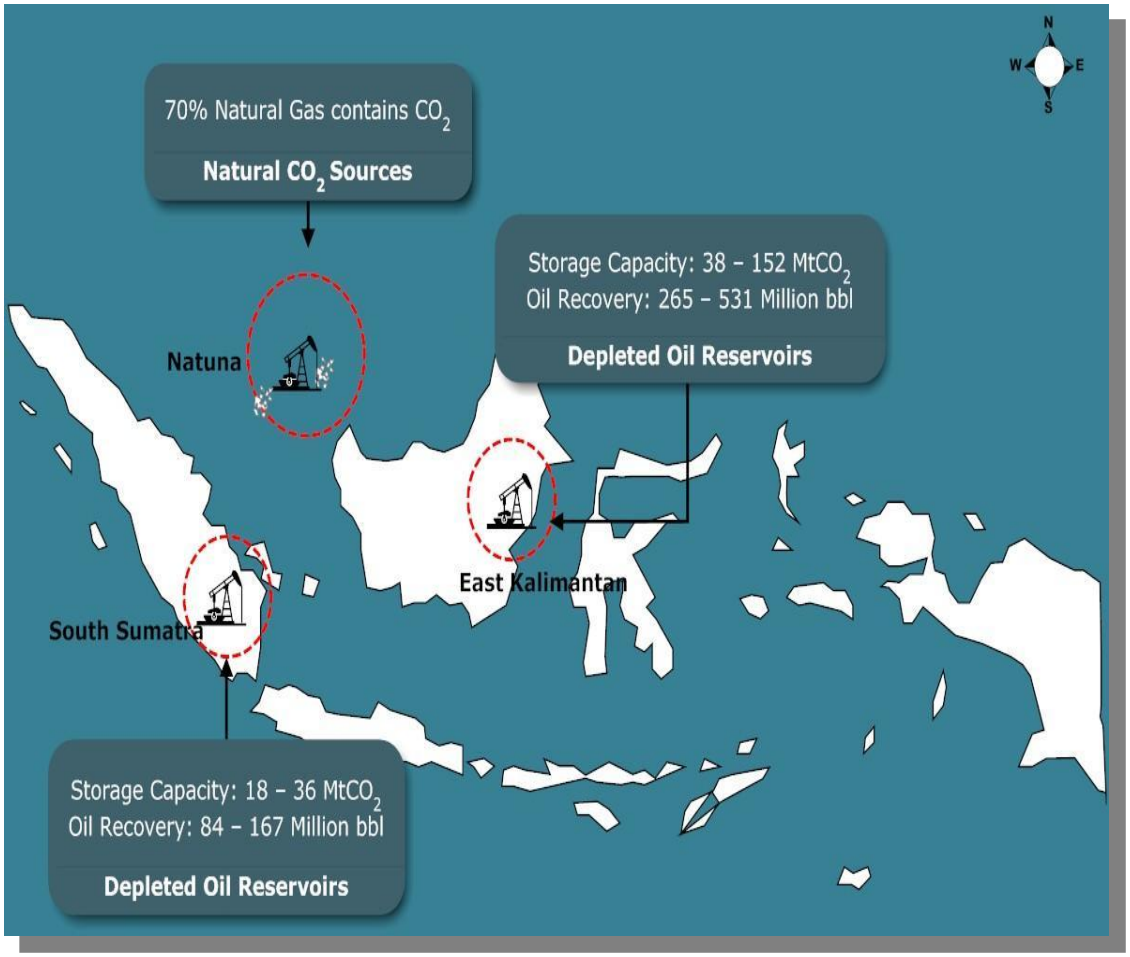
The Main Part of the Study - CO_2 Emission Sources
4 Power Plants & 1 Gas Processing Plant
CCS Capture Options



Geological Potential Storage

Long oil exploration and production history has left a legacy of depleted oil and gas fields, providing:

- **geological stability**
- **well- characterised reservoirs**
- **low population density**
- **existing infrastructures**
- **reduction of exploration cost**



CO_2 Sources, Geological Potential Storage Locations & Estimated Avoided Costs

CO_2 Sources	Geological Potential Storage Location	Pipeline Distance (Km)	Estimated Avoided Cost (US$/t$CO_2$)
Indramayu 1000 MW Steam Coal Power Plant	South Sumatra region (onshore)	655	62.1 (versus 1000 MW plant without capture)
Muara Tawar 750 MW NGCC Power Plant	North Jawa sea (offshore)	15	71.4 (versus NGCC without capture)
Bangko Tengah 600 MW Steam Coal Power Plant	South Sumatra region (onshore)	60	56.2 (versus 600 MW plant without capture)
Muara Jawa 100 MW Steam Coal Power Plant	East Kalimantan region (onshore)	60	76.3 (versus 100 MW plant without capture)
Subang Field Natural Gas Processing Plant	North Jawa sea (offshore)	79.7	10.7 (cost of compressing)

Conclusion and Next Steps for CCS Development in Indonesia

- **Indonesia has several promising options** for CCS application considering its variety of CO2 sources and availability of geological storage
- **International funding and support in collaborative approach** will be required to render at least fully integrated industrial-scale CCS demonstration project in developing countries in providing financial assistance together with the government with appropriate policies, measures and/or instruments.
- Concerns such as long-term liability and project boundaries, **as well as developing robust regulatory framework** will need to be addressed among others through proper **demonstration projects**
- Assessment of potential sites and **confirmation** of the **geological storage** of CO2
- Assessment of **reasonable routes** to geological CO2 storage
- An **estimate of cost impacts** of essential capture-ready measures, such as modifications to plant design and changes in ongoing running costs
- **Environmental considerations**, reviewing and highlighting any potential impacts associated with capture-ready plants and retrofitting

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World Energy Council

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www.worldenergy.org

Thank you