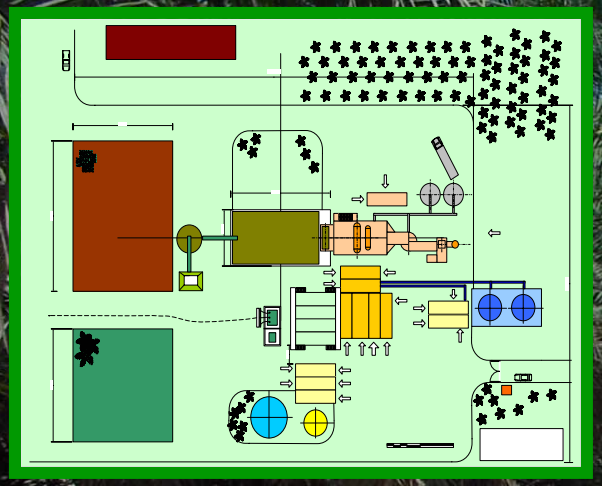


POWERGEN ASIA 2002
2. - 4. OCTOBER 2002
SINGAPORE

Miro R. Susta

IMTE AG
SWITZERLAND
&
CONNEC-T SDN BHD
MALAYSIA

Tan Cheng Huat

SOUTHEAST ASIA REGION
IN
POWER PLANTS
OPPORTUNITIES FOR BIOMASS

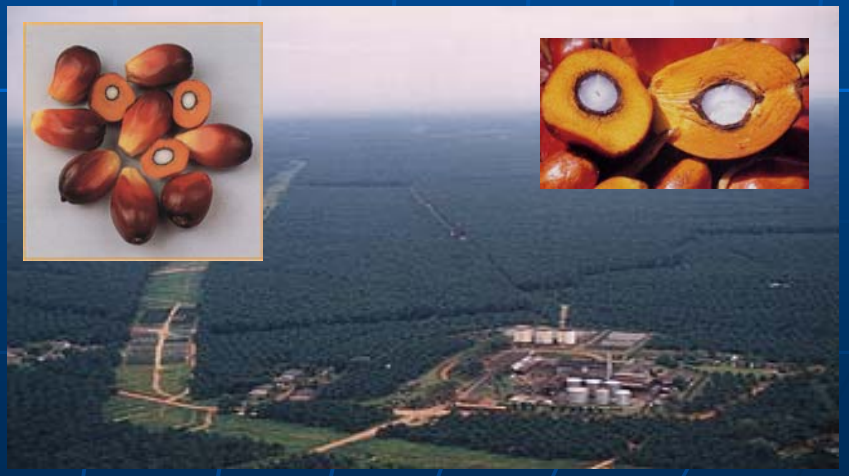
Palm Oil Production

Palm Oil Production

Palm Oil Production

Palm Oil Production

Palm Oil Production



Oil Palm Biomass Waste Specifications

Industrial Analysis of Mill Oil Palm Waste

	Unit	Shell	Dry-Shell	Fiber	Dry-Fiber
Volatile matter	%	71	78.05	75.8	83.4
Fixed carbon	%	19.3	21.2	12.1	13.33
Ash	%	0.7	0.75	3.0	3.27
Moisture	%	9.0	-	9.1	-
Gross calorific value	MJ/kg	18.90	20.77	16.68	18.38
Low calorific value	MJ/kg	17.60	-	15.42	-

Moisture Content (%) and Low Calorific Value of Mill Oil Palm Waste (MJ/kg)

Moisture	Shell		Fiber		Bunch stalk	
(%)	Pure	Oily	Pure	Oily	Pure	Oily
10	20.72	20.93	19.68	20.72	17.58	18.84
20	17.25	18.84			-	-
30	-	-	10.78	11.35	-	-
40	-	-	8.37	9.1	-	-
50	-	-	-	-	7.54	8.16
60	-	-	-	-	5.52	6.03

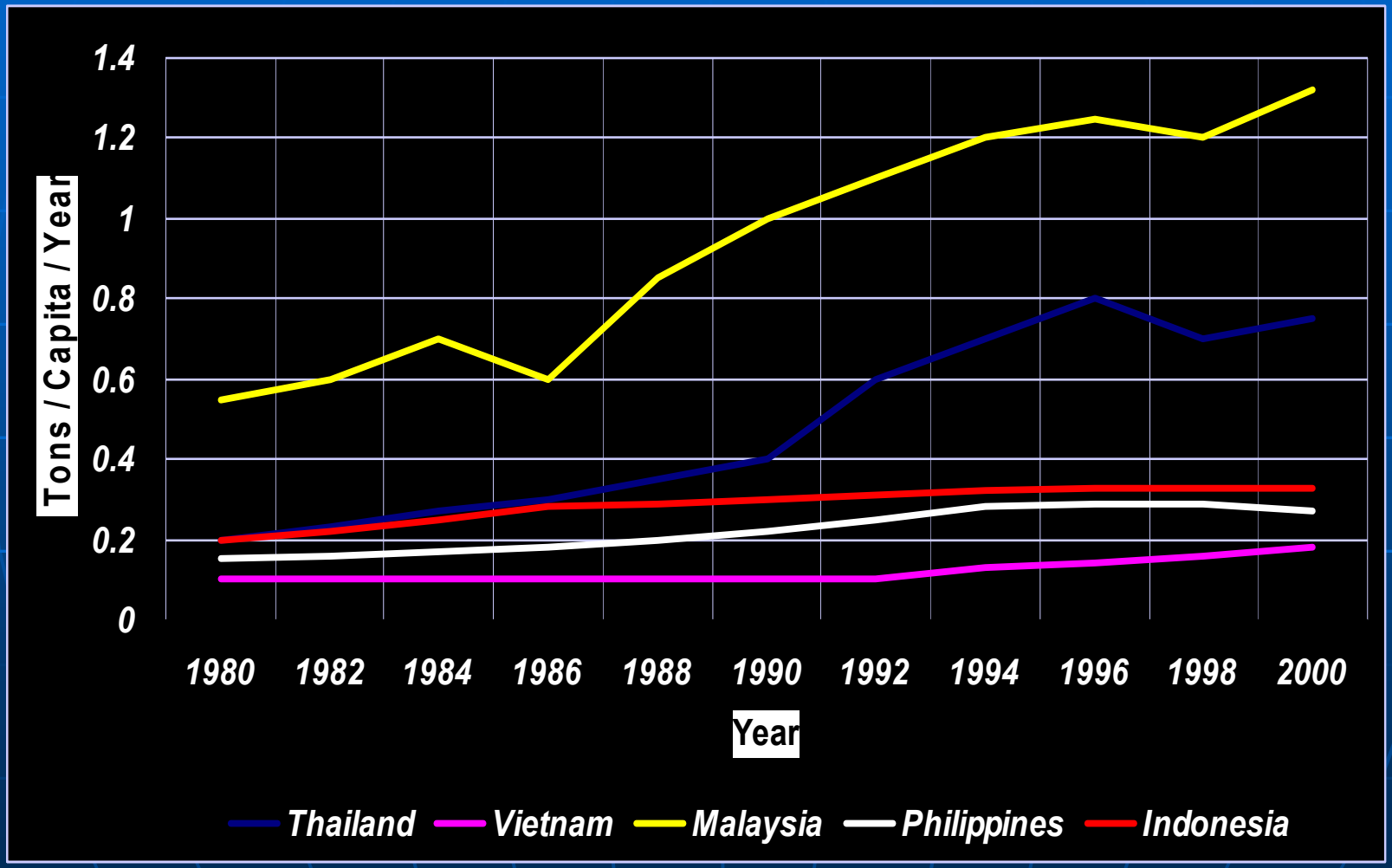
Problem??

Problem??

Problem??

Problem??

CO EMISSIONS PER CAPITA IN SELECTED COUNTRIES

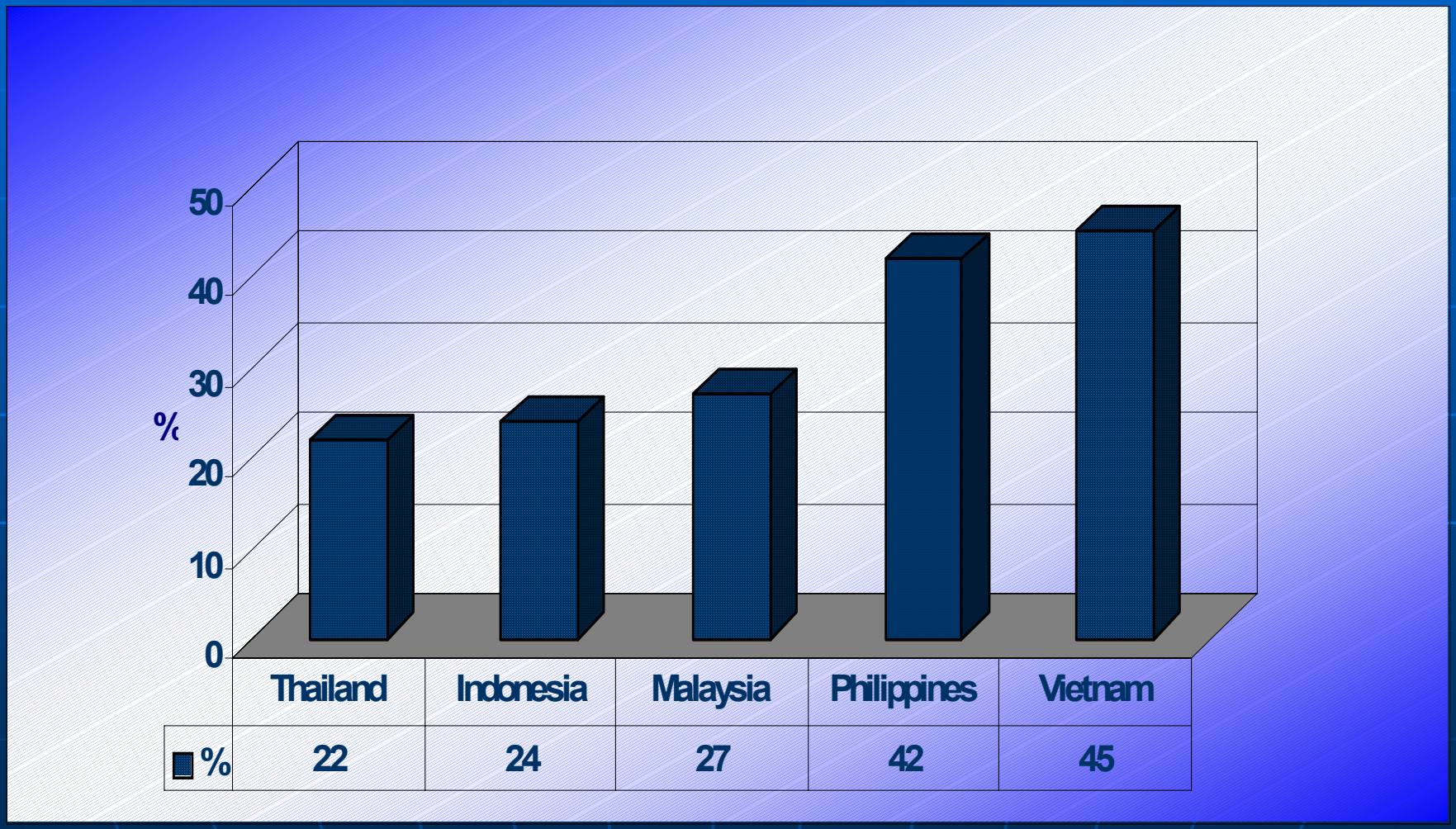


Solution?

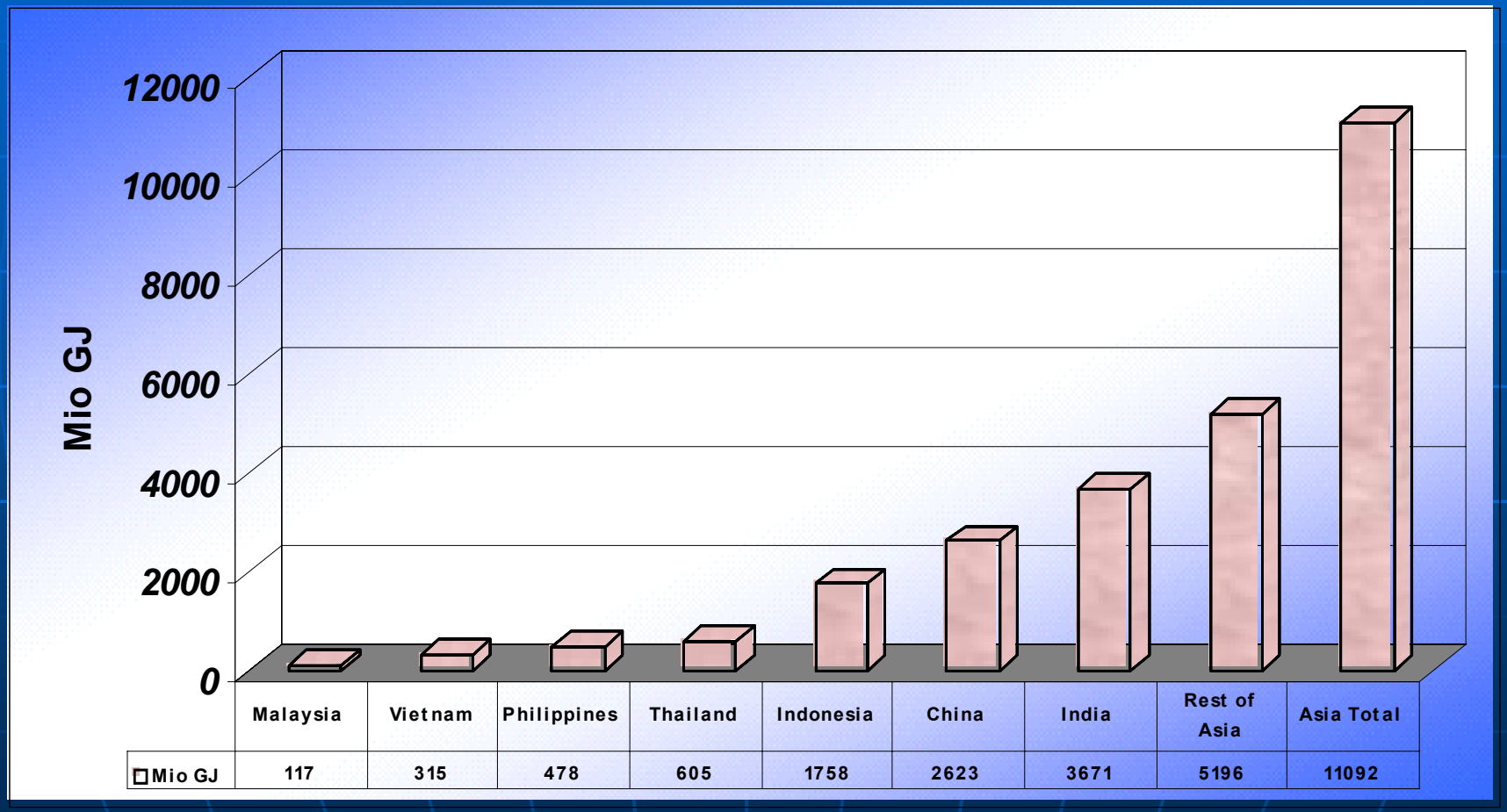
Yes!

Please follow carefully this presentation.

Energy Potential of Biomass Waste Fuels in Southeast Asia

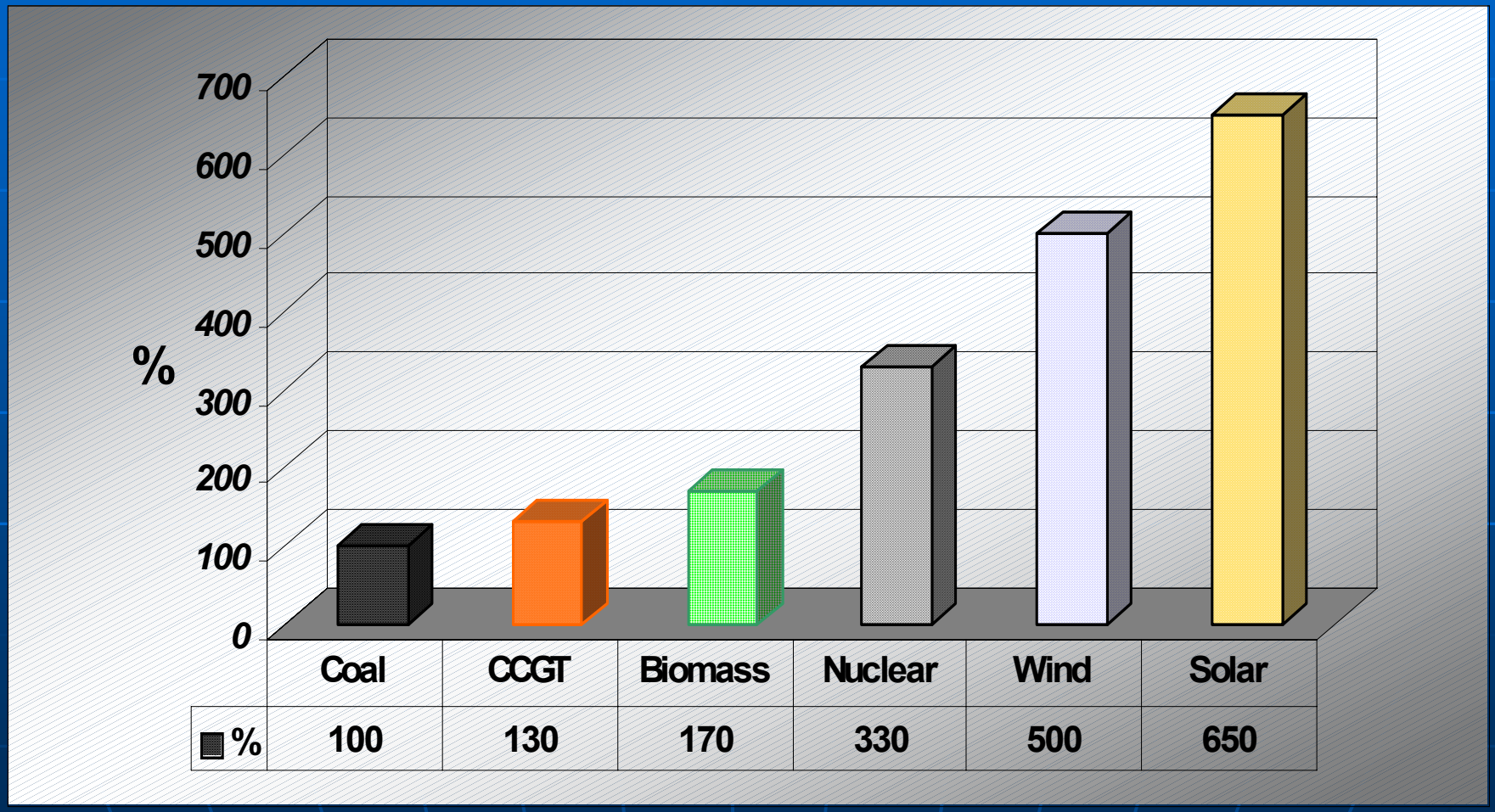


Biomass Energy Consumption in selected Countries



	Malaysia	Vietnam	Philippines	Thailand	Indonesia	China	India	Rest of Asia	Asia Total
Mio GJ	117	315	478	605	1758	2623	3671	5196	11092

PRICE COMPARISON

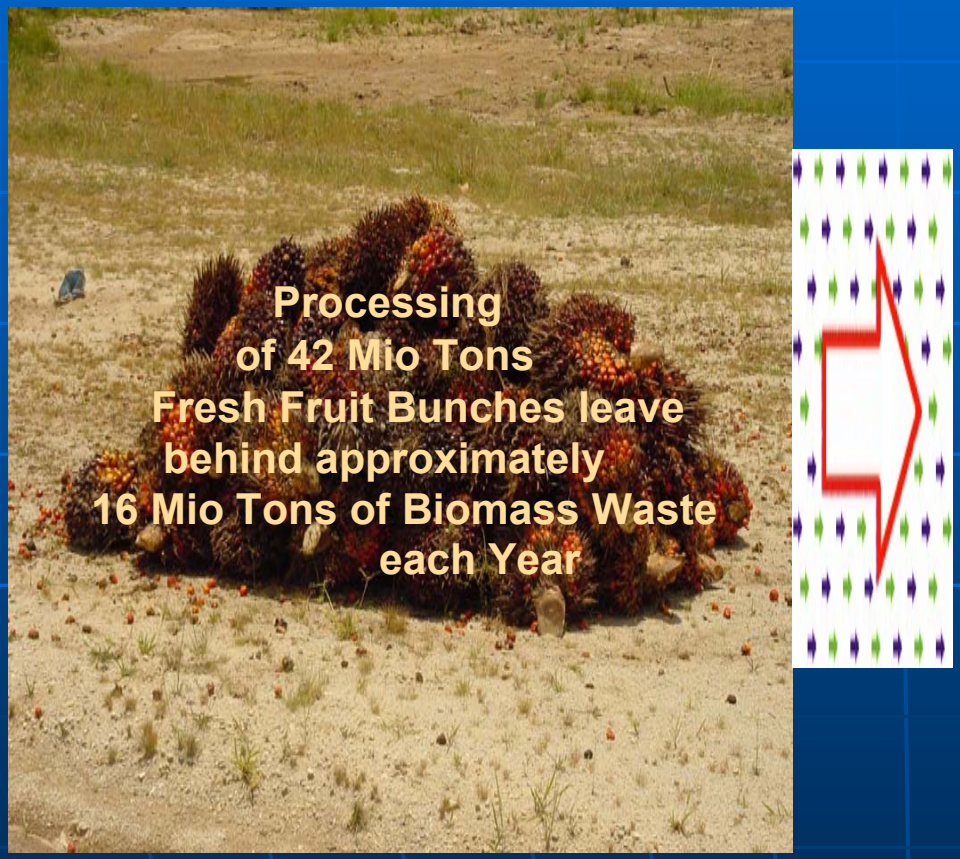


Malaysia


VIETNAM
Gulf of Thailand
THAILAND
0 100 200 km
0 100 200 mi
PHILIPPINES
Spratly Islands
Sulu Sea
Kudat
Kota Baharu
South China Sea
Kota Kinabalu
Sandakan
George Town
Kuala Terengganu
Pulau Labuan
Sabah
Lahad Datu
BRUNEI
Ipoh
Lumut
Miri
Tawau
Strait of Malacca
Kepulauan Natuna (INDONESIA)
KUALA LUMPUR
Kuantan
Sarawak
Celebes Sea
Kelang
Port Dickson
Kepulauan Anambas (INDONESIA)
Sibu
Melaka
Kuching
Borneo
Johor Baharu
SINGAPORE
INDONESIA
INDONESIA

Oil Palm Waste Energy Potential in Malaysia

Oil Palm Waste Energy Potential in Malaysia



Oil Palm Waste Energy Potential in Malaysia

Oil Palm Waste Energy Potential in Malaysia

Typical Project Time Schedule

Activity	Lead Time Starting (Month)	Lead Time Ending (Month)	Duration (Months)
Basic engineering & main equipment selection	0	3.5	3.5

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Main equipment manufacturing & delivery to site	2	15	14

Typical Project Time Schedule

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Basic engineering & main equipment selection	0	3.5	3.5
Detail engineering	2	6	5
Main equipment manufacturing & delivery to site	2	15	14
BOP equipment manufacturing & delivery to site	3	12	10

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Site construction & erection works	6	15	10

TYPICAL PROJECT TIME SCHEDULE

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Basic engineering & main equipment selection	0	3.5	3.5
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Site construction & erection works	6	15	10
Interconnection to TNB distribution network	15	15	1

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Site construction & erection works	6	15	10
Interconnection to TNB distribution network	15	15	1
Commissioning & testing	14	18	5

Estimated Quantity of Biomass Waste necessary for 10 MW Power Plant.

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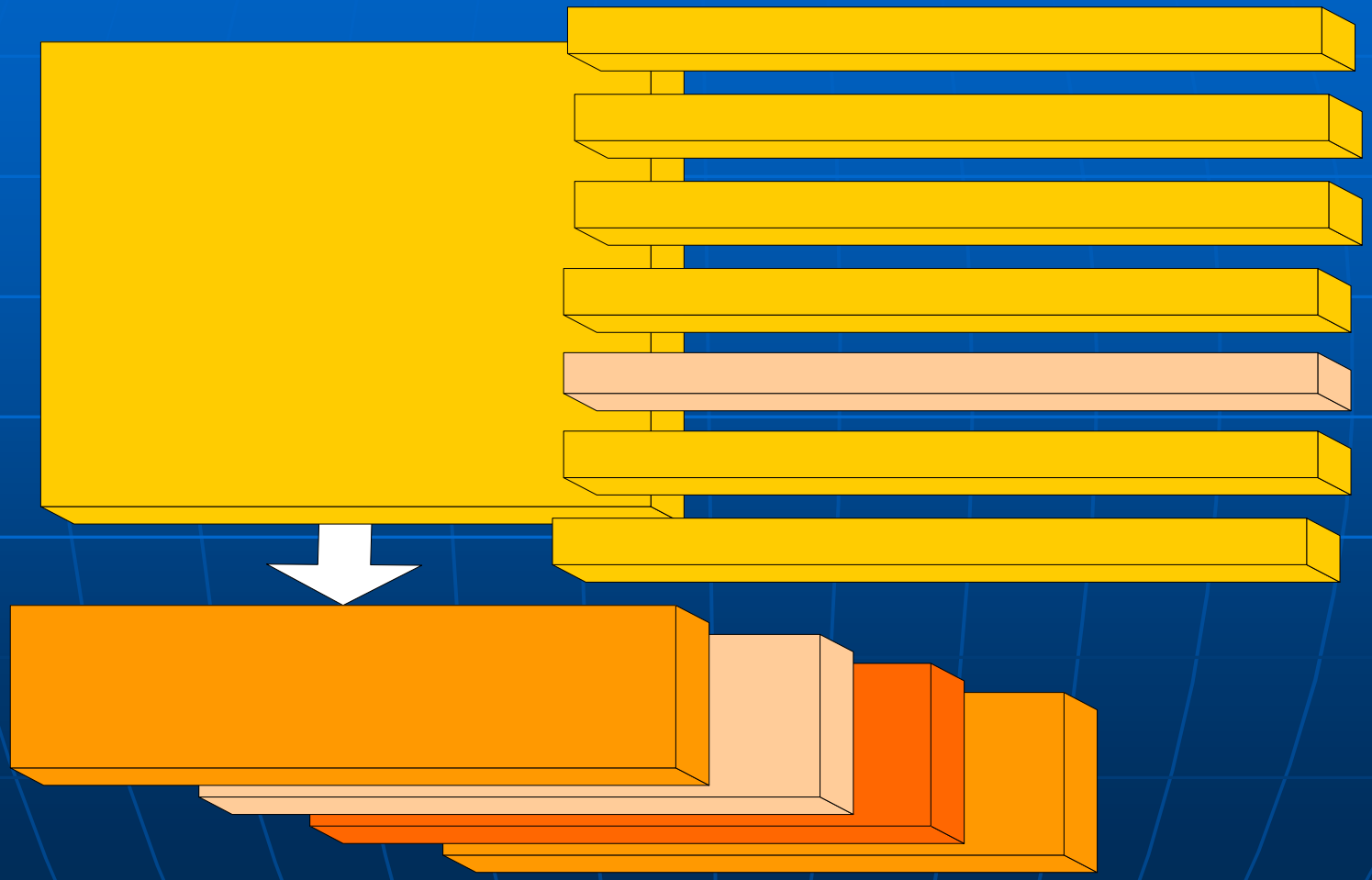
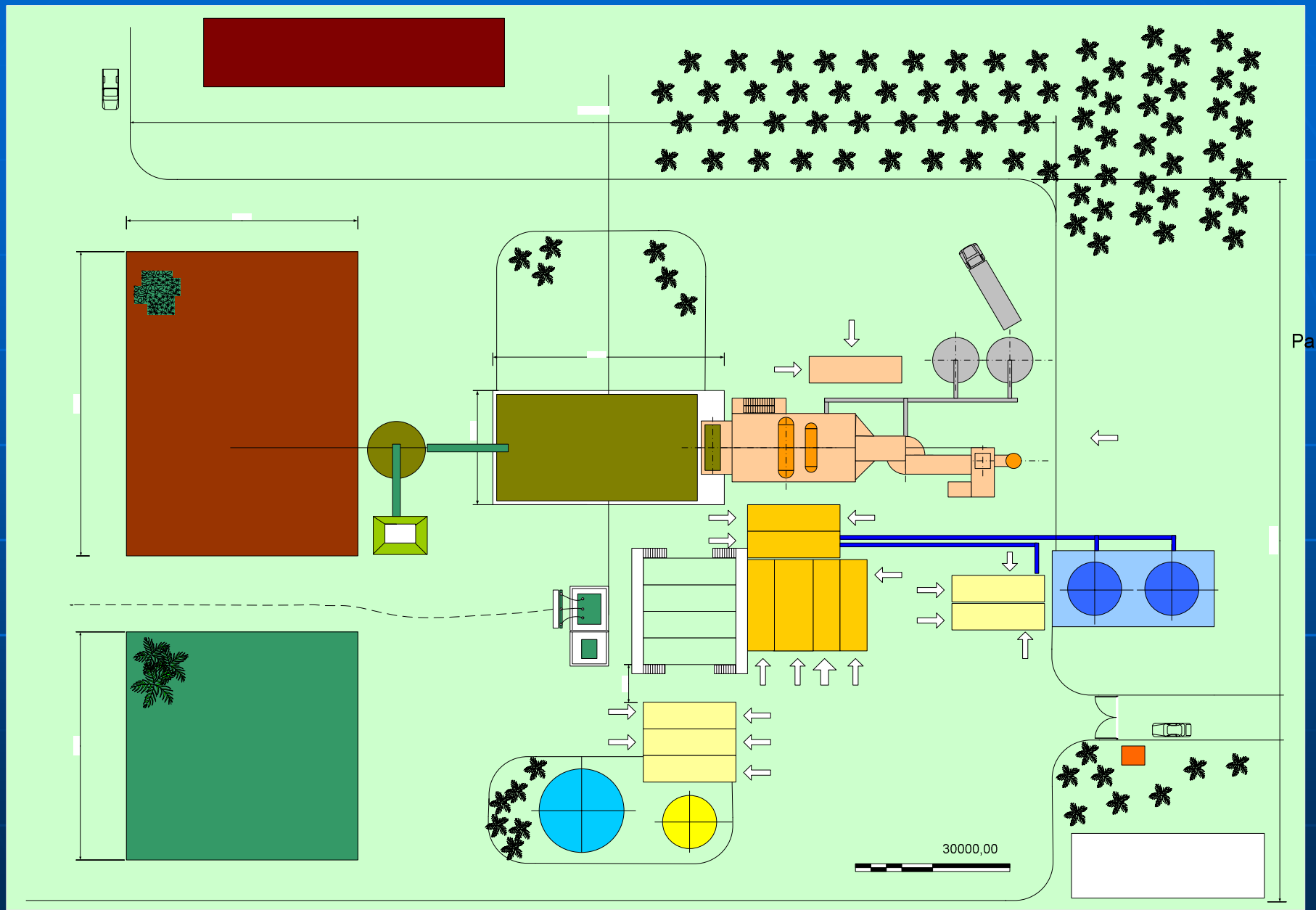
Supporting Figures

Power Plant Gross Output	→	$P = 10$ MW
Power Plant Gross Efficiency	→	$\eta = 25\%$
Power Plant Energy Input	→	$Q_{IN} = 40$ MW
Fuel Low Heating Value	→	Hu = 10'018 MJ/ton
Theoretical Fuel Consumption	→	$F_{th} = 40/10'180 * 3600 = 14.14$ tons/hr
Safety Margin for Drying	→	$S_M = 35\%$
Expected Fuel Consumption	→	$F_C = 14.14/0.65 = 21.75$ tons/hr
Palm Oil Waste (POW) from FFB	→	$P_{OW} = 30\%$
POW from 40 tons/hr PO Mill	→	$P_{OW1} = 40*0.30 = 12.0$ tons/hr
Mill Operating Hours/Day	→	$O_{HM} = 16$
Daily POW Production	→	$D_{POW} = 16*12.0 = 192$ tons/day
Real Plant Consumption	→	$F_{CR} = 0.8*25*24 = 480$ tons/day
Number of 40 ton/hr Mills/Plant	→	$N_{Mills} = 480/92 = 2.5$

Modular Design Concept




Palm
30000,00

Assumptions

- **Total Investment Costs → 12.5 Mio US$**

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- Interest Rate → 6.5 %

Assumptions

- Total Investment Costs → 12.5 Mio US$
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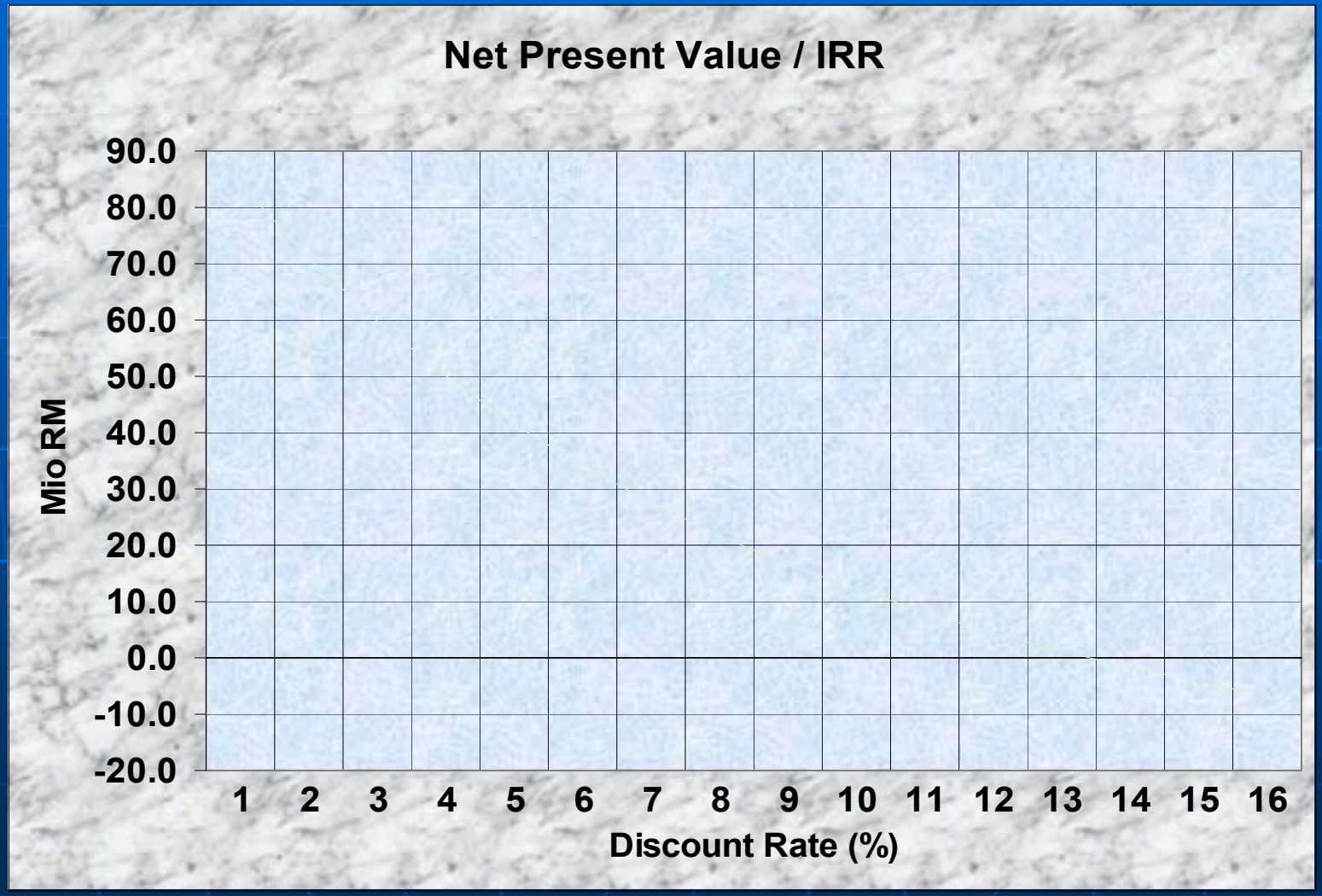
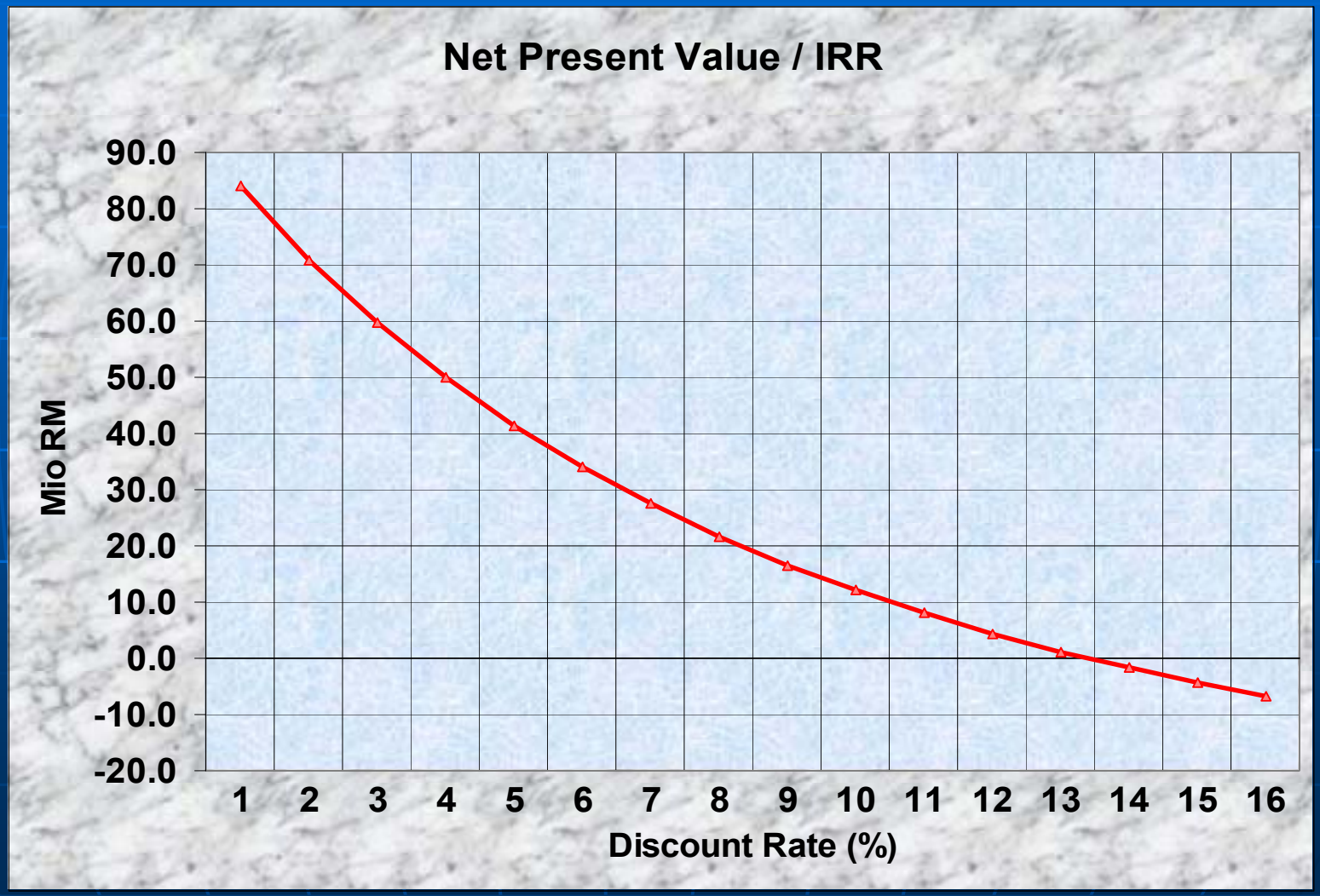
- Debt Repayment Period → 12 years
- Developer's Equity → 25 %
- Interest Rate → 6.5 %
- Construction Period → 18 Months
- Fuel Price → 0.19 US$/GJ

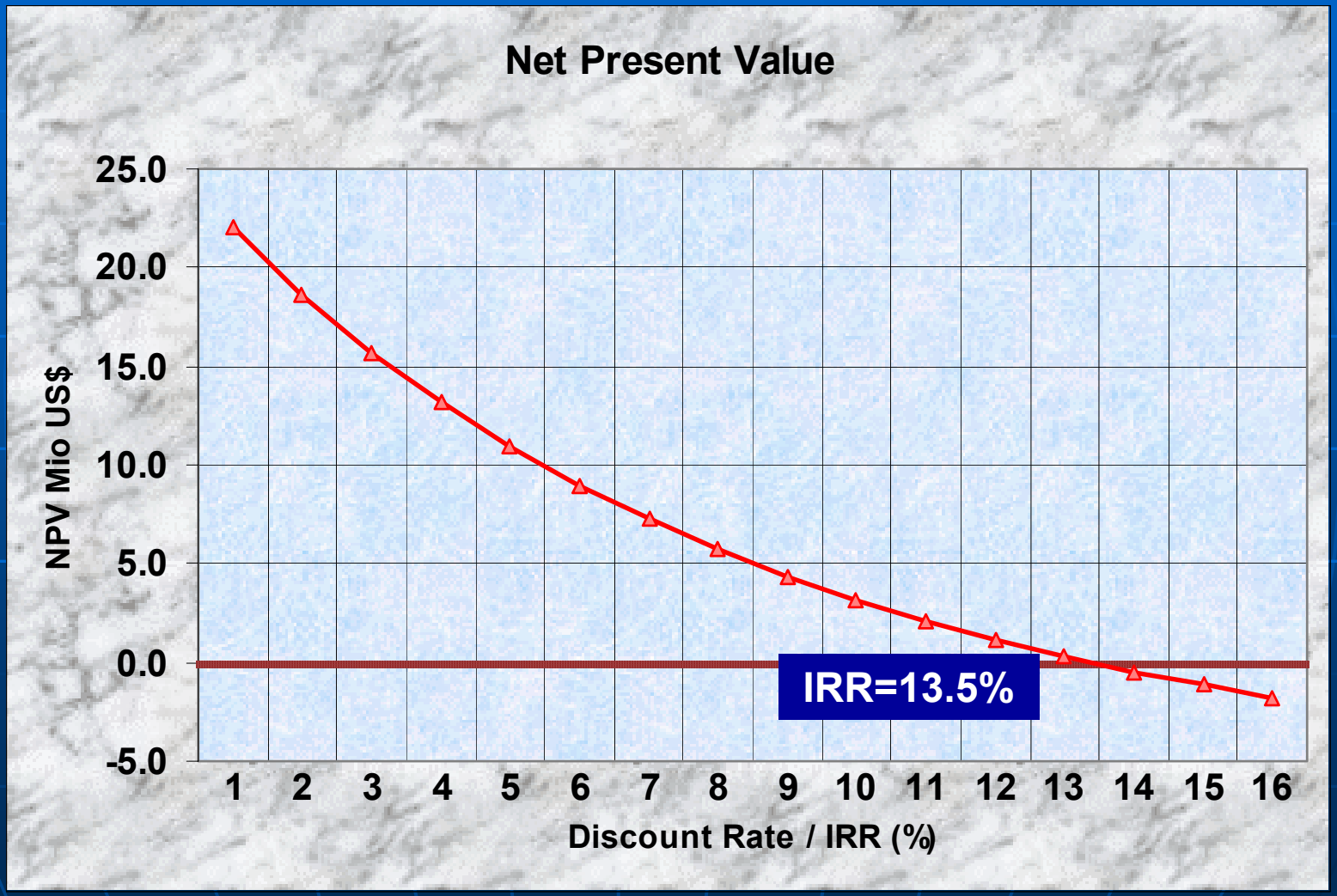
Project Net Present Value



Project Net Present Value



Project Net Present Value



MAJOR PROJECT RISK ASPECTS

COMPLETION TIME	Delays in construction will result in delays in operations.
CONSTRUCTION COST	*Construction cost will exceed the projections.*
PERMITING & APPROVALS	Delay in issuance of certain permits and approvals.
PROJECT PERFORMANCE	*The completed power plant will not perform as guaranteed.*
TECHNOLOGY	Applied technology will fail causing additional replacement costs.
MARKET DEMAND & PRICE	*Increased competition in the power industry reduces power demand.*
ENERGY DISPATCH	Power plant dispatch at a low level.
OPERATION & MAINTENANCE	*O & M costs will exceed projections.*
BIOMASS FUEL SUPPLY	Unreliable fuel supply.
BIOMASS FUEL PRICE	*Increases in the price of oil palm biomass waste.*
EQUIPMENT BREAKDOWN	Unexpected failure of certain equipment.
ENVIRONMENTAL	*Adoption of new laws or regulations, or changes in the inter-pretation or application of existing laws or regulations.*
INFLATION	Revenues may not be sufficiently adjusted to compensate for inflation in operating costs.
EXCHANGE RATES	*Project capital and operating costs may be in foreign currencies, the financing and revenues for the Project are in local currency*
FORCE MAJEURE	The Investor may be subject to certain additional costs.

SUMMARY & CONCLUSIONS – A

BIOMASS UTILIZATION ASPECTS

- Biomass includes all kind of wet and dry agricultural by-products, forestry wood waste products and also including residues;
- Biomass has the potential to sustainably provide a major proportion of the primary global energy supply;
- Biomass is a renewable source of energy; its use does not contribute to global warming;
- Biomass fuels have negligible sulphur content and therefore do not contribute to sulphur dioxide emissions, which cause acid rain;
- The combustion of biomass generally produces less ash than coal combustion, and the ash produced can be used as a soil additive;
- Biomass is a domestic resource, which is not subject to world price fluctuations or the supply uncertainties of imported fuels;
- An exciting alternative economic model promises a better life everywhere without destroying the earth's natural support systems;
- The new economy will be not powered by fossil fuels, but by various sources of wind energy, solar energy (where also biomass energy belongs to) and hydrogen;

SUMMARY & CONCLUSIONS – B

BIOMASS POWER PLANT DESIGNER'S ASPECTS.

- Work closely with a few number of larger biomass suppliers rather than a large number of small suppliers;
- Be aware that biomass waste do not "travel well," and require special fuel handling systems;
- Know that when purchasing biomass, the moisture content and the calorific value must be accounted for;
- Be careful in accepting resource assessment studies, which promise huge supplies of biomass. There is a big difference between promised gross volumes and what is economically viable to recover and use;
- Locate the new biomass waste fired power plant as much as possible near by the biomass waste source and close to the power distribution network.

SUMMARY & CONCLUSIONS – C

EXPECTATIONS FROM GOVERNMENTAL AUTHORITIES

- Grant full support to new biomass based power generation projects;
- A forward-looking and committed national power distribution companies management;
- Ensure guaranteed access for electricity generated in biomass fueled power plant to the national power distribution network;
- To streamline and simplify administrative procedures for the installation of biomass fueled power plants;
- Ensure that the calculation of tariffs for connecting biomass waste fueled power plants to the national grid are fair and non-discriminatory;
- Introduce a bonus system for surplus production;
- Provide clear and concise information to the general public and producers about the environmental and economic costs and benefits of new biomass based power generation technology.

Thank you for your attention.

IMTEAG Switzerland & Connec-T Sdn Bhd Malaysia