ENERGY STUDIES INSTITUTE

Todai Policy Alternatives Research Institute
The University of Tokyo

Energy Policy Roundtable 2012

Overview of ASEAN's Energy Needs and Challenges

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20 April 2012

NUS National University of Singapore

Presentation Outline

1. Energy Poverty in ASEAN
2. ASEAN's Recent and Projected Economic Growth
3. ASEAN's Recent and Projected Total Energy Consumption
4. ASEAN's Energy Resources and Import Needs
5. Electricity Generation in ASEAN
6. Transport Fuel Use in ASEAN
7. Regional Power and Gas Pipeline Networks
8. Potential Role of Renewable Forms of Energy
9. The 5th Fuel: Energy Efficiency
10. Conclusions and Outlook

Energy Poverty in ASEAN

Energy for All

Energy is a critical enabler. Without abundant and reliable energy governments cannot provide the basics:

Food and Water

Education

Health Care

National Security

All societies need abundant and affordable energy to urbanize, modernize and continue to develop

In recognition of the importance of energy access for sustainable economic development and supporting achievement of the Millennium Development Goals (MDGs),

the United Nations General Assembly has designated 2012 as the

International Year of Sustainable Energy for All

2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

Electrification Rates

- The total population of ASEAN is 567 million people. Of these, a startling **160.3 million** have no electricity at all (80% live in rural and remote areas). They use twigs and leaves to cook their food.

- Rural electrification rates range widely throughout the ASEAN region, from 10% in Myanmar to 100% in Singapore

Country	Electrification Rate (%)			Millions
	Total	Urban	Rural	Population without electricity
Brunei	99.7	100.0	98.6	0.0
Cambodia	24.0	66.0	12.5	11.2
Indonesia	64.5	94.0	32.0	81.1
Laos	55.0	84.0	42.0	2.7
Malaysia	99.4	100.0	98.0	0.2
Myanmar	13.0	19.0	10.0	42.8
Philippines	86.0	97.0	65.0	12.5
Singapore	100.0	100.0	100.0	0.0
Thailand	99.3	100.0	99.0	0.4
Vietnam	89.0	99.6	85.0	9.5
ASEAN Region	**71.9**	**91.3**	**54.9**	**160.3**

Source: International Energy Agency Electricity Access Database

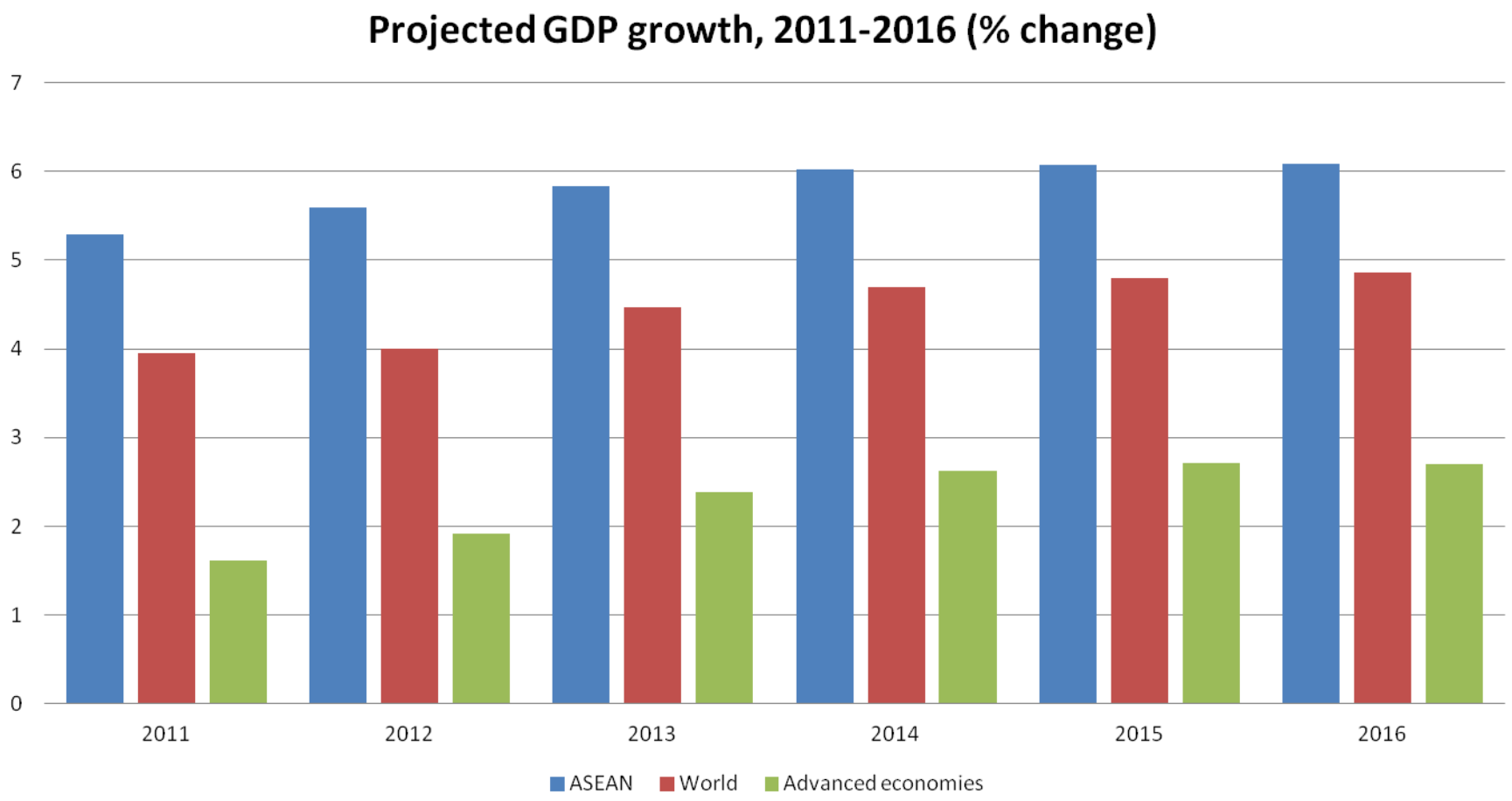
Major Programmes and Targets for Improving Access to Electricity in ASEAN

Country	Program Name	Description	Financing Arrangements
Cambodia	Renewable Energy Strategy	- all villages to have electricity by 2020 - 70% of all rural households to be electrified by 2030 - Remaining 30% of rural households will be targeted through the Renewable Energy Development Programme.	Data unavailable
Indonesia	Rural Electrification Programme – National Energy Management	- 90% electrification for 2020.	Cross subsidies by state owned power utility (PNL) and donors
Lao PDR	Rural Electrification Programme	-80% households to be electrified by 2015. - 90% households to be electrified by 2020. -Electrification of 42,000 rural households through connection to grid of Electricité du Laos (EdL) - Phase 2 will further provide electrification to 10,000 households through off-grid technologies	Cross subsidies and foreign investors (decentralized solutions)
Philippines	Philippines Energy Plan (2004-2013)	- 90% of households to be electrified by 2017.	Grants and loans from a National Electrification Fund and public-private partnerships.

Source: IEA, World Energy Outlook, 2011

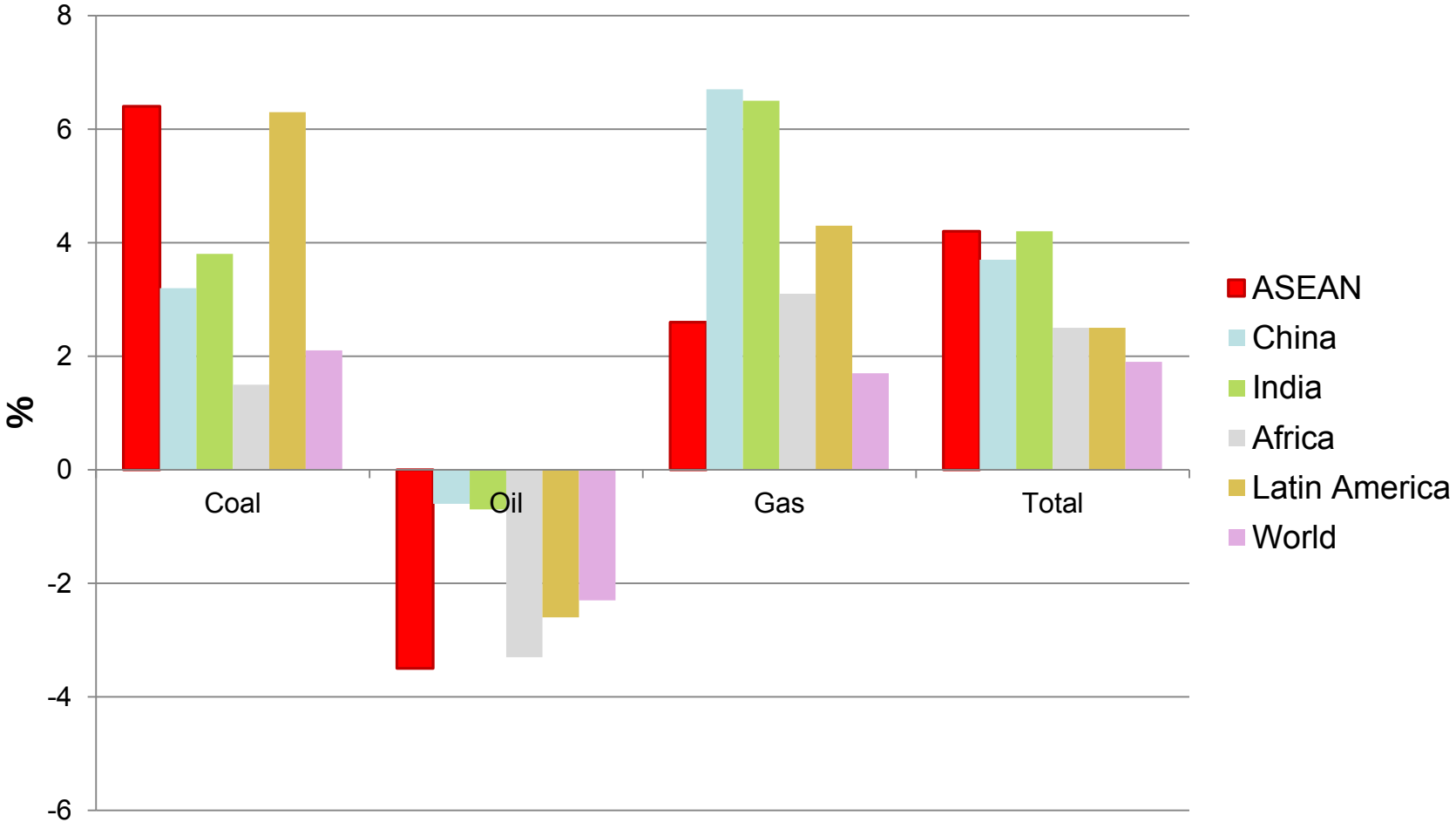
ASEAN's Recent and Projected Economic Growth and Total Energy Consumption

ASEAN, World & Advanced Economies: Projected GDP Growth Rate to 2016



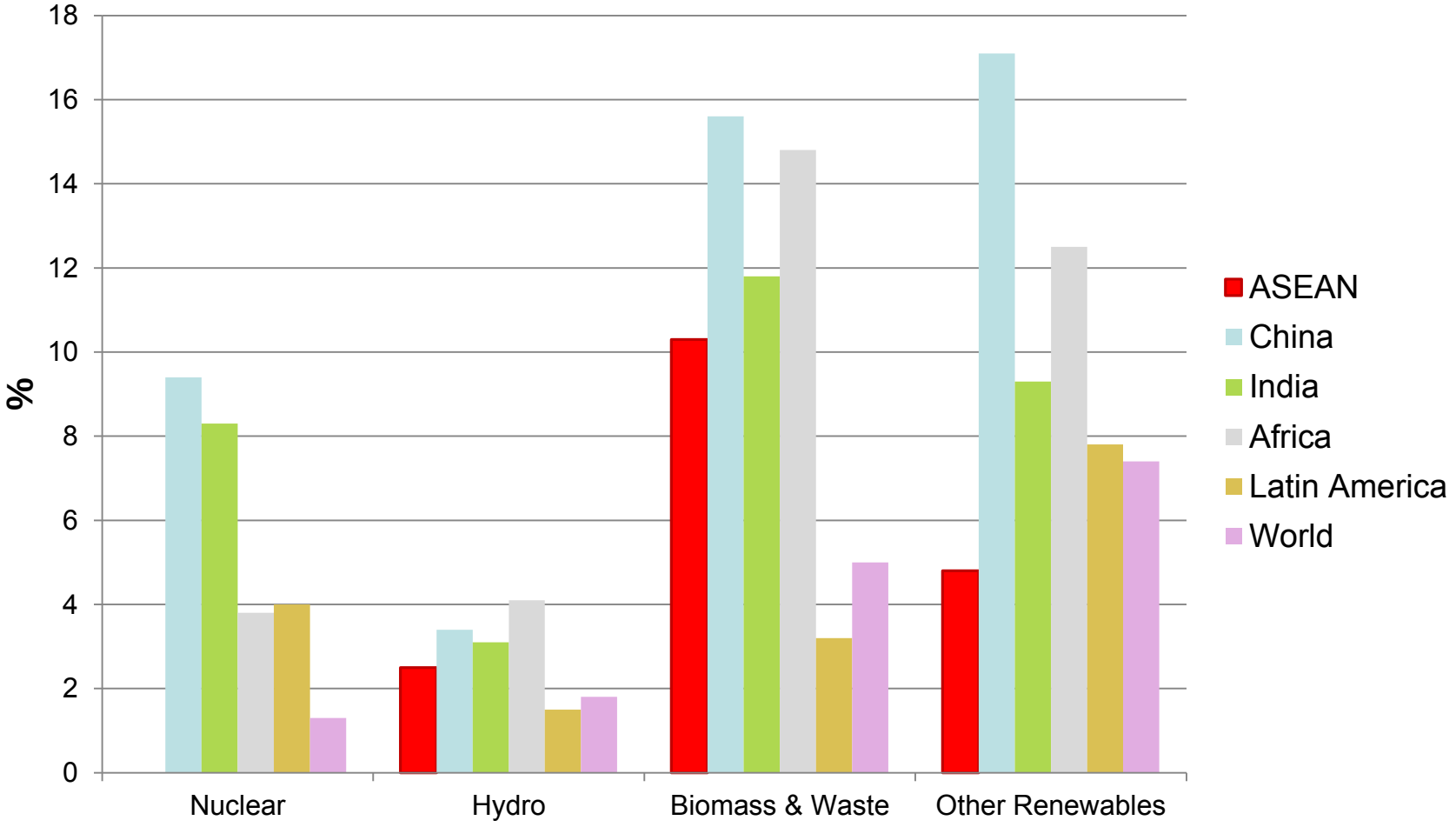
Source: International Monetary Fund, *World Economic Outlook Database*, September 2011

ASEAN AAGR (%) for Power Generation from Fossil Fuels Compared, 2007-2030, IEA Reference Scenario



Source: IEA, (World Energy Outlook 2009. (Reference Scenario)

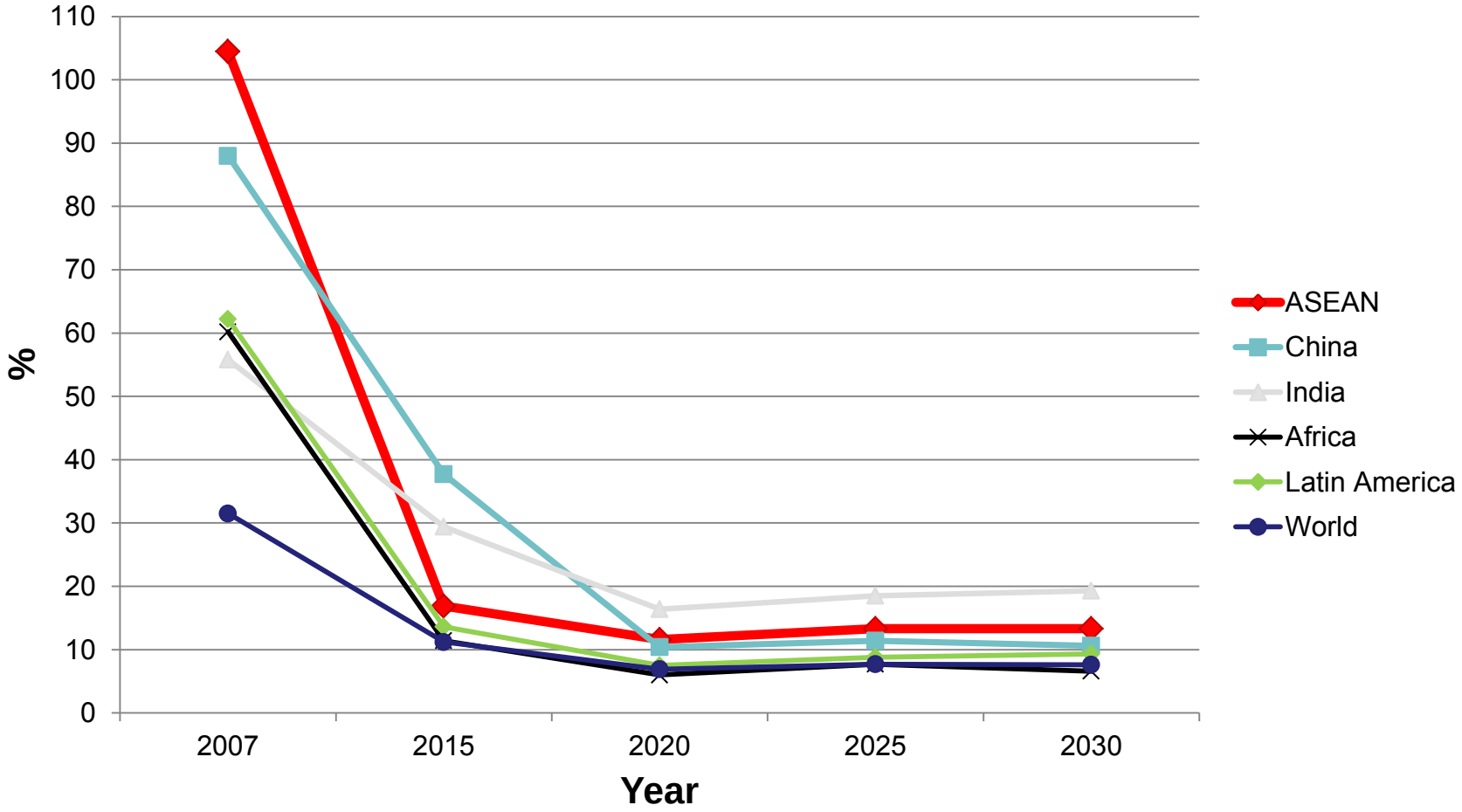
ASEAN AAGR (%) for Power Generation from Nuclear and Renewables Compared, 2007-2030, IEA Reference Scenario



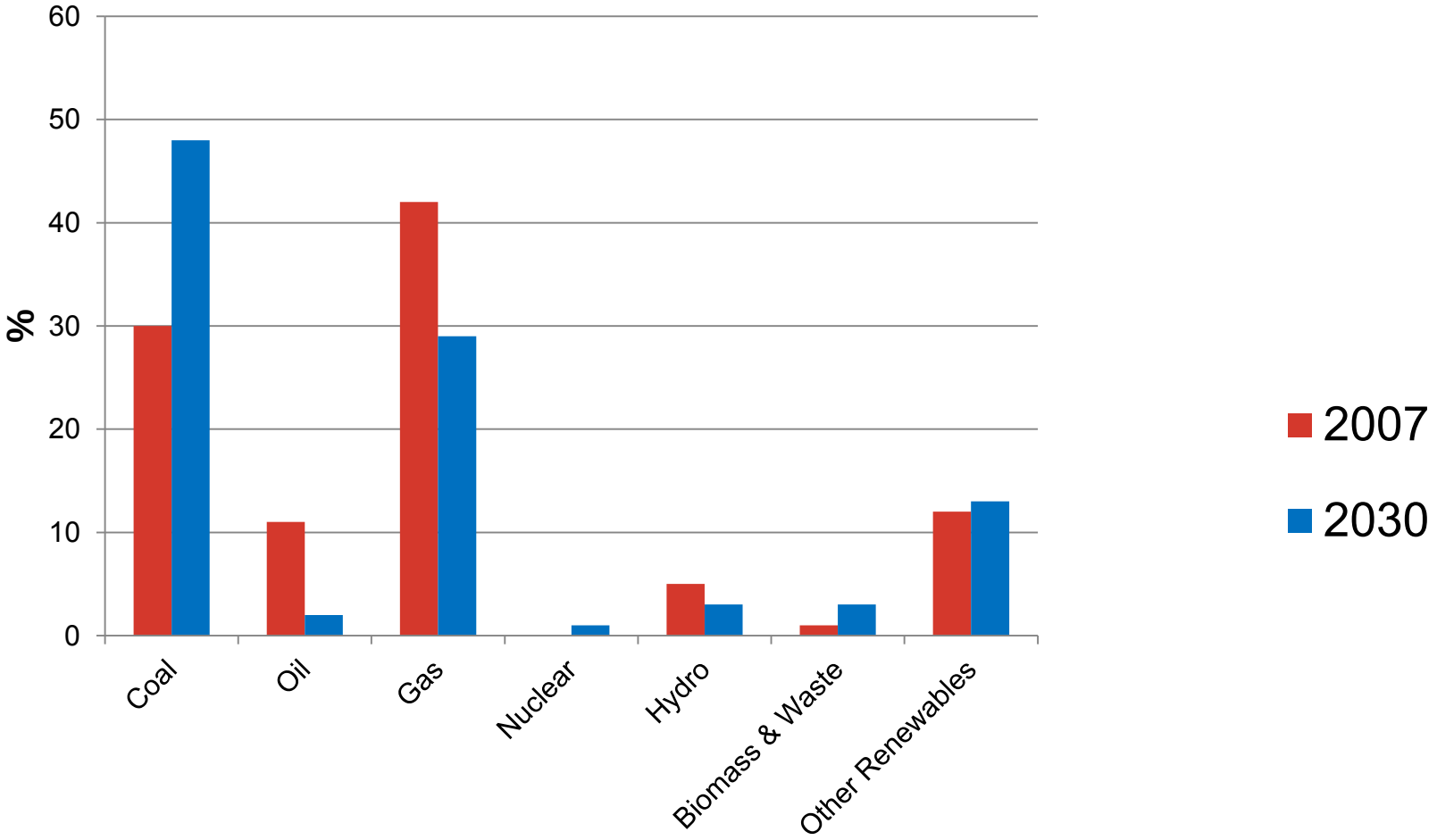
Source: IEA, (World Energy Outlook 2009. (Reference Scenario)

% Growth Total Final Energy Consumption, by Sub-period 2007-2030

IEA Reference Scenario



ASEAN Power Generation (% Share) 2007 and 2030 Compared (IEA Reference Scenario)



ASEAN'S Energy Resources and Energy Import Needs

ASEAN's Energy Resources

Fossil Energy Resources:

- **Oil** -- Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam
- **Gas** -- Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam
- **Coal** -- Indonesia, Malaysia, Philippines, Thailand, Vietnam

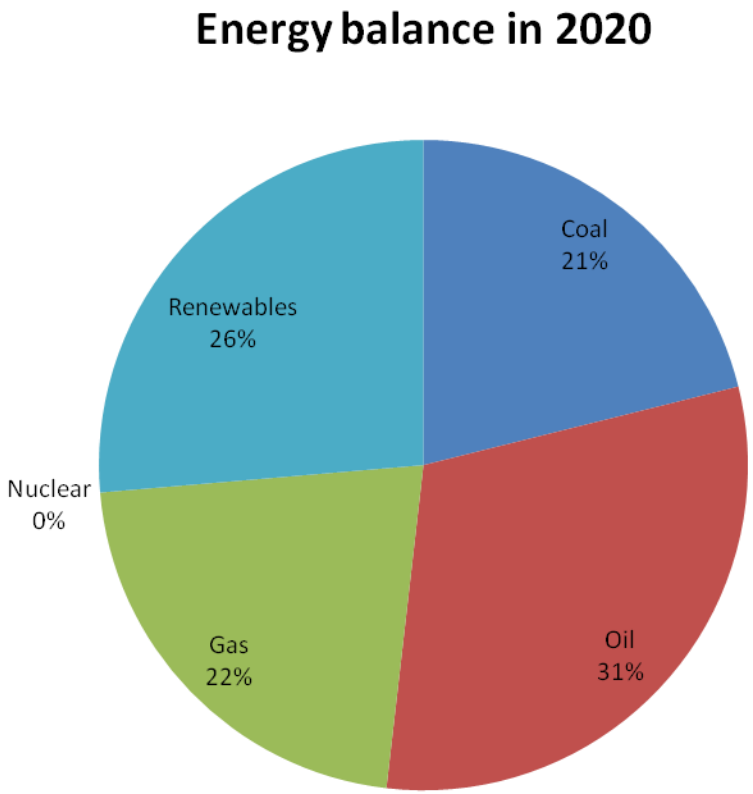
Indonesian coal mine utilizing small contractors, http://www.geokem.com/global-element-dist1.html

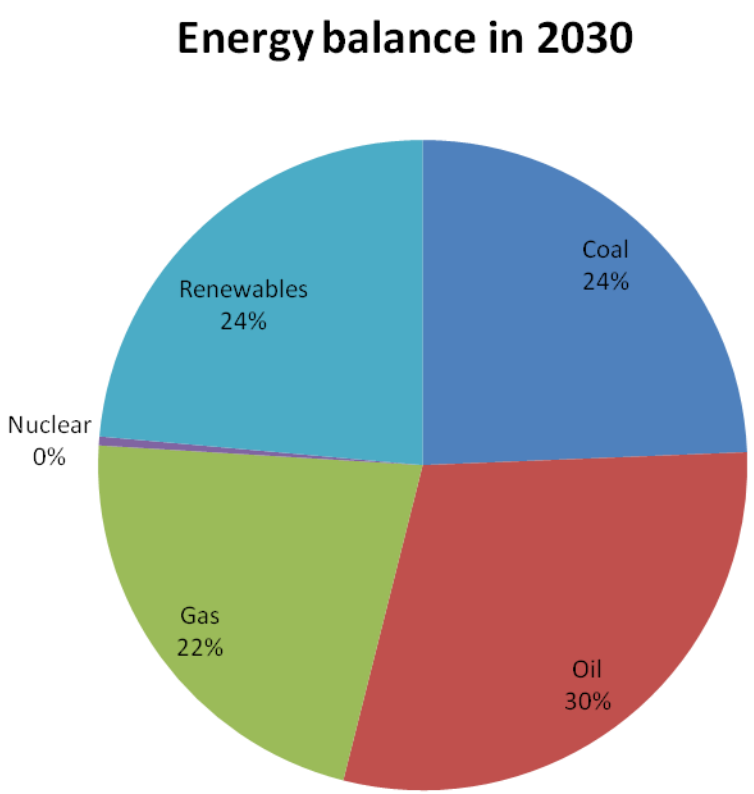
Renewable Energy Resources:

- **Hydro** -- Cambodia, Indonesia, Laos, Myanmar, Philippines, Vietnam
- **Geothermal** -- Indonesia, Philippines
- **Solar** -- all countries have various amounts
- **Wind** -- generally limited potential
- **Biomass** -- all countries have various types and amounts

Indonesia's hydropower station, March 2011, http://en.indonesiafinancetoday.com/read/6178/Bureaucracy-Hampers-Development-of-Hydropower-Plants

Projected ASEAN Energy Balances





Source: IEA, *WEO 2009*

ASEAN's Production, Imports and Exports of Fossil Fuels in 2009

		Fossil Energy Resources			
Country		**Coal and Peat**	**Crude Oil**	**Oil Products**	**Natural Gas**
Brunei	Production	-	8485	-	10454
	Imports	-	-	98	-
	Exports	-	-7667	-	-8009
Cambodia	Production	-	-	-	-
	Imports	-	-	1473	-
	Exports	-	-	-	-
Indonesia	Production	166802	48052	-	67047
	Imports	46	18820	19458	-
	Exports	-136336	-18323	-5020	-31999
Malaysia	Production	1348	34226	-	50341
	Imports	9126	5839	7265	956
	Exports	-119	-12235	-10030	-22288
Myanmar	Production	732	1011	-	10464
	Imports	-	-	642	-
	Exports	-595	-41	-	-7215

* Figures are thousand tones of oil equivalent.

* Data for Laos is unavailable.

Source: International Energy Agency, Energy Balances of Non-OECD Countries, 2011, Paris: International Energy Agency

ASEAN's Production, Imports and Exports of Fossil Fuels in 2009

		Fossil Energy Resources			
Country		**Coal and Peat**	**Crude Oil**	**Oil Products**	**Natural Gas**
Philippines	Production	2474	1143	-	3213
	Imports	4496	6909	7440	-
	Exports	-1052	-1004	-484	-
Singapore	Production	-	-	-	-
	Imports	4	45058	89613	7093
	Exports	-	-46	-82805	-
Thailand	Production	5158	16230	-	19163
	Imports	10625	42361	448	7472
	Exports	-17	-2128	-11500	-
Vietnam	Production	24480	17330	-	7099
	Imports	465	-	14805	-
	Exports	-13995	-13614	-1811	-

* Figures are thousand tones of oil equivalent.

* Data for Laos is unavailable.

Source: International Energy Agency, Energy Balances of Non-OECD Countries, 2011, Paris: International Energy Agency

ASEAN's Production, Imports and Exports of Nuclear and Renewable Energy in in 2009

		Nuclear and Renewable Energy Resources			
Country		**Nuclear**	**Hydro**	**Geothermal**	**Biofuels & Waste**
Brunei	Production	-	-	-	-
	Imports	-	-	-	-
	Exports	-	-	-	-
Cambodia	Production	-	4	-	3664
	Imports	-	-	-	-
	Exports	-	-	-	-
Indonesia	Production	-	979	15981	52981
	Imports	-	-	-	-
	Exports	-	-	-	-282
Malaysia	Production	-	574	-	3205
	Imports	-	-	-	4
	Exports	-	-	-	-223
Myanmar	Production	-	360	-	10531
	Imports	-	-	-	-
	Exports	-	-	-	-

* Figures are thousand tones of oil equivalent. Data for Laos is unavailable.

Source: International Energy Agency, Energy Balances of Non-OECD Countries, 2011, Paris: International Energy Agency

Production, Imports and Exports of Nuclear and Renewable Energy in the ASEAN Region in 2009

		Nuclear and Renewable Energy Resources			
Country		**Nuclear**	**Hydro**	**Geothermal**	**Biofuels & Waste**
Philippines	Production	-	842	8881	6922
	Imports	-	-	-	33
	Exports	-	-	-	-
Singapore	Production	-	-	-	29
	Imports	-	-	-	-
	Exports	-	-	-	-
Thailand	Production	-	615	2	20538
	Imports	-	-	-	57
	Exports	-	-	-	-26
Vietnam+	Production	-	2578	-	25155
	Imports	-	-	-	-
	Exports	-	-	-	-

* Figures are thousand tones of oil equivalent.

•Data for Laos is unavailable.

•Source: International Energy Agency, Energy Balances of Non-OECD Countries, 2011, Paris: International Energy Agency

Electricity Generation in ASEAN

ASEAN Breakdown of Electricity Generation in 2009 (%)

	Coal and Peat	Oil	Gas	Biofuels	Waste	Hydro	Geothermal	Solar PV	Wind
Brunei		1	99						
Cambodia		95.6		0.5		3.9			
Indonesia	41.8	22.8	22.1			7.3	6		
Malaysia	30.9	2	60.7			6.3			
Myanmar		8.9	19.6			71.5			
Philippines	26.6	8.7	32.1			15.8	16.7		0.1
Thailand	19.9	0.5	70.7	40.4		4.8	*neg*	*neg*	*neg*
Singapore		18.8	81		0.2				
Vietnam	18	2.5	43.4			36			

Source: International Energy Agency (IEA)

Coal

The Region depends heavily on coal to generate electricity and this dependence is expected to rise over the next decade.

- Coal represents the cheapest and most convenient fuel to meet the expected surge in electricity demand
- Coal is the undisputed leader in dirty fuel
- Burning coal releases more CO_2 per unit of energy than oil and natural gas.

- In terms of its lifecycle, the mining, transportation and burning of coal leads to major environmental and health hazards, from smog, acid rain, mercury pollution in rivers, to asthma and other respiratory ailments.

Natural Gas

The Region is expected to use more gas over the next decade to generate electricity.

- It is a cleaner fuel than coal
- Thailand and Singapore import large quantities
- Malaysia, Brunei and Myanmar all export gas
- IEA predicts that unconventional natural gas will supply 40% of the increase in global supply
- IEA says recoverable conventional gas resources are equivalent to more than 120 years of current consumption in the world; total gas resources could sustain today's production for 250 years

Oil

The Region will use less and less oil over the next decade to generate electricity.

- It is generally the most expensive way to generate electricity
- It is a highly polluting way to generate electricity
- It makes more sense to refine the oil and use the petroleum products in the transport sector
- Cambodia relies heavily on oil to generate electricity (diesel generators) because it does not yet have coal or gas powered plants.

Nuclear Power

Post-Fukushima:

- Vietnam has not changed its plans to build a nuclear power plant. It has signed agreements with Russia and Japan to build two 1000 MW reactors. Russia will start the construction of the first one in 2013
- Indonesia continues to discuss plans. Malaysia, Singapore and the Philippines have also not discontinued studying this option
- Thailand has put its nuclear plans on hold

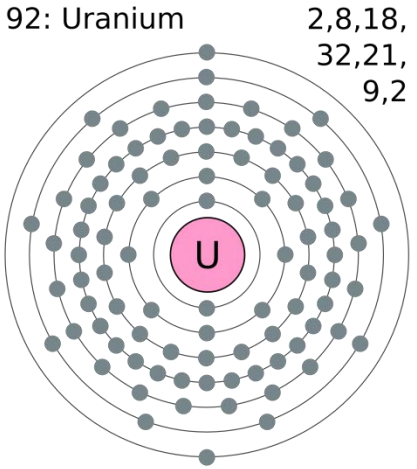
Source: The International Institute for Strategic Studies
http://www.iiss.org/EasySiteWeb/GatewayLink.aspx?alId=32468

Major Advantages:

- Does not contribute to global warming and climate change
- ASEAN lacks adequate domestic coal, gas and oil
- Potentially volatile pricing of fossil fuel imports can be ruinous to the developing countries of ASEAN. Governments forced to subsidise the cost of electricity.

Issues with Nuclear

- Ring of Fire and earthquakes/volcanoes
- Cost
- Lead time for construction of nuclear power plants
- Shortage of skilled labour
- Disposal of radioactive nuclear waste
- Corruption
- Lack of “Maintenance Culture”



Nuclear Security Risks

- Incidents at the nuclear power plant or during transportation of nuclear materials
- Terrorist attacks on nuclear power plant or during transportation
- Theft of radioactive or nuclear materials

Source: The International Institute for Strategic Studies
http://www.iiss.org/EasySiteWeb/GatewayLink.aspx?alId=32468

Transport Fuel Use in ASEAN

Energy Use in the Transport Sector

- The transport sector in Malaysia, Philippines, Thailand, Indonesia, Singapore and Vietnam accounted for 17-35% of total energy consumption in 2009.

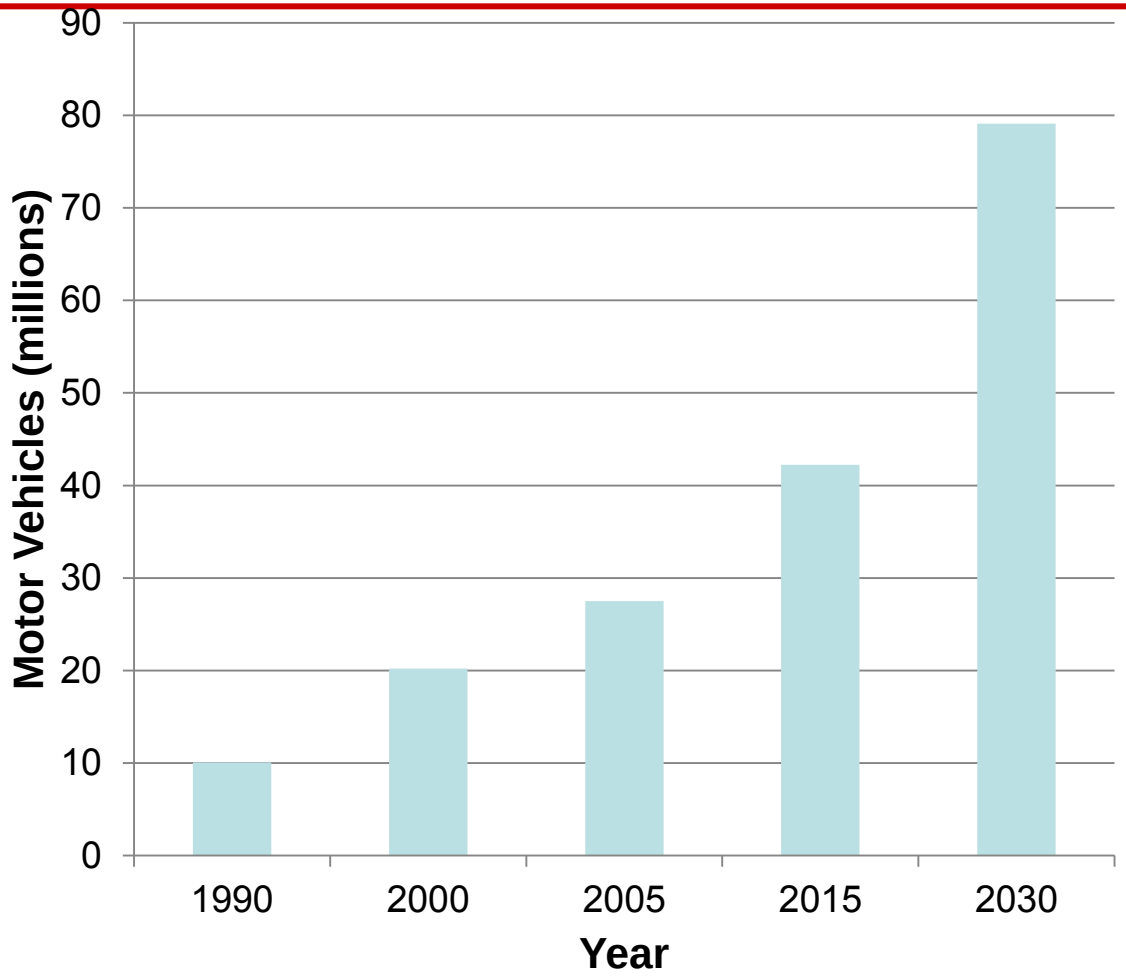
- Transport consumption has increased commensurately with economic growth

Country	Transport Sector Energy Consumption (% of total energy consumption)
Malaysia	35.1
Philippines	35.0
Thailand	25.1
Indonesia	21.6
Singapore	20.3
Vietnam	17.3

Source: International Energy Agency (IEA), (2011)

Vehicle Population

(Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam)

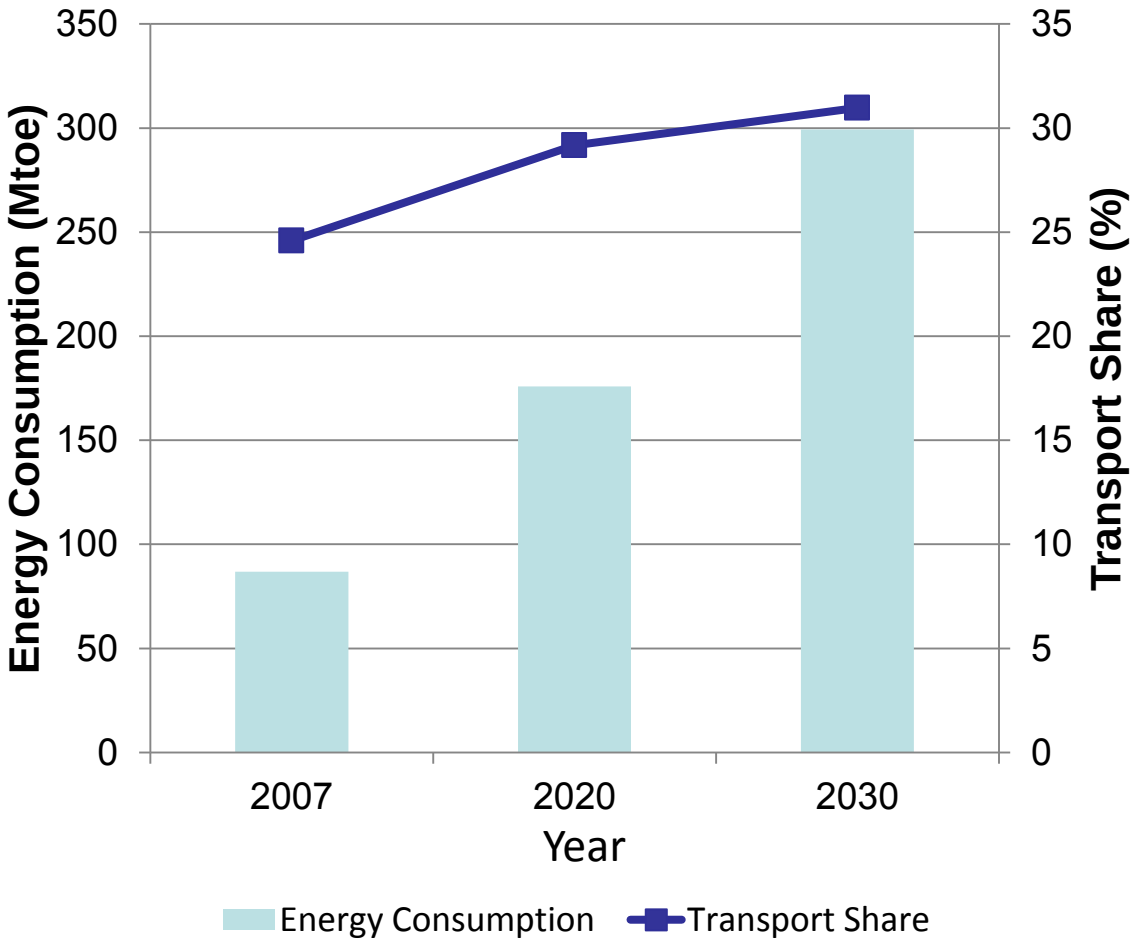


Vehicle population in these ASEAN countries is expected to grow from 10 million in 1990 to 79 million in 2030.

Source, Asia Pacific Energy Research Centre, *APEC Energy Demand and Supply Outlook 4th Edition,* 2009

Projected Transport Sector Consumption

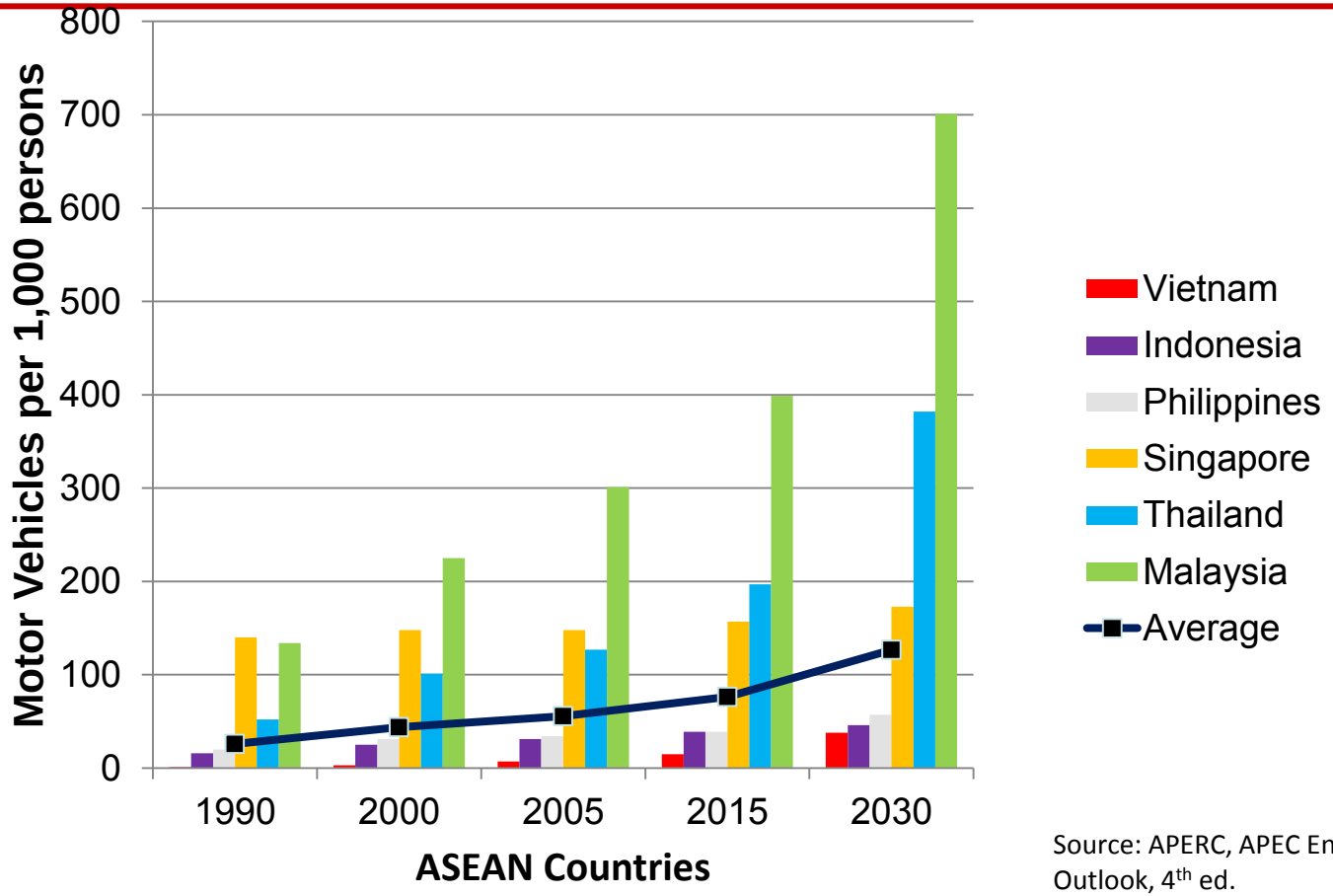
(Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam)



- Transport consumption is projected to increase from 87 Mtoe in 2007 to 176 Mtoe in 2020 and 299 Mtoe to 2030.
- The share of transport is projected to increase from 24.6% in 2007 to 29.2% in 2020 and 31.0% in 2030.

Source: Institute of Energy Economics, *3rd ASEAN Energy Outlook*, Japan 2011

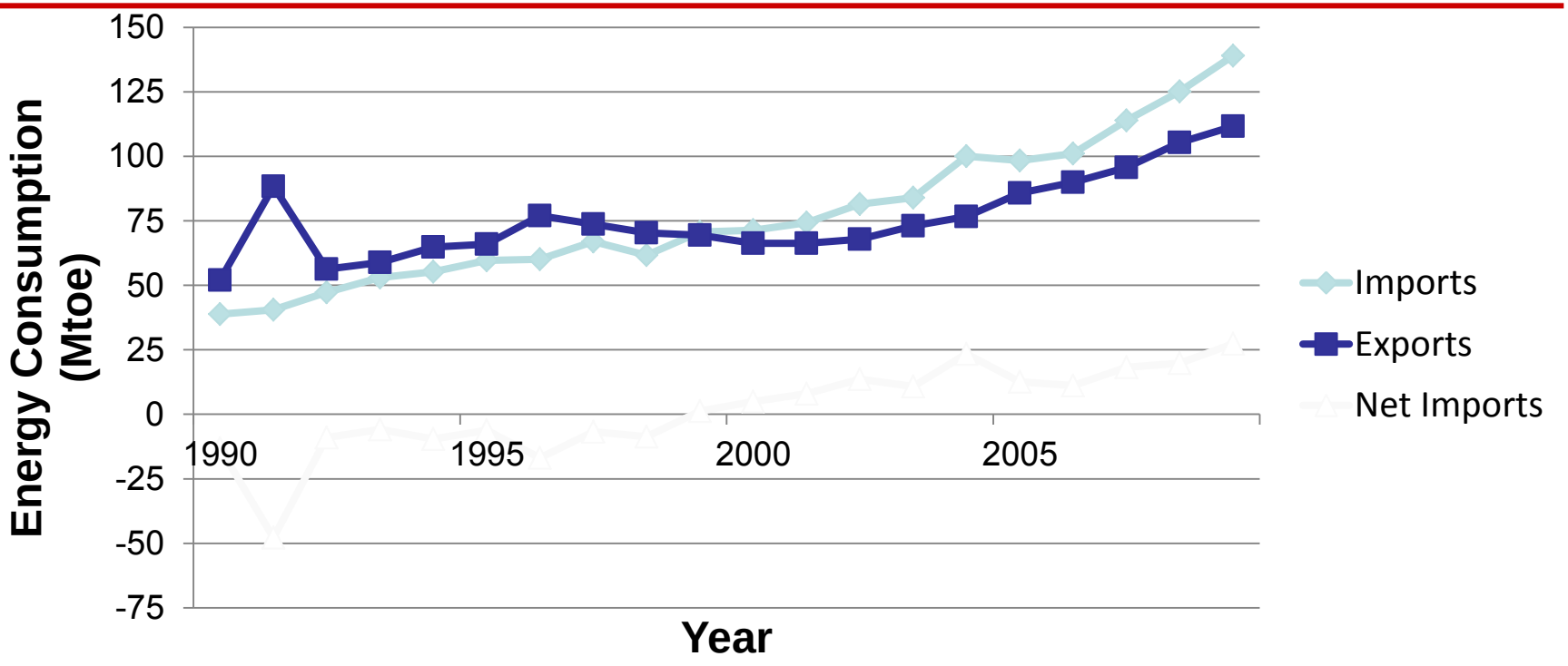
Vehicle Population Per Capita



- On average, this translates to a 492% increase from 26 vehicles per 1,000 persons in 1990 to 127 vehicles per 1,000 persons in 2030.

Source: APERC, APEC Energy Demand and Supply Outlook, 4th ed.

Import/Export of Petroleum Products



Around 1999, ASEAN went from being a net exporter (13.2 Mtoe in 1990) to a net importer (27.4 Mtoe in 2009) of petroleum products.

Source: IEA (2011)

ASEAN Refinery Capacities

Of the ten ASEAN countries, only Cambodia and Laos have no refineries. They must import all their required refined products.

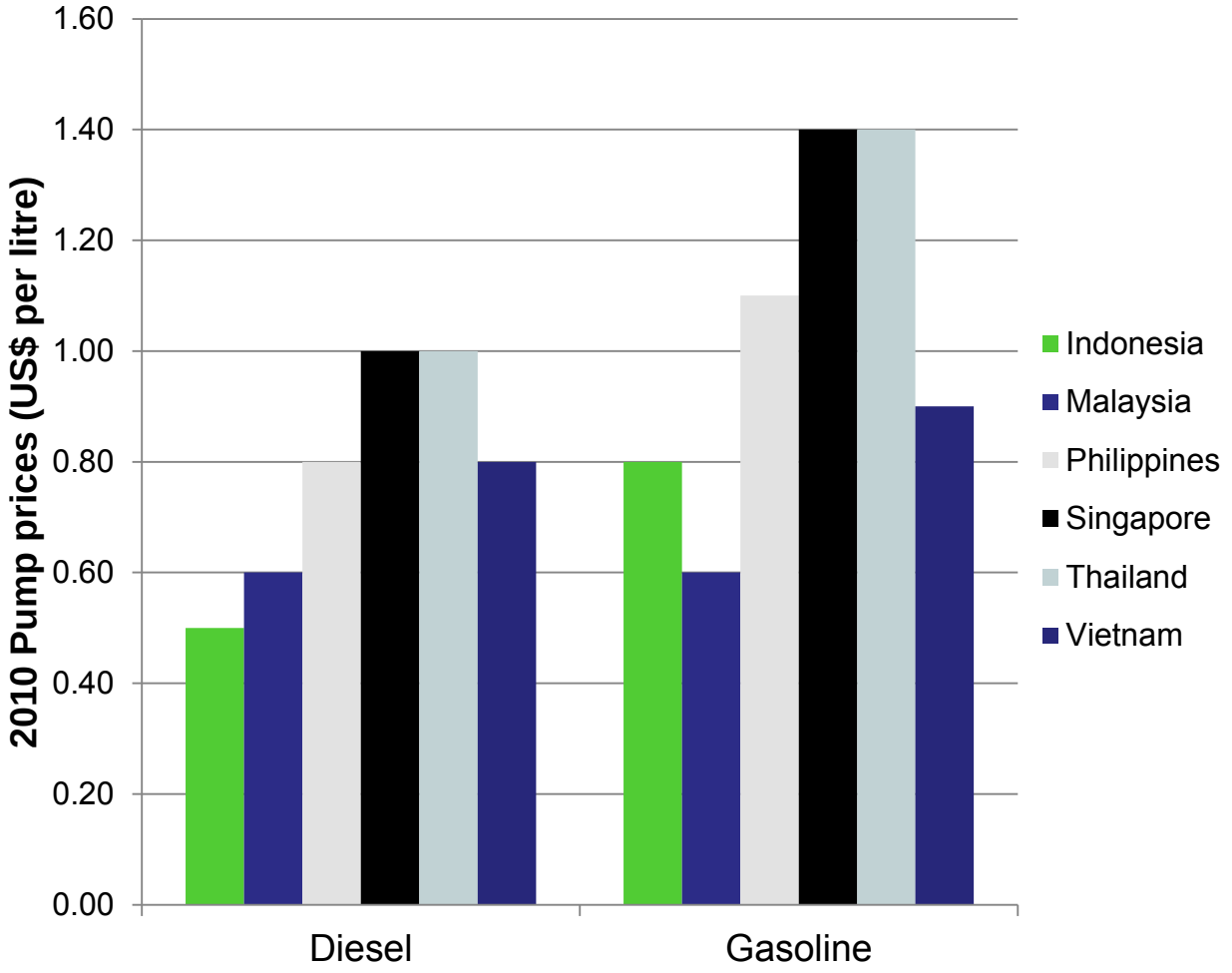
ASEAN	Refinery Capacity (Barrels per day)
Brunei	9,000
Myanmar	57,000
Vietnam*	130,500
Philippines	282,000
Malaysia	515,000
Thailand	729,000
Indonesia	1,000,000
Singapore	1,344,000
Total	4,066,500

* Vietnam's refinery halted temporarily in 2009 but resumed in 2011

Source: EIA Countries Data, 2009. (http://www.eia.gov/countries/)

Pump Prices

- Malaysia and Indonesia have the highest expenditures on fuel subsidies
- The Philippines and Thailand provide targeted subsidies for public transport
- There are no fuel subsidies in Singapore



Source: World Bank (2012)

Fuel Subsidy Implications

- Fuel subsidies hamper the ability of a government to fund other programmes, particularly those directed towards low income groups
- In Indonesia, 40% of high income families benefit from 70% of the fuel subsidies while 40% of the lowest income families benefit from only 15% of the subsidies
- Fuel subsidies also create a strain on government budgets, particularly in times of high fuel prices
- In 2011, fuel subsidies accounted for $14 billion or 11% of Indonesia's state budget, more than the $2.3 billion spent by the government on education and health combined
- In addition, fuel subsidies distort economic prices, discourage energy efficiency improvements and promote wasteful consumption

Ending Fuel Subsidies

- Many ASEAN countries have announced plans to phase out fuel subsidies due to high oil prices which have resulted in increasing government expenditure
- From a political viewpoint, it is difficult to remove subsidies, generating often violent public discontent
- In 1998, a fuel price hike in Indonesia helped trigger student riots which ended President Suharto's 32 year reign
- In 2008, an oil subsidy cut in Malaysia led to student protests, after which the ruling coalition lost a third of its parliamentary seats and control of five states to the opposition
- More recently, in April 2012, weeks of protests led to the Indonesian government reversing plans for an immediate fuel price hike

Ways to End Fuel Subsidies

- The political fallout from removing subsidies can be minimized by ending subsidies at the right moment

- In April 2012, the Taiwanese government found a political opportunity to end fuel subsidies and raise petrol prices by 10% as there were no major elections coming up in the next four years

- Subsidies can also be removed in times of low oil prices. In 2009, the price of oil was at around $35 per barrel, in contrast to the price of over $100 per barrel today

Regional Power and Gas Pipeline Networks

ASEAN Power Grid and Gas Pipeline Network Projects

- ASEAN was established in 1967 (initial membership of 5 states) with the stated goal of promoting regional stability, cooperation, trade, and economic growth

- Energy was identified as a key area for cooperation.
  - Initially, cooperation was viewed as a way of enhancing energy security
  - Of late, the environment is also viewed a driver

- In 1997, the Heads of State at the Second ASEAN Informal Summit (Kuala Lumpur) envisioned an energy integrated Southeast Asia. Energy integration was to be driven by two projects:
  - The ASEAN Power Grid Project (APG)
  - The Trans-ASEAN Gas Pipeline (TAGP)

Map of Proposed ASEAN Power Grid and Gas Pipeline Network Projects

ASEAN Power Grid. (Photo credit: Aseanenergy.org)

Slow Progress on APG and TAGP

The ASEAN Power Grid Project (APG)

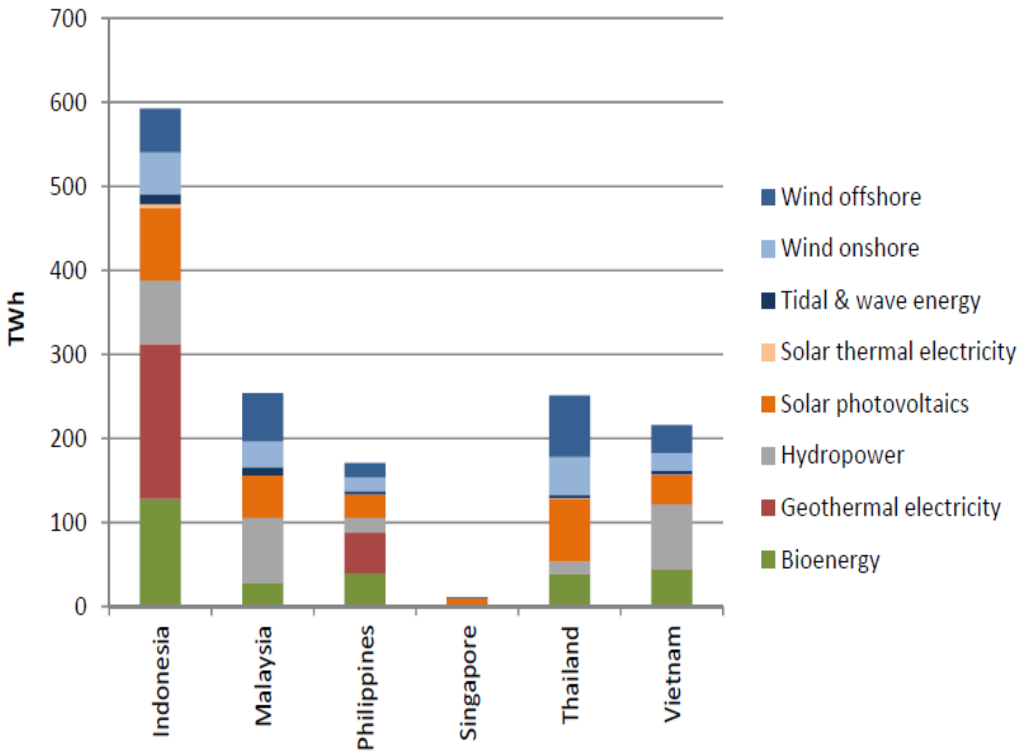
- Bilateral arrangements have driven existing grid interconnections
- Progress going forward will be slow given the complexity and scale of the task
- Electricity trading in ASEAN will be along time coming

The Trans-ASEAN Gas Pipeline (TAGP)

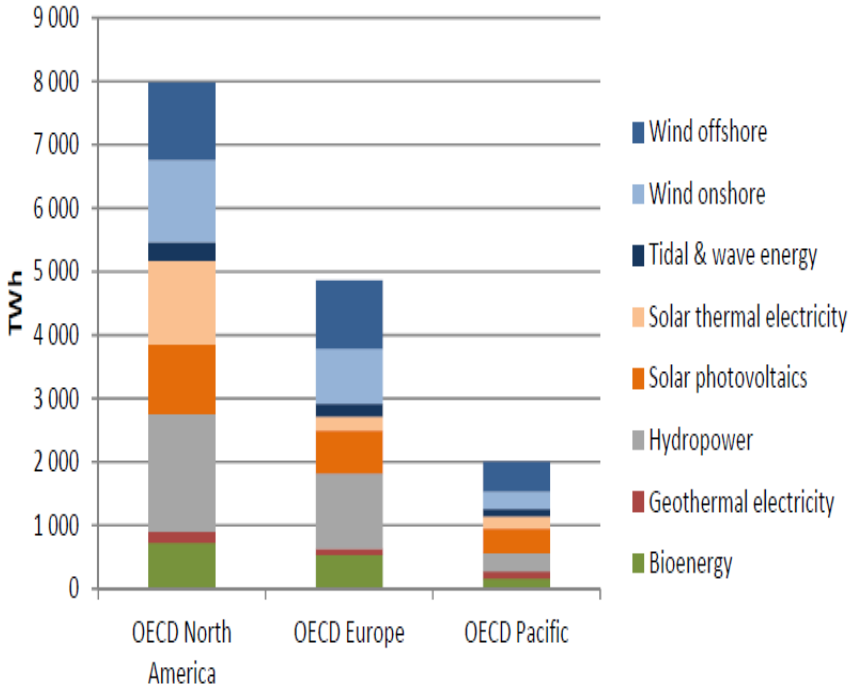
- Efforts to build the TAGP did not pan out as expected, most developments to date are on a bilateral basis
- The evolution of the natural gas market and technological progress has impeded the expansion of the TAGP as previously envisioned
- The flexibility afforded by LNG, a substitute to pipeline transport of gas, would most likely be favoured by governments in the region

Potential Role of Renewable Forms of Energy

Strong Renewable Energy Potential in ASEAN



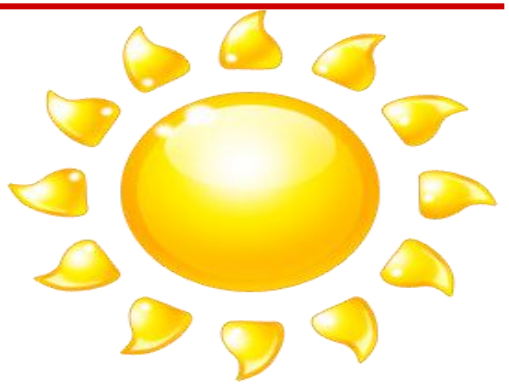
2030 Renewable Electricity Potentials in ASEAN-6 Countries (source: IEA 2011)



2030 Renewable Electricity Potentials in Major OECD-30 Sub-regions (source: IEA 2011)

Renewables for Electricity Generation

Wind, solar, geothermal, etc., can play a useful supplementary role. However, they will not replace fossil fuels in the next two decades.



- Indonesia and Philippines have large geothermal reserves.

- Substantial hydropower resources in the region, but they cannot replace fossil fuels.

Biofuels for Transport

Asia will experience soaring demand for biofuels in the coming years as the demand for private vehicles soars

ASEAN's largest biofuel producers are: Indonesia, Malaysia, Thailand and the Philippines

Biofuel Industry Drivers

- Decline of the region's oil reserves
- Huge imports of oil result in negative trade balances and an outflow of foreign exchange
- Price of oil could reach new heights due to physical and/or political factors
- Subsidisation of oil prices places great strain on government finances (e.g. Indonesia)
- It is hoped that the biofuels industry can help pull thousands of rural residents out of poverty

Concerns Linked with Biofuels

- Deforestation
- Soil and water depletion
- Loss of biodiversity
- Loss of farmland
- Eutrophication
- Haze
- High energy consumption in biofuels production, thus questionable decreases in carbon dioxide emissions
- First generation biofuels are food crops. This can put pressure on food prices and exacerbate of poverty

The 5th Fuel: Energy Efficiency

Poor Energy Efficiency in ASEAN: An Example

	(billion kWh)	% of total net generation
Brunei	0.218	6%
Burma (Myanmar)	0.22	34%
Cambodia	15.359	19%
Indonesia	0.26089	10%
Laos	3.992	7%
Malaysia	1.914	4%
Philippines	7.5	13%
Singapore	2.155	5%
Thailand	8.776	6%
Vietnam	7.987	10%
China	181.151	5%
Europe	242.3985	29%
United States	260.5807	7%
India	219.866	6%
OECD	662.377	7%

The Region has very high transmission and distribution losses.

These waste resources and add to costs.

Energy Efficiency – Overcoming Challenges

- Must convey the right message about how energy efficiency contributes to economic prosperity, focusing on important issues other than climate change mitigation.
- Can shift the emphasis of scaling up energy efficiency from developing technologies to delivering energy savings.
- Both regulatory policies and financial incentives are required to promote energy efficiency market transformation; appropriate emphasis and balance between the two will vary from one country to another.
- Carbon finance remains largely untapped as a major financial incentive to help scale up energy efficiency markets.

Conclusions and Outlook

Concluding Remarks

ASEAN's Electricity Needs

- Still millions of people suffering in this region due to lack of electricity
- The region faces very high demand for electricity over the next two decades
- There is considerable coal and gas in the region, but more will need to be imported
- Coal is a step backwards in terms of global warming
- Nuclear option takes time and comes with many real concerns
- Renewables will contribute only a small portion of required electricity

Concluding Remarks

ASEAN's Transport Fuel Needs

- Phenomenal increase in vehicle ownership expected over next two decades
- Demand for gasoline and diesel will be staggering; most will need to be imported.
- Blending of biofuels into transport fuels expected to be slow; controversial

Regional Power and Gas Pipeline Networks

- Good intentions, and very logical but progress is slow

Energy Efficiency

- Energy efficiency is generally very low. Tremendous scope to improve it

Concluding Remarks

There are many opportunities to assist ASEAN with its provision and use of energy.

The region has good potential to “leapfrog” to the newest energy technologies and not go through the inefficient and environmentally damaging industrial revolution that the rest of the world went through.

Thank you