United Nations Economic and Social Commission for Asia and the Pacific

United Nations ESCAP

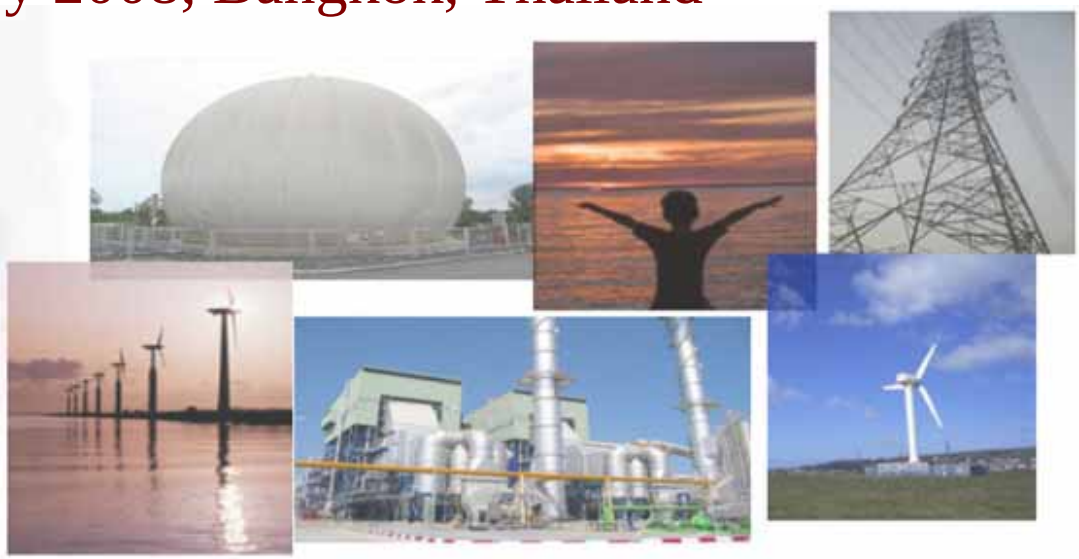
Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

PROMOTION OF BIOGAS AND BIOMASS IN ASIA AND THE PACIFIC

Regional Forum on Bioenergy Sector Development:
Challenges, Opportunities and the Way Forward

23-25 January 2008, Bangkok, Thailand

Alan Dale Gonzales
Executive Director
Full Advantage Co., Ltd.



Objectives of the Study

- ✦ To investigate the current situation of biogas and biomass and their market potential in major countries of Asia and the Pacific;
- ✦ To explore current and next generation biogas and biomass technologies;
- ✦ To explore biomass resources, utilisation and trade;
- ✦ To analyse cross-cutting issues for fostering bioenergy sector development.

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Project Structure: Dan Chang Bio-Energy

Owner/Developer	: Dan Chang Bio-Energy Co., Ltd.
Major Shareholders	: Mitr Phol Sugar Co., Ltd.; Mitr Particle Board; Others
Location	: Dan Chang, Suphanburi, Thailand
Total Capacity	: 53 MW
Fuel	: Bagasse, cane leaves, wood bark and rice husk
Major Off-takers	: EGAT (SPP, 21 years, firm contract) Mitr Phol Sugar Co., Ltd. (steam + power)
Major equipment	: Boilers - 2x120 tph, 68 bar, 510^{0}C (Alstom) Turbine - 41 MW extraction-condensing (Alstom) Existing boilers + turbine (from sugar mill)
O&M	: Internal
Incentives	: BOI privileges, EPPO subsidy
Financing	: Project finance


CHIA MENG CO.,LTD.
2.4 MW rice husk-fired cogeneration plant
with the support of
the EC-ASEAN COGEN Programme
COGEN
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CHIA MENG CO.,LTD.
with the support of

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Project Structure: Chia Meng Rice Mill

Owner/Developer	: Chia Meng Group (Korat) Co. Ltd.
Major Shareholders	: Chia Meng Co. Ltd.
Location	: Chakkaraj, Nakorn Ratchasima, Thailand
Total Capacity	: 2.5 MW
Fuel	: Rice husk
Commissioned Date	: March 1997 (COGEN phase 2 Full Scale Demonstration Project)
Major equipment	: Boilers - Reciprocating inclined grate type. Capacity - 17 tph, 35 bar, 420 oC Turbine – 2.5 MW fully condensing type
European Supplier	: Konus Kessel GmbH, Deutsche Babcock Group


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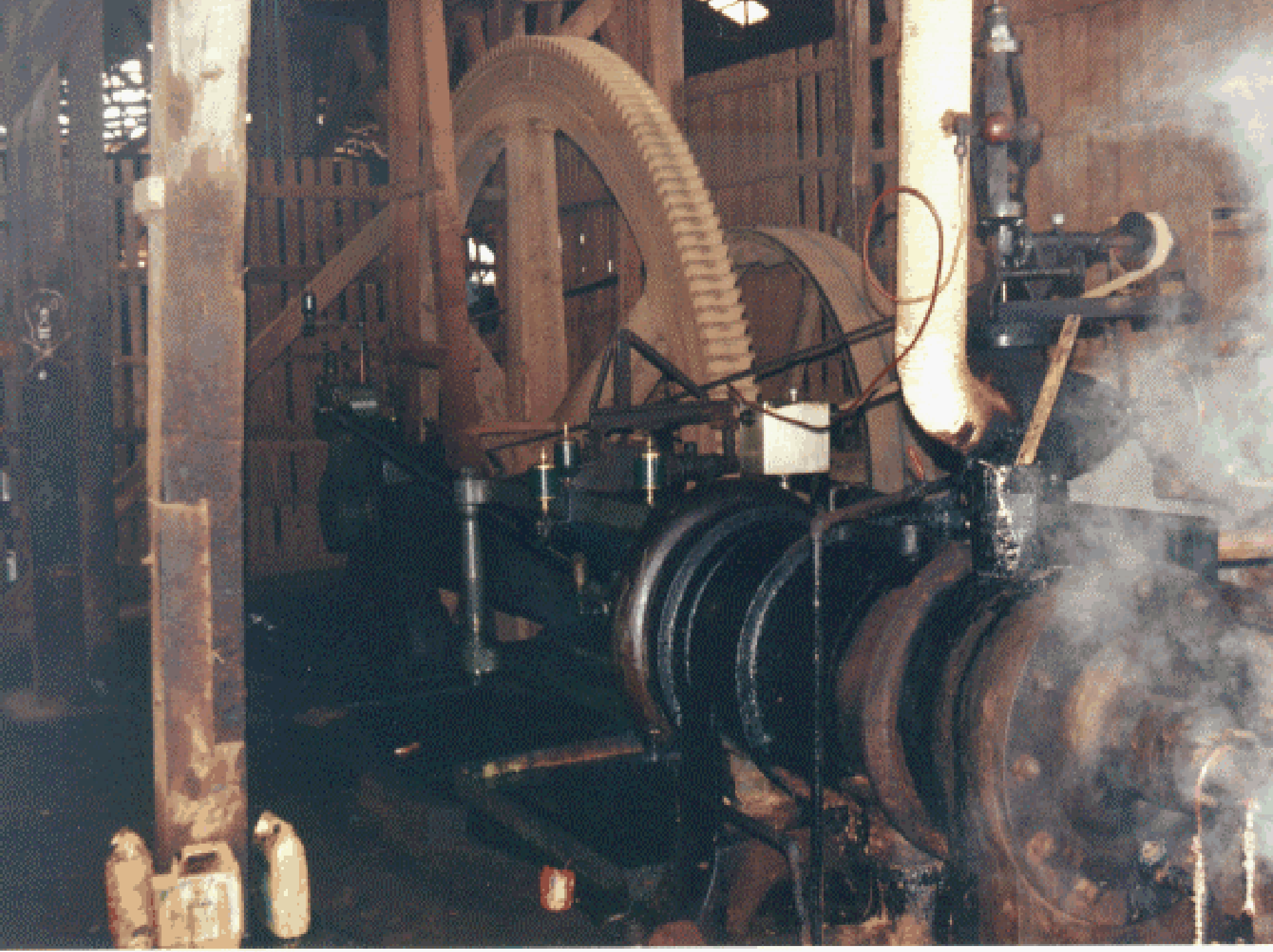
Project Structure: TSH Bio Energy

Owner/Developer	: TSH Bio Energy Sdn Bhd
Major Shareholders	: TSH Resources Bhd
Location	: Kunak, Sabah, Malaysia
Capacity	: 14 MW
Fuel	: EFB (Empty Fruit Bunch), mesocarp fiber and palm kernel shell
Major Off-takers	: SESB (SREP, 21 years, firm contract) TSH Plantation Sdn. Bhd. (steam + power)
Major Equipment	: Boiler - 80 tph, 58 bar, 402^{0}C (Babcock&Wilcox) through ENCO
O&M	: Internal
Incentives	: Tax holidays, accelerated depreciation of CAPEX
Financing	: Corporate finance



Project Structure: Bee Joo Industries

Owner/Developer	: Bee Joo Industries Pte Ltd
Location	: Singapore
Capacity	: 1.0 MW
Fuel	: Wood waste
Major Off-takers	: In-house consumption
Major Equipment	: *Boiler:* Biomass-fired, dynamic water-cooled step-grate steam boiler *Turbine:* Single-stage impulse turbine
O&M	: Internal
Financing	: Corporate finance

Project Structure: Rayong Waste-to-Energy

Owner/Developer	: Rayong Municipality
Location	: Rayong, Thailand
Total Capacity	: 625 kW
Fuel	: Biogas
Major Off-takers	: PEA (VSPP)
Major Equipment	: Gas engine (Jenbacher)
O&M	: External contractor
Financing	: Government funds

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Energy Consumption from Solid Biomass

County	2004	2003	2000	1990
China	217,904	217,695	213,186	200,407
India	213,324	211,201	201,583	175,816
Indonesia	45,072	45,785	43,376	39,451
Malaysia	1,324	2,637	2,531	2,100
Philippines	7,614	10,306	9,541	7,642
Thailand	7,835	14,665	14,257	14,646
VietNam	22,470	23,435	22,631	18,900
Asia (excluding Middle East)	**577,569**	**588,237**	**565,514**	**508,634**

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Energy Consumption from Biogas

County	2004	2003	2000	1990
China	1,278	1,289	1,242	0
India	0	0	0	0
Indonesia	0	0	0	0
Malaysia	0	0	0	0
Philippines	0	0	0	0
Thailand	0	0	0	0
VietNam	0	0	0	0
Asia(excluding MiddleEast)	**1,553**	**1,545**	**1,455**	**61**

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Estimation of Agricultural Residues in China, 2006

Type	Production (ÕÕÕ tons)	Type of residues	Residue production ratio(RPR)	Residue generated (ÕÕÕ tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	100,684	Bagasse	0.291	29,299.04	14.4	421,906.23
		Top & Trashier	0.302	30,406.57	17.39	528,770.22
Paddy	184,070	Husk	0.23	42,336.10	14.27	604,136.15
		Straw(top)	0.447	82,279.29	10.24	842,539.93
Oil Palm Fruit	650	Empty bunch	0.428	278.20	17.86	4,968.65
		Fibre	0.147	95.55	17.62	1,683.59
		Shell	0.049	31.85	18.46	587.95
		Frond	2.604	1,692.60	9.83	16,638.26
		Male bunch	0.233	151.45	16.33	2,473.18
Coconut	290	Husk	0.362	104.98	16.23	1,703.83
		Shell	0.16	46.40	17.93	831.95
		Empty Bunch	0.049	14.21	15.4	218.83
		Frond	0.225	65.25	16	1,044.00
Cassava	4,318	Stalk	0.088	379.98	18.42	6,999.31
Maize	145,625	Corncob	0.273	39,755.63	18.04	717,191.48
GroundNut	14,722	Shell	0.323	4755.206	12.66	60,200.91
Soybean	15,500	Stalk, Leaves, Shel	2.663	41,277.17	19.44	802,428.10
TOTAL	**465,859**			**272,969.47**		**4,014,322.56**

Source: Processed by the Author from FAO Statistics

Estimation of Agricultural Residues in India, 2006

Type	Production (ÕÕÕ tons)	Type of residues	Residue production ratio(RPR)	Residue generated (ÕÕÕ tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	281,170	Bagasse	0.291	81,820.47	14.4	1,178,214.77
		Top & Trashier	0.302	84,913.34	17.39	1,476,642.98
Paddy	136,510	Husk	0.23	31,397.30	14.27	448,039.47
		Straw (top)	0.447	61,019.97	10.24	624,844.49
Oil Palm Fruit	0	Empty bunch	0.428	0.00	17.86	0.00
		Fibre	0.147	0.00	17.62	0.00
		Shell	0.049	0	18.46	0.00
		Frond	2.604	0.00	9.83	0.00
		Male bunch	0.233	0.00	16.33	0.00
Coconut	11,000	Husk	0.362	3,982.00	16.23	64,627.86
		Shell	0.16	1,760.00	17.93	31,556.80
		Empty Bunch	0.049	539	15.4	8,300.60
		Frond	0.225	2475	16	39,600.00
Cassava	7,620	Stalk	0.088	670.58	18.42	12,352.04
Maize	14,710	Corncob	0.273	4,015.83	18.04	72,445.57
GroundNut	4,980	Shell	0.323	1608.54	12.66	20,364.12
Soybean	8,270	Stalk, Leaves, Shel	2.663	22,023.01	19.44	428,127.31
TOTAL	**464,260**			**296,225.04**		**4,405,116.02**

Source: Processed by the Author from FAO Statistics

Estimation of Agricultural Residues in Indonesia, 2006

Type	Production (000 tons)	Type of residues	Residue production ratio(RPR)	Residue generated (000 tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	30,150	Bagasse	0.291	8,773.65	14.4	126,340.56
		Top & Trashier	0.302	9,105.30	17.39	158,341.17
Paddy	54,400	Husk	0.23	12,512.00	14.27	178,546.24
		Straw (top)	0.447	24,316.80	10.24	249,004.03
Oil Palm Fruit	64,255	Empty bunch	0.428	27,501.27	17.86	491,172.65
		Fibre	0.147	9,445.53	17.62	166,430.22
		Shell	0.049	3148.5097	18.46	58,121.49
		Frond	2.604	167,320.80	9.83	1,644,763.48
		Male bunch	0.233	14,971.48	16.33	244,484.35
Coconut	16,375	Husk	0.362	5,927.75	16.23	96,207.38
		Shell	0.16	2,620.00	17.93	46,976.60
		Empty Bunch	0.049	802.375	15.4	12,356.58
		Frond	0.225	3684.375	16	58,950.00
Cassava	19,928	Stalk	0.088	1,753.63	18.42	32,301.83
Maize	11,611	Corn cob	0.273	3,169.71	18.04	57,181.52
Ground Nut	14,700	Shell	0.323	4748.1	12.66	60,110.95
Soybean	749	Stalk, Leaves, Shel	2.663	1,994.69	19.44	38,776.84
TOTAL	**212,168**			**301,795.97**		**3,720,065.88**

Source: Processed by the Author from FAO Statistics

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Estimation of Agricultural Residues in Malaysia, 2006

Type	Production ('000 tons)	Type of residues	Residue production ratio(RPR)	Residue generated ('000 tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	900	Bagasse	0.291	261.90	14.4	3,771.36
		Top & Trashier	0.302	271.80	17.39	4,726.60
Paddy	2,154	Husk	0.23	495.42	14.27	7,069.64
		Straw (top)	0.447	962.84	10.24	9,859.46
Oil Palm Fruit	75,650	Empty bunch	0.428	32,378.20	17.86	578,274.65
		Fibre	0.147	11,120.55	17.62	195,944.09
		Shell	0.049	3706.85	18.46	68,428.45
		Frond	2.604	196,992.60	9.83	1,936,437.26
		Male bunch	0.233	17,626.45	16.33	287,839.93
Coconut	573	Husk	0.362	207.50	16.23	3,367.70
		Shell	0.16	91.71	17.93	1,644.40
		Empty Bunch	0.049	28.0868	15.4	432.54
		Frond	0.225	128.97	16	2,063.52
Cassava	375	Stalk	0.088	32.97	18.42	607.34
Maize	80	Corn cob	0.273	21.84	18.04	393.99
Ground Nut	2	Shell	0.323	0.5491	12.66	6.95
Soybean	0	Stalk, Leaves, Shel	2.663	0.00	19.44	0.00
TOTAL	**79,734**			**264,328.24**		**3,100,867.89**

Source: Processed by the Author from FAO Statistics

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Estimation of Agricultural Residues in Philippines, 2006

Type	Production (Ō000 tons)	Type of residues	Residue production ratio(RPR)	Residue generated (Ō000 tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	24,345	Bagasse	0.291	7,084.43	14.4	102,015.75
		Top & Trashier	0.302	7,352.22	17.39	127,855.16
Paddy	15,327	Husk	0.23	3,525.14	14.27	50,303.79
		Straw (top)	0.447	6,851.04	10.24	70,154.64
Oil Palm Fruit	373	Empty bunch	0.428	159.83	17.86	2,854.61
		Fibre	0.147	54.90	17.62	967.26
		Shell	0.049	18.29856	18.46	337.79
		Frond	2.604	972.44	9.83	9,559.06
		Male bunch	0.233	87.01	16.33	1,420.90
Coconut	14,958	Husk	0.362	5,414.76	16.23	87,881.61
		Shell	0.16	2,393.27	17.93	42,911.25
		Empty Bunch	0.049	732.93759	15.4	11,287.24
		Frond	0.225	3365.52975	16	53,848.48
Cassava	1,757	Stalk	0.088	154.60	18.42	2,847.80
Maize	6,082	Corn cob	0.273	1,660.42	18.04	29,953.91
Ground Nut	29	Shell	0.323	9.41545	12.66	119.20
Soybean	1.03	Stalk, Leaves, Shel	2.663	2.74	19.44	53.32
TOTAL	**62,872**			**39,838.98**		**594,371.77**

Source: Processed by the Author from FAO Statistics

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Estimation of Agricultural Residues in Thailand, 2006

Type	Production (Õ000 tons)	Type of residues	Residue production ratio(RPR)	Residue generated (Õ000 tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	47,658	Bagasse	0.291	13,868.51	14.4	199,706.50
		Top & Trashier	0.302	14,392.75	17.39	250,289.86
Paddy	29,269	Husk	0.23	6,731.86	14.27	96,063.65
		Straw (top)	0.447	13,083.23	10.24	133,972.23
OilPalm Fruit	6,519	Empty bunch	0.428	2,789.94	17.86	49,828.39
		Fibre	0.147	958.23	17.62	16,883.98
		Shell	0.049	319.40944	18.46	5,896.30
		Frond	2.604	16,974.33	9.83	166,857.67
		Male bunch	0.233	1,518.82	16.33	24,802.40
Coconut	1,871	Husk	0.362	677.29	16.23	10,992.49
		Shell	0.16	299.36	17.93	5,367.47
		Empty Bunch	0.049	91.67802	15.4	1,411.84
		Frond	0.225	420.9705	16	6,735.53
Cassava	22,584	Stalk	0.088	1,987.43	18.42	36,608.41
Maize	3,696	Corn cob	0.273	1,009.10	18.04	18,204.18
GroundNut	117	Shell	0.323	37.791	12.66	478.43
Soybean	225	Stalk, Leaves, Shel	2.663	597.84	19.44	11,622.08
TOTAL	**111,939**			**75,758.54**		**1,035,721.41**

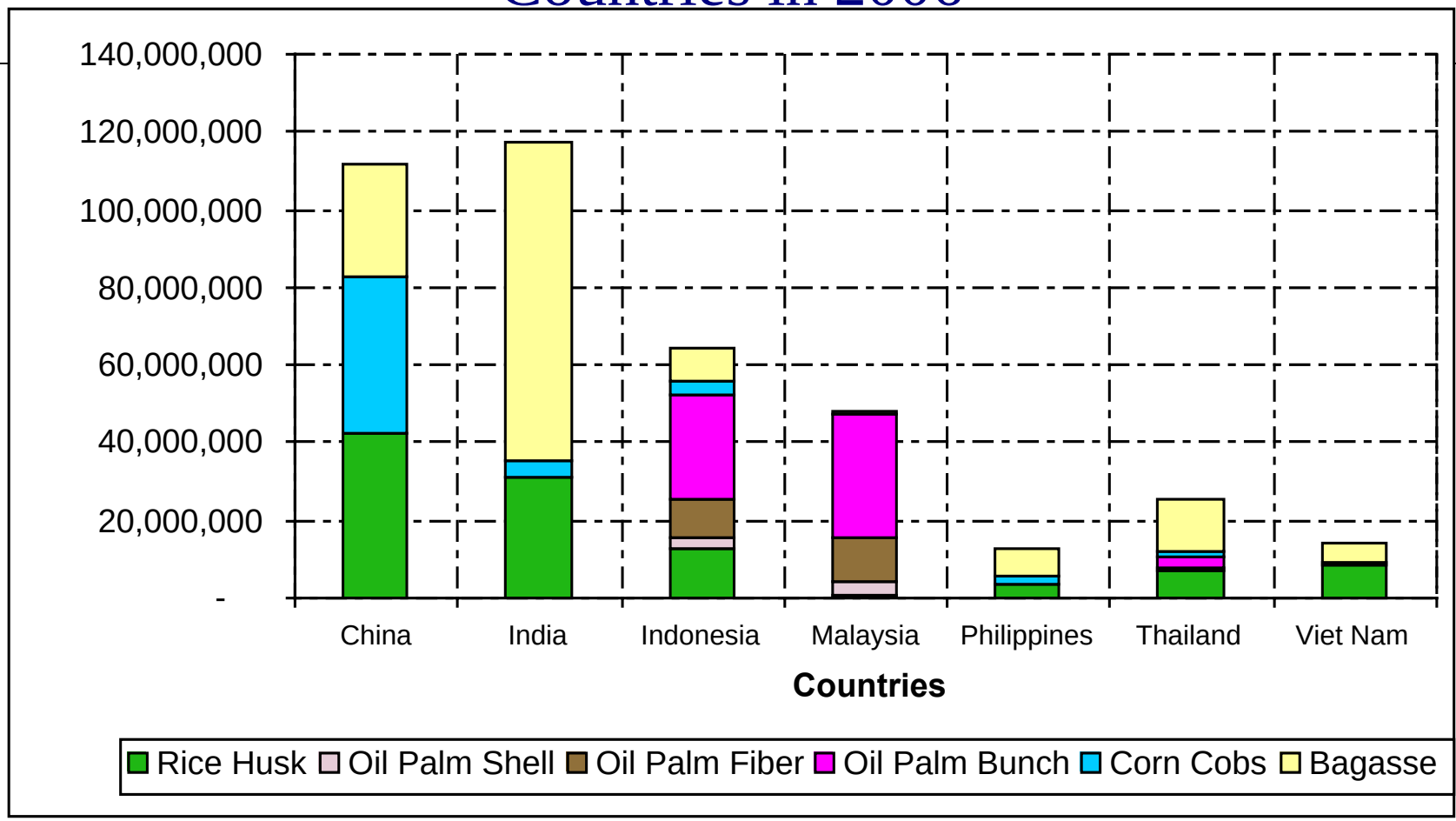
Source: Processed by the Author from FAO Statistics

Estimation of Agricultural Residues in Viet Nam, 2006

Type	Production ('000 tons)	Type of residues	Residue production ratio(RPR)	Residue generated ('000 tons)	Caloific value (MJ/kg)	Enegy (TJ)
Sugar Cane	15,679	Bagasse	0.291	4,562.47	14.4	65,699.61
		Top & Trashier	0.302	4,734.94	17.39	82,340.56
Paddy	35,827	Husk	0.23	8,240.16	14.27	117,587.14
		Straw (top)	0.447	16,014.58	10.24	163,989.30
Oil Palm Fruit	0	Empty bunch	0.428	0.00	17.86	0.00
		Fibre	0.147	0.00	17.62	0.00
		Shell	0.049	0.00	18.46	0.00
		Frond	2.604	0.00	9.83	0.00
		Male bunch	0.233	0.00	16.33	0.00
Coconut	982	Husk	0.362	355.56	16.23	5,770.68
		Shell	0.16	157.15	17.93	2,817.74
		Empty Bunch	0.049	48.1278	15.4	741.17
		Frond	0.225	220.995	16	3,535.92
Cassava	7,714	Stalk	0.088	678.83	18.42	12,504.09
Maize	3,819	Corncob	0.273	1,042.70	18.04	18,810.24
GroundNut	465	Shell	0.323	150.1627	12.66	1,901.06
Soybean	258	Stalk, Leaves, Shel	2.663	687.59	19.44	13,366.68
TOTAL	**64,744**			**36,893.26**		**489,064.17**

Source: Processed by the Author from FAO Statistics

Estimates of Agricultural Residues in Selected Asian Countries in 2006



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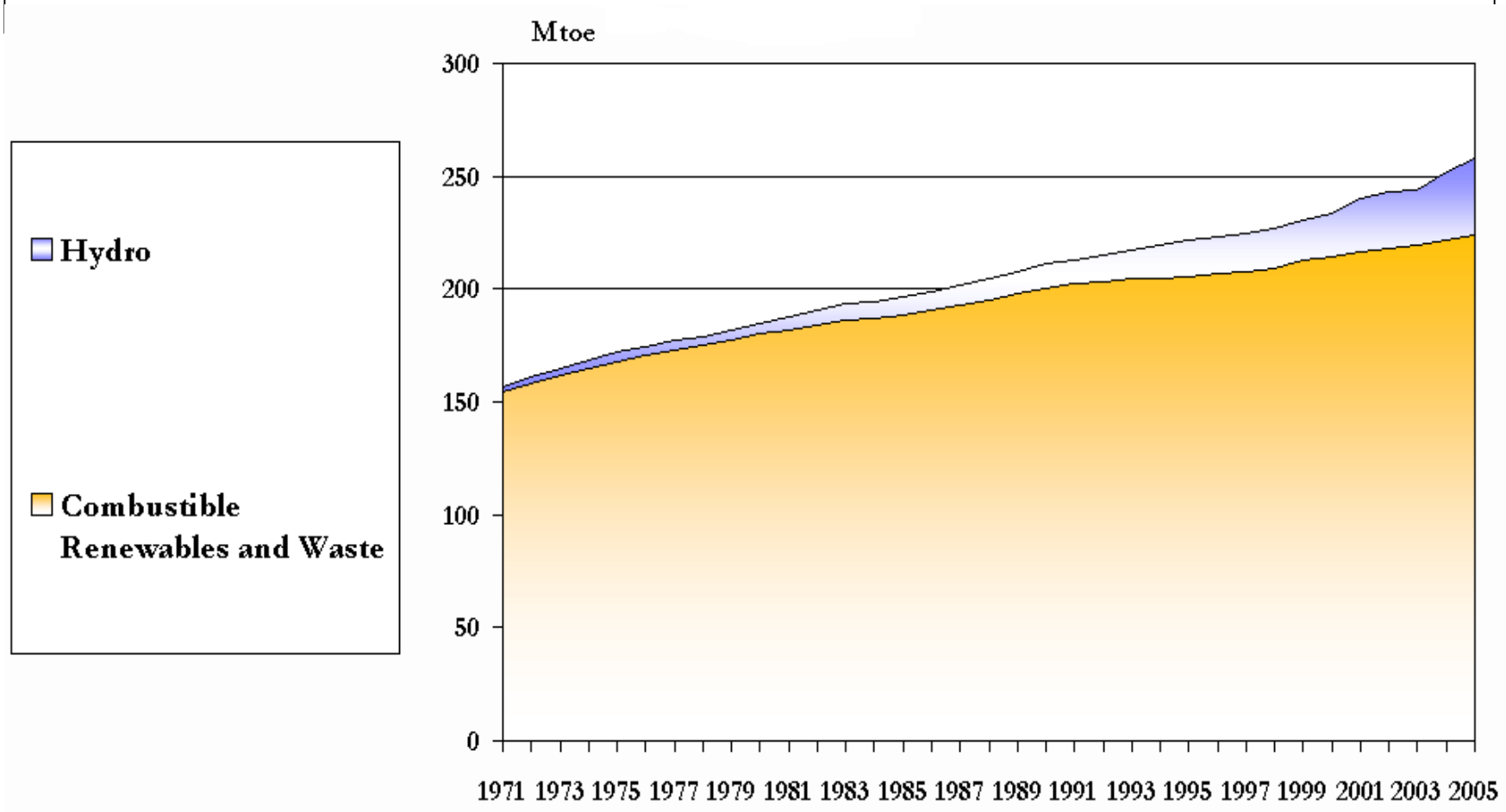
TPES from Renewables in China, 1971-2005



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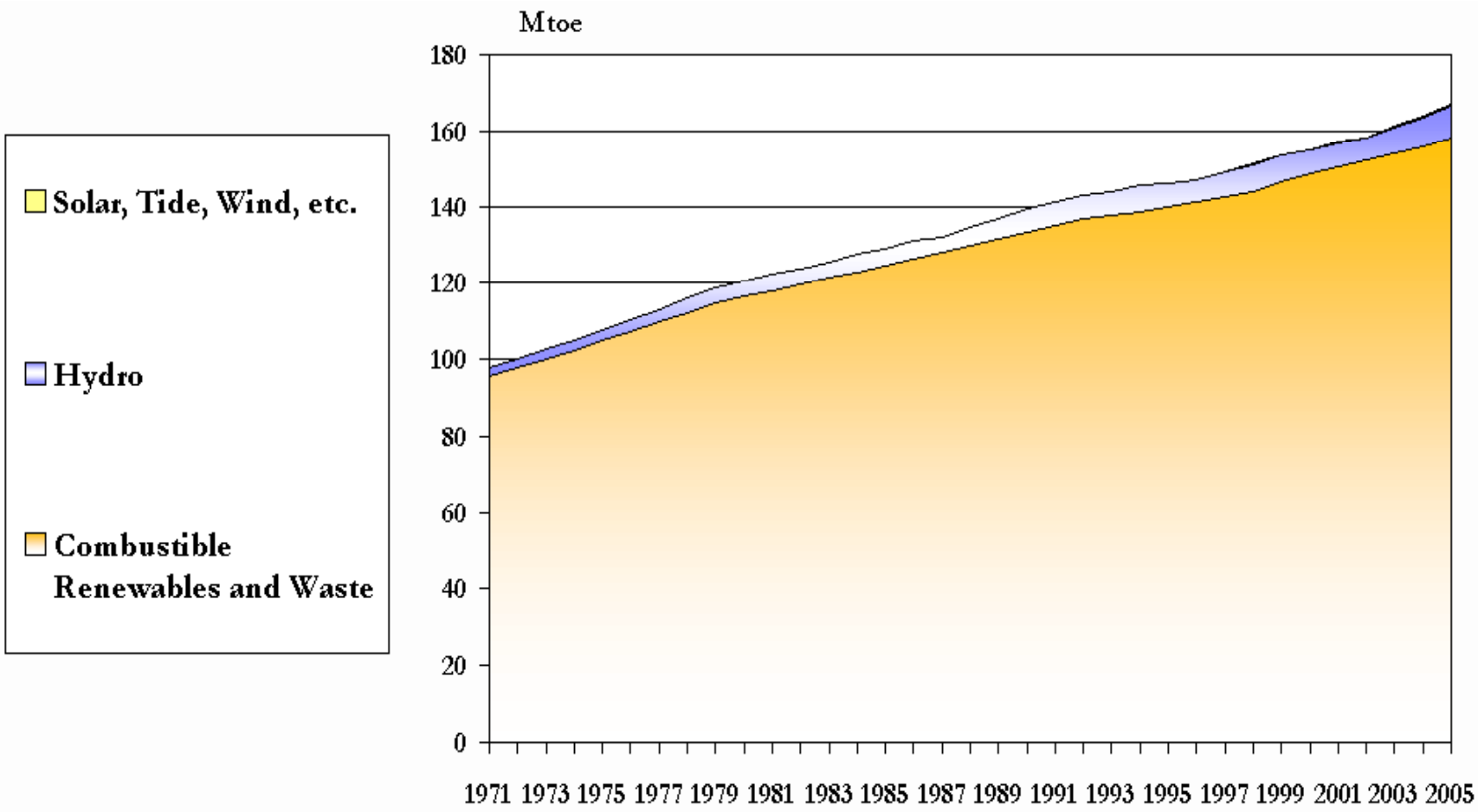
TPES from Renewables in India, 1971-2005



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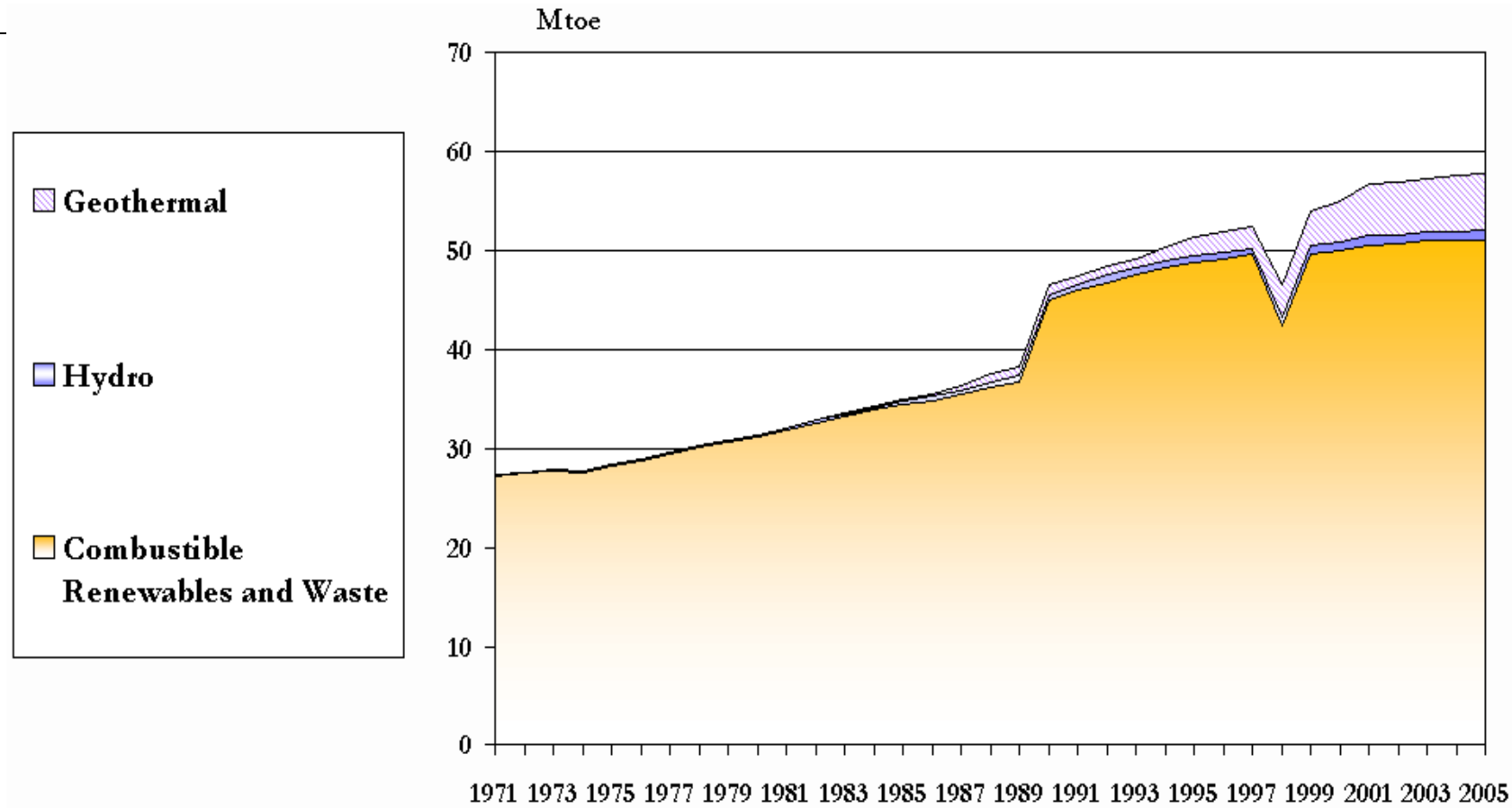
TPES from Renewables in Indonesia, 1971-2005



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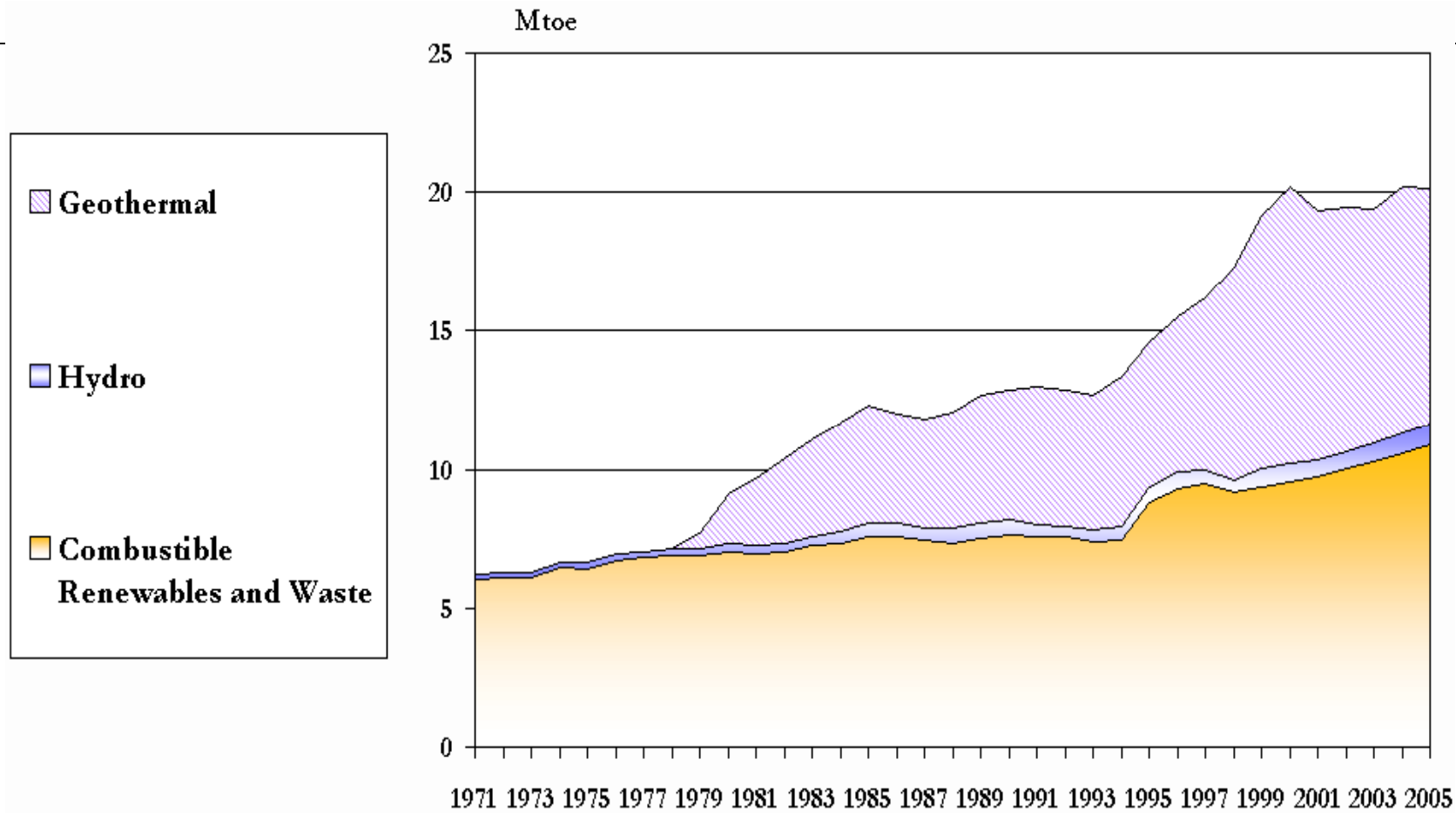
TPES from Renewables in the Philippines, 1971-2005



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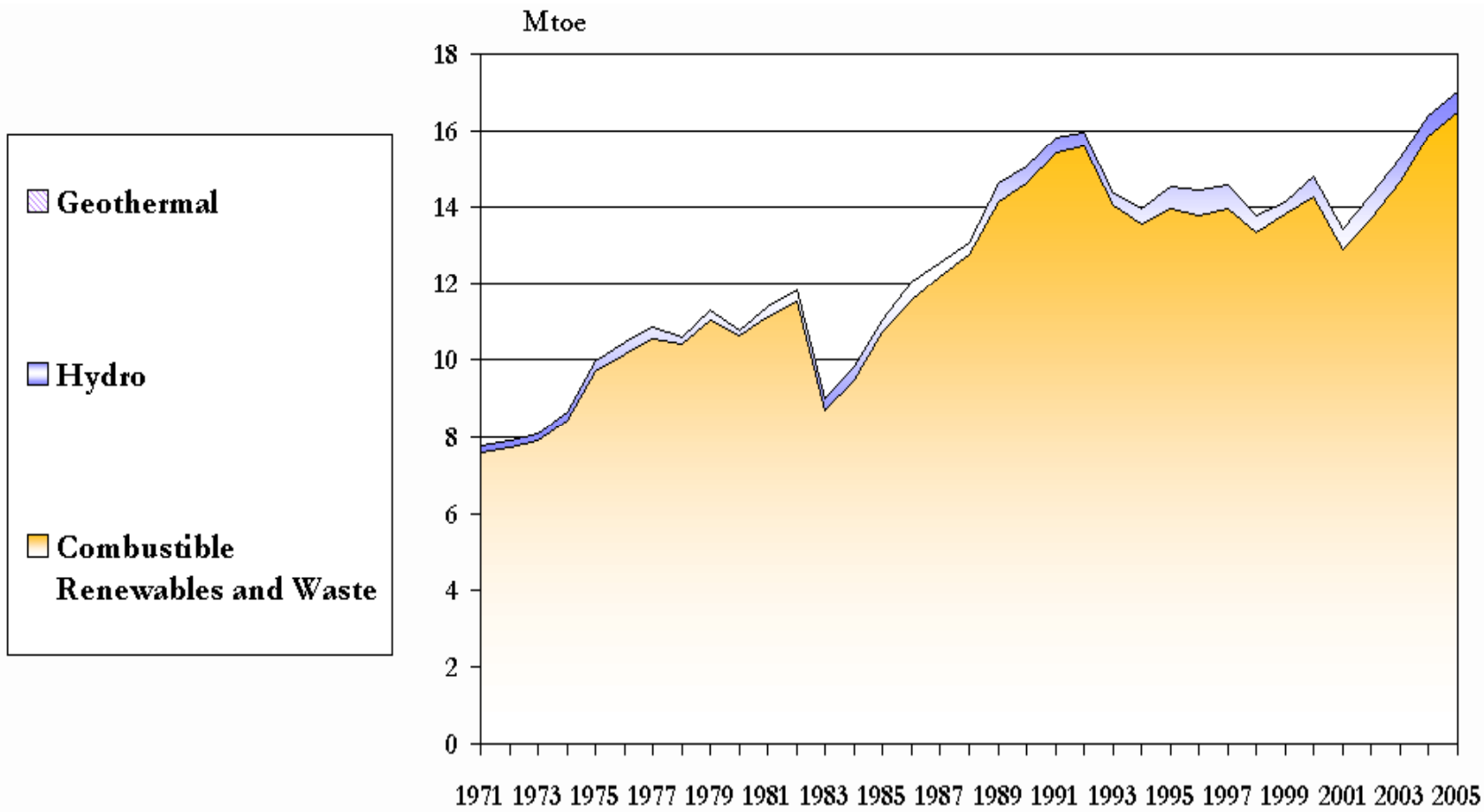
TPES from Renewables in the Thailand, 1971-2005



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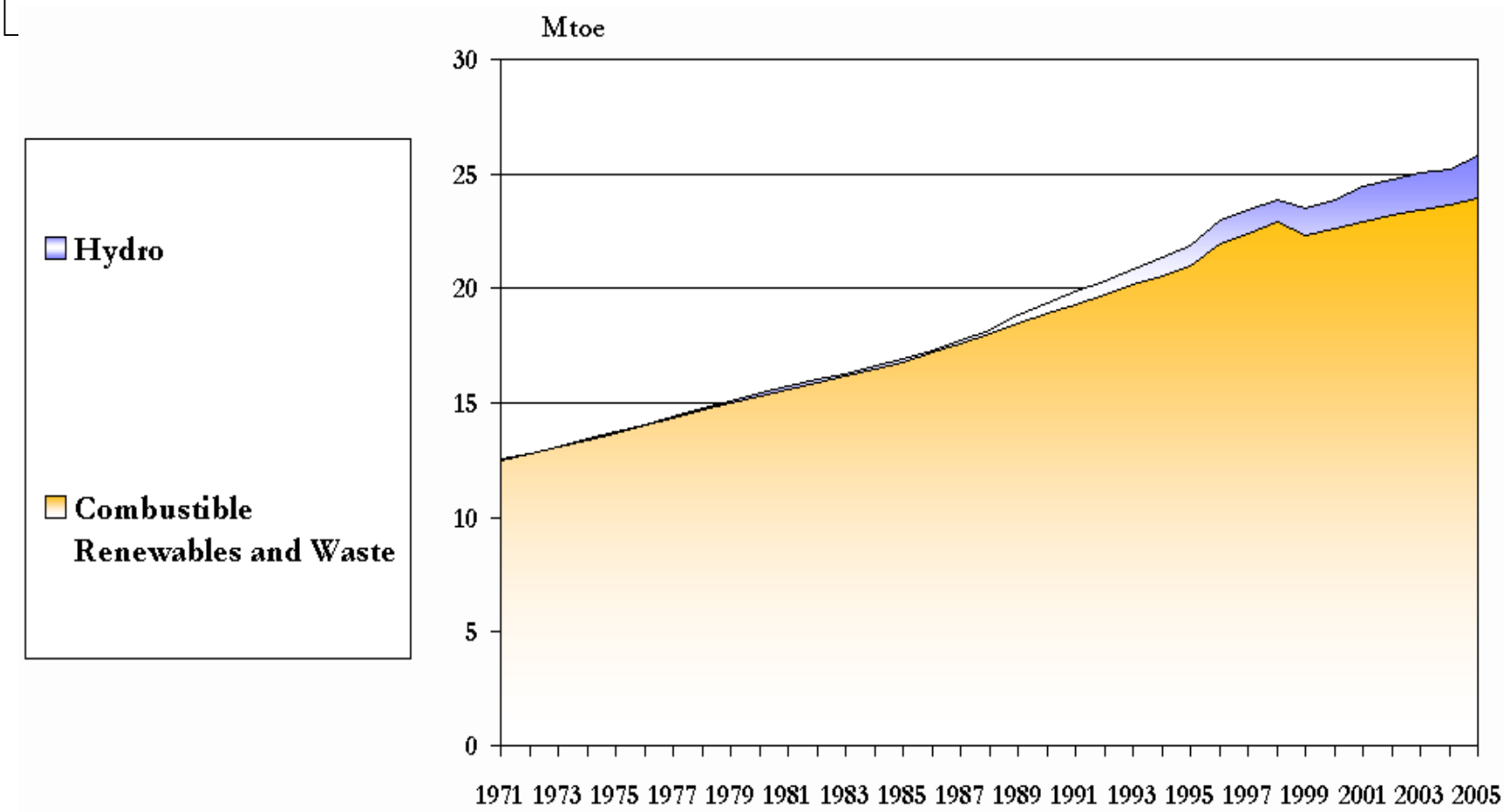
TPES from Renewables in the Viet Nam, 1971-2005



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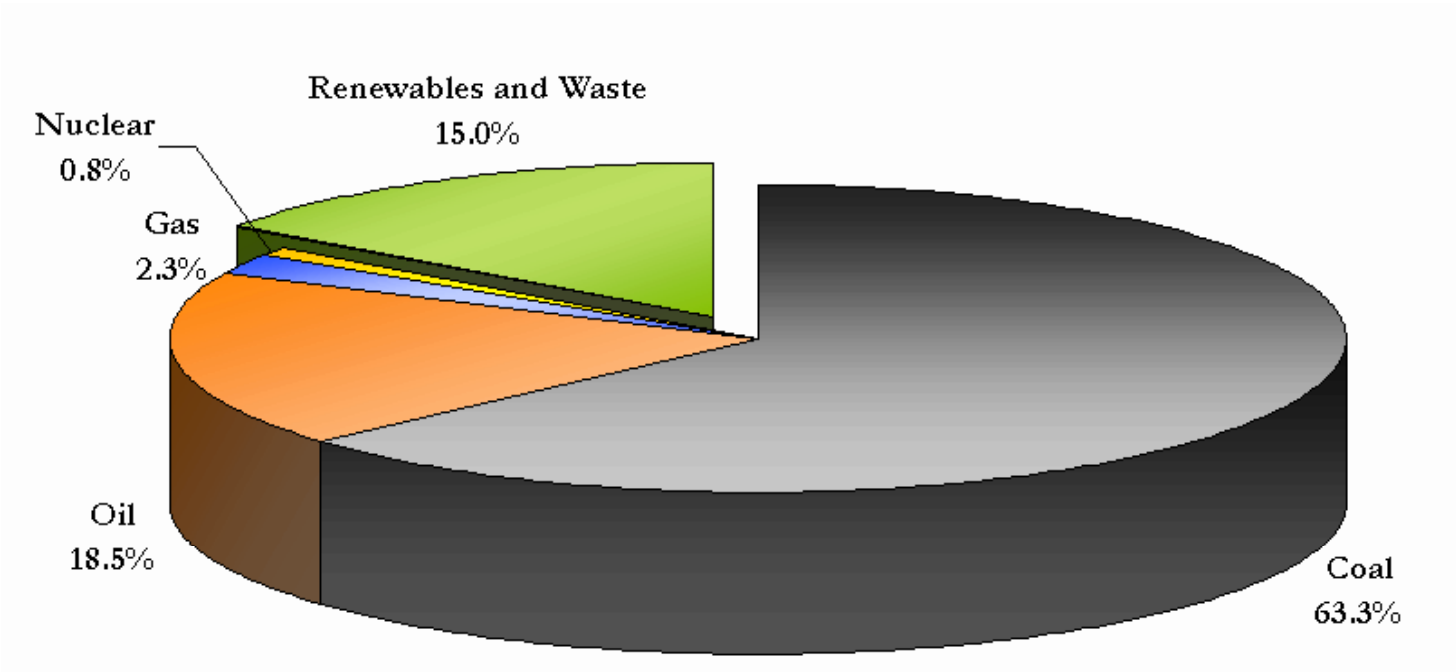
Shares of TPES in China, 2005



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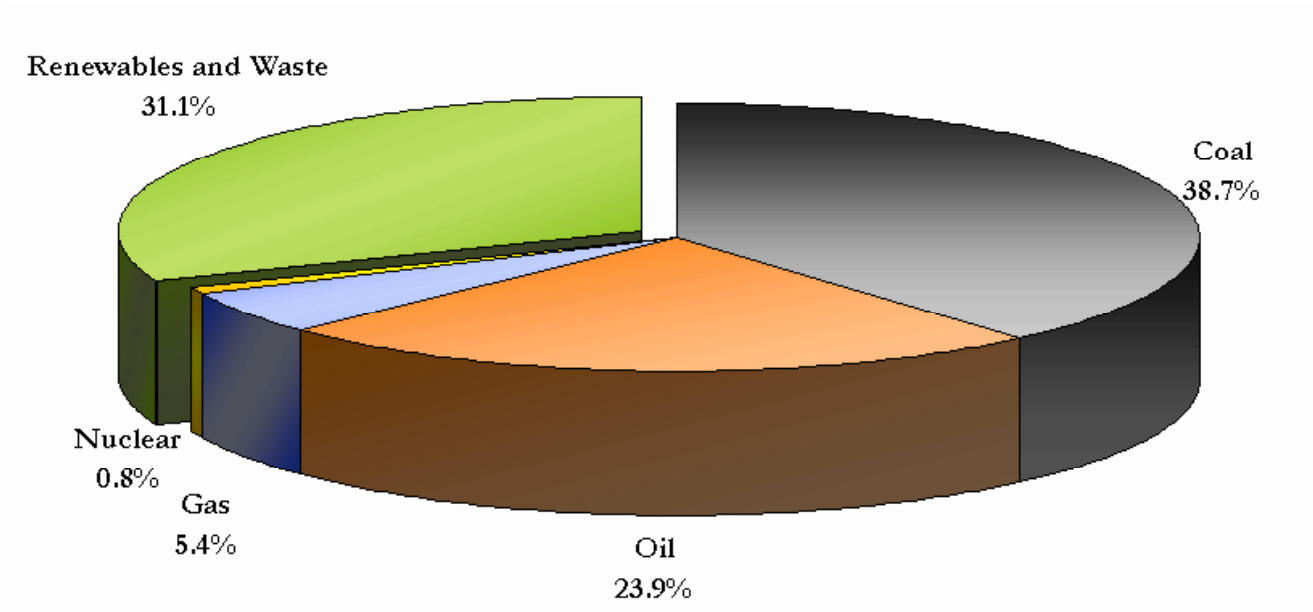
Shares of TPES in India, 2005



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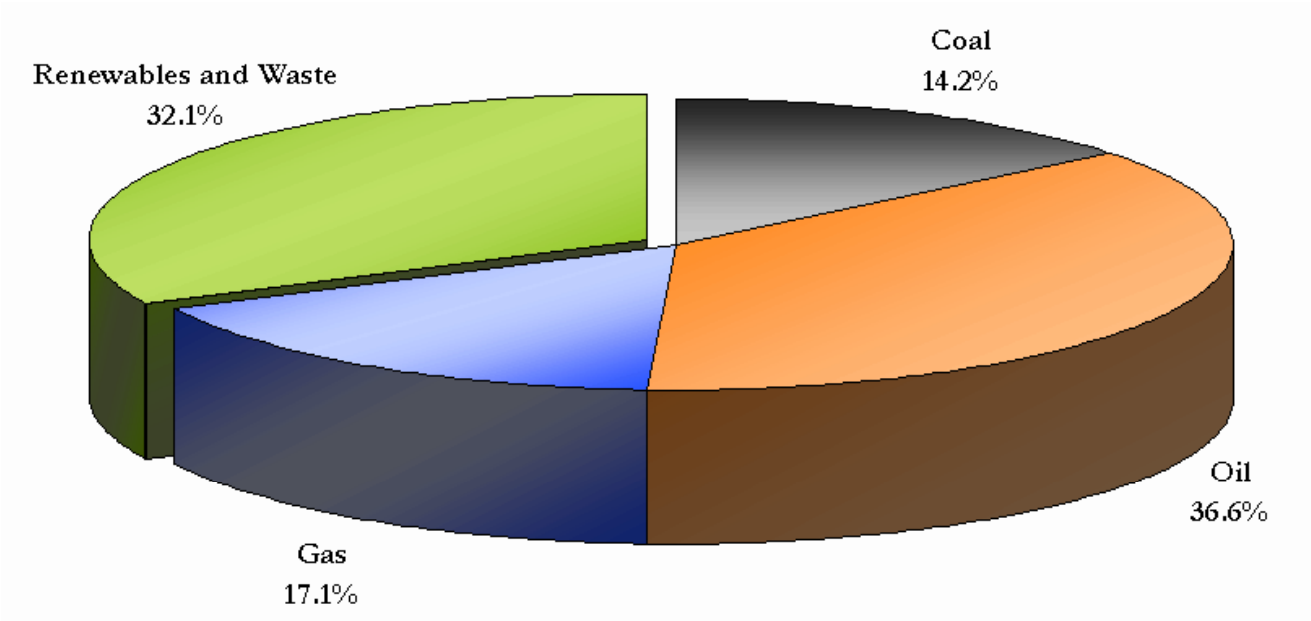
Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Shares of TPES in Indonesia, 2005



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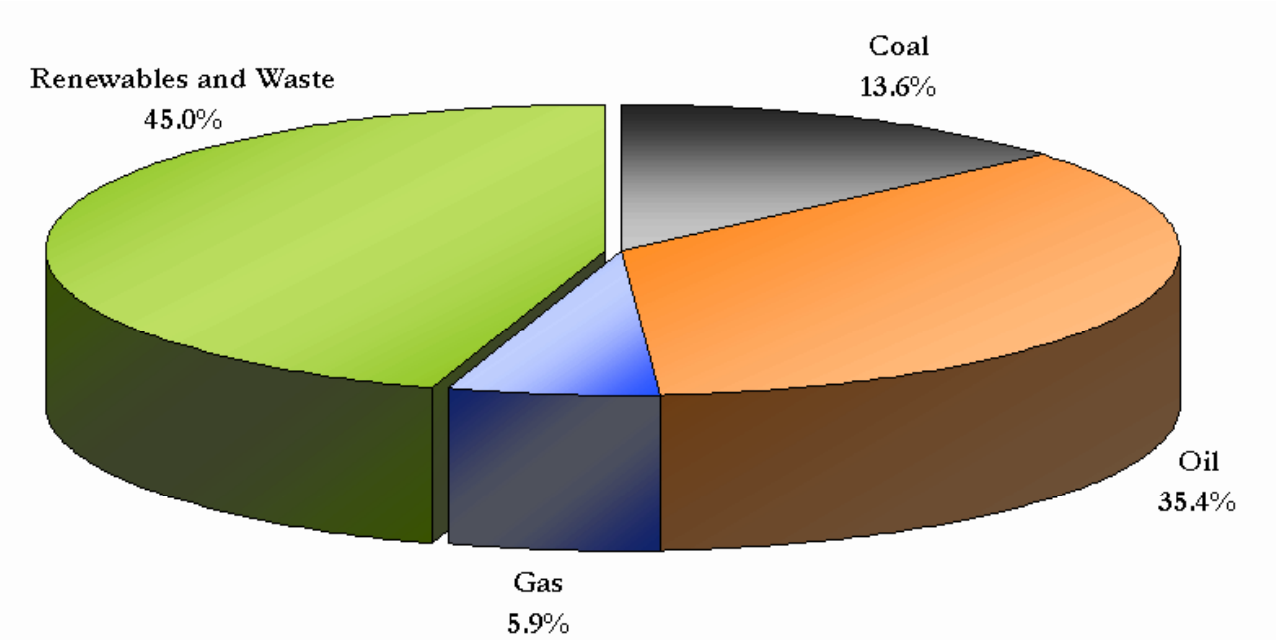
Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

Shares of TPES in the Philippines, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

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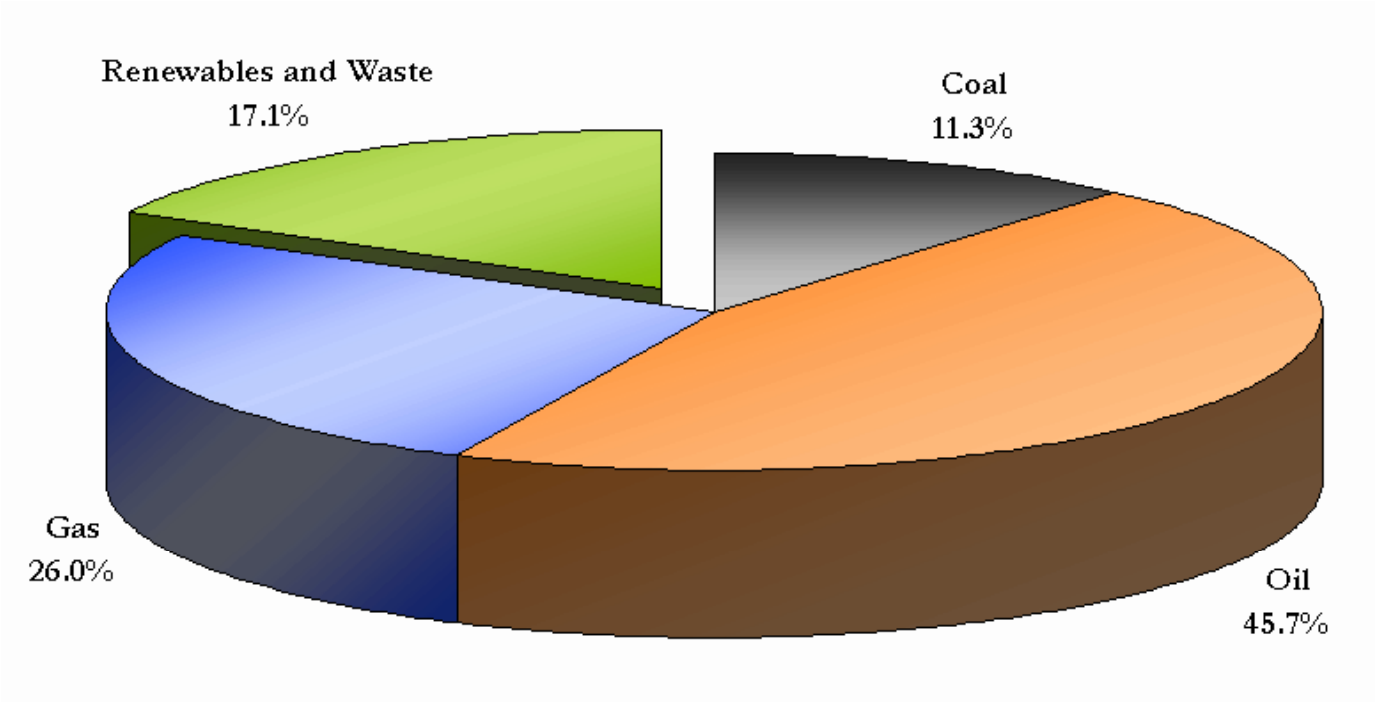
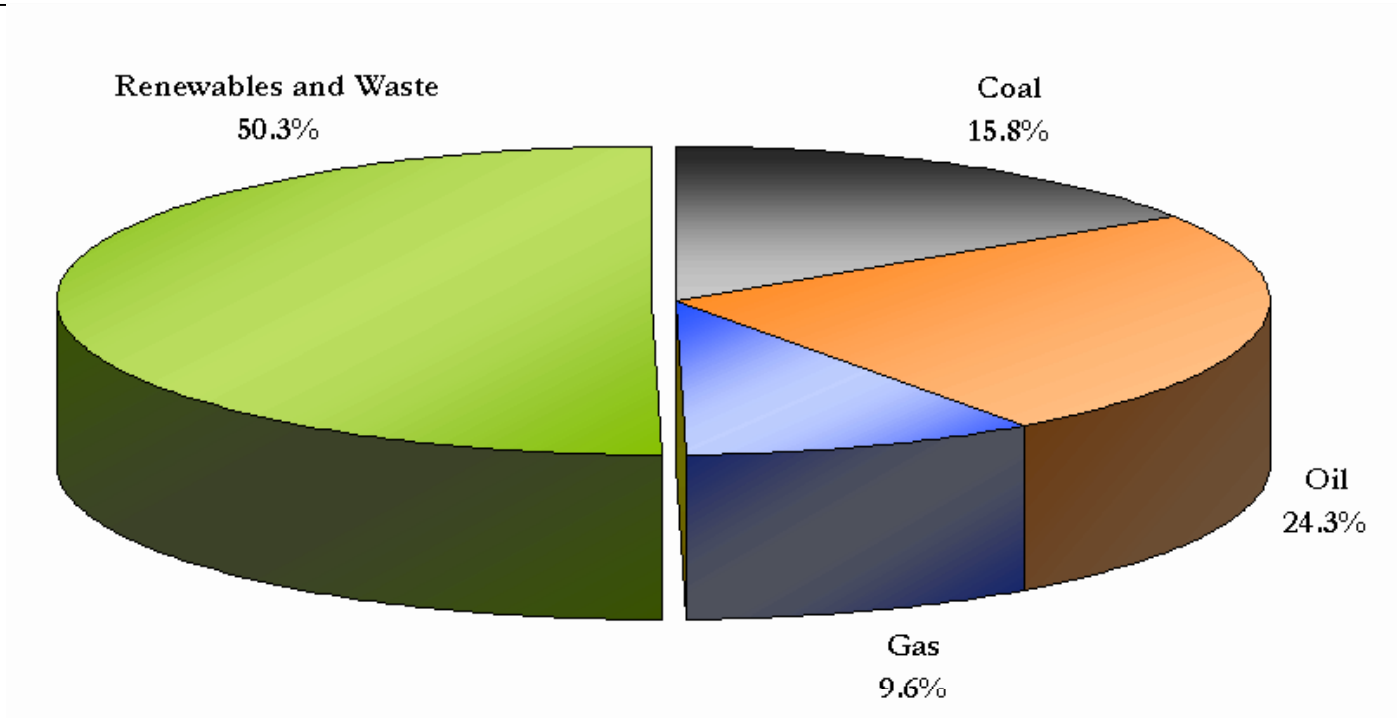
Shares of TPES in the Thailand, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

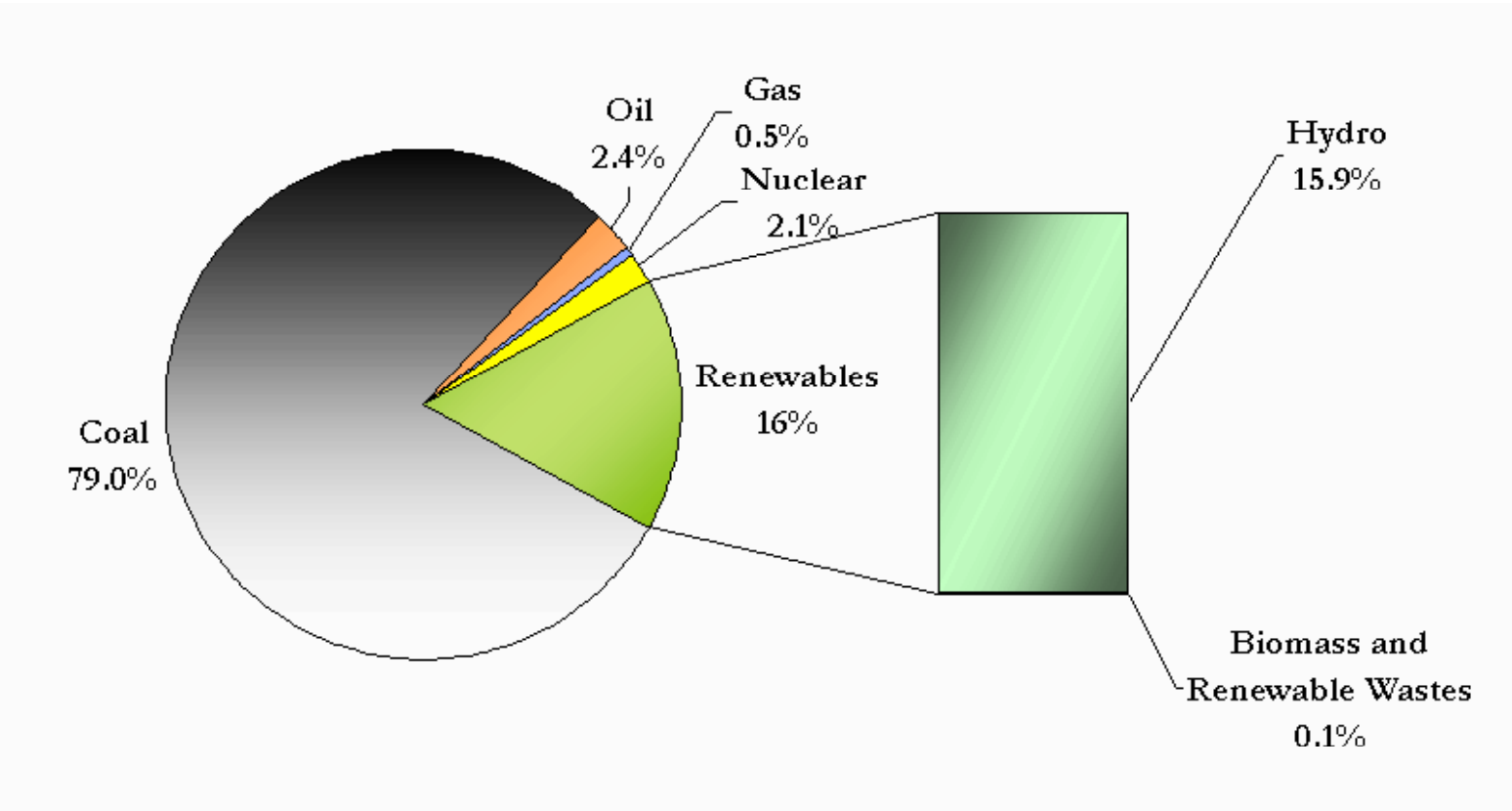
Shares of TPES in the Viet Nam, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

Asian and Pacific Centre for Agricultural Engineering and Machinery (APCAEM)

China Electricity Generation by Fuel Type, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

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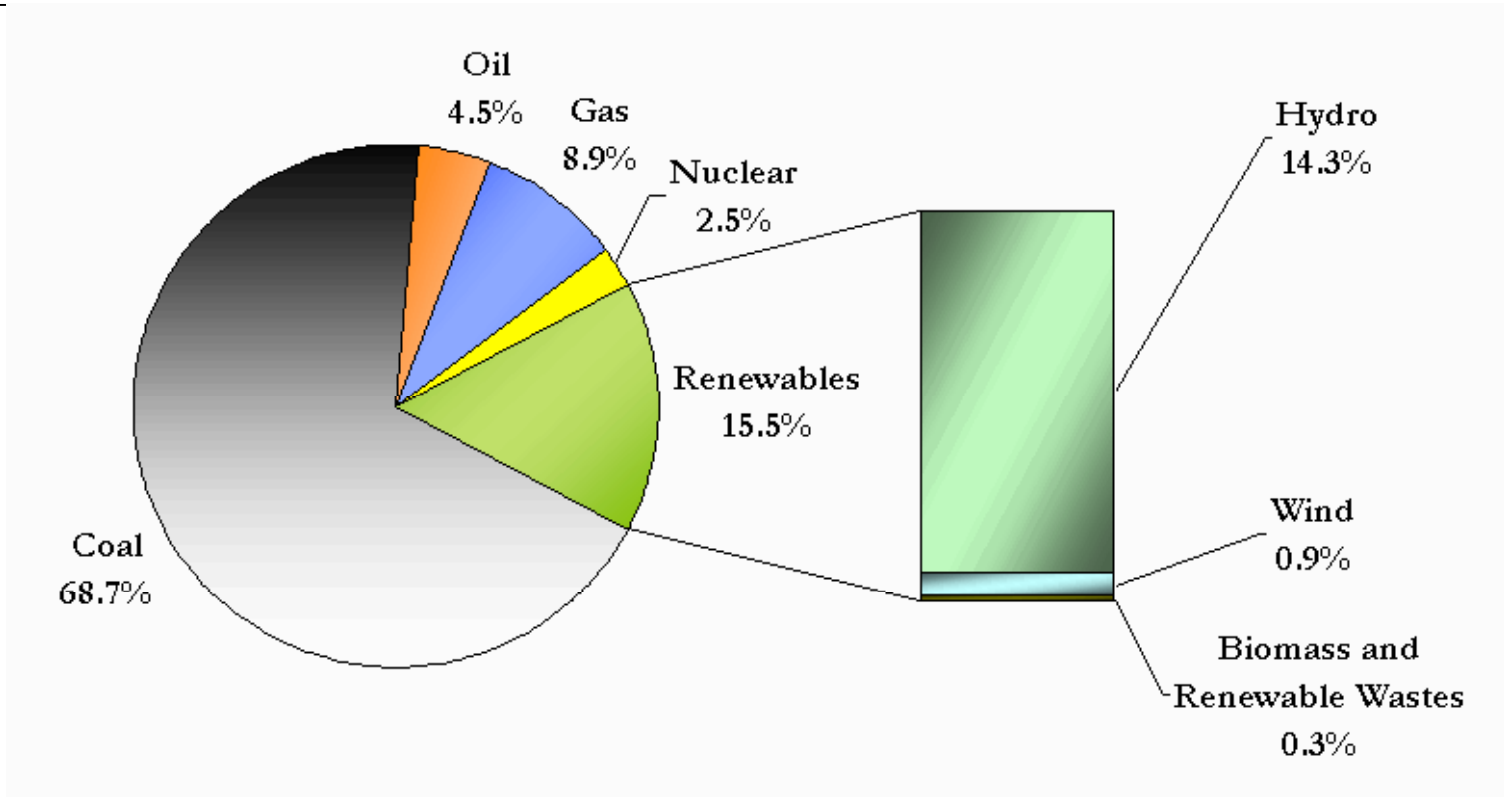
India Electricity Generation by Fuel Type, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

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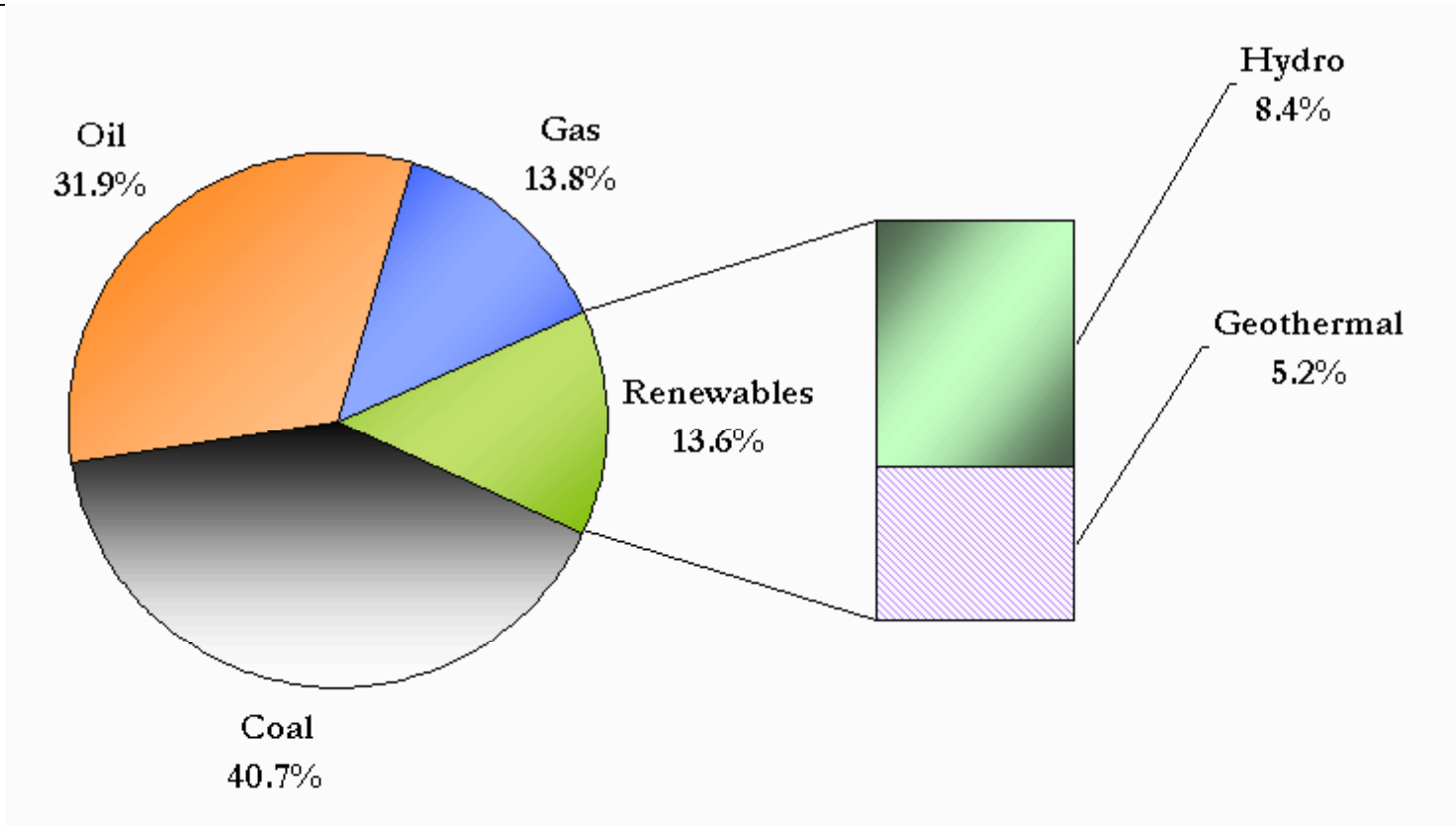
Indonesia Electricity Generation by Fuel Type, 2005



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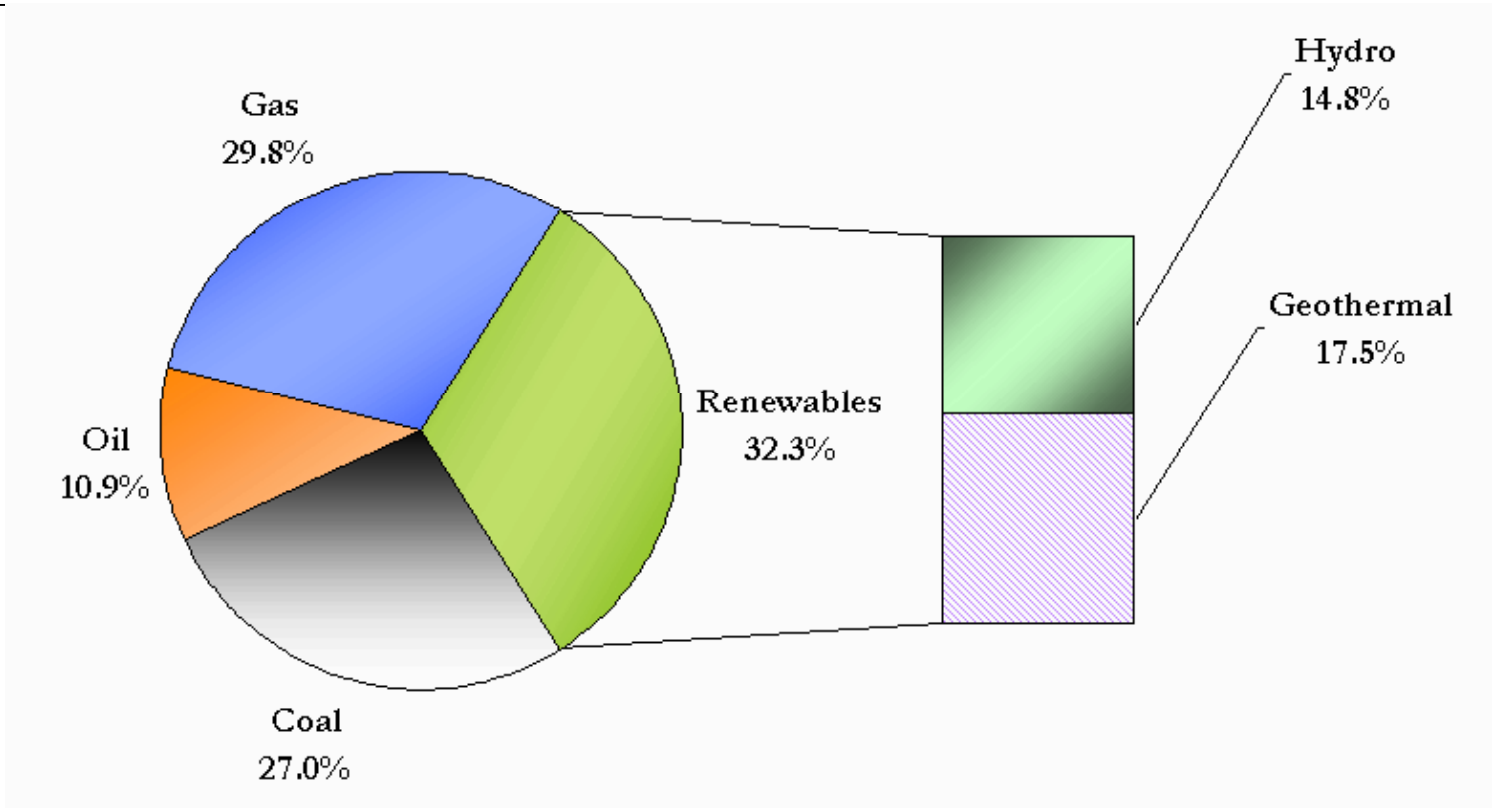
Philippines Electricity Generation by Fuel Type, 2005



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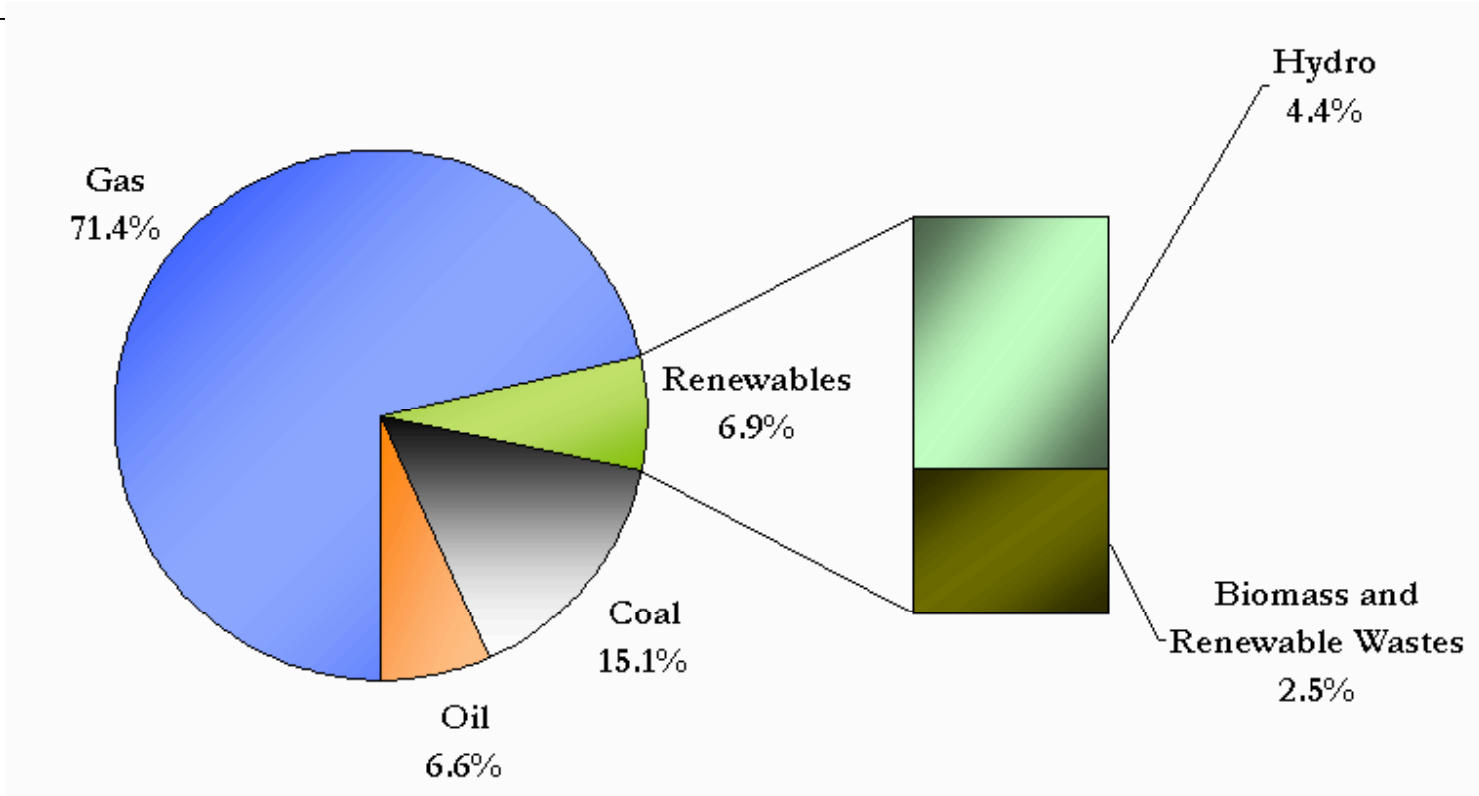
Thailand Electricity Generation by Fuel Type, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

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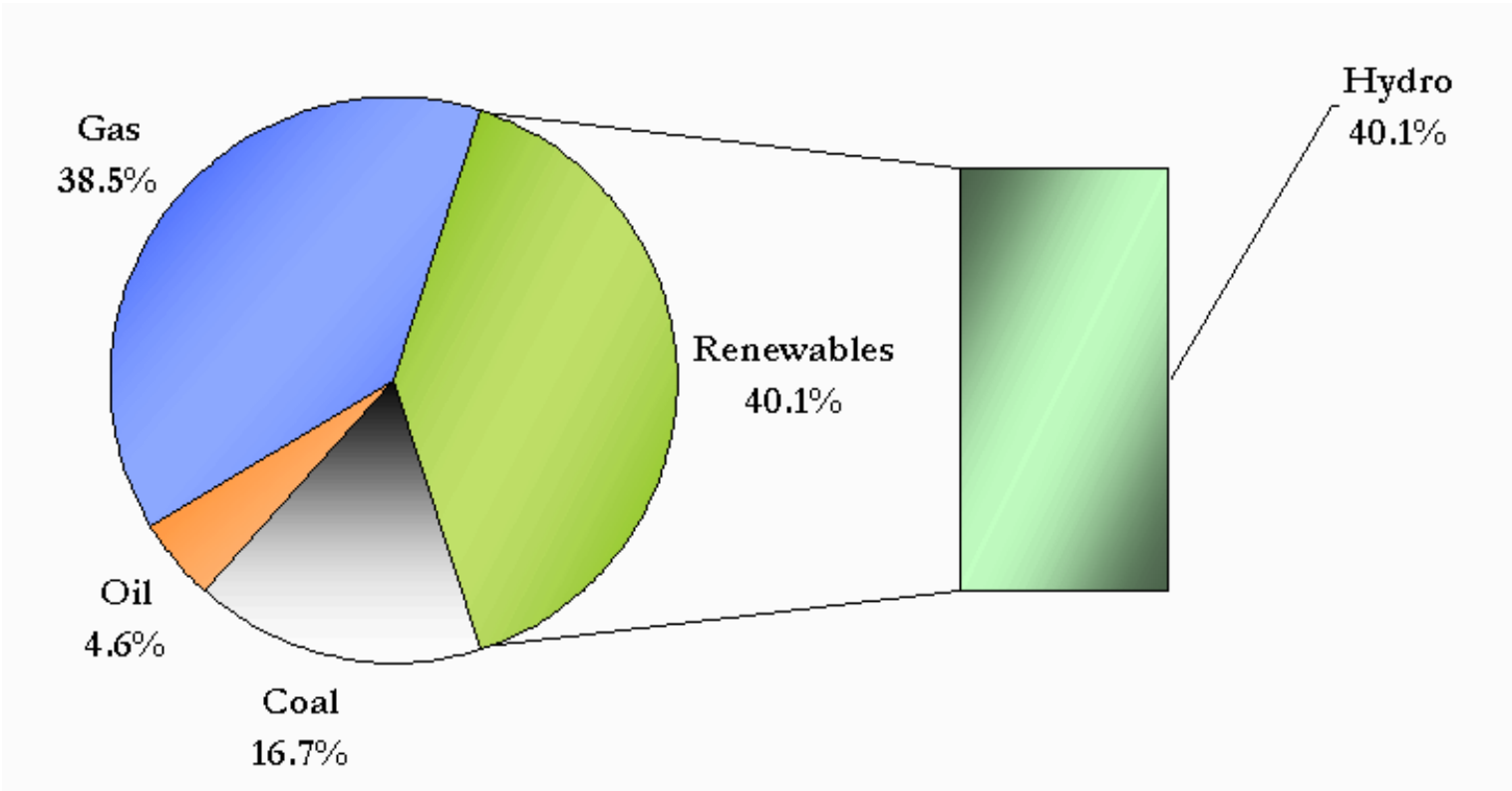
Viet Nam Electricity Generation by Fuel Type, 2005



Source: IEA Energy Statistics © OECD/IEA 2007

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Targets of Different Asian Countries

Country	Target year	RE target (MW)	Bioenergy target (MW)
China	2010	10% of Electricity 5% Primary energy	6,000
India	2003-2012	10% of Electricity power capacity-10,000 MW	-
Indonesia	2025	15% of Total energy 2875 MW	810
Malaysia	2020	20% of Energy mix	-
Philippines	2013	9,265 MW	170 MW based on the perceived projects
Thailand	2011	8% of Total energy	853
Vietnam	-	21-51 MW 1st Phase 175-251MW 2nd Phase	-

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Cross-Cutting Issues

- **Availability and supply of biomass resource**
- **Technology selection, implementation and operational issues**
- **Financial and commercial aspects**
- **Policy, regulatory and institutional aspects**
- **Socio-economic issues**
- **Environmental aspects**

Conclusions (1)

- Many countries in Asia are endowed with rich agricultural and forest resources that are generating wastes and residues. These could be transformed into bioenergy for industrial, household or community-based activities.
- Several factors have made production of bioenergy from feedstock such biomass and biogas economically sensible, environmentally beneficial and politically imperative. These include the rise of oil price to unprecedented levels, fuel security, climate change issues and additional benefits from initiatives such as the Clean Development Mechanism (CDM).
- Proven technologies to convert biomass or biodegradable materials (i.e. municipal solid waste, waste water, etc.) into useful forms of energy for electrical, heating or cooling purposes currently exist. New or next generation technologies also abound in R & D, pilot or demonstration stages. They are expected to contribute in providing more efficient, economical and environmentally friendly solutions in the future.

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Conclusions (2)

- Commercialisation of bioenergy systems brings about the realisation of certain benefits and advantages. However, it also attracts entities with purely commercial interests to participate. This should be balanced with objectives that could involve smaller industries (SMEs), greater access to energy in remote areas, community participation, environmental consciousness, economic growth and social benefits.
- There are large potentials in developing and disseminating household-based biomass technologies in rural areas, especially with energy efficient modern biomass cooking stoves. Analysis shows that this can produce far more economic, social and environmental benefits than centralised biomass power plants.
- Biomass and biogas decentralised systems that are implemented in areas where the energy that is produced is supplied on-site where they are needed, could provide solutions for meeting multi-objectives of generating efficient energy supply, cost effectiveness, environmental sustainability, and supporting economic and social growth in the communities.

Conclusions (3)

- Lack of strong policy incentives has led to slower response in large-scale market uptake of bioenergy technologies, despite wider interest in society and private companies.
- It has been widely acknowledged that direct government subsidies are not enough and effective in eliciting large-scale market response and action. Market-oriented approach should be adopted to promote widespread dissemination and implementation of bioenergy through actions such as support in making financing more accessible, public-private partnerships, improvement of infrastructure and logistics related to transport and supply of biomass residues, and relevant supporting policies.
- For developing countries, the ratification of the Kyoto Protocol and participation in CDM is an added boost to the increase of uptake and implementation of bioenergy. In the absence of relevant approved methodologies for biofuels, CDM is not creating the same stimuli for the biofuels sector.

Recommendations (1)

- ✦Link micro-credits being operated in rural areas to sustainable energy development.
- ✦Establish national and regional funds to support the move toward sustainable rural energy development.
- ✦Build various financial instruments into the existing or future programmes financed by the countries at the national and sub-national levels.
- ✦Conduct activities to build capacities of relevant stakeholders in tapping the financial markets and in mobilising funds from multilateral, bilateral, international and domestic sources.
- ✦Establish preferential tax policies to help reduce the costs of those companies involved in R&D, innovation, manufacturing, market expansion, demonstration and operation of bioenergy.

Recommendations (2)

- ~~Impose a carbon tax on fossil fuels to narrow the cost differences~~ between renewable energies and fossil fuels.
- Implement policies on technology/product standards and regulations, through active engagement of regional authorities, counties, municipalities, and NGOs, such as rural renewable energy associations.
- Aim for the replacement of coal-burning stoves and traditional biomass-burning stoves through wider market application and deployment of energy-efficient biomass stoves via favourable policies, technology innovation and market dissemination efforts.
- Create programmes and mechanisms to help developers buy down development risks by supporting development activities such as: conduct of feasibility studies, technology selection, environmental impact assessment, permitting and consents, activities to secure fuel supply and off-take of bioenergy products, legal considerations and mobilisation of funds.

Recommendations (3)

- Formulate and implement policies encouraging and supporting the grid connection and appropriate feed-in tariffs for electricity produced from bioenergy systems.
- Strengthen bioenergy market service in the areas of technology selection, biomass resource identification and collection, transportation, storage, and product services, and project development and implementation
- Design and implement measures to help the development of the service sector, such as capacity building through training, human resource development and information sharing
- Formulate strategies to integrate sustainable energy into economic development policies and programmes
- Conduct further investigations and market researches in order to draw lessons and experience from the past development, identify key market and policy barriers, and formulate new innovative mechanisms, with the aim to reduce risks and improve the cost-effectiveness of bioenergy investments.

Recommendations (4)

- Take advantage of the benefits brought about by global and international commitments and actions related to trade, poverty alleviation, climate change, and the environment.
- Design relevant standards, monitoring and inspection systems for rural biomass applications.
- Solicit active engagement of key stakeholders to ensure successful dissemination of locally applicable technologies that respect local culture and context. Substantial interest and participation can be mobilised through the involvement of local residents, community leaders, relevant government agencies and enterprises.
- Formulate appropriate CDM methodologies to support the application & registration of clean and efficient bioenergy systems.