Malaysian Grid Emission Factor Calculations

STEP 1 - Calculation of the Operating Margin emission factor (OM)

Method used	Simple OM
Justification	"This study uses both the Simple OM and Simple adjusted OM method to determine the baselines for Malaysia. Undertaking a dispatch data analysis (the preferred methodological option) was considered as well. However, after having talked to TNB Transmission, Ssytem Planning it was demed not possible to use this option, because te data is not readily available from the relevant authorities...
Source	Study on Grid Connected Electricity Baselines in Malaysia, p.11

Assumptions

Type of fuel (danida study)	2006 IPCC (more conservative)
Oil	Residual Fuel Oil
Gas/Oil	Natural Gas
Gas	Natural Gas
Diesel	Diesel
Distillate	Diesel
Coal	Coking Coal

The CO_2 emission coefficient $COEF_i$ is obtained from:

$$COEF_i = NCV_i \cdot EF_{CO2} \cdot OXID_i$$

where

NCV_i is the net calorific value of the unit of fuel i,
$OXID_i$ is the oxidation factor of the fuel,
EF_{co2} is the CO_2 emission per unit of energy of the fuel i.

$$EF_{OM,simple,y} = \frac{\sum_{i,j,y} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where,

$F_{i,j,y}$ is the amount of fuel (mass or volume) i consumed by relevant power sources j in year(s) y,
j refers to the power sources delivering electricity to the grid not including low-operating cost and must run plants, including imports to the grid,
$COEF_{i,j}$ is the CO_2 emission coefficient of fuel (tCO_2/volume) taking into account the carbon content of the fuels used by the relevant power sources j and the percent oxidation of the fuel in year(s) y, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

COEFi Calculation

Type of Fuel	NCVi (TJ/tonne)	OXIDi	EFco2 (tCO2/tfuel)	CO2 EF (tCO2/TJ)	COEFi	Sources/Comments
Residual Fuel Oil	0.0404	100%	3.126	77.38	0.1262904	2006 IPCC Guidelines
Natural Gas	0.048	100%	2.693	56.10	0.129264	2006 IPCC Guidelines
Diesel	0.043	100%	3.185	74.07	0.136955	2006 IPCC Guidelines
Coking Coal	0.0282	100%	2.668	94.61	0.0752376	2006 IPCC Guidelines

Fuel Consumption Calculation

	Fuel Consumption (TJ)			Fuel Consumption (tonnes)		
Type of Fuel	2003	2004	2005	2003	2004	2005
Residual Fuel Oil	18,305.83	24,846.01	2,497.12	453,114.67	615,000.21	61,809.89
Natural Gas	557,517.87	507,224.52	467,251.44	11,614,955.70	10,567,177.51	9,734,404.99
Diesel	1,291.26	688.49	92,722.75	30,029.21	16,011.39	2,156,343.00
Coking Coal	56,261.13	200,229.24	212,927.16	1,995,075.60	7,100,327.66	7,550,608.69
TOTAL	633,376.09	732,988.26	775,398.47	14,093,175.19	18,298,516.77	19,503,166.56

Simple Operation Margin Calculation

Years	Generation (GWh)	CO2 Emission (tonnes)	Baselines (tCO2/MWh)
2003	67,511	38,114,016.91	0.565
2004	77,566	49,374,570.16	0.637
2005	89,338	53,420,946.78	0.598
			0.600

STEP 2 - Calculation of the Build Margin (BM)

Method used	Option 1 for calculating the Build Margin was choosen

Name of Projects / Fuel Types	Year Operation	Capacity, MW	Total Generation, MWh	Fuel Consumption (TJ)	CO2 Emission (tCO2)
1. Tuanku Jaafar Power Station		714	2,840,870	20,914	1,173,384
2. JanaManjung Power Station	Sep-03	2100	11,638,010	112,024	10,598,548
3.TTPC Perlis Power Station	Apr-03	650	11,638,010	91,678	6,790,567
4. Panglima Power Station	Apr-03	720	4,972,300	36,162	2,028,849
5. SKS Prai Power Station	Jun-03	350	2,202,040	15,855	889,514
TOTAL			33,291,230		21,480,861

Build Margin: 0.645 tCO2/MWh

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

source: Energy Commission (2004)

STEP 3 - Calculate the baseline emission factor EFy

Method used	The baselin e emission factor EFy is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$)

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \quad (10)$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

The Baseline Grid Emimssion Factor is then

Efy	0.622	tCO2/MWh