The IEA data work on calorific values

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IEA

The IEA data work on calorific values

Calorific values data: why do we need good data?

The IEA data collection and dissemination

Improving calorific values data quality, globally

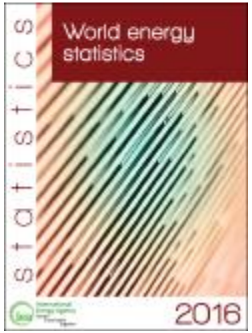
Calorific values: why do we need good data?

The IEA collects statistics and develops balances

Annual Questionnaires
OR
National publications, reports, websites

- Coal
- Oil
- Natural gas
- Renewables
- Electricity & Heat

Commodity balances (Statistics)



Energy balance

Calorific values are a key input to develop energy balances

Mexico

2015

Million tonnes of oil equivalent

SUPPLY AND CONSUMPTION	Coal	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geotherm./ Solar/ etc.	Biofuels/ Waste	Electricity	Heat	Total
Production	7.99	130.95	-	34.36	3.02	2.65	4.20	8.62	-	-	191.79
Imports	5.29 e	0.40	34.67	30.17	-	-	-	-	0.14	-	70.66
Exports	-0.00	-62.28	-9.73	-0.02	-	-	-	-	-0.20	-	-72.24
Intl. marine bunkers	-	-	-0.85	-	-	-	-	-	-	-	-0.85
Intl. aviation bunkers	-	-	-3.45	-	-	-	-	-	-	-	-3.45
Stock changes	0.38 e	0.37	0.56	0.15	-	-	-	-	-	-	1.45
TPES	**13.65**	**69.44**	**21.19**	**64.64**	**3.02**	**2.65**	**4.20**	**8.62**	**-0.06**	-	**187.37**
Transfers	-	-5.98	7.04	-	-	-	-	-	-	-	1.06
Statistical differences	0.31	2.30	0.93	-3.25	-	-	-	-0.00	0.47	-	0.76
Electricity plants	-8.88 e	-	-7.06	-30.39	-3.02	-2.65	-3.99	-1.49	25.40	-	-32.08
CHP plants	-	-	-0.54	-4.20	-	-	-	-0.21	1.36	-	-3.59
Heat plants	-	-	-	-	-	-	-	-	-	-	-
Blast furnaces	-0.72 e	-	-	-	-	-	-	-	-	-	-0.72
Gas works	-	-	-0.77	0.49	-	-	-	-	-	-	-0.28
Coke/pat. fuel/BKB/PB plants	-0.09 e	-	-	-	-	-	-	-	-	-	-0.09
Oil refineries	-	-65.96	57.80	-	-	-	-	-	-	-	-8.17
Petrochemical plants	-	0.15	-0.16	-	-	-	-	-	-	-	-0.01
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-
Other transformation	-	0.06	-	-	-	-	-	-	-	-	0.06
Energy industry own use	-0.39 e	-	-5.71	-13.36	-	-	-	-	-1.54	-	-21.00
Losses	-	-	-	-	-	-	-	-	-3.50	-	-3.50
TFC	**3.88**	-	**72.71**	**13.93**	-	-	**0.22**	**6.92**	**22.14**	-	**119.81**

To convert all physical values into a common energy unit

Calorific values determine the quality of balances (and inventories)

Commodity balances	Bituminous coal kt	Product 2 m3	…
Production	100		
Import	20		
Export	40		
Supply	**80**		
Statistical differences	*0*		
Input to Electricity	50		
…			
Final consumption	30		

Net Calorific Values	Bituminous coal TJ/kt	Product 2 TJ/m3	…
Production	23		
Import	25		
Export	22.5		
Input to Electricity	22		
…			
Final consumption	20		

Energy balance (excerpt)	Bituminous coal TJ	Product 2 TJ	…
Production	2300		
Import	500		
Export	-900		
Supply	**1900**		
Statistical differences	*200*		
Input to Electricity	1100		
…			
Final consumption	600		
….			

Need to collect good data for physical quantities AND calorific values

The IEA calorific values: data collection and dissemination

IEA questionnaires: guidance on ranges by type of fuel

ANTHRACITE
Quality: High carbon content (about 90 % fixed carbon).
Uses: industrial and residential applications

>23 865 kJ/kg

COKING COAL
Quality: High. Bituminous coal with properties to the production of coke oven coke
Uses: Metallurgical industry

>23 865 kJ/kg

OTHER BITUMINOUS COAL
Quality: Lower carbon content and higher volatile matter (>10%)
Uses: Electricity and heat generation, manufacture of cement…

>23 865 kJ/kg

HARD COAL

SUB-BITUMINOUS COAL
Quality: High carbon content: high carbon content (about 90 % fixed carbon).
Uses: Electricity and heat generation.

<23 865 kJ/kg
>17 435 kJ/kg

LIGNITE
Quality: Low carbon content and higher volatile matter
Uses: Electricity and heat generation

<17 435 kJ/kg

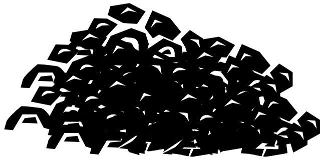
BROWN COAL

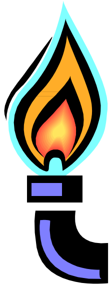
Calorific value on an ash-free but moist basis.

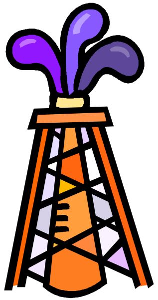
For each fuel, calorific value data may also vary significantly

- over time
- from country to country
- from flow to flow - mainly primary products (e.g. trade ≠ consumption)

Note: the IEA uses average regional values for oil products







Calorific values in the IEA annual questionnaires: example for coal

ANNUAL QUESTIONNAIRE
COAL
(Solid Fossil Fuels and Manufactured Gases)
IEA - Eurostat - UNECE

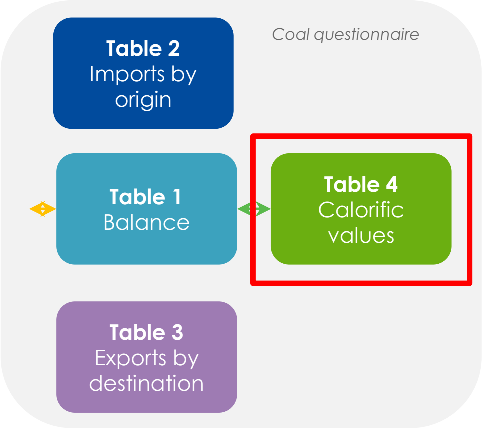


Table 4: Calorific values

- Different calorific values for each flow
- CVs need to be properly balanced to avoid statistical difference in an energy balance
- Estimated Gross calorific value = Net + 5%
- Manufacture gases: reported in TJ (gross)

Country

		Anthracite	Coking coal	Lignite
		MJ/tonne	MJ/tonne	MJ/tonne
		A	B	E
Production	gross -	0	0	0
	net -	0	0	0
Imports	gross -	0	0	0
	net -	0	0	0
Exports	gross -	0	0	0
	net -	0	0	0
Used in main activity plants	gross -	0	0	10230
	net -	0	0	9000
Used in industry	gross -	0	0	0
	net -	0	0	0
For other uses	gross -	0	0	0
	net -	0	0	0

Not all countries submit questionnaires to the IEA. If not, information is more scarce

Typical structure for the IEA database on calorific values

World Conversion Factors (Read-only):1

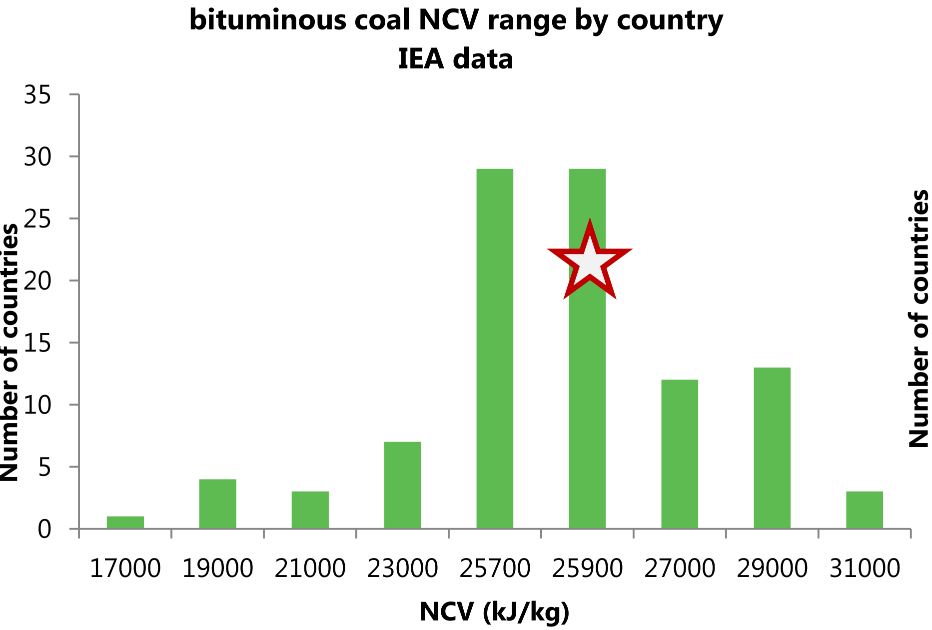
UNIT: kJ/kg | TIME: 2015 | COUNTRY: Austria

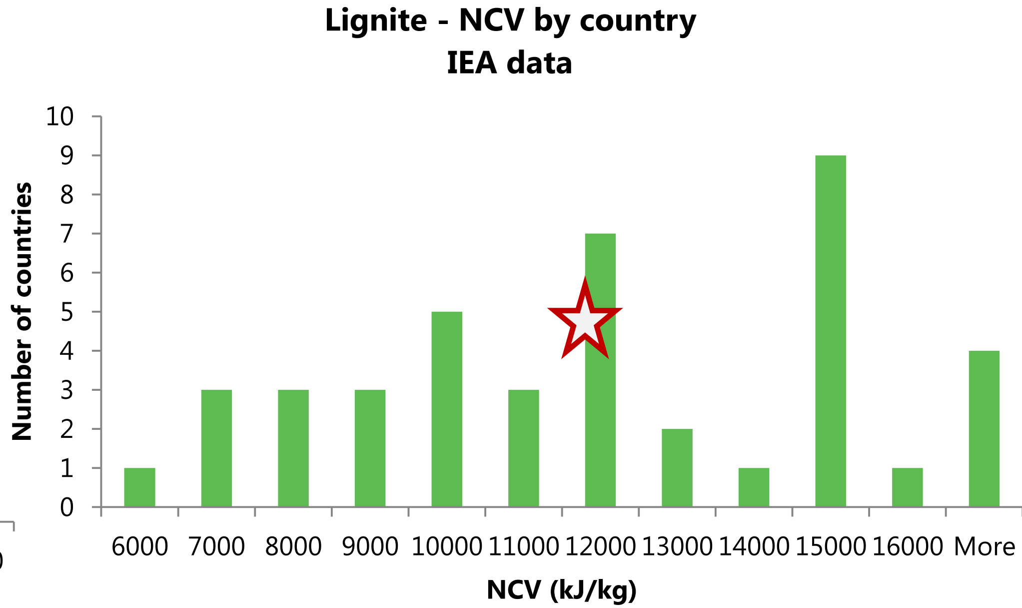
PRODUCT / FLOW	Anthracite	Coking coal	Other bituminous coal	Sub-bituminous coal	Lignite	Patent fuel	Coke oven coke	Coal tar	BKB	Peat	Crud
Average net calorific value	26,700	28,971	27,414	22,082	9,700	31,000	28,595	36,912	19,800	8,800	
NCV of production	x	x	x	x	x	x	28,595	36,912	x	8,800	
NCV of other sources	x	x	x	x	x	x	x	x	x	x	
NCV of imports	26,700	28,971	27,414	22,082	9,700	31,000	28,595	x	19,800	x	
NCV of exports	x	x	27,414	x	x	x	x	36,912	x	x	
NCV of coke ovens	x	28,971	x	x	x	x	x	x	x	x	
NCV of blast furnaces	x	x	27,414	x	x	x	28,595	36,912	x	x	
NCV in main activity producer electricity plants	x	x	26,992	x	x	x	x	x	x	x	
NCV in autoproducer electricity plants	x	x	x	x	x	x	x	x	x	x	
NCV in main activity CHP plants	x	x	26,923	x	x	x	x	x	x	x	
NCV in autoproducer CHP plants	x	x	28,875	x	x	x	x	x	x	x	
NCV in main activity heat plants	x	x	x	x	x	x	x	x	x	x	
NCV in autoproducer heat plants	x	x	x	x	x	x	x	x	x	x	
NCV in industry	x	x	27,414	22,082	9,700	x	28,595	x	x	x	
NCV for other uses	26,700	29,206	27,414	21,914	9,700	31,000	28,595	36,912	19,800	8,800	

IEA World Energy Balances, 2017

Annual data for around 40 products, country-specific (default if no information available)

Examples of calorific value ranges across countries in IEA data





Significant cross-country variability – and default values for many countries

Improving calorific values data quality, globally

International guidance and cooperation among organisations

Chapter 1: Introduction

Default NCV values to convert from units of 10^3 tonnes to units of terajoules are in Table 1.2. These values are based on a statistical analysis of three data sources:

1. **Annual greenhouse gas inventory submissions of Annex I Parties**: UNFCCC Annex-1 countries' national submissions in 2004 on 2002 emissions (Table-1A(b) of the CRF). This dataset contains Net Calorific Values (NCVs), Carbon Emission Factor (CEF) and Carbon Oxidation Factor (COF) for individual fuels for more than 33 Annex 1 countries.
2. **Emission Factor Database**: The IPCC Emission Factor Database (EFDB), version-1, as of December 2003 contains all default values included in the *1996 IPCC Guidelines* and additional data accepted by the EFDB editorial board. The EFDB contains country-specific data for NCV and CEF including developing countries.
3. **IEA Database**: International Energy Agency NCV database for all fuels, as of November 2004. The IEA database contains country-specific NCV data for many countries, including developing countries.

The statistical analysis performed on these datasets has been described in detail in a separate document (Kainou, 2005). The same data set was used to compile a table of default values and uncertainty ranges.

2006 IPCC Guidelines for National Greenhouse Gas Inventories

IEA data are a reference in IPCC Guidelines

Energy statistics guidance also links back to IPCC Guidelines

Statistical Commission
Forty-second session
22-26 February 2011
Item 3(e) of the provisional agenda
Items for discussion and decision: energy statistics

Background document
Available in English only

International Recommendations for Energy Statistics (IRES)

4. Default calorific values

4.48. The default calorific values are provided in Table 4.1 as a reference to countries when no specific calorific values are available. The default calorific values presented below are those used in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006). For a number of products, no calorific values are available in the 2006 IPCC guidelines and thus no value is reported in the table below.

Table 4.1: Default net calorific values for energy products

SIEC Headings				Net Calorific Values (GJ/metric ton)		
				Default value	Range: Lower value	Range: Upper value
0			**Coal**			
01			**Hard coal**			
011	0110		Anthracite	26.7	21.6	32.2
012			Bituminous coal			
	0121		Coking coal	28.2	24.0	31.0
	0129		Other bituminous coal	25.8	19.9	30.5
02			**Brown coal**			
021	0210		Sub-bituminous coal	18.9	11.5	26.0
022	0220		Lignite	11.9	5.5	21.6
03			**Coal products**			
031			Coal coke			
	0311		Coke oven coke	28.2	25.1	30.2
	0312		Gas coke	28.2	25.1	30.2
	0313		Coke breeze			
	0314		Semi cokes	28.2	25.1	30.2
032	0320		Patent fuel	20.7	15.1	32.0
033	0330		Brown coal briquettes (BKB)	20.7	15.1	32.0
034	0340		Coal tar	28.0	14.1	55.0
035	0350		Coke oven gas	38.7	19.6	77.0
036	0360		Gas works gas (and other manuf. gases for distribution)	38.7	19.6	77.0

Yes, but… international data: not a source for national data

Calorific values require country-specific data collection

Source data for calorific values used in the annual questionnaires – AUSTRIA example (personal communication)

Fuel	Source
Anthracite	Emission Trading Schemen (ETS)
Coking coal	steel industry
Other bituminous coal	ETS & coal trade companies
Sub-bituminous coal	ETS
Lignite	ETS & coal trade companies
Patent fuel	coal trade companies
Coke oven coke	steel industry
Coal tar	steel industry
BKB	coal trade companies
Coke oven gas	steel industry
Blast furnace gas	steel industry
Other recovered gases	steel industry
Peat	Default
Biodiesels blended	Biofuel report
Fuel oil	refinery
White spirit and SBP	refinery
Lubricants	refinery
Bitumen	refinery
Paraffin waxes	refinery
Petroleum coke	ETS
Other oil products	refinery
Natural gas	E-Control (regulator)
Industrial waste (non-ren)	ETS & CHP Statistics
Municipal WASTE (ren & non-ren)	CHP Statistics
Solid biofuels	Austrian Energy Agency & ETS
Charcoal	ETS & coal trade companies
Biogases	CHP Statistics
Biodiesels	Biofuel report

What experience can be shared among experts? What are the challenges?

Developing good quality national data on calorific value is essential

Calorific value data quality equally impacts energy balances and inventories. Experts may:

- Enhance information exchange at national level among inventory and energy statistics experts (IEA can help if needed – happens when discrepancies occur)
- Enhance effort on national data collection – what are the possible sources? How to collect the data? What is done elsewhere?
- Use international average values as reference, but not as substitute of national data

www.iea.org/statistics

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