United Nations Statistics Division

Coal, Peat and Derived Fuels

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Workshop on Energy Statistics for ASEAN Countries

21-23 November 2017

Kuala Lumpur, Malaysia

http://unstats.un.org/unsd/energy

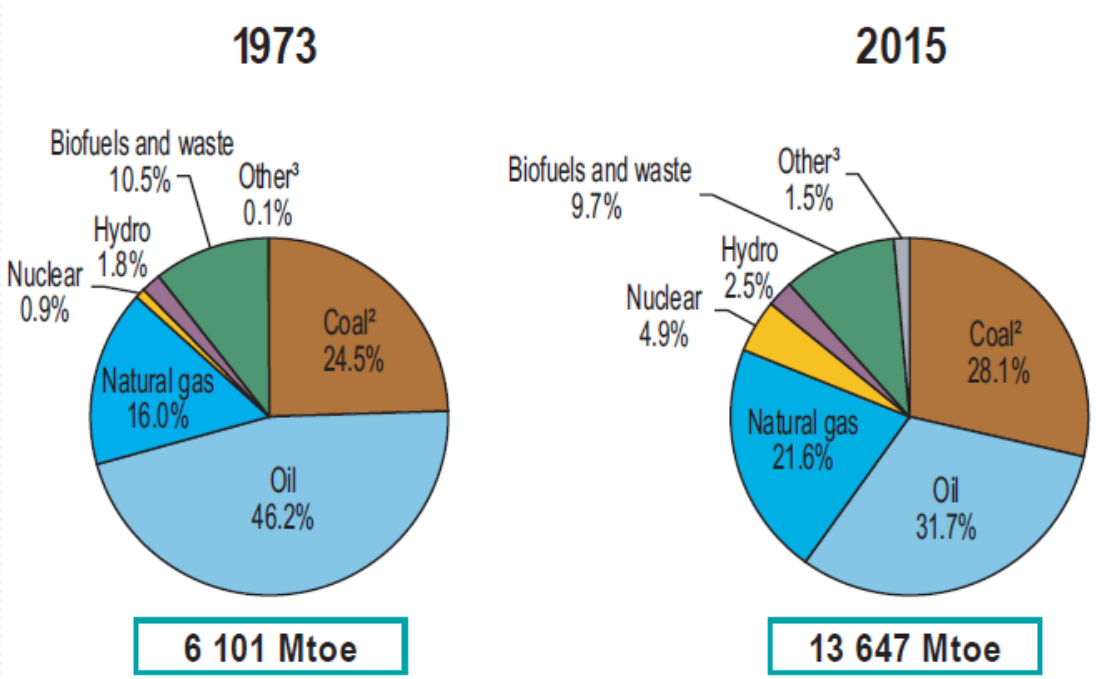
Overview

1. The role of coal
2. Coal classification
3. Coal transformation processes
4. Compiling/Reporting coal data
5. Concluding remarks

The role of coal

- World TES
- 2nd largest source of world's energy supply in 2015
- Largest source of electricity generation (39.3%)

- Source: IEA KWES 2017



Importance of Coal

- Abundant, cheap with low technology barriers
- Used for power generation, iron and steel production and cement manufacture
- Energy security can be enhanced with coal-to-liquids, gas or chemicals

But:

- Environmental concerns: largest CO_2 emission per unit of energy among conventional energy sources
  - Potential for development and deployment of clean coal technologies such as carbon capture and storage

SIEC Headings		
Section / Division / Group	Class	
0		Coal
01		Hard coal
011	0110	Anthracite
012		Bituminous coal
	0121	Coking coal
	0129	Other bituminous coal
02		Brown coal
021	0210	Sub-bituminous coal
022	0220	Lignite
03		Coal products
031		Coal coke
	0311	Coke oven coke
	0312	Gas coke
	0313	Coke breeze
	0314	Semi cokes
032	0320	Patent fuel
033	0330	Brown coal briquettes (BKB)
034	0340	Coal tar
035	0350	Coke oven gas
036	0360	Gas works gas
037		Recovered gases
	0371	Blast furnace gas
	0372	Basic oxygen steel furnace gas

Coal classification

Fuel	Type	Reporting unit	Expected calorific value (kJ/kg, MJ/ton)	GCV estimation
Coking coal	Fossil fuels	kt	25000 - 33000	≈ NCV + 5%
Anthracite		kt	22000 - 29000	≈ NCV + 5%
Other bituminous coal		kt	22000 - 29000	≈ NCV + 5%
Sub-bituminous coal		kt	16000 - 24000	≈ NCV + 5%
Lignite		kt	5000 - 18000	≈ NCV + 5%
Peat		kt	7000 - 13000	≈ NCV + 5%
Oil Shale		kt	2500 - 12000	≈ NCV + 5%
Coal tar	Derived solid products	kt	30000 - 44000	≈ NCV + 5%
Patent fuel		kt	25000 - 32000	≈ NCV + 5%
Coke oven coke		kt	24000 - 32000	≈ NCV
Gas coke		kt	24000 - 32000	≈ NCV + 5%
BKB		kt	15000 - 21000	≈ NCV + 5%
Peat products		kt	8000 - 14000	≈ NCV + 5%
Gas works gas	Manufactured gases	TJ	15000 - 22000	≈ NCV + 10%
Coke oven gas		TJ	15000 - 22000	≈ NCV + 10%
Blast furnace gas		TJ	2000 - 4000	≈ NCV
Other recovered gases		TJ	2000 - 20000	≈ NCV

Coal classification

- Primary coal classification by physical and chemical characteristics (e.g., Calorific Value and Vitrinite mean Random Reflectance)

<table>
<tr><td>Coking coal</td><td rowspan="2">Hard Coal</td><td>Metallurgical Coal</td></tr>
<tr><td>Anthracite</td><td rowspan="3">Steam Coal</td></tr>
<tr><td>Other bituminous coal</td></tr>
<tr><td>Sub-bituminous coal</td><td rowspan="2">Brown Coal</td></tr>
<tr><td>Lignite</td><td></td></tr>
<tr><td>Peat</td><td></td><td></td></tr>
<tr><td>Oil shale and oil sands</td><td></td><td></td></tr>
</table>

Coal classification

- Peat
  - Solid fossil fuel, often a precursor to coal, particularly lignite

Coal classification

- Oil shale and oil sands
  - Sedimentary rock which contains organic matter in the form of kerogen, a precursor of petroleum
  - Oil shale may be burned directly or processed by heating to extract shale oil*
  - Shale oil should be reported as non-conventional oil

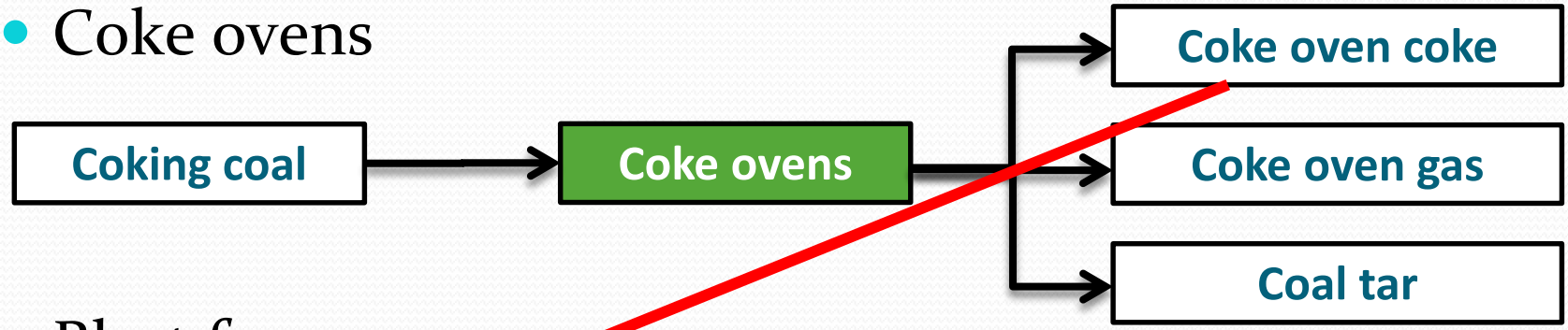
* Note that this term is also used for oil extracted from reservoirs in shale formations

Coal transformation processes

- Transformation: includes fuels used for conversion of energy (e.g., coal to electricity) or for the transformation to derived energy products (e.g., coke ovens, blast furnaces)
  - Reporting what should be transformation in final consumption affects indicators based on final consumption (such as SDG indicator 7.2.1)
- The largest consumption of coal is in electricity and heat generation
- There are several transformation processes unique to the coal sector

Coal transformation processes

- Coke ovens

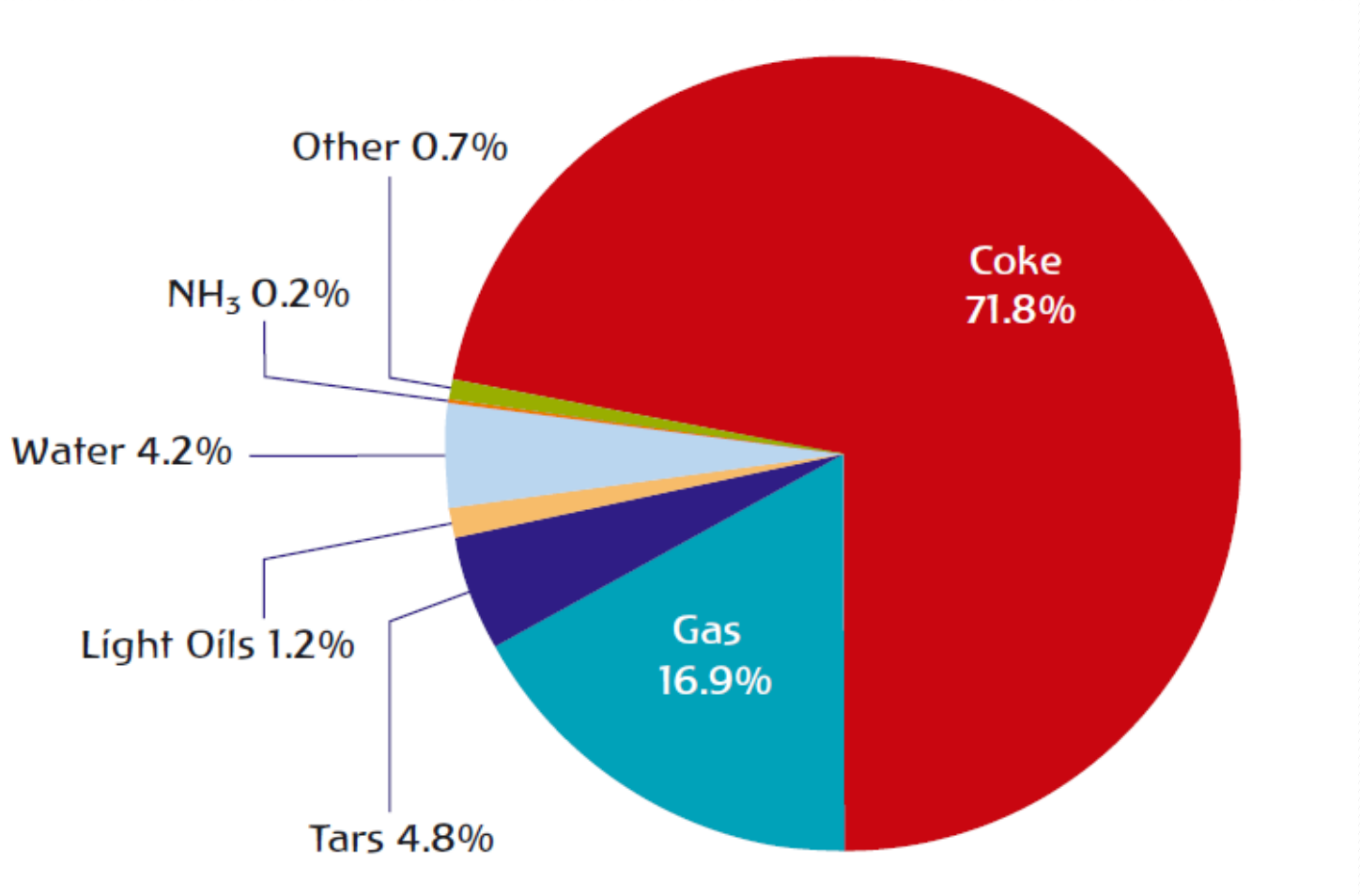


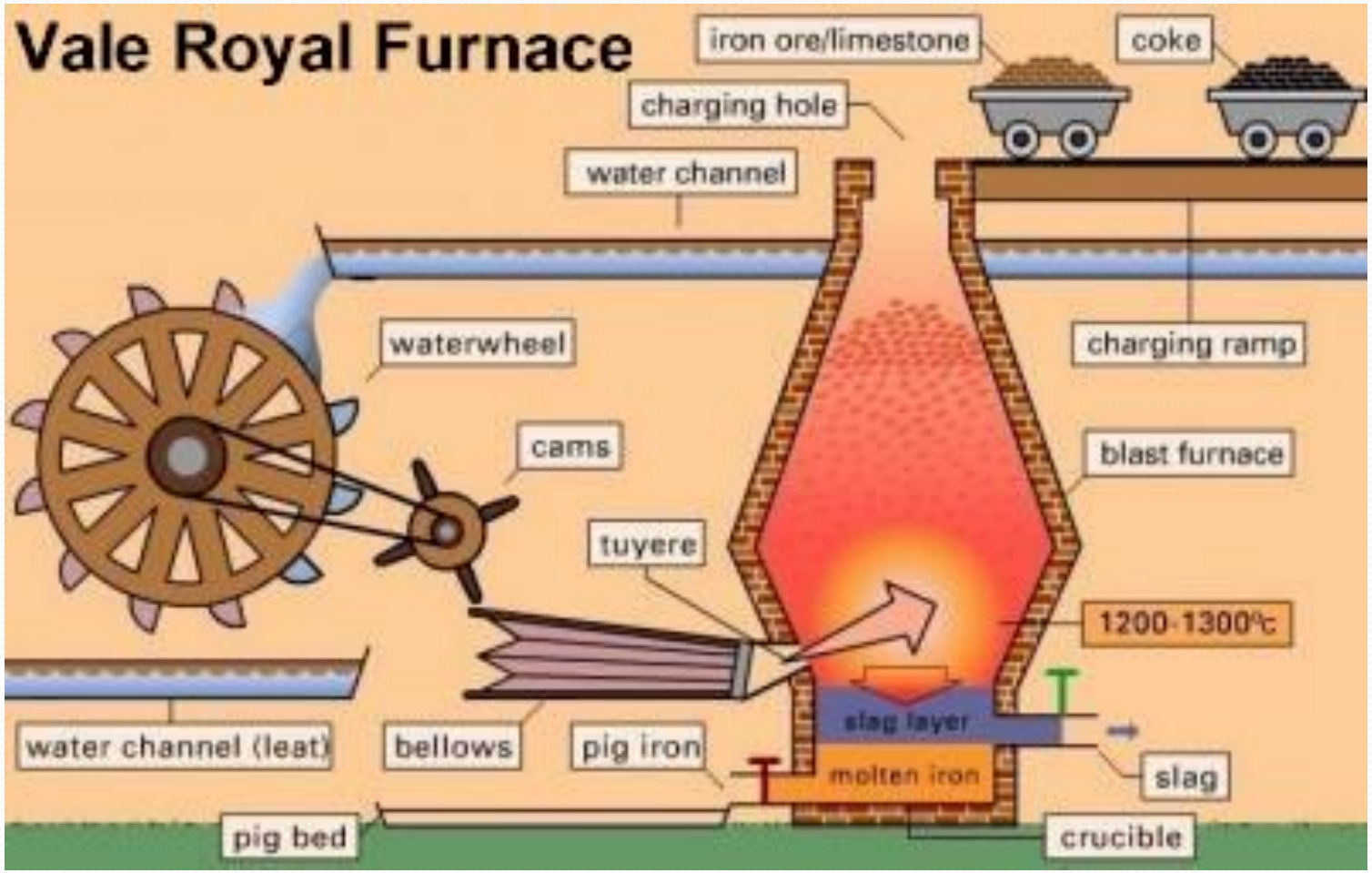
- Blast furnace

- Gas works and coal gasification plants

Coal transformation processes

- Typical mass yields from coke ovens

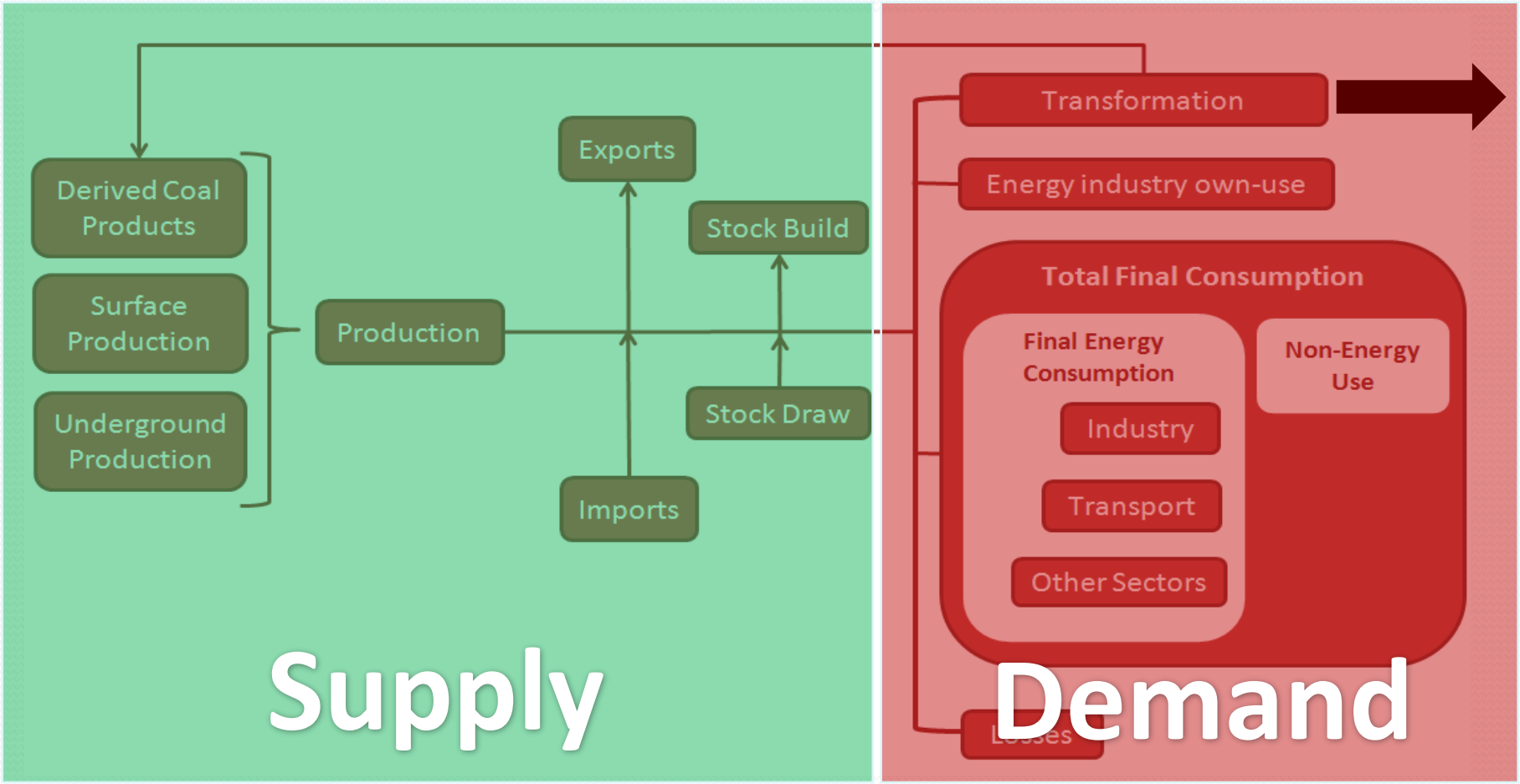



Vale Royal Furnace
iron ore/limestone
coke
charging hole
water channel
waterwheel
charging ramp
cams
blast furnace
tuyere
1200-1300°c
slag layer
water channel (leat)
bellows
pig iron
molten iron
slag
pig bed
crucible

Coal transformation processes

- Patent fuel: manufactured from hard coal fines with binding agent
- BKB or Brown coal briquettes: composite fuel manufactured from brown coal without binding agent
- Coal liquefaction (coal-to-liquid) plants utilize coal to create liquid fuels (diesel, naphtha, etc.).
  - The liquid fuels production must be reported as “Other hydrocarbons” (SIEC 45) together with Oil.
- Peat products: products such as peat briquettes derived directly or indirectly from peat

Compiling/Reporting coal data



- *Note: Some transformation outputs will be reported in other questionnaires such as electricity, oil, and natural gas.*

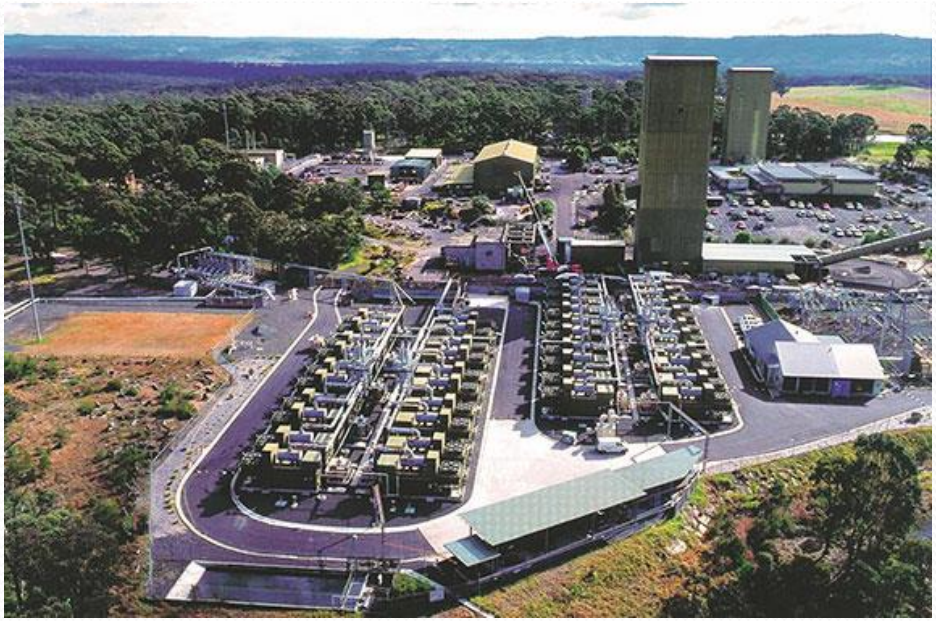
Compiling/Reporting coal data

- Coal washing
  - Removes ash & impurities
  - Improves quality and price
  - Reduces emissions

- Coal washing can significantly affect both the physical amount of coal available and its calorific value
- It is therefore very important to know <u>when</u> the quantity of coal and its NCV are measured
- Measuring these values just before a quantity of coal enters a transformation process is essential as only then the efficiency of the transformation process can be accurately calculated!

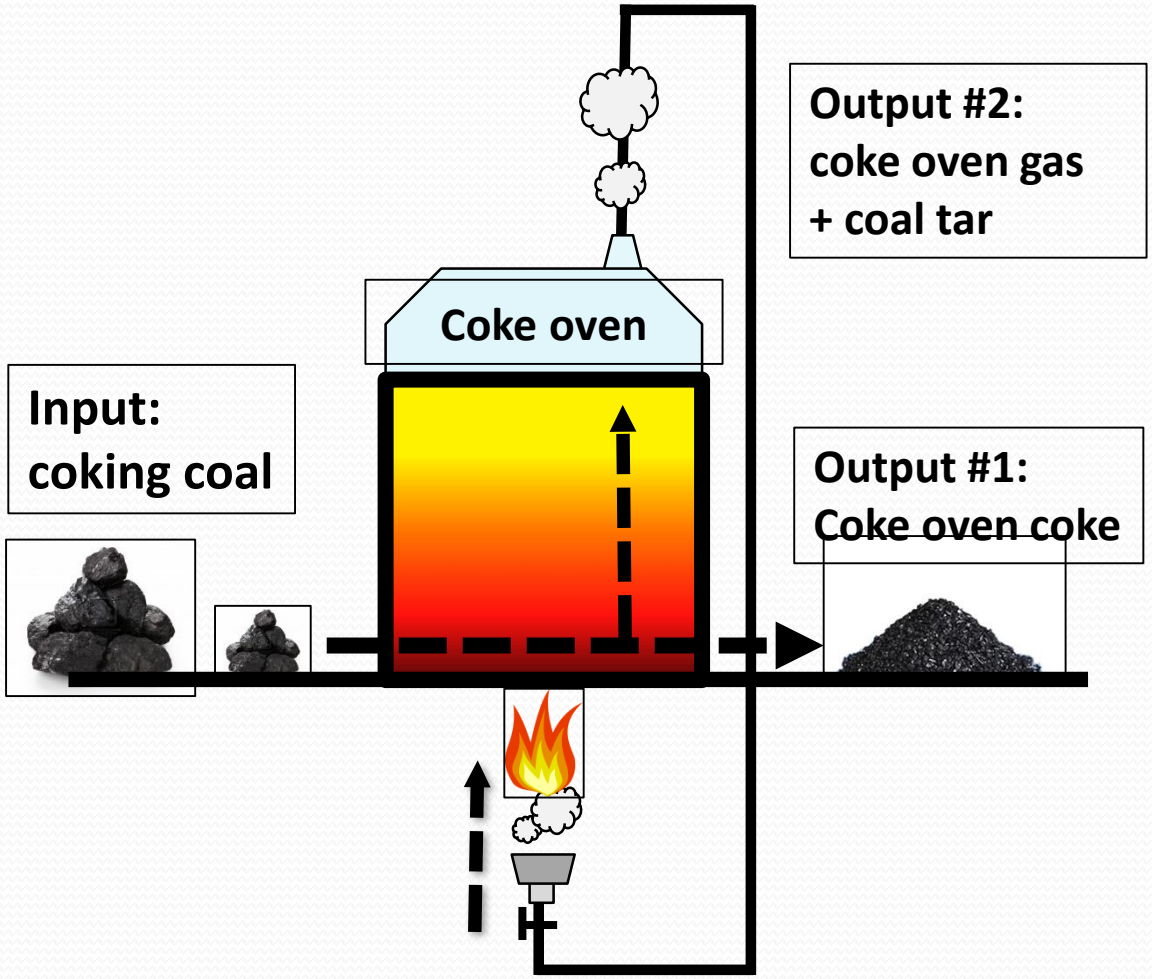
Compiling/Reporting coal data

- **Colliery gas**: although a type of natural gas, it is produced from coal mines, and as such should have production quantities inquired from coal mines.



Colliery gas as a source for generating electricity at the Appin and Tower coal mines in New South Wales, Australia.

Compiling/Reporting coal data



Fuels transformed into another energy form

Transformation

Fuels consumed to support operations

Energy industry Own-use

Compiling/Reporting coal data

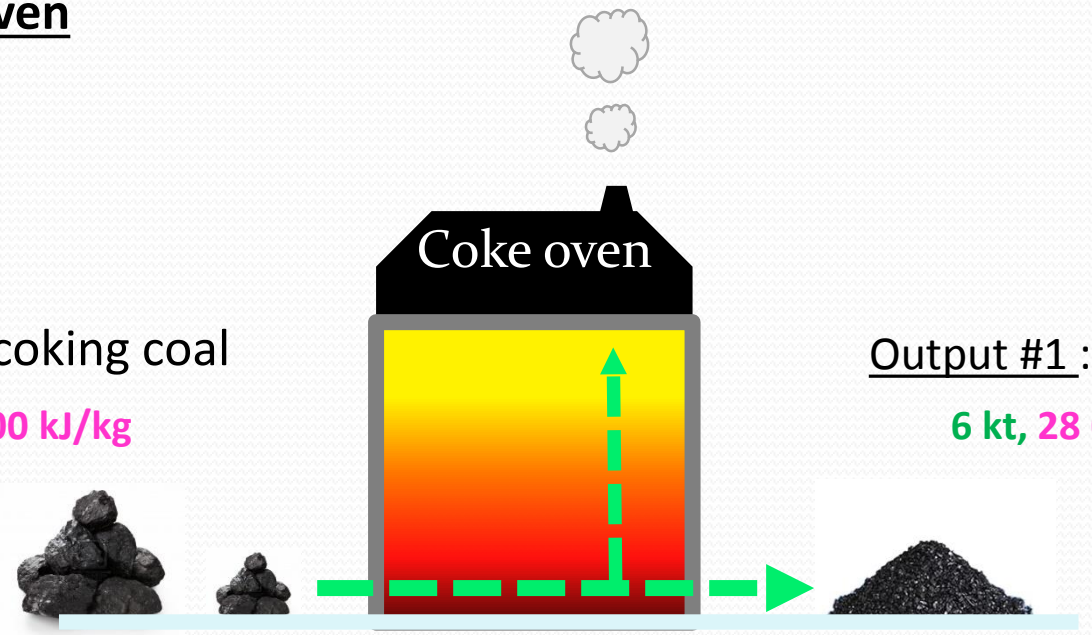
- Data quality checks:
  - Numbers (sums, signs, etc.)
  - Statistical differences
  - Time series consistency
  - Calorific values
  - Transformation efficiency
  - Comparison between tables
  - Physical vs. energy content balance
  - Comparison with other questionnaires
  - Data are complete and tell the correct story
  - Comparison with secondary and partner sources

Quality check: transformation efficiency

Example : Coke oven

Output #2 : coke oven gas + coal tar

15 TJ (gross) + 1 kt, 35 000 kJ/kg



Input : coking coal

10 kt, 26 000 kJ/kg

Output #1 : Coke oven coke

6 kt, 28 000 kJ/kg

$$Efficiency = \frac{15*0.9 + 1*35 + 6*28}{10*26} = 83\%$$

Quality check: transformation efficiency

Expected values

- Electricity plants: 10 – 50% depending on the fuel and main activity / autoproducer
  - Anthracite 30 - 40%
- CHP Plants: 30 – 80%
- Heat Plants: 40 – 100%
- Blast Furnaces: 35 – 45%
- Coke Ovens: 67 – 100% (Coke Oven Coke + Coke Oven Gas)
- Patent Fuel plants: 90 – 100%
- BKB: 85 – 100%
- Gas Works : 67 – 100% (Gas works Gas + Gas Coke)

Compiling/reporting coal data

- **Calorific values** of coal products may differ for different flows such as:

  - Production
  - Imports
  - Exports

Domestic supply

Statistical difference on an energy basis

  - Used in Coke Ovens
  - Used in Blast Furnaces
  - Used in main Activity Plants
  - Used in Industry
  - For Other Uses

Total demand

Compiling/reporting coal data

- For products classified in SIEC under Section 0 (Coal) and Section 1 (Peat), the following list of additional data items applies.

Item number	Data item
2.1	Production
2.1.1	Of which: Underground
2.1.2	Of which: Surface
2.2	Production from other sources

- *Underground production*: from underground mines where coal is produced by tunnelling into the earth to the coal bed.
- *Surface production* refers to production from surface mines.

Compiling/reporting coal data

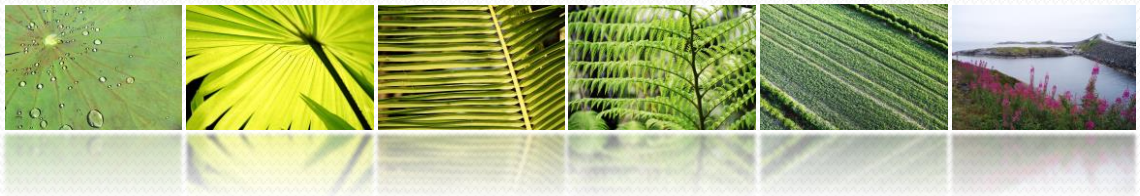
- *Production from other sources* consists of two components:

  (a) recovered slurries, middlings and other low-grade coal products, including coal recovered from waste piles and other waste receptacles; and

  (b) fuels whose production is covered in other sections of SIEC, for example, from oil products (e.g. petroleum coke addition to coking coal for coke ovens), natural gas (e.g., natural gas addition to gas works gas for direct final consumption), biofuel and waste (e.g., industrial waste as binding agent in the manufacturing of patent fuel).

Concluding remarks

- Distinction between transformation and final use (by industry – mainly metallurgical) is important:
  - Recovered gases can be used to generate electricity, for example
  - Indicators based on final energy consumption (SDG 7.2.1)
- Distinction between transformation and own use (by industry – mainly metallurgical) is important:
  - To access efficiency of the process, which in turn can be used as a data quality check
- Assessing country-specific (and flow-specific) Calorific Values important (rather than using default CVs):
  - For the construction of accurate balances and indicators
  - For the accurate assessment of efficiencies



Thank you.

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