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Overview of the Energy Markets

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GLOBAL MARKETS IN CLEAR VIEW

OVERVIEW OF THE ENERGY MARKETS

8-9 OCTOBER 2009

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Objective

Provide an outline of energy markets, industry fundamentals, associated products and trading markets for non technical personnel



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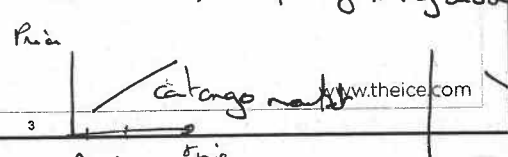
Density of a product
 API: liquid $\nearrow$ = lighter more valuable
 Amsterdam Rotterdam Antwerp
 In volume
 bbl: Blue Barrel

B/L Bill of lading
 Who owns the commodity
 barrels a day.
 30E
 assets of Oil Equivalents
 say: you own the asset
 but: you need to pay
 committed to sell but
 without owning the asset
 trader got the position
 he is the principal
 broker: facilitator in the market agent.
 no market risk
 Δ between physical price
 and futures
 Basis risk

- 11 Some contracts are Platts or Argus linked.
- 12 Spot delivery: 21 days in energy market
- 13 them = unit with or
- 14 oil tankers.

Terminology/definitions

1 API gravity 2 ARA 3 Barrel / bbl 42 vs gallons. 4 B/L date 5 B/D (b.d.) 6 BOE 7 Long/short 8 Bull/bear 9 Broker/trader 10 Basis - Cost of carry	- Hydrocarbon 11 Platts 12 Spot/physical 13 Therm/BTU/Kwh 14 ULCC, VLCC 15 Light/heavy Density of oil 16 Sweet/sour 17 Rank and API - Contango, Backwardation - CFD
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- Labels:
- Oil
 - Gas
 - Coal
 - ~~Market~~
 - Power

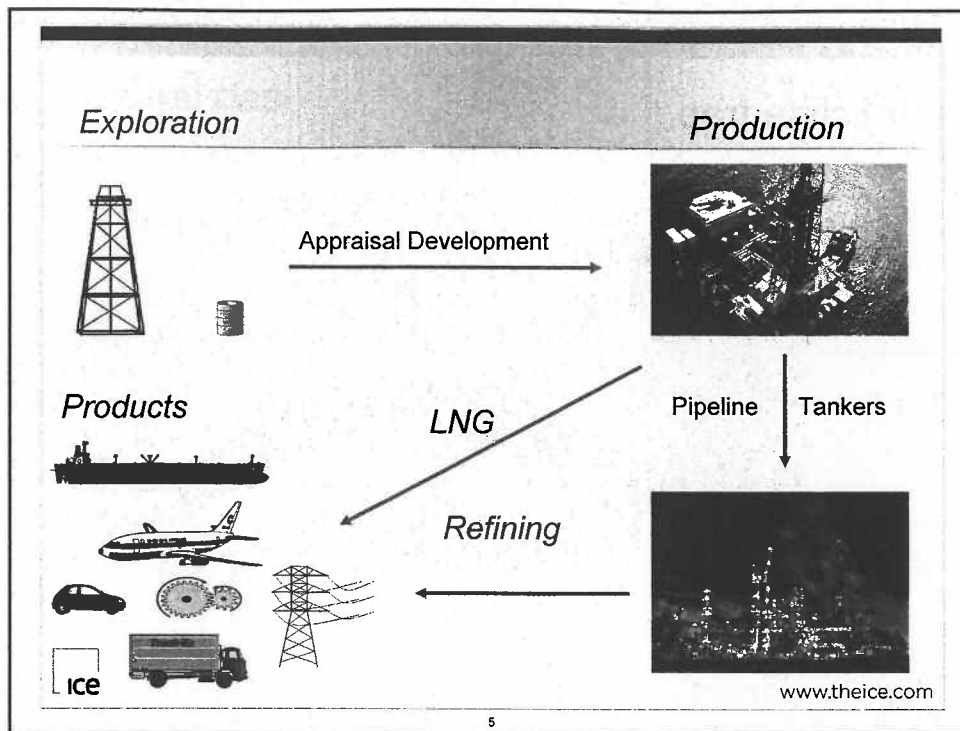
Price drivers

- Short time market.
- Very short time

EXPLORATION & PRODUCTION

- Supply: field
- Demand
- Seasonality
- Weather
- CO2 market.
- Storage capacity
- Politics.
- Infrastructure
- Production cost.
- Correlation between market & end-uses?

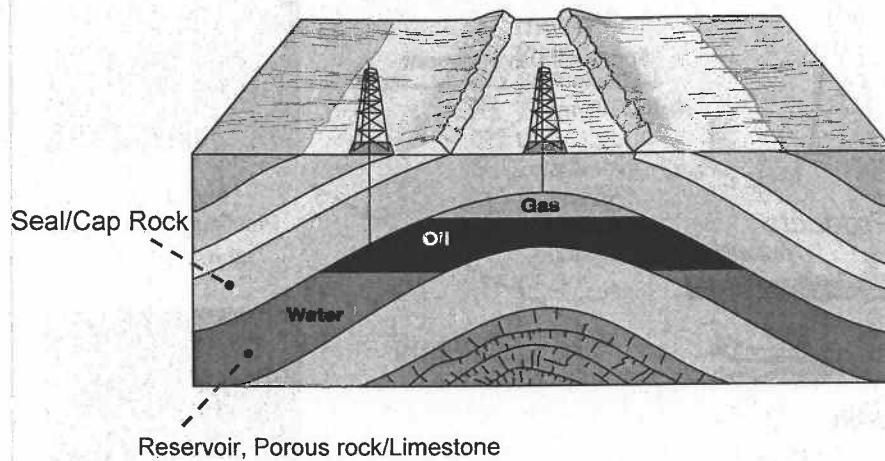
In Summer, when weather too hot nuclear plants have to stop! ! check that!
 Oil WTI (Cushing Oklahoma)
 benchmark for the market.



Exploration summary

- Oil, Gas and coal are organic matter forming hydrogen/carbon compounds – no oxygen, except in coal
- Conditions need to be right
 - formed in sedimentary basins
 - deposits migrate and are retained in porous rocks (Reservoir)
 - trapped by structure allowing hydrocarbons to collect
 - sealed by impervious 'cap' rock
- Seismic & other surveys locate deposits: cheaper than drilling
- Drilling releases pressure and oil/gas rise to surface
- Successful Exploration followed by Appraisal
- Coal deposits mined or open-cast

Anticline trap



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Production

- Production rigs, onshore or offshore
 - Well completions
 - Separation of water & sediment
 - Pipelines: new or existing
 - Production profile: start up, plateau rate, enhanced oil recovery
 - Associated gas: re-inject or export
 - Enhanced recovery: steam injection
- Natural gas:
 - find customers up front
 - transport via gas pipeline or liquid-LNG
 - locality and cost of delivery

15-20 years to start to incentivise exploration.



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Natural gas

- Natural gas consists 98% of methane with 2% other gases
- When found with oil much gas used to be flared off, regarded as a waste product
- Characteristics of natural gas
 - Voluminous
 - Comparatively clean burning
 - Odourless
 - Explosive



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Proved oil reserves, end 2008

*demand: 25.4 bbl
40% of 90%
global demand*



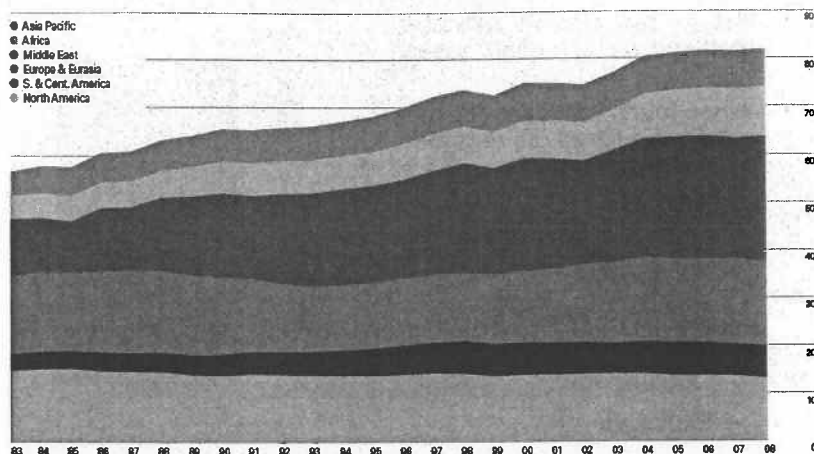
Proved reserves at end 2008
Thousand million barrels

Source: BP Statistical Review .. www.theice.com

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Oil production by area

- Asia Pacific
- Africa
- Middle East
- Europe & Eurasia
- S. & Cent. America
- North America



World oil production increased by 380,000b/d in 2008. OPEC production increased by 280,000b/d despite production cuts instituted late in the year. Saudi Arabia saw the largest production increase, with output rising by 400,000b/d. Russian production fell by 90,000b/d, the first decline since 1998. OECD production fell by 750,000b/d, with Mexico registering the world's largest decline (310,000b/d).

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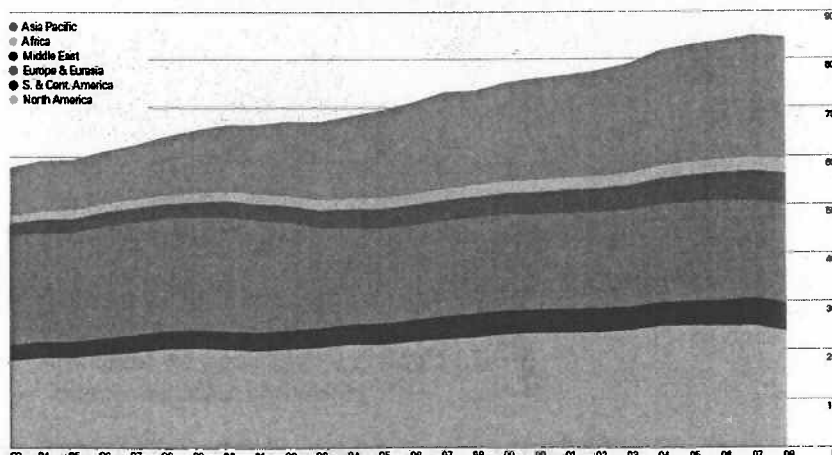
Source: BP Statistical Review

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Oil consumption by area

- Asia Pacific
- Africa
- Middle East
- Europe & Eurasia
- S. & Cent. America
- North America



World oil consumption fell by 420,000b/d, the largest decline since 1982. OECD consumption fell by 1.5 million b/d, driven by a decline of nearly 1.3 million b/d in the US. China again recorded the world's largest incremental growth, rising by 280,000b/d. Consumption growth was above the 10-year average in the exporting regions of the Middle East, South and Central America, Africa and the Former Soviet Union.

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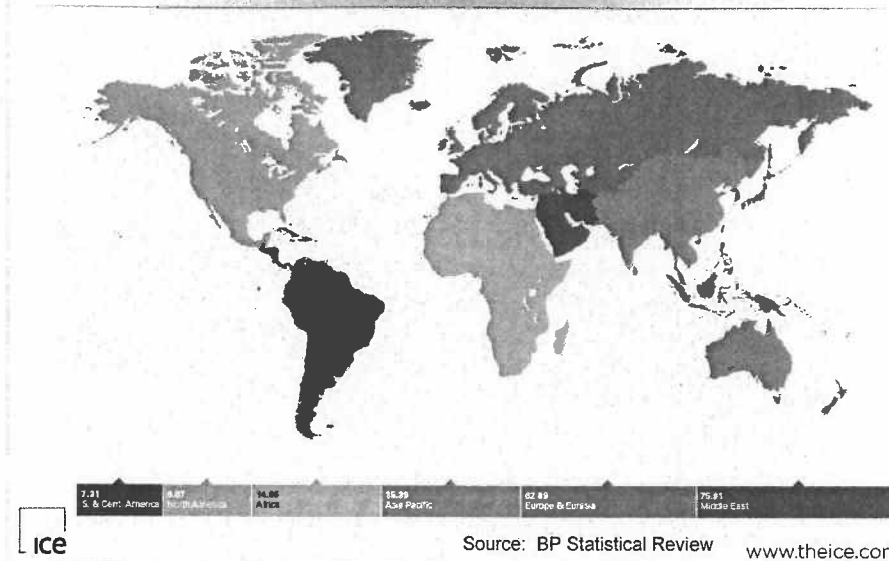
Source: BP Statistical Review

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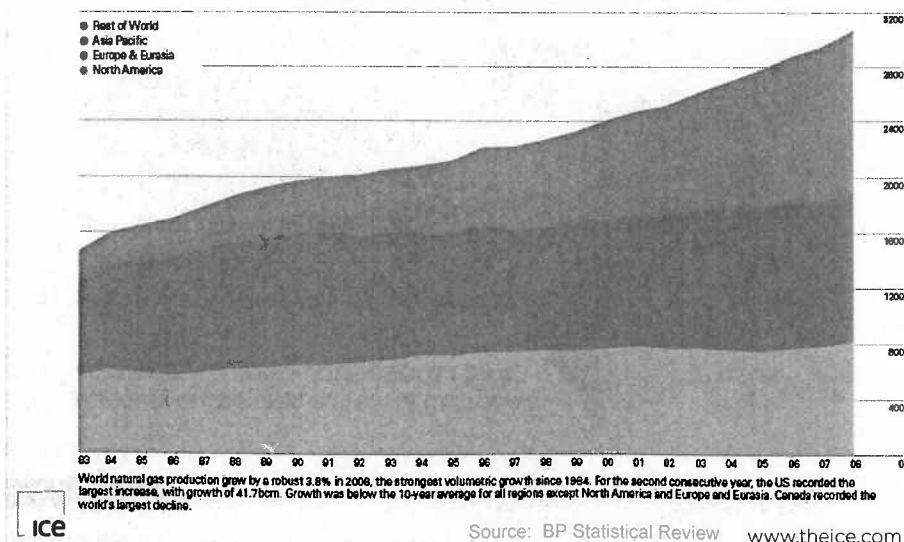
nb/day

Proved natural gas reserves, end 2008



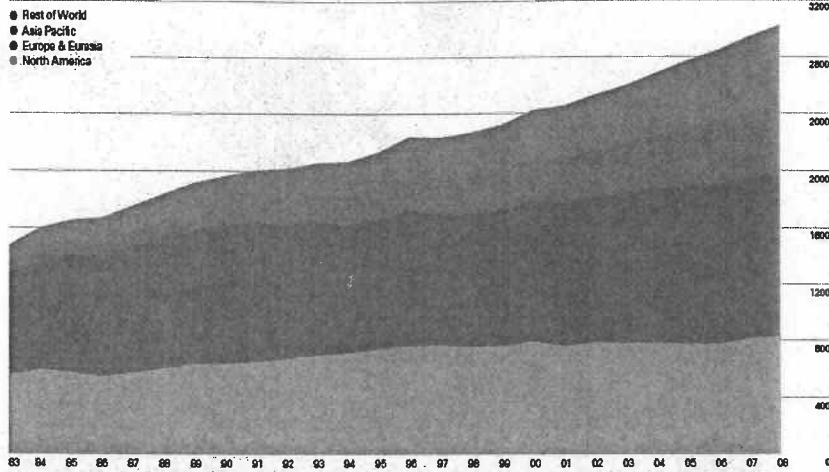
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Natural gas production by area



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Natural gas consumption by area



World natural gas consumption grew by 2.5% in 2008, below the historical average. Growth was broadly distributed, although only North America and the Middle East saw above average growth in aggregate. China accounted for the largest increment to gas consumption, while Russia recorded the largest decline.

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Source: BP Statistical Review www.theice.com

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Proved coal reserves, end 2008



14.1B t Middle East	15.0B t S. & Cent. America	22.0B t Africa	20.1B t North America	20.1B t Asia Pacific	27.2B t Europe & Eurasia
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Source: BP Statistical Review www.theice.com

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POWER GENERATION



Electricity is different

- Produced in Power Stations by consuming Fuel

Characteristics:

- A way to move energy, not a Fuel
 - "Invisible" with no differentiation
 - Cannot be stored
 - Power Systems stable over limited range
- Historically a utility business run by a national or regional state run monopoly



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Energy conversion



Chemical Energy - fossil fuels, biomass



Kinetic Energy - wind, wave/tidal (other renewables)



Potential Energy – hydro electric



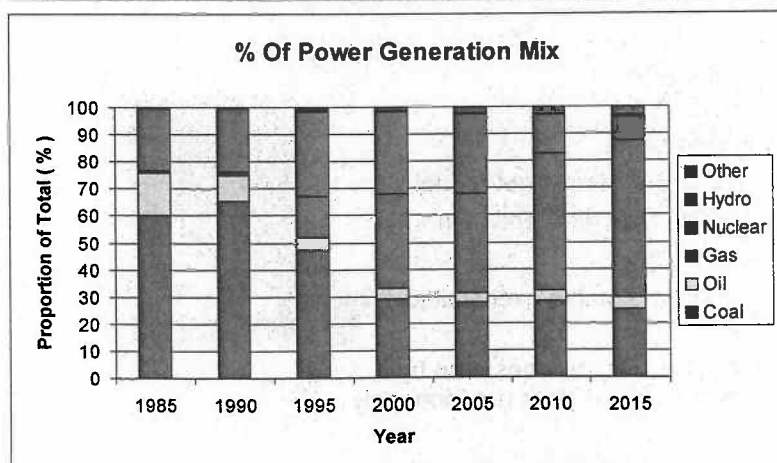
Atomic Energy - nuclear



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UK generation mix



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Power generation

- Physical flow used to drive turbine
- Turbine turns coil of wire in a magnetic field inducing current
- Key issues:
 - What drives the turbine?
 - How efficient is the process?
 - What are the waste products?
 - What does it cost?



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Relative fuel advantages/disadvantages

- Coal (Conventional Steam Raising Boiler):
 - Low fuel costs
 - High capital expenditure - very large footprint
 - Can use local, indigenous coal (social benefits)
 - Low efficiency - potential to improve with super-critical technology
 - High emissions - can be significantly reduced with extra capex
 - Inherently high CO2 emissions
- Oil (Conventional Steam Raising Boiler):
 - Volatile Fuel Costs (can be low) - may attract more tax than alternatives
 - Medium Capex Cost - Large Footprint
 - Marginally better efficiencies than Coal
 - High Emissions - can be significantly reduced with extra capex
 - Medium-level CO2 emissions



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Relative fuel advantages/disadvantages

- Gas (*Combined Cycle - CCGT*):
 - High Fuel Costs (LNG higher than piped Natural Gas)
 - Low Capex Cost - Small Footprint, also Suitable for smaller Projects
 - Short Construction Period
 - Easy to arrange Finance
 - Very high efficiencies
 - Low Emissions (SO_x, NO_x)
 - Low CO₂ emissions but methane losses contribute to greenhouse effect and global warming



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Conventional steam turbine



All you need is heat

Any fuel can be used
Almost all coal, Nuclear, Fuel Oil
Gas Oil, wood, waste, biomass

Comparatively low efficiency

30-40%

Waste products

Steam, CO₂, SO₂
radioactive material

Flexible

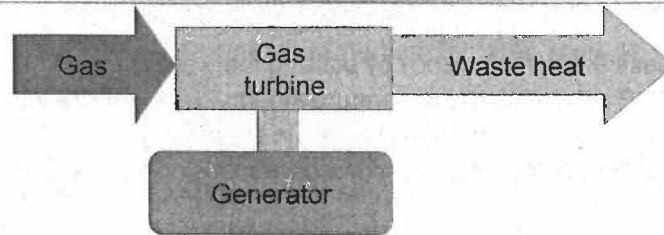
not in the case of nuclear



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Open cycle gas turbine (OCGT single cycle)



Requires clean gases to prevent turbine blade corrosion
Natural gas, gas oil, fuel oil with pre-treatment

Low to medium efficiency 35-40%

Waste products Heat, CO₂, other emissions

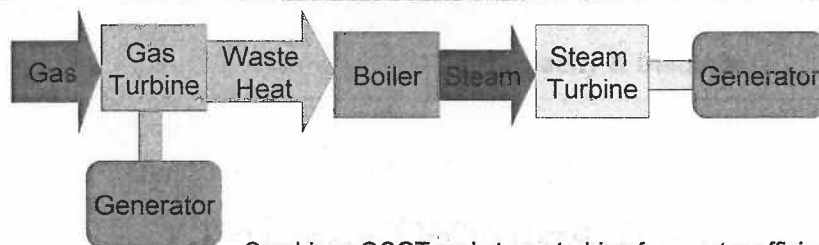
Can be small, used as peaking plants



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Combined cycle gas turbine (CCGT)



Combines OCGT and steam turbine for greater efficiency

Fuel: Natural Gas, Gas Oil, potentially Fuel Oil

Comparatively low capital investment

High efficiency 40-60%

Waste products Steam, CO₂, other emissions



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Combined heat and power and cogeneration

- Increase thermal efficiency by utilising the waste heat
 - CHP normally low temperature steam – used for space heating
 - Very efficient in winter – less so in summer
 - Cogeneration – industrial processes – using heat and electricity
- Often combined with gas-fired CCGT, but could be any form of thermal generation
- May achieve thermal efficiencies of up to 90%
- Micro-generation



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TRANSPORT & SUPPLY



Transport, oil, gas and coal

- Method of transport determines the unit of trading (barrels, tonnes, gallons, cubic metres)
- Capacity of vessels, loading/discharge terminals and length of voyage all affect price
- Once in transit the commodity remains tradable through to the discharge point and beyond



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Other means of transport

Type	Size	Capacity & Distance
Pipeline	6-48"	Up to 1.5mbbl/d (distance unlimited)
Rail	100t car	2500t/train
Barge	600-3000t	Congestion limit
Road	10-40t truck	Congestion limit



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→ Power generators are increasingly managing the supply chain. Move from CIF to FOB

Types of sale

- CIF Cost Insurance Freight Delivery to end location
 - CFR Delivered cost without insurance
 - FOB Free on Board: Cost of oil
 - FAS Free Alongside Ship
 - DES (Delivered) Delivered Ex Ship
 - DDP Delivered Duty Paid
 - Delivered Out Turn (not INCO defined)
- $$\begin{array}{r} \text{FOB} \\ + \text{Transport Cost} \\ \hline \text{CIF} \end{array}$$

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Delivered crude price

The delivered price of crude oil to a refinery comprises :

- The fob price of the crude
- Primary transportation
- Secondary transportation
- Losses and other fees/charges
- Insurance for oil in transit
- Interest cost whilst oil is in transit

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Transport by ship

- ULCC - Ultra Large Crude Carrier - 320,000+ DWt (approximately 2.4m bbl)
- VLCC - Very Large Crude Carrier - 160,000-320,000 DWt (approximately 1.2m-2.4m bbl)
- Suezmax - 120,000-150,000 DWt (approximately 0.9m-1.125m bbl)
- Aframax - 80,000-120,000 DWt (approximately 0.6m-0.9m bbl)
- Panamax - 60,000-80,000 DWt (approximately 0.45m-0.6m bbl)
- Product carriers - 25,000-70,000 DWt

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Assessment

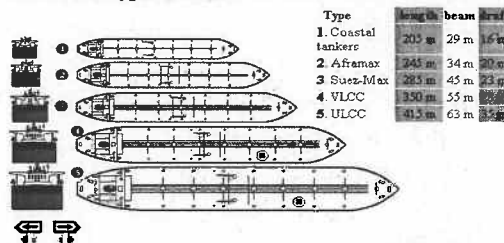


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Tankers size and capacity

The various types of tanker



Tankers are classified according to their deadweight:

- less than 50,000 tons, mainly used for transportation of products (gasoline, gasoil,...);
- "Aframax"—approximately 80,000 tons;
- "Suez-max"—up to 160,000 tons, originally the maximum capacity of the Suez Canal;
- "VLCC" (Very Large Crude Carrier)—up to around 300,000 tons of crude oil;
- "ULCC" (Ultra Large Crude Carrier)—capacity exceeding 300,000 tons. The largest tankers ever built have a deadweight of over 550,000 tons.



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Shipping vessel types

- Clean
 - gasoline, naphtha, gasoil, jet. Colour no darker than 2.5 npa, some chemicals and solvents
- Dirty
 - crude oil and fuel oil



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Shipping – tanker chartering

- SPOT CHARTER [single voyage]
 - Freight is earned on completion of discharge
 - Specific voyage between defined ports or geographic ranges
 - Payment is based on gross quantity in US\$
 - May be a Lump sum or based on 'Worldscale'
- TIME CHARTER [period charter]
 - Vessel chartered for an agreed period for voyages in an agreed 'trading' range
 - Payment during period at an agreed \$ rate per day
 - Bunker and port costs are additional



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Transport – single voyage charter

- Voyage charter: charterer pays the owner (\$x per mt) to complete a specific voyage with a given tonnage usually based on Worldscale rates
- Worldscale Association is an independent association, publishes annually the Worldscale book
- Takes into account port charges, bunkers and exchange rates
- Book rate is 100, and negotiated rates are expressed as a percentage of the book rate e.g. W130 is 130% of the book rate for the voyage



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Example

- Voyage Primorsk to Rotterdam
- Cargo 80,000 mt
- Flat rate 4.68 \$/mt
- Market rate W130
- Actual freight rate $= 4.68 \times \frac{130}{100} = 6.084$ \$/mt

Voyage cost: $80,000 \times 6.084 = \$486,720$



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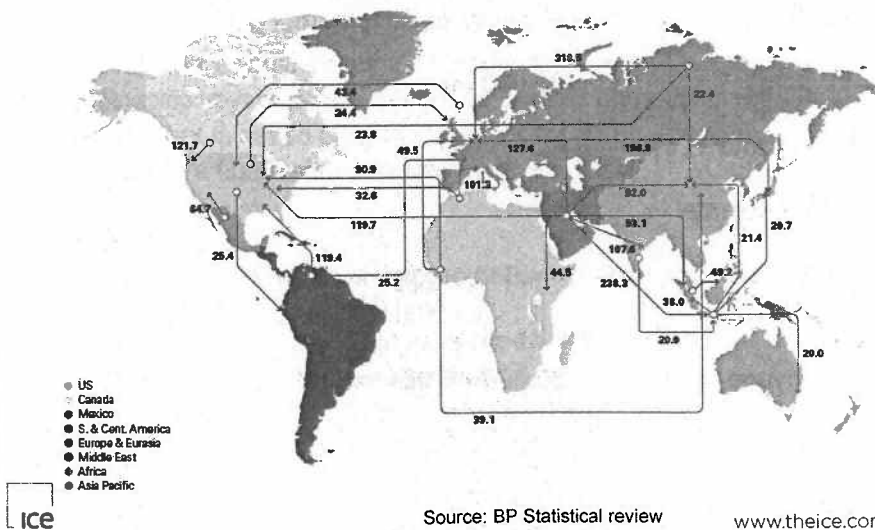
38

Tanker rates

- Lay time - time the tanker owner allows charterer to carry out loading and discharging (lay-can = lay days and cancellation)
- Demurrage - time the charter party uses in excess of lay time to load and discharge, incurs a penalty cost
- Canal/Pipeline/Passage fees – Panama, Suez, Sumed
- Fixed and variable differentials e.g. port duties

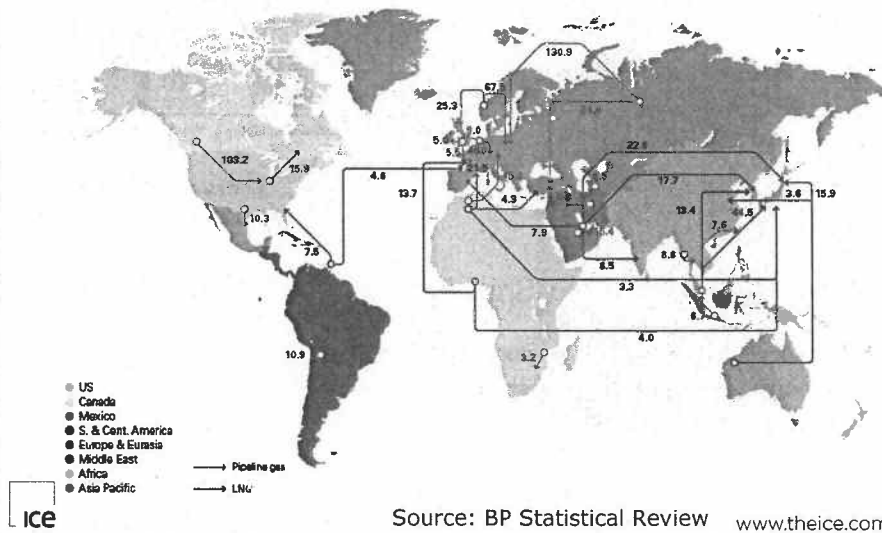


Major oil trade movements 2008



cheap to move oil $\rightarrow$ fluid market
and consistent prices

Natural gas trade movements 2008



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LNG carrier

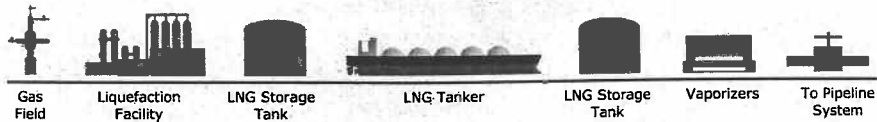


LNG Vessel
Photo courtesy of CH-IV International, <http://ch-iv.com>

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LNG transport stages



Producing Region

Consuming Region

Source: CMS Energy

Liquefaction

Shipping

Regasification

- Liquefies at very low temperatures (-160°C)
- Expensive to liquefy and transport
- Long history of industry



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Pipelines

- Crude pipelines from import point
 - to refineries e.g. US Gulf Coast to Chicago
- Short cuts
 - Sumed, Iraq-Ceyhan (Iraq Mediterranean)
- Product pipelines
 - from refineries and import points to inland depots e.g. Rotterdam
 - Germany
- Crude pipelines from inland production areas
 - to export terminals e.g. Alaska North Slope to Valdez
 - to inland refineries and users e.g. Siberia to Eastern Europe

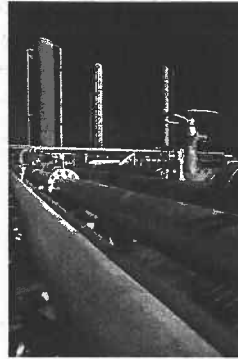


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Pipeline economics

- High capital cost (BTC pipeline completed 2006 - \$billions)
- Flexibility - possibility to fill in products as often the other
- Low physical losses



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Existing and Planned Natural Gas Pipelines to Europe

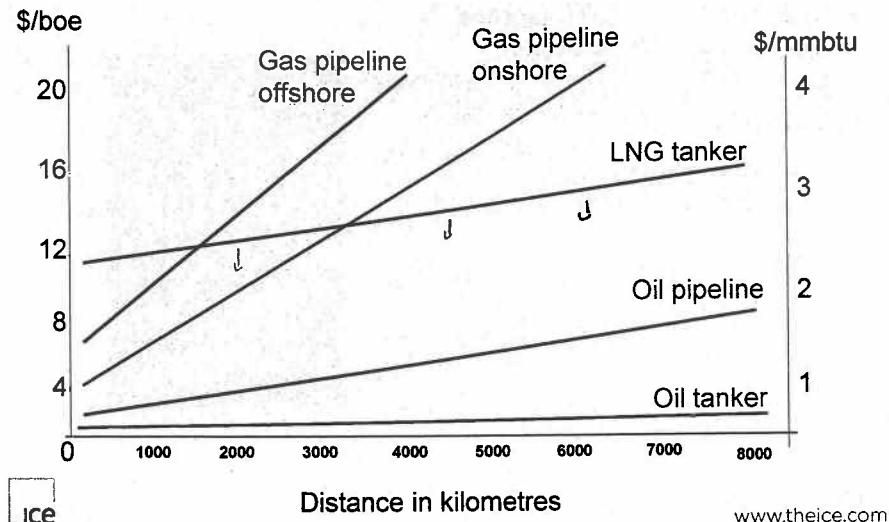


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gas does not flow
naturally
need for pumping
stations.

Transportation



Electricity

- Transported by cable
- Power Systems are stable over a limited range
 - energy losses occur after approximately 100 miles
- Supply must be continuous and instantaneous

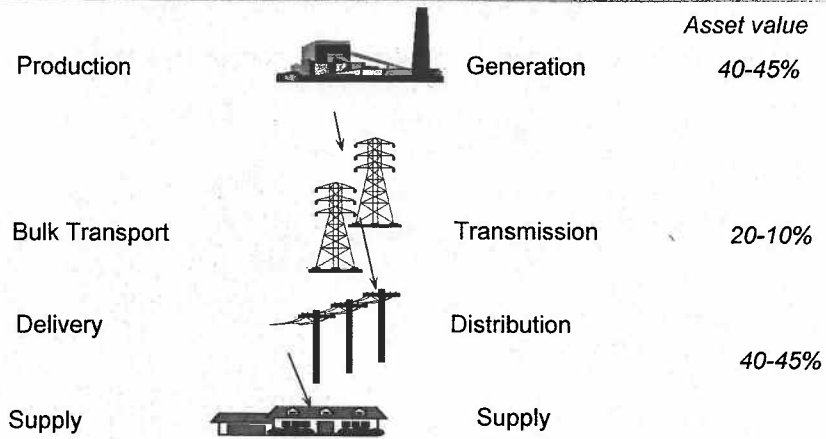
Rate of energy loss



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Electricity supply chain



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CRUDE SELECTION & REFINING



Refining, crude selection and gross product worth

- Crude oil gains value by being refined and sold as finished products

BPSD : Barrel *Per* Standard Day (working 24h/day)

Assay : *investigation to the oil quality*

LP :

Feedstock

Straight run : *from distillation*

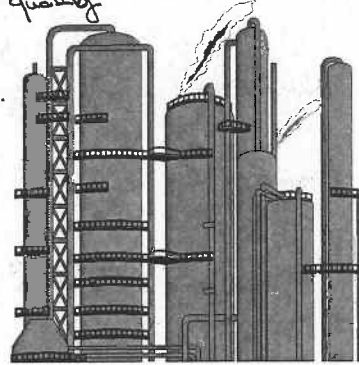
VGO Vacuum Gas Oil

Separation/conversion

Treatment *Extraction of sulfur*

Cracking

Upgrading



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Atmospheric distillation unit

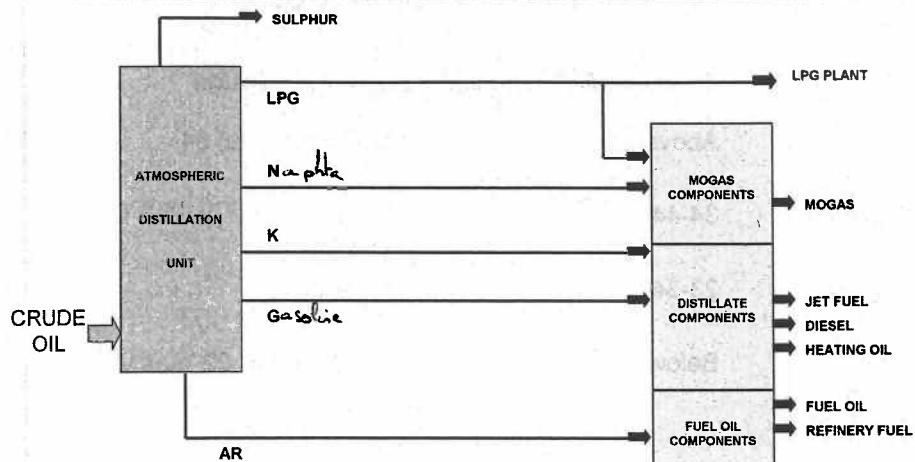
- Separate by fractional distillation at atmospheric conditions the constituents of crude oil: LPG, Naphtha, Kerosene, Distillates, Fuel Oil
- Referred to as the Crude Unit or Crude Column
- Sets the capacity of the refinery by amount of crude processed
- Designed for various crude types depending upon product demand and specification requirements



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Hydroskimmer

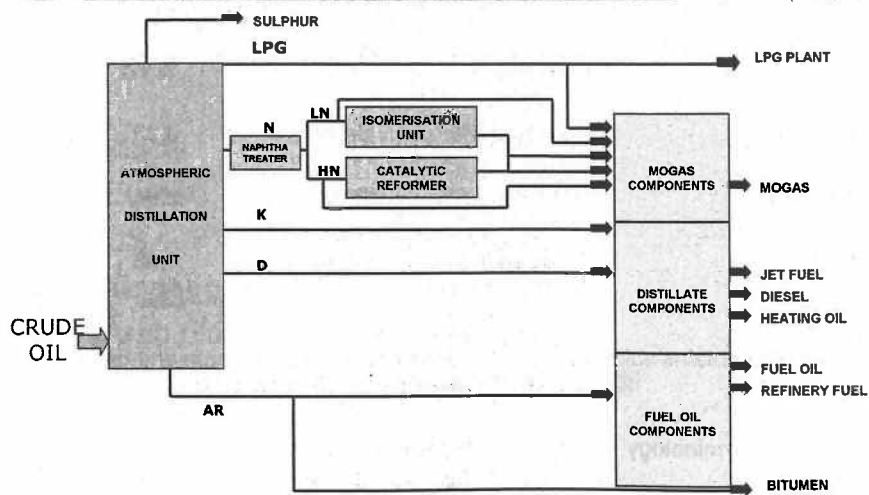


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Elementary gasoline production



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50 °C

600 °C

API gravities – light/heavy

	API	Crude
Very light	Above 44	Arun (Indonesia) 54
Light	34-44	Brent (UK) 38
Medium	23-34	Kuwait 31
Heavy	Below 23	Maya (Mexico) 22



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Sulphur content – sweet/sour

	Range	Crude	% Wt
Low	up to 0.5%	Brent	0.23
Medium	0.5% - 1.5%	Oman	0.94
High	Above 1.5%	Dubai	1.68

Ends in SE Asia

Crude oil contains sulphur:

causes pollution, corrosion and gives less energy on combustion

Terminology

Sweet - Low sulphur

Sour - High sulphur



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Crude classification

- By country
 - Saudi Light
 - Iranian Heavy
 - Dubai
- By load port
 - Forcados
 - Bonny
 - Cabinda
- By field
 - Brent
 - Forties
 - Ekofisk
 - Urals



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Price and units

- Crude \$/bbl
- Products
 - Europe \$/mt
 - US c/g (fuel oil \$/bbl)
 - Singapore \$/bbl (fuel oil \$/mt)
 - Arab Gulf
 - \$/bbl - Jet/Gas oil
 - \$/mt - Naphtha/Fuel oil



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Measurements and conversions

- Volume - measured in barrels
1 barrel = 42 American gallons (36 Imp. Gallons)
 - Weight - metric tons
 - Conversion factors
- | | bbls/mt |
|----------------|---------|
| Brent | 7.55 |
| Dubai | 7.30 |
| Naphtha | 9.00 |
| Motor Gasoline | 8.60 |
| Jet/kerosene | 7.90 |
| Gas oil | 7.50 |
| HSFO | 6.40 |



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Gross product worth - GPW

- Brent
- Simple distillation

23.6%	naphtha	\$550.00 mt	=	\$129.80
9.7%	kero	\$515.00 mt	=	\$49.96
25.3%	gas oil	\$478.00 mt	=	\$120.93
38.4%	low sulphur fuel oil	\$176.00 mt	=	\$67.58
3%	fuel & loss			

100%

Total GPW = \$368.27

(per metric ton @ 7.55 barrels mt)

GPW = \$48.78

Crude Price = \$43.75

Margin = ?

Value for 1t of crude oil

→ crack price



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Refined product traded

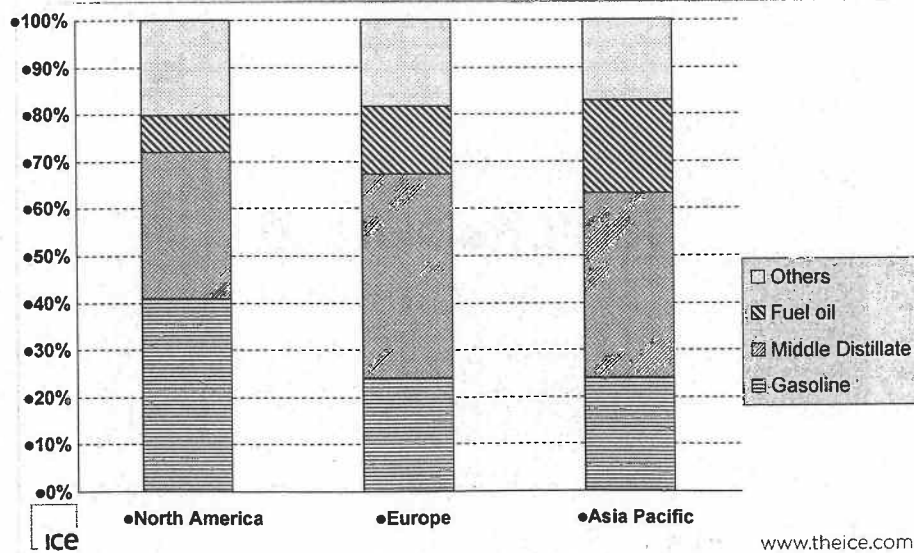
Product	Main uses
LPG	Transported in bottle of gas
Gasoline	
Naphtha	Petrochemicals
Jet Kerosene	
Burning Kerosene	Cooking & heating fuel
Gas Oil/Heating Oil/Diesel	
LSFO	Low sulfur (1%) Fuel Oil
HSFO	High Sulfur (3,5%) Fuel Oil



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Regional production per barrel

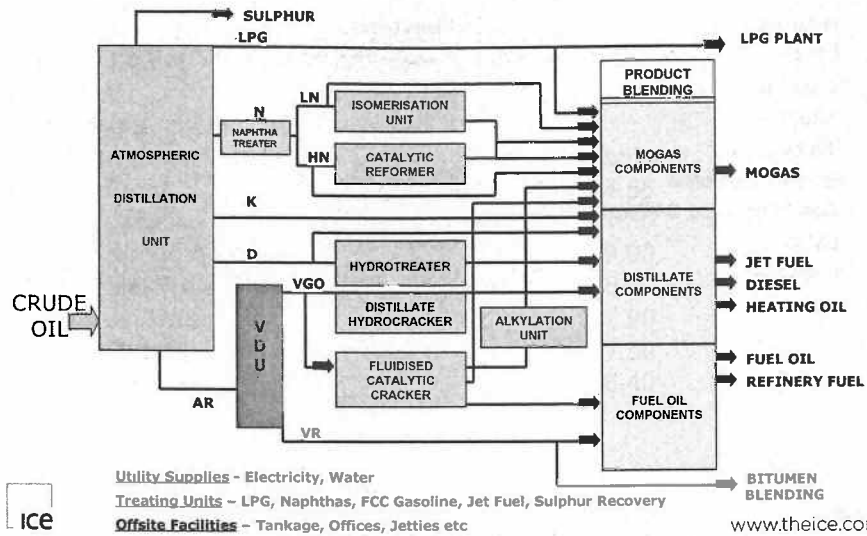


quality working
of quality feedback

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Complex refinery configuration



VDU: Vacuum Distillation Unit
 VGO: Vacuum Gas Oil

SUPPLY & DEMAND

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52/53 forward cover
date

Supply and demand

The price of a commodity reflects all that is known about the product at any moment. It is expressing the market's expectation regarding:

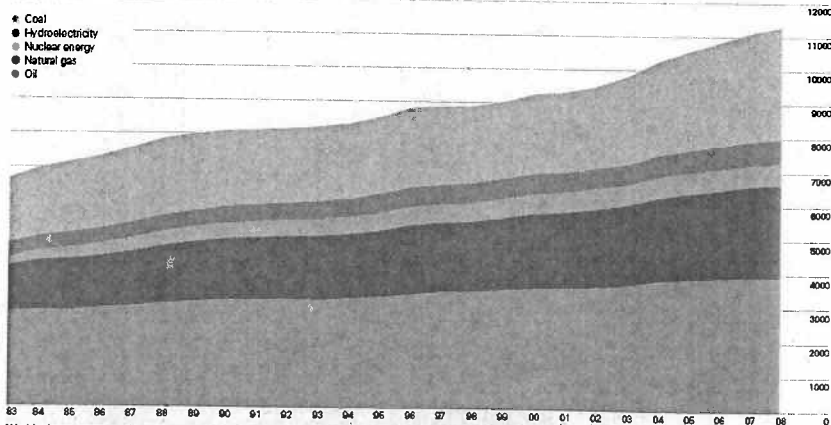
- Supply and demand factors/expectations
- Perception of future changes in market conditions
- Political/environmental/regulatory factors



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World primary energy consumption 2008



World primary energy consumption grew by 1.4% in 2008, below the 10-year average. It was the slowest year since 2001. Oil remains the world's dominant fuel, though it has steadily lost market share to coal and natural gas in recent years. Oil's share of the world total has fallen from 36.7% to 34.8% over the past decade. Oil consumption and nuclear power generation declined last year, while natural gas and coal consumption, as well as hydroelectric generation, increased.

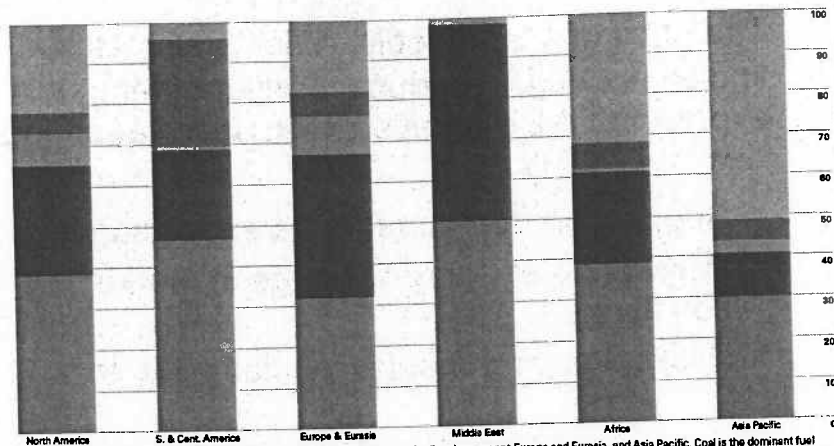


Source: BP Statistical review

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Regional primary energy consumption pattern 2008



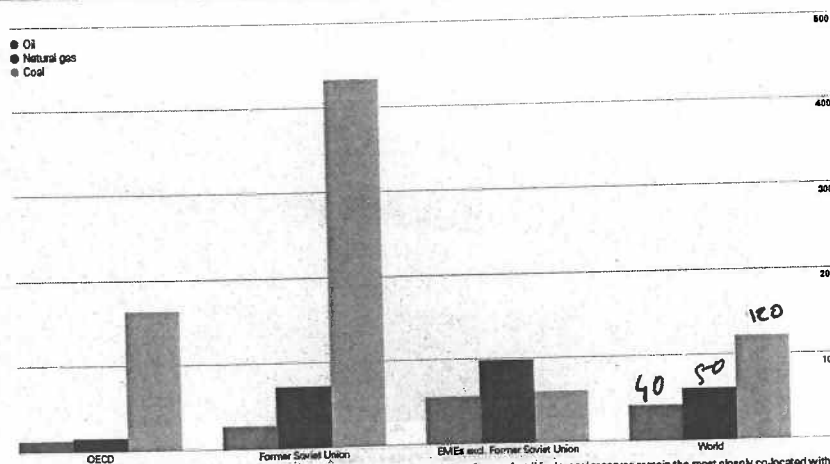
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Source: BP Statistical review

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Fossil Fuel Reserves to Production Ratios

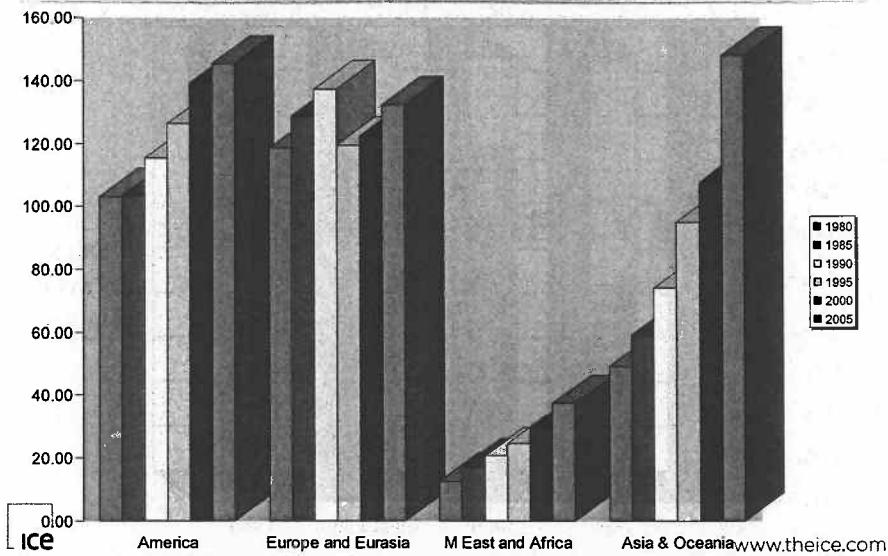


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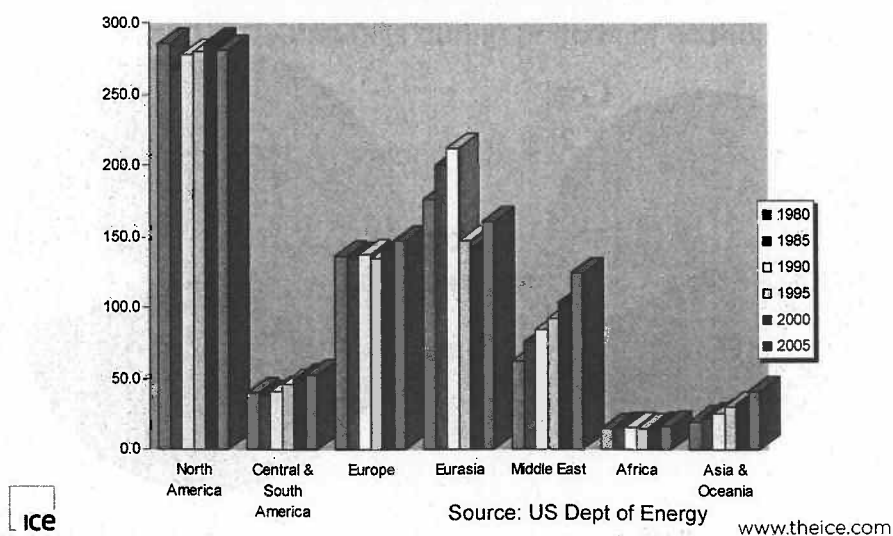
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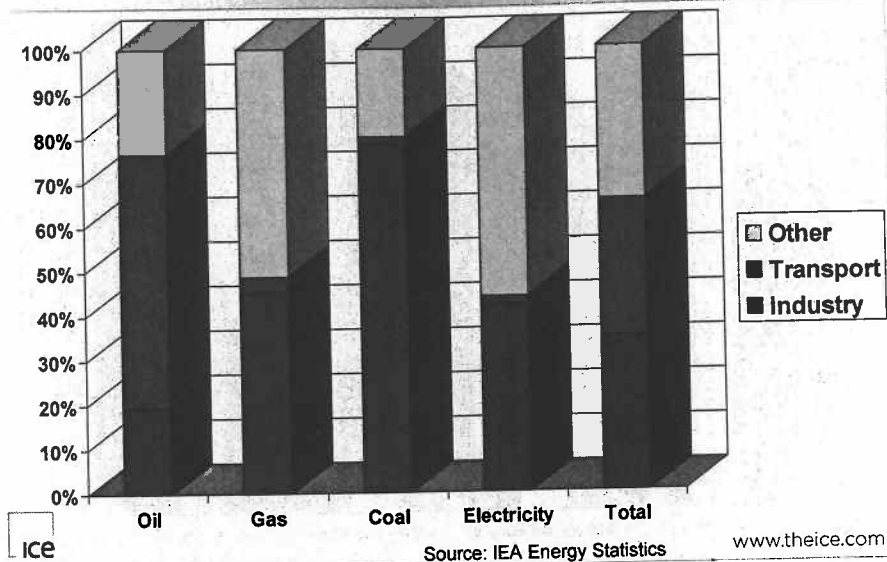
Total primary energy consumption (Quadrillion btu)



Per capita (per person) total primary energy consumption (million btu per person)

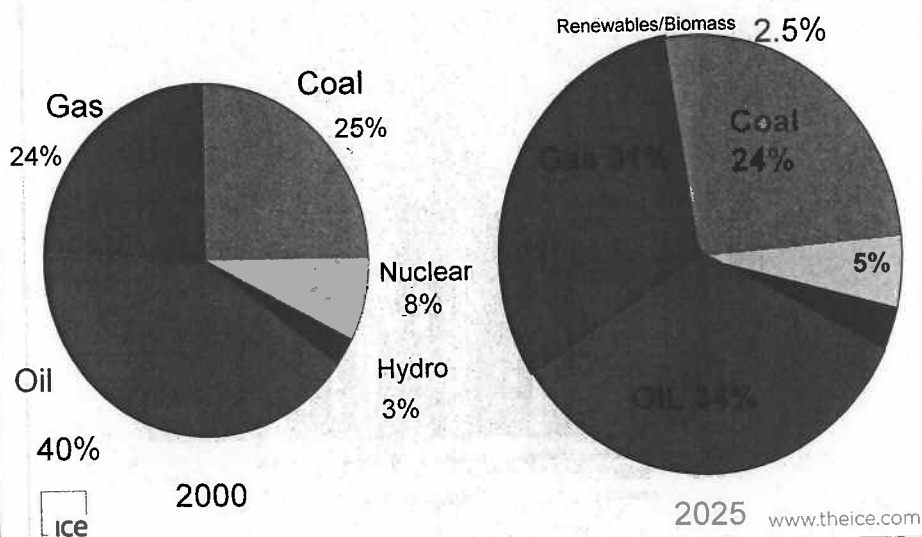


Final energy consumption per sector



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Forecast primary energy consumption



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OIL MARKETS SUPPLY & DEMAND

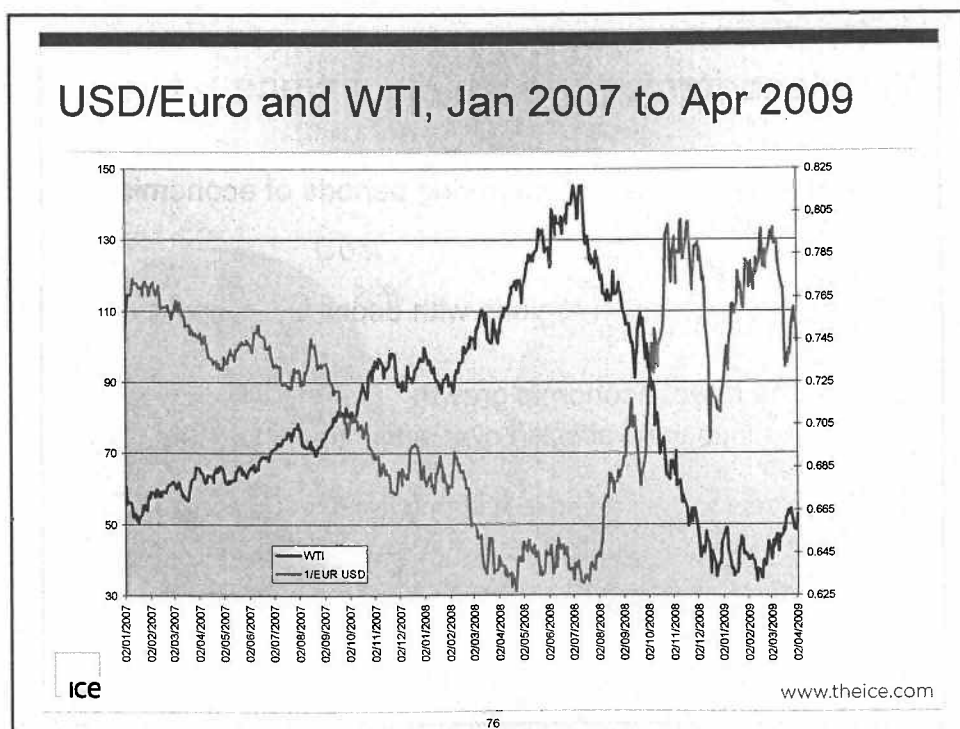
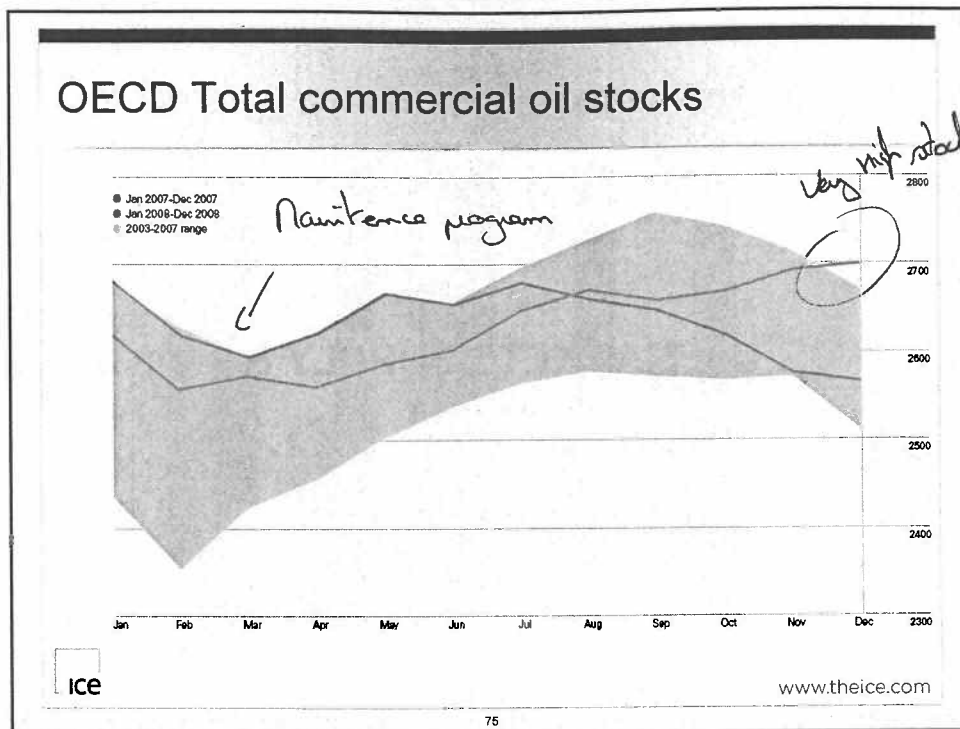


World economic conditions

- Oil demand rises and falls during periods of economic growth and decline
- Oil demand grows in regions with economic growth
- Oil prices affect economic growth
 - Prices tend to be affected over a short/medium term period
 - Political factors can have a strong impact on prices and inventories



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Dpt of Energy
to Petroleum Industry

US Oil inventories, DOE and API weekly statistics

Reports Filed
voluntarily by around
450 companies

Crude Oil Inputs/Runs/Stocks by PADD

Products Produced/Stocks

Crude & Product Imports/Exports

Published Wednesday morning 9.30 a.m. EST.

for previous week

1-25 regions in US



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Refined product markets

- Markets have developed around
 - Refining centres
 - Regional import/export centres



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Main product markets

North West Europe/ARA

- Naphtha
- Gasoline
- Jet
- Gasoil, Diesel
- HSFO, LSFO

US East Coast

- Gasoline
- Heating Oil
- LSFO

US Gulf Coast

- HSFO

Far East

- Kerosene
- Gas Oil
- Naphtha
- HSFO



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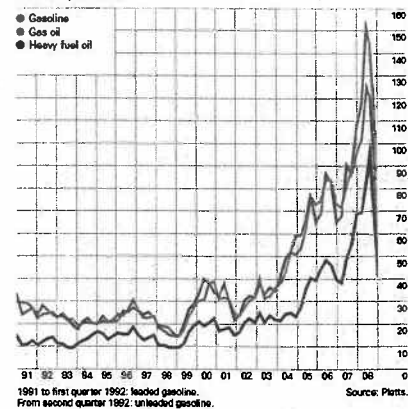
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Oil product prices, Rotterdam and US Gulf coast

Rotterdam product prices

US dollar per barrel

- Gasoline
- Gas oil
- Heavy fuel oil

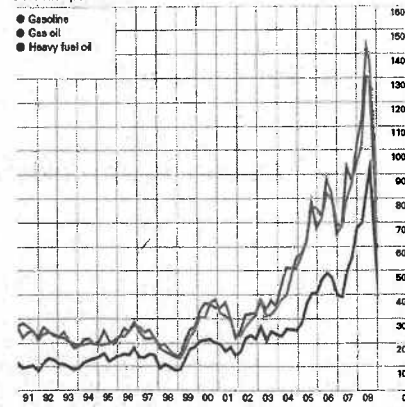


1991 to first quarter 1992: leaded gasoline.
From second quarter 1992: unleaded gasoline.

US Gulf Coast production prices

US dollar per barrel

- Gasoline
- Gas oil
- Heavy fuel oil



Source: BP Statistical review

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Alternative commodities

Substitutes

- Fuel Oil for Power Generation: replaced by gas fired power stations; swing electricity producers can switch between fuel oil and natural gas
- Gas Oil: replaced by Natural Gas for heating
- Transport Fuels: no ready substitutes; demand for Gasoline, Diesel and Jet Fuel continues to grow absolutely and relative to the rest of the barrel
- Power generation: choices are between Coal, Nuclear and Gas for the majority of generation; also hydroelectric & renewables
- Renewable energy sources become more viable as the price of oil, gas and coal rises



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Oil market fundamentals

- 1990 Iraq invades Kuwait: prices and refinery margins rise dramatically
- 1991 Desert Storm, prices fall \$10 bbl in one day
- Collapse of Soviet Union but exports continue
- Economic upturn in Asia supports prices until its collapse in 1997/8
- OPEC increase quotas, mild Winter, economic downturn
- Saudi/Iran understandings: reduced OPEC quotas lead to price recovery
- 2000 Prices increase to \$30 due to OPEC quotas, economic recovery in US and Far East, tighter product specifications
- 2002 Prices retreat as US economy slows down, product & crude stocks increase
- 2004 Strong global growth and uncertainty in supply, Middle East, West Africa, Venezuela
- 2005 China and India compete for oil supplies, limited global refining capacity;
- Q4 2006 prices correct lower, followed by a further move higher 2007
- 2008 prices accelerate to all time highs in July, Chinese demand; major correction and fall across all markets, squeeze on credit and bank failures



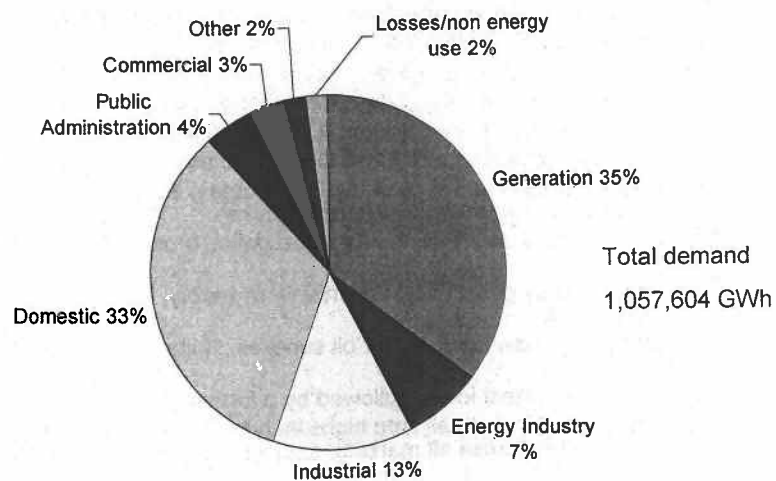
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NATURAL GAS SUPPLY & DEMAND



UK gas demand



DUKES: DTI Digest of UK Energy Statistics

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Gas consumption

- Domestic
 - Central heating, hot water, cooking
- Industrial and commercial
 - Steel, paper, chemicals...
- Power generation
 - Combined Cycle Gas Turbine
 - Combined Heat and Power
- Refineries / Producers
- Fertilisers
- Transport



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Gas demand

- Gas demand is highly variable
 - Within day
 - Seasonally
- Main determinates of gas demand
 - Temperature
 - Economic activity
 - Behaviour patterns
 - Price of gas and competing fuels
 - Government policy



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Gas price volatility in competitive markets

- Seasonality: Summer in US, Winter in UK
- Weather: Consumption can treble on a very hot or cool day
- Local/regional supply/demand pressures
- Lack of flexibility: outlet pressure must be maintained
- Logistics: Pipeline and Storage bottlenecks
- Lack of storage: expensive
- Weak Arbitrage Mechanisms
 - Time and costs involved in fuel switching
 - Limitations of the physical delivery system
- US: Utility obligations



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Gas price determinants – competitive market

- | | |
|-------------------------|-------------------------|
| • Supply | • Stocks |
| • Demand | • Exchange rates |
| • Weather | • Market infrastructure |
| • Shut-ins/maintenance | • Electricity demand |
| • Shipping availability | • Politics |
| | • Oil prices |



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Gas market impact

- Oil prices are driven primarily by demand for transport fuels and crude oil supply
- Natural gas mainly competes with fuel oils in the medium term: prices tend to follow oil prices in most markets
- In competitive gas markets, prices tend to follow short term/spot benchmarks and local fundamentals: influence of fuel oil and gas oil prices likely to be less
- Weak Arbitrage Mechanisms
 - Time and costs involved in fuel switching
 - Limitations of the physical delivery system
- The main impact over time will be structural: decline in demand for fuel oil and heating oil, move towards natural gas benchmarking



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Competing fuels

- **Power**
 - Coal
 - Fuel Oil
 - HEP and Nuclear tend to be fixed
 - Renewables
- **Industrial**
 - Gas Oil/ Fuel Oil
 - Coal
 - Electricity
- **Domestic**
 - Gas Oil
 - Electricity



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