Petroleum production

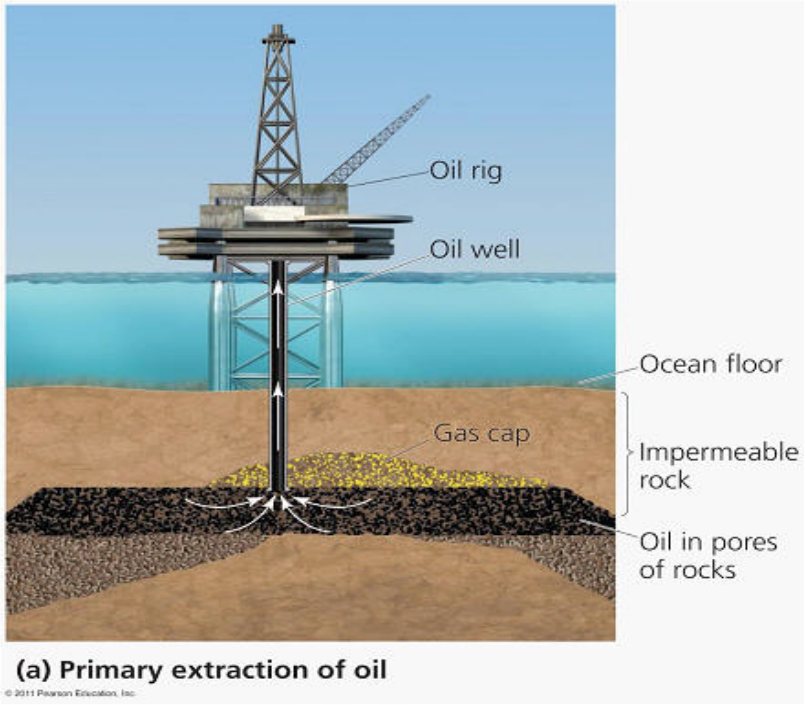
Joel Collett

- Extraction
- Processing and separation
- Energy requirements

Extraction

Primary recovery:

Uses the oil reservoir's natural pressure



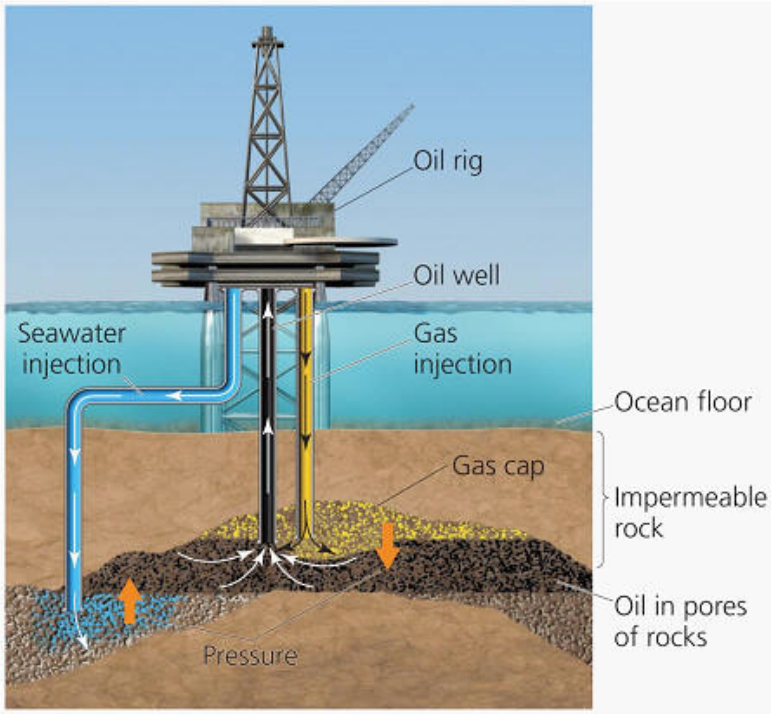
(a) Primary extraction of oil

Extracts 5-15% of total oil.

Extraction

Secondary recovery:

Uses fluid or gas injection to increase oil well pressure.



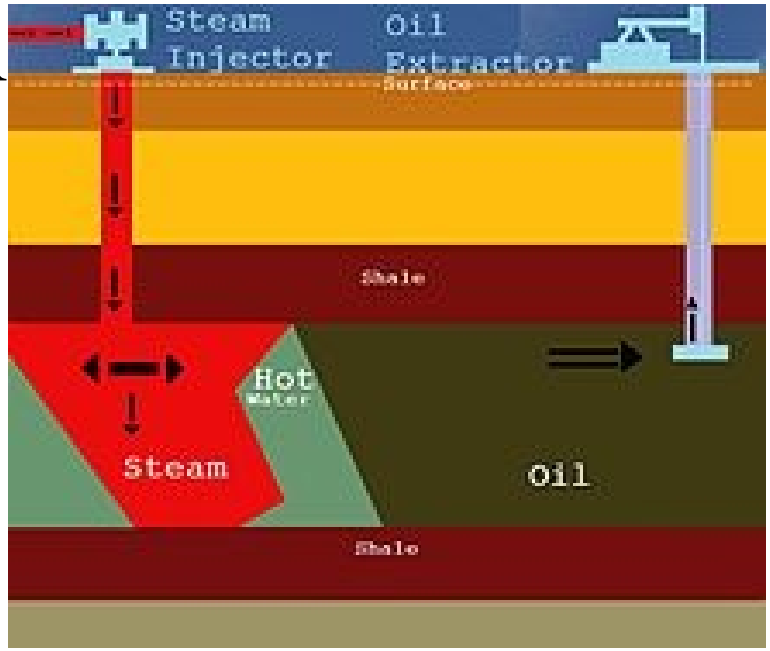
(b) Secondary extraction of oil

After primary and secondary recovery, 35-45% of oil has been extracted.

Extraction

Enhanced recovery

Changes oil mobility using heat or chemical treatment

A 

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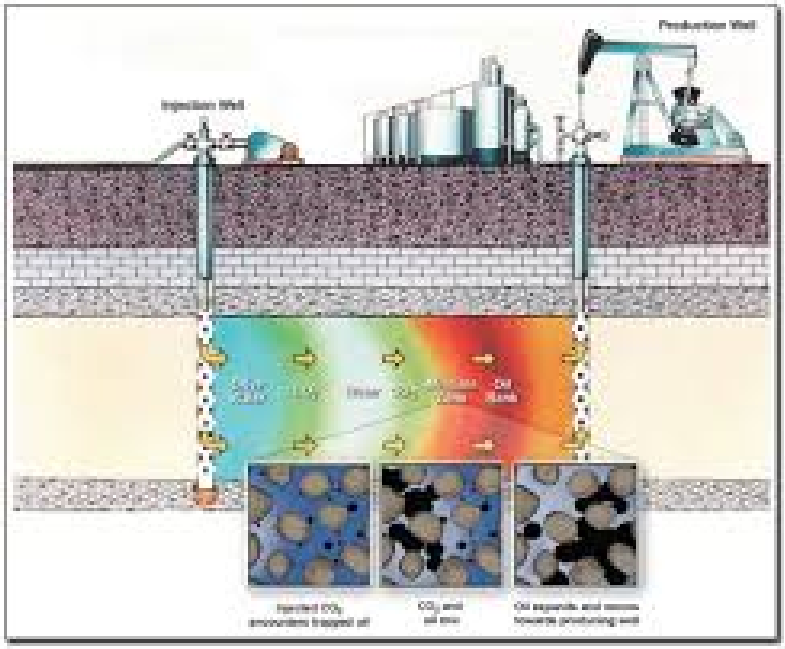
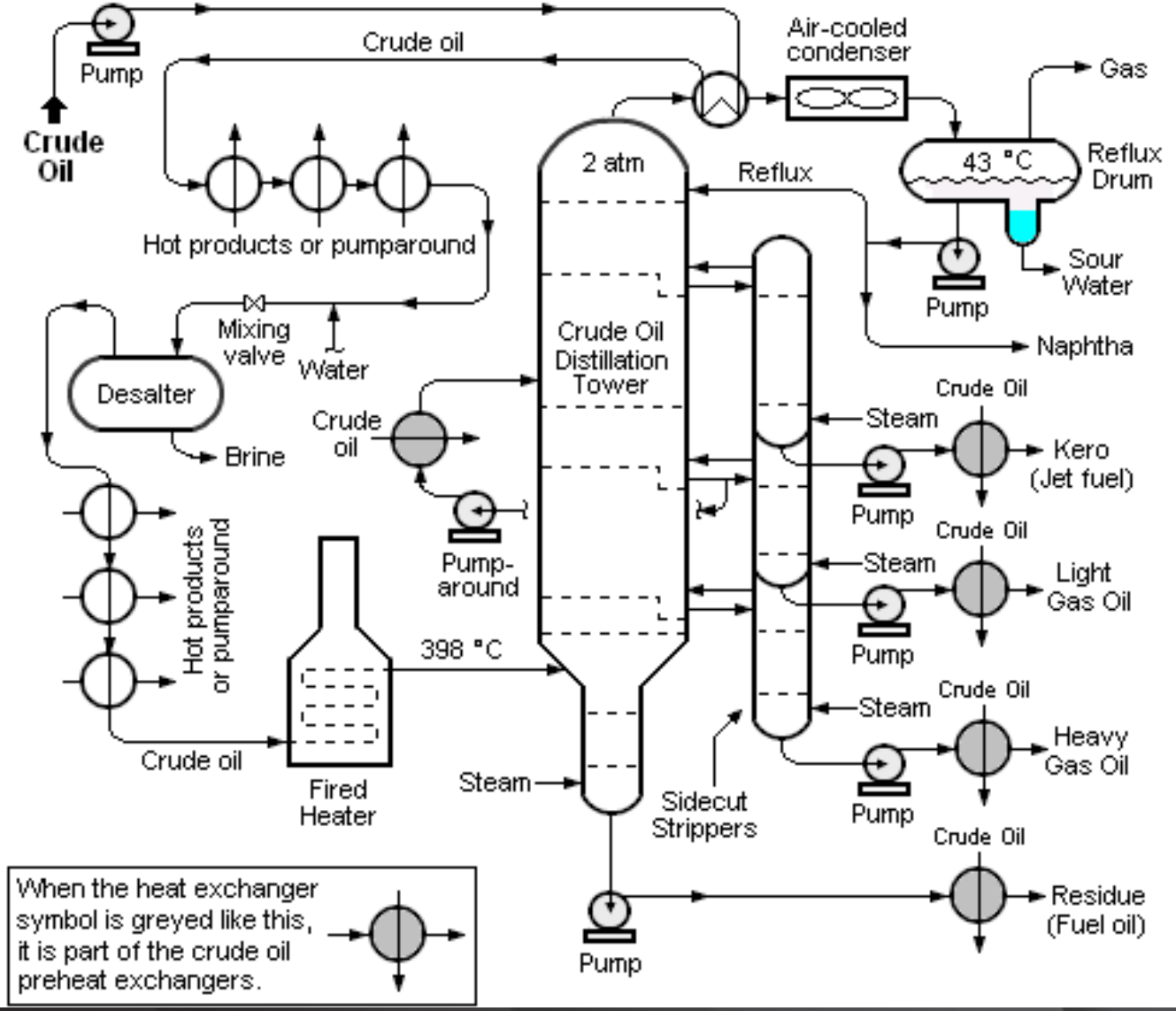


Processing

Jamnagar oil refinery, Gujurat, India

Distillation into fractions

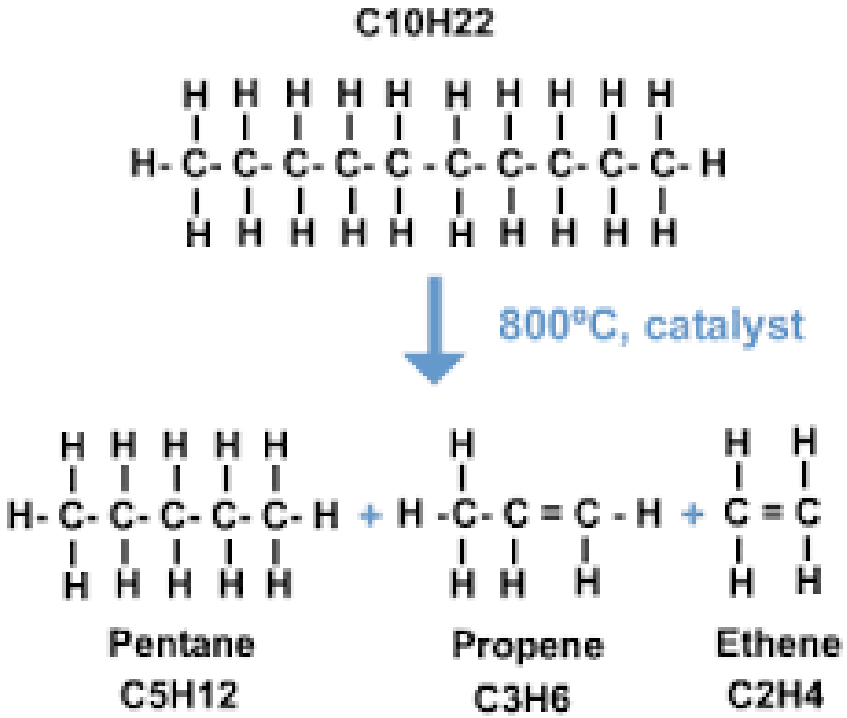


Fractions

Name	Number of Carbon Atoms	Boiling Point (°C)	Uses
Refinery Gas	3 or 4	below 30	Bottled Gas (propane or butane).
Gasoline	7 to 9	100 to 150	Fuel for car engines.
Naphtha	6 to 11	70 to 200	Solvents and used in gasoline.
Kerosene (paraffin)	11 to 18	200 to 300	Fuel for aircraft and stoves.
Diesel Oil	11 to 18	200 to 300	Fuel for road vehicles and trains.
Lubricating Oil	18 to 25	300 to 400	Lubricant for engines and machines.
Fuel Oil	20 to 27	350 to 450	Fuel for ships and heating.
Greases and Wax	25 to 30	400 to 500	Lubricants and candles.
Bitumen	above 35	above 500	Road surface and roofing.

Cracking

Reducing chain length of hydrocarbons using heat and catalysts

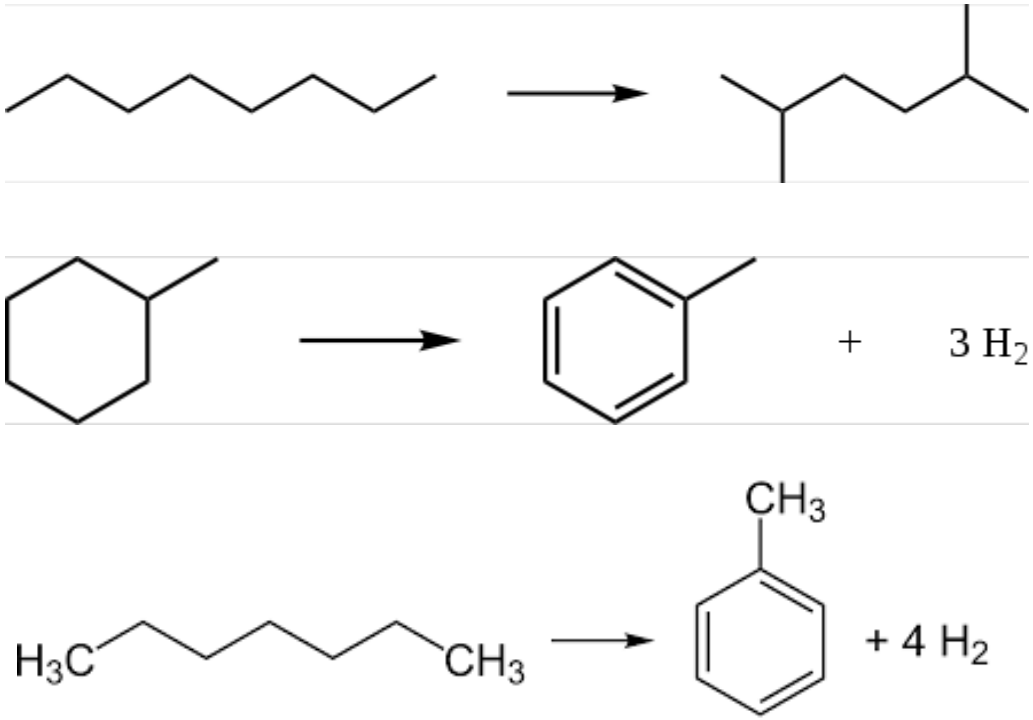


- Thermal Cracking
- Steam Cracking
- Catalytic Cracking
- Hydrocracking

Generally employ solid acidic alumina silicate catalysts (zeolites)

Reforming

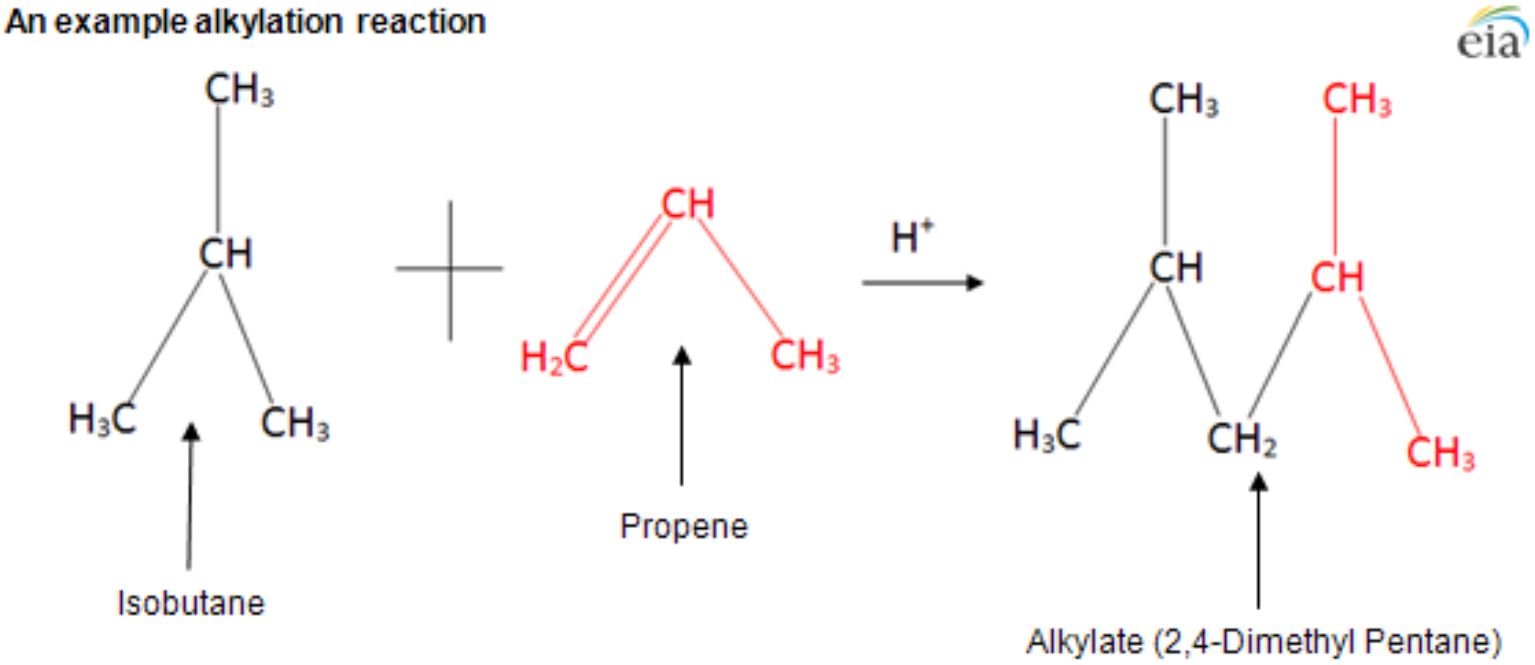
Catalyzed formation of aromatics and branched alkanes more suitable for gasoline blends



Catalyzed by platinum and rhenium chlorides or zeolites

Alkylate

Creates high octane branched alkanes using acid catalysts (sulphuric, HF etc.)



Sulphur removal

Merox process

$$RSH + NaOH \longrightarrow NaSR + H_2O$$

$$H_2S + NaOH \longrightarrow Na_2S + H_2O$$

$$Na_2S + H_2S \longrightarrow NaHS \text{ (Sodium Hydrosulfide)}$$

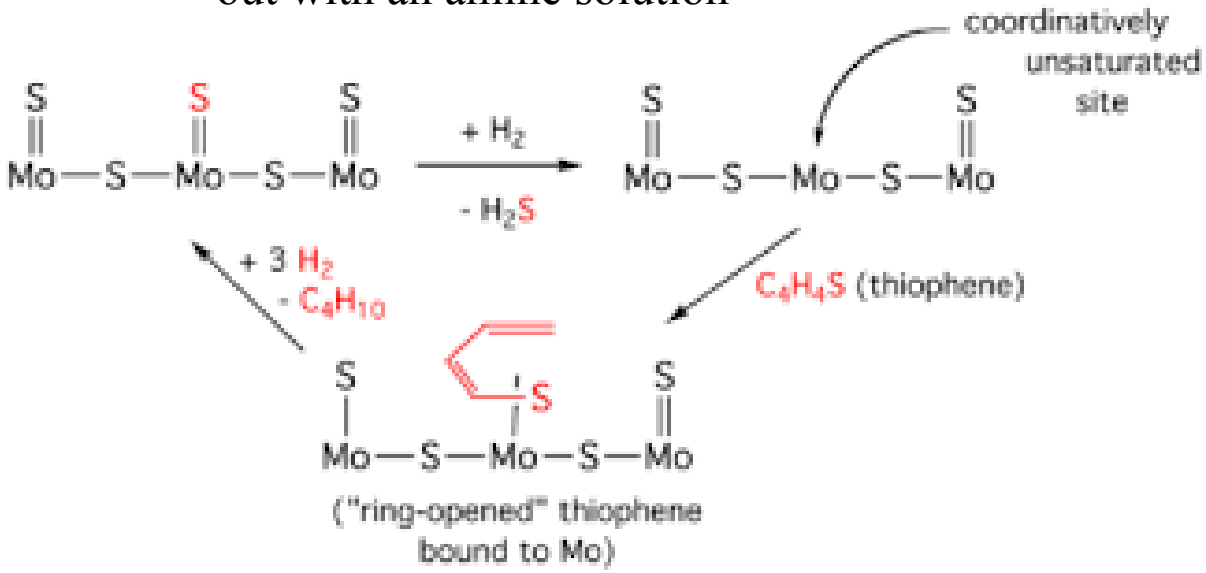
$$NaSH + O_2 \longrightarrow Na_2S_2O_3 \text{(Sodium thiosulfate)}$$

$$2NaSR + \tfrac{1}{2}\, O_2 + H_2O \longrightarrow 2NaOH + RSSR$$

Sulphur removal

Hydrosulfurization

Uses hydrogen and a Mo or Co catalyst to produce H_2S which can be scrubbed out with an amine solution



Energy Efficiency of Production

Table 5. Refining Energy Efficiencies for Individual Petroleum Products

	Overall Petroleum Refinery Efficiency	
	90.1% (with all products included)	86.4% (with less desirable products excluded)
Gasoline	87.7%	83.3%
Diesel	90.3%	86.7%
LPG	94.3%	92.1%
Residual oil	94.3%	92.1%
Naphtha	94.3%	92.1%

$$33\ \frac{kWh}{gal\ gasoline} \times \frac{1}{83.3\%} = 39.6 \frac{kWh}{gal}$$

$$34 \frac{kWh}{gal\ diesel} \times \frac{1}{86.7\%} = 39.2 \frac{kWh}{gal}$$

CTR/ANL Wang, M "Estimation of Energy Efficiencies of U.S. Petroleum refineries" Mar, 2008