Replacement fuels - An overview

With oil prices on the uptick, what do we burn when oil runs out? With world oil production about to peak and head towards a steep decline, what fuels are available to meet rising global energy demand? These questions, once thought to address a fairly remote contingency, have become increasingly urgent. Following the publication of his new book, *Beyond oil: The view from Hubbert’s Peak*, oil expert, geologist and professor Ken Deffeyes has updated his CLSA U course, which addresses the earth’s supply of potential replacement fuels.

Ken Deffeyes looks at the potential replacement fuels – natural gas, coal, tar sands and heavy oil, oil shale, uranium and even hydrogen. Utilising the analytical tools developed by his former colleague, the pioneering petroleum-supply authority M King Hubbert, he also talks about the likely future production of these replacement fuels with special reference to oil products. He also gives an overall energy picture covering the likely sources the world can rely on in the near future, and the special roles to be played by conservation, high-mileage diesel vehicles, nuclear power plants and wind-generated electricity.

Course instructor

Ken Deffeyes is a professor emeritus at Princeton University. A geologist raised on an Oklahoma oil field, Ken believes oil production will peak within 10 years and subsequently fall into a permanent decline. He explores possible long-term solutions to curb dependence on crude oil, including conservation and alternative energy sources, such as natural gas, nuclear power, as well as solar, wind and geothermal energy. Although Ken doesn’t believe these remedies will be enacted before short-term trouble occurs, he tells audiences what they can do to thrive, even after Hubbert’s peak has passed. His book *Hubbert's Peak: The Impending World Oil Shortage* was published in 2001.
Wake up!!!

We are here

Peak Oil

www.oilcrisis.com
License plate, Durham, North Carolina
Hubbert, U.S. oil prediction, 1956
United States oil production

Diagram showing the relationship between $P/Q$ and $Q$ (billion barrels) with a data point labeled 1958.
Hubbert theory

\[ Y = a + m X \]
\[ P/Q = a - (a/Q_t) Q \]
\[ P = a (1 - Q/Q_t) Q \]
Hubbert, world oil prediction 1968
World oil production
DOW JONES NEWswire
March 6, 2003

Saudi Arabia has told Western government and oil officials that the kingdom’s crude oil output has reached its limit at around 9.2 million barrels per day and won’t rise further, even with a war looming in Iraq.
TWILIGHT IN THE DESERT
THE COMING SAUDI OIL SHOCK AND THE WORLD ECONOMY
MATTHEW R. SIMMONS
It was an incredible revelation last week that the second largest oil field in the world is exhausted and past its peak output. Yet that is what the Kuwait Oil Company revealed about its Burgan field. The peak output of the Burgan oil field will now be around 1.7 million barrels per day, and not the two million barrels per day forecast for the rest of the field’s 30 to 40 years of life, Chairman Farouk Al Zanki told Bloomberg. (November 12, 2005)
World oil prediction from CERA, 2005
Exxon Mobil energy outlook, June 2006

Global Energy Supply/Demand

- Oil
- Gas
- Coal
- Other

Y-axis: MBDOE (Million Barrels of Oil Equivalent)
X-axis: Years (1980, 2005, 2030)
Plot of ExxonMobil oil prediction
World, new oilfields found
Exact peak date
ALL NEW!

WEEKLY WORLD NEWS

THE WORLD'S ONLY RELIABLE NEWSPAPER

WHAT THE GOVERNMENT DOESN'T WANT YOU TO KNOW...

NO MORE OIL!

WORLD SUPPLY WILL BE GONE IN 6 MONTHS

• ECONOMY WILL COLLAPSE
• MILLIONS WILL STARVE

DRY!

CANADA TEENS
Hubbert's error
Cumulative plots of world oil
Barrels found versus exploration wells
Four million barrels per exploration well
United States natural gas prices
Essential service
Industries at risk

- Agriculture
- Automotive
- Aviation
- Zymurgy
Rationing by inconvenience

The descent of Mount Petroleum

Beyond Oil: The View from Hubbert's Peak
by Kenneth S. Deffeyes

Robert K. Kaufmann

Nostradamus has nothing on M. King Hubbert, who predicted in 1956 that Peak Oil would occur around 1995. Nevertheless, economic and institutional forces, Deffeyes' updated version of Hubbert's analysis states that 228 billion barrels will be recovered from US oil fields, which is about 30% higher than Hubbert's estimate. Deffeyes does not mention this increase, perhaps because he views Hubbert as his 'patron saint', but by doing so he misses an opportunity to demonstrate the strength of Hubbert's method, which is that relatively large uncertainties about recoverable oil supply have relatively little effect on the timing of the peak in production. Deffeyes' contention that US oil independence has been an illusion, and that it's no longer economically feasible to develop offshore and foreign oil fields may well be correct. However, it was not in Deffeyes' scope to consider the long-term implications of increased oil production. If US oil independence is any indication of the West's economic strength, then increased oil production may be the first step in the process of regaining the economic strength lost during the 1970s.
TURN OUT THE LIGHTS!
Coal gas delivery, Paris, 1870
Dimethyl ether (DME)

- Almost ideal diesel fuel
- No C-C bonds: no soot
- Vapour pressure
  - < propane
  - > butane
- Nontoxic (Hair spray)
- Made from coal
  - synthetic gas
  - make methane
  - dehydrate
- Pilot plant in China
Volvo truck running on dimethyl ether
Business plan 1: DME

- Coal gasification
  - Flexible as to product
  - Pollutant recovery
  - Carbon dioxide sold for oil recovery

- For DME, acquire
  - Air Products patents
  - A coal or lignite producer
  - Flying J truck stops
  - Volvo trucks and diesels
Business plan 2: Ethanol from cellulose

- Read US Patent 6,939,704
  *Trichoderma reesei*
  aka “jungle rot”

- Iogen (Canadian) already has
  C$46m from Shell
  C$15m from PetroCanada

‘If you can’t beat ‘em join ‘em.’
Business plan 3: Revised food supply

- Fertilisers – nitrogen, coal, legumes, potassium, mined phosphate, analytical control
- Pesticides, diagnostic tools
- Crop types, local, root cellars
- Water lifting, wind
What would Jesus drive?
Four Horsemen of the Apocalypse

- War
- Famine
- Pestilence
- Death
M. King Hubbert, 1930s
Worldwide per-capita oil consumption is closely correlated with the standard of living. In developing nations like China and India increasing prosperity requires increasing per-capita oil consumption. However, oil is a finite resource whose production globally is about to begin to decline irreversibly. Consequently the growing demand for oil is leading to a global conflict in which the Gulf War, the 9/11 attack, and the war in Iraq are just the first three skirmishes. These skirmishes pale in comparison with the looming potential conflict over oil with China.
CLSA U is an ongoing executive education programme designed to bring you firsthand information. Draw your own conclusions and make more informed investment decisions - all in a conducive learning environment reminiscent of university days.

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