Hawaii Hydrocarbons Outlook: Preliminary Report

Presented to the Hawaii Energy Forum
by
Dr. Jeff Brown
December 2002
Retainer List

Government-Owned State Oil Companies* and Agencies

1. Saudi Aramco (Saudi Arabia)
2. Kuwait Petroleum Corporation: KPC (Kuwait)
3. Abu Dhabi National Oil Company: ADNOC (Abu Dhabi, UAE)
5. Emirates National Oil Company Ltd.: ENOC (Dubai, UAE)
6. Bahrain Petroleum Company: BAPCO (Bahrain)
7. Petronas (Malaysia)
8. Malaysia LNG: MLNG (Malaysia)
9. Pertamina (Indonesia)
10. Korea National Oil Corporation: KNOC (Korea)
11. Korea Gas Corporation: KOGAS (Korea)
12. SINOPEC/CPCCC (China)
13. Chinese Petroleum Corporation: CPC (Taiwan)
14. Petron Corporation (Philippines)
15. PTT Public Company Limited: PTTPLC (Thailand)
16. Petroleos de Venezuela: PDVSA (Venezuela)
17. Indian Oil Corporation: IOC (India)
18. International Energy Agency: IEA (France)
19. Statoil (Norway, Singapore)
20. U.S. Government
22. U.S. Energy Information Administration
23. Australian Bureau of Agriculture & Research Economics: ABARE (Australia)

Note: *some partially privatized
Retainer List

Private Corporations

1. ExxonMobil Corporation (USA, Singapore)
2. ChevronTexaco Corporation (USA)
3. Unocal Corporation (USA)
4. Conoco Inc (USA)
5. Universal Oil Products: UOP (USA, Singapore)
6. Tesoro Petroleum Companies (USA)
7. Nippon Oil Company (Japan)
8. Showa Shell Sekiyu (Japan)
9. Cosmo Research Institute/Cosmo Oil (Japan)
10. Idemitsu Kosan (Japan)
11. Mitsubishi Corporation (Japan)
12. Kansai Electric Company (Japan)
13. Itochu Corporation (Japan)
14. BP (Singapore, UK)
15. Oiltanking (Singapore, Germany)
16. LG-Caltex/LG Gas/Kukdong Gas (Korea)
17. SK Corporation: Yukong (Korea)
18. S-Oil Corporation (Korea)
19. Reliance Petroleum Limited (India)
20. Reliance Industries Limited (India)
21. Tata International, Ltd. (India)
22. TotalFinaElf (France)
23. Aluminium Pechiney (France)
24. Shell Oil Products (Singapore)
25. Arthur D. Little (Singapore)
26. Singapore Petroleum Corporation, Ltd. (Singapore)
27. Shell International Gas (UK)
28. BHP Billiton (Australia)
29. Australia LNG (Australia)
30. Gorgon Australian Gas (Australia)
31. McKinsey and Company (UK, USA, Singapore)
Overview

• Trends in hydrocarbons that may affect Hawaii (today)
  – Petroleum
  – Coal
  – Gas
  – Additional topics (time permitting)

• Impacts/interactions in Hawaii (next month)
Hawaii Primary Energy Consumption Hydrocarbons vs. Others

- Oil: 88%
- Coal: 6%
- Others: 6%
Electricity Generation Fuel Mix by Utility: 2001

HECO
- Oil
- Coal
- Other

HELCO
- Oil
- Coal
- Other

KE
- Oil
- Coal
- Other

MECO
- Oil
- Coal
- Other
Share of Petroleum Products, Hawaii vs U.S., 2001

- Propane
- Gasoline
- Jet Fuel
- Diesel
- Fuel Oil
Petroleum Outlook

• Given current plans, Hawaii’s dependence on oil looks set to continue over the next several decades

• Aside from environmental concerns, this dependence raises two important issues:
  – The long-term oil supply/price outlook
  – Energy security
Petroleum Outlook

- Will the world run out of cheap oil in the foreseeable future?
  - The 1981 Hawaii Integrated Energy Assessment projected that the price of oil would be between $64 and $334 per barrel in 2005. Oil fired power generation was to comprise between 6.4 and 20.5 percent of total power generation.
  - Why were they so far off?
World Oil Discoveries and Production: Five-Year Averages

Discoveries
Production

billion barrels

Petroleum Outlook

• Ignores the fact that reserves/production are dependent on price/technology:
  – Higher price yields increased reserves
  – Higher price spurs exploration/production
  – Technological developments such as enhanced recovery increase recoverable reserves
  – Higher price spurs development of unconventional oil
Petroleum Outlook

• Estimates:
  – The world has consumed just under 1 trillion barrels of oil.
  – The U.S. Geological Survey has identified 3 trillion barrels of ultimately recoverable conventional reserves.
  – It is estimated that there are 3.3 trillion barrels of heavy oil and tar sands.
  – Shale oil reserves are estimated at 15 trillion barrels.
  – Gas could also play a role through GTL.
## Comparison of World Oil Price Projections, 2005-2020

(2000 Dollars per Barrel)

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<thead>
<tr>
<th>Forecast</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
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## Global and Asia-Pacific Incremental Oil Demand, 1990-2002
\( (kb/d) \)

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<th>Year</th>
<th>World</th>
<th>Asia-Pacific</th>
<th>Share of AP</th>
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<td>1990</td>
<td>330</td>
<td>704</td>
<td>213%</td>
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<tr>
<td>1991</td>
<td>410</td>
<td>596</td>
<td>145%</td>
</tr>
<tr>
<td>1992</td>
<td>560</td>
<td>923</td>
<td>165%</td>
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<tr>
<td>1993</td>
<td>330</td>
<td>707</td>
<td>214%</td>
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<tr>
<td>1994</td>
<td>840</td>
<td>882</td>
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<tr>
<td>1995</td>
<td>1,400</td>
<td>927</td>
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<td>1996</td>
<td>1,630</td>
<td>823</td>
<td>50%</td>
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<td>1997</td>
<td>1,500</td>
<td>845</td>
<td>56%</td>
</tr>
<tr>
<td>1998</td>
<td>420</td>
<td>-249</td>
<td>-59%</td>
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<tr>
<td>1999</td>
<td>1,620</td>
<td>958</td>
<td>59%</td>
</tr>
<tr>
<td>2000</td>
<td>640</td>
<td>490</td>
<td>76%</td>
</tr>
<tr>
<td>2001</td>
<td>230</td>
<td>98</td>
<td>43%</td>
</tr>
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<td>2002*</td>
<td>170</td>
<td>143</td>
<td>84%</td>
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<td>Total</td>
<td>10,080</td>
<td>7,846</td>
<td>78%</td>
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*Projected

Sources: IEA (for World Demand) and FACTS Inc. (for Asia Pacific)

Asia’s growth is driving world demand growth.
Crude Oil Imports into Hawaii

Thousands of barrels


Foreign

Domestic
(mainly ANS)

Alaska’s decline and Asia’s growth will affect Hawaii in the future.
Alaska North Slope Production-History and Forecast

(Hypothetical production w/ passage of ANWR legislation)
Crude Oil Imports to Hawaii: 2000

- United States: 31%
- China: 23%
- Indonesia: 17%
- Australia: 15%
- Malaysia: 6%
- Thailand: 2%
- Argentina: 2%
- Vietnam: 2%
- Papua New Guinea: 1%
- Venezuela: 1%
What will Hawaii do?

- Pay more for traditional sources.
- Upgrade refineries to take oil from the Middle East.
- Bring in oil from non-traditional sources (West Africa).
Energy security: Although Hawaii is not dependent on the Middle East, remember that the market moves together
- Price spikes affect everyone
- Supply itself has never really been a problem

**Crude Prices**

- Brent Platt’s Curr(Adj) Mid (US$/bbl)
- Dubai Platt’s Mth1(Adj) Mid (US$/bbl)
- WTI Cushing Platt’s Mth1(Adj) Mid (US$/bbl)
A Brief History of the U.S./Hawaii Strategic Petroleum Reserve (SPR)

• **1973-1974**: Arab Oil Embargo cuts of flow oil from many Arab nations into the U.S. Sends economic shockwaves through the country.

• **1975**: Energy Policy and Conservation Act (EPCA) established – President Ford announces plan to establish a reserve of up to 1 billion barrels of petroleum.

• **1977**: Government acquires Gulf of Mexico salt caverns and first shipment of 412,000 barrels of Saudi Arabian light crude is delivered to the SPR.

• **1982-1998**: Hawaii Congressional Delegation makes repeated efforts for Hawaii SPR and, from 1989 to 1998, for priority access to SPR.


• **1998**: President Clinton signs the “Emergency Petroleum Supply Act” authored by Senator Akaka, giving Hawaii priority access to the U.S. SPR in the event of a drawdown.
  – Allows 1) Hawaii to buy oil at a price equal to the average of all successful bids and, 2) Hawaii-bound tankers to be loaded on a “first priority” basis

• **2002**: Current inventory of 595 mmb of crude in SPR, deliverable to market at a max rate of 4.1 mmb/d within 15 days of Presidential order.
Oil Summary

- The world will not run out of relatively cheap oil in the foreseeable future.
- Hawaii will have to pay a larger premium for its low sulfur crude slate.
- Prices spikes are inevitable as long as Hawaii depends on oil.
Coal-fired Electricity in Hawaii

- Every year since 1993 (when AES Hawaii’s 180 MW coal-fired power plant came online), coal has accounted for about 15% of Hawaii’s electricity.
  - End result: Hawaii less dependent on oil, though equally dependent on hydrocarbons, for electricity

- HECO’s latest IRP calls for an additional 180 MW of coal-fired capacity in 2016.
World Recoverable Coal Reserves

- United States
- Former Soviet Union
- China
- India
- Australia
- Germany
- South Africa
- Poland
- Other

Overall, coal is abundant and cheap

United States: 110 Billion Short Tons
Former Soviet Union: 230 Billion Short Tons
China: 110 Billion Short Tons
India: 70 Billion Short Tons
Australia: 60 Billion Short Tons
Germany: 50 Billion Short Tons
South Africa: 50 Billion Short Tons
Poland: 20 Billion Short Tons
Other: 40 Billion Short Tons

World Total: 1,083 Billion Short Tons

United States

Former Soviet Union

China

India

Australia

Germany

South Africa

Poland

Other

Billions Short Tons

Bituminous and Anthracite
Subbituminous and Lignite

FACTS Inc.
AES signed contract in 1990

Japanese Steam Coal Import Costs in U.S. Dollars/short ton

- **Australia**
- **Indonesia**
- **Total**

Note: Price includes fuel cost, freight and insurance; 2002 "Total" cost is based on year-to-date through November 2002

Comparing Emissions - Gas, Oil, Coal

- SO2 kg/TOE
- NOx kg/TOE
- CO2 kg C/billion J
World Coal Consumption by Region: 1990, 2005, 2020

- Industrialized Countries
- EE/FSU
- China and India
- Other Developing Countries

Billion Short Tons

Source

FACTS Inc.
Clean Coal Technology (CCT)

• New generation of Clean Coal Technology is rapidly evolving

  – **Increased efficiency**
    • Power plants using CCTs currently 30-50% efficiency. By 2030, over 50% efficiency possible for commercially viable, large-scale power generation using CCTs.

  – **Reduced emissions**
    • CCTs reduce SO$_2$ and NOx emissions to levels lower than those of a comparably sized oil-fired plant.
    • Traditional coal-fired plant CO$_2$ emissions are 20% higher than oil-fired plant, but can be reduced with CCTs.

  – **CCT capital costs** (currently roughly 2X costs of oil- and gas-fired plants) are also expected to drop significantly within the next 20 years.
Hawaii Gas Consumption, 1990-2001

Billion Btu


Synthetic Natural Gas (SNG)

Liquefied Petroleum Gas (LPG)
Hawaii Gas Prices versus U.S. Mainland

PADD-V Price of Natural Gas Delivered to Residential Consumers

PADD-V Price of Natural Gas Delivered to Commercial Consumers
Gas is a “hot” fuel globally.

Growth Rates by Fuel, World 2001-2020

Source: EIA International Energy Outlook 2002
Top Ten Countries with Proven Natural Gas as of January 1, 2002

- Russia: 1,600 Trillion Cubic Feet
- Iran: 800 Trillion Cubic Feet
- Qatar: 500 Trillion Cubic Feet
- Saudi Arabia: 200 Trillion Cubic Feet
- UAE: 200 Trillion Cubic Feet
- United States: 200 Trillion Cubic Feet
- Algeria: 100 Trillion Cubic Feet
- Venezuela: 100 Trillion Cubic Feet
- Nigeria: 50 Trillion Cubic Feet
- Iraq: 50 Trillion Cubic Feet

Source: Oil & Gas Journal
World Natural Gas Consumption and Production by Region, 2001

North America: 27.8 TCF
EE/FSU: 23.3 TCF
Western Europe: 15.4 TCF
Asia & Oceania: 10.5 TCF
Middle East: 6.8 TCF
Central & South America: 3.4 TCF
Africa: 2.1 TCF

Source: EIA
World Long-Term LNG Contracts and Liquefaction Capacity, 2001

- **Asia**: 77.3 million metric tonnes per annum (mtpa)
- **Europe**: 25.8 mtpa
- **North America**: 4.0 mtpa
- **Africa**: 33.0 mtpa
- **Atlantic Basin**: 10.0 mtpa

*Source: EIA*
Piped Natural Gas Market versus LNG Market

World Natural Gas Consumption, 2001

- Piped Natural Gas: 95%
- LNG: 5%

Source: EIA
A Buyer’s Market

• 106.1 mtpa of proposed LNG projects is on the drawing board, which would **double worldwide LNG capacity (to 213.2 mtpa)** by the end of the decade.
  – Qatar alone is planning 43.5 mtpa

• The prospect of plentiful supply has led to a **buyer’s market**, with new contract structures specifying **less crude oil linkage** and **lower constants** in the LNG formula.
Comparison of Old Asian Contracts (Japan) with New Asian Contracts (Chinese Guangdong)

Asian LNG Prices, Delivered

- **Japan**
- **Guangdong**

Crude ($/b)

($/mmBtu)

2.50 2.70 2.90 3.10 3.30 3.50 3.70 3.90 4.10 4.30 4.50

15.00 16.00 17.00 18.00 19.00 20.00 21.00 22.00 23.00 24.00 25.00

FACTS Inc.
Potential For Hawaii LNG Imports

- Several producers (e.g. Shell and BP) have approached stakeholders in Hawaii about the possibility of supplying LNG to the state.
- Possible supply sources are **Sakhalin** (Russia) and **Tangguh** (Indonesia).
- Only possible site for receiving terminal, regasification terminal, and storage facilities would be **Barber’s Point**.
- Potential LNG demand for Oahu is most likely around **1.2 mtpa**.
Hybrids: An Overview

• Hybrid vehicles use a combination of an electric motor and an internal combustion engine.
• Key advantage: Hybrids use existing infrastructure.
• With tax breaks, the cost can be similar to a non-hybrid vehicle.
  – Cost is about $2,000-4,000 higher than a comparable vehicle.
  – Federal tax credit is currently $2,000.
  – Fuel saving is approximately $100 per year.
Hybrid Vehicles

• Currently there are two automakers with hybrid vehicles on the market.

  – Toyota Prius
    • Gas mileage: **52 city/45 highway** (automatic transmission)

  – Honda Insight and Civic
    • Insight’s gas mileage: **57 city/56 highway** (automatic transmission)
    • Civic’s gas mileage: **48 city/47 highway** (automatic transmission)
Pacific Region Comparison of Fuel Cell and Hybrid Vehicle Sales 2000-2020

- Electric-Diesel Hybrid
- Electric-Gasoline Hybrid
- Fuel Cell Gasoline
- Fuel Cell Hydrogen

Thousands


FACTS Inc.
Hawaii’s Hybrid Market, Key Points

- **Toyota**
  - Averages **5 Prius** sales a month.
  - In Hawaii the typical buyer is a **middle-aged Caucasian**.
  - Sales of **Prius** are **lagging** this year, due to California’s high demand for hybrids.

- **Honda**
  - Initial costs to produce the **Insight** was roughly **$40,000**, Honda sold vehicles at a loss.
  - Introduced **Civic** hybrid platform this year and sales made a **tremendous leap** over Insight sales.
  - Sales of **Civic** hybrids average **4-5 a month**.
An Overview of Hawaii’s Liquid Fuel Taxes

• State Tax
  – Hawaii places a per gallon charge for each gallon of petroleum fuel refined, manufactured, produced or compounded by a licensed distributor.

• County Tax
  – A county tax is placed on each gallon of petroleum fuel refined, manufactured, produced or compounded by a licensed distributor. Rates are determined by city ordinance and vary throughout the counties.

• Environmental Tax
  – The state levies an additional $.05 per barrel (or fractional part of a barrel) environmental tax on petroleum imported by a distributor into Hawaii.

• General Excise Tax
  – A general excise tax (GET) is first applied on distributor to wholesaler fuel sales at a discounted rate or .005%, also known as a wholesale GET. The full 4% is then levied on wholesaler to consumer sales.
Country-by-Country Comparison of National Gasoline Fuel Tax Rates
Fuel Taxes: General Thoughts

• Applying the GET on fuels accentuates the impact of swings in the price of oil.

• Existing taxes on energy consumption are generally not environmentally logical.
  – High taxes for motorist, low taxes for industry.

<table>
<thead>
<tr>
<th>Carbon Prices Implied in Fuel Prices (U.S.)</th>
<th>Gasoline</th>
<th>Heavy Fuel Oil</th>
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</thead>
<tbody>
<tr>
<td>Carbon (kg/liter)</td>
<td>0.66</td>
<td>0.80</td>
</tr>
<tr>
<td>Price per liter</td>
<td>0.37</td>
<td>0.11</td>
</tr>
<tr>
<td>Carbon (kg/$ spent)</td>
<td>1.68</td>
<td>7.27</td>
</tr>
</tbody>
</table>

• A carbon tax aims to create an incentive to move away from carbon intensive fuels.
The End.

Thank you!