Occasional Energy Report
Number 48

Facts versus Myths:
Dispelling Common Misinformation About
Hawaii’s Energy and Power Situation

April 2012
The Hawaiian Situation
Energy? It’s About the Oil

There has been a lot of debate about whether or not Hawaii is “the most fossil fuel dependent state.” This is all a matter of definition—and doesn’t really matter.

Two things are clear:

1) Hawaii relies on foreign imports for virtually all of its fossil fuel needs (even coal), and

2) Hawaii is disproportionately dependent on oil.
Fuel Oil? Who Uses Fuel Oil Anymore?

The “Oil Demand Barrel” – Hawaii’s Share of Fuel Oil is 12 Times National Average

In most of the US, fuel oil was chased out of the market when prices rose in the 1970s.

In the big “demand decline” in the US following the 1979/80 price increases, the demand for other products hardly declined at all. The US “price-induced conservation” was almost entirely a result of switching away from fuel oil.

Depending on definitions of total oil demand, fuel oil in Hawaii is still one-quarter to one-third of the demand barrel.
Hawaii’s Power Sector Remains Heavily Oil-Dependent

Power Sector’s Share of Oil Demand
While the US rapidly moved away from oil in electricity generation after the 1970s, Hawaii’s share of oil for the power sector has increased.

Fuel Demand in Power Sector
- Renewable*
- Nuclear
- Gas
- Coal
- Oil

* Hydro, Biomass, Geothermal, Solar, and Wind

** Alaska, California, Oregon, & Washington

Mainland
USWC**
Hawaii

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

Mainland
USWC**
Hawaii

0% 5% 10% 15% 20% 25% 30% 35%


Hawaii
Mainland US
West Coast
A History of US West Coast Use of Fuel Oil in Electricity in One Picture

- WA
- OR
- CA
- AK
- HI

Years: 1960 to 2008

Fuel Oil Use (in barrels)
Not Only Does Hawaii Use Fuel Oil in the Power Sector...It Uses the Most Expensive and Scarce Kind of Fuel Oil

Most of the world’s fuel oil is “HSFO,” High-Sulfur Fuel Oil (also known as “Bunker C”). This is used mainly as fuel for ocean-going vessels. Its sulfur content can run up to 4.5% by weight.

Hawaii uses “LSFO,” Low-Sulfur Fuel Oil. Its sulfur content is 0.5% sulfur by weight.

There are small markets in LSFO in the US Gulf Coast, New York, and Northern Europe. All are far from Hawaii.

On the US West Coast, the LSFO market vanished entirely in the 1980s. The only remaining markets accessible to Hawaii are in the Far East. Hawaiian prices are inextricably linked to prices in Japan, Korea, and Singapore.
Refining and Oil Supply
FACT: Hawaii’s Crude Oil Import Pattern is Unique in the US

Hawaiian Crude Imports by Source, 1989 and 2010

- **1989:** Almost half of supply from US.
- **2010:** Not one drop from US.

Hawaiian refineries have not made investments to process high-sulfur crudes and still meet today’s environmental standards.

Crudes available from the West Coast (Alaskan, Californian, Canadian) are all too high in sulfur for Hawaii.

Asia Pacific crudes make up only 2% of US West Coast refinery supply—as opposed to 84% in Hawaii.
**MYTH:** WTI is the World Benchmark Crude, and Represents the Prices in the World Market (Hey, I saw it on CNN!)

There are three crude futures traded in major exchanges:

- WTI (Texas)
- Brent (UK North Sea)
- Dubai+Oman (Middle East)

WTI is “unhooked” from the world oil market, and irrelevant. Saudi Arabia—the world’s largest oil exporter—no longer prices its crudes against WTI.

Anyone who uses WTI in an analysis of today’s oil prices is an amateur.
FACT: WTI is Landlocked...and Don’t Forget the Jones Act
MYTH: Oil is Oil. Crude oil prices in one market can be used as a reasonable proxy for fuel oil prices in another market.

Oahu’s power plants do not burn crude oil—they burn fuel oil. In particular, they burn low-sulfur fuel oil (LSFO).

The only LSFO markets in the Pacific Basin are in Asia. There is no LSFO market on the US West Coast. California, Oregon, and Washington (wisely) switched away from LSFO in the 1970s.

Using Brent to represent LSFO is clearly wrong...and using WTI is just plain ridiculous!
MYTH: There is nothing special about oil prices in the Asia Pacific market.

"Nordhaus reports a median correlation between 31 different crudes ("with long historical records and widely dispersed markets") of 99.7%"

True...but misleading!

Things can be "correlated" even if there are huge absolute differences between them.

Tapis and Brent crude oils are 99.8% correlated in 2000-2011...but look at the differentials!
MYTH: The market will take care of everything.

Economists are aware that various kinds of distortions can affect the operation of a market. But economic pundits in Hawaii seem bent on ignoring the messy details and applying simplistic Econ 101.

Incorrect Assumptions = Incorrect Conclusions

Incorrect Assumption #1: The world oil market is efficient
Incorrect Assumption #2: No barriers to entry in Hawaii
Incorrect Assumption #3: Scale is not a factor.
Incorrect Assumption #4: Geography does not matter.
FACT #1: The oil market is filled with distortions.

Oil is political, and some players have undue market power. To take one example, Saudi Arabia—the world’s largest exporter—charges different prices to different parts of the world.

Unlike utilities, the Saudis charge the highest price to their biggest customers—East Asia!
FACT #2: It’s hard to get into the Hawaiian market.

To take a simple example, HECO is often criticized for not getting low prices for their fuel oil supply (though the prices they pay are very similar to those paid in Japan).

How would HECO buy fuel oil from the market? The only way to land fuel oil in bulk in Hawaii is through the terminals of the refiners.

The problem, of course, is that the Hawaiian economy can only support a certain number of import terminals. Duplication is costly except in special circumstances. (But so is limited competition...)

Which brings us to our third point...
FACT #3: Size matters—and in the world of oil, Hawaii is tiny.

For example, Hawaiian refineries are too small to be economic in today’s market. But the two refineries together have too much capacity for the local market!

The same holds true for import terminals and other facilities.

Real competition in energy would require duplication of facilities...but the market is too small to justify multiple companies.
FACT #4: Location, location, location. Geography matters.

Oil-wise, Asia is at “the end of the pipeline.”

...Hawaii is 3,000-6,000 miles beyond the end of the pipeline.

Asia Pacific crude exports, mmb/d
FACT #4-a: In case you don’t believe us, take a closer look.

This map, from BP Statistical Review, tells an important story: There are no major cross-Pacific flows of oil.
Hawaii’s Refineries are Reliant on Fuel Oil Income...

- Hawaii refineries have little desulfurization. They also have very little “cracking”—a set of processes that convert fuel oil into higher-value products like diesel, jet fuel, and gasoline.

- Tesoro has the least cracking compared to its crude capacity. All things held equal, higher crude runs at Tesoro means a higher fraction of output as fuel oil.

- The total refinery capacity made sense two decades ago, when looking at a growing market.

- Excess capacity cannot be used economically because the refineries have high costs per barrel and are far from crude sources and export markets.

*excluding mild cracking such as visbreaking
Tesoro reported a company-wide loss in 2010. Guess which refinery was the biggest loser?

We estimate Tesoro spent $2.6 billion on feedstock & opcosts in 2010—a huge risk of capital. Refiners are the bank tellers of the oil industry...

...just because they handle a lot of money does not mean they are rich.
MYTH: Tesoro could buy cheaper crudes... 
...but instead it chooses the most expensive crude and passes the cost on to Hawaiian consumers.

This is almost too silly to refute. Yet we’ve heard this a lot lately.

A lot of people seem to think Tesoro works like a public utility. It doesn’t. Tesoro faces a set of product prices, all linked to the external market. Of course, it wants to nudge those prices as high as it can...

Tesoro’s profits are those product prices minus the price of crude it buys. For every extra dollar it spends on crude oil, it loses a dollar of profit. Even if you assume Tesoro is an evil capitalistic corporation bent on squeezing out the last dime from the public, it is never in Tesoro’s self-interest to pay higher prices for crude oil.

But what about that Argentinian crude that is so cheap? What about North African crudes? The simple answer—look at a map. Transport costs money.
It’s No Wonder Tesoro Wants Out, Part 2

The HCEI, as envisioned, will cut demand for fuel oil and slow demand for other oil products.

But there is already overcapacity...

Hawaii Power Sector Oil Demand Forecast, barrels/day

- 0
- 5,000
- 10,000
- 15,000
- 20,000
- 25,000
- 30,000
- 35,000
- 40,000

The Bulk of Hawaii’s Petroleum Infrastructure is on Oahu

[Map of Hawaii's petroleum infrastructure with storage capacities and refinery capacities shown.]
The Critical Segments of the Import Infrastructure
Belong to the Two Refiners...

8 Inch
LSFO (Black)

10 inch
Products

8 inch
Clean Product (White)

Submerged pipeline

20 Inch
20 Inch - Crude

30 Inch
30 Inch - Clean Product

30 Inch

16 Inch - Bunker

Barbers Point Harbor – Loading Facility

Kahe Power Plant

Honolulu Transportation Terminal – Bottom loading rack

Sand Island Terminal – Petroleum truck loading rack

Honolulu Marine Terminal – Vessel loading facility

Seven Mooring Buoys

Single Point Mooring (SPM) Buoy
The Power Sector and Changing Energy Markets
MYTH: The price of electricity in Hawaii shouldn’t be tied much to the price of oil.

“Back of the envelope math problem for HECO: even if fuel oil was 40% of its production cost (unlikely), fuel oil prices would have to double (+100%) to justify a 40% rise in average electricity prices.

--Paul Brewbaker

An important calculation shouldn’t be done on the back of an envelope. Still, we have an envelope handy...

### OAHU, September 2011

<table>
<thead>
<tr>
<th>Fuel Oil Price, $/b</th>
<th>$135.17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat, mmBTU/b</td>
<td>6.2</td>
</tr>
<tr>
<td>Cost, $/mmBTU</td>
<td>$21.80</td>
</tr>
<tr>
<td>BTU/mmBTU</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Heat Rate (BTU/kWh)</td>
<td>11,000</td>
</tr>
<tr>
<td>Fuel Cost $/kWh</td>
<td>$0.2398</td>
</tr>
</tbody>
</table>

### RATES (PER kWh)

| Oahu Average     | $0.327 |
| Fuel component   | 73%    |

Incorrect Assumptions = Incorrect Conclusions (GIGO)
MYTH: Studies elsewhere show that increases in fuel cost should have only a mild effect on Hawaii electricity prices.

“A 2008 California study projected that a doubling of fuel prices would lead to a 20-25% increase in the cost of electricity.”

True ..but misleading!

Californian Electricity by Source, 2010

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables and Nuclear</td>
<td>32%</td>
</tr>
<tr>
<td>Imports (mostly hydro &amp; coal)</td>
<td>29%</td>
</tr>
<tr>
<td>Gas-fired generation</td>
<td>38%</td>
</tr>
<tr>
<td>Oil &amp; Coal</td>
<td>1%</td>
</tr>
</tbody>
</table>

Only 39% of California’s power generation capacity is directly exposed to fuel cost increases. Almost all of that is gas. Fuel is a small fraction of electricity production costs...in California.
The Trajectory of Hawaiian Electricity is Different...

Average Electricity Price, cents/kWh

Anyone who knows the energy business looks at this chart and sees that Hawaii’s prices look like the history of oil prices.

The rest of the US has broken this link. As long as Hawaii continues to burn oil as the primary power source, nothing will change this basic picture.
As mentioned before, the expected declines in fuel oil demand pose problems for the refiners.

At the same time, however, they leave Hawaii in 2030 still consuming more than 20,000 b/d of oil in the power sector.
There has been a Fundamental Change in the US Energy Outlook...

EIA: US Natural Gas Production, tcf

US natural gas production is soaring.

The US has been a growing net importer of gas. But now, the LNG terminals that were built to bring in gas are applying for licenses to export instead. Within a decade, EIA predicts that the US will be a major net exporter.
US Oil Prices and Gas Prices Have Become Uncoupled...

EIA: US Oil and Gas Prices, 2010 $/mmBtu

EIA now foresees rising gas prices—but price still lower than in the past, and rising much more slowly than oil.

This is the prediction even though the US is expected to become a net exporter of natural gas within a decade.
LNG is Now a Real Possibility for Hawaii

### LNG vs LSFO in the Hawaii Power Sector

<table>
<thead>
<tr>
<th></th>
<th>LSFO</th>
<th>LNG (low)</th>
<th>LNG (high)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price, $/barrel</strong></td>
<td>$129</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Price, $/mmBTU</strong></td>
<td>$20.87</td>
<td>$11.26</td>
<td>$14.76</td>
</tr>
<tr>
<td><strong>Heat Rate, BTUs/kWh</strong></td>
<td>11,000</td>
<td>6,200</td>
<td>6,200</td>
</tr>
<tr>
<td><strong>Fuel element of power generation, cents/kWh</strong></td>
<td>22.96</td>
<td>6.98</td>
<td>9.15</td>
</tr>
<tr>
<td><strong>Fuel price element compared to LSFO</strong></td>
<td>100%</td>
<td>30.4%</td>
<td>39.9%</td>
</tr>
<tr>
<td><strong>Heat Required, trillion BTU/y</strong> (100 MW plant at 90% capacity factor)</td>
<td>8.67</td>
<td>4.89</td>
<td>4.89</td>
</tr>
<tr>
<td><strong>Fuel Cost, million $/year</strong></td>
<td>$181</td>
<td>$55</td>
<td>$72</td>
</tr>
<tr>
<td><strong>Savings, million $/year</strong></td>
<td>$126</td>
<td>$109</td>
<td></td>
</tr>
<tr>
<td><strong>% Savings</strong></td>
<td></td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td><strong>Relative Carbon Footprint</strong></td>
<td>100%</td>
<td>38%</td>
<td>38%</td>
</tr>
</tbody>
</table>

LNG in a combined-cycle baseload plant is more energy-efficient than fuel oil. Natural gas also has a smaller carbon footprint. Put these together and you get a large carbon advantage and a substantial cost advantage.

Gas turbines are also superior for load-following—which is required by fluctuating sources like wind and solar.
Conclusions

Hawaii remains highly exposed to the oil market. This will continue to be the case even if the HCEI reaches its 2030 goals.

Other US consumers feel the pain of high oil prices at the pump—but not on their electricity bills. Hawaii gets both.

Hawaiian utilities can only affect the present situation in a limited way without reliable access to import infrastructure.

LNG may offer a clean and efficient bridging fuel to a fully renewable economy, and deserves careful consideration.