

The Short and Long of Oil Prices

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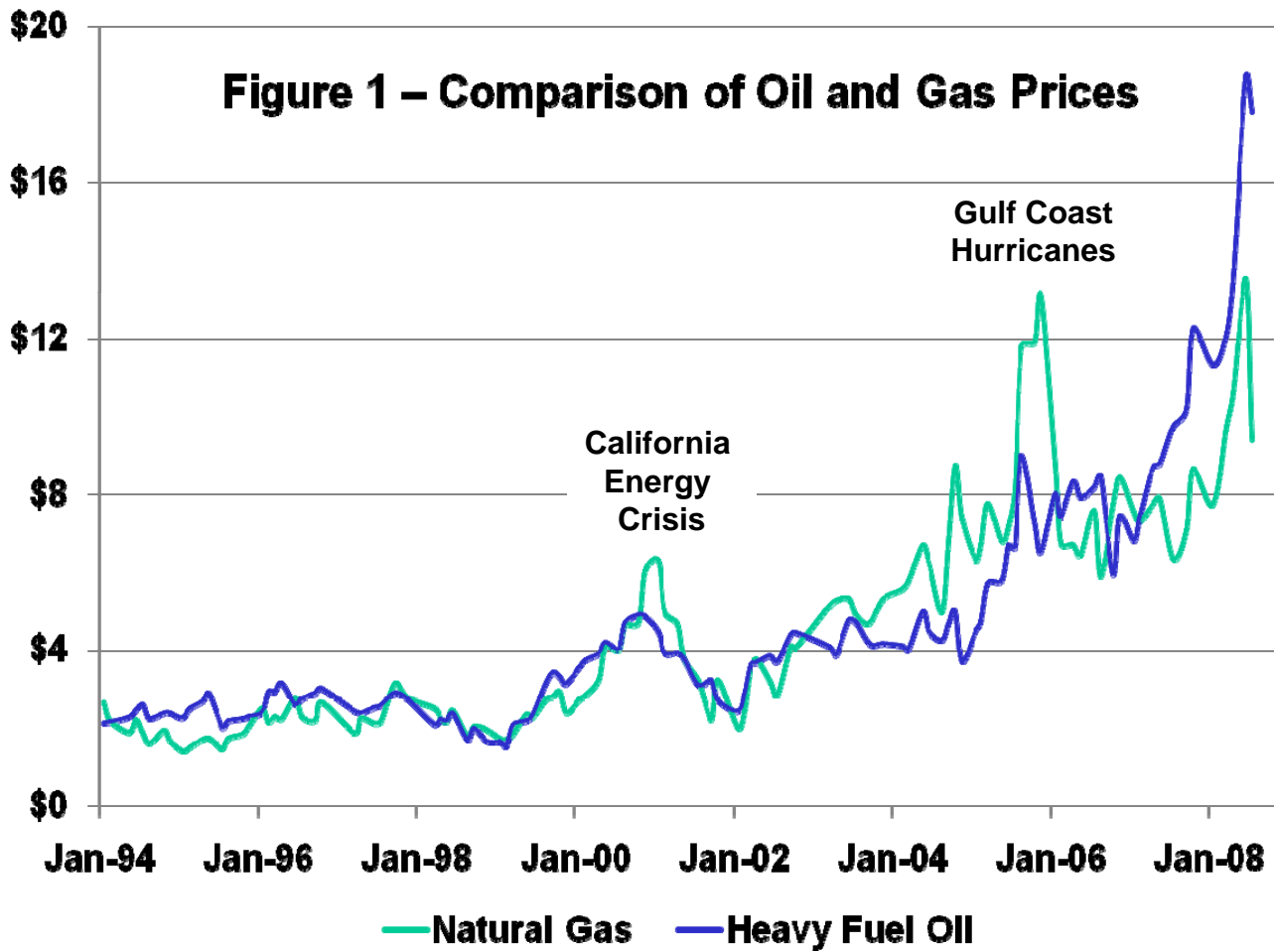
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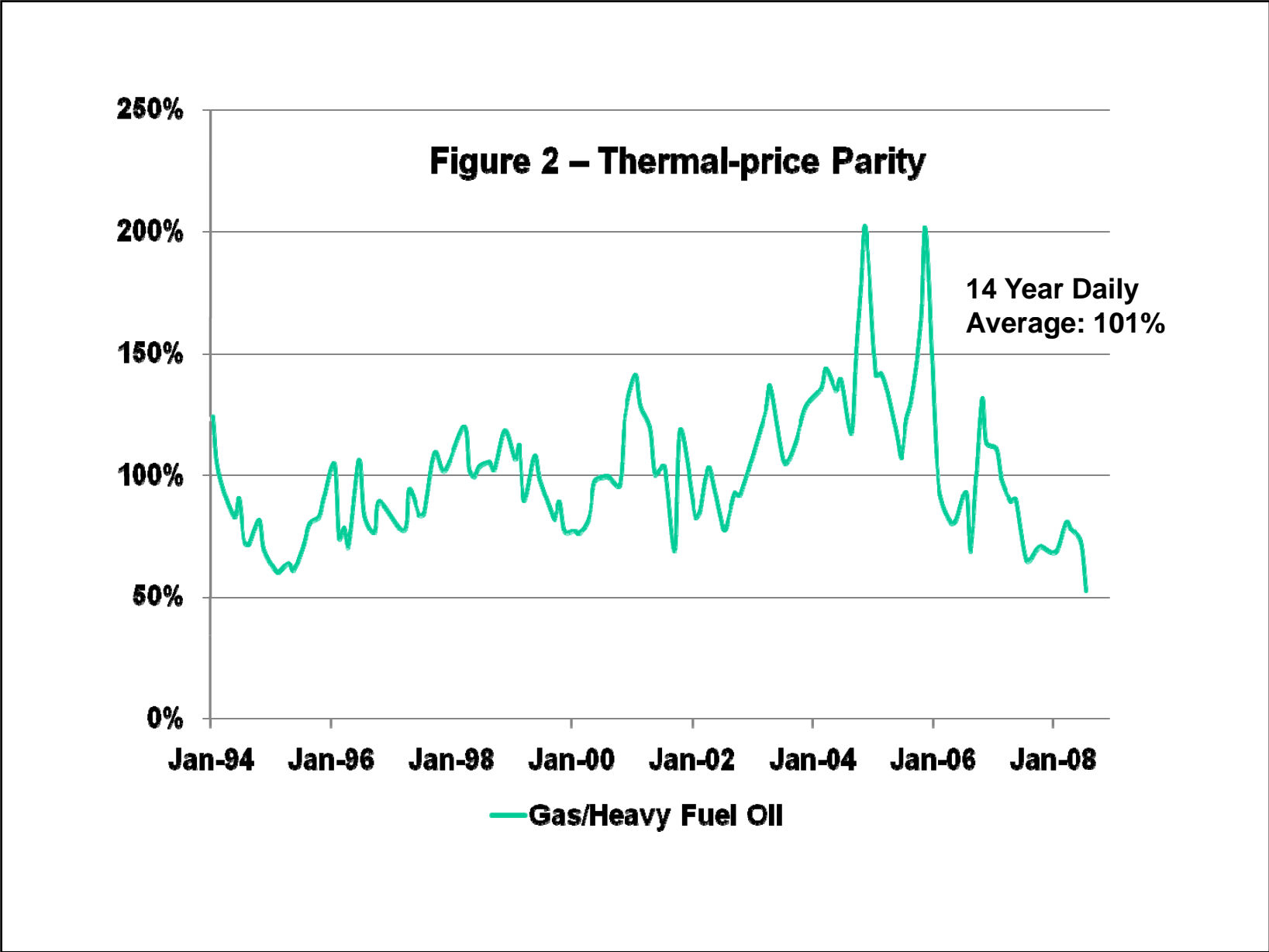
**Presentation to:
Pacific Northwest Power and
Conservation Council
Natural Gas Advisory Committee**

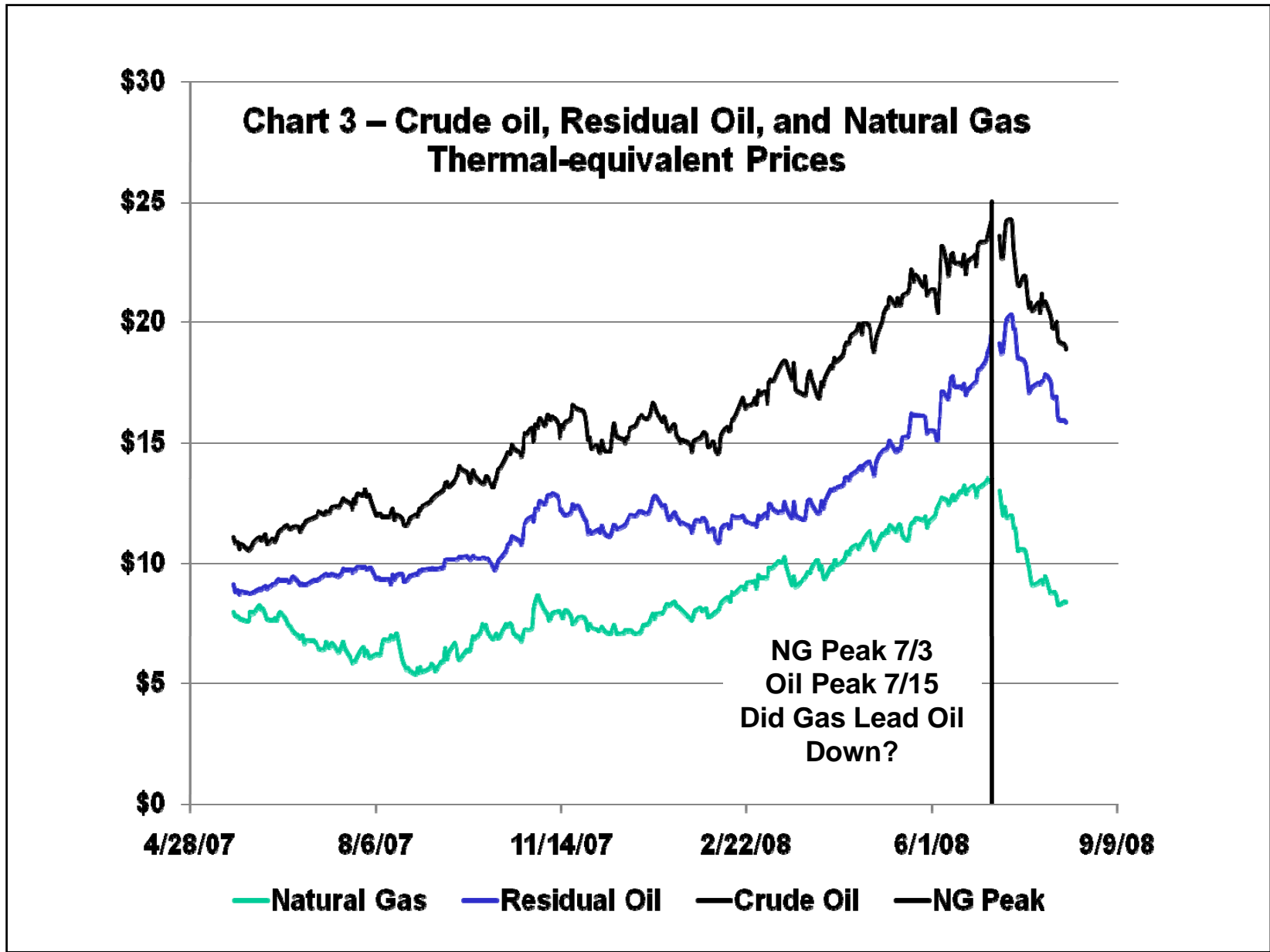
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Introduction – Why Oil Prices are Important

- **Natural gas prices are the most important determinant of wholesale power prices and will determine the likely direction of cost over the next decade.**
- **Gas prices, in turn, are linked to oil prices. Fuel switching allows natural gas and petroleum products to compete - pushing prices towards thermal price parity.**
- **Heavy fuel oil prices are typically less than crude oil prices, reflecting the refining cost of converting heavy oils to light products, such as gasoline and diesel.**
- **However, price competition in the short term has been sporadic and relative price movements have been extreme.**
- **Particularly, as oil prices have peaked, there has been a marked departure from the normal relationship. In my view, this will not hold for the long term.**







The Crude Oil Price Run-up, 1998-2008

Various explanations are given for the oil price run-up:

- **Extraordinary economic growth in Asia and other developing economies leading to rapid oil demand growth.**
- **Production and refining infrastructure shortages.**
- **The decline in the US Dollar (USD).**
- **Price subsidies and controls in China, India, and elsewhere.**
- **Speculation.**
- **Resource exhaustion (“peak oil”).**
- **All of the above.**

Chart 4 - Economic Growth and Oil Consumption

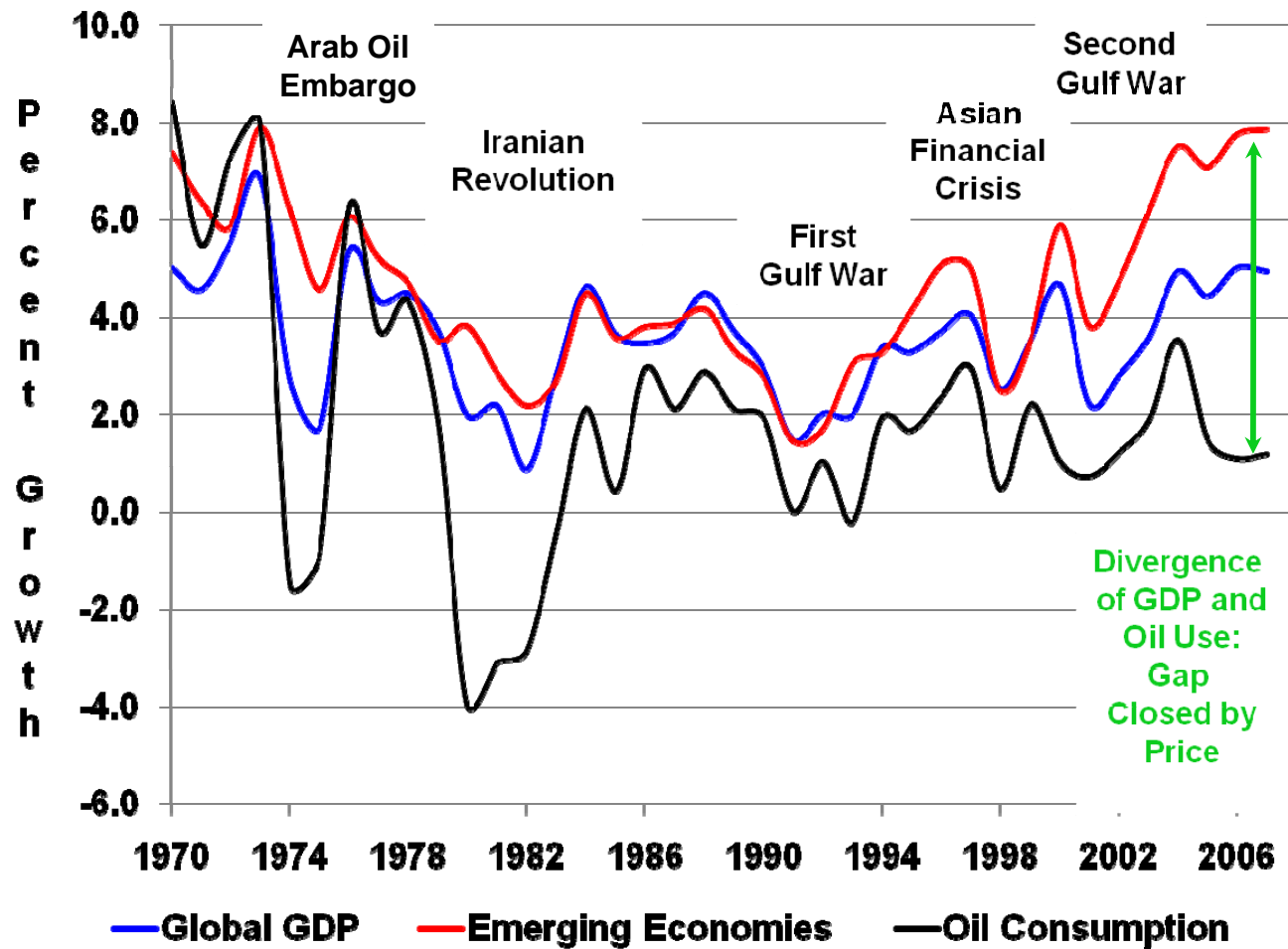


Chart 5 – Impact of Product Margins on Crude Oil Prices

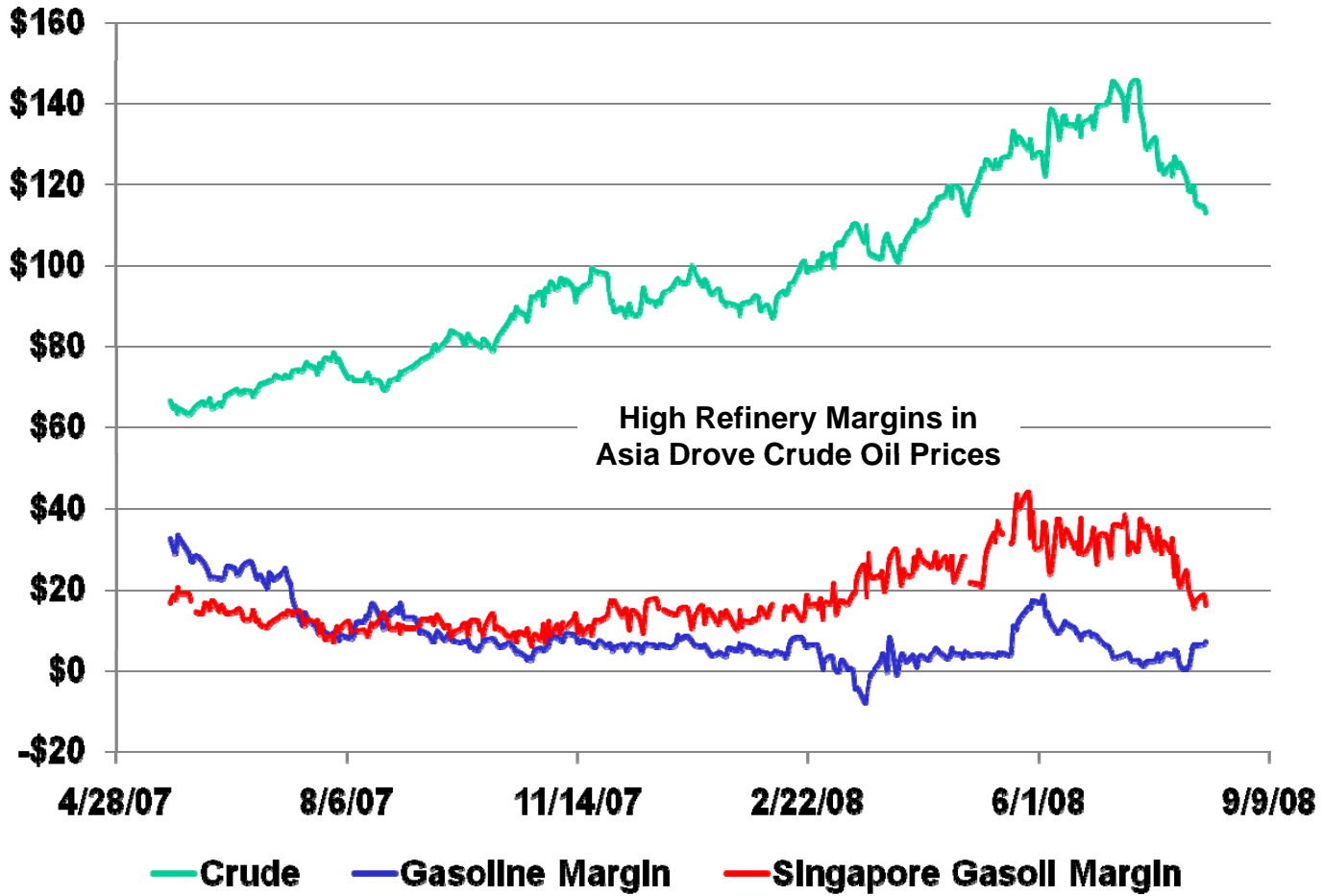


Chart 6 – Impact of USD Devaluation on Crude Oil Prices

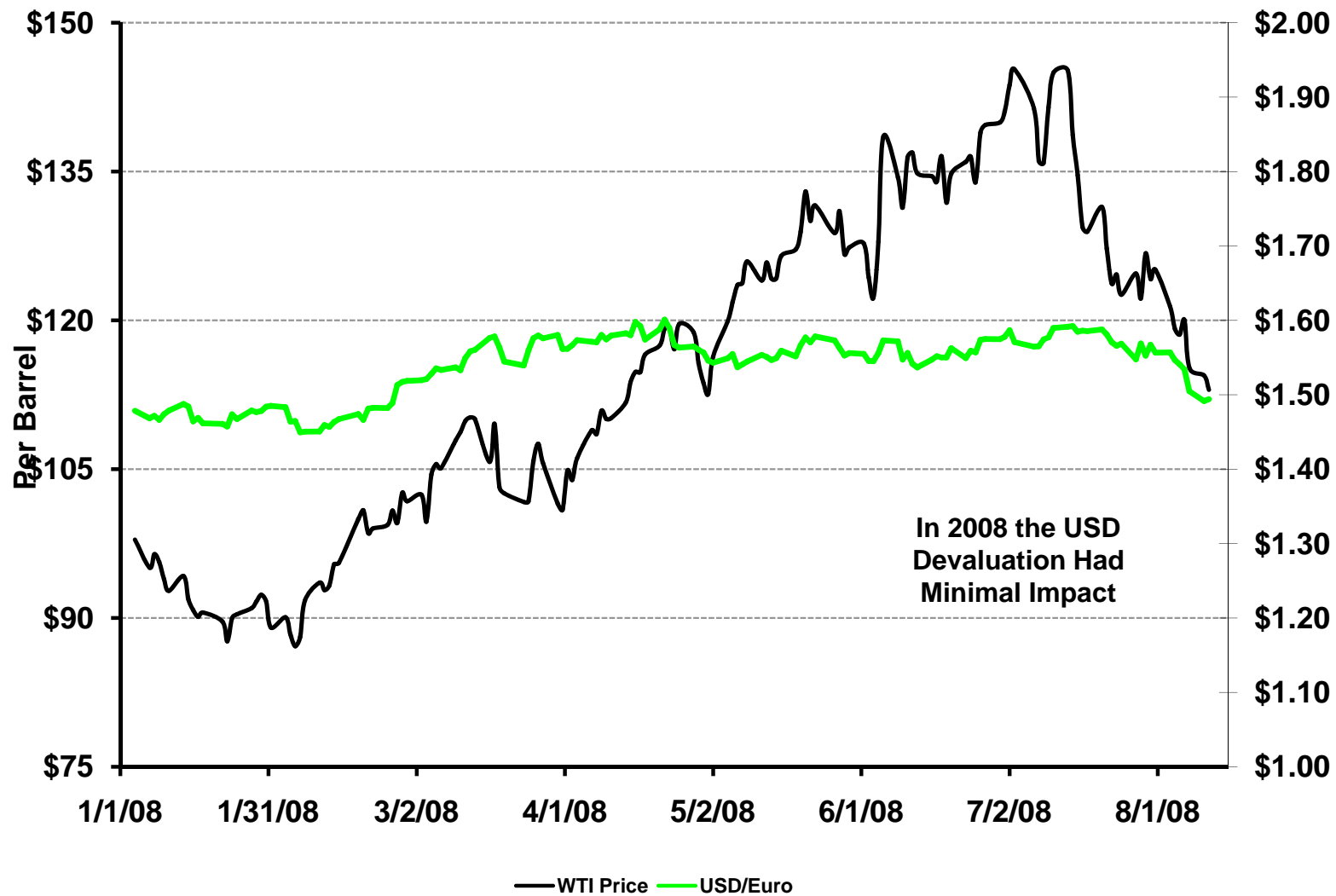


Chart 7 – Trading Volume Increase of “USO” Index to WTI

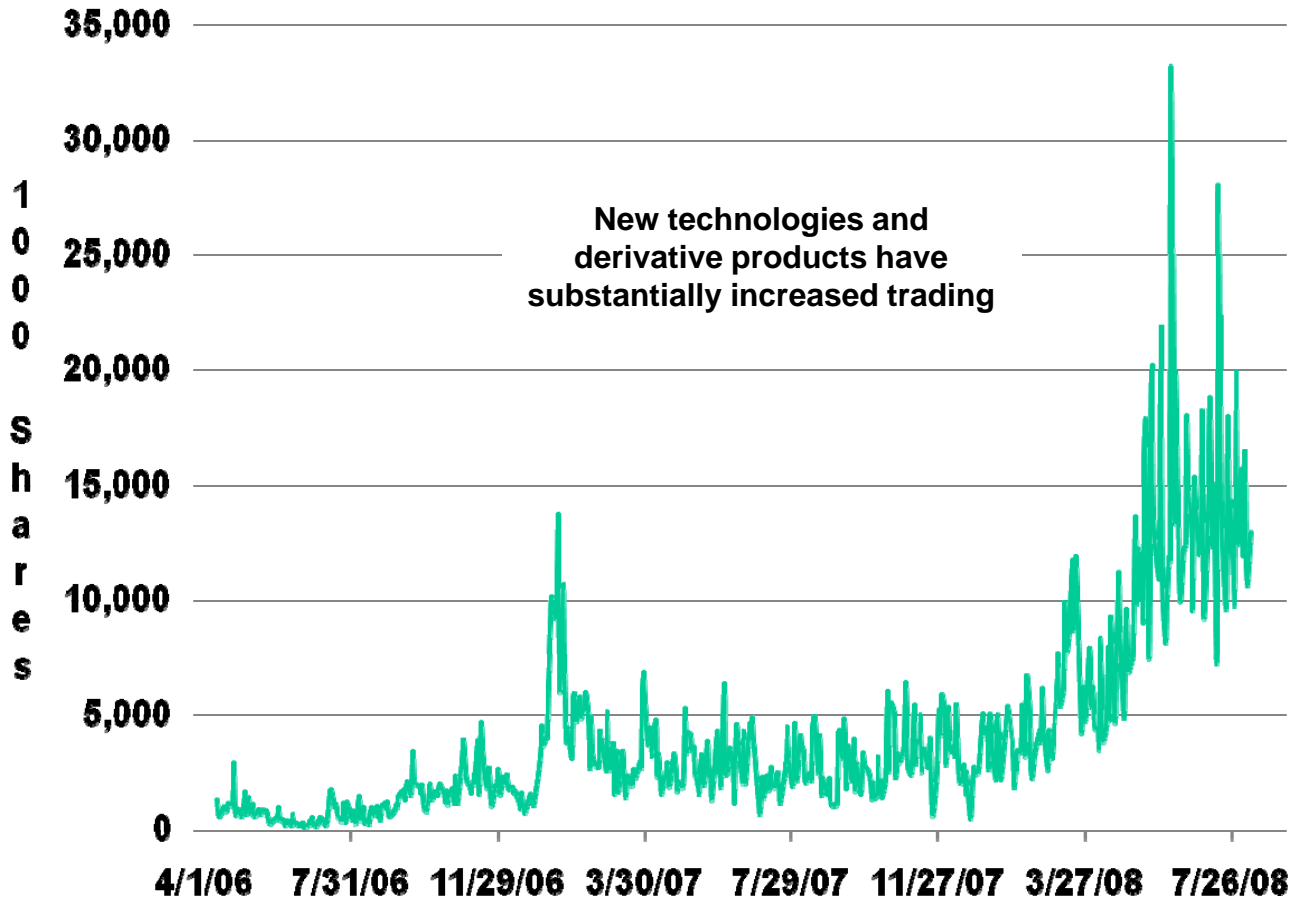
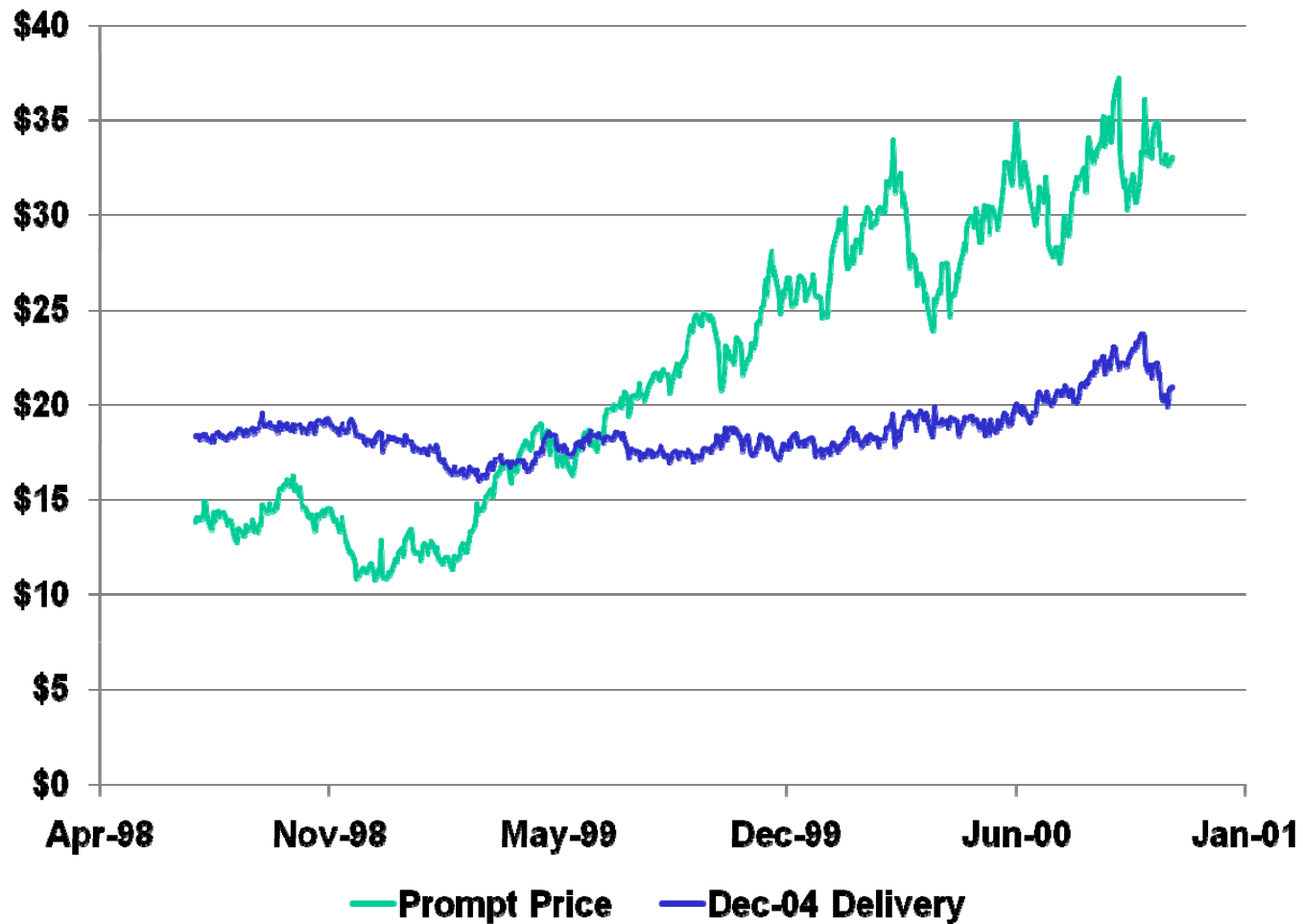


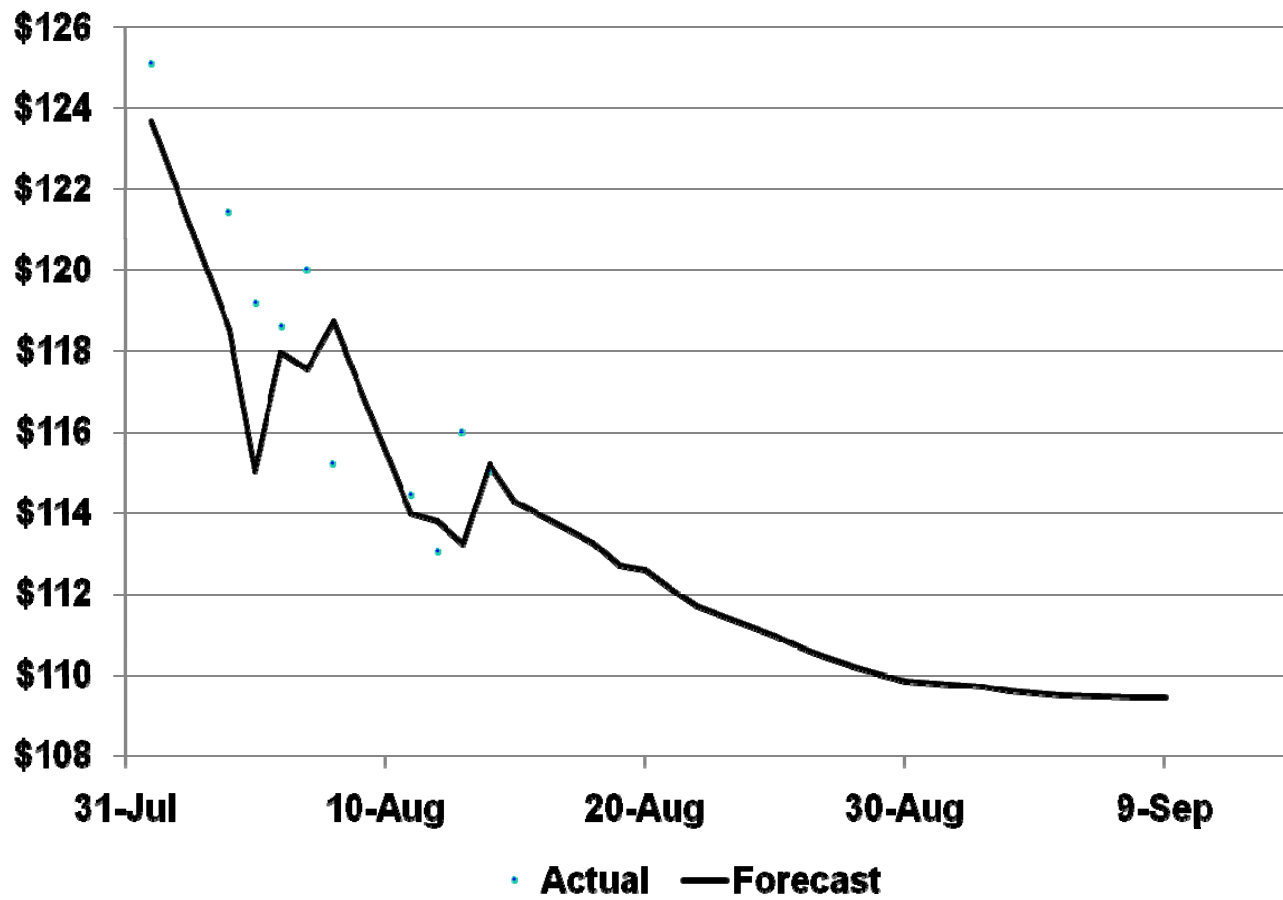
Chart 8 – Previous Relationship of Spot and Forward Prices



The Short-term Outlook

- During the price run-up in June, Goldman Sachs and a number of forecasters predicted oil prices of \$150 per barrel by the end of the year.
- Current predictions are less explicit, but the general consensus is decidedly more bearish. Lehman Brothers' forecast (7/22) is for \$110 per barrel in 4Q08 and \$90 by 1Q09.
- Many of these forecasts were based on faulty or misleading data. During period of rapid market changes there can be pronounced distortions.
- For example, China was stockpiling oil products in advance of the Olympics and to avoid price control adjustments.
- Likewise, some oil producers may have been holding back production in order to get higher prices in future months.
- Price movements in the next few months depend critically on global economic growth. If prices of \$150 per barrel or more were to persist for longer than one year the global economy would clearly falter. Thus, such projections are highly suspect.

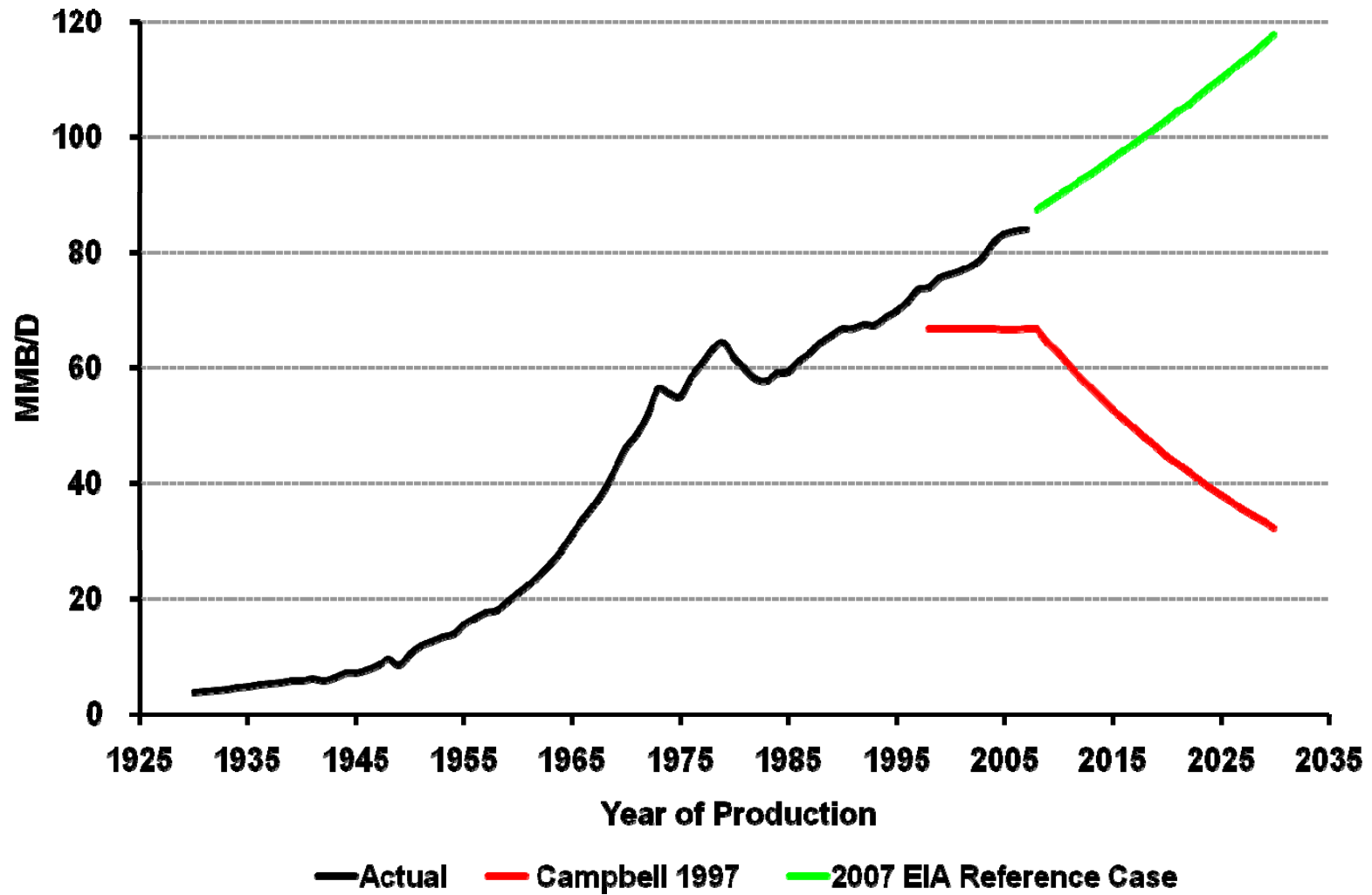
Chart 9 – Short-term Projected Prices



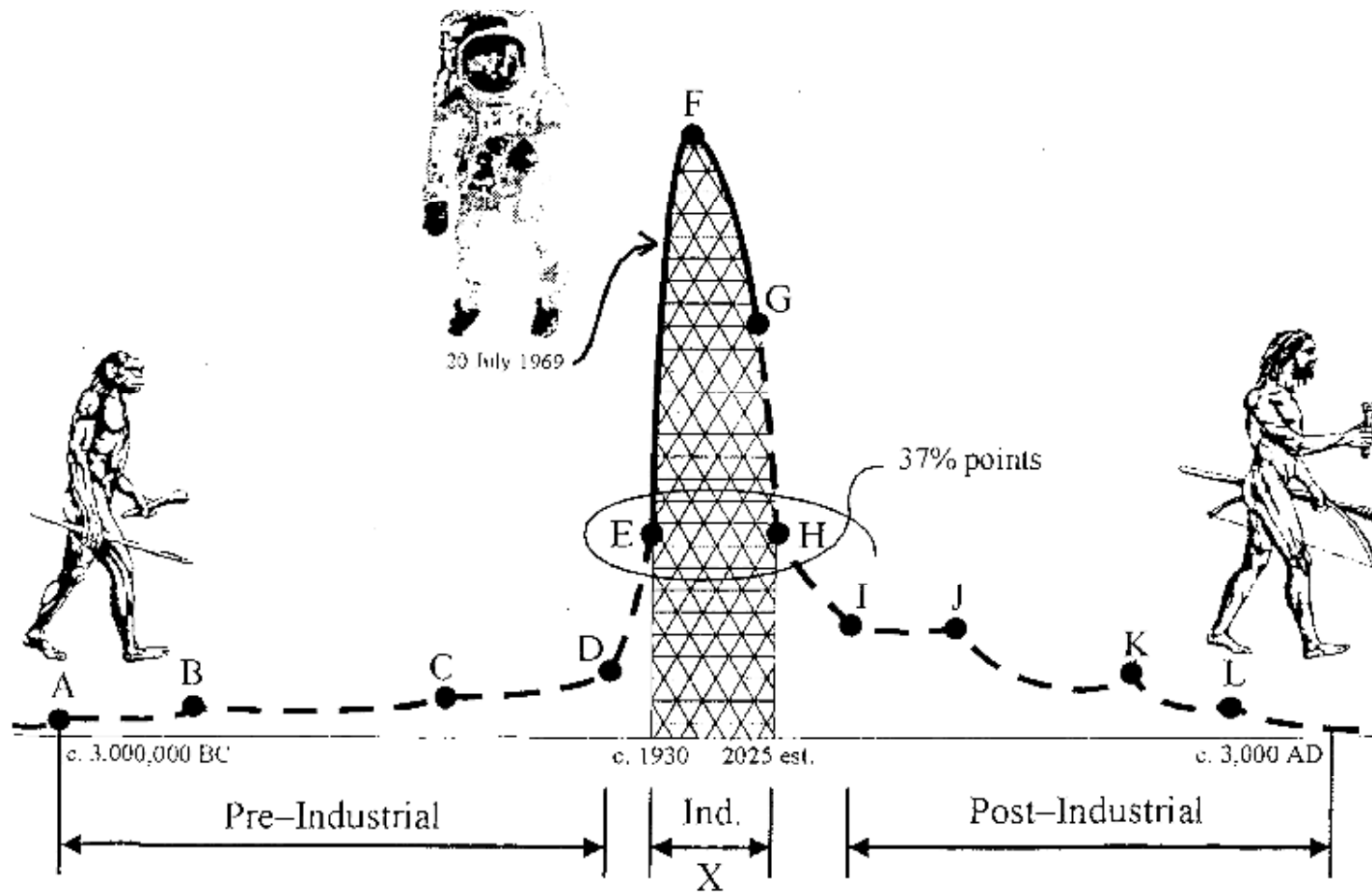
The Long-term Outlook

- The main motivating force behind rising forward prices has been pessimism about future supply, in the face of strong economic growth.
- The pessimism has been driven primarily by exploration geologists (Campbell, Simmons, et al) who believe that most conventional crude oil deposits have been discovered.
- In contrast, most economists (Lynch, Adelman, et al) see little or no long-term supply constraints.
- The resource base of unconventional oils – oil sands, oil shale, very heavy oils, etc. is enormous on the order of 5 to 10 times conventional oil deposits.
- The issue is the cost differential, which is largely unknown and has been greatly exaggerated by present price levels.
- A better way to understand the long-term price of oil is to look at the cost of alternative end-use technologies.

Chart 10 - Global Oil Supplies, A Division of Opinion



“Peak oil” Enthusiasts See a Malthusian Future



Cost and Price

Professor Morris Adelman:

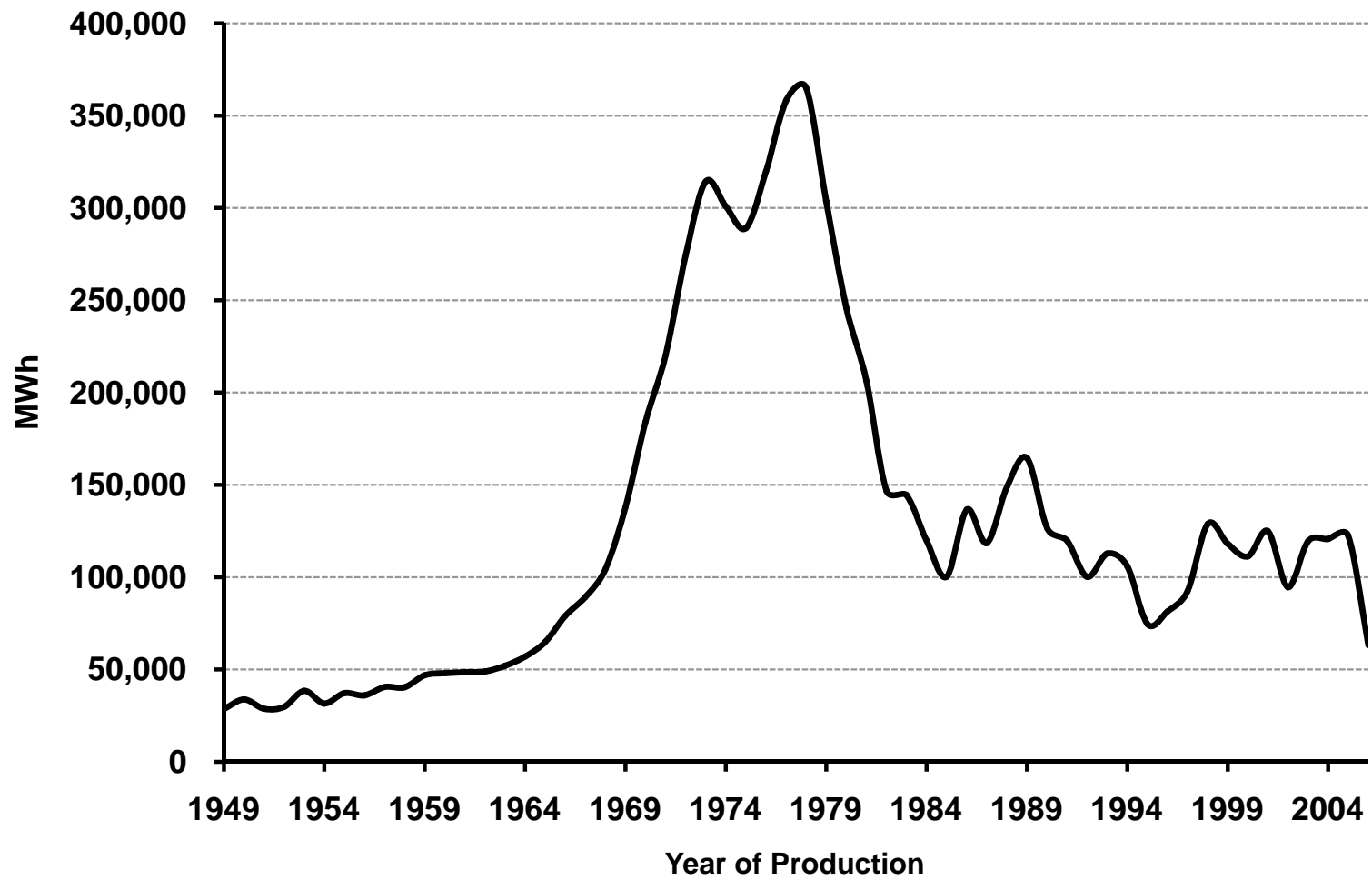
“No mineral, including oil, will ever be exhausted. If and when the cost of finding and extraction goes above the price consumers are willing to pay, the industry will begin to disappear. How much oil is still in the ground when extraction stops, and how much was there before extraction began, are unknown and unknowable. The amount extracted from first to last depends on cost and price.”

A strong inference:

If longer-term marginal costs of finding and developing oil supplies correspond to prices observed in the last year then global oil demand (and therefore production) will have peaked or will peak in the near future and decline.

But, what is long-run marginal cost? And, what are the costs of substitutes?

Figure 4 - Oil used in U.S. Power Generation



Hybrid Cars

- **Present designs replace the internal combustion machine with gasoline driven electric motors, but do not attempt to use battery-stored electricity.**
- **The cars get better gasoline mileage, but do not have fuel switching capability.**
- **Nonetheless, their successful introduction is a significant steppingstone to technologies that will replace gasoline.**
- **US Hybrid Sales have increased from 10,000 in 2000 to 355,000 in 2007.**

Plug In Hybrid Electric Vehicles (PHEVs)

- PHEV's have gasoline electric generators that charge on-board high-tech lithium-ion (Li-ion) batteries. Or, motorists can charge the battery using a standard household electric plug. The household charge will allow driving on the battery before the generator takes over. (70% of all car trips in the U.S. are less than 40 miles.)
- The following cars plan to use the PHEV technology:
 - Toyota Prius will add 7 miles by battery
 - GM's concept car, the Volt due in 2010, will allow 40 miles by battery
 - Ford Escape
 - Saturn Vue
 - Subaru G4e
- The National Resources Defense Council and other environmental groups have challenged the advantages of PHEVs, because they may depend on electricity generated with coal. This is not, however, a marginal analysis - natural gas is usually the marginal fuel.
- GM has made data on the Volt's intended performance available and is used in the following calculations.

Table 2 - Resource Marginal Cost
Electric Batteries Compared to Transport Fuel from Oil Sands
 (Assumes \$60 crude oil, \$8 per million Btu natural gas)

	<u>Gas Generator</u>	<u>With distribution</u>
Fixed Costs	\$0.022	\$0.022
Fuel Costs	\$0.056	\$0.056
Trans. & Dist.		\$0.021
Total	\$0.078	\$0.099
kWh per 40 miles	8	8
Cost	\$0.624	\$0.792
	<u>Diesel*</u>	<u>Gasoline*</u>
Threshold/bbl	\$60.00	\$60.00
Conversion		\$12.00
Distribution		\$6.30
Total	\$60.00	\$78.30
Per gallon	\$1.43	\$1.86
At 30 mpg	\$1.91	\$2.49
Battery Running Cost %	32.8%	31.9%

*Excludes taxes

Li-ion battery technology

- **Critical to the success of PHEVs are efforts to make Li-ion batteries safe, lightweight, powerful, and cost-effective.**
- **GM is co-developing (with spin-offs from MIT) the nanophosphate battery, based on batteries used for rechargeable power tools. This battery is expected to double present storage relative to weight.**
- **In December Stanford announced its researches had developed a Li-ion battery based on silicon lithium nanowires that improves existing laptop batteries by a factor of 10 to 1 in performance versus weight. It is estimated to take 5 years to market. Researchers believe it could easily be sized up for cars.**

Pellet stoves - inconvenient but cheap

- **Pellet stoves burn small manufactured pellets and are automated to maintain flow into the burner and regulate temperature. Pellets can be made from wood, sawdust, nut shells, and similar waste bio-materials. Modern stoves have catalytic converters to minimize pollutants.**
- **Heating costs for a building 2,000 to 3,000 square feet:**
 - **Stove \$1,700 to \$3000**
 - **Monthly electricity \$9**
 - **Fuel \$240 to \$400 per year**
- **Costs are approximately 5 to 7 times cheaper than heating oil.**
- **Stoves require loading of pellets (about 40 pounds) every day or two and weekly cleaning.**

Conclusion

- For the next month oil prices are likely to continue to weaken.
- For 4Q08 and 2009, oil prices could rise if the global economy avoids a recession. However, I do not think this very likely.
- Heavy fuel oil prices and natural gas prices will move closer to thermal parity, mainly because oil prices will likely decline.
- For the long-term oil prices are unlikely to strike an equilibrium path above \$60 per barrel (2008 \$). This is because there are too many end-use alternatives that will be provoked by higher prices.