

## **National Commission on Energy Policy**

### **A Proposal to Design and Construct a National Index of Leading Oil Dependence Indicators (LODI)**

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### **Oil Dependence in Context**

Concerns about America's substantial and growing dependence on imported petroleum and refined products, and on the rising cost of both, have reignited the energy policy debate, within less than a year since enactment of the "comprehensive" Energy Policy Act of 2005. These concerns can be categorized broadly as: macro economic and consumer welfare consequences of high oil prices at home and geo political and foreign policy consequences abroad. The economic consequences of exposure to the world oil market include the risk of supply disruptions, persistently high prices, international capital and investment flows and structural U.S. deficits. The foreign and security policy dimensions of the oil problem include constraints on U.S. policy, the flow of petrodollars to governments, organizations and individuals with political aims inimical to those of the U.S., and military burdens associated with the protection of U.S. interests. More recently added to the policy agenda, are the environmental consequences of oil use, with particular regard to its contribution to climate change.

Given the confluence of these factors, calls are frequently heard to seek to eliminate U.S. dependence on other countries for oil imports – the battle cry of "energy independence". The point of departure for this paper is that such a policy, previously pursued under the Nixon, Ford and, to a lesser degree, the Carter Administration, is both impractical and undesirable. It is impractical for the foreseeable future because it would require a 60% reduction in oil use, given the limited scope displacing imports with added domestic oil production or currently available oil substitutes. If drilling were allowed in Alaska's Arctic National Wildlife Refuge, for example, at its peak production would displace well under 10% of oil imports. A large reduction in U.S. oil use would require raising the domestic price of oil by a factor of five or ten or more (for example, gasoline prices would rise to \$6–\$20 per gallon). Even in the unlikely case that motorists and other energy users were willing to accept such a drastic price increase, this cost likely exceeds any conceivable benefit to the nation, indicating that energy independence is a target not worth seeking.

More importantly, meeting domestic oil requirements solely with domestic supply would have only marginal effects on about the global market for oil. For example, unless the U.S. were energy independent *and* economically isolated from the rest of the world, supply disruptions to

the global market would continue to affect the United States through higher fuel prices, regardless of oil import levels.. The world price cannot be replaced by a U.S. price of oil. Meanwhile, isolating U.S. markets could make oil prices *more* volatile as any domestic supply constraints, disruptions, disasters or economic cycles, would have to be absorbed entirely within a comparatively much smaller (domestic) oil market. On the foreign policy side, U.S. oil “independence” would be unlikely to change the strategic equation with regard to oil-exporting countries or regions, or to the flow of petrodollars from sales to all other oil importing countries. Rather, oil independence policies would be contrary to the need for U.S. access to other energy supplies, such as LNG, that will require a broader engagement in, rather than withdrawal from international energy markets.

If energy independence is not a viable policy, what is it? The purpose of this document is propose the design and construction of a national index of leading oil dependence indicators, or LODI, that, in defining the ability to measure progress on oil policy, would concurrently provide indicators of what the component elements of a successful oil policy might be. The leading indicators, or metrics, are briefly summarized below.

### **Economic Indicators**

The principal economic concern has been the vulnerability of the macroeconomy – a decrease in economic activity or increase in inflation – to supply disruptions or to the price effects of supply/demand imbalances in the world oil market. These conditions might be caused by economic forces (e.g., growth in oil use in China and India), natural disasters (e.g., hurricanes disabling production and refinery capacity), or political factors (e.g., market manipulation by members of OPEC or other key suppliers). The more than doubling of world oil prices over the past three years, due to growth in global oil demand far outstripping expansion of production capacity, has heightened worries about the economic and political consequences of reliance on a production-constrained world oil market. Added to this concern is the contribution of oil import payments to the US current account deficit, which is viewed as unsustainable and possibly compounding the risk of a unmanaged dollar depreciation and related financial crises.

#### *Macroeconomic Vulnerability to Oil Market Disruptions and Oil Intensity*

Recent estimates suggest that a reduction in the world supply of oil and products relative to demand of 1 million barrels per day (or 1.2%), would increase the short term oil price by around \$3-\$10 per barrel; a disruption of twice this magnitude might roughly double the price effect. In turn, a \$10 price increase would immediately transfer about \$40 billion per year (about 0.4% of GDP) in purchasing power from US consumers to foreign oil suppliers (oil imports are around 4 billion barrels per year). Recent estimates from macro-simulation models suggest that each \$10 per barrel increase in the price of oil reduces US GDP by around 0.3 to 0.6%; this is somewhat lower than suggested by some older studies, due to the declining oil intensity of the economy over time.

This suggests that oil intensity of GDP (i.e. barrels per dollar of real GDP) would be a useful metric for summarizing the economy’s vulnerability to oil price shocks. Oil use per capita could be a supplemental indicator at the level of individual market participants. As oil intensity

declines (as it has by 50% since the 1970s) expectations are for a lesser economic impact from a given increase in the oil price. However, oil intensity measures have a number of limitations. First, the share of oil that is imported also matters as this determines the net income transfer to foreign suppliers and hence may contribute significantly to deflation of aggregate domestic demand and impacts on the trade balance. Second, the economy is more vulnerable when it is in recession as opposed to a boom, and when there are constraints on the ability of monetary and fiscal authorities to counteract economic disruptions. Third, even a dramatic decline in oil intensity need not spare the country significant economic pain. To wit: as oil intensity, measured in *physical volume* relative to GDP, declined, oil *expenditures in real dollars* became a larger share of GDP.

### *Short and Long Term Demand and Supply Elasticities*

Another dimension of vulnerability to oil price run-ups or shocks is the extent to which firms and consumers have options for substituting into less oil-intensive products; substitution possibilities are in part reflected in the own price elasticity of demand for oil products (that is, the percent reduction in demand in response to a 1% increase in price).

Recent literature reviews suggest a long run gasoline demand elasticity of around  $-0.4$  to  $-0.7$ . Roughly 30-50% of this elasticity is attributed to reduced vehicle use, while the remainder reflects improvements in fuel economy of the vehicle fleet; thus, in the short term the gasoline demand elasticity is estimated at around  $-0.2$  to  $-0.3$ . Since crude oil prices are currently around 40% of retail fuel prices, these estimates suggest a 1% increase in oil prices (or a 0.4% increase in gasoline prices) would reduce gasoline use by 0.08 to 0.12% in the short term and 0.15 to 0.30% over the longer term.

But gasoline accounts for less than half of total oil use in the United States (other uses include diesel fuel for trucks, rail and ships, aviation fuel, home heating oil, petrochemicals). There is a more limited literature on the elasticity of demand for total oil use; studies for various OECD countries suggest a short run elasticity of around  $-0.05$  and a long run elasticity of around  $-0.30$  to  $-0.70$ , though there is considerable variation across different estimates. Moreover, these studies imply that non-gasoline oil products are more price-responsive than gasoline; it is not immediately obvious why this should be the case.

Nonetheless, this evidence underscores the fact that there are currently only limited options for responding to oil price run-ups or shocks; substitution possibilities could be enhanced over the longer term by developing economically viable alternatives to current technologies, such as alternative fuel vehicles. It also indicates why achieving energy independence would be difficult; under the common assumption that the demand elasticity is the same at different price levels, then reducing oil demand by 60% would require an increase in the domestic price of oil of 4 to 20 times the current price!

### *Merger & Acquisition Policy Implications*

Worldwide refining capacity expansion has not kept pace with growth in demand for distillates, and a significant imbalance appears to exist between available types of crude oil and capacity to refine especially heavy sulphur crudes. Distillation limitations can influence crude as well as refined product prices. Changing or new environmental specifications for gasolines, which are driven by U.S. regulation, also play a role. The shortage of global refining capacity has developed for three reasons (Verleger): (1) because the largest oil companies declined to expand capacity in the last decade because of low returns on investment, (2) because China did not build sufficient refining capacity to satisfy growth in its demand, and (3) because competition regulators in Europe and the United States forced divestiture of refining assets as part of M&A approval. The Federal Trade Commission, believing that conditioning mergers on divestiture of refining capacity would increase competition, presided over the transfer of refineries from the major to small independent refiners who proved unable to raise capital needed for expansion. The full extent of distillation capacity pressures on the price of crude oil(s) and products is not fully understood and deserves further study. Refining capability and compatibility with oil quality would constitute one of the indicators in the LODI.

### *Balance of Trade and Financial Consequences of Oil Imports*

The trend of large and growing oil imports concurrent with a persistently high and growing current account deficit is reflected in frequently voiced concern assuming a causal relation between the two. Thus, the trade balances and accumulating holdings of US financial assets by oil exporters have been cited as threatening US economic interests, quite apart from other dangers posed by oil-import dependence.

In follow-on research, it would be useful to subject that presumption to quantitative rigor. No doubt problems associated with China's huge trade surplus with the United States, impinging on currency markets and our labor market, deserve attention. Does oil warrant being singled out for comparable unease? The proceeds of imported oil sales are used in a variety of ways -- investment in US Treasury bills, fixed industrial investments in the United States, and exports. It is precisely the quantification of these and related questions that would help put the trade balance issue on a firmer footing. A component indicator of the LODI could be constructed to measure increment or decrement of oil import cost contribution to the balance of trade.

### **Foreign Policy Dimensions of Oil Dependence**

Dependence on oil has important geo political and foreign policy implications. Crude oil availability and price are elements of U.S. relations with a significant range of oil consuming and oil producing nations. On the supply side with members of OPEC, Russia and other oil producers in the former Soviet Union, in Latin America with regard to Venezuela and in North America with regard to Mexico and Canada. On the demand side, U.S. diplomacy must take account of relations among the members of the International Energy Agency, and with nations experiencing rapid growth in demand, namely China and India. National security itself is at risk to the extent that oil revenues enable regimes such as Iran or Libya to finance nuclear weapons development; such as Sudan to finance repression of minorities; such as Saudi Arabia to indirectly support terrorist groups. Furthermore, the protection of the Persian Gulf, through which transit most of

the region's oil exports, is part of the burden carried by the US military in a region whose political instability has historically engaged the U.S. defense establishment.

### *Constraints on Policy*

Dependence on oil affects US foreign and defense policy to the extent that nations that supply it disagree with various aspects of U.S. foreign policy, and may retaliate by harming US economic interests through manipulation or disruption of the oil market. U.S. diplomacy has been historically problematic with regard to the monarchies of the Middle East, many of whom are members of OPEC, that govern on a poor record of human rights. More recently, U.S. foreign and trade policy has been complicated by the resurgence of Russia's participation in the oil market through State-controlled entities whose interests cannot be said to be entirely commercial. Similarly, Caspian Sea oil producers represent difficult choices for U.S. policy as to trade-offs among multiple policy objectives: diversification of oil supplies, military co-operation, promotion of democratic practices, openness to private investment in hydrocarbon development. While it may be difficult to quantify the value of these State-to-State relations on foreign policy, they remain part of the global oil equation.

### *Petrodollars and Terrorism*

Foreign policy concerns evolve to security considerations with the possibility, indeed the probability that payments for oil imports finance terrorist activity. Buoyant oil revenues may have emboldened Iran in its determination to develop its nuclear program, in addition to financing terrorist activity throughout its sphere of influence. Iran's potential nuclear capability would have repercussions not only for the balance of power in the region, but also for the possibility of providing terrorist groups with access to fissionable material.

Progress toward reducing this concern might be measured as a reduction in revenue flows to risky oil exporters (presumably influencing both the risk and magnitude of an attack). Importantly, it is not tied to U.S. oil imports alone, or to U.S. energy independence. Rather, it is tied to the prevailing world price and how much they are selling (not how much they are selling to the United States alone). If desired, some of the costs themselves might be crudely quantified by combining economic valuation techniques with expert opinion on the likelihood of adverse scenarios.

### *Military Burden of Protecting Oil Supplies*

Assessing the extent to which oil dependence imposes a burden on the Defense establishment can be quantified by examining the different ways strategic oil interests pervade military operations and spending. However, the value of this exercise is often challenged on the premise that reduced reliance on oil, per se would not materially change military responsibilities in areas such as the Persian Gulf. Clearly, energy plays a role in military planning, as evidenced most recently by a study commissioned by the Southern Command to assess the impact of South American energy re-nationalization trends on U.S. security.

One can allocate part of the Defense budget in normal peacetime years to Middle East operations. One can add to this annual cost the expected cost, on an annualized basis, of conventional wars fought in the Middle East, including human and medical costs. A recent study put this cost at \$15 to \$50 billion. [Such estimate, however, tend to be speculative because it is impossible to assign a specific level of military spending in the Middle East to the specific protection of oil supplies. U.S. interests in the Middle East are broader than ensuring the free flow of oil, of course, and include promoting peace between Israel and the Palestinians, stability, and political freedom in Egypt, Iraq and Lebanon, containing the ambitions of Syria and Iran, and mitigating spread of terrorism.

### *Strategic Stockpiles and Alternative Supply Disruption Mitigation Tools*

The 1973 Arab oil embargo illustrated the economic risk of an oil supply disruption and demonstrated the need for oil importers to develop policy tools to mitigate the impacts of future supply shocks. The major developed countries responded to the embargo by agreeing to a treaty that established, in practice, government and private stockpiles equivalent to at least 90 days of net oil imports. The U.S. Strategic Petroleum Reserve (SPR) is the world's largest government stockpile and it single-handedly covered the U.S. import obligation through much of the 1980s. At its current size of about 690 million barrels, the SPR is equal to a little less than 60 days of imports. World strategic currently amount to about 1.4 billion barrels and are likely to grow, including in China and India.

The theoretical effectiveness of the SPR or an alternative reserve mechanism in the event of a disruption depends on the magnitude of oil injected into the market and on the drawdown rate. The Department of Energy estimates that the SPR can deliver 4.4 million barrels per day, or about one third of U.S. daily imports of crude oil and petroleum products, exclusive of available security stocks in other IEA member countries.

The effectiveness of the SPR is difficult to fully evaluate. With the exception of a few test sales and non-emergency sales and swaps, the SPR has only been used under two emergency declarations by the President: the January 1991 Desert Storm drawdown of 17 million barrels and the 2005 post-Katrina drawdown of 11 million barrels. The lessons learned from these cases do not provide sufficient insight as to the benefits of an emergency drawdown responding to a large and prolonged supply disruption, although historically such disruptions have been of relatively short duration.

The SPR policies of IEA member States, coupled with extended oil market backwardation may have induced unintended behavior on the part of private stock holders. Verleger estimates that usable commercial stocks in OECD countries (most of which are IEA members) were at 19 days of supply in 1987 and at about 8 days of supply in 2004.

A variety of measures or metrics, such as reserve size, composition, drawdown rates, world supply disruptions and price shocks, and inter-country coordination, are relevant for measuring the effectiveness of strategic stockpiles. It is equally important to examine how strategic stockpiles interact with private holdings and how the existence of such stockpiles is *tied*

to both foreign policy constraints and the likelihood of supply disruptions (e.g., by influencing domestic or foreign behavior).

### *Market Power and the Rise of Parastatals*

From its inception, the oil industry has seldom been viewed as entirely competitive; whether due to the distorting influence of government intervention or the industry's penchant for consolidation, coordination of production, or market-influencing collusion. The classical interplay of freely determined demand and supply in transparent international and domestic markets does not faithfully capture the essence of the oil business. Furthermore, the present day oil supply industry is dominated by government control of resources and production capacity, exercised either directly, or through para-Statal organizations that are principally accountable to governments rather than to private shareholders. Coordinated market intervention is assumed for OPEC members, but non-OPEC suppliers, including Mexico and Norway are known to implicitly coordinate their activities with those of OPEC. Of the ten oil producers with the largest proven reserves, only one (Canada) has an oil industry that is not government-run. The concern therefore arises as to whether political control of both oil resources and production capacity and related exercise of market power are growing and, if so, whether such a trend compounds the problem of oil dependence.

There is agreement among analysts that escalating oil demand in China, India, and elsewhere, production limitations within and outside of OPEC and highly constrained distillation capability are the key contributing factors to the prevailing high world oil price. It appears unnecessary to look for collusion to explain present market conditions, except for the tendency of government-controlled entities to under-invest in production and distillation capacity. A more elusive issue concerns the robustness of the "peak oil" argument—expressed by at least some knowledgeable observers—that high real oil prices and supplier dominance would be the most likely shape of things to come. While follow-on inquiry might clarify the claims and counter-claims surrounding the oil-depletion debate, it is unlikely that analysis will provide convincing resolution of the question, even if it were relevant to projected near term conditions in the marketplace.

Concern over government-directed collusion to raise oil prices is an anti-trust and free trade issue for which there are at present limited institutional remedies. The emergence of national oil companies has been a steady trend over much of the past 50 years: Aramco, PDVSA, the Iranian National Oil Co., Lukoil, and so on. Is there a "tipping point" where that phenomenon acquires a steady, irreversible momentum that radically shifts supply and demand decisions away from market forces? What of its consequences—China's CNOC freezing out the Western multinationals in, say, Sudan with the possibility of a political quid-pro-quo subsumed in what superficially appear to be purely concessionary terms? Such a possibility suggests closer scrutiny than did NIOC's abortive pursuit of UNOCAL. Similarly, what are the implications of Russian oil giant Rosneft raising capital in the West to finance expansion of capacity that is controlled by its government? An indicator could be constructed to measure degree and intensity of government intervention in the oil sector; degree of State control of production capacity decisions; evidence of collusion to restrain supply to markets; indices of privatization of the oil sector; indices of private capital investment in the oil sector.

## **Environmental Security**

While traditional concerns about oil use have centered on its economic and foreign policy dimensions, growing concerns about climate change have complicated oil policy considerations. Local environmental effects of oil use are less of a concern today than in the past due to tight regulations that spurred technological improvements such as double hulls to reduce the risk of oil spills from tankers, more secure storage tanks at refineries, and improvements in passenger vehicle technologies that dramatically reduced tailpipe emission rates.

However, because carbon dioxide emissions are proportional to the amount of fuel combustion, what matters for the atmospheric accumulation of heat-trapping gases is the total (absolute) amount of oil consumption. Scientists typically focus on safe concentration levels and the need to limit accumulated emissions to those levels. This implies a need to essentially eliminate oil use in the next century. To do so will require mitigation measures that carry a price. Economists, seeking to both quantify marginal benefits as well as consider a likely near-term price based on long-term concentration targets, have come up with controversial and speculative prices of \$5 to \$50 per ton of current emissions of carbon, or about \$0.5 to \$6 per barrel of oil.

### **Strawman LODI: Component Elements of an Index**

1. Oil consumption per unit of GDP
2. Oil consumption per capita
3. Oil Supply geographic diversification
4. Excess production capacity
  - Wholesale market power index
5. Distillation capacity and surge capacity
  - Retail market power index
6. Strategic Stocks
  - Volume and drawdown capability
  - Institutional arrangements for coordinated use
7. Oil imports contribution to balance of trade
8. Government control of oil sector
  - Nationalization index
  - Privatization index
  - Market collusion index
  - Private investment index
9. Fuel substitution index
10. Environmental index
  - GHG emissions per unit of GDP
  - GHG per capita
11. Military posture