Trends of the Net Energy of Petroleum Products in Different Countries Using Energy Intensity Ratios

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A chief metric for the value of an energy resources and systems which it is consumed in is the energy return on energy invested (EROI), a measure of net energy (Hall et al., 1988). EROI is calculated as the energy content of the produced (or captured at some site in the supply chain) energy resource divided by the sum of energy inputs required to extract the resource. In addition, prices of energy carriers and total energy expenditures act as system-wide economic indicators describing the role of energy in the broader economy. From a standpoint of all other characteristics of two energy systems, technologies, or resources being equal, the one with higher EROI will have a greater benefit to society. In addition, the complexity of human societies are limited by the net energy of their energy resources (Tainter, 1988).

EIRp, energy intensity ratio

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EIRp = \frac{1}{\text{fuel price}} \times \left( \frac{\text{Energy}/\text{GDP}}{\text{fuel price}} \right)
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EIRp, fuel X = (1/Fuel price) x (Energy/GDP) of economy

The EIR is a tool to view the energy system within a country in terms of its effective net energy. EIRp can be interpreted as “the energy intensity of a fuel or energy resource divided by the aggregate economic energy intensity of a country.”

Discussion: EIRp of Diesel

Overview

• EIRp and price have an inverse relationship. As the price of energy (e.g., crude oil) rises, economies must become more efficient in the use of the energy to maintain the same EIRp or effective net energy of the economy.

• For all countries (save for India), the EIRp declines from the late 1990’s through 2008 as the price of oil increased. This indicates that the countries did not become more energy efficient (e.g., lower their energy intensity) as fast as energy prices rose.

Mexico and Indonesia (oil exporters)

• Mexico’s EIRpmax was 58 in 1980 which occurred during the lowest real daily average crude oil prices during the study period. Mexico’s EIRpmin is 2.4 (2008) which occurred during the highest real daily average crude oil price of the study period. Post-2004, when Mexico ceased to be an oil exporter, its EIRp falls in line with India and Thailand, both of which are oil importers.

• Mexico’s EIRp was 58 in 1980 - the highest of all countries studied before a steady decline afterward. Mexico’s EIRp is 8.8 in 2001, making Mexico’s EIRp/EIRpmax = 6.6. Mexico’s lowest EIRp is higher than the maximum EIRp for the U.K., Thailand, Canada, India, and China. One possibility for Mexico’s disparity to other subsidizing countries may be that Mexico remains an oil exporter enabling it to tax gasoline lightly.

TAXING NATIONS

• Post-2000, the EIRp’s of the members of the European Union, which makes up most of the highly taxed category, converge together as a single currency is introduced. The United Kingdom, which historically had a lower EIRp than the rest of Europe began to track other European countries post-2000 even though the U.K. did not join the currency union.

• Though Turkey and Japan are not in the EU, their EIRp-curves follow the same pattern as the other highly taxed countries. Taxes may lead to a decrease in the energy intensity of the countries by artificially raising the price of the energy.

REFERENCES


