Energy Markets as an Integrated Global System

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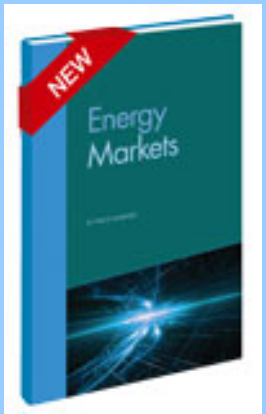
Modern Energy Markets

Energy Markets

By Vince Kaminski



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This book written by industry leader Vincent Kaminski provides an exhaustive description of the energy markets, covering both the fundamentals of the production, transportation, storage and distribution processes, as well as market design and linkages between different markets.

Energy Markets enables you to learn everything you need to about the realities of working within these markets and describes the most important types of transactions and instruments used, in an accessible, straightforward manner.

Key chapters focus on:

- Energy Trading and Marketing
- Energy Markets: The Plumbing
- Oil
- Green Markets
- Energy Markets: The Instruments
- Natural Gas
- Electricity and Coal

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Integration of Energy Markets

- **Energy markets evolved over the last 20 years into an integrated, global system**
- **Transmission of shocks between different parts of the system along constantly evolving channels**
  - **No market is an island**
  - **Proverbial "rain in Spain" (or lack of it) provides a jolt to the natural gas markets across the globe**
  - **A trader or a risk analyst has to understand the entire energy complex and links connecting different parts across time and space and different specific energy commodities**
  - **Technical progress and the speed of propagation and adoption of new technologies can reverse very quickly production and consumption trends**

Integration of Energy Markets (2)

- **The markets for different physical commodities form what can be called a tightly coupled system**
  - **Complicated and evolving feedback loops between different components of the system**
  - **Non-stationarity. The statistical properties of the system evolve over time.**
  - **Multiplicity of interacting agents**
  - **Adaptation. The market participants learn and adjust their behavior in order to survive and prosper in a changing world.**
  - **Evolution. The system evolves and remains far removed from a stable equilibrium at any point in time.**
  - **Openness. The boundary between a given system and its environment is fuzzy at best. One has to understand many external influences to explain the behavior of the system. A clever trading manager will actively seek to gather a diverse team representing many backgrounds and cultures.**

Source: Neil F. Johnson, Paul Jefferies, Pak Ming Hui, "Financial Market Complexity. What Physics Can Tell Us about Market Behaviour," Oxford University Press, 2003.

The Emerging BTU Market

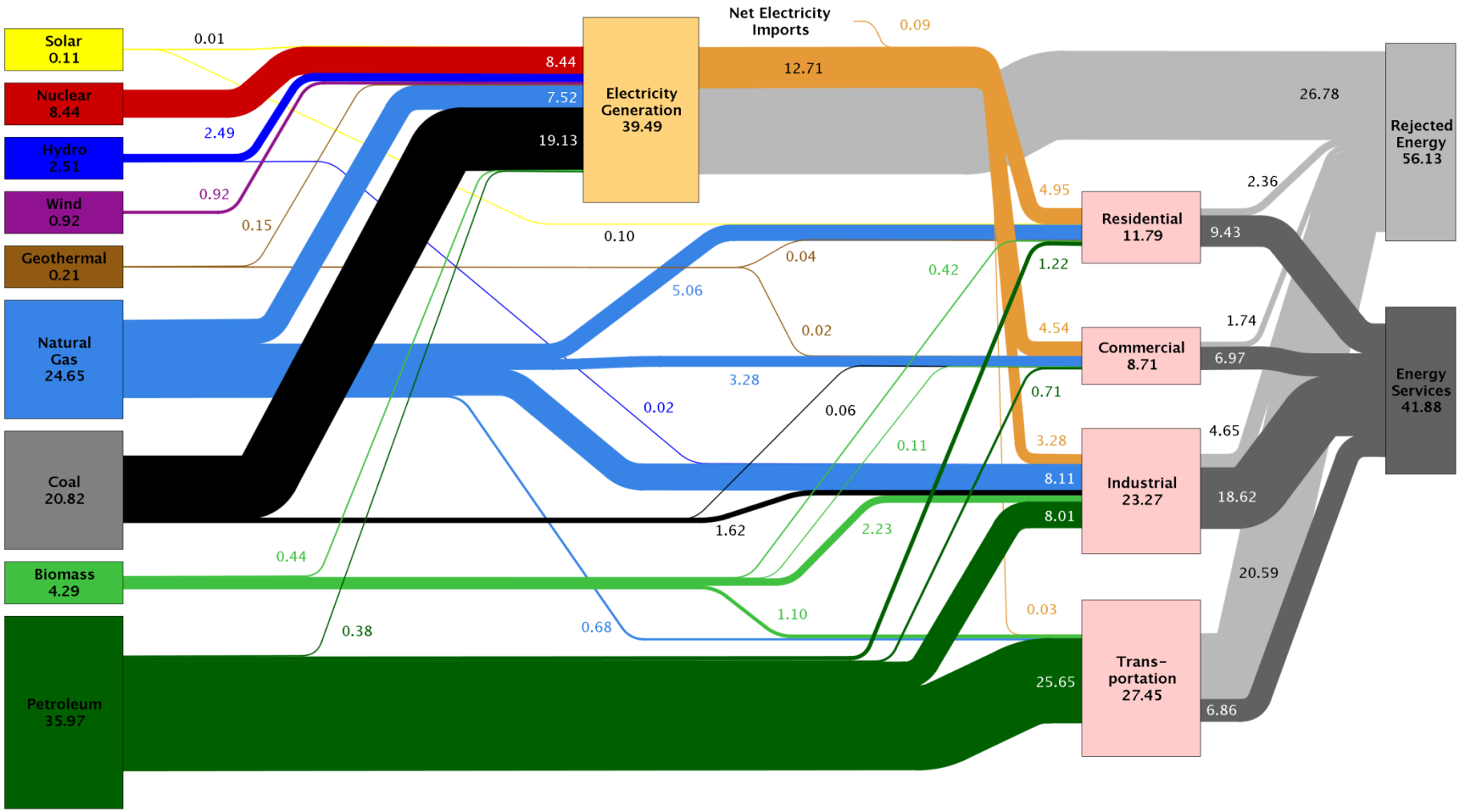
- **Trading in the emerging global energy market will require a unique combination of skills**
  - **Understanding of the physical layer of the industry (the technology and infrastructure behind production, distribution and storage of energy commodities)**
  - **Financial engineering skills**
  - **Understanding of the institutional and geopolitical framework of the energy markets**
- **Skills related to energy finance, trading and risk management are often learned on the job**
- **The business schools in most cases don't understand the complexity of the skills required in this area and don't offer comprehensive energy related programs (with a few notable exceptions)**

Linkages

- Links between different parts of the energy complex arise from:
  - Volumetric flows
    - Different energy commodities are either substitutes or complements
  - Competition for scarce resources, including human and financial capital
  - Economic policies and regulation
  - Geopolitical developments
- An example: ethane

Estimated U.S. Energy Use in 2010: ~98.0 Quads

Lawrence Livermore National Laboratory



Source: LLNL 2011. Data is based on DOE/EIA-0384(2010), October 2011. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for hydro, wind, solar and geothermal in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." (see EIA report for explanation of change to geothermal in 2010). The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 80% for the residential, commercial and industrial sectors, and as 25% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

THE IMPORTANCE OF ENERGY MARKETS

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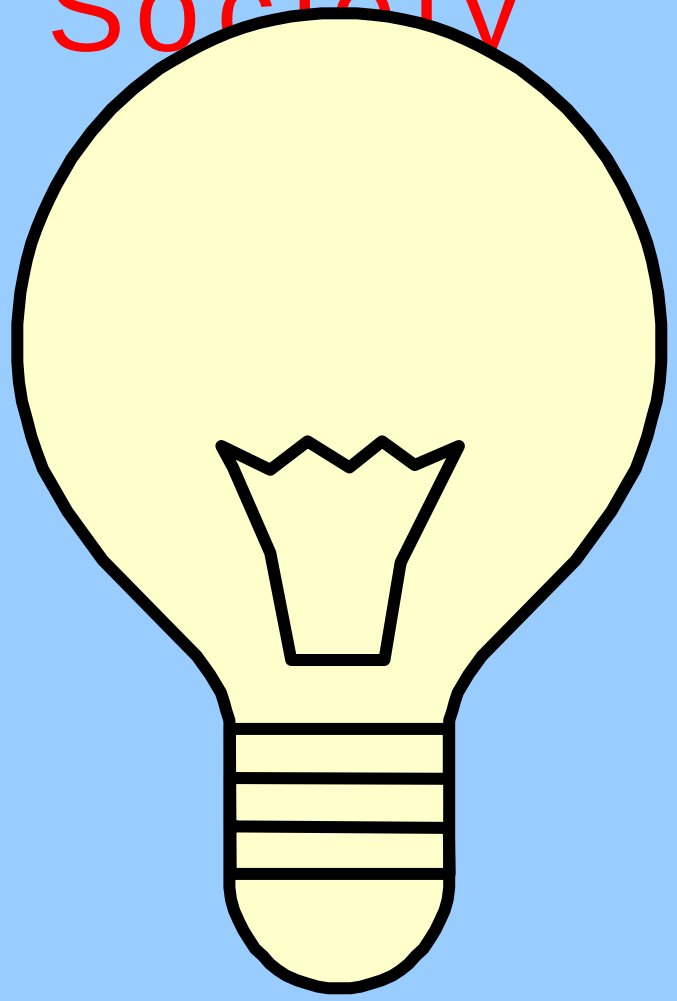
Energy Consumption in a Post-Industrial Society

100 W



11,000 W

Energy Consumption in a Post-Industrial Society (2)

- **Energy input required to sustain an average person as a biological organism: 100 W**
- **Energy input required by a member of a post-industrial society living in North America : 11,000 W**
- **About 4/5 of humanity clusters closer to the left hand side of the energy consumption spectrum but is determined to catch up**
- **At the same time, we are experiencing growing difficulties of increasing supplies of non-conventional energy commodities**

The Importance of Energy

- **The importance of energy:**
  - **An average American uses ~25 bbls of oil per year**
  - **An average barrel of oil has 5.8 MMBTUs**
  - **An average man working for an hour generates 240 BTUs**
  - **1 bbl of oil is an equivalent of 25,000 hours of labor (12.5 years @ 40 hours / week)**
  - **Each American has 300+ “energy slaves” (700+ if natural gas and coal is counted)**
- **Our standard of living depends on continuous access to energy supplies**

Source: www.theoildrum.com

EROI

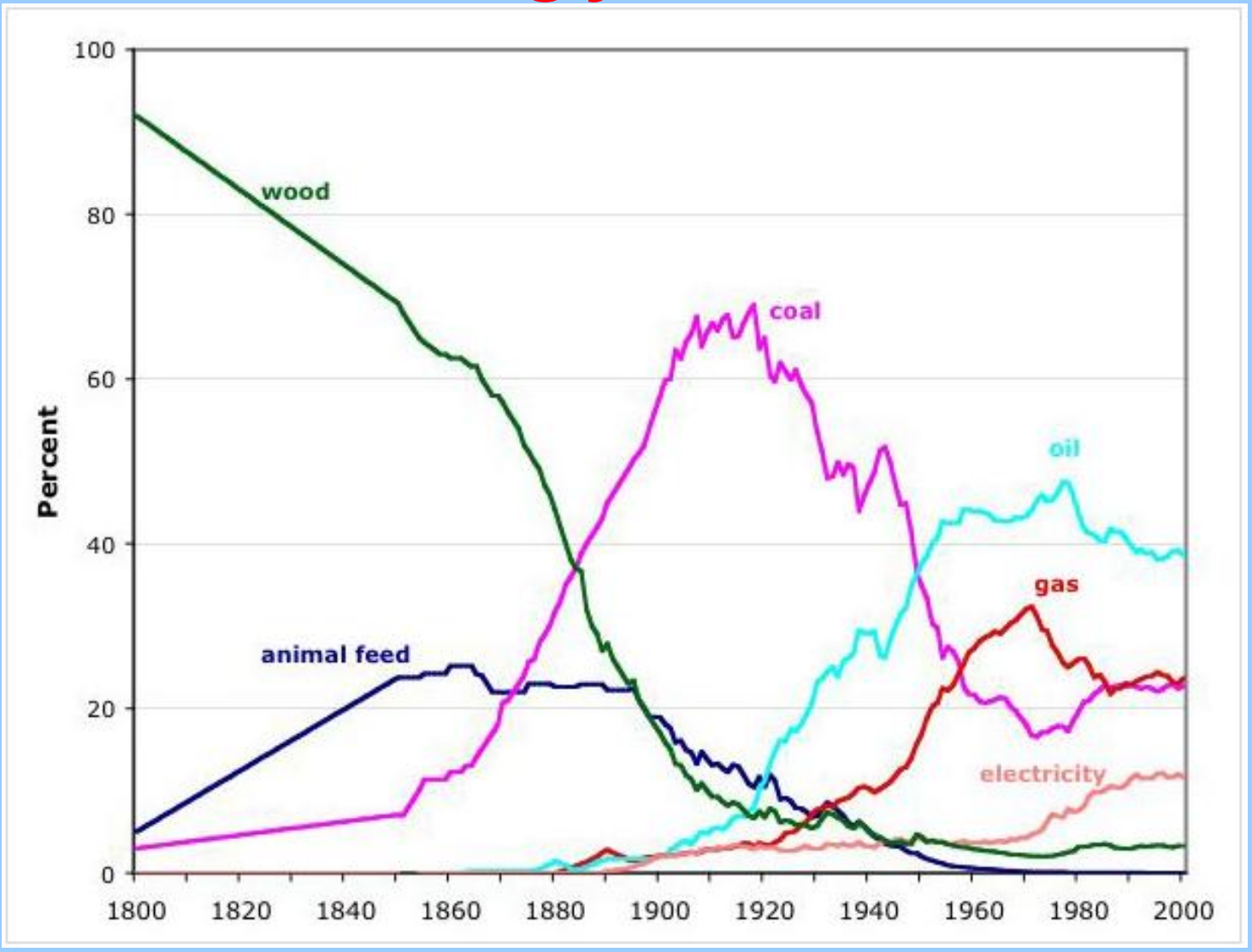
- **EROI – Energy Return on Investment**

- **Energy Returned to Society / Energy Required to Get Energy**
- **A very elusive concept but the trends are unmistakable**
- **Alberta tar sands EROI**

Author	Date	Technique	Resource	System Boundary	EROI
Kymlicka, W.	2006	-	Alberta	-	<5:1
DOE	2006	surface;in situ	Alberta	-	7.2:1; 5:1
Günther, F.	2008	-	Alberta	Shallow sands	1.5:1
Heinberg, R.	2003	-	-	-	1.5:1
Swenson, R.	2005	-	-	-	3:01
Homer-Dixon, T.	2005	-	Alberta	-	4:01
Sereno, M.	2007	-	-	-	1-3:1
Legislative Peak Oil and Natural Gas Caucus	2007	-	Alberta	-	3:01

Source: http://www.theoildrum.com/node/3839

US Energy Sources



Cutler J. Cleveland, Energy Transitions Past and Future, Encyclopedia of Earth, www.eoearth.org

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