Outline

- Why high oil prices are a problem
- What limits to growth look like
- Implications for EROI analysts
High Oil Prices are a Problem: A huge amount of oil looks to be available

- We extract the cheapest first

- The cutoff on supply seems to be a price / EROI limit
  - How much can the consumer afford?
Energy use allows us to transform raw materials into finished products

- Extracting raw materials requires energy
- Transport requires energy
- Even services require energy
Increased energy use is associated with increasing prosperity

Source: Based on 2012 BP Statistical Review of World Energy and USDA Economic Research Data
High cost leads to lower energy consumption – Not affordable!

Source: Wages from BEA Table 2.1. Fossil Fuel costs from EIA Annual Energy Review Tables 3.2 and 2.9. Total energy consumption (includes renewables) from EIA Annual Energy Review Table 1.3; Population from EIA Int. Energy Statistics.
High oil prices + globalization = Problem for historic big users

Source: Based on 2012 BP Statistical Review of World Energy data
Growth seems to go to those countries that use the least oil in their mix.

Note: Ratio of total energy consumed to oil (including biofuels) consumed, based on BP’s 2012 Statistical Review of World Energy.
Growth seems to go to those countries that use the least oil in their energy mix (cont.)

Note: 2009-2011 Average Real GDP % Growth, Based on USDA International Macroeconomic Data Sets. World GDP reflects 2005$ weighting.
Another issue: Food and oil prices tend to rise together

- Oil used in plowing, harvesting, transport, herbicides, pesticides, irrigation

Source: Oil is spot oil price from EIA; food index is from Food and Agriculture Organization of the United Nations.
A related issue: High oil prices lead to RECESSION for importers

- Economist James Hamilton showed that oil price spikes were connected with 10 out of 11 US recessions

Source: Based on BP 2012 Statistical Review of World Energy data
Part of our problem comes from a shift among energy types, as oil prices rise.

- Human: $$$$$$$
- Animal: $$$$$$
- Electricity: $$$
- Oil: $$$$$
- Coal: $\$

Sources differ in nature: electricity is an energy carrier; humans and animals use food to generate the energy they provide.
High oil prices lead to depressed wages

- As expected, if switch is away from *human wages*

Source: 2012 BP Statistical Review of World Energy, BEA Private Industry Wages, and CPI-Urban from BLS.
How high oil prices lead to depressed wages

- Businesses seek to mitigate falling profits

Source: Illustration by author.
A few reasons why rising oil prices are a problem

- Wages don’t rise, as oil price rises
  - Less money for discretionary expenditure
    - Cars
    - New homes
    - Charitable giving
  - Layoffs in the above sectors
- More debt defaults
  - Bank bailouts needed

- Governments especially at risk
  - Lower taxes; higher expenditures
Government gets caught in the middle

Credits: Texaspolicy.com, Thetaxhaven.com.au, Usahitman.com, politic365.com, autoevolution.com
Governments already having trouble collecting enough taxes

- Relates to lower wages, globalization lowering business taxes

Source: Based on US Bureau of Economic Analysis data.
Debt problems are another issue

- What is needed for a growth-based system?
  1. More and more materials, taken from natural world
  2. System of transforming these materials into goods and services people want / need
  3. Way for people to pay for the goods and services

- As prices go up, there is a need for more debt
  - Get less and less oil back for every dollar invested
  - “Investment sinkhole” effect
Financing Strategy

- Borrow a significant share of the original cost
  - To set up oil / gas production facilities
  - To build factories to produce cement and to build new cars
  - To cover government cost of new roads, schools, etc.

- Energy from fossil fuels should make it possible to
  - Raise salaries of common workers, so they can repay debt with interest
  - Raise profits of factories, so businesses can repay debt with interest
  - Raise taxes collected by governments, so government can repay debt with interest
Financing strategy doesn’t work if

- Wages are stagnating
- Economic growth is flat (or worse)

**Scenario 1: Underlying Financial System**

- 2010
- 2020
- 2030
- 2040

**Scenario 2: More Likely Actual Growth Pattern**

- 2010
- 2020
- 2030
- 2040
Government is trying to pump up debt, but can’t get it back to the wage-earner.
How do these issues relate to Limits to Growth?

Note: Base scenario from 1972 Limits to Growth, printed using today’s graphics by Charles Hall and John Day in “Revisiting Limits to Growth After Peak Oil” http://www.esf.edu/efb/hall/2009-05Hall0327.pdf
What does history of collapses say?

- Overshoot and collapse studied by many
  - “Secular Cycles” by Peter Turchin and Sergey Nefedov
- Population typically found a new resource
  - Cleared land for farming
  - Or began using irrigation
  - Current situation: Began using fossil fuels about 1800
- Problems developed over 200+ years
  - Combination of rising population, depleting resources, more pollution (salt from irrigation)
- Civilizations eventually disappeared
  - Replaced by others elsewhere
In collapse scenarios, problems appeared as **FINANCIAL PROBLEMS**

- Greater wage dispersion
- Greater use of debt
- Government had problems collecting enough taxes
  - Tainter calls problem “complexity,” but complexity has cost
- Revolts, epidemics, resource wars

- Quite different from what many think of as “peak oil”
General Shape of Collapse

Based on *Secular Cycles* by Peter Turchin and Sergey Nefedov.
Symptoms now are similar to prior to financial collapses

- Greater wage dispersion
  - Common workers had trouble paying for “basics”
- Greater use of debt
  - Borrow to get around limits
  - Can’t continue indefinitely
- Government had problems collecting enough taxes
  - Led to uprisings, government collapse
  - Inability to pay government workers
- Spiking food / energy costs
Implications for EROI Analysts

- We already seem to be close to financial collapse
  - “Space” for declining EROI is virtually zero
Implications for EROI Analysts (cont.)

- Human wages are extremely important for keeping the system going
  - Need to be local wages, not overseas wages

- Theoretically possible to get around lack of human wages with huge government component
  - Government is another component not included in EROI analyses
  - Related to the minimum EROI for society needed to function
Four distinct elements necessary for system to work

1. Energy measured in EROI
2. Adequate wages for humans
3. Availability of credit to fund new investment
   a. Problem as cash flow declines
   b. Worst issue on front-ended energy sources
   c. Users need debt as well: Electric cars
4. Funds to pay taxes, government fees
Most companies need over $100 barrel to be cash flow neutral after capex and dividends.

Exhibit 6: Most of the listed oil companies need over US$100/bbl to balance the budget

Oil price required by oil companies to be free cash flow neutral after capex and dividends (2013E)

Source: Goldman Sachs Research estimates.
Taxes on oil companies play a major role

Government Take by Jurisdiction – often 70% to 90%

Source: Barry Rodgers Oil and Gas Consulting http://www.bgrodgers.com/world-fiscal-map/
High taxes play a role in US too

- North American Tight Oil Cost Comparison
  - By Barry Rodgers, Oil & Gas Journal, May 2013
  - In $80 barrel US tight oil
    - CapEx: $22.60
    - OpEx: $ 7.50
    - Government take: $33.29
    - EROI would consider energy component of CapEx and OpEx
  - In Canada, Government take is only $19.50 per tight oil barrel
Oil companies are incredibly huge

Source: http://www.tni.org/article/planet-earth-corporate-world
Previous list left out National Oil Companies

- Companies larger than Conoco Philips by volume
  - Saudi Aramco – Saudi Arabia
  - Gazprom – Russia
  - National Iranian Oil Company
  - Pemex – Mexico
  - Kuwait Oil Company

- If these included, 12 out of 13 largest companies in world are oil companies
Oil and gas company revenues are a huge share of government revenues

- Saudi Arabia - 80% to 90%
- Kuwait – 80%
- Qatar – 70%
- Iran – 65%
- Algeria – 60%
- Venezuela – 50%
- Russia – Nearly 50%
- Iraq – 97%

How do solar panels / wind turbines fill this gap?
Collision is now taking place

- Governments need more taxes
- Consumers can’t afford high prices
- Companies need higher prices or more debt

- Plays out with less investment
- Example – Jahan Castberg project delayed in Norway
  - Government wants more taxes
  - Doesn’t fit with investment goals
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