## Life cycle and triple-bottom-line analysis: An ecological economics approach to assessing the impact of fracking

Md Rumi Shammin Associate Professor, Environmental Studies, Oberlin College

& Application of the EE framework to Fracking

# Organization

& Scale, distribution, efficiency

### & Sustainability – four principles

ø Limits

*σ* Triple bottom line

- ন্ব Social
- ন্ব Ecological
- ন্ব Economic
- ø Equity
  - ম Intergenerational
  - ম Intragenerational
- ø Interdependence, resilience

& Holistic, comprehensive

**Basic Elements of Ecological Economics Approach** 

### Neoclassical "factors of production"

k Capital (K)k Labor (L)k Land (N)

Economic production (output) = f (L, N, K)

### Gross Domestic Product (GDP)

#### • GDP = C + I + G + NX

- C = Consumption
- I = Investment
- G = Government spending
- NX = Net exports = Exports Imports

### Ecological economics: four capitals

- Built capital (BC)
- Human capital (HC)
- Social capital (SC)
- Natural capital (NC)

Human well-being = f (NC, SC, HC, BC)

### Genuine Progress Indicator (GPI)

### $\overline{\text{GPI}} = \overline{C_{\text{adj}}} + \overline{G} + W - D - S - \overline{E} - N$

- C<sub>adj</sub> = Personal consumption adjusted for income inequality
- G = Growth in capital stocks
- W = Non-monetary contributions to welfare
- D = Defensive private expenditures
- S = Depletion of social capital
- E = Costs of environmental degradation
- N = Depletion of natural capital

#### GROSS PRODUCTION VS. GENUINE PROGRESS, 1950-2004



# What is the scope of typical environmental impact assessment?

Neo-classical		Ecological
	Typical economic analysis today	
Linear	Neoclassical factors of production Most environmental externalities Some avoided costs Some indirect social benefits	Holistic

# How does the EE model fit into conventional economic model?

	Typical economic analysis today	
Linear	Neoclassical factors of production Most environmental externalities Some avoided costs Some indirect social costs and benefits	Holistic considers the full range of social, economic and ecological costs and benefits

Ideally, the benefits are monetized and the results are incorporated in macro and micro economic models of analysis Impact assessment
Neoliberal normalization
Cost-benefit analysis
Policy development

Application of the EE model to fracking

#### & What is included on the analysis?

- ø Economic impact
- ø Social impact
- ø Environmental impacts

#### & Life cycle analysis.

- ø EROI
- ø Exploration, extraction, distribution, use, disposal

# Impact assessment

## Energy Return on Energy Invested (EROEI)



http://8020vision.com/2011/10/17/energy-return-on-investment-eroi-for-u-s-oil-and-gas-discovery-and-production/

#### k What is included on the analysis?

- ø Economic impact
- ø Social impact
- ø Environmental impacts
- & Life cycle analysis.
  - ø EROI
  - ø Exploration, extraction, distribution, use, disposal
- The time frame of the analysis.

   ø Short term vs long-term
- & Scope of analysis
  - Who benefits and who pays the costs? (equity and justice)

# Impact assessment

many small farmers utilize neoliberal logic when assessing impacts of hydraulic fracturing and shale gas development, particularly as rapid energy development relates to their land-use decisions.

(*Malin*, 2013)

## Neoliberal normalization

Most farmers sampled here argued that environmental impacts had been sensationalized by the media and irrational residents with too much concern for the environment.

They displayed normalization of fracking's impacts using two narratives marked by neoliberal logic: one that completely rejected claims of environmental impacts, and another discourse that recognized environmental impacts but balanced them against more salient economic development needs.

(*Malin*, 2013)

## Neoliberal normalization

As fracking spreads, people may employ neoliberal ideologies to help normalize it, analyzing risks using largely individual-level cost-benefit frameworks. Cost-benefit narratives help residents utilize market-based, or neoliberal, logic to balance risks of water and air pollution, for example, against benefits of economic development

(Finewood and Stroup, 2012),

## Neoliberal normalization

k It is just a tool − outcome depends on how you use it

& What is included and what is not included?

ℵ What is valued and what is not valued?

▶ How are non-monetary values used in decision-making?

## Cost-benefit Analysis

## Benefits (incomplete list)

- Lease revenue for landowner
- Tax revenue for local government
- & Economic growth for nation
- ℵ GHG emissions avoided (?)ℵ Others ...

### Costs (incomplete list)

- & Capital/operating cost
- & Air and water pollution
- & GHG emissions
- & Land degradation
- & Subsidy
- & Infrastructure costs
- ℵ Loss of property values
- k Future livelihood impacts
- & Others ...

## Example of *potential* benefits and costs

ℵ Time frame of analysis

& Distribution of benefits and costs

Persistent issues in cost-benefit analysis

k Fundamental change in policy frameworkø Embrace EE framework

Recautionary principleØ Look before you leap

# Moving forward: Policy Development

# World subsidies to fossil fuel consumption vs renewables in 2009 (billion USD)



#### Schematic geology of natural gas resources





## U.S. Natural Gas Production, 1990-2035

trillion cubic feet



Source: U.S. Energy Information Administration, AEO2012



# How do GHG emissions compare for shale gas, conventional gas, and coal electricity production?



Based on Howarth RW, Santoro, R and Ingraffea, A. Methane and the greenhouse-gas footprint of natural gas from style formations, Climatic Change 2011



### **Typically 4 to 6 million gallons per well**

EPA estimated that if 35,000 wells are hydraulically fractured annually in the US, the amount of water consumed would be equivalent to that used by 5 million people.

Water use for fracking operations





Fundamental change in policy framework

 ø Embrace EE framework

& Comprehensive, long-term, life cycle approachØ Impact assessment and cost-benefit analysis

& Consider equity and justice

Fundamental policy reformnot just for fracking

# Moving forward: Policy Development