The Impact of Energy Sprawl on Biodiversity and Ecosystem Services

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Outline

• Introduction, Background and Motivations
• Research Questions
• Study Design
• Data Collection
• Anticipated Applications
• Timeline
• Questions
Background

Source: EIA 2010
Background

- Existing Oil or Gas Wells
- Potential Wind Development

Source: NREL 2003 and Leu et al 2008
US CO₂ Emissions by Energy Type

- Petroleum
- Coal
- Natural Gas
- Renewables (including wind)

Source: EIA 2009
Research Questions

1. How does wind energy development compare to oil and gas development in impacts to biodiversity and ecosystem services?

2. How does energy development compare to other land uses in impacts to biodiversity and ecosystem services?

3. How do characteristics of the landscape affect the level and intensity of these impacts?
The number of published studies of wind, oil and natural gas development impacts on seven indicators of biodiversity and ecological services. Only papers with primary data on the impacts of onshore wind, oil or gas development were included.

Source: Jones 2011
Indicators of Biodiversity and Ecosystem Services

Wildlife Mortality
Habitat Loss
Fragmentation/Edge Effect
Noise and Light Pollution
Invasive Species
Carbon Storage and Sequestration
Water Resources
Study Design

Existing Wind Energy Facilities
Study Design

Existing Oil and Gas Wells
Example Plots

Wind

Oil & Gas
Wildlife Mortality

- # of turbines and RD
- # of met towers and height
- Meters of road, road type and vegetation
- Meters of power line and type
- # of waste pits
- # of flare stacks
- # of gas compressors
Mortality Data Collection

6 Turbines, 77 m RD
1.5 km of Access Road, Grassland Habitat

6 Waste Pits
2.6 km of Access Road, Grassland Habitat
1 km of Three Phase Power Line
Habitat Loss
: Square Meters of Anthropogenic Disturbance

Noise Pollution
: Number of Noise Sources

Light Pollution
: Number of Light Sources

Invasive Species
: Meters of Roads and Other Linear Features
: Square Meters of Temporary Disturbance
Habitat Loss/Invasives Data Collection

5.6 Hectares Habitat Lost
3.3 Hectares of Temporary Disturbance

10.8 Hectares Habitat Lost
6.7 Hectares of Temporary Disturbance
Noise and Light Data Collection

6 Noise Sources
6 Light Sources

6 Noise Sources
0 Light Sources
Habitat Fragmentation/Edge Effect

:GIS Frag, mean distance to nearest human footprint
Fragmentation Data Collection

GIS Frag = 127.11

GIS Frag = 45.12
Carbon Storage and Sequestration

: Carbon Storage Potential of Land Cover and Soil in Plot minus Potential of Area Covered by Impervious Surface

Water Resources

: Water Used for Construction and Operation of Facilities

: Square Meters of Impervious Surface
Total Potential Carbon Storage in Plot:
3.1 million kilograms
Total Carbon Storage Potential Removed:
233,000 kilograms
Water Loss: 15,000 gallons
2.3 Hectares of Impervious Surface

Total Potential Carbon Storage in Plot:
4.3 million kilograms
Total Carbon Storage Potential Removed:
594,000 kilograms
Water Loss: 416,000 gallons
4.1 Hectares of Impervious Surface
Covariates

Land Use
Land Cover
Land Ownership
Date of Development
State
County
Mean Slope
Mean Elevation
Median Income
Housing Density
Political Affiliations
Anticipated Applications

1. Direct comparison of wind, oil & gas and other land uses on various indicators.
   – Per unit land area
   – Per unit energy produced

2. Determine which landscape characteristics affect the impacts of energy sprawl.

3. Improve the capabilities of predicting future impacts based on alternative land use scenarios.

4. Provide a research model to improve management and policy decisions.
Limitations

• Global Climate Change
• Temporal Aspects
• No Direct Competition

Additional Research

• No Substitute for Quality Field Research
• Increase Amount, Quality, and Transparency
• Expand Focus to Indirect Impacts
Timeline

• Data Collection Currently Underway
• Data Analysis Anticipated Spring 2012
• Results Available May 2012
• Manuscript Submission Summer 2012
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Committee
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• Currently Seeking Funding for Student Work Study Position
• For More Information visit: http://warnercnr.colostate.edu/~nfjones/
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References

• Jones, N. 2011. Bar graph of published studies in energy development pertaining to seven indicators of biodiversity and ecosystem services.

Image Sources

Images (in order of appearance)
http://windenergy1.com/?p=351
http://www.flickriver.com/photos/38037974@N00/set/72157600675321988/
http://www.safewatermovement.org/what-is-hydrofracking/
http://www.treatyenergy.com/flashsite/index-1
http://earthobservatory.nasa.gov/IOTD/view.php?id=5656
http://www.tj-hitech.com/products/
http://www.bitesizegreen.com/