Experiential and Visual Impacts of Energy on the Pennsylvania Landscape
OUTLINE:

I. Marcellus Shale and the Eastern United States
II. Visual and Experiential Impacts
III. State Parks and Natural Areas
IV. Crowdsourced Scenic/Visual Amenity
V. Predictive Models
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MARCELLUS SHALE
Pennsylvania factors influencing shale gas development and impacts:

1) Largely rural and depopulated
2) Marcellus region watersheds are 91% Forest and Agriculture Landcover (2011 USGS LUCL)
3) Marcellus regional watersheds average 77% forested hectares, while non Marcellus basins average just 48%.
4) There are 3 times as many dirt roads in the Marcellus basins.
5) 400% more developed high intensity residential outside of the Marcellus Region

Projected gas wells in Sullivan County—6,000
Lifetime estimated royalty per well—$1.6m
$1.6m x 6,000/6428 = $1.5m/person
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Well Flaring
Nighttime Working Lights and Light Pollution
Traffic and Roads

Rock trucks, tankers, oversized vehicles
Roads
Roads

**Figure 2.18** State forest road in Moshannon State Forest that was improved for shale-gas development but retained significant wild character value. A gas line ROW is adjacent to the road.

**Figure 2.19** State forest road in Moshannon State Forest that was improved for shale-gas development but retained wild character value. Note that the canopy is still closed over the top of the road.
Pipeline clearing
Texas Eastern gas transmission lines in Greene County, Pa. have been moved above ground in anticipation of longwall coal mining which will soon be advancing beneath them.
During installation and after “re-vegetation”
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### Average Spatial Disturbance for Marcellus Shale Well Pads in Forested Context (acres)

<table>
<thead>
<tr>
<th>Description</th>
<th>Before</th>
<th>After</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest cleared for Marcellus Shale well pad</td>
<td>3.1</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>Forest cleared for associated infrastructure (roads, pipelines, water impoundments, etc.)</td>
<td>5.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect forest impact from new edges</td>
<td></td>
<td></td>
<td>21.2</td>
</tr>
<tr>
<td><strong>TOTAL DIRECT AND INDIRECT IMPACTS</strong></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>12.14 Hectares</strong></td>
</tr>
</tbody>
</table>
Land Use

- Forest: 48%
- Farmland: 47%
- Other: 5%

Legend:
- Potentially Visible Wells
- Areas
- Study Area
<table>
<thead>
<tr>
<th>Description</th>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest cleared for Marcellus Shale well pad</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>Forest cleared for associated infrastructure (roads, pipelines, etc.)</td>
<td>636</td>
<td>981</td>
</tr>
<tr>
<td>Indirect forest impact from new edges</td>
<td></td>
<td>2363.5</td>
</tr>
<tr>
<td><strong>TOTAL DIRECT AND INDIRECT IMPACTS</strong></td>
<td>3344.5</td>
<td>1353.5 Hectares</td>
</tr>
</tbody>
</table>
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Bark Cabin
East Branch Swamp
Pine Creek Gorge Natural Area
Mt. Pigsah
Bucktail State Park
Well Pad Visibility
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"We are interested in devising a model of a species’ environmental requirements from a set of occurrence localities, together with a set of environmental variables that describe some of the factors that likely influence the suitability of the environment for the species."

Philips et al. 2006: 232

"A niche-based model represents an approximation of a species’ ecological niche in the examined environmental dimensions... [and] thus represents an approximation of the species’ realized niche (i.e., smaller than its fundamental niche)."

software and articles: http://www.cs.princeton.edu/~schapire/maxent/
MODEL INPUTS:

- depth.asc
- disttopipe.asc
- disttoroads.asc
- landuse.asc
- naturalarea.asc
- slope.asc
- thickness.asc
- water.asc

- 2009permits
- 2010permits
- 2011permits
- 2012permits
- 2013permits
- 2014permits
- allpermits

ALL MODELS WERE CROSSVALIDATED
HIGH PROBABILISTIC MODEL FOR FUTURE DEVELOPMENT: SUMMARIZED BY BASIN (SUB-WATERSHED)
HIGH PROBABILISTIC MODEL FOR FUTURE DEVELOPMENT: SUMMARIZED BY BASIN (SUB-WATERSHED)
LEAST COST SURFACE MODELS:
dirt and gravel roads
forested area
streams and water bodies
wetlands
agriculture and pasture

a new shape of pennsylvania?

http://marcellusbydesign.psu.edu

http://hamercenter.psu.edu
THANK YOU