A Research Study: Energy Development and the Transportation System
Colorado Ranks Highly in Energy Production

10th Total energy production
11th Crude oil production
6th Natural gas production
9th Coal production
6th Wind power capacity
Potential for Energy Development Remains High

- 10 of nation’s 100 largest natural gas fields
- 3 of nation’s 100 largest oil fields
- Oil shale – estimated 1 trillion barrels
- Sunny climate for solar energy
- Windy conditions ideal for wind energy
- Agriculture base key for biofuel production
Goals of the Study

- Provide an industry overview for each energy source
- Correlate phases of energy development to transportation activity
- Provide a relative comparison of transportation activity between sources
- Develop a planning tool to assess future energy development scenarios
- Provide recommendations for further CDOT planning efforts
Literature review
- Colorado data and studies
- Neighboring states

Key person interviews
- Representatives of energy industry
- Energy professional organizations
- State regulatory agencies
- Local community officials
Resources Reviewed

- **Non-Renewable**
  - Crude oil
  - Natural gas
  - Coal bed methane
  - Oil shale
  - Uranium
  - Coal

- **Renewable**
  - Wind
  - Solar
  - Biofuels
Oil and Gas

- 38,000 active wells in Colorado
- 85% of wells are in 6 counties
- Wells typically operate 10-30 years
- Natural gas – pipelines
- Crude oil – tanker trucks
# Oil and Gas Trip Generation Rates

## Oil and Gas Trip Generation Rates (average trips per well)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Crude Oil</th>
<th>Natural Gas</th>
<th>Coal Bed Methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development&lt;sup&gt;1,2&lt;/sup&gt;</td>
<td>1,710</td>
<td>1,721</td>
<td>684</td>
</tr>
<tr>
<td>Production (Annual)</td>
<td>974</td>
<td>111</td>
<td>742</td>
</tr>
<tr>
<td>Reclamation&lt;sup&gt;2&lt;/sup&gt;</td>
<td>250</td>
<td>73</td>
<td>146</td>
</tr>
</tbody>
</table>

<sup>1</sup> Development phase includes all activities prior to production (site preparation, drilling and completion)

<sup>2</sup> Development and reclamation trips represent single occurrences.
Uravan mineral belt – oldest in U.S.
Production halted in 2009
Long distance haul to 2 processing facilities
- Cañon City
- Utah
65% of Colorado coal goes out of state
75% of rail freight volume originating in Colorado
50% of rail freight coming into Colorado
Transported by 120-130 car coal trains
Wind

<table>
<thead>
<tr>
<th>Phase</th>
<th>Trips per Turbine</th>
<th>Trips per MW(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>126</td>
<td>79</td>
</tr>
<tr>
<td>Operations (Annual)</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

\(^1\) Trips per MW calculated based on average wind turbine capacity of 1.6 MW

- **Turbine blades up to 130 feet long**
16 MW of photovoltaic capacity in Colorado
6 utility-scale facilities

**Solar Power Trip Generation Rates**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Trips per MW¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>202</td>
</tr>
<tr>
<td>Operations (Annual)</td>
<td>50</td>
</tr>
</tbody>
</table>

¹ One MW of capacity typically requires approximately ten acres of solar panels.
Biofuels

- 125 million gallons of ethanol / year
- 10 million gallons of biodiesel / year

<table>
<thead>
<tr>
<th>Biofuel Trip Generation Rates</th>
<th>Trips per Million Gallons of Ethanol or Biofuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input-Related</td>
<td>793</td>
</tr>
<tr>
<td>Output-Related</td>
<td>442</td>
</tr>
<tr>
<td>Total</td>
<td>1,235</td>
</tr>
</tbody>
</table>
Oil and Gas Model
(A Planning Tool)

- **Energy Development Activity**
  - Number of wells
  - Oil
  - Natural Gas
  - Coal Bed Methane

- **Trip Generation Module**
  - **Inputs**
    - Resource
    - Level of development
    - Location (Basin)
    - Timing of development
  - **Factors**
    - (by development phase)
    - Trip generation rates
    - Fleet mix
  - **Outputs**
    - (by basin and year)
    - Annual trips by development phase
    - Trips by vehicle classification

- **Corridor Allocation Module**
  - **Inputs**
    - Annual trips by development phase and basin
    - Fleet mix
    - Heavily impacted corridors
  - **Factors**
    - Access to resources
    - Nearest population centers
    - Routes for long-haul
    - Percent allocation of basin trips to impacted corridors
  - **Output**
    - (by impacted corridor and year)
    - Trips per day
    - VMT
    - Light, medium and heavy truck trips per day

**Phases of Development:**
- Development (includes site development, drilling and completion)
- Production (operation and maintenance)
- Reclamation (well retirement)
Recommendations for CDOT

- Expand planning efforts on oil and gas development
- Pursue relationships and partnerships with energy sector
- Build partnerships with resource/regulatory agencies to ensure CDOT’s interests are considered
- Take a statewide perspective in identifying best routes for oversized loads (wind turbines)
- Continue focus on improving safety at highway/rail crossings
- Incorporate energy development into regional and statewide transportation plans