Utility-Scale Solar Energy Tutorial: Technologies, Environmental Impacts and Mitigation Measures

Environmental Science Division
Argonne National Laboratory

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BLM and DOE Are Preparing a Solar Energy Development Programmatic Environmental Impact Statement to:

- To facilitate environmentally sound utility-scale (>20 megawatts (MW)) solar energy development in six southwestern states
- BLM is focused on identifying sensitive public lands to be excluded from solar development, and priority development areas (solar energy zones) that are well-suited to solar development.
- Both agencies are developing a standard set of mitigation measures that will be applied to solar energy development projects.

150 MW Solar Trough Plant at Kramer Junction, CA
Solar Technologies Being Assessed in PEIS

- Concentrating Solar Power
  - Parabolic trough
  - Power tower
  - Dish Engine

- Photovoltaic
What Results do BLM and DOE Expect from the Programmatic EIS?

- Identification of land that is appropriate for utility-scale solar energy development (technically and environmentally).
- Establishment of policies, strategies, and requirements that would apply to solar energy projects supported by DOE or located on BLM-administered lands:
  - Design features (best practices) for deploying solar projects
  - Methods to minimize impacts to resources
- Evaluation of impacts of development in solar energy zones.
- Amendment of BLM land use plans in the six-state area to address solar energy development.
- Streamlining of future project-specific assessments through tiering to analyses in the PEIS.
Key Elements of the Solar PEIS

- Potential programmatic requirements
  - Policies regarding solar energy development, such as
    - Defining lands excluded from solar development
    - Interagency consultation requirements
    - Financial bond requirements
  - Required design features
    - Mitigation measures/Best Management Practices that will be required of all solar energy development projects on BLM land

- Programmatic level cultural resource and tribal consultations
  - A programmatic agreement with State Historic Preservation Officers and the Advisory Council is being pursued
  - Tribal consultation: input from all tribes has been solicited; follow-up is in process
BLM Locations being Evaluated

- BLM Lands in the six states (Arizona, California, Colorado, Nevada, New Mexico, Utah)

- Only lands with the best technical resources are being considered for development, i.e., those with less than 5% slope and high solar irradiation levels (>6.5 kilowatt-hours/meter\(^2\)/day)

- Sensitive areas to be excluded are National Landscape Conservation Lands (for example, Wilderness Areas and National Monuments), critical habitat for Federal Threatened and Endangered Species, Areas of Critical Environmental Concern, Special Recreation Management Areas, other BLM sensitive land classes

- 24 proposed solar energy zones – approximately 677,400 acres – these areas are being studied most thoroughly because BLM wants to focus development in these areas
Resources and Impacts Being Evaluated:

- Lands & Realty
- Specially Designated Areas
- Rangeland Resources
- Recreation
- Military Aviation
- Minerals
- Soil, Air, and Water
- Ecological and Special Status Species
- Visual
- Noise
- Paleontology
- Cultural Resources
- Native American Concerns
- Economic and Social
- Transportation
- Waste Management, Health & Safety
Arizona


* 34 Active Applications:

22 Parabolic Trough
6  Power Tower
5  PV
2  unknown

1 Fast Track

*as of February 2009
California


*55 Active Applications:

- 4 Parabolic Trough
- 5 Power Tower
- 2 Dish Engine
- 17 PV
- 27 unknown (CSP)

9 Fast Track of which 6 have been approved (Imperial Valley Solar appealed by Quechan Tribe)

*as of February 2010
Colorado


Currently no active applications

* 34 Active Applications:
  - 9 Parabolic Trough
  - 2 Power Tower
  - 10 PV
  - 13 unknown CSP
  - 4 Fast Track of which 2 have been approved

* as of February 2009
New Mexico


* 4 Active Applications:

  2 Parabolic Trough
  2 Unknown (CSP)

* as of February 2009
Utah


Currently no active applications
Utility-Scale Solar Energy Development Involves Unique Impacts to Some Environmental Resources

- Land use
- Water resources
- Ecological resources
- Visual resources
- Air quality
- Acoustics
- Hazardous materials/waste management
- Health & Safety

But not necessarily to others

- Cultural resources
- Paleontological resources
- Transportation
- Socioeconomic
- Soil Resources
Land Use: Common Impacts

- Solar facilities are a dedicated use of land that will preclude other uses (e.g., grazing, recreation, mining, transmission facilities)
- Potential conflicts with military training ranges and special-use areas (most areas will not have a conflict unless structures are greater than 200 ft – Nevada Testing and Training Range is an exception)
- Specially-designated areas (e.g., Wilderness Areas) within about a 25-mi radius can be impacted (e.g., viewshed impacts, impacts to wilderness and scenic area values, habitat impacts, migration corridors)
- Development of a large industrial facility, increased traffic, and access to a previously remote area could change the character of the landscape
- Impacts from road and transmission line construction include loss of land to physical structures, changes in recreational use
Land Use: Technology-Specific Impacts

- Land use assumptions for Solar PEIS (for a 400 MW facility):
  - Parabolic trough requires about 2,000 acres
  - Power tower, dish engine, and PV facilities require about 3,600 acres
  - Developers typically apply for considerably more land in the ROW than the facility footprint will require; allows for avoidance areas, some flexibility in project layout

- Solar One & Two Facility near Dagget, CA (10 MW Power Tower, 126 acres) – now closed
- Denver International Airport (2 MW Tracking PV, 7.5 acres)
Land Use: Mitigation Measures

- Hold early discussions with DoD to identify their concerns
- Review needs for future transmission capacity
- Hold early discussions with holders of existing BLM land use authorizations to ensure that use of their facilities will not be impaired, or to develop arrangements to end the authorizations and/or compensate holders
- Retain public access to lands surrounding solar facility
- Consult local stakeholders early in the planning process to identify conflicts and issues
Soil disturbing activities during construction could loosen soil and increase the potential for erosion from surface runoff and wind action; also destroy or damage biological soil crusts.

Compaction could occur with heavy vehicle traffic, increasing the potential for surface runoff.

In seismically active areas, liquefaction is a potential hazard – especially in areas with shallow groundwater.

Consider potential for subsidence.

Mitigation would include using sedimentation and dust control measures, limiting vehicle traffic to roads, and using design criteria to address seismic hazards.
Water Resources: Impacts by Development Phase

- **Construction**
  - Water use – Largest need is for dust suppression (up to 6 ac-ft/MW)
  - Land disturbance will alter drainage patterns of floodplains, wetlands and riparian areas
  - Surface water quality could be adversely affected through increased runoff, erosion, sedimentation and spills

- **Operations**
  - Water use impacts dependent on solar technology (see next slide)
  - Surface water quality could be adversely affected through increased runoff, erosion, sedimentation and spills
Water Resources: Impacts from Operations

Technology-Specific Water Use Estimates (ac-ft/yr\(^a\))

<table>
<thead>
<tr>
<th>Technology</th>
<th>Water Use for a facility</th>
<th>100 MW</th>
<th>400 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CSP</strong></td>
<td>Wet cooling and washing</td>
<td>500-1,500(^b)</td>
<td>2,000-6,000</td>
</tr>
<tr>
<td>Parabolic trough and Power Tower</td>
<td>Hybrid cooling and washing</td>
<td>140-300</td>
<td>560-1,200</td>
</tr>
<tr>
<td></td>
<td>Dry cooling and washing</td>
<td>70-150</td>
<td>280-600</td>
</tr>
<tr>
<td>Dish Engine</td>
<td>Mirror washing</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>PV</td>
<td>Panel washing</td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

\(^a\) Conversion from gal/h/MW to ac-ft/yr/MW assumes 1 gal = 0.0000031 ac-ft
\(^b\) Ranges of water use for CSP assume 30% to 60% operating times
** Workforce water supply would range between 0.2 and 6 ac-ft/yr
Water Resource: Mitigation Measures

- **Siting and Design**
  - Maximize water conservation through technology selection and/or water source selection
    - Use of recycled water if available

- **Site Characterization and Construction**
  - Use best management practices (BMPs) to
    - Avoid alteration of existing drainage systems
    - Maintain water quality
    - Comply with new NPDES Construction General Permit

- **Operations**
  - Presence of heat transfer fluids or thermal energy storage fluids at CSP facilities introduced possibilities of off-site migration (or infiltration)
    - Use BMPs such as pollution prevention and physical barriers (e.g., berms)
    - Maintain water quality
  - Withdrawal of groundwater for the facility should not cause overdraft of aquifers – e.g., groundwater table drops, land subsidence, decreased flows to surface water bodies, discharge/recharge processes
Ecological Resources of Concern

- Plant communities
- Invasive noxious non-native plants
- Wildlife species
  - Amphibians and reptiles
  - Birds
    - Migratory birds
    - Bald and Golden Eagles
  - Mammals
    - Small mammals
    - Small game and furbearers
    - Big game
- Aquatic habitats and species
- Special status species
  - Species listed under the Endangered Species Act
  - BLM-designated species
  - State-listed species
  - Rare species (species of concern, S1, and S2 species)
Ecological Resources: Impacts

- **Construction**
  - Construction impacts are similar to impacts associated with any large facility development
    - Alteration of drainage patterns
    - Vegetation/habitat removal
    - Harassment of resident animal species
    - Surface runoff, sedimentation, erosion, fugitive dust
    - Discharge or release of contaminants
  
- **Operations**
  - Solar energy facilities provide poor ecological habitat during the life of the project
  - Potential long-term source of fugitive dust and surface water and sediment runoff
  - Impervious surface increases runoff rates
  - Considerable volumes of water necessary for operation may result in alteration of groundwater flow, affecting wetlands, springs, and riparian and aquatic habitats
  - Little animal use of site because of exclusionary fencing, lack of productivity
Ecological Resources: Technology-Specific Impacts

- Parabolic trough and power tower facilities
  - Water withdrawals for wet cooling could result in habitat loss
  - Mortality from bird collisions (mainly a power tower concern), also for power lines
Ecological Resources: Technology-Specific Impacts (cont.)

- **Dish engine**
  - Wildlife disturbance from noise during operation
  - Areas between dishes kept free of vegetation to reduce probability of fire

- **PV facility**
  - Noise and water use impacts greatly reduced
  - Low-lying vegetation between panels would not be a fire hazard, but need invasive species monitoring
Ecological Resources: Mitigation Measures (cont.)

- **Construction**
  - Avoid construction during breeding seasons of protected species if needed
  - Establish buffer zones around sensitive species
  - Use explosives within specified distances from wildlife and surface waters and within specified times
  - Obtain water from off-site

- **Operations**
  - Use red or dual red and white strobing or flashing lights on power tower
  - Promptly clean up toxic spills before they can enter aquatic habitats

- **Transmission Lines and Roads**
  - Mark shield wires with devices that reduce collision potential
  - Allow raptor nests to remain in place on transmission line support structures
  - Locate transmission facilities in previously disturbed areas
Ecological Resources: SEZ-Specific Mitigations for Special Status Species

- Conduct pre-disturbance surveys
- Avoid and protect discovered populations and occupied habitats
- Translocate individuals (plants and desert tortoises) from areas of direct effect;
- Develop compensatory mitigation of direct effects on occupied habitats
  - Habitat restoration
  - Habitat creation
  - Greater than 1:1 ratio
- Mitigation should be developed in consultation with USFWS and state
Visual Resources: Impacts by Development Phase

- **Construction**
  - Presence of solar energy collectors and support facilities
  - Vegetation clearing and erosion may be visible for an extended time

- **Operations**
  - Scale of solar facilities makes them very visible (PEIS assumes solar field in the range of 5 to 9 acres/MW)
  - Height of power towers (PEIS assumes up to 650 ft) may increase visual impacts
  - Glare from CSP facilities can greatly increase visual impacts
  - Steam plumes
  - Night sky impacts
Visual Resources: Technology-Specific Impacts

- Parabolic Trough
  - Appearance differs dramatically based on distance, angle of view, time of day
  - PEIS assumes facilities occupy 5 acres/MW; glint and glare from ground level and elevated viewpoints
  - Collector arrays are about 18-25 ft high (relatively low profile); appear as line or band from ground level
  - Buildings for administration and to house steam turbine generator (STG), cooling tower, condensers, tanks, pipes, evaporation ponds
  - Ancillary facilities and plumes can add to impacts

*Parabolic Trough Facility from an Elevated Viewpoint*
Visual Resources: Technology-Specific Impacts (cont.)

- **Power Tower**
  - PEIS assumes facilities occupy 9 acres/MW.
  - Tower heights in BLM applications range from 150 to 650 ft
  - Receiver light may be difficult to look at from nearby locations; can be visible for long distances (more than 20 mi)
  - Heliostats may cause glare
  - Power block buildings and plumes same as for trough facilities

*eSolar Sierra Suntower Facility, Lancaster CA*
Visual Resources: Technology-Specific Impacts (cont.)

- **Dish Engine and PV**
  - PEIS assumes facilities occupy 9 acres/MW
  - Units approximately 38 ft high and wide
  - No STG, cooling tower, or plumes reduces impacts

- **PV Systems**
  - Also assume 9 acres/MW.
  - Panels low to the ground (often less than 10 ft)
  - Support buildings taller than collectors
  - No STG, cooling tower, or plumes reduces impacts
  - Dark panel surfaces are less reflective than mirrors

*10 20-kW Solar Dish Engine Units in Alice Springs, Australia (Credit: R. McConnell. Source: NREL)*

*PV Panels, Nellis Air Force Base, Nevada*
Visual Resources: Mitigation Measures

- **Siting and Design**
  - Avoid off-site reflection of glare from mirrors; add fencing with slats or other screening when unavoidable.
  - Locate projects outside the viewsheds of key observation points or as far away as possible, avoid prominent landscape features.
  - Bury cables and pipelines where possible.

- **Construction**
  - Clear only to the edge of designed grade changes.
  - Install weed-free native grasses and shrubs in areas of disturbed soil.

- **Operations**
  - Maintain re-vegetated surfaces until landscape is re-established.
  - Practice dust abatement and noxious weed control.
Air Quality: Impacts by Development Phase

- **Construction**
  - Fugitive dust emissions from soil disturbance (PEIS assumes up to 3,000 acres per year per facility) and engine exhaust emissions
  - Minimum site preparation in relatively flat desert environments
  - Moderate but temporary impacts from activities occurring near the site boundaries.

- **Operations**
  - **Positive impact due to fossil-fuel emissions avoided**
  - Negligible adverse impacts because of little or no fossil fuel use (small amount of natural gas use at trough/tower facilities to maintain HTF temp)
  - Minor emissions from emergency diesel-fired generators and fire-water pump engines
## Air Quality: Examples of Emissions Avoided During Operations

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>% of AZ Fossil-Fuel Emissions Displaced *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>1.0% - 1.8%</td>
</tr>
<tr>
<td>Bullard Wash</td>
<td>1.8% - 3.3%</td>
</tr>
<tr>
<td>Gillespie</td>
<td>0.9% - 1.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3.6% - 6.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>% of NV Fossil-Fuel Emissions Displaced *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amargosa Valley</td>
<td>13.0% - 23.4%</td>
</tr>
<tr>
<td>Dry Lake</td>
<td>6.4% - 11.6%</td>
</tr>
<tr>
<td>Delamar Valley</td>
<td>6.8% - 12.2%</td>
</tr>
<tr>
<td>Dry Lake Valley North</td>
<td>31.5% - 56.8%</td>
</tr>
<tr>
<td>East Mormon Mountain</td>
<td>3.7% - 6.6%</td>
</tr>
<tr>
<td>Gold Point</td>
<td>2.0% - 3.6%</td>
</tr>
<tr>
<td>Millers</td>
<td>6.9% - 12.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>70.3% - 126.5%</td>
</tr>
</tbody>
</table>

* Range = 9 ac/MW to 5 ac/MW.
Air Quality: Mitigation Measures

- Use cooling tower drift eliminators to minimize particulate matter emissions from parabolic trough and solar power technologies.

- During construction in winter, avoid soil disturbance activities in early morning hours during which low wind speeds and stable atmospheric conditions could cause extremely high concentrations due to limited horizontal and vertical dispersion.

- Use dust suppressants, complying with federal, state, and local laws and regulations.

- Loose materials generated during project activities should be watered as necessary.

- Stage construction to limit exposed area.

- Suspend soil disturbance activities during periods of high winds.
Acoustic Environment: Impacts by Development Phase

- **Construction**
  - Minimum site preparation in relatively flat desert environments
  - Diesel engine of construction equipment is dominant source of noise
  - Highest noise levels will be in power block area

- **Operations**
  - Noise generating activities include those from transformers, fans, maintenance and repair, emergency power generators and fire-water pump engines (intermittent, ~2 hrs/mo for maintenance)
  - Solar field noises include those from solar tracking devices, dish engines, and mirror washing.
  - Transformer noise is a constant low-frequency humming tone
Acoustic Environment: Technology-Specific Impacts

- **Parabolic Trough and Power Tower**
  - Power block area has high noise levels (not near boundaries)
  - Wet and dry cooling towers generate the highest noise levels
  - With thermal energy storage, power generation noise levels could cause impacts in nearby communities due to operation at night

- **Dish Engine**
  - Construction noise impacts from drilling to install concrete foundations, however shallow drilling depth and drilling soft soils will reduce noise
  - Noise sources from engine, electric generator, cooling system, and air compressor
    - Noise level is 88 to 89 A-weighted decibels (dBA) at a distance of 3 ft; attenuates to 40 dBA at 330 ft
    - Potential noise impacts from 10,000 or more dish engines could be substantial in nearby communities (within 2 miles)

- **PV Facility**
  - Noise is barely perceptible at site boundaries
Acoustic Environment: Mitigation Measures

- If a wet cooling tower is to be used, site the louvered side to face away from sensitive human receptors. If possible, locate the cooling tower so that nearby equipment can act as a barrier.

- Select quieter fans and operate at lower speed, particularly at night. Use silencers on fan stacks if a high degree of noise reduction is required.

- Install a new transformer with reduced flux density if transformer noise becomes an issue, or install barrier walls or enclosures.

- Locate stationary construction equipment and noise generating equipment as far as practicable from nearby residences, and take advantage of topography or site within an existing noisy area.

- Schedule noisy activities to occur at the same time.

- Consult with nearby residents/businesses to address noise issues.
Hazardous Materials and Waste: Impacts by Development Phase

- **Construction**
  - Hazardous materials and wastes increase risk of fire and contamination of environmental media
  - Pre-existing hazards (e.g., unexploded ordnance) need to be surveyed for and removed prior to construction

- **Operations**
  - All technologies will have substantial quantities of dielectric fluids in switches, transformers, and capacitors – not highly toxic and generally easily cleaned up if spilled
  - Need to avoid use of substances that have high global warming potential
Hazardous Materials and Waste: Technology-Specific Impacts

- **Parabolic Trough and Power Tower**
  - Environmental media contamination from spills or leaks in the heat transfer fluid (HTF) system
  - High-volume wastes (e.g., lubricating and compressor oils, hydraulic fluids) have recycling options
  - Thermal energy storage (TES) systems contain large quantities of salt that are capable of chemical burns and act as strong fertilizers

- **Dish Engine**
  - External heat engines may leak hydrogen at a rate of 0.5 cubic ft/d
  - Initial deployment, central storage facility, and annual change-outs of compressed gas cylinders containing hydrogen pose a fire risk

- **PV Facility**
  - Only a small array of hazardous materials in use at the facility
  - Toxic metals fixed in solar panels include cadmium, selenium, and arsenic; damaged panels may be treated as hazardous waste
Hazardous Materials and Waste: Mitigation Measures

- Consider flammability of HTFs and cylinders in designing Fire Management Plan, including designed storage facility and proper operating procedures.
- Design systems to limit hazardous material release (e.g., secondary containment, valve, sensors).
- Survey project sites for unexploded ordnance, especially if projects are within 20 mi of a current U.S. DoD installation or formally used defense site.
- Employ “just in time” ordering procedures to limit amount of hazardous materials on the site.
Health & Safety: Impacts to Workers and the Public

- **Occupational Health and Safety Risks**
  - Retinal exposures due to high levels of glare
  - Increased cancer from exposure to magnetic fields of high strength
  - Injury during construction and operation of facilities and associated transmission lines
  - Exposure to weather extremes
  - Working at extreme heights
  - Exposure to hazardous substances

- **Public Health and Safety Risks**
  - Potential eye damage from glare from mirrors, heliostats, and power tower receivers
  - Aviation safety interference
  - Traffic accidents in the vicinity of solar facilities (Ivanpah draft EIS raised concern regarding accidents due to driver distraction by glare)
Health and Safety: Technology-Specific Impacts (cont.)

- **Parabolic Trough and Power Tower**
  - Potential exposures to HTFs or TES media would be controlled
  - Reflected light from mirrors and heliostats, when seen at short distances, could exceed thresholds for vision protection

- **Dish Engine**
  - No risk of asphyxiation from hydrogen cylinders
  - Potential for retinal damage from reflected light is small

- **PV Facility**
  - Potential for limited exposure to cadmium and other heavy metals from broken or cracked modules and/or during fires; risk is small
  - No reflected light issues
Health & Safety: Mitigation Measures

- **Occupational Health and Safety**
  - Conduct a safety assessment to describe safety issues and means to mitigate them, including glare exposure from mirrors, heliostats, and/or power towers
  - Consider measures to reduce occupational EMF exposures

- **Public Health and Safety**
  - Evaluate the potential exposure of the public to glare from parabolic trough mirrors; prepare plans to limit exposures to safe levels
  - Limit potentially-hazardous exposures of the public through project design
  - Projects must comply with FAA safety regulations
Paleontology and Cultural Resources

- Difference in land requirements between technologies does not necessarily correspond to difference in magnitude of impacts; all are location- and resource-dependent

- Exception to above is visual impacts on cultural resources, such as on trails, traditional cultural properties, and cultural landscapes

- Mitigate impacts using established BLM processes for paleontological resources and historic properties
Native American Concerns: Nevada as an Example

- Tribal Consultations:
  - June 2008 – State Office notification letter for PEIS to 27 tribes offers consultation and cooperating agency status
  - July 2009 – Letter from CA Desert District to all federally recognized tribes in 6 states, included maps of the proposed SEZs, but not other BLM lands available for ROW application.
  - July – Sept 2009 – Field Office (Black Rock, Ely, Humboldt, Pahrump, Stillwater) and District Office (Southern Nevada, Winnemucca) Follow-up with some tribes
  - Sept 2009 – present – Argonne follow up – telephone contact and letter resent as requested.
  - To date, have received 2 “no concerns” responses, one consultation deferred, and one statement that the areas are beyond tribal traditional use areas.
Impacts and Mitigation for Other Resources (cont.)

- **Socioeconomics**
  - Relatively large number of temporary jobs created during construction
  - Low number of long-term operations jobs
  - Long-term social change and disruption not likely because of low long-term employment numbers; some impacts possible during construction, especially for facilities in sparsely populated rural areas.
  - Impacts to housing and public service may occur with construction in-migration
  - Impact on property values unknown – may decrease due to deterioration of landscape or perceived health effects; may increase due to more access to employment

### Direct Employment for Solar Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Peak Construction FTEs</th>
<th>Operations FTEs</th>
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<tbody>
<tr>
<td></td>
<td>100 MW</td>
<td>400 MW</td>
</tr>
<tr>
<td>Parabolic Trough</td>
<td>350</td>
<td>1400</td>
</tr>
<tr>
<td>Power Tower</td>
<td>170</td>
<td>680</td>
</tr>
<tr>
<td>Dish Engine</td>
<td>69</td>
<td>275</td>
</tr>
<tr>
<td>PV</td>
<td>32</td>
<td>130</td>
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</table>
Impacts and Mitigation for Other Resources (cont.)

- **Transportation**
  - Oversize shipments will be necessary for deliveries of STGs and transformers used for trough and power tower technologies
  - Potential for glare to interfere with overhead flights – pilot distraction
  - Construction impacts depend on proximity to major roads (new construction), and upgrades needed to existing roads, size of facility (130 to 1400 workers commuting to site for a 400 MW facility).
  - Several options for mitigation of impacts, including local road improvements, multiple site access locations, staggered work schedules, ride-sharing
Cumulative Impact Issues and Considerations

- Past, Ongoing and Foreseeable Actions
- Geographic Extent of Effects
- Effects by Resource
- Systems effects
  - Habitat fragmentation
  - T&E species
  - Water resources
  - Visual character
  - “Urbanization”
Solar Energy PEIS Update

- Draft PEIS expected December 2010
- Final PEIS issuance will depend on nature and number of comments, expected no later than December 2011