Appendix F: Energy and Natural Resources Report

For Programmatic Environmental Impact Statement on Utility-Scale Solar in Washington State

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For the

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DEPARTMENT OF ECOLOGY
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Table of Contents

List of Figures and Tables

Figures

Tables

Acronyms and Abbreviations List

BESS	battery energy storage system
BMP	best management practice
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
gen-tie line	generation-tie transmission line
kWh	kilowatt-hour
L&I	Washington State Department of Labor and Industries
LPG	liquefied petroleum gas
mi/gal	mile per gallon
MW	megawatt
PEIS	Programmatic Environmental Impact Statement
PV	photovoltaic
RCW	Revised Code of Washington
USC	*United States Code*

Executive Summary

The type and quantity of energy and natural resources used in construction, operation, and decommissioning of a utility-scale solar energy facility can affect overall availability of energy sources for other uses. This resource report reviews energy and mineral resources in the study area; assesses demands for electricity, transportation fuel, and construction aggregate by the different facility types; and evaluates impacts to energy and mineral resources due to the assessed demands, by facility type.

The key resources that are applicable to utility-scale solar energy facilities and evaluated in this Programmatic Environmental Impact Statement (PEIS) include the following:

- Electricity that is generated from renewable and non-renewable sources.
- Transportation fuels including gasoline and diesel fuel.
- Construction aggregate (the collective term for sand, gravel, and crushed stone).

The analysis of utility-scale solar energy facilities found the following:

- Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction, operation, and decommissioning of facilities would likely result in **less than significant impacts** on energy and natural resources.
- **No significant and unavoidable adverse impacts** on energy and natural resources would occur.

Crosswalk with Energy and Natural Resources Report for Utility-Scale Onshore Wind Energy

Two PEISs are being released at the same time, one for utility-scale solar energy facilities and one for utility-scale onshore wind energy facilities. This crosswalk identifies the areas with substantial differences between the energy and natural resources reports for each PEIS.

Utility-Scale Solar Energy PEIS (this document)	Utility-Scale Onshore Wind Energy PEIS
• Different specific energy and natural resource use estimates and resulting different ranges of potential impacts • Some differences in actions to avoid and reduce impacts	• Includes analysis of wind as a primary energy resource and the potential for facilities to affect adjacent wind resource availability • Different specific energy and natural resource use estimates and resulting different ranges of potential impacts • Some differences in actions to avoid and reduce impacts

1 Introduction

This resource report describes energy and natural resources within the study area and assesses probable impacts associated with types of facilities (alternatives), including a No Action Alternative. Chapter 2 of the State Environmental Policy Act Programmatic Environmental Impact Statement (PEIS) provides a description of the types of facilities analyzed (alternatives).

This section provides an overview of the aspects of energy and natural resources evaluated in this resource report and lists relevant regulations that contribute to the evaluation of potential impacts.

1.1 Resource description

The energy resource is considered in two components: the primary energy resource and secondary energy resource, as follows:

- Primary energy means energy as a found, natural resource (wood and sunlight are examples).
- Secondary energy means an energy commodity that is derived by processing a primary energy source (electricity and gasoline are examples of secondary energy). Much of the secondary energy available inside the study area was produced outside the study area and imported as electricity or liquid fuels.

The non-energy natural resource considered in this resource report is mineral resources. Of mineral resources in the study area, only construction aggregate (crushed rock, gravel, and sand) is relevant to construction, operation, or decommissioning solar energy facilities.

1.2 Regulatory context

Potentially applicable federal, state, and local laws and regulations are listed in Table 1, which contribute to the evaluation of energy or natural resources impacts. For local regulations, Table 1 lists categories of laws, plans, and policies that could apply depending on the local jurisdiction in which a facility is proposed.

Table 1. Applicable laws, plans, and policies

Regulation, statute, guideline	Description
State	
Chapter 194-40 Washington Administrative Code, Clean Energy Transformation Act	Commits Washington to an electricity supply free of greenhouse gas emissions by 2045 and requires utilities to phase out coal-fired electricity by 2025 and be greenhouse gas emissions neutral by 2030.
Chapter 43.21F Revised Code of Washington (RCW), State Energy Office	Requires development of a State Energy Strategy at least once per 8 years. The State Energy Strategy provides estimates of electricity needs in the future.

Regulation, statute, guideline	Description
Chapter 70A.535 RCW, Clean Fuels Program	Implements a low carbon fuel standard for vehicle fuels delivered in Washington state.

2 Methodology

This section provides an overview of the process for evaluating potential impacts and the criteria for determining the occurrence and degree of impact. Details about the technical approach and impact assessment are included in Sections 2.2 and 2.3.

2.1 Study area

The study areas for the energy and natural resources element includes the overall solar geographic study area (Figure 1).

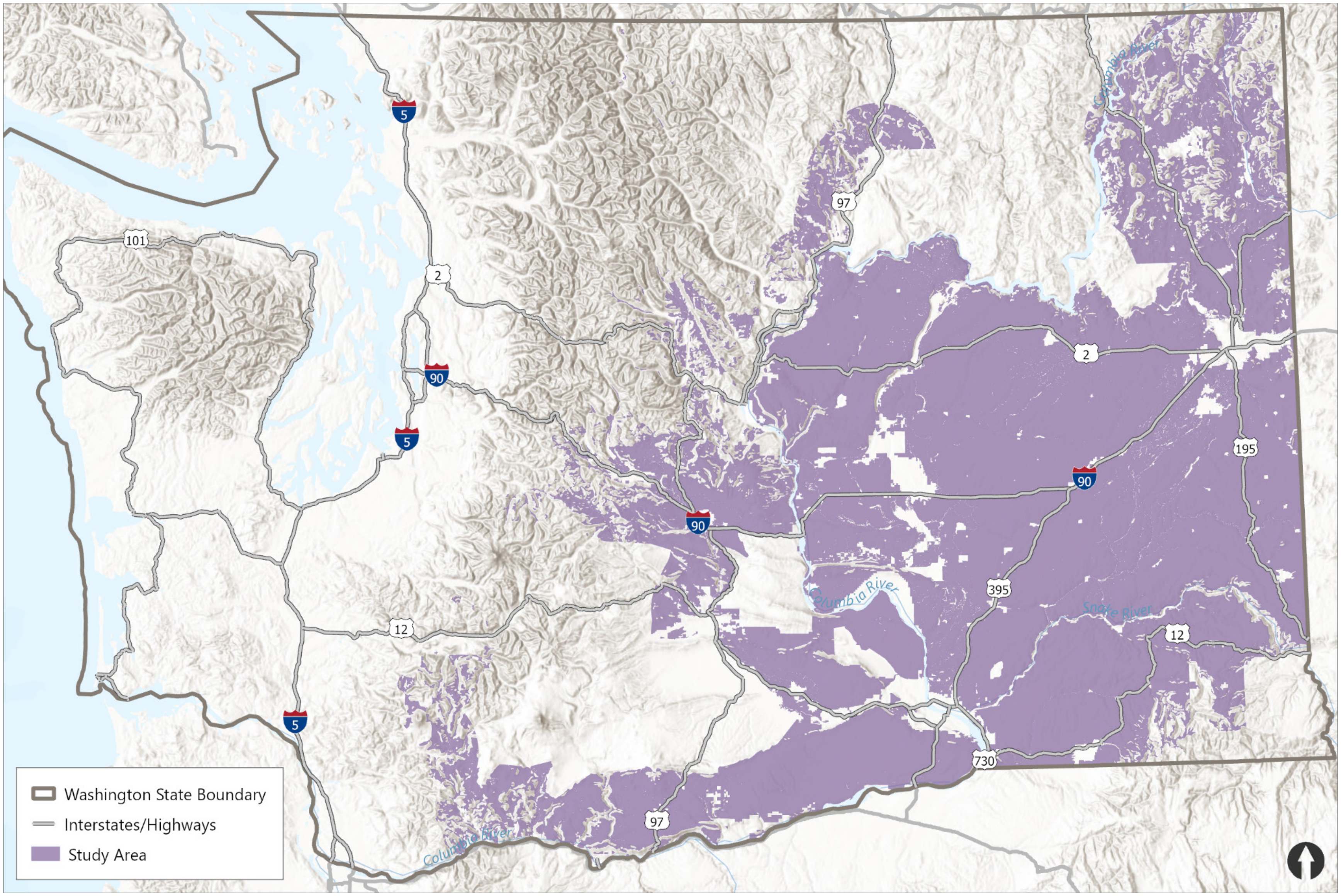

Figure 1. Solar Energy Facilities PEIS – geographic scope of study

2.2 Technical approach

The energy and natural resources evaluation was completed based on the following steps:

1. Determine energy and natural resource demands for previously analyzed utility-scale solar energy facilities. This includes attention to materials used to construct facilities, worker commuting; transportation of materials and equipment, and on-site equipment.
2. Calculate needs for these resources relative to the facility size, specifically per megawatt (MW) of installed capacity.
3. Compare the calculated needs with published information about sources and quantities of the energy and natural resources available in the study area. Where available energy and natural resources could not be quantified specifically for the study area, they were quantified for Washington state as a whole.

2.3 Impact assessment

Significant impacts on energy and natural resources would occur if a facility resulted in any of the following:

- Demand for electricity sufficient to induce construction of new production capacity (whether inside or outside of the study area)
- Permanently increased demand for transportation fuels sufficient to affect statewide annual production
- Demand for construction aggregate sufficient to induce one or more new surface mines

This resource report covers only impacts of energy consumption by a new solar energy facility. Impacts on public service or utility providers are analyzed in the *Public Services and Utilities Resource Report* (ESA 2024a). Emissions that may be associated with use of energy and natural resources are analyzed in the *Air Quality and Greenhouse Gases Resource Report* (ESA 2024b).

3 Technical Analysis and Results

3.1 Overview

This section describes the potential adverse impacts on energy and natural resources that might occur for a utility-scale solar facility analyzed in the PEIS. This section also evaluates actions that could avoid, minimize, or reduce the identified impacts, and potential unavoidable significant adverse impacts. This resource report analyzes resources and demands on secondary energy and construction aggregate during construction, operation, and decommissioning of the facilities considered.

3.2 Affected environment

Primary energy existing inside the study area consists of the following:

- Wind
- Sunlight
- Biomass
- Geothermal heat[1]
- Snowpack, glaciers, and other freshwater
- Petroleum and gas plays
- Coal deposits
- Uranium deposits

Utility-scale solar energy facilities do not substantively affect any primary energy resources, so these are not described further in this section.

Secondary energy available in the study area consists of the following:

- Electricity
- Gasoline
- Diesel fuel
- Fuel oil
- Natural gas
- Liquefied petroleum gas (LPG [e.g., propane])[2]

Utility-scale solar energy facilities do not demand secondary energy intended for stationary heating (fuel oil, natural gas, and LPG), so these are not described further in this section. Electricity and transportation fuels (gasoline and diesel fuel) are described in more detail below.

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[1] Geothermal heat refers to naturally occurring heat from below the earth's surface, not geothermal heat pumps or "geo-exchange," in which engineered systems move heat between above and below the ground surface.
[2] Aviation gasoline, kerosene (jet fuel), and marine diesel are also possible in the study area.

All remaining natural resources that are relevant to utility-scale solar energy facilities are evaluated in other PEIS resource reports, with the exception of construction aggregate, which is described in more detail below.

3.2.1 Electricity

In 2023, Washington State consumed 88,702 million kilowatt-hours (kWh) of electricity (Table 2).

Table 2. Electricity consumption in Washington, 2023

Sector	Energy consumed (million kWh)
Residential	38,787
Commercial	29,164
Industrial	20,648
Transportation	103
TOTAL	**88,702**

Washington is a net exporter of electricity, meaning that more electricity is generated in the state than consumed. In 2023, Washington generated 98,726 million kWh of electricity (Table 3). The State Energy Strategy provides estimates of future electricity needs for the state.

Table 3. Electricity generation in Washington, 2023

Primary energy source	Energy generated (million kWh)
Wind	7,601
Sunlight	363
Biomass	351
Freshwater	60,840
Petroleum	15
Natural gas	16,914
Coal	4,138
Uranium	8,435
Other	69
TOTAL	**98,726**

The primary energy sources used to generate electricity in Washington do not necessarily originate in Washington. In particular, all natural gas and all uranium used to generate electricity in Washington was imported into the state. Petroleum products were also derived from crude oil extracted elsewhere.

3.2.2 Transportation fuel

In 2019, Washington consumed 2.8 billion gallons of gasoline and 950 million gallons of diesel fuel (EIA 2024a).

As with electricity, Washington is a net exporter of transportation fuels. Washington has the fifth-largest crude oil refining capacity in the United States, processing domestic and foreign crude oils. The state's five refineries can process approximately 648,000 barrels of crude oil per day (EIA 2024b), producing approximately 4.2 billion gallons of gasoline and 2.5 billion gallons of diesel each year.[3] The Clean Fuel Standard (Chapter 70A.535 Revised Code of Washington [RCW]) requires suppliers to gradually reduce the carbon intensity of transportation fuels to 20% below 2017 levels by 2034.

3.2.3 Construction aggregate

Construction aggregate is the collective term for sand, gravel, and crushed stone. Regulatory agencies typically segregate this resource into the following two components: 1) sand and gravel; and 2) crushed stone. Production of each is surveyed at the state level on a quarterly time period by the U.S. Geological Survey, and surface mine permitting is handled by the Washington State Department of Natural Resources (DNR). Additionally, resource availability in the study area can be assessed from DNR aggregate resource maps. Active permitted aggregate surface mining resource sites are shown in Figure 2.

Though it is a non-renewable resource, construction aggregate is readily available in Washington. In 2023 Washington produced 30.9 million metric tons of sand and gravel from 544 active permitted surface mines, and 14.4 million metric tons of crushed stone from 298 active permitted surface mines (USGS 2024; DNR 2023).

[3] Assuming capacity factor (uptime) 90% and assuming 19.5 gallons of gasoline and 11.5 gallons of diesel produced from each barrel of input crude (see EIA 2024b).

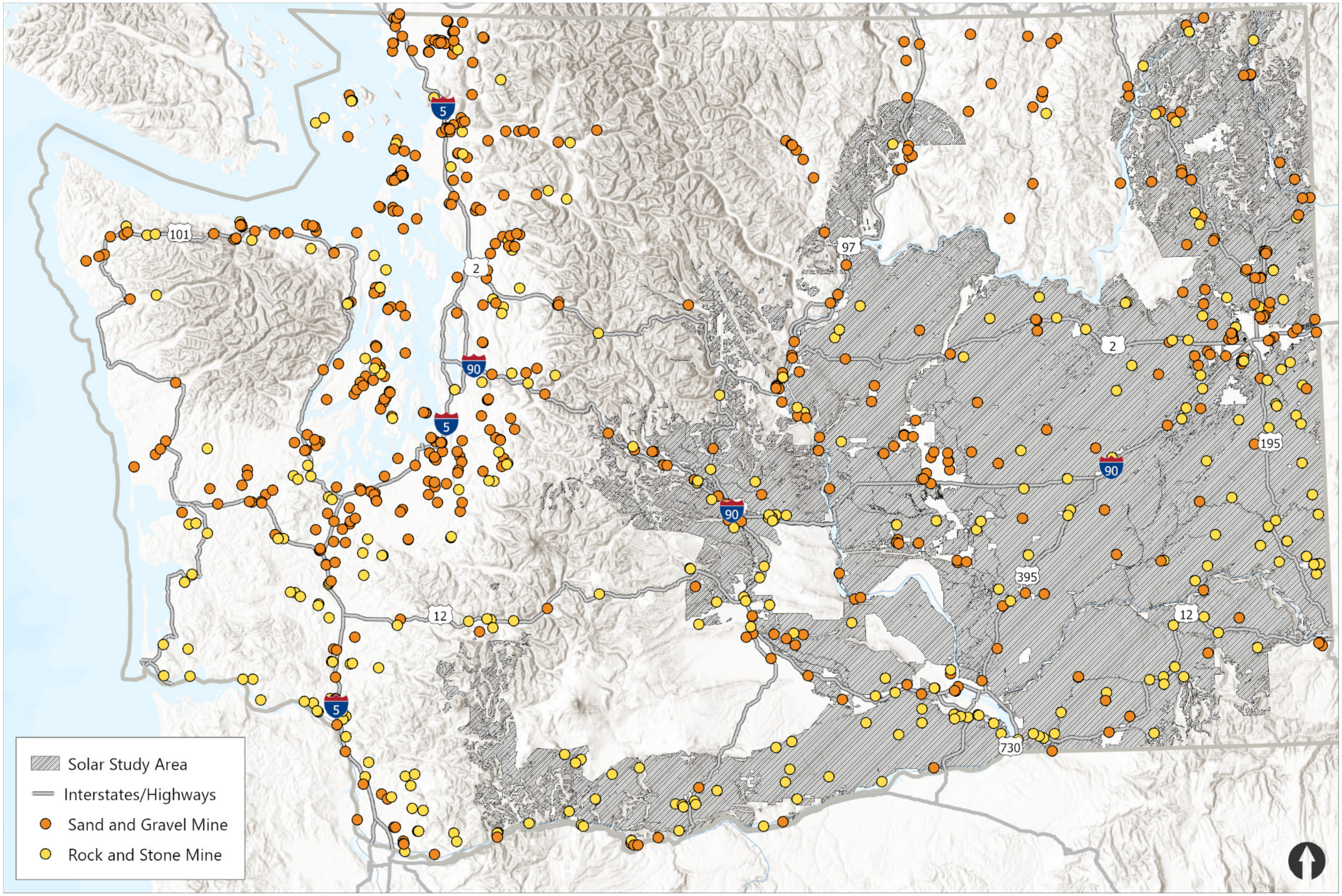

Figure 2. Aggregate resource locations

Data source: DNR 2023

3.3 Potentially required permits

If the facility developer would be drawing electricity from the local utility during the construction phase, then the following permit would be required (L&I 2024):[4]

- Washington State Department of Labor and Industries (L&I) electrical permit via Electronic Permit and Inspection System[5]

Transportation fuels consumed for utility-scale solar energy facilities would be purchased on the open market, which requires no permits.

If a facility includes extraction of sand, gravel, or rock for construction aggregate, then the following permits may be required. Solar energy facilities are not expected to include these activities on site.

- DNR's Surface Mining Reclamation Permit for extraction of materials such as sand, gravel, or rock from state- or privately owned lands
- The Washington State Department of Ecology's (Ecology's) Sand and Gravel Permit for extraction of materials that have a discharge of process wastewater, stormwater, or mine dewatering water

3.4 Small to medium utility-scale facilities of 20 MW to 600 MW (Alternative 1)

Solar energy facilities capable of generating between 20 and 600 MW of energy are assumed to range from 200 to 6,000 acres for purposes of the impact analysis. The demand for electricity, transportation fuels, and construction aggregate would vary depending on the size and nature of each solar facility. The extent and magnitude of impacts would also vary depending on the geographical region of a specific facility and the lengths of roads and generation-tie transmission lines (gen-tie lines) that may be required.

3.4.1 Impacts from construction

Small to medium facilities would consume electricity and transportation fuel during the site characterization and construction phase to run construction equipment, generators, and vehicles. Construction would use aggregate for concrete foundations for the solar array, gen-tie lines, and buildings and for constructing access roads. Gravel would likely be used for parking areas and equipment storage areas.

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[4] This resource report covers only impacts of energy *consumption* by an energy project. Additional permits are likely required for the energy project's generation intertie.

[5] Some cities, and Tacoma Power, displace the L&I electrical permits with their own electrical permits. However, because the study area excludes urban areas, the relevant permitting agency will always be L&I.

3.4.1.1 Electricity

During site characterization and construction activities, electricity would be needed to power construction tools and equipment and to power construction lighting. This demand can be met either with portable generators or with electricity provided by a utility. In the case of portable generators, the energy source used to generate electricity is diesel fuel and the generators would add to the transportation fuel demand (see next subsection). In the case of electricity provided by a utility, the facility developer would collaborate with the local utility to extend distribution infrastructure to the facility. Electricity demands for construction of small to medium facilities are typical of construction projects generally, and they are often dominated by construction trailers.

3.4.1.2 Transportation fuels

Small to medium facilities would consume transportation fuels during site characterization and construction for three broad purposes: on-road fuels (diesel and gasoline) for worker commuting, on-road fuels for haul-truck trips, and off-road fuels (diesel and dyed diesel) for site equipment.

The *Transportation Resource Report* estimates 100 to 400 workers per energy facility site, with construction lasting 6 to 18 months (ESA 2024c). Assuming an average 50-mile travel distance to the (remote) work site and an average light vehicle economy of 23.7 miles per gallon (mi/gal; Davis and Boundy 2022), between 55,700 gallons and 669,000 gallons of fuel demand for worker commuting during construction, without carpooling, is expected.

Building materials and solar and electrical equipment would be shipped to the site via various modes, but the demand on transportation fuel resources in the study area would be almost entirely from the final leg driven by trucks. The *Transportation Resource Report* estimates between 120 and 6,000 truck trips required for transporting solar equipment, assuming an average 150-mile travel distance to the work site and an average heavy track fuel economy of 6.2 mi/gal (Davis and Boundy 2022); this would equate to a demand for 5,810 to 290,000 gallons of fuel.

At the facility site, site preparation and road construction would employ earth-moving equipment such as bulldozers, excavators, and loaders. Foundation and structure installation might include equipment such as telehandlers, skidsteers, and pile drivers. Extrapolating estimates from proxy projects of similar sizes, on-site construction equipment is expected to demand between 53,200 and 1.6 million gallons of transportation fuel.

The combined transportation fuel consumed by worker commuting, delivery, and site equipment at small to medium solar energy facilities during construction would be 127,000 to 2.82 million gallons. Diesel or gasoline for construction would be purchased from suppliers in Washington. Relative to the total annual fuel production in Washington, 127,000 to 2.82 million gallons represents 0.004% to 0.089% of the total available transportation fuel resource produced in the state.

3.4.1.3 *Construction aggregate*

Construction of facilities would use aggregate for concrete foundations for the solar array, gen-tie lines, and buildings and for constructing access roads. Gravel would likely be used for parking areas and equipment storage areas.

Demand for aggregate during the construction phase would be about 287 cubic yards per MW of facility capacity (BLM 2013, 2021; Tetra Tech 2023). A small to medium utility-scale facility would demand between 5,750 cubic yards and 172,000 cubic yards of aggregate. Assuming 1 cubic yard of aggregate weighs 1 metric ton, relative to the 45.3 million metric tons of sand, gravel, and crushed stone produced in Washington in 2023 (see Section 3.2.3), these aggregate demands would range from 0.01% to 0.38% of the total available resource produced annually. The total of 45.3 million metric tons of aggregate comes from 842 active permitted surface mines in the state. Aggregate may need to be obtained from multiple mines, depending on the facility location. To keep costs down, facility proponents would typically source aggregate as close as possible to the proposed facility site, with a 25-mile haul typically doubling the cost of aggregate products (DNR 2024).

Impacts on aggregate resources in the vicinity of a facility site would primarily include a temporary reduction in available supply of those materials for other projects; however, the relative impact on those resources would be dependent on the number of local and regional suppliers as well as the number of other facilities to be constructed around the same time frame.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction of small to medium facilities would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.4.2 Impacts from operation

Operation includes maintenance activities that would likely require fuel for maintenance vehicles and tools. Electricity would be needed for lighting, heating, and other domestic purposes at buildings. Gravel would be needed for upkeep of access roads.

3.4.2.1 *Electricity*

A facility would consume electricity during operations and maintenance. Electricity would be used to power the tracking system of the solar arrays, operations and maintenance buildings, sensors, lights, and similar facility components. This energy consumption is much less than the energy generated by the facility and may be drawn from the facility’s own generation (“parasitic load”), or may be drawn from the local electric utility, depending on facility specifications.

3.4.2.2 Transportation fuels

Small to medium facilities would consume gasoline and diesel fuels for maintenance vehicles during the life of the facility. On-road diesel fuels and gasoline would be used to power vehicles for maintenance crews.

Demand for transportation fuels during the operations phase would be about 58 gallons of diesel and gasoline per year, per MW of nameplate capacity (BLM 2021; Tetra Tech 2023). A small to medium utility-scale facility would require between 1,150 gallons and 34,500 gallons of diesel and gasoline each year.

Relative to the total annual fuel production in Washington, gasoline and diesel required by a small to medium utility-scale facility would consume less than 0.0011% of the total available resource produced annually.

3.4.2.3 Construction aggregate

During operations and maintenance, construction aggregate would only be needed to maintain maintenance roads leading to photovoltaic (PV) arrays and supporting facilities. If it is assumed that new surface gravel is needed once every 5 years, and gravel would be 4 inches deep, average annual demand would range from 500 to 16,000 cubic yards per year depending on facility size and access points (Skorseth and Selim 2000).

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the operation of small to medium facilities would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.4.3 Impacts from decommissioning

Small to medium facilities would consume energy and natural resources during the decommissioning phase, similar in nature to those anticipated during construction activities.

3.4.3.1 Electricity

Decommissioning a facility at the end of its useful life would remove generating capacity from the region, which would have to be replaced by an equal amount of generation to meet energy demand.

Impacts on local electricity demand would be similar to construction. Electricity would be needed to run equipment necessary for decommissioning. This demand could be met through the use of portable generators or electricity brought in from the local utility.

3.4.3.2 Transportation fuels

Small to medium facilities would consume gasoline and diesel fuels for decommissioning activities and would mirror the demand for these fuels for the construction phase. This is because disassembly is more akin to construction then simple demolition, and materials would also need to be hauled away.

3.4.3.3 Construction aggregate

Because new infrastructure would not be created, decommissioning is not expected to require additional construction aggregate.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the decommissioning of small to medium facilities would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.4.4 Actions to avoid and reduce impacts

Site-specific mitigation actions would be developed during project-specific reviews and permitting for each facility proposed in the future. The following types of actions would avoid and reduce potential impacts.

3.4.4.1 Siting and design considerations

To reduce impacts on energy and natural resources, applicants may consider the following options:

- Limit construction of new roads and design new roads based on federal, state, and local requirements and based on local climate conditions, soil moisture, and erosion potential. Consider the use of existing roads, parking and staging areas, and utility corridors to the maximum extent feasible and if safe and structurally sound. Design any new access roads to the appropriate standard no higher than necessary for the intended function.
- Minimize electricity demand by using facility power for operational needs whenever possible, using high-efficiency fixtures and appliances in operations buildings, and using high-efficiency security lighting.

3.4.4.2 Permits, plans, and BMPs

This section lists actions associated with potential permits, plans, or best management practices (BMPs). BMPs are activities, maintenance procedures, managerial practices, or structural features that prevent or reduce adverse impacts. These may be required in permits or plans by a regulatory agency and include the following:

- If the facility has an aggregate storage capacity of oil greater than 1,320 gallons or where a discharge could reach a navigable water body, either directly or indirectly, a Spill Prevention, Control, and Countermeasure Plan is required to prevent spills during construction and operation and to identify measures to expedite the response to a release if one were to occur. The plan would be prepared in consultation with Ecology and pursuant to the requirements of *Code of Federal Regulations* Part 112, Sections 311 and 402 of the Clean Water Act, Section 402 (a)(1) of the Federal Water Pollution Control Act, and RCW 90.48.080.

- Minimize transportation fuels use by encouraging carpooling or electric vehicle use for work crews, providing multiple site access locations and routes, shifting work hours to facilitate off-peak commuting times to minimize congestion, or implement a ride-sharing or shuttle program. These actions would mitigate impacts related to the daily commutes of construction workers.
- Use alternative fuel, electric, or latest-model-year vehicles as facility service vehicles.
- Implement operational measures, such as limiting engine idling time and shutting down equipment when not in use.
- Limit the idling time of diesel equipment to no more than 5 minutes unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).
- Reuse suitable excavated materials to replace in disturbed areas once construction has been completed.
- Recycle all components of a facility that have the potential to be used as raw materials in commercial or industrial applications.
- Identify and secure commitments from aggregate suppliers with maximum possible notice.
- Schedule facility construction to avoid simultaneous large demands on the aggregate resource by other local projects.

3.4.5 Unavoidable significant adverse impacts

Through compliance with laws and permits and with implementation of actions to avoid and mitigate significant impacts, small to medium utility-scale solar facilities would have **no significant and unavoidable adverse impacts** on energy and natural resources from construction, operation, or decommissioning.

3.5 Large utility-scale facilities of 601 MW to 1,200 MW (Alternative 2)

Solar energy facilities capable of generating between 601 to 1,200 MW of energy are assumed to range from 6,010 to 12,000 acres for purposes of the impact analysis. The demand for electricity, transportation fuels, and construction aggregate would vary depending on the size and nature of each solar facility. The extent and magnitude of impacts would also vary depending on the geographical region of a specific facility and the lengths of roads and gen-tie lines that may be required. Most energy and natural resource demands of solar energy facilities scale linearly with facility size.

3.5.1 Impacts from construction

Large facilities would consume energy during the site characterization and construction phase to run construction equipment, generators, and vehicles. Construction would use aggregate for concrete foundations for the solar array, gen-tie lines, and buildings and for constructing access roads. Gravel would likely be used for parking areas and equipment storage areas.

3.5.1.1 Electricity

Though electricity demands for large facilities would be proportionally higher than those for small to medium facilities, the electric loads are identical, limited to low demands for some stationary construction equipment and construction trailers/housing. During site characterization and construction of large facilities, the demand for energy is not expected to require new or substantially modified production or energy transmission.

3.5.1.2 Transportation fuels

Construction worker travel times would likely be similar to those noted for small to medium facilities, but the size and schedule for the facilities would require more workers or a longer construction period. The *Transportation Resource Report* estimates 300 to 800 workers per large energy facility, with construction lasting 6 to 18 months. Assuming an average 50 mile travel distance to the (remote) work site and an average light vehicle economy of 23.7 mi/gal (Davis and Boundy 2022), between 167,000 gallons and 1.34 million gallons of fuel demand for worker commuting during construction, without carpooling, is expected.

On-site construction equipment activities would be similar for small to medium facilities, but scaled proportionately. Extrapolating estimates from proxy project of similar size, on-site construction equipment is expected to demand between 1.60 million and 3.19 million gallons of transportation fuel.

The demand for freight transport would increase proportionate to the larger site size and greater number of solar panels. Scaling estimates developed for the Bluebird Solar Energy Project provide a range of 557,000 gallons to 1.11 million gallons.

The combined transportation fuel consumed by worker commuting, delivery, and site equipment at large solar energy facilities would be 2.32 million to 5.64 million gallons. Diesel or gasoline for construction would be purchased from suppliers in Washington. Relative to the total annual fuel production in Washington, 2.32 million to 5.64 million gallons represents 0.073% to 0.2% of the total available transportation fuel resource produced in the state. This demand would be temporary over the 6- to 18-month construction period.

3.5.1.3 Construction aggregate

A large utility-scale facility would require between 173,000 cubic yards and 345,000 cubic yards of aggregate. Assuming 1 cubic yard of aggregate weighs 1 metric ton, relative to the 45.3 million metric tons of sand, gravel, and crushed stone produced in Washington in 2023 (see Section 3.2.3), these aggregate demands would range from 0.38% to 0.76% of the total available resource produced annually. This would be for the construction period of 6 to 18 months. The total of 45.3 million metric tons of aggregate comes from 842 active permitted surface mines in the state. Aggregate may need to be obtained from multiple mines, depending on the facility location.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction of large facilities would likely result in **less than**

significant impacts on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.5.2 Impacts from operation

3.5.2.1 Electricity

Though electricity demands for large facilities would be proportionally higher than those for small to medium facilities, the electric loads are identical, limited to low demands from the tracking system, operations and maintenance buildings, sensors, lights, and similar facility components.

3.5.2.2 Transportation fuels

Demand for transportation fuels during the operations phase of a large utility-scale facility would be between 34,600 gallons and 69,000 gallons of diesel and gasoline each year.

Relative to the total annual fuel production in Washington, gasoline and diesel required by a large utility-scale facility would consume less than 0.0022% of the total available resource produced annually.

3.5.2.3 Construction aggregate

If it is assumed that new surface gravel is required once every 5 years, at a depth of 4 inches, average annual demand would range between 16,000 and 31,000 cubic yards per year depending on facility size and access points.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the operation of large facilities would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.5.3 Impacts from decommissioning

Large facilities would consume energy and natural resources during the decommissioning phase, similar in nature to those anticipated during construction activities.

3.5.3.1 Electricity

Decommissioning impacts on local or regional demand for electricity would be similar to construction.

3.5.3.2 Transportation fuels

Decommissioning large facilities would require between 2.3 million and 5.6 million gallons of transportation fuels.

3.5.3.3 Construction aggregate

Because new infrastructure would not be created, decommissioning is not expected to require additional construction aggregate.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the decommissioning of large facilities would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.5.4 Actions to avoid and reduce impacts

Actions to avoid and reduce impacts for large facilities are the same as those identified for small to medium facilities (Section 3.4.4).

3.5.5 Unavoidable significant adverse impacts

Through compliance with laws and permits and with implementation of actions to avoid and mitigate significant impacts, large utility-scale solar energy facilities would have **no significant and unavoidable adverse impacts** on energy and natural resources from construction, operation, or decommissioning.

3.6 Solar energy facility and co-located battery energy storage system (Alternative 3)

While incorporating co-located battery energy storage systems (BESSs) and solar facilities requires additional construction inputs, adding BESS to conventional solar makes solar energy dispatchable to meet demand, even when the sun is not activating PV panels.

BESS systems are typically containerized and require a small portion of the overall facility footprint. BESSs can be added inside the boundary of the utility-scale solar facility they support.

3.6.1 Impacts from construction

Relative to a conventional solar installation, solar augmented with a BESS would require a small amount of additional resources during construction for the BESS portion of the facility.

3.6.1.1 Electricity

Compared to facilities analyzed in Sections 3.4 and 3.5, construction of a utility-scale solar energy facility and a co-located BESS would be similar, with a minor addition of additional electricity demand for constructing the BESS storage container or structure. Electricity use may be more intensive for short periods during testing of the installed BESS equipment, prior to regular operations. Similar to facilities without a BESS, the demand for energy during construction is not expected to require new or substantially modified production or energy transmission.

3.6.1.2 Transportation fuels

Adding BESS to conventional solar facilities would require some additional hours for construction and installation, increasing demand for transportation fuels to support worker commuting. Impacts would be similar to facilities described in Sections 3.4 and 3.5, except that more truck trips would be required to transport the BESS and any additional gravel needed for the areas around the BESSs, and a few additional containers of support materials and equipment delivery may be required. The relative increase in fuel for construction of the BESS would be minimal compared to what is already demanded for construction of the larger facility.

3.6.1.3 Construction aggregate

A BESS would typically be installed on a concrete slab and/or gravel area. The estimated aggregate required would be about 1,000 cubic yards per acre, and an acre of slab would be sufficient to support 40 to 200 megawatt-hours of BESS capacity. Facilities without a BESS were estimated to require 5,750 to 345,000 cubic yards, so the addition of a BESS to a facility would not be a dramatic change to aggregate demand. Therefore, construction impacts would be similar to facilities without a BESS.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction of solar energy facilities with co-located BESSs would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.6.2 Impacts from operation

A BESS would require additional resources during operations and maintenance.

3.6.2.1 Electricity

Electricity demands for facilities with a BESS would be similar to facilities without a co-located BESS. BESSs have a round-trip efficiency of approximately 90% (EIA 2021). That is, approximately 10% of the stored energy is lost as heat during operation of the system. This loss can be characterized as an energy requirement of the system, but because the lost energy is drawn entirely from the storage input, it is not drawn from the associated electric grid.

3.6.2.2 Transportation fuels

Adding BESSs to a conventional solar facility would require additional hours for maintenance, which would result in a minor increased demand for transportation fuels beyond to what is already demanded for operation of the facility as a whole.

3.6.2.3 Construction aggregate

Similar to facilities without a BESS, during operations and maintenance, construction aggregate would be needed only to maintain maintenance roads. Since the BESS would be co-located with other facility areas, there are no additional demands for aggregate resources during operations.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the operation of solar energy facilities with co-located BESSs would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.6.3 Impacts from decommissioning

3.6.3.1 Electricity

Impacts from decommissioning would be similar to impacts from construction for electricity.

3.6.3.2 Transportation fuels

Decommissioning would also have approximately the same demand for transportation fuels as construction.

3.6.3.3 Construction aggregate

Because new foundations and infrastructure would not be created, decommissioning is not expected to require additional construction aggregate.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the decommissioning of solar energy facilities with co-located BESSs would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.6.4 Actions to avoid and reduce impacts

Actions to avoid and reduce impacts are the same as those identified for small to medium facilities (Section 3.4.4).

3.6.5 Unavoidable significant adverse impacts

Through compliance with laws and permits and with implementation of actions to avoid and mitigate significant impacts, utility-scale solar energy facilities with co-located BESSs would have **no significant and unavoidable adverse impacts** on energy and natural resources from construction, operation, or decommissioning.

3.7 Solar energy facility combined with agricultural land use (Alternative 4)

3.7.1 Impacts from construction

3.7.1.1 Electricity

Demands on local electricity during construction would be the same as those considered for facilities in Sections 3.4 and 3.5. Similar to facilities without agricultural land use, the demand for energy during construction is not expected to require new or substantially modified production or energy transmission.

3.7.1.2 Transportation fuels

Demands on transportation fuels during construction would be similar to those considered for facilities without agricultural land use. A small reduction may be induced by lower construction aggregate deliveries and less road construction (see Section 3.7.1.3), or there could be a need for some additional truck trips for different material or components for different facility layouts to accommodate agricultural use. Therefore, construction of facilities combined with agricultural land use would have impacts on transportation fuels similar to facilities without agricultural land use.

3.7.1.3 Construction aggregate

Agrivoltaic system installation may demand less construction aggregate than facilities without agricultural land use if facility design focuses on maximizing arable land and minimizing access roads. Therefore, construction impacts would be less than or similar to facilities without agricultural land use.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the construction of solar energy facilities with co-located agricultural use would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.7.2 Impacts from operation

For a facility that includes agricultural land uses, any existing agricultural lands would be maintained, or new agricultural use could be co-located with the utility-scale solar facility, including rangeland or farmland. Activities at agrivoltaic facilities may include maintenance of existing or addition of new infrastructure, roads, fences, gates, and operation of farming machinery. If the agricultural uses exist prior to facility construction, there would not be additional energy or resource use beyond the continuation current conditions and the impacts considered for facilities without agricultural uses. New agricultural uses could generate some additional seasonal and temporary resource use from discing, harvesting, or other activities involving agricultural equipment. During operations, the agrivoltaic features of these facilities could require more maintenance-related truck trips, which would vary by facility.

3.7.2.1 Electricity

Agrivoltaics can increase solar energy production from the cooler air zone created under modules. Solar PV panels work most efficiently below a certain temperature threshold. Plants that are co-located with solar installations cool solar panels from below via evapotranspiration, helping them produce electricity more efficiently (USDA 2024). This is a contrast with a conventional solar installation, which prioritizes eradicating plant growth and, with that, any associated cooling benefits. Relative to a conventional installation, panels installed in an agrivoltaic system would be expected to more efficiently produce energy for the regional power grid.

Agriculture can draw significant amounts of electricity, in particular for running irrigation pumps. Shading provided by solar panels can reduce the need for irrigation relative to farms operating independently of solar energy generation (NREL 2022, 2024; Zainol Abidin et al. 2021). The area-specific demand for irrigation is driven still lower by the simple fact of sharing acreage with the PV equipment. Between these two effects, the agrivoltaic demand for electric service is expected to be lower on a per-acre basis than conventional agriculture. The farmer can realize benefits by directly drawing on the energy produced on-site rather than from the local utility, providing two benefits. First, it reduces demand on the local electricity provider. Second, it reduces the amount of energy purchased at retail prices, while still supplying electricity back to the grid at wholesale prices.

Because agrivoltaics have a lower area-specific demand than conventional agriculture, and because the energy facility can supply on-site electricity for farming operations, solar facilities co-located with agriculture are not anticipated to have additional electricity demand compared to facilities without agricultural uses.

3.7.2.2 Transportation fuels

As with electricity demand, sharing acreage with the PV equipment means that agrivoltaic area-specific demand for transportation fuels may be lower than for conventional agriculture. Facilities without agricultural land uses must suppress plant growth to prevent solar panel obstruction. This is usually accomplished with herbicides or regular mowing. In contrast, agrivoltaics can keep solar panels unobstructed by maintaining low-height native plants or pollinator habitat, incorporating grazers on the land to manage plant height, or planting certain crops under and around solar panels that would not grow high enough to cast shade. Agrivoltaics may therefore avoid use of some transportation fuels for mowing and herbicide applications that were assumed for facilities without agricultural use.

3.7.2.3 Construction aggregate

During operations and maintenance, demand for construction aggregate would be unchanged from those expected for facilities without agricultural land use.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the operation of solar energy facilities with co-located agricultural use would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.7.3 Impacts from decommissioning

3.7.3.1 Electricity

Impacts from decommissioning would be similar to impacts from construction for electricity.

3.7.3.2 Transportation fuels

Decommissioning would also have approximately the same demand for transportation fuels as construction.

3.7.3.3 Construction aggregate

Because new foundations and infrastructure would not be created, decommissioning is not expected to require additional construction aggregate.

Through compliance with laws and permits and with implementation of actions that could avoid and reduce impacts, the decommissioning of solar energy facilities with co-located agricultural use would likely result in **less than significant impacts** on energy and natural resources, including electricity, transportation fuels, and construction aggregate.

3.7.4 Actions to avoid and reduce impacts

Actions to avoid and reduce impacts are the same as those identified for small to medium facilities (Section 3.4.4).

3.7.5 Unavoidable significant adverse impacts

Through compliance with laws and permits and with implementation of actions to avoid and mitigate significant impacts, utility-scale solar energy facilities with co-located agricultural use would have **no significant and unavoidable adverse impacts** on energy and natural resources from construction, operation, or decommissioning.

3.8 No Action Alternative

Under the No Action Alternative city, county, and state agencies would continue to conduct environmental review and permitting for utility-scale solar energy development under existing state and local laws on a facility-by-facility basis.

The potential for energy and natural resource use for future utility-scale solar energy developments under the No Action Alternative would be the same as those noted for Alternatives 1 through 4, depending on facility size and design, and would have **less than significant impacts**.

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