

Supply Chain	Component	Description of Component	State of U.S. Supply Chain
Batteries	Electrolytes - liquid	An electrolyte is the medium, which can be liquid or solid, that provides ion transport between the	Moderate
Batteries	Electrolytes - solvents	An electrolyte is the medium, which can be liquid or solid, that provides ion transport between the	Limited
Batteries	Electrolytes - additives	Additives are one of the electrochemically active materials that contribute to the electrochemical	Moderate
Batteries	Anode materials - natural graphite	Most lithium-ion batteries have a graphite anode. Both natural and synthetic graphite can be used.	Moderate
Batteries	Anode materials - synthetic graphite	Most lithium-ion batteries have a graphite anode. Both natural and synthetic graphite can be used.	Moderate
Batteries	Anodes	Anodes are one of the major components of lithium-ion batteries. They are the negative battery	Limited
Batteries	Precursor cathode materials	LiB cathode production requires high purity precursor materials to ensure high performance and	Limited
Batteries	Cathode materials - cobalt sulfate (CoSO ₄)	The cathode of a lithium-ion battery can have many different chemistries, depending upon the	Limited
Batteries	Cathode materials - nickel sulfate (NiSO ₄)	The cathode of a lithium-ion battery can have many different chemistries, depending upon the	Limited
Batteries	Cathode materials - lithium hydroxide (LiOH)	Lithium hydroxide is one of the main compounds produced for use in Li-ion cells, specifically for	Limited
Batteries	Cathode materials - lithium carbonate (Li ₂ CO ₃)	Lithium carbonate is one of the main compounds produced for use in Li-ion cells, specifically for	Limited
Batteries	Cathode active materials (e.g. NCA, NMC, LCO, etc.)	In lithium-ion batteries, lithium ions move between an anode and a cathode through an electrolyte. The	Limited
Batteries	Binder	Binder materials hold the active material particles within the electrode of a lithium-ion battery (LiB)	Limited
Batteries	Battery management system	A component of battery energy storage system that monitors and protects the battery pack, preventing	Significant
Batteries	Battery thermal management system (B-TMS)	Thermal management systems control the temperature of the cells according to their	Significant
Batteries	Electrical systems	Component of battery energy storage system.	Moderate
Batteries	Separators	Separators for lithium-ion batteries are generally made of polyethylene, polypropylene, or layered	Moderate
Batteries	Controller	A component of battery energy storage system, for monitoring, controlling, protecting, and	Limited
Batteries	Battery cells	An electrochemical cell comprised of one or more positive electrodes and one or more negative	Significant
Batteries	Battery module	A module with 2 or more battery cells configured electrically, in series or parallel, to create voltage or	Significant
Batteries	Battery pack	A pack is a cluster of modules, which is a cluster of cells.	Significant
Batteries	Inverter	Inverters in energy storage systems convert direct current (DC) power stored in the batteries into	Significant
Batteries	Container housing		NA
Batteries	Packaging		NA

Electric grid	Large power transformers (LPTs)	LPTs are a key grid component needed to modernize and increase the capacity of the U.S. power grid and	Limited
Electric grid	Large power transformer cores	Cores, also known as laminations, are made from high-permeability and domain-refined GOES.	Moderate
Electric grid	Grain-oriented electrical steel (GOES) (for LPTs)	Grain-oriented electrical steel (GOES) is a key material input for the LPT supply chain.	Limited
Electric grid	Continuously transposed conduction (CTC) copper wire (for	CTC copper wire is a key material input for the LPT supply chain.	Limited
Electric grid	Conservator tanks (for LPTs)	The conservator system consists of several main components that facilitate the cooling of the	Moderate
Electric grid	Conservator bladders (for LPTs)	The conservator system consists of several main components that facilitate the cooling of the	None
Electric grid	Insulating materials (for LPTs)	Cellulose derived materials used as solid insulation within a	Moderate
Electric grid	Tap changers (for LPTs)	A transformer tap changer is a component designed to change the output voltage of a transformer by	Moderate
Electric grid	Bushings (for LPTs)	Bushings provide the electrical connection between a transformer and the electrical transmission	Moderate
Electric grid	Converters (for HVDC transmission)	Converters are key component to control Voltage/ Current/Power. There are 2 main types of HVDC	None
Electric grid	DC breakers/switchgears (for HVDC transmission)	DC breakers are a key component to cut DC current. There are 2 types of DC breakers (switchgear): one is	None
Electric grid	DC filters (for HVDC transmission)	The filters consist of capacitors, inductors, and resistors.	None
Electric grid	AC Switchyards (assembly) (for HVDC transmission)	An AC switchyard connects the AC transmission line with the HVDC converter station. The primary	Moderate
Electric grid	Insulated-gate bipolar transistors - (IGBT) (for HVDC transmission)	A voltage controlled power electronics device that acts as an output switch.	None
Electric grid	Capacitor	Component of the DC filter	Moderate
Electric grid	Inductor	Component of the DC filter	None
Electric grid	Arrestor	Component of the DC filter and AC switchyards	Moderate
Energy efficiency	Heat pump assembly	An outdoor unit that uses heat sinks to transfer heat from outside to inside or vice versa. Used in both residential and commercial applications--mostly in	Significant
Energy efficiency	Residential electric water heaters	This category includes the following electric appliances for heating water:	Moderate
Energy efficiency	Insulation	Insulation is used to trap warm or cool air inside a building, improve occupant comfort, and protect	Significant
Rail	Transit and passenger rail	Train, subway, and transit car manufacturing	Significant
Hydrogen	Electrolyzers	Electrolyzers, which use electricity to split water into hydrogen and oxygen, are a critical technology for	NA - nascent market
Hydrogen	Fuel cells	Fuel cells react hydrogen and oxygen to generate electricity with water as a byproduct. This includes	NA - nascent market
Solar	Metallurgical-Grade Silicon (MGS)	Metallurgical-grade silicon (MGS) is the primary input material for polysilicon (it is also called silicon	Significant
Solar	Solar-grade polysilicon	Polysilicon is the high-purity product obtained by refining MGS. PV is the primary consumer of	Moderate

Solar	PV wafer	A thin slice, sheet, or layer of semiconductor material of at least 240 square centimeters that	None
Solar	PV cell (crystalline or thin-film)	The PV cell is the smallest semiconductor element of a solar module. It performs the immediate	None
Solar	Polymeric backsheet (laminators)	A sheet on the back of a solar module that serves as an electric insulator and protects the components of	Significant
Solar	Backsheet materials (film extrusion)	Nearly all backsheets use polyester (PET), often in combination with polyvinyl fluoride (PVF),	Limited
Solar	Backsheet materials (PVF resins)	Nearly all backsheets use polyester (PET), typically in some combination with polyvinyl fluoride (PVF),	Limited
Solar	Encapsulant film	Encapsulant film forms a protective barrier around the PV cells, essentially laminating the cells. The	Moderate
Solar	PV Module	Connected and laminated PV cells within a protected final assembly, ready for installation. Module	Significant
Solar	Inverter - general	Inverters convert direct current (dc) electricity from the modules into alternating current (ac) for	Significant
Solar	Torque tube	A structural steel support element that is part of a solar tracker. Torque tubes are rotated by a drive	See trackers and steel tubes
Solar	Steel tubes	A structural steel support element.	Significant
Solar	Structural fasteners	A component used to connect the mechanical and drive system components of a solar tracker to the	Moderate
Solar	Inverter - subcomponents: optimizers	Components are generally manufactured in separate locations from where they are eventually assembled	Moderate
Solar	c-Si ingot	Polysilicon is melted to grow monocrystalline silicon ingots. The monocrystalline silicon ingot then gets	None
Solar	Trackers - general	PV trackers are used to orient modules more directly toward the sunlight to increase energy production	Significant
Solar	Combiner boxes	Electronics required to perform tracking algorithm, including weather reading, sensors, and	Moderate
Solar	Charge controller	(For direct current systems). The charge controller regulates the flow of electricity from the PV modules	Moderate
Solar	Balance-of-module components - Flat glass	Flat glass used for PV module assembly.	Limited
Solar	Racking / Mounting structures (aluminum and steel)	PV mounting structures hold PV panels in place. Steel rails connect PV modules to the tracker.	Significant
Solar	Junction box (including connectors)	The junction box houses all the electric components for a solar panel. They function to connect the solar	Significant
Solar	Edge Seals	Edge seals are protective barriers or seals that are applied around the edges of the solar module to	Significant
Solar	Pottants	Pottants, also known as potting compounds or encapsulation resins, are used for sealing and	Significant
Solar	Adhesives	Adhesives are used throughout the manufacturing process for solar panels. For example, they are used	Significant
Solar	Bus ribbons	Bus ribbons are metal conductors used to interconnect solar cells within a solar module or	NA
Solar	Bypass diodes	Bypass diodes are module component that provide an alternate current when a cell or panel becomes shaded or faulty	NA
Vehicles - electric, fuel cell,	Light-duty electric vehicle (LDV EV) as	Light-duty battery electric vehicles and plug-in hybrid vehicles	Moderate

Vehicles - electric, fuel cell,	Medium- and heavy-duty electric vehicles	Electric busses, heavy trucks, and medium duty trucks and vans.	Moderate
Vehicles - electric, fuel cell,	EV charging assembly	Assembly of EV Charging Units - Level 2 and DC fast chargers.	NA
Wind	Generator (component of the drivetrain)	The generator is a component of the drivetrain, which, along with the gearbox, converts the torque	Moderate
Wind, offshore	Blade	A blade that is responsible for converting wind energy to low-speed rotational energy	None
Wind, offshore	Tower	A tubular or lattice structure that supports the nacelle and rotor of a wind turbine.	None
Wind, offshore	Flanges	A flange is a large-diameter component used to connect	None
Wind, offshore	Offshore wind vessel	A vessel used for the development, transport, installation, operation, or maintenance of offshore	None
Wind, offshore	Offshore wind foundation	The foundation secures an offshore wind tower and other above-water components to the seafloor using	Limited
Wind, offshore	Offshore wind transition piece	Transition pieces house access and safety equipment and act as a connection between the tower and	None
Wind, offshore	Offshore wind mooring system	This is part of the offshore wind foundation.	None
Wind, offshore	Substation assembly	Offshore wind substations collect electrical power from multiple wind turbines, step up the power to a higher voltage, and transmit the power to on	Limited
Wind, offshore	Large steel plates	Large steel plates are rolled into the circular monopile or tower sections	None
Wind, offshore	Nacelle (assembly)	The nacelle houses the drivetrain, including the generator and gearbox (for geared drivetrains),	None
Wind, offshore	Hub	Hubs are comprised of large castings made of iron.	None
Wind, offshore	Bearings - yaw, pitch	A wide range of bearings serve different functions throughout a wind turbine, mainly to assist rotation	None
Wind, offshore	Cables, array and export	Array cables link individual wind turbines to the offshore substation. They are connected to each	Limited
Wind, offshore	Power converter	Power converters enable the efficient conversion of the variable frequency output from an induction	None
Wind, onshore	Blade	A blade that is responsible for converting wind energy to low-speed rotational energy	Limited
Wind, onshore	Tower	A tubular or lattice structure that supports the nacelle and rotor of a wind turbine.	Moderate
Wind, onshore	Flanges	A flange is a large-diameter ring shaped connector that is used to assemble the bodies of the steel	Limited
Wind, onshore	Power converter	Power converters enable the efficient conversion of the variable frequency output from an induction	Significant
Wind, onshore	Gearboxes (component of the drivetrain)	In geared drivetrains, gearboxes are used to increase the rotational speed from a low speed rotor to a	Limited
Wind, onshore	Forged rings and shafts	Forged rings and shafts are used in several components, including the main generator shaft,	NA
Wind, onshore	Nacelle (assembly)	The nacelle houses the drivetrain, including the generator and gearbox (in geared drivetrains), as well as other subcomponents including the yaw	Significant
Wind, onshore	Hub	Hubs are comprised of large castings made of iron.	Limited

Wind, onshore	Bearings - onshore	A wide range of bearings serve different functions throughout a wind turbine, mainly to assist rotation (e.g. clawing ring bearing, pitch bearing, yaw	Moderate
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Description of U.S. Supply Chain	45X & 48C Eligibility	Description of 45X Coverage
According to the DOE Grid Energy Storage Supply	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
According to the DOE Grid Energy Storage Supply	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
The NAATBatt Lithium-Ion Battery Supply Chain	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
There are 6 facilities that produce natural graphite	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
There are 4 facilities that produce synthetic graphite	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
According to the DOE Grid Energy Storage Supply	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials)
There is 1 U.S. facilities producing cathode	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
The DOE Grid Energy Storage report notes that	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
The DOE Grid Energy Storage report notes that	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
There are 2 facilities listed in the NAATBatt Lithium-	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
The DOE Grid Energy Storage Supply Chain Deep	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
In the U.S., 2 foreign-owned companies, BASF	45X & 48C eligible	One of the battery components listed as eligible for 45X (electrode active materials, which includes
2 U.S. facilities produce binders according to the	45X & 48C eligible	One of the battery components listed as eligible for 45X (for anode and cathode materials)
At least 6 facilities produce battery management	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
There are over 20 domestic facilities that produce	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
There are five US facilities that produce electrical	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
The United States has 3% of global capacity for	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
Only 1 facility in the NAATBatt database is	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
Battery cell production is an area in which the	45X & 48C eligible	One of the battery components listed as eligible for 45X
The DOE Grid Energy Storage Supply Chain Deep	45X & 48C eligible	One of the battery components listed as eligible for 45X
The U.S. has significant module, pack, and rack	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
Many facilities that produce inverters for solar	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
Insufficient data for assessment.	48C only	45X covers most of the components for batteries (anode materials, cathode materials,
Insufficient data for assessment.	48C only	45X covers most of the components for batteries (anode materials, cathode materials,

According to the DOE Electric Grid Supply Chain	48C only	45X does not cover grid modernization components like large power transformers (LPTs), but these fit
For large power transformer cores, the	48C only	45X does not cover grid modernization components like large power transformers (LPTs), but these fit
GOES is a major weak point in the LPT supply	48C only	45X does not cover grid modernization components like large power transformers (LPTs), but these fit
According to the Electric Grid Supply Chain Deep	48C only	45X does not cover grid modernization components like large power transformers (LPTs), but these fit
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According to the Electric Grid Supply Chain Deep	48C only	45X does not cover grid modernization components like large power transformers (LPTs), but these fit
Manufacturing of key components of the	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
Demand for HVDC components like DC	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
Demand for HVDC components like DC filters	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
Demand for HVDC components like AC	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
There is not significant domestic manufacturers	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
According to the DOE Electric Grid Supply Chain	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
No significant domestic manufacturers for this	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
According to the DOE Electric Grid Supply Chain	48C only	45X does not cover grid modernization components like high-voltage direct current technology (HVDC),
According to the IEA Technology Perspectives Report (2023) in 2021	48C only	45X does not cover energy efficiency technology, but 48C covers investments in facilities that produce or
Combining data on shipments of domestically	48C only	45X does not cover energy efficiency technology, but 48C covers investments in facilities that produce or
BGA's database at BuildingClean.org lists	48C only	45X does not cover energy efficiency technology, but 48C covers investments in facilities that produce or
According to IBISWorld, the US Train, Subway and	No	Neither 45X nor 48C cover rail transit
Due to the dynamic and emerging nature of	48C only	Not covered by 45X. Covered by 48C under investment
Due to the dynamic and emerging nature of the	48C only	Not covered by 45X. Covered by 48C under investment
There are currently 6 plants producing MGS in	48C only	While 45X covers polysilicon refining, the language does not mention that primary inputs for polysilicon
Four operating polysilicon facilities are listed in the	45X & 48C eligible	This is one of the solar energy components eligible for 45X

The DOE Solar Deep Dive report notes that the	45X & 48C eligible	This is one of the solar energy components eligible for 45X
No operational facilities producing PV cells are	45X & 48C eligible	This is one of the solar energy components eligible for 45X
Backsheets for solar modules are typically	45X & 48C eligible	This is one of the solar energy components eligible for 45X
The DOE notes that PVDF-based backsheets	48C only	While 45X covers polymeric backsheets, the language does not mention coverage of subcomponents or
PVF resin is manufactured at two U.S. facilities,	48C only	While 45X covers polymeric backsheets, the language does not mention coverage of subcomponents or
While the United States has significant capability to	48C only	45x does not mention the encapsulant film component for PV modules. 48C covers investments
U.S. module assembly (with imported cells)	45X & 48C eligible	This is one of the solar energy components eligible for 45X
There are 16 domestic inverter facilities listed	45X & 48C eligible	This is one of the solar energy components eligible for 45X
	45X & 48C eligible	This is one of the solar energy components eligible for 45X
There are at least 14 U.S. facilities that produce	45X & 48C eligible (for torque tubes only)	Torque tubes are covered under 45X but not other types of steel tubes used in solar installations
Generally solar fasteners are standard parts that are	45X & 48C eligible	This is one of the solar energy components eligible for 45X
Only one domestic optimizer producer was	48C only	45x covers five types of inverters (central, utility, commercial, residential, and micro), but doesn't
The United States has not active c-Si ingot, wafer, or	Possibly 45X & 48C eligible	It is unclear whether this is covered under 45X. 45X covers solar grade polysilicon, as well as the wafers
In total, there are about 26 U.S. facilities that produce	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention other components of
There are four facilities in the DOE's solar	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention other components of
BGA identified three manufacturers and four	48C only	45x coverage does not mention balance of module component items like the charge controller. 48C
Because of the current gaps in the domestic PV	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention other components of
China currently manufactures a significant	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
BGA identified 3 manufacturers with 15	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
Most companies that produce resins and epoxy	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
BGA identified over 50 US facilities, operated by four	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
BGA identified over 50 US facilities, operated by four	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
Insufficient data for assessment. BGA identified	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/
Insufficient data for assessment. BGA identified at least three domestic	48C only	45x covers torque tubes and structural fasteners for tracking, but does not mention structures for racking/ mounting or other components of the tracking
In 2022, domestic production accounted for	48C only	45X does not cover vehicles (apart from battery components), 48C covers investments in production

There are currently over 20 manufacturing plants	48C only	45X does not cover vehicles (apart from battery components), 48C covers investments in production
Limited data is available regarding the current scale	48C only	45X does not cover vehicles (apart from battery components), 48C covers investments in production
Domestically produced generators represent 36%	48C only	Within the nacelle, 45x only seems to cover assembly of the drivetrain and other tower-top components
It may be possible to leverage existing suppliers	45X & 48C eligible	This is one of the wind energy components covered under 45X.
Original equipment manufacturers and project	45X & 48C eligible	This is one of the wind energy components covered under 45X.
Flanges are not manufactured domestically	45X & 48C eligible	These are likely covered under 45X since they are part of the towers (which are covered)
Qualified installation vessels are under	45X & 48C eligible	This is one of the wind energy components covered under 45X.
To date, domestic offshore wind manufacturing is	45X & 48C eligible	This is one of the wind energy components covered under 45X.
No major facilities for transition piece	45X & 48C eligible	This is one of the wind energy components covered under 45X.
There is no evidence of facilities	45X & 48C eligible	This is one of the wind energy components covered under 45X.
As of 2021, there was not domestic offshore wind supply chain capacity	48C only	Wind components covered by 45X don't seem to include substations / grid connection equipment. 48C covers investments in facilities that produce or recycle
While some U.S. manufacturers will be able to fabricate the smaller	45 eligible	These are likely covered under 45X as they are a key component of offshore wind foundations and towers (both of which are covered)
Original equipment manufacturers and project	45X & 48C eligible	This is one of the wind energy components covered under 45X. It covers "the assembly of the drivetrain
Operational manufacturing facilities for offshore wind	48C only	45x only seems to cover blades, nacelle, tower, offshore wind vessels, and offshore wind foundations.
There is not domestic production of bearings	48C only	Within the nacelle, 45x only seems to cover assembly of the drivetrain and other tower-top components
Grid interconnection cabling and equipment is	48C only	Wind components covered by 45X don't seem to include subcomponents like cables (while 45x does
No evidence of facilities producing power	48C only	45x only seems to cover blades, nacelle, tower, offshore wind vessels, and offshore wind foundations.
The domestic wind industry supply chain	45X & 48C eligible	This is one of the wind energy components covered under 45X.
As of 2021, the US had capacity to produce towers	45X & 48C eligible	This is one of the wind energy components covered under 45X.
BGA confirmed only one domestic facility producing	48C only (possibly 45X)	45x only seems to cover blades, nacelle, tower, offshore wind vessels, and offshore wind foundations.
BGA identified at least 7 facilities, operated by	48C only	45x only seems to cover blades, nacelle, tower, offshore wind vessels, and offshore wind foundations.
The domestic content of gearboxes is 10% by value.	48C only	Within the nacelle, 45x only seems to cover assembly of the drivetrain and other tower-top components
According to the DOE Wind Energy Supply Chain Deep	48C only	Wind components covered by 45X don't seem to include subcomponents like forged rings and shafts.
Domestic nacelle assembly, where domestic and imported components are	45X & 48C eligible	This is one of the wind energy components covered under 45X. It covers "the assembly of the drivetrain
The Land Based Wind Market Report (2022) prepared by Lawrence	48C only	45x only seems to cover blades, nacelle, tower, offshore wind vessels, and offshore wind foundations. Hubs are not mentioned. 48C covers investments in

According to the DOE Wind Energy Supply Chain Deep Dive Report, the domestic	48C only	Within the nacelle, 45x only seems to cover assembly of the drivetrain and other tower-top components within their cover housing, but does not mention the
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Sources for U.S. Supply Chain Status

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