Solar PV to Hot Water Lifecycle Assessment

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		Inputs		Outputs	
Transport		Electricity (embodied inputs) Machinery (embodied inputs) Labor (embodied inputs) Fuel - Gasoline, Diesel Land	Raw Material Mining	GHG Emissions Air Pollution Nutrient Runoff Tailings Raw Material	Step 1: Raw Material Mining Quartz and metal ore are mined using standard mining methods, namely surface mining. Large combustion engine machinery is operated by people. Mining requires large land areas. Digging releases GHG and air pollution. Nutrient runoff is created by soil erosion and tailings.
		Electricity (embodied inputs) Machinery (embodied inputs) Buildings (embodied inputs) Labor (embodied inputs) Fuel - Coal, Biomass, Nat. Gas Water	Refining Raw Materials	Refining Waste GHG Emissions Combustion Emissions Refined Materials	Step 2: Refining Raw Materials Quartz sand and ore are refined into usable material. Electricity and fuel are used for heat to melt ore, and operate machinery (done by humans). Water is used as coolant and cleaner. Done in buildings. Unusable material creates polluting waste or recycled. Burning fuel creates GHG and Combustion Emissions.
		Electricity (embodied inputs) Machinery (embodied inputs) Buildings (embodied inputs) Labor (embodied inputs) Fuel - Gasoline, Diesel Water	Manufacturing	Manufacturing Waste GHG Emissions Solar Panels	Step 3: Manufacturing Machinery operated by humans use electricity to assemble delicate cells and panels. This is done in buildings. Water is used and coolant and cleaner. Combustion fuel is used for material transport in the facility (GHG). Manufacturing waste can create pollution or be recycled.
		Electricity (embodied inputs) Machinery (embodied inputs) Buildings (embodied inputs) Labor (embodied inputs) Fuel - Gasoline, Diesel Land	Installation	Installation Waste GHG Emissions Solar Power Installation	Step 4: Installation Panels are transported via combustion engines to warehouses, then distributed to installers the same way. Electricity is used by laborers for tools and devices. Buildings are storage and offices, or a residential building. Much land is used for utility scale solar, but residential installations also claim unobstructed space.
		Inverter (embodied inputs) Lines to grid (embodied inputs)	Electricity Distribution	Heat Electricity	Step 5: Electricity Distribution Electricity is converted from DC to AC in an inverter, the manufacturing of which contains embodied inputs and outputs. Lines connecting the solar panels to the grid or electrical system also contain embodied inputs. This distribution loses some energy to heat, but also transports the electricity to be used.
		Electric Water Heater (embodied inputs) Electricity Water	Use	Heat Hot Water	Step 6: Use An electric hot water heater, which contains embodied inputs, is needed to use electricity to heat water. Water also needs to be in the water heater. Some of this heat dissipates into the air, but, at the time of use, is mostly contained within the water.
Impacts					
	Climate Impacts C02 Combustion Engines Mining Releases Electricity (Embodied Combustion)			Air Quality Impacts VOC/NOx/SOx/Particulates Burning fuel to heat ore Mining Releases	
Water Quality Impacts Nutrient Runoff Mined Land Tailings			ent Runoff led Land	Resource Consumption Land Fossil Fuels Heavy Metals	

References: http://www.madehow.com/Volume-1/Solar-Cell.html https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1530-9290.2011.00439.x Ore