U.S. Department of Energy
Categorical Exclusion Determination Form

Program or Field Office: Advanced Research Projects Agency - Energy (ARPA-E)

Project Title: 25A1152 - 1366 Direct Wafer: Enabling Terawatt Photovoltaics

Location: Massachusetts

Proposed Action or Project Description: American Recovery and Reinvestment Act: ☒

For photovoltaics (PV) to reach terawatt scale and meet ARPA-E targets for energy generation, emissions reductions, and US jobs, three criteria must be met. PV devices must be: (1) low-cost (<$0.80/Wp); (2) made from abundant materials; and (3) high-efficiency (>20%)—in order to reduce balance-of-system costs. Crystalline silicon is the only technology capable of meeting all three criteria. (CdTe and CIGS can only support tens of GW/yr, based on feedstock availability.) The single barrier still limiting silicon's market penetration is the 35-year-old grand challenge of making monocrystalline-equivalent wafers without the cost and waste of sawing. 1366 Technologies has developed a kerfless wafering process called Direct Wafer, which will deliver high-performance wafers at a fraction of the current cost. Our breakthrough is a method for attaching molten silicon to a reusable forming substrate, solidifying a thin sheet, and then releasing a wafer cleanly from the substrate. To date, we have fabricated hundreds of 50 mm wafers in a prototype Direct Wafer machine. We have verified clean release, rapid cycle time, tight geometry control, in-situ surface texturing, low dislocation density, and 20 µs bulk carrier lifetime. Our R&D objective is to generate industry-standard 156 mm Direct Wafers capable of supporting 20% solar cells (Phase 1), and scalable hardware to enable rapid ramp-up (Phase 2). At the conclusion of this program, we will have eliminated enough risk to secure funding for scaleup. Direct Wafer will slash fully-installed system costs from ~$4/W to ~$2/W (~$0.10/

Categorical Exclusion(s) Applied:

X - B3.6 Siting/construction/operation/decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development and pilot projects

*-For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, see Subpart D of 10 CFR10 21 Click Here

This action would not: threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive Orders; require siting, construction, or major expansion of waste storage, disposal, recovery, or treatment facilities, but may include such categorically excluded facilities; disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; or adversely affect environmentally sensitive resources (including but not limited to those listed in paragraph B.(4)) of Appendix B to Subpart D of 10 CFR 1021). Furthermore, there are no extraordinary circumstances related to this action that may affect the significance of the environmental effects of the action; this action is not "connected" to other actions with potentially significant impacts, is not related to other proposed actions with cumulatively significant impacts, and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211.

Based on my review of information conveyed to me and in my possession (or attached) concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer: /s/ William J. Bierbower Digitally signed by William J. Bierbower DN: cn=William J. Bierbower, o, ou, email=william.bierbower@hq.doe.gov, c=US Date: 2009.12.18 10:21:42 -05'00' Date Determined: 12/18/2009

Comments: Webmaster:

will have eliminated enough risk to secure funding for scaleup. Direct Wafer will slash fully-installed system costs from ~$4/W to ~$2/W (~$0.10/kWh) by cutting wafer costs by 80% and increasing cell efficiencies to 20%. We will eliminate the two most expensive steps in wafer manufacture—casting and sawing—and improve silicon utilization from today's 7 g/W to 2 g/W (effectively tripling silicon capacity). Capital intensity will be low—a single Direct Wafer machine costing $250k to build and occupying 3 m2 of floor space will be able to produce 10 MWp annually, enabling 1 GW/yr wafer production within the footprint of a basketball court. Per-Watt capex will be 9% the cost of today's ingot furnaces and wire saws. Finally, time to market will be short—Direct Wafer will produce industry-standard 156 mm wafers for processing by existing companies in existing solar cell factories. By addressing PV's key limitation, Direct Wafer will transform PV from niche to mainstream. It will enable 600 GW of installed PV in the US by 2025, save 694 million metric tons of annual CO2 emissions, and spawn a multi-million-job domestic PV manufacturing and installation industry. Direct Wafer manufacturing is ideally-suited to the US because labor is a small component of total cost, environmental impact is inherently low, and our IP can remain well-protected. With silicon and wafer production in the US, and module manufacturers locating near US demand, cell manufacturers will be incentivized to collocate—bringing the entire PV value chain to America. Ultimately, American leadership in energy can only be ensured with a strong crystalline silicon PV industry—no other technology combines the fundamentals of low cost, high efficiency, and earth-abundant feedstock to support large-scale impact.