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ARPA-E award of $1.2M under REFUEL projects for energy-dense carbon-neutral liquid fuels

Sustainable Innovations Inc is the leader of this proposal which is entitled "Electricity form an energy-dense carbon-neutral energy carrier" and the main scope is the transformation of a destructive greenhouse gas, CO_2, into a high value energy carrier. By integrating specialized teams in electrochemical systems and systems integration, the electrochemical synthesis of methanol (MeOH) and its conversion to dimethyl ether (DME), an ideal Carbon-Neutral Liquid Fuel (CNLF) will be addressed; and a parallel effort will be devoted to the efficient conversion of DME to electricity in a direct DME fuel cell. Starting with commercialization cost/performance targets that meet ARPA-E requirements, the team members will conduct applied research on concepts substantiated in the laboratory to create disruptive CNLF technologies. The effort will advance both the electrochemical CO_2 to fuels conversion technology and the direct oxidation fuel cell, culminating in laboratory scale proof of concepts for both technologies. In the case of electroreduction of CO_2 to methanol, catalysts will be developed that are highly selective and durable, building upon Sustainable Innovation's prior work with transition metal (TM) supported catalysts. Northeastern University will contribute advanced characterization of TM catalysts and optimization of catalytic function through synthetic methods. Los Alamos National Laboratory will develop two separate pathways for direct DME conversion at high and low temperature, in addition to a third hybrid methodology, supported by **Advent Technologies** high temperature membranes. Durability testing at FuelCell Energy, Inc. as well as economic and commercialization studies will provide critical technology feedback. Harnessing a CNLF cycle around DME offers a path to reducing carbon emissions, providing multi-day energy storage from wind and solar, and long-distance energy delivery from remote locations.

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