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NOVEL HEAT EXCHANGER FOR BUILDING DECARBONIZATION

Additional submitted attachment is included below.

CALIFORNIA ENERGY COMMISSION

ELECTRIC PROGRAM INVESTMENT CHARGE 2021-2025 (EPIC 4)
RESEARCH CONCEPT PROPOSAL FORM

The CEC is currently soliciting research concept ideas and other stakeholder input for the EPIC 4 Investment Plan. For those who would like to submit an idea for consideration, we ask that you complete this form and submit it to the CEC by 5:00 p.m. on **July 2, 2021**.

To submit the form, please visit the e-commenting link, https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=20-EPIC-01, enter your contact information, and then use the "choose file" button at the bottom of the page to upload and submit the completed form. Thank you for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

   Pinakin Patel, ppatel@t2mglobal.com, (203) 300 6130

2. Please provide the name of the contact person's organization or affiliation:

   President and Co-founder, T2M Global LLC

3. Please provide a brief description of the proposed concept you would like the CEC to consider as part of the EPIC 4 Investment Plan. What is the purpose of the concept, and what would it seek to do?

   NOVEL HEAT EXCHANGER FOR BUILDING DECARBONIZATION: T2M Global is pleased to propose its concept of a novel heat exchanger based on advanced materials to provide an affordable heat exchanger to recover low-level heat in HVAC applications. Buildings use 38% of U.S. energy, a significant portion of which is lost as low-level heat. Conventional heat exchangers are not affordable for low level heat recovery, and too expensive to install and maintain. More efficient, modular heat exchangers are needed, which can be mass-manufactured, standardized, and sold as retrofit packages for residential and commercial buildings.

4. In accordance with Senate Bill 96, please describe how the proposed concept will **"lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals."** For example, what technical and/or market barriers or customer pain points would the proposed concept

address that would lead to increased adoption of clean energy technologies? Where possible, please provide specific cost and performance targets that need to be met for increased industry and consumer acceptance. For scientific analysis and tools, what data and information gaps would the proposed concept help fill, what specific stakeholders will use the results, and for what purpose(s)?

The waste heat recovery field is plagued by high-cost capital equipment with long payback periods. Widespread waste heat recovery has not been adopted due to this "first cost" barrier. Traditional heat recovery exchangers are prohibitively capital intensive. The proposed polymeric heat exchanger would provide a robust, cost-effective retrofit packages for heat recovery from traditional boilers, chillers, etc. This would integrate high-performance plastics with high-speed manufacturing and transform the heat recovery industry.

Recent developments in advanced materials have opened new pathways to cost-effectively recover low-level heat. These materials are more resistant to corrosion and fouling, and hence can be installed in conventional systems without additional maintenance. Promising materials with tunable properties properties – like thermal conductivity and mechanical strength – have recently been developed. CEC should sponsor projects on using these materials to perform scale-up, manufacturing development and application development of inexpensive heat exchangers. Such heat exchangers would allow better ventilation in buildings and help combat the sick building syndrome. Their deployment in various industrial and building sectors would improve the efficiency of all thermal systems, and reduce California's dependence on natural gas.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the technology at scale?

   The integration of the proposed technology in industrial and building sectors would lead to:
   • 20% reduction in industrial natural gas usage by recovery and reuse of over 938 million therms of NG.
   • $1B/yr natural gas savings to CA consumers and IOUs. This frees up resources for investment to expedite green technology development, scale-up, and deployment.
   • 13M tons CO2e/year removed from emissions.
   • Meet 2030 CA GHG Emission Mandate. According to the CEC, CA needs to reduce GHG emission at a rate of 13M tons CO2e/year to meet its 2030 goals. An efficient HEX by itself has the potential to account for ~40% of this goal

• Establish NG-Fuel Self-Sufficiency for CA by replacing >9,000 GWh of NG fuel generated electricity import from out-of-state with in-state resources

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.

   Thermal conductivity of the material (W/m-K), Effectiveness of the heat exchanger as a function of operating fluids (%), Manufacturability of the HEX (m/min), Parasitic losses per energy recovered (%)

7. Please provide references to any information provided in the form that support the research concept's merits. This can include references to cost targets, technical potential, market barriers, etc.

   The energy consumption in buildings can be found in the DOE report on improving the efficiency of buildings:
   https://www.energy.gov/sites/prod/files/2017/03/f34/qtr-2015-chapter5.pdf