DOCKETED	
Docket Number:	20-EPIC-01
Project Title:	Development of the California Energy Commission Electric Program Investment Charge Investment Plans 2021-2025
TN #:	238681
Document Title:	T2M Global Comments - MANUFACTURING DEVELOPMENT OF HIGH PRESSURE MEMBRANE MODULES AND RELATED NOVEL WASTE HEAT TO POWER SYSTEMS
Description:	N/A
Filer:	System
Organization:	T2M Global
Submitter Role:	Public
Submission Date:	7/2/2021 4:58:43 PM
Docketed Date:	7/2/2021

Comment Received From: T2M Global
Submitted On: 7/2/2021
Docket Number: 20-EPIC-01

MANUFACTURING DEVELOPMENT OF HIGH PRESSURE MEMBRANE MODULES AND RELATED NOVEL WASTE HEAT TO POWER SYSTEMS

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?

   MANUFACTURING DEVELOPMENT OF HIGH PRESSURE MEMBRANE MODULES AND RELATED NOVEL WASTE HEAT TO POWER SYSTEMS: T2M is pleased to propose its concept of high pressure membrane module development for waste heat to power applications . These modules are needed for waste heat to power cycles which convert the low-level waste heat into electricity without additional GHG emissions. The largest amount of unutilized waste heat from industrial operations is in the low-temperature group (150-300°F). There is no commercially available cost-effective technology to benefit from this wasted heat because it is economically difficult to recover and reuse. Upgrading this low-temperature waste heat to higher value electricity at competitive costs will deliver greater sustainability to industrial operations.

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)?

High pressure modules are a critical component of advanced waste heat to power cycles. Such modules are also used in water desalination which is a growing industry in CA given the exacerbating wildfires. 5 quadrillion Btu/yr waste heat is wasted every year. Higher efficiency technologies are required to convert this wasted resources into power.

There is currently no US supply chain for high pressure modules. CEC should fund development of advanced materials and designs, scale-up, manufacturing and supply chain development of higher pressure modules in the range of 2000-3000 psi.

CEC should also fund scale-up, packaging and application development of novel, high-efficiency waste heat to power systems.

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 proposed waste to power heat can utilize any waste heat irrespective of its source. It would have the following benefits:

- Assuming 20% addressable market (1 quad/yr) we estimate over 44,000 GWh/yr of electricity production with no additional GHG emissions (assuming 15% efficiency of the waste to power cycle). This would contribute significantly to California's goal for 100% clean electricity by 2045 (SB 100).
- The corresponding amount of natural gas saved for electricity generation at 7200 BTU/kWh heat rate in California would be 1.6 billion cuft per year. At a delivered natural gas price of $10/MMBTU to the host site, the cumulative potential savings to California customers is estimated to be $3.2 billion /yr
- Advanced waste heat to power cycles using high pressure modules also enable energy storage. This ability to produce on-demand power would increase the penetration of renewables in the Californian grid. This opens up additional revenue streams like grid support, ancillary services, energy arbitrage for the industries making them more competitive.

- The higher pressure membrane module has the potential to reduce the capital cost of the waste heat to power system by 50% and to lower the cost of dispatchable power to well below convetional power generation and storage technologies.
- Developing a California based supply chain for these units would create thousands of new local, high-paying, clean-tech jobs.

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

   Pressure capability (psi), waste heat to power efficiency (%), waste heat to power system output (kW), low-level waste heat quality (degrees C), footprint of the system (sq-ft)

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.

   https://www.energy.ca.gov/news/2021-03/california-releases-report-charting-path-100-percent-clean-electricity : SB - 100