DOCKETED	
Docket Number:	20-EPIC-01
Project Title:	Development of the California Energy Commission Electric Program Investment Charge Investment Plans 2021-2025
TN #:	238914
Document Title:	T2M Global Comments - GREEN HYDROGEN FROM WASTE BIOMASS
Description:	N/A
Filer:	System
Organization:	T2M Global
Submitter Role:	Public
Submission Date:	7/15/2021 4:10:14 PM
Docketed Date:	7/15/2021

Comment Received From: T2M Global
Submitted On: 7/15/2021
Docket Number: 20-EPIC-01

GREEN HYDROGEN FROM WASTE BIOMASS

Additional submitted attachment is included below.

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?

   GREEN HYDROGEN FROM WASTE BIOMASS: T2M Global is pleased to propose (a) gasification of waste biomass and syngas to H2 for much needed long-duration energy storage, (b) a multi-purpose energy station equipped with H2 dispensers and fuel cells that can support microgrids using green H2, (c) the demonstration can begin with a modular system starting with 100 kg/day, (d) deployment can be a 1 ton/day module, (e) such a module can be used for utility-scale storage.

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 benefits of the proposed concept include:

(a) Reduce the risk of wildfires by utilizing downed or cleared forestry wood.
(b) Create higher value H2 from waste biomass with potential of up to 10 million tons of green H2 per year.
(c) Reduce GHG emissions and improve health in DAC/EJ communities by using clean fuel.
(d) Increase penetration of renewables by supporting intermittency (350,000 GWh/yr) of renewables.
(e) Create new high paying, clean tech jobs in California
(f) Reduce water consumption of the state – much needed for preparedness for the drought-prone CA climate.

Green H2 for stationary power: California has a potential to produce 25% of its electricity using green H2 produced from underutilized resources such as waste biomass from forestry and agriculture. These are the major sources of the growing fire hazards in CA. Utilities plan on reducing the risk of wildfires by clearing the trees and vegetaion near the transmission and distribution lines. This collected biomass is currently a stranded resource.

The green H2 from this waste biomass is a win-win opportunity for California. It provides a solution to reduce GHG emissions and is a new energy carrier to meet CA's mandate for clean and green energy. There are different pathways to convert biomass into green fuels such as syngas, RNG, liquid fuels, fertilizers and green H2. The H2 yield of these processes needs to be increased to make them economically competitive.

Grid and Microgrid Support: California urgently needs a mid-to-long duration storage solution to retain the value of its excess renewable electricity. SB-1369 identified the need for Green Electrolytic Hydrogen as a synergistic solution. A lack of reliable, affordable storage has hampered the penetration of renewables. This is a huge opportunity for H2 which can be produced using the excess electricity. This hydrogen can be used in a fuel cell to produce on-demand electricity thus supporting a larger penetration of renewables. Up to 66,000 GWh/yr will be needed to support the intermittent renewables (up to 350,000 GWh/yr). Demonstrating this green H2 technology will create opportunities for California businesses.

Water Independent Power: California is facing an unprecedented water shortage. CEC should support H2 production technologies that don't need significant amounts of water, such as advanced electrolyzers.

Enhanced Safety for Disadvantaged Communities (DACs): The value-added use of waste forestry biomass to produce biogas provides a source of renewable hydrogen and also reduces the risk of forest fires in CA. The availability of hydrogen in these communities offers them a more resilient grid while reducing PSPS events. The green H2 will also be ideal for emission free back-up power.

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 concept has the capability to make the California grid self-sufficient by providing an estimated 66,000 GWh of electricity (25% of the current capacity) which would reduce its dependence on Natural Gas as well as imports of energy from other states. As per DOE estimations, there is enough biomass to make the CA grid 100% green and renewable.

   The waste biomass gasifier would help reduce the risk of wildfires by encouraging the removal of biomass. It would also open up additional revenue streams in the form of tipping fees for accepting/processing the waste biomass. This low-cost feedstock would allow production of lower-cost green H2.

   The proposed concept has the potential to reduce the cost of green H2 to <$2/kg. This would make it competitive with H2 from fossil fuels, and therefore, promote renewable technologies. It can also provide load shifting capability to provide a solution to the worsening duck-curve.

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

   Wood and biomass removal from fire prone areas (ton/day); H2 cost ($/kg); Energy Consumption for H2 production (kWh/kg); Energy storage capacity (kWh/day); Power rating (kW); Long Duration Energy Storage (MWh/yr); Ramp-up, Ramp-down and start-up capacity for grid support (kW/s)

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.

   Novel concepts for low cost H2 production are needed to meet California's H2 cost targets (See page 3 in the CAFCP roadmap: https://cafcp.org/sites/default/files/Roadmap-for-Deployment-and-Buildout-of-RH2-UCI-CEC-June-2020.pdf). Cost estimates for Green H2 can be found on page 30 in Green Hydrogen Coalition's guidebook: Green Hydrogen Guidebook — GREEN HYDROGEN COALITION (ghcoalition.org). The cost predictions of H2 for transport can be found on pages 65 and 66 of CEC staff report: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2019-total-system-electric-generation/2018 ; California's electricity production data can be found at: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2019-total-system-electric-generation/2018