California Energy Commission
DOCKETED
12-EPIC-01
TN 72653
FEB 14 2014

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February 13, 2014

Docket # 12-EPIC-01
EPIC TRIENNIAL INVESTMENT PLAN 2015-17
Proposed Energy Research Initiative Questionnaire

Title: Woody Biomass Densification, Torrefaction and Gasification

Investment Areas:
Applied Research and Development
Technology Demonstration and Deployment

Electricity System Value Chain:
Generation

Issues and Barriers:
According to the California Biomass Collaborative's 2007 CA Biomass Resource Assessment, there are projected to be about 40 million BDT per year of biomass resources (technically available) in California in 2020, with the potential to provide 6,800 MW of electrical capacity and 51 TWh of electrical energy generation. Residues from the forestry sector account for 35% of the total tonnage and 42% of the electrical capacity. Residues in the forestry sector fall into the following categories: forest thinnings, logging slash, shrubland treatments, and mill residues. Mill residues, which account for less than 25% of the forest sector biomass resource, can be easily and cost effectively accessed. For this reason most mill residues are already utilized, either for energy production or for some other higher value use.

The other forest residues, forest thinning, logging slash, and shrubland treatments, are all typically located in remote locations far from power plants and population centers. These resources must be transported long distances before being processed and utilized. In most cases this is cost prohibitive. For example, logging slash and thinnings typically cannot be transported cost effectively more than 30 to 50 miles. Technologies such as pelletization, briquetting and torrefaction can be used to densify these resources before they are transported, thereby improving their cost effectiveness. Torrefaction combined with pelletization can increase volumetric energy densities, and therefore decrease transportation costs by a factor of three.

Biomass to electricity conversion in conventional grate boiler steam fired power plants is typically very inefficient, especially for smaller scale distributed systems. Biomass gasification technologies coupled with boiler, engine-generator and even fuel cell technologies can improve these energy conversion efficiencies significantly, especially if combined heat and power strategies are employed. These technologies are in the early stages of commercialization and need to be supported through further research and development and technology demonstration projects.

Initiative Description and Purpose:
This initiative will support the research, development, demonstration and deployment of forest residue densification technologies and biomass gasification technologies that demonstrate high energy conversion efficiencies. Methods for cost-effectively sorting, processing and transporting forest residues from the field to their point of use need to be developed. This should include development of

field deployable torrefaction and densification technologies. In addition, highly efficient biomass conversion technologies, such as gasification, need to be developed and demonstrated. This should include technologies that employ combined heat and power strategies to maximize energy conversion efficiencies. It should also emphasize smaller scale systems (i.e., < 3 MWe) that are suitable for distributed generation applications. The recommended funding levels for projects under this initiative are:

- Applied Research and Development – $500,000 minimum to $5 million maximum
- Technology Demonstration and Deployment - $2 million minimum to $5 million maximum

Stakeholders:
Stakeholders who support this initiative include: renewable power advocates, ratepayers, climate mitigation advocates, environmentalists, distributed generation advocates, electric utilities, municipalities, independent power producers, rural communities, economic development advocates, forest products industry, air quality management districts, CAL FIRE, US Forest Service.

Background and State-of-the-Art:
Numerous technology developers are working on biomass densification technologies. Biomass torrefaction technology is in the development and early commercialization stages. To overcome transportation cost barriers what is needed are smaller, transportable systems that can be deployed in the field at forest landings and/or in small rural communities close to the biomass resource. Most of the early commercialization efforts for torrefaction have focused on large-scale, centralized facilities. This initiative should focus on distributed scale systems.

The Schatz Energy Research Center (SERC) has participated in testing and technology development efforts with Renewable Fuel Technologies (RFT), a torrefaction company based in Hayward, CA. RFT is one of the few technology developers working on a field deployable unit. RFT has developed and demonstrated a 0.1 ton per day unit (initial prototype) and a one ton per day unit (current prototype), and is currently poised to begin development of a 20 ton per day unit. Testing, development and demonstration testing with RFT has been funded through private funds, as well as grant funds from the California Energy Commissions Energy Innovation Small Grant program. Funding is also anticipated from the USDA/USDOE Biomass Research and Development Initiative (BRDI).

Distributed scale biomass gasification technologies are also in the development and early commercialization stages. Numerous companies currently offer downdraft units that produce a low Btu content syngas along with tar laden oily water as a hazardous by-product. Developing gasifiers that produce a cleaner, higher Btu content syngas can potentially help overcome barriers to the deployment of this distributed generation technology. Indirectly heated gasifiers can produce a cleaner, higher Btu content gas that is often rich in hydrogen. The syngas from these gasifiers can be used to power engine-generators, purified for use as pure hydrogen fuel that can be used in a fuel cell, or even upgraded for use in the synthesis of bio-fuels and other bio-based products. SERC is currently working with Proton Power, Inc. to integrate an indirectly heated gasifier with a PEM fuel cell. The is a cutting edge project and it is anticipated that further research, development and demonstration will be necessary to successfully bring this technology to market. A handful of other developers are also working on similar indirectly heated gasification technologies. Funding sources for this work can include the USDA/USDOE BRDI program and the USDA Hazardous Fuels Woody Biomass Utilization Grant program.

Justification:
These woody biomass utilization technologies can enable the cost effective use of a large source of currently inaccessible biomass resources. This will provide new opportunities for distributed

renewable generation, especially in rural settings. This will reduce greenhouse gas emissions, stimulate rural economies, and provide energy security benefits for ratepayers. Estimates of benefits include:

	Densification/Torrefaction	**Gasification**
Sector	Distributed and central generation	Distributed generation
Performance improvements	Increase density of forest residue biomass & reduce transportation costs by a factor of 3	Clean, hydrogen rich, high BTU content syngas for distributed energy applications
Market potential	2,200 MWe	1,400 MWe + 21 Trillion BTUs/yr (heat)
CO2e Savings (mmTons/yr)	5.8	3.7
Jobs (direct & indirect)	4,400 – 5,200	2,800 - 3,300

Ratepayer Benefits:

- Potential energy and cost savings
- Increased safety (removing forest fuels will reduce wildfire threats, controlled use of forest residues will improve air quality)
- Societal benefits (greenhouse gas reductions, reduced wildfire threat, energy security, rural economic development)
- Environmental benefits (greenhouse gas reductions, improved forest health, reduce wildfire threat)
- Greenhouse gas emissions reduction
- Low emission vehicles (potential to develop synthetic biofuels, potential to generate electricity to charge electric vehicles)
- Waste reduction (reduce forest slash piles that are currently burned in place)
- Economic development (create jobs, stimulate rural economies)

Public Utilities Code Sections 740.1 and 8360:

The proposed initiative has a reasonable probability of providing benefits to ratepayers. There are many potential benefits and the technological development have a reasonable probability of success. The proposed initiative will support numerous policy goals, such as developing distributed generation and developing biomass energy resources. The proposed initiative does not duplicate, but instead can leverage other research efforts. The proposed initiative offers benefits such as: environmental improvement, public safety, and cost effective and efficient use of an under-utilized biomass resource.