**SWATeam Recommendation**

Name of SWATeam: Energy SWATeam

SWATeam Co-Chairs: Bill Rose and Andrew Stumpf Date Submitted to iWG: April 3, 2020

Specific Actions/Policy Recommended (a few sentences):

**The College of ACES should conduct a Feasibility Study to construct and operate an anaerobic digester on the University of Illinois at Urbana-Champaign campus**. **The College of ACES should then proceed in accordance with the results of the Feasibility Study.**

Recruit qualified faculty and staff and/or hire a contracting engineering firm to undertake this study and use the 2014 “South Farms Anaerobic Digester Feasibility Study” and David Rivera-Kohr’s “Anaerobic Digester at the U of I” presentation as references. This new feasibility study should help the University:

1. identify the optimal location for the digester considering transportation of feedstocks (e.g. COW pipeline from 2014 study), proximity to the natural gas (NG) pipeline and campus fleet, and the College of ACES’ plans for future construction (e.g. new Dairy Farm);
2. determine feedstock options (i.e. food waste from dining halls, campus buildings, restaurants and industrial partners, agricultural waste, animal manure and carcasses) and quantities from both on-campus and off-campus sources and projected monthly and annual outputs of biogas (cubic feet) and solid/liquid digestate (tons). This should include a breakdown of chemical constituents in biogas and digestates with specific focus on the monthly and annual outputs of valuable molecules (e.g. methane, nitrates, phosphates, potash);
3. evaluate optimal biogas and digestate end uses for reducing greenhouse gas emissions and for best return on investment with particular focus on Compressed Natural Gas (CNG) production for the campus vehicle fleet or MTD buses, Renewable Natural Gas (RNG) injection into the NG pipeline, biogas Combined Heat & Power (CHP) to meet parasitic energy load of digester and associated machinery, and applying digestates to agricultural fields as fertilizer. Include a recommended course of action for meeting the University’s sustainability goals;
4. determine the optimal location for a CNG facility if the recommended option for biogas use is found to be RNG pipeline injection or CNG considering the most feasible CNG use scenarios (campus fleet trucks, cars, or MTD buses);
5. determine prospective economics for implementation scenarios including life cycle costs of construction, equipment, transportation, etc., prospective savings from reduced expenditure (e.g. natural gas, vehicle fuel, fertilizer, waste transportation and disposal) and projected profits from energy credits (RECs, RINs, LCFSs), sale of digestion and upgradation byproducts, charges for facility use, acceptance of outside waste, etc.;
6. evaluate mechanisms for integrating the recovered energy into campus’ energy generation and distribution system, e.g. determine the feasibility, economics and emissions associated with RNG pipeline injection, converting 8-12 campus fleet vehicles to CNG annually, using an Internal Combustion Engine to meet electricity needs of the host facility and dumping excess electricity onto the local grid, using biogas CHP with renewable energy technologies (e.g. solar, Deep Direct Use geothermal) to meet parasitic energy loads;
7. determine potential sources of funding and evaluate the feasibility of owning and operating the system considering different partnership scenarios including the University alone and partnerships with private entities (e.g. GESS International, Inc., American Biogas Council, CR&R Environmental Services, EESI) or surrounding cities or counties—include other parties’ willingness to participate;
8. compile a list of environmental, economic and other benefits associated with anaerobic digestion and utilization of biogas and digestate byproducts including those mentioned in the references. Include whether global water consumption will be reduced if digestate is used for fertilizer as opposed to generating an equal amount of traditional fertilizer and estimate time for return on investment given different biogas use scenarios;
9. address and/or update the “recommended next steps” from 2014 feasibility study;
10. investigate reasons why the previous feasibility study did not lead to digester construction and, if not already addressed by the previous criteria, collect information or take necessary steps to address those concerns.

**This study should be completed by FY22 (June 30, 2022).**

Rationale for Recommendation (a few sentences):

Anaerobic digestion is a waste management process that utilizes organic matter (animal waste and food waste) to produce biogas and bio-fertilizer. A consortium of bacteria breaks down the organic matter in the absence of oxygen (hence anaerobic) inside a bioreactor. The technology is mature and has been implemented across the world in similar environments. Locally, the Urbana-Champaign Sanitary District and several Big Ten Universities utilize anaerobic digestion for waste management and generation of renewable energy and fertilizer. The 2014 feasibility study did not lead to construction of a digester despite the important benefits identified that streamline campus operations and support the campus’ environmental and sustainability goals. Scientific evidence raising concerns about the impacts of climate change, pollution and the degradation of natural environments highlights the immediate action needed to mitigate long-term environmental impacts. In light of this body of scientific research, the student community, multiple sustainability advisory committees, and administrators foresee the important benefits operating the anaerobic digester brings to campus.

Connection to iCAP Goals (a few sentences):

Utilizing anaerobic digestion for energy generation and soil fertilizer production will reduce total greenhouse gas (GHG) emissions from campus and possibly from off-campus partners. Ultimately, it moves the University closer to the stated iCAP goal of being carbon neutral by 2050 or before. Operating the digester will also streamline waste disposal on campus, reduce waste disposal spending and reduce the amount of organic waste sent to the landfill. The University of Illinois signed a Resilience Commitment in 2016 and having an Anaerobic Digester on-campus will prove to be a long-term benefit for the University and Champaign-Urbana community as it increases the community’s energy, agricultural and waste disposal independence and sustainability. This effort solidifies the University’s commitment to sustainability and combating climate change.

Using biogas to generate CNG for the campus vehicle fleet would fulfill the transportation goal of increased reliance on renewable fuel. Additionally, this effort will reduce demand for traditional fertilizer production—thereby reducing global GHG emissions and possibly water consumption—and will have additional benefits for reducing nutrient runoff, reducing pathogens and weed seeds in manure and reducing manure odor. Furthermore, having a digester will provide educational and research opportunities to faculty, staff and students interested in this sustainable technology. Overall, possessing an anaerobic digester will satisfy interests from each SWATeam and will significantly advance the University’s progress toward iCAP goals in several areas.

Perceived Challenges (a few sentences):

1. Ensuring the proposed study leads to further consideration and construction of the digester is not certain. The proposed study must be thorough enough to provide the required information to make an informed decision regarding implementation of a digester into campus operations and infrastructure in the near future. The feasibility of its implementation should be a holistic analysis which considers multiple factors beyond just economics.
2. Funding the construction and operation of the digester will be a challenge. The construction costs of the digester, waste transfer and storage infrastructure and biogas utilization machinery are estimated at $12-15 million. This funding could come from University funds (ACES, iSEE, SSC, tuition, etc.), external grants (EPA, DOE, DOD, USDA, NSF, etc.), private foundations, industry and government partners, etc. There is interest from the surrounding communities in sharing the benefits that implementing this technology brings. Involving the community could alleviate the burden of funding the digester, increasing overall costs linearly while increasing feedstocks and outputs exponentially.
3. Funding this feasibility study is not as cost intensive as the digester (~$50-100k), however, it may be useful to identify sources of funding outside the College of ACES, i.e. SSC.

Suggested unit/department to address implementation: College of Agricultural, Consumer, and Environmental Sciences

Anticipated level of budget and/or policy impact (low, medium, high): medium

Individual comments are required from each SWATeam member (can be brief, if member fully agrees):

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| Team Member Name | Team Member’s Comments |
| David Rivera-Kohr | I support this recommendation. Having a digester would undoubtedly bring us closer to several iCAP and SWATeam goals, alleviate our burden on the environment and have long lasting benefits for the University. However, I must stress that this recommendation will only make a difference if the University is willing to fund a digester operation or cooperate with private or government partners to the same effect. |
| Bill Rose | This recommendation advances one technology of the possible suite of technologies  needed to reduce fossil fuel reliance. It does so with an appropriate but modest step—a  feasibility study. |
| Andy Stumpf | I support this recommendation. An update of the 2014 feasibility study is needed to  consider emerging technologies and modular installations (e.g., QUBE Renewables)  that may reduce the overall cost. The use of a digester would support ACES’ goal of  reducing organic material from the waste stream and produce beneficial byproducts  (i.e., fertilizer and biogas). The City of Urbana may also be interested in partnering with  U of IL to meet its residential food-scraps waste reduction goals. The feasibility study  considers having private companies build and operate the facility. There may also be  tax credits available to finance the development (e.g., Sect 45 Production Tax Credit). |
| Mike Larson | I am not able to support this recommendation at this time. There is not sufficient information available at this time to clearly demonstrate that the construction of a digester has sufficient environmental benefits to justify the expense. As such spending $100,000 on a study for a potential $10 million dollar project does not make sense at this time. If the economics can be further developed to help demonstrate that this project is financially viable, my recommendation might change. |
| Tim Mies | I am very supportive of projects such as this in general, but given the range of costs in the $50-100K range along with the recommendation directed at a college without a clear discussion on costs/funding options, I think that the recommendation needs further work. By waiting to forward this recommendation after discussions and feedback from funding sources, such as SSC, I feel it might have a higher success. Having seen these across the countryside in Germany along with large ag waste producers in the US, this could be a proven viable investment in campus’ future that we should continue to purse. |
| Dave Boehm | A feasibility study is needed to analyze this as a practical test case for this technology. Having a wide range of energy production and waste management alternatives are vital to meeting the iCAP goals. |
| Yun Kyu Yi | Find alternative energy sources that require great effort and this recommendation shows our commitment. This is one recommendation that requires more investigations and commitment from stakeholders to successfully deployed to the campus. I recommend the university to conduct a feasibility study to find its applicability to our campus. |
| Karl Helmink | Other Big Ten universities operate digesters. Feasibility study ok.  Not sure that this is the highest funding priority for the university, given all of the deferred maintenance that we have. |
| Tugce Baser | Unavailable for comment |
| Jayce Carlson | I like the overall idea of this, however the price seems extreme for the amount of savings we would be receiving in return. I would not go through with the study unless we are confident in planning on following through with the digester. In addition, I almost rank this equal with the master plant, just from an economic standpoint the other two recommendations may be more feasible at this time. |
| Marcela Vega | The recommendation is very well described, and it goes in the right direction towards the iCAP goals. Although, due to the big investment required it should be carefully analyzed. Looking for external funding or public incentives is a good alternative to move forward. |

Comments from Consultation Group (if any; these can be anonymous):

Sarthak Prasad:

My name is Sarthak Prasad, and I work as the Sustainable Transportation Assistant in the Facilities & Services department at the University of Illinois. I have been working very closely with David Rivera-Kohr on this recommendation, and I believe building an anaerobic digester on-campus will go a long way to achieve our Carbon Neutrality goal. Therefore, I recommend that the College of ACES perform this feasibility study as soon as possible. Following the completion of this feasibility study, the College of ACES would evaluate the study and proceed as recommended.

An anaerobic digester on-campus at the new Dairy Farm location will provide a holistic solution to not only College of ACES’, but also to the University’s and possibly the greater CU community’s waste management (including manure and potentially animal carcass waste), renewable energy and biofuel generation, bio-fertilizer production, increase in employment and research opportunities. The anaerobic digester at the Urbana-Champaign Sanitary District (UCSD) does not, currently, process manure or food waste in raw form. UCSD has been a great partner for the University of Illinois, and they serve the community admirably. However, if we build a digester on-campus that will reduce the burden on UCSD’s operation and they would be able to serve our growing community even better.

Currently, the manure is applied on university property for nutrient recovery, most of the food waste produced on campus goes to the landfill, and animal carcasses are incinerated. However, these wastes have very high biogas potential, and if processed in an anaerobic digester we can produce biogas which can be used to generate electricity and heat or processed into renewable natural gas (RNG). We can inject this RNG into the natural gas pipeline and use it at Abbott Power Plant or elsewhere on-campus. The RNG can also be compressed into Renewable CNG and used as a transportation fuel for the campus fleet or community.

Lastly, the construction of the new Dairy Farm will start in the next couple of years, and if we build the anaerobic digester during the construction, that will reduce the overall cost.

The University has a goal to be carbon neutral, and I believe this will be worthwhile investment to move towards this goal. Again, the anaerobic digester will support the University’s goals of zero waste, land and water, transportation, energy, research and education, and resiliency. For the reasons mentioned above, it would be extremely beneficial that the College of ACES perform this feasibility study as soon as possible to support the University’s goals.

German Bollero (ACES Associate Dean for Research):

We will consider the feasibility study for the anaerobic digester as we develop our priorities for FY21.

Explanation and Background (can be supplied in an attachment):

South Farms Anaerobic Digester Feasibility Study: see the link below <https://icap.sustainability.illinois.edu/files/project/197/Anaerobic%20Digester%20Feasibility%20Study.pdf>

Anaerobic Digester at the U of I (attached)