4/7/22

**INTERVIEW WITH**: Mike Larson, F&S Director of Utilities Production and Chair of the Energy Generation, Purchasing, and Distribution SWATeam (2017)

**CONCISE SUMMARY:**

On 4/7/22, the team met with Mike Larson. This interview gave valuable insight on the transitioning to clean energy, as well as the challenges that go along with using renewable sources. In the short term, it is recommended to focus on conservation as well as carbon capture technologies. He does not believe carbon capture is feasible for the long term, but it could be a valuable technology to use while technologies such as nuclear are being developed further. He believes that when nuclear is commercially viable, it will be the best option for campus. He also thinks that electrification of the university could be positive, but only if the grid electricity becomes more renewable. At the moment, the efficiency of Abbot is greater than the electricity sources that power the grid. If the campus were to be electrified and converted to hot water, technology such as heat recovery chillers should also be considered.

**DETAILED INTERVIEW NOTES:**

**Questions:**

1. How much renewable energy is feasible to purchase/ is there any limit to how much we should purchase?
   1. Buying too much renewable can cause issues
   2. Cycling up and down of generators, which leads them to be inefficiency without storage
   3. Vast majority of resources should be going into conservation
2. What storage options have potential on campus? Could we increase the chilled water system? Potential for a hot water system like chilled water?
   1. Heat recovery chiller, heat from chilled water could be sourced to hot water
   2. Hot water system
   3. Storage is very expensive, a lot of challenges with Lithium batteries anyway
3. Hydrogen at Abbott Power plant? (Storing renewable energy in hydrogen to produce steam)
   1. Steam from electricity is not feasible
   2. Hot water from electricity is more feasible
4. Can distribution systems be improved on campus?
   1. Issues with the grid in general when dealing with renewables
5. Do you have a personal vision for clean energy transition on campus?
   1. Micro Nuclear reactors are the most viable currently due to its reliability
   2. They need still a lot of research to be commercially applicable
   3. Stress on putting money into continued research
6. What do you believe will be the most important technology in energy transition?
   1. Long term: Nuclear Technology
   2. Short term: carbon capture and conservation
   3. Geothermal
   4. Heat recovery chiller
   5. Storage

**General Notes:**

* Other Fuels at Abbott:
  + Did a fuel study of biomass; looked at most feasible fuel (agriculture)—corn. Is not designed to do the entire biomass but a portion may be feasible (around 10%). They would need a newer type of boiler to do biomass (U of Iowa is close to 100% biomass using oat holes (idk how to spell again lol).)
    - Would take heavy investment to convert the technology, and to create storage for biomass (need large volume of storage)
      * No current plans to convert to biomass
    - Perhaps create a gasification plant for biomass? Seems conceptually viable but would be costly. There has not been a lot of economic research.
    - Stogre boilers currently used for coal but can be used for other
    - Tree trimming can be used to burn as well
    - Transportation still an issue
    - Also is using crops for fuel the best use for the crops.
* Nuclear to Abbott
  + Caleb applied for a grant (FROM THE DEPARTMENT OF ENERGY; about 60-70 million dollars) for a test reactor on campus. Was not successful in acquiring a large grant; if they did get the grant, it would be adjacent to the power plant and the steam would be connected to the plant to spin a turbine to power the campus.
    - He got a grant to do the study, but not for the actual implementation
    - Mike believes the most viable solution today would be micro nuclear reactors. This HAS to be a technology we should continue to research and invest the money in. Nuclear is the most predictable (vs wind and solar) and is proven at a larger scale.
* 5 peak MW solar farms and 10 peak MW solar farms are existing; these would be sized to fill in gaps in our demand. If we build more solar farms, there would be certain points of the year where the electricity would go to the grid and wouldn’t alleviate the present needs of the campus (less reliable due to sun hours and lack of storage systems). The plant is used to heat the campus; not generate electricity.
  + We have a power purchase agreement with local wind farms
* CIF - geothermal field
* Heat recovery chillers (within Abbott?). Conventional chillers need place to reject heat (usually in cooling tower)
  + We can instead connect hot side to heating system for a building
* Carbon capture at Abbott boilers. Can be done in next 5-10 years
* Biomass: transportation costs make it seem infeasible; also seems wasteful to take agriculture from food resources. Not land efficient
* Storage from electricity for steam- extremely expensive
  + Technology exists but expensive & need large number of batteries (plus additional solar farm needed)
  + Lithium-ion batteries - mining is not great
    - Other batteries coming up
    - Sodium ion
* Converting from steam to hot water
  + Heat recovery chillers
* Wind energy PPA
  + Uni wanted to buy more, but like solar, if we buy much more, we would be selling too much more back to the grid
* Stresses to look outside university’ energy, not just in the campus “box”
* Solar/ wind variability- leads to generators fluctuating their load to make up for losses (shade, etc.), and this isn’t good
* During “gaps” where we are not generating enough clean energy, it is hard to find clean sources, so this is where we would need to access nuclear and fossil fuels.
  + The only solution to this would be storage; but it is not economically feasible (batteries are too expensive). People are currently researching new ways to store energy (compressed air, heating salts, and more).
* During summer, solar is not an issue. In the winter, the electrical demand decreases, but the steam (heating) demand increases, so the plant generates more power. So, all the solar must generally be turned off or sent to the grid. \*Offsite solar farm 3? Most of this power would be bought and immediately sold to the grid
  + Use an electric boiler to make steam during these weak seasons; in the evenings when the solar power goes away, there needs to be a resource to replace this reliance on solar at night (when solar is not pumping). It would become very costly to implement such technologies; this would make the other technologies less efficient and only “sort of offsetting them” and ultimately potentially increase emissions
* If Abbott continues to burn fossil fuels, they need to do this to create steam so there is no need for more electricity from renewables in winter. Steam demand is not going away (unless we switch to a hot water system).
* Hot water system:
  + Turn abbot into hot water plant
  + Still would be fueled by fossil fuels but it would be lowered
  + Or heating at the buildings, electrical infrastructure to run all this equipment
  + Powered by the grid which has a worse carbon footprint than Abbott
  + Naive to think the grid will figure out how to do renewables
  + Abbot 80% efficient, grid is 40%. Efficiency being from the fossil fuel plants
  + Grid is not renewable, and grid reliability is not good
* Short term: energy conservation, should be where the greatest number of resources go
* Building growth needs to be done very efficiently if it needs to happen
* Doesn’t like carbon capture long term, but probably good short term