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E-mail 1/9/24

1. At the last AE Oversight Committee Meeting, I asked how we might **capture the cost of carbon** were we to invest in local dispatchable generation, for instance at Decker. I would like to know how we might include a shadow price for carbon just as we did for REACH for the period before we can use green fuels. This might be thought of as extending REACH to any AE natural gas generation.

   Austin Energy can include the cost of carbon in the real-time offer curve for any of its generating units, which will result in the unit only being dispatched at higher prices when it provides more financial protection for our customers' rates. ERCOT dispatches generation units through price signals to serve the demand with the most cost-efficient solution. Increasing the generation unit's dispatch price will allow for other units in ERCOT to be dispatched first.

2. Green energy technology is changing rapidly. What are AE's plans to **future-proof** any new local dispatchable generation systems so they can easily accommodate cleaner fuels, and potentially a variety of those fuels? In other words, how do we make the system fuel flexible?

   Austin Energy will seek to "future-proof" both new and existing generation to be capable of accommodating cleaner fuels. This will be done through a combination of planning upfront to invest in clean capable technologies and retrofitting systems when necessary to be able to burn clean(er) fuels.

   Manufacturers of turbines are still working through the design of the components that will be needed to accommodate clean fuels at scale. There is a possibility that we may need to move incrementally to cleaner fuels as new technological advancements are made. As a hypothetical example, a turbine specified today might only be capable of 50% hydrogen combustion without additional changes or equipment. Austin Energy would look to make that initial investment, and then make the system more capable as the technology and the availability of source(s) of hydrogen merited the additional upgrades.

   Austin Energy will also look to retrofit existing generation with remaining usable life to accommodate clean fuels as the parts/components become available. As we are investing in periodic maintenance on existing generating units, we will make forward-looking investments in clean capable systems where possible, minimizing the stranded costs of buying systems that are not capable of handling clean fuels.

3. How would any proposed local dispatchable generation provide **frequency benefits** for the grid?

The current electric grid was designed for generators using spinning turbines to make electricity. These spinning turbines create a physical inertia that serves to dampen intermittency created on the grid by other generators coming on-line or tripping off-line. In addition, customer loads such as motors can disrupt the frequency, leading to the potential for cascading frequency issues. The inertia in rotating generation helps mitigate these effects.

Solar power does not have inertia, and rapid changes in power due to clouds passing over or a solar farm tripping off-line could cause frequency issues. This can be mitigated through emerging inverter technology, but it would require upgrades for most solar to be able to accommodate frequency response. Wind turbines have rotational inertia locally, but because of the way they are coupled to the grid that inertia is not realized at the grid level. As such, these resources are also potentially negative influences on grid frequency. Local dispatchable generation has tremendous benefits to the system frequency by mitigating the negative impacts of other resources interacting with the grid.

4. How would any proposed local dispatchable generation be **more efficient** than our current local gas generation? At the AEUOC meeting it was mentioned that the turbines work better. Tell me more.

   The newer generation units use less fuel to produce each MWh of electricity. For example, the Decker GTs (peakers) use ~13 MMBtus/MWh. The Sandhill GTs (peakers) use ~10 MMBtus/MWh. The Sandhill Combined Cycle uses ~8 MMBtus/MWh. Some of the newer natural gas (hydrogen capable) generation units have an efficiency of less than 7 MMBtus/MWh. These numbers represent the heat rate for a generating unit. The lower the heat rate, the more electricity produced for each MMBtu of fuel. An analogy could be similar to miles per gallon in the cars, the older car (Decker GT) gets 15 miles per gallon of fuel but the newer car (proposed unit) gets 30 miles per gallon of fuel. New generating units would be dispatched before the older, less efficient units. Therefore, even if the newer units are running on gas, outside of tighter grid conditions in which all units are needed, the new units would run first and would reduce emissions from the current state in which less efficient units are the only option and must run more frequently to serve the grid.

5. What is the status of the **Demand Response** program today, and what are AE's plans to expand and improve it? What are the current incentives for participation and their success rate as incentives? If the current incentives have not been as successful as we'd like, what improvements are being considered?

   Please see the attached program overview slides to view the status of the demand response programs and associated incentives. Additionally, the list below shows the demand response performance for each program offered.

Average Curtailment During a Typical 2022 DR Event (total 43.8 MW)

- Commercial Demand Response: 15.5 MW
- Smart Thermostats: 18.5 MW
- One-way Thermostats: 8.7 MW
- Behavioral Demand Response (2023) 1.1 MW

Demand response programs are heavily dependent on customer participation. Austin Energy has made several improvements to build program participation including adding a pay for performance incentive and a seasonal incentive increase. Soon, we plan to enhance our marketing and communications of demand response programs and add managed electric vehicle charging to our program portfolio. In the long-term, we will add a program to incentivize battery utilization for demand response.

6. What is the **potential for solar at Decker** as a renewable complement to the local dispatchable generation? Has AE considered using the reservoir for floating solar considering this is already in the load zone? What are (other) ways we can get more solar in our area?

   There is currently a small solar installation at Decker. Dependent on other commitments on the Decker plant site there may be the opportunity to increase the amount of solar at Decker. Solar requires ~8 acres per MW, so overall size would be limited. Floating solar is an option but would materially impact the recreational activities on the lake and is more expensive than ground mounted solar.

7. How can we deploy **batteries** here in our load zone? I understand there was a study that predicted spreading batteries around the city would be very cost effective. Can you tell me where this fits into AE's plan? When will AE start deploying meaningful storage? I would like to know the status of the RFQs that AE recently solicited for storage.

   There was a study done that showed spreading distribution-connected batteries smaller than 1 MW throughout our load zone would be cost effective assuming we are able to "catch" and reduce our 4 coincident peaks under current ERCOT market rules. The study did not look at the physical feasibility of locating these batteries. (It assumed they could be located within substations, some of which are space constrained.) Instead, the study focused on the economics based on an assumption set. That type of battery deployment fits into distribution system studies, and we have included more details on this topic below.

   Austin Energy did an RFP for large, transmission-connected, utility scale batteries and then short-listed and solicited proposals for a site-specific utility scale battery within our load zone. The analysis on the final proposals overlapped with the Generation Resource Plan Update and the economics of those proposals have been factored in the analysis. Austin Energy has opted not to propose a contract for any of the proposals given the pending Generation Resource Plan work but will revisit the opportunity after the Plan is adopted.

The challenges with the deployment of batteries at the distribution level (locally) are two-fold. The biggest concerns are where to place batteries and whether it can be done affordably. Battery energy storage requires the physical space to accommodate the batteries themselves as well as the associated switch gear to allow it to connect with the grid. Distribution scale battery systems require a lot of space, a one MW-hour battery would require a minimum space the size of an 18-wheeler just for the batteries, the switch gear would take up additional space, as would the physical barriers to keep the public away from potential hazards.

While we can consider placing a large bank of batteries at a single location, that does affect their potential value (although the cost per unit would be somewhat lower than more distributed systems). Batteries generally provide a greater opportunity for creating value for the utility the closer they are located to customer load. Distributed batteries, as referenced, can be substantially harder to site and interconnect. The idea of putting a large battery in every substation is not very practical, as we would run into space limitations at many of them.

An additional concern related to the location and siting of batteries is the hosting capacity of the distribution system at any given location. Every individual location needs to be studied to understand how much storage the system can handle without overloading existing infrastructure. Grid interactive systems like solar arrays can also pose limitations on how much storage can/should be deployed at any given location.

While we have just spoken at length about the challenges, this does not mean that we are not considering storage within our load zone. In fact, it is quite the opposite. Storage is considered as a non-wires alternative solution now as we approach any grid constraints on a one-off basis. In addition, we are continuing to survey the market for current best pricing for broader system-wide applications.

8. What plans do you have for **additional utility scale wind or solar** PPAs - beyond replacement PPAs?

   Austin Energy intends to issue an RFP in early spring for additional utility scale carbon free generation supply. This will typically be wind or solar, but we also keep it open to new carbon free technologies in case vendors propose new technologies that would be valuable additions to the portfolio.

9. What is the state of Austin Energy and City of Austin **energy efficiency** programs? How much more energy efficiency can we achieve and what plans do we have to expand or improve these programs?

The Austin Energy energy efficiency portfolio currently includes 7 retrofit and appliance rebate programs (spanning both residential, including multifamily, and commercial market sectors) as well as the green building programs for new construction and code development.

It is difficult to say exactly how much more energy efficiency can be achieved in the future, as this type of assessment is typically done through a market potential study. Our most recent one was conducted in 2014, and we are planning to include an updated one in the "For Further Study" section of the forthcoming Generation Plan.

Our current energy efficiency program forecast is captured in the table below:

	2024	2025	2026	2027	2028	2029	2030	2031
Projected MW	***51.8***	***48.43***	***44.94***	***42.45***	***41.94***	***41.27***	***38.63***	***37.3***

Please note that this forecast contemplates maintaining a consistent level of participation but assumes that costs will increase even while megawatt savings decrease.

The declining projections have to do with the following factors:

1) Changes in the baseline for new construction: as code continues to capture more and more of the low hanging fruit, increased efficiency over code becomes more expensive and produces lower MW savings.
2) For retrofit energy efficiency measures: these are generally more costly and invasive than new construction, and customer acquisition as well as implementation becomes more challenging as the market becomes more saturated. This does not mean that there is not still ample opportunity, but that those megawatts are increasingly expensive and difficult to reach, so we are anticipating that our costs will increase as our megawatt savings decrease even if we are to maintain current levels of participation.
3) The shift toward electrification will have a counteractive impact on megawatt savings, and, while Austin Energy understands it to be a net benefit from an environmental perspective, we also anticipate that it will drive electrical demand up as HVAC and water heating systems are transitioned from gas to electric. Under the current framework, it is difficult for the energy efficiency programs to support a transition to electrification due to the nature of the megawatt savings goals. This is why we are recommending a transition to greenhouse gas emission reduction as the metric for program success rather than megawatt savings.

It is also worth noting that some of the challenges we have extracting further energy efficiency is a product of the success of our programs. Austin is unique in that we have had the Green Building Program driving energy efficiency in new construction and code adoption for the last 20+ years. Similarly, our energy efficiency programs have been successfully operating at the cutting edge for the last 20+ years, meaning low hanging fruit that may be available in other parts of the state – such as transitioning incandescent lighting to LEDs, is more saturated here, and thus we are reaching for increasingly more expensive and difficult measures.

An updated Market Potential Study will be instrumental in helping to inform how best to shape our programs to capture the most value for our resources and customers. Such a study will also inform whether highly prescriptive megawatt goals may have unintended consequences for the programs in their flexibility to remain on the forefront of the industry.

10. What is the time frame that Austin Energy believes that **geothermal energy** might be economically viable to serve AE customers? Might we be able to transition our district heating and cooling over to geothermal and reduce demand for other types of generation in the process?

Austin Energy does not have a good estimate for when geothermal energy will be economically viable. As we were conducting our technology readiness assessment for the Resource Generation Plan update, we made a determination that geothermal generation was likely to be challenged to be widely available in time to contribute to the generation portfolio within the 2030 timeframe of the update. That said, discussions with industry subject matter experts that we believe to be objective indicate geothermal could begin to take off in the 2030 timeframe. The other challenge we see to geothermal is that any resources developed at scale are likely to come from South or West Texas first, using abandoned oil and gas wells. These will be outside of the AE load zone, so they will not help with our localized challenges in the short term. We see geothermal as a potentially viable long-term play and would look to incorporate it as soon as feasible. Geothermal would act more like a baseload plant, which makes it a very attractive option once it is proven.

Austin Energy's District Cooling systems are located in high-density areas such as Downtown and Mueller. With currently available technologies ground-source temperature control for buildings requires quite a bit of physical space and would not be suitable for our current district energy plants.

In addition, the District Cooling system already operates in an environmentally sustainable manner, chilling water overnight when energy is cheap and plentiful, and wind output is high. It then uses that chilled water as energy storage to reduce the daytime peak load.

For new subdivision construction, Whisper Valley is the only local project we have seen that has tried the ground-source temperature control approach. We are not privy to all of their financials and performance data, but our general research into ground-source applications is that they tend to be challenging in Central Texas. We do not have the seasonal temperature variances necessary to accommodate the thermal exchange needed. Given the long, hot summers of Central Texas, heat from homes would be constantly pumped into the ground, leading to the temperature of the ground to rise too high to be an effective heat sink. Ideally, this would be followed by an equally long winter to be able to pump all of that “banked” or stored heat back out of the ground and use it to warm the homes. This would then leave a cold sink to pull from in the coming summer for cooling, starting the cycle all over.