Minutes from meeting of IRP Stakeholder Technical Advisory Group (STAG)
Meeting 5 – September 6, 2023

Overall takeaways:

1. Ascend Analytics presented initial results from modeling two of GWP's scenarios. These results are not set in stone and the modeling is still in progress.
2. After the third townhall meeting at which community members expressed a desire for another STAG scenario (in place of GWP's third scenario), GWP and Ascend Analytics agreed to make a third scenario available to STAG. Rather than replace GWP's third scenario, the IRP team opted to increase the number of scenarios being modeled, for a total of 6 (3 GWP scenarios and 3 community scenarios).
3. STAG discussed options for the third scenario and ultimately decided on an approach that would be an intermediary to its two existing scenarios.
4. STAG's three proposed scenarios are:
    a. A 100% clean energy by 2035 scenario that integrates City Council's various clean energy goals, with a focus on local resources. The scenario will model accelerated electrification compared to GWP's scenarios.
    b. A 90% by 2035, 100% by 2042 scenario that models a long-duration energy storage project built in Glendale during the IRP period. The scenario will take a "middle path" on local resource assumptions, falling between STAG's first scenario and GWP's baseline.
    c. A 90% by 2035, 100% by 2040 scenario that takes comparable assumptions to scenario 2 on local resource potential.

Presentation from Ascend Analytics about initial results from modeling two of GWP's scenarios:

1. See the accompanying PowerPoint PDF for the slides presented by Ascend.
2. Ascend presented initial results from the modeling of two of GWP's scenarios: the California policy scenario and the Glendale goal scenario. For both scenarios, Ascend had results on the resource buildout required to meet the scenarios' clean energy goals (100% by 2045 for California policy, and 100% by 2035 for Glendale goal) and on the timeline at which each scenario would meet the requirements of California's renewable portfolio standard and clean energy mandate. Additionally, for the California policy scenario, Ascend presented the scenario's overall energy mix and its carbon emissions through 2045.
3. **Disclaimer:** The results presented during this meeting were preliminary only and will change before the IRP is finalized.
4. Ascend's presentation included:
    a. California policy scenario resource buildout
        i. This graphic (slide 5) shows new resources that will be built each year to meet California's clean energy mandate (100% by 2045). New resources start being built in 2027, which reflects the time it will take GWP to plan for and build any new projects.
            1. (2027 is the start date only for completely new resources; any resources already contracted/planned for construction before 2027 will still be assumed to be built on-schedule.)
        ii. Note that this graphic only reflects utility-owned resources. No behind-the-meter, customer-owned resources are displayed here as those are "baked in" to

the model and do not emerge as an output in the results. This graphic also does not display any existing resources on GWP's system.

iii. There are two main reliability constraints to consider when we decide what resources to build:
    1. Having sufficient capacity to meet demand, even at peak demand (like the N-1-1 conditions in which major resources go offline).
    2. Loss of load hours (LOLH) – this measures how many hours in a year GWP is unable to meet customer demand, on average. (Ideally, a portfolio will have an LOLH of 2.4 hours, or less, lost in a year.)

iv. The internal combustion engines (Wartsila units) that will be coming online in a couple of years are a main resource that can help GWP meet these capacity requirements. But to retain enough capacity over time, the model's main reliability resource is 4-hour batteries.

v. You can see that the only resource being built from 2035 onward is 4-hour batteries. From 2035-2044, the model adds 5 MW of batteries each year. In reality, that's not how GWP would be likely to go about procuring those (it'd likely be larger MW of batteries procured every few years).
    1. All this storage is incremental to the 75 MW that's already planned for development locally as part of the Grayson Repower.

vi. The other three resources being chosen by the model to meet reliability constraints are new geothermal, new wind, and new solar.
    1. Before 2030 when the 60% Renewable Portfolio Standard requirement kicks in, the model chooses to add a lot of new renewable generation (in the form of geothermal and wind).
    2. The capacity of these resources is really important when the model chooses them, even more important than cost. Solar is the least expensive resource of these three, but as we get more and more renewables on the system, the resource's capacity factor plays a bigger role in what resource is chosen in the model. (If you went back a few years, it would've been the opposite and the cheapest resource would've been selected first.) Wind can produce energy for a greater portion of the time than solar, meaning it's worth more of its total nameplate capacity (i.e., it has a higher capacity factor). That's why the model is choosing new wind and geothermal over more solar, because wind can help meet reliability requirements.

b. Glendale goal scenario resource buildout

i. Again, this graphic (slide 6) doesn't display any existing resources on GWP's system. Like with the other scenario, behind-the-meter resources are "baked in" to the model and not displayed as an output in this graphic.

ii. In this scenario, we replace local fossil resources like internal combustion engines, Grayson, and Magnolia with a fuel that doesn't produce carbon emissions to meet the 100% clean energy by 2035 constraint. The model chose 90 MW of hydrogen combustion turbines and 25 MW of 8-hour storage as replacement resources. Because this scenario has more ambitious clean energy requirements, we're going beyond the needs that 4-hour batteries can meet and into the area where we need longer storage.

1. For the purposes of this model, we make the assumption that hydrogen will be available in 2035.
2. The model put all the hydrogen buildout in 2035 because it's most cost effective to run natural gas all the way through that point, right up until the clean energy target date. In reality, GWP would likely operate differently and pursue blending of hydrogen before 2035. So the model showcases the hydrogen buildout simplistically.

iii. Other than that difference, the results are relatively similar to the California policy scenario. We have an early buildout of geothermal, which the model likes as both a clean energy resource and capacity-providing resource. And then wind and 4-hour storage to have sufficient energy on top of what already exists.

5. Total new resource additions
    a. Slide 7 gives a view of the aggregate buildout of new utility-scale resources. In the Glendale goal scenario, the model builds 80 MW more resources, because this scenario is retiring gas units and replacing that capacity, meaning we have to build out significantly more.
    b. The California policy scenario makes more incremental investments compared to the Glendale goal scenario.
6. California policy energy mix
    a. Slide 8 shows the overall energy mix through the IRP period for the California policy scenario. Immediately, you see a big jump in geothermal. Coal retires as the Intermountain Power Project transitions from coal to a natural gas/hydrogen blend. And over time, reliance on natural gas decreases.
7. California policy clean energy
    a. Slide 9 shows when the California policy scenario will be meeting California's clean energy requirements – a 60% Renewable Portfolio Standard In 2030, and 100% of retail sales from clean energy by 2045. GWP is hitting its RPS targets 1-2 years sooner than it needs to.
    b. You can see there's a gap here between the blue line (which reflects all clean energy) and the green line (which reflects just renewable resources as defined by California). Things that would be "clean" energy, but not "renewable" energy, are nuclear and large-scale hydropower, so that's why the blue line is higher than the green.
    c. The modeled portfolio ultimately gets to 110% RPS/clean energy, which gets at 1) making up for when resources are generating compared to when you have demand you need to meet, and 2) having enough capacity in reserve.
8. Glendale goal clean energy (slide 10 was skipped for time)
9. Dispatchable resource capacity factors
    a. This graphic (slide 11) displays how much GWP would actually run dispatchable resources in the California policy scenario, as reflected by their capacity factors. (Dispatchable resources are those GWP can quickly turn on and off to meet system needs during stressful periods. Capacity factors are reflected as a percentage and

indicate what percent of a resource's maximum potential generation, i.e., its nameplate capacity, it actually produces.)

  i. The lighter blue line at the top is the Magnolia unit – that stays relatively constant over time.
  ii. The yellow line is the Intermountain Power Project. Once that starts to move away from gas (in 2035) and convert to hydrogen, it will contribute more toward clean energy requirements while having less impact on the carbon constraints of the portfolio. That means you're going to run it more, resulting in it having an increasing capacity factor.
  iii. In orange the 54 MW of internal combustion engines (Wartsila units) stay relatively low. Their usage starts to trend upward toward the end of the IPP period, but that has very little impact on emissions, because the fossil retirements taking place more than offset their usage.

b. California policy carbon emissions
  i. Slide 12 displays the year-by-year carbon emissions for the California policy scenario.
  ii. There are very quick reductions in the early years of the IRP period as IPP is retired from coal. As renewables are added, those become much bigger portion of the resources meeting demand, and emissions continue to drop across entire study.
  iii. It's important to note that there are still carbon emissions in 2045 in this California policy scenario – the operation of natural gas resources doesn't go to zero. (This is because California's clean energy mandate only applies to *retail sales* of energy, not *total energy generated*. That allows utilities to continue to run non-renewable, carbon-emitting resources like natural gas for a very small portion of the time, as long as the amount of electricity generated by those resources doesn't exceed the amount of electricity lost in the transmission and distribution systems.)
  iv. The remaining emissions in 2045 are a tiny fraction of current emissions. It'd be huge step forward to go to even this California policy case, let alone the 2035 goal. The question then becomes how much you're willing to pay to reduce the last chunk of emissions down to zero.

10. Questions and discussion points among the STAG related to this presentation included:
  a. Hydrogen:
    i. Multiple members raised concern with the assumption around hydrogen availability underpinning the results of the Glendale goal scenario. They wondered if hydrogen is likely to exist at that scale in 12 years, given it is virtually nonexistent today.
      1. Ascend acknowledged that this is a large assumption to make, but that projects are ongoing that are likely to ramp up hydrogen supply (Intermountain Power Project, federal hydrogen hubs, etc.). Strategen noted that there are also federal power plant regulations from the Environmental Protection Agency that may require use of hydrogen in the future, resulting in market development.

            2. Strategen acknowledged that it is challenging to create reliable assumptions this far out, and there is uncertainty with how the future will develop. Since the IRP is revised every 5 years, GWP will know more about the hydrogen situation the next time this plan is created and can revise its assumptions based on the latest knowledge. If the model suggested hydrogen be built imminently, that would be more of a cause for concern given the constraints in hydrogen supply today. Since the model isn't forecasting a need for hydrogen until roughly a decade from now, GWP has more time to plan and let the market develop before placing too much reliance on hydrogen.
        ii. One member clarified whether the use of hydrogen in the Glendale goal scenario would be developed or imported.
            1. GWP responded that it would be imported, in the way that the Intermountain Power Project is doing (from Utah to the LA basin).
            2. SoCalGas is currently examining its ability to import hydrogen to the LA basin through a rate case.
        iii. Are we worried about nitrous oxide (NOx) emissions if so much hydrogen is being selected to meet the 2035 clean energy goal?
            1. GWP responded that NOx is created when hydrogen is burned in the presence of oxygen. Hydrogen combustion would create NOx, but can be managed in the way GWP does with natural gas pollutants.
            2. GWP also explained that solar + storage isn't as dispatchable (meaning GWP can quickly turn the resource on and off to meet system needs) as hydrogen, so hydrogen might fulfill a different role in its portfolio.
    b. Transmission:
        i. One member asked whether these results consider what the transmission impacts of the portfolio are, given that the selected resources are predominantly remote, not local.
            1. Ascend responded that their analysis does consider limits on transmission lines, but these results come out of their Production Cost and Resource Adequacy models, which have not yet been run. The initial results presented today show which resources can be built, irrespective of where they are. The next layer of modeling will take a more granular view of the GWP system and pinpoint where energy will come from.
            2. The initial results shown here display what various resources could generate if they were producing at their peak. At peak production, the energy generated would be more than transmission capacity. The maximum transmission capacity will be 247 MW after 2027 (when a new project is completed). But even with that additional capacity, there'll still be a bottleneck.
        ii. One member noted that the model seems built for importing resources, but there's an inherent tension with that assumption. Not all resources can be developed externally because of transmission constraints. But utility-scale

development locally runs into space constraints. That could suggest a need for more emphasis on customer-sited resources.

c. Geothermal:
    i. One member asked whether the model's heavy reliance on geothermal reflects projects that are already planned and are likely to be available, or if it's an aspirational assumption.
        1. Ascend responded that there is a large amount of geothermal potential that can be developed. Ascend's model isn't over-projecting what might be available. The question is whether the resources will be developed at the prices they expect.
        2. GWP added that there are numerous locations where geothermal can be accessed, but not all are cost effective. GWP was involved in geothermal projects a few years ago which underproduced and never met the capacity they expected. Geothermal can be risky, but GWP is still looking at procuring it.
d. Solar:
    i. GWP and some STAG members raised points about the lifecycle emissions of certain renewable technologies, like solar, as something that should be considered when comparing technologies to each other.
        1. Ascend clarified that this IRP doesn't look at lifecycle emissions, only those created to generate energy.
    ii. One member asked why existing solar projects aren't reflected in the modeling results for either scenario.
        1. Ascend responded that the modeling outputs displayed in this meeting don't display resources that are already existing or contracted in GWP's system. Both existing utility-scale solar and customer solar and "baked in" to the model to account for their contribution, but not displayed in these graphs.
    iii. One member asked why there seems to be a mismatch between City Council's emphasis on solar (like creating a pathway to 10% customer adoption) and Ascend's scenario results, which don't show rapid solar buildout.
        1. Ascend responded that Council's efforts pertain to behind-the-meter customer solar, not utility-scale solar, which the model is concerned with. So they are two different issues. Ascend's model includes 'baked in' assumptions about how much new rooftop and local solar will come online, although these are not displayed in modeling results.
    iv. One member raised that they have a hard time believing that Ascend's model thinks hydrogen is more efficient and cost effective than solar.
        1. Ascend responded that it's not necessarily that hydrogen is more efficient or cheaper than solar, but that the resources fulfill different needs in GWP's system. Hydrogen offers a value that solar might not provide, that is, providing dispatchable power at times of peak demand.
    v. One member asked whether the life expectancy of solar projects is taken into consideration in the model.

            1. Ascend responded that many energy contracts are priced on a $/MWh generated basis. That means that a longer solar contract could cost more total, but the price per unit of energy would be less compared to some other resources.
    e. Greenhouse gas emissions:
        i. Comparing slide 8 with slide 12, how is it possible that emissions are going so far down when natural gas in the portfolio remains basically the same?
            1. Ascend responded that this discrepancy stems from a flaw in the visualization in slide 8, in which hydrogen blended with natural gas (for instance, in the Intermountain Power Project, or IPP) are lumped together under the 'natural gas' label. In reality, natural gas would ramp down and hydrogen would ramp up as the IPP is transitioned fully to hydrogen.
        ii. In response to Ascend's point about the added costs of getting carbon emissions down to zero, one STAG member commented that things could change that would make the cost more reasonable in the future.
    f. Other:
        i. Can you clarify what nameplate capacity is?
            1. Ascend responded that nameplate capacity refers to the most energy a resource will ever generate. If you hear someone talking about 100 MW of solar, that's referring to nameplate capacity.
            2. There's another type of capacity (called accredited capacity) that considers a resource's reliability impact, so it's adjusted to reflect when the resource produces energy compared to when demand is.
            3. A cloudy day won't reduce solar's nameplate capacity. It would reduce solar's actual energy output. It would also impact the accredited capacity.

Presentation from Strategen Consulting on third townhall and scenario implications:

1. See the accompanying PowerPoint PDF for the slides presented by Strategen.
2. Strategen presented a readout of the third townhall and introduced the addition of a third STAG scenario.
3. Questions and discussion points among the STAG related to this presentation included:
    a. One member asked how GWP's first and third scenarios (the California mandate and the lowest cost scenarios) are different, noting that the California mandate scenario would likely already optimize for cost?
        i. Strategen responded that the first scenario will not be as cost sensitive as the third scenario, meaning the results are likely to look different. The third scenario will take the lowest-cost option to comply with California's clean energy mandate, including the use of renewable energy credits (RECs) when cheapest. The first scenario won't include as much of a reliance on RECs. The first scenario could also go 'above and beyond' California's mandate by achieving 100% clean energy slightly faster, potentially at an incrementally higher cost. The third

scenario would likely not do that, because it would always opt for the lowest-cost resource selection.

   ii. Strategen also clarified a question raised at the third townhall about the use of RECs in GWP's third scenario. The question had asked whether that strategy might ultimately be more expensive than GWP developing clean energy itself, given the increasing social cost of carbon and price of RECs. Strategen explained that GWP's third scenario doesn't prioritize the use of RECs above all other strategies; it prioritizes the lowest-cost option. The hypothesis going into this scenario is that there are likely to be cases where purchasing RECs is cheaper than GWP developing clean energy itself. But if it turns out that isn't the case, then the model will select the new clean energy development instead. While the social cost of carbon is increasing over time, the most salient carbon price for this scenario is actually the CARB carbon price (the price at which RECs are sold), given this is the price GWP will have to pay for using resources that emit greenhouse gases.

b. One member asked where the CARB prices being used in the model came from. In Ascend's 'key assumptions' spreadsheet (which was shared with members before the meeting), the carbon price listed seems lower than the allowance price reached at a recent sale. They said they weren't familiar with the details of that auction, but saw that allowances sold for more than the stated CARB carbon price for this year.

   i. Ascend responded that it wasn't familiar with this particular sale, but that their assumptions on CARB's carbon price are aligned with the floor price, because historically the market has cleared at that price. That floor price grows exponentially year over year.

Polling exercise and discussion on STAG scenario 3.

11. Strategen conducted a poll of the STAG to gauge their interest in potential directions to take for STAG scenario 3. These were used as a starting point for discussion among the group.
12. The poll asked members to reflect on elements that are missing from existing scenarios that they might want to test in STAG 3; elements from existing scenarios that they'd like to include in STAG 3; the year at which STAG 3 should achieve 100% clean energy; and whether there should be an interim clean energy target before reaching 100%.
13. See the accompanying PowerPoint PDF for results of the poll.
14. After STAG took the poll, discussion included the following:
    a. Some members wanted to see a scenario that reflects the life cycle environmental impacts of resources being evaluated, like electric vehicles, and how that might impact customer adoption.
       i. Strategen responded that a life cycle analysis is not possible in the IRP, but that STAG could opt to assume that fewer customers adopt EVs than GWP anticipates.
       ii. Strategen also noted it can add this idea to the 'parking lot' of topics that have been raised by STAG, but that aren't possible to integrate in the IRP, for report out at a later date.

b. One member suggested adopting 2040 as a compromise 100% clean energy year, given that the group was fairly split in its preference. (A majority of members favored a 100% clean energy date between 2040 and 2045, with no year having a majority.) Other members seemed to agree with this suggestion.

c. One member suggested the group take an approach suggested by some attendees at the third townhall, which would result in a more moderate version of STAG's scenario 1 (relaxing some of the emphasis on customer-sited resources and doing so with a 100% clean energy date between 2035-2040).

    i. This member emphasized the importance of taking direction from townhall attendees given that people go out of their way to come to townhalls, especially the last one which was held on a Saturday. They noted that, while GWP might say STAG was chosen to be representative of Glendale, it is not actually representative. There are only three women and one person under the age of 40 in STAG. They stated townhalls often have different demographics, with younger attendees and more renters than STAG.

d. One member suggested adopting more conservative estimates on distributed energy resources (DERs) than are being assumed in GWP's scenarios to model what the impact would be if customer DER adoption was lower than anticipated.

    i. Several members pushed back on this idea, saying that GWP's scenarios already take a 'conservative' view on DER adoption and STAG's scenarios should explore higher assumptions.

15. After the group discussed these points and a handful of ideas emerged, Strategen launched an addition to its original poll and asked the group to vote on the ideas raised for STAG 3.
    a. The accompanying PowerPoint PDF includes results of these two questions (questions 5 and 6).

Outcomes of the meeting:

16. STAG agreed on a third scenario with the following characteristics:
    a. Achieving 90% clean energy by 2035 and 100% by 2040.
    b. Developing 75 MW of distributed energy resources by 2040. (This is a lowering of the DER requirements in STAG's scenario 1. STAG 1 will model 100 MW of DERs, per Council goal.)

Next steps:

17. Strategen will send a survey to STAG to decide on the detailed assumptions going into all three STAG scenarios. Once results are received (and shared with STAG), Strategen will send these assumptions to Ascend to begin modeling.
18. Strategen, Ascend, and GWP are compiling a public 'key assumptions' spreadsheet, following a request at the last townhall, which will outline major data points driving Ascend's model. This document has already been shared with STAG, but additional time will be provided for STAG review and questions before it is finalized. Strategen will be organizing optional STAG office hours for members to ask questions on both this document and the assumptions survey.