

Game Theory Instructions

The purpose of Game Theory is to consider the implications of Future World Scenarios, how those scenarios could impact Seattle City Light (SCL), and how SCL should prepare for them.

The gaming participants will assess three Future World Scenarios and try to place SCL in the best position possible to “weather the storm” associated with each scenario. Weathering the storm could mean many things, from staffing up the IT department in order to meet higher technological demands to downsizing the total workforce by 25% in order to cut costs due to a massive regional recession.

In each Future World Scenario, you will determine what actions (Gaming Action) SCL should do to place it in the best position to manage the implications of that scenario. It is expected that some Gaming Actions may be applicable to all scenarios, while other Gaming Actions may be mutually exclusive to each scenario.

Identifying Gaming Actions is the point of the Game Theory exercise.

These Gaming Actions generally affect one or more business departments within most companies. Let’s call these business departments Impact Zones. Impact Zones are associated with major business functions, such as IT, Finance, Operations, Human Resources, etc.

For example, in the above Future World Scenario where SCL needs to staff up to meet higher IT demands, the Gaming Action is hiring more IT staff. The Impact Zones affected could be IT, Human Resources, and likely Finance. Hiring those new IT people may engage all three of those departments (Impact Zones); the IT department because they will acquire new employees and have more available resources to accomplish new tasks, the Human Resources department because they will have to recruit the new employees and insure them, and the Finance department because they will have to budget for and accommodate the employees’ salary requirements.

Ultimately each scenario evaluated will have a list of Gaming Actions the participants think are necessary for SCL to implement along with a series of Impact Zone recommendations for each Gaming Action. We will be doing these exercises in the small group format like before, but it would be helpful for each participant to read the Future World Scenarios in advance and begin thinking about what SCL should do in each scenario to “weather the storm”.

Understanding how Gaming Actions get Accomplished at SCL within Impact Zones steers a strategic plan.

The Impact Zones we will be using for our gaming will be the following:

- Government Affairs and Legal (lobbying, contracts, policies)
- Communications (internal and external)
- People and Culture (HR, safety)
- Finance (budget and financial planning)
- Facilities and Oversight (compliance, security)
- Energy and Resources (power management, planning, marketing)
- Environment (programs)
- Customer Experience (customer operations, rates and redesign)
- System Operations (generation, transmission, distribution ops)
- Engineering (generation, transmission, distribution design and build)

Internal Considerations Analysis

What Do We Need to Work on Internally?

- **Managing Capital Projects:**
 - Overbudget
 - Overdue schedules
 - Unnecessary projects / vanity projects
 - Prioritizing capital projects over expense / maintenance projects to the detriment of SCL (cost, safety, etc.).
- **Bureaucracy and Change:**
 - Too big to be nimble
 - Lack of utility interest from the City Council
 - Outdated processes, legacy and roadblocks
 - No method to implement creative ideas and concepts
 - No method to incite buy-in for change
 - Too much paper and process
- **Reactive Instead of Proactive due to:**
 - Lack of funds
 - Lack of management support / interest
 - Lack of employees / resources
 - Lack of preparedness / plans
- **Long-Term Financial Planning:**
 - Rate structure is insufficient and worrisome
 - Revenue and expense projections and assumptions inaccurate
 - Debt load
- **IT Infrastructure and Implementation:**
 - Universally hated
 - Outsourcing is inefficient
 - Integration is cumbersome
 - Systems are inadequate
 - Employee training is inadequate
- **Internal Communications:**
 - Information hoarding systematic in certain silos
 - Information roadblocks occur in middle management
 - One directional communication routes (Top down only)
 - Inadequate documented processes and other employee educational and informational resources

What Do We Need to Capitalize on Internally?

- Outage response and restoration
 - Quick response time to outages
 - Equitable restoration plans
- Affordability
 - Currently inexpensive comparatively
 - Do not turn off residential non-pay customers
 - Low-income programs
- Environmentally friendly
 - Good stewardship messaging
 - Environmentally friendly generation
 - Environmental partnership opportunities with customers
- Positive relationship with customers
 - Programs designed to enhance direct communication experience with customers
 - Creative large customer power solutions
- Skilled and developed leaders
 - Educational opportunities
 - Internal advancement opportunities

What Other Ambiguities Are We Concerned About?

- Workforce skill / preparedness / succession
 - Reallocation of existing workforce to changing needs / positions
 - Retaining workforce in tight job market
 - Adequate pay structures
 - Knowledge transfer
- Rates and rate structures
 - Less kwh use
 - Costs in wires not power
 - Interconnect expenses
 - Transmission
 - Socialized expense equity
 - Rate shock / rate trajectory
- Disruptive technologies
 - Storage
 - Electric vehicles
 - Electrification
 - Conservation

- Appropriate funding and resource allocation
 - Visible projects get funds but maintenance or ongoing projects overlooked
 - Employee workload not allocated equitably
 - Not enough funding for upcoming needs. Too much funding for the loudest voices.
- Aging assets (costs and repair / replace decisions)
 - To build or not to build generation
 - How to best rebuild and update for grid modernization
 - How to incorporate changing loads due to storage and electrification
 - Stranded asset decisions
- Municipal based structure impeding on efficient utility operations
 - Policies
 - Pet projects
 - Lack of interest in utility

External Considerations Analysis

Combined Short-Term Themes

- More electric vehicles but not to problematic levels
- Increased climate change impacts but no substantive changes in policy or process
- More environmental regulations
- Fossil fuel generation use will decrease
- Electrification of things will increase but not to problematic levels
- Grid modernization / infrastructure become more critical
- Revenues and expenses and rate pressures will be problematic
- Consumer choice and self-supply desires need to be managed
- Population will continue to grow regionally
- Load use patterns will begin to change
- No new generation will be built

Combined Long-Term Themes

- Climate change will lead to major disruptions in load / operations / policy
- Distributed energy and self-supply will be common
- Energy storage will be wide spread and common
- Electric vehicles will be impactful to the electric industry
- Electrification of things will be impactful to the electric industry
- There will be no more natural gas heat (electric conversion)
- There will be no more carbon-based generation
- Power generation will be less centralized
- Grid modernization / delivery infrastructure will need to be prioritized
- Utility rates / structure will be very different
- Cyber-security will be very important

External Considerations

Short-Term Themes by Group

Think Tank

- More storms will occur due to climate change
- Fossil fuel use for generation will decrease
- Distributed generation will increase
- Power prices and therefore rates will increase
- More environmental regulations and laws
- EV will increase but not be everywhere
- Water changes due to climate change will have power supply consequences

Executive Team

- Customers will still have significant needs and expectations from SCL
- Seattle policy makers will not give SCL the attention it needs
- Consumer choice and electric competition are coming
- Infrastructure and grid integration are becoming more critical and valuable
- Climate change will continue to make a mark
- Electrification of things will continue to grow
- No new utility scale generation will be built
- Labor costs and resources will get tighter
- Customers will still have needs and wants from us
- Most utilities will not have drastically different short-term strategies
- Revenues and expenses will continue to diverge making funding inadequate

Review Panel

- There will be more electric vehicles on the road
- Population will grow in Seattle
- The region will continue its liberal leanings and policies

External Considerations

Long-Term Themes

Think Tank

- Electric vehicles will be commonplace in Seattle - 50% or greater
- Institutional bureaucracy will be worse at SCL
- Cyber security will be a major issue
- Delivery infrastructure will take a bigger role (poles / wires)
- SCL will still be a relevant entity
- Climate change will be a major disruptor in SCL operations / load / generation / policies
- Electricity will still be needed
- Distributed energy and storage / grid modernization will be a bigger role

Executive Team

- No more carbon-based generation
- Energy storage takes a bigger role
- Power generation is spread out to more sources less centralized
- SCL governance will be different
- Utility rate structures will be very different
- SCL will be a part of a large western reliability market
- The electrification of things will impact SCL
- Transportation changes will be transformational

Review Panel

- Better and more energy storage
- Climate change impacts will continue
- Natural gas usage will be less
- There will be more electrification of things
- Population will continue to grow

Future World Scenarios

Attack!

In 2021 a highly sophisticated ransomware cyber-attack simultaneously occurred at the Electric Reliability Council of Texas (ERCOT) and the Midcontinent Independent System Operator (MISO) which resulted in two US electricity market disruptions. The ransomware subsequently infected not only the market operations at MISO and ERCOT but also activated several dormant foreign nation imbedded viruses that lead to widespread critical physical asset manipulation and destruction. Two North American electric grids experienced substantial system damage and cascading outages. The disruptions took their toll on many specialized critical physical assets (power plants, transmission lines and large specialized transformers) which lead to widespread lengthy outages that make hurricane outages look like a walk in the park.

Initially, the US economy took a substantial nosedive. Major manufacturing and electricity dependent businesses had to close or limit operations as the electric grid was sectionalized and electricity was rationed and allocated as needed for a period of two months, with a focus towards emergency sectors like healthcare and shelters. Once full restoration occurred, many businesses stay closed, leading to a national recession. Industry, cautious of a repeat event occurring or the recession languishing further, chose to reduce redevelopment and expansion plans in the US. As a result of the initial crises, US electric demand decreased 8% almost immediately after the attack. The ongoing economic impact further took its toll on electric growth. An additional 5% load loss occurred through 2030, with no new electric growth after that for the next 20 years. Seattle faired a similar load loss fate.

Utility expenses associated with the attack were substantial. The ransom payments alone increased the average cost of electric power 4% nationwide. The immediate costs of restoring and further hardening the grid and generating assets after the attack resulted in an additional 12% increase. Finally, the federal, state and local regulations that came down like a blizzard in the wake of the event greatly increased utilities' operating costs for compliance. This resulted in an additional 22% increase in the average cost of electric power nationwide through 2040. Many large central station power plants such as coal, hydro and nuclear chose to retire early rather than implement the costly, necessary mitigating equipment and processes to remain compliant under the new regulations.

The labor market was substantially impacted by these events as well. As businesses closed and industry stubbornly refused to grow, unemployment rates increased rapidly. This resulted in downward pressure on wages but increased competitiveness for skilled positions. Population centers and large cities found themselves with increased homelessness and poverty. Low-income assistance and social programs became more necessary as time went by. Population density increased as people opted for more multi-family housing options. These labor events played out in Seattle to an even greater degree than in other cities in the US.

Due to the disruptive and shocking nature of the attack and the very public exposure of the vulnerability of the electric grid, consumer sentiment regarding electric utilities soured. A general sense of distrust ensued resulting in a multitude of social and policy changes. First, consumers began demanding more off-grid electric options from developers, policymakers and utilities. Tesla created at-home power houses which produced and stored enough electricity to serve a 2,000 sq. ft. home at a cost only 20% higher than on-grid electric power services. Many utilities saw rapid implementation of these at-home power houses, resulting in a need for utility level implementation policies, grid modernization considerations, central power considerations, etc.

In effect, a single attack on the power grid created a revolution in the way people perceived the existing infrastructure as well as what new options created in the wake of the attack were available to them, with businesses scrambling to cash in on the “new electrical reality”. In much the same way as the internet changed the brick-and-mortar book store, the attack changed power production and consumption.

Some Possible Implications for Consideration

- Higher energy costs nationwide
- Electric load loss nationwide
- Early decommissioning of coal, hydro, and nuclear power plants
- Increase in cyber-security regulations
- Increase in other utility regulations
- Negative consumer views on electric utilities - messaging
- Increase in population density – load profile impacts
- Higher unemployment
- Increased needs in social programs and assistance
- Heightened consumer desire for off-grid options
- National economic recession
- Grid Modernization needed
- Load loss – what to do with excess generation
- Staffing levels

I’m Melting...

Starting in the mid-1900s, the Earth saw catastrophically higher temperatures around the globe. Climate change impacts, which had been growing for years, suddenly become spectacularly visible in 2021 due to a massive melt-off of the polar ice caps. Sea levels rose rapidly, resulting in shocking destruction in low lying nations and coastal communities around the globe. In the years that followed, further weather events such as hurricanes, fires, floods and drought lead to irreversible species impacts and an indefensible human death toll.

Nations around the world responded to the irrefutable evidence of this calamitous climate change by implementing immediate and stringent carbon reduction policies. The United States alone called for the immediate shuttering of all coal plants by 2025 and the elimination of all natural gas-fired power

plants by 2040. Natural gas as a residential and commercial heating source was also phased out during that period as well, culminating in the electrification of all heat sources by 2040. The population of the United States rose to the challenge and did its part to reduce, reuse and recycle. A movement of consumer-driven energy efficiency rose and spread even to the Midwest. As a result, despite pressure for more electricity due to the electrification of things and natural gas to electric heat conversion, electric demand nationwide remained flat for the next 20 years. However, Seattle saw a steady decline in electric demand during this same period due to exceptional efficiency efforts.

The environmental community was appalled at the impacts to the species associated with the 2021 event. They double-downed on their efforts to mitigate for future climate change impacts to species in order to save them from destruction. The Bonneville Power Administration ultimately had to breach the lower Snake River dams and invest billions in the Columbia River projects resulting in a 50% increase in power production costs by 2027. Further impacting Bonneville, the changes in snow patterns and run-off due to climate change resulted in power production profiles that increased costs an additional 20% by 2030. Due to the species implications, Seattle chose not to relicense its current fleet of dams nor expand or build new dams.

The immediate impacts of the sea level rise lead to a massive migration of people due to foreign refugee relocation and domestic coastal communities choosing not to rebuild. In the immediate aftermath, Seattle opened its doors to 40,000 foreign refugees, mostly from south pacific island nations. Social programs, housing and public assistance was strained in order to accommodate the refugees. Furthermore, many people from low-lying rural and suburban areas surrounding Seattle chose to move to the city, further exacerbating the housing and transportation crisis. Seattle's immediate response to the swelling population and the embarrassment of the impossible traffic congestion, which became a running joke due to a skit on Last Week Tonight with John Oliver, was to immediately, and with gusto, improve transportation infrastructure. In 2027 Seattle completed an ambitious and comprehensive electric-powered mass transit system. This system, combined with a vigorous but healthy growth of electric vehicles and other electrification programs, had a measurable impact on Seattle City Light's required power supply profile. SCL electric load was now peaking at night, though load factor had improved.

Some Possible Implications for Consideration

- Stringent global efforts to reduce carbon
- Federal regulations immediately resulting in no new carbon-based generation being built and all carbon-based generators being phased out by 2040
- Federal regulations that aims to eliminate all natural gas consumption nationwide by 2050
- Federal regulation for species mitigation is revitalized and increases mitigation costs by 40%
- No new storage-based dams are licensed
- Existing storage-based dams are allowed to retire on schedule
- Hydrology is impacted due to climate change, resulting in different power production profiles at existing dams
- A rapid increase in the electrical conversion of most consumer goods, including vehicles
- Regional capacity sufficiency

- Rate restructuring
- Power supply shortages

Poverty

In 2021 a global depression, the likes no one had ever seen, occurred. By 2045, when the world crawled out from the effects of the extended depression, it was clear the impact left scars. In hindsight, the depression was kicked off by a perfect storm of global issues. The values of US-based stock markets were hyperinflated and needed a 20% correction in order to normalize. This was true for other markets worldwide as well. Across the globe there was a dramatic increase in nationalism from most industrialized or “western” nations, leading to a generalized “us against them” attitude worldwide. There was a massive slowdown of “free trade” and numerous trade wars amongst nations occurred due to this polarization. Vast corruption of third world nations resulted in swarming refugee migration and the commoditizing of fear by governments worldwide. The disparity between the have and have not’s reached epidemic levels never before seen, even worse than what preceded the crash of 1929. The efficiency of work and mechanization of work lead to less middle-class jobs, resulting in low-paying service jobs or high-paying intellectual jobs, but in all cases not enough jobs. Mass poverty in industrialized nations greatly increased, causing rising dissatisfaction of the population. Working became a privilege, not an assumed right.

Throughout the 2020’s and 2030’s, the US saw massive poverty due to a 28% unemployment rate and an additional 35% underemployment rate. Many businesses closed their doors or downsized during this time. Seattle did not escape the grips of this scourge. It too experienced massive unemployment resulting in increasing homelessness and an unrelenting need for social programs. Social assistance programs were stressed to the point where the federal government had to help fund certain state and municipal government services, and basic services organizations, including utilities, to support low- and no-income populations. Seattle implemented programs to assist those poverty stricken but prioritized homelessness, leaving Seattle City Light short of relief and badly needing funding. SCL’s late and no-pay accounts were putting so much pressure on SCL that debt service payments were in jeopardy.

The vast majority of consumers became very price conscience. They cared less about external issues and feel-good programs and more about keeping themselves afloat. As a result, consumers rejected funds being spent on new gadgets, environmental protection, labels and identity / vanity objects. They became hyperaware of conservation for the sole purpose of saving money and not for saving the planet. Consumer participation in helping others with bill pay assistance programs dwindled.

The federal government passed several bills aimed at jumpstarting the economy through modernized “New Deal” infrastructure programs. Two programs of interest impacted Seattle. First was a massive funding project initiated in 2022 for transmission and distribution grid modernization. Seattle successfully acquired \$50,000,000 in funds from this federal program. The only caveat to the program was that SCL had to add 2 full-time equivalent employees for every \$1,000,000 in funds received, thus increasing the workforce of SCL by 100. The grid modernization helped dramatically with consumer-based remote power stations, battery storage devices and reverse flow technologies

located throughout the grid. This was particularly handy given the impact of the next federal program. The second New Deal program impacting SCL was the Electric Vehicle (EV) Infrastructure Program bill of 2027. This bill provided funds for cities to build out electric vehicle charging infrastructure in order to encourage rapid EV adoption and therefore stimulate the economy. Seattle, always a trailblazer on environmental and social issues, bid the most aggressive EV infrastructure program and won. The federal government wanted to use Seattle's success as a messaging campaign nationwide. As a result, the greater Seattle area received \$500,000,000 for EV infrastructure. The program was a massive success. EV adoption in the Seattle area skyrocketed and impacted SCL's electric load requirements and load profile.

Some Possible Implications for Consideration

- Less industry overall (lower electric loads)
- Higher unemployment rates
- Less employees needed at SCL
- Increase cost sensitivity of consumers and less ability to pay
- Less consumer appetite for new gadgets and "things"
- Increase conservation awareness and action focusing on: reduce, reuse, and recycle
- Federal investment in EV infrastructure as a means to prop up the economy
- Federal investment in transmission and grid modernization as a means to prop up the economy
- Communications changes to address changing consumer sentiment
- Government affairs programs and legal implications