SIEMENS
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CWL IRP and Master Plan

Assumptions and Scenarios

Restricted

October 24, 2019

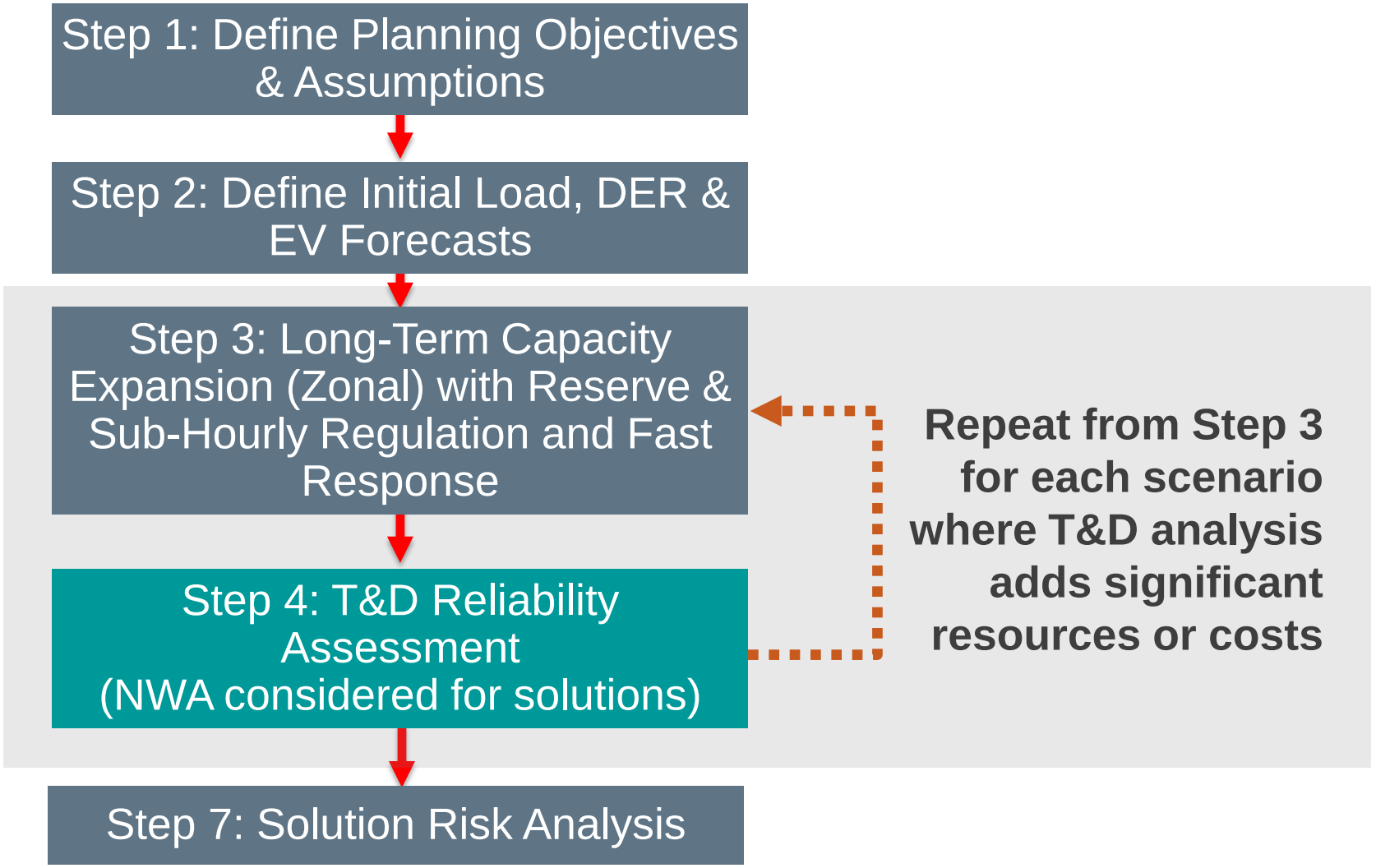
Long-Term Planning Objective

Develop a resource and T&D plan that supports the community wide greenhouse gas emission reductions levels of 35% by 2035, 80% by 2050, & 100% by 2060, in a reliable and cost effective manner.

This broad objective can be broken down to more manageable supply and T&D system targets:

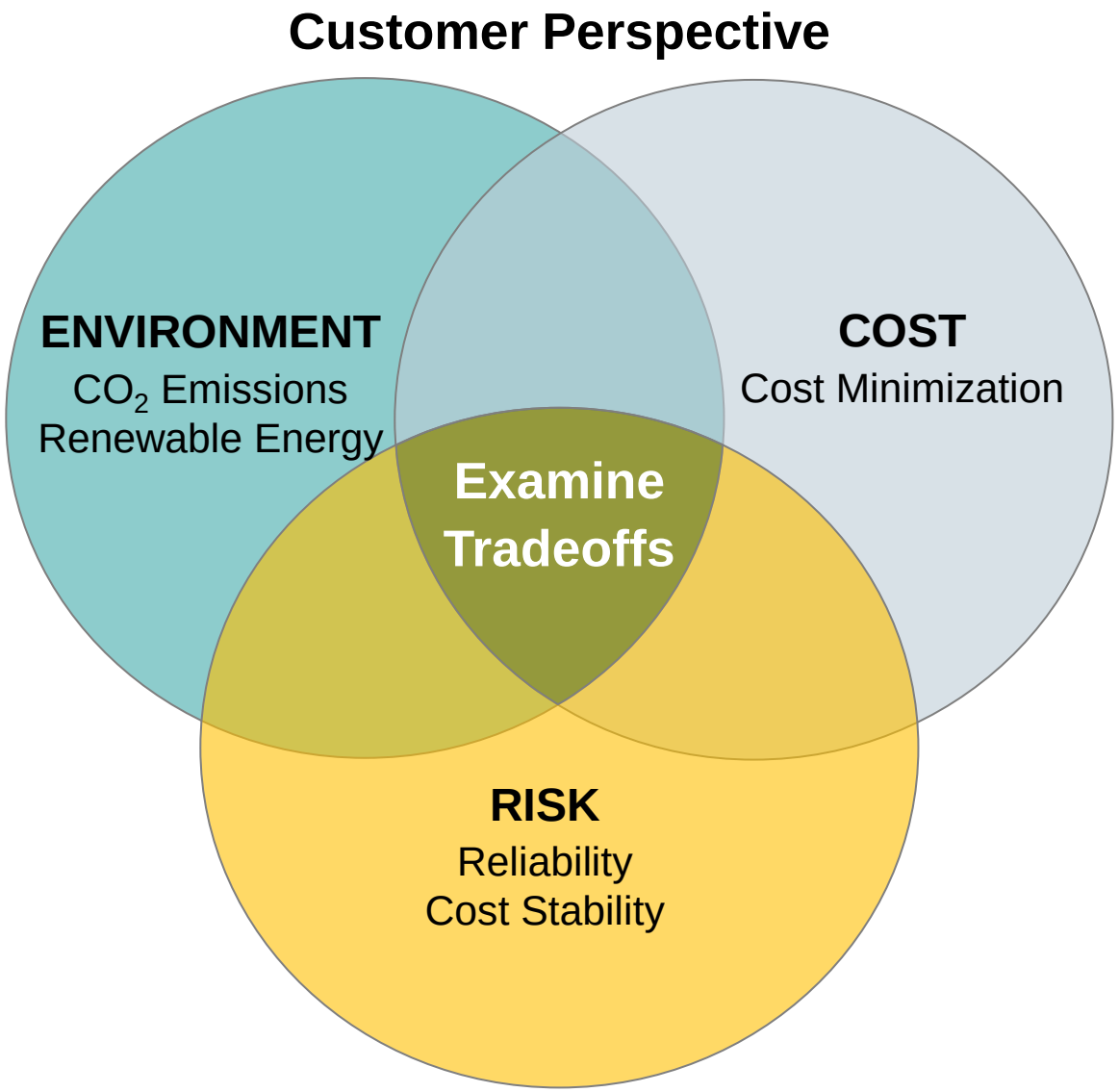
- Meet Greenhouse Gas (GHG) Reduction Targets
- Maintain or Increase Reliability
- Choose Least Cost Alternatives That Meet GHG and Reliability Targets

An Integrated Approach to the IRP and T&D Planning



Step 1: Select Objectives, Metrics and Scenarios

Both IRP and Master Plan Require Identifying and Evaluating Tradeoffs



Potential IRP Objectives/Metrics

OBJECTIVES (illustrative)	METRICS (illustrative)
Least Cost	Present value of revenue requirements (PVRR)
Reliable	Static Reserve Margin Target (MISO Load Serving Entity (LSE) target) Meets or exceeds Loss of Load Expectation (LOLE) requirements High probability, low impact (e.g. outage of large generator or transmission line)
Sustainable	Emissions in Carbon or Carbon equivalent tons (or reductions from a base year as in CWL Adopted Targets – 80% reduction by 2050, 100% by 2060)
Rate Stability or Risk Minimization	Range of result across different future scenarios Exposure to Market Transactions
Percent of Local Supply?	Percent of utility scale and distributed supply resources that are sited within the CWL service territory
Economic Growth ?	Job creation
Resilient (Optional scope addition)?	Able to maintain supply to critical loads, timely restoration of supply to customers Low probability, high impact (e.g., tornado creates wide spread outages)

T&D Master Plan Objectives/Metrics

	OBJECTIVES (illustrative)	METRICS (illustrative)
Transmission	Support the least cost generation expansion plan	Present value of revenue requirements (PVRR) of combination of generation + transmission to support generation
	Support the least cost distribution expansion plan	Present value of revenue requirements (PVRR) of combination of distribution + transmission to support distribution
	Maximize Cost Effective Non-Wire Alternatives	Ratio of PVRR of NWA solution to PVRR of alternative “classical” solution > 1
Distribution	Least Cost Distribution (meeting all technical requirements)	Present value of revenue requirements (PVRR)
	Identify and Improve System Reliability Issues	Improvement in reliability metrics (SAIDI / SAIFI) for target areas
	Replace ageing infrastructure	Percentage of assets remaining beyond its technical life.
	Reduce Technical Losses	% System Losses (calculated vs. historical)
	Increase DER Hosting	% increase, MW increase
	Displace fossil sources with CWL projects/programs	MW of carbon free resources connected to CWL MWh of carbon free energy delivered to CWL
	Enhance resiliency	MW of priority load served with microgrids of backup generation

How Portfolios are identified and evaluated

- Define Scenarios so they describe a range of plausible future conditions
- Identify baseline assumptions for each Scenario
- Run least cost expansion plan for each Scenario
- Develop a list of portfolios
- Determine implications on transmission/distribution system
- Adjust portfolios as needed
- Test to see how each portfolio performs against each scenario
- Select the best performing portfolio, and identify no-regret, or limited regret strategies that cross all futures scenarios

Example Scenario Narratives

Base Case (refers to the broader market)

- The base case is the “most likely” case, built with commodity forecasts based on industry expert averages
- All other scenarios reference the base case (individual uncertainties are at the same levels or are higher or lower than the base case)
- In the base case:
  - Natural gas prices move upward 48% in real dollars from 2019 to 2039.
  - Net and peak load forecasts increase at a moderate rate – (0.5 - 1%/ year).
  - Capital costs generally decline slightly for fossil resources, more for wind and approximately 45% or more for solar and storage resources.

Example Scenario Narratives

High Technology

- This scenario assumes that technology costs decline faster than in the base case, allowing renewables and battery storage to be more competitive.
- Given the abundance of low to no carbon generating technologies, CO_2 is no longer an issue.
- Increased demand for natural gas is more than met with advances in key technologies that unlock more shale gas, increasing supply at lower gas prices relative to the base case.
- Less demand for coal results in lower coal prices relative to the base case.
- Utility-sponsored energy efficiency costs rise early in the forecast but ultimately fall back to below base levels due to technology advances, allowing for new and innovative ways to partner with customers to save energy.
- As technology costs fall, customers begin to move towards electrification. This results in more electric vehicles, higher adoption of rooftop solar/energy storage, and trend towards highly efficient electric heat pumps in new homes as the winters become more mild and summers become warmer.

Example Scenario Narratives

High Regulatory

- Carbon is priced higher than the base case due to more aggressive national regulation of carbon emissions.
- A fracking ban is imposed, driving up the cost of natural gas as the economic supply dramatically shrinks.
- Tighter regulations are implemented on burning coal. As these regulations are imposed, prices for coal decrease due to declining demand.
- High regulation costs are a drag on the economy and load decreases relative to the base case.
- Renewables and battery storage are widely implemented to avoid paying high CO2 prices which drives higher energy prices. Capital costs for renewables would face a certain amount of upward price pressure that comes from higher demand as utilities and developers shift away from new fossil generation toward renewable energy.
- Utility-sponsored energy efficiency costs are higher as more codes and standards are implemented, leaving less low hanging fruit.

Key Inputs for Proposed Scenarios - For Discussion

Scenario Element	Reference Case	High Technology case	High Regulatory case	High economic growth	High Renewable / Carbon Free	Scenario 5	Scenario 6	Scenario 7
Target Year for 80% Carbon Reduction	2050	2050	2050	2050	2030			
Target Year for 100% Carbon Reduction	2060	2060	2060	2060	2035			
Economic Growth	Base	High	Low	High				
Regional load	Base	Base	Base	High				
New Transmission Lines	None	None	None	Allowed				
Thermal Capital costs	Base	Base	Base	Base				
Renewables and Battery Storage Capital costs	Base	Low	Base	Base				
DSM, EE, DR Penetration	Base	High	Base	Base				
Delivered coal prices	Base	Base	High	Base				
Delivered natural gas prices	Base	Low	High	Base				
CO2 Emission Prices	Base	Low	High	Base				
Electric Vehicle Penetration	Low	High	Low	High				
DER	Base	High	High	High				
Fracking and Methane regulations	Status Quo	Status Quo	Stringent	Status Quo				
Coal Emissions and Waste Regulations	Status Quo	Status Quo	Stringent	Status Quo				

*All Scenarios 5-7 open for discussion and input from the Task Force and CWL

Assumptions with Entity Providing Initial Recommendation

Assumption	Entity Providing Initial Recommendation
Regional load Growth	Siemens
Economic Development Prospects	Task Force / CWL
Thermal Capital costs	Siemens
Renewables and Battery Storage Capital costs	Siemens
DSM, EE, DR Penetration	Task Force / CWL / Siemens
Delivered coal prices	Siemens
Delivered natural gas prices	Siemens
CO2 Emission Prices	Siemens
Electric Vehicle Penetration	Task Force / CWL / Siemens
DER	Task Force / CWL / Siemens
Fracking and Methane regulations	Siemens
Coal Emissions and Waste Regulations	Siemens
Cost and performance of new generation	Siemens
State Environmental Policies	Siemens
Federal Environmental Policies	Siemens
Target years and Percent for Carbon Reduction	Task Force / CWL
Priority on locally sited generation	Task Force / CWL
Retirements and Conversions	CWL
Cost of Capital Assumptions	CWL
Economic and Inflation Assumptions	CWL
Debt / Equity Assumptions	CWL

Questions for the Task Force

1. Other than the primary objective on slide 2, what other objectives does the Task Force have for this project?
2. Are there particular concerns with the existing CWL electrical system or supply that Siemens should be aware as we start our analysis?
3. Are there particular concerns with respect of CWL standards of construction or reliability Task Force feels need to be addressed?
4. Are there any limitations and /or concerns with the development of new transmission lines?
5. Are the assessment of “resiliency” opportunities important to the Task Force? This could be a scope addition depending on the depth of the analysis.
6. Please confirm that the carbon reduction targets and goals assume a net carbon reduction, e.g., can CWL import power from a generation source that produces carbon emission so long as they export (or purchase) sufficient excess carbon free power at a different time to offset (or net out) the carbon produced?