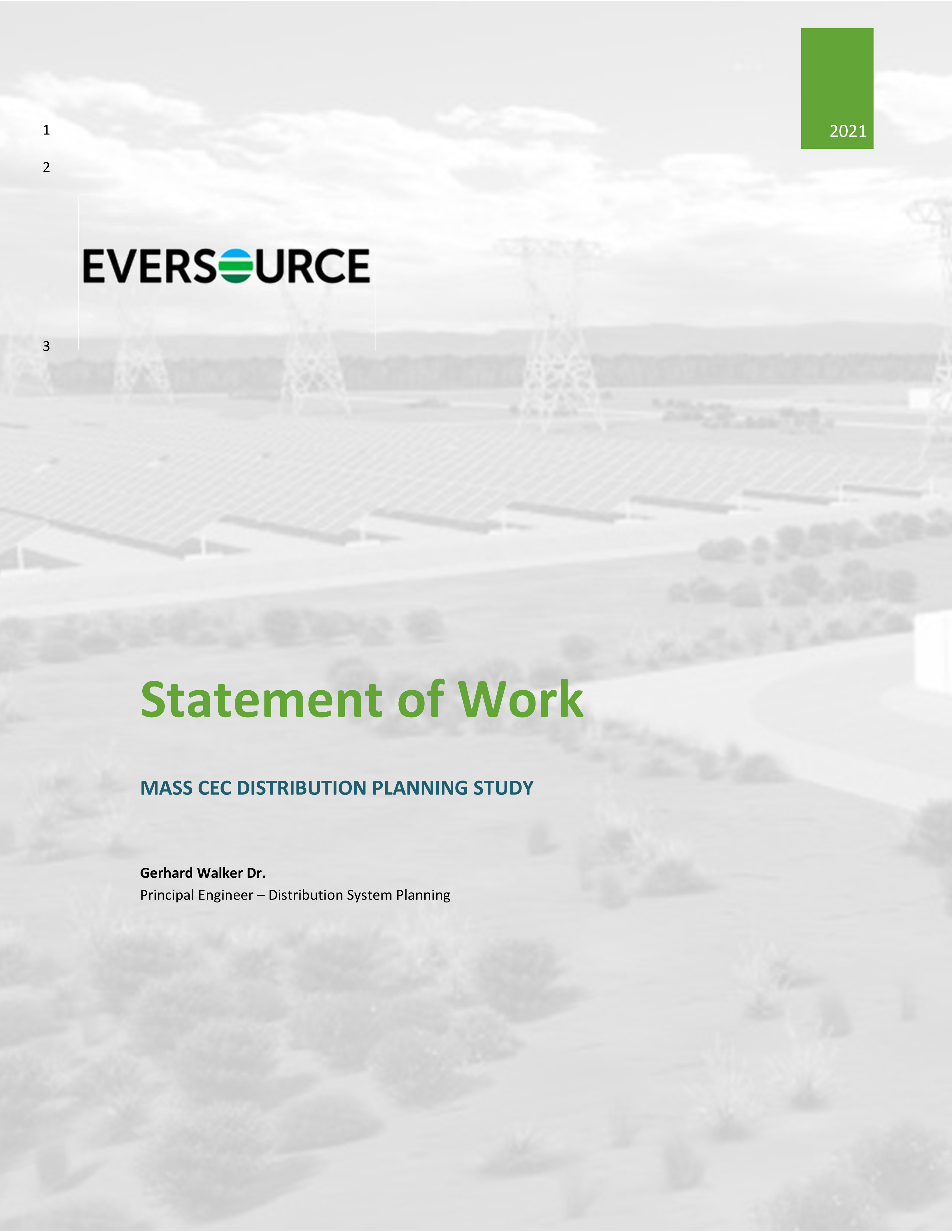

2021

Statement of Work

MASS CEC DISTRIBUTION PLANNING STUDY

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EXECUTIVE SUMMARY

As part of the Mass CEC's Distribution Planning Study to evaluate different technologies and approaches, Eversource has agreed to participate as an active contributor providing input into the overall question of how much, if left to its own devices, the 2030 and 2050 Massachusetts Clean Energy Goals will cost in terms of additional distribution investments. Similar to studies done in Europe[1] to evaluate impacts on the distribution system, this is essential to the discussion of technologies which have the potential of deferring such investments.

Eversource will provide a high-level overview of estimated system impacts by geographic location, decade, and voltage levels to understand when, where, and what part of the system will require investments due to capacity constraints. This is critical to the follow up studies, as it enables a better understand what certain technologies can achieve when matching solution to problem.

Eversource will look at investments needed by

a.	**Decade**:	2021 till 2030, 2031 till 2040, and 2041 till 2050
b.	**Bulk Station**:	With a total of 102 Bulk Stations
c.	**Voltage Level**:	Bulk Stations, Primary Distribution, Secondary Distribution

By using the Massachusetts Decarbonization Roadmap 2050[2] and Clean Energy Plan 2030[3]

By providing the overall cost of the energy transition, the value of alternative solutions can be better qualified, and solutions that hold no merit discarded, allowing utilities, policy makers, and developers to focus their efforts on those that hold the largest potential to provide an overall societal benefit. Furthermore, Eversource hopes to provide clarity to regulators, policy makers, and the general public on the overall efforts and costs involved in transitioning the energy system.

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[1] https://www.cleanenergywire.org/news/germanys-power-grids-need-110-billion-euros-investment-2050-operator-says

[2] https://www.mass.gov/doc/ma-2050-decarbonization-roadmap/download

[3] https://www.mass.gov/doc/interim-clean-energy-and-climate-plan-for-2030-december-30-2020/download

OBJECTIVES AND KEY RESULTS

The company will commit to achieving four objectives during the study. Each objective is uniquely suited to being addressed by a Massachusetts Electric Distribution Company (EDC) as it requires access to customer and critical infrastructure information (CII).

I. **Objective**: Deliver a base line forecast for every Massachusetts bulk substation operated by Eversource up to the year 2050 as an 8760-hour profile
    a. Key Result: Trend Load Forecast showing natural load development
    b. Key Result: Base Line EV Scenario
    c. Key Result: Base Line PV Scenario
    d. Key Result: Base Line Battery Storage Scenario
    e. Key Result: Allocation of resources across all bulk stations
    f. Key Result: Generation of time series profiles (8760 hours) for each DER Type
    g. Key Result: Generation of time series profiles for 2030, 2030, 2040, and 2050

II. **Objective**: Build load curves by bulk substation in Massachusetts based on the state's 2030 and 2050 objectives
    a. Key Result: Clean Energy EV Scenario
    b. Key Result: Clean Energy PV Scenario
    c. Key Result: Clean Energy Sector Conversion Scenario
    d. Key Result: Clean Energy Battery Storage Scenario
    e. Key Result: Allocation of resources across all bulk stations
    f. Key Result: Generation of time series profiles (8760 hours) for each DER Type
    g. Key Result: Generation of time series profiles for 2030, 2030, 2040, and 2050

III. **Objective**: Determine number of main assets which are likely to find themselves in need of replacement due to capacity violations caused by the change from the Base Line Scenario to the Massachusetts Goals
    a. Key Result: List percentage of pole mounted transformers that will encounter capacity constraints by bulk station
    b. Key Result: List sub stations which will likely encounter capacity constraints
    c. Key Result: Provide capacity constraints for above listed assets for 2030, 2030, 2040, and 2050

IV. **Objective**: Provide a marginal cost estimate between the Base Line Scenario and the State's 2030 and 2050 objectives
    a. Key Result: Develop base line cost model for respective grid investments
    b. Key Result: Provide cost by asset type
    c. Key Result: Provide cost by decade
    d. Key Result: Provide cost by voltage level
    e. Key Result: Provide cost by bulk substation

WORK PACKAGES

In order to achieve the Objectives and Key Results outlined above, Eversource intends to break down the project into the following work packages.

WP1: SYSTEM RELATIONSHIP MODEL

In this work package, Eversource will build a relational database that allows the tracing of the type and number of customers behind each asset. Later on, in the project, this will allow Eversource to build expected levels of DERs behind each asset, based on the customers present.

E.g. If a scenario calls for 1 in 4 households to have an EV, an evaluation can be done for each pole mounted transformer by the number of households they supply and their rating.

Table 1: Risk associated with WP1

Description	Likelihood	Impact	Risk	Mitigation
Data Quality Data might present with faulty relationships or missing data fields	High	Medium	Medium	For the purpose of this project Eversource will assume all system data at face value. The scope and timing of this project does not warrant extensive clean up actions, which are ongoing inside Eversource in parallel.
Data Management Without proper tools, the management of the data will be limited to basic analysis	High	High	High	The amount of correlated data that needs to accumulated is high. Eversource is currently building an Azure Data Analytics Sandbox and actively hiring into the planning department to assist in this endeavor
Data Security/Sensitivity The information used will be CII and customer information	High	High	High	Eversource will not share any of the data from this WP outside of the company aside from the findings of further WPs.

Deliverables:

1. List of customer types and annual consumption
2. Relational list of all customers to applicable
    a. Pole mount transformers
    b. Feeders
3. Relational list of all pole mount transformers to circuits
4. Relational list of all circuits to feeders
    a. Relational list of all feeders to substations
    b. Relational list of all substations to feeders
5. Relational list of all feeders to bulk substations

WP2: BUILDING SCENARIOS

WP2 will include building the Base Line Scenario as well as using the Mass Clean Energy Goals for 2030[4], as well as the Massachusetts 2050 Decarbonization Roadmap[5] scenarios are created that identify statewide changes in the following sectors

a. PV installations, both behind the meter and utility scale systems, as a total of installed AC power and the respective voltage level they are expected to be interconnected on
b. Electrification of vehicles as percentage of overall gasoline and diesel consumption for mobility in the state
c. Conversion of standard heating to heat pump systems as well as expansion of heat pump solutions into residential settings previously without any cooling solution
d. Battery storage as total installed MW with an assumption to the hour range of the solutions and the respective voltage level they are expected to be interconnected on
e. An allocation method which allows the breakdown of statewide scenarios by Eversource Bulk Station.

Eversource is expecting that the vendor selected by the Mass CEC will lead this effort and work in close cooperation with Mass CEC and Eversource.

Table 2: Risk associated with WP2

Description	Likelihood	Impact	Risk	Mitigation
Allocation Methods State Scenarios have to be broken down regionally by bulk substation. This will have to be based on certain criteria. But as there are other operates in Massachusetts, without their participation uncertainties might be the result	High	Medium	Medium	Eversource will assume an even allocation behind each bulk station. If National Grid will not participate in this scope of work, Eversource will make assumptions on their stations to break down state goals and allocate to Eversource territory

<u>Deliverables</u>:

1. Adoption rates of technologies (% of customer) by bulk station by scenario
2. Base Line Scenario
3. Massachusetts Clean Energy Scenarios
4. Scenarios for 2030, 2030, 2040, and 2050
5. Scenarios as 8760 profiles

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[4] https://www.mass.gov/doc/interim-clean-energy-and-climate-plan-for-2030-december-30-2020/download

[5] https://www.mass.gov/doc/ma-2050-decarbonization-roadmap/download

WP3: IMPACT ANALYSIS

Using the scenarios created, Eversource will conduct an analysis to determine where, and when, capacity needs are likely to appear. Eversource will conduct this study with a split along

Note: Eversource will conduct no system wide power flow study but will rather focus on asset capacity levels and simplified approaches to observing constraints.

a. **Timelines**: Focusing on when certain constraints will appear by decade (2021-2030, 2031-2040, and 2041-2050)
b. **Geographic Locations**: Geographic locations will be specified by bulk substations that Eversource operates in Massachusetts. Given different adoption propensities of different technologies, this step is critical to provide an understand which problems occur where, and what adoptions might offset each other.
    - **Allocations based**
c. **Voltage Levels**: Eversource will provide a level of understanding where in the system investments are required to happen. The segmentation will be done by
    - **Secondary Distribution:** Pole/pad mounted xxx/230V and beyond
    - **Substations:** Distribution substations between bulk stations and secondary distribution investments, such as capacity upgrades
    - **Bulks Substation:** Substation investments (on property) such as capacity upgrades
    - **Primary Distribution:** Any distribution equipment that is not included in the other three categories
d. **Methodology:** Eversource will use average % of adoption rates of technologies by customer by equipment type. As a result, similar to the following Figure 1, Eversource will have the ability to declare assets at risk of overloading based on the number of customers and the remaining head room or total asset capacity.

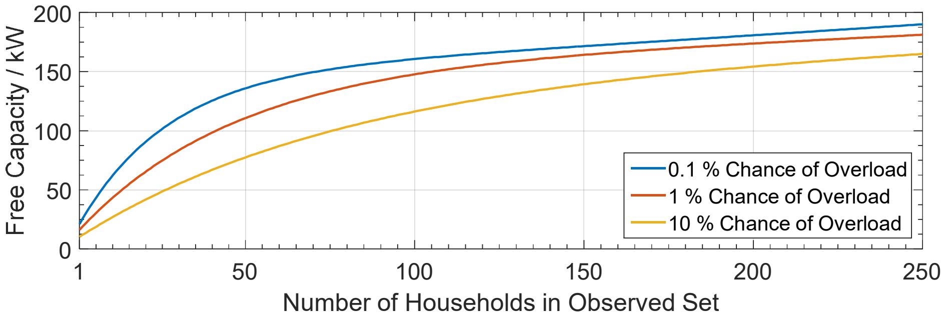

Figure 1: Overload Probability of Assets by Number of Households with a given EV Adoption Scenario[6]

Table 3: Risk associated with WP3

Description	Likelihood	Impact	Risk	Mitigation
N/A				

Deliverables:

1. List of assets that are at a high probability of overload due to clean energy targets
2. Timeline of expected asset overloads

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[6] Impact and Chances of Electric Mobility for the German Low Voltage Distribution Grids, sierke VERLAG - Internationaler Wissenschaftsverlag; 1st edition (15 Mar. 2018), ISBN-10 : 3868449485 ISBN-13 : 978-3868449488

WP4: IDENTIFICATION OF MARGINAL BUDGET

In this WP Eversource will focus on determining a marginal budget based on the marginal increase of asset replacements required, for the in WP3 determined required system upgrades. Cost parameters will be taken from historic experience when replacing and upgrading assets in the Eversource service territory. All budget requirements will be provided as cumulative net present value of the incurred revenue requirements.

Note: Eversource will use high level assumptions and simplified methods for the calculation of the cost and revenue requirements.

Table 4: Risk associated with WP4

Description	Likelihood	Impact	Risk	Mitigation
N/A				

Deliverables:

1. Estimated budget requirements by asset class
2. Estimated budget requirements by voltage level
3. Estimated budget requirements by bulk substation region
4. Estimated budget requirements by decade

With the focus in this study on different voltage levels, the key indicator of required system upgrades will be set to the transformer level. The underlying assumption will be, that if capacity constraints are observed at the transformer level, there is a high probability of supplied feeders requiring capacity upgrades as well. Eversource is aware that those investments will be required and will accommodate feeder related investments through a multiplier on transformers/substation related upgrades.