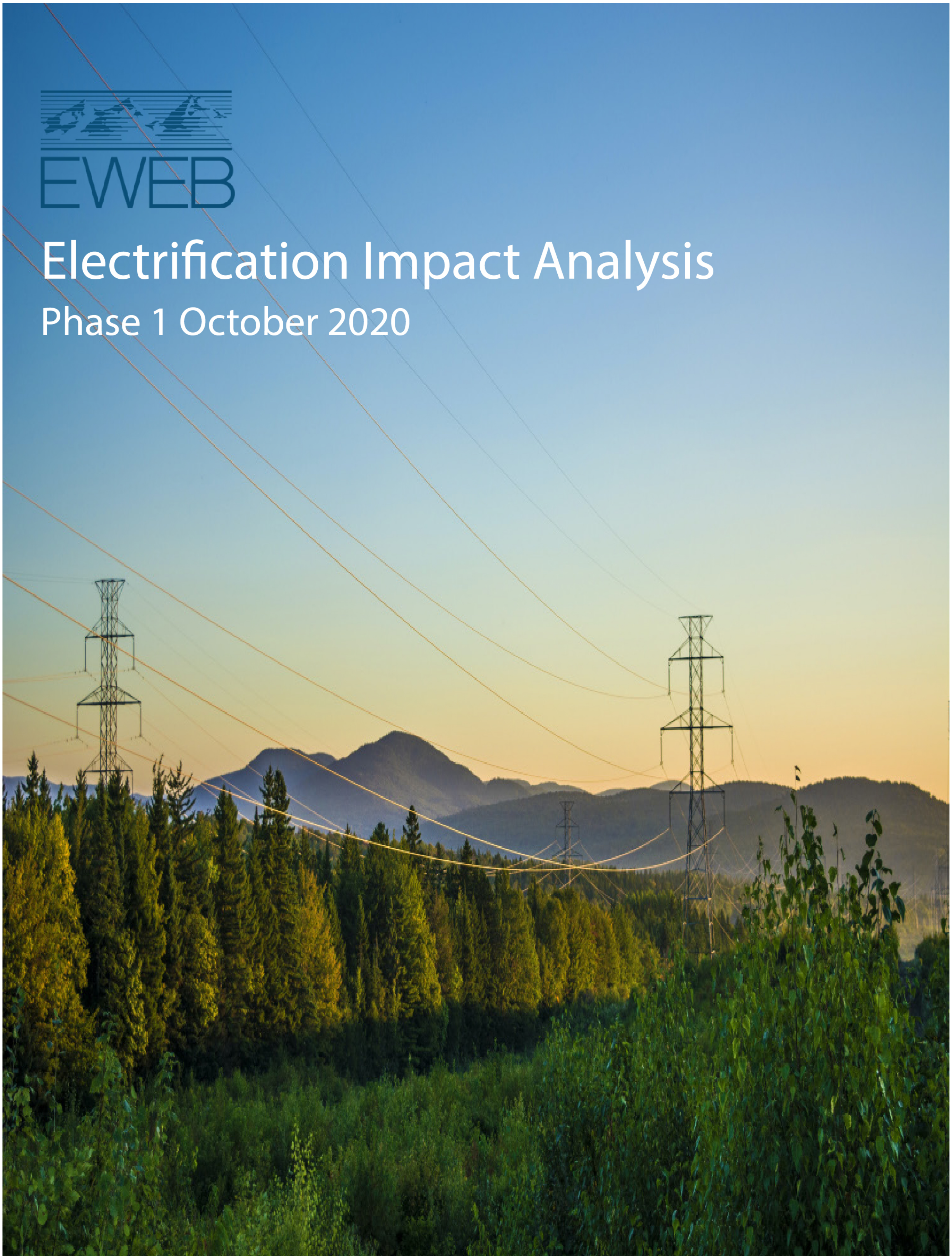
EWEB

Electrification Impact Analysis

Phase 1 October 2020



2 Executive Summary

Transitioning from fossil-based fuel use to electricity while continuing to "green" the electrical grid and pursuing energy efficiency are often cited as common pathways to reduce carbon emissions associated with climate change.

While electrification can play an important role in helping meet carbon reduction goals, it is just one part of a larger carbon reduction strategy. Studies consistently show that achieving economy-wide deep decarbonization[1] requires action on multiple fronts, including de-carbonizing fuels, energy efficiency, carbon mitigation/ sequestration and offsets, reducing non-combustion GHGs, and electrification using a cleaner grid. The electrification of transportation and building energy use are key components of the electrification pathway and could have far reaching impacts on EWEB and its customers.

The goal of this study is to quantify the potential impacts of electrification using data-driven analysis and to help the utility understand various electrification futures, including the policies and programs, resources, technology and infrastructure that may be needed to meet customers' changing energy needs.

This study targets the transportation and building sectors which could experience electrification over the next 30 years. Phase I of the study's scope focused on end-uses within these sectors that are the most relevant to a majority of EWEB's customers.

Study Scope		
	In-scope	**Out-of-scope**
Transportation sector	Passenger and light duty vehicles	Commercial freight vehicles Transit buses
Buildings sector	Residential & commercial space & water heating	Industrial process loads

Key Findings

Transportation

While passenger and light duty electric vehicle (EV) adoption is expected to increase, the rate and timing of adoption is uncertain. This study examines a range of EV market penetration rates from 3% on the low end to 100% of total vehicle stock by 2050.

The energy and peak impacts to EWEB due to EV adoption are dependent on the number of EVs adopted as well as the charging behavior of EV owners. In the study, we analyzed both unmanaged EV charging and managed charging to understand the potential impacts to the utility. Based on research, EWEB estimates that the peak of *unmanaged* EV charging would take place around 7PM when overall power consumption is highest and there is increased use of fossil-based fuel-burning generators on the grid. Further analysis of *managed* charging behavior found that shifting peak EV charging from 7 PM to 12AM (off-peak) moves the EV charging load away from EWEB's existing system peak and results in lower energy costs and lower carbon emissions.

In all except the fastest modeled adoption rate, unmanaged EV charging load growth is linear. A high level of EV adoption could increase EWEB's average system load up to 15% and increase peak demand up to 30%.

[1] Deep decarbonization can have different definitions depending on the study, but typically means reducing 1990 GHG emission levels by at least 80% by 2050.

Assuming unmanaged charging behavior, the study also estimates that each new EV, on average, represents a 75% reduction (2.75 MTCO2e/vehicle) in annual carbon emissions compared to a new light-duty gasoline vehicle. Based on various potential EV adoption rates, this could reduce community carbon emissions annually in the range of 10,000 (low growth) to 100,000 MTCO2e (fastest growth) by 2030.

In order to calculate carbon emissions from unmanaged EV charging, EWEB multiplied hourly unmanaged charging behavior by the hourly NWPP grid carbon intensity. The analysis concluded that the average annual carbon intensity of unmanaged EV charging was 0.22 MTCO2e/MWh which is higher than the NWPP grid average annual carbon intensity (0.19 MTCO2e/MWh) because unmanaged EV charging takes place during peak electricity use. While EWEB's portfolio carbon intensity is lower than the NWPP, using regional carbon intensity assumptions acknowledges that future load growth may be met with market resources which are part of a larger, regional electric grid.

Managed charging could be used to reduce peak impacts as well as the carbon intensity of EV charging. Currently, EWEB offers incentives for Level 2 charger installation, specifically because this equipment can be programmed to charge at certain times. In addition, EWEB has started a public education campaign to encourage customers to shift discretionary energy use, like EV charging, to off-peak hours (10PM to 6AM).

Due to the limited penetration of EVs in our service territory, EWEB has not yet implemented an electric vehicle charging rate and/or load management program. However, EWEB is preparing for a future where such programs could be implemented.

Buildings

Of the many different end-uses within the residential and commercial sectors, this study focuses on space and water heating. These end-uses were chosen because improvements in heat pump technology offer competitive alternatives to traditional electric and natural gas equipment. In addition, the consumption patterns of these end-uses, particularly space heating, correlate to EWEB's existing system peaks, which could have environmental, economic, and social impacts for EWEB customers.

EWEB's existing system load is weather dependent primarily due to the amount of electric space heating load within our service territory today. To understand potential impacts to peak load under a range of weather conditions, EWEB analyzed peak energy use during average (1-in-2) weather as well as less frequent cold weather conditions (1-in-10).

Based on EWEB customer data and information from Northwest Natural Gas (NWNG), we estimate that approximately 25% of residences and 35% of commercial businesses in EWEB service territory use natural gas for space and water heating. Using this data, we estimated the impact to average load, peak load and carbon emissions that may occur due to converting existing natural gas space and water heating to electricity.

Similar to EV adoption, the potential impact of electrification of space and water heating has a wide range of uncertainty. To illustrate the potential impacts to the utility, we analyzed low, medium and high levels of conversion (10%, 50%, and 80%, respectively).

Converting 80% of existing *residential* natural gas space and water heating could increase EWEB's average system load up to 8% and increase 1-in-10 peak demand up to 17%. Conversion of 80% of *commercial* natural gas space and water heating could increase EWEB's average system load an additional 3% and increase 1-in-10 peak demand an additional 10%.

It should be noted that space and water heating equipment efficiency play an important role on the impacts to EWEB. Because electric heat pumps lose capacity to heat at very cold outside temperatures, many heat pumps are paired with a backup heat source, typically in the form of an electric resistance attachment to an air handler, or a gas furnace. Thus, the estimated energy use during EWEB's cold winter peaks is dependent on the amount of backup heat used during cold weather. To show a range of potential peak impacts based on installed heat pump performance, EWEB estimated peak impacts based on both optimal and sub-optimal heat pump installation. Optimal installation assumes that heat pumps would be installed to utilize little or no electric resistance back-up and perform well at low temperatures. Sub-optimal installation, where a heat pump relies on electric resistance heat more frequently, could increase the potential peak impacts.

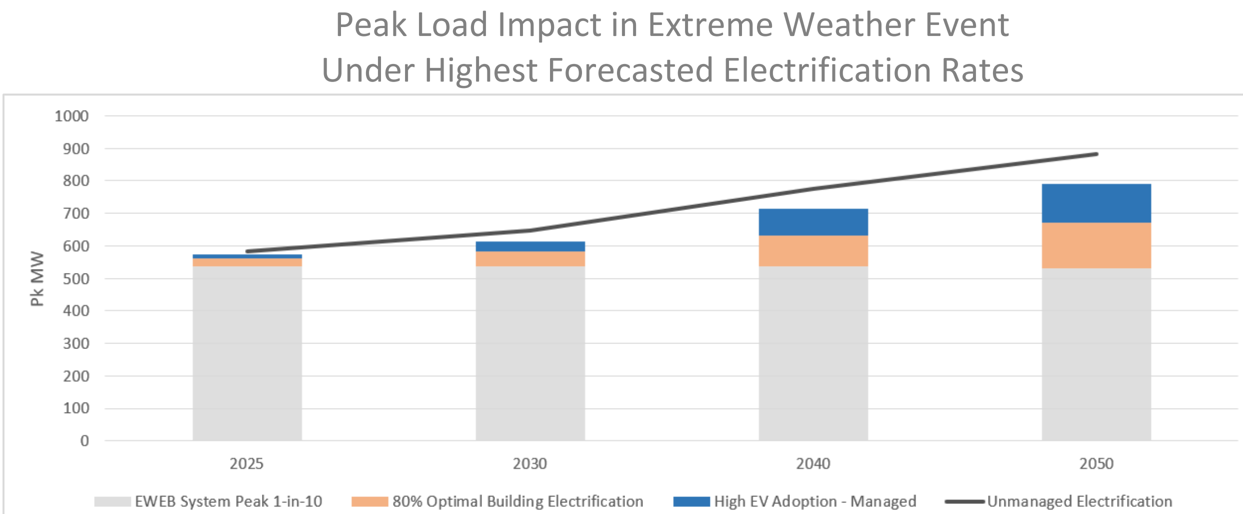
As was done with transportation electrification, EWEB staff used an hourly carbon emissions factor for the Northwest Power Pool (NWPP) to model the potential impact that electrification of space and water heating can have on GHGs. The study finds that conversion of gas space and water heating to electricity is likely to yield carbon savings, which are included in the cumulative summary below. However, it should be noted that expected, and yet uncertain, reductions in the carbon intensity of the electric grid and natural gas system over the next 30 years make anticipated carbon reductions due to conversion more uncertain. In addition, there is variation of the building stock (age, insulation, business-type, space heating requirements, etc.) within EWEB's service territory, which creates further uncertainty when estimating the potential community-wide carbon savings associated with natural gas conversions.

Cumulative Impacts of Electrifying Transportation and Buildings

<u>**Energy and Peak Impacts**</u>

Assuming high levels of electrification, EWEB could experience load growth of up to 64 aMW by 2050 (roughly 20% increase) and could add between 50-70% to peak load during colder, less frequent (1-in-10) weather events.

To present a range of potential peak impacts as a result of high electrification, EWEB assumed two different scenarios: managed and unmanaged electrification. In the chart below, the peak impacts of managed electrification are shown in the bar charts. Managed electrification assumes: (1) peak EV charging would be shifted from 7 PM to 12AM and, (2) optimal installation of new space and water heat pumps (i.e. units that require little or no electric resistance back-up and perform well at low temperatures). Unmanaged electrification assumes that 1) EV peak charging would remain at 7 PM and, 2) sub-optimal installation of new space and water heat pumps (i.e. heat pump relies on electric resistance heat more frequently during peak).



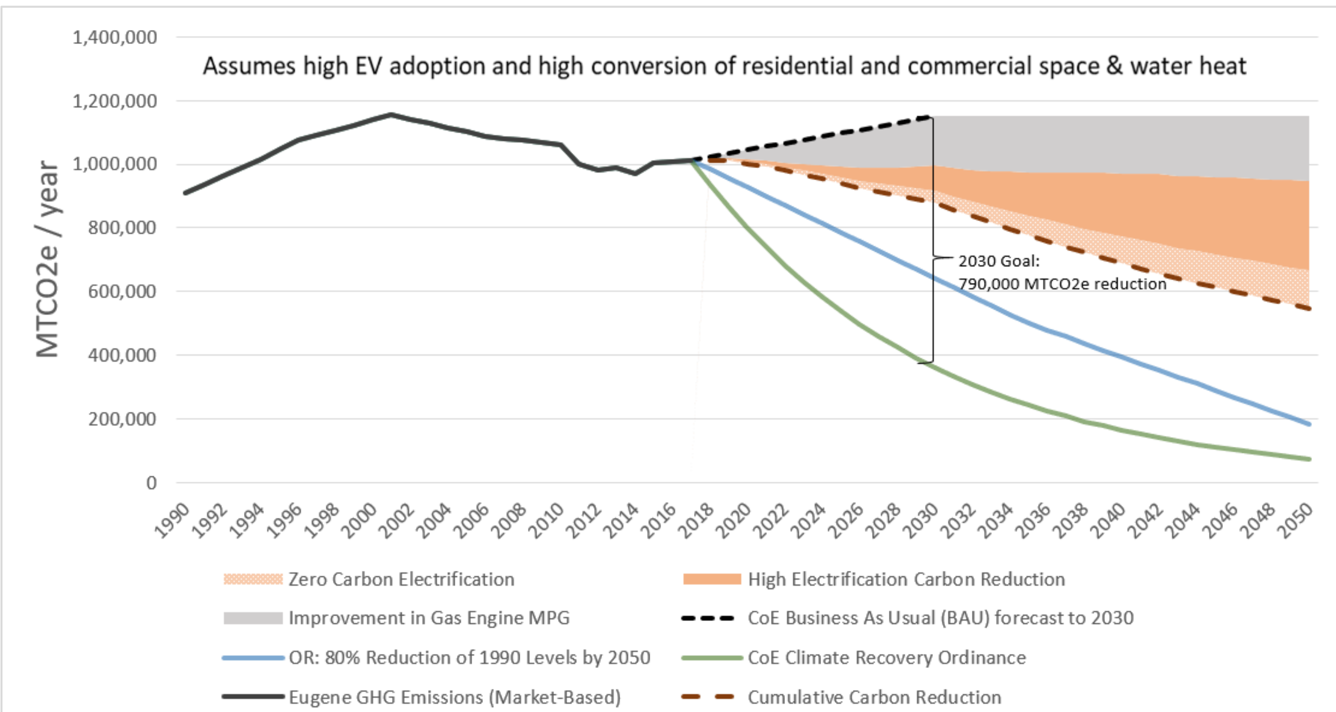
Carbon Reduction Impacts

In addition to the actions identified by the City of Eugene's Climate Action Plan (CAP) 2.0, electrification of light-duty vehicles and buildings can support community carbon reduction goals. As a result of high EV adoption and high conversion of residential and commercial space and water heating, electrification could reduce 109,000 MTCO2e annually by 2030 (approximately 14% of the City of Eugene's carbon reduction goal).

To help illustrate the benefits of other carbon reduction actions that are indirectly related to electrification, this study also modeled carbon savings due to improvements in internal combustion vehicle efficiency (MPG) over time, as well as the potential benefits of utilizing zero carbon electricity, to account for a continual "greening" of the grid.

Taken altogether, improvements in transportation fuel efficiency plus high levels of zero-carbon electrification could help meet as much as 34% of the City's carbon reduction goal by 2030. These total carbon savings alone could be more than 50% of the CAP 2.0 goal by 2050.

Eugene MTCO2e Reduction Goals



In addition to the electrification carbon reductions shown in the chart above, the City of Eugene and its community partners have identified 245,000 MTCO2e in carbon reduction commitments by 2030. The City of Eugene plans to continue to identify more actions to meet the 790,000 MTCO2e reduction goal through the process outlined in the CAP 2.0.

Summary

The pace of electrification is expected to be slow in the next decade, giving EWEB opportunity to respond and adapt to emergent trends.

On a forecasted, average energy basis, EWEB's power portfolio has enough surplus energy to meet our customers' electrification needs and we expect that the forecasted pacing and magnitude associated with all electrification scenarios can be managed with our existing portfolio. If needed, EWEB can purchase additional energy products from the wholesale energy market to supplement the portfolio, as new long-term resources are considered and developed as part of the broader Electricity Supply Planning process.

While electrification may require EWEB to purchase additional energy on the supply-side, Demand-side Management (DSM) can be a mitigation strategy for EWEB as well. DSM includes conservation programs to incent technologies that reduce overall energy consumption, as well as consumer education to voluntarily shift discretionary use to off-peak times.

For example, we estimate that EWEB customers could reduce the current peak load associated with electric resistance heating by at least one-third, by replacing existing low efficiency units with standard efficiency heat pumps. Other voluntary demand management programs can be a cost-effective mitigation strategy today. Examples include alerting customers when peak events are forecasted and requesting that they shift their peak energy use to the extent possible, or EWEB energy management personnel working with industrial customers to identify site-specific peak reduction solutions.

Rate design and electricity pricing will also play an important role in sending our customers effective price signals. While the northwest does not have strong peak market price signals today, that could change over time. Rates designed around peak price signals could influence customer consumption patterns and help mitigate peak impacts from electrification.

Phase 1 of this study presents a wide range of potential outcomes to the utility, which reflects the uncertainty surrounding influences of local and regional policy on electrification as well as consumer technology choices. Phase 1 focuses on the potential impacts of electrification without analyzing the costs to customers who choose to electrify. The cost/benefit of these individual customer choices play an important role in forecasting expected electrification levels over the next 30 years. Further, EWEB programs have the potential to influence those customer electrification choices (i.e. 'smart' electrification).

To build on the context and findings of Phase 1, the following topics can be explored in more detail in Phase 2 of the Electrification Impact Analysis:

- Changes to the carbon intensity of the NWPP and to the natural gas system over time
- Further understanding of consumer and EWEB costs associated with electrification, including resources, infrastructure, and individual customer upgrade costs
- Explore 'smart' or 'beneficial' building and transportation electrification programs and how EWEB programs can influence the rate and impacts of electrification
- Additional scenarios, such as rapid population growth and other climate-related uncertainties, including impacts on hydroelectric production
- Deeper dive into the capacity of our power supply and delivery (transmission and distribution) system, including transformer loading under different electrification scenarios
- Continued conversations with stakeholders to refine assumptions, modeling, and forecasted results
- Further analysis of potential peak energy savings and potential DSM/conservation programs

Phase 2 is scheduled to be completed in 2021.