2021 PSE Integrated Resource Plan

K Economic, Health and Environmental Benefits Assessment of Current Conditions

This appendix describes the methodology, initial assumptions and results for the Economic Health and Environmental Benefits Assessment per WAC 480-100-620 (9).

Contents

1. OVERVIEW

The Clean Energy Transformation Act (CETA) requires utility resource plans to ensure that all customers benefit from the transition to clean energy. To achieve this goal, an Economic, Health and Environmental Benefits Assessment must be performed to provide guidance to the development of the utility's Clean Energy Action Plan (CEAP)[1] and Clean Energy Implementation Plan (CEIP).[2] The purpose of the assessment is to identify and quantify the existing conditions for all customers and to identify disparate impacts to communities within and around PSE's service territory that are related to resource planning. The goal is for the utility to propose actions and programs that are not simply lowest reasonable cost, but also distribute its benefits equitably among customers.

This appendix explains the methodology used to create PSE's assessment, the data sources used to define certain customer groups, the metrics used to measure current conditions and PSE's first attempt to define and apply customer benefit indicators. The current methodology is informed by PSE's understanding of the Washington Utility and Transportation Commission (WUTC) rules issued in December 2020; however, this first attempt to incorporate the new rules is preliminary and lacks significant stakeholder feedback and iteration. PSE expects the analysis to evolve during development of the CEIP and future IRPs based on stakeholder feedback from both public participation and the Equity Advisory Group, as well as insights gained through experience and observation of industry best practice.

Strategy

To evaluate the equitable distribution of benefits, the assessment considers the following as defined in WAC 480-100-620 (9):

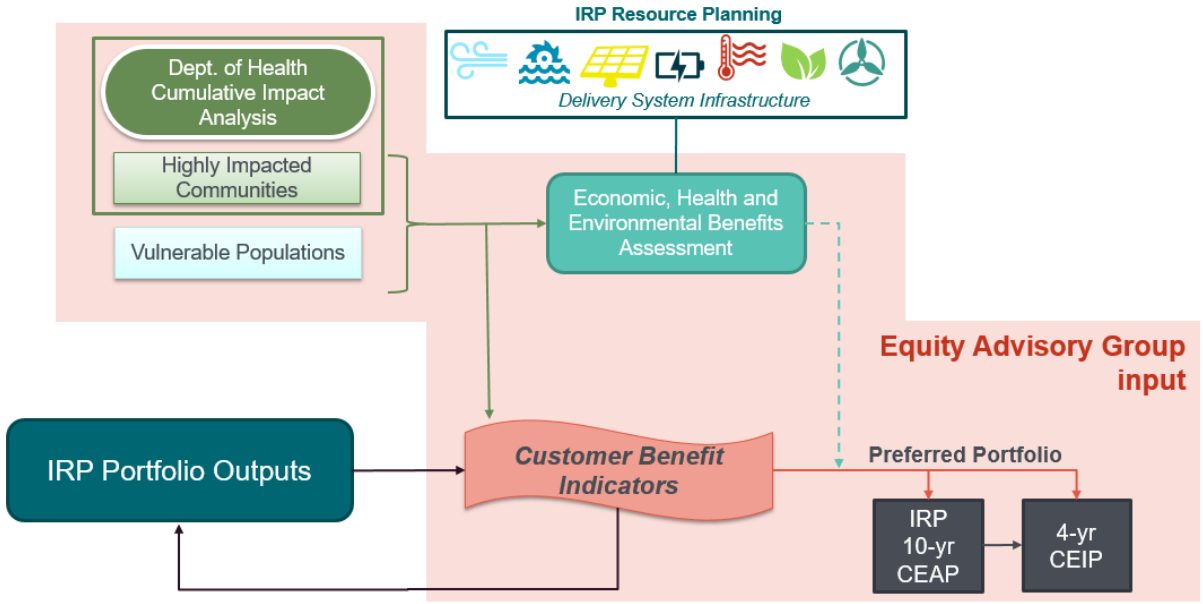
- energy and non-energy benefits and reductions of burdens to vulnerable populations and highly impacted communities
- long-term and short-term public health and environmental benefits, costs and risks, and
- energy security risk.

1 / The Clean Energy Action Plan is a 10-year outlook that achieves the clean energy transformation standards.
2 / The Clean Energy Implementation Plan identifies specific targets and actions PSE will take toward meeting the energy transformation standards.

Process Flows

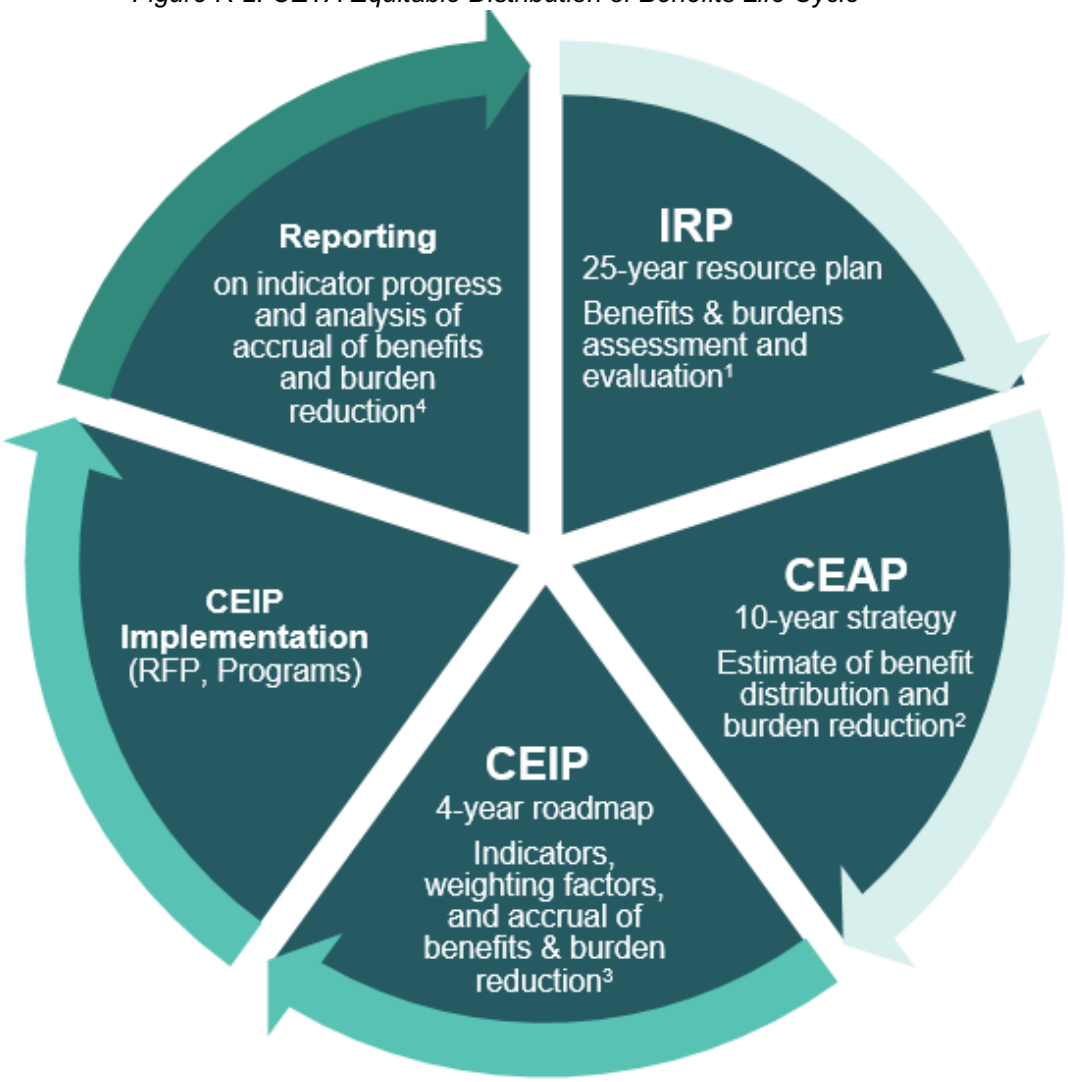
The Economic, Health and Environmental Benefits (EHEB) Assessment (or "the Assessment") fits into a much broader framework of planning for the equitable distribution of burdens and benefits in the transition to a clean energy future. Figure K-1 shows the where the EHEB Assessment fits in the context of the IRP, Clean Energy Action Plan and Clean Energy Implementation Plan. Information generally flows from broader, longer term analysis (the IRP) toward more specific, actionable analysis (the CEIP) and public input is solicited throughout.

Figure K-1: Equitable Distribution of Burdens and Benefits in the Planning Process



Learning and evolving from cycle to cycle is important to this process. The simplified process flow shown in Figure K-2 highlights the iterative nature of the process. Results from the CEIP will in turn help define inputs and improvements for future EHEB Assessments.

Figure K-2: CETA Equitable Distribution of Benefits Life Cycle



NOTES
1. IRP Assessment and Evaluation: Draft WAC 480-100-620(9) and (11)(g)
2. CEAP Estimates: Draft WAC 480-100-620(12)(c)(ii)
3. CEIP Indicators and Weighting Factors: Draft WAC 480-100-640(4) and (5)(a)
4. Reporting on indicator progress: Draft WAC 480-100-650(1)(d)

Definitions

Definitions are key to this assessment, and PSE anticipates the following definitions may change over time as a result of stakeholder feedback and the Department of Health's cumulative impact analysis.

ENERGY BURDEN. The share of annual household income used to pay annual home energy bills.

EQUITABLE DISTRIBUTION. A fair and just, but not necessarily equal, allocation of benefits and burdens from the utility's transition to clean energy. Equitable distribution is based on disparities in current conditions. Current conditions are informed by, among other things, the assessment described in RCW 19.280.030(1)(k) from the most recent integrated resource plan.

HIGHLY IMPACTED COMMUNITIES. A community designated by the Department of Health based on the cumulative impact analysis required by RCW 19.405.140 or a community located in census tracts that are fully or partially on "Indian country," as defined in 18 U.S.C. Sec. 1151.

VULNERABLE POPULATIONS. Communities that experience a disproportionate cumulative risk from environmental burdens due to: Adverse socioeconomic factors including unemployment, high housing and transportation costs relative to income, access to food and health care, linguistic isolation, and sensitivity factors such as low birth weight and higher rates of hospitalization.

PORTFOLIO OUTPUT. A unique measured value that is the result of a particular portfolio or sensitivity analyzed in AURORA based on the portfolio characteristics. These outputs are used to capture the customer benefit indicators.

CUSTOMER BENEFIT INDICATOR. An attribute, either quantitative or qualitative, of resources or related distribution investments associated with customer benefits described in RCW 19.405.040(8).

OCCUPIED HOUSING UNIT. A U.S. Census Bureau term which refers to a house, apartment, mobile home, group of rooms or single room intended for occupancy, which is occupied. Occupied housing units provide a reasonable estimate for the number of PSE customers in a given census tract.

RESILIENCY. The ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event.[3]

3 / https://grouper.ieee.org/groups/transformers/subcommittees/distr/C57.167/F18-Definition&QuantificationOfResilience.pdf

2. METHODOLOGY

The EHEB Assessment results in two primary work products: 1) identification of named populations and 2) assessment of disparities between named populations and a "typical PSE customer." Each of these work products is related to the other, but each is a distinct deliverable.

For this IRP, PSE elected to perform a geographic analysis for both components of the Assessment. All data used in the Assessment were aggregated to the census tract level and reported as averages by census tract. Census tracts are a geographic unit delineated by the United States Census Bureau. Census tracts are small, relatively permanent subdivisions of a county which generally contain populations between 1,200 and 8,000 people, with an ideal size of around 4,000 people. The land area of a census tract can vary drastically because population is the primary driver behind the delineation of the unit.

Census tracts are useful for this type of assessment for a number of reasons. Demographic, public health, economic, environmental and other types of data are often readily available by census tract, which allows for meaningful comparisons between data types and streamlined data processing into Assessment frameworks. Census tracts are generally small enough to provide better insight into individual communities than lower resolution subdivisions such as zip code or county. Census tracts are also relatively stable over time, which allows for trend analysis over multiple Assessment cycles.

PSE acknowledges that a geographic assessment includes limitations. Aggregating data into fixed geographies often ignores the distribution of characteristics across a population within a given geography. Additionally, some data sources that transcend geographic boundaries pose problems in a geographic assessment, such as job creation or community-wide electric vehicle charging stations. PSE expects this Assessment to evolve over time to overcome some or all of these limitations. PSE will explore determining customer groups by characteristics, rather than geographically designated information, in future IRPs. Please see the Future Work section at the end of this appendix for more information specific actions PSE plans to implement in future EHEB Assessments.

Identification of Named Populations

Named populations include highly impacted communities and vulnerable populations (see above definitions). In this IRP, named populations are represented as census tracts which meet specific criteria. The following sections detail the criteria used for each named population.

Also included below is a description of the "typical PSE customer." While not a named population under CETA rule, the typical PSE customer is an important component of the EHEB Assessment for defining a baseline comparison.

Typical PSE Customer

The typical PSE customer is used to represent the status quo for most PSE customers. Any time a metric or measure refers to the typical PSE customer, it is referring to the average of all census tracts across PSE's electric service territory.

The typical PSE customer will serve as a baseline from which to measure current disparities.

Vulnerable Populations

Vulnerable populations attributes are intended to describe disproportionate cumulative risk from burdens due to:

- Adverse socioeconomic factors including unemployment, high housing and transportation costs relative to income, access to food and health care, and linguistic isolation; and
- sensitivity factors, such as low birth weight and higher rates of hospitalization.

The Washington State Department of Health developed a health disparities map and composite score as defined in the Washington Environmental Health Disparities report.[4] In the report, vulnerability is represented by indicators of socioeconomic factors and sensitive populations. The attributes listed under the sensitive populations and socioeconomic factors closely align with the definition of vulnerable populations in the rulemaking and are illustrated in Figure K-3. PSE selected the attributes from this list, as shown in Figure K-4.

4 / *https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/InformationbyLocation/WashingtonEnvironmentalHealthDisparitiesMap*

Figure K-3: Indicators, Washington Environmental Health Disparities Map

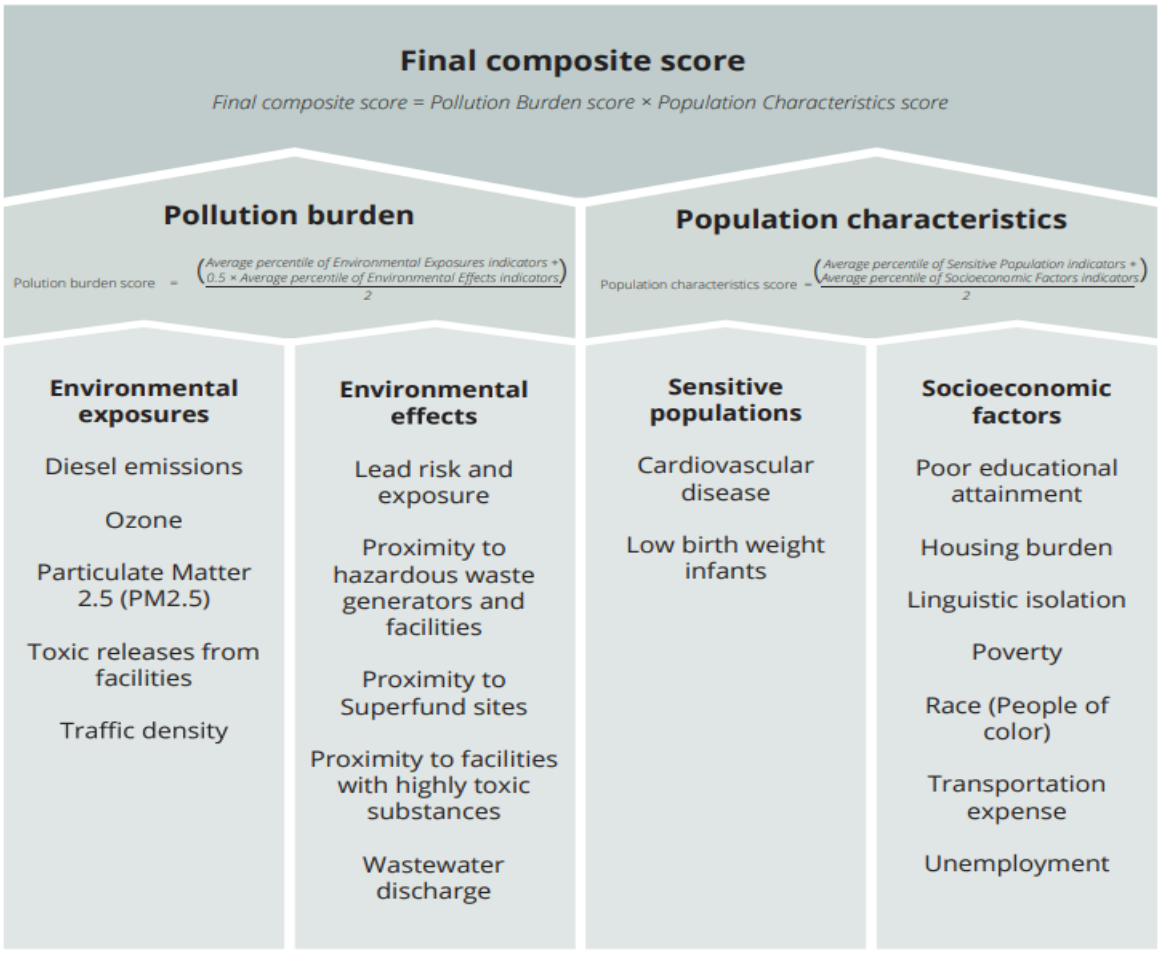


Figure credit: University of Washington Department of Environmental & Occupational Health Sciences. Washington Environmental Health Disparities Map: technical report. Seattle; 2019.

Figure K-4: PSE EHEB Attributes for Vulnerable Populations

Indicators	Specific Attribute
Sensitive Populations	Cardiovascular disease
	Low birth weight
Socioeconomic Factors	Housing burden
	Linguistic isolation
	Poverty
	Transportation expense
	Unemployment

Data Source for all attributes: Washington Department of Health Washington Tracking Network Query Portal (https://fortress.wa.gov/doh/wtn/WTNPortal/)

PSE has averaged the score for each of the attributes above and sorted these average scores by ranked percentile. The ranked percentile score for each census tract is then converted to a 1-10 score where a score of 1 is assigned to the ranked percentile between 0 percent and 10 percent, 2 is assigned to the ranked percentile 10 percent to 20 percent, and so on.

PSE has chosen an average score of 9 or 10 to define a vulnerable population, which was influenced by the scoring criteria established for highly impacted communities in the Cumulative Impact Analysis discussed below. PSE may further refine the scoring criteria for vulnerable populations based on future stakeholder feedback.

Highly Impacted Communities

Highly Impacted Communities (HICs) are defined by the Washington Department of Health Cumulative Impact Analysis (CIA) and identified as census tracts with an overall score on the Environmental Health Disparities (EHD)[5] Map of 9 or 10.[6] The CIA was recently published, and PSE expects additional WUTC rulemaking in 2021 to provide more guidance on the application of the CIA in the IRP and CEIP processes. For this IRP, PSE did its best to utilize the CIA in the absence of this specific rulemaking.

Tribes have been defined by the CIA as census tracts that are fully or partially on “Indian Country” as defined in 18 U.S.C. Sec. 1151. PSE obtained Tribal Census Tract data from the U.S. Census Bureau TIGERweb map server for Tribal Census Tracts and Block Groups. Any census tracts that intersect areas identified in this dataset are designated as tribal lands and have been included as Highly Impacted Communities per CIA guidance.

5 / https://fortress.wa.gov/doh/wtn/WTNIBL
4 / https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/ClimateProjections/CleanEnergyTransformationAct

The CIA incorporated a "Climate Projections 2050" layer into the EHD Map that includes temperature and precipitation change projections as a result of climate change. However, the CIA notes there is limited literature to support inclusion of these projections into present day public health measures used in the EHD Map. Therefore, the Climate Projections 2050 data has not been incorporated into the criteria to define HICs in PSE's Assessment.

Measurement of Disparities

The second work product of the Assessment is to measure disparities of customer benefit indicators across PSE's service area. Disparities were measured at the census tract level, as well as aggregated to the average score of each group: typical PSE customers, highly impacted communities and vulnerable populations.

As required by the CETA legislation and IRP/CEIP rulemaking, customer benefit indicators will span the areas of public health, environment, economic factors, energy security and resiliency, and energy and non-energy benefits. The purpose of these indicators is to quantify existing conditions observed across PSE's customers in order to evaluate disparities between populations within each customer base. PSE developed an initial set of indicators presented in Figure K-5.

Figure K-5: Summary of Customer Benefit Indicators

Category	Customer Benefit Indicator	Definition	Data Source
Public Health	Particulate Matter Emissions	Total emissions from all sources. Data representative of the sum of primary species of Particulate Matter 2.5 µm and Particulate Matter 10 µm.	U.S. Environmental Protection Agency 2017 National Emissions Inventory https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
	SO_2 Emissions	Total emissions from all sources.	U.S. Environmental Protection Agency 2017 National Emissions Inventory https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
	NO_x Emissions	Total emissions from all sources.	U.S. Environmental Protection Agency 2017 National Emissions Inventory https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data

K Customer Benefits Assessment

Category	Customer Benefit Indicator	Definition	Data Source
	Environmental Health Disparities Map Overall Score	Representative of overall environmental health disparities across Washington state due to Environmental Exposures, Environmental Effects, Socioeconomic Risk Factors and Sensitive Population Risk Factors.	Wash. Department of Health (Washington Tracking Network) https://fortress.wa.gov/doh/wtn/WTNIBL
Environment	Solar Choice participation	Number of PSE customers enrolled in Solar Choice programs	PSE
	Green Power participation	Number of PSE customers enrolled in the Green Power program	PSE
Economic Factors	Energy Burden	Percentage of household income spent on energy	Department of Energy LEAD Tool https://www.energy.gov/eere/slsc/maps/lead-tool
	Poverty	Percent of population living below 185% the federal poverty level	Wash. Department of Health (Washington Tracking Network) https://fortress.wa.gov/doh/wtn/WTNIBL
	Unemployment	Percentage of the population in the labor force and registered as unemployed	Wash. Department of Health (Washington Tracking Network) https://fortress.wa.gov/doh/wtn/WTNIBL
	Net Metering	Number of PSE customers participating in Net Metering program	PSE
Energy Security & Resiliency	Distribution Redundancy	*Percent of PSE-owned circuits equipped with redundancy features*	PSE
	Distribution Automation	*Percent of PSE-owned circuits equipped with automation*	
Non-energy Benefits	Residential EV hookups	*Number of known PSE customers with EV charging stations by resident*	PSE

Disparities in the Assessment are represented as relative "disparity scores." A disparity score is a measure of the burden of one community as it relates to the general population. Disparity scores are presented on a scale from 1 to 10, where a score of 1 represents the least burdened (or most benefited) communities and a score of 10 represents the most burdened (or least benefited) communities.

The disparity score of a community is calculated based on the ranked percentile of the community against the rest of the communities in the population. Generally, data for specific customer benefit indicators are aggregated to the census tract geospatial resolution. The values for all the census tracts in either Washington state or PSE's service territory (depending on the scope of the data) are ranked from least burdened to most burdened. The census tracts in the 0-10 percent of the rankings are assigned a score of 1, the census tracts in the 10-20 percent of the rankings are assigned a score of 2 and so on.

Disparity scores are useful because they allow for simple comparisons between different data types. For example, you can easily compare disparities between particulate matter emissions and unemployment, even though these two data types would typically have different units of measure and magnitudes. Disparity scores also allow for combination of disparate data types – for example, if you were interested in the disparity of all air quality measures instead of particulate matter, SO_2 and NO_x separately.

The primary drawback of disparity scores is that they are only relative measures; they show differences between communities, but do not show the magnitude of those differences. Since the magnitude of disparities is obscured by the ranking system, analysts must return to the source data to understand how much more burdened a score of 10 is than a score of 1.

3. RESULTS

Identification of Named Populations Results

Figure K-6 shows the census tracts across PSE's service area which have been identified as named populations. The figure shows three maps. The first map shows all of the census tracts which compose PSE's electric service territory highlighted in teal. PSE's electric service territory encompasses 489 census tracts in western Washington.

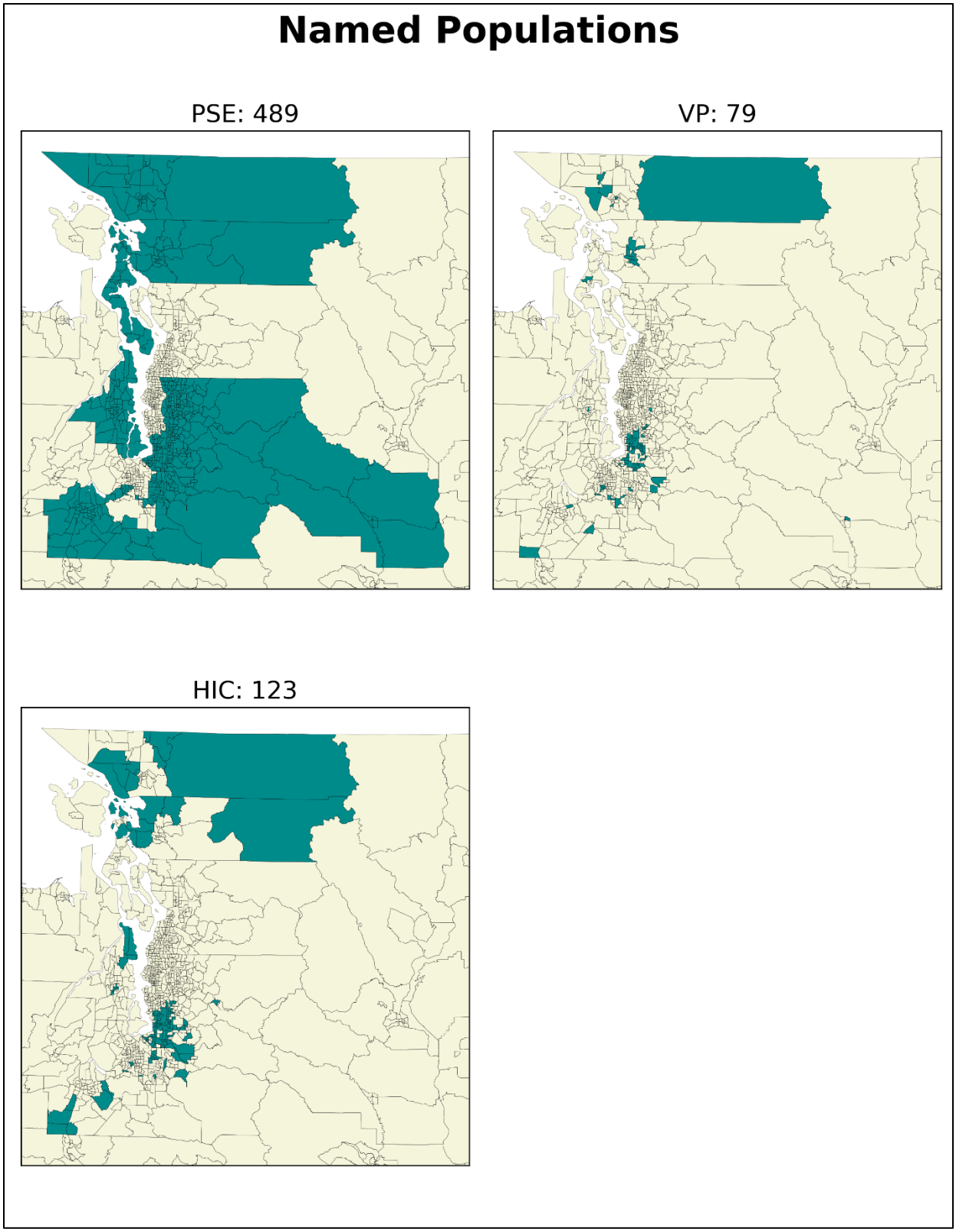
The second map, in the upper right, shows the census tracts identified as vulnerable populations, highlighted in teal. The Assessment identified 79 census tracts which met the criteria to be designated a vulnerable population. On the basis of occupied housing units within these census tracts, vulnerable populations account for approximately 17 percent of PSE's customers.

The third map, in the lower left, shows the census tracts identified as highly impacted communities, highlighted in teal. The Assessment identified 123 census tracts which met the criteria to be designated a highly impacted community. On the basis of occupied housing units within these census tracts, highly impacted communities account for approximately 25 percent of PSE's customers.

There is considerable overlap between census tracts identified as vulnerable populations and highly impacted communities. Of the 79 census tracts identified as vulnerable populations, 55 census tracts were also identified as highly impacted communities. This result is not surprising, as many of the criteria used to identify highly impacted communities are also used to identify vulnerable populations.

Generally, vulnerable populations tend to be more urban than highly impacted communities. This is largely due to the inclusion of tribal lands in the highly impacted community criteria, which tend to be on rural lands. Of the 123 census tracts identified as highly impacted communities, 47 census tracts intersect with tribal lands.

Figure K-6: Named Populations



Measurement of Disparities Results

The disparity measurement results are presented in a similar manner to the named population results above, where each map corresponds to a specific named population. Each census tract is color-coded to a specific disparity score between 1 and 10, where low disparity scores are deeper blue and high disparity scores are deeper red. Next to each map title is a number which represents the average disparity score for that named population. This number is the average of all the individual census tract disparity scores shown on the map for that named population.

The following discussion of the disparity measurement results includes important notes about the data used to assess that customer benefit indicator, interpretation of any disparities identified and initial observations on how this information may be used to develop a more equitable electric portfolio in the future.

Particulate Matter Emissions

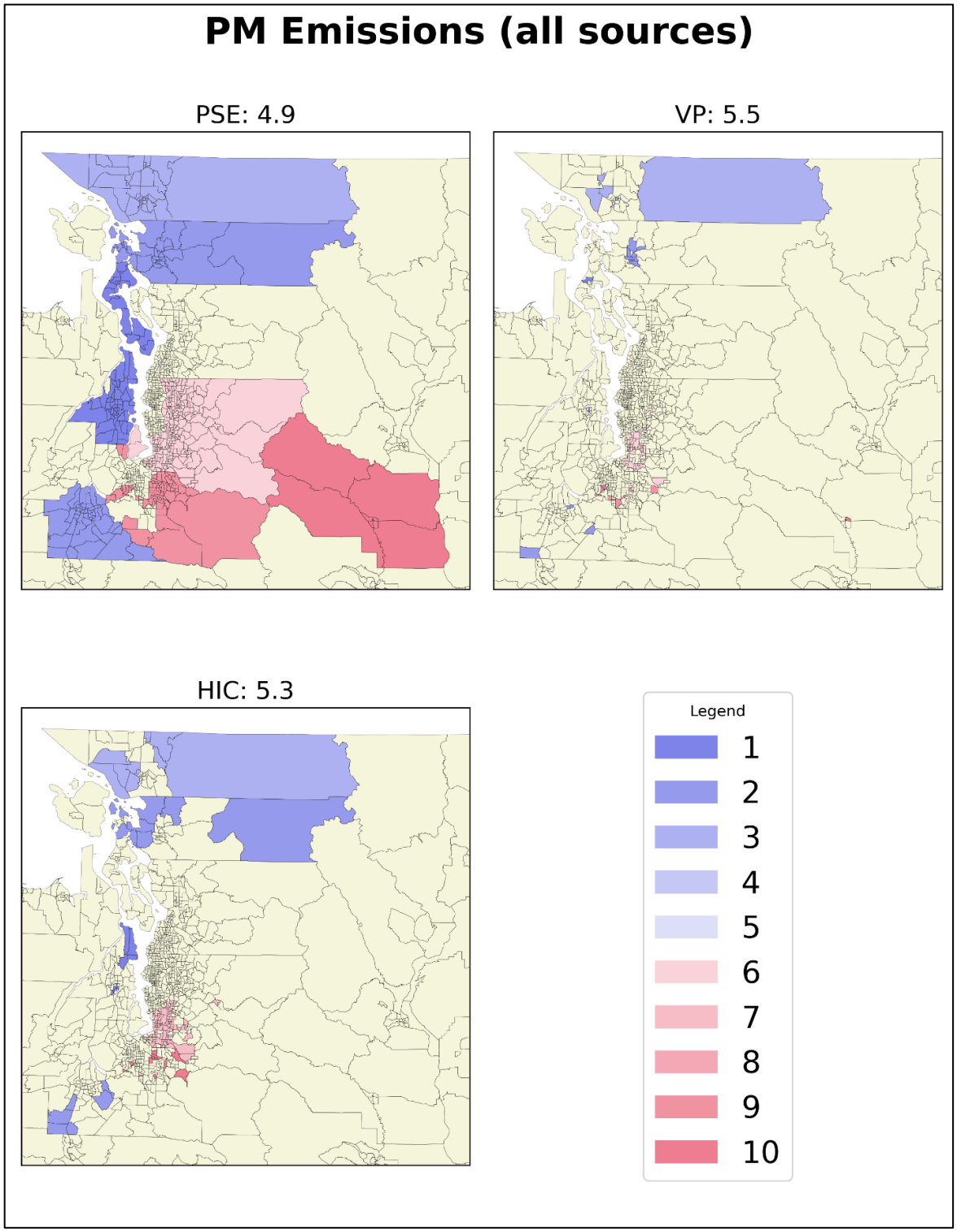
Figure K-7 shows the disparity score results for particulate matter (PM) emissions. Data for PM were obtained from the U.S. Environmental Protection Agency 2017 National Emissions Inventory (NEI). Data are representative of the average annual emissions for the year 2017. The NEI is updated on a three-year cycle. The NEI aggregates data from numerous sources for many different air quality pollutants. The data used for this Assessment represents total emissions, in tons, from all sectors. Sectors span a number of emitting sources such as agricultural practices, electricity generation, industrial processes and others. Please refer to the NEI Technical Support Document for further detail.[7] PM may be reported in different ways. The data used in this study includes the sum of filterable and condensable PM for particle sizes of both 2.5 µm and 10µm. PM may be inhaled and is linked to health problems including aggravated asthma, decreased lung function and nonfatal heart attacks.

PM data is reported by the NEI at the county level, therefore, all census tracts within each county have been assigned the same disparity score. PM data was collected for the entirety of Washington state. The average Washingtonian would have a disparity score of between 5 and 6. Figure K-7 shows that the typical PSE customer has a disparity score of 4.9, which means the typical PSE customer experiences slightly less PM pollution than a typical Washingtonian.

PM disparities are highest in inland census tracts which are susceptible to wildfire and agricultural burning smoke, which both generate large quantities of PM. Urban areas also have higher PM disparities resulting from higher densities of sources like traffic, construction sites and industrial processes. These urban impacts result in higher disparities for PSE's vulnerable populations and highly impacted communities, with scores of 5.5 and 5.3, respectively. This shows that the named populations are slightly more impacted than the typical PSE customer.

7 / https://www.epa.gov/sites/production/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf

Figure K-7: Particulate Matter Emissions



SO_2 Emissions

Figure K-8 shows the disparity score results for sulfur dioxide (SO_2). Data for SO_2 were obtained from the U.S. Environmental Protection Agency 2017 National Emissions Inventory (NEI) and are representative of the average annual emissions for the year 2017. The NEI is updated on a three-year cycle. The NEI aggregates data from numerous sources for many different air quality pollutants. The data used for this assessment represents total emissions, in tons, from all sectors. Sectors span a number of emitting sources such as agricultural practices, electricity generation, industrial processes and others. Please refer to the NEI Technical Support Document for further detail.[8] SO_2 has the potential to react with other compounds in the air giving rise to particles which result in increased PM. If inhaled, SO_2 may cause respiratory discomfort. SO_2 also contributes the creation of acid rain.

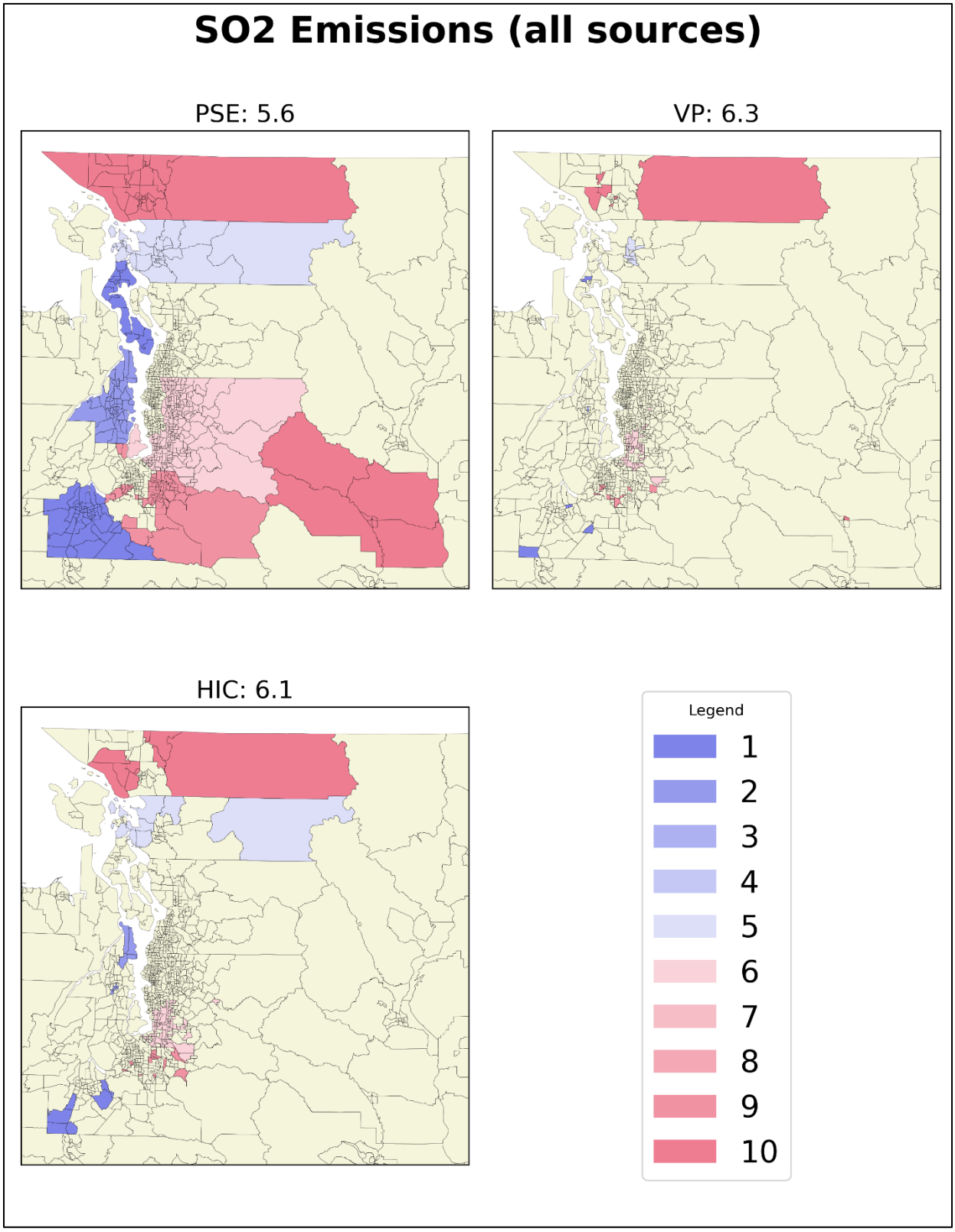
SO_2 data is reported by the NEI at the county level, therefore, all census tracts within each county have been assigned the same disparity score. SO_2 data was collected for the entirety of Washington state. The average Washingtonian would have a disparity score of between 5 and 6. Figure K-8 shows that the typical PSE customer has a disparity score of 5.6, which means the typical PSE customer experiences about the same SO_2 burden as a typical Washingtonian.

SO_2 disparities are highest in urban census tracts, and Kittitas County also has a high SO_2 disparity.

The urban SO_2 impacts result in higher disparities for PSE's vulnerable populations and highly impacted communities, with scores of 6.3 and 6.1, respectively. This shows that the named populations are slightly more impacted than the typical PSE customer.

8 / https://www.epa.gov/sites/production/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf

Figure K-8: SO_2 Emissions



NO_X Emissions

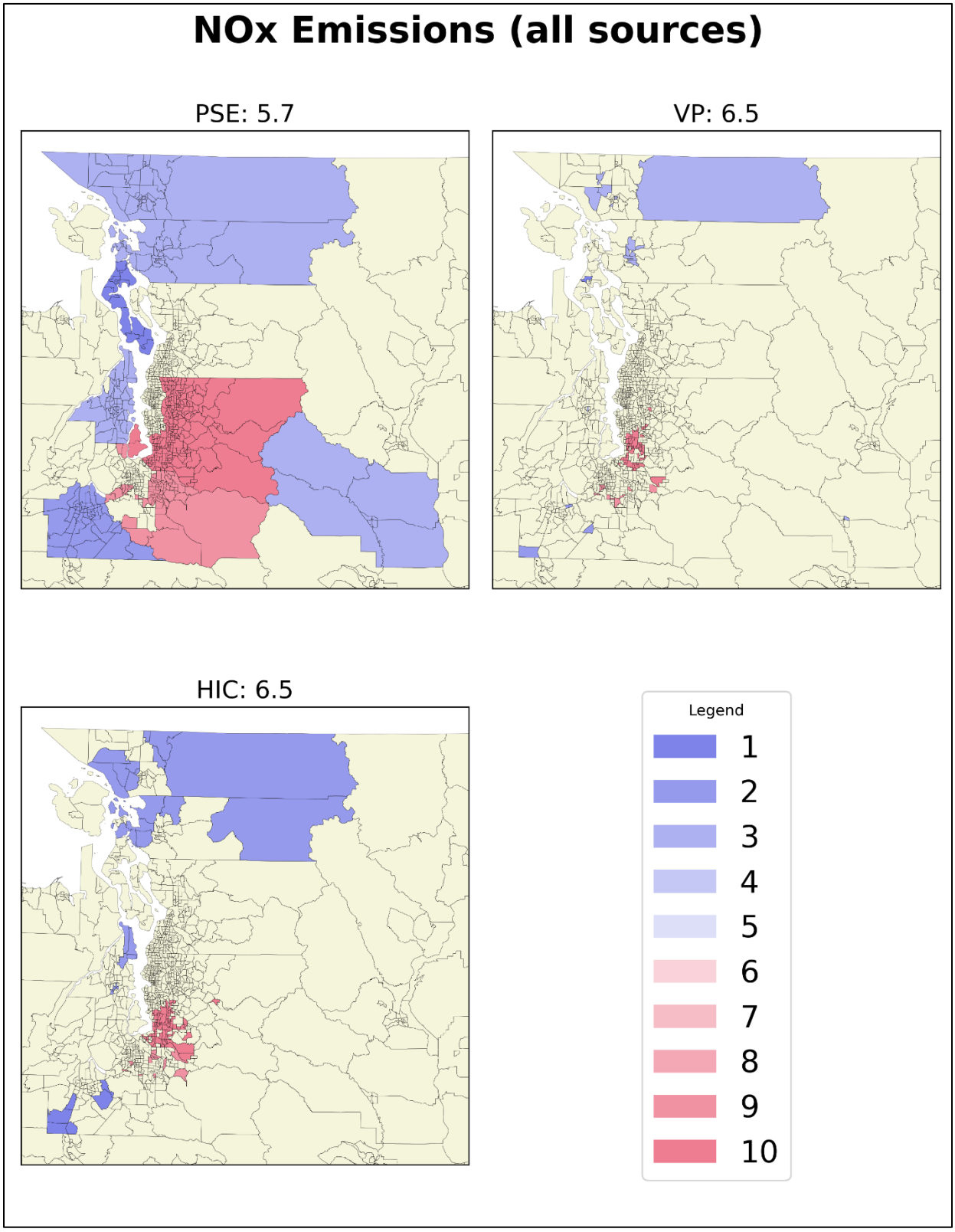
Figure K-9 shows the disparity score results for nitrous oxides (NO_x). Data for NO_x were obtained from the U.S. Environmental Protection Agency 2017 National Emissions Inventory (NEI) and are representative of the average annual emissions for the year 2017. The NEI is updated on a three-year cycle. The NEI aggregates data from numerous sources for many different air quality pollutants. The data used for this assessment represents total emissions, in tons, from all sectors. Sectors span a number of emitting sources such as agricultural practices, electricity generation, industrial processes and others. Please refer to the NEI Technical Support Document for further detail.[9] NO_x has the potential to react with other compounds in the air giving rise to particles which result in increased PM. If inhaled, NO_x may cause respiratory discomfort. NO_x also contributes the creation of acid rain.

NO_x data is reported by the NEI at the county level, therefore, all census tracts within each county have been assigned the same disparity score. NO_x data was collected for the entirety of Washington state. The average Washingtonian would have a disparity score of between 5 and 6. Figure K-9 shows that the typical PSE customer has a disparity score of 5.7, which means the typical PSE customer experiences about the same NO_x burden as a typical Washingtonian.

NO_x disparities are highest in urban census tracts. The urban NO_x impacts result in higher disparities for PSE's vulnerable populations and highly impacted communities, with scores of 6.5 for both named populations. This shows that the named populations are more impacted than the typical PSE customer.

9 / https://www.epa.gov/sites/production/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf

Figure K-9: NO_x Emissions



Environmental Health Disparities Map Overall Score

Figure K-10 shows the disparity score results for the Environmental Health Disparities (EHD) Map overall score. Data for the EHD Map overall score were obtained from the Washington Department of Health Washington Tracking Network. The overall score is a composite index of public health burden from environmental effects and exposures to sensitive populations. The EHD Map overall score touches on a number of public health indicators, provided in Figure K-10. Please refer to the EHD Map Report for further detail on each of these indictors.[10]

Figure K-10: Environmental Health Disparities Map Overall Score Indicators

Category	Indicator
Environmental Exposures	NOx-Diesel Emissions
	Ozone Concentration
	PM2.5 Concentration
	Populations near Heavy Traffic Roadways
	Toxic Releases from Facilities
Environmental Effects	Lead Risk from Housing
	Proximity to Hazardous Waste Treatment Storage and Disposal Facilities
	Proximity to National Priorities List Facilities
	Proximity to Risk Management Plan Facilities
	Wastewater Discharge
Socioeconomic Factors	ACS: Limited English
	No High School Diploma
	Population Living in Poverty <= 185% of Federal Poverty Level
	Transportation Expense
	Unaffordable Housing (>30% of income)
	Unemployed
Sensitive Populations	Death from Cardiovascular Disease
	Low Birth Weight

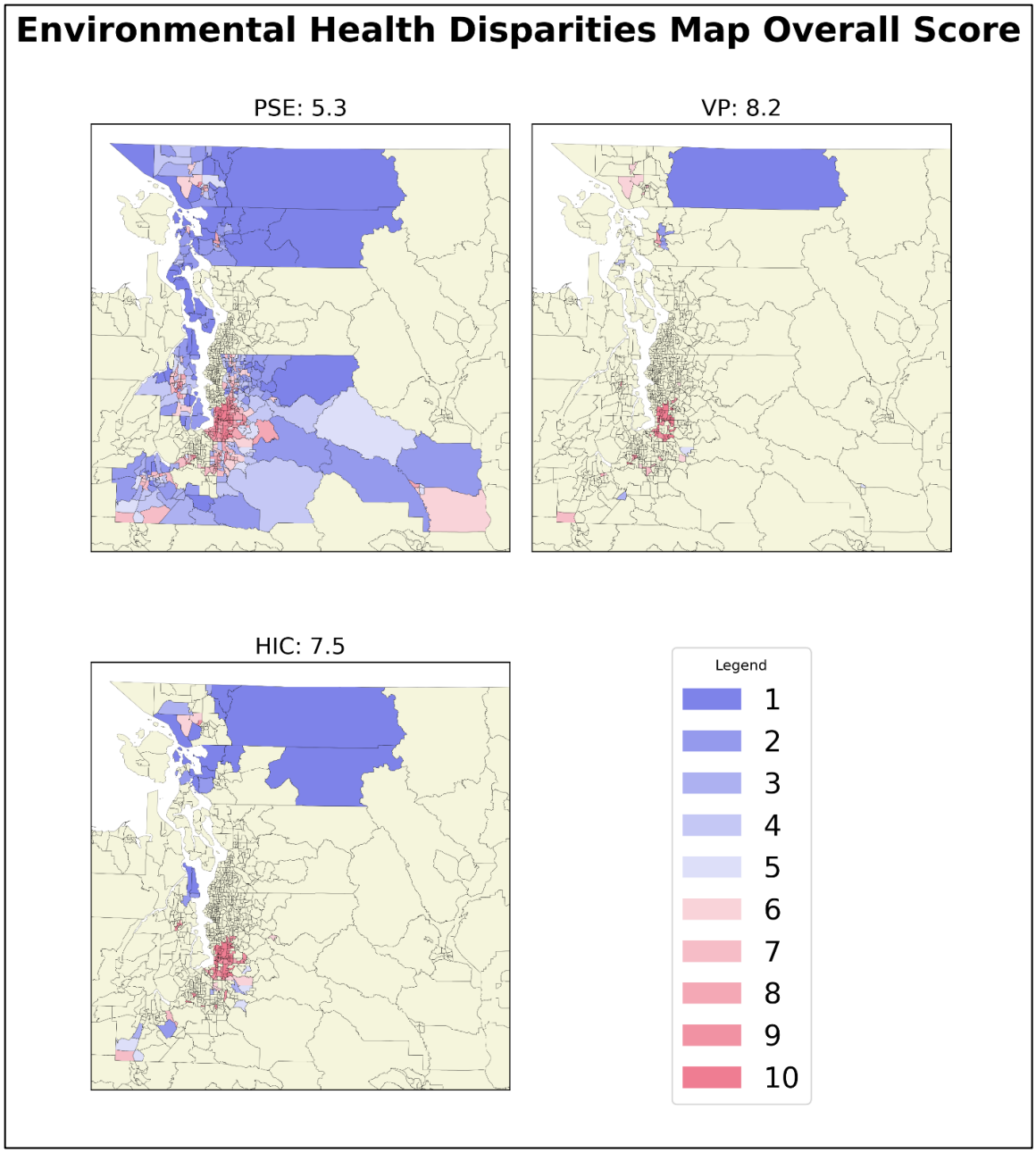
10 / https://deohs.washington.edu/sites/default/files/images/Washington_Environmental_Health_Disparities_Map.pdf

EHD map data is reported at the census tract level for the entirety of Washington state. The average Washingtonian would have a disparity score of between 5 and 6. Figure K-11 shows that the typical PSE customer has a disparity score of 5.3, which means the typical PSE customer experiences about the same environmental public health burden as a typical Washingtonian.

Urban areas have the highest environmental public health burden according to the EHD map overall score. The urban impacts result in higher disparities for PSE's vulnerable populations and highly impacted communities, with scores of 8.2 and 7.5 for vulnerable populations and highly impacted communities, respectively. This shows that the named populations are more impacted than the typical PSE customer.

Many of the same indicators used to develop the EHD Map overall score are also used to identify highly impacted communities and vulnerable populations. This explains why vulnerable populations and highly impacted communities show such a significantly higher burden than the typical PSE customer.

Figure K-11: Environmental Health Disparities Map Overall Score



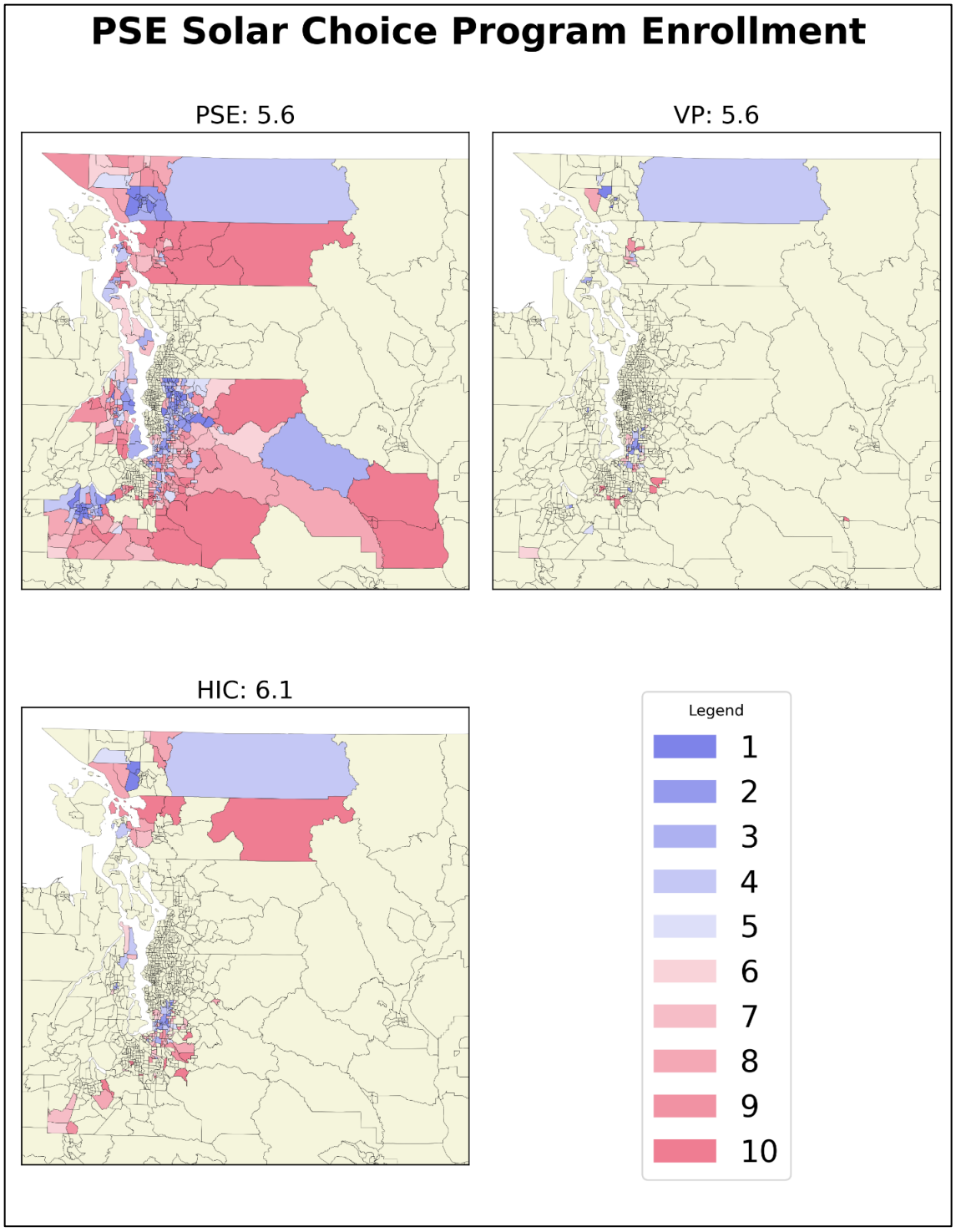
Solar Choice Enrollment

Figure K-12 shows the disparity score results for PSE's Solar Choice program. The Solar Choice program allows PSE customers to pay a premium on their bill to source a portion of their energy from solar facilities. Enrollment is voluntary. Data for Solar Choice enrollment were obtained from PSE records. Solar Choice enrollment is modeled as a customer benefit, therefore lower scores correspond to higher program enrollment and higher scores with lower program enrollment.

Individual customer enrollment was aggregated at the census tract level. Solar Choice enrollment data was only available for PSE customers, therefore it is not possible to compare scores to the average Washingtonian. The typical PSE customer has a disparity score of 5.7, which falls into the expected range of 5 to 6.

Solar Choice enrollment disparities are greatest in rural areas of PSE service territory. Vulnerable populations have an average disparity score of 5.6, equal to that of the typical PSE customer, which indicates no disparity between the typical PSE customer and vulnerable populations. However, highly impacted communities have an average disparity score of 6.1, which is higher than the typical PSE customer, suggesting that highly impacted communities experience this benefit less than the typical PSE customer.

Figure K-12: Solar Choice Program Enrollment



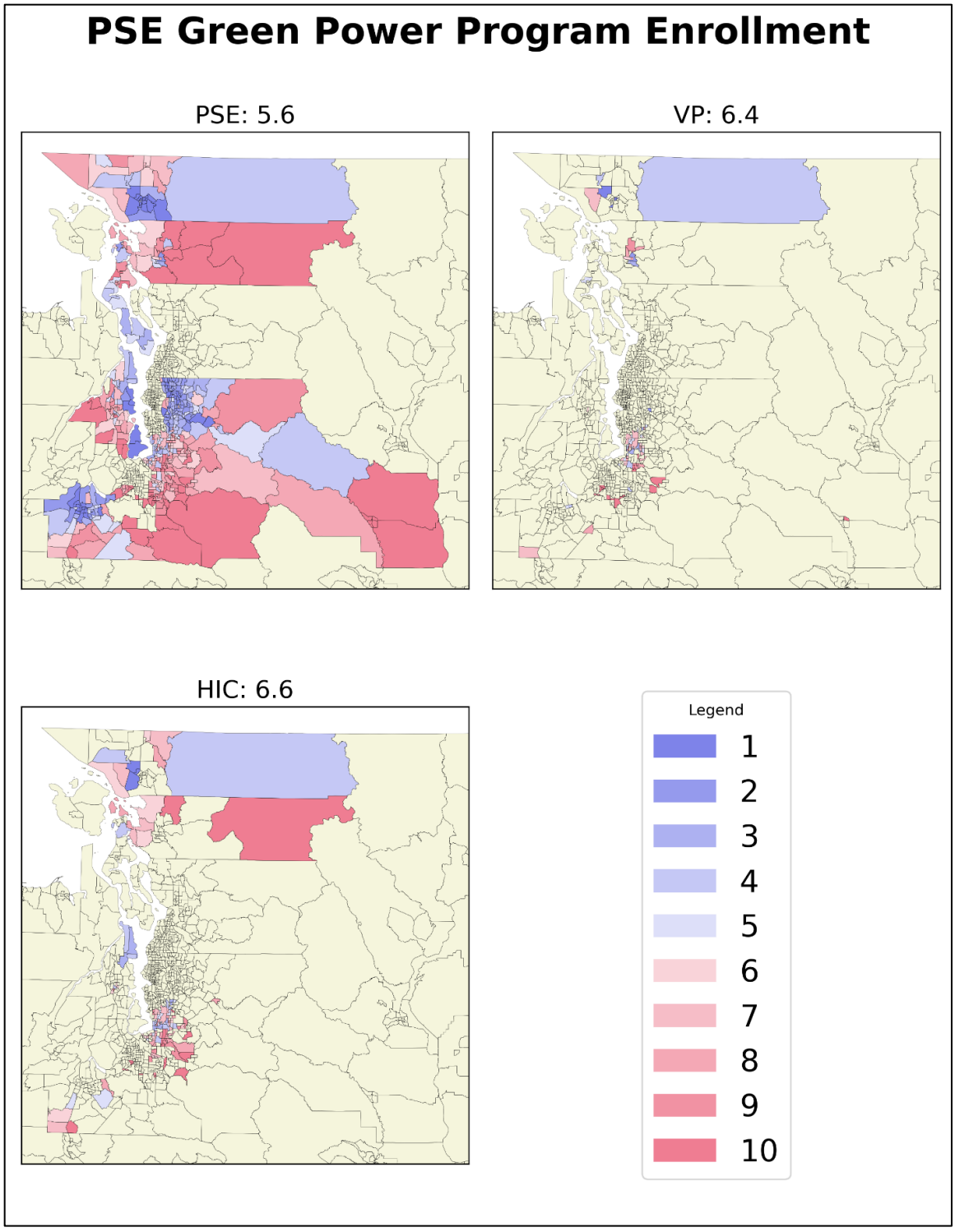
Green Power Enrollment

Figure K-13 shows the disparity score results for PSE's Green Power program. The Green Power program allows PSE customers to pay a premium on their bill to source a portion of their energy from renewable generation facilities. Enrollment is voluntary. Data for Green Power enrollment were obtained from PSE records. Green Power enrollment is modeled as a customer benefit, therefore lower scores correspond to higher program enrollment and higher scores with lower program enrollment.

Individual customer enrollment was aggregated at the census tract level. Green Power enrollment data was only available for PSE customers, therefore it is not possible to compare scores to the average Washingtonian. The typical PSE customer has a disparity score of 5.6, which falls into the expected range of 5 to 6.

Green Power enrollment disparities are greatest in rural areas of PSE service territory. Vulnerable populations and highly impacted communities have higher disparity scores than the typical PSE costumer at 6.4 and 6.6, respectively. This suggests that named populations experience this benefit less than the typical PSE customer.

Figure K-13: Green Power Program Enrollment



Energy Burden

Figure K-14 shows the disparity score results for energy burden. Data for energy burden were obtained from the U.S. Department of Energy Low-Income Energy Affordability Data (LEAD) Tool.[11] The LEAD Tool leverages data from the 2016 5-year American Community Survey to estimate energy burden in communities across the United States. Energy burden is a measure of the percent of income spent on residential housing energy. Residential housing energy includes electricity, gas and other fuels. Transportation energy is not included in energy burden. The LEAD tool allows users to filter data to identify relationships over a number of factors including income level, building age, heating fuel type, building type and tenure. Energy burden data for this Assessment did not filter criteria and therefore includes all income levels, all building ages, all heating fuel types, all building types, and both renter- and owner-occupied housing.

Energy burden data is reported by the LEAD Tool at the census tract level for the entirety of Washington state. Therefore, the average Washingtonian would have a disparity score of between 5 and 6. Figure K-14 shows that the typical PSE customer has a disparity score of 3.2, which suggests the typical PSE customer experiences a significantly lower energy burden than a typical Washingtonian.

Energy burden tends to be highest in rural areas. This is a well-established trend across the United States and has been attributed to factors including high concentrations of low-income households, prevalence of inefficient manufactured homes, use of propane or fuel oil for heating and lack of program resources.[12] PSE's vulnerable populations and highly impacted communities, with scores of 3.6 and 3.8, respectively, have higher energy burdens than the typical PSE customer, but still well below the typical Washingtonian. This shows that PSE customers have, on average, lower-cost bills than most Washington residents.

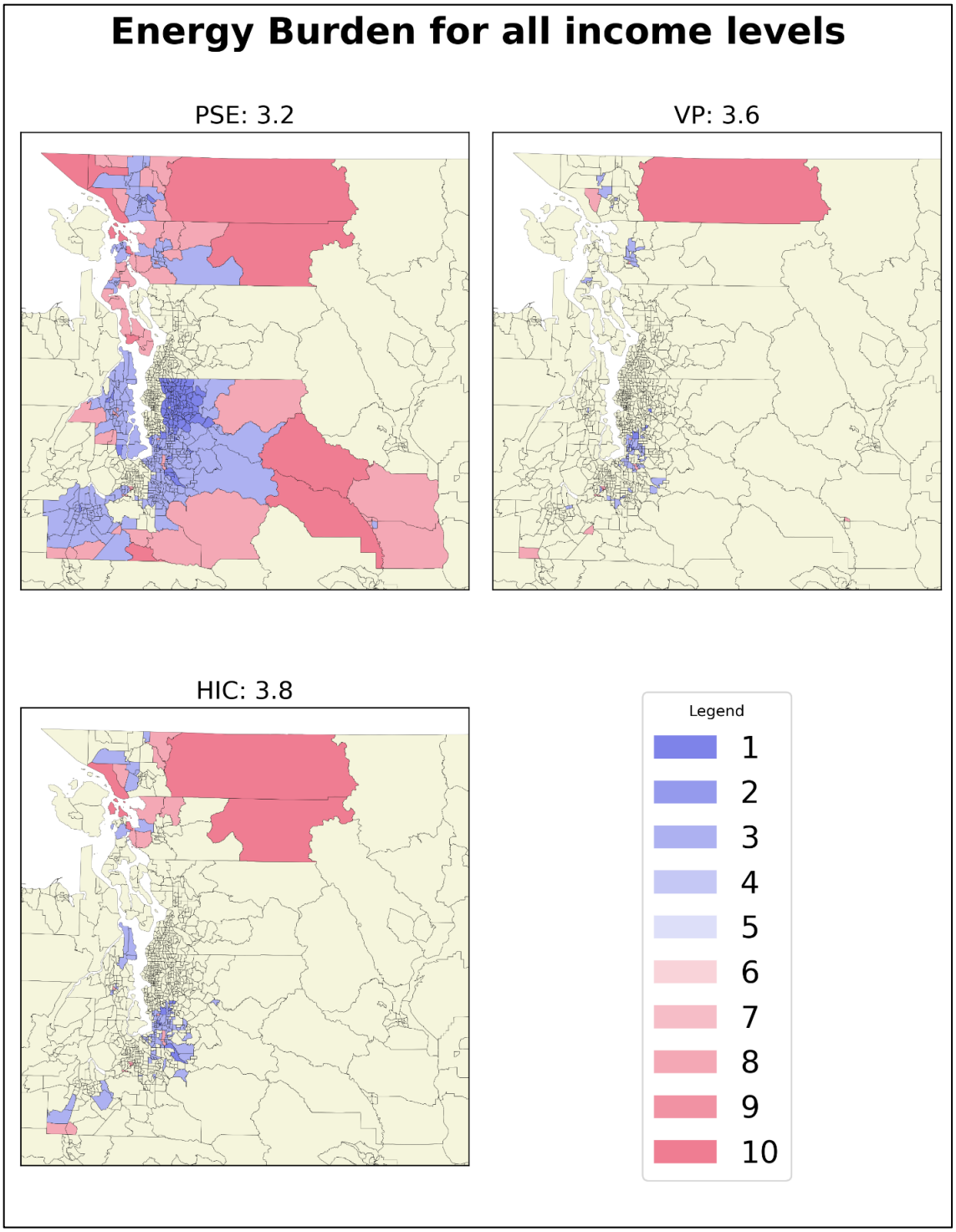
11 / https://www.energy.gov/eere/slsc/maps/lead-tool
12 / https://www.aceee.org/sites/default/files/publications/researchreports/u1806.pdf

PSE is continuing to develop and expand its low-income weatherization and energy assistance programs. As identified in the Low-Income Household Needs Assessment[13] prepared by Cadmus for PSE, several steps have been outlined to continue to improve assistance to low-income households. These steps include:

- further research to understand factors contributing to lack of participation in underserved groups
- deeper analysis into customer segmentation to better understand characteristics of underserved groups
- develop new strategies to inform targeted outreach to underserved groups
- use the new tools/strategies developed to support new pilots and programs to reach underserved groups

13 / Low-Income Household Needs Assessment, Oct 2020, available from Washington Utilities and Transportation Commission Documents and Proceedings document management system upon request

Figure K-14: Energy Burden



Poverty

Figure K-15 shows the disparity score results for poverty. Data for poverty were obtained from the Washington Tracking Network Query Portal.[14] The data are a measure of the percent of the population in any census tract living with household income less than or equal to 185 percent of the federal poverty level. Income data were obtained from American Community Survey 5-year rollup.

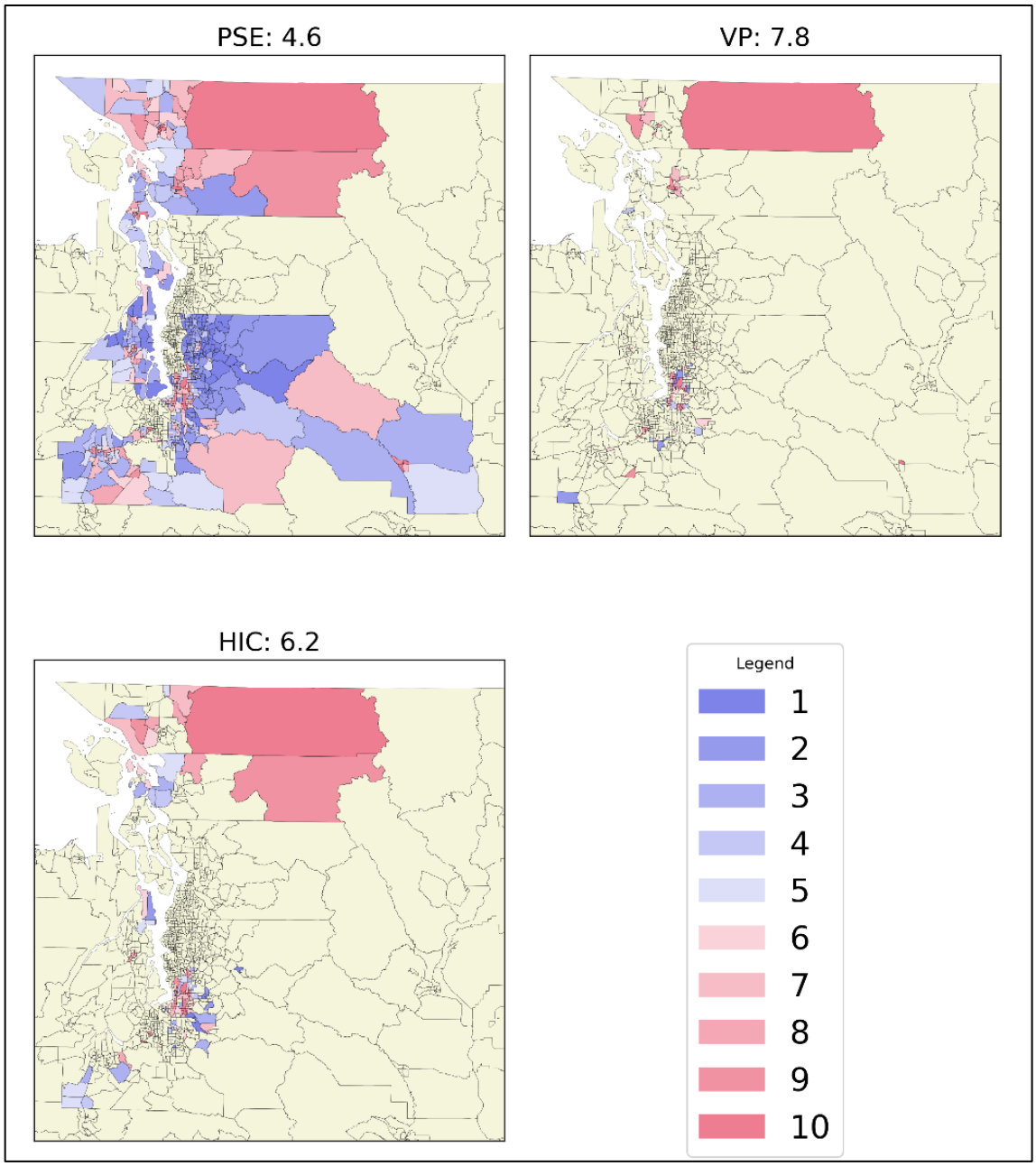
Poverty data is reported by the Washington Tracking Network at the census tract level for the entirety of Washington state. The average Washingtonian would have a disparity score of between 5 and 6. Figure K-15 shows that the typical PSE customer has a disparity score of 4.6, which suggests the typical PSE customer experiences less poverty burden than a typical Washingtonian.

Poverty burden is mixed throughout both urban and rural communities. PSE's vulnerable populations and highly impacted communities, with scores of 7.8 and 6.2, respectively, have significantly higher poverty burdens than the typical PSE customer. This result is expected, considering poverty burden is an indicator used to identify both highly impacted communities and vulnerable populations.

14 / https://fortress.wa.gov/doh/wtn/WTNPortal#!q0=3625

Figure K-15: Poverty

Population Living in Poverty <=185% of Federal Poverty Level



Unemployment

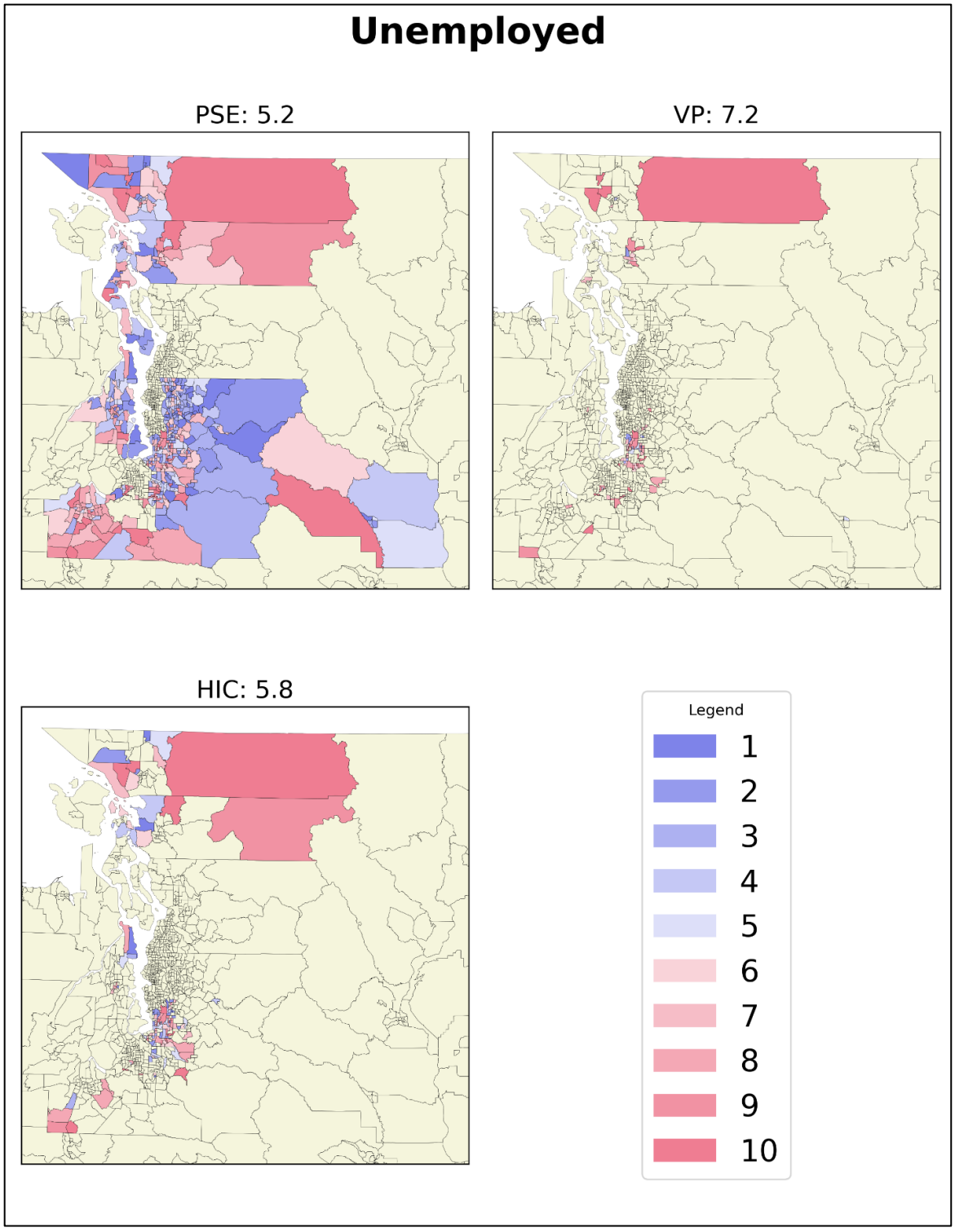
Figure K-16 shows the disparity score results for unemployment. Data for unemployment were obtained from the Washington Tracking Network Query Portal[15] and are a measure of the percent of the working population over 16 years old in any census tract who are currently unemployed. Unemployment data were obtained from American Community Survey 5-year rollup.

Unemployment data is reported by the Washington Tracking Network at the census tract level for the entirety of Washington state. Therefore, the average Washingtonian would have a disparity score of between 5 and 6. Figure K-16 shows that the typical PSE customer has a disparity score of 5.2, which suggests the typical PSE customer experiences unemployment burden about the same as a typical Washingtonian.

Unemployment burden is mixed throughout both urban and rural communities. PSE's vulnerable populations and highly impacted communities, with scores of 7.2 and 5.8, respectively, have higher unemployment burden than the typical PSE customer. This result is expected, considering unemployment burden is an indicator used to identify both highly impacted communities and vulnerable populations.

15 / https://fortress.wa.gov/doh/wtn/WTNPortal#!q0=3625

Figure K-16: Unemployment



Net Metering Installations

Figure K-17 shows the disparity score results for PSE customers who have installed net metering equipment at their homes. Net metering equipment is installed voluntarily, at the customer's expense. Data for net metering installations were obtained from PSE records. Net metering installations are modeled as a customer benefit, therefore lower scores correspond to higher program enrollment and higher scores with lower program enrollment.

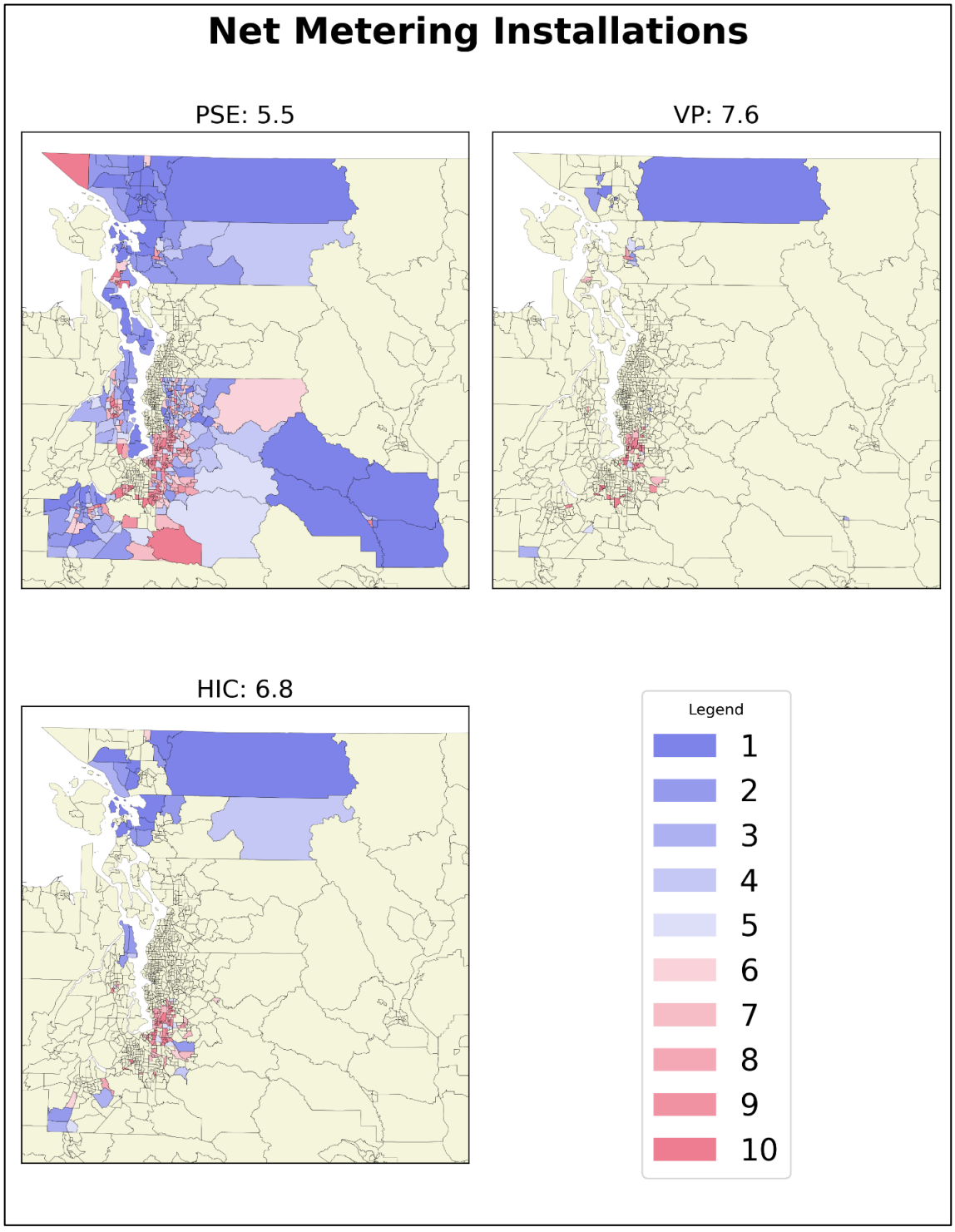
Net metering installations are an indicator of residential energy generation rates across PSE's service territory, such as rooftop solar installations. Residential energy generation may reduce energy burdens through reduced energy bills and improve air quality through load reductions of thermal resources, and it may also increase benefits such as energy resiliency through increased distributed generation and property values through property improvement.

Individual customer data was aggregated at the census tract level. Net metering installation data was only available for PSE customers, therefore it is not possible to compare scores to the average Washingtonian. The typical PSE customer has a disparity score of 5.5, which falls within the expected range of 5 to 6.

Net metering installation disparities are greatest in urban areas of PSE service territory. This may be correlated with higher rates of tenancy and more constrained space.

Vulnerable populations and highly impacted communities have higher disparity scores than the typical PSE costumer at 7.6 and 6.8, respectively. This suggests that named populations experience this benefit less than the typical PSE customer.

Figure K-17: Net Metering Installations



Distribution Redundancy

One measure of resilience is how flexible the grid is in responding to a wide array of disruptive events or disasters, such as wind storms, wildfires and earthquakes. An interconnected grid with multiple paths available to serve customers can restore power to customers more quickly during interruption events by re-routing power through alternate feeds. This may be from an adjacent distribution or transmission line being served by the bulk electric system or via a local microgrid when the larger system is not available.

The initial evaluation of this flexibility in PSE's territory focused on reviewing the alternate paths available to serve customers based on existing data that only identified whether an alternate path existed. The results show that most areas in PSE's territory have similar levels of this type of flexibility, but more information and analysis are needed to determine whether this is a useful measure of resiliency since all available switching points do not provide the same level of backup capacity to customers. In many cases, limiting factors, such as circuit topology or loading limits, reduce the number of circumstances under which an alternate path is useful. Identifying and quantifying these and other limitations is difficult and further analysis is needed.

Note that having multiple paths for routing power to customers is likely just one of many potential system characteristics that may help to define resiliency. Further work and a broader discussion is needed to determine the value of this type of resiliency as well as what other characteristics provide value and should be included in a resiliency analysis.

Distribution Automation

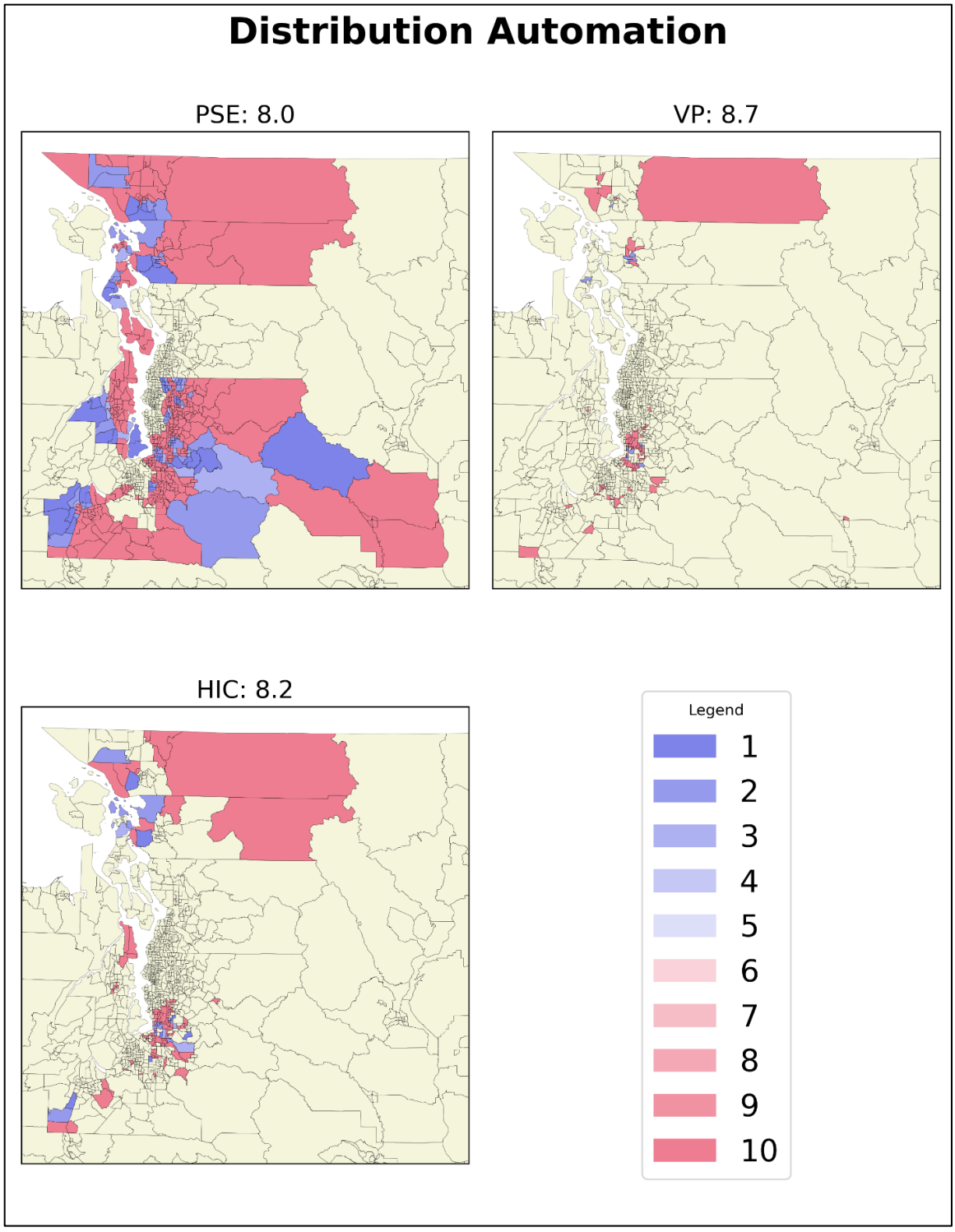
Figure K-19 shows the disparity score results for distribution automation. Distribution automation is a measure of the percent of linear miles of distribution circuits in a given census tract which are equipped with distribution automation devices such as Fault Location, Isolation and Self Restoration (FLISR) equipment. Distribution automation allows for minimization of service interruptions for affected customers and faster response times to interruptions by re-routing power to customers through alternate feeds, some of which may be served by microgrids. Distribution automation is an indicator for energy resiliency, as greater automation improves PSE's ability to recover from interruptions. Distribution automation is modeled as a customer benefit, therefore lower scores correspond to greater benefits and higher scores with reduced benefit.

Distribution automation data was only available for PSE's service area; therefore, it is not possible to compare scores to the average Washingtonian. The typical PSE customer has a disparity score of 8.0, which falls outside of the expected range of 5 to 6. Since the typical PSE customer has a disparity score greater than the expected average range of 5 to 6, it means that PSE's service territory has a low degree of automation. This is reflected in the data, as 75 percent of PSE census tracts have no distribution automation.

Vulnerable populations and highly impacted communities have disparity scores higher than to the typical PSE costumer of 8.7 and 8.2, respectively. This suggests that named populations experience this benefit less than the typical PSE customer.

Distribution automation is one of many possible indicators of energy resiliency. PSE is actively working both internally and with industry partners to develop more fitting measures of energy resiliency. Beyond distribution automation, PSE is actively exploring other technologies and initiatives to improve resiliency such as microgrids. Microgrids are geographic areas with a self-sufficient energy supply. Microgrids do not rely on the larger grid for power in times of need and therefore greatly increase the resiliency of structures located within the microgrid. Microgrids incorporating key facilities such as hospitals, emergency response facilities and governance facilities could help reduce burdens from high impact, low frequency power interruptions.

Figure K-19: Distribution Automation



Electric Vehicle Charge Station Installations

Figure K-20 shows the disparity score results for PSE customers who have installed electric vehicle (EV) charging stations at their homes. EV charging stations are installed voluntarily, at the customer's expense. Data for EV charging stations were obtained from PSE records. EV charging station installations are modeled as a customer benefit, therefore lower scores correspond to higher program enrollment and higher scores with lower program enrollment.

EV charging station installations are an indicator of EV adoption rates across PSE's service territory. This is a rudimentary measure of EV adoption, as not all EV owners will install a charging station. EV adoption may be associated with a decrease in burdens such as air quality impacts and noise pollution. However, tracking specific reductions in these burdens is difficult, since electric vehicles are mobile and will move between communities. EV charging stations provide a reasonable proxy for where EVs may drive the most, as drivers tend to drive most around their homes and communities.[16]

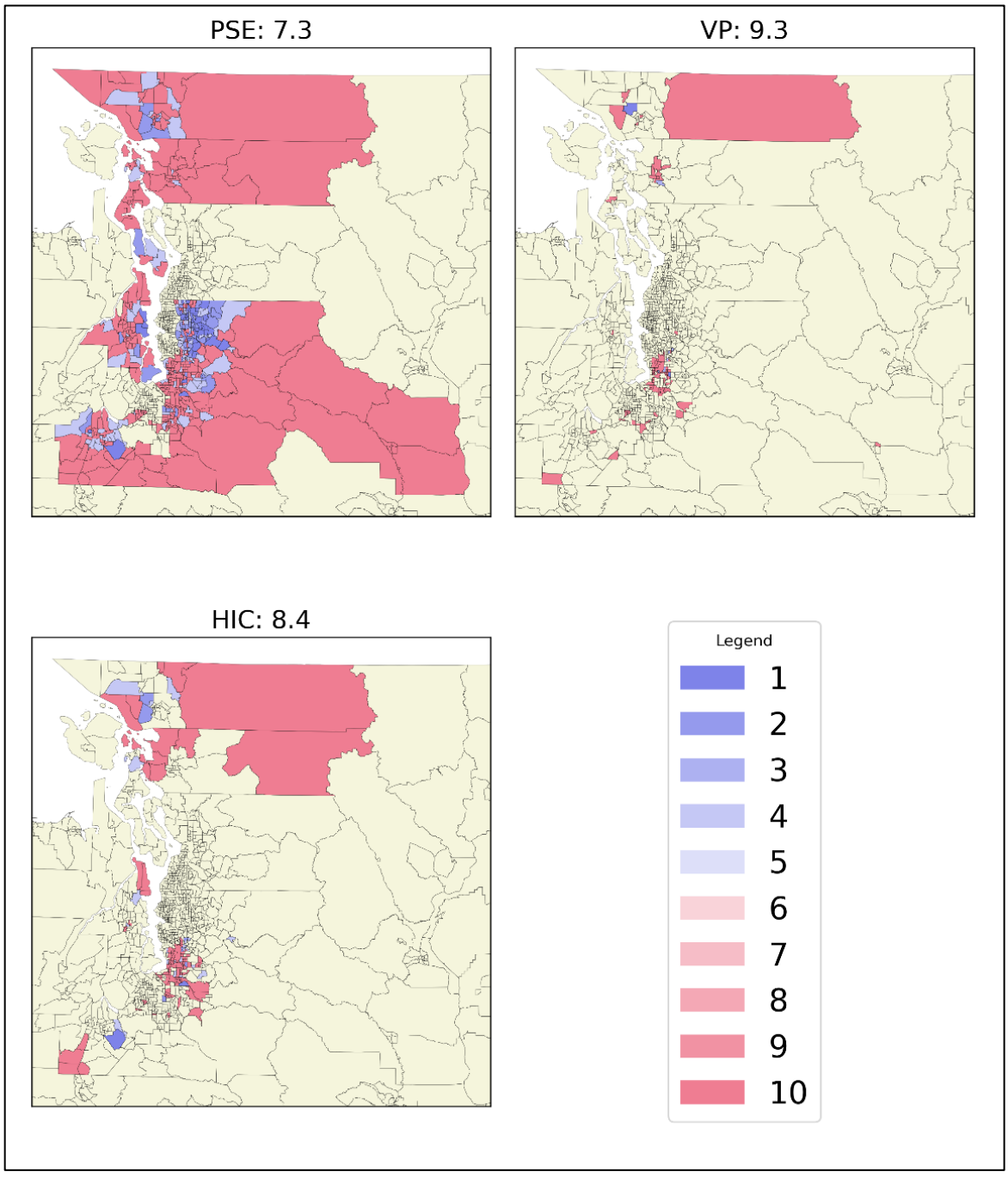
Individual customer data was aggregated at the census tract level. EV charging station installation data was only available for PSE customers, therefore it is not possible to compare scores to the average Washingtonian. The typical PSE customer has a disparity score of 7.3, which falls outside of the expected range of 5 to 6. This shows a significant bias in the data toward a higher disparity (i.e., fewer EV charging station installations). This is expected, since EVs are a newer technology and adoption rates are still relatively low. It is fair to say that the typical consumer does not own an EV, and the results reflect this reality.

Vulnerable populations and highly impacted communities have significantly higher disparity scores than the typical PSE costumer at 9.3 and 8.4, respectively. This suggests that named populations experience this benefit much less than the typical PSE customer.

16 / https://www.bts.gov/statistical-products/surveys/national-household-travel-survey-daily-travel-quick-facts

Figure K-20: Residential Electric Vehicle Charge Station Installations

Electric Vehicle Charge Station Installations (residential)



4. EHEB ASSESSMENT FUTURE WORK

PSE put a great deal of thought and effort into developing a methodical and robust framework to assessing disparities across PSE's service area. However, PSE acknowledges that there is still a great deal of work to be done. PSE received valuable feedback from stakeholders on opportunities for improvement. Next steps for continued development of the EHEB Assessment are outlined below.

- **Geographic vs Demographic Assessment.** PSE elected to perform a geographic assessment for the named population portion of the assessment. It was brought to PSE's attention that it may add value by continuing to assess highly impacted communities using the geographic framework, but to shift the vulnerable population assessment to a demographic framework. PSE believes the different perspective of incorporating a demographic framework for assessing impacts to vulnerable populations will add new insights to the EHEB Assessment.
- **Average vs Binary Criteria.** PSE elected to select vulnerable populations based on an overall average of several vulnerability criteria. It was suggested that PSE select vulnerable populations based on a binary select process whereby, if the community qualifies for any single vulnerability criteria that community would be designated a vulnerable population, regardless of the scores for other criteria. PSE believes enacting this change would result in a more inclusive definition of vulnerable populations and would add value to the assessment, particularly accompanied with inclusion of a demographic framework discussed above.
- **Customer Benefit Indicator Selection.** PSE developed an initial list of customer benefit indicators for use in the EHEB Assessment. These indicators were developed largely through an internal process and vetted through stakeholder engagement during IRP meetings. However, PSE recognizes that much more customer input and engagement is needed to refine the customer benefit indicators. PSE will continue to revise and refine the customer benefit indicators through the CEIP public participation process and consultation with the Equity Advisory Group. Furthermore, PSE received feedback that customer benefit indicators should be outcome-based, as opposed to modeling of specific programs or actions. PSE will engage stakeholders in developing outcome-based customer benefit indicators.
- **Customer Benefit Indicator Development.** In addition to the customer benefit indicator selection discussed above, PSE is also in the process of developing and refining its understanding of customer benefit indicators. Indicators that inform areas such as energy security and resiliency require development of new measures and data sets to better understand disparities of named populations. As these new measures and data sets are established, vetted and informed through public participation, they will be added to the Assessment.
- **Data Resolution.** PSE selected the census tract as the default geospatial resolution for the EHEB Assessment. Stakeholders recommended investigating higher data resolutions such as customer-level data or census block level-data. PSE will investigate incorporation of higher data resolution into future iterations of the EHEB Assessment.