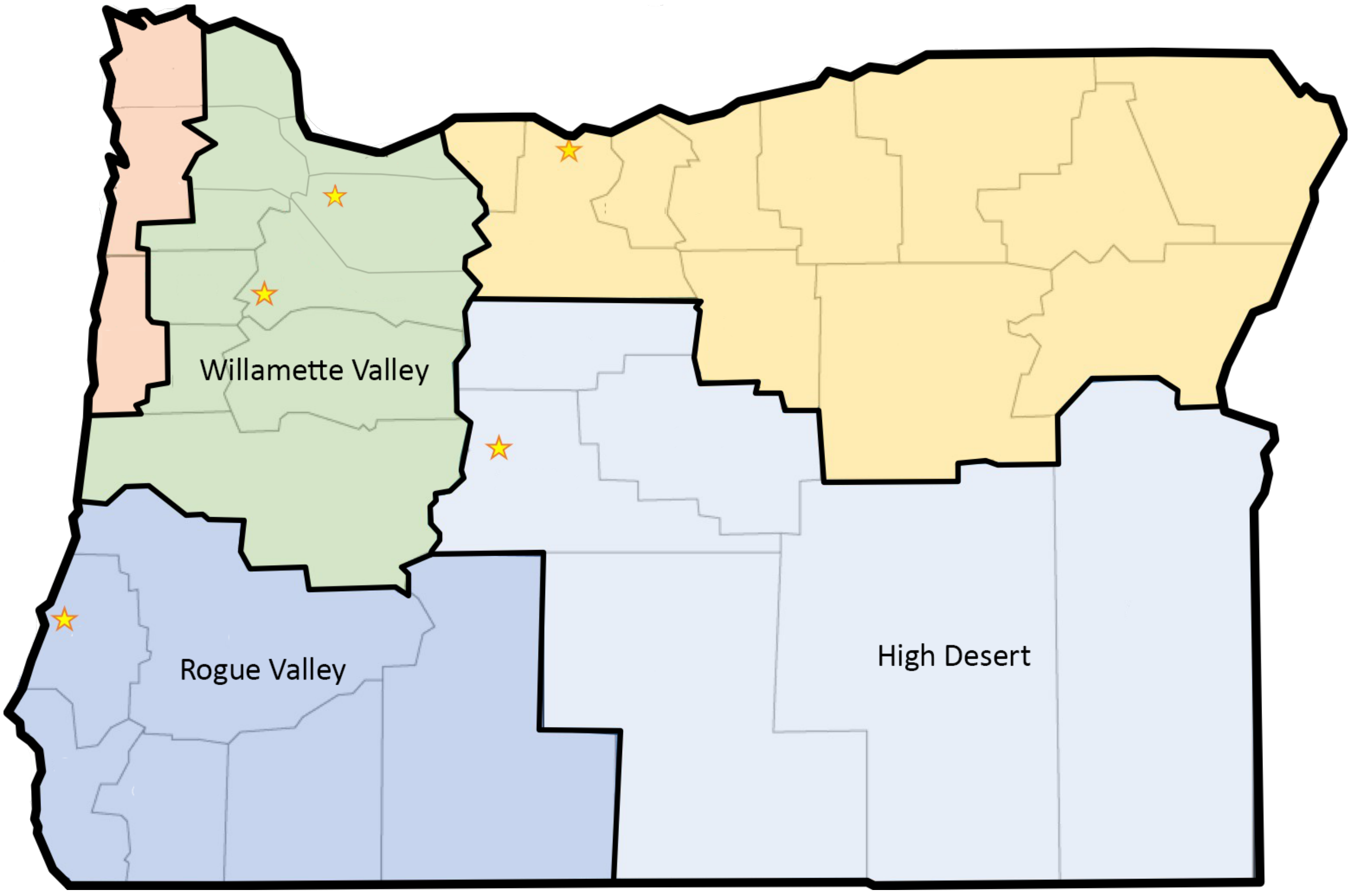

BARRIERS AND OPPORTUNITIES TO NET-ZERO COMMERCIAL-INDUSTRIAL DEVELOPMENT

PART 1: RESEARCH REPORT

ENERGY TRUST OF OREGON NET ZERO FELLOWSHIP, OCTOBER 2022

NOTE: PART 2: DESIGN GUIDE UNDER SEPARATE COVER

mwa architects

Energy Trust of Oregon

CONVERGENCE ARCHITECTURE

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Definitions and Acronyms

BDI	Business Diversity and Inclusion
BMP	Best Management Practices
CCT	Light Correlated Color Temperature
COBID	Certification Office for Business Inclusion and Diversity
ESJ	Equity and Social Justice
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
FDC	Fire Department Connection
GSI	Green Stormwater Infrastructure
HVAC	Centralized Heating, Ventilating, and Air Conditioning
ILFI	International Living Futures Institute
LBC	Living Building Challenge
LEED	Leadership in Energy and Environmental Design
LED	Light Emitting Diode
LID	Low Impact Development
Metro	Multi-county agency including Clackamas, Multnomah and Washington Counties
MWA	MWA Architects, Inc.
MWESB	Minority-owned, Women-owned, or Emerging Small Business
NZF	Net Zero Fellow
Net Zero	Net Zero Energy
ODOE	Oregon Department of Energy
OEESC	Oregon Efficiency Specialty Code
PV	Photovoltaic
USGBC	United States Green Building Council
OSSC	Oregon Structural Specialty Code
MWBE	Minority/Women-owned Business Enterprise
NREL	U.S. Department of Energy and the National Renewable Energy Laboratory

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1. Executive Summary

This Research Report is developed by MWA Architects, Inc. (MWA) in collaboration with Convergence Architecture (CA) as part of Energy Trust of Oregon's Net Zero Fellowship. The goal of the research is to increase the Oregon design and development industries' knowledge of net zero commercial-industrial development and bring Oregon closer to net zero energy. The study included research in three regions: Willamette Valley, Rogue Valley, and High Desert. Net zero energy commercial-industrial developments are low cost to operate especially as the cost of energy increases.

COMMERCIAL-INDUSTRIAL DEVELOPMENT

Definition: Publicly or privately owned individual buildings or collection of buildings. May be a development on a campus. Typically, they are employment centers located in industrially zoned neighborhoods and provide living wage jobs to our communities.

COMMERCIAL-INDUSTRIAL TYPOLOGIES

Building typologies addressed in this research include:

- Mixed-use office
- Warehouse
- Pre-engineered metal building
- Unoccupied service building

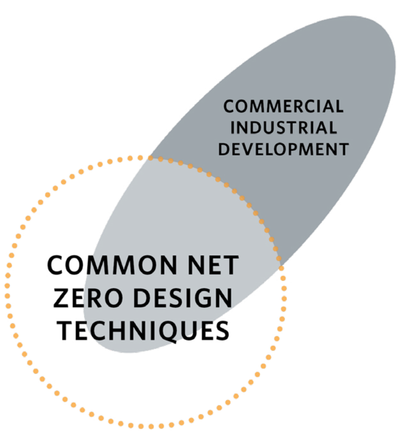

FIGURE 1 NET ZERO DESIGN AND COMMERCIAL INDUSTRIAL DEVELOPMENT SHARED OPPORTUNITIES

1.1 CLIMATE, CULTURE, POLITICS AND DESIGN

Research and design are both needed to facilitate net zero commercial-industrial development. This report is a reference document and is part one of a two-part guide for net zero commercial-industrial development in Oregon:

Part 1 Research Report: The Research Report identifies potential barriers in local development codes, standards, and policies for commercial-industrial net zero development. It includes information gathered from past and predicted environmental and community factors influencing commercial-industrial net zero development in Oregon. This compiled information will facilitate an understanding of policy reasoning and implementation and will guide next steps for public agencies and design firms with advancing net zero commercial-industrial development.

THE RESEARCH REPORT:

- Includes a list of ordinances, policies and goals identified during interviews with public agencies, focusing on identifying barriers to net zero commercial-industrial development
- Identifies priority research areas for selected development and design communities
- Explores barriers to net zero commercial-industrial development
- Summarizes areas for improvement through interviews with regional developers whose 'boots on the ground' give a 2022 context for advancing to net zero development in their communities

Part 2 Design Guide: The Design Guide provides examples of design and detailing for four typical commercial-industrial building types. This guide is directed towards design firms, especially minority-owned, women-owned, and emerging small businesses (MWESB), as well as public agencies as an informational tool to introduce solutions that support net zero building design by all.

Ultimately, this research reduces friction in transitioning commercial-industrial developments to net zero design by making an accessible, consolidated, replicable resource on Oregon code standards and the environmental conditions of the Willamette Valley, Rogue Valley, and High Desert within the context of energy conservation. This knowledge provides a basis for early design decisions that prioritize energy efficiency.

The Part 1 Research Report should be used in tandem with Part 2 Design Guide. It will be most effective to search the text for what is needed for your net zero energy project and then refine the data from there for your exact site location.

Net zero design for commercial industrial buildings share many details with net zero design techniques for other building types (Figure 1). This research and the associated design guide target commercial-industrial development for three reasons: (1) this development type has often been omitted from energy conservation in design conversations, (2) this development type is often 'infrastructure' which we rely on for safety and community health, and (3) although often omitted from energy conservation conversations, these developments can consume large amounts of energy; wit, and with moderate adjustments, are enabled to achieve great energy savings. Although industrial facilities often have very large process loads in comparison to the building energy use, moving towards net zero energy design will still reduce overhead operational costs. Techniques for energy reduction in processing equipment, while important, is not part of this study. This research adds commercial-industrial building and campus development needs to our commonly understood net zero design techniques (Figure 1).

1.2 NET ZERO ENERGY DEFINITION

Net zero energy buildings have the potential to create as much energy as they consume over the course of each year. The idea is to design around energy conservation and utilize natural resources, knowledge, and insight to negate a building's annual energy use. This is realized through the two major component groups that make up buildings: envelope (walls, floors, roof, windows, and doors) and building equipment (lighting, heating, ventilation, and mechanical). When the larger context of a campus, neighborhood or community is part of the development solution, shared infrastructure becomes an opportunity. Occupant behavior, system(s) operations, and building maintenance largely contribute to the success or failure of net zero developments. A holistic approach balancing design and site layout maximizes energy production and conservation which ultimately optimizes development.

1.3 AUDIENCE

This document is a resource for designers and policy makers interested in making their communities more conducive to net zero commercial-industrial developments. Our research, reporting and dissemination approach has been thoughtfully planned to get practical net zero commercial-industrial design parameters to a wide audience with special attention to small minority and women-owned design firms. The target audiences are:

- Architectural design firms; especially small minority and women-owned firms
- Public agencies with commercial-industrial assets
- Public agencies who have influence on local development regulations

1.4 KEY FINDINGS

Key findings are found in each section of this report.

Section 3 Regional Climatic Context

Oregon's climate is changing in every region, and we need to be designing in anticipation of those conditions. Findings are found in grey text boxes within each subsection and in subsection 3.4 Climate-based Design Opportunities. Design opportunities are elaborated in Part 2, Design Guide.

Section 4 Existing Policies and Regulations

Many policies and regulations have been created and more are in progress to address net-zero energy design and climate change. Approaches vary and many jurisdictions need funding and policy support to get to net-zero energy. Only the Portland Metro area jurisdictions are currently addressing energy use in commercial-industrial development. Findings are found at the end of each policy or regulation following 'net zero commercial-industrial development impact,' and in subsection 4.3 Conclusion.

Section 5 Cultural and Political Climate

Oregon has a variety of regional cultural influences. All can find common ground around energy conservation. How to get to net-zero together is the challenge and it must be a movement demanded by the people. Findings are found in grey text boxes within each subsection, and in subsection 5.4 Conclusion.

2. Approach

Every development type should move towards net zero regardless of size or location. Cost barriers should be removed and the perception that investing in energy conservation will be at the expense of function must evolve. Researching and documenting three regions' unique climate, cultural context, and evolution of current sustainable development ordinances provides a framework for other Oregon communities to organize and inform their transition to net zero development.

There is a lack of open-source net zero commercial-industrial development resources. Within the sustainable design movement, net zero design tools access has historically been an exclusive place for academia and large national design firms. Commercial-industrial development will fall even farther behind unless this typology receives equal attention to other developments such as housing, commercial office, or cultural typologies. This report moves commercial-industrial development into the net zero energy design conversation with a collection of development policies and regulations assembled through interviews and internet research. Not all applicable codes and regulations are included; focus was given to emerging policies and regulations for commercial-industrial development obtained in interviews with agencies in the three identified regions. Each document was assessed, and those with direction relevant to commercial-industrial development were included. There are many more energy and design policies, codes, and regulations for other development typologies in Oregon

Design firms can use this document as a starting point and framework for net zero design conversations with commercial-industrial developers, property owners and local authorities having jurisdiction. The framework is meant to be referenced and replicated and can be used as a checklist for projects and agencies across Oregon regions. Public agencies can review this document to see themes and share lessons learned to increase understanding of their own and other net zero development regulations. Each agency interviewed for this report is in a different place in their net zero journey, but public agencies are well-positioned to lead the way in energy use requirements for net zero commercial-industrial developments.

The three fastest growing communities in Oregon were selected because their commercial-industrial development patterns have the greatest impact on energy consumption. Each has existing energy statements or ordinances. This report reviews these energy statements to learn how they support net zero commercial-industrial development. Findings from this research are also relevant and accessible to our smallest communities, especially when considering other benefits of net zero commercial-industrial development: jobs retention and net zero design affordability.

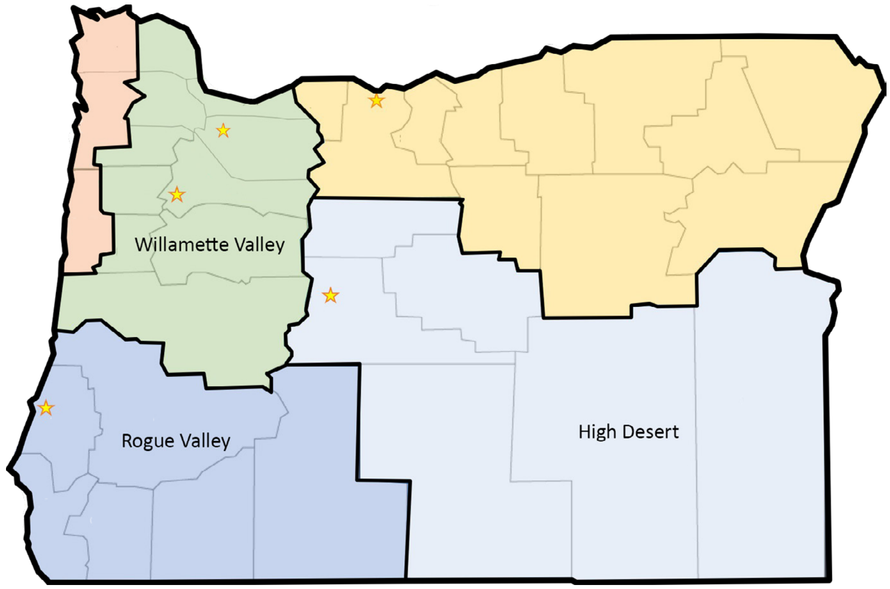

FIGURE 2 REGIONS OF OREGON STUDIED

The three regions and communities included in this research are (Figure 2):

Willamette Valley: The Portland metropolitan area, including the City of Portland and Metro regional agency, is the fastest growing region in Oregon. Washington County is also included as an emerging Portland metropolitan development area.

Rogue Valley: Located in the Rogue Valley in Southern Oregon, Medford is Oregon's eighth-largest city; however, they have experienced slower growth than the Portland metropolitan area.

High Desert: Located in the high desert of central Oregon, Bend is Oregon's seventh-largest city. Between 1980 and 2020, Bend's population has more than quintupled.

MWA and CA conducted this work by:

- Researching development ordinances with net zero or energy conservation components in each of the three cities: Portland, Medford, and Bend.
- Interviewing public agency representatives to gain insight into their executed and in-progress sustainability ordinances.
- Researching region-specific opportunities, with special attention to climate and geology. Each region corresponds with one of the three cities – Willamette Valley (Portland Metropolitan Area), Rogue Valley (Medford), and High Desert (Bend).
- Linking regional research to net zero design opportunities, using each region's resources for envelope (energy conservation design) and energy generation.

3. Regional Climatic Context

By 2040, every region in Oregon will experience climate-based barriers for meeting net zero goals for all development types. Net zero is an essential tool in our adaptation and mitigation of climate-based challenges. Commercial-industrial development will fall even farther behind as this typology receives less attention than other developments such as housing, commercial office, or cultural typologies. The solution is to include commercial-industrial development in climate-based design solutions.

Every year droughts and wildfires begin earlier and last longer. Data shows that they have grown beyond our valleys and are climbing our hills and mountains[1]. Where we experience devastating wildfires and drought, we are also experiencing reduced return of previously-existing native flora and fauna. Habitat has changed and migrated. After years of repeated and extended summer seasons, regrowth has slowed. Species hardened to the new conditions remain and prepare to expand into new areas as this cycle moves north across Oregon. Although change is predicted to be uneven, annual temperatures are set to increase (Figure 3):

- At least 2-4 degrees Fahrenheit by 2040 and an additional 6-8 degrees Fahrenheit by 2080.
- Average summer temperatures are predicted to increase 4-6 degrees Fahrenheit by 2040 and 8-13-degrees Fahrenheit by 2080.
- Average winter temperatures increasing 1-2 degrees Fahrenheit by 2040 and 3-6-degrees Fahrenheit by 2080[2].

WILLAMETTE VALLEY

- Today = 4C (mixed marine)
- Future = 3A (warm humid)

ROGUE VALLEY

- Today = 4C (mixed marine)
- Future = 3B (warm dry)

HIGH DESERT

- Today = 5B (cool dry)
- Future = 4B (mixed dry)

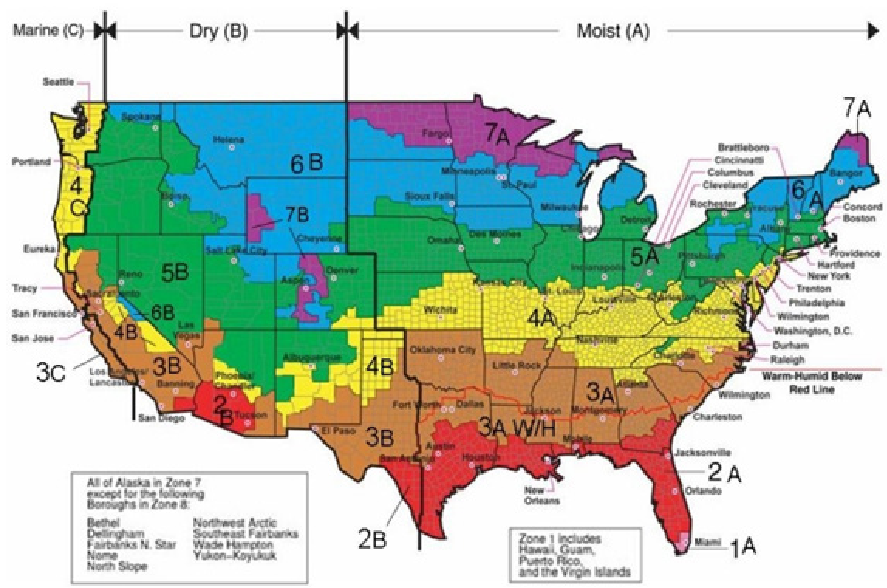

FIGURE 3 CLIMATE CHANGE ACROSS THE UNITED STATES

In addition to increasing drought and fire conditions in summer, we are also seeing an increase in precipitation volume and duration during winter months. Increased rain intensity wreaks havoc with bare and unstable hillsides[3]. Waterways fill quickly and breach their banks with increased frequency. In addition to slope instability,

[1] https://www.energytrust.org/wp-content/uploads/2019/09/190913_ETO_NZ_presentation.pdf

[2] https://www.ipcc.ch/sr15/chapter/spm/

[3] https://www.thenewsguard.com/community/photos-lincoln-county-landslide-leads-to-evacuation/article_2daeca20-4543-11eb-9862-0f6252fb4fdb.html

dam removal projects to save our native fish species, such as Chinook and Steelhead salmon, have gained traction. The future of our native salmon populations and the needs of our farmers remain unclear[4]. The combined impacts of climate change and human-led restoration projects creates additional variables to contend with when forecasting the climate.

When our climate is unpredictable, it affects our ability to get to net zero equitably in the built environment. For example, solar arrays may not be as effective if we experience thick or low cloud cover. Passive systems are effective but can be more difficult to implement in extreme conditions. The upfront cost of high-tech active solutions is not always accessible for areas or developers who cannot afford the out-of-pocket expenses or who are unaware of available financial incentives.

The most impactful tool in our adaptation kit is designing with climate in mind. This accomplishes two goals: (1) prioritizes energy reduction in buildings by leveraging climate-based design, and (2) recognizes that technology brings solutions only for those who can afford it. Adaptation will not be successful unless we reduce energy needs in our buildings and make net zero accessible to all populations. Commercial-industrial developments are needed in every climate in Oregon and their designs must adjust to those climatic opportunities if they are to achieve net zero. This Section introduces the three unique geographical regions: Willamette Valley, Rogue Valley, and High Desert.

Following each region's climate and geological conditions are net zero climatic opportunities in commercial-industrial design. These include solar-based opportunities, water-based opportunities, and geology-based opportunities. By understanding climate conditions, new commercial-industrial development can leverage naturally occurring resources and conditions to decrease energy use.

Sun path diagrams track the sun's position in the sky and length of daylight as the earth rotates around the sun. Reading a sun path diagram is important to making optimal building orientation, location, and position decisions. Cloud coverage is also important to calculate to assess annual solar access.

Latitude defines solar opportunity and affects the area's potential to implement net zero design in two ways: (1) passive solar heating, and (2) solar energy collection.

When designing for net zero it is important to reference climate data. Understanding climate data is the key to selecting appropriate elements and materials that will aid in thermal comfort and reduced energy consumption. Information on weather and climate, such as dry summers and wet winters, inform designers on what building conditions they need to anticipate when designing for maximum energy efficiency. By designing around the conditions of a given anticipated weather pattern, buildings will be more successful in accommodating those environmental factors and creating a design that promotes health and wellbeing with reduced energy consumption.

Geology is important to designing for net zero, as energy exchange opportunities vary depending on geologies of rock, sand, or clay.

[4] https://www.opb.org/article/2021/09/02/salmon-steelhead-willamette-endangered-spill-drawdown/

3.1 WILLAMETTE VALLEY

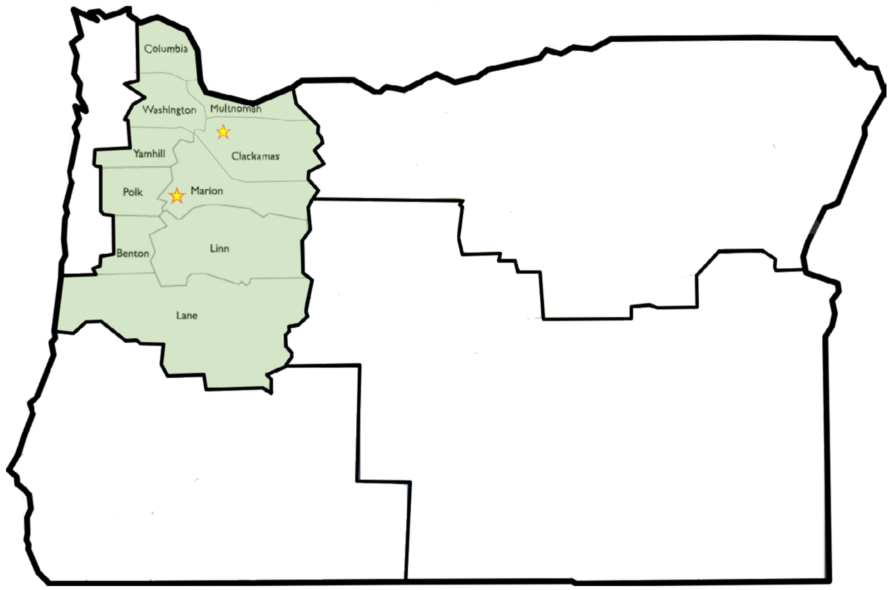

FIGURE 4 WILLAMETTE AND TUALATIN VALLEY

WILLAMETTE VALLEY DESIGN PARAMETERS SUMMARY

Current Climate: Warm, dry summers; Mild, wet winters; Passive systems perform well

Geology: Ground source systems perform well; Low opportunity for geothermal systems

Future Climate: Warm, humid

The Willamette Valley (Figure 4) is defined as a 150-mile stretch of the Columbia River basin that runs south from Portland to Eugene. It is bordered on the east by the Cascades, west by the Coastal Mountain range, and south by the Calapooya Mountains, making the valley 60 miles at its widest. Willamette Valley jurisdictions include Multnomah County, Clackamas County, and Washington County, which together are also served by the regional agency, Metro. The elevation ranges from 10 feet above sea level to approximately 450 feet above sea level at its highest elevation. The Willamette Valley also includes the Tualatin Valley and the Willamette and Tualatin River watersheds[5].

The Willamette River is the longest river in the United States to flow North. It is 13th largest in volume, formed through plate tectonics and volcanism and altered by erosion. Willamette Falls is the second largest waterfall in North America. As a result of these geographical features and flooding, a series of dams were constructed. These dams provide protection from flooding, electrical power generation, and agricultural irrigation for the region. Today, these dams also have well-recorded histories of cultural and environmental destruction[6].

3.1.1 CLIMATE DATA

The Willamette Valley is characterized by warm, dry summers and mild, wet winters featuring a long rainy season. Summers are clear while winters are cloudy. The valley experiences a long growing season and mild winter. By understanding these conditions, new commercial-industrial development within the Willamette Valley will have the opportunity to leverage naturally occurring resources and conditions to increase energy use efficiency.

[5] https://www.oregonencyclopedia.org/articles/willamette_valley/#.YoJVE-jMKUk

[6] https://www.opb.org/article/2021/09/02/salmon-steelhead-willamette-endangered-spill-drawdown/

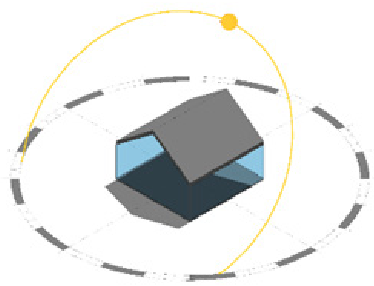

FIGURE 5 WILLAMETTE VALLEY SUMMER SOLSTICE

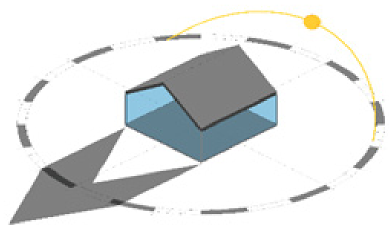

FIGURE 6 WILLAMETTE VALLEY WINTER SOLSTICE

3.1.1.1 WILLAMETTE VALLEY – SUN PATH

The latitude of the Willamette Valley is approximately 45 degrees north. This defines solar access opportunities and affects the area's potential to implement net zero design in two ways: (1) passive solar heating, and (2) solar energy generation Passive solar heating in the Willamette Valley's climate can be optimized to heat commercial-industrial buildings. These building types often can withstand interior temperature fluctuations which can be an energy efficiency opportunity. Though the Willamette Valley cooling season for buildings spans spring, summer and fall, heating loads increase with elevation along the Cascade and Costal Ranges.

To understand the solar heating conditions of the Willamette Valley, it is valuable to reference summer and winter solstice sun path diagrams, Figures 5 and 6. In designing net zero, sun path diagrams are used as tools for saving energy through understanding the sun's position and length of daylight.

Sun path diagrams track the sun's position in the sky and length of daylight as the earth rotates around the sun. Reading a sun path diagram is important to making optimal building orientation, location, and position decisions. Figure 5, shows the sun depicted during the summer solstice at noon on June 21st, with the sunrise at 5:22 am and sunset at 9:03 pm in the Willamette Valley. Note that in this diagram the sun rises in the northeast and sets in the northwest. In Figure 6, the sun is depicted during the winter solstice at noon on December 21st, with the sunrise at 7:50 am and sunset at 4:27 pm in the Willamette Valley.

When considering solar energy generation, winters have an average cloud coverage exceeding 80 percent and an average of 26 cloudy days in January, unlike the less than 40 percent cloud coverage in July when sunshine is most abundant and less than half the days are cloudy. This makes the Willamette Valley a good candidate for solar energy generation systems.

3.1.1.2 WILLAMETTE VALLEY AVERAGE TEMPERATURE AND PRECIPITATION

WILLAMETTE VALLEY – AVERAGE TEMPERATURE + PRECIPITATION

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average high in F	46.8	51.1	56.1	61.1	67.6	73.4	81.1	81.8	76.6	64.4	52.4	45.8
Average low in F	34.7	35.4	37.8	40.7	45.3	50.1	53.4	53.1	49.0	42.8	38.4	34.4
Precipitation in inches	6.19	4.85	4.28	2.88	2.29	1.55	0.54	0.65	1.38	3.01	6.64	7.10

Information on weather and climate, such as dry summers and wet winters, inform designers on what building conditions they need to anticipate when designing for maximum energy efficiency.

The climate of the Willamette Valley is primarily influenced by precipitation, with increased rainfall in areas with higher elevation. Snowfall is increasingly common and extreme weather conditions such as ice storms have followed snow events more frequently in the past decade[7].

The Willamette Valley is characterized by:

Humidity: High humidity in the morning and low humidity in the afternoon, ranging from about 70-80 percent in January to 30-50 percent in the summer months.

[7] https://www.oregonlive.com/environment/2022/04/blistering-june-heat-unprecedented-april-snow-climate-change-makes-extreme-weather-more-likely-in-oregon.html

Temperature: Historically, there are only 5-15 days out of the year when the Willamette Valley reaches temperatures above 90 degrees Fahrenheit and temperatures below zero occur historically once every 25 years. High temperatures are typically around 80 degrees Fahrenheit in the summer to 40 degrees Fahrenheit in the winter, with average lows being around 50 degrees Fahrenheit during the summer and 30 degrees Fahrenheit in the winter. September and October are chilly but comfortable, with temperatures ranging from 60-70 degrees Fahrenheit in the afternoons.

Precipitation: Seasonal rain typically begins in November and continues through late spring. Cooler temperatures result in mountain snow, typically from December through March. Climate change is expected to increase temperatures all year round statewide. Heavier and longer precipitation events during wet periods and drier extended summers will likely result from these increased temperatures in the Valley.

Weather events: Ice storms and severe weather average 5-10 inches per year, historically. High winds may occur several times per year, causing ice storms in the northern portion of the Valley due to cold air flowing thorough the Columbia Gorge.

3.1.2 GEOLOGY

The Willamette Valley has a unique geology created by the multiple catastrophic Missoula Floods at the end of the last ice age. The Valley is in a broad alluvial plain, created over time by sediment carried by tributaries along the Willamette River, resulting in a rich agricultural foundation. It is bordered on the west by early Tertiary marine sedimentary and volcanic rocks of the Coast Range, and on the east by Tertiary and Quaternary volcanic and volcaniclastic rocks of the Cascade Range. The first 5-50 meters of these valley deposits are comprised of clay, silt, sand and gravel from the Coast and Cascade ranges. The other Pleistocene sand and gravel deposited after the Missoula Floods was deposited in tributaries along the Cascade Range which are responsible for most of the sediment found in the valley. This geology provides low to no access to regional geothermal heat or energy sources.

Geology is important to designing for net zero, as energy exchange opportunities vary depending on geologies of rock, sand, or clay. Broadly, the Willamette Valley geologic character accepts ground source heat pump technology well. This heat exchange system linked to heating and cooling preconditioning is key to commercial-industrial net zero design.

3.1.3 IMPACT OF CLIMATE CHANGE ON BUILDING DESIGN

It is predicted that climate change will increase the temperature of the Willamette Valley, resulting in wetter winters and drier summers, as well as decreased snowfall. These changes will impact environmental, social, and economic local conditions. This places stress on infrastructure, buildings, and human health.

These changes cause warmer oceans, increased moisture in the air, and increased storm intensities, which, in turn, result in more flooding in the Willamette Valley. During the summer months, these temperature changes will also result in an increase of seasonal wildfires and drought. In Section 3.4 is a list of building design solutions for commercial-industrial development. These solutions, when combined with the reference material in Part 2, the Design Guide, focus on the large range in building sizes and occupancies and present building design opportunities for campus scale solutions.

3.2 ROGUE VALLEY

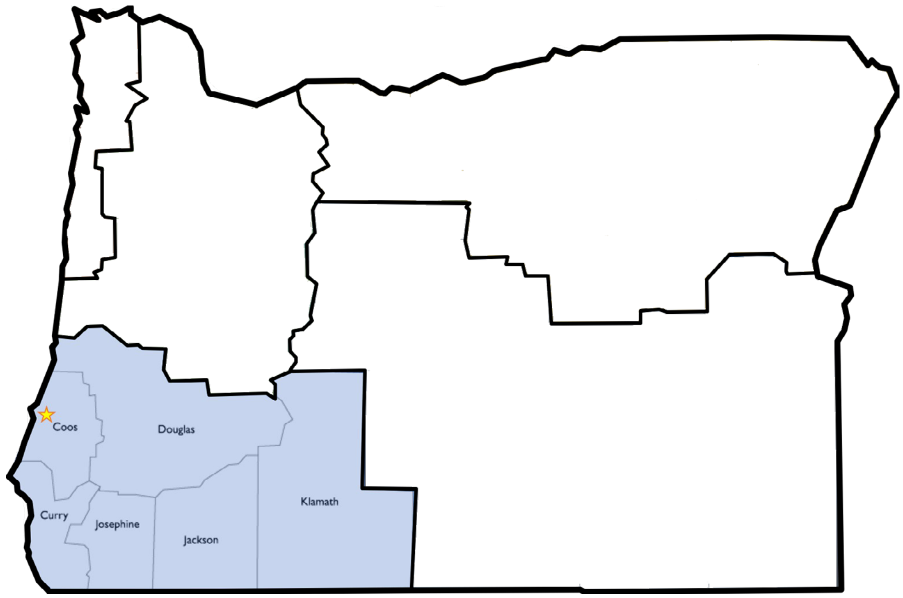

FIGURE 7 THE ROGUE VALLEY

ROGUE VALLEY DESIGN PARAMETERS SUMMARY

Current Climate: Hot, dry summers; Mild, wet winters; Passive systems perform well

Geology: Ground source systems perform well; Moderate opportunity for geothermal systems

Future Climate: Warm, dry

The Rogue Valley (Figure 7) is a rugged area located in Southwest Oregon and includes the cities of Medford and Grants Pass. Unlike the Willamette Valley, the Rogue Valley is less populated and includes mountains and ridges separated by deep river valleys that flow toward the Pacific Ocean. The climate is mild, with temperatures ranging from 32-92 degrees Fahrenheit and minimal snow and precipitation. Winds are also mild and warm; sunny days with warm dry evenings can be expected from May through September. It is framed by the Cascade and Siskiyou mountains and carved out by glaciers that deposited nutrient dense soil and formed hills and valleys.

3.2.1 CLIMATE DATA

The Rogue Valley is characterized by warm summers featuring a long dry season and mild winters. Summers and winters often feature clear skies. The valley experiences a long growing season. By understanding these conditions, new commercial-industrial development within the Rogue Valley will have the opportunity to leverage naturally occurring resources and conditions to increase energy use efficiency.

3.2.1.1 ROGUE VALLEY – SUN PATH

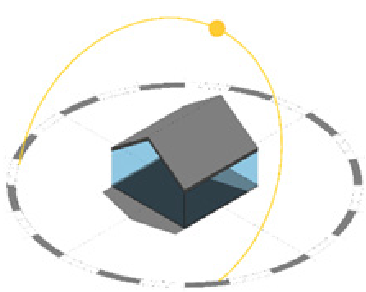

FIGURE 8 ROGUE VALLEY SUMMER SOLSTICE

The latitude of the Rogue Valley is approximately 42 degrees north. This defines solar access opportunities and affects the area's potential to implement net zero design in two ways: (1) passive solar heating, and (2) solar energy generation. Passive solar heating in the Rogue Valley's climate can be optimized to heat commercial-industrial buildings. These building types often can withstand interior temperature fluctuations which can be an energy efficiency opportunity. Though the Rogue Valley cooling season for buildings spans spring, summer, winter, and fall, heating loads increase with elevation along the Cascade and Siskiyou Mountain ranges.

To understand the solar heating conditions of the Rogue Valley, it is valuable to reference summer and winter solstice sun path diagrams, Figures 8 and 9. In designing net zero, sun path diagrams are used as tools for saving energy through understanding the sun's position and length of daylight.

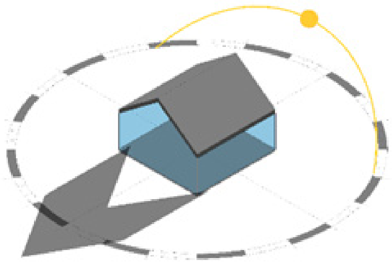

FIGURE 9 ROGUE VALLEY WINTER SOLSTICE

Sun path diagrams are tools that track the sun's position in the sky and length of daylight as the earth rotates around the sun. Reading a sun path diagram is important to making optimal building orientation, location, and position decisions. In Figure 8, the sun is depicted during the summer solstice at noon on June 21st, with sunrise at 5:35 am and sunset at 8:52 pm in Medford, Oregon. In Figure 9, the sun is depicted during the winter solstice at noon on December 21st, with the sunrise at 7:39 am and sunset at 4:40 pm in Medford, Oregon.

Cloud coverage is also important to calculate to assess annual solar access. In the Rogue Valley cloud coverage is greatest in the Winter months such as December and January who experience more than 80 percent of total potential cloud coverage. Summers, however, are rarely cloudy, with an average of 20 percent cloud coverage.

When designing for net zero, sun path diagrams are used as tools for saving energy through passive building design. Understanding the sun's position and length of daylight allows designers to predict where elements such as shading may be useful. Sun path diagrams predict where heating and cooling elements will be needed, allowing designers to save energy and aim for zero.

3.2.1.2 ROGUE VALLEY AVERAGE TEMPERATURE AND PRECIPITATION

ROGUE VALLEY – AVERAGE TEMPERATURE + PRECIPITATION												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average high in F	44.7	50.7	56.3	62.3	70.7	79.0	87.7	87.0	79.7	67.0	50.0	43.0
Average low in F	29.3	31.3	33.7	36.7	42.0	47.7	52.7	51.7	45.0	37.7	33.7	29.3
Precipitation in inches	3.19	2.56	2.39	1.56	1.29	0.73	0.39	0.45	0.72	1.43	3.40	3.92

Information on weather and climate, such as dry summers and wet winters, inform designers on what building conditions they need to anticipate when designing for maximum energy efficiency.

In designing for net zero it is important to reference climate data. Understanding climate data is the key to selecting appropriate elements and materials that will aid in thermal comfort and reduced energy consumption. By designing around the conditions of a given anticipated weather pattern, buildings will be more successful in accommodating those environmental factors and creating a design that promotes health and wellbeing with reduced energy consumption.

The Rogue Valley is characterized by:

Humidity: Moderate humidity in the morning and afternoon, ranging from about 83 percent in January to 59-65 percent in the summer months. Fog is prevalent below 1000 feet elevation late fall, winter, and spring. Freezing fog is common in winter.

Temperature: The Rogue Valley experiences more temperature extremes than the rest of Oregon and is typically the warmest part of the state in the summer. Medford experiences 55 days a year with temperatures above 90 degrees Fahrenheit while also experiencing 20 days in January with temperatures of 32 degrees Fahrenheit or below. Medford ranges from 72 degrees Fahrenheit in July to 37 degrees Fahrenheit in December which is a greater range than most other areas of Oregon including the Willamette Valley.

Precipitation: Medford's average annual precipitation is 18.8 inches, with 75 percent falling between November and March. Like the Willamette Valley, the Rogue Valley's precipitation is primarily influenced by elevation, with the driest areas being at lower elevations and the wettest areas being at the highest. The driest zone averages less than 20 inches per year and extends from Central Point through Medford and ending at Ashland. Mount Ashland, with an elevation of 7,500 feet, receives 50 inches per year and the wettest zone extends from Roseburg to Quartz Mountain.

Weather events: The Rogue Valley experiences periodic drought accompanied by wildfire. These events have increased to become seasonal. In 2022 fire season was declared June 1. When temperatures are consistently hot and sunny, forest fuels are primed to burn while years of drought contribute to increased fire risk.[8]

3.2.2 GEOLOGY

The Rogue Valley extends from the Klamath-Siskiyou Mountains to the High Cascade Mountains. These mountains evolved 34 to 24 million years ago when active volcanoes deposited thousands of feet of lava, mudflows, and volcanic ash.

Approximately 7 million years ago, a shield volcano erupted and spread andesite lava over much of the valley. The thickest portion of the lava flow is 730 feet thick and is located near Lost Creek Lake. The western edge of the flow is 150 feet thick at Castle Rock. Following the volcanic activity, the Rogue River proceeded to wear away most of the andesite lava cap and the underlying Payne Cliffs Formation. Erosional processes continue to shape the landscape. To the east, between 1 and 2 million years ago stratovolcanoes formed in the High Cascades. These include Mt. St. Helens, Mt. Hood, Mt. McLoughlin, Mt. Lassen, Mt. Shasta, and Mt. Mazama (also known as Crater Lake), resulting in opportunities for geothermal heating or energy generation near those areas.

Geology is important to designing for net zero, as energy exchange opportunities vary depending on geologies of rock, sand, or clay. Broadly, the Rogue Valley geologic character accepts ground source heat pump technology well. This heat exchange system linked to heating and cooling preconditioning is key to commercial-industrial net zero design.

3.2.3 IMPACT OF CLIMATE CHANGE ON BUILDING DESIGN

It is predicted that climate change will increase the temperature of the Rogue Valley, resulting in drier winters and drier summers as well as decreased snowfall. These changes will impact environmental, social, and economic local conditions. This places stress on infrastructure, buildings, and human health.

These changes cause warmer oceans, increased moisture in the air, and increased storm intensities, which, in turn, result in more flooding in the Rogue Valley. During the summer months, these temperature changes will also result in an increase of seasonal wildfires and drought. In Section 3.4 is a list of building design solutions for commercial-industrial development. These solutions, when combined with the reference material in Part 2, the Design Guide, focus on the large range in building sizes and occupancies and present building design opportunities for campus scale solutions.

[8] https://jacksoncountyor.org/emergency/News/News-Information/fire-season-begins-june-1-2022-in-jackson-and-josephine-counties

3.3 HIGH DESERT

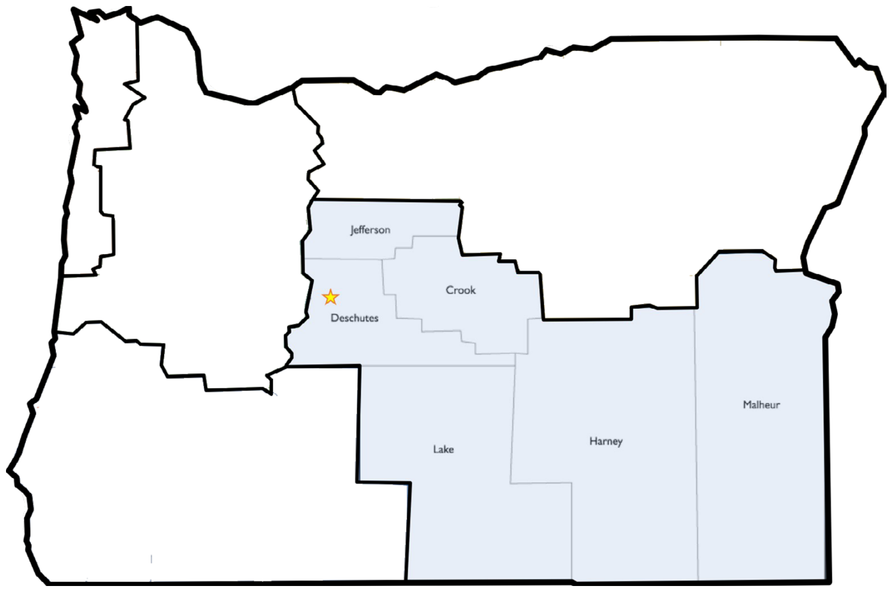

FIGURE 10 THE HIGH DESERT

HIGH DESERT DESIGN PARAMETERS SUMMARY

Current Climate: Hot, dry summers; Cold, mixed winters; Passive systems perform well

Geology: Ground source systems perform well; High opportunity for geothermal systems

Future Climate: Mixed, dry climate

Oregon's High Desert (Figure 10) in Eastern Oregon includes the cities of Bend, Redmond, Prineville, and Burns. It begins at the eastern foot of the Cascades and continues through central and southeastern areas of the state. It has a distinct climate zone, differing in temperature, precipitation and elevation from other parts of Oregon. The High Desert is set at a high elevation, averaging 4,000-6,000 feet above sea level.

The name "High Desert" comes from this extreme elevation. It was formed 30 million years ago by lava flows. The Cascade Mountain range of Central Oregon prevents precipitation from reaching the High Desert. Instead, moisture collects at mountain tops resulting in rich green vegetation at mountain peaks and annual snowfalls that can reach 450 inches or more. Precipitation, however, isn't as abundant in the high desert valleys, as Bend receives less than 12 inches per year, making it a dry climate. The High Desert includes wildflowers, river canyons, black lava flows, and clear blue waterways. It also includes angular and large mountains and rock formations such as Smith Rock.

3.3.1 CLIMATE DATA

The Central Oregon High Desert is characterized by a long dry season of warm summers and cold winters. Summers and winters often feature clear skies. By understanding these conditions, new commercial-industrial development within the High Desert will have the opportunity to leverage naturally occurring resources and conditions to increase energy use efficacy.

3.3.1.1 HIGH DESERT - SUN PATH

The latitude of the High Desert is approximately at 44 degrees north. This defines solar access opportunities and affects the area's potential to implement net zero design in two ways: (1) passive solar heating, and (2) solar energy generation. Passive solar heating in the High Desert climate can be optimized to heat commercial-industrial buildings and reduce cooling loads. These building types often can withstand interior temperature fluctuations which can be an energy efficiency opportunity. Though the High Desert cooling season for buildings spans spring,

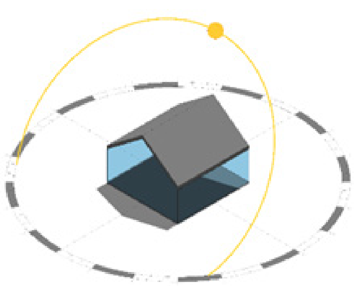

FIGURE 11 HIGH DESERT SUMMER SOLSTICE

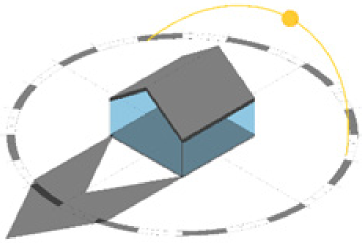

FIGURE 12 HIGH DESERT WINTER SOLSTICE

summer, and fall, nighttime heating loads increase with elevation along the Cascade Mountain range.

Sun path diagrams are tools that track the sun's position in the sky and length of daylight as the earth rotates around the sun. Understanding how to read a sun path diagram is important for determining building orientation, location, and position. In Figure 11, the sun is depicted during the summer solstice at noon on June 21st, with sunrise at 5:22 am and sunset at 8:52 pm in Bend, Oregon. In Figure 12, the sun is depicted during the winter solstice at noon on December 21st, with sunrise at 7:35 am and sunset at 4:27 pm in Bend, Oregon.

When designing for net zero, sun path diagrams are used as tools for saving energy through passive building design. Understanding the sun's position and length of daylight allows designers to predict where elements such as shading may be useful. In passive building design, natural reoccurring conditions are considered during the design process to create buildings that efficiently utilize elements such as heating and cooling to increase energy efficiency. Sun path diagrams predict where heating and cooling elements will be needed, allowing designers to save energy and aim for zero.

3.3.1.2 HIGH DESERT AVERAGE TEMPERATURE AND PRECIPITATION

HIGH DESERT – AVERAGE TEMPERATURE + PRECIPITATION

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average high in F	40.2	44.5	52.2	58.7	66.7	74.7	85.0	84.0	76.0	63.2	47.7	38.5
Average low in F	21.7	23.2	27.2	30.2	36.5	42.2	47.0	45.7	38.5	31.5	26.2	20.5
Precipitation in inches	1.20	0.94	0.84	0.83	1.08	0.75	0.51	0.42	0.41	0.71	1.17	1.59

Information on weather and climate, such as dry summers and wet winters, inform designers on what building conditions they need to anticipate when designing for maximum energy efficiency.

It is important to reference climate data when designing for net zero. Understanding climate data is the key to selecting appropriate elements and materials that will aid in thermal comfort and reduced energy consumption. By designing around the conditions of a given anticipated weather pattern, buildings will be more successful in accommodating those environmental factors and creating a design that promotes health and wellbeing with reduced energy consumption.

The High Desert is characterized by:

Humidity: Low humidity throughout the day, ranging from about 73 percent in January to 42-49 percent in the summer months.

Temperature: The High Desert receives its highest monthly precipitation in the winter months with a secondary maximum during late spring and early summer. Annual moisture distributions are very similar to those in western Oregon: a winter peak followed by a steady decrease, with lowest monthly averages in summer. In the eastside of the High Desert, however, spring and summer peaks are much more pronounced with the four wettest months being March through June. The months of July through September are generally the driest of the year throughout the region. These months are characterized by isolated local thunderstorms which can trigger wildfires. Summers are generally quite warm, although the relatively high elevations tend to moderate the temperatures. The mean maximum summer temperatures reach the 90's during the warmest summer months[9].

[9] file:///C:/Users/jvonbargen/Downloads/SR_no._919_OCR.pdf

Precipitation: Bend's average annual precipitation is 11.7 inches, with 75 percent falling between November and March in the form of snow. The driest zone extends across southeast Oregon and includes the Steens mountain range, with averages of less than 10 inches per year. Chiloquin, north of Klamath Falls and with an elevation of 4,180 feet, receives 22 inches per year and is the wettest High Desert zone.

Weather events: The High Desert experiences drought, wildfire, and flooding[10]. These have increased to become seasonal. In 2022 fire season was declared June 1. When temperatures are consistently hot and sunny, forest fuels are primed to burn while years of drought contribute to increased fire risk. Flooding is brought on by thunderstorms and heavy seasonal rains leading to localized property damage and compromised public health when sewers overflow.

3.3.2 GEOLOGY

The High Desert of Central Oregon emerged from a series of volcanic events beginning 50 million years ago. The volcanic and sedimentary rock found here is part of the Claro Formation which formed during a tropical climate era. The frequent volcanic ash deposits trapped plant and animal evidence in extensive fossil caches. A period of erosion was followed by more lava flows 33 million years ago. Volcanic activity continues in the area today. Understanding an area's context is important in designing for net zero because buildings that are the most energy efficient take into consideration their location[11]. This region, and areas south of this region, have opportunities for geothermal heating or energy generation.

Geology is important to designing for net zero, as energy exchange opportunities vary depending on geologies of rock, sand, or clay. Broadly, the High Desert geologic character accepts ground source heat pump technology well. This heat exchange system linked to heating and cooling preconditioning is key to commercial-industrial net zero design. In the High Desert, a lateral system may be necessary when the volcanic layers are near the ground surface. This tempering approach is often called an earth tube system.

3.3.3 IMPACT OF CLIMATE CHANGE ON BUILDING DESIGN

It is predicted that climate change will increase the temperature of the High Desert resulting in drier summers and wetter winters in the form of rainfall and decreased snowfall. These changes will impact environmental, social, and economic local conditions and places stress on infrastructure, buildings, and human health.

Climate change will trigger elevated ocean temperatures coupled with an abundance of moisture in the air, thus resulting in increased storm intensities and increased flooding in the High Desert. During summer months, the escalated temperatures will result in an increase of seasonal wildfires and drought. In Section 3.4 is a list of building design solutions for commercial-industrial development. These solutions, when combined with the reference material in Part 2, the Design Guide, focus on the large range in building sizes and occupancies and present building design opportunities for campus scale solutions.

[10] https://ktvz.com/news/bend/2022/06/03/after-heavy-rain-causes-street-flooding-in-bend-odot-explains-steps-to-avoid-repeat/

[11] https://www.fs.usda.gov/detail/deschutes/recreation/rocks-minerals/?cid=stelprdb5385354#:~:text=Central%20Oregon%20has%20been%20shaped,conditions%20that%20supported%20lush%20woodlands.

3.4 CLIMATE-BASED BUILDING DESIGN OPPORTUNITIES

Solar-based opportunities:

- Solar arrays (using photovoltaics)
- Passive heating and cooling (including night-time cooling)
- Daylighting
- Solar shading at windows and doors (all sides of building)
- Whole building shading

Water-based opportunities:

- Solar water pre-heating for use in showers and plumbing fixtures
- Rainwater collection for irrigation (shoulder season only)
- Grey water recycling for irrigation and toilet flushing
- Vegetated roof (fire resistant species) in combination with rainwater collection or solar array[12]

Geology-based opportunities:

- Thermal mass building envelope technology to mitigate temperature peaks and valleys[13]
- Earth tubes for cooling and heating[14]
- Geothermal energy generation
- Ground source heat pump technology

[12] https://www.pacifichorticulture.org/articles/green-roofs-dry-in-the-sky/

[13] https://www.greenesa.com/blog/thermal-mass-use-for-heating-and-cooling

[14] https://www.greenbuildingadvisor.com/article/all-about-earth-tubes

4. Existing Policies and Regulations

This section provides information on green building standards for designing for zero. To transition towards net zero building as standard practice, there must be a shift in how we approach building and construction and an understanding of the associated challenges to net zero design. Collecting information on building codes, case studies, site analysis, and permit requirements will aid in the shift to net zero and facilitate environmentally-conscious design.

4.1 PLANS, REGULATIONS AND POLICIES SUMMARY

4.1.1 WILLAMETTE VALLEY

Metro – Regional Industrial Site Readiness Project 20-year Plan (2014)

The Metro Regional Industrial Site Readiness Inventory examines the region's inventory of large industrial sites available to existing and future employers. This report examines policy, tax base, investments, and jobs created through development of the inventoried sites. It focuses on available land and protecting inventory accuracy. It is important to have an accurate inventory of land to use for development as the area relies on a globally competitive environment to attract jobs and businesses. Oregon is an income-tax-dependent state, meaning that higher paying trade-sector jobs improve Oregon's economy by generating revenue for public services such as schools.

Net zero commercial-industrial development impact:

Identifies industrial lands loss and low valuation, leading to no capital funding access and job loss. Net zero design can revalue these developments as cost-effective to operate and inspire innovation.

Metro – Metro Sustainable Development (in progress)

Metro has reviewed its portfolio and recent projects against its existing sustainability policy to find missed opportunities. As part of its efforts to improve policy, and to better reflect the actual new facilities and retrofits that are being completed, Metro is targeting 100% emissions reduction by 2040. They are creating a Climate Task Force for each department across the agency. Task force members will aid in disseminating the new policy to each department and keep the policy at the forefront of decision-making efforts in all areas. The goal is to have representation and coordination in their approach to sustainability policy and net zero improvements. They will implement standards for their new buildings and upgrades and ask their contract holders (architects, construction teams, subconsultant groups, etc.) to design to International Living Futures Institute (ILFI) Core Green Building Certification℠ (Core). Additionally, Metro has reached out to local Certification Office for Business Inclusion (COBID) architectural and engineering firms to receive feedback on some of their proposed policy updates in order to identify and remove barriers for completing this work as they move forward. Metro hopes to become a regional leader in how to develop, implement, and stay accountable to an appropriately aggressive and responsive climate policy.

Net zero commercial-industrial development impact:

Provides leadership in water and energy conservation development and is beta testing on a commercial-industrial project. Pairs well with net zero design techniques.

City of Portland – Portland Marine Industrial Land Analysis (2021)

The City of Portland Marine Industrial Land Analysis seeks to update the City of Portland's economic opportunities. This analysis research involved many participants including the Port of Portland, owner of marine terminals in the Portland metro area. In analyzing this research, it is important to keep in mind that the harbor economy is different than other industries and that different growth strategies experience different challenges. One of these challenges is a greater demand on land to accommodate larger ships and unit trains which can be in direct opposition with ecological best practices. Dredging and transport (rail) by fossil fuel-based equipment are additional areas where net zero innovations are needed. Portland's economy relies on these ships and trains as necessary to support the trade-sector industries crucial to Oregon's economy. The city handles most port to port commodity flows, leading in auto trade but suffering with grain's declining market share. Terminal land is also important to Oregon's economy as it triggers investment in new facilities. However, economic opportunity may come too late for available land. When looking at grain and auto cargo for example, grain cargo anticipates 152 percent of existing capacity by 2040, and auto cargo anticipates 118 percent of existing capacity by 2040. To address this challenging business climate and protect industrial areas, improvements can be made through planned investments and an increase in competition. However, each of these proposed solutions has tradeoffs and challenges.

Net zero commercial-industrial development impact:

Identified industrial lands loss, low valuation leading to no capital funding access and job loss. Net zero design can revalue these developments as cost-effective to operate and inspire innovation.

City of Portland – Green Building Policy (2015)

The City of Portland Green Building Policy is a code standard that seeks to accept environmental responsibility for building practices in the City of Portland. The city recognizes its role and responsibility in implementing and promoting building practices that protect the city and its natural environment and wishes to promote practices that focus on the wellbeing of individuals and their environment through reducing construction practices that negatively affect vegetation, wildlife, and other ecosystems.

Net zero commercial-industrial development impact:

Specifically addresses limited commercial-industrial development and sets energy reduction goals.

Prosper Portland, Multnomah County, Energy Trust of Oregon – PropertyFit / Commercial Property Assessed Clean Energy - CPACE (2015)

The City of Portland and Multnomah County use the CPACE financing model, a national initiative offered to improve building performance for those who may be restricted by budgets. Building owners use energy savings to repay the cost of eligible improvements through a benefits assessment (like a tax assessment) during a period of up to 20 years. The assessment is tied to the property and transfers to any new property owners until repaid. This program provides direct economic benefits to property owners and tenants, as well as to the local community due to increased green jobs and diminished greenhouse gas emissions.

Net zero commercial-industrial development impact:

Will provide financial assistance through gap financing on projects with demonstrated energy conservation goals, including commercial-industrial developments.

4.1.2 WASHINGTON COUNTY

Washington County - Commercial Property Assessed Clean Energy - CPACE (in progress)

Washington County is currently looking to its county peers in Multnomah and Deschutes Counties to develop its own CPACE program. Once adopted, this program will allow Washington County to help developers finance commercial energy reductions by offering rebates, incentives, and access to energy efficiency information and guidelines. This program will increase the number of energy efficient developments in the Washington County area, decreasing energy use and benefiting the local economy while making Washington County a more competitive area for developers, investors, and property owners to consider.

Net zero commercial-industrial development impact:

Provides financial assistance through gap financing on projects with demonstrated energy conservation goals, including commercial-industrial developments.

Washington County - Energy Management Policy (2021)

Washington County recently adopted an Energy Management policy for their county operations, which targets the decarbonization of their buildings and their fleet (by transitioning to electric vehicles). The intent is to align with Federal goals of being net zero by 2050, first by creating and implementing green policy guidelines for the county's internal operations and then by developing a community action plan. By beginning with internal operations, the county hopes to set an example of what is possible and inspire those in the area. The county will engage with residents to develop a community action plan that represents community interests and priorities as part of these green policy guidelines. Because this is a newly adopted policy, implementation goals and priorities of the community plan are to be determined.

Net zero commercial-industrial development impact:

Aligns local and federal energy conservation goals which sets up the county for federal loan and grant application success, includes commercial-industrial developments.

4.1.3 ROGUE VALLEY

City of Medford – Community Vision 2040 (in progress)

The City of Medford 2040 Community Vision is a community-driven initiative facilitated by the City of Medford to understand community members' vision for the city over the next 20 years and develop a plan to meet their goals. The city would like to transform Medford into a vibrant, welcoming, and inclusive urban community that embraces environmental preservation by the year 2040. This initiative will build on the city's current economic base and improve education and employment opportunities while fostering a sense of community and diversity.

Net zero commercial-industrial development impact:

Provides a beginning framework for developing an energy and water conservation and resilience implementation plan. This is another opportunity to connect leadership with this NZF research.

4.1.4 HIGH DESERT

City of Bend – Community Climate Action Plan (CCAP) (2019)

The CCAP is a set of strategies and actions that will guide both the City and the community to achieve fossil fuel reduction goals established by City Council Resolution 3044. The actions will encourage and incentivize businesses and residents, through voluntary efforts, to reduce GHG emissions and fossil fuel use. Climate Action Goals include:

- Reduce community-wide fossil fuel use by 40% by 2030
- Reduce community-wide fossil fuel use by 70% by 2050[15]

Net zero commercial-industrial development impact:

Creates a citizen committee to review climate action goals and projects with implementation paths. Includes commercial-industrial developments, specifically for private developers. This is another opportunity to connect leadership with this NZF research.

City of Bend – Strategic Energy Management Plan (2020)

The city adopted its Strategic Energy Management Plan in Fall 2020, which describes actions the city will take to achieve its fossil fuel reduction goals established in Resolution 3044. The city will continue implementing projects described in the plan over the next several years, creating lasting change that moves the city towards net zero.

Net zero commercial-industrial development impact:

Creates energy conservation goals and implementation projects for city developments. Includes publicly owned commercial-industrial developments.

City of Bend – Buildable Lands Inventory (2016)

The Bend Buildable Lands Inventory details land available for development within the Bend Urban Growth Boundary. This land may be used for residential or commercial development. Housing needs and economic opportunities are considered in determining eligible land, and include planning efforts around specific expansion areas and opportunities.

Net zero commercial-industrial development impact:

Identified industrial lands loss, low valuation leading to no capital funding access and with that, job loss. Net zero design can revalue these developments as cost-effective to operate and inspire innovation.

[15] https://www.bendoregon.gov/city-projects/sustainability/community-climate-action-plan

4.2 RELEVANT OREGON CODE STANDARDS

4.2.1 ASHRAE 90.1 – ENERGY STANDARD FOR BUILDINGS (EXCEPT LOW-RISE RESIDENTIAL) (2019)

Standard 90.1 provides the minimum requirements for energy efficiency in building design and is a benchmark for commercial building codes in the United States. It is updated every three years and serves as an important reference.

4.2.2 2021 OREGON ENERGY EFFICIENCY SPECIALTY CODE

Oregon Energy Efficiency Specialty Code (OEESC) is an Oregon specific code standard based on ASHRAE 90.1-2019. In this updated energy code, all Oregon Structural Specialty Code (OSSC) buildings will use the ASHRAE 90.1-2019, including low-rise residential. A zero-code energy calculator for new buildings has been made available and results are required for permit of new buildings. Permitting requirements starting October 2022 will include:

- A 'solar-ready zone' will be identified on the plans for roofs with an orientation between 110 to 270 degrees of North or roofs that are low-slope; 40% of the roof must be identified less skylights, vegetated roof, and mandatory setbacks
- 5 PSF dead load for solar energy generation equipment in 'solar-ready zone'
- Roof access and escape pathways for future fire fighter access
- Future equipment must be located, and pathways established between roof and equipment
- No 'solar-ready zone' less than 8 feet in any direction or less than 80 square feet

4.2.3 RAINWATER HARVESTING

The Willamette Valley experiences an abundance of precipitation which presents a unique design opportunity where rainwater may be used as a resource in designing for net zero. A challenge and potential barrier to utilizing rainwater as a tool is that rainwater harvesting is perceived as wholly illegal in Oregon. In addressing this challenge, it is important to understand local laws and how precipitation can be utilized in the context of designing for net zero and what that means regarding local laws, policies, and ordinances that may not prohibit using rainwater.

Rainwater harvesting is legal in Oregon, but only if it is caught in a rooftop system or via an impervious artificial surface such as an open basin. This law is in place so that residents of Oregon do not capture large amounts of rainwater for personal use as it is difficult to legally define who is entitled to rainwater that falls to the ground. Rainwater harvesting via rooftop systems is legal and does not require permits. Artificial impervious surfaces are also covered under these legal guidelines, but permits may be required to ensure compliance with local laws.

Rainwater harvesting that is pursued legally has many environmental benefits, including energy conservation. The benefits of collecting and re-using rainwater on site include decreasing stormwater runoff, preventing waste, and limiting the use of introduced water that needs to be pumped on site. Rainwater is safe to use as greywater. It is not approved as suitable for drinking but can be used to flush toilets, or for irrigation. Though rainwater is abundant in the Willamette Valley, it is not an unlimited resource and changes to rainfall patterns via climate change may impact supply levels.

4.3 CONCLUSION

Each region is in a different place in their support of net zero regulations for commercial-industrial development. Although the Willamette Valley's Metro agency has advanced a measurable standard and is beta testing it in 2022, Washington County is coming from behind with a new attitude towards growth, equity, and sustainability. The Rogue Valley region's City of Medford is just completing their comprehensive vision for balancing energy use and other competing needs, namely water. It may be years before an implementable plan follows this work. In the High Desert, the City of Bend has elected to lean into community feedback and has split their net zero so that the community-wide plan can move at a pace comfortable for residents, while the city moves forward with attending to City assets under a separate plan. At the State level, net zero ready design is now codified, but more work is required to make incremental net zero design solutions standard. Burdening developers with the cost of code or regulatory interpretation increases the cost of net zero development. While each region has moved at an independent pace, all have moved closer to net zero principles in their regulations. By assembling these stories of regulatory progress in this research, we hope that other regions and communities will find their way to net zero and include commercial-industrial development in their regulatory solutions.

5. Cultural and Political Climate

The fellowship team completed interviews and outreach with agencies responsible for development in the three regions to discuss barriers and opportunities to net zero design. Potential challenges affecting commercial-industrial development were shared from the local, cultural perspective. Four questions were asked in each interview:

- What kind of industrial development is happening in your region and work?
- What is the status of policy around energy and industrial development in your region?
- How did this evolve and what were the conversations leading to your current path?
- What are the concerns and challenges being voiced?

The fellowship team also cross-referenced published regulatory requirements with ‘in progress’ pre-legislative information obtained in the interviews.

5.1 WILLAMETTE VALLEY

WILLAMETTE VALLEY - WASHINGTON COUNTY SUMMARY

Development context: Technology sector growth

Recent policy movement: CPACE financing structure emerging

Barriers: Historically slow/no growth jurisdiction

Recommendations: Public Private Partnerships to move net zero development forward in commercial-industrial sectors

5.1.1 WASHINGTON COUNTY

To understand Washington County commercial-industrial development and related net zero regulatory requirements, the fellowship team conducted interviews with representatives from planning, sustainability, land use, and transportation department perspectives.

Development is happening in Washington County: it is fondly referred to as the “Silicon Forest.” Intel is likely the most well-known industrial development in the area, but there are several other businesses in every corner of the county: from warehouses to research and development facilities, to flex offices and high tech or biotech labs. There are also advanced manufacturing facilities, data centers and fiber hubs, plus all the infrastructure required to support these energy-intensive businesses. With renewed attention to rebuilding technology manufacturing in the United States, Washington County is well-positioned to grow[16].

Oregon state code is the leading policy for energy conservation and building requirements in the County. Washington County administrators are drafting new language to address their local energy footprint and have participated in Energy Trust’s Strategic Energy Management program since 2012. Commercial Property-Assessed Clean Energy (CPACE), a federal financing structure in which building owners borrow money for energy efficiency, renewable energy, or other projects and make repayments via an assessment on their property tax bill.

The County is a welcoming location for industrial development, and they are cautious to impede that progress and economic benefit to the region by implementing additional energy conservation requirements; they would prefer to incentivize energy-efficient developments. Many of the new industrial buildings are tilt-up concrete construction or simple pre-manufactured or pre-engineered metal buildings. The County would like to partner with developers and businesses, especially on land intensive sites, to seize opportunities for rooftop solar, stormwater management, and other intersections of sustainability and economics. The Washington County board recently adopted an Energy Management Policy, the first formalized policy of several smaller strategies, which will hopefully be the

[16] https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/

beginning of additional energy policy adoption. At this time, budget and resources are needed to enact and implement a full climate action plan, but the County seeks to align with the Federal goal of net zero by 2050.

The County is working on internal operational improvements that will support the community engagement necessary for successful Community Action Plan creation and implementation. The County is working closely with three other counties in the region to understand health vulnerability metrics in the community and to think strategically about next steps. Climate change conversations and energy policy are front and center for the County's Sustainability Program, Emergency Management Cooperative, and the newly formed Economic Development team. Each of these County groups are focused on how to be more proactive and resilient. Agencies across jurisdictions are talking about solutions and sharing their stories.

There is a two-headed challenge: (1) Bring more resources and information to the community and engage with marginalized people by recognizing and reducing barriers to community engagement, and (2) Secure financial resources to support a fully developed climate action plan. Washington County has historically operated on a very lean budget. The board of commissioners only recently became paid positions, and the first woman of color commissioner now serves her community. This has boosted equitable community representation. Access to grants, federal support, and other funding opportunities will allow Washington County staff to take community-endorsed energy conservation proposals to the board for approval. This will support growth in the area and the need to expand services and respond to community needs, a double win when leveraging CPACE. There is promise in Washington County conversations taking place around sustainability, and supportive policies are being made that are the beginning steps toward a net zero future in the area.

5.1.2 METRO REGIONAL GOVERNMENT

To understand how Metro is improving commercial-industrial development and developing net zero internal requirements, the fellowship team conducted interviews with Metro representatives from planning, project management, and sustainability group perspectives.

The Willamette Valley contains multiple counties, and one regional organization that does work in many of them is Metro. With a diverse portfolio, Metro manages the Oregon Zoo, Convention Centers, parks, waste and recycling facilities, and cemeteries in Washington, Yamhill, Multnomah, and Clackamas Counties. Of these varied project types, waste and recycling transfer stations and convention centers may be the most industry-centric building types. Metro recognizes that they have a variety of assets, and that typology matters because the net zero opportunities are different across asset types. In the coming years, there will be new transfer stations with anaerobic Waste-to-Energy processes (renewable gas), as well as additional energy efficiency upgrades and solar energy retrofits onto existing facilities of varying types.

Metro's current sustainability plan is to have an 80% emissions reduction across the organization by 2050. As the impacts of climate change are being seen and felt presently, they have determined that they need to be more aggressive and are currently targeting 100% emissions reduction by 2040. They are creating a Climate Task Force with each department across the agency represented and coordinated in their approach to sustainability policy and net zero improvements. They are looking to not only implement standards for their new buildings and upgrades, but also asking their contract holders (architects, construction teams, subconsultant

WILLAMETTE VALLEY - METRO REGIONAL GOVERNMENT SUMMARY

Development context: Internal Operations and Maintenance Assets plus vehicle to support net zero development in the North Willamette Valley counties

Recent policy movement: ILFI CORE Certification program for new developments

Barriers: Plan needed to address existing assets and energy consumption

Recommendations: Develop/ implement a modernization program for existing assets with emphasis on addressing local climate solutions groups, etc.) to implement the ILFI Core Green Building Certification℠ (Core) [17]. Being a regional organization, Metro is uniquely positioned to influence multiple communities with the example that their sustainability policy sets. They are working now to get their own policy revised and in order to bring other adjacent agencies into conversation and take a stronger leadership role within the region. The organization is looking at California to see how state climate policies are developed and implemented. There are conversations emerging about how to create and leverage a cross-jurisdiction climate policy.

Metro recognized the need for better water quality and conservation, energy conservation, and waste recovery within their properties. Upon reviewing the data around their existing sustainability policy, Metro realized that cost and size thresholds within the policy were too high to be applied to most of their projects. The intent was there, but the impact was not occurring at the level that it had been planned on or hoped for. This realization became a catalyst for the agency to take a deeper dive into their portfolio and reflect upon their policy, recent projects, regular maintenance and operations, and opportunities for improvement. This set the course for the creation of the Climate Task Force and new policy development.

Challenges for moving forward echo what we've heard from other areas and organizations: funding. For Metro, funding is piecemeal and diverse, often via bonds. Going forward, capital projects planning teams must account for the costs of these net zero policy efforts, such as ILFI CORE program, while also teaming with design partners and contractors to find cost savings through large-scale procurement and purchasing of standard materials required for net zero. For instance, negotiating a purchasing contract for solar panels could be modeled on current furniture procurement contracts where products and pricing are set. The organization is building alignment on a shared sense of principles across all departments while simultaneously engaging stakeholders through implementation. Stakeholder engagement will be addressed via the Climate Task Force and the organization will check in on the effectiveness and adjust as needed to be a regional leader for others to look to and follow.

5.2 ROGUE VALLEY

ROGUE VALLEY - CITY OF MEDFORD SUMMARY

Development context: Agricultural industrial developments

Recent policy movement: Adaption Plan emerging

Barriers: Water scarcity, illegal water/energy use enterprises, lack of power system redundancy, migrating industries due to climate change

Recommendations: Develop *Implementation Plan* to follow Adaption Plan and move net zero forward; aggressively seek out federal grants targeting net zero development and 'green' job creation

To understand Rogue Valley commercial-industrial development and related net zero regulatory requirements, the fellowship team conducted interviews with representatives from the City of Medford planning department and Medford Water Board.

Rich soils and an historically mild climate have attracted agricultural industry to the Rogue Valley area for over a century. Businesses such as Amy's Kitchen and Harry & David have benefitted from being close to this food packing hub. The timber industry was followed by valley orchards with vineyards trending in the past few decades. The latest formal arrival has been the marijuana industry.

In addition to concern for supporting the local agricultural industry through climate change, there are concerns emerging around the unintended consequences of marijuana legalization. Human trafficking, water rights violations, and crime have been on the rise. Illegal water draws from regional watersheds for marijuana production has put a strain on already stressed water and energy systems.

In support of local industry, the local chapter of the Small Business Administration (SBA) is active; Business Oregon has a strong presence too. Southern Oregon Economic Development, Inc. (SOREDI) has facilitated CARES Act funding

[17] https://living-future.org/core/

distribution and regularly works to make Rogue Valley a contender for business and infrastructure funding. At the state level, the Regional Solutions Team was established in 2014 to aid community and economic development (ORS 284.752). The Team recognizes the unique needs of each Oregon region, works locally to identify priorities, solves problems, and moves project opportunities forward. Most recently, HB 3000 was passed (2022) to move more funding to counties inequitably entrenched in illegal marijuana growing facilities, like Josephine County. Looking at energy specifically, the City of Medford has crafted a Climate Adaptation and Resiliency Plan (CARP) which addresses energy goals. It has not been adopted yet and implementation is not funded. Currently there are no government program funding communities seeking to develop their first climate or energy action plan. This means not only limited progress but also inconsistency in the plans that are developed.

Redundancy is a need for both water and energy. The energy footprint of water impacts the Medford area with the same intensity as energy itself. The need for reliable energy sources with redundancy is imperative and there is no easy solution for the area. The significance of this situation should not be overlooked. The water and energy risks and impacts that the Rogue Valley is experiencing is likely a harbinger for what other communities will face. Assisting them with solutions will benefit other communities. The first line of defense is to reduce energy consumption, which in this area means water consumption. Water is energy, according to Paula Melton of BuildingGreen[18]. She notes that, “Nationally, roughly 4% of total electricity use in the United States is for pumping and treating potable water and wastewater.” There are two public potable water fill stations in the area. One in Jackson County and another smaller station in the City of Medford. Wells turning dry or contaminated has long been an issue in the area. The droughts and new volume of consumption, legal or not, added to by the marijuana industry has pushed the water crisis to a new extreme. The Medford Water Board noted that in recent years Jackson County has come within one month of running out of potable water. This is evident in the Oregon Water Resources Department monitoring and reporting.

There are adaptation possibilities for changing Rogue Valley conditions. With the coming habitat migration due to climate change, the Medford area industrial employment opportunities will shift, specifically water dependent ones like agriculture. A statewide water project could balance needs and may be necessary, as no one county or water or energy district can solve this alone.

To address Southern Oregon energy challenges, larger multi-agency solutions are needed. Thinking at a systems level will create a path to solutions, but to fund and balance these solutions for equity, a state office must to step up to mediate. This includes water access, energy access, and access to a model plan for climate adaptation that is inclusive of energy goals and all development typologies. Currently this region’s experience is that net zero isn’t economical for all, especially in communities where potable water is not a given right. Looking forward, we know it isn’t an option to avoid energy conservation as part of our adaptation toolkit either. Thinking about commercial-industrial developments in this context, communities need these developments to be net zero facilities to provide long-term stable employment because facilities with low, managed operational costs have a better chance of long-term fiscal success.

[18] https://www.buildinggreen.com/primer/embodied-energy-tap-water

HIGH DESERT - CITY OF BEND SUMMARY

Development context: Limited commercial-industrial development as public agency expansion and resilience projects

Recent policy movement: Community and Public Agency action plans in implementation

Barriers: High residential growth and very low business growth create an imbalance in opportunity

Recommendations: Address all development types with regulations to include commercial-industrial public and private investments

5.3 HIGH DESERT

To understand how the high desert region is improving commercial-industrial development and developing net zero internal requirements, the fellowship team conducted interviews with representatives from the City of Bend planning and sustainability departments.

The high desert of Central Oregon is experiencing a population boom. Over the past decade the area has been popular with families and the recent pandemic has exacerbated the demand for housing. Recently, multifamily housing and single-family homes have come to the forefront of development. These recently acquired populations are unique: they work remotely. This has led to an imbalance of development types in this region; the housing to employment ratio is tipping steeply towards housing. Furthermore, private commercial-industrial development has been priced out of the area.

This means that commercial-industrial developments in the area are specifically in public works, e.g. transportation and infrastructure, as the city stretches to absorb and serve the newest housing units. One such facility is the Juniper Ridge Public Works Campus that will house utilities groups, engineering personnel, and fleet services.

Resilient energy and water systems are needed now. Over the next 5-10 years, infrastructure will continue to expand to fold in redundancies needed to ensure Bend's future. Threats to power distribution, like wildfire, have brought the state of the larger regional system to the table for residents and administrators. These projects include a new master plan for the water reclamation facility, a regional water resource recovery facility, and expanded water filtration facility. Each of these improvements will have energy and climate goals. Although policies and regulations are moving in a positive direction, more needs to be done. This may be where public-private partnerships yield faster change. Where public agencies can demonstrate and legislate, private businesses can replicate, exponentially changing the commercial-industrial development standard to net zero.

To define their community and City climate goals, Bend City Council voted to establish a new Environment and Climate Committee in 2020. The committee's primary focus is to provide input and recommendations to the City Council on topics related to environmental stewardship and oversee implementation of the Community Climate Action Plan, adopted in December of 2019. Separately, to attend to the City's development portfolio, a Strategic Energy Plan was proposed citing facilities and operations carbon neutrality for all City facilities by 2030.

There are no formal benchmarks when implementing the Strategic Energy Plan. Instead, all City projects are planned as net zero ready. An example of this is the future Juniper Ridge Public Works Campus. This project benefits from planning: Expectations for energy were known upfront and included in the solicitation for design and construction. The hope is that by tracking the Juniper Ridge Campus progress, the experience will parlay into a possible green building standard that would become available across the City. As the project matures, participants will first uncover what kind of building they want to build then set sustainability goals. This will establish the functional needs before sustainability goals and may result in the use of sustainability certification programs to align development with the Plans. Simultaneously, the community is encouraged to participate by piloting energy conservation measures on their homes and businesses, such as solar arrays.

Bend plan developers have prioritized communicating to the community that their needs are being met first. Alignment with larger sustainability industry benchmarks

STORY OF THE BEND COMMUNITY ACTION PLAN

- The plan began as a grassroots community uprising; non-profits pushed the agenda and learned how to grow broader support.
- Organized campaigning led to demand for action at the local level.
- 2016: The Community Action Plan passed city council, however, as a 4:3 resolution support needed to grow.
- The resolution was in soft language to begin building broad support and space for others to weigh-in.
- Uncertainty emerged about who would be implementing the climate action plan: the non-profit or the city?
- 2018: A Partners for Places grant allowed for this to be addressed over the next two years and hiring a Sustainability Coordinator.
- 2018: The Plan established an Environment and Climate Committee made up of citizens.
- 2019: When Bend City Council passed the plan 5:2, it was enough to keep moving with mixed support.
- It was key to not ask for resources immediately and save that for future budget cycles and specific projects.
- Leadership evolved: New, progressive members of council who favored this work replaced those against the plans.
- Now, a committee of community members makes the plan recommendations to city council, giving the pace of progress over to the citizens.

follow the functional needs. This gives the community and stakeholders confidence that resources are being spent wisely.

The Urban Sustainability Directors Network received a grant through the Partners for Places program specifically for climate action planning, and large sustainability projects. The grant program is place-based and required (1) a community connection and, (2) a non-profit community partnership in leadership for the grant application to be successful. This two-year, $150,000 grant helped the City of Bend hire staff to conduct community engagement and develop the plan, allowing time for residents to buy in before implementation began

Following the Bend Community Action Plan story, shows how growing grassroots and leadership support eases change required to implement a Climate Action Plan and can move net zero design forward. The biggest risk is the financial pressure. Budgets are finite. Scrutiny over how assets are used and resources spent, is best ameliorated by proven project success.

5.4 CONCLUSION

We consistently heard from each region that public and private commercial-industrial development budgets can hardly accommodate moderate energy efficiency in their projects, so they can't reasonably be expected to stretch to cover costs associated with net zero design. Climate data shows that designing for energy and climate is essential to functionality and livability as regional climate conditions continue to shift. The costs to respond to the climate crisis are increasing and there is efficiency and cost benefit to planning on net zero or net zero ready instead of going back to retrofit our infrastructure. There is economic value, both in building assets and job creation, to expanding net zero commercial-industrial developments now. In addition to suggesting peer State of Oregon agencies connect and share their net zero stories, regional recommendations to achieve climate resilience associated with net zero design for commercial-industrial developments include:

Willamette Valley

- Public private partnerships to move net zero development forward in commercial-industrial sectors
- Develop and implement a modernization program for existing assets with emphasis on addressing local climate solutions

Rogue Valley

- Further develop the Implementation Plan to follow the Adoption Plan to move towards net zero
- Identify and utilize federal grants that target net zero development and 'green' job creation

High Desert

Address all development types with regulations to include commercial-industrial public and private investments, and public-private development

Public agencies are well-positioned to lead the way in energy use requirements for net zero commercial-industrial development. Because each region is comprised of many jurisdictions, we need common state-wide net zero and energy conservation leadership to move commercial-industrial development into all codes and out of exclusions and appeals language.

Our current energy efficiency code is a start, but for all to reach that code expectation and develop equitably, we need to find a way to breach regional code, regulation, cultural, political, and fiscal barriers. Connecting public agencies to each other through stories, lessons learned, and themes of different paths to net zero development regulations will help remove barriers to implementation of recommendations. Additionally, direct state-wide support to engage directly with communities and agencies may be the best way forward.

6. Conclusion

This report identifies the climate and cultural conditions in three Oregon regions that influence the potential for net zero design in commercial-industrial development. While a top-down State mandate for net zero ready is in place for 2022, we must support agencies and communities equitably in achieving this goal. As an accessible, consolidated resource on emerging Oregon code standards and the environmental conditions of the Willamette Valley, Rogue Valley, and High Desert, this report only begins to advance the conversation about what it takes to get to commercial-industrial development net zero design. We hope to inform many more conversations across Oregon about how to support higher performance in this area of development and for the design guide to provide a basis for design decisions that prioritize energy efficiency.

In the Willamette Valley, cultural and political climates vary greatly across the region. Bringing commercial-industrial development into the fold of regulation and resources in an area where this ranges from private semiconductor manufacturers to parks operation and maintenance facilities can seem daunting. Solutions can be found in climate-based design, shared regional experiences, and aligned regulatory development requirements. Campus or neighborhood scale net zero infrastructure will be required to affordably capture energy savings, and City or Regional leadership is needed.

The Willamette Valley has multiple counties, and currently, for the energy-intensive businesses across Washington County, we are seeing the need to bring more resources and information to the community, engage with marginalized people, and reduce barriers to community engagement. Similarly, we find as existing policies and regulations move towards net zero design, a struggle for funding leads to an equity and social justice crisis.

In the Rogue Valley, cultural and political views are more homogenous but need multi-agency support to achieve implementation. Each county in this region is separated by wealth disparity and local struggles with potable water access, adequate law enforcement and a climate migration future that will threaten jobs and the regional identity. Solutions and resources must be brought from outside the region to attain a sustainable, net zero path forward. That means state and federal agencies and non-profits will be part of the solution, especially to augment staffing so that grants, loans, and other funding sources may be pursued.

The Medford Area of the Rogue Valley is at the forefront of the energy footprint of water impacts from the booming legalized marijuana industry and new residents. Water access, energy access, and access to a model plan for climate adaptation that is inclusive of energy goals and all development typologies are imperative. Otherwise, only those who can afford the available resources will have access to them.

The High Desert has been struck by growth only possible in the age of technology: the remote worker. Demand for residential construction has boomed and with it the need for infrastructure expansion. Commercial-industrial development is the infrastructure solution needed: water treatment, wastewater treatment, and recycled water to meet the growing population's demands.

Although policies and regulations are moving in a positive direction, more must be done. We have learned through this research and our regional partners' compelling testimony that our regional climate context is linked not just to development but to livelihoods and identity.

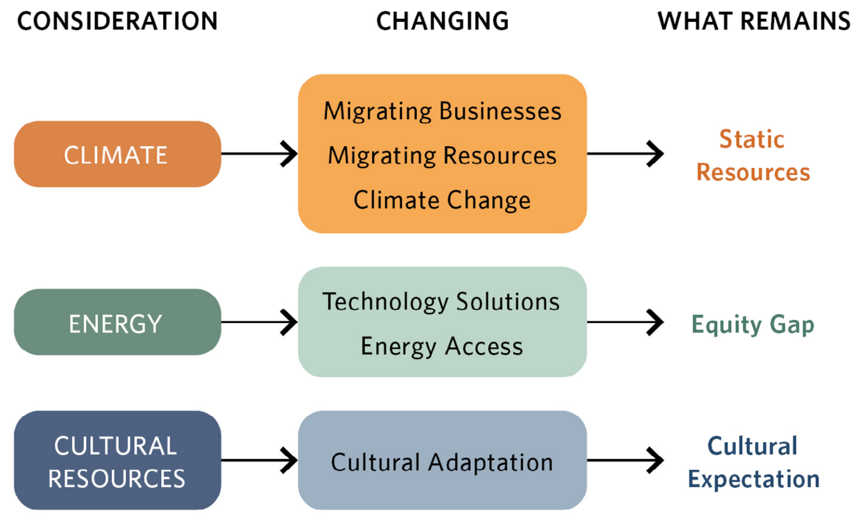

FIGURE 13 WHAT'S TO COME

Finally, the most difficult change of all: cultural and political context. A population boom like the one in Bend can lead to an imbalance of development types, and private commercial-industrial growth can be priced out of the area. Where our culture and politics are wrapped up in our environment and perceived wealth, we must manage expectations to get to our new reality. Otherwise, this is what's to come (Figure 13).

The complexities of various regional areas include climate conditions, economic circumstances, energy resources, cultural identities, and more. While some of these issues have been identified in this Research Report, it would be impossible to fully synthesize and summarize the challenges ahead of us in a single document. Many factors are pressing on our commercial-industrial developments and land, despite the critical importance of infrastructure, employment, and energy conservation. Transitioning to net zero commercial-industrial development is of utmost importance and it is the fellowship team's hope that policy makers, public agencies, and architectural design firms will use the information provided here to work collaboratively to implement the recommendations of both the Research Report and the Design Guide.

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2. Case Studies and Resources

Energy Trust of Oregon – Path to net Zero Projects Case Studies

The Energy Trust of Oregon Path to net zero project case studies focus on strategies towards net zero projects.

International Living Futures Institute – Zero Energy Case Studies

United States Department of Energy, Office of Energy Efficiency and Renewable Energy – Zero Energy Buildings Case Studies

American Institute of Architects (AIA) Framework for Design Excellence