The Power of Oregon Prison Gardens

Agrivoltaics at Warner Creek Correctional Facility

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Landscape Architecture
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Project Overview

Research has shown that there are many physical and mental benefits from having gardens in prison. Gardens provide Adults in Custody (AICs) the opportunity to connect with nature, learn new skills, build relationships, and access fresh healthy food, among many other benefits. With the introduction of renewable energy to an existing prison garden, this project explores how solar panels can expand the current benefits of the existing prison garden at Warner Creek Correctional Facility. Through a literature review, case study analysis, and site visits, this research proposes a new site for agrivoltaic implementation which overlaps with Oregon Department of Corrections Sustainability Plan. Although landscape architects cannot solve issues of mass incarceration or climate change alone, they can help promote renewable energy to maximize mutual benefits to increase land use efficiency, improve the human experience of incarceration, and address food security inside prison.

Acknowledgements

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Context

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Mass Incarceration

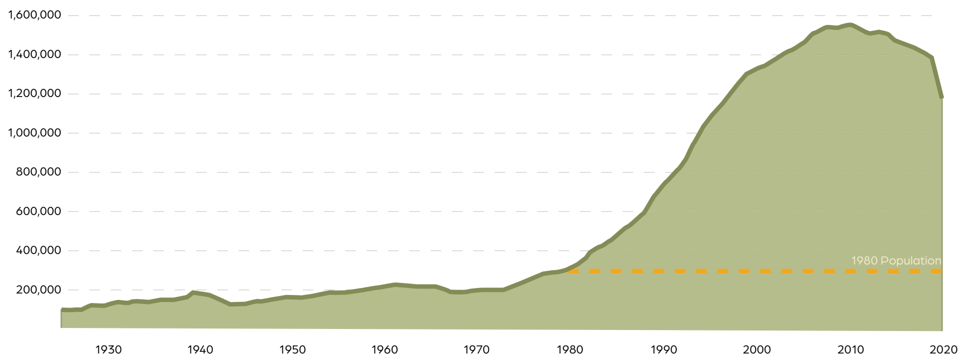
The U.S. currently has 1.8 million people incarcerated which is the largest incarcerated population anywhere in the world. Beginning in the late 1970s there was an exponential increase in people incarcerated due to shifts in policy such as mandatory minimums which required lengthy prison sentences. In Oregon, there are approximately 13 thousand people in the prison system which contributes to the overall 32 thousand people that are in jail, prison, or on probation or parole. Although there has been a recent small decline in the number of people incarcerated, the effects of mass incarceration will still be felt for many decades to come.

Diagram (Top Right)
Source: *https://www.prisonpolicy.org/profiles/OR.html*

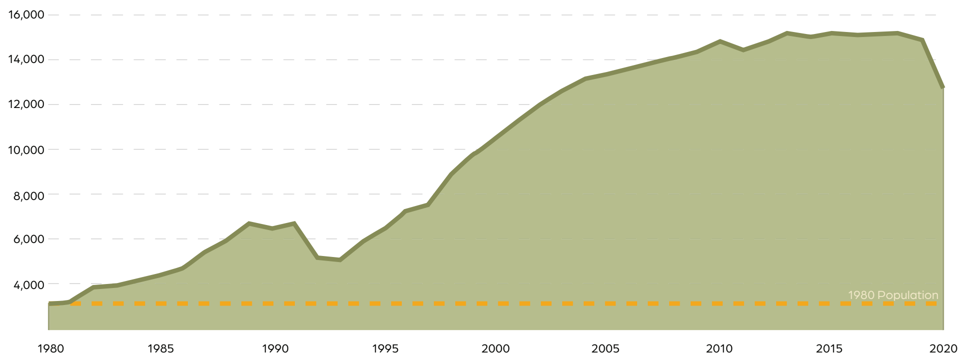
Graphs (Bottom Right)
Source: *sentancingproject.org*

U.S. Prison Population Compared to World

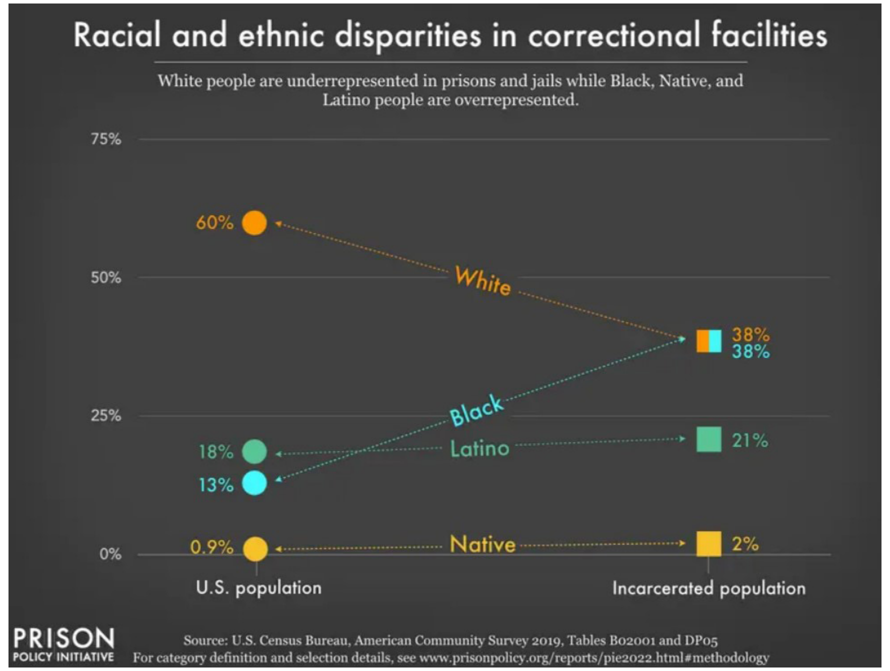
United States Prison Population (1925–2020)



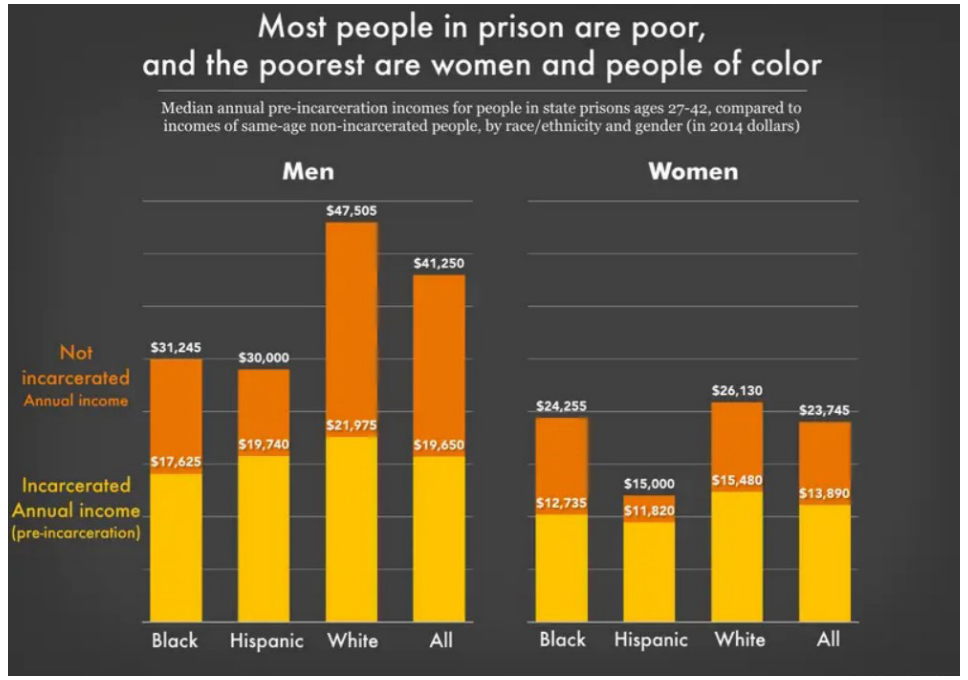
Oregon Prison Population (1980–2020)



Racial and Ethnic Disparities in Correctional Facilities



Correlation of Incarcerated People and Poverty



Inequity of Incarcerated People

The issue of mass incarceration is not an issue that is felt equally amongst our population. Communities of color have been disproportionately affected by the prison system. In Oregon, Black people are five times more likely to be incarcerated than any other race. Moreover, studies have shown a strong correlation between those who are incarcerated and people that are in poverty.

Diagrams (Left)
Source: *https://www.prisonpolicy.org/profiles/OR.html*

Life in Prison

Daily life in prison is rigid and ruled by mundane routine, policy, and procedure to ensure safety. The environment is often harsh, sterile, confined, and lacking in privacy. AICs have a lack of autonomy, and it can be difficult to remain hopeful especially when serving life sentences. Often there is very limited time allowed for recreation or access to nature. All of these things can contribute to AICs experiencing declining mental and or physical health conditions.

Collage (Left)
Created By: *Mikayla McKone*

Example Prison Meal

Breakfast

Lunch

Dinner

Food in Prison

The American prison system feeds almost 2 million inmates a full three meals per day on around two to four dollars" (Camplin, 2016). Often, prisons use tactics to cut costs such as buying predominantly flash frozen food or using the "re-rack" system in which uneaten food is frozen and reserved later in the week. Thus, inmates rarely have access to fresh fruits and vegetables.

Nutraloaf is the quintessential example of cheap, easy, and the bare minimum; it really embodies the phrase "food as punishment". There is no "universal recipe", but essentially it is leftover food that is mashed together and then baked. Nutraloaf, also called disciplinary loaf, is "intended to be void of flavor, and therefore any notion of pleasure" (Camplin, 2016).

Nutraloaf

"Food's value [in prison] is based on two things: the void (or lack of enough) and the lack of choice"

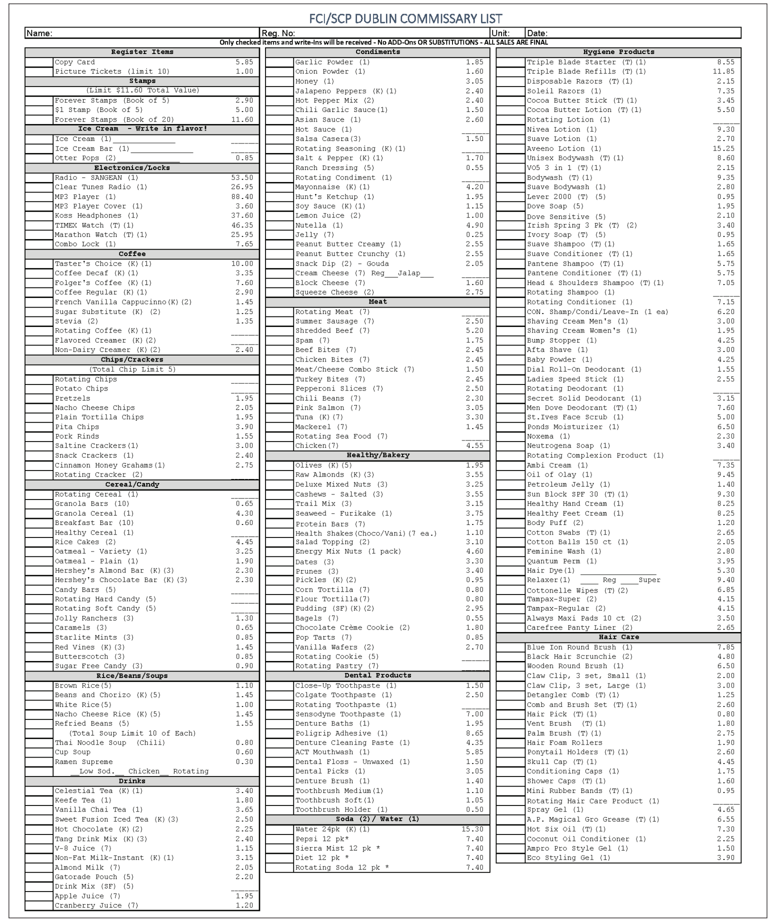
\- Erika Camplin

Images (Left)
Source: *https://www.themarshallproject.org/2015/07/07/what-s-in-a-prison-meal*

Image (Right)
Source: *https://poststar.com/nutriloaf/image_e6a3fec0-4405-526c-b773-b47c8e677c00.html*

Commissary

Example of Commissary Items and Prices for FCI (Dublin, CA)



FCI/SCP DUBLIN COMMISSARY LIST

Name: | Reg. No: | Unit: | Date:

Only checked items and write-Ins will be received - No ADD-Ons OR SUBSTITUTIONS - ALL SALES ARE FINAL

Register Items	
Copy Card	5.85
Picture Tickets (limit 10)	1.00
Stamps	
(Limit $11.60 Total Value)	
Forever Stamps (Book of 5)	2.90
$1 Stamp (Book of 5)	5.00
Forever Stamps (Book of 20)	11.60
Ice Cream - Write in flavor!	
Ice Cream (1)______	______
Ice Cream Bar (1)______	______
Otter Pops (2)______	0.85
Electronics/Locks	
Radio - SANGEAN (1)	53.50
Clear Tunes Radio (1)	26.95
MP3 Player (1)	88.40
MP3 Player Cover (1)	3.60
Koss Headphones (1)	37.60
TIMEX Watch (T)(1)	46.35
Marathon Watch (T)(1)	25.95
Combo Lock (1)	7.65
Coffee	
Taster's Choice (K)(1)	10.00
Coffee Decaf (K)(1)	3.35
Folger's Coffee (K)(1)	7.60
Coffee Regular (K)(1)	2.90
French Vanilla Cappucinno(K)(2)	1.45
Sugar Substitute (K) (2)	1.25
Stevia (2)	1.35
Rotating Coffee (K)(1)	______
Flavored Creamer (K)(2)	______
Non-Dairy Creamer (K)(2)	2.40
Chips/Crackers	
(Total Chip Limit 5)	
Rotating Chips	______
Potato Chips	______
Pretzels	1.95
Nacho Cheese Chips	2.05
Plain Tortilla Chips	1.95
Pita Chips	3.90
Pork Rinds	1.55
Saltine Crackers(1)	3.00
Snack Crackers (1)	2.40
Cinnamon Honey Grahams(1)	2.75
Rotating Cracker (2)	______
Cereal/Candy	
Rotating Cereal (1)	______
Granola Bars (10)	0.65
Granola Cereal (1)	4.30
Breakfast Bar (10)	0.60
Healthy Cereal (1)	______
Rice Cakes (2)	4.45
Oatmeal - Variety (1)	3.25
Oatmeal - Plain (1)	1.90
Hershey's Almond Bar (K)(3)	2.30
Hershey's Chocolate Bar (K)(3)	2.30
Candy Bars (5)	______
Rotating Hard Candy (5)	______
Rotating Soft Candy (5)	______
Jolly Ranchers (3)	1.30
Caramels (3)	0.65
Starlite Mints (3)	0.85
Red Vines (K)(3)	1.45
Butterscotch (3)	0.85
Sugar Free Candy (3)	0.90
Rice/Beans/Soups	
Brown Rice(5)	1.10
Beans and Chorizo (K)(5)	1.45
White Rice(5)	1.00
Nacho Cheese Rice (K)(5)	1.45
Refried Beans (5)	1.55
(Total Soup Limit 10 of Each)	
Thai Noodle Soup (Chili)	0.80
Cup Soup	0.60
Ramen Supreme	0.30
__Low Sod.__ Chicken__ Rotating	
Drinks	
Celestial Tea (K)(1)	3.40
Keefe Tea (1)	1.80
Vanilla Chai Tea (1)	3.65
Sweet Fusion Iced Tea (K)(3)	2.50
Hot Chocolate (K)(2)	2.25
Tang Drink Mix (K)(3)	2.40
V-8 Juice (7)	1.15
Non-Fat Milk-Instant (K)(1)	3.15
Almond Milk (7)	2.05
Gatorade Pouch (5)	2.20
Drink Mix (SF) (5)	______
Apple Juice (7)	1.95
Cranberry Juice (7)	1.20

Condiments	
Garlic Powder (1)	1.85
Onion Powder (1)	1.60
Honey (1)	3.05
Jalapeno Peppers (K)(1)	2.40
Hot Pepper Mix (2)	2.40
Chili Garlic Sauce(1)	1.50
Asian Sauce (1)	2.60
Hot Sauce (1)	______
Salsa Casera(3)	1.50
Rotating Seasoning (K)(1)	______
Salt & Pepper (K)(1)	1.70
Ranch Dressing (5)	0.55
Rotating Condiment (1)	______
Mayonnaise (K)(1)	4.20
Hunt's Ketchup (1)	1.95
Soy Sauce (K)(1)	1.15
Lemon Juice (2)	1.00
Nutella (1)	4.90
Jelly (7)	0.25
Peanut Butter Creamy (1)	2.55
Peanut Butter Crunchy (1)	2.55
Snack Dip (2) - Gouda	2.05
Cream Cheese (7) Reg___Jalap___	______
Block Cheese (7)	1.60
Squeeze Cheese (2)	2.75
Meat	
Rotating Meat (7)	______
Summer Sausage (7)	2.50
Shredded Beef (7)	5.20
Spam (7)	1.75
Beef Bites (7)	2.45
Chicken Bites (7)	2.45
Meat/Cheese Combo Stick (7)	1.50
Turkey Bites (7)	2.45
Pepperoni Slices (7)	2.50
Chili Beans (7)	2.30
Pink Salmon (7)	3.05
Tuna (K)(7)	3.30
Mackerel (7)	1.45
Rotating Sea Food (7)	______
Chicken(7)	4.55
Healthy/Bakery	
Olives (K)(5)	1.95
Raw Almonds (K)(3)	3.55
Deluxe Mixed Nuts (3)	3.25
Cashews - Salted (3)	3.55
Trail Mix (3)	3.15
Seaweed - Furikake (1)	3.75
Protein Bars (7)	1.75
Health Shakes(Choco/Vani)(7 ea.)	1.10
Salad Topping (2)	3.10
Energy Mix Nuts (1 pack)	4.60
Dates (3)	3.30
Prunes (3)	3.40
Pickles (K)(2)	0.95
Corn Tortilla (7)	0.80
Flour Tortilla(7)	0.80
Pudding (SF)(K)(2)	2.95
Bagels (7)	0.55
Chocolate Crème Cookie (2)	1.80
Pop Tarts (7)	0.85
Vanilla Wafers (2)	2.70
Rotating Cookie (5)	______
Rotating Pastry (7)	______
Dental Products	
Close-Up Toothpaste (1)	1.50
Colgate Toothpaste (1)	2.50
Rotating Toothpaste (1)	______
Sensodyne Toothpaste (1)	7.00
Denture Baths (1)	1.95
Poligrip Adhesive (1)	8.65
Denture Cleaning Paste (1)	4.35
ACT Mouthwash (1)	5.85
Dental Floss - Unwaxed (1)	1.50
Dental Picks (1)	3.05
Denture Brush (1)	1.40
Toothbrush Medium(1)	1.10
Toothbrush Soft(1)	1.05
Toothbrush Holder (1)	0.50
Soda (2)/ Water (1)	
Water 24pk (K)(1)	15.30
Pepsi 12 pk*	7.40
Sierra Mist 12 pk *	7.40
Diet 12 pk *	7.40
Rotating Soda 12 pk *	7.40

Hygiene Products

[illegible]

Most institutions follow nutritional standards set by the Bureau of Prisons; however, there is not a set standard for nutritional guidelines for all correctional facilities in the United States. Typically, a menu is created which rotates every six weeks, and usually only fulfills the bare minimum nutritional requirements. Diets are often high in carbs and sodium which can lead to increased health risks.

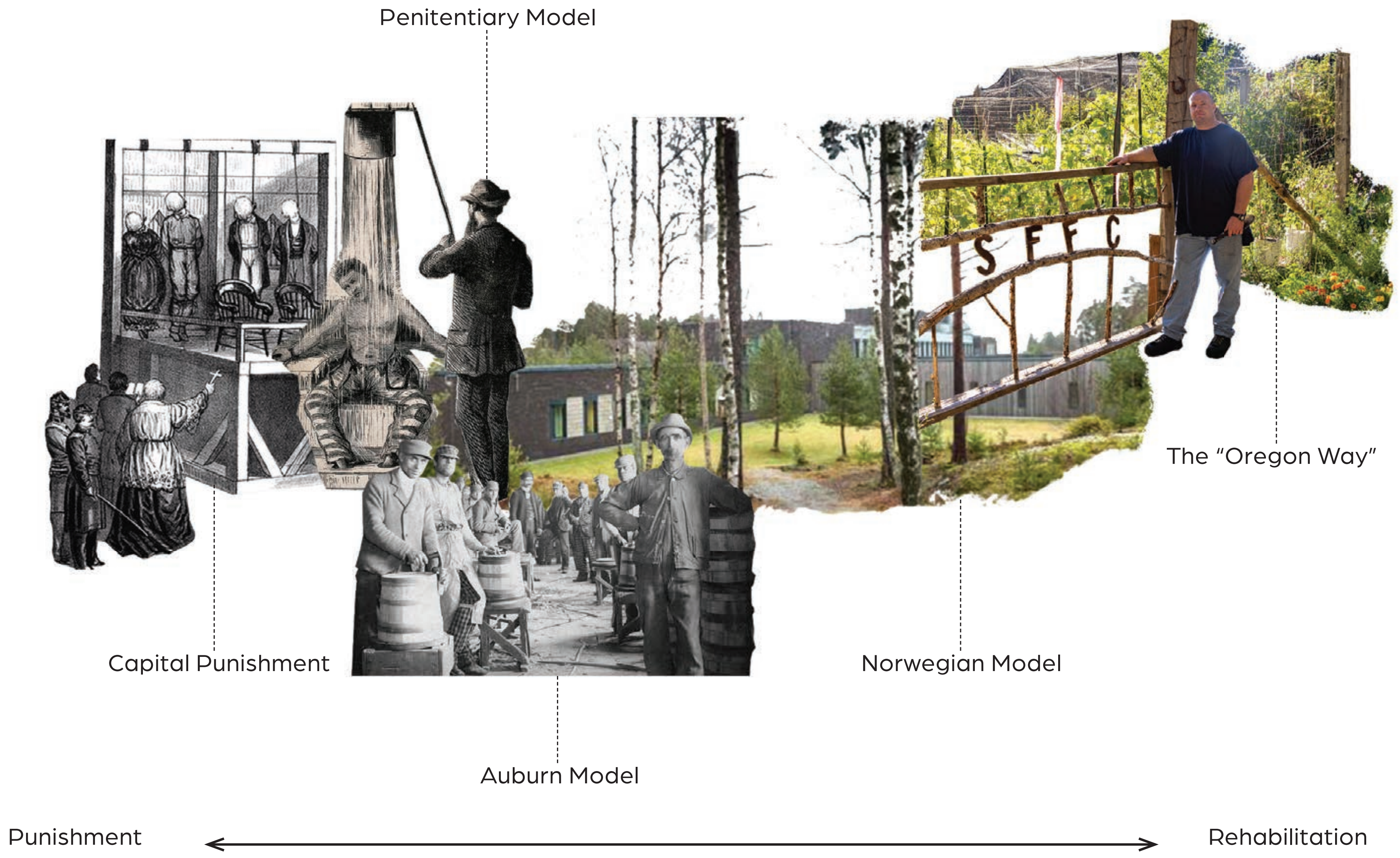
Commissary is vital to life inside because it allows inmates the opportunity to supplement their diets from what is provided and is a way for them to "express individuality and creativity as sort of a rebellion from the rigid existence within prison" (Camplin, 2016). For example, inmates will pool their resources of items bought from commissary together to create "spreads" to celebrate special occasions.

Images (Left)
Source: *https://www.bop.gov/locations/institutions/dub/*

Image (Right)
Created by: *Mikayla McKone*

Collage of Common Commissary Food Items

Prison Model Spectrum



What is the Purpose of Prison?

For centuries, capital punishment or torture were used to deal with lawbreakers. However, in the 18th century, Quakers created the Penitentiary Model which confined inmates to their cells to allow them to reflect on their moral failings as penance. In the early 1800s, the Auburn Prison Model was introduced which allowed inmates to leave their cells daily to perform hard labor.

The Norwegian Prison Model, developed in the 1990s, is one that is highly renowned and often referenced as a way that prison can be a space to rehabilitate people to rejoin society. They have significantly shorter sentences and try to allow inmates to live as "normal" of lives as possible while they serve their sentence. In Norway, they view the loss of freedom as the punishment. This means that inmates are able to still cook their own meals, recreate as they please, and have regular family visits.

Collage (Left)
Created By: *Mikayla McKone*

The Oregon Department of Corrections has begun to adapt principles of the Norwegian Model into what they call "the Oregon Way" which prioritizes employee and AICs' health and wellbeing to improve incarceration outcomes.

Vocational Training + Recidivism

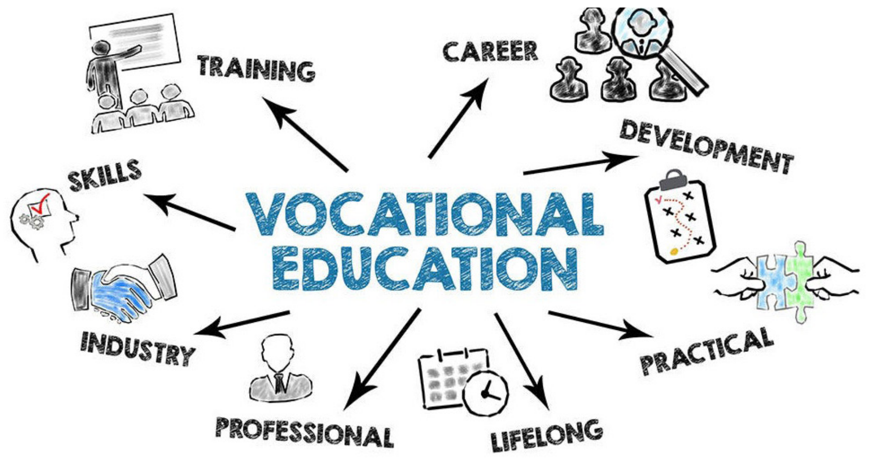
Vocational training programs are a critical component for rehabilitation efforts in prison. Often, these skill-based programs set AICs up for success in employment when they are released from prison. These programs give AICs goals to work towards and help bring positive meaning to their time spent incarcerated.

A commonly used metric for the success of these programs is to compare the recidivism rates of their participants to AICs who did not participate in those programs. Recidivism refers to the arrest and conviction of someone three years or less after they had previously been arrested or released from incarceration. In Oregon, the recidivism rate is around 40% for those who are convicted of a new crime with about 20% of those convictions leading to reincarceration. The recidivism is drastically lowered, to 4%, for AICs who participated in the prison garden program.

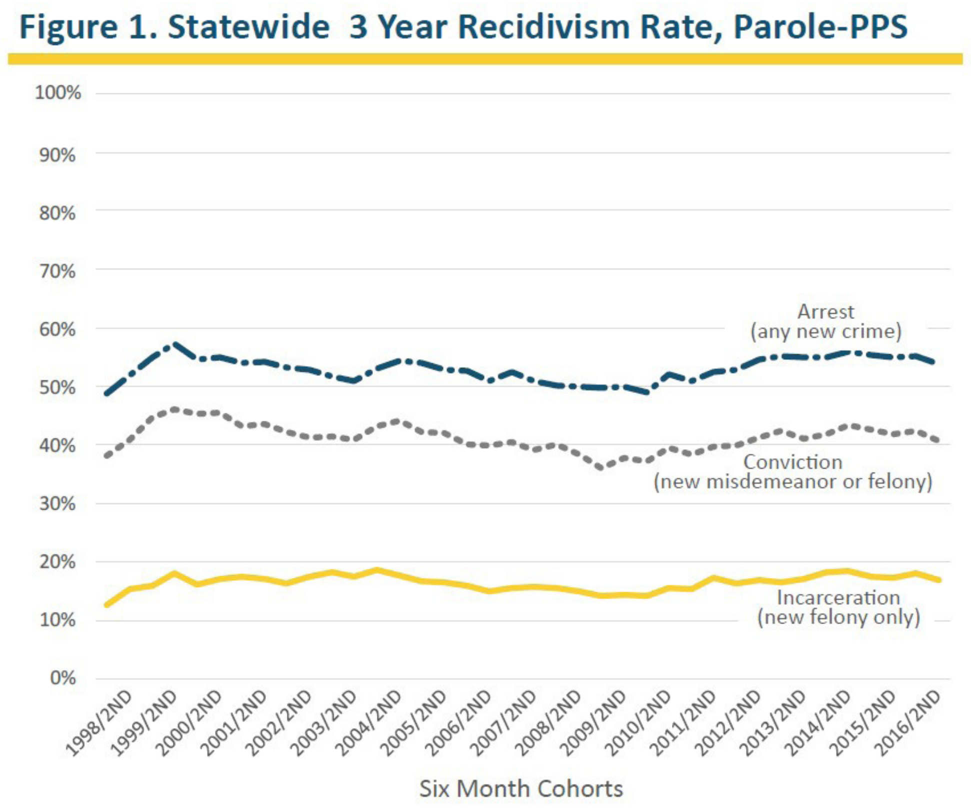
Diagram (Top Right)
Source: *https://medium.com/@rananiki720/vocational-education-6f2a9208735e*

Graph (Bottom Right)
Source: *McAlister et al. (2020)*

Vocational Education Diagram



Oregon Recidivism Rates



Prison Gardens

One popular vocational training program used in several correctional facilities across the country is prison garden programs. Many benefits have been documented through research for the implementation of prison gardens such as reduced recidivism of participants, increases in fresh healthy produce, and increased access to nature. However, some of the benefits are more qualitative such as feelings of tranquility, improved self-worth, and improved relationships.

Diagram (Right)
Created By: *Mikayla McKone*

Background Image Source: *https://education.ucdavis.edu/ccs-in-sight-garden-program*

Benefits of Prison Gardens:

Prison Garden Precedents

The first prison garden program in the United States was started at Rikers Island in 1997 in partnership with the Horticultural Society of New York. It has been very successful with a 40% lower recidivism rate than the general prison population.

Another well-known prison garden is the Insight Garden Program in California. As part of the IGP program, inmates also participate in therapy work alongside working with plants. This program has had great success and has even been implemented in a couple other states.

In Oregon, the nonprofit group Growing Gardens has implemented gardens in all 12 correctional facilities in the state. Each of these precedents provides AICs with hands on experience in the garden and the food grown is used directly in the prison's kitchen.

Images (Right)
New York Source: *https://gardencollage.com/change/environmental-justice/inside-rikers-island-prison-garden/*

California Source: *https://i1.wp.com/insightgardenprogram.org/wp-content/uploads/2021/10/SQ-garden-implementation1.jpg*

Oregon Source: *https://rootsofsuccess.org/new-hope-for-women-in-an-oregon-correctional-facility/*

New York

California

Oregon

Oregon DOC Sustainability in Prison Project

In 2012, the Oregon DOC joined the Sustainability in Prisons Project (SPP). SPP was founded through a partnership between the Evergreen State College and the Washington Department of Corrections to address the issues of both environmental degradation and mass incarceration. Their projects include bringing nature into prisons, conservation efforts, educational programing for AICs, and evaluating how the prisons operations can be more sustainable. Overall, the goals of their program is to "reduce the environmental, economic, and human costs of prisons" (Sustainability in Prisons Project, 2024).

Oregon DOC released a 5-year sustainability plan as part of its participation in the SPP. This document detailed several short term and long term goals, some of which I've selected to highlight (page right) the relevance of my project.

Diagram (Left)
Source: *Oregon Department of Corrections Sustainability Plan (2017-2022). (2018)*
Modified By: *Mikayla McKone*

Image Cover (Right):
Source: *Oregon Department of Corrections Sustainability Plan (2017-2022). (2018)*

<u>Short Term Goals</u>

•Expand sustainable gardening classes to 10 facilities + provide volunteers to facilitate the programs

•Increase sustainability jobs to all facilities and have reentry job placement

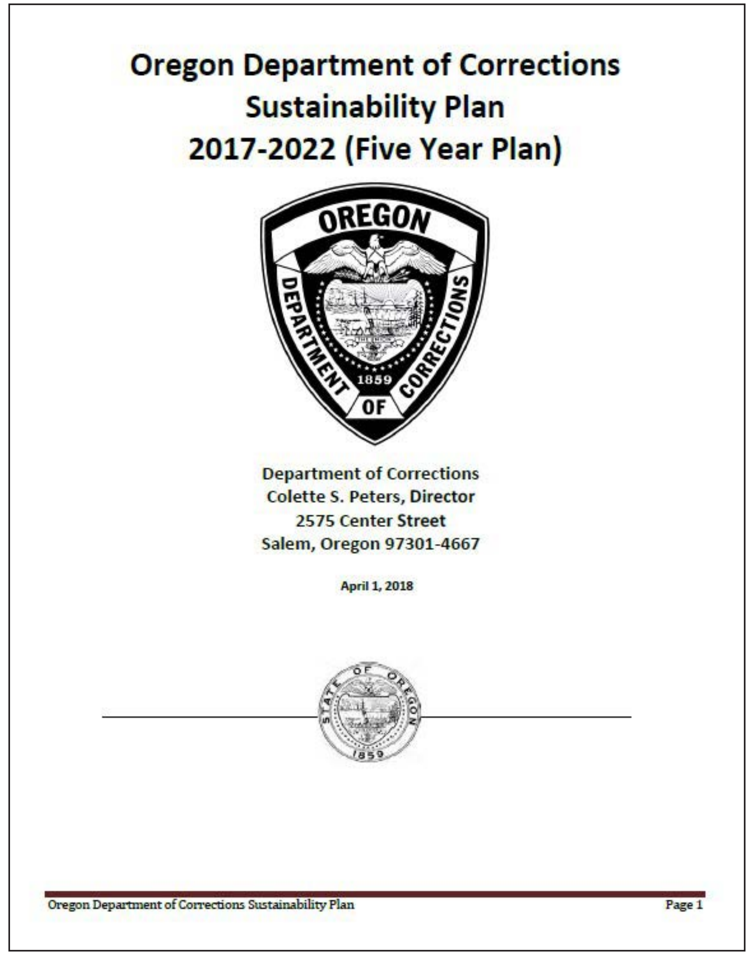
•Five hundred acres of farmland in production with non-profits to donate 75% of produce to food banks

<u>Long Term Goals</u>

•Decrease water consumption by having facility landscaping be 50% native drought tolerant plants

•Have solar panels installed at two facilities

•Reduce GHG emissions to 75% below 1990 levels by 2050


Oregon Department of Corrections
Sustainability Plan
2017-2022 (Five Year Plan)

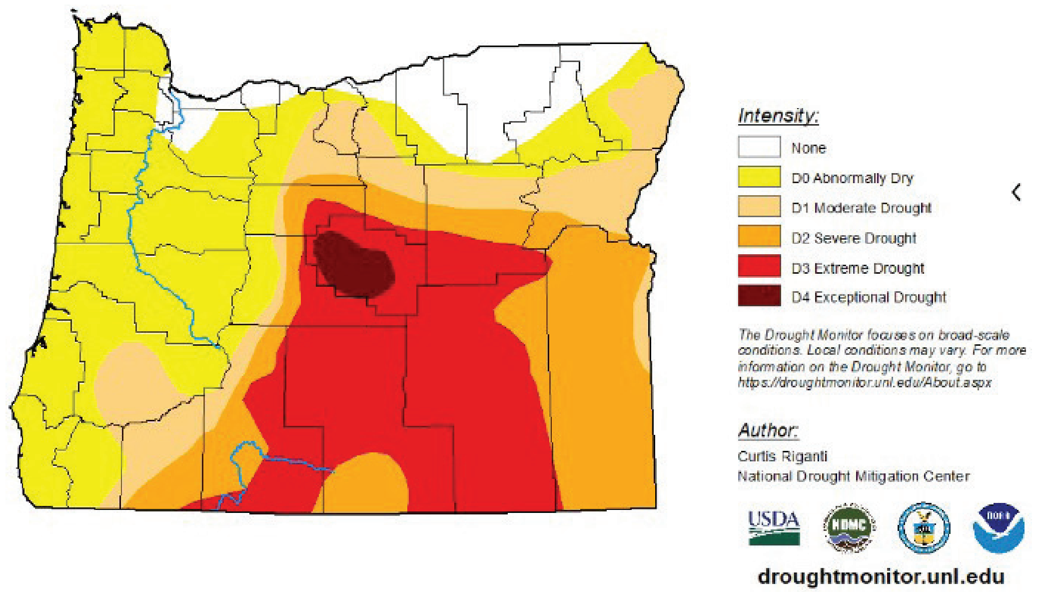
Department of Corrections
Colette S. Peters, Director
2575 Center Street
Salem, Oregon 97301-4667

April 1, 2018

Oregon Department of Corrections Sustainability Plan — Page 1

Climate Change

U.S. Drought Monitor: Oregon (12.13.22)



News Headlines of Climate Change

https://www.koin.com/news/oregon/climate-report-says-extreme-weather-events-stress-pnw-communities-industries/

https://www.opb.org/article/2023/05/29/forecasters-worried-about-extended-oregon-fire-season/

https://www.koin.com/news/oregon/how-oregon-counties-have-seen-rising-temperatures-in-the-last-100-years/

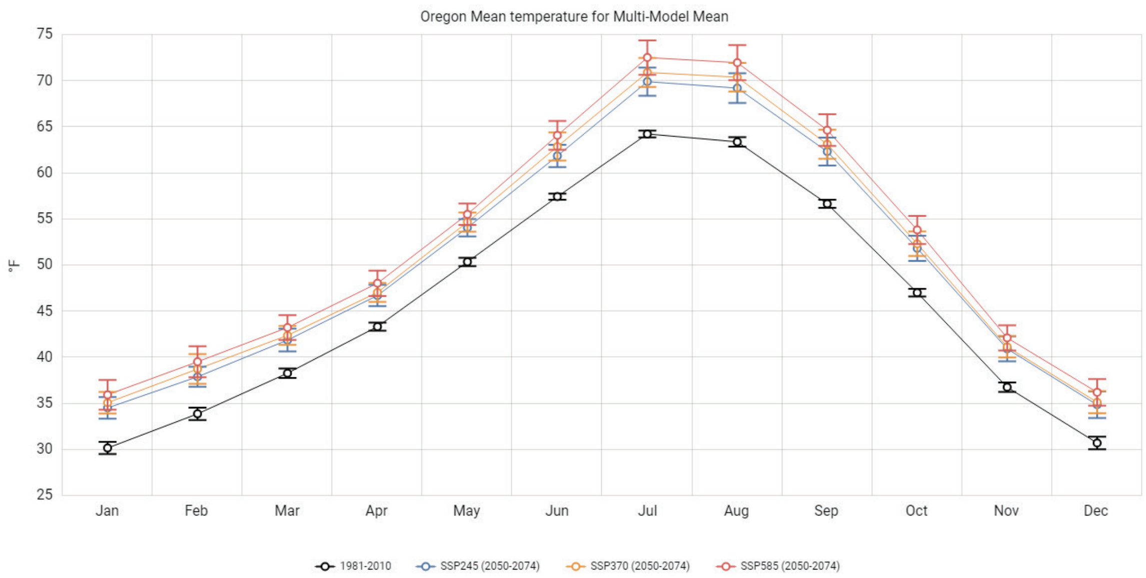
Many of the goals listed in the Oregon DOC Sustainability Plan are a direct result of efforts to mitigate and adapt to climate change and severe weather. In the past decade, Oregon has experienced some of the hottest and driest conditions, especially in the central and eastern parts of the state. Several projections have indicated a likely annual rise in mean temperature for Oregon of about 5-6 degrees Fahrenheit. Southern and Eastern Oregon are naturally the drier parts of the state which means they are especially susceptible to drought. These changing conditions can be particularly problematic for growing seasons and irrigation for farming and gardens across the state.

Drought Map (Left)
Source: *droughtmonitor.unl.edu*

Headlines (Left)
Source: *Listed below photos*

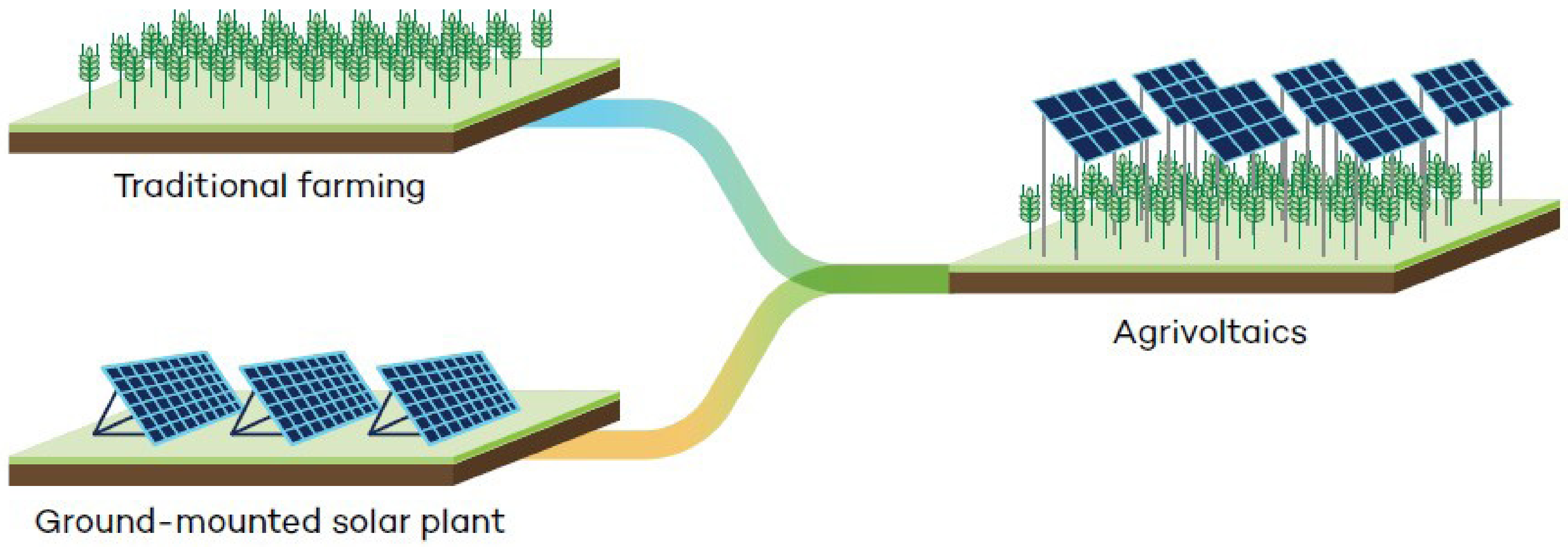
Graph (Right)
Source: *https://apps.usgs.gov/nccv/loca2/nccv2_loca2_counties.html*

Projections of Increasing Mean Temperature in Oregon



“Agri-” *relating to food production*

“-Voltaics” *relating to solar energy production*



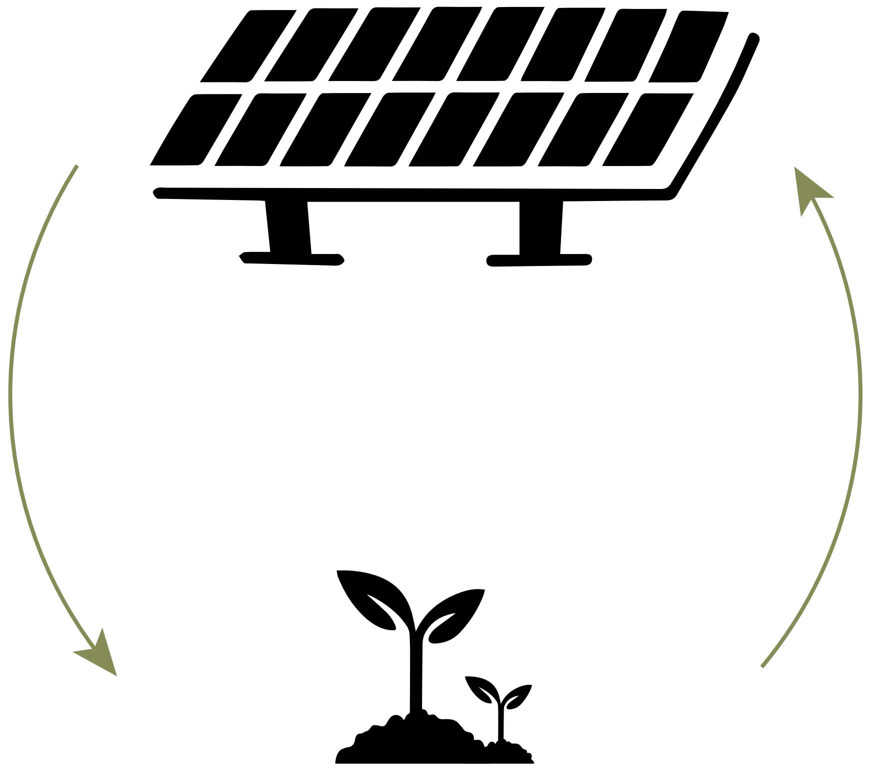
Agrivoltaics

Agrivoltaics is the co-location of solar energy production and agriculture uses. Although still a relatively new practice, agrivoltaics has the potential to increase land-use efficiency compared to traditional agriculture or solar farms alone. Much research is currently underway to study how production for both energy and crop yield can be optimized.

Definition (Top Left):
Source: *https://agsci.oregonstate.edu/newsroom/sustain-able-farm-agrivoltaic*

Diagram (Bottom Left):
Source: *Rahman et al. (2023)*

Symbiotic Relationship of Agrivoltaics Diagram



Benefits of Agrivoltaics

Water
• Increase soil moisture • Potential to collect rain water • Reduce irrigation demand
Energy
• Energy production • Increase solar panel efficiency • Reduce greenhouse gas emissions
Food
• Increase select crop yeild • Protection from severe weather • Diverse microclimate

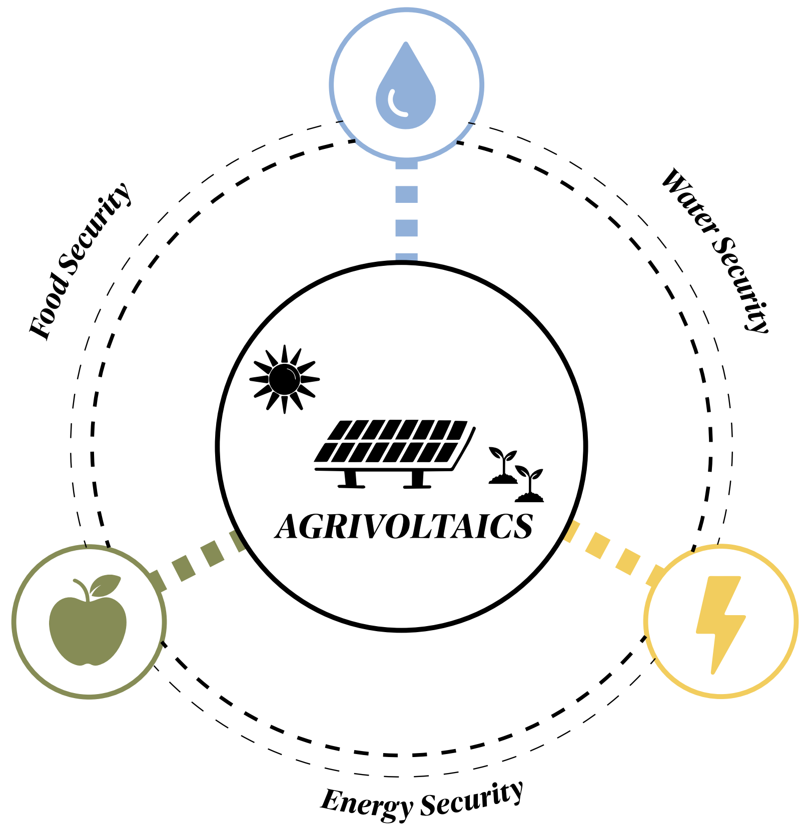
Water, Energy, Food Nexus

Agrivoltaics provides a solution to issues that arise in the Water-Energy-Food nexus. Essentially, a symbiotic relationship occurs where both the plants and solar panels can mutually benefit. For example, the evapotranspiration from the plants can help cool the panels down making them more efficient. Simultaneously, the shade provided by the panels can help retain soil moisture, improve yields for some crops, and protect plants from extreme weather such as hailstorms.

Diagram (Left)
Created By: *Mikayla McKone*
Icon Source: *https://thenounproject.com/*

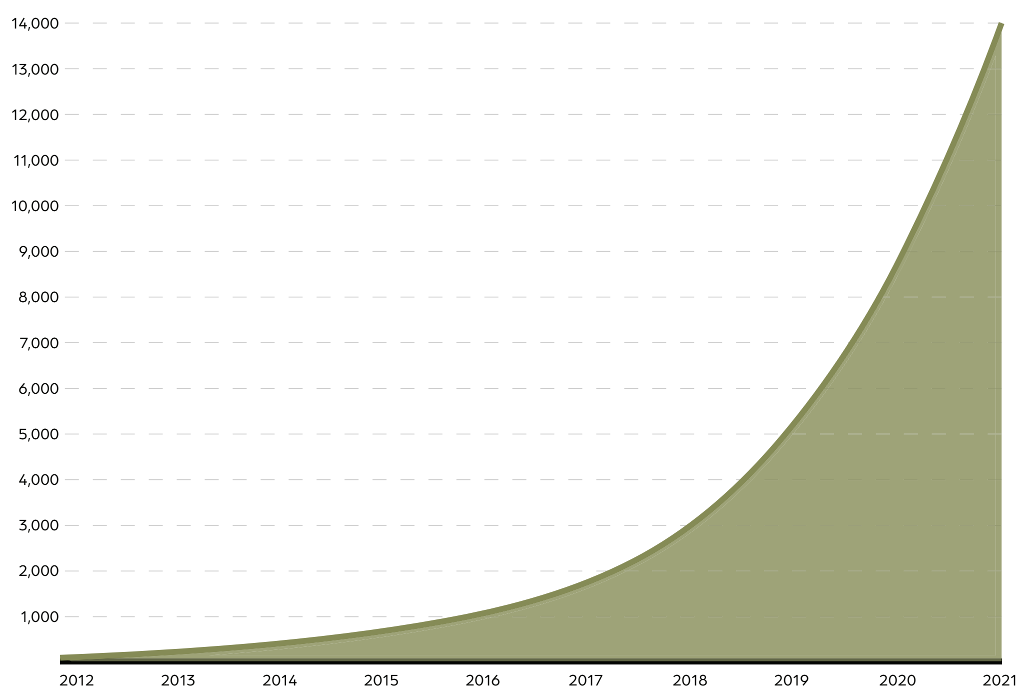
Digarma (Right)
Source: *Cansino-Loeza et al. (2020)*
Modified By: *Mikayla McKone*

Water-Energy-Food Nexus Diagram



Agrivoltaics Around the World

Installed Agrivoltaic Capacity Worldwide, 2012–2021 (MW)

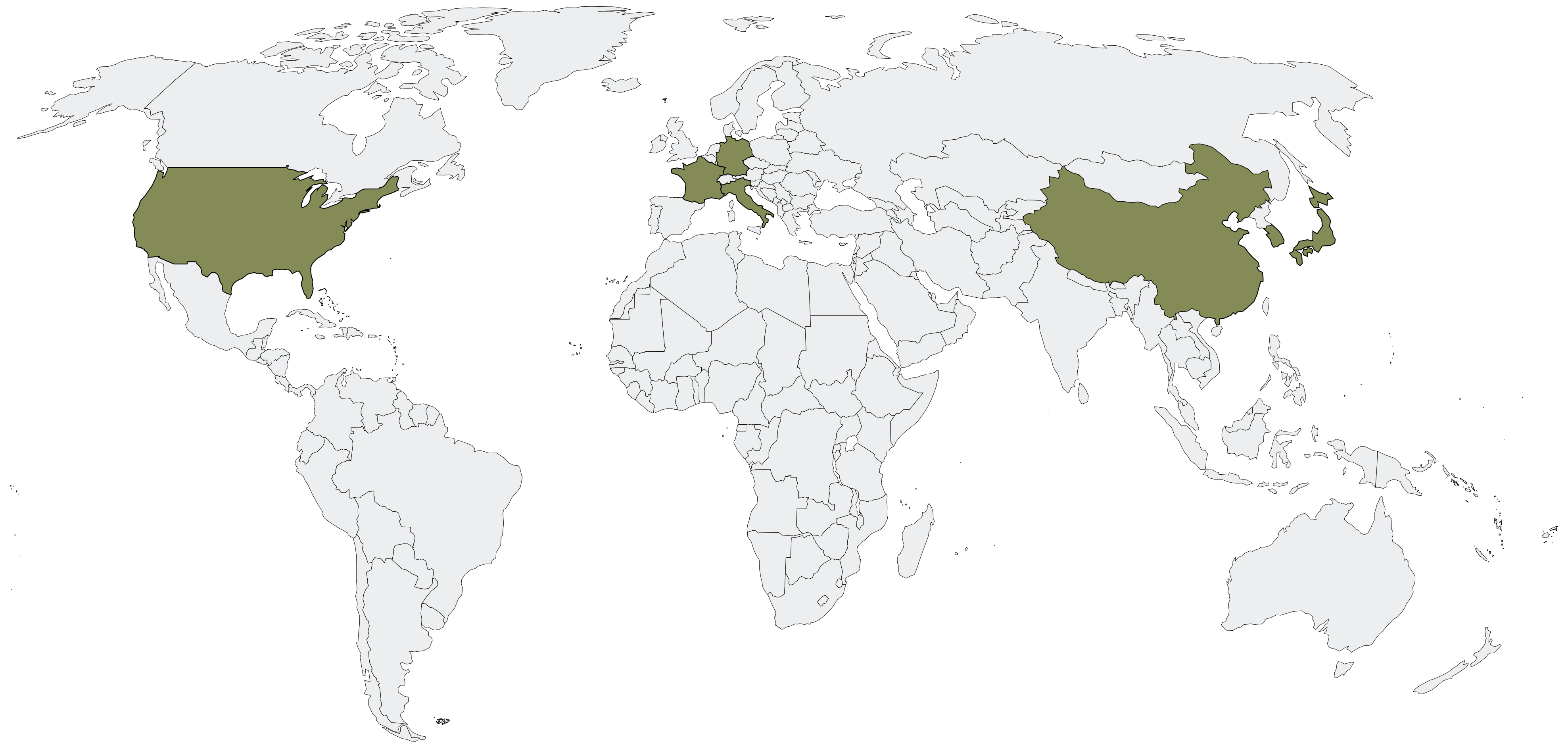


In the last decade, agrivoltaics installations have increased dramatically with the sharpest increase in the last 5 years. The practice first began in countries like Japan, Germany, and France; however, research has expanded to the United States, China, Italy, and South Korea, among others (Rahman, 2023). Although each country has its own definition of what agrivoltaics is, the variations in terminology are relatively minimal. Many different designs, layouts, and crop pairings are being tested to optimize benefits in hopes of scaling up installations around the world.

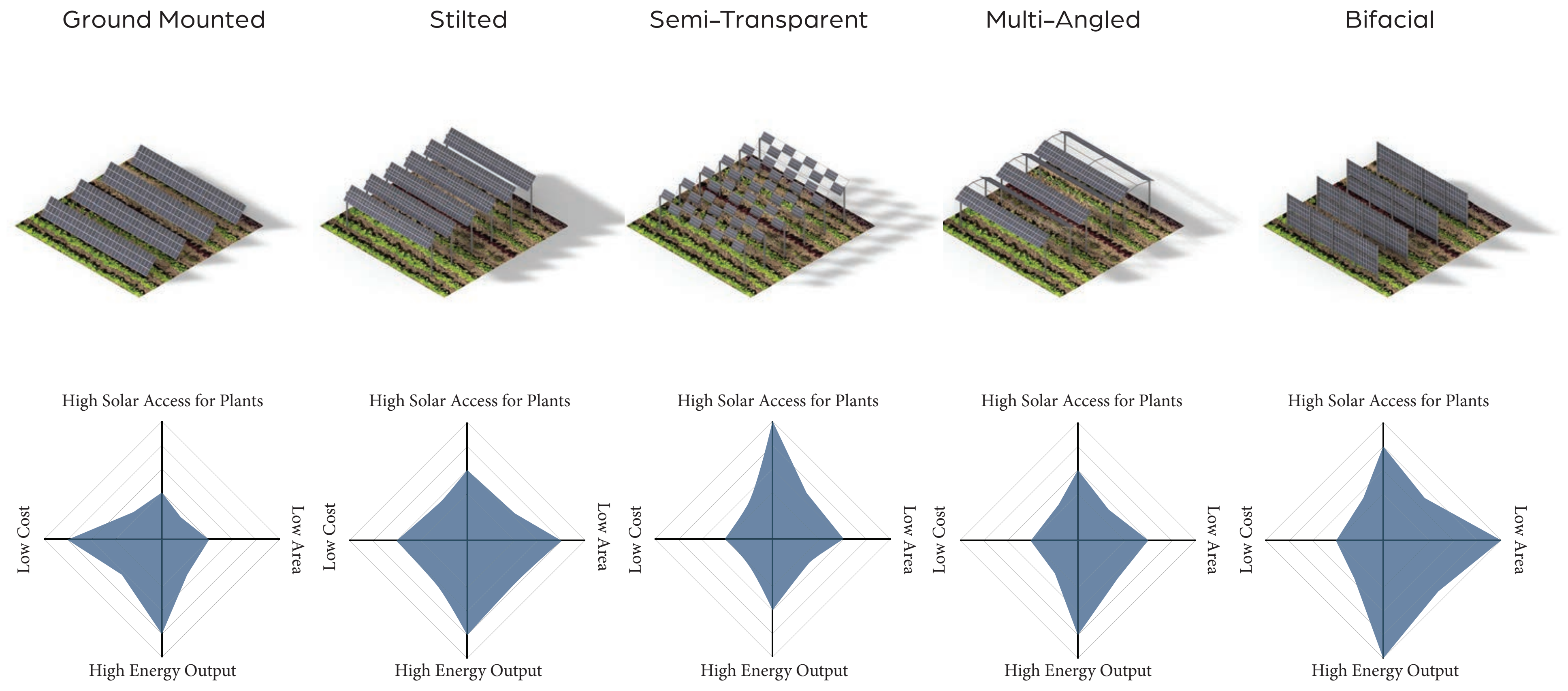
Graph (Left)
Source: *(Dawnbreaker, 2022)*

Map (Right)
Base Map Source: *https://www.freeworldmaps.net/printable/*
Modified By: *Mikayla McKone*

Leading Countries of Agrivoltaic Research



Five Most Common Types of Agrivoltaic Installations



Prison Security Compatability

Minimum	■	■	■	■	■
Medium		■	■	■	
Maximum					

Agrivoltaic Typology

Within the agrivoltaic typology, there are five main types of agrivoltaic configurations. The most common and cheapest approach is using ground mounted solar panels. They are larger, lower to the ground, and fixed at a certain angle to optimize energy production. Because of their size, the crops would need to be planted farther apart.

Another common type is stilted panels which have a support structure which raises the panels overhead. Stilted panels have the option of being either fixed at a particular angle or they can be installed to rotate as the sun moves. They tend to have a higher cost than ground mounted because of the increased material required for the support structure and if they use solar tracking technology.

Semi-transparent panels and multi-angled panels are adaptations from the stilted model, and both attempt to give plants more uniform light saturation and precipitation exposure. The last typology is vertical bifacial panels which are typically more efficient than the other typologies because they can receive sunlight from both sides of the panels. Because of their form, their optimal orientation is facing East-West compared to the other typologies which are better oriented to face South.

Diagram (Left)
Created by: *Mikayla McKone*

Colorado

Oregon

California

North Willamette
Research & Extension
Center

CDCR

Agrivoltaic Precedents

The largest agrivoltaic installation in the United States in Jack's Solar Garden in Longmont, Colorado. Jack's Solar Garden is a family farm which has converted a portion of their property to agrivoltaics. Their installation is made up of 3,276 stilted solar-tracking solar panels which produce 1.2 MW (Mega Watts) which is enough to power 300 homes annually. The energy produced is purchased and used from its community subscribers, which helps offset some of the cost of initial installation. (Colorado Agrivoltaic Learning Center, 2024)

In Oregon, agrivoltaic research is being conducted through OSU's North Willamette Research and Extension Center located in Aurora, Oregon. Their five-acre installation was completed in 2021 and it focuses on researching long-term sustainable farming, energy production, and water conservation. (Sustainable Farm Agrivoltaic, 2022)

Images (Left)
Jack's Solar Garden: *https://www.jackssolargarden.com/*

North Willamette Research & Extension Center: *https://extension.oregonstate.edu/nwrec/agrivoltaic-project*

CDCR: *https://solarbuildermag.com/news/sunedison-installs-18-4-mw-of-solar-power-at-california-prisons/*

Although there are no precedents of agrivoltaics used in prison gardens, there are examples of prisons installing solar arrays outside security fencing to power their operations. The California Department of Corrections and Rehabilitation (CDCR) has several renewable energy projects already constructed through a private partnership with SunEdison. One of those projects is at Ironwood State Prison which has 2,600 solar panels installed to produce 1.18 MW. (Solar Daily Staff Writers, 2008)

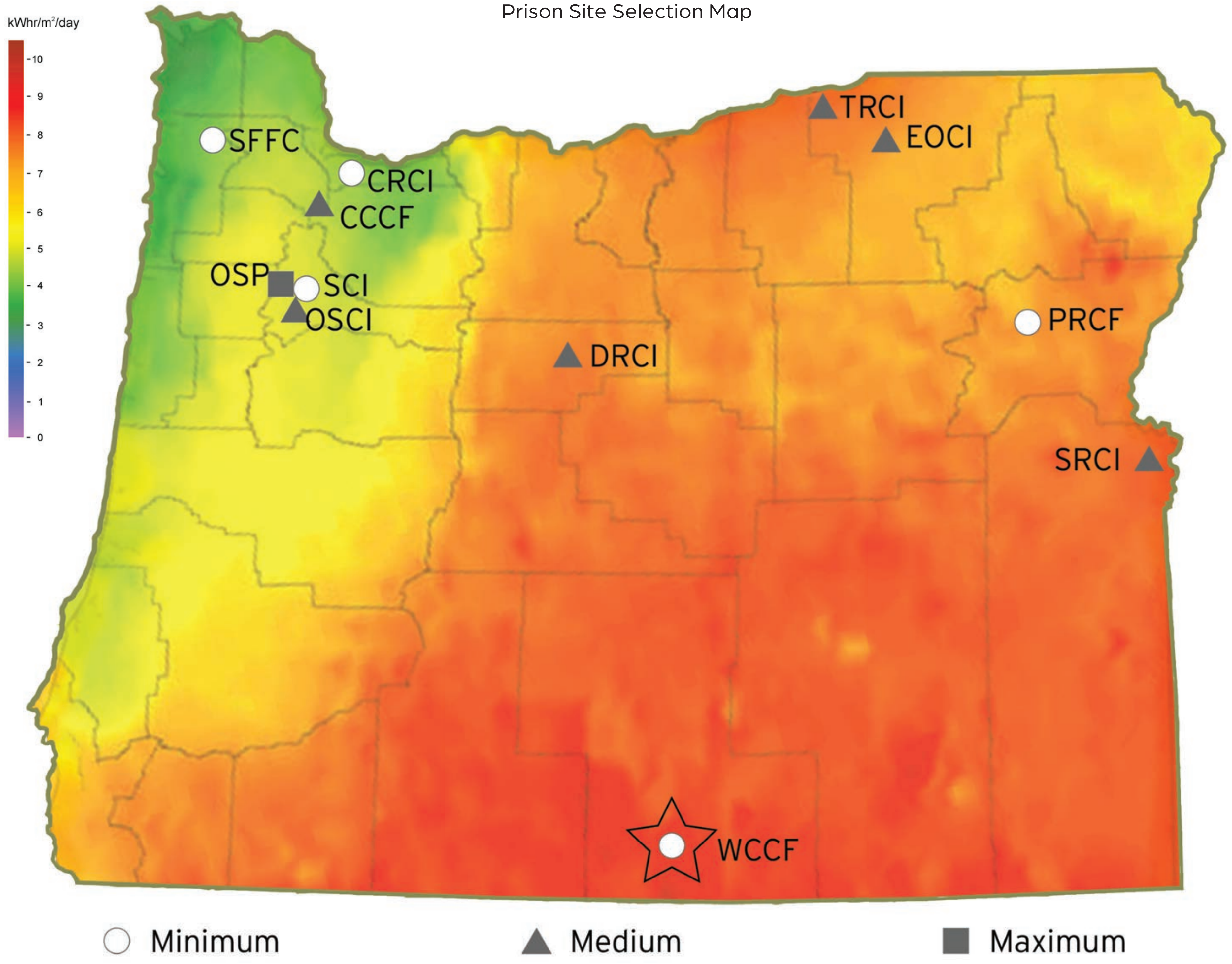
Design Process

Site Selection

Site Analysis

Goals and Objectives

Prison Site Selection Map



Site Selection

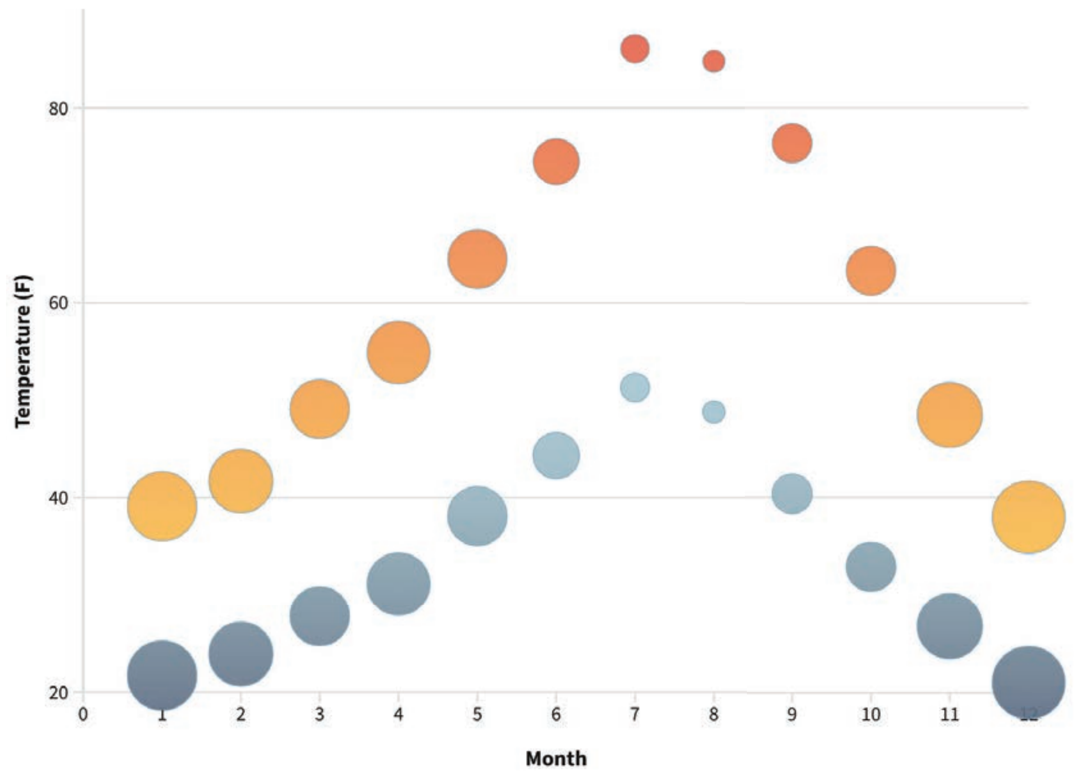
There were two main criteria used to select a prison garden site which would be best suited for the addition of solar panels: a lower-level security prison and solar potential. In Oregon there are 12 prison facilities (one maximum security, six medium security, and five minimum security).

I first narrowed down my search to focus on the five minimum-security prisons. The reason for this is because AICs in these facilities are closer to being released into the community, and they generally have more gate clearance which means they can participate in more vocational programs.

Next, I compared the location of each of the minimum-security prisons to identify which facility would receive the best solar potential. The map displayed (left) shows the direct irradiance (DNI) during summertime which ultimately identified Warner Creek Correctional Facility (WCCF) as having the most ideal conditions for an agrivoltaic prison garden.

Map (Left)
Direct Normal Solar Radiation : *University of Oregon Solar Radiation Monitoring Lab*
Modified by: *Mikayla McKone*

Average Climate in Lakeview (1991–2020)



LEGEND

Low High Average High Temperatures (° F)

Low High Average Low Temperatures (° F)

Low High Relative Precipitation (inches)

Lakeview, Oregon
"Tallest Town in Oregon"

Lakeview is a small rural town in Eastern Oregon with a population of around 2,300 people. It is close to 4,800 feet in elevation earning it the nickname "Tallest Town in Oregon". Lakeview sits at the edge of the high desert, so it typically has hot summers (75°–100° F) and mild winters (25°–45° F). On average they have 213 sunny days in the year and get 14" of rain and 28" of snow annually.

It became a town in 1876, with its history rooted in logging and agriculture; however, today it has become one of Oregon's leaders in renewable energy production.

Graph (Left)
Data Source: *https://www.ncei.noaa.gov/cdo-web/*
Created By: *Mikayla McKone*

Map (Top Right)
Base Map Source: *Google Earth*
Modified By: *Mikayla McKone*

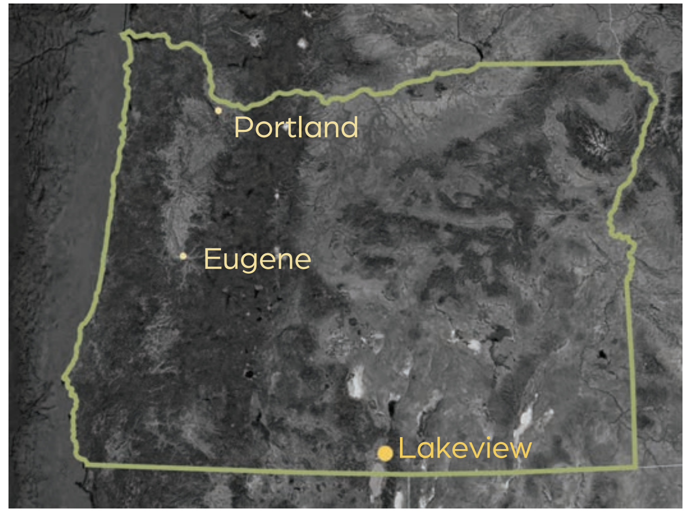
Collage (Bottom Right)
Created By: *Mikayla McKone*

Annual Rainfall

Sunny Days Annually

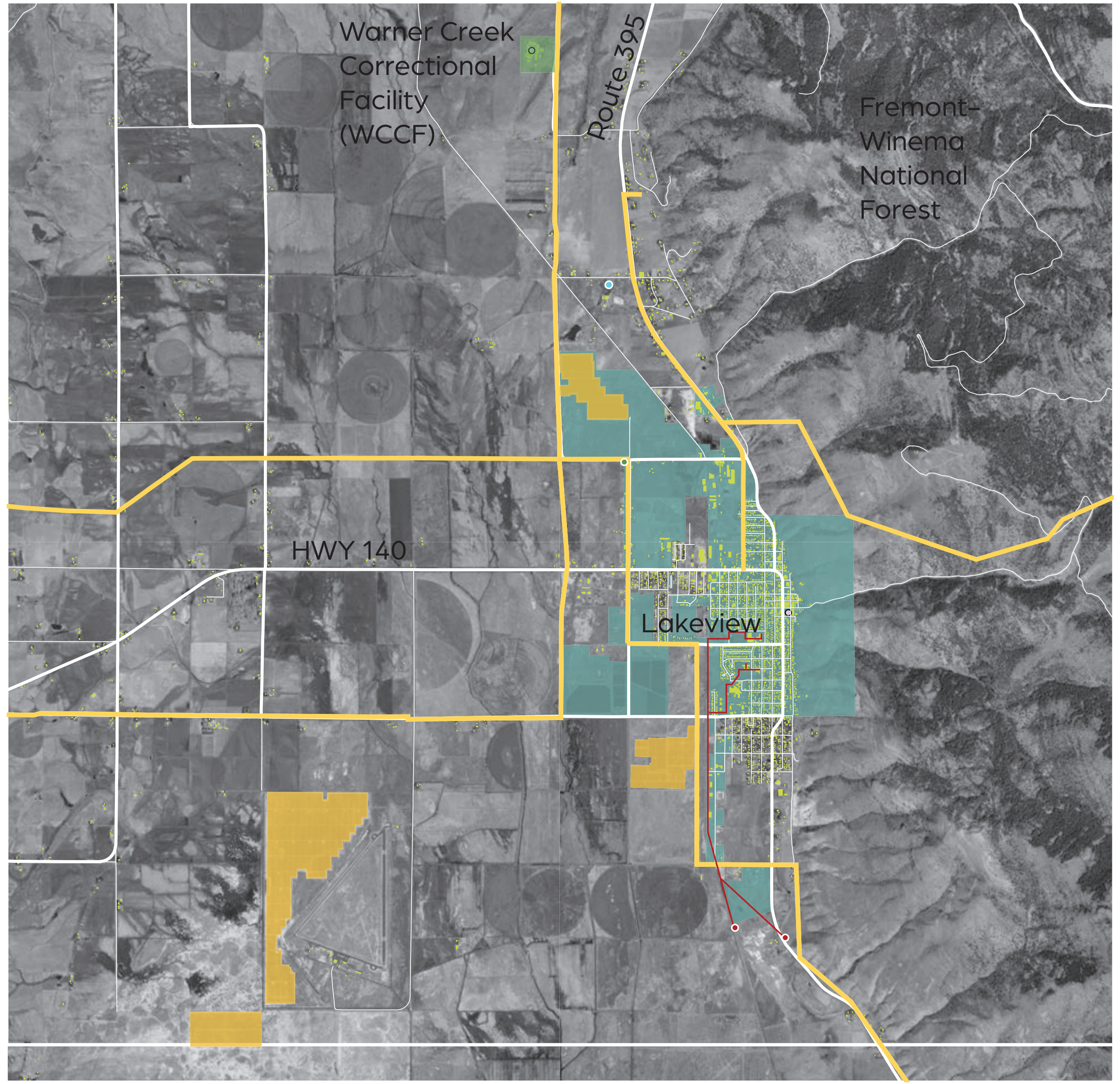
Annual Snowfall

Lakeview Key Map



Lakeview History Collage

Lakeview Context Map



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LEGEND

- Warner Creek Correctional Facility (WCCF)
- Existing Solar Projects
- Transmission Lines
- Roads
- Buildings
- Lakview City Boundary
- Old Perpetual Geyser
- Geothermal Well
- Geothermal Pipeline
- Biomass Plant

Renewable Energy in Lakeview

In 1923, a well was drilled and struck a geothermal hot spot creating a 50-foot geyser (Old Perpetual) in Lakeview. Although this became a popular attraction, it was also the discovery of a source of potential geothermal energy for the town to use. Eventually wells were drilled, and pipelines were laid, to offset energy costs for Lakeview's hospital, high school, middle school, elementary schools, industrial park, and Warner Creek Correctional Facility. Currently, Lakeview has been awarded $100,000 by the Oregon Department of Energy's Community Renewable Energy Grant Project to expand their geothermal energy to help service more of the town.

As of 2020, there are eight solar installations generating power (Outback Solar, Blackcap Solar, Blackcap Solar II, Airport Solar, Lakeview Solar, Rock Garden Solar, Garrett Solar, and Alkali Solar) with several more installations approved for development.

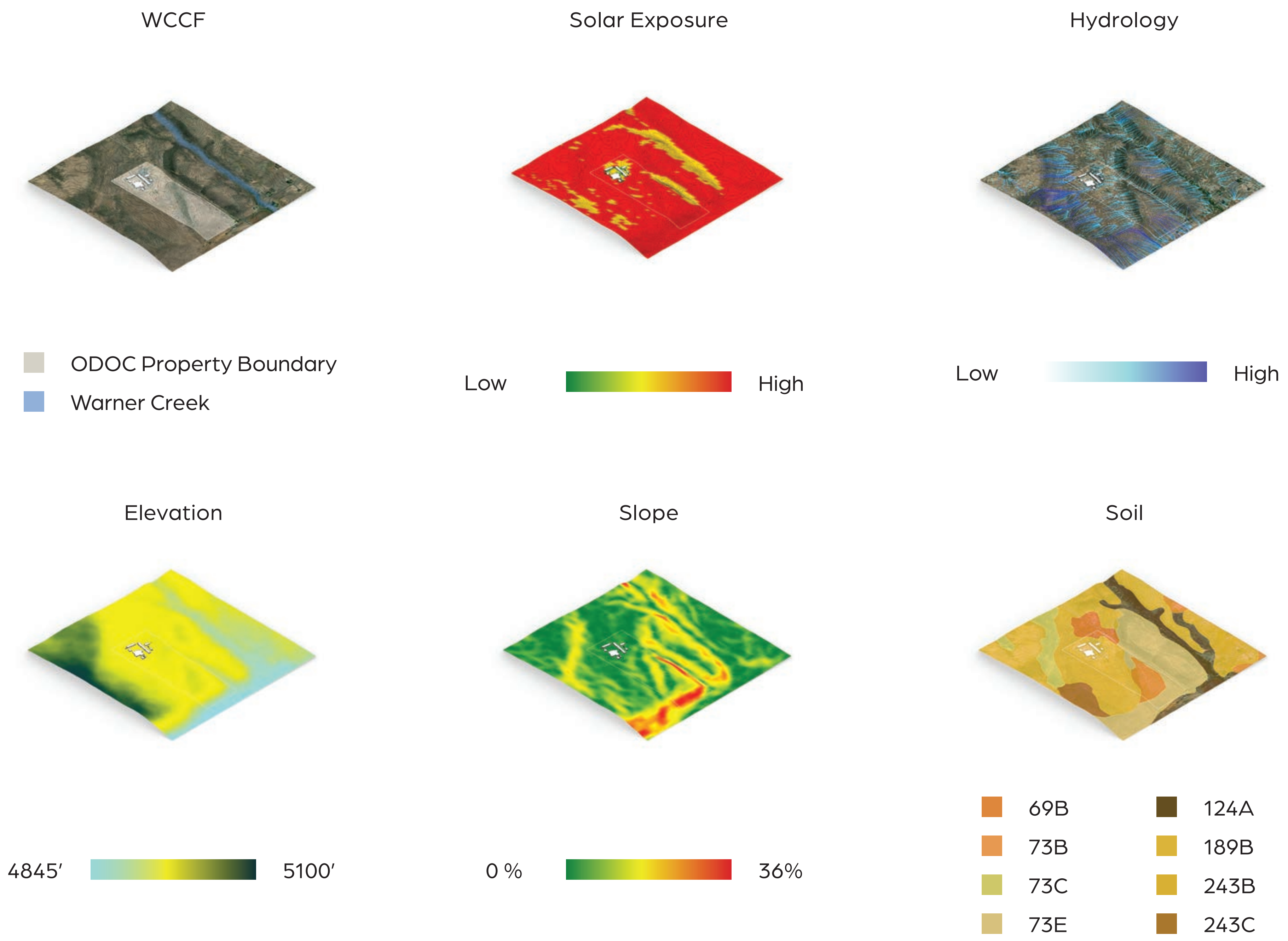
In addition, in partnership with Iberdrola Renewables, Lakeview has a biomass cogeneration plant which produces 26.8 MW, enough to power 18,000 homes and steam for the local Collins Fremont Sawmill. A majority of the biomass source comes from unusable material produced during the local timber operations.

Despite being a smaller rural town, Lakeview has sizable investments into renewable energy and has shown its commitment to being a leader in sustainable energy production in Oregon.

Graph (Left)
Base Map Source: *ArcGIS*

GIS Data Sources: *NOAA, ODOT, OregonGEOHub*

Modified By: *Mikayla McKone*



Site Analysis

Pictured here are some of the site analyses that I looked at for my site including solar exposure, hydrology, elevation, slope, and soil. The buildings of the prison are clustered in the northern part of the property that Oregon DOC owns. To the east is the prison's namesake, Warner Creek. Overall, the area has good solar exposure since the surrounding vegetation is mainly low sagebrush. The facility buildings are predominately two stories tall which does create some shading on the northern and eastern parts of the site.

Warner Creek Correctional Facility sits at about 4,900 feet in elevation. There is not a significant amount of slope changes where the buildings and current garden are. However, there is a detention pond to the east of the buildings and between Rabbit Hill Road where surface water collects. On the site there are two different soil classifications: 189B (Oxwall gravelly clay loam) and 69B (Donica gravelly sandy loam). Both types drain water quickly; however, they could use soil amendments to increase their nutrient value which is important especially for growing food.

Diagram (Left)
Created By: *Mikayla McKone*

Warner Creek Correctional Facility

WCCF opened in 2005 and can house up to 400 AICs. WCCF employs 110 people and is an important employer for the Lakeview community. The facility is located four miles northwest of Lakeview, and occupies less than sixteen percent of the land that Oregon Department of Corrections owns. In 2008, WCCF received the State Energy Efficiency Design award primarily for its use of geothermal energy.

The existing garden is near the prison's entrance and visitor's parking. The garden is roughly an acre in size and has a small shed and a large shade structure within the fencing. The rows run perpendicular to Rabbit Hill Road and there are a few small trees dispersed throughout.

In partnership with the Institute for Applied Ecology, some AICs participate in the Sage Brush Program which helps grow sagebrush seedlings to replant recently burned areas and restore critical Greater Sage-Grouse habitat.

Map (Right)
Base Map Source: *ArcGIS*
Created By: *Mikayla McKone*

WCCF Existing Site Plan

WCCF Building Facilities

Existing Garden Area

Transmission Lines

Overall Project Goals

There are five main goals of The Power of Oregon Prison Gardens Project which are listed below in order of their priority:

1) Increase access to fresh healthy food
2) Expand AIC's ability to connect with nature
3) Increase renewable energy use at WCCF
4) Expand vocational training opportunities
5) Facilitate positive relationships between WCCF and the community of Lakeview

Collage (Right)
Created By: *Mikayla McKone*
Source Images: *https://www.growing-gardens.org/lettuce-grow https://www.npr.org/2021/11/14/1054942590/solar-energy-colorado-garden-farm-land*

Project Objectives

Objectives were created as ways to measure each of the five overall goals. These objectives are tangible ways in which the landscape architecture field can help improve the prison environment. Overall, these goals and objectives were an important reference which helped guide me through the rest of the design process.

1) Increase access to fresh healthy food
- Expand garden space
- Create orchards

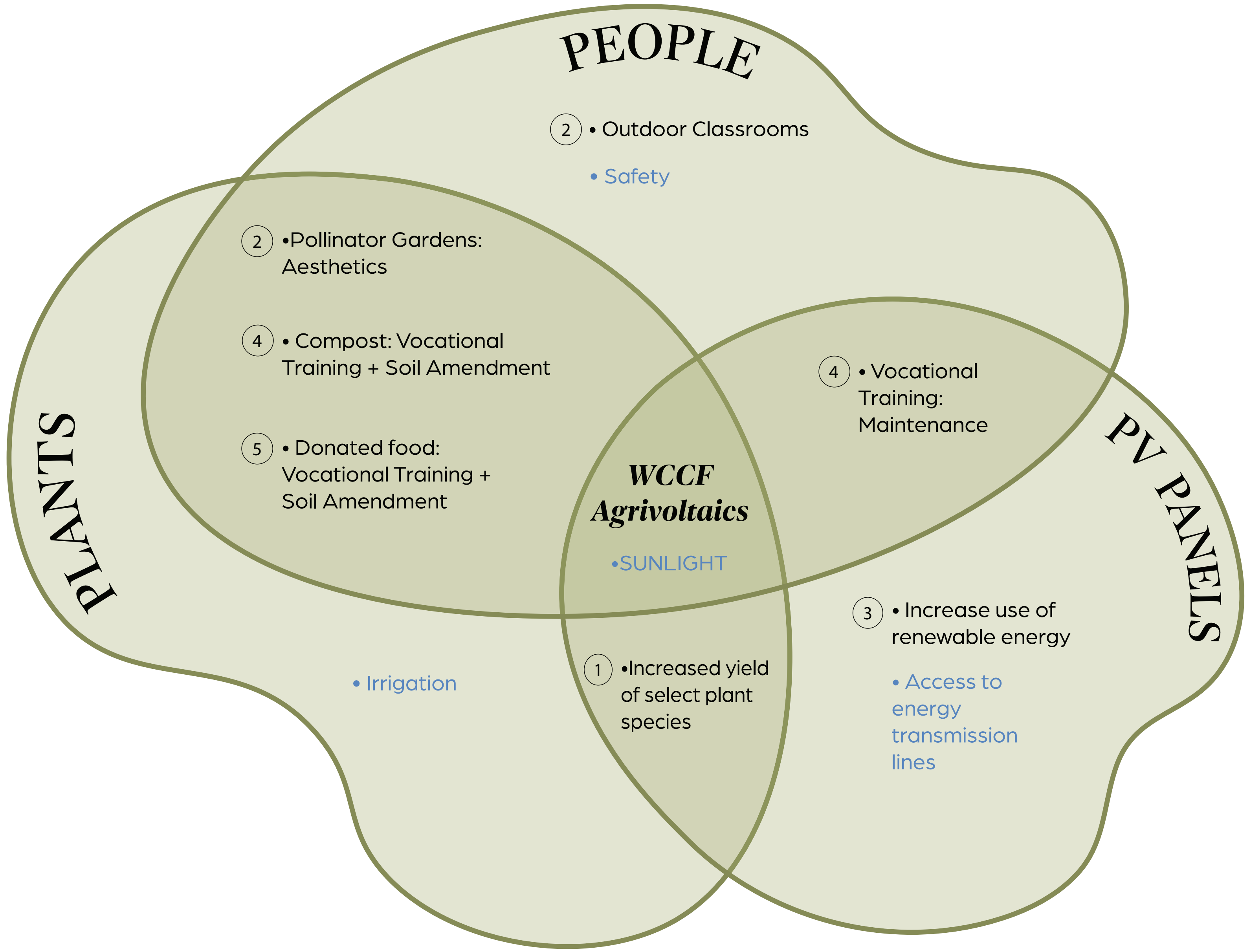
2) Expand AIC's ability to connect with nature
- Maintain views to surrounding hills
- Add color with pollinator gardens
- Create outdoor classrooms

3) Increase renewable energy use at WCCF
- Install solar panels

4) Expand vocational training opportunities
- Increase participation of garden program
- Add vocational program for solar panel maitenance
- Add vocational training for bee keeping

5) Facilitate positive relationships between WCCF and the communitiy of Lakeview
- Donate additional produce to food banks
- Create a farmstand of produce for WCCF visitors

People–Panel–Plant Needs Venn Diagram



Design Considerations

The last step before beginning the design was to evaluate the potential needs and opportunities of the main components of my design: people, photovoltaic panels, and plants to help identify where synergies could happen between my goals and objectives. This would ultimately create more multifunctionality in the design. For example, the need for maintenance on the solar panels also can serve as a new educational opportunity and vocational training program at WCCF which would contribute to achieving Goal 3 and Goal 4.

Diagram (Left)
Created By: *Mikayla McKone*

Design Exercise

Site Plan

Circulation

Design Elements

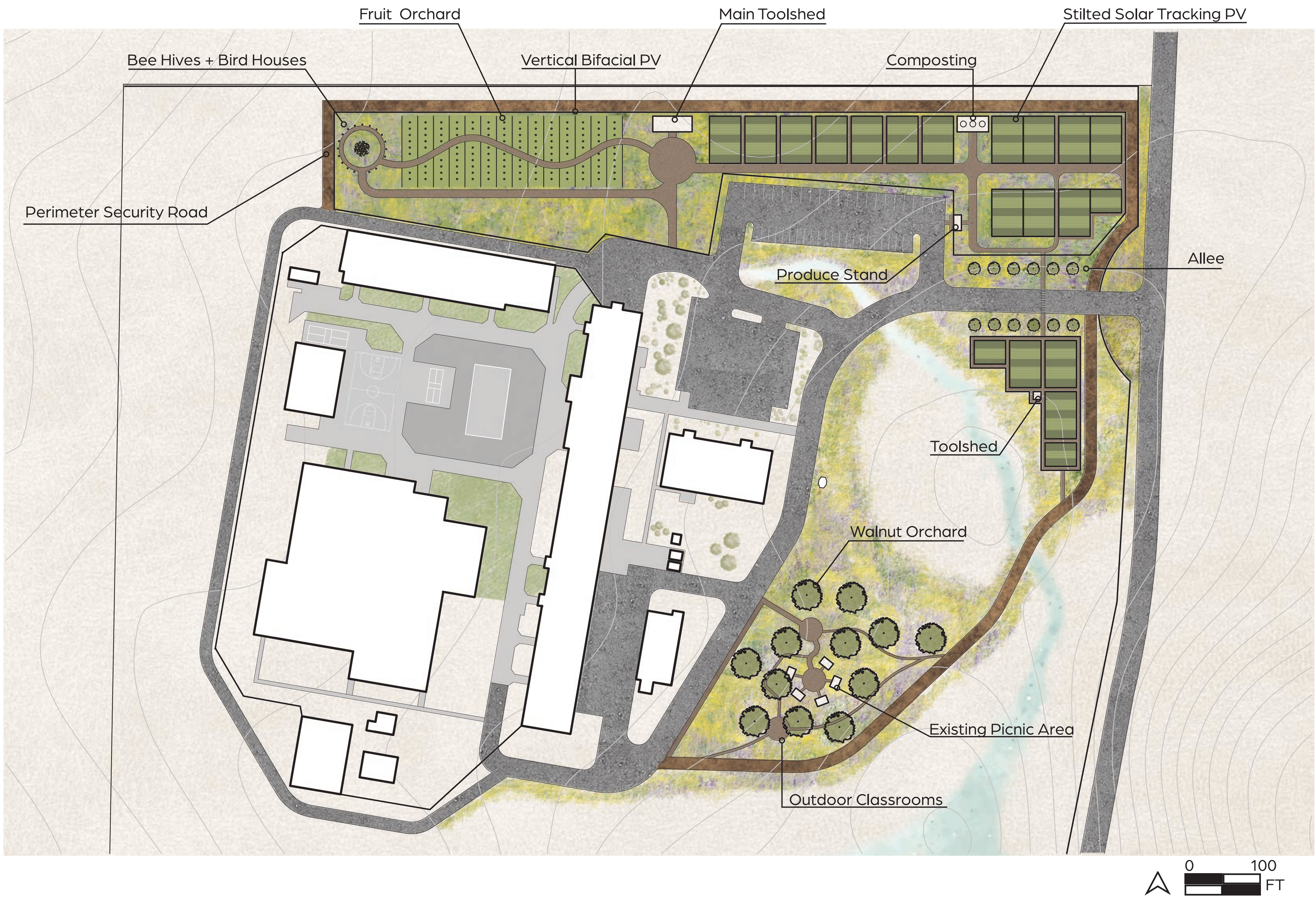
Site Plan

The redesigned garden is two acres which is double the size of the existing garden. This expansion means there is more area to grow food, produce energy, and get more AICs involved.

For energy production, there are two types of photovoltaic panels used, vertical bifacial and stilted solar tracking. These systems will need regular maintenance providing AICs with an opportunity to get valuable vocational training in a very sought-after industry. Moreover, additional vocational training opportunities include bee keeping and composting as complementary programs to food production in the garden.

At the southern end of the site there is a walnut orchard that surrounds the existing covered picnic tables. Within the grove there are two circular outdoor classrooms which provide another space for AICs to gather and learn outdoors.

Site Plan (Right)
Created By: *Mikayla McKone*

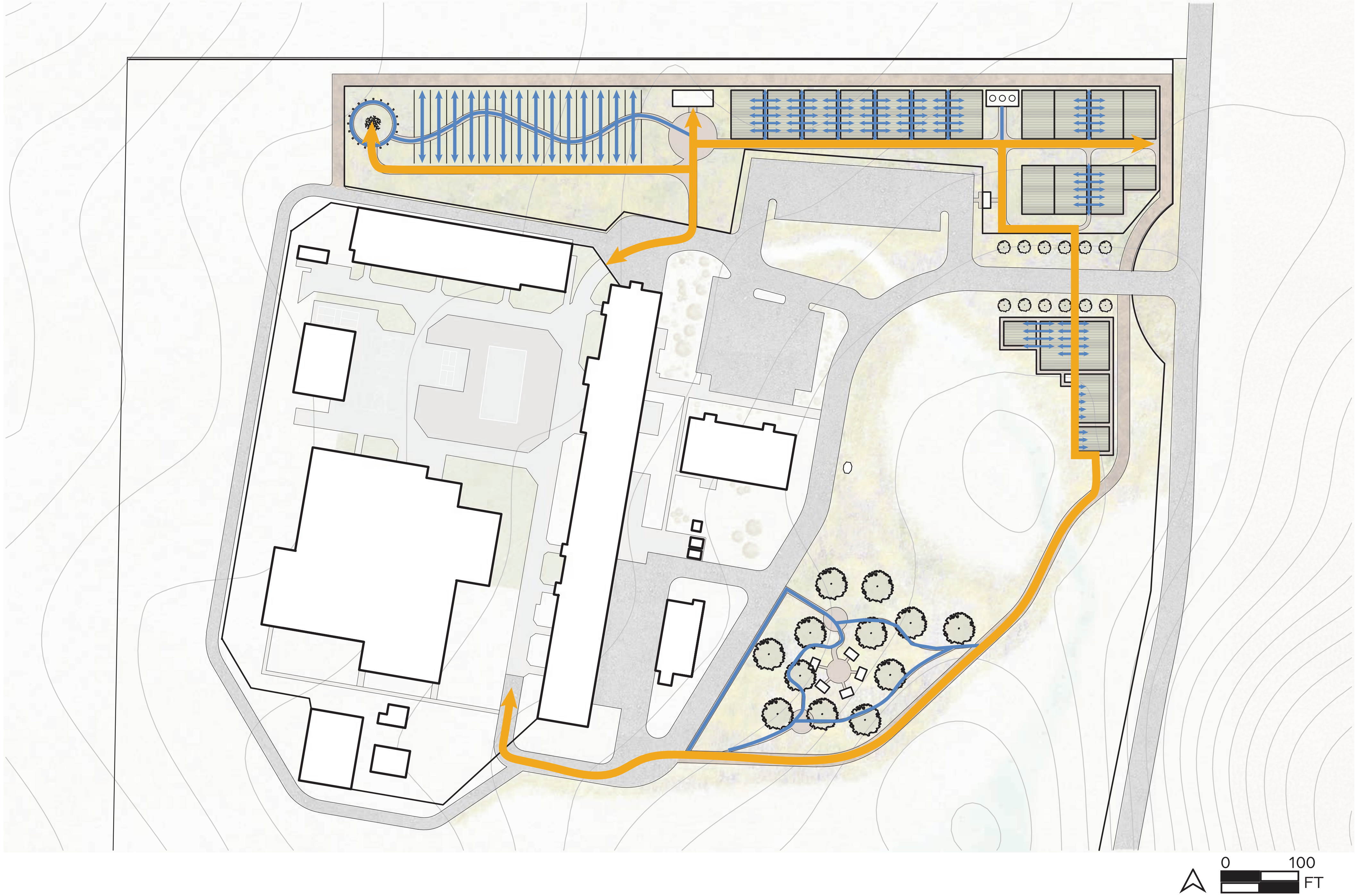


Site Plan Circulation

The main circulation in the garden, highlighted in dark orange, are wider (8′–12′) and more direct paths between each area. The linear East–West axis running through the garden was created to maintain viewsheds to the surrounding hills.

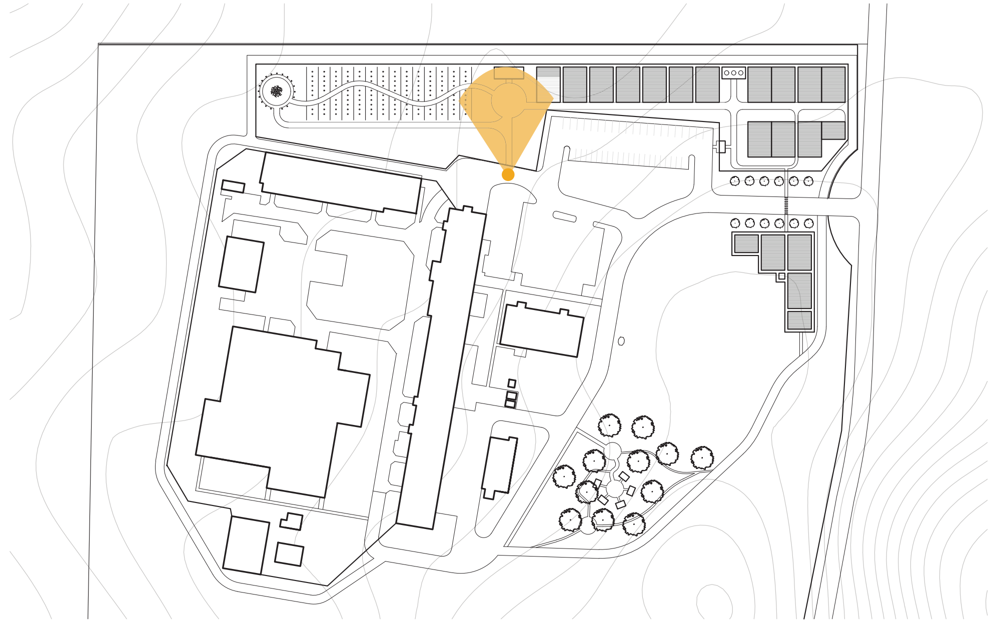
The secondary pathways, pictured in blue, are typically narrower (2′–5′), especially through the garden rows, and occasionally meander. The paths are made from wood chips which can be sourced from the local Collins sawmill in Lakeview.

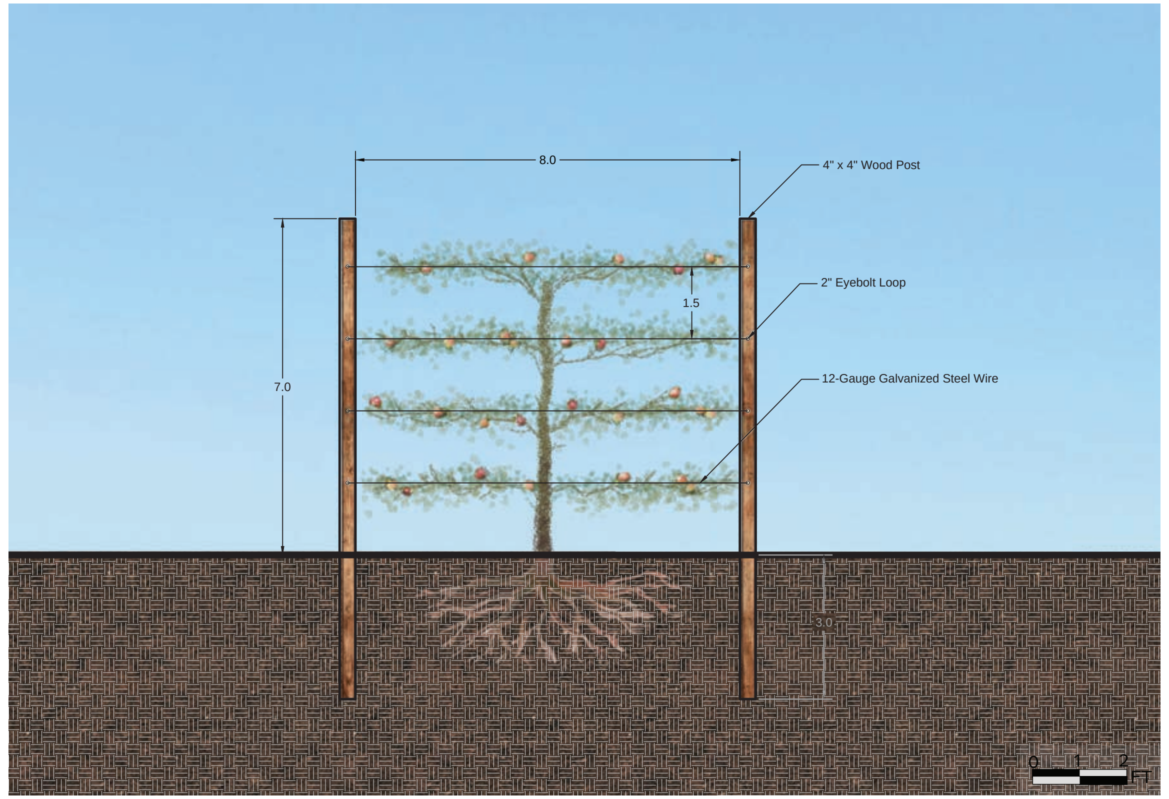
Site Plan (Right)
Created By: *Mikayla McKone*



Entrance

As an AIC exits the main gates from the facility, the entrance to the garden is directly ahead. For safety and security reasons, the garden must be fenced in, especially with the addition of solar panels. However, the surrounding fences have the opportunity to be more engaging, uplifting, and inspiring than plain chain link fences. Even from the outside, this can signal to AICs and community members that this garden is a valued and a respected place of pride for gardeners. At the gate, AICs are greeted by a large sign that welcomes them into the garden. On either side of the path are flowers and planted herbs which add to the sensory experience of entering the garden. The entrance path leads them to a large gathering space in front of the main tool shed. This central space is an opportunity for the AICs to bond as a team and receive their daily assignments.



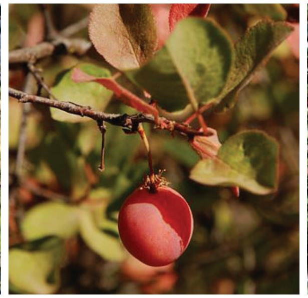


Fruit Orchard Agrivoltics

To the west of the main tool shed is the fruit orchard. Planted in this orchard are two dwarf varieties of apple trees and two dwarf varieties of plum trees. Alternating the rows of fruit trees are rows of vertical bifacial panels which are oriented East-West to capture the most sunlight throughout the day. These panels can absorb sunlight on either side of the panel which makes them up to twenty percent more efficient than traditional PV panels (Khan et al., 2017).

To complement and mimic the vertical form of the panels, the fruit trees are espaliered which also makes it easier to harvest the fruit. Each row of panels are 20 feet from one another, with the trees being placed in the sunniest zone in between them. The curved interior path of the orchard allows users to easily access each row while also providing visual interest.

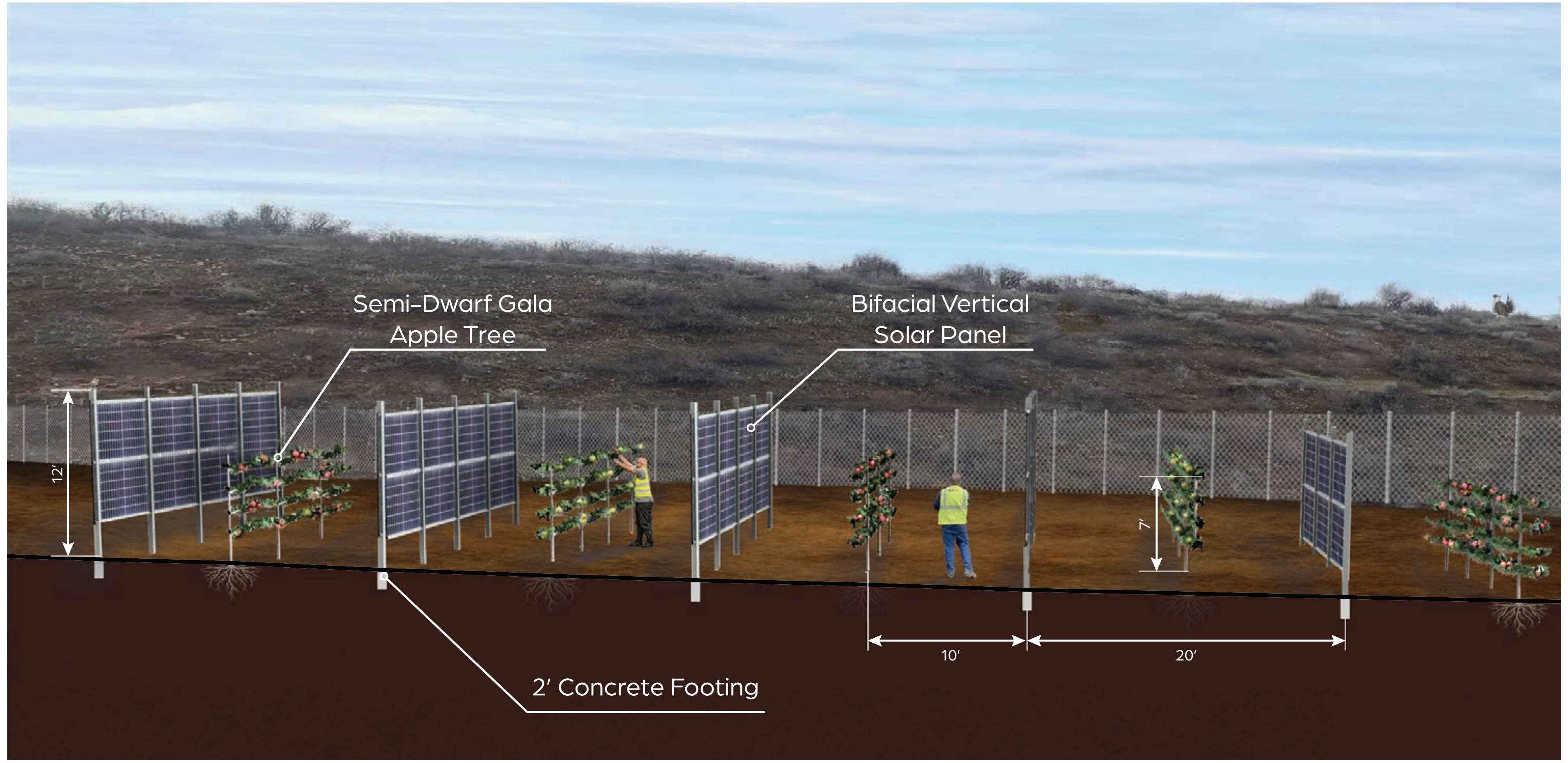
Mount Royal Plum
Prunus 'Mount Royal'



Klamath Plum
Prunus subcordata

Semi-dwarf Gala Apple
Malus domestica 'Gala'

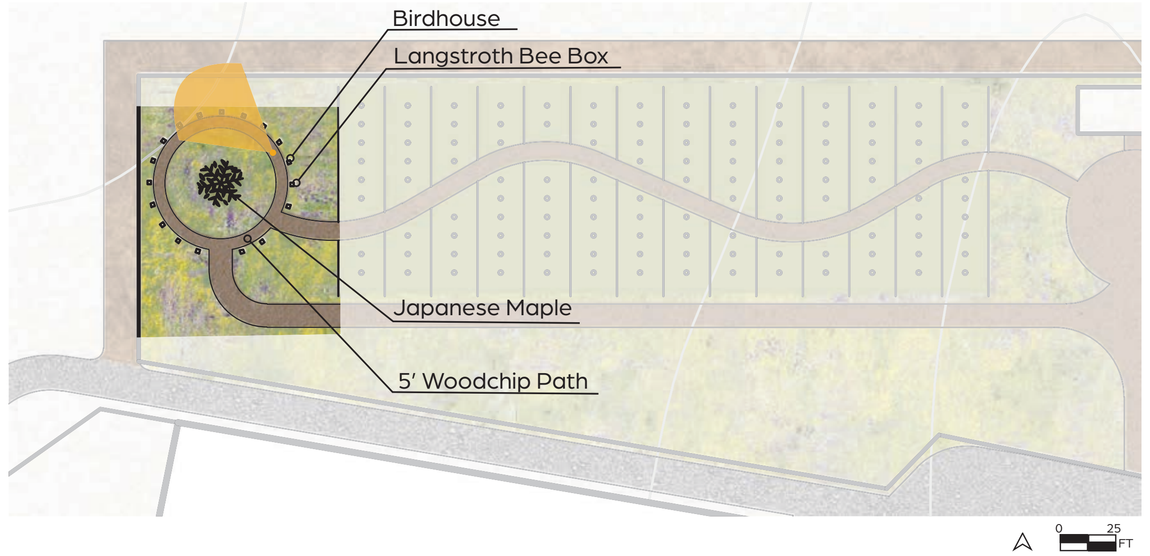
Semi-dwarf Fuji Apple
Malus domestica 'Fuji'

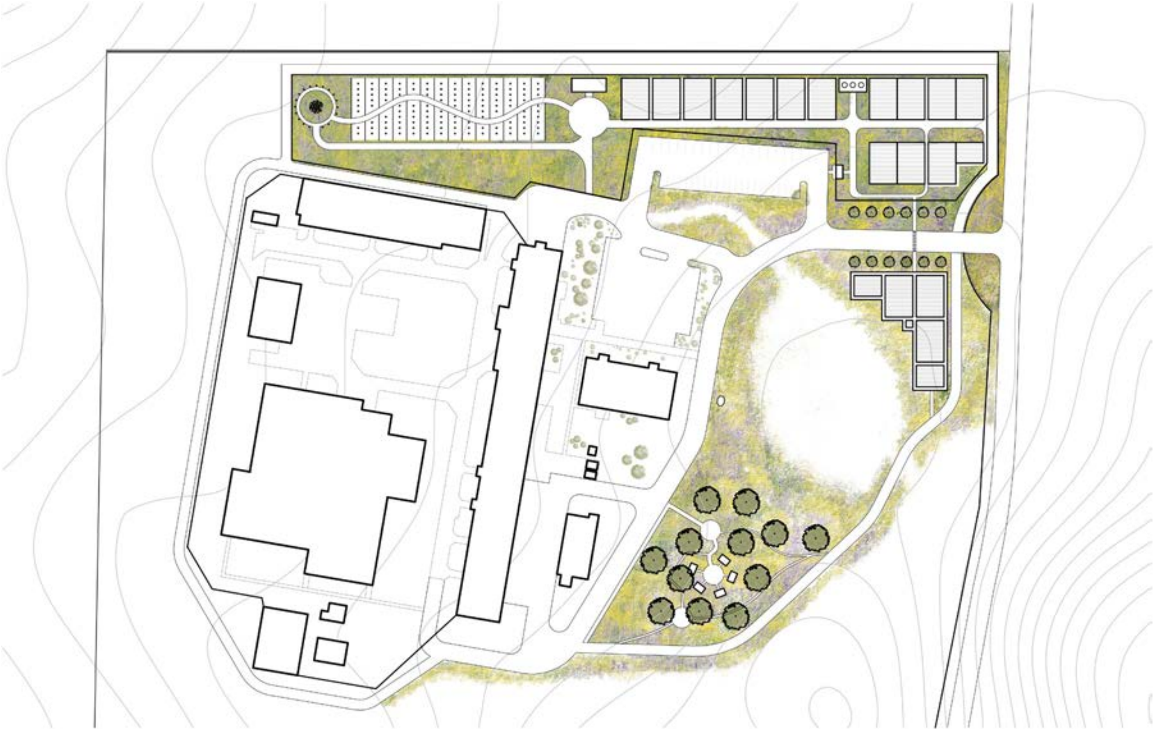


The Birds and the Bees

The path from the fruit orchard leads to the birdhouse and beekeeping area. As AICs walk along the circular path, they can access the alternating nine bee boxes and nine bird houses. Adjacent to the path, this space is rich with flowering shrubs such as Utah Service Berry and Pinemat Manzanita. Many different forbs such as Oregon Sunshine, Showy Milkweed, and White Mule's Ear are used to help attract pollinators.

This area provides many benefits to both the AICs and the surrounding environment including opportunities for AICs to learn apiary practices, pollination for the expanded garden, production of honey, and support for local wildlife. The honey collected from the hives can be used in the prison's kitchen or donated to local food banks.





Pollinator Plant Palette

The pollinator plant palette is used throughout the whole garden redesign to help bring life to the sterile environment of the prison facilities. The main goals for selecting plants included providing food for local pollinators and increasing habitat for local wildlife. Native and drought tolerant qualities were a focus to narrow the plants that were selected to help ODOC's long term goal of lowering their overall water consumption.

The colors chosen for the palette are informed by color theory used in healing gardens. The plants chosen are drought tolerant and native species that consist of calming and uplifting colors with shades of soft pinks, warm yellows, and soothing greens. Overall, the pollinator plant palette was chosen to evoke feelings of tranquility, peacefulness, and warmth.

Utah Service Berry
Amelanchier utahensis

Rosy Pussytoes
Antennaria microphylla

Pinemat Manzanita
Arctostaphylos nevadensis

Greenleaf Manzanita
Arctostaphylos patula

Cutleaf Penstemon
Penstemon richardsonii

Sulfur-flower Buckwheat
Eriogonum umbellatum

Oregon Sunshine
Eriophyllum lanatum

Red Husker Penstemon
Penstemon digitalis 'red husker'

Showy Milkweed
Asclepias speciosa

Common Sage
Salvia officinalis

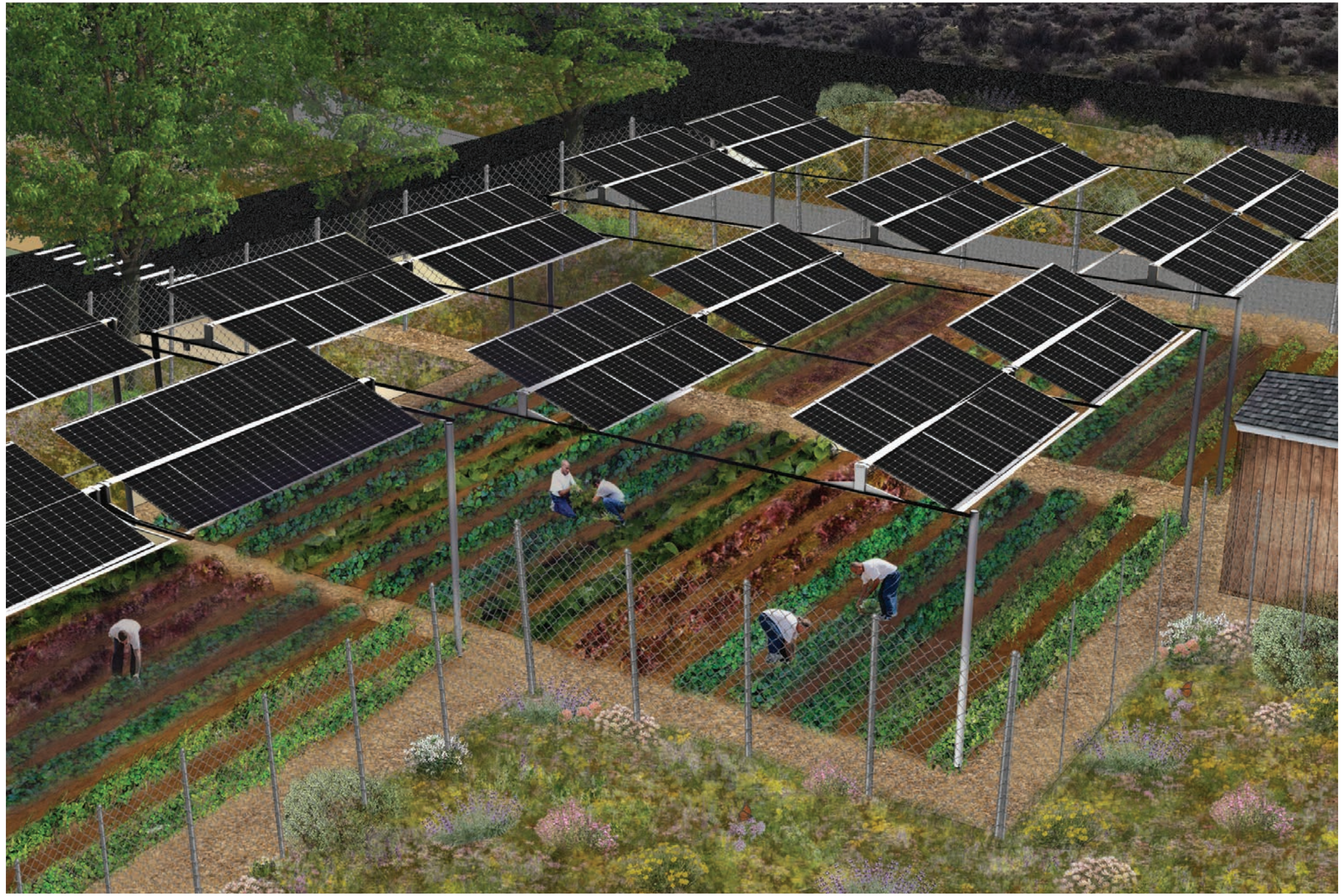
Panicled Bulrush
Scirpus microcarpus

Showy Townsendia
Townsendia florifer

White Mule's Ear
Wyethia helianthoides

Idaho Fescue
Festuca idahoensis

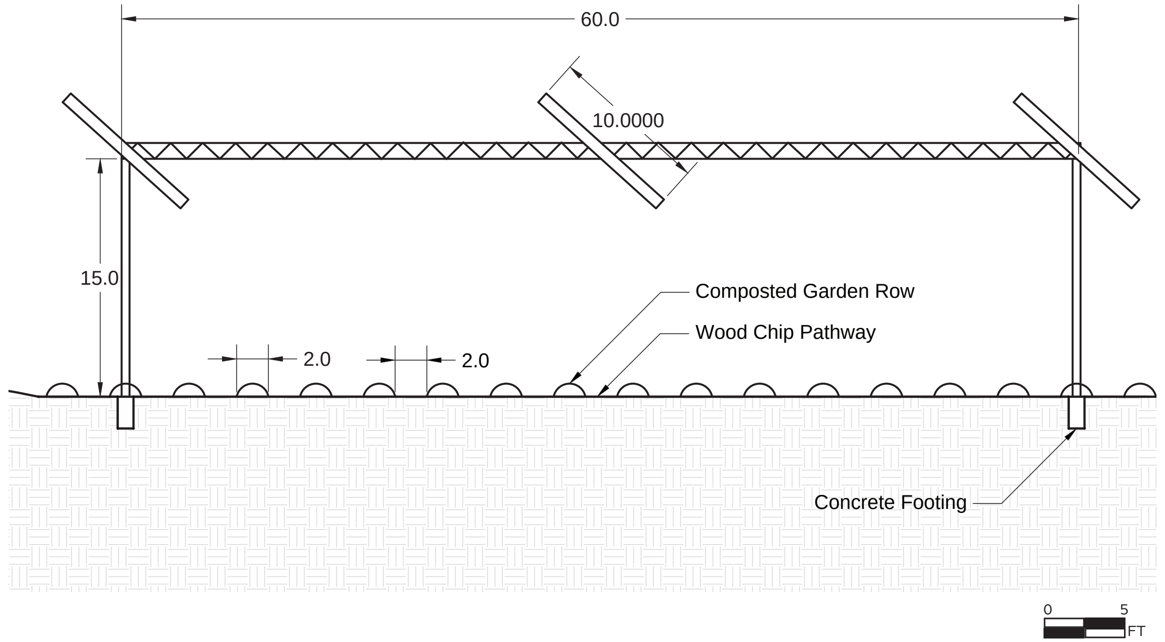
Bluebunch Wheatgrass
Pseudoroegneria spicata

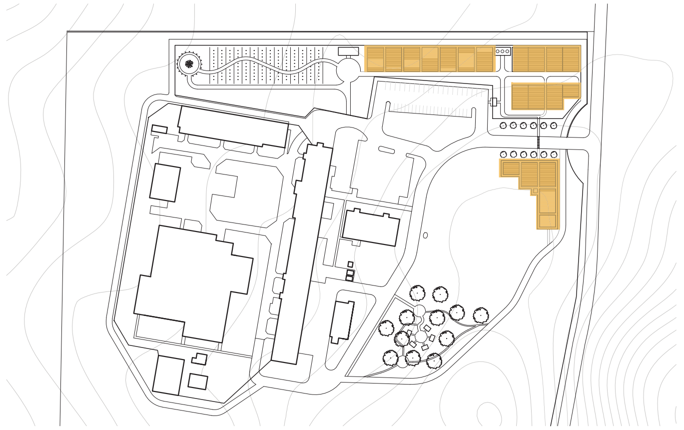


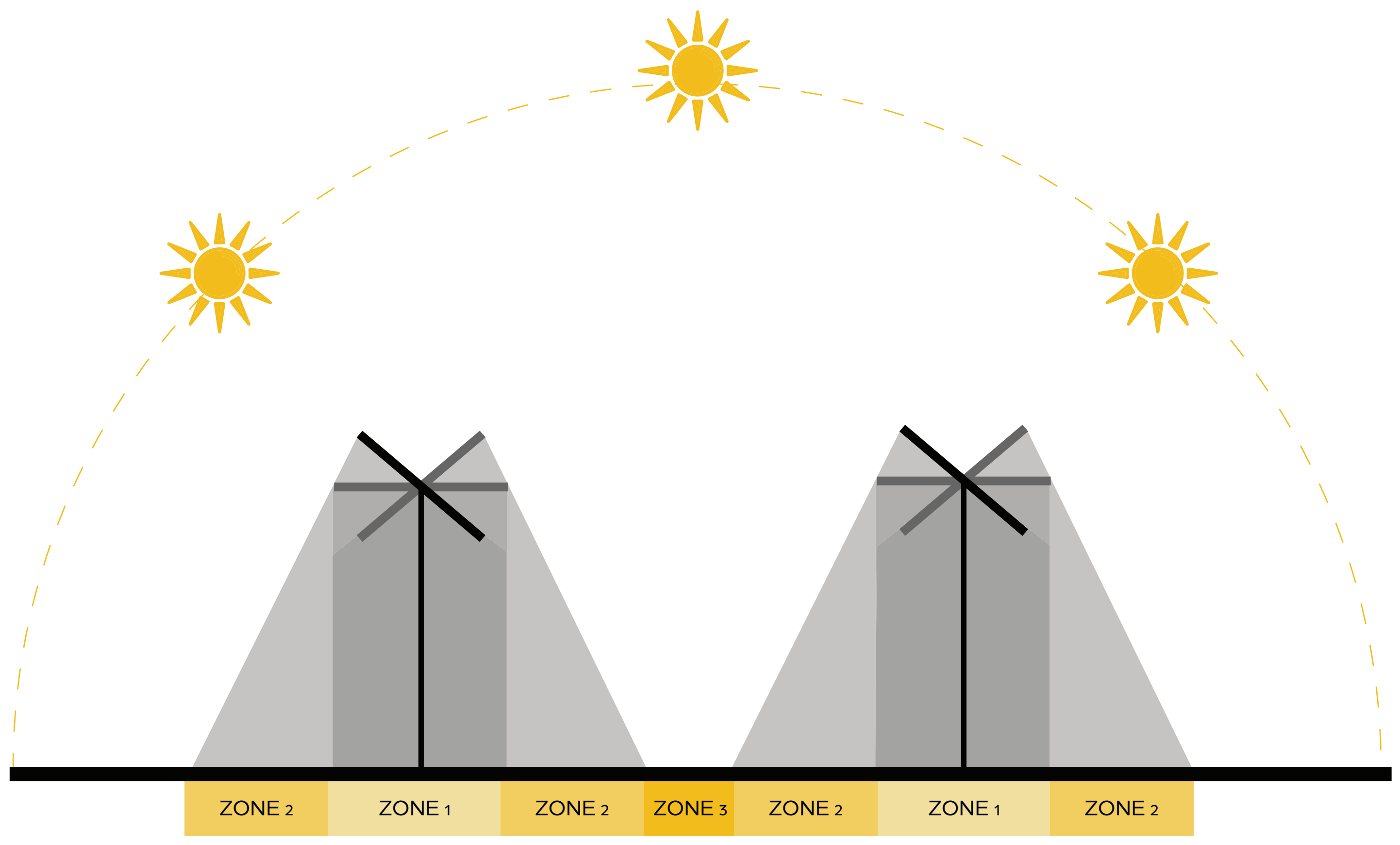
Main Garden Agrivoltaic Module

The main garden areas are where most of the food production is located. These spaces are made up of rectangular modules that are each 40 feet wide and 60 feet long. Each module represents the planted row crops on the ground and the solar panels above. There are three rows of solar panels, spaced 20 feet from each other, and lifted 15 feet overhead by steel framing. The panels are oriented South and rotate with the sun to increase their efficiency.

Below the panels, AICs are shaded from the sun while they garden the rows of plants. Each module contains 15 rows of crops. Each row is 2 feet wide and there is a 2-foot walking path on either side. The food grown in the garden will drastically increase the availability of fresh produce AICs are able to consume while they serve their sentence. More nutritious diets have been shown to decrease health issues while also improving behavioral issues.







ZONE 1

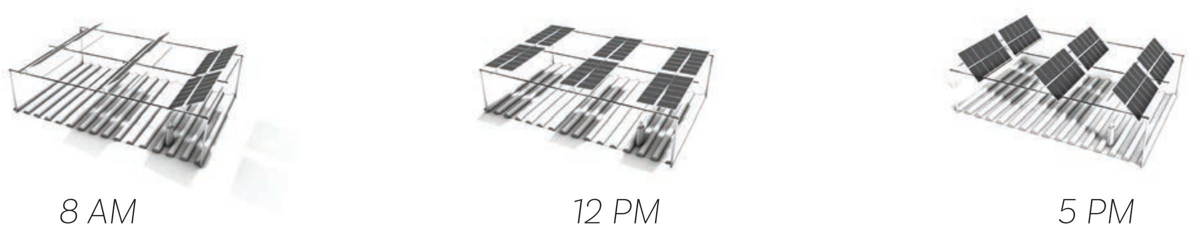
Kale
Swiss Chard
Lettuce
Spring Onion
Arugula

ZONE 2

Cucumber
Carrot
Potato
Broccoli
Beets

ZONE 3

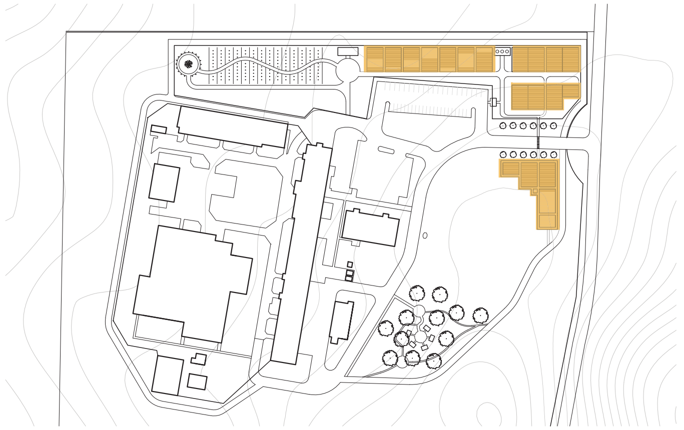
Tomato
Bell Pepper
Jalapenos
Eggplant
Strawberry
Watermelon



Planting Zones

Since the panels rotate with the sun, this creates a variety of light conditions and microclimate for each row. This means that different rows can support certain types of plants more than others. Every species has its own light saturation point which is the optimal amount of sunlight that the plant can photosynthesize during a day. Past this threshold, the additional sunlight the plant is exposed to is not beneficial and can decrease the amount of moisture available to the plant.

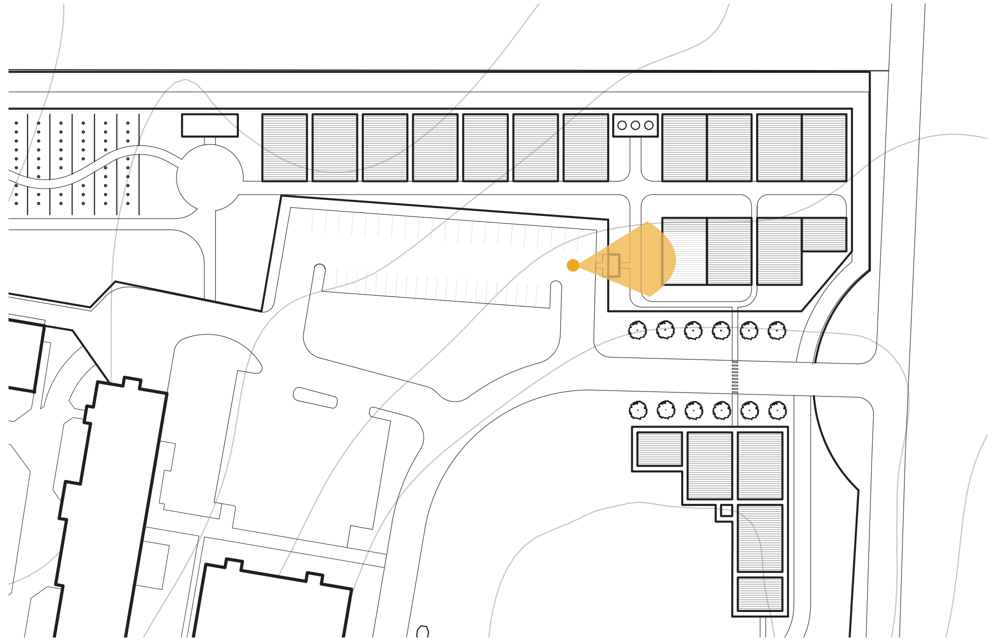
Zone one is mostly shaded throughout the day and crops such as kale and spring onions do well here. Zone two receives partial sunlight during the day which is optimal to grow crops like carrots, broccoli, and beets. Zone three receives the most sunlight and should be reserved to grow crops like tomatoes, peppers, and fruit.

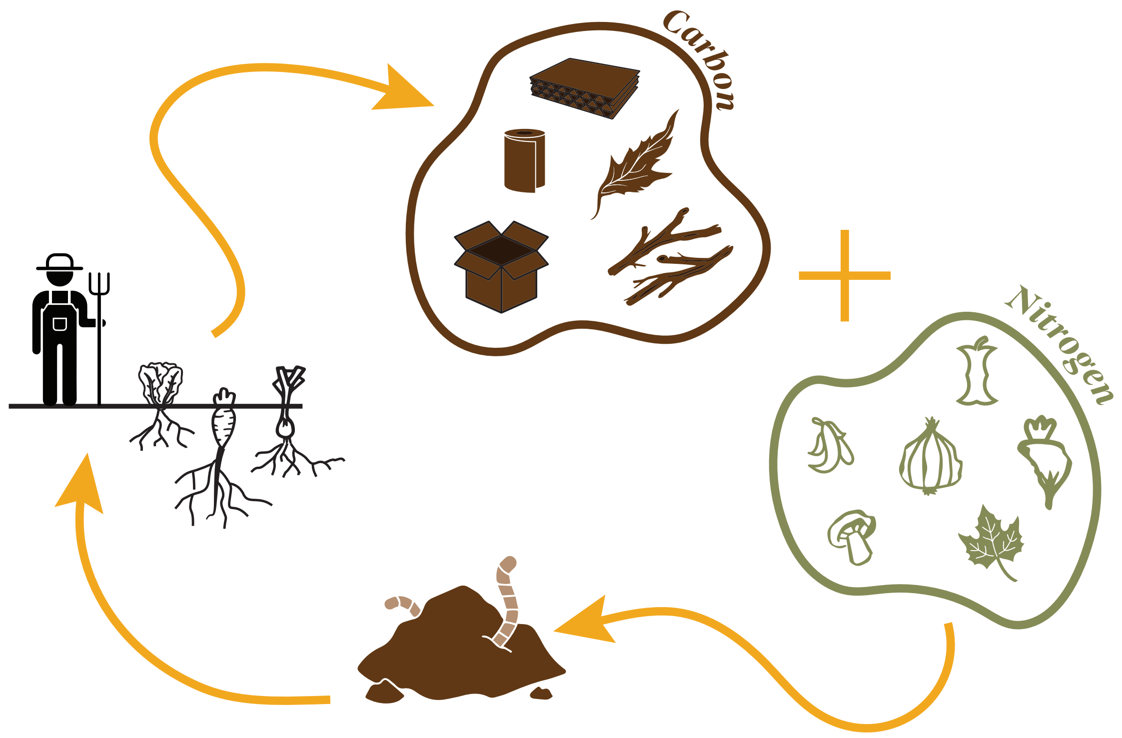


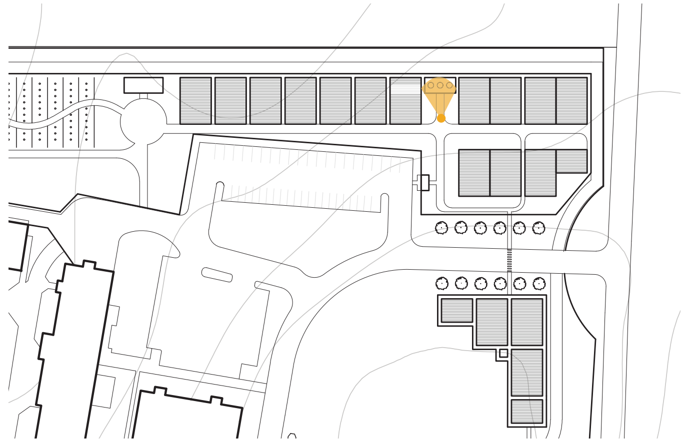
Produce Stand

A large motivator for some AICs is to feel a sense of purpose and make a positive impact in the community. Donating a portion of what is produced in the garden to local food banks can help fulfill this need.

Additionally, WCCF visitors would be able to enjoy some of the food grown in the garden as well. The produce stand is located adjacent to the visitor parking lot for ease of access, and its maintenance and management is yet another job opportunity to get more AICs involved in the garden.



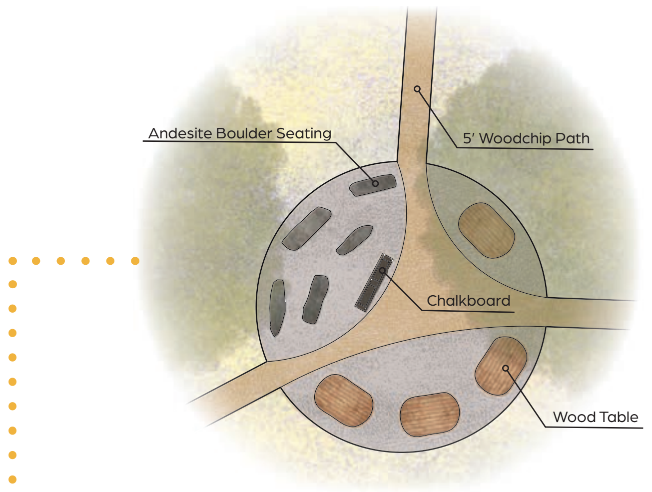




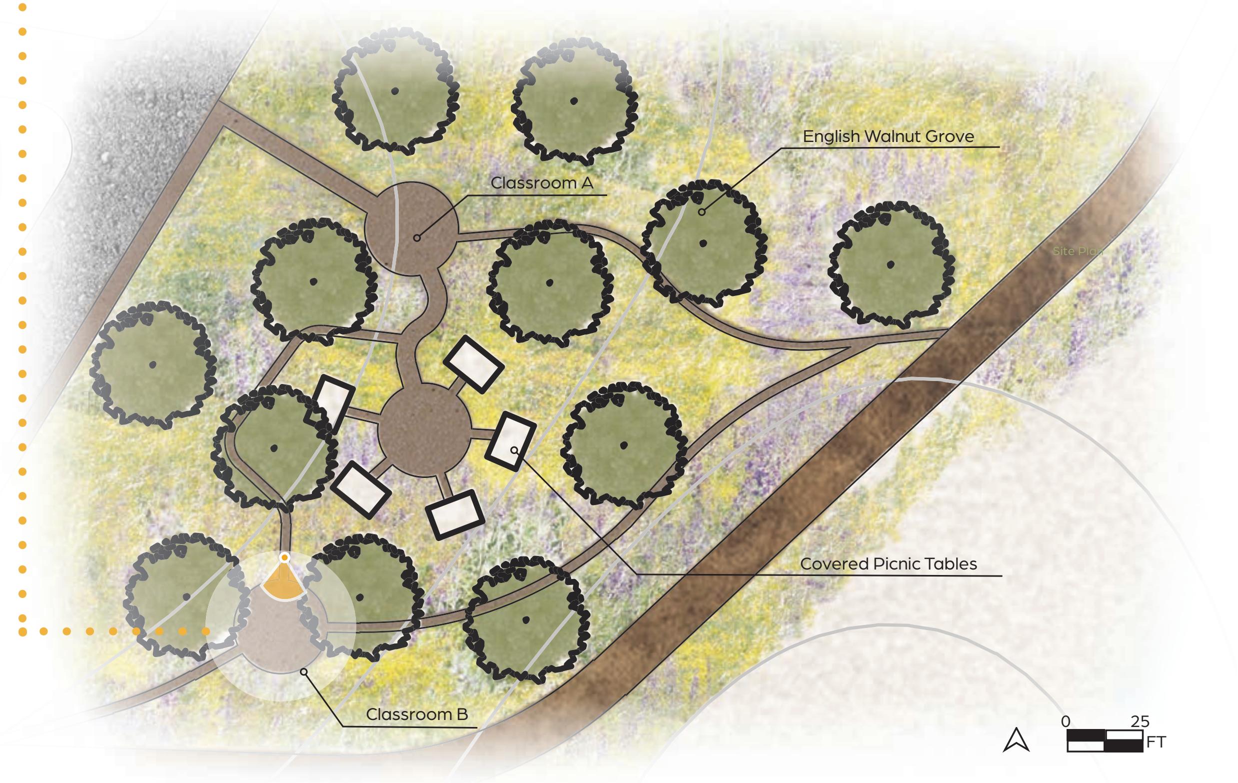
Composting

Food scraps from the prison's kitchen and unwanted plant material from the garden can be combined with woodchips or sawdust from the local sawmill, as well as paper products from inside the prison such as paper towels to create compost. Finding the right ratio of materials will be dependent on the inputs and may vary seasonally which can be part of the learning process for AICs. The compost created can then be used back in the garden to help enrich the soil to grow more food.

The composting material is loaded into three enclosed agitated in-vessel composting systems. Each tub has an internal auger which helps mix and aerate the compost and can help speed up the composting process. Some of the electricity the solar panels produce can be used to power this system. Some advantages of using an enclosed system include that it can cut down on rodents and contain smells. Ultimately, composting on site adds nutrients back to the soil, helps cut down on the amount of garbage the prison hauls away, and is another way that AICs can expand their garden education.



Carpathian English Walnut
Juglans regia 'Carpathian'



Outdoor Classrooms

Because the linear nature of the solar panels can mimic the formality of the prison environment, the design includes an area dedicated to contemplation which can help break up the uniformity of the rest of the garden. This space is not fenced in to allow AICs to feel more relaxed and calmer. A grove of English walnut trees provide lots of shade this space, while also creating opportunities for AICs to learn how to harvest the nut and create dyes from the husks.

Two outdoor classrooms are nestled among the grove of walnut trees. These classrooms are 20 feet in diameter and are meant to serve as another space for small groups to gather and learn outdoors. They are designed to be a place of respite with their circular form connected by winding paths and dappled sunlight. In each classroom there are seating and work benches to accommodate a variety of lessons.

Moving Forward

Estimates

Impact

Opportunity

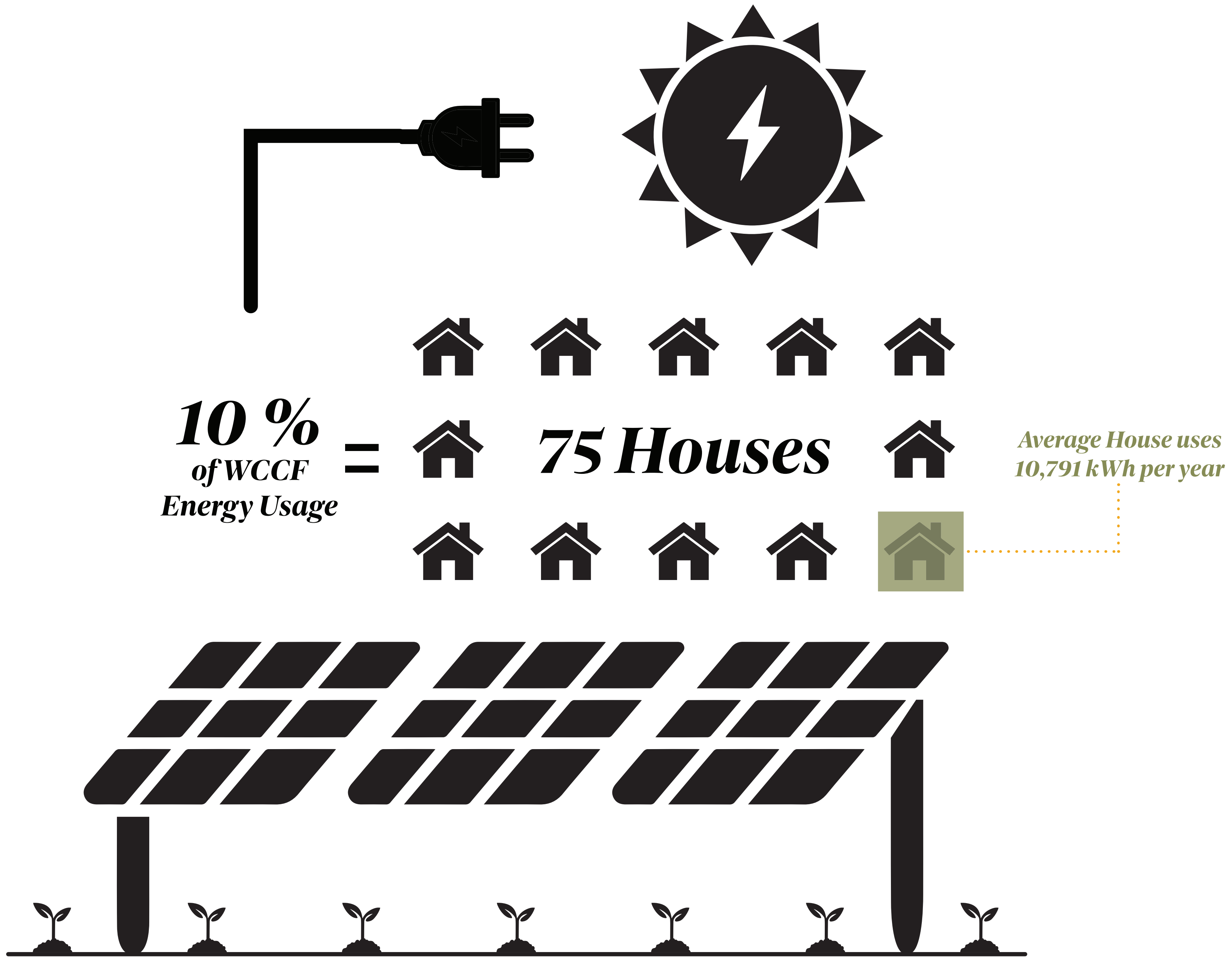
Food Production Estimate

Although there are many assumptions to be made when trying to estimate how much food a garden will produce, a consensus is that around 200 square feet of typical row crop garden is enough space to feed one person for a year (Iannotti, 2023). Some of the variables that can alter this estimate are what kind of crops are being grown, what the diet of the individual is, length of growing season, and garden layout, among many others.

Using this estimate, I have calculated that the expanded garden space (87,120 sq ft) could be enough to feed around 350 people per year. This number also reflects an assumed twenty percent decrease in food production due to the shading of the solar panels (Rahman et. al, 2023). However, this would still be enough to cover more than 85 percent of the AICs housed at WCCF.

Diagram (Right)
Created By: *Mikayla McKone*

$$\left(\frac{\text{New Garden Space (87,120 sq. ft.)}}{\text{Garden Space for One Person (200 sq. ft.)}}\right) \times \text{Solar Panel Shading (80 \%)} = \text{350 Adults in Custody}$$



Energy Production Estimate

`Calculating the amount of energy produced between the two types of solar panels in the design and the impact on the prison's energy needs requires several assumptions to be made. Although there are accurate ways to measure the energy use at the prison, this information is not publicly available. To get an estimate for how much energy I believe WCCF uses, I used multipliers of kwh per square foot for two prisons in Washington and then averaged them using WCCF square footage. My estimate for how much energy WCCF uses annually to operate is 8,150,860 kw which is enough energy to power 766 single-family homes.

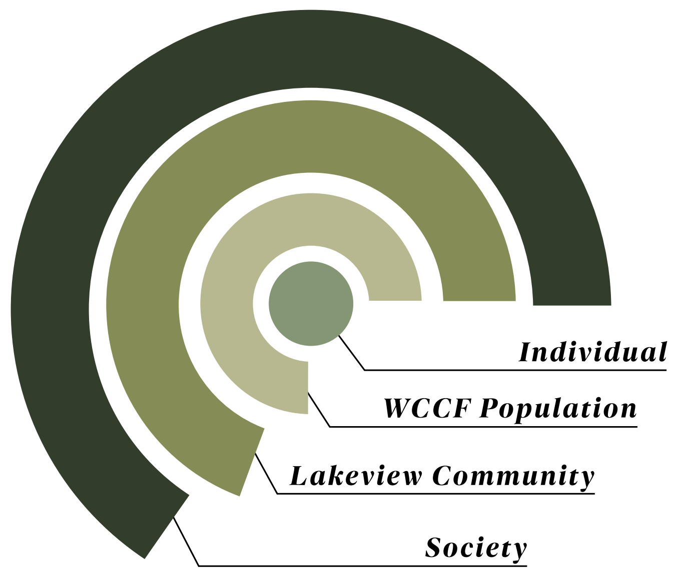
For the 1,853 solar panels in my design. I estimate that they will produce a total of 815,320 kwh. This estimate assumes 400w panels and a production ratio for Oregon of 1.1. Production ratio refers to the difference in how much energy a panel is producing divided by how much the panel is rated to produce (Thoubboron, 2018).

Overall, the calculated energy estimate means that the panels in my design would be enough to provide WCCF with 10% of its energy demands, equivalent to the power 75 single-family homes, which would help bring ODOC closer to their goals of lowering GHG emissions listed in the ODOC 5 Year Sustainability Plan.

Diagram (Left)
Created By: *Mikayla McKone*

See Appendix (pg. 100-101) for calculations

Social Impact of Agrivoltaics at Warner Creek Correctional Facility



- Increased physical and mental health
- Increased variety and access to vocational training

- Reduced recidivism
- Improved environment for AICs and staff
- Decrease spending on operational costs (energy, waster removal, etc.)
- Reduced cost for mental and physical health services

- Increased food security through donation (Food banks, WCCF visitors)
- Source of pride for community
- Potential for Clean Power Co-op

- Food justice movement
- Reduced GHG emissions through renewable energy production
- Shift cultural attitudes
- Add to agrivoltaic research

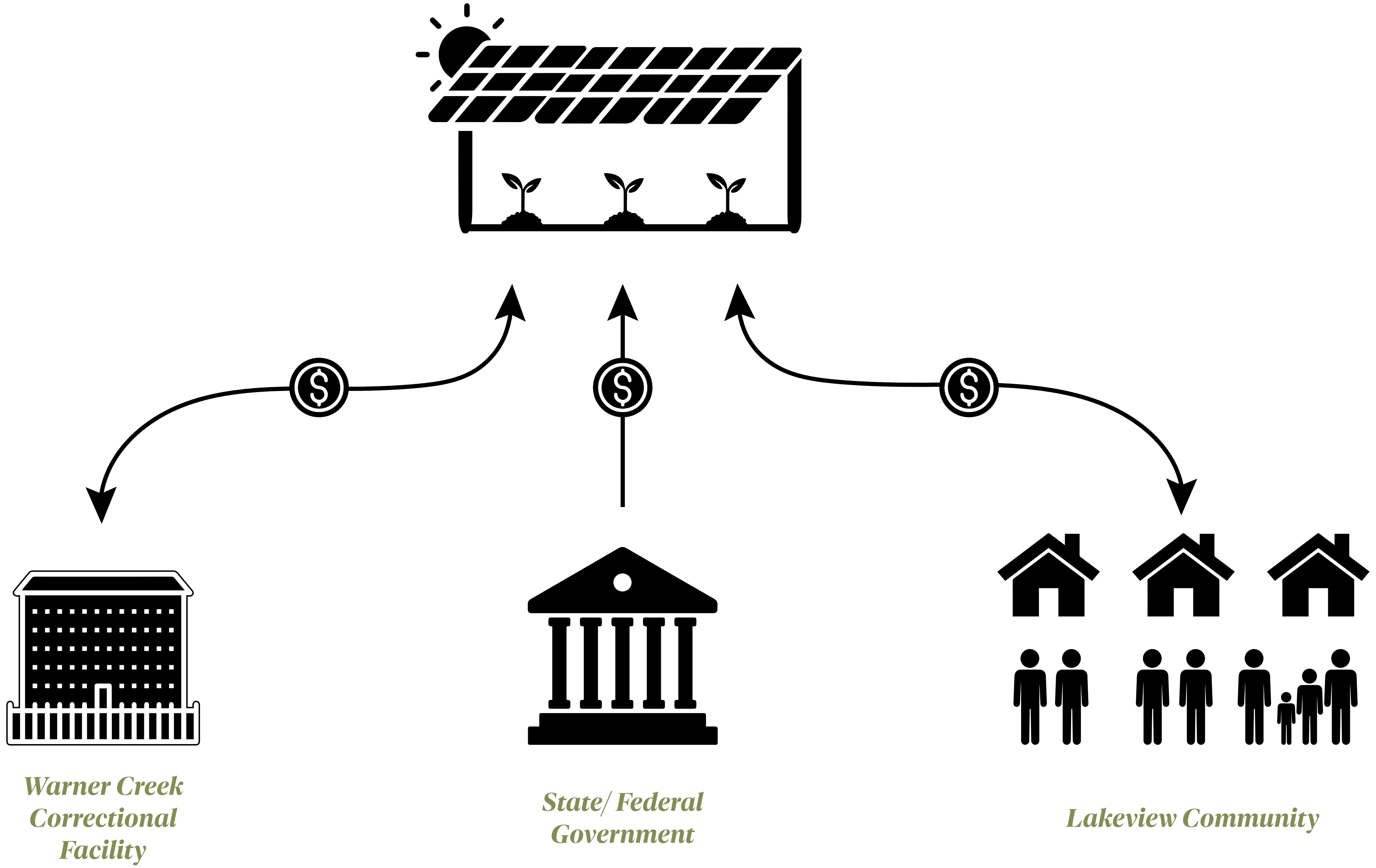
Positive Impact Ripple Effect

This project has the potential to have a ripple effect of benefits starting from the individual AIC to the WCCF population, to the Lakeview Community, and beyond to society in general. The most immediate and significant impact would be for the AICs who participate in the agrivoltaic garden program. They would have regular access to a space that would reduce the mental burden of prison, gain employable skills, and produce food that would significantly improve their diets. These changes in meals are benefits that will be felt even by those AICs who are not able to participate directly in the garden. Overall, the prison environment would be improved and there could be a reduction on mental and physical health services needed. Because of the solar panels and composting, there would be a reduction in operational costs including money spent on energy and waste removal. This money could then be reallocated to other rehabilitation programs for AICs.

For the Lakeview community, donated food from the garden could support several families in need and any visitors to WCCF. The prison's commitment to supporting renewable energy and rehabilitation would be a source of pride for the community that may inspire other prisons to replicate its success. Some of the energy produced may even be able to support a portion of the communities' energy needs. Lastly, the societal impact of an agrivoltaic prison garden is that it aligns with other movements such climate change mitigation, the food justice movement (belief that access to healthy food is a human right), and research for renewable energy.

Diagram (Left)
Source: *Soble et al. (2020)*
Modified By: *Mikayla McKone*

Funding Options for Agrivoltaics at WCCF



Funding Opportunities

Although the cost of solar panels is decreasing, there is still a large upfront cost to install solar arrays. However, there are forms of governmental financial support available to help consumers switch to renewable energy. Most of the options are only available on smaller scales of tax credits, incentives, and rebates for homeowners. Options for funding are more limited for communities and large institutions which come in the form of grants. In 2022, Lakeview was awarded $100,000 through the Community Renewable Energy Grant Program to further develop the town's geothermal well to expand heating to reach more residence, businesses, and public facilities. Lakeview could reapply for this grant to help afford the upfront costs of agrivoltaics.

Another avenue that could help pay for the costs would be to develop a partnership between WCCF and the Oregon Clean Power Co-op. Oregon Clean Power Co-op is an organization which gets individuals in local communities to invest in renewable projects by either becoming owners or subscribers to receive credits on their energy bills. The solar panels at the Lakeview Library are a successful example of this program. Although this partnership could increase positive relationships between WCCF and Lakeview, a tradeoff would be that a portion of the energy produced would be used by the community rather than reducing the prison's own GHG emissions. Likely, for a project like this to be implemented, there would need to be a combination of funding from the prison, the government, and the community.

Diagram (Left)
Created By: *Mikayla McKone*

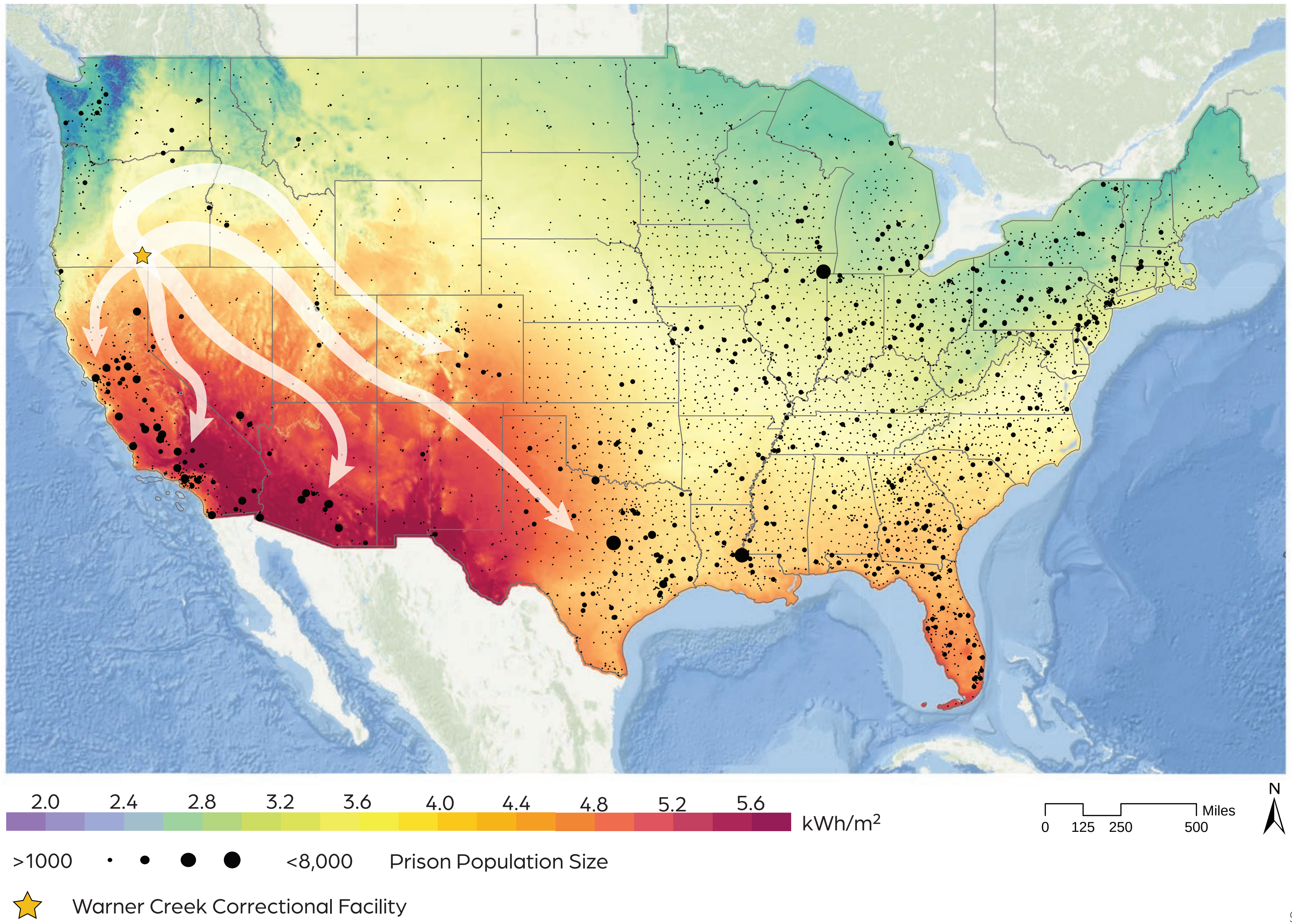
Prison Agrivoltaics Expansion

If agrivoltaics can be implemented successfully at Warner Creek, this could be a precedent for implementing agrivoltaics into other existing prison gardens around the United States.

The benefits of agrivoltaics in prison gardens could be increased if implemented in states such as California, Arizona, or Texas because they have larger prison population sizes and more solar potential compared to Oregon. In other words, these programs would have the ability to impact more individuals and communities while increasing their energy and food security.

Map (Right)
Created By: *Mikayla McKone*
GIS Data: *https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::prison-boundaries/about*
https://solargis.com/maps-and-gis-data/download/usa

Opportunities for Agrivoltaics in United States Prisons



Conclusion

Although the issues of mass incarceration and climate change are large and complex, I believe that landscape architects can play a key role in helping to solve these issues. The landscapes we design can maximize benefits and increase multifunctionality for people and the environment. A project like The Power of Oregon Prison Gardens helps show how influential landscape architecture can be in changing public opinion, especially on controversial topics. Ultimately, I hope that this project can help move ODOC more towards a rehabilitation focused model and be a pillar for "the Oregon Way" while reaching their sustainability goals.

Diagram (Left)
Created By: *Mikayla McKone*

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Annual Prison Energy Use Calculations

508,000 sq ft. (WCCF)	x	[21.32 kwh/sq ft] Airway Heights Corrections (WA)	=	10,830,560 kwh
508,000 sq ft. (WCCF)	x	[10.77 kwh/sq ft] Coyote Ridge Correction Center (WA)	=	5,471,160 kwh

$$\frac{10{,}830{,}560 \text{ kwh} + 5{,}471{,}160 \text{ kwh}}{2} = 8{,}150{,}860 \text{ kwh}$$

Solar Panel Calculations

Garden Modules

634,920 kWh	=	1.1 (OR production ratio)	x	1443 # of panels	x	400W Wattage per panel

Orchard

180,400 kWh (System Size)	=	1.1 (OR production ratio)	x	410 # of panels in my design	x	400W Wattage per panel

815,320 kWh (Total System Size)	=	634,920 kWh	+	180,400 kWh

$$\frac{815{,}320 \text{ kWh}}{8{,}150{,}860 \text{ kWh}} = 10\%$$

10% WCCF energy demand covered by solar panels

Production Ratio = output estimate/ max power rating for a single panel