ENERGY, EQUITY & EMPOWERMENT
Residential Photovoltaics in the Global City of Portland, Oregon

Installing Photovoltaics on the Sally McCracken Building
(Image from Lewis & Clark Digital Scholarship Multisite: Oregon Solar Policy)

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TERMINOLOGY

Renewable Energy (RE) – Energy derived from natural resources with short cycles of natural replenishment (ie. solar, wind, hydroelectric, tidal (kinetic) biomass, biofuel). For the purposes of this paper: natural gas, and nuclear are not considered RE.

Renewable Energy Technology (RET) – Technology that produces usable energy from RE sources, including the technical infrastructure that may be required for utilization.

Photovoltaics (PV) – Semiconducting cells and systems that convert solar energy into electricity via the *photovoltaic effect*.

Green Capitalism – a political-economic theory that criticizes of capitalism's dependency on fossil fuels and environmental degradation.

Global City Theory (GCT) – An urban theory, coined by Saskia Sassen's *The Global City* (2001) that conceptualizes the role of cities as nodes in a global economic network.

Central City Concern (CCC) – A 501(c)(3) nonprofit agency serving single adults and families in the Portland metro area who are impacted by homelessness, poverty and addictions. With a staff of 800+, an annual operating budget of $60 million, CCC helps 13,000 individuals annually.

Lewis & Clark College (LC) – A private liberal arts college in Portland, Oregon.

Median Fixed Income (MFI) – Static calculated by the US Census Bureau, where median value of all forms of household income is taken, over 12 months.

Federal Poverty Level (FPL) – A measure of annual income issued by the Department of Health and Human Services (HHS). 2017 level is currently: $12,060 for an individual, and scales up to $41,320 for families of eight.

Social Vulnerability / Vulnerability – the idea that socioeconomic conditions can increase the possibility of harm from risks.

Risk – the possibility that a systemic perturbation will negatively affect an individual.

Equity – differing from equality, implies that in attempts to improve the human condition fairness must be considered to address the socio-economic variability.

ABSTRACT

Renewable energy development theoretically aims to address social vulnerability in attempts to mitigate and adapt to climate change. The nature of resilient development, however, often ignores issues of social vulnerability and equity. Vulnerable populations are characterized by socio-economic positions that increase their risks to change. These populations possess less resilience against risks of hydrocarbon combustion-induced climate change, increase market price of energy, and displacement due to RE development caused displacement. In a three part, multi-method, critical analysis, I root global issues of energy and resilience in the locale of global city, Portland Oregon. Depicting the ways in which RE development in local economies can empower vulnerable residents, I explore I look at issues of equity and decision-making agency implicit in the policies that guide residential photovoltaic development. Understanding Portland as a 'global city' allows interesting connections to be made between local inequities and the globalization of; energy infrastructure, political economy, and vertically distributed modes of production.

Key Terms: Political Economy, Global Energy Infrastructure, Social Vulnerability, Risk Resiliency, Environmental Gentrification, Global City Theory, Green Capitalism

INTRODUCTION

Energy has been a driving force in the creation of Earth's natural and built environments and has played a key role in the evolution of biological life, the structure of society, and human intelligence. The commodification of energy paired with the privatization of space, has framed the human relationship with energetics under capitalist modes of production. This paper explores the role of energetic economy within the connected network of environment and society. Understanding the world as a connected system of intersubjective relations, an equitable analysis necessitates equal credence to all actors. This paper attempts to emphasize intersections of global energy infrastructure, political economies, and local sociality through a critical exploration of local combustion and consumption. "Combustion economies" have been around since the first prehistoric use of fire (Pyne, 2011). Millennia later during the Industrial Revolution this combustion economy turned to fossil fuels, and development soared. The need for firewood shifted to the need for coal, and humans no longer experienced the "constraint of living on solar income", and instead began combusting "past solar heat" in the form of coal, minerals, and forests" (Burkett & Foster, 5). Combusting hydrocarbons allowed for rapid development, and perpetuated this spatio-temporal dissonance, which violated the parity between humans and their surroundings pre-industrial revolution and resulted in climate change and environmental degradation (Bradshaw, 2013, Bradford 2006).

Many Renewable Energy Technologies (RETs) use natural energy sources that are functions of solar input (ie. wind, hydro-kinetic, biomass). This theoretically combines the 'constraint of living on solar income', with the technological efficiency that society demands. Through this paper, I examine the renewable energy (RE) transition under ideals of Green Capitalism that critique vertically distributed global energy economies (Foster et al., 2001, Hawken, 1999, Rivkin, 2014), and question issues of local equity as a product of economies of scale. I argue that RE development and implementation must be framed within a multi-faceted, interdisciplinary framework that can imagine development where society, natural environments and species alike, have more equitable stakes and power over systemic changes. In a three-part methodology, I posit Global City Theory to address how global energy economies and vertically distribution manifest in the city of Portland. To illustrate global power within the locale of Portland, I examine social vulnerability to environmental gentrification and displacement that and mechanisms that affect residents'; agency, future-resiliency, equitable accessibility, and empowerment vis-a-vis decision-making.

PART ONE, a descriptive component, illustrates the level of participation Portland has had in solar energy development. I spatially compare PV presence, social vulnerability data, and

PV incentive-participation data, finding that both PV installations, and incentives go to areas of less vulnerability. **PART TWO**, an explanatory component for part one, examines the form of PV incentives, and how they might contribute to this uneven distribution. Under legal, political, technical, and infrastructural analytical frameworks I address issues of accessibility, and environmental injustice. This piece relies on analysis of three primary PV policies and incentives: US Renewable Energy Tax Credit, Oregon's Renewable Energy Tax Credit, and the Energy Trust of Oregon's solar tax incentive, augmented by an informative interview with a Field Energy Consultant from major solar installation company, SolarCity. **PART THREE,** an instrumental discussion, looks at the social implications of institutional, bureaucratic development, and questions ethics and action. This piece takes form as a case study on PV installations for the Sally McCracken building in downtown Portland, an affordable housing complex owned and operated by the nonprofit Central City Concern (CCC). Examining multi-family affordable housing as urban places of concentrated vulnerability, a network of relations is depicted that can transcend many of the socio-economic barriers that RE development faces. I examine their recent PV installation, and discuss what parts of the project *can* and *should* be replicated to create new modes of access, while also maintaining that certain aspects of inequality remain outside the power of third-parties.

By examining energy, equity, and empowerment at the small scale of the individual, home, and neighborhood, I found that current RE infrastructure, policies, and incentives are only accessible and beneficial to populations that are already resilient: specifically, homeowners above the FPL. Decisions over future energy security and PV resiliency must be made on their behalf of vulnerable populations, due to the political economy of access and decision-making, which further amplifies relations of dependence, disempowerment, and risk for the socioeconomically marginalized.

PART ONE: ENERGY & ECONOMY

Theoretical Frameworks: Discount Rates, Substitutes, and Economies of Scale

"Fossil energies are by far the most widely used, providing a little over 80% of the world supply of primary energy. Oil still represents the most important share (34%), followed by coal (26%), natural gas (21%), renewable energies (13%) and lastly nuclear power (6%)" (Rojey, 2009). The US energy economy is vertically integrated due to the nature of extraction, the role of monopolistic utilities, and the impact that massive government subsidies have on market price. Consumers must choose to pay more per kWh for RE access and participation. Many environmental economists argue that fossil fuel subsidies ignore a massive issue of environmental value and global population growth, which is expected to exceed 9 billion by 2050, and double our energy demands by 2060 (Smil, 2000). A method that aims to consider the economic value of future environmental and social health can be described as a 'discount rate'. "Discounting is fundamentally how we value the future relative to the present" by "the issue of how we value the welfare of future generations relative to present ones (the time discount rate)", and "the issue of how wealthy future generations will be relative to preset ones and whether it is appropriate to shift costs from the present to the future" (Foster et al., 2011: 95-96). Some environmental economists take a position like Nordhaus, arguing for a higher discount rate, and allowing for a slower transition away from fossil fuels. Others like Stern, argue for a smaller discount rate and immediate action to curtail carbon emissions (Foster et al., 2001). Government agencies and federal and state energy commissions use discount rates in design and planning, and use this to determine law and policy that determine prices and Renewable Portfolio Standards (RPS) for utility companies. RETs have high initial costs and low operating costs while hydrocarbon energies have low initial costs (due to subsidies) and higher costs over time

(Walker, 2013: 8). Discount rates determine how these costs are valued by affecting "total levelized cost of electricity from the plant less than changing fuel price, plant installed cost, or capacity factor" (Ringer, 2008: 18). Although RETs naturally have a lower discount rate than hydrocarbon energies, utilities like PGE charge a higher market price, and it is important to scrutinize policy as a method of price distortion, which I will explore later.

The combustion economy, like other market economies, has a long history of substitutes you can trace back to the first discovery of fire (Pyne, 2011). Natural gas was first introduced to stabilize the market at times when fossil fuels were scarce, and inflation was a risk: "when oil is cheap, the price for natural gas is depressed and drilling for gas is curtailed. Already, producible reserves of natural gas have diminished. When cheap natural gas is no longer available, it will be supplanted by oil" (Abelson, 1989). Substitutes are often responses to market-risk, but it is important to question the nature of the risk. Who is subject to these risks? Is it really the consumer? Or is it the fossil fuel corporations risk of other energy technologies that don't face the same level of resource-scarcity? Hydrocarbon energies require large-scale infrastructure, complicated operations, massive amounts of capital, and a vertically integrated economy. RETs have different economies of scale, and although some require medium-large scale operations (ie. hydroelectric, biomass) others are designed to be efficient on a household scale (ie. wind, ethanol, geothermal, and solar). "Large projects involving third-party financing are responsible in large part for the growth in the solar market from 205 to present" (Walker, 2013: 2), is it time time to focus on smaller economies of scale where solar is a beneficial substitute? In a report titled, *Wind and Ethanol: Economies and Diseconomies of Scale*, John Farrell the director of Energy Democracy Initiative for Local Self-Resilience argues that the REs can benefit from local development in rural America because they cut out many transportation-related, and social costs.

Farrell argues, “To date, policy makers have designed renewable energy incentives that offer higher rewards for bigger facilities. They should more closely examine the tradeoffs attendant to large scale production systems” (Farrell, 2007: 3). This study looks to further investigate Farrell’s argument by challenging its relevance in the local, urban setting of Portland and examining equity as an important tradeoff to consider.

Background: Energy Insecurity, Political Economy of Representation, and Spatial Vulnerability

Low-income households are more socially and financially vulnerable to changes in market price for utility-based energies. A report by public-policy and new market development manager, Patrick Sobel titled: *Power to Empowerment: Plugging Low Income Communities Into the Clean Energy Economy* articulates the nature of tradeoffs vulnerable families are forced to make over energy, and their risk of disempowerment. American low income families spend between 10-50% of income on electricity compared to the national average of 2.5% (Sobel, 2016, Chandler, 2016), and another 50+% of their income on rent (Center on Budget and Policy Priorities, 2016). Sobel argues that disproportionately high energy costs detract from flexibility to make social investments in; education, personal savings, healthcare, or debt reduction and that “addressing America’s growing and concentrated energy cost challenges is essential to unlocking the full economic potential of low and moderate income communities” (Sobel, 2016). Scholars specializing in equitable energy accessibility, Diana Hernandez and Stephen Bird calculate that energy insecurity affects 1.89% of national energy use, a portion—if addressed effectively that could save—4-11 billion dollars the 67% of families (at or below the Federal poverty line) who face the risk of energy insecurity. Out of these families, 55% are rent their homes, and 49% are African American) (Hernandez, 2014, Bird & Hernandez, 2012: 1).

These impoverished families, at risk for energy insecurity maintain positions where they are unable to make decisions towards protecting themselves from systemic change due to vicious feedback loops that reinforce and replicate their vulnerability. In cities, this process can be understood under mechanisms of GCT and environmental gentrification, where RE development avoids addressing energy security by only incurring change for urban populations of "global elite", situated in the city core, that result in a local struggle to stay resilient. A spatial study performed by Jordan Wirfs-Brocks of Insider Energy found that Portlander's who are below 50% Federal Poverty Level spend 22% (compared to Sobel's national estimate of 9.92%) on electricity—an annual average of $1543.88 (Wirfs-Brock, 2016). In a city where urban sustainable development has strengthened the global city center, this risk of energy insecurity only further disempowers the vulnerable vernacular: "green investment in the city's core – ultimately contributed to the demarcation of racialized poverty along 82nd Avenue" discussing how these displacement "crises have been shifted to the household and neighborhood scale" (Goodling et al., 2015:1). Replicating concerns over environmental gentrification, Lisa Bates' 2012 *Gentrification and Displacement Study* conducted by the Portland Bureau of Sustainability reimagines the concerns of Bird & Hernandez, at Sobel's economic scale. Reflecting Hernandez's vulnerable characteristics, Bates includes renters, communities of color, and income-level in her four-factor definition of vulnerability, arguing that mechanisms of displacement can be amplified by residential RET investments that "can make the neighborhood more attractive and create upward pressure on rents and property values" (Bates 2012: 4). Residential PV systems have been found to increase the value of homes without increasing property taxes, and cut energy premiums by 75% (Hoen et al., 2011: 46), creating more resilience for some while others are spatially estranged.

Data & Methods

> Distinctions can be made in justice theory (and everyday justice practice) between situations in which distributional inequalities are the consequences of the actions or informed choices made by the same people who are affected by them, and those where there is a dislocation between those benefiting from and suffering from patterns of distribution. (Walker, 2012: 32)

Guided by GCT, environmental gentrification, and Portland's concern over spatial inequality, I chose to visually convey residential PV development and social vulnerability using spatial analysis. Spatial data came from a couple different sources. I acquired the first dataset from the Bureau of Sustainability's *Portland Solar Map,* including all residential and commercial installations from 2001-2011. These data included the size of every system, the type of system (photovoltaic, water heating, pool heating, space heating), the cost of the system, and the tax credit attributed to the system. I used these data set to single out residential photovoltaics from other systems that fall into the solar category. I also used these data to calculate the percent of the total system cost that was covered by tax credits. This was more of an investigative procedure, and I did not use this tax credit data for my methodology since it did not have enough specific metadata attached to draw any important conclusions.

Second, to illustrate and analyze risk and vulnerability present in residential communities, I attained the shapefiles from Bates' *Gentrification and Displacement Study* that was developed using 2010 Census data. This study theoretically tied into my investigation,

Risk Factor	Evaluation Criteria	Vulnerability Score: Yes (1)	Vulnerability Score: No (0)
% Renters	Is proportion of renters in the census tract greater than 45.6%?	1	0
% Communities of Color (CoC)	Is proportion of CoC in the census tract greater than 27.4%?	1	0
% Population age 25+ without bachelor's degree	Is proportion of population 25+ without bachelor's degree in the census tract greater than 56.3%?	1	0
% Households with income at or below 80% MFI	Is proportion of households with income at or below 80% MFI in the census tract greater than 43.7%?	1	0
Vulnerability Score		Max: 4	Min: 0

Every census tract gets evaluated based on the above listed criteria and the total scores on the four risk factors are added to get the overall "vulnerability scores". Census tracts that score at least 3 out of maximum 4 are defined as "vulnerable census tracts".

Image 1. Vulnerability Index Criteria (Bates, 2010).

and already had spatially indexed Portland by discrete characteristics of vulnerability and risk of displacement. Mentioned previously, Bates defines vulnerability using four "characteristics that make resisting displacement more difficult" (Bates, 2010: 1): renters, communities of color, population without a bachelor's degree above the age of 25, and low median income. Figures 3-11 focus on the two of the four risks Bates uses to calculate vulnerability, that resonate with Bird & Hernandez's studies on energy poverty and characteristics that embody elevated risk to utility price changes (Hernandez, 2014, Goodling et al., 2013, Bates, 2012): renter risk and income (presented as MFI). To avoid over-generalizing data and demographics, I decided not to explore the third overlapping risk factor "communities of color", since Hernandez speaks specifically about African American populations. Third, I introduced the issue of policy-based decision making and inequitable incentives by acquiring data from the Oregon Department of Energy on Residential Renewable Energy Tax Credits (RETC). These data were sent to me in a series of Excel spreadsheets of credits granted between 1986 and 2015. I refined this dataset to include only photovoltaic installations, and locations within the boundaries of Portland. I geocoded these addresses to create a shapefile of XY points that I could analyze with the first two datasets.

I primarily used spatial statistics tools from the ArcGIS toolbox to evaluate these datasets against each other. I also used the Attribute-Calculation function and Statistical Summary reports to gather the data shown in Figure 2. Figures 3-11 used: Hotspot Analysis, and Optimized Hot Spot Analysis to represent PV and RETC point data within polygonal vulnerability data. These tools both display significant spatial clusters based on high or low values, but Optimized Hot Spot Analysis generates results by creating a new polygon shapefile, instead of combing results with existing points.

Results

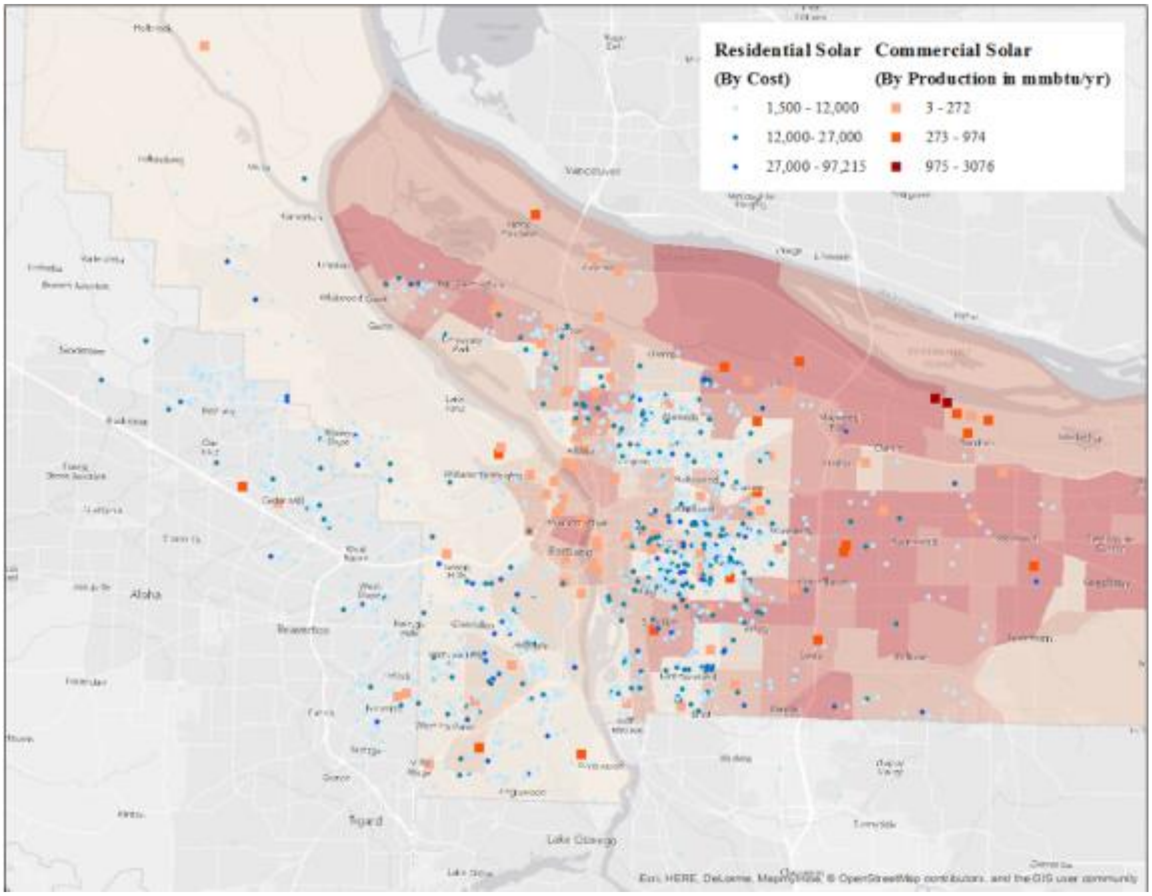


Figure 1. Map of Photovoltaic Installations and Vulnerability Data

First, I mapped the Portland solar dataset against the vulnerability dataset to describe the relationship between PV presence and vulnerability characteristics. It was immediately obvious that more residential PV installations were present in census tracts that were not vulnerable. The densest areas of blue dots can be seen in the inner SE area of Portland in the Ladd's Addition, Laurelhurst, Irvington, Hollywood, and Alameda neighborhoods. The commercial systems however, were located primarily in areas of high vulnerability, and Portland City Center.

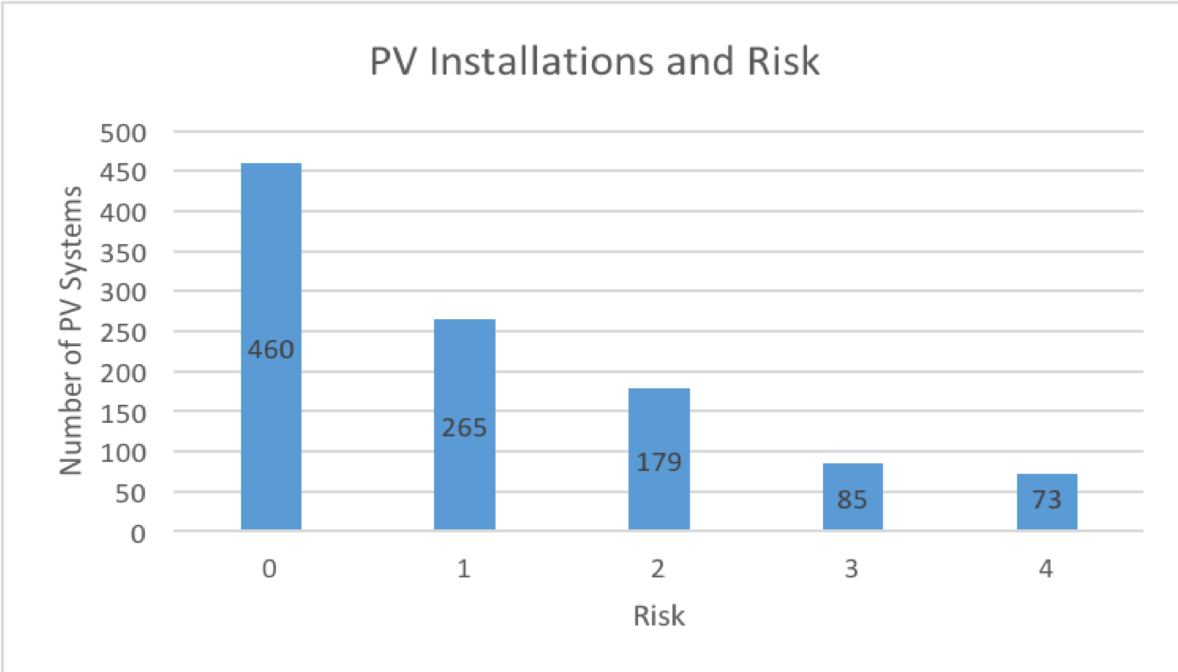


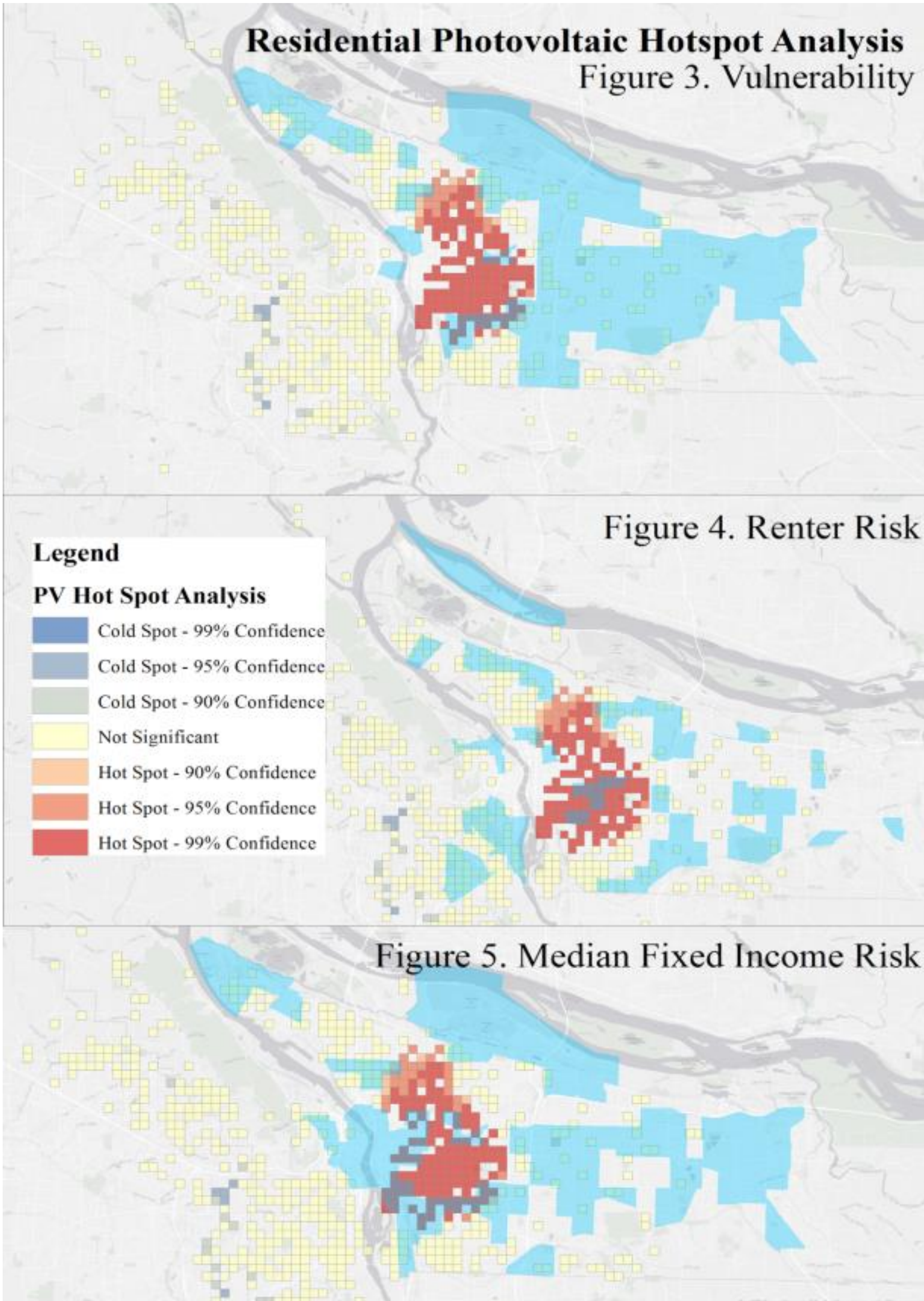
Figure 2. Relationship between Risk and Residential PV Development

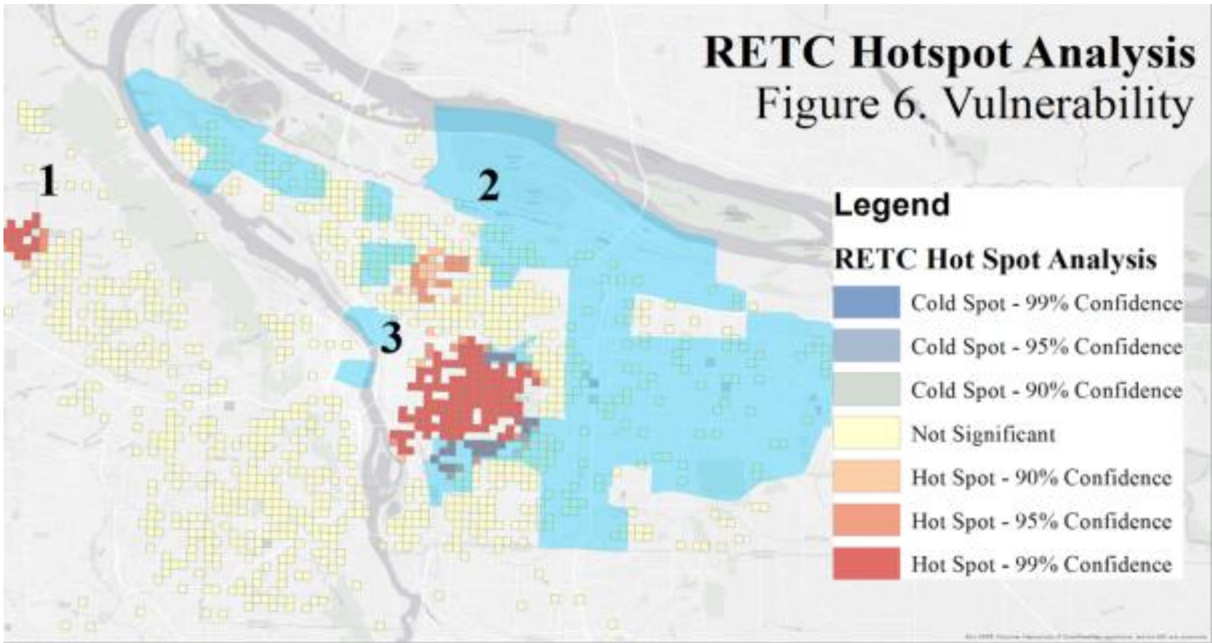
I used the statistical summary tools to calculate the residential photovoltaic points within polygons of different risks, and created a quantitative bar graph to display the results. I found that the data I was using displayed a strong relationship between low risk populations, and less PV presence. Tracts with vulnerability scores of zero had the most PV systems, totaling 460. Tracts with vulnerability scores of one had almost 50% less, totaling 265. Tracts with vulnerability scores of two contained 179 systems, and categorically vulnerable tracts had less PV systems put together than any other single risk. Tracts with a score of three had 85 systems, and tracts characteristic of all four risks only had 73. There is a clear negative relationship between risk factors and PV installations, and this bar graph describes some of these issues of distribution I originally hypothesized.

To illustrate vulnerability data to PV presence, RETC presence, and total value of all tax credits I performed Hot Spot Analysis comparing each of these three variables with renter risk, median fixed income risk, and whether the tract was deemed vulnerable to gentrification by the

Portland Gentrification and Displacement study.

Figures 3, 4 and 5 further develop observations of inequality that Figure 1 and 2. I chose Figure 3 shows clearly that the area in Portland with the most significant presence of photovoltaics by quantity and proximity, only overlap with vulnerable tracts on the very perimeters of the hotspot. Specifically overlap occurs around the Creston-Kenilworth neighborhood. Another small area of overlap is contained to a single census tract between Laurelhurst and Montavilla neighborhoods next to I-84. Figure 4 singles out the tracts where the percentage of renters is above 45.6%, and these areas cover more of Portland than vulnerability in general. The areas where the PV installation hot spots overlap with renter risk are primarily on the inner Eastside between Laurelhurst and Creston-Kenilworth, with an of North Portland, Mount Tabor, Sunnyside, and Ladd's Addition. Figure 5 does not show nearly as much overlap as Figure 4, and the areas where significant PV presence overlaps with the risk of low MFI are around Creston-Kenilworth, I-84, and Sullivan's Gulch.


Residential Photovoltaic Hotspot Analysis
Figure 3. Vulnerability
Figure 4. Renter Risk
Legend
PV Hot Spot Analysis
Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence
Figure 5. Median Fixed Income Risk



RETC Hotspot Analysis
Figure 6. Vulnerability

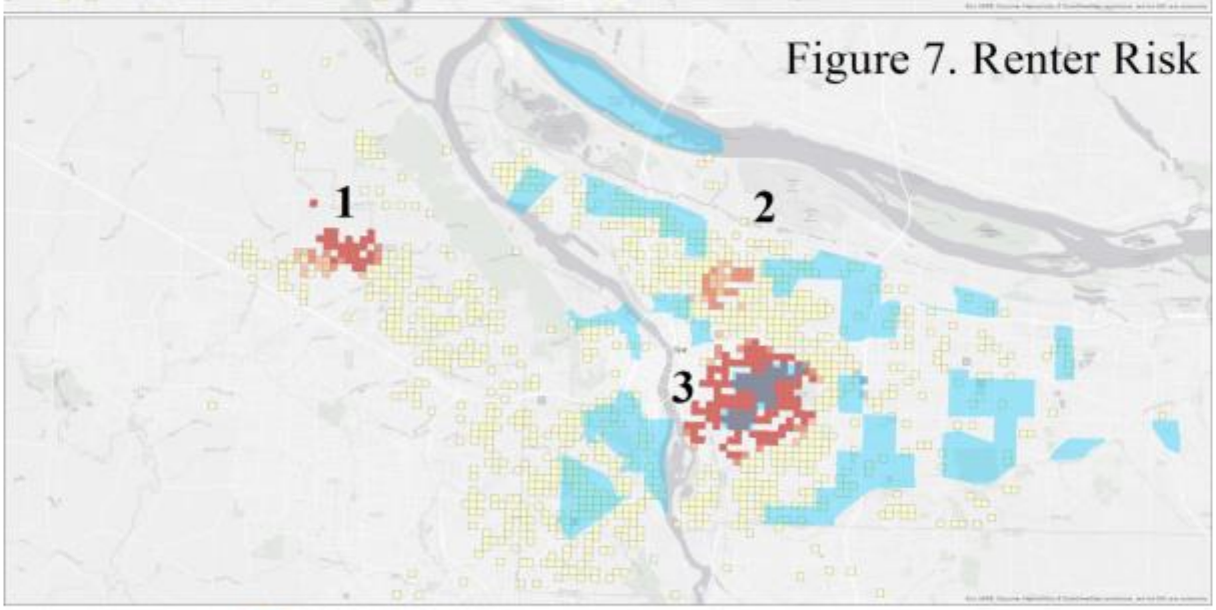


Figure 7. Renter Risk

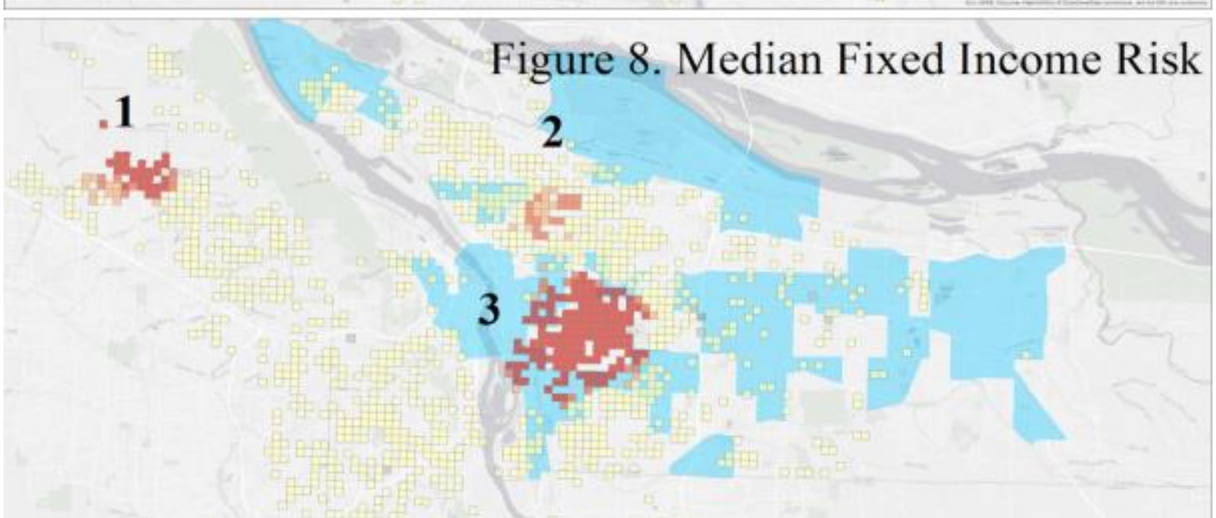


Figure 8. Median Fixed Income Risk

Figures 6, 7, and 8 show the same vulnerability polygons with the Hot Spot Analysis results from RETC data. This analysis found three hotspots, that are marked with numbers 1-3. The two hotspots on the Eastside, in Figure 6, align with the largest PV hotspot, with less significance North of I-84, secluding a small area in the North East Portland neighborhood. Another hotspot appeared on the Westside around Forest Park and Skyline.

Vulnerability only overlaps here in the Creston-Kenilworth neighborhoods and in a small area of Rose City Park. Figure 7, with hotspots similar to Figure 6 show more overlap of RETC and tracts with risks of renters. I hypothesize that the increase of overlap for specifically the risk of renters, is due to the sheer size of the renting population in Portland, and how it is characterized not only by people who rent out of financial necessity, but those who rent to maintain their transient mobility. RETC's Hotspot 1 and Hotspot 2 do not have any overlap with renter-risk, but similar to the PV hotspot, RETC Hotspot 3 has overlap around Sunnyside, Richmond, and Creston-Kenilworth neighborhoods. Figure 8 shows again, MFI risk not overlapping with RETC Hotspot 1 or 2, and similar to the PV maps, RETC Hotspot 3 has overlap around Rose City Park, Sullivan's Gulch, Richmond, and Creston-Kenilworth.

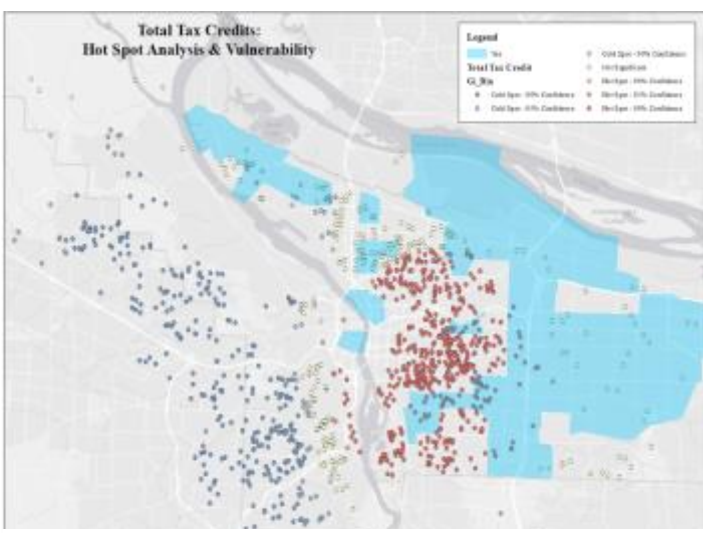


Figure 9

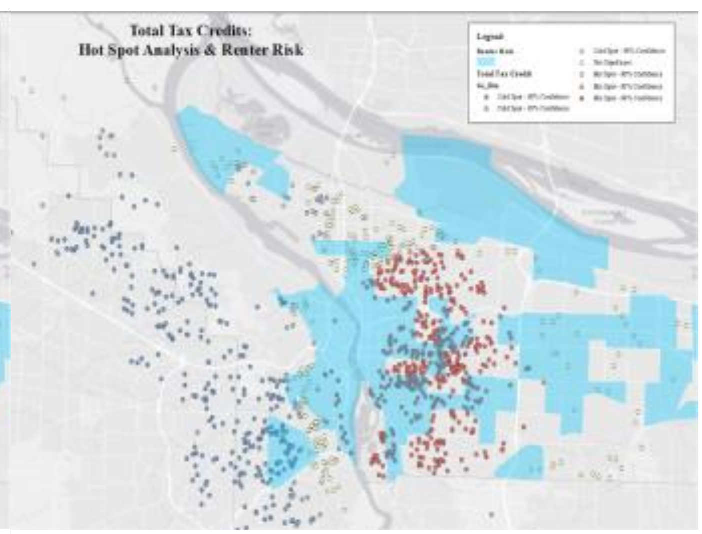


Figure 10

For Figures 9, 10, and 11, I was required to use a different Hot Spot Analysis, that displayed as points, since these data I was comparing each had a unique numerical value. These points depict the value of tax credit received by a home for their PV installation, and the Hotspot analysis displays significant clusters based on tax credit size. This Hotspot analysis basemap shows a significantly proximal large tax credits in the same area as PV's main hotspot, and RETC's Hotspot 3 with an exception of a small area that borders the Waterfront downtown. Figure 9 shows an overlap with this hotspot of high tax credits where I-84 borders Laurelhurst, and in the Foster-Powell neighborhood. Figure 10 depicting renter risk against this tax credit Hotspot also shows more overlap, primarily around Richmond, and where Laurelhurst and Sunnyside reach 60th. Figure 11 reveals more overlap than I would have expected from the other two MFI maps, showing overlap in Sullivan's Gulch, Rose City Park, Richmond, Creston-Kenilworth, Brooklyn, Powell-Foster, and Northeast Portland. There is no overlap of MFI risk and the high tax credit Hotspot in a solid area covering Irvington, Roseway, Laurelhurst, Sunnyside, or Montavilla, but this could also be due to the presence of many wealthy families in these areas that may disqualify the area from the low MFI risk.

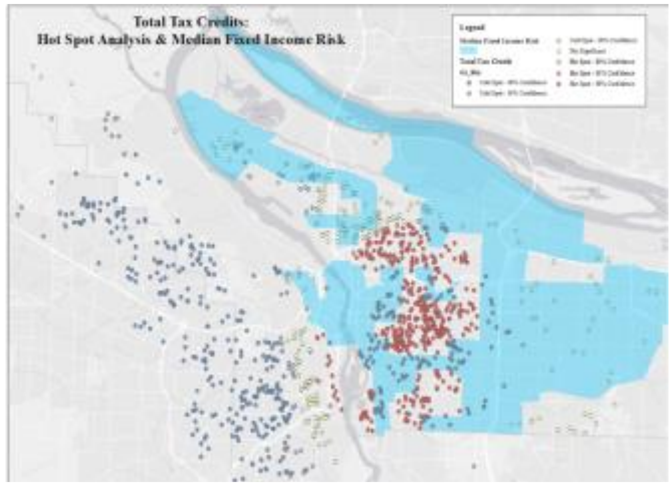


Figure 11

PART TWO: EQUITY & ACCESS

Theoretical Frameworks: Global City Theory and Environmental Gentrification

High density environments suit solar technology over many other RETs (wind, water, geothermal, biomass), due to its efficient scale that can serve an individual. I chose the urban locale of Portland, Oregon because of its relationship to global economies and rhetoric of sustainability. I examine Portland under Saskia Sassen's urban Global City Theory (GCT), because it is characterized by its; concentrated command in the organization of the world economy, key location for finance and specialized service firms, sites leading production and innovation, and markets that consume these products (Sassen, 2001). Alongside critiques of globalization, other GCT scholars express concern over urban hierarchical organization that is "entrenching rather than loosening existing global power relations" (Robert Cohen, 1981: 49-50), and augmenting tension between images that express global landscapes of power and images that form the local vernacular" (Zukin, 1992: 139).

Portland continues to promote a global identity of sustainable living, and symbolically reinforces this cultural value through urban policy, and development. Recently Portland experienced rapid population growth nearing 2.5 million, and a growth rate of 111 people per day from July 2014 to July 2015 (Census Bureau, 2015), and has become a space for national critique on urban management, and the risk of displacement. Continuing to pursue a more accomplished image of sustainable development the city of Portland responded to this population growth with an intent to transition into 100% renewables by 2050 (As reported by Andrew Theen in an Oregonian article on April 10, 2017). This commitment affects mainly large-scale actors, utilities, and business falling under Farrell's critique of "better not bigger". Following Zukin's concept of global and local images in tension, I question for whom is this commitment going to benefit, and incorporate skepticism over ‘environmental gentrification’, where "operating under the seemingly apolitical rubric of sustainability, environmental gentrification builds on the material and discursive successes of the urban environmental justice movement and appropriates them to serve high-end redevelopment that displaces low income residents" (Checker, 2011: 210). Nationwide, PV installations are "overwhelmingly occurring in middle-class neighborhoods that have median incomes ranging from $40,000 to $90,000" due to the nature of RE policies that produce "split incentives": different rewards for different agents of access (Hernandez, 2013: 1, Bird & Hernandez, 2012). The structure, form, and implementation of RE policies and PV incentives is extremely deterministic in the political economy of representation and decision-making agency. Analysis in this section aims clarifies how Portland policies and incentives may nominally address globally inequalities but can ignore and exacerbate issues of local equity.

Background: Issues of Equity and Access in Policies and Incentives

"55% of building buyers are willing to pay 5k-10k more for green features in a new home" (Walker, 2013: 3). For the other 45% however, an investment of this size is not feasible for many different reasons. What specifically contributes to the inability or disincentivization to make investments in one’s future resilience, independence, and the greater good? After illustrating the uneven spatial distribution of Portland’s residential PV development, we must ask *why*? *Why* are there these inequalities, and in what ways does the bureaucratic process of incentivising green energy serve and not serve different groups of people? A 2012 study on federal tax credits found that, "U.S. clean energy tax credits have gone predominantly to higher-income Americans. Taxpayers with AGI in excess of $75,000 have received about 60% of all credit dollars aimed at energy-efficiency, residential solar, and hybrid vehicles" (Borenstein & Lucas, 2012: 25). Energy, especially renewable energy is not simply an issue of the environment, but is tightly bound to the dynamics of society and issues of equity, access, distribution, and social justice. This is not something that developing global cities have been practicing, and attending to effectively. Winifred Curran, an urban geographer, and Tina Hamilton, who focuses her studies on corporate social responsibility, ethical markets, and sustainability boldly argue that, "Social justice is supposed to be an explicit part of any definition of sustainability [and] the surge in environmental awareness in cities has not been matched with concern for social equity" (Curran and Hamilton, 2012: 1028), conveying skepticism over urban sustainable development, and notions of sustainability that leave out entire communities, and ignore social issues.

"Governments will spend tens of trillions of dollars to improve environmental performance, reverse sprawl, and achieve resilience. Urban designers have a responsibility to ensure that investments in resilience translate into improved livability, community, opportunity, and equality" (Brown & Dixon, 2014: 276). In Section 2.2.3 of the Portland Plan, finalized in 2012, the city of Portland nods to this responsibility, describing the city's 'vision for equity: "The benefits of growth and change are equitably shared across communities. No one community is overly burdened by the region's growth. All Portlanders and communities fully participate in and influence public decision-making" (The Portland Plan, 2012). Although articulated, this does not ensure that the reality of development will be equitable. It is important to scrutinize the efficacy of legislation, policy, and incentives in facilitating the Portland's goal accomplishments. This is where RE policies and incentives can illuminate who has the means to access, participate, and benefit, and who does not.

To see specifically why residential PV is not accessible for low-income, vulnerable communities, I draw attention to the process of decision-making. In *Beyond Distribution and Proximity: Exploring the Multiple Spatialities of Environmental Justice*, Gordon Walker frames justice as a procedure, and the sense that a critical approach includes, “a call or demand for more democracy, openness and inclusion in processes of decision-making is about enabling access to spaces, and flows between spaces, that have previously been restricted” (Walker, 37). Scholars of energy and equality, Bird and Hernandez ground this concept in language and structure of renewable energy policy, characterising this form of inequality it under the theory of *split incentives*: “a circumstance in which the flow of investments and benefits are not properly rationed among the parties to a transaction, impairing investment decisions” (Bird and Hernandez, 2012: 2). To examine accessibility of incentives and decision-making, part two evaluates three PV incentives: the Federal Renewable Energy Tax Credit, the Oregon Residential Renewable Energy Tax Credit, and the Energy Trust of Oregon’s Energy Trust Incentives.

Data & Methods

After reviewing all of the RE policies and incentives that applied to Oregon on the Database of State Incentives for Renewables & Efficiency (DSIRE), I narrowed down the list to those that pertained to: residents in Portland and photovoltaics. This process suggested the primary incentives for residential PV in Portland were: Federal and State Renewable Energy Tax Credits (RETC), and the utility-partnered Energy Trust of Oregon’s Renewable Energy Certificate. I confirmed that these incentives are accessed most by residents in an interview with a field energy consultant from SolarCity, who I will refer to as “Sam” throughout this paper. Although Sam gave me permission to use his real name, and content from our interview, but due to employment instability and company uncertainty, I decided against using his real name. I gained information on these incentives from online databases: DSIRE, EnergyStar, the Energy Trust of Oregon, and the IRS.

Results

The Federal Renewable Energy Tax Credit allows a taxpayer to “claim a credit of 30% of qualified expenditures for a system that serves a dwelling unit located in the United States that is owned and used as a residence by the taxpayer” for solar, geothermal, small wind, and fuel cell technologies. Notably, solar technologies including have the longest life in this tax credit set to end in 2021, while other technologies have already been written out of the incentive. This credit also has no upper limit, so the 30% coverage will apply for any size system. Already there are a couple restrictions implicit in this policy; outlining that the resident must *own* and *use* the residence the technology is outfitting. However, for solar technologies the incentive conveys that “the home served by the system *does not* have to be the taxpayer’s principal residence”. This is potentially misleading because one might think it possible to create access for low-income residents who are mostly “ineligible because they have non-positive tax liability” (Borenstein & Lucas, 2012: 25). The Federal Renewable Energy Tax Credit does not cover rentals, but does provide parameters for cooperative housing where tenants are stockholders, and condominium management associations.

The Oregon Department of Energy’s Residential Renewable Energy Tax Credit (RETC) covers many technologies, but for PV systems is based on the generating capacity of the system per watt. Information about this tax credit online claim that this amount is $1.50/WDC, but was recently decreased to $1.30 cent per watt. With the upper limit on this credit set at $6000, or 50% of the total system cost over 4 years, Sam explained that this decreases the efficient system size to 4.68kW. The credit covers systems from 0.5-10kW, so this incentive of only $1.30/WDC makes larger systems unachievable for any household without expendable income and surplus capital means. This illuminates the irony of this policy that occurs in the process of decision making, restricting customers and disincentivizing half of the energy that could potentially be generated. Again, the beneficiary of this tax incentive must have positive tax liability, but they also have a pass-through option if the partner has positive tax-liability. This incentive is set to end at the end of 2017, but any projects completed before would be grandfathered into the next 4 years of tax incentives. At the moment renewing or amending the RETC is being considered, but depends highly on budget constraints and other bureaucratic decisions that are specific to the state. Although this incentive applies to the residential and low-income residential sectors, this issue is brought up again that the reliance on tax-incentives already disables many low-income families from moving forward in these decisions.

The Energy Trust of Oregon is a public benefits fund that has a couple PV incentives through partnerships with utility companies: PGE and Pacific Power. This incentive exists in the form of Renewable Energy Certificates (RECs), that "represent the environmental benefits associated with generating electricity from renewable resources like solar. RECs are a separate product from the electricity that is generated and may be separately traded to businesses, individuals and utilities that want to support renewable energy" (Energy Trust of Oregon REC Fact Sheet). This incentive is dependent on a contractual obligation to PGE and Pacific Power that is typically 15-20 years long. For PV systems, benefit range from $0.45-$0.55/WDC depending on the efficiency of the system, and has an upper limit of 1,000kW system-sizes. Recently the upper limit was decreased from $4,500 to $3,200 maximum for PGE and from $4,600 to $3,600 maximum for Pacific Power. For non-profit sectors however, which includes multi-family low income housing, the benefit can go up to $0.90/WDC and $135,000.00 total. Technical restrictions build the premise of this incentive, aiming to increase efficiency and utility partnerships among systems. Installations must have over 75% total solar resource fraction (TSRF), which depends on structural characteristics of the roof, as well as shade around the home from buildings and trees. The systems must be grid-connected, and net-metered, and hold warranties for many of the components. This incentive also shifts ownership of the credits orm the customer to Energy Trust after 5 years for the remaining 15 years of the agreement. This incentive very explicitly makes the customer/producer dependent on the contractual relationship to utility companies and the Energy Trust, and net metering specifically gives PGE and Pacific Power more control over their willingness to pay for energy and how the customer can benefit from surplus energy generation. For customers/producers to receive these incentives there are even more restrictions and disqualifiers include; past bankruptcies, past student loan delinquencies, and credit scores lower than 600. This incentive makes it clear that the customers they are willing to serve must be very specifically able and secure with their personal financials, as well as the volatility of the market and utility company's decisions.

After reviewing these three incentives, and literature that discusses them, I compiled all relevant information into a table. Many technical insights regarding policy implementation and limits to equity came from my interview with SolarCity field energy consultant, which I give more attention to in Part Three.

	Federal RETC	**Oregon RETC**	**Energy Trust of Oregon**
Financial Benefits	30% credit. residence of PV installation. No upper limit.	$1.3/WDC, from systems up to 10kWh. $6k maximum credit, or 50% over 4 years.	**$0.45-0.55/WDC depending on efficiency.** Maximum $3600-4600 depending on PGE v. Pacific.
Individual Requirements	Owner must have positive tax liability. Owner must own and use the property of the installation (no rentals, but includes condominiums and cooperatives). Property does not need to be owner's *principal residence*.	Applies to residential and low-income residential. Available to renters, and third parties, as well as property owners. Must have positive tax liability. Must own the system.	Must own/use the property. Owners must have: good credit, no bankruptcies, no student loan delinquencies, and positive tax liability.
Technical Requirements	Must be installed after 2008.	Most profitable system size with a $1.3/WDC incentive is 4.68kWh (Sam from SolarCity, Interview 2/16/17). Recognized as premium efficiency by the Oregon Department of Energy.	For systems 75% TSRF +, 15 year agreement with Energy Trust via. Net metering. Specific to building, if individual moves the system belongs to ETO.
The Policy Itself	Is not equally distributed among income brackets (Borenstein & Lucas). The 30% incentive begins to decrease in 2019.	Is currently under budgetary review by the state, and the incentive per WDC may be decreased again soon (Sam from SolarCity, Interview 2/16/17).	Requires a contract with PGE or Pacific that typically lasts 20 years.

PART THREE: EMPOWERMENT & DECISION MAKING

Theoretical Frameworks: People's Technology, Climate Change, and Social Vulnerability

Tradeoffs between energy and equity are managed by people, not technology. Renewables tend to fall victim to reductive thinking and ontological analysis. In the Cyborg Manifesto, socialist-feminist scholar Donna Haraway illustrates the intimate connection between the organic human body, and the inorganic machine in an effort to contribute to theory in, "a post modernist, non-naturalistic mode and in the utopian tradition of imaging a world without gender, which is perhaps a world without genesis, but maybe a world without end. The cyborg incarnation is outside salvation history" (Haraway, 1984: 292). Understanding RET within this ideological framework of techno-social-optimism, allows combat reductive, linear, conclusions, and assumptions over value. Haraway's also argues that this polarization of organism and machine "has been a border war. The stakes in the border war have been the territories of production, reproduction, and imagination" (Haraway, 1984: 292). I invoke this radical theory throughout this paper, encouraging imagination to expand meanings of empowerment.

Jeremy Rivkin's *Zero Cost Marginal Society* also describes technologies as potentially socialist-tools. Specifically, Rivkin examines how RETs can create a new group of economic agents: the "prosumer". A 'prosumer' is an individual who collapses their dependency on global modes of production, and takes on the role and responsibility of both the producer and consumer. For a household, the stage of distribution is made optional, and is mediated through contracts with utilities, which can help increase savings, and even generate positive cash flow for a home connected to the grid. Rivkin echoes concerns over the vertical structure of energy infrastructure, and the monopoly utilities have on distribution in the United States, but supplies a technological antidote in his discussion of Smart Grids. Smart Grids allow for more independent prosumers through infrastructure that automatically optimizes efficiency using sensor-technology, the Internet of Things, cloud-based information management, and autonomous user-participation. RETs and horizontally-distributed energy infrastructure creates a space for energy independence, equitable access, and decision-making empowerment by providing "cleaner, safer, more affordable energy directly to users through the mass production of sophisticated devices that require little sophistication to use" (Bradford, 2006: 19). Installing residential RET is not only an expression of personal-resilience, but can also be understood as an act of resistance, and global opinion. By avoiding fossil fuels and encouraging growth in RET, individuals are acting in support of climate change mitigation efforts.

Populations disempowered by hegemonic power structures, are also more vulnerable to climate-change induced risks due to their existing level of resilience and lack of resources for recovery. In a 2014 study, Credit Week, a major actor in financial analytics in the United States found that vulnerability of a country (level of "day-to-day changes in productivity") to climate change is inversely related to prosperity. The United States is globally classified as less vulnerable, but the local implications are immense in the way we consider inequality of; climate risk, social risk, economic risk, and risk resiliency. In, *Social dimensions of climate change: equity and vulnerability in a warming*

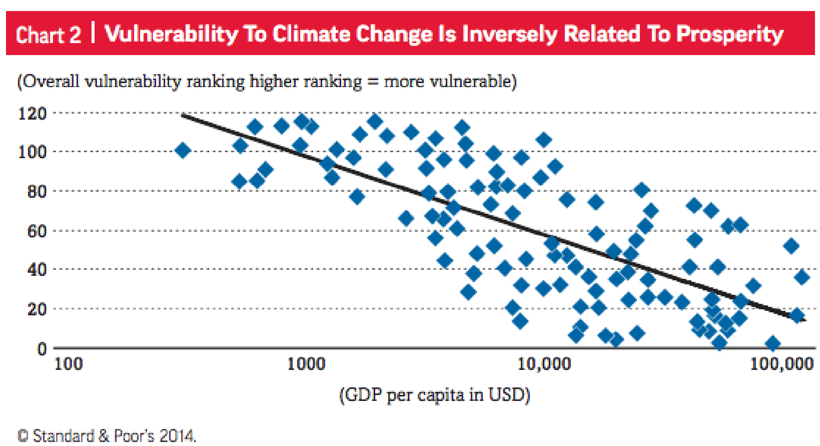


Image 2. (Standard & Poor, 2014)

world, Mearns and Norton call to deepen our understanding of "who is vulnerable to the consequences of climate change, where, how, and why. This understanding includes not only how climate change contributes to vulnerability, but also how climate change policy and response measures may magnify the effects of many existing drivers of vulnerability. Short term, the biggest impact on poor people may result less from changing climate itself than from policies adopted to mitigate climate change" (Mearns & Norton, 2009: 22). Advocating for more equitable, and socially empowering RE policies and incentives may not be a priority for major stakeholders in the energy industry. A brief social-network analysis I conducted in 2015 indicated that there is a lot of investor overlap between the solar and fossil fuel industry. The graphic depicting investors of 10 major oil companies, and 19 major solar companies (shown below) serves to reinforce skepticism over the values and tradeoffs that may contribute to decision-making within the energy industry.

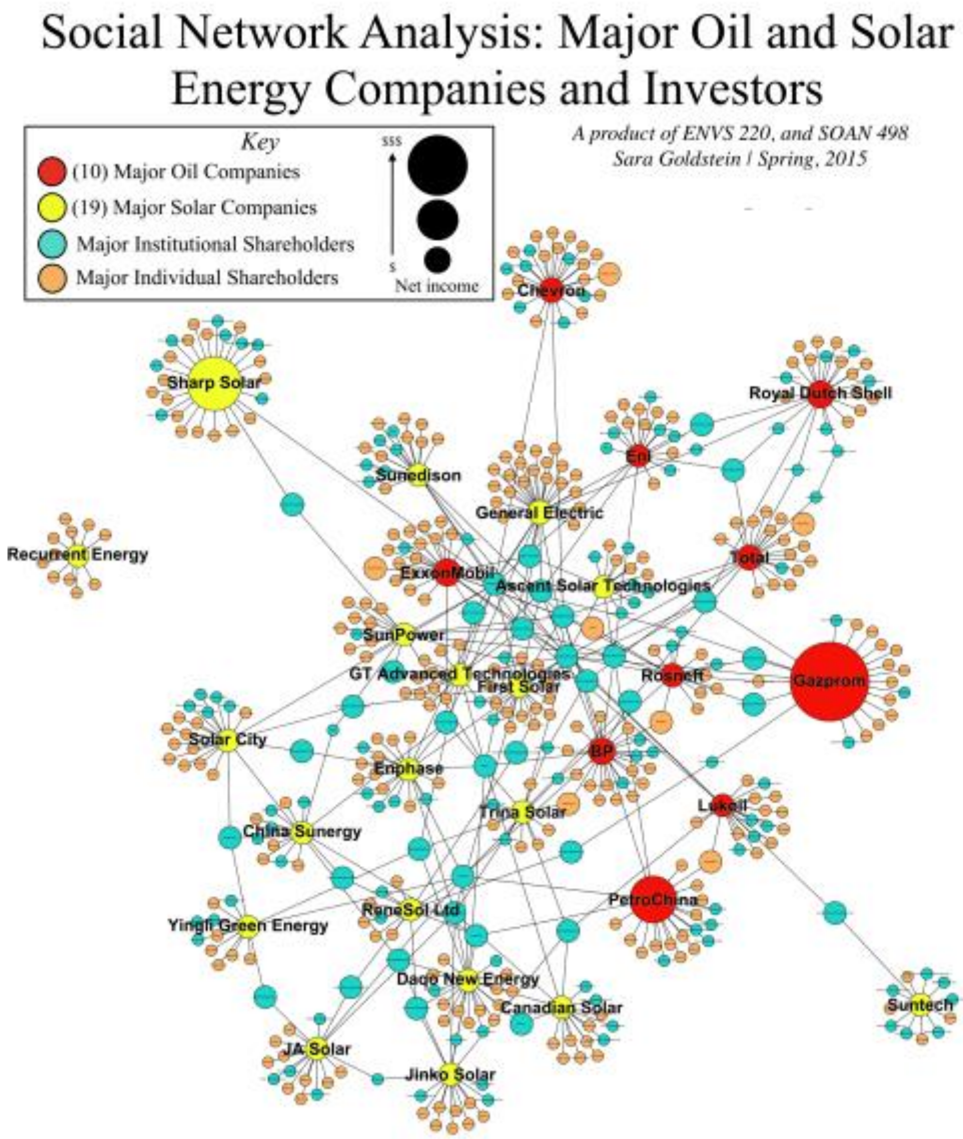


Image 3. Social Network Analysis of Major Solar and Oil Stakeholder (Sara Goldstein, 2015)

Background: Third-Party Agents for Access, Equity, and Empowerment

In a vertically distributed economy, some actors have the power to mediate access on behalf of vulnerable populations. I discuss these agents as “third-parties”, and they can be individuals or institutions. In my interview with SolarCity’s field energy consultant, Sam explained the nature of his job, and how as a third-party actor, he mediates connections between consumer and PV technology. From our interview, it was clear to me that Sam continuously exceeds, even transcends his job description by assisting and reaching out to families that need help managing the bureaucratic PV policies and incentives described in Part Two. Sam spends hours on the phone with his customers, and making himself available at all hours of the day--even weekends. Sam even violates the legal boundaries of RE policies, since many residents struggle filing their tax credits applications. He described a couple instances where he met with older couples who had difficulty filling out their only tax forms (assistance that is not legally allowed by anyone who is not a tax accountant). Sam also recalls many residents who convey interest and financial ability to install PV but become disinterested due to the complicated technical and bureaucratic elements. Sam explains his own motivations as well, and his personal incentives to combat employment vulnerability, and income-resiliency (a portion of his earnings are commissioned). Sam notes that SolarCity's major competitor: SunRun, pulled operations out of Oregon recently due to changes in RE tax policies and incentives. He was nervous, and mentioned he was already beginning a new job search since RETC was being reviewed for revisions, potentially decreasing incentive per kWh. SolarCity's Oregon market is also vulnerable to these changes in policy, and rely on the margin of work done by people like Sam to think creatively, and imaginatively with the restrictive policies he is given. In this section I also consider non-profit organizations as important third-party agents, who function like a corporate institute, but address the needs of vulnerable populations. Non-profits have the advantage of policies created for charities, and are not taxed in accordance with the philosophy that work is contributing to increase the well-being of struggling populations.

Non-profit run urban affordable housing is a perfect example of a third-party acting to create access for disempowered residents who may be more susceptible to risks. Non-profits, in turn take on some of the market-based risks that effect the urban residential housing sector, like the price of energy, and vertical energy distribution. Providers of affordable housing have the same options of combatting global and local energy risks via RET, and a larger capacity to access capital, navigate policies, and make decisions. Installing RE systems on multi-family affordable housing has been successful in including low-income residents in RE development (Mullendore: 2015, Taylor et al. 2016) as well as enabling "low-income housing developers to generate significant electric bill savings by reducing utility demand charges or generating revenue through providing grid services" (Mullendore, 2015). PV helps mitigate many risks for affordable-housing complexes, and the residents that live there by supplying "reliable power for a range of critical facilities and essential building service loads. They can power water booster pumps, lighting, telecommunications, re-alarms and security cameras, elevators, and climate controls" (Mullendore, 2015). Legally bound to continue missions of providing affordable housing and residential resources, non-profit organizations seeking to increase resiliency to climate change, market dynamics, and vertical power relations, in turn, pass on benefits to their residents who would not have had access alone.

Case Study: Central City Concern & the Sally McCracken Building

Image 5. Sally McCracken Building: 532 NW Everett Portland, OR 97209 (Screenshot from GoogleMaps)

Central City Concern (CCC) is a 501(c)(3) nonprofit agency based in Portland, Oregon serving “adults and families in the Portland metro area who are impacted by homelessness, poverty and addictions” (Taken from Central City Concern’s Website). CCC’s logo shows a home, a heart, and a handshake, and its mantra reads “*Equity and Inclusion”.* CCC manages many affordable housing complexes committed to providing residents with; debt services, resident support services, property management, reserves, utilities, maintenance, and other smaller expenses, the Sally McCracken building located in downtown Portland has 95 units of housing and two floors that serve as office and management space., the Sally McCracken building is. Located in Chinatown, Sally McCracken is characterized by an extremely vulnerable census tract. Solar would be unattainable by most residents since historic districts are typically looked over for solar projects due to zoning restrictions. Facing hikes in electricity costs, which have been slowly climbing from 7.03 cents/kWh in 2003, to 11.55 cents/kWh in 2015 (Oregon Public Utility Commission, 2015 & US Energy Information Administration) the Sally McCracken building, run by the nonprofit Central City Concern recently installed a 22.75kWh PV system as a response. I examine this case study to emphasize the role and potential of third-party actors in more equitable urban development. It is important to parse the agency involved in situations like this one, and I discuss the *who* that is included in risk, resilience, vulnerability, and decision-making. A critical look at this case study aims to represent processes of agency and equity. This case study came to me through involvement of Lewis & Clark students participating in the Renewable Energy Projects program, funded by an optional fee every student might pay with their tuition. Wendy, the point of contact for this project provided me with documents, graphs, spreadsheets of budget considerations, and literature that justified decisions made for the installation. Many of the images below, were shown in a collaborative presentation between Lewis & Clark students and CCC members.

Installing Photovoltaics

Utilities comprise 20% of the CCC's operating budget, totaling $1.37 million. To stabilize energy-use, CCC decreased consumption by 20% from 2006, abating 2,068,580 kW through; lighting and H/AC upgrades, weatherization, energy saving appliances, day lighting, passive systems, sub-metering, heat recovery, passive systems, renewable energy, and solar heating. Already participating in anti-fossil fuel markets through efforts like these, when the

Sally McCracken building was due for a roof replacement and seismic upgrade the renewable energy coordinator evaluated the possibility of a solar installation.

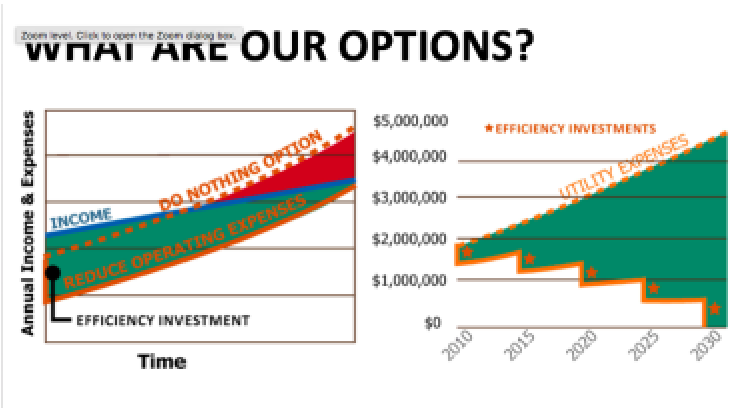


Image 5. Rational for Efficiency Investments (From CCC & LC Presentation at the LC Environmental Affairs Symposium, 2016)

The Sally McCracken building faced impending budgetary problems, with utility escalation at 3.30% per year, the cost of energy per kWh projected to nearly double by 2030. Assuming a utility rate increase of $0.164713/kWh, CCC was concerned that this escalation in utility budget would detract from other services provided by their budget. The first step in the solar process, was a consultation with an installer, ImagineEnergy. Evaluating the building's Total Solar Resource Fraction (TSRF) at 85%, the building qualified to have strong production potential, qualified for the Energy Trust of Oregon rebate, and was a suitable host for a 22.75 kWh photovoltaic system. The payback looked promising for CCC, and the impact would be abating approximately one whole month (April

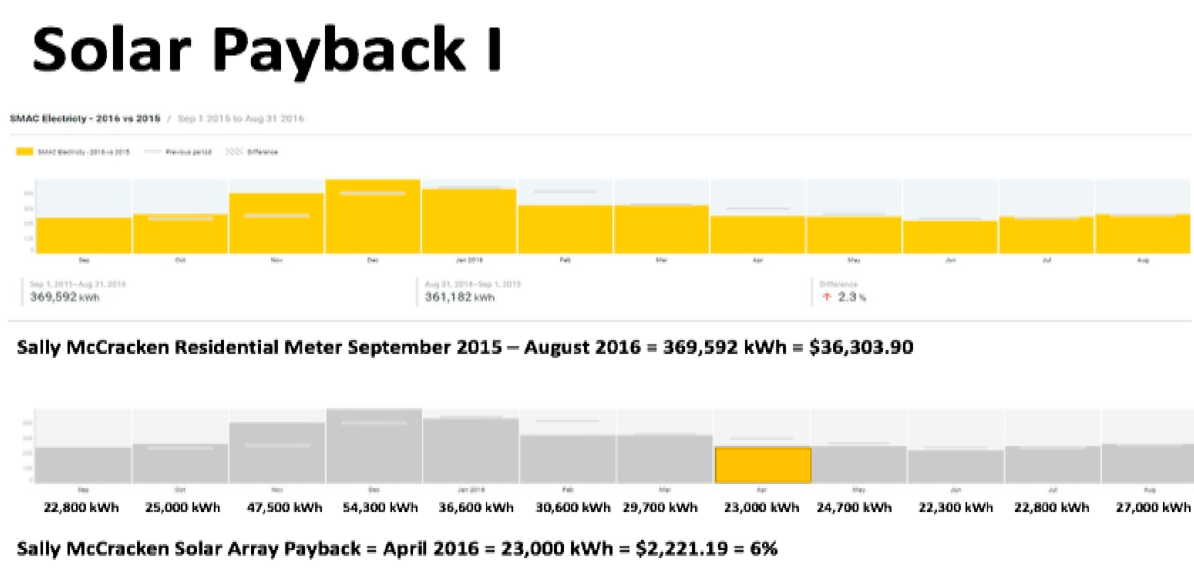


Image 6. Calculating Solar Payback (From CCC & LC Presentation at the LC Environmental Affairs Symposium, 2016)

shown in Image 5) of electricity expenses. With a promising long-term payback, this system incurred a high initial cost of $94,480 and the Sally McCracken management team had to figure out how to finance this installation up front.

Accessing Capital and Navigating Solar Policies & Incentives

The first financing option considered projected a 10-year payback period. This option received a rebate from the Energy Trust of Oregon of $22,750 ($1.00/W), and the 30% Federal Residential Renewable Energy Tax Credit of $21,519. The

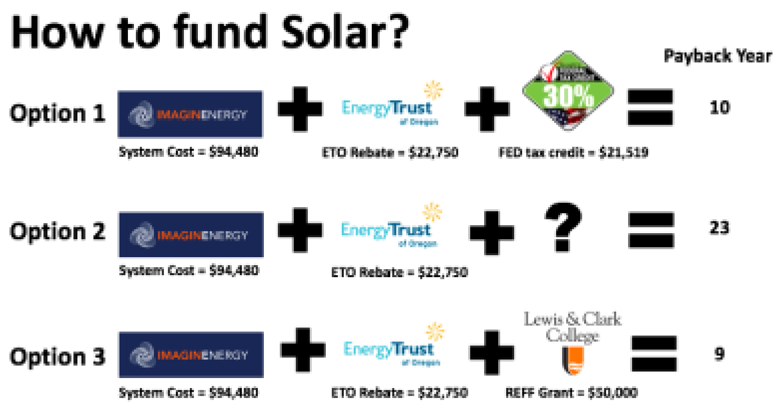


Image 7. Weighing PV Financing Options (From CCC & LC Presentation at the LC Environmental Affairs Symposium, 2016)

second option was to replace the Federal Tax Credit with a grant from the Lewis & Clark College of $50,000, decreasing the payback period by one year. Although one year does not seem like a significant amount, the size of operating expenses for large multi-family dwellings like Sally McCracken add up. The new 23kW system could reduce utility expenses by 6% per year, a one-year difference would decrease payback by 6% of a later year's costs. CCC runs using short term and long term budget models, and this difference made their long-term budget more reasonable and feasible overall. During construction, the installation faced a few barriers. First, the weather at the time of construction was unforeseeably bad, and the installation itself was postponed, delaying production time. CCC had enough resources, to reschedule this large installation, and make up the unexpected financial difference. Second, the Sally McCracken building is a registered historic building, and the project had to go through historic review, and structural aspects had to be amended to keep the system below eye-level. Sam from SolarCity described how individual households positioned in historic districts are completely written off by installation companies, due to complicated, restrictive zoning rules and regulations. For CCC, these policies were disruptive, not restrictive, and were successfully managed by the CCC team, and Lewis & Clark students through another round of historical zoning paperwork. Comparing this installation to the spatial analysis performed in Part One, we would see PV enter a vulnerable census tract with little residential representation.

The Sally McCracken's solar installation is a perfect example of connecting the benefits of solar energy benefits to vulnerable populations without access. This installation seems to reinforce their strategic vision of accomplishing equity, and CCC's mission to; increase access, ensure sustainability & growth, improve equity, become a higher performing organization, and enhance person and community-focused services (Taken from CCC & LC's Presentation in Lewis & Clark's Environmental Affairs Symposium, 2016). However, is important to parse the agents of action in this project, and acknowledge how CCC itself also conveyed its own form of social vulnerability. Business structure's identity in the global political economy keys us into some risks non-profits are vulnerable to as well. Despite the tax exemption granted to 501(c)(3) organizations, non-profits do not have the same competitive advantage as other corporations, due to the nature of their work. While other US corporations must participate in 20% revenue taxation, all the work done by that company contributes to the growth and development of the business itself. CCC and other non-profits naturally work *on behalf* of other parties, and donation-based income that is often restricted and awarded over time, as opposed to up front. CCC's investment in PV had high up-front capital costs, that were not easily found in CCC"s exiting budget projections. CCC had options, but Wendy describes another option where Sally McCracken didn't install the PV system, and 10 years CCC would have to transition residents into paying for their own utility usage. Wendy stressed the work in researching, developing, community outreach, and capital financing that Lewis & Clark was able to contribute through student involvement and the Green Energy Grant. Expanding the role and responsibility of third-party agency beyond Sam, CCC, and Lewis & Clark I question whether substantive empowerment will require work from all agents of access, and if, in turn, this may collapse vertical global power relations.

DISCUSSION

In this multi-method, interdisciplinary exploration of RE development, I found that PV policies and incentives play a significant role in restricting access, and decision-making power socially vulnerable residents of Portland, Oregon have for clean-energy empowerment. Part One looks at the contribution sustainable urban development has in environmental gentrification. While development in RE and PV abates fossil fuel use and promotes urban resiliency against global shortage, this resiliency is often only a benefit to global city core, and leaves out and the vulnerable vernacular. Vulnerable families are therefore entrenched in their dependency on utilities, which contributes to perceptions of energy insecurity, and at risk for price-based displacement due to development from the city core. Oregon PV policies and incentives inform these inequalities, and maintain access for middle to upper class residents, removing decision-making ability from vulnerable communities. Channeling Gordon Walker's call for spatial inclusion and equality as a responsibility, and the responsibility of policy-makers I found that these policies were not crafted with social equity in mind, and should be a topic of reconsideration and reform-efforts. Looking at capital modes of production and arguments for green capitalism, I continue to question whether equity is even possible without challenging the vertical distribution of energy capital. Looking at third-party agents as facilitating the local compression of vertical power differences, Sam and CCC provide strong examples of work that can be done to empower actors in small economies of scale.

Technology will inevitably augment and reshape these dynamics and in the coming years Sam and I discussed the possibility for solar cooperatives, that position themselves somewhere between the household and non-profit scale. Some technologies, and technical infrastructures may lend themselves to Haraway's cyborg anthropology, and create platforms for equity, empowerment, and independence from global power. An example of this is smart grids technology, that can work alongside or replace the function of utility companies. These grids allow many levels of participation, and involve individuals equally in processes of energy production, distribution, and consumption. Farrell might argue that smart grids are the technology need to develop small economies of scale, because they have the ability connect and isolate agents and groups of agents from greater systemic change. Sensor technology allows these functions to occur in direct response to perturbations, such as political unrest, natural disasters, and climate-change related extreme weather events. It is exciting to see technological development rooted in ideals of social equity, but there is a lot of work to be done with current infrastructure and policy. I hope that more research and literature can be compiled conveying concerns over equitable development, and I hope that the individual sees their own ability to mediate intersections of benefit and access, as well as fight for structural change that might further enable resiliency.

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