

CAPSTONE

A NET-ZERO COMMUNITY: A RESOURCE MANUAL FOR SUSTAINABLE  
DEVELOPMENT AND PUBLIC POLICY

Submitted by

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### **The land that started it all:**

My first source of inspiration was actually a plot of land located north of Highway 20 in the Town of Hamilton in Skagit County, Washington. This land provides an opportunity for development and community revitalization. Currently, the land is located within the Town's Urban Growth Area, has water rights, and is outside the floodway. It would be a great opportunity for the community, making it safer for current residents and adding housing supply to an already low inventory market, which will help business and industry as well as economic development.

**One thing not considered...**

Unfortunately, this paper does not consider or discuss gentrification or displacement of communities. I acknowledge that sustainable development can be expensive and pursued by predominately socially and economically advantaged populations. Sustainable development, despite its numerous environmental and economic benefits, can change the character of the community and increase the cost of living inadvertently displacing current community members. Social justice and equity must be considered when discussing climate change, sustainability, and the environment.

## **ABSTRACT**

*This resource manual outlines the concept of a net-zero carbon and energy community focusing on sustainable development frameworks, methods, community components, and examples of current efforts in Washington State. This manual also summarizes existing policy at the local, state, and federal level that can support and incentivize sustainable development. Policies include public and private funding opportunities, tax incentives, mandates, streamlined permitting processes, fee waivers, and exemptions for building codes and land use.*

## INTRODUCTION

Burning fossil fuels for electricity, heat, and transportation emit greenhouse gases (GHG) that contribute to climate change.<sup>1</sup> Greenhouse gases trap heat in the upper atmosphere, impacting the Earth's temperature, sea level, precipitation patterns, severe weather events, and water resources, all of which adversely affect human health and safety, infrastructure, food and water supplies, and natural ecosystems. Planned interventions in the built environment can reduce carbon emissions, alter consumption habits, and improve efficiency and sustainability at the individual and community-level. This paper explores conceptually how to actualize a net-zero community through review and synthesis of sustainable development frameworks, methods, community components, examples of efforts in Washington State, and current policies at the local, state, and federal level that can incentivize sustainable development. Building a net-zero community can be an effective way to reduce carbon pollution and improve conservation.

Frameworks help guide and standardize sustainable development while methods such as architectural and engineering design, renewable energy, energy efficiency, SMART technology, carbon offsets and sequestration, and land use and city planning help achieve it. A model community must consider several components including homes and buildings, transportation, infrastructure, energy, water, and sustainable agriculture. Utilization of the above methods and community components not only promote sustainability, they also benefit individuals and communities economically. Furthermore, examples of public, private and non-profit efforts in Washington State demonstrate implementation and can help inform policy through their successes and challenges. Policy at all levels of government is key to changing human behavior and reducing carbon emissions in the built environment.

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<sup>1</sup> U.S. Environmental Protection Agency, *Sources of Greenhouse Emissions*, <<https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>>

This paper attempts to answer the following questions: What frameworks and certification programs exist to guide sustainable development? What sustainable development methods can facilitate reaching net-zero carbon emissions in a community? What does a net-zero, sustainable community look like? What policies currently exist at the local, state, and federal level to incentivize the development of net-zero communities? The sections in this paper outline a net-zero definition, relevant frameworks, sustainable development methods, community components, examples of current efforts in Washington State, and an overview of applicable policies at the local, state, and federal levels.

### **NET-ZERO DEFINITION**

The term *net-zero carbon*, or carbon neutrality, refers to the state in which the net amount of emissions of carbon dioxide equivalent (climate warming gases) equals zero due to a combination of reduction of emissions and carbon capture. Humans inevitably produce or contribute to carbon emissions in a number of ways. Biologically, nearly all life forms on land, waters and oceans release carbon dioxide as part of their respiration; however, these releases are balanced by uptake of carbon dioxide by plants and algae, particularly the vast populations in oceans and forests. In addition, “decomposition of organic matter, forest fires, and emissions from volcanic eruptions” release carbon dioxide.<sup>2</sup> However, these releases are far less significant compared to those from anthropogenic sources, such as “power generation, transportation, industrial sources, chemical production, petroleum production, and agricultural practices.”<sup>3</sup> Given current human behavior and economic pressures, carbon output will always be positive, so in order to achieve neutrality, humans must consider ways to reduce and offset emissions. There

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<sup>2</sup> U.S. Department of Energy National Energy Technology Laboratory, *Carbon Dioxide 101*  
<<https://www.netl.doe.gov/research/coal/carbon-storage/carbon-storage-faqs/what-are-the-primary-sources-of-co2>>

<sup>3</sup> *Ibid*

are a number of options, including natural carbon sequestrers such as planting more trees or supporting healthy soils, and changes in human behavior and decisions such as reducing consumption and improving efficiencies. On the other hand, *net-zero energy* refers to zero net energy consumption, meaning renewable energy produced on-site roughly equals energy consumed over a year. Subsequent sections will elaborate on the application of these definitions.

## **FRAMEWORKS**

In effort to maximize efficiencies and achieve net-zero carbon and/or energy in the built environment, governments and organizations have developed frameworks to help facilitate and foster sustainable development. These frameworks, each unique with some common components, set forth standardized guidelines and best practices for buildings and communities. These frameworks predominately focus on new development (rather than retrofiting), and currently, most new development incorporates some level of sustainability using these guidelines. Over the years, architects and builders have changed the way they design and develop. The following overview of frameworks will outline best practices and outcomes that must be considered when developing sustainable, net-zero buildings and communities.

### **Leadership in Energy and Environmental Design (LEED)**

The LEED certification program, administered by the U.S. Green Building Council, is a green building rating system that provides a framework to create healthy, highly efficient, and cost-saving green buildings for all residential, community, and commercial projects.<sup>4</sup> LEED certification is the most widely used framework in over 165 countries and territories with more than 92,000 projects completed every day.<sup>5</sup> Ultimately, “LEED buildings save energy, water, resources, generate less waste and support human health” all while reducing costs and improving

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<sup>4</sup> U.S. Green Building Council, *LEED is green building*, <<https://new.usgbc.org/leed>>

<sup>5</sup> *Ibid*

human productivity.<sup>6</sup> There are four certification levels: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points), and Platinum (80+ points). LEED version 4, implemented in October 2016, provides a checklist for new construction and major renovations including 110 total possible points with considerations in: location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation and regional priority.<sup>7</sup>

LEED certification can help achieve net-zero energy and carbon in buildings. The New Building Institute released its 2018 *Getting to Zero Status Update and List of Zero Energy ("ZE") Projects* report, a "compilation of almost 500 certified, verified and emerging zero energy projects in the U.S. and Canada."<sup>8</sup> "Of the ZE Verified projects, 70 percent are LEED-certified or registered with LEED, with most reaching either Platinum or Gold certification levels."<sup>9</sup> LEED requires and rewards rigorous energy efficiency standards and methods. For example, new projects that demonstrate 50% energy use reduction can earn up to 18 points.<sup>10</sup> LEED also encourages onsite renewable energy production and provides access to a digital platform called Arc to collect and monitor performance data.<sup>11</sup> Lastly, the U.S. Green Building Council offers an education program called Pathway to Net Zero, which compiles resources to help LEED projects achieve net-zero energy, water, and waste.

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<sup>6</sup> U.S. Green Building Council, *LEED is green building*

<sup>7</sup> U.S. Green Building Council, *Checklist: LEED v4 for Building Design and Construction*, <<https://www.usgbc.org/resources/leed-v4-building-design-and-construction-checklist>>

<sup>8</sup> New Buildings Institute, *2018 Getting to Zero Status Update and List of Zero Energy Projects*, Published January 2018. <[https://newbuildings.org/wp-content/uploads/2018/01/GTZ\\_2018\\_List.pdf](https://newbuildings.org/wp-content/uploads/2018/01/GTZ_2018_List.pdf)>

<sup>9</sup> Blackwelder, Alysson. "Report Shows How LEED Helps Achieve Zero Energy Goals." *U.S. Green Building Council*. February 08, 2018. <<https://www.usgbc.org/articles/report-shows-how-leed-helps-achieve-zero-energy-goals>>

<sup>10</sup> *Ibid*

<sup>11</sup> *Ibid*

LEED successfully facilitates making buildings greener, provides a universal standard and approach for building green, and opens up a market for sustainable, environmentally friendly products through increased consumer demand.<sup>12</sup> However, LEED can benefit from some improvements. For example, LEED should better prioritize, incentivize, or gauge innovation. Currently, builders focus on earning points rather than producing the most environmentally friendly or innovative outcome.<sup>13</sup> In addition, building green can be cost prohibitive and time consuming compared to more traditional development.<sup>14</sup> Finally, LEED is prescriptive rather than performance based, meaning that a building can meet certification requirements without completing any inspections or evaluation to guarantee the building's performance.<sup>15</sup> This is the key difference between LEED and the International Living Future Institute challenges and certifications, which are performance based.

### **International Living Future Institute (ILFI)**

Headquartered in Seattle, WA, the International Living Future Institute partners with local communities and offers resources and guidance to promote sustainability and green buildings and infrastructure solutions.<sup>16</sup> They administer a number of challenges and certifications including: living building challenge, living community challenge, zero energy certification, and zero carbon certification.

### ***Living Building Challenge***

“The Living Building Challenge is a green building certification program and sustainable design framework that visualizes the ideal for the built environment.” Living buildings are self-

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<sup>12</sup> Avsatthi, Bhushan, “Advantages and Disadvantages of LEED,” *Green Modeling*, Published June 26, 2013. <<https://www.green-modeling.com/sustainability/advantages-and-disadvantages-of-leed.html>>

<sup>13</sup> *Ibid*

<sup>14</sup> *Ibid*

<sup>15</sup> *Ibid*

<sup>16</sup> International Living Future Institute, *About Us*, LinkedIn <<https://www.linkedin.com/company/international-living-future-institute/>>

sufficient, producing more energy than they use over a year and they treat all water on site. In order for a building to be certified, it must meet the performance metrics over a year. There are seven performance areas, referred to as petals in a metaphorical flower, including place, water (net-positive), energy (net-positive), health and happiness, materials (low impact and nontoxic), equity, and beauty. “There are hundreds of registered projects around the world representing millions of square feet of commercial, institutional, educational and residential construction.” The Bullitt Center is one example of a certified living building, which will be discussed later.<sup>17</sup>

### ***Living Community Challenge***

The Living Community Challenge scales up to the community level, developing a framework to create and promote healthy living, net-positive water and energy, multi-purpose community elements, natural ecosystems, and places that are safe to walk, bike, and have access to affordable public transportation. The imperatives of a living community include restoring a community’s healthy relationship with nature, treating all water, operating within a balance, relying on solar power, promoting healthy lifestyles (physical and psychological), using safe materials, supporting equity, and natural beauty.<sup>18</sup>

### ***Zero Energy Certification***

The ILFI’s Zero Energy Certification is an international certification. Certified projects must demonstrate zero-energy performance meaning “one hundred percent of the building’s energy needs on a net annual basis must be supplied by on-site renewable energy. No combustion is allowed.” This means buildings must produce energy onsite from renewable

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<sup>17</sup> International Living Future Institute, *Living Building Basics*, <<https://living-future.org/lbc/basics/>>  
Source for entire section

<sup>18</sup> International Living Future Institute, *Living Community Basics*, <<https://living-future.org/lcc/basics/>>  
Source for entire section

sources like solar, wind, or geothermal to meet net annual demands. Certification is based on performance data audited by a third party.<sup>19</sup>

### ***Zero Carbon Certification***

The ILFI's Zero Carbon Certification is also a worldwide third party certified standard that highlights efficient buildings. The difference is that it certifies buildings that offset their energy use with renewable energy and does not require onsite production. The standard is: "One hundred percent of the project's energy use must be offset by on- or off-site renewable energy on a net annual basis. Projects must achieve a high level of energy efficiency as established by the ILFI. New projects may not include combustion." Similar to the other ILFI frameworks, certification is dependent upon a successful one-year performance period.<sup>20</sup>

### **Passive House Institute U.S. (PHIUS)**

The two main PHIUS certifications include PHIUS+ 2015 Passive Building Standard and the newly released PHIUS+ 2018 Getting to Zero. In 2014, PHIUS, in partnership with the Building Science Corporation, was awarded a U.S. Department of Energy Grant to develop the first climate specific passive building standard.<sup>21</sup> Passive buildings incorporate design principles to maximize energy efficiency such as insulation, airtight envelope, high performance windows and doors, balanced heat and moisture recovery ventilation, minimize space cooling, and solar heating.<sup>22</sup> Resulting from the 2014 grant funded collaboration, "the PHIUS+ [2015] Certification Program is the leading passive building certification program in North America. It

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<sup>19</sup> International Living Future Institute, *Zero Energy Certification*, < <https://living-future.org/net-zero/certification/>> Source for entire section

<sup>20</sup> International Living Future Institute, *Zero Carbon Certification*, < <https://living-future.org/zero-carbon-certification/>> Source for entire section

<sup>21</sup> Passive House Institute US, *PHIUS+ 2018: Getting to Zero*, <<http://www.phius.org/phius-certification-for-buildings-products/phius-2018-getting-to-zero>>

<sup>22</sup> Passive House Institute US, *Passive House Principles*, <<http://www.phius.org/what-is-passive-building/passive-house-principles>>

is the only passive building certification that combines a thorough passive house design verification protocol with a stringent Quality Assurance/Quality Control (QA/QC) program performed onsite by highly skilled and specialized PHIUS+ Raters and Verifiers.”<sup>23</sup> The PHIUS + 2015 standards accounts for differing climate zones and markets, sets forth rigorous goals, and prioritizes cost effectiveness.<sup>24</sup> Some of the benefits of the PHIUS+ certification include:

- Energy and carbon reduction targets and performance metrics
- Expert assistance in design and modeling to help achieve targets
- Testing and inspections to assure quality
- EPA Zero Energy Ready Home and EPA Indoor airPLUS status<sup>25</sup>

The PHIUS+ 2018 Getting to Zero is the first updated revision and will eventually replace PHIUS+ 2015.<sup>26</sup> The revisions still use pass/fail performance based standards that include prescriptive quality assurance requirements.<sup>27</sup> Some of the changes under the new standard are that the space-condition targets are set zone-by-zone (rather than in terms of climate) and the criteria will continually adjust for building sizes and occupancies.<sup>28</sup> Also, the source energy criterion is tightened in the new standards so the focus shifts closer towards net-zero.<sup>29</sup>

## **Built Green**

Built Green is a program of the Master Builders Association of King and Snohomish Counties that certifies green homes, remodels, apartments, and communities.<sup>30</sup> As of April 2018, they have certified over 32,000 units, and 52% of new homes in Seattle and 32% King County-

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<sup>23</sup>Passive House Institute US, *PHIUS+ Certification Overview*, <<http://www.phius.org/phius-certification-for-buildings-products/phius-2015-project-certification/phius-certification-overview>>

<sup>24</sup> Passive House Institute US, *PHIUS+ 2018: Getting to Zero*

<sup>25</sup> Passive House Institute US, *PHIUS+ Certification Overview*

<sup>26</sup> Passive House Institute US, *PHIUS+ 2018: Getting to Zero*

<sup>27</sup> *Ibid*

<sup>28</sup> *Ibid*

<sup>29</sup> *Ibid*

<sup>30</sup> Built Green, <<https://www.builtgreen.net/>>

wide in 2016 were Built Green.<sup>31</sup> Some of the benefits of certifying a project as Built Green include access to municipal and utility incentives, savings in resources such as water and energy, and additional value to the project.<sup>32</sup> Built Green also offers a number of checklists and handbooks as resources for achieving greener projects.<sup>33</sup>

### **Net Zero Energy Building (Net ZEB)**

The standard definition and framework for a Net Zero Energy Building (Net ZEB) was established by Sartori et. al (2010). “The wording ‘Net’ underlines the fact that there is a balance between energy taken from and supplied back to the energy grids over a period of time, nominally a year.”<sup>34</sup> In other words, the difference between export energy (feed-in energy flowing from the building to the grid) and import energy (delivered energy supplied by the grid to the building) must be greater than or equal to zero.<sup>35</sup> The list of relevant characteristics and criteria include:

- Boundary conditions (such as a single or multiple buildings)
- Crediting system (metrics and accounting for energy site, source, cost and emissions)
- Net-zero balance (load, time, energy efficiency and supply)
- Temporal energy match (synergy between building and energy infrastructure), and
- Monitoring procedure (design data and simulations)<sup>36</sup>

Net-zero homes are air-tight, well insulated, and energy efficient, which enables them to produce as much renewable energy as they consume over the course of a year, resulting in no energy bill

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<sup>31</sup> Built Green

<sup>32</sup> Built Green, *Certification Process*, <<https://www.builtgreen.net/certification/#certificationprocess>>

<sup>33</sup> Built Green, *Resource*, <<https://builtgreen.net/resources/#builders>>

<sup>34</sup> Sartori, I., Napolitano, A., Marszal, A. J., Pless, S., Torcellini, P., & Voss, K. (2010). “Criteria for Definition of Net Zero Energy Buildings,” *EuroSun 2010: International Conference on Solar Heating, Cooling and Buildings: 28 September - 1 October 2010*, Graz, Austria EuroSun 2010. 3

<sup>35</sup> *Ibid*, 4-5

<sup>36</sup> Sartori, “Criteria for Definition of Net Zero Energy Buildings,” 6-8

and a net-zero carbon.<sup>37</sup> Zero energy homes can be built as single or multifamily and in varying climates and locations.

## **EcoDistricts**

EcoDistricts, a Portland, Oregon based organization, developed a certification based on metrics used to promote sustainable, urban community development with a focus on resiliency, social, economic and ecological innovation, income, education and health disparities, and equity.<sup>38</sup> EcoDistricts has a protocol and certification guide to help cities and neighborhoods collaborate and achieve higher performance outcomes.<sup>39</sup> For example, the protocol lays out the following priorities and objectives:

- Place: Strong civic engagement, preservation and celebration of culture and history, diverse and affordable housing, and accessible public spaces and services for daily needs
- Prosperity: Equitable access to quality education and career pathways, a robust employment base with increasing jobs and job quality, and entrepreneurial innovation and business start-ups
- Health and Well-Being: Active living based on walkability and recreation; equitable health outcomes based on accessible, affordable health care; affordable, local, fresh food; remediated toxic environments; and strong public safety
- Connectivity: A street network that accommodates diverse ages and abilities by using multiple travel modes and shared mobility options, and a high-quality digital network providing equitable connectivity and leveraged community data

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<sup>37</sup> Zero Energy Project, *What Are Zero Energy Homes*, <[https://zeroenergyproject.org/buy/zero-energy-homes/?gclid=EAIaIQobChMIqNz14sGQ3AIVj-NkCh1KtQakEAAAYAAEgKP-fD\\_BwE](https://zeroenergyproject.org/buy/zero-energy-homes/?gclid=EAIaIQobChMIqNz14sGQ3AIVj-NkCh1KtQakEAAAYAAEgKP-fD_BwE)>

<sup>38</sup> EcoDistricts, <<https://ecodistricts.org/about/>>

<sup>39</sup> *Ibid*

- Living Infrastructure: Healthy soils, water, trees, and wildlife habitat; accessible nature; and natural processes integrated into the built environment
- Resource Regeneration: More efficient water use; diversion of waste from landfills; reuse of remediated land; and the pursuit of energy efficiency, technology advancements, and renewable energy production that reduce greenhouse gas emissions<sup>40</sup>

The EcoDistricts certification and maintenance process for neighborhoods involves four steps: 1) decisions must demonstrate commitment to equity, resilience and climate protection; 2) form a collaborative governance, 3) create an implementation roadmap to guide projects, and 4) track and measure impact and performance over time.<sup>41</sup>

In conclusion, each of these frameworks set forward guidelines and best practices that inform sustainable development of buildings and communities. Unfortunately, without added financial and policy motivations, these frameworks may not be used because they can add time and cost to a project. For example, it might take longer to find building materials that meet the sustainability standards and then might cost more to purchase them. Achieving net-zero carbon and/or energy in buildings and communities does not come without a cost, but looking at the social, environmental, and economic benefits in the long run can balance the increased upfront time and expenses. Sustainable, net-zero development must utilize a combination of these frameworks in addition to considering the sustainable development methods and community components as discussed in the next two sections.

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<sup>40</sup> EcoDistricts, *Protocol: The Standard for Community Development*, Version 1.2. Updated September 2017. <<http://ecodistricts.org/wp-content/uploads/2017/09/ed-protocol-guide-v1.2-FINAL-27Sept17.pdf>>

<sup>41</sup> Bennett, Rob. "EcoDistricts Certified: In a Challenging Era, 11 Communities Step Up" *EcoDistricts*. Published July 31, 2017. <<https://ecodistricts.org/ecodistricts-certified/>>

## **ACHIEVING NET-ZERO: SUSTAINABLE DEVELOPMENT METHODS**

In addition to applying the frameworks and certifications described above, net-zero community development must also consider and implement a combination of sustainability methods to reduce and offset carbon emissions. For the purpose of this paper, five methods will be considered: 1) architectural and engineering design, 2) renewable energy and energy efficiency, 3) SMART technology, 4) carbon offsets and sequestration, and 5) land use and city planning (density and green/open spaces).

### **Architectural and Engineering Design**

Architectural and engineering design can significantly reduce anthropogenic carbon emissions from a buildings perspective. La Roche discusses the carbon-neutral architectural design process (CNDP), which is a system used by architects to achieve net-zero carbon in buildings.<sup>42</sup> La Roche acknowledges the challenges of precisely calculating building emissions and that it “is not possible to eliminate all of a building’s emissions” because “energy and water will always be used, and some waste will always be produced.”<sup>43</sup> The goal of the architectural design should be to reduce emissions as much as economically possible and offset the remaining using features such as renewable energy.

Four architectural considerations “that directly affect building emissions at the urban scale are size, density, mix of uses, and layout.”<sup>44</sup> To design and construct buildings with smaller carbon footprints, architects must consider energy (renewable sources and efficiency), heating and cooling systems, placement and geometry of the building, and water usage and catchment. In addition to building new, architects can also focus on designs for retrofitting, reusing, or repurposing spaces and buildings that already exist, such as redeveloping

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<sup>42</sup> La Roche, Pablo. *Carbon-neutral Architectural Design*. Second ed. Boca Raton: CRC Press, 2017.

<sup>43</sup> *Ibid*, 32

<sup>44</sup> *Ibid*, 36

infrastructure or implementing new technologies.<sup>45</sup> Engineering and consulting firms are also key players in developing and implementing innovative solutions supporting environmental sustainability. Firms often consult on environmental management, recycling, waste management, pollution prevention, composting, low impact development, storm water management, transportation, LEED certification, and Living Buildings.<sup>46</sup>

### **Renewable Energy and Energy Efficiency**

The second consideration is energy, specifically renewable energy and energy efficiency. Energy is critical to people's day-to-day life operations, such that the electricity sector, including the generation, transmission, and distribution of energy, contributes 28% of total U.S. greenhouse gas emissions (including carbon dioxide).<sup>47</sup> Carbon is released during the combustion of fossil fuels such as coal, oil, and natural gas, which are common sources of electricity.<sup>48</sup> Electricity enables the utilization of appliances, heating and cooling systems, and technology.

Reducing how much energy is produced, transmitted, utilized, and stored are key to reducing the individual and community carbon footprint. Switching to a renewable energy source is arguably the most direct way to reduce carbon emissions through the harnessing of energy in an environmentally clean and sustainable way. Examples of renewable energy sources include solar, wind turbines, hydro (dams and micro), wave, tidal, geothermal, and biofuels. Most of these alternatives have zero carbon emissions, while a few can either reduce or be close to net-zero (biofuels, some hydro). Washington State benefits from a highly renewable energy portfolio. In fact, "Washington ranks second in the nation, after California, [with] more than

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<sup>45</sup> 2030 Palette, *Urban Retrofit*, <<http://2030palette.org/urban-retrofit/>>

<sup>46</sup> 2020 Engineering, *Expertise*, <<https://www.2020engineering.com/expertise/>>

<sup>47</sup> U.S. Environmental Protection Agency, *Sources of Greenhouse Emissions*

<sup>48</sup> *Ibid*

three-fourths of the state's net electricity generation [originating] from renewable resources, predominantly hydroelectric power.”<sup>49</sup> Specifically, “Hydroelectric power provides more than two-thirds of Washington's net electricity generation and almost nine-tenths of the state's renewable power generation. Non-hydroelectric renewable energy sources, mainly wind and biomass, provide almost one-tenth of the state's total net electricity generation. Washington is among the top 10 states in the nation in electricity generation from renewable resources other than hydropower.”<sup>50</sup>

Reductions in carbon emissions can also be achieved through changes in energy distribution systems. From the production source, energy is then transmitted and distributed to homes and buildings. This complex system to connect electricity producers to consumers is called “the grid.”<sup>51</sup> “Our current electric grid was built in the 1890s . . . Today, it consists of more than 9,200 electric generating units with more than 1 million megawatts of generating capacity connected to more than 300,000 miles of transmission lines.”<sup>52</sup> In more recent years, there has been increased conversation around microgrids and off-grid systems.

The department of energy defines a *microgrid* as “a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously.”<sup>53</sup> In 2015, microgrids only accounted for 1.3 gigawatts (GW) or 0.1% of the total U.S. installed electric generating capacity, and 80% of operational microgrids are in seven

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<sup>49</sup> U.S. Energy Information Administration, *Washington State Profile and Energy Estimates*, <<https://www.eia.gov/state/analysis.php?sid=WA>>

<sup>50</sup> *Ibid*

<sup>51</sup> U.S. Energy Information Administration, *Electricity Explained: How Electricity is Delivered to Consumers*, Updated August 31, 2017. <[https://www.eia.gov/energyexplained/index.php?page=electricity\\_delivery](https://www.eia.gov/energyexplained/index.php?page=electricity_delivery)>

<sup>52</sup> U.S. Department of Energy Office of Electricity Delivery and Energy Reliability, *What is the Smart Grid*, <[https://www.smartgrid.gov/the\\_smart\\_grid/smart\\_grid.html](https://www.smartgrid.gov/the_smart_grid/smart_grid.html)>

<sup>53</sup> Lantero, Allison, “How Microgrids Work,” *U.S. Department of Energy*, Published June 17, 2014 <<https://www.energy.gov/articles/how-microgrids-work>>

states.<sup>54</sup> In 2016, there were 160 microgrids with an increased capacity of 1.6 GW, and it is expected to increase to 4.3 GW by 2020.<sup>55</sup> The seven states with the most microgrids are Alaska, California, Georgia, Maryland, New York, Oklahoma, and Texas.<sup>56</sup> Microgrids can promote utilization of local energy generation, provide back up during times of crisis (storms or power outages), can promote more energy independence among communities, and in some instances can be more sustainable and environmentally friendly.<sup>57</sup> Microgrids are not managed by a public or for-profit utility; therefore, individual power producers can manage their own power supply and make some money from their generation, helping their return on investment.

Microgrids are also more resilient against cyber attacks, storms, natural disasters, and other disruptions, which motivated a project called Brooklyn Microgrid in Brooklyn, New York City, NY.<sup>58</sup> This project would install infrastructure to allow a network of buildings to disconnect from the larger grid and “independently distribute locally sourced electricity without mediation from the utility.”<sup>59</sup> Another example, Ameren Corp recently completed a \$5 million microgrid project at its Technology Applications Center in Champaign, Illinois, which is one of the only utility-scale projects in the United States.<sup>60</sup> This microgrid produces up to 1,475 kilowatts, which can “provide 180 residences and 12 commercial buildings with power from dedicated wind, solar, and natural gas resources, backed up by a bank of lithium-ion batteries.”<sup>61</sup>

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<sup>54</sup> Grimley, Matt, “Report: Mighty Microgrids,” *Institute for Local Self-Reliance*, Published March 3, 2016. < <https://ilsr.org/report-mighty-microgrids/>>

<sup>55</sup> Center for Climate and Energy Solutions, *Microgrids*, <<https://www.c2es.org/content/microgrids/>>

<sup>56</sup> *Ibid*

<sup>57</sup> *Ibid*

<sup>58</sup> Peck, Morgen, “A Microgrid Grows in Brooklyn,” *Scientific American*, Published April 22, 2016.

<<https://www.scientificamerican.com/article/a-microgrid-grows-in-brooklyn/>>

<sup>59</sup> *Ibid*

<sup>60</sup> Wagman, David, “First Utility-Scale Microgrid in U.S. Enters Service,” *IEEE Spectrum*, Published May 26, 2017, < <https://spectrum.ieee.org/energywise/energy/the-smarter-grid/first-utilityscale-microgrid-in-us-enters-service>>

<sup>61</sup> *Ibid*

One step further is *off-grid* systems, which refer to autonomous, self-sufficient, stand-alone systems disconnected from the grid entirely. Off the grid homes, for example, typically produce energy from solar panels, a small wind turbine, or a microhydro system (run of the river or waterwheel), and include an inverter and some ability to store energy such as a battery to back up.<sup>62</sup> Off-grid homes must also consider the most efficient processes for space heating and cooling, water supply, septic system, lighting, ventilation systems, and appliances.<sup>63</sup> Off-grid homes tend to use less electricity and may even have an energy surplus during some months of the year. There have also been off-grid applications to commercial buildings. For example, there is the EcoCenter in San Francisco, California, the first 100% off the grid commercial building in the city.<sup>64</sup> Building features include: “a living roof, high recycled-content cement flooring, walls made from structurally insulated panels, solar panels that store surplus energy to a battery, and a unique eco-machine that harvests rainwater for use in plumbing and treats it using a system that’s part septic technology and part wetlands.”<sup>65</sup> Off-grid communities or cities would be much more difficult to develop.

Both microgrids and off-grid applications can be alternatives to the traditional grid, especially as existing infrastructure continues to age, restrictions to access continue, and the grid’s resiliency against storms and natural disasters diminishes. However, intermittency of renewable energy, inefficient storage capabilities, and unstable year-round demand can be barriers and disadvantages to microgrids and off-grid applications, which generally make them

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<sup>62</sup> U.S. Department of Energy, *Microhydropower Systems*, <<https://www.energy.gov/energysaver/buying-and-making-electricity/microhydropower-systems>>

<sup>63</sup> Holladay, Martin, “How to Design an Off-Grid House,” *Green Building Advisors*. Published June 2, 2017. <<http://www.greenbuildingadvisor.com/articles/dept/musings/how-design-grid-house>>

<sup>64</sup> Scott, Cameron, “EcoCenter: San Francisco’s First Off-Grid Commercial Building is Up and Running,” *Inhabitant*, published September 26, 2011. <<https://inhabitat.com/ecocenter-san-franciscos-first-off-grid-commercial-building-is-up-and-running/>>

<sup>65</sup> *Ibid*

less feasible for most individual homes and communities. For example, if buildings rely most on electricity from solar production, during the day and in the summer, there will be excess production, but during the night and winter, production may be insufficient. If storage technology is not efficient or lacks sufficient capacity, buildings may be without access to enough energy to function at even the most basic levels. Since microgrids and off-grid applications may not provide the necessary year round stability, most net-zero buildings are still tied to the main grid and managed by private or municipal utilities. They still produce just as much or more energy than they consume over the course of a year, despite having the grid as a backup (this is the case for the Bullitt Center).

Energy efficiency, on the other hand, is viewed as a low cost mechanism to achieve carbon emission reductions. Energy efficiency is defined as useful energy output divided by energy input.<sup>66</sup> Efficiencies can improve every step of the process starting with production, transmission, distribution, and ending with consumer utilization. For the purpose of this paper, and the crafting of a carbon neutral community, energy efficiency at the source of utilization is the focus. There are several consumer decisions that can drastically improve energy efficiency. These include appliances, light bulbs, home weatherization, and SMART technology. With light bulbs as an example, a standard incandescent light bulb is 60 watts, compared to LED, which is 7-10 watts.<sup>67</sup> According to Mark Buehrer, Founder and Director of 2020 Engineering and 2020 LED lighting, lighting accounts for about 30% of a building's energy cost and LED lights are 80% more efficient. His company has been working on tunable LED lighting, which means that every light has an IP address and can adjust lighting (color and intensity) based on time of day

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<sup>66</sup> Randolph, John and Masters, Gilbert M. *Energy for Sustainability: Technology, Planning, Policy*. Washington, D.C.: Island Press, 2008.

<sup>67</sup> Viribright, "Comparing LED vs CFL vs Incandescent Light Bulbs"

<<https://www.viribright.com/lumen-output-comparing-led-vs-cfl-vs-incandescent-wattage/>>

and natural light. Making buildings more resistant to air exchange, or weatherization, can also improve energy efficiency. For example, homeowners in Washington State save up to \$270 every year on their energy bill by instituting home weatherization measures.<sup>68</sup> Weatherization can be as simple as adding insulation and sealing cracks to reduce heat loss and conserve energy.<sup>69</sup>

### **SMART Technology**

Another means to improve energy efficiency is through SMART technology, which is the third major method that should be considered in sustainable development. Technology continues to become more prevalent and affordable, and the emerging SMART technology can be key to increasing efficiency and reducing consumption of energy and water. SMART stands for Self-Monitoring Analysis and Reporting Technology,<sup>70</sup> and applications are being developed for smart cities, smart buildings, and smart grids.

A smart city uses technology and data collection to more efficiently manage a city and its resources.<sup>71</sup> Through data monitoring and analyzing, technology enables increased interconnectedness and efficiencies among a city's infrastructure, transportation system, buildings (schools, hospitals, libraries, municipal buildings), power plants, water treatment systems, and other community assets.<sup>72</sup> A smart building similarly uses technology and data collection to improve efficiencies, namely in space utilization and reduction in energy consumption. For example, a smart building can monitor human activity and natural lighting in spaces and more accurately turn lights on and off or adjust the heating and cooling systems as

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<sup>68</sup> Washington State Department of Commerce, *Weatherization Programs – Washington State*, <<http://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/>>

<sup>69</sup> *Ibid*

<sup>70</sup> TechTerms, *SMART*, <<https://techterms.com/definition/smart>>

<sup>71</sup> Musa, Sam. "Smart Cities – A Roadmap for Development," *University of Maryland*, Published January 2016, <[https://www.academia.edu/21181336/Smart\\_City\\_Roadmap](https://www.academia.edu/21181336/Smart_City_Roadmap)>

<sup>72</sup> Musa, "Smart Cities – A Roadmap for Development"

needed. Lastly, smart grids look to revolutionize the current electric grid to automate and better manage complex technology and electricity needs.<sup>73</sup> A smart grid integrates “technology that allows for two-way communication between the utility and its customers” and “respond digitally to quickly changing electric demands”.<sup>74</sup> Four of the main benefits of the smart grid include: 1) increasing efficiency of electricity transmission, 2) reducing peak demand (meaning utilities might not have to power up natural gas powered peaker plant<sup>75</sup>), 3) increasing integration of large scale renewable energy systems, and 4) increasing integration of customer owned renewable energy systems.<sup>76</sup> Overall, being able to incorporate and accommodate advancing technologies will help to modernize the way in which we produce and consume energy while improving efficiency at every step of the process.

### **Carbon Offsets and Sequestration**

In addition to clean and renewable energy sources combined with advanced technologies, capturing and sequestering (storing) carbon, or generating carbon offsets, is critical to getting to net-zero carbon emissions, and thus is the fourth considered method for sustainable development. A *carbon offset* is defined as “a certificate representing the reduction of one metric ton (2,205 pounds) of carbon dioxide [equivalents].”<sup>77</sup> Carbon capture and sequestration can be accomplished naturally, architecturally, or technologically. Design and development of a community must be done through a conservation lens. For example, natural carbon capture and sequestration can be achieved through planting trees in urban and suburban areas, promoting

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<sup>73</sup> U.S. Department of Energy Office of Electricity Delivery and Energy Reliability, *What is the Smart Grid?*

<sup>74</sup> *Ibid*

<sup>75</sup> Peaker power plants are used in times of high demand. They can be activated quickly to supplement base load power sources.

<sup>76</sup> U.S. Department of Energy Office of Electricity Delivery and Energy Reliability, *What is the Smart Grid?*

<sup>77</sup> Terrapass, *Carbon Offsets Explained*, <<https://www.terrapass.com/climate-change/climate-change-carbon-offsets-explained>>

sustainable forest practices, and habitat restoration. Also, communities can be developed to include more open and green spaces and living walls and roofs on buildings.

Community forests and open and green spaces are key to healthy cities, habitat ecosystems, humans, and animals. Trees create a canopy that provides a number of environmental, economic, and health benefits. For example, a tree canopy can sequester carbon while preserving and protecting natural lands, ecological reserves, wetlands, and habitat for wildlife and plants.<sup>78</sup> Tree stands also help manage storm water by intercepting rainfall from ground run off, reduce the urban heat island effect, heating/cooling costs, air temperatures, and air pollution, and increase property values, provide wildlife habitat, and improve quality of life.<sup>79</sup> Environmentally, “a tree can absorb as much as 48 pounds of carbon dioxide per year and can sequester 1 ton of carbon dioxide by the time it reaches 40 years old.”<sup>80</sup> In fact, “based on field data from 10 USA cities and national urban tree cover data, it is estimated that urban trees . . . currently store 700 million tons of carbon . . . with a gross carbon sequestration rate of 22.8 million [tons of carbon per year].”<sup>81</sup> Results from a study in Montgomery, Alabama found that “the city’s urban forest removes 3.2 million pounds of pollutants from the air annually” at a value of \$7.9 million and “sequesters 11,263 tons of carbon each year and stored a total of 1.45 million tons of carbon.”<sup>82</sup>

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<sup>78</sup> Healthy Parks Healthy People, *Urban planning and the importance of green space in cities to human and environmental health*, <<http://www.hphpcentral.com/article/urban-planning-and-the-importance-of-green-space-in-cities-to-human-and-environmental-health>>

<sup>79</sup> Urban Watershed Protection, *Urban Tree Canopy*, <<https://www.cwp.org/urban-tree-canopy/>>

<sup>80</sup> Evans, Erv, “Tree Facts,” *North Carolina State University*, <<https://projects.ncsu.edu/project/treesofstrength/treefact.htm>>

<sup>81</sup> Nowak, David and Daniel Crane, “Carbon storage and sequestration by urban trees in the USA,” *Science Direct*. Published March 2002 <<https://www.sciencedirect.com/science/article/pii/S0269749101002147>>

<sup>82</sup> Urban Watershed Protection, *Urban Tree Canopy*

In addition, research suggests that exposure to large expanses of green spaces and forests have a number of physical and mental health benefits.<sup>83</sup> Studies have found a connection between urban forests and “fewer deaths from cardiovascular and lower respiratory-tract illnesses (Donovan et al. 2013), faster recovery from surgery (Ulrich 1984), stress reduction (Thompson et al. 2012), and lower prevalence of asthma rates (Lovai et al. 2008).”<sup>84</sup> Researchers have also found that urban forests can be an important “source of food, medicine, and materials for some urban residents” (Poe 2012) and that there is “a positive correlation between access to green space and physical activity.”<sup>85</sup> Furthermore, the research shows improved academic performance when exposure to urban forests increases as well as increased social cohesion.<sup>86</sup>

Living walls and roofs further maximize the utilization of limited space for plants and trees in urban and suburban settings.<sup>87</sup> Living green roofs involve the creation of a contained green space, often times in the form of a garden or trees.<sup>88</sup> Benefits of green roofs include waste diversion, storm water management, improved air quality (capturing carbon and other pollutants), energy efficiency (decreasing use of heating and cooling systems), and increasing biodiversity for improved habitat and urban agriculture applications.<sup>89</sup> Living or green walls can encompass many forms of vegetation, can be developed inside or outside of buildings, and perform well in tropical or temperate climates and in full sun or shade.<sup>90</sup> Similar to roofs, green walls can improve air quality (indoors and out), energy efficiency, and biodiversity. Overall,

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<sup>83</sup> Hanson, Pia, and Matt Frank, “The Human Health and Social Benefits of Urban Forests,” *Dovetail Partners, Inc*, Published September 19, 2016.

<[https://www.dec.ny.gov/docs/lands\\_forests\\_pdf/ucfdovetail2016rpt.pdf](https://www.dec.ny.gov/docs/lands_forests_pdf/ucfdovetail2016rpt.pdf)>, 2

<sup>84</sup> *Ibid*, 3

<sup>85</sup> *Ibid*, 5

<sup>86</sup> *Ibid*, 5

<sup>87</sup> Healthy Parks Healthy People, *Urban planning and the importance of green space in cities to human and environmental health*

<sup>88</sup> Green Roofs for Healthy Cities, *About Green Roofs*, <<https://greenroofs.org/about-green-roofs/>>

<sup>89</sup> *Ibid*

<sup>90</sup> Green Roofs for Healthy Cities, *About Green Walls*, <<https://greenroofs.org/about-green-walls/>>

these strategies can increase conservation and carbon capture and sequestration in communities and so must be considered in sustainable development.

### **Land Use and City Planning**

The fifth and final sustainable development method considered in this paper is land use and city planning. “Efficient land use, brought about by compact, mixed-use, pedestrian, and transit-oriented development, and in-fill redevelopment” can improve sustainability such as reducing travel distances and dependency on automobiles and saving energy.<sup>91</sup> In *Conservation Design for Subdivisions*, Randall Arendt describes conventional residential layouts versus a conservation design. He defines conventional as “residential developments where all the land is divided into house lots and streets, with the only open space typically being undevelopable wetlands, steep slopes, floodplains, and storm water management areas.”<sup>92</sup> Downfalls to the conventional design include poor pedestrian infrastructure, minimal to nonexistent open green spaces, and fewer natural environments for plant and wildlife habitat.<sup>93</sup>

On the other hand, conservation design “refers to residential developments where... half or more of the buildable land area is designated as undivided, permanent open space”, which can be achieved by “designing residential neighborhoods more compactly.”<sup>94</sup> Environmental benefits to development with more open and green spaces, like parks, golf courses, and community gardens, range from carbon sequestration to enhanced habitat as previously mentioned. More open and green spaces also make compact living more attractive and viable.<sup>95</sup>

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<sup>91</sup> Randolph and Masters, *Energy for Sustainability: Technology, Planning, Policy*, 583

<sup>92</sup> Arendt, Randall. *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks*. Washington, D.C.: Island Press, 1996

<sup>93</sup> *Ibid*

<sup>94</sup> *Ibid*

<sup>95</sup> Healthy Parks Healthy People, *Urban planning and the importance of green space in cities to human and environmental health*

Compact development, which increases density and reduces sprawl, encourages mixed housing including smaller homes on smaller lots, accessory dwelling units, duplexes or town homes, and multifamily complexes. Smaller lots may lead to reduced water consumption, and smaller homes or homes with shared walls reduce energy consumption. Compact living can improve community efficiencies, increase utilization of alternative transportation, and improve community infrastructure. Compact communities can better develop interurban trails and infrastructure for bikes, pedestrians, and public transit, which reduces the demand and utilization of fossil fuel emitting vehicles.

In conclusion, carbon reduction and offsets through architectural and engineering design, renewable energy, energy efficiency, SMART technology, carbon capture and sequestration, and land-use and city planning are key methods for sustainable, carbon neutral development.

## **BUILDING A CONCEPTUAL MODEL: COMMUNITY COMPONENTS**

In addition to utilizing the full range of sustainable development frameworks and methods previously discussed, conceptualizing a model sustainable and net-zero carbon community requires consideration of several key components. These include homes and buildings, energy production and grid management, waste and water treatment and management systems, transportation, infrastructure, and community food production.

### **Homes and Buildings**

Residential and non-residential buildings are arguably the most important component to developing a sustainable, carbon neutral community. “Buildings use almost three-fourths of the electricity generated in the United States, which means that buildings are responsible for a corresponding fraction of the carbon emissions and other pollution associated with power

plants.”<sup>96</sup> The main end uses for energy in residential and commercial buildings include space heating (25%), lighting (19%), space cooling (12%), water heating (11%), refrigeration (8%), and electronics (8%).<sup>97</sup>

Homes can be built or retrofitted to be greener and even net-zero energy. A green home uses “less energy, water and natural resources” and “is more efficient, and creates less waste.”<sup>98</sup> Methods of building a green home include using nontoxic materials, natural light and ventilation, renewable energy production onsite (solar, wind, geothermal, biomass), efficient plumbing, fixtures and appliances, water conserving irrigation systems, and recycled materials (carpet, tiles) or renewable materials (bamboo, hemp, wood).<sup>99</sup> For the New Buildings Institute, ideal buildings

Provide natural light and ventilation; have superior thermal comfort through mixed-modes with occupant-level control; vary design and windows by orientation; utilize shading and optimize views; have DC power; dynamically respond to occupancy, weather, and work hours; automate plug load management; produce renewable energy onsite; and use energy storage and electric vehicles interactively with the electricity grid. Do all this with fewer materials and toxins, at a quarter or less of today’s energy and water, and with little to no carbon emissions.<sup>100</sup>

In a conceptualized model community, all single and multifamily housing and non-residential buildings should be near or net-zero energy. Ideally, the community would have a mix of single and multifamily homes, but in more urban settings majority will likely be multifamily, whereas suburban or rural may have more single family. A single family home in any setting should be smaller with smaller yards or gardens. Larger buildings could include a living roof, terrace or walls. All buildings should include a water catchment or harvesting system to use

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<sup>96</sup> Randolph and Masters, *Energy for Sustainability: Technology, Planning, Policy*, 214.

<sup>97</sup> *Ibid*, 214.

<sup>98</sup> Benjamin, Heather. "Green Homes 101." *U.S. Green Building Council*. Published December 22, 2015. <<https://www.usgbc.org/articles/green-homes-101>>

<sup>99</sup> *Ibid*

<sup>100</sup> New Buildings Institute, *2018 Getting to Zero Status Update and List of Zero Energy Projects*

towards irrigation. All appliances should be electric and energy efficient and toilets should be composting and use minimal water.

## **Energy Production and Grid Management**

All residential and non-residential buildings should be equipped with solar power generation capabilities. This could look like solar photovoltaic panels on a roof or stand-alone array, or even solar windows (especially good for tall buildings with a lot of windows). There is research being done at the University College London to turn “glass panels into photovoltaic modules that can be integrated directly into buildings.”<sup>101</sup> The technology is still emerging and not as efficient as a photovoltaic solar panel, but if a solar window can operate at 10% efficiency, then one square meter of window at peak could produce 50 W.<sup>102</sup> Ideally, all solar generation is tied to either the main grid or a community’s microgrid with some off-grid applications where efficient to do so.

For residential buildings, “the average U.S. household uses about 11,000 [kilowatt hours] (kWh) of electricity a year,”<sup>103</sup> although this usage varies according to the size of home, number of residents, and consumption habits. Another estimate calculates the “average at 2 watts for every square foot.”<sup>104</sup> Both averages can be used to calculate the needed solar capacity to accommodate an average home. The calculation is as follows: 11,000 kWh divided by 12 months a year means the average home uses about 900 kilowatts (kW) per month. Assume the average full-capacity sun exposure available per day is 5 hours (about 150 hours per month), then 900

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<sup>101</sup> Extance, Andy, “The Dawn of Solar Windows,” *IEEE Spectrum*, Published January 24, 2018, <<https://spectrum.ieee.org/energy/renewables/the-dawn-of-solar-windows>>

<sup>102</sup> *Ibid*

<sup>103</sup> Sendy, Andrew, “How many square feet of roof space is needed for solar panels,” *Solar Estimate*. Published April 10, 2018. <<https://www.solar-estimate.org/news/2018-04-10-how-many-square-feet-do-you-need-and-how-much-electricity-will-it-produce>>

<sup>104</sup> AMECO Solar, *How Many Solar Panels are Needed for a 2,000 Square Foot Home*, <<http://solarexpert.com/2013/11/07/how-many-solar-panels-are-needed-for-a-2000-square-foot-home/>>

kW divided by 150 hours equals a 6 kW solar array necessary for net-zero, which is 20 panels at an estimated 300 watts per panel. Using the two-watt per square foot figure, for example, a 3,000 square foot home times 2 watts per square foot equals 6000 watts, or 6 kW. In other words, this calculation estimates that a 3,000 square foot home using an average of 900 kW per month will need a 6 kW solar array or 20 solar panels. This calculation is simplified, and therefore is not exact.<sup>105</sup> Some limitations and considerations in this calculation that should be considered include:

- Age and quality of roof (some roofs may be too old or otherwise unsuitable in their construction)
- Size of roof (on average only about 40% of a roof's surface area can be used)
- Angle of roof (may not be able to access sun)
- Direction to sun (best direction to face panels is south)
- Weather and sun exposure (sun hours available per day)
- Capacity of the solar panel (current technology is about 300 watts per panel)

Sun exposure is trickier in some states and climates. For example, Washington State's annual average is about 4.5 sun hours per day compared to Arizona, which receives 6.5.<sup>106</sup> In the winter, Washington's average sun exposure can be as low as 1.16-1.6 hours per day.<sup>107,108</sup> This means that when energy is needed the most for heating, production will be at its lowest.

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<sup>105</sup> According to 2016 census data, the average size for a new single-family house is 2,661 square feet. Dietz, Robert, "New Single-Family Home Size Trends," *National Association of Home Builders*, Published February 17, 2017. <<http://eyeonhousing.org/2017/02/new-single-family-home-size-trends/>> For the purpose of simplifying the calculation, I rounded up to 3,000 square feet from the national average. It is also worth noting that in an urban setting, a single-family house this size would not be common. It can be argued too that single-family homes should not be this large anyways and so new development should be looking at smaller footprints to reduce carbon emissions and energy consumption.

<sup>106</sup> Solar Direct, *Solar Electric System Sizing Step 4 – Determine the Sun Hours Available Per Day* <<http://www.solardirect.com/pv/systems/gts/gts-sizing-sun-hours.html>>

<sup>107</sup> *Ibid*

There are other energy related considerations and challenges to consider as well. First, because a net-zero community will most likely rely upon solar energy, the issue of intermittency will need to be addressed. Modern, Western human lifestyles demand stable access to electricity throughout the day and year. There are three main options to address intermittency at a building and community level: small-scale wind production, battery storage, and grid management.

Residential wind turbines can provide an efficient and cost effective way to produce clean energy and lower electricity bills by 50-90%.<sup>109</sup> Wind and solar complement each other because sunny and windy times tend to be opposite (day versus night, respectively), thus reducing the intermittency issue of only using one or the other as the sole energy source. A small turbine with a 5-kW generating capacity would likely be enough to meet all electricity needs for a typical American home.<sup>110</sup> One challenge with horizontal axis wind turbines is with size because a 5-kW wind turbine would be approximately 18 feet in diameter and 80 feet tall, really only making it feasible in rural areas.<sup>111</sup> Strides have also been made in improving vertical axis wind turbine technology.<sup>112</sup> On average, the cost of a wind turbine ranges from \$10,000 to \$70,000 depending on system size, height, and installation expenses (with <1-kW off-grid turbines generally costing \$4,000 to \$9,000 to an upwards of \$350,000 for a 100-kW turbine).<sup>113</sup> There are several residential wind turbine models that can be considered; six options are reviewed [here](#).

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<sup>108</sup> More detailed averages by city in Washington, month, and tilt can be found here: <https://rredc.nrel.gov/solar/pubs/redbook/PDFs/WA.PDF>

<sup>109</sup> EcoGlobe, *Best Residential Wind Turbines for Home Use*, <<https://eco-globe.com/best-residential-wind-turbines/>>

<sup>110</sup> Wind Energy Foundation, *Wind Power your Home*, <<http://windenergyfoundation.org/wind-at-work/wind-consumers/wind-power-your-home/>>

<sup>111</sup> *Ibid*

<sup>112</sup> Dvorak, Paul, “Vertical axis wind turbine technology continues to improve,” *Windpower Engineering & Development*, Published August 7, 2017, <<https://www.windpowerengineering.com/business-news-projects/vertical-axis-wind-turbine-technology-continues-improve/>>

<sup>113</sup> Wind Energy Foundation, *Wind Power your Home*

Battery storage technology could include community battery, home battery backup, and electric vehicle (EV) battery options. For a community battery example, Puget Sound Energy installed a 2-megawatt or 4.4 megawatt-hour lithium ion battery system in Glacier, WA as a pilot to improve the reliability of electric service for customers.<sup>114</sup> The purpose of the project is to serve as short-term backup in the event of a power outage, reduce system loads during high demand periods, and balance energy supply and demand to support intermittency of renewable energy generation.<sup>115</sup> In fact, it “successfully provided six hours of energy during a planned outage to the local service area.”<sup>116</sup> Unfortunately, this project has been challenging in part because of the attempt to integrate new technology on an aging energy infrastructure but also because of community push back and skepticism.

Another option is solar plus storage for homes, which is a grid-tied solar power system with an inverter and battery backup, which can protect homes from grid outages.<sup>117</sup> For the third battery storage option, National Renewable Energy Laboratory has been exploring electric vehicle grid integration, which involves using a smart grid to connect plug-in electric vehicles to building energy systems, utility grids, and renewable energy sources to help with energy and grid management.<sup>118</sup> The idea being that the vehicle can adapt based on the energy load to charge when there is a low demand (electricity is cheaper and more plentiful) and stop charging when demand is high in effort to avoid firing up a peaker plant (often natural gas generation). The

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<sup>114</sup> Puget Sound Energy, *Glacier Battery Storage Project*, <<https://pse.com/inyourcommunity/pse-projects/system-improvements/Pages/Glacier-battery-storage-project.aspx>>

<sup>115</sup> *Ibid*

<sup>116</sup> Williams, Juliana and Aaron Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance,” *Washington State Housing Finance Commission*. Published December 2017. <<http://www.wshfc.org/energy/reportESSB5939.pdf>>

<sup>117</sup> Wholesale Solar, *Solar Plus Storage - Grid-Tied Solar Power Systems with Battery Backup* <<https://www.wholesalesolar.com/grid-tie-battery-backup>>

<sup>118</sup> U.S. Department of Energy National Renewable Energy Lab, *Electric Vehicle Grid Integration*, <<https://www.nrel.gov/transportation/project-ev-grid-integration.html>>

other benefit is that an EV battery could in theory provide emergency back-up and bi-directional power flow for reducing peak-power demands.<sup>119</sup> While storage technologies and research have been advancing, there are still limitations which make a microgrid and off-grid community less feasible or not feasible at all.

The other energy consideration would be who manages the energy and grid, such as a private utility company or a public utility district. This is important because if the community is tied to the main grid, they will need a utility to manage. Also to note, carbon emissions will be dependent upon to the sources of energy the utility uses. Each utility has a different energy portfolio with varying renewable energy capacities.

### **Waste and Water Treatment**

Another important component to consider for sustainable development is the management and treatment of waste and water. Buildings can be equipped with rainwater catchment and harvesting systems. “Rain water harvesting usually involves larger cisterns or multiple barrel systems that can store enough water to help water landscapes during long dry summers. Simple practices like amending soil with compost, mulching, and smart watering are the first steps to storing and conserving water.”<sup>120</sup> Having access to rainwater can allow for a community to sustainably water green spaces and community gardens, which can provide sources of carbon sequestration and food. Sustainable waste and water management and treatment can also be very beneficial. For example, processing waste through a Janicki Omni Processor<sup>121</sup> can provide a source of energy as well as potable water for community needs. Composting toilets, such as utilized in the Bullitt Center in Seattle, can also process human waste

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<sup>119</sup> U.S. Department of Energy National Renewable Energy Lab, *Electric Vehicle Grid Integration*

<sup>120</sup> City of Seattle Public Utilities, *Rain Water Harvesting*,

<[http://www.seattle.gov/util/environmentconservation/mylawngarden/rain\\_water\\_harvesting/](http://www.seattle.gov/util/environmentconservation/mylawngarden/rain_water_harvesting/)>

<sup>121</sup> Explained in a later section.

through an aerobic system that saves water and energy, controls carbon dioxide, and results in a nutrient rich fertilizer byproduct that can be used in gardens.<sup>122</sup> Ultimately, the goal of water and waste management is to conserve and reuse water and promote sustainability.

## **Transportation and Infrastructure**

In the United States, transportation of people and goods accounted for about 29% of the total energy consumption in 2017.<sup>123</sup> About half of that transportation related energy consumption is used in communities for passenger travel in light vehicles, buses, and commuter rail,<sup>124</sup> so improving community transportation systems and infrastructure is key to sustainable development and reducing carbon emissions. According to 2015 data, transportation accounted for 27% of the total U.S. greenhouse gas emissions, predominately through fossil fuel combustion in cars, trucks, ships, trains, and planes.<sup>125</sup> It is important to acknowledge that transportation systems and needs will differ depending upon population, density, geographic location, and if the community is urban, suburban or rural. For example, in denser, urban settings, it is easier for people to walk or bike or use a tram or trolley to get places, where as a suburban area may rely more heavily on buses and trains, and rural areas will likely rely heaviest on passenger vehicles. For the purpose of this paper, transportation modes considered include passenger vehicles, public transit, bicycles, and walking. It is also worth acknowledging that in order for a successful and accessible transportation system, a community must also develop the necessary infrastructure. The challenge will be in balancing a community's transportation needs with the different modes in an effort to achieve carbon neutrality.

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<sup>122</sup> Smith-Gardiner, Nina, "Composting Toilets at the Bullitt Center," *Bullitt Center*, Published June 14, 2012. <<http://www.bullittcenter.org/2012/06/14/composting-toilets-at-the-bullitt-center/>>

<sup>123</sup> U.S. Energy Information Administration, *Energy Use for Transportation*  
<[https://www.eia.gov/energyexplained/index.php?page=us\\_energy\\_transportation](https://www.eia.gov/energyexplained/index.php?page=us_energy_transportation)>

<sup>124</sup> Randolph and Masters, *Energy for Sustainability: Technology, Planning, Policy*, 583

<sup>125</sup> Environmental Protection Agency, *Sources of Greenhouse Emissions*

First, identifying community needs depends on a number of factors including population, geographic size, density, access to resources (such as grocery stores), and proximity to other communities and places of employment. It must be assumed that residents' transportation needs will vary – some needing to leave the community to work (with varying commute lengths) and others needing to travel within and around the community. For this reason, a transportation system must be comprehensive in an attempt to meet everyone's needs, and is why each of the four main modes of transportation – walking, biking, transit, and passenger vehicles – must be affordable and accessible to the members of the community. The second component will be in crafting this comprehensive system in a way that promotes net-zero carbon emissions or near enough to net-zero to offset in other ways.

Since carbon dioxide is emitted as a result of fossil fuel combustion, the only way to achieve carbon neutral transportation is to eliminate all gas powered vehicles. To do this, electric cars and buses must be utilized, in addition to light rail, trains, or trams for longer distances. One idea, in addition to some residents owning their own electric vehicle (EV), would be to have a community supported car share program, where EVs can be made publicly available to reserve on a day-by-day or month-by-month basis. An EV fleet could include multiple models to accommodate for varying commute lengths and number of passengers. In addition, community car share programs should encourage residents to carpool. Also, in order for an EV only community to work, there must be ample access to charging infrastructure.

Ideally, EV owners will have a Level 2 charging station installed in their place of residence and/or access to charging at work.<sup>126</sup> For single-family homes, charging stations will need access to a 240 volt, 40 amp electrical outlet to power 32 amp electric vehicle supply

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<sup>126</sup> Level 2 charging stations are typically 240 volts, 32 amps where as a level 1 is a standard 120-volt outlet with 8-12 amps. For plug-in hybrids, a level 1 at 12 amps can fully charge a vehicle overnight, but for full electric vehicles, a level 1 could take two days.

equipment (EVSE) which is limited to operating at 80% of the circuit rating; for most, it will be located in the garage. It is more challenging to install charging stations in multifamily residences and commercial buildings, which is why an EV only community is more likely to be suburban or rural rather than in an urban setting. For residential and commercial buildings with parking garages, some can be built EV ready, otherwise there will be heavy reliance on public charging stations. Publicly available Level 2 and Level 3 charging stations should be accessible to residences and businesses, with enough parking spaces for each EV in the local car share fleet and additional stalls urban residents who own an EV can rent monthly or annually. The community charging center should be SMART (interacting with the grid), fully equipped with solar panels and developed in a centralized community location or locations that are accessible by foot or bike. There should also be bike racks near the charging stations so people who bike to a car can securely lock up it up. People living and working in the same community may eliminate the need for passenger vehicles all together.

Community transit is also critical to sustainable, net-zero carbon transportation. For those who are not able or interested in owning a passenger vehicle, or carpooling, community buses should be readily available to allow mobility within the community, but also to connect to other cities and counties. Although there are many electric bus makes and models, there are two generalized technologies. First are buses with a high capacity battery that can travel longer distances but require longer charging periods (often overnight). This model would be more ideal for bus routes requiring longer distances but fewer trips per day. The other option is a bus that can be rapidly charged but has a much shorter range. For example, one electric bus manufacturer, Proterra in California, offers three different models:

1. FC series: better for 24 hours circulator routes, 55-87 miles nominal range, and can recharge 19-38 miles per 10 minutes
2. XR series: better for low daily mileage, 136-238 miles nominal range, and about 2.5 hours charge time
3. E2 series: better for longer routes, 251-426 miles nominal range, and about 4.5 hours charge time<sup>127</sup>

In order to accomplish a robust public transit system, depending on the routes and demand, multiple models will likely need to be incorporated.

Lastly, alternatives to vehicular transportation like bicycles and walking are crucial to promoting a carbon neutral transportation sector, and a community must also build out a safe and accessible infrastructure. To first consider biking, the Washington Area Bicyclist Association (WABA) published a guide for building a bicycle friendly neighborhood that outlines the benefits of biking, the importance of bike infrastructure, and building community support. First, the benefits of biking include: 1) increased affordability, 2) reduced local congestion, 3) improved individual health, 4) increased environmental sustainability (reduced fuel consumption and air pollution), and 5) improved community safety.<sup>128</sup>

Secondly, it is very important to develop bicycle infrastructure that meets the community's mobility and safety needs. "Estimates show that approximately 7% of people are sufficiently confident in mixing with car traffic without some sort of accommodation" and that "up to 67% of people prefer to ride a bike in a space designated for bikes."<sup>129</sup> WABA also notes "studies show that the addition of bike infrastructure both significantly increases the number of

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<sup>127</sup> Proterra, *Catalyst Vehicle Range*, <<https://www.proterra.com/performance/range/>>

<sup>128</sup> Washington Area Bicyclist Association, *Building a Bicycle Friendly Neighborhood: A Guide for Community Leaders* (2013). Washington, D.C. <<http://www.waba.org/wp-content/uploads/2014/09/waba-guide-for-community-leaders-web.pdf>>, 8-11

<sup>129</sup> *Ibid*, 13

people biking and significantly decreases the risk of injury while biking.” These figures demonstrate the importance of building designated bicycle infrastructure to improve mobility within the community and connecting to other communities. These infrastructure options include cycle tracks, buffered bike lane, standard bike lane, shared use lane, reallocation of road space, trails and clear signage.<sup>130</sup> In order for government to invest in this type of infrastructure, there must be strong community support.

Also, for biking to reach its full potential and benefits as an alternative mode of transportation, there must be community education and outreach to ensure riders learn and practice safety, have interest and comfort in riding, and have access to safe and well maintained bicycles. For example, bicyclists should be required to wear a helmet, learn how to use hand signals and share the road with motor vehicles and take care with pedestrians, and wear bright and reflective clothing and lights (especially at night or in poor weather conditions). Also, making bicycles publicly available through a bike share program may also improve ridership. Much like the EV car share, bikes on racks should be located in a centralized location and/or throughout the community available to use daily, monthly, or annually as needed. Another consideration, as more people shift towards biking, is ensuring destinations have access to secure bike racks and facilities to clean up such as showers. If all of these considerations are accounted for, community members may be more inclined to opt into riding a bike rather than driving a passenger vehicle.

In addition to bicycles, the other alternative to vehicle transportation method is walking. Promoting walkable communities, including the development of safe and accessible pedestrian infrastructure, is the last major component to consider for carbon neutral transportation. Walking

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<sup>130</sup> Washington Area Bicyclist Association, *Building a Bicycle Friendly Neighborhood: A Guide for Community Leaders*, 14-19

has many of the same benefits as biking such as improving human health and safety, the environment, affordability, and overall quality of life.<sup>131</sup> Walking also has similar barriers, which include limited distance capabilities (not reasonable for longer commutes), infrastructure (limited or non-existent), economic (new facilities and program costs), and environment (paved roads and trails impact natural environment).<sup>132</sup> But a lot of research has been done to consider what characteristics can be engineered in a community to promote walking. An article by Neal Templin in the *Wall Street Journal* outlined many of the components that make walkable communities work. To summarize:

- Destinations that matter to residents, such as stores, parks, schools, restaurants, and churches, must be within a 5-minute walk
- Municipalities may have to rewrite building codes to permit a blend of uses
- Design and build narrower streets to slow down traffic so it is safer to walk
- Plant trees to make shade and separate sidewalk from street and make sidewalks wide
- Carefully calibrate length of block to maximize community efficiency and design each block to have a destination within sight
- Improve walker experience by making surrounding appearances more pleasing and welcoming such as having residential flower gardens or interesting commercial window displays
- Promote higher density in residential areas – at least 10 houses per acre – to help make neighborhoods more vibrant<sup>133</sup>

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<sup>131</sup> U.S. Department of Housing and Urban Development, *Creating Walkable & Bikeable Communities*, <<https://www.huduser.gov/portal/sites/default/files/pdf/Creating-Walkable-Bikeable-Communities.pdf>>, 10-14

<sup>132</sup> *Ibid*, 16-19

<sup>133</sup> Templin, Neal, “What Makes Walkable Communities Work,” *The Wall Street Journal*. Published June 26, 2018. <<https://www.wsj.com/articles/what-makes-walkable-communities-work-1530065220>>

While this summary is not exhaustive, it outlines characteristics to consider in the effort to promote a well-functioning walkable community. Another critical piece to pedestrian infrastructure, as well as for bicycle infrastructure, is trails. Interurban trails can provide a safe, more scenic, enjoyable, and uninterrupted alternative to sidewalks that can further ease a person's commute and encourage more exercise. All this being said, "the hope is to create communities that use walking and biking for short commutes and mass transit for longer ones"<sup>134</sup>, but recognizing there may still be a need for passenger vehicles, which is why low or no carbon emitting options must be incorporated.

### **Broadband**

While infrastructure is often thought of as roads, bridges, and trails to promote the transportation of people and goods, another form of infrastructure is broadband. As it relates to sustainably developing a carbon neutral community, access to broadband can help in two main ways. First, broadband allows individuals to work from home, thus eliminating emissions associated with commuting. Other potential benefits include supporting entrepreneurs, start-ups, and businesses of all sizes, tele-health, and Internet purchases of goods not readily available within the community. Secondly, much of the technology discussed earlier to help promote efficiencies are SMART or IoT (internet of things), thus require high speed broadband and access to the cloud. Without the Internet dependent technology to maximize efficiencies, achieving carbon neutrality in a community would be far more challenging. For communities to access reliable and fast Internet service, there must be a broadband or fiber backbone. While many urban communities do not worry about access to the Internet, rural communities often lack viable broadband or wireless Internet options and may even lack reliable cellular service. As the

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<sup>134</sup> Templin, "What Makes Walkable Communities Work"

economy continues to modernize and more heavily rely upon evolving technology, fast and reliable broadband is ever more important to promote community and economic prosperity.

### **Sustainable Agriculture**

The last component to consider in developing a sustainable community is agriculture as it relates to a localized and sustainable food source, managing food waste, and consumption habits. In 2016, agriculture activities contributed to 9% of total U.S. greenhouse gas emissions mainly through nitrous oxide (application of synthetic and organic fertilizers, growth of nitrogen-fixing crops, the drainage of organic soil, and irrigation practices) and methane (livestock – ruminants and manure).<sup>135</sup> Sustainable and local agriculture can improve human health and food access, independence, and safety. It also improves a community’s social, economic, and environmental prosperity while reducing its carbon footprint.

Local agriculture reduces the costs and carbon emissions associated with the transportation of food products longer distances. Modern food distribution systems rely heavily on motorized and airfreight transportation, which use fossil-fuels, pollute the air, and damage wildlife habitats.<sup>136</sup> Local agriculture also increases local control and management of the food and farming processes, which can help minimize other environmentally harmful agricultural practices such as overusing pesticides or mismanaging waste (manure), which can damage air and water quality. In particular, urban agriculture can “help improve the ecological performance of cities” by creating “an improved microclimate and to conserve soils, to minimize waste in cities and to improve nutrient recycling, and to improve water management, biodiversity, the O2

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<sup>135</sup> U.S. Environmental Protection Agency, *Sources of Greenhouse Emissions*

<sup>136</sup> Deelstra, T. and H. Girardet (2000). “Urban agriculture and sustainable cities.” In N. Bakker, M. Dubelling, S. Gundel, V. Sabel-Koschella, and A. Zeeuw (eds.), *Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda*. Feldafing, Germany: Food and Agriculture Development Centre (ZEL)

- CO2 balance, and the environmental awareness of city inhabitants.”<sup>137</sup> Agriculture also provides economic opportunities, such as jobs, workforce development, and a source of income to residents. Lastly, community agriculture has physical and mental health benefits. For example, an organization in Washington State called Growing Veterans provides farming opportunities for veterans and recognizes the therapeutic and rehabilitative nature through peer support and community cohesion and engagement.<sup>138</sup>

Agriculture in urban, suburban, and rural settings can include a wide range of applications: 1) rooftop, community, school, and home gardens, 2) greenhouses, 3) hydroponic and aquaponics systems, 4) plant nurseries, and 5) small and large farms, poultry and livestock.<sup>139</sup> In more urban areas, these agricultural applications can be located indoors, on vacant lots, roofs, postindustrial landscapes, or other sites, whereas suburban and rural areas will have access to more land and can have larger areas that are designated to agriculture.

Food waste and individual consumption habits also impact a community’s carbon footprint. Approximately 1.3 billion tons of food, or one third of all food produced, goes to waste, contributing to unnecessary energy and water consumption, emissions from transportation, and methane released during decomposition.<sup>140</sup> In the United States, “food waste creates about 8% of all human-caused greenhouse gas emissions,” which is “the equivalent of 43 million cars.”<sup>141</sup> In addition to reducing food waste, humans changing their diets can significantly reduce greenhouse gas emissions. In fact, “a global switch to a low-emissions diet

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<sup>137</sup> Deelstra, “Urban agriculture and sustainable cities,” 47

<sup>138</sup> Growing Veterans, <<https://growingveterans.org/>>

<sup>139</sup> Russ, Alex . *Urban Environmental Education Review*. Ithaca: Cornell University Press, 2017. Chapter 25: Urban Agriculture by Ilène Pevec, Soul Shava, John Nzira, and Michael Barnett <https://muse.jhu.edu/>

<sup>140</sup> World Wildlife Fund, *Fight climate change by preventing food waste,*”

<<https://www.worldwildlife.org/stories/fight-climate-change-by-preventing-food-waste>>

<sup>141</sup> *Ibid*

could result in an estimated 30% reduction of food-related emissions.”<sup>142</sup> Low-emissions diet involves reducing or eliminating meat consumption because meat has a high greenhouse gas footprint (especially cattle who produce a lot of methane). In fact, meat contributes “to over 20% of the carbon footprint of total food waste.”<sup>143</sup>

In conclusion, to develop a net-zero, sustainable community, one must consider the main community components: homes and buildings, energy production and grid management, waste and water treatment and management, transportation, infrastructure, and local community food production.

## **EXAMPLES OF EFFORTS IN WASHINGTON STATE**

Governments, organizations, and communities across the United States and abroad are working to reduce carbon emissions, improve sustainability, and develop communities towards conservation and net-zero. This section highlights some of the major organizations, programs, businesses, and building developments in Washington State. These efforts are moving local communities towards their sustainability goals through designing, building, and advocating for sustainable, net-zero, or living buildings and communities. Each effort demonstrates the applications of one or more of the aforementioned sustainable frameworks, development methods, and community components.

### **Community Organizations and Programs**

Washington State benefits from a number of community organizations and programs dedicated to promoting sustainability in buildings, energy, and communities. These coalitions and organizations through various campaigns help inform and mobilize community members

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<sup>142</sup> Climate Action Tracker, *Reducing food waste and changing diet could drastically reduce agricultural emissions*, Published January 23, 2018, < <https://climateactiontracker.org/press/reducing-food-waste-and-changing-diet-could-dramatically-reduce-agricultural-emissions/>>

<sup>143</sup> Food and Agriculture Organization of the United Nations, *Food wastage footprint & Climate Change*, <<http://www.fao.org/3/a-bb144e.pdf>>

around sustainability issues. In order for any change to happen, it is critical to have community support. This section highlights a small sample of local and regional organizations doing relevant work in sustainable development.

### ***WSU Energy Program***

Washington State University (WSU) Energy Program is a self-supported department within the university that provides customers with energy services, products, education and information.<sup>144</sup> Their staff includes energy engineers, energy specialists, technical experts, and software developers located in Olympia and satellite offices throughout the state.<sup>145</sup> Their customers include “large and small businesses, public and private utilities, local and state governments, tribes, federal agencies and facilities, manufacturing plants, professional and trade associations, schools, universities, national laboratories, and consumers.”<sup>146</sup> WSU Energy Program works on projects around building efficiency, clean fuels and alternative energy, supporting public facilities, computer services, industrial efficiency, agricultural efficiency, and research and evaluation. WSU Energy Program would be a great resource for communities looking to explore and pursue sustainable, net-zero development.

### ***Climate Solutions***

Climate Solutions, an organization with offices in Seattle, WA, Olympia, WA, and Portland, OR, is pushing for 100% clean energy in the Pacific Northwest by 2035. They advocate for removing coal from the grid, improving energy efficiency, phasing out gas fired plants, increasing renewable energy, and phasing out fossil fuels for surface transportation.<sup>147</sup> Some of

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<sup>144</sup> WSU Energy Program, *About Us*, <<http://www.energy.wsu.edu/AboutUs.aspx>>

<sup>145</sup> *Ibid*

<sup>146</sup> *Ibid*

<sup>147</sup> Climate Solutions, *100% Clean*, <<https://www.climatesolutions.org/100-percent-clean>>

their other efforts include The City Climate Movement, Urban Energy Efficiency, Clean Urban Transportation, and New Energy Cities.

The City Climate Movement involves partnering with local governments and other organizations to reduce carbon emissions and increase resiliency to climate change.<sup>148</sup> An example of this partnership in Washington State is the King County-Cities Climate Collaboration, a collaboration between King County and 13 cities “to adopt and achieve formal, shared countywide carbon emissions reduction targets” and providing staff expertise and support to cities to establish and implement “best practice information, lessons learned, tools, and resources.”<sup>149</sup> The Urban Energy Efficiency campaign involves promoting energy efficiency in buildings such as an urban cap and trade for buildings, technology, energy codes, and living buildings.<sup>150</sup> Clean Urban Transportation involves development and operation of public transit services and land use planning to reduce urban sprawl and protect rural open space.<sup>151</sup> These efforts also include promoting clean vehicles and fuels such as through a renewable fuels standard or expanding access and affordability of public charging stations for electric vehicles.<sup>152</sup> Lastly, in 2016, Climate Solutions completed the seventh and final year of the New Energy Cities program. This program combined research on carbon reduction best practices and partnered with local communities to help develop “clean energy goal-setting, clean energy transition planning, policy development, program design, and implementation.”<sup>153</sup>

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<sup>148</sup> Climate Solutions, *The City Climate Movement*, <<https://www.climatesolutions.org/bright-future/urban-clean-energy/the-city-climate-movement>>

<sup>149</sup> *Ibid*

<sup>150</sup> Climate Solutions, *Urban Energy Efficiency*, <<https://www.climatesolutions.org/bright-future/urban-clean-energy/urban-energy-efficiency>>

<sup>151</sup> Climate Solutions, *Clean Urban Transportation*, <<https://www.climatesolutions.org/bright-future/urban-clean-energy/clean-transportation>>

<sup>152</sup> Climate Solutions, *Clean Urban Transportation*

<sup>153</sup> Climate Solutions, *New Energy Cities*, <<https://www.climatesolutions.org/programs/new-energy-cities>>

## *Shift Zero*

Shift Zero, based in Seattle, WA, is “an alliance of [thirty two] organizations, each with its own mission and approach to sustainability in the built environment,” focusing on water, energy, land-use, transportation, buildings, and toxicity of materials.<sup>154</sup> As an alliance, they “promote one goal: the equitable adoption of zero net carbon buildings at scale.”<sup>155</sup> One of the alliances main priorities is advocating and promoting “cost-effective means to build and retrofit buildings that are zero net carbon.”<sup>156</sup> They define a Zero Net Carbon (ZNC) building “as a highly energy efficient building that produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually. To reach ZNC, these buildings first maximize energy efficiency, then maximize on-site renewable energy generation as practical, and then procure off-site renewable energy that is additional, local, equitable, and legally assigned to the building.”<sup>157</sup> The Shift Zero 2018 initiatives include:<sup>158</sup>

- 20 by 2020 Building Challenge: construction of 20 Passive House projects of 20,000 square feet or larger, within King County by the year 2020<sup>159</sup>
- Zero Net Carbon Policy Toolkit: toolkit for developing and implementing incentives and policy reforms that will drive market development of green, zero net carbon buildings<sup>160</sup>
- Roadmap to Zero Net Energy Building Code: support proposals to change energy code and identify political, structural and market changes required to be successful<sup>161</sup>

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<sup>154</sup> Shift Zero, *Member Organizations*, <<https://shiftzero.org/member-organizations/>>

<sup>155</sup> *Ibid*

<sup>156</sup> Shift Zero, *Statement of Purpose*, <<https://shiftzeroorg.files.wordpress.com/2018/04/shift-zero-statement-of-purpose-3.pdf>>

<sup>157</sup> Shift Zero, *What is Zero Net Carbon Building?* <<https://shiftzero.org/what-is-zero-net-carbon-building/>>

<sup>158</sup> Shift Zero, *Shift Zero Initiatives*, <<https://shiftzero.org/initiatives/>>

<sup>159</sup> Shift Zero, *20 by 2020 Building Challenge*, <<https://shiftzero.org/20x2020/>>

<sup>160</sup> Shift Zero, *Zero Net Carbon Policy Toolkit*, <<https://shiftzero.org/toolkit/>>

<sup>161</sup> Shift Zero, *Roadmap to Zero Net Energy Building Code*, <<https://shiftzero.org/roadmap/>>

- ZNC in Affordable Housing Tax Credit Allocation Criteria: develop a new allocation criteria for affordable housing projects supported by the Low Income Housing Tax Credit to promote a 3-tiered energy efficiency bonus point system<sup>162</sup>
- Energy Performance Disclosure and Upgrade at Point of Sale: create a mechanism for energy disclosure at the point of listing and potential energy efficient upgrade mandates, making a home's energy performance more transparent<sup>163, 164</sup>
- PACE (Property Assessed Clean Energy) Financing: enable property owners to fund building improvements such as energy efficiency, solar PV, water conservation and seismic upgrades by placing a lien on the property for the term of the debt that is paid back by the property owner as a special assessment on their property tax bill that stays with the property if sold<sup>165</sup>

Some of the Shift Zero members include 350 Seattle, 475 High Performance Building Supply, American Institute of Architects, Built Green, Climate Solutions, Housing Development Consortium, International Living Future Institute, New Buildings Institute, Northwest EcoBuilding Guild, NW Energy Coalition, Passive House Northwest, Solar Washington, Seattle 2030 District, and Sustainable Connections, among others.

### ***Sustainable Connections***

Sustainable Connections in Bellingham, WA, is dedicated to community sustainability through a number of programs focusing on green building and smart growth, sustainable business development, local food and farming, and energy efficiency and renewables. Most

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<sup>162</sup> Shift Zero, *ZNC in Affordable Housing Tax Credit Allocation Criteria*, <<https://shiftzero.org/lihtc/>>

<sup>163</sup> Shift Zero, *Energy Performance Disclosure and Upgrade at Point of Sale*, <<https://shiftzero.org/energy-performance-disclosure/>>

<sup>164</sup> More on energy use disclosure can be found here: <http://aceee.org/sector/local-policy/toolkit/residential-disclosure>

<sup>165</sup> Shift Zero, *Property Assessed Clean Energy (PACE) Financing in Washington*, <<https://shiftzero.org/pace/>>

relevant to sustainable development is their Green Building and Smart Growth Program, which supports local businesses and advances cutting edge, sustainable practices.<sup>166</sup> Rose Lathrop, Program Director for Green Building & Smart Growth, Energy, and Sustainable Business, noted that Sustainable Connections has worked with both EcoDistricts and Shift Zero in promoting sustainable development in Bellingham, such as with the downtown Waterfront Redevelopment project, and with policy including accessory dwelling units, land-use and infill toolkit, and alternative parking requirements in urban housing development.

### ***The Bullitt Foundation***

The Bullitt Foundation, founded in 1952 by Dorothy Bullitt and headquartered in Seattle, WA, is committed to “promoting responsible human activities and sustainable communities in the Pacific Northwest.”<sup>167</sup> The Foundation funds projects in five main areas including:<sup>168</sup>

1. Regional Ecosystem Health: Applied research and tool development, conservation finance and environmental economics, ecosystem preservation and ecological restoration, efficient use of water, management of forests, agriculture, and open spaces.<sup>169</sup>
2. Energy, Climate, and Materials: Promote livable cities including energy, energy storage, buildings, transportation and industry that eliminate the externalized costs of carbon, fossil fuels, and toxic chemicals. Support research and policy that incentivizes and removes barriers.<sup>170</sup>

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<sup>166</sup> Sustainable Connections, *Green Building & Smart Growth Program*, <<https://sustainableconnections.org/programs/green-building/>>

<sup>167</sup> The Bullitt Foundation, *Mission*, <<http://www.bullitt.org/about/mission/>>

<sup>168</sup> The Bullitt Foundation, *Programs*, <<http://www.bullitt.org/programs/>>

<sup>169</sup> The Bullitt Foundation, *Regional Ecosystem Health*, <<http://www.bullitt.org/programs/regional-ecosystem-health/>>

<sup>170</sup> The Bullitt Foundation, *Energy, Climate, and Materials*, <<http://www.bullitt.org/programs/energy-climate-and-materials/>>

3. Green Buildings: Promote innovation in commercial and residential buildings; implement designs, materials, and technologies that emphasize sustainability and performance based outcomes. Work with public, private and non-profit partners to promote policies, practices, codes, and incentives.<sup>171</sup>
4. Resilient Cities And Health Communities: Promotes public and alternative transportation, density, urban green spaces, affordable and green housing, resilient and efficient infrastructure, access to healthy and locally sourced food (urban agriculture), and the community values of equity, inclusion, and diversity.<sup>172</sup>
5. Thought Leadership And Innovation: supports bold, cutting edge or potentially risky initiatives that break through systemic barriers and make significant contributions to sustainability (“an incubator of big ideas”).<sup>173</sup>

Overall, the Bullitt Foundation is an important resource and source of funding for sustainable projects, with a focus on the Portland, OR to Vancouver, BC corridor.

### ***Capitol Hill Housing***

Capitol Hill Housing coordinates the Capitol Hill EcoDistrict in Seattle, which is a local neighborhood-based program to help advance environmental sustainability and community health in a highly dense urban setting.<sup>174</sup> The goals of the Capitol Hill Ecodistrict include building cultural and climate resiliency, engaging community members, increasing mobility, improving health and safety of public spaces, and promoting sustainable development and

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<sup>171</sup> The Bullitt Foundation, *Deep Green Buildings*, <<http://www.bullitt.org/programs/deep-green-buildings/>>

<sup>172</sup> The Bullitt Foundation, *Resilient Cities, Healthy Communities*, <<http://www.bullitt.org/programs/resilient-cities-healthy-communities/>>

<sup>173</sup> The Bullitt Foundation, *Thought Leadership and Innovation*, <<http://www.bullitt.org/programs/thought-leadership-and-innovation/>>

<sup>174</sup> Capitol Hill EcoDistrict, *About the EcoDistrict*, <<http://capitolhillecodistrict.org/about-the-ecodistrict/>>

resource conservation.<sup>175</sup> Their performance areas focus on water, habitat, culture, energy, materials, transportation, health, and equity. According to Joel Sisolak, Senior Director of Sustainability and Planning at Capitol Hill Housing, they have been working on the EcoDistrict since 2011 to build a holistic approach to community health, sustainability, and equity through local governance, stakeholder development, and coalition building. Ultimately, he said they have been directing neighborhood growth and development, and testing innovative strategies and working with local governments to scale up. The Capitol Hill EcoDistrict was established before the Portland-based official EcoDistricts' protocol and certification, and served as a major source of inspiration and guidance.

### **Private Sector: Business and Industry**

While non-profit and non-governmental organizations play a critical role in sustainable development and advocating for relevant policy, they cannot do it alone. Businesses can serve as invaluable allies through providing financial support and propelling sustainability through innovations and product development. Key industries include, but are not limited to, engineering, architecture, builders, construction, manufacturing, and technology. This section highlights a sample of businesses across the key industries in Washington State doing work to support sustainable, net-zero community development.

### ***2020 Engineering***

From an engineering design and environmental consulting perspective, 2020 Engineering, located in Bellingham, WA is a great example. They have made strides “with the research, planning, and/or design of over 300 sustainable and low impact development (LID) projects...at residential, commercial, educational, and municipal levels.”<sup>176</sup> Some of their

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<sup>175</sup> Capitol Hill EcoDistrict, *About the EcoDistrict*

<sup>176</sup> 2020 Engineering, <<https://www.2020engineering.com/#about>>

projects in Washington include: Wilkes Elementary School (Bainbridge Island), Cascade Middle School (Sedro Woolley), Roche Harbor Resort (San Juan Islands), the Bullitt Center (Seattle), Bertschi School (Seattle), Greenfire Campus (Seattle), Valley View Middle School (Snohomish), and zHomes (Issaquah).<sup>177</sup> Broadly, these projects focus on enhancing sustainability in homes, schools, and commercial buildings through increased efficiencies, renewable energy, water management and harvesting systems, sustainable infrastructure, and living/green spaces. See the “Sustainable Community Developments” section for more details on some of these projects.

### ***Renewable Energy Manufacturers***

As previously noted, one of the single most critical components to net-zero development involves the installation and utilization of renewable energy. Many energy technologies are manufactured in Washington State, and some states such as Washington have tax incentives tied specifically to local made products. Some of the high quality and well-known renewable energy manufacturers in Washington include:

- Iték Energy: solar panel manufacturing; located in Bellingham, WA
- Canyon Hydro: micro hydroelectric systems; located in Deming, WA
- Outback Power: off grid and grid connected solar panel inverters and storage systems; located in Arlington, WA
- Oscilla Power: wave energy converters; located in Seattle, WA
- Regenis: constructing and maintaining anaerobic digesters on dairy farms; located in Ferndale, WA

Sustainable and alternative energy can be produced in a variety of ways, and so communities must rely upon the private sector to research, innovate, and develop products in order to maintain

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<sup>177</sup> 2020 Engineering, *Projects*, <<https://www.2020engineering.com/projects/>>

a diverse energy portfolio, improve energy efficiencies, meet community demands, and reach sustainability goals and targets.

### ***Janicki Bioenergy***

Another cutting edge technology being designed and manufactured in Washington is called the Omni Processor, manufactured by Janicki Bioenergy in Sedro Woolley, WA. While electric power is one output, the main function of the Omni Processor is processing wastewater. The system starts with solid fuel combustion where “Biosolids or other wet waste streams enter a dryer where the moisture is evaporated. The dried, solid waste is now a fuel that proceeds to a fire where it is burned in a very controlled fashion, reducing the solids to a dry fly ash.”<sup>178</sup> Then “the heat that is generated by the controlled fire heats water in the boiler pipes to create steam,” which is “fed to a steam engine, which runs a generator to produce electricity. This electricity is then used to power the ... Omni Processor and produces surplus electricity.”<sup>179</sup> Lastly, the steam is filtered and then condensed, distilling the water to potable standards.<sup>180</sup> While the Omni Processor has been predominantly developed for installation in Africa, the technology should be considered for residential applications as a sustainable way to manage wastewater.

### ***Microsoft***

Washington State is also home to Microsoft (Headquarters in Redmond, WA), which has been at the forefront of incorporating IoT technologies into cities, buildings, and farms to make them smarter, safer, and more efficient. While Smart Cities are still at the concept level, Microsoft launched their CityNext project to accelerate the digital transformation of smart cities nationally and across the world. Smart Cities use IoT technology to collect and analyze data from

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<sup>178</sup> Janicki Bioenergy, *How the Janicki Omni Processor Works*,  
<<https://www.janickibioenergy.com/janicki-omni-processor/how-it-works/>>

<sup>179</sup> *Ibid*

<sup>180</sup> *Ibid*

SMART devices and sensors, using high-speed networks and cloud infrastructure.<sup>181</sup> Insights derived from data can more accurately help cities address issues such as traffic congestion, but it also can improve energy efficiency and resiliency in infrastructure.<sup>182</sup> Some of the sustainability outcomes include smarter water management and water quality testing, environmental monitoring, multi-modal and advanced transit, and smart buildings.<sup>183</sup>

Smart buildings can significantly improve energy efficiency through automation of the buildings features. For example, sensors can detect if someone is occupying a space, and if they leave, the system can automatically turn off the heat or air conditioning and the lights.<sup>184</sup> A testament to the success of technology integration in improving energy efficiency is Microsoft's very own 88-acre, 164 building "smart campus." According to Bert Van Hoof, Program Manager of Microsoft's Azure IoT, they collect 2 million data points every 5 minutes through a system of interconnected sensors and monitor and process in real time. As a result of tracking space utilization and identifying then improving inefficiencies, Microsoft has sustained a 6-10% total energy savings annually for the last five years. Technology will continue to be highly crucial in maximizing community and individual efficiencies.

### ***Puget Sound Energy***

Lastly, private utilities, such as Puget Sound Energy (PSE), have taken significant measures in promoting renewable energy and sustainable development not only within their company but also through financial contributions, incentives, and programs made available to customers and community partners. PSE has a robust renewable energy portfolio including wind,

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<sup>181</sup> Yesner, Ruthbea, "Accelerating the Digital Transformation of Smart Cities and Smart Communities," *Microsoft*. Published October 2017 <<http://info.microsoft.com/rs/157-GQE-382/images/Accelerating-the-Digital-transformation-of-smart-cities.pdf>>, 3

<sup>182</sup> *Ibid*, 3

<sup>183</sup> *Ibid*, 4

<sup>184</sup> Microsoft, *IoT for smart cities and infrastructure*, <<https://www.microsoft.com/en-us/internet-of-things/smart-city>>

solar, hydroelectricity, and biogas.<sup>185</sup> For example, more than one-third of PSE's energy portfolio is hydroelectric power and they own and operate three large wind farms producing electricity for nearly 200,000 homes.<sup>186</sup>

PSE has a number of programs to help customers reduce their carbon footprint including Solar Choice (match customer electricity use with solar power),<sup>187</sup> Green Power (match customer electricity use with a mix of renewables),<sup>188</sup> Carbon Balance (purchasing carbon offsets from local projects),<sup>189</sup> and Customer Connected Solar (net metering available to customers who connect and generate electricity through solar, wind, micro hydro, biomass, or fuel cells, up to 100 kW in capacity).<sup>190</sup> Another program, called Green Direct,<sup>191</sup> targets large customers such as corporations, universities, and municipalities offering them an ability to purchase 100% of their energy from dedicated, local, renewable energy sources.<sup>191</sup> This program will fund the 171-megawatt Skookumchuck Wind Energy Project in Lewis County (southwestern Washington).<sup>192</sup> Public utilities like Seattle City Light (SCL) offer similar programs (Customer Solar and Green Up) and renewable energy investments.<sup>193</sup>

PSE also offers a series of incentives for customers who want to improve their home's energy efficiency. Currently, PSE offers a free home energy assessment, up to 20 free LED light

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<sup>185</sup> Puget Sound Energy, *Green Power*, <<https://pse.com/savingsandenergycenter/GreenPower/Pages/default.aspx>>

<sup>186</sup> Puget Sound Energy, *Electricity Supply*, <<https://pse.com/aboutpse/EnergySupply/Pages/Electric-Supply.aspx>>

<sup>187</sup> Puget Sound Energy, *Solar Choice*, <<https://pse.com/savingsandenergycenter/SolarChoice/Pages/default.aspx>>

<sup>188</sup> Puget Sound Energy, *Green Power*

<sup>189</sup> Puget Sound Energy, *Carbon Balance Program*, <<https://pse.com/savingsandenergycenter/CarbonBalance/Pages/default.aspx>>

<sup>190</sup> Puget Sound Energy, *Customer Connected Solar*, <<https://pse.com/savingsandenergycenter/CustomerConnectedSolar/Pages/Customer-Connected-Solar.aspx>>

<sup>191</sup> Puget Sound Energy, *Green Direct*, <<https://pse.com/savingsandenergycenter/GreenPower/Pages/Green-Direct.aspx>>

<sup>192</sup> *Ibid*

<sup>193</sup> Seattle City Light, *Renewable Energy*, <<https://energysolutions.seattle.gov/renewable-energy/>>

bulbs, and rebates for household upgrades such as for energy efficient technologies and appliances (such as old refrigerators).<sup>194</sup> “In 2016, PSE completed a Sweeps Campaign to distribute free LED light bulbs and energy efficiency information via targeted mailing and door-to-door canvassing... The Sweeps Campaign delivered 5,861 LEDs to 2,000 individuals for an estimated annual energy savings of 7,546,038 kWh in Bellingham.”<sup>195</sup>

In conclusion, the private sector in Washington State plays a critical role in propelling sustainable development forward through innovation, technology advancements, financial investments, renewable energy, and developing and implementing sustainable practices.

### **Sustainable Community Developments**

There are several local projects that highlight a diversity of sustainable development methods and applications in residential housing and commercial buildings. These development efforts combine architectural and engineering methods, as well as renewable energy, energy efficiency, water management, and technology. Examples include: the Bullitt Center, Greenfire Campus, zHome, TC Legend Homes, Zero Net Energy Tiny House (ZeNETH), Port Townsend EcoVillage, and Bellingham Organics.

#### ***The Bullitt Center***

The Bullitt Center, completed in 2013, is a net-positive, six-story, 52,000 square foot commercial building located in the Capitol Hill neighborhood of Seattle, WA. It is regarded as the “greenest commercial building in the world” and is certified as a Living Building by the International Living Future Institute. Some of the building features include passive heating and cooling, ground source heating, capturing and treating water, composting toilets, automated

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<sup>194</sup> Rice, Nathan, “City of Bellingham Climate Protection Action Plan,” 2018 Update. <<https://www.cob.org/Documents/pw/environment/Climate%20Protection%20Action%20Plan%202018%20Update.pdf>>, 72

<sup>195</sup> *Ibid*, 72

external blinds, bike rack and repair station, smart controls, an elevator that converts kinetic energy into electricity, and a constructed wetlands.<sup>196</sup> Furthermore, the Bullitt Center “is powered by a 244 kW rooftop solar array, composed of 575 PV panels. All rainwater that falls on the site is collected in a cistern in the basement, treated to potable drinking standards, and supplies all water needs of the building.”<sup>197</sup> The Bullitt Center was also constructed using local Forest Stewardship Council Certified timber, which sequesters 545 metric tons of carbon for the life of the building.<sup>198</sup> Lastly, the Center contains a constructed wetland garden of horsetail on the 3<sup>rd</sup> floor terrace that filters up to 500 gallons of gray water each day.<sup>199</sup> The Bullitt Center exemplifies sustainable development. However, while local, state, and federal incentive programs were attained, there were also a number of challenges with local building codes, up front costs, financing, and insurance. Policy that relates to projects such as the Bullitt Center will be further discussed in the last section of this paper.

### ***Greenfire Campus***

The Greenfire Campus includes mixed-use, commercial and residential buildings that replaced a parking lot in Ballard, a neighborhood in Seattle, WA. The campus includes a five-story apartment building with 18 units (ranging from 500-1,500 square feet), and a four-story (18,000 square foot) office building with retail on the ground level.<sup>200</sup> “Alongside the buildings there are rainwater storage cisterns, a pea patch, urban agriculture, yards, decks, plazas and a

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<sup>196</sup> U.S. Green Building Council, *Living Proof: The Bullitt Center Three Years Later*,

<<https://www.usgbc.org/education/sessions/living-proof-bullitt-center-three-years-later-10406582>>

<sup>197</sup> International Living Future Institute, *Bullitt Center*, <<https://access.living-future.org/bullitt-center-0>>

<sup>198</sup> Bullitt Center, *Building Features Tall Timbers*, <<http://www.bullittcenter.org/building/building-features/tall-timbers/>>

<sup>199</sup> Bullitt Center, *Building Features Water Washing*, <<http://www.bullittcenter.org/building/building-features/water-washing/>>

<sup>200</sup> Greenfire Campus, *Location*, <<http://www.greenfirecampus.com/location.html>>

riparian zone designed to provide bird habitat and to filter water through rain gardens.”<sup>201</sup> Fifty percent of the site is dedicated to wildlife habitat, storm water management, and gardens. The buildings include two rainwater harvesting systems that collect and store water to provide irrigation.<sup>202</sup> The buildings were also built with natural ventilation/passive cooling, heat recovery ventilators, low volatile organic compound materials, and green roofs.<sup>203</sup>

### ***zHome***

zHome is a net-zero, 10-unit town house development located in Issaquah, WA. Of the 10 units, according to Zillow, two of the units are one bedroom (with a market value of \$358K-\$479K), five are two bedrooms (with a market value of \$628K-\$733K), and three are 3 bedrooms (with a market value of \$714K-\$865K), ranging from about 800-1700 square feet.<sup>204</sup> zHome is a public-private partnership with partners including the City of Issaquah, King County, Built Green, Port Blakely Communities, Puget Sound Energy, Washington State University Energy Program, Howland Homes and Ichijo USA, Ltd.<sup>205</sup> zHome is the first multifamily, carbon neutral development in the United States that uses “zero net energy and 60% less water, emit[s] net-zero carbon emissions, [has] clean indoor air and use[s] only low toxicity materials.”<sup>206</sup> 2020 Engineering helped design the rainwater harvesting for toilets and laundry, but other features include well insulated walls, double-pane windows, ground source heat pumps, heat recovery ventilators, energy efficient lighting fixtures and appliances, roof-mounted

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<sup>201</sup> Greenfire Campus, *Location*

<sup>202</sup> 2020 Engineering, *Greenfire Campus*, <<https://www.2020engineering.com/portfolio-item/site-development-project/>>

<sup>203</sup> Greenfire Campus, *Green Features*, <<http://www.greenfirecampus.com/green-features.html>>

<sup>204</sup> Zillow, < [https://www.zillow.com/homes/for\\_sale/Issaquah-Highlands-Issaquah-WA/762902\\_rid/globalrelevanceex\\_sort/47.545274,-122.016172,47.544311,-122.018527\\_rect/18\\_zm/](https://www.zillow.com/homes/for_sale/Issaquah-Highlands-Issaquah-WA/762902_rid/globalrelevanceex_sort/47.545274,-122.016172,47.544311,-122.018527_rect/18_zm/)>

<sup>205</sup> Northwest EcoBuilding Guild, *zHome – A Zero Net Energy Community*, <<http://www.ecobuilding.org/green-building/project-spotlights/zhome-a-zero-net-energy-community>>

<sup>206</sup> 2020 Engineering, *zHome – A Net Zero Community, Issaquah , WA*, <<https://www.2020engineering.com/portfolio-item/sample-project/>>

photovoltaic solar panels (~72 kW's), and many of the materials were recycled, reclaimed, and regional.<sup>207</sup> Furthermore, there are electric vehicle charging stations located on site, which can accommodate four cars at any given time. Access to charging stations in urban areas enable and encourage automobile users to use electric vehicles, which further reduces carbon emissions.

### ***TC Legend Homes***

#### Cedarwood

One example of an affordable net-zero energy home is in Bellingham, WA. Built in June 2014, Cedarwood is a 2 story, 1-bedroom, 1-bathroom, 1,055-square-foot home “that features high-efficiency appliances, a balcony, a greenhouse, a patio, a loft, tongue-and-groove pine ceilings, and solar photovoltaic panels—all for \$151,908 or \$144 per square foot (not counting the land). A 3.2-kW PV system is all it takes to power the home, thanks to a highly insulated building envelope and high-performance equipment.”<sup>208</sup> This home was built in collaboration with TC Legend Homes and the homeowners to be more affordable, which can be challenging for many green homes. Some of the home’s features include:

- Passive solar heat gain during the cold months
- Foundation is constructed from insulated concrete forms with rigid foam to absorb and store the sun’s heat
- The walls and roof are assembled from structurally insulated panels featuring continuous foam insulation
- The house is south facing to maximize passive solar gain and solar panels.
- The primary heat source is an electric mini-split heat pump

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<sup>207</sup> Defendorf, Richard, “A Net-Zero Multifamily Project in Seattle,” *Green Building Advisor*. Published September 23, 2011. <<http://www.greenbuildingadvisor.com/blogs/dept/green-building-news/net-zero-multifamily-project-seattle>>

<sup>208</sup> TC Legend Homes, *Affordable Net-Zero-Energy House*, Published February 23, 2015, <<http://www.tclighthouse.com/portfolio-of-work/2014/12/10/bellingham-net-zero-energy-house>>

- Earth tubes which air passes through to pre-warm the air in the winter and pre-cool the air in the summer
- Smaller and more efficient appliances
- Tankless on demand hot water system
- Majority open living space<sup>209</sup>

As a result of its ingenuity, in 2014 it “won the grand prize in the Affordable category at the U.S. Department of Energy’s Housing Innovation Awards.”<sup>210</sup>

### Power House

Another example of an innovative home built by TC Legend Homes is nicknamed Power House. This 2,700 square foot duplex has “2 stories, 3 bedrooms, 3 bathrooms, 3 multi-purpose rooms (loft, rec room and sunroom), semi-covered deck, covered parking, acid-stained concrete slab foundation, radiant-heat floors, exposed beams, Hardie plank & milled cedar siding, metal roof, solar hot water, 9.9 kW solar array, [and] 2 electric car charging stations.”<sup>211</sup> The custom home cost under \$150 per square foot to build, and over the course a year the home is net-positive energy including capacity to charge two electric vehicles.<sup>212</sup> Some of the house’s features include: “airtight shell, structural insulated panel (SIP) construction, numerous south-facing windows and passive solar design, highly efficient heat pump, solar hot water, and a solar PV array using Bellingham-built Itek modules.”<sup>213</sup> The house has no electrical or heating bills and uses no oil, natural gas, or other fuels.<sup>214</sup> “The house qualifie[d] for a one-time federal tax credit of approximately \$10,500 and Washington State solar production credits of approximately

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<sup>209</sup> TC Legend Homes, *Affordable Net-Zero-Energy House*

<sup>210</sup> *Ibid*

<sup>211</sup> TC Legend Homes, *Bellingham Power House*, Published June 23, 2015, <<http://www.tclegendhomes.com/portfolio-of-work/2015/7/23/bellingham-power-house>>

<sup>212</sup> *Ibid*

<sup>213</sup> *Ibid*

<sup>214</sup> *Ibid*

\$5,000 a year until 2020.”<sup>215</sup> On July 31, 2018, TC Legends Homes was selected as a 2018 Housing Innovation Award winner in the Custom for Buyer category.

### ***Zero Net Energy Tiny House (ZeNETH)***

Another effort in Bellingham, WA is around affordable and sustainable tiny homes as a way to reduce residential carbon footprints. A student group at Western Washington University through the Institute for Energy Studies has been working on a project called ZeNETH. The project, still in its conceptual phase, aims to design and construct a superefficient, net-positive grid-tied 230 square foot tiny home including a kitchen, dining, lounge, bathroom and bedroom.<sup>216</sup> The design includes a kitchen with an electric range, small oven, and refrigerator, a combined washer/dryer, small electric water heater, ductless heat pump, and a two-kilowatt solar array.<sup>217</sup> According to their project timeline, they plan to start construction in January 2019 and anticipate it taking around 6 months, with the first open house being September 2019.<sup>218</sup> Their base cost for construction is \$40,250 or \$175 per square foot.<sup>219</sup> Kulshan Community Land Trust and CAZ Energy Services also have a similar project.<sup>220</sup>

### ***Port Townsend EcoVillage***

The idea of the Port Townsend EcoVillage first emerged in 2003 to build a community from scratch that would “minimize its ecological footprint, provide for economic diversity, adhere to compassionate communication, stick with consensus, use permaculture principles [(“principles of caring for the earth, caring for each other, and sharing the surplus”)], and grow

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<sup>215</sup> TC Legend Homes, *Bellingham Power House*

<sup>216</sup> Simpson, Aiden, Darrin Gordon, Nick Schmeck, and Patrick Shive, *Project ZeNETH Policy Report*. Western Washington University. June 2018.

<sup>217</sup> Zero Net Energy Tiny House, *Our Design*, <<https://wp.wvu.edu/projectzeneth/our-design/>>

<sup>218</sup> Zero Net Energy Tiny House, <<https://wp.wvu.edu/projectzeneth/>>

<sup>219</sup> Zero Net Energy Tiny House, *Our Design*

<sup>220</sup> CAZ Energy Services, *Bellingham Tiny Homes*, <<https://www.cazenergy.com/tiny-home/>>

much of its own food.”<sup>221</sup> The first home was built in 2007; in 2008 they built a community center, and in 2009 an attached greenhouse and community garden.<sup>222</sup> By 2017, the EcoVillage has grown to 28 adults and 10 children and is 7.5 acres including twelve units on 4,000 square foot lots<sup>223</sup> and over 6 acres of commonly owned land with community gardens, orchards, and shared buildings.<sup>224</sup> Beginning January 2017, spaces were made available to tiny home development with the first ground breaking in February 2018.<sup>225</sup> Over all, the Port Townsend EcoVillage is a strong example of sustainable community development and building a sense of community among the residents to foster their strong commitment to an ecologically low impact way of living.

### ***Bellingham Organics***

Bellingham Organics is a proposed “40,000 square foot, solar powered commercial greenhouse with a closed-loop aquaponics system, fed by harvested rain water and capable of producing organic food year round”.<sup>226</sup> The facility is proposed for downtown Bellingham, WA in a currently vacant property in disrepair. “Aquaponics is a combination of fresh water aquaculture (fish/shrimp- protein production) and hydroponics (growing vegetables, greens, and herbs without soil). The nutrient rich water from the aquaculture tanks is used to irrigate and fertilize the plants, and then the water is recycled back to the fish tanks, which creates a closed-

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<sup>221</sup> Port Townsend EcoVillage, *A Brief History of PTEV*, <<https://ptecovillage.org/a-brief-history-of-ptev/>>

<sup>222</sup> *Ibid*

<sup>223</sup> Cohousing Association of the United State, *Port Townsend EcoVillage*, updated July 31, 2018, <<https://www.cohousing.org/Port%20Townsend%20EcoVillage>>

<sup>224</sup> Port Townsend EcoVillage, *2017 Highlights*, Published February 6, 2018. <<https://ptecovillage.org/recent-highlights/>>

<sup>225</sup> Port Townsend EcoVillage, *Tiny Houses*, <<https://ptecovillage.org/tiny-houses/>>

<sup>226</sup> Anderson-Loucks, Tamara, “2020 Engineering Pioneers Sustainability and Green Building Movement,” *Business Pulse Magazine Fall 2017*, Published September 26, 2018. <[https://issuu.com/business-pulse/docs/business\\_pulse\\_magazine\\_fall\\_2017](https://issuu.com/business-pulse/docs/business_pulse_magazine_fall_2017)>, 18

loop system.”<sup>227</sup> The project is currently unfunded, but ideas such as this can revolutionize urban agriculture and provide benefits of supplying local organic food, provide jobs, and offer educational opportunities.

In conclusion, each of these highlighted examples in Washington State demonstrates how sustainable development methods have been advocated for and implemented. These efforts, among others, will continue to inform how we as a society can move forward towards carbon neutral development and ultimately a carbon neutral way of life.

## **POLICY OVERVIEW**

Building a sustainable, net-zero community can be an effective way to reduce carbon emissions and improve the environment. But, these efforts must be supported through policy and public sector investments. This policy overview section discusses a sample of policies at the local, state, and federal level that can help alter and guide human behavior and propel communities to achieve their sustainability goals. In order to achieve this, governments must find a balanced and productive combination of incentives, disincentives, codes/laws, and enforcement. Incentives encourage positive decisions and help overcome barriers whereas disincentives (such as taxes and fees) can deter people from harmful decisions and account for external costs. Codes and laws set forth mandates and regulatory requirements, guiding practices, and enforcement ensures accountability and penalizes for noncompliance (fees, condemnation, or jail). Generally speaking, mandates “can be difficult to be passed by city councils and decision makers if there is much public resistance and can also impose significant costs to construction businesses that are not ready for [changing] industry standards. Using incentives is often the easiest way of pushing the market toward energy efficiency and zero net carbon buildings.”<sup>228</sup>

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<sup>227</sup> Anderson-Loucks, “2020 Engineering Pioneers Sustainability and Green Building Movement,” 18

<sup>228</sup> Shift Zero, *Zero Net Carbon Policy Toolkit*

Thus, a robust policy plan must include a diversity of approaches because there is no single policy solution.

### **Local Government:**

Municipal and county governments have jurisdiction over a number of policies that impact sustainable development including building codes, permitting processes, zoning, and land use. Every city has a different set of policies, but for the purpose of the paper, the local government section will focus on policies forwarded in Bellingham, WA and Seattle, WA as two viable models.

Before discussing specific policies, it is helpful to review five general incentive types highlighted by Shift Zero's *Zero Net Carbon Policy Toolkit* that can be applied to any municipality. To summarize, effective incentives include:

1. Expedited Processes: expedite planning and review, permitting, and inspection processes; assign a single point of contact for the project
2. Land Use Incentives: exemptions and bonuses from base zone and code laws such as overhanging encroachments and bonuses in height, floor area ratio, density, or lot coverage, or reduce parking spot requirements
3. Technical Assistance: teach industry professionals how to develop more sustainably, provide access to a technical advisor or advisory committee
4. Marketing Assistance, Recognition, and Publicity Incentives: help developers promote their green buildings
5. Financial Incentives: grants, subsidies, permit fee reductions, fee waivers, leverage private/utility incentives<sup>229</sup>

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<sup>229</sup> Shift Zero, *Zero Net Carbon Policy Toolkit*

Local incentives options can go a long way in promoting sustainable development. Cities such as Bellingham and Seattle have begun multiple efforts to provide such incentives.

### ***Bellingham***

Founded by former Seattle Mayor Greg Nickels, Bellingham joins Seattle and over 1,000 other cities nationwide in signing the U.S. Conference of Mayors' Climate Protection Agreement, vowing to reduce carbon emissions in their respective cities below 1990 levels, which is consistent with the Kyoto Protocol.<sup>230</sup> Communities are also working to reduce climate change and emissions by participating in ICLEI's Cities for Climate Protection campaign, adopting aggressive emission reduction targets, and developing action plans to guide and track their progress.<sup>231</sup>

#### Climate Protection Action Plan

The first step a local government should take is adopting sustainability or climate change action plans or initiatives that set forward goals or targets to reduce carbon emissions.<sup>232</sup> Action plans outline policy priorities and recommendations for how to achieve carbon reduction and can inform policy makers on their decisions and actions. In 2007, Bellingham City Council passed a Climate Protection Action Plan, "which included emissions reduction targets for 2012 and 2020."<sup>233</sup> The five milestones set in 2007 were: 1) inventory emissions, 2) establish reduction targets, 3) develop a climate action plan, 4) implement policies and procedures, and 5) monitor and verify results.<sup>234</sup> Between 2000 and 2012, community emissions dropped 17% (exceeding

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<sup>230</sup> The United States Conference of Mayor, *Mayors Climate Protection Center*,  
<<https://www.usmayors.org/mayors-climate-protection-center/>>

<sup>231</sup> City of Bellingham, *Cities are Taking Action*,  
<<https://www.cob.org/services/environment/climate/Pages/cities-taking-action.aspx>>

<sup>232</sup> Shift Zero, *Zero Net Carbon Policy Toolkit*

<sup>233</sup> City of Bellingham, *Climate Protection Action Plan*,  
<<https://www.cob.org/services/environment/climate/Pages/program.aspx>>

<sup>234</sup> *Ibid*

the original target of 7%) as a result of implementing 48 emissions reduction measures.<sup>235</sup> To date, the City completed the five milestones and in 2018 updated the Climate Protection Action Plan establishing new community emission targets for 2030 (70% below 2000 levels) and 2050 (85% below 2000 levels).<sup>236</sup>

The City of Bellingham has identified 56 community emissions reductions measures in six strategies.<sup>237</sup> To name a few of the measures:

1. Energy Efficiency and Conservation<sup>238</sup>

- Utilities and community organizations offering money saving rebates for energy efficiency in residential, commercial, and industrial buildings
- Climate education and outreach
- Community Energy Challenge – whole building energy assessments and upgrades (retrofits, remodels, lighting, insulation, efficient appliances)
- Water use efficiency program and residential water metering
- Home rehabilitation and retrofits programs
- Project RENT – energy efficiency education and outreach to students who rent
- Energy Efficiency in multifamily buildings and public schools
- Waterfront District Energy – explore development of energy systems

2. Renewable Energy<sup>239</sup>

- PSE Green power purchases
- Solar Permitting Improvements
- Solar purchasing campaign

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<sup>235</sup> Rice, “City of Bellingham Climate Protection Action Plan,” 13

<sup>236</sup> *Ibid*, 13

<sup>237</sup> *Ibid*, 14-21

<sup>238</sup> *Ibid*, 70-83

<sup>239</sup> *Ibid*, 84-88

- Community solar projects – residents can lease panels in an off-site array
  - Residential wind power
3. Transportation<sup>240</sup>
- Biodiesel and biofuels
  - Car sharing
  - Smart trips/public transportation
  - Biking
  - Safe routes to schools
  - Promoting hybrid and electric vehicles
4. Green Building<sup>241</sup>
- Bin-Bump-Up program – reducing building permit review time for certified green projects (Built Green 4 or 5 star, or LEED Silver, Gold, or Platinum)
  - Integrated design meeting with City’s Green Project Review Team
  - Advanced materials and methods policies – help businesses and homeowners achieve LEED and Built Green standards
  - 2030 Districts – left by private sector to focus on efficiencies, building energy use, water consumption, and transportation emissions
5. Waste Reduction<sup>242</sup>
- Recycling construction and demolition waste
  - Organic food waste recycling
  - Increase residential curbside recycling
  - Banned plastic bags

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<sup>240</sup> Rice, “City of Bellingham Climate Protection Action Plan,” 89-94

<sup>241</sup> *Ibid*, 95-96

<sup>242</sup> *Ibid*, 97-98

## 6. Land Use<sup>243</sup>

- Development of Urban Villages – strategic city planning, mixed-use, transit corridors, access to services
- High density development – density bonuses, inclusionary zoning, cluster subdivisions to preserve green spaces, infill housing toolkit, accessory dwelling units, purchase and transfer of development rights, public-private partnerships for parking, wetland mitigation, and storm water management

Using Bellingham as an example, setting targets and establishing action plans outlining strategy and methods will continue to inform and promote sustainable practices and policies necessary to achieving a net-zero community. Once policy opportunities and recommendations are identified, the governing bodies must adopt policy to promote the target outcomes and change community behavior.

### Incentives, Municipal Codes and Enforcements

The main policy approaches that can alter human behavior include: incentives, disincentives, municipal codes (regulations and requirements) and enforcement (penalty for noncompliance). The City of Bellingham has developed an online resource specifically outlining green building incentives. Bellingham is “the first city in Washington State to offer a solar panel permit exemption program, and [they] also offer a variety of credits, fee reductions, [and] exemptions...that support sustainable development.”<sup>244</sup> Some of these policies include:

- Eliminating building permit and engineering requirements for residential solar installations

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<sup>243</sup> Rice, “City of Bellingham Climate Protection Action Plan,” 99-100

<sup>244</sup> City of Bellingham, *Green Building Incentives*,  
<<https://www.cob.org/services/environment/lid/pages/green-building.aspx>>

- Excluding the cost of solar panels when determining permit fees for non-residential buildings, saving more than \$2,000 in fees and an expedited, two week permit review
- Identifying and pre-approving innovative green building technologies and techniques such as advanced framing, amended soils, composting toilets, solar water heating, and roof-mounted photovoltaic solar panels
- Offering up to a 50% reduction in storm water development charges if rainwater harvesting, rain gardens, vegetated roofs, paver, or porous concrete/asphalt are implemented

Streamlined processes, code exemptions, and reducing fees are all local policies that can help incentivize sustainable development. In the case of streamlined permitting, for example, city issued permits for solar panel installations doubled from 2009 to 2010 and reached 145 in 2015.<sup>245</sup> In 2016, Bellingham’s residential and commercial solar capacity was 3,349 kW and 609 kW, respectively, producing 3,037,439 kWh of solar power (about 225 homes for a year) and preventing over 2,300 tons of CO<sub>2</sub>e emissions, which equates to the annual emissions from about 450 cars.<sup>246</sup>

There are also a number of codes and enforcements that can be implemented to mandate changes in a positive direction. For example, local municipalities could enact minimum standards or future targets, and then penalize (through assessing a fee) those who do not meet the standards. Potential options include setting forth energy use or efficiency standards, requiring new development to follow a sustainability framework (like LEED), or requiring building tune-ups, carbon audits or inspections to ensure low carbon footprint and optimization of energy and water performance by identifying low or no cost actions to improve building sustainability. The

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<sup>245</sup> Rice, “City of Bellingham Climate Protection Action Plan,” 85

<sup>246</sup> *Ibid*

challenge with the mandate and enforcement approach is to make sure it does not cause undue burden for developers or pass down costs to exacerbate unaffordability. On the other hand, codes and enforcement can help keep a community accountable in achieving their desired outcomes. For example, sustainable development projects reap the benefits of incentives, some of which were mentioned in the above section. The challenge is ensuring that projects that receive those benefits follow through on their sustainability promises. One idea would be to monitor building performance for projects that claim a framework or certifications, and penalize projects that do not meet the standards.<sup>247</sup> This approach attempts to ensure fair competition by rewarding good development with incentives and penalizing development that takes advantage of the system and deterring developers from not meeting their sustainability targets. Shift Zero recommends limiting penalties to 1-4% of the building value then increasing to 5% for developers who continue to offend after 5-10 projects; any penalty larger than 5% could back fire and disincentivize net-zero development.<sup>248</sup>

## ***Seattle***

### Seattle Climate Action Plan

Similar to Bellingham, Seattle also has a climate action plan, which was first adopted in June 2013 and updated in April 2018.<sup>249</sup> The purpose of the plan is to outline a strategy and roadmap to reduce carbon pollution, with special attention to the transportation and buildings sectors since they are the leading contributors of greenhouse gas emissions in Seattle.<sup>250</sup> In 2011, the Seattle Mayor and City Council adopted a goal for the community to become carbon neutral by 2050 and in 2013 a Climate Action Plan was created with near and long term goals and

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<sup>247</sup> Shift Zero, *Zero Net Carbon Policy Toolkit*

<sup>248</sup> *Ibid*

<sup>249</sup> City of Seattle Office of Sustainability & Environment, *Climate Change*, <<http://www.seattle.gov/environment/climate-change>>

<sup>250</sup> *Ibid*

strategies.<sup>251</sup> The City Council directed the Office of Sustainability & Environment to identify actions. Some of the recent transportation and building policy priorities and actions taken by the city include:

- Transportation.<sup>252</sup>
  - Expanding transit, bicycling, and pedestrian infrastructure and services
    - Multi-modal mobility - 2017 New Mobility Playbook and mobility hubs
  - Expanding charging infrastructure to foster increased adoption of electric vehicles
    - 2017 pilot program to permit installation of public EV charging stations in non-residential streets
    - Seattle City Light Charging Program
    - Amend electrical code to ensure new parking was built to accommodate EV charging infrastructure
    - Electric and hybrid municipal fleet
    - Electrification of ride shares and taxis
    - All electric bus fleet by 2040
  - Guiding growth to walkable and transit-accessible neighborhoods
  - Providing price signals that reflect the true cost of driving and incentivize shared and electric transportation choices
- Buildings.<sup>253</sup>
  - Adopted a green building goal for all new municipal buildings in 2000
  - Created a LEED incentive program for private projects in 2001

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<sup>251</sup> City of Seattle, *Seattle Climate Action*, Published April 2018, <[http://greenspace.seattle.gov/wp-content/uploads/2018/04/SeaClimateAction\\_April2018.pdf](http://greenspace.seattle.gov/wp-content/uploads/2018/04/SeaClimateAction_April2018.pdf)>

<sup>252</sup> *Ibid*, 8-9

<sup>253</sup> *Ibid*, 9-12

- Measure and share building energy use information
  - Adopted 2010: Seattle’s Benchmarking Program (SMC 22.920) – requires owners of non-residential and multifamily buildings to track and report energy performance
- Building improvements to increase energy and water efficiency
  - Adopted 2016: Building Tune-Ups Ordinance (SMC 22.930) – requires commercial buildings over 50,000 sq ft to identify low or no cost building operations and maintenance improvements – to be phased in by building size in 2019
  - Building Tune-Up Accelerator Program – incentives for early compliance, voluntary for mid-sized buildings (50,000-100,000 square feet)
- Provide incentives such as rebates and financing to offset costs
  - Oil Heated Home Conversion Program – incentives for homeowners to replace oil heating with electric heat pumps
  - Zoning incentives – access additional height, floor area, or density in certain zones if they meet the City’s Green Building Standard or the Living Building Pilot Program or redevelopment if meet the goals of Seattle 2030 District
- Implement codes for new construction and requiring ongoing evaluation and optimization of energy use

Seattle has taken action over the years in an effort to achieve their goals. For transportation, the City adopted an urban village strategy in 1994 to guide transportation policies. In 2015 they passed a Levy to Move Seattle and in 2016 the regional Sound Transit 3 levy was

passed, both of which accelerate the investment and expansion in transit, bicycling, and pedestrian infrastructure.<sup>254</sup> Through Seattle's investments in alternative transportation methods and infrastructure, single occupant vehicle usage declined by 10% and transit utilization increased 6%, biking increased 3%, and walking increased by almost 6%.<sup>255</sup> In terms of energy, Seattle City Light became the nation's first carbon neutral electric utility and energy efficiency savings account for 11% of their resource portfolio.<sup>256</sup> In 2014, four years after Seattle adopted its Energy Benchmarking Program, three consecutive years demonstrated a 2.7% decrease in energy use.<sup>257</sup> For the Building Tune-Up ordinance, Seattle anticipates a 10-15% reduction in individual building energy use, 5-8% reduction in commercial, and a 6-9% reduction of greenhouse gas emissions.<sup>258</sup> Furthermore, Seattle's zoning incentives have resulted in building developments that are 15-25% more energy efficient than code.<sup>259</sup> These are just some examples of Seattle's performance on the goals and targets set forth in their Climate Action Plan. For more details, visit the most recent [Implementation Strategy Progress Report](#), which was published in February 2015 and tracks Seattle's progress for transportation and land uses, building energy, waste, preparing for climate change, and Council priority actions.<sup>260</sup>

#### Incentives, Municipal Codes and Enforcements

The City of Seattle has outlined a series of incentives, mandates, codes, and regulations that promote sustainable development. Some of the incentives include:

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<sup>254</sup> City of Seattle, *Seattle Climate Action*, 8

<sup>255</sup> *Ibid*, 9

<sup>256</sup> *Ibid*, 9, 11

<sup>257</sup> *Ibid*, 10

<sup>258</sup> *Ibid*, 10

<sup>259</sup> *Ibid*, 12

<sup>260</sup> City of Seattle, *Seattle Climate Action Plan Implementation Strategy Progress Report*, Published February 2015,

<<https://www.seattle.gov/Documents/Departments/OSE/CAPDetailedStatusReportFeb2015.pdf>>

- Green Building Permitting: Permitting incentives to encourage sustainable development are available for projects meeting green building standards and minimum energy efficiency, water conservation and waste reduction thresholds.
- Living Building / Deep Green Pilot: Land use departures are available for projects aiming to meet the Living Building Challenge or Seattle’s Deep Green criteria.
- Incentive Zoning: LEED Silver or Gold certification is a minimum requirement to access additional floor area in certain zones. Higher floor area ratio or density is allowed for projects in low-rise multifamily zones that meet green building standards.
- Utility Rebates: Seattle City Light provides rebates supporting energy conservation in new construction and existing buildings. Seattle Public Utilities has rebates for potable water reductions and for rainwater collection, as well as reduced fees for storm water reduction systems.
- Community Power Works: Support for energy upgrades in single-family homes through low cost energy assessments, rebates, financing, and pre-approved contractors.
- Homewise: The Seattle Office of Housing operates a weatherization program for single-family homes with low-income households and apartment buildings with low-income tenants, including free weatherization and home improvement loans.<sup>261</sup>

Some of the mandates, codes, and regulations include:

- Energy Benchmarking and Reporting Program: Requires owners of non-residential and multifamily buildings 20,000 square feet or greater to track energy performance through the U.S. EPA’s Portfolio Manager, to report annually to the City and to provide an energy

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<sup>261</sup> City of Seattle. *Promoting Sustainable Development*, Published May 2015.  
<<https://www.seattle.gov/Documents/Departments/OSE/GreenBuildingOverviewMay2015.pdf>>

disclosure report, upon request, to tenants, buyers or other qualified parties. Buildings under 20,000 square feet may voluntarily benchmark and disclose.

- Seattle Energy Code (SEC): Developing cost-effective strategies for reductions in building energy use, the SEC ensures owners and tenants have efficient building envelopes and systems as well as effective tools to manage operational energy use.
- Green Factor: A scoring system for landscapes, required in certain parts of Seattle, with credits for various features such as trees, shrubs and rain gardens to help increase the quantity and improve the quality of urban landscaping.
- Storm Water Code: Green Storm Water Infrastructure: Requires projects to implement green storm water infrastructure to the maximum extent feasible. GSI examples include permeable pavement, bioretention facilities, and green roofs.
- High Performance Building Code: Using the International Green Construction Code as a guideline, provisions have been incorporated into Seattle Codes, including plumbing and irrigation requirements, construction material storage and waste management requirements, and allowances for greater insulation thickness.
- Construction & Demolition (C&D) Waste: The City's goal is to recycle 70% of construction waste by 2020. Requirements include landfill disposal bans on readily recyclable C&D materials, C&D processing facility certification, and submittal of Waste Diversion reports by permitted projects.<sup>262</sup>

When it comes to building and zoning codes, outdated policies can serve as a huge barrier to promoting the development of sustainable, net-zero communities. In Seattle, the Bullitt Center is a perfect example of how a living building broke multiple codes, requiring exemptions but eventually inspiring changes to the codes. These code changes are called the Living Building

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<sup>262</sup> City of Seattle. *Promoting Sustainable Development*

Pilot ([SMC 23.40.060](#)), which allows developers “to request additional departures from the Seattle Land Use Code through Design Review, and provides height and floor area incentives for buildings attempting to meet the Living Building Challenge.”<sup>263</sup> The Living Building pilot was adopted as a part of Seattle’s climate strategies, and was updated on July 2, 2018 along with the new 2030 Challenge Pilot. The 2030 Challenge for Planning, issued by Architecture 2030, adopts reduction targets for energy, water, and transportation.<sup>264</sup> The Pilot’s intention is to preserve and renovate historic and existing buildings to be higher performing and more energy efficient.<sup>265</sup> The pilot will expire December 31, 2025 or after 20 projects have enrolled.<sup>266</sup> Projects that qualify under the Living Building Challenge Pilot Program and 2030 Challenge High Performance Existing Buildings Pilot Program are eligible for benefits, which were strengthened in the update. Specifically, developers that are constructing new buildings or additions can benefit from:

- Up to 25 percent more floor area ration (up from 15%)
- Up to 30 percent more floor area if saving an unreinforced masonry structure
- 5 feet of additional height for residential construction or 15 feet of additional height for non-residential construction in zones with height limits of 85 feet or less
- 25 feet of additional height for residential construction or 30 feet of additional height for non-residential construction in zones with height limits greater than 85
- Additional design departures for the pilot programs as specified in [SMC 23.41.012D](#)<sup>267</sup>

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<sup>263</sup> City of Seattle Department of Construction and Inspections, *Living Building & 2030 Challenge Pilots*, < <http://www.seattle.gov/dpd/permits/greenbuildingincentives/livingbuildingpilot/>>

<sup>264</sup> *Ibid*

<sup>265</sup> *Ibid*

<sup>266</sup> *Ibid*

<sup>267</sup> *Ibid*

The updated ordinance also includes a new penalty formula for buildings that fall short of the requirements.<sup>268</sup> The new formula is more transparent and predictable and projects can be penalized up to 5% of the construction value.<sup>269</sup>

### ***Environmental Protection Agency Resource for Local Governments***

The EPA considers components of green buildings to include: 1) energy efficiency and renewable energy, 2) water efficiency, 3) environmentally preferable building materials and specifications<sup>270</sup>, 4) waste reduction, 5) toxics reduction, 6) indoor air quality, and 7) smart growth and sustainable development.<sup>271</sup> In June 2013, “EPA Region 4 developed the *Sustainable Design and Green Building Toolkit* (2013) to help local governments identify and remove barriers to sustainable design and green building in their permitting processes.”<sup>272</sup> “The toolkit addresses local codes and ordinances that affect the design, construction, renovation, and operation and maintenance of a building and its immediate site. It contains an assessment tool, a resource guide, and a guide to developing an action plan for implementing changes to the permitting process.”<sup>273</sup> For more information, visit the [Sustainable Design and Green Building](https://www.epa.gov/smartgrowth/sustainable-design-and-green-building-toolkit-local-governments)

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<sup>268</sup> Freed, Molly, “Seattle’s Living Building Pilot Program Receives Improved Incentives in Update,” *Trim Tab*, Published June 29, 2018, < <https://trimtab.living-future.org/blog/seattles-living-building-pilot-program-receives-improved-incentives-in-update/>>

<sup>269</sup> *Ibid*

<sup>270</sup> “Environmentally Preferable Products (EPP) and services have a lesser or reduced negative effect on human health and the environment when compared with competing products or services that serve the same purpose. This comparison applies to raw materials, manufacturing, packaging, distribution, use, reuse, operation, maintenance, and disposal. Environmentally preferable products possess more than one environmentally friendly attribute.” More information at:

General Services Administration, *Environmentally Preferred Products*, <<https://www.gsa.gov/governmentwide-initiatives/sustainability/buy-green-products-services-and-vehicles/buy-green-products/environmentally-preferred-products>>

<sup>271</sup> U.S. Environmental Protection Agency, *Components of a Green Building*, <<https://archive.epa.gov/greenbuilding/web/html/components.html>>

<sup>272</sup> U.S. Environmental Protection Agency, *Sustainable Design and Green Building Toolkit for Local Governments*, <<https://www.epa.gov/smartgrowth/sustainable-design-and-green-building-toolkit-local-governments>>

<sup>273</sup> *Ibid*

[Toolkit for Local Government](#),<sup>274</sup> [Excel Tool for Sustainable Design and Green Building Assessment Toolkit](#),<sup>275</sup> and [Tools and Resources for Sustainable Communities](#) (which helps with transportation, affordable housing, economic development, water, land use and revitalization, codes, ordinances, and regulations, among others).<sup>276</sup>

## **Washington State Government**

Washington State has a number of policies that can help promote sustainable communities. For the purpose of this paper, this section will discuss some of the current incentives and mandates in the following categories: clean air, energy, buildings, and transportation. One consideration to note is that many state administered programs are in part or fully funded by federal “pass through” dollars.

### ***Clean Air***

#### Clean Cities

Clean Cities, a program of the U.S. Department of Energy’s Vehicle Technologies Office, is a national coalition dedicated to promoting and advancing “alternative fuels and advanced vehicles, fuel blends, fuel economy, hybrid vehicles, and idle reduction” to reduce petroleum and carbon emissions in the transportation sector.<sup>277</sup> The coalition also “provides information about financial opportunities, coordinates technical assistance projects, updates and maintains databases and websites, and publishes fact sheets, newsletters, and related technical

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<sup>274</sup> U.S. Environmental Protection Agency, *Sustainable Design and Green Building Toolkit for Local Governments*, <[https://www.epa.gov/sites/production/files/2014-09/documents/sustainable-design-permitting-toolkit-06\\_27\\_13\\_formatted.pdf](https://www.epa.gov/sites/production/files/2014-09/documents/sustainable-design-permitting-toolkit-06_27_13_formatted.pdf)>

<sup>275</sup> U.S. Environmental Protection Agency, *Excel Tool for Sustainable Design and Green Building Assessment Toolkit*, <[https://www.epa.gov/sites/production/files/2015-10/sustainable\\_design\\_and\\_green\\_building\\_assessment\\_tool.xlsx](https://www.epa.gov/sites/production/files/2015-10/sustainable_design_and_green_building_assessment_tool.xlsx)>

<sup>276</sup> U.S. Environmental Protection Agency, *Tools and Resources for Sustainable Communities*, <<https://www.epa.gov/smartgrowth/tools-and-resources-sustainable-communities#tools>>

<sup>277</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Electric Vehicles: Tax Credits and Other Incentives*, <<https://www.energy.gov/eere/electricvehicles/electric-vehicles-tax-credits-and-other-incentives>>

and informational materials.”<sup>278</sup> There are nearly 100 local coalitions across the country.<sup>279</sup> Locally, the Puget Sound Clean Air Agency manages the Western Washington Clean Cities program, a not-for-profit membership organization established in 1998 and located in Seattle, WA.<sup>280</sup> The Puget Sound Clean Air Agency has jurisdiction over King, Kitsap, Pierce and Snohomish counties, which represent over half of Washington State’s population.<sup>281</sup>

### Clean Air Agencies

In addition to the Puget Sound Clean Air Agency, there are five other clean air agencies in Washington State:

1. Northwest Clean Air Agency (Island, Skagit, and Whatcom Counties),<sup>282</sup>
2. Olympic Region Clean Air Agency (Clallam, Grays Harbor, Jefferson, Mason, Pacific, and Thurston counties)<sup>283</sup>
3. Southwest Clean Air Agency (Clark, Cowlitz, Lewis, Skamania and Wahkiakum counties)<sup>284</sup>
4. Spokane Regional Clean Air Agency (Spokane County)<sup>285</sup>
5. Benton Clean Air Agency (Benton County)<sup>286</sup>

The goal of the clean air agency is to “protect public health, improve neighborhood air quality, and reduce [the] region’s contribution to climate change.”<sup>287</sup> The Clean Air Agencies are special

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<sup>278</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Electric Vehicles: Tax Credits and Other Incentives*

<sup>279</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Clean Cities Coalition Network*, <<https://cleancities.energy.gov/about/>>

<sup>280</sup> Western Washington Clean Cities, *About Us*, <<http://www.wwcleanair.org/268/About-Us>>

<sup>281</sup> Puget Sound Clean Air Agency, *About Us*, <<https://www.pscleanair.org/35/About-Us>>

<sup>282</sup> Northwest Clean Air Agency, <<http://nwcleanairwa.gov/>>

<sup>283</sup> Olympic Region Clean Air Agency, <<https://www.orcaa.org/>>

<sup>284</sup> Southwest Clean Air agency, <<http://www.swcleanair.org/>>

<sup>285</sup> Spokane Regional Clean Air Agency, <<https://www.spokanecleanair.org>>

<sup>286</sup> Benton Clean Air agency, <<http://bentoncleanair.org/>>

<sup>287</sup> *Puget Sound Clean Air Agency, About Us*

purpose regional government agencies established under the 1967 Washington Clean Air Act ([RCW 70.94](#)). The agencies are responsible for protecting air quality and enforcing local, state, and federal air quality regulations for public and private entities.<sup>288</sup> Focuses among the agencies include asbestos, outdoor burning (wildfires, agricultural, recreational), wood heating, business and industrial sources, climate change, air pollutants, clean transportation (vehicles, engines, and fuels), and community equity and access.

### Greenhouse Gas Emissions

In 2008, Washington State enacted [RCW 70.235](#) Limiting Green House Gas Emissions, which will help improve air quality in addition to mitigating climate change and the associated negative ramifications. This law sets forth emission reduction targets for the state as follows:

- By 2020, reduce overall emissions of greenhouse gases in the state to 1990 levels;
- By 2035, reduce overall emissions of greenhouse gases in the state to twenty-five percent below 1990 levels;
- By 2050, the state will do its part to reach global climate stabilization levels by reducing overall emissions to fifty percent below 1990 levels, or seventy percent below the state's expected emissions that year.<sup>289</sup>

These levels are consistent with limits set by other states, and at the time, were thought to be the levels necessary to stabilize global carbon levels by the end of the century.<sup>290</sup> However, in 2016, based on current need and global temperatures, the Washington State Department of Ecology recommended that 2035 targets be increased to 40% below 1990 levels and 2050 targets be

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<sup>288</sup> Northwest Clean Air Agency, *About Us*, <<http://nwcleanairwa.gov/about-us/>>

<sup>289</sup> RCW 70.235.020, *Greenhouse gas emission reductions – reporting requirements*, <<http://app.leg.wa.gov/RCW/default.aspx?cite=70.235.020>>

<sup>290</sup> Rees, Sarah, “Washington Greenhouse Gas Emission Reduction Limits,” *Washington State Department of Ecology*, Published December 2016, <<https://fortress.wa.gov/ecy/publications/documents/1601010.pdf>>, vi

increased to 80% below 1990 levels.<sup>291</sup> Setting greenhouse gas emission reduction targets help inform and encourage policy that will help communities reach these goals. With these mandates, communities will be forced to innovate and develop more sustainably. Net-zero carbon and energy buildings and communities can go a long way in helping the state reach these goals.

## ***Energy***

### Energy Independence Act

In Washington State, Renewable Portfolio Standards were established in 2006 as a part of the Energy Independence Act ([RCW 19.285](#)). Renewable Portfolio Standards “require utilities to ensure that a percentage...of the electricity they sell comes from renewable resources. States have created these standards to diversify their energy resources, promote domestic energy production and encourage economic development. Roughly half of the growth in U.S. renewable energy generation since 2000 can be attributed to state renewable energy requirements.”<sup>292</sup> The renewable energy “targets increase over time, from 3 percent in 2012, to 9 percent in 2016, to 15 percent in 2020. Eligible resources include water, wind, solar energy, geothermal energy, landfill gas, wave, ocean or tidal power, gas for sewage treatment plants and biodiesel fuel and biomass energy.”<sup>293</sup> Some sources of energy, such as hydroelectricity, have restrictions or are not eligible. The “standard is applicable to all utilities that serve more than 25,000 customers”<sup>294</sup> and “utilities must pursue all conservation that is cost-effective, reliable and feasible.”<sup>295</sup> As of 2016, “utilities are on track to meet all of the current energy efficiency and renewable energy targets

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<sup>291</sup> Rees, “Washington Greenhouse Gas Emission Reduction Limits,” vii

<sup>292</sup> National Conference of State Legislatures, *State Renewable Portfolio Standards and Goals*, Published July 20, 2018. <<http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx#w>>

<sup>293</sup> Washington State Department of Commerce, *Energy Independence Act*, <<https://www.commerce.wa.gov/growing-the-economy/energy/energy-independence-act/>>

<sup>294</sup> National Conference of State Legislatures, *State Renewable Portfolio Standards and Goals*

<sup>295</sup> Washington State Department of Commerce, *Energy Independence Act*

of the Energy Independence Act.”<sup>296</sup> Having such a mandate in place forces increased investment in renewable energy sources, which promotes more community sustainability over time.

### Renewable Energy Sales and Use Tax Exemption

In states such as Washington that have sales tax, exemptions can help make the purchasing of renewable energy systems more affordable. Washington had a 100% exemption for solar photovoltaic systems up to 10 kW and 75% exemption for systems up to 500 kW, but the policy for small-scale PV systems expired as of September 30, 2017.<sup>297</sup> However, customers buying greater than 500 kW of solar panels are still eligible for a 75% sales tax refund, meaning they pay the sales tax at the point of purchase then apply to the Department of Revenue for a refund.<sup>298</sup> Furthermore, [RCW 82.08.962](#) outlines sales tax exemption eligibility for equipment used to generate electricity. Equipment using fuel cells, wind, biomass, tidal, wave, geothermal, anaerobic digestion or landfill gas to generate electricity are eligible for a 75% sales tax exemption, which expires January 1, 2020.<sup>299</sup> Lastly, “Storage equipment used directly with renewable energy systems is eligible for a 75 percent sales tax exemption” but “is scheduled to expire January 1, 2020.”<sup>300</sup> In order to ensure renewable energy systems and storage remain affordable, extending tax exemptions are critical.

### Renewable Energy System Cost Recovery Incentive

The Renewable Energy System Cost Recovery, [WAC 458-20-273](#), “authorizes an incentive payment based on production to offset the costs associated with the purchase of

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<sup>296</sup> Washington State Department of Commerce, *2017 Biennial Energy Report and State Energy Strategy Update*, Published December 2016, < <http://www.commerce.wa.gov/wp-content/uploads/2017/03/Commerce-Biennial-Energy-Report-2017.pdf>>

<sup>297</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

<sup>298</sup> *Ibid*

<sup>299</sup> U.S. Department of Energy, *Renewable Energy Sales and Use Tax Exemption*, <<https://www.energy.gov/savings/renewable-energy-sales-and-use-tax-exemption>>

<sup>300</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

renewable energy systems located in Washington state that generate electricity. Qualified renewable energy systems include: solar energy systems, wind generators, and certain types of anaerobic digesters.”<sup>301</sup> For solar power, the Production Incentive, established by [RCW 82.16.165](#), “is paid per kilowatt hour (kWh) to those who install solar based upon the size of the solar system, date of certification/installation and whether or not the solar modules are Made in WA.”<sup>302</sup> The following table summarizes the incentive base and bonus rates by year:<sup>303</sup>

Fiscal year of system certification	Base rate - residential-scale	Base rate - commercial-scale	Base rate - community solar	Base rate - shared commercial solar	Made in Washington bonus
2018	\$0.16	\$0.06	\$0.16	\$0.06	\$0.05
2019	\$0.14	\$0.04	\$0.14	\$0.04	\$0.04
2020	\$0.12	\$0.02	\$0.12	\$0.02	\$0.03
2021	\$0.10	\$0.02	\$0.10	\$0.02	\$0.02

“Solar systems of 1 kW through 12 kW are classified as ‘residential’ regardless of the type of facility where they are installed. The maximum annual incentive payment for residential scale is \$5,000/year. Solar systems larger than 12 kW are classified as ‘commercial’ unless they are installed as a Community Solar Project. The maximum commercial annual incentive payment is \$25,000/year.”<sup>304</sup>

### Net Metering

Established by [RCW 80.60](#), net metering of electricity establishes an interconnected metering system where eligible customers who generate renewable energy “receive credit for

<sup>301</sup> WAC 458-20-273 Renewable energy system cost recovery, <http://apps.leg.wa.gov/WAC/default.aspx?cite=458-20-273>

<sup>302</sup> Solar Washington, *Solar Incentives, Tax Credits, Net Metering, & More*, [https://www.solarwa.org/solar\\_incentives](https://www.solarwa.org/solar_incentives)

<sup>303</sup> RCW 82.16.165 Annual production incentive certification, <http://app.leg.wa.gov/RCW/default.aspx?cite=82.16.165>

<sup>304</sup> Solar Washington, *Solar Incentives, Tax Credits, Net Metering, & More*

excess electricity produced by their system...at retail electric rates on the next month's utility bill."<sup>305</sup> "Net metering is available on a first come, first-served basis to qualified systems up to 100 kilowatts (kW) of capacity though larger systems may interconnect at the utility's discretion, until the cumulative generating capacity of net metered systems equals 0.5 percent of the utility's 1996 peak demand."<sup>306</sup> Net metering means that net-positive energy homes will not only have no energy bill, but they will also receive money for their excess power. Being able to draw from private residential and commercial solar systems can help utilities improve their renewable portfolio by reducing the need for coal and natural gas power plants.

#### Clean Energy Fund (CEF)

Established in 2013, the CEF, administered by the Washington State Department of Commerce, appropriates capital funds to invest in the development and installation of clean energy.<sup>307</sup> "Funds are used for research, development, and demonstration (RD&D) of clean energy technology and projects through several tracks that include grants to revolving loan funds, utilities, and bond issuances for renewable energy manufacturing."<sup>308</sup> Much of the \$76 million was awarded for energy storage demonstration projects (Avista, PSE, and Snohomish Public Utility District (PUD)), to match federal funds for research and development (Pacific Northwest National Lab and Snohomish PUD), and to utilities for grid modernization.<sup>309</sup> Grid modernization includes public-private partnerships on projects such as battery chemistry and

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<sup>305</sup> Solar Washington, *Solar Incentives, Tax Credits, Net Metering, & More*

<sup>306</sup> Williams and Dumas, "Tax Incentives and Strategies for Renewable & Distributed Energy Finance"

<sup>307</sup> *Ibid*

<sup>308</sup> *Ibid*

<sup>309</sup> *Ibid*

storage, microgrids, transmission and distribution control systems, integration of renewable energy, and improved resiliency.<sup>310</sup> Specific projects include:

- Clean Energy Fund 1: \$15 million in 2013-14 budget. \$14.3 million in grants awarded to three electric utilities. These investments in grid modernization focused on demonstrating different batteries and energy storage systems. All systems are now operational and undergoing extensive technical and economic evaluation by the Pacific Northwest National Lab (PNNL).
  - Snohomish County PUD: multiple Lithium-Ion battery manufacturers within a single substation. \$2.4 million grant
  - Snohomish County PUD: Vanadium Flow battery within an urban substation, \$4.4 million grant
  - Avista Pullman: Vanadium Flow battery deployed at the Schweitzer Engineering manufacturing facility, \$3.2 million grant
  - PSE Glacier: Lithium-ion battery storage deployed in Glacier, WA, a remote community, \$3.8 million grant
- Clean Energy Fund 2: \$13 million in 2015-16 budget. \$12.5 million in grants awarded to five electric utilities. Most of these projects include a focus on microgrids combining solar with storage and load controls to provide resiliency benefits. Projects are expected to have deployments in 2019 and 2020.
  - Snohomish County PUD: Arlington Microgrid, \$3.5 million grant
  - Avista Utilities: Spokane Urbanova, multiple microgrids, \$3.5 million grant
  - Energy Northwest: Horn Rapids solar and storage, \$3.0 million grant

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<sup>310</sup> Washington State Department of Commerce, *Grid Modernization under the Clean Energy Fund (CEF)*, < <https://www.commerce.wa.gov/growing-the-economy/energy/clean-energy-fund/energy-grid-modernization/>>

- Seattle City Light: Miller Community Center solar & storage microgrid pilot, \$1.5 million grant
- Orcas Power And Light Company: Decatur Island solar & storage microgrid, \$1.0 million grant<sup>311</sup>

CEF has also promoted energy from waste, including the purchase and installation of a DVO Phosphorus Recovery System at Edaleen Dairy in Lynden, WA. This technology further processes already anaerobically digested cow manure into a nutrient rich solid byproduct used as a soil amendment.<sup>312</sup> In the case of Edaleen Dairy, the anaerobic digester and dissolved air flotation (DAF) combination has proven to be successful and should be considered for other dairy farms in effort to improve manure management with the added benefit of selling energy back to the grid. Proper manure management is important for both clean water and clean air.

### ***Homes and Buildings***

#### Energy Efficiency and Solar Grants

Another program administered by the Washington State Department of Commerce is the Energy Efficiency and Solar Grants. The purpose of the program is “to increase energy efficiency and reduce water costs at state public higher education institutions, local government facilities, state agencies and kindergarten through 12th grade (K-12) public school districts.”<sup>313</sup> Funding has been made available to provide operational cost savings improvements to facilities, installation of solar panels, energy efficiency improvements, and to the Department of Enterprise

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<sup>311</sup> Washington State Department of Commerce, *Grid Modernization under the Clean Energy Fund*

<sup>312</sup> Washington State Department of Commerce, *Case Study DVO Phosphorus Recovery System*, <<http://www.commerce.wa.gov/wp-content/uploads/2017/12/DVO-Phosphorus-Recovery-System-Edaleen-Case-Study.pdf.pdf>>

<sup>313</sup> Washington State Department of Commerce, *Energy Efficiency and Solar Grants*, <<https://www.commerce.wa.gov/growing-the-economy/energy/energy-efficiency-and-solar-grants/>>

Services for resource conservation managers to assist state agencies and schools.<sup>314</sup> In 2013, the State Legislature allocated \$25 million to the program, of which \$14 million in grants were awarded to 45 recipients.<sup>315</sup> One of these recipients was the University of Washington Bothell and Cascadia Community College to help fund their fourth solar-photovoltaic array, which was installed on the LB2 building in the summer of 2014.<sup>316</sup> The campus received \$553,000 in grant funds and matched with \$100,000 to install the 99.84-kilowatt array, which nearly tripled their total on campus solar capacity and reduced the greenhouse gas footprint on campus by nearly 100,000 pounds of carbon dioxide annually.<sup>317</sup>

### High-Performance Public Buildings

In 2005, the legislature passed Engrossed Substitute Senate Bill (ESSB) 5509 ([RCW 39.35D](#)) establishing high performance requirements for state agencies, higher education institutions, school districts, community development grant recipients, and housing trust fund projects receiving state funding for new construction or major renovations.<sup>318</sup> The bill intends for state-owned buildings to use nationally recognized standards including Leadership in Energy and Environmental Design (LEED), Washington Sustainable Schools Protocol (WSSP), and the Evergreen Sustainable Development Standard (ESDS).<sup>319</sup> The ESDS “is a green building performance standard required of all affordable housing projects receiving capital funds from the

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<sup>314</sup> Washington State Department of Commerce, *Energy Efficiency and Solar Grants*

<sup>315</sup> University of Washington Bothell, *New Solar Energy Installation Coming Summer 2014*, <<https://www.uwb.edu/sustainability/news/2014-dept-of-commerce-grant>>

<sup>316</sup> *Ibid*

<sup>317</sup> *Ibid*

<sup>318</sup> State of Washington Joint Legislative Audit and Review Committee, *High Performance Public Buildings: Impact on Energy Use is Mixed*, Published June 23, 2011.

<<http://leg.wa.gov/jlarc/AuditAndStudyReports/Documents/11-7.pdf>>, 1

<sup>319</sup> *Ibid*, 3

Washington State Housing Trust Fund.”<sup>320</sup> The bill “requires that all major facility projects of public agencies receiving funding in a state capital budget shall be designed, constructed, and certified to at least the LEED silver standard.”<sup>321</sup> In addition, the bill created monitoring and reporting requirements to track costs and savings and to ensure economic, community, and environmental goals are being achieved.<sup>322</sup> And lastly, the bill requires that a joint audit committee conduct a performance review of the high-performance buildings program.<sup>323</sup> The Washington State Department of Enterprise Services is available to consult on projects throughout the design and construction phases, especially regarding LEED and reporting requirements and provide technical assistance to ensure cost effectiveness.<sup>324</sup>

On June 23, 2011, the Joint Legislative Audit and Review Committee published the results of their performance review on the High Performance Public Buildings program, and their results were mixed. They found that agencies and school districts reported that high performance buildings increased public building costs by 1-3% (\$2.5 million added to state agencies and high education projects and \$9.5 million added to school district projects).<sup>325</sup> The committee also found mixed results in reducing energy costs with some projects meeting expectations for energy efficiency and others not, but results suggest improvement over time.<sup>326</sup> The last major finding

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<sup>320</sup> Washington State Department of Commerce, *Evergreen Sustainable Development*, <<https://www.commerce.wa.gov/building-infrastructure/housing/housing-trust-fund/housing-trust-fund-evergreen-sustainable-development/>>

<sup>321</sup> RCW 39.35D.030, *Standards for major facility projects*, <<http://app.leg.wa.gov/RCW/default.aspx?cite=39.35D.030>>

<sup>322</sup> State of Washington Joint Legislative Audit and Review Committee, *High Performance Public Buildings: Impact on Energy Use is Mixed*, 6

<sup>323</sup> RCW 39.35D.800 *Performance review – Report*, <<http://app.leg.wa.gov/RCW/default.aspx?cite=39.35D.800>>

<sup>324</sup> Washington State Department of Enterprise Services, *Green Building & LEED*, <<https://des.wa.gov/services/facilities-leasing/energy-program/green-building-lead>>

<sup>325</sup> State of Washington Joint Legislative Audit and Review Committee, *High Performance Public Buildings: Impact on Energy Use is Mixed*, 1

<sup>326</sup> *Ibid*, 1

was that assessing the performance was limited because not all state agencies are reporting their data as required by the law.<sup>327</sup>

In September of 2016, the Washington State Department of Enterprise Services (DES) published their biennial legislative report on the implementation of the High Performance Public Buildings program. DES tracks 138 projects of which 124 are state-owned with LEED project certification state (82 have been certified, others are pending certification).<sup>328</sup> Washington public projects have utilized a variety of methods in order to receive points in a combination of each of the eight LEED categories to achieve certification. First, for location and transportation, projects encourage pedestrian and bicycle transportation by adding bike racks and shower/changing facilities.<sup>329</sup> Second, for sustainable sites, projects retrofit outdoor lighting, capture, treat and release storm water, and replace landscaping with native plants.<sup>330</sup> Third, for water efficiency, projects replace irrigation systems to reduce potable water consumption.<sup>331</sup> Fourth, for Energy and atmosphere, projects improve thermal envelopes, utilize more efficient heating and cooling systems, natural ventilation, natural lighting, and renewable energy sources.<sup>332</sup> Fifth, for materials and resources, projects organize recycling programs including food waste and construction materials.<sup>333</sup> Sixth, for indoor environmental quality, projects incorporate natural and day lighting, natural air ventilation, light sensors and sunshades, and operable windows. Seventh, for innovation, facility managers educate tenants on best practices, install information

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<sup>327</sup> State of Washington Joint Legislative Audit and Review Committee, *High Performance Public Buildings: Impact on Energy Use is Mixed*, 2

<sup>328</sup> Washington State Department of Enterprise Services, *High Performance Public Green Buildings*, Published September 2016, <[https://des.wa.gov/sites/default/files/public/documents/Facilities/Energy/Green\\_Website/2016GreenBuildingReport.pdf](https://des.wa.gov/sites/default/files/public/documents/Facilities/Energy/Green_Website/2016GreenBuildingReport.pdf)>, 22

<sup>329</sup> *Ibid*, 27

<sup>330</sup> *Ibid*, 27

<sup>331</sup> *Ibid*, 28

<sup>332</sup> *Ibid*, 29

<sup>333</sup> *Ibid*, 32

kiosks, and design open work areas.<sup>334</sup> Lastly, for regional priority, projects are aware of the surrounding forests, wetlands, and natural resources and design their strategy to best protect and conserve those spaces.<sup>335</sup>

### Energy Related Building Standards

In 2009, the Washington State Legislature adopted the American Institute of Architects' Architecture 2030 Challenge with the goal to reduce energy savings by 70% compared to 2006 by the year 2030.<sup>336</sup> Energy consumption reduction requirements for buildings were codified in [RCW 19.27A](#). The law states in 19.27A.160 that "residential and nonresidential construction permitted under the 2031 state energy code must achieve a seventy percent reduction in annual net energy consumption, using the adopted 2006 Washington state energy code as a baseline."<sup>337</sup> The state started moving incrementally towards this target in 2013.<sup>338</sup> In a December 2015, the Washington State Building Code Council published a report to the Legislature outlining the progress made towards the goal. The report concluded that Washington State was on track to meet the saving targets for the 2012-15 cycle, which was to achieve between 26-36% cumulative energy savings, with residential between 3-12% and commercial 8-18%.<sup>339</sup> Overall, "achieving the goals of the energy code mandate can help [Washington State] transition to zero net carbon commercial and residential buildings in Washington."<sup>340</sup>

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<sup>334</sup> Washington State Department of Enterprise Services, *High Performance Public Green Buildings*, 36

<sup>335</sup> *Ibid*, 36

<sup>336</sup> Jonlin, Duane, David Kokot, and Eric Vander, "2015 Washington State Energy Code Progress Toward 2030," *Washington State Building Code Council*, Published December 2015.

<[https://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=Building%20Energy%20Codes%20FINAL%20II\\_1128c03c-7395-4b06-878a-06537ef8707f.pdf](https://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=Building%20Energy%20Codes%20FINAL%20II_1128c03c-7395-4b06-878a-06537ef8707f.pdf)>, 9

<sup>337</sup> RCW 19.27A Energy-Related Building Standards,

<<http://app.leg.wa.gov/rcw/default.aspx?cite=19.27A&full=true>>

<sup>338</sup> *Ibid*

<sup>339</sup> Jonlin, et. al, "2015 Washington State Energy Code Progress Toward 2030," 2

<sup>340</sup> Shift Zero, *Roadmap to Zero Net Energy Building Code*

## Weatherization Assistance Program

Nationally, since its inception in 1976, the Weatherization Assistance Program has served more than 7 million families, serving about 35,000 homes every year and saving households an average of \$283 per year.<sup>341</sup> Home weatherization can improve energy efficiency and reduce consumption by conducting a home energy audit, air sealing, adding insulation, moisture control, and ventilation.<sup>342</sup> Washington State's Weatherization Program, administered by the Washington State Department of Commerce, receives funding from the U.S. Department of Energy (DOE), Bonneville Power Administration (BPA), and U.S. Health and Human Services (HHS) in addition to matching funds from utilities for qualified low-income households.<sup>343</sup> Twenty-eight agencies across Washington State deliver weatherization services, including 19 nonprofit community action organizations, six public agencies, and three tribal housing authorities.<sup>344</sup> In Bellingham, the weatherizing agency (Opportunity Council) also manages the Building Performance Center, one of the state's three state-of-the-art building performance training facilities that provides weatherization training for contractors and other community action programs.<sup>345</sup>

In terms of program outcomes, weatherization production trends have declined over the last seven years. In 2009, the American Recovery and Reinvestment Act had given the weatherization program a significant, but temporary boost in funding, which was used between 2010-2011. In Washington State, production was at an all time high in 2010 with almost 9,000

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<sup>341</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Weatherization Assistance Program*, <<https://www.energy.gov/eere/wipo/weatherization-assistance-program>>

<sup>342</sup> U.S. Department of Energy, *Weatherize*, <<https://www.energy.gov/energysaver/weatherize>>

<sup>343</sup> Washington State Department of Commerce, *Weatherization Program*, <<https://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/>>

<sup>344</sup> Schueler, Vince, "The Washington State Weatherization Plus Health Pilot: Implementation and Lessons Learned," *WSU Energy Program*, Published July 23, 2018, <<http://www.energy.wsu.edu/documents/WxHSummaryReport.pdf>>, 15

<sup>345</sup> Rice, "City of Bellingham Climate Protection Action Plan," 71

units, and then declined to 7,451 units in 2011.<sup>346</sup> By fiscal years 2011-13, only 3,000-5,000 units per year were weatherized, and declined even further during fiscal years 2015-17 to an average of about 2,200 units per year.<sup>347</sup> For the program period between July 1, 2018 and June 30, 2019, the anticipated DOE allocation for Washington State is \$4,325,258, of which \$699,825 has been designated for Training and Technical Assistance and \$3,625,433 for program costs.<sup>348</sup> Currently, the U.S. Department of Energy is reviewing the 2018 Washington State Low Income Weatherization Assistance Plan.<sup>349</sup>

## ***Transportation***

### Electric Vehicle Sales Tax Exemption

[RCW 82.08.809](#) and [RCW 82.12.809](#) outline retail sales and use tax exemptions for vehicles using clean alternative fuels and electric vehicles<sup>350</sup> and was amended to expand the exemptions to certain plug-in hybrids effective July 15, 2015.<sup>351</sup> Plug-in hybrids and electric vehicles are eligible for a tax exemption for up to \$32,000 of the sale or lease price of the vehicle.<sup>352</sup> The exemption is set to expire July 1, 2019 or once the total number of qualified

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<sup>346</sup> Kunkle, Rick, “Washington State Low-Income Weatherization Program Evaluation Report for 2012,” *WSU Energy Program*, Published August 2014, <<http://www.commerce.wa.gov/wp-content/uploads/2015/12/HIP-Weatherization-2012-Evaluation-Executive-Summary.pdf>>, 1

<sup>347</sup> Schueler, “The Washington State Weatherization Plus Health Pilot: Implementation and Lessons Learned,” 15

<sup>348</sup> Washington State Department of Commerce, *Washington State Low-Income Weatherization Assistance Plan 2018*. <<http://www.commerce.wa.gov/wp-content/uploads/2018/07/2018-State-Plan-Final-Draft-3.6.18.docx>>, 1

<sup>349</sup> Washington State Department of Commerce, *Weatherization Documents*, <<https://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/weatherization-program-documents/>>

<sup>350</sup> “Use tax is a tax on the use of goods or certain services in Washington when sales tax has not been paid. Goods used in this state are subject to either sales or use tax, but not both. Thus, the use tax compensates when sales tax has not been paid.” Washington State Department of Revenue, *Use Tax*, <<https://dor.wa.gov/find-taxes-rates/use-tax>>

<sup>351</sup> Washington State Department of Revenue, *Electric Vehicles*, <<https://dor.wa.gov/get-form-or-publication/publications-subject/tax-topics/electric-vehicles>>

<sup>352</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

vehicles (backdated to July 1, 2015) reaches 7,500, whichever comes first.<sup>353</sup> As of mid-March 2018, the number reach 6,843 electric vehicles registered with the state.<sup>354</sup> For perspective, the number of qualified vehicles receiving this incentive is a fraction of the total market share in Washington. As of December 31, 2017, there were 27,858 registered plug-in and electric vehicles.<sup>355</sup> Furthermore, the installation, construction, or improvements made to EV infrastructure are exempt from sales and use taxes and tenants of public lands used for EV infrastructure are exempt from state leasehold excise taxes.<sup>356</sup> Both of these exemptions are set to expire January 1, 2020.<sup>357</sup>

#### Clean Alternative Fuel Commercial Vehicles Tax Credit

“The Clean Alternative Fuel Commercial vehicle tax credit is a state tax credit against a commercial entity’s business and occupation or public utility tax liability for the purchase, conversion or lease of clean alternative fuel commercial vehicles.”<sup>358</sup> The credits are codified by [RCW 82.04.4496](#) (Business and Occupation Tax Chapter) and [RCW 82.16.0496](#) (Public Utility Tax Chapter). Clean alternative fuel is define as electricity, dimethyl ether, hydrogen, methane, natural gas, liquefied natural gas, compressed natural gas, or propane.<sup>359</sup> The value of the credit is based on gross weight and incremental cost amount and summarized in the following table:

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<sup>353</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy”

<sup>354</sup> Le, Phuong, “Washington state’s electric-vehicle sales-tax break to end,” *The Seattle Times*, Published March 21, 2018, < <https://www.seattletimes.com/seattle-news/washington-states-electric-vehicle-sales-tax-break-to-end/>>

<sup>355</sup> West Coast Green Highway, *Map of WA PEV Registration by County*, <[http://www.westcoastgreenhighway.com/pdfs/Map\\_WAEVRegistrationByCounty.pdf](http://www.westcoastgreenhighway.com/pdfs/Map_WAEVRegistrationByCounty.pdf)>

<sup>356</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

<sup>357</sup> *Ibid*

<sup>358</sup> *Ibid*

<sup>359</sup> RCW 82.04.4496 (15)(b), *Credit—Clean alternative fuel commercial vehicles. (Expires January 1, 2022.)*, < <http://app.leg.wa.gov/rcw/default.aspx?cite=82.04.4496>>

Gross Vehicle Weight	Incremental Cost Amount	Maximum Credit Amount Per Vehicle	Maximum Annual Credit Per Vehicle Class
Up to 14,000 pounds	50% of incremental cost	\$25,000	\$2,000,000
14,001 to 26,500 pounds	50% of incremental cost	\$50,000	\$2,000,000
Above 26,500 pounds	50% of incremental cost	\$100,000	\$2,000,000

This tax credit can incentivize business investment in the electrification of their commercial fleet, but is scheduled to expire January 1, 2022.

#### Public and Alternative Transportation Grants

Washington State Department of Transportation offers public transportation grants to transit systems, non-profits, tribes, ports, state agencies, counties, cities, and private operators to help improve access and mobility.<sup>360</sup> Grants can be used to “provide transit services within and between cities, create transit-oriented infrastructure, purchase new buses and other equipment, provide public transportation service for the elderly and people with disabilities, and improve public transportation in and between rural communities.”<sup>361</sup> Many of these grant programs allow local projects to leverage other state and federal funding. Some of the grant programs include:

- Consolidated Grant Program: To improve public transportation within and between rural communities, provide transportation services between cities, purchase new buses and other equipment, and provide public transportation service for seniors and persons with disabilities. For 2017-19, \$62 million were allocated for 129 projects in all 39 counties.<sup>362</sup>
- Formula Grant Program: To improve public transportation for Washington residents,

<sup>360</sup> Washington State Department of Transportation, *Public Transportation Grants*, <<http://www.wsdot.wa.gov/Transit/Grants/>>

<sup>361</sup> *Ibid*

<sup>362</sup> Washington State Department of Transportation, *Consolidated Grant Program*, <<http://www.wsdot.wa.gov/Transit/Grants/competitive.htm>>

particularly for persons with disabilities, seniors, children and people in rural areas. For 2017-19, more than \$48.7 million was awarded to transit agencies.<sup>363</sup>

- New Revenue Grant Programs: To improve multimodal transportation through programs to help make walking and bicycling safer with better connections to transit, rail, and ferries. With the new revenue, two new grant programs have been established:
  - The Puget Sound Transit Coordination Grant: coordinated transit-related projects in the central Puget Sound area, joint planning and coordination
  - The LEAP Transportation NL-3 proviso program: transit related projects<sup>364</sup>
- Regional Mobility Grant Program: Supports local efforts to improve transit mobility and reduce congestion such as new transit services, park and rides, and new buses. In 2017, 44 new and continuing projects were approved for approximately \$93 million.<sup>365</sup>
- Safe Routes to School: Provide technical assistance and funding to public agencies to improve conditions for and encourage children to walk or bike to school. Since 2005, about \$71 million has been awarded to 182 projects. Children biking and walking at project locations has increased approximately 20%<sup>366</sup>
- Vanpool Investment Program: Awarded to transit agencies looking to expand their vanpool fleet vehicles. In 2017-19, approximately \$10 million was awarded to 14 transit agencies to purchase 425 vanpool fleet vehicles.<sup>367</sup>

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<sup>363</sup> Washington State Department of Transportation, *Formula Grant Program*,  
<<http://www.wsdot.wa.gov/Transit/Grants/transit-funded-list.htm>>

<sup>364</sup> Washington State Department of Transportation, *New Revenue Grant Programs*,  
<<http://www.wsdot.wa.gov/Transit/Grants/newrevenue.htm>>

<sup>365</sup> Washington State Department of Transportation, *Regional Mobility Grant Program*,  
<<http://www.wsdot.wa.gov/Transit/Grants/mobility.htm>>

<sup>366</sup> Washington State Department of Transportation, *Safe Routes to School*,  
<<https://www.wsdot.wa.gov/LocalPrograms/SafeRoutes/>>

<sup>367</sup> Washington State Department of Transportation, *Vanpool Investment Program*,  
<<http://www.wsdot.wa.gov/Transit/Grants/vip.htm>>

Each of these grant programs have a significant impact improving Washington State's transportation and infrastructure. According to a report published in 2016, the transportation sector was the largest contributor of greenhouse gases in Washington State, accounting for 42.8% of emissions in 2013.<sup>368</sup> This speaks to the importance of transportation grants dedicated to expanding public transit and encouraging alternatives to fossil fuel combusting transportation methods. In order to develop a sustainable, net-zero community, it is critical to decarbonize and electrify the transportation sector.

In conclusion, all of these aforementioned state policies can help incentivize, mandate or contribute to sustainable community development as it relates to clean air, energy, homes and buildings, and transportation and infrastructure.

### **Federal Government**

Policy is top-down, meaning that policy set at the federal level supersedes policy at the state and local levels. As it is, federal policy often sets minimum standards and requirements; however, that does not entirely discourage States from using their autonomy and 10th amendment right to set their own policies. In many cases, like Washington State, state policy can be more environmentally progressive. Regardless, the federal government can still help by providing federal tax incentives, funding relevant state programs, and setting mandates or minimum requirements. Similar to the State Government section, this paper will consider a sample of federal policies relating to energy, homes and buildings, and transportation. Also, it is important to note that federal policy and agency priorities have changed dramatically with the Trump Administration. Many of the policies discussed in this section are under threat and may change or have changed already.

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<sup>368</sup> Sandlin, Gail, "Report to the Legislature on Washington Greenhouse Gas Emissions Inventory: 2010-2013," *Washington State Department of Ecology*, Published October 2016, <<https://fortress.wa.gov/ecy/publications/documents/1602025.pdf>>

## *Energy*

### State Energy Program

Created by Congress in the early 1970's, "the U.S. Department of Energy's State Energy Program (SEP) provides funding and technical assistance to states, territories, and the District of Columbia to enhance energy security, advance state-led energy initiatives, and maximize the benefits of decreasing energy waste."<sup>369</sup> The programs goals are to: increase energy efficiency, implement energy security, resiliency and emergency preparedness, reduce energy cost and waste, promote economic growth and improve environmental quality.<sup>370</sup> Oak Ridge National Laboratory conducted an evaluation of SEP projects to demonstrate benefits and opportunities of SEP nationally. The study found that SEP funds supported:

- 15,264 energy audits of residential, commercial, and industrial buildings performed
- 12,896 buildings retrofitted to be more energy efficient
- 92,488 energy-efficient LED traffic lights installed
- 6,434 alternative fuel vehicles purchased or converted
- \$30,403,388 in loans made and \$12,345,608 in grants extended
- 604,050 students educated on energy efficiency
- 78 energy emergency plan elements developed<sup>371</sup>

In 2009, the American Recovery and Reinvestment Act "provided \$3.1 billion for SEP formula grants with no matching fund requirements."<sup>372</sup> For each fiscal year between 2013-2016,

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<sup>369</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *State Energy Program*, <<https://www.energy.gov/eere/wipo/state-energy-program>>

<sup>370</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *About the State Energy Program*, <<https://www.energy.gov/eere/wipo/about-state-energy-program>>

<sup>371</sup> National Association of State Energy Officials, *U.S. State Energy Program*, <<https://www.naseo.org/state-energy-program>>

<sup>372</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *About the State Energy Program*

Congress has appropriated \$50 million to SEP with \$668,340-\$711,860 of that allocated to Washington.<sup>373</sup> In 2017, SEP funds have been found to help save and leverage funds; each \$1 spent is associated with annual savings of 1.03 million source BTUs, energy cost savings of \$7.22, and leveraged by \$10.71 of state and private funds.<sup>374</sup> Sadly, the FY 2018 budget request suggests eliminating the State Energy Program along with the Weatherization Assistance Program as well.<sup>375</sup>

Since 2010, Washington State has received \$9.5 million from SEP.<sup>376</sup> One example of a SEP funded project is the life cycle cost tool for state facilities ([RCW 39.35B](#)), which provides economic information on the facility (cost of operation and maintenance) including an emphasis on energy efficiency and renewable energy.<sup>377</sup> Another SEP funded program is the Community Energy Efficiency Program (CEEP), created by the Washington State Legislature in 2009. CEEP, managed and executed by the WSU Energy Program, “encourages homeowners and small businesses across the state to make energy efficiency retrofits and upgrades.”<sup>378</sup> The CEEP pilot concluded in March 2012, having helped thousands of Washington residents and business owners save energy and money.<sup>379</sup> Recognizing the benefits, the Washington State Legislature passed funding in the 2012 and 2013 capital budget to extend the program through June 30, 2015.<sup>380</sup> Since 2009, CEEP has resulted in over 37,000 residential energy efficiency assessments

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<sup>373</sup> National Association of State Energy Officials, *U.S. State Energy Program*

<sup>374</sup> *Ibid*

<sup>375</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *FY 2018 Budget at-a-Glance*, Published May 2017, <[https://www.energy.gov/sites/prod/files/2017/08/f35/11.%20WIPO%20-%20FY%202018%20Budget%20At-A-Glance\\_0.pdf](https://www.energy.gov/sites/prod/files/2017/08/f35/11.%20WIPO%20-%20FY%202018%20Budget%20At-A-Glance_0.pdf)>

<sup>376</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *State Energy Program*

<sup>377</sup> *Ibid*

<sup>378</sup> Washington State University Energy Program, *Community Energy Efficiency Program*, <<http://www.energy.wsu.edu/BuildingEfficiency/CommunityEEProgram.aspx>>

<sup>379</sup> *Ibid*

<sup>380</sup> *Ibid*

with over 30,000 homes making energy efficiency updates.<sup>381</sup> Other CEEP funding recipients include: Avista, Clark Public Utilities, Community Power Works, Opportunity Council, Puget Sound Energy, Sustainable Living Center, and Thurston Energy.<sup>382</sup> It is programs like CEEP that policy needs to support because they can help propel existing communities towards sustainability targets like net-zero.

### Energy Efficiency and Conservation Block Grant Program

Authorized in 2007 by the Energy Independence and Security Act, and administered by the U.S. Department of Energy, the Energy Efficiency and Conservation Block Grant (EECBG) exemplifies the kind of federal funding local communities need access to in order to make sustainable, net-zero development accessible and affordable. In 2009, the American Recovery and Reinvestment Act appropriated “\$3.2 billion in block grants to cities, communities, states, U.S. territories, and Indian tribes to develop, promote, implement, and manage energy efficiency and conservation projects” in the transportation, building, and other sectors.<sup>383</sup> Through a program evaluation for cost effectiveness, energy savings, cost savings, social cost savings, and job creation, it was found that:

- For every dollar spent, participants received \$1.76 in savings over the lifetime
- Life time energy savings and renewable generation was about 413 million source MMBTUs, the equivalent as all non-transportation related energy use for 2.2 million households over a year
- Lifetime cost savings totaled \$5.2 billion

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<sup>381</sup> Washington State University Energy Program, *Community Energy Efficiency Program in Washington State*, < [http://www.energy.wsu.edu/documents/CEEP%202013-2014%20Report\\_Jan%202015.pdf](http://www.energy.wsu.edu/documents/CEEP%202013-2014%20Report_Jan%202015.pdf)>

<sup>382</sup> Washington State University Energy Program, *Community Energy Efficiency Program*

<sup>383</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Energy Efficiency and Conservation Block Grant Program*, < <https://www.energy.gov/eere/wipo/energy-efficiency-and-conservation-block-grant-program>>

- Social costs of \$1.8 billion were avoided due to carbon emission reductions
- Created or retained 62,900 direct, indirect or induced jobs

One example of an EECBG success story in Washington State is the Thurston County “Here to There” program, which received \$2.2 million from EECBG to reduce vehicle miles travelled (VMT) by improving access to travel options throughout the county.<sup>384</sup> The project, started in August 2010 and completed in August 2013, resulted in a reduction of 5.9 million VMT per year, which contributed to lower transportation costs, reduced congestion, improved safety, and reduced greenhouse gas emissions.<sup>385</sup>

Business Energy Investment Tax Credit (ITC)

The Business Energy Investment Tax Credit ([26 USC § 48](#)) is a federal, corporate tax credit administered by the U.S. Internal Revenue Service for alternative energy technologies. Eligible entities include commercial, industrial, investor-owned utilities, cooperative utilities, and agricultural. The ITC has been amended a number of times including being significantly expanded by the Energy Improvement and Extension Act of 2008 (H.R. 1424) and most recently in February 2018 as a part of the Bipartisan Budget Act of 2018. The below table summarizes the value of the tax credit by year and technology type.<sup>386</sup>

<b>Technology</b>	<b>12/31/16</b>	<b>12/31/17</b>	<b>12/31/18</b>	<b>12/31/19</b>	<b>12/31/20</b>	<b>12/31/21</b>	<b>12/31/22</b>	<b>Future Years</b>
PV, Solar Water Heating, Solar Space Heating/Cooling, Solar Process Heat	30%	30%	30%	30%	26%	22%	10%	10%

<sup>384</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *EERE Success Story – Washington: Integrated Transportation Programs & Coordinated Regional Planning*, Published November 2, 2013, <<https://www.energy.gov/eere/success-stories/articles/eere-success-story-washington-integrated-transportation-programs>>

<sup>385</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *EERE Success Story – Washington: Integrated Transportation Programs & Coordinated Regional Planning*

<sup>386</sup> U.S. Department of Energy, *Business Energy Investment Tax Credit*, <<https://www.energy.gov/savings/business-energy-investment-tax-credit-itc>>

Hybrid Solar Lighting, Fuel Cells, Small Wind	30%	30%	30%	30%	26%	22%	22%	N/A
Geothermal Heat Pumps, Microtubines, Combine Heat and Power Systems	10%	10%	10%	10%	10%	10%	N/A	N/A
Geothermal Electric	10%	10%	10%	10%	10%	10%	10%	10%
Large Wind	30%	24%	18%	12%	N/A	N/A	N/A	N/A

Residential Renewable Energy Tax Credit

The Residential Renewable Energy Tax Credit is a federal, personal tax credit administered by the U.S. Internal Revenue Service for solar photovoltaic, solar water heat, geothermal heat pumps, small wind turbines, and fuel cells using renewable fuels. This residential tax credit was established by the Energy Policy Act of 2005, extended by the Energy Improvement and Extension Act of 2008, and further enhanced by the American Recovery and Reinvestment Act of 2009. Most recently, the Bipartisan Budget Act of 2018 reinstated the tax credit for fuel cells, small wind, and geothermal.<sup>387</sup> Similar to the Business ITC, the residential also includes a gradual step down in the credit value. The following table summarizes the value of the tax credit by year and technology type.<sup>388</sup>

<b>Technology</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>Thereafter</b>
Solar Electric Solar Water-Heating Fuel Cell Small Wind Geothermal Heat Pump	30%	26%	22%	0%

Currently, stand-alone storage systems do not qualify because the federal tax code does not explicitly reference them; “however, the IRS issued Private Letter Rulings in 2013 and 2018,

<sup>387</sup> U.S. Department of Energy, *Residential Renewable Energy Tax Credit*, <<https://www.energy.gov/savings/residential-renewable-energy-tax-credit>>

<sup>388</sup> *Ibid*

which address energy storage paired with PV [photovoltaic] systems. In both cases, the IRS ruled that the energy storage equipment when paired with PV met the statutory definition of a ‘qualified solar electric property expenditure,’ as was eligible for the tax credit.”<sup>389</sup>

### Renewable Electricity Production Tax Credit

The Renewable Electricity Production Tax Credit is another federal, corporate tax credit administered by the U.S. Internal Revenue Service available to commercial and industrial entities. It “is an inflation-adjusted per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The duration of the credit is 10 years after the date the facility is placed in service for all facilities placed in service after August 8, 2005.”<sup>390</sup> Qualified energy resources include geothermal, solar, wind, biomass, hydroelectric, tidal, wave, and solid waste/land fill.<sup>391</sup> The PTC was first enacted in 1992 and has been renewed and/or expanded by the American Recovery and Reinvestment Act of 2009 (H.R. 1 Div. B, Section 1101 & 1102), the American Taxpayer Relief Act of 2012 ([H.R. 8, Sec. 407](#)), the Tax Increase Prevention Act of 2014 ([H.R. 5771, Sec. 155](#)), the Consolidated Appropriations Act of 2016 ([H.R. 2029, Sec. 301](#)), and the Bipartisan Budget Act of 2018 ([H.R. 1892 Sec. 40409](#)).<sup>392</sup> “The tax credit amount is \$0.015 per kWh in 1993 dollars for some technologies” and “the inflation adjustment factor used by the IRS is 1.5792.”<sup>393</sup> For the first 10 years of operation, wind, geothermal, closed loop biomass, and solar systems constructed prior to 2018 and not claiming the ITC are eligible for \$0.023 per kWh

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<sup>389</sup>U.S. Department of Energy, *Residential Renewable Energy Tax Credit*

<sup>390</sup> U.S. Department of Energy, *Renewable Electricity Production Tax Credit*,  
<<https://www.energy.gov/savings/renewable-electricity-production-tax-credit-ptc>>

<sup>391</sup> *Ibid*

<sup>392</sup> *Ibid*

<sup>393</sup> *Ibid*

and other eligible technologies at \$0.012 per kWh.<sup>394</sup> Wind facilities constructed by end of 2019 can qualify for the credit at \$0.019 per kWh.<sup>395</sup>

### Modified Accelerated Cost Recovery System

The Modified Accelerated Cost Recovery System (MACRS) allows commercial, industrial, and agricultural entities to “reduce tax liability through annual depreciation deductions over a specified property life.”<sup>396</sup> Solar electric, solar heat, geothermal, and small wind are eligible for a cost recovery period of five years, and biomass, solid waste, fuel cells, land fill gas, tidal, wave, and anaerobic digestion are eligible for seven years.<sup>397</sup> As it stands, most recently modified by the Consolidated Appropriations Act of 2015, “equipment placed in service before January 1, 2018 can qualify for 50% bonus depreciation. Equipment placed in service during 2018 can qualify for 40% bonus depreciation. And equipment placed in service during 2019 can qualify for 30% bonus depreciation.”<sup>398</sup> Entities are also eligible to depreciate energy storage equipment. “Stand-alone storage systems, or storage systems charged less than 50 percent of the time by a qualified renewable energy system, are eligible for the 7-year MACRS depreciation schedule. Storage systems charged 50 to 100 percent of the time by a renewable energy system are eligible for the 5-year MACRS depreciation schedule.”<sup>399</sup>

### 1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits

“The Section 1603 program was created as part of the American Recovery and Reinvestment Tax Act of 2009 to increase investment in domestic clean energy production. Under Section 1603, the Department of the Treasury made payments in lieu of investment tax

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<sup>394</sup> U.S. Department of Energy, *Renewable Electricity Production Tax Credit*

<sup>395</sup> *Ibid*

<sup>396</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

<sup>397</sup> U.S. Department of Energy, *Modified Accelerated Cost-Recovery System*,  
<<https://www.energy.gov/savings/modified-accelerated-cost-recovery-system-macrs>>

<sup>398</sup> *Ibid*

<sup>399</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

credits to eligible applicants for specified energy property used in a trade or business or for the production of income. The purpose of the 1603 payment was to reimburse eligible applicants for a portion of the cost of installing the specified energy property. Specified energy property includes solar, wind, geothermal, biomass, fuel cells, hydropower, combined heat and power, landfill gas, municipal solid waste, and microturbine property.”<sup>400</sup> Energy projects that qualified for this program must have started construction in 2009, 2010, or 2011. By December 2013, ‘the Treasury Department had awarded more than 9,000 grants totaling \$18.5 billion.’<sup>401</sup> The had been proven a success supporting between 52,000 to 75,000 jobs and leveraging more than \$30 billion in private investments.<sup>402</sup> As of March 31, 2017, Section 1603 Program funded 105,972 projects, totaling \$25.7 billion, with 34.5 GW (gigawatts) capacity generating 91.2 TWh (terawatt-hours) of electricity.<sup>403</sup> Washington State received \$975,700,000 in total funding for 160 projects rated at an installed capacity of 1,469.67 MW. The program expired December 31, 2011, but continued to stimulate projects.<sup>404</sup>

## ***Homes and Buildings***

### **Building Technology Research And Development**

On April 27, 2018, the U.S. Department of Energy announced up to \$34.5 million in funding to support building technology research and development through two programs: Buildings Energy Efficiency Frontiers & Innovation Technologies (BENEFIT) 2018 and Solid-

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<sup>400</sup> U.S. Department of the Treasury, *Recovery Act 1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, <<https://www.treasury.gov/initiatives/recovery/Pages/1603.aspx>>

<sup>401</sup> Solar Energy Industries Association, *1603 Treasury Program*, <<https://www.seia.org/initiatives/1603-treasury-program>>

<sup>402</sup> *Ibid*

<sup>403</sup> U.S. Department of the Treasury, *Overview and Status Update of the 1603 Program*, Published April 2017, < <https://www.treasury.gov/initiatives/recovery/Documents/Status%20overview.pdf>>

<sup>404</sup> Mendelsohn, Michael and John Harper, “§1603 Treasury Grant Expiration: Industry Insight on Financing and Market Implications,” *National Renewable Energy Laboratory*, Published June 2012, <<https://www.nrel.gov/docs/fy12osti/53720.pdf>>

State Lighting Research.<sup>405</sup> BENEFIT 2018, funded up to \$19.5 million, will support 15-25 cost-shared projects that focused on early-stage R&D and technologies to improve efficiency, reduce the energy costs in buildings, and facilitate interaction with the electricity grid.<sup>406</sup> There are six areas of focus: 1) advanced separation technologies for building energy efficiency, 2) advanced building materials, 3) high performance windows, 4) novel approaches for cyber-physical systems in buildings, 5) integration research of advanced commercial energy efficiency packages, and 6) advancements in natural gas and other fuel-driven equipment.<sup>407</sup>

Solid-State Lighting (SSL) Research, funded up to \$15 million, will support 10-15 cost-shared projects that conduct early-stage, innovative research in solid-state lighting technology such as light-emitting diode (LED) and organic light-emitting diode (OLED) products to improve efficiency and reduce energy use.<sup>408</sup> The four topic areas include: 1) core technology research for LEDs, OLEDs, and Cross-cutting lighting research, 2) proof-of-concept and Prototype Development for LEDs and OLEDs, 3) advanced fabrication R&D, and 4) innovative lighting in limited mock field application.<sup>409</sup>

#### Energy Efficient New Homes Tax Credit for Home Builders

This tax credit for home builders expired December 31, 2017, but was a corporate tax credit with a maximum rebate of \$2,000. The Bipartisan Budget Act of 2018 reinstated the credit for homes constructed in 2017, but homes constructed on or after January 1, 2018 are not

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<sup>405</sup> U.S. Department of Energy, *Department of Energy Announces \$34 Million for Innovation Building Technologies Research and Development*, Published April 27, 2018 <<https://www.energy.gov/articles/department-energy-announces-34-million-innovation-building-technologies-research-and>>

<sup>406</sup> *Ibid*

<sup>407</sup> *Ibid*

<sup>408</sup> *Ibid*

<sup>409</sup> *Ibid*

eligible.<sup>410</sup> The purpose of this tax credit is to support homebuilders in building new, energy efficient homes that met the energy saving requirements outlined in the statute. Some of these requirements include reducing “heating and cooling energy consumption by 50% relative to the International Energy Conservation Code” and “meet minimum efficiency standards established by the Department of Energy.”<sup>411</sup>

#### Residential Energy Efficiency Tax Credit

The Residential Energy Efficiency Tax Credit also expired on December 31, 2017, but had provided rebates for energy efficiency improvements to buildings’ envelope and for purchases of high-efficiency water heaters, furnaces, broilers, heat pumps, air conditioners, building insulation, windows, and roofs.<sup>412</sup> The Bipartisan Budget Act of 2018 reinstated the tax credit to include purchases made in 2017, but purchases in 2018 are not eligible.<sup>413</sup> The maximum credit for purchases made between 2011 and 2017 is \$500.<sup>414</sup>

#### ***Transportation***

##### Qualified Plug-in Electric Vehicle (PEV) Tax Credit

The PEV tax credit is available for the purchase of qualified plug-in hybrid and electric vehicles with a battery capacity of at least five-kilowatt hours, has a gross weight of up to 14,000 pounds, and meets specified emission standards.<sup>415</sup> The minimum credit value is \$2,500 and the maximum is \$7,500, which is only available for the tax year the car was purchased in.<sup>416</sup> “Phase

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<sup>410</sup> U.S. Department of Energy, *Energy-Efficient New Homes Tax Credit for Home Builders*, <<https://www.energy.gov/savings/energy-efficient-new-homes-tax-credit-home-builders>>

<sup>411</sup> *Ibid*

<sup>412</sup> U.S. Department of Energy, *Residential Energy Efficiency Tax Credit*, <<https://www.energy.gov/savings/residential-energy-efficiency-tax-credit>>

<sup>413</sup> *Ibid*

<sup>414</sup> *Ibid*

<sup>415</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Electric Vehicles: Tax Credits and Other Incentives*

<sup>416</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

out of the credit begins when 200,000 qualified EVs have been sold by each manufacturer<sup>417</sup>, after which the value of the credit declines over four calendar quarters to zero.”<sup>418</sup> The tax credit applies to qualified vehicles purchased after December 31, 2009 and is still active.

### Low or No Emission Vehicle Program

The Low or No Emission Vehicle Program, administered by the Federal Transit Administration, is competitive grant funding that can be used to purchase or lease zero-emission and low-emission transit buses in addition to acquiring, constructing, and leasing of required supporting facilities and research.<sup>419</sup> The funds are available to local, state, and federal government entities, public transportation providers, private and non-profit organizations, and higher education institutions.<sup>420</sup> The FAST Act secured \$55 million in funding per year through the fiscal year 2020 and in April 2018 the Federal Transit Administration released a notice of funding for up to \$84.45 million.<sup>421</sup>

Over all, federal policy, when combined with local and state policy, can play an influential role in incentivizing and setting mandates for sustainable, net-zero development. Environmentally progressive policy must start at the top to ensure that all states are contributing towards the common goal of reducing greenhouse gas emissions and increasing sustainability and efficiencies in our communities.

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<sup>417</sup> Electric vehicle manufacturers include: Audi, BMW, Cadillac, Chevrolet, Chrysler, Fiat, Ford, Honda, Hyundai, Kia, Mercedes, Mini, Mitsubishi, Nissan, Porsche, Quantya, Smart, Tesla, Toyota, Victory, Volkswagen, and Volvo. Plug in America, *Find Plug-in Vehicles*, <<https://pluginamerica.org/vehicles/>>

<sup>418</sup> Williams and Dumas, “Tax Incentives and Strategies for Renewable & Distributed Energy Finance”

<sup>419</sup> U.S. Department of Transportation Federal Transit Administration, *Low or No Emission Vehicle Program*, <<https://www.transit.dot.gov/funding/grants/lowno>>

<sup>420</sup> U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *Electric Vehicles: Tax Credits and Other Incentives*

<sup>421</sup> U.S. Department of Transportation Federal Transit Administration, *Low or No Emission Vehicle Program*

## CONCLUSION

In order to combat human-caused climate change, individuals and communities must address the large and growing carbon footprint associated with the built environment, specifically looking to reduce emissions in buildings, energy, and transportation. Community ecosystems are complex requiring consideration of a multitude of factors, many of which are summarized in this manual. As a resource and toolkit, this manual can inform readers on sustainable development frameworks, methods, and community components, in addition to demonstrating the implementation of these factors through local projects. However, much of this would not be possible without local, state, and federal policy to promote sustainability and propel communities towards their targets. The policy overview highlights and summarizes some of the most relevant laws and incentives, but existing policy is far from sufficient to meet current needs and to achieve net-zero energy and carbon development affordably.

Frameworks like LEED or Living Building Challenge are critical to developing net-zero communities because they standardize and guide building development towards common sustainability targets. Builders can achieve these standards through utilizing methods in engineering and architectural design, renewable energy, energy efficiency, technology, carbon sequestration, and land use and planning. While many of these methods are age old, achieving heightened levels of sustainability will require creativity and thoughtfulness, often rethinking or recreating old methods to achieve new outcomes. Creativity and thoughtful intention must be applied throughout the community whether embracing new development or revitalizing existing communities and infrastructure. Either way, to achieve community-wide sustainability targets, developers must consider all community components including residential and nonresidential buildings, energy production and grid management, waste and water treatment, transportation

and infrastructure, broadband, and agriculture as a local food source. Neglecting any one of these major components can make achieving net-zero challenging.

Sustainable development frameworks, methods, and community components are only theoretical until applied to projects successfully implemented into communities. Washington State has made significant strides in sustainability through advocacy, education and outreach, public and private partnerships, and advancing technology. Through these efforts, Washington is home to a number of successful sustainable community projects. The successes and challenges of these projects help inform future projects and policies. For example, the Bullitt Center inspired changes to Seattle's municipal codes to further encourage sustainable, net-zero development.

At the end of the day, policy serves one function: to influence or change human behavior. In the case of sustainable development, local, state, and federal policy incentives and deterrents influence the public and private sectors. Policy can drive innovation and advancements in technology as well as shift consumer market demands and individual decisions. Take energy efficiency as an example. Improving a home's energy efficiency is not only good for the environment (reducing energy related carbon emissions), it is also economically beneficial potentially saving people money on their energy bills. Policy can further incentivize energy efficiency by funding home weatherization programs (to conduct energy audits and make home improvements), or subsidizing otherwise relatively expensive products like LED lights, energy efficient appliances, passive heating and cooling systems, or even solar panels. By subsidizing these technologies, and making them more competitive in the free market, consumers are more likely compelled to purchase them. When there is a market demand for a product, private companies will innovate, shift their supply towards consumer demand (in this case energy efficient products), and prioritize producing better quality products more quickly and more

affordably. As business and industry become better at developing and manufacturing, the product will become more competitive in the free market. The question then becomes, can the free market promote consumer access independently or will government policy intervention to some extent always be necessary to ensure accessibility?

Policies that enact public investments or incentives may not always be necessary to thrive, but they can help stimulate economic and environmental prosperity. The American Recovery and Reinvestment Act of 2009 is a prime example. In a time of economic recession, the American Recovery and Reinvestment Act directed federal funding to programs to help spur individual and community prosperity and sustainable development, whether through weatherization programs, grants, or tax incentives. Over time, the United States economy rebounded and many formerly cost prohibitive products and technologies are now economically viable on their own. For example, solar technology has improved dramatically over the last decade decreasing the cost. At some point, policy incentives may not be needed to subsidize advanced technologies like solar because it will become cost efficient without assistance and people will make the choice to purchase.

It is also important to acknowledge how policies at the local, state, and federal level interact. Policy at one level of government may inspire policy at another. For example, in 1971 Washington State passed the State Environmental Policy Act, which was inspired by the 1969 National Environmental Policy Act. Both policies are still active and used today. Also, policies at different levels may be combined or stacked for added benefits. An example is for electric vehicles. Individuals who purchase a qualified electric vehicle can benefit from up to a \$7,500 federal tax credit while simultaneously benefitting from a Washington State sales tax exemption on the first \$32,000. This means for a single EV purchase, the consumer could save about

\$10,000 total, which makes an otherwise relatively more expensive car more competitive in the market and thus more compelling to purchase. It can be challenging to identify and understand how policies interact. In the long run, synergistic policies are imperative to maximize incentives and promote progress, but currently most local, state, and federal policy around sustainable development seem piecemeal and lack coordination.

All this being said, despite the numerous valiant efforts at the local and state levels, America continues to fall grossly behind in development of net-zero communities. The policy trends are especially discouraging under the Trump Administration, who have systematically attacked environmental policy and regulations whether it be defunding the Environmental Protection Agency, rolling back Corporate Average Fuel Economy Standards, denying climate change and the associated ramifications, encouraging increased extraction of fossil fuels, or reducing the social cost of carbon to nearly zero. In a time when environmentally progressive policy is needed the most, America is failing.

But now is not the time to give up! Communities must come together to set sustainability targets and pass policy to support making changes to the built environment. Net-zero energy and carbon communities are the future; they are a part of the solution that will enable humans to mitigate and adapt to the changing times.

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