0 × 50—Preparing Seattle's Building Stock for a Carbon-neutral 2050

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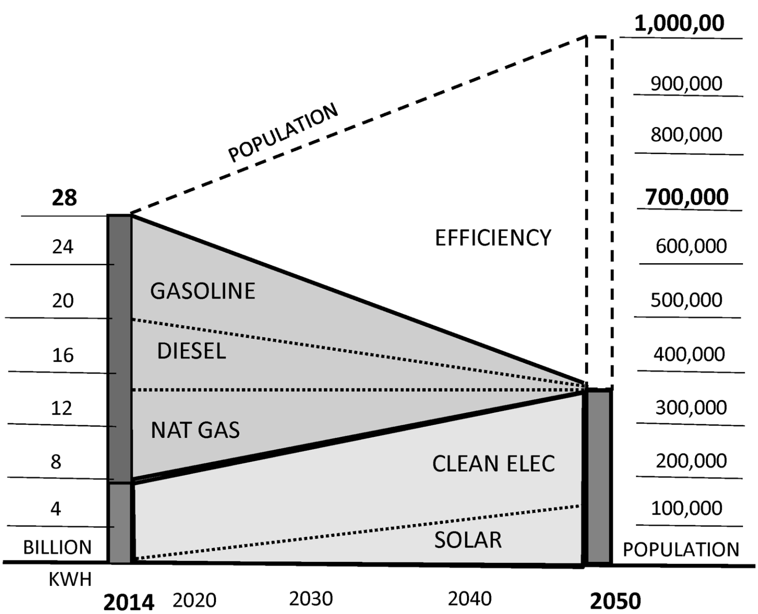
ABSTRACT

Seattle's elected officials have set a target for transforming the city's "core energy"—including all of the energy serving its buildings and transportation, to be carbon-neutral by the year 2050. What does the city need to do with its building stock beginning *today* to ensure that it can hit that target in a single generation? The question was studied in part in the 2010 Stockholm Environment Institute (SEI) study *Getting to Zero—A Pathway to a Carbon-Neutral Seattle* (SEI 2010), as well as the *2013 Seattle Climate Action Plan* (CAP 2013), both of which set targets and made general recommendations but necessarily stopped short of pinning down a detailed step-by-step solution. This paper proposes a set of potential strategies, centered on the concept of "zero-carbon-ready" communities. This set of strategies forms one of several possible pathways to carbon-neutrality that will be debated over the months and years to come. While a number of the components of this strategy are already incorporated into the Seattle Energy Code and other legislation, further actions are still required. These actions must be structured to maintain Seattle's vibrant economy and culture while dramatically improving the energy efficiency of Seattle's buildings.

THE BASIC OUTLINES OF THE CHALLENGE

Seattle's elected officials have set a target for transforming the city's core energy to be carbon-neutral by the year 2050. "Core energy" is the term used in the 2010 Stockholm Environment Institute (SEI) report *Getting to Zero—A Pathway to a Carbon-Neutral Seattle* to encompass all of the energy used in Seattle's transportation, waste handling and buildings—essentially all energy consumed other than that used in manufacturing and shipping (SEI, 2010). Transportation accounts for roughly half of Seattle's "core energy" use, while the remaining half is mostly used in buildings (SEI 2010, p. 9). Of that building energy use, half is electricity, and half fossil fuel, while virtually all transportation energy is fossil fuel (SEI, 2010, p. 32). Therefore, only about a quarter of our core energy is currently provided by electricity. Seattle is in the enviable position of owning an electric utility with large hydroelectric dams providing half of its electricity and most of the remainder derived from wind power and additional hydroelectric dams in the region (SCL, 2006), so the city can plausibly become "zero net carbon" without becoming fully "zero net energy." Still, the city's leadership has set an aggressive goal: As its population approaches a million, Seattle must stretch its existing clean energy capacity (plus whatever solar and additional non-fossil-fuel power it can generate) to replace nearly all of the fossil fuel currently used. This will require dramatic efficiency improvements for buildings and vehicles



Energy Use and Population in Seattle

36 Years to Zero Carbon

alike. Unlike vehicles however, which are replaced regularly, buildings last for generations. Therefore in addition to very high standards for new construction, Seattle's strategies must ensure significant improvements to the lion's share of its existing buildings. To have a reasonable chance of achieving the city's target of carbon neutrality by 2050, a significant course correction is likely required.

THE BASIC OUTLINES OF A SOLUTION

During the 36 years between today and 2050, the gasoline, natural gas, diesel and heating oil we now use must be replaced almost entirely by "clean energy." The cleanest of clean energy is efficiency and waste reduction, potentially comprising half of the savings that will be needed for both buildings and transportation, even given a growing population. Solar power, another promising resource, is currently expensive but projected to become cost-competitive within the decade as solar costs plummet and battery technologies emerge (SEIA, 2014). Seattle's buildings, including all the non-industrial processes within them, will need to operate on the remaining hydro and other clean power that is not required for transportation, plus whatever solar energy and waste heat can be captured. This would appear to be an unattainable goal, were it not for the fact that it is already a reality. Seattle's six-story Bullitt Center is famously operating well below zero net energy (Bullitt, 2014). Nationally, the list of verified net zero energy buildings is increasing rapidly, even in much more challenging climate zones (DOE, 2014). To quote Mark Frankel of the New Buildings Institute, "That which exists must be possible."

Where will Seattle find such dramatic building energy use reductions, as well as a significant reduction in fossil fuel for heating? Speculating about the future course of events, one rough approximation might be as follows:

- 50% from increased efficiency and reduced waste
- 15% from storage, retrieval and transfer of heat energy, potentially including off-site thermal transfer via district energy networks
- 20% from solar energy, mostly solar photovoltaic
- 15% from (presumed) future strategies or technologies yet to be developed, including additional sources of clean energy generation

COMPONENTS OF A PROPOSED STRATEGY

The components of a proposed strategy are given in further detail in the following pages:

1. Establish a “Zero-Carbon-Ready Community” (ZCRC) standard for new construction, requiring provisions for *future* high-performance systems such as operable sunshades, ground source heat pumps, heat recovery systems and thermal storage to be built into the original construction.

2. Utilize each “Substantial Alteration” project as an opportunity to upgrade the building to be close to the energy standard for new construction, and incrementally upgrade shorter-lived systems as they are replaced over time.

3. Strengthen the Seattle Energy Code for new construction to meet the local “best practice” standard (approximately 25% beyond the current code).

4. Design heating systems to accommodate storage, retrieval and transfer of waste heat (including off-site “district energy” connections where practicable).

5. Provide infrastructure for future solar energy generation and vehicle charging.

6. Establish utility rates and policies to incentivize optimal energy performance of occupied buildings.

7. Recognize opposing personal beliefs and political considerations.

ZERO-CARBON-READY COMMUNITIES

The roof of a downtown Seattle high-rise cannot accommodate a photovoltaic (PV) array large enough to support all of its power needs, and similarly a hospital or grocery will almost certainly consume more process energy than could be generated with its own rooftop PV. On the other hand, a low-rise school, warehouse, parking structure or community center would likely generate more energy than it needs. Using current best-practice technology for an office or multi-family building*, and covering most of its roof in PV†, the building could be as tall as 2-1/2 stories and operate entirely on its own power. Some modest advances in computing, lighting, PV and other technologies could reasonably lead to a self-sustaining 3-story building. One could envision a community where the low-rise buildings offer their excess electricity to buildings that are taller or house more intense uses, using the local electric utility as a broker, although no such policy is currently planned.

As mentioned above, with its hydroelectric utility and its ambitions to add still more renewable generating capacity, Seattle can technically become "carbon-neutral" without being fully "zero-net-energy." While rooftop PV can potentially generate enough power to meet a three-story building's annual energy needs, Seattle's existing hydro power should be able to provide clean power for a fourth story[3], even while meeting the city's evolving needs for industry, electric vehicles, street lighting and other uses.

While electric energy is easy to transmit over distances but difficult to store, thermal energy is difficult to transport but relatively easy to store. Excess heat energy can be stored for hours, days or even seasons, but transporting it off-site requires expensive urban infrastructure. While many American cities are served by steam systems that are over a century old, a number of European cities boast extensive new district energy systems that efficiently distribute hot water from heat sources to heat users. Such European-style district hot water systems are large-scale, long-term civic investments similar to bridges or water utilities, and would require the cooperation of local governments, taxpayers and private investors. Seattle has recently embarked on the beginnings of one such system as part of a strategy to further its Climate Action Plan goals, with the anticipation that more will follow as viable opportunities present themselves. Since a substantial proportion of energy used in Seattle buildings goes to space heating and water heating, this reuse of low-grade waste heat on a large scale could dramatically further the concept of a "zero-carbon community."

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*Three high-performing Seattle area office buildings are currently operating at EUIs of 11, 19 and 22 (less than half of conventional Seattle code-minimum buildings), and therefore an EUI of 18 might be selected as the current "state of the art" for building energy consumption.
†The PV array forming the roof of the Bullitt Center in Seattle produces 16 kWh per square foot annually, or 55 kBtu per square foot. If a similar array were to cover 80 percent of a building's roof area, then a building could be (55/18 × 0.80 =) 2-1/2 stories tall.

Zero-carbon *ready* (as opposed to just zero-carbon) means that the new buildings and substantial alterations within a community are built such that they can be easily upgraded to full zero-carbon status in the future without intrusive or expensive alterations. In this manner, PV arrays, heat recovery systems, exterior solar shading and other expensive components can be added when economic conditions are right, a decade or two in the future. Meanwhile, long-lived components of the building such as the fenestration and core mechanical systems would meet the zero-carbon standard from the beginning.

BRINGING SEATTLE'S EXISTING BUILDINGS UP TO PAR

Substantial Alterations

By far the great majority of Seattle's buildings in the year 2050 will be those already standing in 2014 (O'Connor, 2004). With the substantial alterations rules in the most recent Seattle Energy Code (SEC, 2013, Section C101.4.7), the city has begun a methodical process of improving the performance of existing buildings. "Substantial alterations" are most commonly defined in Seattle code as projects that "substantially extend the physical or economic life of the building," and this new code provision mandates that such buildings be brought mostly, but not entirely, up to current energy code standards. Such major renovation projects provide an opportunity for "deep green" energy upgrades, and this should avoid the need to impose mandatory upgrades of occupied buildings in future years. If one or two percent of Seattle's building stock were to undergo substantial alteration projects each year, by 2030 the city would have upgraded 20-30 percent of them. If we also assume that another 10 percent will have been demolished and replaced by that time, and that a further 10 percent will undergo voluntary energy upgrades, in total that would result in half of their building stock being substantially upgraded by 2030*. By 2050 these improvements could reach nearly all of Seattle's existing buildings.

Absent a substantial alterations project, several additional policies and processes contribute to incremental increases in energy efficiency over time:

*These are very rough estimates, as the actual number of substantial alterations and demolitions varies widely from year to year.

Replacement of Obsolete Equipment

Obsolete fixtures and equipment are periodically replaced with newer and (presumably) more efficient hardware that meets current codes and standards. One common example is the replacement of incandescent light bulbs with more efficient CFL lamps, and their subsequent replacement with even better LED lamps. On a larger scale, major mechanical equipment such as chillers and air handlers is periodically replaced, and thereby upgraded, as each element reaches the end of its useful life.

Minor Alterations

The Seattle Energy Code sets thresholds for alterations projects, requiring upgrades to related portions of certain altered systems that exceed those thresholds. In this manner, lighting controls, lighting power density, economizers for HVAC systems, building insulation and other systems are gradually improved as related projects occur in the building, proportionate to the scale of the other work (SEC, 2013, Section C101.4.3).

Periodic Audits and Retro-commissioning

Seattle's Climate Action Plan contemplates future rules such as periodic auditing and basic retro-commissioning of existing buildings, to be implemented before 2030. This concept is based upon similar regulations already in force in San Francisco, New York City and elsewhere. (In addition, the emerging field of third-party energy monitoring services might provide an economical alternative to on-site audits.) If implemented, these regulations would provide each building owner and manager with an actionable list of energy system improvements and could require correction of at least the most fundamental system deficiencies, (AEA, 2014).

Utility-funded Programs

Seattle City Light maintains ongoing energy conservation programs, ranging from home energy audits to large-scale industrial interventions (SCL, 2014a). Each of these programs has the potential to upgrade buildings that would otherwise have remained untouched by the energy code. Recent utility pilot programs are exploring a "pay for performance" approach that would reward actual energy savings over time rather than just assumed future savings (SCL, 2014b).

If All Else Fails…

For those buildings still consuming excessive energy in future decades, other programs and policies may be required to mandate efficiency. However, it is imperative to try everything possible now, to avoid the need for mandatory upgrades of occupied buildings in the future.

CONSISTENTLY SENSIBLE BUILDING DESIGN

To have even a fighting chance of hitting Seattle's zero-carbon target, our new construction and substantial alterations projects will need to adhere to certain fundamental principles. Very-high-performance buildings typically look and function much the same as conventional buildings, but they *integrate* the full package of cost-effective strategies (EPA, 2014). While none of these strategies by itself is especially revolutionary, together they will require changes to long-standing habits and traditions for the design, construction and operation of buildings. The following basics should be applied to the design of each building, in roughly this sequence:

Reduction of Primary Energy Loads/Elimination of Waste

The initial step is always to reduce the need for primary energy in the first place (Quarforth, 2009). Common strategies include well-insulated and sealed buildings to contain conditioned air; controls that minimize lighting, heating, ventilation and plug loads when they're not needed; active shading to eliminate unwanted solar gain; and the strategic use of trees and landscape for seasonal comfort.

Internal "Btu Recycling"

Certain processes consume heat and generate waste heat simultaneously, providing an opportunity for the low-grade "waste" heat energy to be recycled directly in the process. Hot water going down a shower drain preheats the incoming cold water, while warm exhaust air preheats incoming ventilating air. Variable refrigerant flow (VRF) systems move excess interior zone heat to perimeter zones as needed during heating seasons.

Daily Thermal Storage

The supply of waste heat rarely hits its peak simultaneously with the demand for that heat; i.e., space heating demand typically occurs in the morning, while excess heat is produced in the afternoon. The daily thermal cycle in a building can be accommodated with a bin or tank of thermal storage material that absorbs excess afternoon heat and later releases it for morning warm-up.

Seasonal Thermal Storage

An entire season of summer heat can be captured by circulating that heat through loops of pipe in deep underground bores, warming the surrounding tons of soil and rock, and then withdrawing that heat the following winter utilizing a ground source heat pump system. Thousands of such systems are operating across the US and Europe, but Seattle's local combination of cheap energy and expensive drilling has thus far limited the local adoption of this technology. Ground-source heating and cooling systems can serve individual buildings or larger districts, and may in the long run be essential to eliminate fossil fuel heating while limiting wintertime electric power use.

Efficient and Appropriately-sized Equipment and Systems

Mechanical system efficiency encompasses high-performance boilers and chillers, low-velocity duct systems, economizers, heating and cooling functions decoupled from ventilation, and more. Federal law limits the city's ability to mandate higher equipment efficiencies, so other regulatory strategies need to be employed to encourage adoption of above-code equipment. Conventional mechanical design has traditionally applied multiple factors of safety, resulting in equipment that is extensively oversized even for peak loads (Graham, 2009), so a new practice standard should require that such equipment be sized much closer to its actual demand.

On-site Solar Energy Generation

The purchase and installation of extensive photovoltaic (PV) arrays might profitably be delayed while costs continue to drop and efficiency increases. However, rooftops of new buildings should be designed to reserve the largest area feasible for future PV and solar water heating systems.

SPACE HEATING REDUCTIONS

One important category of "consistently sensible building design," and an essential prerequisite for high performance in cool climates, is a dramatic reduction in the energy used for space heating. This represents by far the largest use of fossil fuels in Seattle buildings (SEI, 2011, p. 32), and it occurs mostly during our overcast months when solar energy is least available. However, a high-performance building envelope in Seattle's mild climate, combined with effective heat recovery systems, could reduce the required heating energy to a small fraction of its current level (CEPHEUS, 2014). A number of strategies exist for making substantial progress on this front, a few of which are already mandated to some extent by Seattle codes:

Reduce Primary Heating Load

- Slow the heat loss through the building envelope (improved fenestration, reduced thermal bridging)
- Minimize air leakage through the building envelope and verify with pressure testing
- Orient glazing to make use of low-angle winter sun (passive heating)
- Reduce the heating temperature setpoint—comfortable for occupants if an improved building envelope keeps interior surfaces warm (EWC, 2014)

Utilize Waste Heat

- Recover and reuse heat from exhaust air and waste water, including waste heat from kitchens, data centers and other processes
- Transfer excess interior zone heat out to perimeter zones (using VRF systems)
- Utilize thermal mass (or phase change materials) to mitigate daily temperature swings
- Store excess afternoon heat to use for morning warm-up (thermal storage)
- Store excess summer heat underground for use the following winter (ground source heat pump)
- Import waste heat from nearby industrial or process sources (district energy)

Deliver Heat Using High-efficiency Equipment

- Eliminate electric resistance heat and replace with high-efficiency (hydronic or heat pump) systems
- Decouple ventilation air supply from space heating and cooling (dedicated outdoor air system)

As noted, it will likely be essential to *eliminate electric resistance heating* from new construction (except perhaps for extremely efficient small buildings), and mandate hydronic systems capable of connecting to ground source heat pumps, waste water heat recovery, VRF systems, district energy systems, and other sources of recovered heat. Such a policy is likely to be unpopular among builders and developers, because electric resistance heating is cheap and convenient for new construction and alterations, while hydronic systems add construction cost and complexity. However, electric resistance heating uses 3 to 4 times more energy than heat pumps, and can't make use of any stored or transferred heat energy. Once a building's fundamental heating system type is installed, to change it in the future would be extremely expensive and disruptive. Therefore, it is imperative to build space heating systems today that will support the "net-zero-carbon" level of performance required for future decades.

Off-site Thermal Heat Transfer (District Energy)

A district energy system capable of accepting waste heat (from industry, power generation, data centers, sewers) and then transferring that heat to nearby buildings where it's needed (residential, restaurant, laundry, healthcare) would get a second use from the original Btus. Extensive recovery and re-use of waste heat is likely to be an essential component in reaching Seattle's carbon-neutral goal while maintaining occupant comfort. A district energy system requires infrastructure development in the public right of way, well beyond the budgets of typical building construction projects. It is a powerful but expensive option for energy conservation—requiring a long payback period on the investment, as long as energy prices remain low—so its use should initially be focused on locations where conditions are optimal and where potential suppliers and users of heat energy are clustered close to each other.

ON-SITE ENERGY GENERATION AND VEHICLE CHARGING

Solar Capacity

The 2012 Seattle Energy Code includes modest requirements for renewable energy systems in new construction, and further requirements for more extensive "solar-ready roofs." This latter requirement recognizes that the costs of photovoltaic systems continue to fall rapidly while their efficiency continues to improve. A policy of preparing the roof and electrical service for convenient solar energy installations in the not-too-distant future will make PV systems financially viable sooner than would be the case if the installation were to require structural upgrades, relocation of vents and fans, and other disruptive changes.

In addition to photovoltaic systems, solar water heating systems also provide significant clean energy, for preheating domestic water and service water, as well as for recharging thermal storage and ground-source systems in Seattle's heating-dominated climate.

Electric Vehicle Charging Infrastructure

A fundamental aspect of Seattle's carbon-neutral ambitions will be the gradual replacement of the city's internal combustion vehicles with vehicles powered by the city's hydro- and solar-generated electricity. While hydrogen fuel cells and other technologies might hold some promise, the most likely zero-carbon transportation scenario involves battery-powered electric vehicles. Vehicle parking facilities should be designed so that they can incorporate future battery charging without intrusive or expensive remodeling, but without adding significant cost at the time of initial construction.

Direct Solar to Vehicle?

An intersection of the above two technologies might be realized if solar PV could directly charge parked vehicles (or their spare batteries), thus bypassing the electric grid entirely and obviating the DC to AC to DC conversion losses that would otherwise occur.

ECONOMIC IMPACTS

High-performing buildings often cost more to build than conventional buildings, particularly while the technologies utilized are still relatively new and unfamiliar to the design and construction community. The resulting buildings would be higher-quality and cost their occupants less to operate, and therefore should command higher market values (Cascadia, 2009), although such additional upfront construction cost is anathema to most owners and developers. It is also important to consider the potential secondary benefits of individual energy efficiency measures: A high-quality building envelope would result in a smaller heating system size, exterior operable blinds would reduce the required cooling system size, and together those smaller systems could reduce the required mechanical room space and even the floor-to-floor height.

The overall impact of high-performing buildings on our economy will clearly be positive. A substantial fraction of the present Washington State GDP, approximately 6%, is currently being sent out of state to purchase fuel (Commerce, 2012), while some additional amount goes to mitigate the environmental and health impacts of importing and burning that fuel. Renewable energy and energy conservation would keep the lion's share of that money circulating in the Seattle metropolitan area, through enhanced employment and business profits (Shuman, 2010).

To reach carbon-neutrality, we obviously need to stop burning fossil fuels, but the process of eliminating fossil fuel use will be a rocky road. Because Seattle is something of a bellwether nationally, gas and oil industries might forcefully resist this transition as they strive to prolong the status quo and maintain market share. The City of Seattle will have to carefully navigate the large-scale implications of such a transition, while keeping its big-picture goals in mind.

Future technical advances in affordable building performance are likely (but unknowable), as battery storage, PV efficiency, electric vehicle charging, computing efficiency, fuel cells, and other technologies continue their rapid development. Over the coming decades, some of these advances may help put us over the top in pursuit of our ultimate "carbon neutral" goal, but they are highly uncertain. Advanced technologies that are expensive today will likely come down in cost during the period after they are mandated by city codes and ordinances and have thus become commonplace in construction*.

New code requirements mandating extensive heat recovery or district energy systems are likely to meet heavy resistance from building owners and developers due to the uncertain payback on investment. Therefore, some form of financing assistance, tax incentive program or utility support would help protect the interests of those critical stakeholders as the city moves through the transition. To what extent should the larger community, through taxes or utility rates, support the development of individual high-performance buildings? This difficult question will need to be addressed as Seattle advances down this path.

A regional carbon pricing mechanism is being contemplated by the

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*This requires a period of time for the product supply chain, engineering practice, and contractors' perception of risk to adjust to the new requirements.

State of Washington, and may be necessary to align market forces with improved efficiency. Economic policies, including taxes and utility rate structures, must be aligned so that energy efficiency and waste reduction are perceived as being in each stakeholder's economic self-interest, rather than just a burdensome expense to be avoided. Seattle will also need to address the issue of maintaining its economic competitiveness with neighboring cities and the region as a whole. This might be accomplished through cooperative action with like-minded jurisdictions, as is already beginning to occur through the Regional Code Collaboration (RCC, 2014).

OPPOSING PERSONAL AND POLITICAL BELIEFS

If we continue to construct buildings just as we do today, those buildings will continue to perform just as they do today. Substantial changes to building performance will require substantial changes to the design, construction and operation of our buildings, and perhaps our utilities. These changes will be cheered by some, but resisted by others who fear that their business practices will be disrupted or their livelihoods threatened. Even when such concerns are more imagined than real, they must be addressed directly. A large and outspoken portion of society believes firmly that global warming and the attendant changes to the climate are not caused by human activities (or even that global warming itself does not exist), and thus that there is no reason to disrupt the status quo (PPP, 2013). Finally, many conservative citizens are concerned about what they perceive to be unwarranted government intrusion into their business practices, private property rights and personal decisions.

Specific groups opposing such a transition to a high-performance building stock may include:

- Developers, due to increased construction costs (especially during the initial transition period)
- Natural gas utilities, due to reduced market share
- Mechanical and electrical engineers, due to increased system complexity and liability concerns
- Architects, due to concerns about restrictions on expansive glazing and other design expressions
- Property owners, due to concerns about costs for alterations and improvements

Fear of change and resistance to change by impacted groups are very common and understandable reactions. Ideally, a shared vision would be developed that will be seen by the design, construction and ownership communities as being more appealing than maintaining the status quo. Financing and technical assistance to make the changes in conventional practice would certainly ease the transition (Dockx, 2013).

Net Zero Carbon Demonstration Projects

A significant number of buildings constructed and operating in accordance with the "ZCRC" standard would demonstrate the concept's feasibility to the rest of the building community. Municipal support, tax policy or utility financing could perhaps fund the incremental costs of high energy efficiency for those pilot projects. This is needed both to demonstrate to builders and developers that such construction is possible, and to work out the technical understanding of how high-performance standards will be best implemented for a variety of building types and scales.

CONCLUSIONS AND FUTURE STEPS

If the scenario outlined above were implemented in the near future, Seattle's new buildings and substantial alteration projects would start meeting the "Zero-Carbon-Ready Community" standard. By definition, non-intrusive future additions to the existing systems would bring those buildings to zero carbon at some appropriate point in the future. However, if instead the city were to continue allowing new buildings and substantial alterations to fall short of this standard, a round of disruptive and expensive upgrades to those buildings would be required before 2050 to meet the city's goal.

A ZCRC energy efficiency standard for each building type would be based on the performance of best-performing local examples, readied for the addition of future high-performance systems, and including provisions for as much PV generation as is feasible on the structure. It is likely that technical advances in the near future, such as tighter appliance standards, efficient lighting technology and low-energy computing systems, will further aid in meeting these targets.

Potential Future Steps

If such a ZCRC approach were to be successfully implemented, a number of additional steps would likely be required, all of which would necessitate extensive input from industry stakeholders and elected officials. These might include:

1. Implement a "Zero-Carbon-Ready Community" construction standard in the Seattle Energy Code.
2. Align utility policy to support the transition from natural gas heating to high-efficiency electric systems, in coordination with improved building envelopes and overall energy load reductions.
3. Work with homebuilders and state legislators to permit a higher performance tier for single-family homes in Seattle and similarly motivated jurisdictions.
4. Initiate two dozen demonstration projects involving a representative range of building types.
5. Provide financing mechanisms and technical assistance for design and construction teams.

Establishing Seattle's zero-carbon goal represented a critical and courageous step by the city's elected officials. That policy provided a solid basis for the work to follow, shifting the debate from "Should we do this at all?" to "Of all the available choices, how should we do this most effectively?" It recognizes Seattle's responsibility as a leading world city to align our own self-interest with the interests of the rest of the nation and beyond. The hard work of implementing the policy will proceed amid the rough-and-tumble of competing priorities, limited budgets and uncertain futures. As Seattle chooses directions and moves forward, these policies will be clearing a new pathway for the city and all of the communities that follow in its footsteps. The strategy outlined in this article represents one such potential pathway.

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