



## Executive Summary – Five Big Goals for 2040: Energy *Rewiring the Northwest's Energy Infrastructure: An Integrated Vision and New Investment Strategy*

### About This Report

*Rewiring the Northwest's Energy Infrastructure* shows how the Northwest can advance a world-class, sustainable, resilient energy system, beneficial and affordable to the people who pay for it.

This is a project of The Evergreen State College's Center for Sustainable Infrastructure (CSI). CSI champions a new paradigm for infrastructure investment in the Northwest and beyond, building alignment around a 25-year investment vision to meet long-term goals.

In 2014, CSI's inaugural report, *Infrastructure Crisis, Sustainable Solutions: Rethinking Our Infrastructure Investment Strategies*, set Five Big Goals for 2040 covering energy, water, recycling, transportation and overall performance. This first follow-on report focuses on energy with the framing question: How can the Northwest build one of the world's most sustainable, resilient, and affordable energy systems by 2040? It pays special attention to optimizing across traditional silos. Managing electricity, transportation, heating, waste, and water separately misses synergistic benefits. The report recommends institutional innovations that connect these infrastructures to realize common benefits.

The report is based on interviews of 33 energy thought leaders including Northwest utility executives, advocates, business innovators, regulators, analysts and agency leaders, as well as targeted research and literature survey. CSI synthesized results and created a review team of 20 to review and refine them. The contents are the responsibility of its primary author, CSI Director Rhys Roth.

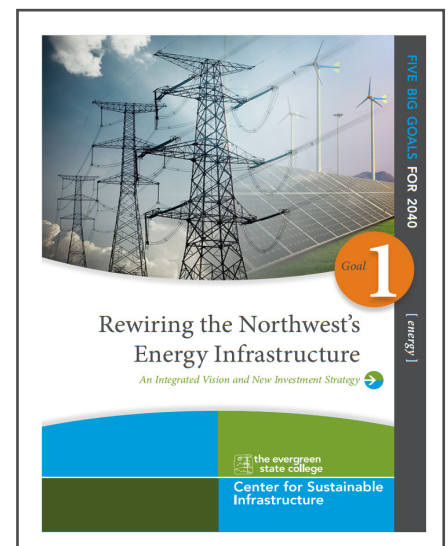
### Vision 2040: Seismic Changes in Energy

Today's energy framework, broken into discrete silos, remains little changed from a century ago. The electric grid moves power generated at centralized stations, substantially from fossil energy, to millions of consumers. Buildings and industry also use fossil energy for much of heat and cooling. Vehicles run on oil-powered combustion engines. But radical changes are in motion. A smart grid is emerging that networks millions of points of energy production, use, and storage with instant communication and response capability. The grid is primed to fuel a swing to electrified vehicles and heating systems. Energy is increasingly renewable.

The 25-year implications are seismic. Thought leaders are struggling to understand them and craft effective responses. Nonetheless, the new CSI report distills a 2040 vision from the conversations:

- Electricity carries a greater load – at least 90% of power produced from sun, wind, waste and water.
- At least 80% of heating, cooling and hot water is supplied by low-carbon systems.
- The efficiency of electricity use increases 50% or more. The grid is multi-directional with energy customers taking an active role.
- Energy storage and management seamlessly balance fluctuating electricity supply and demand, making most fast-ramp natural gas plants potentially obsolete.
- Electricity powers a strong majority of ground transportation miles. Heavy vehicles that cannot electrify use sustainable fuels.

The system will provide numerous benefits including reduced air and water pollution, improved public health, energy price stability and affordability, a more resilient grid, a plethora of new jobs and energy businesses, and replacement of cash-draining energy imports. Climate disruption will be a powerful driver to reduce carbon fuels and improve infrastructure resiliency. Dramatic cost drops in renewable technologies undermine the argument that a move to low-carbon sources will drive radical cost increases.



A sustainable energy infrastructure will be much more complex than today's, but a flexible, smart, super-efficient, clean system will likely be technically manageable, more resilient, less risky and no more expensive. This report reviews feasibility and affordability in depth. It offers five key conclusions, three innovations to put us on the right investment pathway, and two additional audacious ideas.

## Five Key Conclusions

- **Technology and market change drivers will transform the energy sector in the decades ahead.**

Rapidly declining costs and improving performance for energy technologies and systems – including solar panels, energy storage, electric vehicles, flexible demand, heat pumps, microgrids, and energy efficiency – will reshape the sector and alter utility models. New tools enabling customers to produce and manage energy will significantly change their relationship with utilities. This report reviews the state of play in these energy innovations.

- **It's not just about electricity; transportation and heating are huge, too.**

Transportation represents over 25% of U.S. energy use. Heating and cooling consumes over 40%, much from fossil fuels. By 2040 most demand will be electrified and supplied from low-carbon sources. Solar hot water, heat pumps and district systems will heat and cool buildings. Cars, light trucks, buses and trains will be substantially electrified. Heavy vehicles that cannot be electrified – airplanes, heavy trucks, shipping – will use certified sustainable substitutes.

- **It's time to begin reimagining our utilities – electric, natural gas, and wastewater.**

In years ahead customers will be able to affordably invest in power generation and efficiency systems that significantly reduce the energy they buy, thus reducing utility revenue. Utility models will need a rethink. The most successful utilities will bridge silos, innovating whole system solutions across energy, transportation, water and waste. Electric utilities will have an essential role coordinating the energy 'backbone' underlying a world-class energy system.

- **Customers will bring billions of dollars in new investment to our energy infrastructure.**

Technology companies offer increasingly attractive tools enabling customers to produce and manage energy. Customers will invest billions of dollars in energy efficiency, flexible demand and clean generation. With better tools to calculate the value that customer investments bring to the system, utilities and governments can provide incentives that maximize benefits.

- **State leadership is key to steering energy system change to optimize value and benefits for everyone.**

State leaders possess a vantage point above silos of electricity, transportation, and heating, and thus are in the best position to coordinate revamping of energy investments and policies. States must act as chief conveners bringing together key stakeholders to shape strategies and agreements. A silo-busting strategy for an integrated energy system will provide greatest common benefits. States must work together to build regional collaboration that advances the Northwest vision. They must also support local planning capacity to enable smarter investments. The next two sections detail state initiatives.

## Three Innovations to Put Us on the Right Trajectory

### A New Statewide Infrastructure Strategy

A State Infrastructure Strategy is a silo-busting platform to consider whole systems and identify integrated solutions. It will:

1. Set clear, high level, system-wide goals and performance metrics
2. Rethink regulations, policies, and processes that govern utility investment to better align with goals and reward progress on metrics
3. Remove barriers to non-utility energy investments that align with goals – Ensure utilities pay-for-performance based on actual value private systems contribute to the larger system
4. Encourage innovative capital formation to develop integrated projects, including joint ventures, community projects and public-private partnerships
5. Advocate federal policy changes supporting system-wide goals – Adapt lean management to coordinate regulatory agencies and enable more efficient permitting
6. Rethink state clean energy spending to maximize whole system value –Target strategic initiatives where existing markets are failing or moving too slow
7. Tackle a coming retirement wave by coordinating training and education pathways.

## A New Infrastructure Investment Discipline

Maximizing return on investment of state, federal, and customer dollars requires a new investment discipline. The key is to systematically evaluate a broader set of options, costs, risks and benefits before locking into a particular approach. Investing more time and resources up front will yield superior return on the far greater dollars spent on implementation. Sustainable Asset Management adds integrated strategies that reveal solutions benefiting more than one infrastructure system, and 'Triple Bottom Line' metrics that measure social and environmental as well as financial factors.

The Northwest boasts an extraordinary resource to inform electricity infrastructure planning – the Northwest Power and Conservation Council. As we enter a new era of integrated solutions that dissolve boundaries between electricity, transportation, and heating silos, we may need to update the Power Council mandate. Alternatively, states could establish a new agency modeled on and collaborating closely with the Council, dedicated to optimizing the whole energy system.

## A New Utility Compact

*Without fundamental changes in the utility business model, erosion of revenue from new customer investments could create serious challenges. Utilities also face other issues:*

- Utility capital investments may not provide optimal pathways to a sustainable, resilient and affordable system, and could become stranded in a decade or two.
- State laws such as Renewable Portfolio Standards and net metering have been grafted onto the existing system to essentially force utilities to buy new renewable energy. But these policy mechanisms may not be the most affordable way to obtain desired results.
- Customer and utility investments are not coordinated or incentivized to serve a coherent set of statewide or regional goals. Inertia from organizational culture and the experience, skill sets, and tools of its leaders and staff can block utility innovation.
- Planning institutions are not mandated to uncover optimal pathways across silos that provide the most affordable, sustainable and resilient energy solutions.

*A new utility compact to overcome these challenges will:*

- Reward utilities for performance on statewide goals
- Treat energy efficiency, distributed generation and flexible demand as co-equal resources
- Rethink renewable energy mandates and incentives to ensure fairness among utility customers, open opportunity to lower-income people, encourage and optimize private investment, and sustain the market for new renewable energy
- Require utilities to implement Sustainable Asset Management and the new investment discipline
- Encourage utilities to take on silo-bridging projects that better enable whole system solutions and optimize benefits.

## Two Audacious Ideas

### Infrastructure Renewal for Sustainable Jobs

States should target energy infrastructure investments where markets are not acting at necessary scale or speed, marshaling low-cost capital through public bonds or a state infrastructure bank. Targeted investment could focus on high-performance retrofits for tenant-occupied commercial buildings and homes, high speed rail powered by clean electricity, electric vehicle infrastructure, transmission and energy storage to tap large renewable energy resources, and district heating and cooling systems. Renewing the Northwest's energy infrastructure could create tens of thousands of sustainable jobs, with money now spent on imported fossil fuels redirected toward in-state resources and systems.

### Living Laboratory: Scaling Up the Northwest's World-Class R&D

The Northwest has special expertise and capacity in smart grid, energy storage, bioenergy, electrified vehicle infrastructure, super-efficient buildings, pay-for-performance project models, clean heating and cooling, microgrids, carbon fiber materials and cyber-security. We should coordinate these capacities to build a region-wide living laboratory by investing in research institutions and incentivizing our utilities and companies so that Northwest institutions can effectively compete for new R&D investment. Pacific Northwest National Laboratory, Bonneville Power Administration, regional universities and state energy funds are key players.



**Rhys Roth** Director of The Center for Sustainable Infrastructure  
 rothr@evergreen.edu (360) 480-6749