

The West Coast Clean Economy

Opportunities for
Investment & Accelerated
Job Creation



A report commissioned by the
Pacific Coast Collaborative

Prepared by:





The Pacific Coast Collaborative

On June 30, 2008, the leaders of the States of California, Oregon, Washington, and Alaska, and the Province of British Columbia, signed the Pacific Coast Collaborative (PCC) Agreement. Through annual meetings, the PCC promotes a common front for cooperative policy alignment, action, and information sharing among the Governors of the states of Washington, Oregon, California, and Alaska, and the Premier of British Columbia.

For more information on the PCC, please visit:
www.pacificcoastcollaborative.org

Authors

GLOBE Advisors, a subsidiary of the Vancouver-based not-for-profit GLOBE Foundation, was established in 2005 in response to an increasing demand for project-based consulting services in the environmental business sector.

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CCS is headquartered in Washington, DC with over 40 national and field experts across the U.S. Team members have extensive qualifications in environmental science, public policy, economics, management, business, law, education, communications, and finance. Many have experience as public officials, high-level policy advisors, and academic, non-profit, community, and business leaders.

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Preface

Members of the Pacific Coast Collaborative (PCC), in particular the states of California, Oregon, and Washington, and the province of British Columbia, have commissioned this report by GLOBE Advisors and the Center for Climate Strategies, to identify opportunities for accelerated job creation and investment in clean energy supply and energy efficiency, green buildings, clean transportation, and climate resiliency – collectively referred to in this study as the “clean economy”.

The PCC was originally formed in recognition of the unique and shared circumstances of all the jurisdictions on the West Coast of North America. Bounded by the Pacific Ocean and the unique geography and ecosystems of its coastline, sharing energy and transportation networks, the region shares a set of values and an outlook that are distinctly “West Coast” in nature. The West Coast jurisdictions form a mega-region with a population in excess of 50 million and a GDP of more than \$2.5 trillion that collectively constitutes the world’s sixth largest economy.¹

Opportunities abound for the members of the PCC to act jointly and cooperatively to maximize the benefits of their shared economies and to minimize the overlap of efforts to address shared priorities and challenges. But at this time and with remarkable consistency, whether it is Governor Brown of California, Governor Kitzhaber of Oregon, Governor Gregoire of Washington, or Premier Clark of British Columbia, the leaders of the PCC have made clear that their main priority is to accelerate the creation of new sustainable jobs across the region and to stimulate the development of new markets and investment opportunities to better insulate the region from the impacts of the troubled global economy.

In keeping with the founding mission of the PCC, this report presents a range of opportunities for cooperative action among the four West Coast jurisdictions to create new jobs, to attract new investment, to expand positive synergies, and to enhance an already unparalleled quality of life.

The clean economy job opportunities presented in this report were quantified using proven methodologies that allow for the identification of “clean” or environmental industries and occupations across a number of key sectors, as well as for a consistency in the comparison of numbers across all of the West Coast jurisdictions. Employment growth estimates, GDP contributions, and investment projections presented in this report are net, and take into consideration anticipated growth and shifts within the existing economy.

The modeled scenarios to 2020 are derived in part upon insights garnered from analyses originally related to areas outside the West Coast region. As a result, in order to more accurately assess the macroeconomic dimensions of a thriving West Coast clean economy, including job creation, GDP, and new investment estimates, further analysis will be required. This will be particularly important in linking specific policy actions to employment creation goals.

Becoming a world leader in clean economy growth requires strong leadership, a clear vision, and a well-articulated plan. California is a prime example of this type of leadership, having demonstrated progressive environmental and technological innovation and setting standards that have been adopted by many other jurisdictions across North America and around the world.

This report is not an advocacy document. It is a forward-looking assessment of what is and what could be as the West Coast region progresses toward a cleaner, lower-carbon economic future. The pages that follow provide practical guidance on how members of the PCC can work together to create what ultimately will be the West Coast region’s single most powerful competitive advantage – a cleaner and more sustainable economy.

¹ The four jurisdictions examined in this study (e.g., California, Oregon, Washington, and British Columbia) are referred to collectively in this report as the “West Coast region”. Note to reader: All monetary values expressed in the report are in US currency unless otherwise stated.



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The West Coast jurisdictions form a mega-region with a population in excess of 50 million and a GDP of more than \$2.5 trillion that collectively constitutes the world's sixth largest economy.

Highlights

The findings of this study to date include the following key points:

1. The clean economy is the single most important global opportunity on the medium-term horizon, with revenues expected to reach \$2.3 trillion by 2020. The West Coast region, which is globally competitive with other economic powerhouses in Asia and Europe, is ideally positioned to realize the economic, social, and environmental benefits of clean economic growth.
2. A conservative estimate of current clean economy GDP contributions and employment for the West Coast region totals \$47.2 billion and more than 508,000 full-time equivalent direct production jobs (see Figure 1).
3. This analysis indicates that progressive policy actions could expand clean economy GDP contributions in the region to \$142.7 billion by 2020, and could grow clean economy jobs by more than 200% over current numbers by 2020, equal to an estimated 1.03 million new jobs (net). Put another way, for every one clean economy job in 2010, more than two *additional* jobs can be created over the next decade.
4. The above estimates for GDP and employment growth also signal massive clean economy investment opportunities for the West Coast region. Preliminary estimates of cumulative investment opportunities to 2020 range between \$147 and \$192 billion (in \$2010).
5. Three key sectors of the economy stand out for their job growth potential across the region: the Energy Efficiency and Green Building sector (which shows the largest overall increase in new employment), followed by the Environmental Protection and Resource Management and the Clean Transportation sectors.
6. Accelerating the transition to a cleaner economy requires vision, leadership, and coherent, economy-wide, strategic approaches. By harmonizing environmental standards and requirements and exploiting the synergies of each jurisdiction's strengths, a globally competitive market for clean technology, products, and services can be established.
7. Achieving a cleaner economy requires a leveling of the playing field for clean energy, energy efficiency, and clean transportation solutions. Promoting price mechanisms that include the full costing of carbon is critical, as are financing and other non-price mechanisms to remove barriers inhibiting the advancement of the clean economy.
8. The opportunity costs of inaction related to climate change adaptation are too great to be ignored and the employment growth opportunities in related infrastructure, planning, research, monitoring, and innovation too important to be overlooked.
9. Region-wide collaboration with respect to workforce development, harmonized building codes and equipment standards, market development initiatives, economic gains from intra-regional trading, and region-wide infrastructure investments would provide measurable benefits for PCC members.
10. The PCC clearly has a strong foundation upon which to build a prosperous and globally competitive clean economy. That being said, it would be wrong to assume that this future will happen of its own accord, or that the West Coast region's abundant natural resources will sustain its current high standards of living or insulate it from the stresses and shocks present in the larger global economy.



Figure 1: Direct production jobs in the West Coast region's clean economy by sector in 2010 (total: 508,000 FTE jobs) and projected job estimates to 2020 under a high-growth, policy-driven scenario (total: more than 1.5 million FTE jobs).

Source: GLOBE and CCS, 2012



Executive Summary

Members of the Pacific Coast Collaborative (PCC), in particular California, Oregon, Washington, and British Columbia, commissioned this report by GLOBE Advisors (GLOBE) and the Center for Climate Strategies (CCS). The report identifies opportunities for accelerated job creation, investment, and market capture in each jurisdiction by leveraging the potential of the emerging West Coast “clean economy” through the power of regional collaboration.

The “clean economy” represents a shift in the host economy toward less carbon-intensive solutions and longer-term, sustainability-based planning and programming. The fundamentals of a cleaner economy promote enhanced economic performance and global competitiveness, energy and environmental security, and sustained investment.

More specifically, however, there are sectors within the economy that are directly responsible for supplying technologies, products, and services that have measurable environmental benefits in terms of their abilities to reduce greenhouse gas (GHG) emissions and improve both energy and resource security and efficiency. These specific sectors can in fact be thought of as a subset of the larger economy and are the core focus of this study.

Research has shown that clean economy jobs have grown on average 2-3 times faster than total jobs in the economy over the last decade, and they are more resilient to market volatility and vulnerabilities.

Drawing upon the many departments and agencies of the governments of California, Oregon, Washington, and British Columbia, and supplemented by extensive research and the resources of GLOBE and CCS, a detailed examination was conducted of the opportunities for investment and employment in the region's clean economy.

A parallel analysis was conducted of programs and policies in each jurisdiction to identify factors enabling or impeding job creation and investment attraction and to highlight successful strategies that could form the basis for region-wide collaboration.

KEY MARKET OPPORTUNITY AREAS

This report identifies five key clean economy sectors or "market opportunity" areas: Clean Energy Supply, Energy Efficiency and Green Building, Clean Transportation, Environmental Protection and Resource Management, and Knowledge and Support.

The areas of highest potential in terms of job growth and industrial development within the five market opportunity sectors are:

- i. **Energy Efficiency & Green Building** – In particular, related to whole building retrofitting, energy efficient equipment, and new, high-efficiency green building construction.
- ii. **Environmental Protection & Resource Management** – In particular, greater recycling and reuse, more efficient infrastructure, and the enhancement of measures to promote the conservation of natural resources and the restoration of damaged ecosystems.
- iii. **Clean Transportation** – In particular, electric and alternative fuel vehicles, enhanced public transit infrastructure, and lower-carbon intensive energy sources such as natural gas.
- iv. **Clean Energy Supply** – In particular, distributed energy systems, smart grid infrastructure and transmission, and enhanced integration of energy from clean and renewable sources.
- v. **Knowledge & Support** – In particular, educational institutions for workforce skills development and strengthening centers of excellence that build on the knowledge base of the clean economy.

The analysis shows that by 2020, the West Coast region's clean economy could grow by more than 200% through the adoption of progressive policy measures that build upon anticipated economic growth, both locally and in rapidly expanding Asian economies in need of clean solutions. This represents up to \$95.5 billion in new GDP contributions, 1.03 million new, net clean economy jobs, and investment opportunities conservatively estimated at between \$147 and \$192 billion (in \$2010) by the year 2020. These estimates represent growth on top of the \$47.2 billion in GDP contributions, 508,000 full-time equivalent (FTE) direct production jobs, and existing investment levels throughout the West Coast region's clean economy in 2010.

Employment growth can be attributed particularly to the Energy Efficiency and Green Building and the Environmental Protection and Resource Management areas of the economy. The Clean Transportation and the Clean Energy Supply components would also contribute significantly to new job growth, although to a lesser degree.



REALIZING THE MARKET OPPORTUNITIES

Significant opportunities exist for accelerating the transition to a cleaner economy, but this will require a clear vision, proactive leadership, and strategic, systems-based planning approaches. Leveraging on the strengths of each jurisdiction can result in regional collaborative synergies and a globally competitive market for clean technology, products, and services. However, this growth cannot be sustained by public policy action alone and requires active participation by the business community and investment by the private sector. The two are linked: public sector policy creates private sector opportunity for clean economic action.



Source: Carmanah Technologies (Victoria, British Columbia)

Achieving the clean economy requires a leveling of the playing field for clean energy, energy efficiency, and clean transportation solutions.

Promoting price mechanisms that include the full costing of carbon and energy, as well as other non-price mechanisms that remove barriers, are equally important in stimulating innovation and driving private sector investment.

In keeping with the founding mission of the PCC, this report presents a range of opportunities for cooperative action amongst the four West Coast jurisdictions to create new jobs, attract new investment, expand positive synergies, capture emerging markets, and to enhance an already unparalleled quality of life. Benefits from regional collaboration include:

- i. Harmonized codes and standards that can reduce transaction and program administrative costs for firms and governments, respectively, remove barriers, and foster investment by driving large-scale market demand for energy efficiency;
- ii. Development of a regional market which allow firms to develop products and services for larger markets and gain important economies of scale;

- iii. Inter-regional workforce development that can help deliver learning curricula targeting clean economy production and process skills, as well as addressing knowledge shortages;
- iv. Positive network externalities that allow for the creation and exploitation of synergies that would not occur by the efforts of a single jurisdiction;
- v. Economic gains from inter-regional trading that can be achieved from comparative advantages created through specialized clean economy goods and service production within the jurisdictions; and
- vi. Strong regional policy alignment designed to attract outside capital and lift up new forms of sustainable infrastructure and environmental services and stimulate high job creation potential.

Some of the overarching enablers that will accelerate clean economy growth include:

- i. Clear and stable policy frameworks that encourage private sector investment and public sector support for demonstration projects and the early adoption of clean technologies;
- ii. Financial assistance programs and mechanisms that facilitate investments in energy efficiency and green building for households, commercial establishments, and public buildings, including greater use of bonds to finance clean economy investments; and
- iii. Broad-based public awareness, post-secondary education and training, and K-12 education programs that build a wider appreciation of the clean economy, strengthen the “knowledge” components of the labor force, and better prepare civil society for clean economy employment opportunities.

POTENTIAL AREAS FOR FUTURE COLLABORATION

The PCC and its member jurisdictions may wish to pursue some of the following opportunities as part of future agendas to accelerate the transition to a cleaner economy and stimulate job creation by:

- i. Working cooperatively to expand private investment in the region's clean energy sector and leveling the playing field to facilitate deployment of clean energy supply throughout the west coast region.
- ii. Promoting the use of "highest" green building standards for public buildings, particularly with respect to energy efficiency retrofits and new building construction; promoting the use of zero-net energy building design and practices; and encouraging private sector support for innovative financing mechanisms.
- iii. Building on the West Coast Green Highway initiative by expanding on additional, region-wide clean transportation initiatives that include using joint purchasing power for low carbon vehicles; integrating electrification and /or alternative fuel use in port activities and coastal ferry systems; exploring the regional benefits of high-speed rail corridors; and lowering the carbon footprint of long-haul trucking operations.
- iv. Continuing to collect and share data and information for use in monitoring efforts and for developing the region's climate adaptation and resiliency strategies, including the potential to further develop emergency response plans and create a region-wide natural capital index.
- v. Establishing a resource recovery initiative to develop a market for recycled goods and deconstruction resources, diverting potentially reusable material away from landfills and creating immediate employment and business opportunities.

vi. Harmonizing environmental and energy efficiency standards and requirements, where appropriate, to accelerate clean economy initiatives and to provide greater levels of transparency, predictability, and certainty to businesses, entrepreneurs, and private sector investors.

vii. Creating a network of existing centers of excellence to facilitate greater collaboration on research and development by lowering associated costs and improving information sharing.

viii. Attracting and retaining high caliber workers, researchers, and investors from around the world by developing shared vision and leveraging marketing and branding efforts to promote the strengths of the West Coast region's clean economy.

In summary, the research supporting this report points to the clean economy as the next major global economic opportunity. For the West Coast region, the clean economy and the policies that drive it are a path to global competitiveness and prosperity. That being said, it would be wrong to assume that this future will happen of its own accord, or that the region's abundant natural resources will sustain its current high standards of living or insulate it from the stresses and shocks present in the larger global economy. The clean economy and its employment opportunities can be won or lost depending on decisions made now.



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Between 1998 and 2007, clean economy jobs in the US grew by 9.1% while total jobs grew by 3.7%.



Introduction

The “clean economy” is neither an abstract concept nor a separate component of the larger economic system. It represents a shift in the host economy toward less carbon-intensive solutions and longer-term, sustainability-based planning and programming. A clean economy is one that promotes enhanced economic performance, strengthens global competitiveness as well as energy and environmental security, and promotes sustainable investment.

As noted by the Brookings Institute, “the clean economy matters because its emergence responds to critical global and national environmental, security, and economic trends and associated challenges, most notably the growing demand for global environmental sustainability, the sharpening need for resource security, and the aspiration everywhere toward economic transformation.”¹

In broad terms, the clean economy is about creating and retaining wealth and jobs, reducing the carbon footprint of societies, restoring the natural environmental balance of critical ecosystems, and implementing improvements in energy and industrial efficiency, all of which contribute to enhanced economic competitiveness.

Research by the PEW Charitable Trusts shows that between 1998 and 2007, clean economy jobs in the US grew by 9.1%, while total jobs grew by only 3.7%.² The West Coast region in particular is well advanced in terms of the clean economy and well positioned to receive its economic benefits. Of the total new clean economy jobs created in the US in 2007, 21% were in California, Oregon, and Washington.³ Clean economy employment in California grew by 53% from 1995 to 2010, while jobs in the wider economy in that state grew by 12%.⁴

The concept of the clean economy also supports enhancing local manufacturing and related employment opportunities, and utilizing recycled or locally-sourced raw materials

wherever feasible. It also promotes the export of value-added, processed materials and advanced products with lower embodied energy. By reducing the need for imported energy, materials, goods, and services, the goal is to keep capital circulating longer through local sourcing and supply chains.



In terms of developing resiliency to market shocks, a newly released study by Next10 found that the clean economy in the US lost fewer jobs than did the overall economy during the height of the recent recession. In California for example, from January 2009 to January 2010 the overall economy lost 7% of jobs while the clean economy sectors lost only 3%.⁵

While clean and renewable energy sources and technologies figure largely in the substance of the clean economy, the opportunities for job creation and investment promotion range far wider and find expression in all areas of public policy and private enterprise.

In addition, investments and developments in clean technology sectors such as solar and biofuels in countries like China and Brazil are transforming the market opportunities and underscore the importance of working as a region to remain globally competitive.

1 See: http://www.brookings.edu/~media/Files/Programs/Metro/clean_economy/0713_clean_economy.pdf, p. 9

2 See: http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf, p. 3

3 IBID

4 See: http://next10.org/next10/publications/pdf/MSOG_2012_M2.pdf

5 See: http://next10.org/next10/publications/pdf/MSOG_2012_M2.pdf

In 2010, HSBC Global Research estimated worldwide revenues for the clean economy at \$500 billion and predicted that this value could grow to \$2.3 trillion by 2020.⁶

It is hard to imagine any other global economic opportunity of this magnitude on the near- to medium-term horizon, suggesting that the clean economy and the policies that drive it are a key pathway to global competitiveness.

While investment incentives and stimulus spending are important short-term drivers of change, the clean economy encompasses structural adaptations that recognize the need for forward-looking strategies that minimize the negative impacts of economic growth and maximize positive contributions to the West Coast region's quality of life and collective prosperity.

6 HSBC Global Research (2010), Sizing the Climate Economy



KEY TRENDS

Some of the more important trends shaping the evolution of the clean economy are highlighted below.

High volatility in commodity supply and prices will be a continuing fact of life for at least the next two decades.

Research from the McKinsey Global Institute's Sustainability and Resource Productivity Practice suggests that prices for commodities (e.g., energy, materials, food, water, etc.) will remain high and volatile for at least the next 20 years as global resource markets oscillate in response to surging global demand and inelastic supplies.⁷

The impacts of this reality will be felt both globally and locally throughout the West Coast region. While this volatility may temper "business-as-usual" economic growth, it also presents a unique window of opportunity to promote clean technology solutions to meet growing demands for global commodities and to stabilize price volatility.

For example, clean technology can be leveraged to provide reliable renewable energy supply (e.g., biofuels, hydrogen, etc.) to reduce demand pressures on carbon intensive fuels, and also to accelerate the adoption of more energy-efficient practices in industries such as agriculture and construction, where cleaner practices and technologies can lead to higher crop yields and lower energy consumption respectively. It is anticipated that supply increases from sustainable sources, along with resource productivity improvements, will be able to sustain up to 30% of the world's resource demand by 2030 and will help make global growth sustainable for generations to come.⁸

Natural gas technologies and liquefied natural gas as a fuel alternative are ripe with potential for job creation and investment promotion – particularly in use with ferry fleets, large urban vehicle fleets, and long-haul intercity trucking.

As stressed by US President Barack Obama in his State of the Union address in January 2012, the development of natural gas will create jobs and power trucks and factories that are cleaner and cheaper. His address set the course for federal support for a variety of initiatives, including tax credits equivalent to 50% of the extra cost of purchasing natural gas-powered trucks compared to those that run on diesel or gasoline.

7 See: <https://www.mckinseyquarterly.com/PDFDownload.aspx?ar=2887>

8 See: <https://www.mckinseyquarterly.com/PDFDownload.aspx?ar=2887>



While on the positive side, the greater use of natural gas as a cleaner motive fuel can offer a significant payoff in terms of potential GHG emissions reductions, concerns over the environmental impacts from the increased use of hydraulic fracturing or “fracking” technologies to capture natural gas from deep sedimentary shale gas deposits have been raised. British Columbia has been demonstrating leadership in this area by becoming the first province in Canada to enforce the public disclosure of ingredients used for fracking.⁹ This is also an area where the West Coast jurisdictions have leverage power in working with federal agencies to ensure that the expanded use of natural gas does not lead to corresponding deleterious environmental impacts – as was recognized in the collaborative agreement signed by Premier Clark and Governor Gregoire in February 2012.

Natural gas use is only one way of accelerating the clean economy. Its potential as a reliable energy source that can compliment other renewable power sources and can be rolled out in the immediate term. Exploiting a stable one hundred year supply of a cleaner energy source will reverberate throughout the economy, and will help to overcome boom and bust cycles that have been so much a part of our recent economic history.

Full costing of carbon is an essential element in strengthening the clean economy. Implicit in the foregoing is the fact that over the long-term, distortions of the energy marketplace that have artificially lowered the true costs of fossil fuels serve as disincentives to the deployment of

renewable and clean energy technologies. This is true in terms of both the price paid at the pumps for fossil fuels and for raw commodities. As well, there are significant untold costs related to health and the environment that at the moment are treated as externalities. While government subsidies and financial incentives for renewable energy to a limited extent have helped to “level the playing field”, such public cost outlays are unsustainable in the long run and must be led by private sector investment.

In North America, carbon pricing mechanisms in leading jurisdictions including California and British Columbia, and collaborative efforts such as the Regional Greenhouse Gas Initiative (RGGI) in the US Midwest, have been effective for driving improvements in energy efficiency.

Whether through direct or indirect carbon taxes, other market-based mechanisms, or other policy approaches, the real costs of all forms of energy generation and deployment must be allowed to work their way through the economy. The full costing of carbon is an essential component for driving clean economy innovation and investment, and for creating long-term, sustainable employment.

Sub-national economic development and carbon management initiatives are also emerging as key drivers of change to accelerate this successful transition. While progress on the development and implementation of a multilateral regulatory regime governing GHG emissions reductions has been minimal, significant gains have been made by state and local governments.

⁹ See: <http://www.newsroom.gov.bc.ca/2012/01/canadas-first-hydraulic-fracturing-registry-now-online.html>

The importance of cities as leaders in preparing for and adjusting proactively to climate change cannot be understated. As was noted by the World Bank, cities are the “first responders to climate impacts.

Indeed, cities in the four West Coast jurisdictions under review have become “hotbeds”, driving growth of the clean economy through a variety of sustainability initiatives and programs designed to preserve urban ecological integrity, improve waste management, reduce energy use associated with the built environment, limit urban sprawl, and enhance social and economic well-being. Below are examples from each jurisdiction.



Example 1: San Jose, California, has embarked on a fifteen year plan for economic growth, environmental sustainability, and an enhanced quality of life for its community. The San Jose Green Vision Plan will transform San Jose into the world center of clean technology innovation, promote cutting-edge sustainable practices, and demonstrate that the goals of economic growth, environmental stewardship, and fiscal responsibility are inextricably linked.¹⁰

¹⁰ See: <http://greenvision.sanjoseca.gov/GreenVisionGoals.aspx>



Example 2: Portland, Oregon, is pursuing an assertive, bottom-up regional development strategy to move to a carbon-free future as part of the Climate Prosperity Alliance, a national coalition of regions that share a common belief that they can simultaneously expand economic opportunities and reduce GHG emissions through practical strategies involving business, government, education, and other community partners.¹¹

¹¹ See: <http://www.climateprosperity.com>



Example 3: Seattle, Washington, is updating its Climate Action Plan that lays out a roadmap for how Seattle can become a carbon neutral city by the year 2050 and includes strategies identifying how it can reduce its GHG emissions in the transportation, building, energy, and waste sectors.¹²

¹² See: <http://www.seattle.gov/environment>



Example 4: Vancouver, British Columbia, has assembled a group of independent experts named the Greenest City Action Team, with the mandate of helping the City identify actions needed to help it become the “greenest city in the world” by 2020.¹³

¹³ See: <http://vancouver.ca/greenest-city/background.htm#team>

AN ACCELERATED POLICY AGENDA

While the incremental transition toward cleaner, lower-carbon business practices is inevitable, achieving the full investment and job creation benefits of the clean economy will be possible if the West Coast region focuses on the four key areas highlighted below.

Job creation within the clean economy can best be realized with a clear, strategic approach. Despite an uneven playing field that favors fossil fuel use and consumption, energy from renewable sources continues to be the fastest-growing sector of the global energy mix and offers the greatest potential to address issues of energy security and sustainability. Solar, wind, and biomass sectors on average produce more net jobs throughout the supply chain than traditional energy sources such as coal and natural gas. (see Figure 2).

Figure 2: Average employment over life of facility (jobs per MW of average capacity).

	Manufacturing, construction, installation	Operating & maintenance/fuel processing	Total
Solar PV	5.76-6.21	1.20-4.80	6.96-11.01
Wind power	0.43-2.51	0.27	0.70-2.78
Biomass	0.40	0.38-2.44	0.78-2.84
Coal-fired	0.27	0.74	1.01
Natural gas-fired	0.25	0.70	0.95

Note: Based on findings from a range of studies published in 2001-04. Assumed capacity factor is 21% solar PV, 35% for wind, 80% for coal, and 85% for biomass and natural gas.

Source: UNEP, ILO, IOE and ITUC, 2008

A sole emphasis on more jobs per MW, however, raises questions about long-term costs and whether the goal should be to make the economy more productive. In fact, even with higher initial costs with technologies such as solar, these technologies are more cost-effective in the long run because the fuels used to drive these technologies are free and renewable and labor costs for maintenance are low, while at the same time, incurring none of the carbon externalities.

As noted by the International Energy Agency, the deployment of renewable energy so far has focused on just a few of the available technologies. Even in more advanced markets, this has been hampered by problems of systems integration, limited budgets, lack of access to primary energy resources, and action delaying political debate.

An important caution is warranted here, however. One of the great disappointments of recent economic revitalization initiatives was the failure of the much heralded “green jobs” boom to materialize overnight. Indeed, this has resulted in a backlash in many quarters to clean economy initiatives that promise increased employment opportunities.

The reality is that clean economy jobs cannot and will not materialize overnight. As noted in the sections to come, while some immediate employment gains can be realized through specific initiatives such as building retrofits or renewable energy deployments (as evidenced in California’s highly successful Million Solar Roofs initiative), industries need time to plan long-term clean technology investments and ramp up with the skilled labor. Production processes have to be redesigned and new capacities brought on-line. This take time. Even the deployment of lower-cost natural gas as an energy source or the integration of renewable energy supplies into the energy grid will require a period of adjustment and transition. That is the reality of the marketplace, a reality that early proponents of the “green job revolution” failed to recognize.

The important point to note, however, is that once these changes take root, they lead to job gains that are stable, long-term, and higher paying. The earlier cited Next10 report on California’s green jobs bears witness to this fact, and similar assessments of British Columbia’s green economy carried out by GLOBE Advisors have conveyed the same message.

To maximize the acceleration of job creation and investment in the clean economy, there is need for a clear vision, progressive and forward-looking policies, and concerted action toward change.

There is a need for more private sector investment and the stable policy frameworks to encourage these investments.

The jobs are there and they will prove greater in all respects than many existing industries. Jobs in clean technology development, as one example, already are collectively larger than those in many primary resource industries throughout the West Coast region such as mining and oil and gas. And there is much room for further growth and investment.



Immediate local employment and investment gains will come from improvements to existing infrastructure and the built environment. Not all clean economy jobs will arise from the deployment of new technologies or from renewable and cleaner energy sources. Research cited throughout this report reveals that programs supporting energy efficiency upgrades and the renovation of the existing built environment can have immediate and positive benefits, not only in terms of job creation, but also in setting the stage for longer-term growth in the green building market and strengthening the resiliency of our urban areas to the impacts of climate change.

Indeed, energy efficiency ranks at the top in terms of attracting investment capital because these applications can be applied immediately to existing infrastructure and generate positive cash flows faster than new technologies or existing, expensive, and capital-intensive projects based on proven technologies. Energy efficiency initiatives also help to lower electricity bills, making buildings more affordable for consumers and increasing disposable income.

There is also a need for expertise related to preparing infrastructure for the impacts of a changing climate, such as extreme weather events that include coastal storm surges, flooding, drought, and wild fires.

It's about improvement, not revolution.¹⁴ The "greening" of existing skilled trades and the introduction of sustainable practices into existing businesses is the most practical means to achieve a cleaner economy.

There is a need to build on the knowledge economy.

While new jobs are at the core of the clean economy, the future of the clean economy is inextricably linked to strengthening the knowledge elements of society. Investments in innovation, education, skills training and upgrading, and professional development will have immediate payoffs in terms of employment opportunities at home, and will strengthen the region's competitive advantage in the larger global marketplace.

The member jurisdictions of the PCC are already world leaders in many aspects of the knowledge economy. California has set the world standard for innovation for fuel standards and electric vehicle development and deployment. British Columbia is also a global leader in technology development for the hydrogen and fuel cell transportation sector. Opportunities abound for the West Coast jurisdictions to continue this leadership in many areas related to the clean economy, but it will require sustained investment in the knowledge economy.

Regional collaboration provides significant competitive advantages. Despite its enormous size and diversity, the West Coast region is one extended geographic, economic, and social ecosystem. The region's local economy is connected by multiple energy, information, transportation, and trade channels through which flow hundreds of millions of dollars of commerce daily.

California, Oregon, Washington, and British Columbia are acknowledged leaders in realizing the economic opportunities implicit in tackling the twin challenges of global economic competition and environmental protection and recognize the benefits of policy harmonization and collaborative leadership in close partnership with key stakeholders. Furthermore, growing the regional clean economy to its optimal level will require close coordination and collaboration by the partners. The many benefits arising from such collaboration are identified below.

1. Economic Gains from Intra-regional Trading:

The most direct benefits from regional collaboration are gains from trade. Producers with a comparative advantage in one jurisdiction can provide a clean

14 The other top areas attracting investment dollars in rank order are: Recycling technologies, Green Building Materials, Water Resources Conservation, Home Products, Geothermal Energy, Applications and Technologies to improve Solar and Wind Energy, Cleantech Marketing Companies and Websites, Green Services and Investment Funds, and Environmental Services. Source: <http://researchwhitepaper.com/venture-capital-blog/10-green-sectors-attracting-investments-863.html>



economy good or service more efficiently than producers in another jurisdiction. This reduces costs to consumers and enables firms in each jurisdiction to specialize, increasing the aggregate size of the clean economy. An example could be the supply of cellulosic ethanol to meet low carbon fuel standards in the region. If a firm develops a new production technique that reduces costs of ethanol and can sell to fuel blenders out of state, this allows the blenders to purchase a lower cost ethanol as well as increases the revenues of the innovative firm.

2. Harmonized Codes and Standards: The development of region-wide standards for the clean economy can reduce transaction costs for firms, as well as reduce program administrative costs. As one example, the NW Energy Star building codes for residential buildings were developed regionally by the NW Energy Efficiency Alliance and its stakeholders, and were later integrated into the 2009 national residential building energy codes.¹⁵ In addition, the PCC project on energy standards for equipment has resulted in harmonized standards for televisions in BC and California. While identical codes and standards may not be practical across all jurisdictions given differences in regional economics and climate, the use of common tools and principles can help to this end.

3. Regional Market Development: Regional collaboration can also provide firms with larger common markets for their goods. When considered with common regional standards, firms can develop products and services for larger markets, gaining important economies of scale. Economies of scale reduce the average per unit cost of clean economy goods and services as production

increases. Lowering the costs of many clean economy goods and services is essential for them to gain market share. This is evidenced by the collective regional economic demand for building construction and/or building equipment systems as one example.

4. Inter-regional Workforce Development: There is a long history of labor mobility throughout the West Coast region, which is critical for knowledge transfer as well as for providing a trained workforce for the clean economy. Regional workforce development can help mitigate such shortages through regional training programs that deliver high-quality learning curricula targeting clean economy production and process skills. Examples of process training include the Green Building Council's Leadership in Energy and Environmental Design (LEED) professional accreditation programs, the Climate Action Reserve's (CAR) verification training program, and the Oregon-Washington Jobs and Innovation Acceleration program for the US Economic Development Administration.

5. Positive Network Externalities: Positive network externalities allow an "expansion of the pie," so to speak, by creating synergies that would not occur by the efforts of a single jurisdiction alone. As an example, positive network externalities develop when more users purchase electric vehicles (EVs) because of their increased infrastructure and acceptance. The PCC's Green Highway Initiative linking Southern California to BC with new transportation technologies to stimulate private infrastructure investment recognizes these positive network externalities. Other examples include improved marketing and branding recognition for the West Coast region's clean economy and the stronger political voice that a collaborative approach carries when seeking federal political attention.

¹⁵ See: <http://neea.org/successstories/codes.aspx>

6. 21st Century Infrastructure: According to studies by the American Society of Civil Engineers and others, the West Coast region will need to invest in up to \$1 trillion of infrastructure projects in the next 20 years. With strong regional policy alignment designed to attract outside capital and lift up new forms of green infrastructure and environmental services, job creation in the clean economy could happen at an even greater scale through a cooperative approach that uses public-private partnerships for example.

The analysis throughout this report demonstrates how cooperation in many key areas provides win-win opportunities for investment and job growth that will enable the West Coast region to stay competitive in the highly volatile global marketplace. By scaling clean economy market opportunities through creative leadership and multi-jurisdictional mechanisms such as the PCC, the West Coast region will be better able to achieve prosperity for its citizens while confronting the risks and impacts of a changing climate.

The West Coast region has historically benefited from strong economic, social, and environmental leadership, which in many instances has set the stage for the quality of life and prosperity enjoyed by many of its citizens. The PCC provides an opportunity for the use of the West Coast region's strengths, synergies, and economic power to set in motion new trends that will enable the vast opportunities of the clean economy.

Region-wide clean economy strengths include:

- An environmentally-conscious population strongly supportive of lifestyles that leave a smaller carbon footprint;
- A history of innovation as evidenced by strong and growing clusters of clean technology and advanced energy companies;
- A hospitable quality of life that attracts a skilled and diverse workforce;
- A widely distributed network of post-secondary educational institutions offering advanced education and skills training programs;
- Leadership on energy efficiency codes and standards and a long history of world-class, demand-side management programs by energy utilities;
- A high concentration of research facilities focused on clean technology research;
- A wide array of environmental networks, organizations, and think-tanks;
- A full spectrum of available alternative and renewable energy resources and options;
- A large natural resource base including large reserves of natural gas which will continue to sustain the region's economic well-being; and
- A strategic location adjacent to the rapidly expanding economies in Asia.

Defining the Clean Economy

There have been numerous studies over the last several years that have tried to describe, define, measure, and quantify the green or clean economy and related employment. Most, however, have failed to accurately define the bigger picture. The words “green” and “clean” are somewhat abstract in nature and are often used interchangeably. This, in part, has fuelled some of the confusion and misconceptions.

The “green” economy is often passed off as a sector or subset of the rest of the economy. More correctly, the focus should be on the “greening” of all industries and all sectors, a more broad-based approach that is essential to accelerated investment attraction and job growth.

To that end, there are occupations in every business and industry sector throughout the economy that are increasingly incorporating specialized skills and working with new technologies to improve processes and, in turn, to reduce the environmental impacts, increase efficiencies, and lessen the consumption of scarce natural resources in their operations. This is essentially a “greening” of the entire economy.

The Environmental Careers Organization (ECO), Canada’s national sector council for environmental occupations, has defined “green jobs” as those that work directly with information, technologies, or materials that minimize environmental impact, and also require specialized skills, knowledge, training, or experience related to these areas¹.

¹ See: <http://www.eco.ca/pdf/Defining-the-Green-Economy-2010.pdf>



1. Clean Energy Supply

- Biofuels/Biomass
- Geothermal
- Hydropower
- Wind
- Solar Photovoltaic
- Solar Thermal
- Waste-to-Energy
- Wave/Ocean Power
- Renewable Energy Services
- Smart Grid

2. Energy Efficiency & Green Building

- Energy-saving Consumer Products
- HVAC & Building Control Systems
- Lighting
- Energy-saving Building Materials
- Green Architecture & Construction Services
- Green Building Materials
- Professional Energy Services

3. Clean Transportation

- Public Mass Transit & Rail
- Fuel Cells
- Electric Vehicle Technologies
- Battery Technologies
- Natural Gas Vehicles
- Non-motorized Transport

4. Environmental Protection & Resource Management

- Air & Water Purification Technologies
- Carbon Storage & Management
- Pollution Reduction
- Professional Environmental Services
- Recycled-Content Products
- Recycling & Reuse
- Remediation
- Waste Management & Treatment
- Water Efficient Products
- Conservation
- Organic Food & Sustainable Farming
- Sustainable Forestry Products

5. Knowledge & Support

- Regulation & Compliance
- Education & Training

Figure 3: Key market opportunity sectors and segments that define production-side activities of the West Coast region's clean economy.



However, within the economy, there are specific sectors or segments that are directly responsible for supplying technologies, products, and services that have measurable environmental benefits in terms of their abilities to reduce GHG emissions and improve both energy and resource efficiency. These specific “clean” sectors can in fact be thought of as a subset of the larger economy. This smaller subset of sectors and segments is the focus of this report and is referred to collectively as the “clean economy” (as outlined in Figure 3).

Along the lines of what is described above, the US Bureau of Labor Statistics (US BLS) has developed a two-pronged definition for classifying green jobs.

According to the US BLS, green jobs are either:

- A. Production Jobs** – Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; or
- B. Process Jobs** – Jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources.²

To measure and quantify these jobs, the US BLS has described two approaches:

- 1) The *output approach*, which identifies establishments that produce green goods and services and counts the associated jobs; and
- 2) The *process approach*, which identifies establishments that use environmentally friendly production processes and practices.

² See: <http://www.bls.gov/green>

The focus should be on the “greening” of all industries and all sectors, a more broad-based approach that is essential to accelerated investment attraction and job growth.

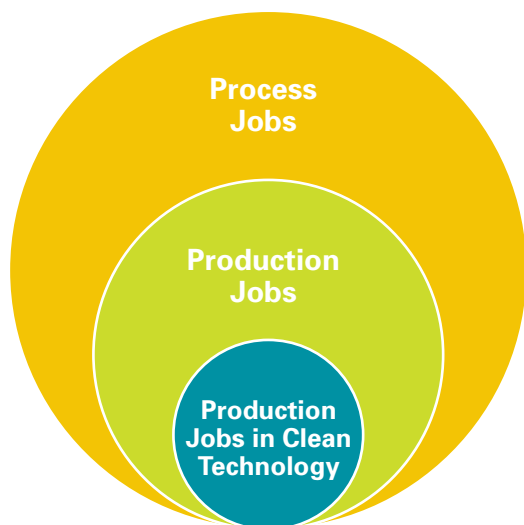


Figure 4: Clean jobs in the economy can be considered as either “process” or “production” jobs.

Production jobs are related to producing a specific set of goods and services, and are in and of themselves not concerned with the environmental impact of the production process. These occupations, for example, include jobs in the clean technology design and manufacturing sector. Other examples of production jobs include wind farm technicians and electric vehicle engineers. The output approach alone, however, does not cover all activities and associated jobs that favorably impact the environment.

The process approach, on the other hand, is concerned with whether the business uses practices or technologies that have a favorable impact on the environment, regardless of the good or service produced. The process approach is relevant to any industry. An example of a process job would be a mining engineer who is working to lower energy consumption and the environmental impact of operations through the application of clean technologies.

By considering this two-pronged definition, we see that there are multiple, overlapping layers for the definition of clean economy (as illustrated in Figure 4). Each approach requires different measurement strategies and will tend to count different jobs, with some overlap in industries that produce clean economy goods and services.

For the purposes of this report, clean economy jobs were quantified using the methodology employed by the Brookings Institution in its 2011 *Sizing the U.S. Clean Economy* study which looks purely at “output” or “production-side” jobs as defined by the US BLS, rather than the “process” jobs which are larger in size and beyond the scope of this analysis (see the Methodology Document for more details).

The approach applied by the Brookings Institution was used as it attempts to overcome the shortfalls of quantifying job numbers using the North America Industry Classification System (NAICS), which fails to identify clean economy activities or environmental groupings of industries and occupations. It also allows for the comparison of baseline job numbers across the West Coast jurisdictions.

The sector framework presented in Figure 3 above that was developed to describe the clean economy for this project is unique to the West Coast region. While the five key sectors are arranged somewhat differently from the Brookings Institution study, the individual segments were kept in alignment to allow harmonization of results and to compare job numbers across the jurisdictions. Additional segments were added to this analysis in the Clean Transportation sector – including rail, natural gas, and non-motorized transportation, while segments related to nuclear energy and green chemical products were removed.

Overall, these sectors and segments represent areas of highest employment growth potential in the region (although the opportunities vary to different degrees by sector and by jurisdiction). They also are the areas that contribute the most to long-term sustainability and region-wide competitiveness.



3

West Coast Market Opportunities by Sector

This section focuses on opportunities that:

- Score high on their ability to stimulate investment capital;
- Have net positive impacts on job creation;
- Advance clean energy goals and reduce fossil fuel consumption by developing clean, local sources of energy; and
- Are expected to stimulate significant benefits from regional collaboration in terms of workforce and market development, the harmonization of codes and standards, the economic gains from inter-jurisdictional trade, and other positive network externalities.

The opportunities presented are in many ways unique to the West Coast region, and are based on existing strengths, which include the availability of critical inputs such as investment capital, current public policy and program initiatives, access to research and development (R&D) clusters and education and training institutions, the engagement of local entrepreneurs and the private sector, and potential synergies that may be generated through region-wide collaboration.



Photo Source: <http://www.bchydro.com>

CLEAN ENERGY SUPPLY

The West Coast region has already established itself as the clean energy “power house” of North America, due in part to strong clean energy technology manufacturing, knowledge, and investment clusters, and an abundance of clean energy resources, including hydro, wind, solar, wave, tidal, geothermal, and biomass. Ranking at the top of their national indices for clean energy, California, Oregon, Washington, and British Columbia are front-runners in clean energy research, development, deployment, and financing (see Figure 5).

Figure 5: US/Canadian clean energy rankings by state/province.¹

US			CANADA	
Rank	State	Score	Province	Score
1	CA	95.3	BC	7.5
2	OR	79.4	QC	6.3
3	MA	71.8	MB	6.3
4	NY	63.1	NS	6.1
5	CO	60.2	ON	6.0
6	WA	60.0	PEI	5.2
7	NM	57.0	NL	5.0
8	MI	57.0	SK	3.7
9	CT	56.9	NB	2.9
10	VT	53.2	AB	1.3

Source: Clean Edge (2011) and Corporate Knights (2010)

¹ US rankings were prepared by Clean Edge; the index is measures of each state’s relative performance in each equally weighted category of technology deployment, public policy, and capital attraction. Scoring data is sourced from public and private sources, which are aggregated and analyzed as key indicators for each of the three categories. For more information, see: <http://www.pdxeconomicdevelopment.com/docs/cleantech/Oregon-Clean-Energy-Economy.pdf>. Canadian rankings were prepared by Corporate Knights as part of the 2010 Green Provincial Report Card. For more information, see: <http://static.corporateknights.ca/CK31-GreenProvinces2010.pdf>

Clean electricity as a percentage of total generation amongst the West Coast jurisdictions is growing due to established policy targets such as renewable portfolio standards (RPS). It should also be noted that British Columbia has no coal-fired generating facilities (although the province does import some coal-fired electricity), and Oregon and Washington have programs to phase out their coal power plants by 2020 and 2025, respectively.



In the US, revenues from wind power generation are expected to grow 11.2% annually to \$6.4 billion in 2016, and favorable national government legislation is expected to persist as the US diversifies its energy portfolio.

The Western states already account for almost 19% of US installed wind-generating capacity (California at nearly 8% of total capacity, Washington at nearly 6%, and Oregon at 5%), and additional opportunities for attracting investment in wind generation and related component manufacturing exist throughout the region.

BC has been a latecomer into the wind industry sector but is quickly ramping up with 2 projects now online with 246 MWs and 5 additional projects with electricity purchase agreements (EPAs) with the province's Crown utility.

The opportunities in clean energy supply can be considered in terms of their scale of development and deployment, as described below.

Utility Scale Energy Supply – At the utility scale (e.g., greater than 20 MWs in size), the real opportunity areas stem from the ability to use available clean energy resources effectively by promoting and showcasing the region as the clean energy hub and proving grounds for the North American marketplace in order to attract investment capital and a skilled labor force.

In its ten-year Regional Transmission Plan to 2020, the Western Electricity Coordination Council (WECC) recognizes a need for a cooperative planning approach to developing long-term sustainable transmissions connections.² The report states that in some cases, long-distance transmissions infrastructure to access renewable sources of power can augment localized renewable energy generation and can be more cost effective.

The study suggests the need for more demand-responsive transmission upgrades to alleviate the increasing congestion along existing connections and suggests an integrated Pacific-Northwest strategy from BC to California as a potential solution.

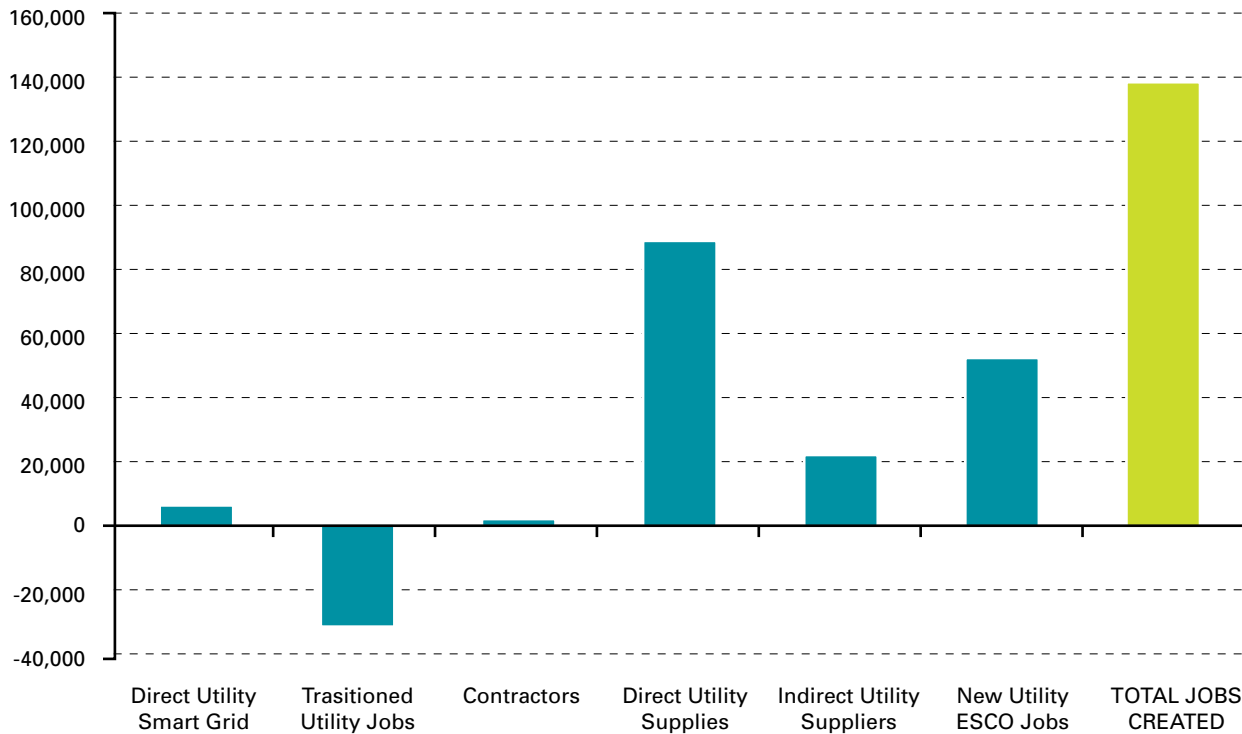
To be successful, it is essential that the transmission system and related interconnections allow for the efficient integration of clean, renewable energy into the grid. This also means incorporating climate adaptation strategies into the planning process for transmission infrastructure (e.g., transmission lines will have to be sited and designed to deal with increasing risks from extreme weather and storms) and incorporating smart grid technologies that improve system reliability.

The large, grid-connected, clean energy resources being developed to meet the region's renewable energy targets are largely intermittent in nature, such as solar photovoltaic (PV) and wind turbines with variable hourly outputs, and are being sited outside of demand (load)

² See: http://www.wecc.biz/library/StudyReport/Documents/Plan_Summary.pdf

It is essential that the transmission system and related interconnections allow for the efficient integration of clean, renewable energy into the grid.

Figure 6: Projected smart grid jobs created and transitioned in the US, 2009 - 2018



Source: KEMA, The US Smart Grid Revolution: KEMA's Perspectives for Job Creation, 2009

centers. The current and forecasted megawatt (MW) capacity of these intermittent resources will require additional electricity transmission capacity to carry these renewable resources to load centers. Transmission expansion and grid integration can also improve the reliability of the electricity system as the capacity to handle additional renewable expands in the future.

As illustrated in Figure 6, the job creation potential from improvements to grid reliability and operational efficiencies through new and existing transmission infrastructure initiatives are substantial, although capital requirements are also high.

In evaluating the California-Oregon Intertie (COI), "Pacific Northwest (PNW) and California entities have shown that there is no long-term capacity available on the COI to move Canadian and PNW renewables into California. If renewable projects in the PNW are to be financed and constructed, the projects will need power purchase agreements, and in order to deliver or receive the power under the agreements, construction of additional transmission capacity into California will be needed".³

In its call for regional collaboration, the Western Governors Association recommended in 2010 that an analysis be undertaken with respect to determining the benefits of "consolidation or virtual consolidation of the numerous Balancing Authorities into bigger regions, which can efficiently accommodate large amounts of variable output generation, better wind and solar forecasting, and mandatory grid reliability standards that support expanded renewable generation while maintaining grid reliability".

The region can work to develop policies that drive technical solutions to high-penetration renewable power grid operation, leading the way for policy adoption in the Western regional market. These opportunities include:

- Improved forecasting;
- Faster scheduling;
- Balancing area coordination; and
- Regional imbalance energy markets.

³ See the Executive Summary for the PNW/CA Transmission Investigations, May 2011, available at: http://www.oatiosis.com/TANC/TANCdocs/exec_summary_pnw_ca_trans_6_14_2011_clean.pdf

Progress on these actions can lower electricity rates and smooth the integration of renewables, as well as improve reliability, make more efficient use of existing transmission, reduce the amount of operating reserves required, provide new revenue streams for utilities that can market their flexible resources and transmission, and promote sharing of resources and closer coordination of electric systems across the region.

District Scale Energy Supply – Projects at the district or community scale (e.g., less than 20 MWs in size) have potential for some of the highest local job benefits.

In terms of district-scale solar power, the bulk of US capacity is located in the West. California leads in terms of both PV and thermal solar capacity in the US with approximately 67% of total capacity. Although recent concerns have been raised about whether California will be able to sustain its explosive growth in this industry, analysts predict the installation of more than 1 million residential solar projects in the state by 2020, adding on the order of \$30 billion to the economy and creating more than 20,000 new jobs per year⁴. Also relevant in terms of the local job creation potential in all four jurisdictions is the solar thermal/hot water industry, which can be stimulated through energy efficiency and targets such as net-zero energy building and related green building codes.

District-scale bioenergy projects also carry job creation potential for the region, particularly related to biomass-powered community energy projects, as well as those tied to the development of advanced biofuels in the areas of cellulosic ethanol and algae-based biodiesel. As one example of success, British Columbia's Bioenergy Network (BCBN) has successfully leveraged CAD \$61.7 million of partner investment from an initial CAD \$12.5 million to fund 21 projects with a range of bioenergy applications, creating local jobs in communities throughout the province.

Anaerobic digesters, methane capture at landfill sites, distributed heat, and combined heat and power (CHP) systems have the potential to displace dirtier fuels and create local jobs related to project design, construction, and operations, in both industrial and municipal settings.

Additional opportunities in bioenergy exist throughout the region for using waste streams to displace fossil fuels, promoting torrefied fuels to displace coal, developing transportation fuel demonstration projects, and promoting on-site biomass-to-energy systems in agricultural and industrial settings.

Jobs created through fuel switching initiatives exist in the commercial and industrial sectors, particularly around replacing diesel with natural gas and or co-generation in primary resource-based industries, such as forestry, mining, and oil and gas.

Summary of Key Opportunities:

CLEAN ENERGY SUPPLY

- Development and deployment of utility-scale renewable energy projects are important across the region, particularly in wind.
- Upgrades to regional transmission infrastructure and deployment of smart technologies to allow greater integration of renewable energy into the grid; this could also include consolidation of the numerous Balancing Authorities into bigger regions.
- Development of district or community-scale energy projects, including geo-exchange, solar thermal and PV, distributed heat, biomass CHP systems, and anaerobic digesters, as well as the deployment demonstration projects for proving emerging technologies and to serve as training facilities.
- Fuel switching to low carbon alternatives such as biofuels, natural gas, and renewable energy technologies in industrial applications that can create jobs, and reduce both operating costs and GHG emissions.

⁴ Building a Brighter Future, AECOM 2011



ENERGY EFFICIENCY & GREEN BUILDING

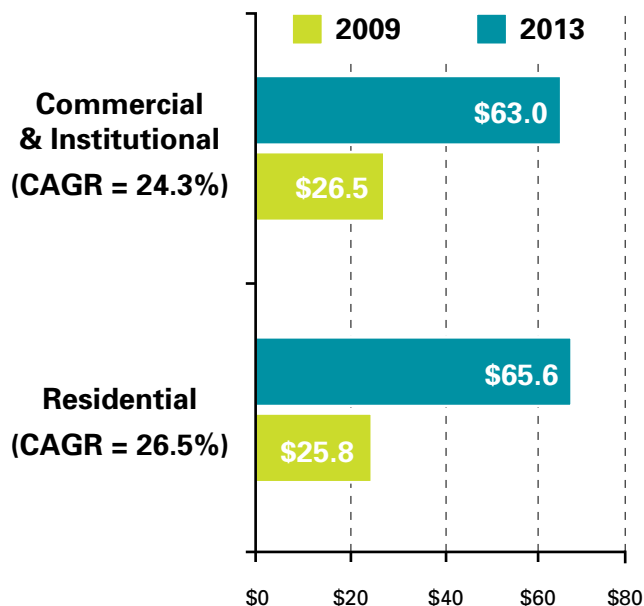
This analysis shows that the Energy Efficiency and Green Building sector has the highest potential for new, local job growth based on the policies examined (see Section 4 of this report). Opportunities in this sector are encouraged by governments at all levels leading by example and by encouraging demand within the residential, commercial, and institutional sectors through regulation (e.g., harmonized legislated energy efficiency targets, green building codes, and higher-performance standards). Encouraging consumer awareness through energy benchmarking and labeling programs for buildings is also important, as are economic incentives, creative financing mechanisms, and innovative partnership models to advance the sector.

According to McGraw-Hill, the combined value of the commercial, institutional, and residential green building market in the US is projected to reach \$128.6 billion by 2013, more than double its value of \$52.3 billion in 2009 (see Figure 7).⁵ The values include the retrofit and building renovation market, as well as new construction, and show significant compound annual growth rates (CAGR) of 24.3% and 26.5% for the Commercial/Institutional and Residential sectors respectively.

Green building requires a total systems approach that increasingly involves an Integrated Design Process (IDP) where architects, engineers, contractors, and other stakeholders work together during the planning phase to create synergies and to identify creative solutions, an approach that has had very positive results in terms of delivering energy and cost savings.

⁵ McGraw-Hill Construction Report (2008).

Figure 7: US green building market by segment, 2009 - 2013 projections (billions of US\$)



Source: McGraw-Hill Construction Report, 2008

The West Coast jurisdictions have more LEED-certified projects per capita than their national averages.

The West Coast region is a leader in green building from a North American perspective. As one example, the West Coast jurisdictions have more LEED-certified projects per capita than the national averages of 23.3 and 9.5 per 1 million people in the US and Canada, respectively (see Figure 8).

Figure 8: LEED-certified building deployment, December 2010

State/Province	LEED Projects Per 1M People	LEED Certified Projects (December 2011)
California	29.0	1,081
Oregon	59.9	231
Washington	56.7	380
British Columbia	19.7	89

Source: <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>

In Washington and Oregon, the Sixth Northwest Conservation and Electric Power Plan, produced by the Northwest Power and Conservation Council, is a key policy driver for progressive building codes in these states. The Sixth Northwest Power Plan is binding on the Bonneville Power Administration, and drives energy conservation requirements to all their customer utilities. The Plan outlines an electricity supply future for the Pacific Northwest that states that 80% of future electrical load growth will be secured through energy conservation.

In California, the work of the California Energy Commission, through its Energy Action Plan and a number of other programs, is important for driving state-wide energy efficiency initiatives. In British Columbia, the Energy Plan, the Energy Efficiency Act, the Energy Efficient Buildings Strategy, and programs such as LiveSmart BC, are critical drivers for improvements in energy efficiency.

Energy-efficient Whole Building Retrofits – The “low-hanging fruit” within this sector in terms of the clean job creation potential lies within building energy efficiency retrofits. Money saved on energy costs can be spent elsewhere in the economy. Governments at all levels have the potential to stimulate the industry and create jobs by encouraging retrofits of existing public and private buildings where appropriate, including personal dwellings, small businesses, and public institutions such as schools and hospitals.

California has shown leadership in this area, with its state-wide residential retrofit program “Energy Upgrade California”, designed to help overcome some of the key barriers facing this segment by providing a one-stop-shop with information on and access to rebates, financing, certified contractors, and home energy ratings.⁶

The private sector is rolling out creative financing mechanisms to fund retrofits. California’s investor-owned utilities (IOUs) commit more than 80% of their annual energy efficiency budgets to retrofits (amounting to approximately \$800 million/year in support of energy efficiency retrofits). The California Property Assessed Clean Energy (PACE) Program is administered through the Pacific Housing Finance Agency (PHFA), a California State Joint Powers Authority. Any city or county in the state can join the program, which is using its existing bonding authority to raise capital for projects that have been aggregated across multiple jurisdictions.

Using this aggregation approach, the program aims to secure greater access to capital and lower transaction costs for local PACE programs and the projects that they fund.⁷ It should be noted that this program is limited by federal regulations for the residential retrofit market and is just beginning for the non-residential market.

Other PACE programs are rolling out across the state in various counties and municipal jurisdictions focused on commercial building retrofits, including San Francisco and Los Angeles. In addition, the California Public Utilities Commission (PUC) is about to propose an “On-bill Energy Efficiency Repayment Program”, allowing building and home owners to obtain market-originated loans for energy efficiency and potentially renewable electricity generation projects, to be repaid through significantly lowered monthly utility bills.

In British Columbia, groundbreaking 2010 legislation under the *Clean Energy Act* has allowed for “improvement financing”, often referred to as pay-as-you-save or utility on-bill financing. This legislation enables utilities to introduce financing that is transferable between building owners and renters. In addition, the successful “Live Smart BC

⁶ See: <https://energyupgradeca.org>

⁷ See: <http://eetd.lbl.gov/ea/ems/reports/pace-pb-032311.pdf>



Location: Mead Center for American Theater (Washington, D.C.) Photo by Nic Lehous, courtesy of Wood WORKS! BC

Efficiency Incentive Program” continues to stimulate job growth by providing CAD \$30 million for upgrades to homes over 2 years, with a further CAD \$11.7 million available from the provincial utilities.⁸ The province launched a CAD \$15 million 3-year program in January 2011 to support small businesses through energy efficiency advisors, enhanced product incentives, equipment installation, and funding for innovative energy solutions.

In Oregon, Governor Kitzhaber launched the “Cool Schools” initiative to further accelerate the rate of energy efficiency retrofits in state schools to create jobs and save resources that could be directed to improve building performance. Cool Schools expands financing mechanisms for energy efficiency upgrades in public schools across Oregon and centralizes access to financial and technical support.⁹ Since Governor Kitzhaber signed the bill into law in June 2011, nearly 400 school buildings have received energy audits, while 11 school districts have applied for or secured more than \$9.5 million for school retrofits.

The Cool Schools effort builds on a decade of preparation and data collection. Since 2002, energy efficiency programs have stimulated a \$76 million net increase in Oregon’s wages and \$11 million in new business income for the state. In 2007 alone, energy efficiency programs created nearly 5,000 jobs in the state, and it’s been found that for every \$1 million invested in energy efficiency projects, up to 17 jobs can be created.¹⁰

Washington’s Weatherization Program, through its Department of Commerce, reduces the utility costs of

low-income families through home energy efficiency. Since 1993, the state’s weatherization programs have weatherized nearly 70,000 low-income households, creating new clean economy jobs and funding lasting improvements to the industry.¹¹

In addition to specific programs similar to those in other states, Washington has embraced an overarching policy of requiring all electric utilities to acquire all cost-effective conservation.¹² This relieves the state of much of the work of creating programs since it leaves to the electricity industry itself the formulation of the means to achieve this goal.

Building retrofits are expected to account for 25% of the expected savings estimated in the sixth NW Power Plan. Conservation programs to implement the Power Plan and the conservation requirements in Washington are expected to create 23,000 new jobs over the time horizon of the Power plan, including approximately 2,000 jobs from the building sector alone.¹³

Enormous opportunities exist for additional region-wide collaboration and leadership with respect to energy efficiency retrofits in terms of shared policy and program approaches, aggregated financing and partnership initiatives, and labor market education and training.

11 See: <http://www.commerce.wa.gov/site/500/default.aspx>

12 Initiative 937, also known as the Energy Independence Act, was passed by the voters in 2006. It requires that the largest utilities in the state that serve almost 90% of Washington’s electricity load acquire all cost-effective conservation calculated by using the methodology used the Northwest Power and Conservation Council, which in turn was created by the NW Power Planning and Conservation Act of 1980 in order to make conservation the resource of choice in utility planning.

13 Jobs and conservation numbers were computed by staff of the NW Power and Conservation Council using data from the Sixth Northwest Conservation and Electric Power Plan (2010).

8 See: <http://www.newsroom.gov.bc.ca/2011/04/increased-home-efficiency-rebates-help-families-save.html>

9 <http://www.oeonline.org/our-work/climate/global-warming-policy-solutions>

10 http://governor.oregon.gov/Gov/media_room/press_releases/p2011/press_111011.shtml

New Building Construction – Regional governments can continue leading by example with improvements to their state and provincial building codes to stimulate job growth in new green building construction. Established energy efficiency targets for new buildings, such as EnerGuide and LEED minimum requirements, and encouraging policies that support net-zero energy buildings, will stimulate demand in the sector for energy-efficient building materials and skilled labor.

Washington and California already require major facility projects funded in their capital budgets, or projects paid for through financing contracts, to be LEED Silver-certified. British Columbia has mandated a LEED Gold and a “Wood First” policy requirements for the construction of all new public buildings. Through its Power Smart program, the provincial utility has a “New Construction Program” offering considerable financial incentives for whole building, lighting, and system design.¹⁴

Inspired by Architecture 2030’s Challenge goals of “no fossil fuel use for buildings by 2030”, the California Energy Commission’s (CEC) changes to Title 24 require net-zero energy performance in residential buildings by 2020 and in commercial buildings by 2030.¹⁵ This comes on top of a 30-plus year history of requiring ever-higher levels of building efficiency, now surpassing levels of the US EPA Energy Star and US Green Building Council’s LEED buildings.

Provincial and state governments can continue supporting municipalities in the region by harmonizing building standards, codes, and regulations, and removing barriers to the deployment of green building technologies.

¹⁴ See: http://www.bchydro.com/powersmart/builders_developers/high_performance_building_program.html?WT.mc_id=rd_construction

¹⁵ See: http://www.energy.ca.gov/2007_energy_policy/index.html

Construction Waste Management and Deconstruction

– At present, construction, renovation, and deconstruction (formerly referred to as demolition) of residential and commercial buildings produce an enormous amount of waste. Despite increased recycling, most of the debris still ends up in landfills, with the US EPA estimating that construction and demolition waste in the US amounts to more than half of the municipal waste stream.

Oregon and California are showing leadership through local efforts in deconstruction. One successful example is a project in Portland that recycled 92% of the waste produced when several structures were torn down to build a new arena for the Portland Trail Blazers basketball team. Although deconstruction currently costs slightly more than demolition, the savings are expected to increase as contractors gain experience and the market for used materials grows. The key to making building material reuse economical is to design for disassembly. Potential for creating new employment opportunities throughout the value chain exist, including jobs in innovation and design, deconstruction, and waste/resource stream management.

While the deconstruction segment is a relatively new industry, it has a high growth potential and presents an immediate area ripe for job creation and region-wide collaboration. Although each jurisdiction has different building codes, establishing a common set of standards or requirements for deconstruction under a “West Coast Resource Recovery Initiative” would enable enterprises embarking on this nascent industry to share resource networks and business opportunities. Developing a region-wide market for recycled materials (e.g., reclaimed doors, brickworks, etc.) would create immediate employment opportunities, particularly in inner-city areas, and would help reduce the amount of potentially reusable material that ends up in landfills.

Green Construction Materials and Energy-efficient Technologies

– Jobs exist throughout the supply chain for green construction products and energy-efficient technologies. Energy-efficient windows and doors made from wood, innovative insulation materials, and laminated products are just a few examples. Engineered wood products, such as cross-laminated timber (CLT), have the potential to revolutionize the construction industry by replacing traditional building materials in certain applications.¹⁶ FP Innovations, the world’s largest nonprofit forest research institute, recently released a handbook on CLT, and the technology is being considered for inclusion in

¹⁶ Article published in Business in Vancouver Magazine, April 1, 2011. See: http://www.bivinteractive.com/index.php?option=com_content&task=view&id=4022&Itemid=61

green building codes in North America. The future could also see more building materials coming from nanotechnology-based industries that are much stronger and many times lighter than traditional steel and cement, with lower environmental impacts.

As well, establishing minimum efficiency standards for technologies such as televisions and set-top boxes, lighting, and other common household electronics will generate local economic growth by putting money back into consumers' pockets. These standards also yield environmental benefits by reducing energy demand and GHG emissions from power plants since "plug loads" are the fastest growing end use for electricity.

Appliance and equipment efficiency standards are one of the most effective ways of reducing energy use. Appliance efficiency standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, creating economies of scale and facilitating lower consumer energy costs and spurring efficient technology innovation.

Appliance and equipment efficiency standards can be implemented at the state/provincial level for appliances not covered by federal standards, or where higher-than-federal standard efficiency requirements are appropriate due to regional achievement of market transformation from voluntary measures utilities' demand-side management programs. In addition, in British Columbia, standards can be set for products manufactured within the province (e.g., windows, boilers), even if national standards are in place, as Natural Resources Canada regulations apply strictly to imports or inter-provincial-territorial trade.

Regional coordination of appliance and equipment efficiency standards increases the market size for retailers and manufacturers, raising the incentive to provide energy efficient product choices to consumers in all jurisdictions. For example, British Columbia has adopted California Energy Commission's Tier 2 energy efficiency standard for televisions. Supported by BC Hydro and California investor-owned utility programs, this appliance standard promotes market transformation in jurisdictions and will support nearly 7,000 GWh of electricity savings in BC and California, creating nearly 9,000 jobs as consumers re-spend savings in the economy.

In addition, extending and leveraging the existing energy efficiency knowledge base in the region serves as a springboard for leadership, job development, and the creation of new, specialized industries. Establishing a knowledge base on energy efficient technologies (through

governments, agencies, utilities, and academia) creates an economic opportunity to export know-how and establish niche industries such as hardware / software to support new demand for highly energy-efficient, global products.

The regional knowledge base and expertise in this area can be linked directly to green building strategies and requirements and stimulated through the sale and installation of technologies such as northern climate heat pump water heaters, smart appliances, demand-side meters and controls, efficient natural gas water heaters, boilers, and furnaces, solar thermal equipment, geothermal heat pumps, and heat recovery ventilators.

Summary of Key Opportunities:

ENERGY EFFICIENCY & GREEN BUILDING

- Recognizing that this sector shows the largest potential for new job growth to 2020, particularly in the areas of energy-efficiency retrofits and new building construction.
- Providing public sector leadership for early adoption of energy efficiency technologies through active projects involving public buildings, as well as aggressive targets (e.g., net-zero energy buildings) and green building codes and standards as drivers for industry growth and employment.
- Instituting a greater focus on deconstruction, waste diversion, and material recycling/reuse to provide a variety of jobs throughout the value chain.
- Promoting green building materials in construction and energy-efficient appliances through minimum standards that boost employment in industries such as forestry and value-added manufacturing, and reduce consumer costs with resultant economic spin-offs.
- Developing harmonized standards for energy-efficient appliances and equipment, lowering energy costs for consumers and stimulating the development of a regional knowledge base on efficient equipment that creates spin-off industries and jobs (e.g., smart appliances and grid technologies).

CLEAN TRANSPORTATION

The Clean Transportation sector includes enormous employment opportunities for the West Coast region related to the design, manufacturing, and deployment of clean-powered vehicles, development of alternative fuels and related infrastructure, and improvements to systems for the movement of goods and people. The sector includes land-based vehicle transport, public mass transit, marine and air transport (although air transport is not considered as part of this analysis), and non-motorized transport, as well as intelligent or “smart” transportation systems.



Employment generation within the Clean Transportation sector was considered from a three-pronged investment strategy¹⁷ as part of this study and encompasses:

1. **Avoiding** or reducing trips through integrating land use and transport planning and enabling more localized production and consumption. This may also include strategies that improve systems and promote changes in transportation patterns such as work-from-home initiatives.
2. **Improving** vehicles and fuels as a priority to reduce urban air pollution and GHG emissions. This also includes the manufacturing of clean vehicles and the development of new transportation technologies.
3. **Shifting** to more environmentally efficient modes, such as public mass transit, car sharing, and non-motorized transport (for passenger transport) and to rail and water transport (for freight) where applicable.

¹⁷ The three-pronged investment strategy was developed by the United Nations Environmental Programme (UNEP) work on the green economy. See: http://www.unep.org/greeneconomy/Portals/88/documents/ger/10.0_Transport.pdf

Avoiding Trips and Improving Systems – All West Coast jurisdictions have been actively working to integrate regional land-use planning, housing, and transportation along with incentives for developers to pursue projects consistent with regional and community sustainability plans. In California, for example, Metropolitan Planning Organizations (MPOs) in the state must prepare a Sustainable Communities Strategy (SCS) within their Regional Transportation Plans, which sets forth a vision for growth for the region taking into account the transportation, housing, environmental, and economic needs of the region.¹⁸ Sharing best practices for land-use and transportation planning across the West Coast region could help in terms of making existing systems and new developments more efficient.

From a systems perspective, intelligent transportation systems (ITS) include everything from traffic and transit controls, to sophisticated telematic systems for connecting electric vehicles (EVs) to the smart grid and for ship navigation. Such applications have positive effects on transportation system efficiency and sustainability, safety, the environment, congestion, and traveler mobility and convenience.¹⁹

The ITS industry is predicted to grow by 40% over 2009 to \$73 billion in North America by 2015, employing an estimated 203,000 people.²⁰

Washington and other jurisdictions along the West Coast are developing New Mobility Hubs that will enhance transit-oriented development features such as telework centers, workforce housing, and mixed use retail to help support sustainable communities. The network of New Mobility Hubs would benefit the region by providing real-time traffic and transit information; carpool, vanpool, and bike-buddy matching; and bicycle storage and cycling information, with jobs throughout the value chain.

Promoting Cleaner Vehicles & Related Technologies

– In terms of vehicle transportation, provincial and state targets in the region for reduced GHGs from the transportation sector and policies, such as low carbon fuel standards which require a 10% cut in GHG emissions intensity by 2020, are driving improvements in fuel efficiency and alternative fuel usage.

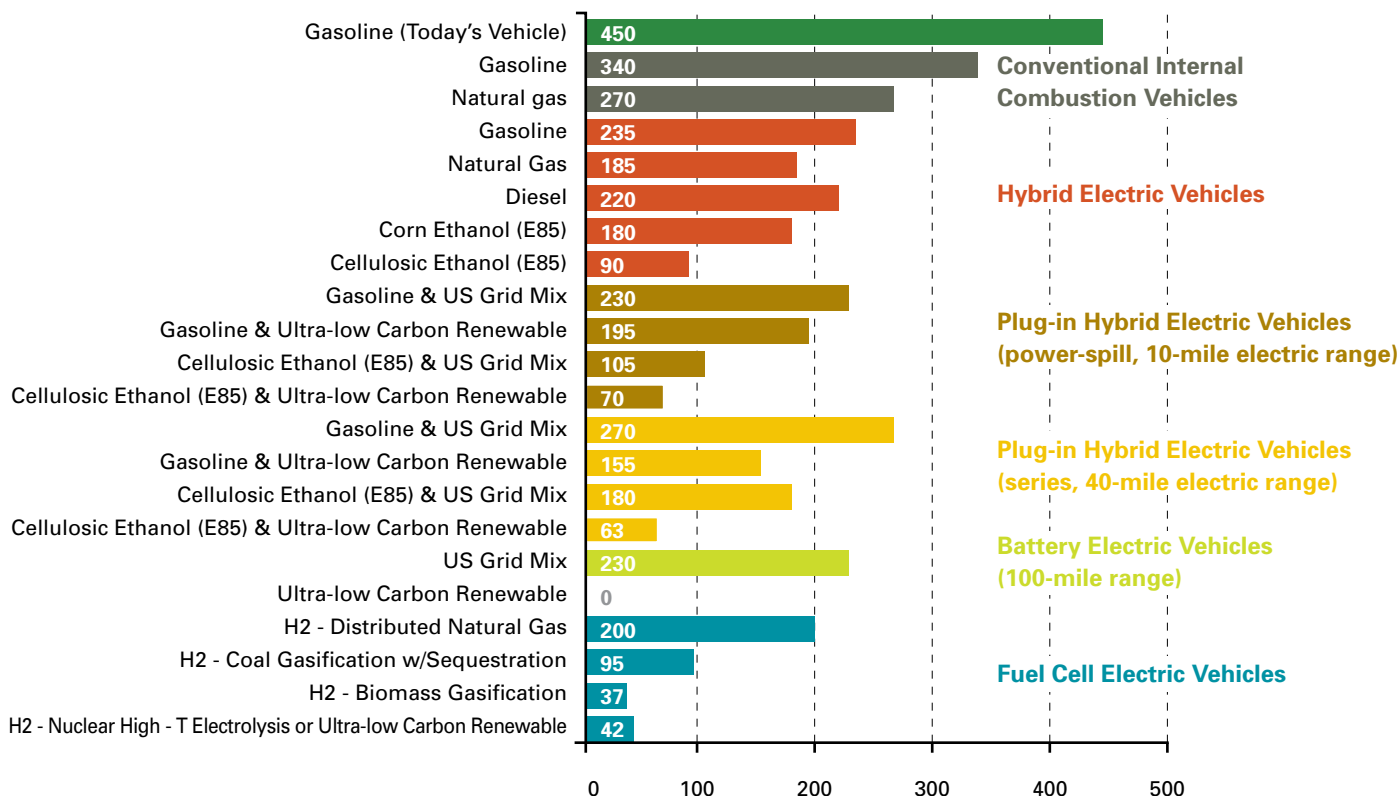
¹⁸ See: <http://www.arb.ca.gov/cc/sb375/sb375.htm>

¹⁹ The Intelligent Transportation Society of America (2011). Sizing the US and North American Intelligent Transportation Systems Market: Market Data Analysis of ITS Revenues and Employment

²⁰ IBID

Figure 9 below gives an idea of the projected state of technologies in 2035-2045, based on GHG emissions (grams of CO₂) per mile for a mid-sized car.

Figure 9: Well-to-wheels GHG emissions for mid-sized car based on a projected state of technologies in 2035-45. Ultra-low carbon renewable electricity includes wind, solar, etc.



Low/high band: sensitivity to uncertainties associated with projected fuel economy of vehicles and attributes of fuels pathways, e.g. electricity credit for ethanol or hydrogen, electric generation mix, fraction of biomass-to-hydrogen plants with carbon sequestration, etc.

Source: US Department of Energy, 2010

What is apparent from Figure 9 is that hybrid electric and plug-in hybrid EVs, when combined with cellulosic ethanol-based biofuels, show significant GHG reduction potential over conventional vehicles fuelled by gasoline or natural gas.

It should be noted that the numbers for corn ethanol do not include GHG emissions from land-use change, which can significantly increase their overall footprint. In addition, the values presented for plug-in hybrid and battery EVs are based on the average carbon intensity for the US national electricity grid, which is considerably more carbon intensive than the grid for the West Coast region.

When battery EVs are fuelled by renewable or hydro electricity, these vehicles present the lowest GHG emission scenario of all and have the added benefit of being available for roll-out in the immediate term.

For example, EVs charged in Washington state at the present time produce about 35% of the GHG emissions produced by vehicles charged by the average US grid. Using Washington's current average grid mix with an additional 12% renewable content (a projected scenario for 2023 by Washington state), battery EVs produce a mere 84 grams of CO₂ per mile.

While hydrogen fuel cell vehicles also present a low GHG emissions scenario, fuel cell system technology is still under development, with the anticipated launch of commercial vehicles in the 2014-2016 timeframe (in the range of 10,000 vehicles). Several studies have shown that hydrogen infrastructure can be effectively deployed in tandem with vehicle roll-out with current technologies.

Advancing Alternative Fuels – The promotion of natural gas technologies as a fuel alternative, particularly for ferry fleets, large urban vehicle fleets, and long-haul intercity trucking, shows particular promise for the West Coast region.

At the recent meeting between the Governor of Washington and the Premier of British Columbia, a comprehensive suite of joint undertakings related to natural gas, renewable fuels, and clean transportation were announced. These ranged from sharing information on the possible use of Liquefied Natural Gas (LNG) for use in coastal ferries and in the heavy-duty vehicle sector, to joint reviews of regulatory oversight and information disclosure on the environmental impacts of shale gas recovery and natural gas storage to enable firming of intermittent electric generators.

The two jurisdictions committed also to work together to share information related to low carbon and renewable transportation fuels, including legislation and regulations to encourage the use and development of low carbon fuels, with a particular focus on creating a uniform market for biodiesel products across Washington and British Columbia. Information sharing on the development of advanced aviation fuels, including developing new markets for these fuels, was also part of the joint undertakings announced by the Governor and the Premier.

The West Coast Green Highway Initiative – The West Coast jurisdictions are focused on a number of sustainable transportation projects and have signed a Memorandum of Understanding (MoU) in support of an "Alternative Fuels Corridor" to help incubate the acceptance of alternative fuels and stimulate refueling infrastructure investment from BC to Baja California.²¹ The "West Coast Green Highway" is an initiative to advance sustainable transportation solutions and the adoption and use of cleaner fuels and vehicles

along the 1,350 mile Interstate 5 corridor, including biofuel, electric, natural gas, and hydrogen fuel cell powered vehicles, with the goal of using alternative fuels as a bridge toward a zero-emissions, fossil fuel-free corridor.



Source: Washington State Government

The "West Coast Electric Highway" would connect the major high tech hubs of Vancouver, Seattle, Portland, San Francisco, and Los Angeles with fast charging for EVs. The roll-out of these initiatives and related projects has large job creation potential in terms of the vehicles, the supply of alternative fuels and infrastructure, and logistics. West Coast jurisdictions are also evaluating joint procurement opportunities to accelerate the adoption of EVs and lower the per-unit costs.

In addition, Washington, Oregon, and California were among six states selected to participate in "The EV Project", a \$230 million US Department of Energy (DoE) project to spur electric vehicle ownership and infrastructure. Nissan North America and General Motors/Chevrolet are partners in The EV Project and will launch a total of 8,300 electric vehicles to select markets. Drivers of the Nissan LEAF zero-emissions electric car and the Chevrolet Volt plug-in hybrid with extended range, who qualify to participate in The EV Project will receive a free residential charger.

Expanding on The EV Project, Coulomb Technologies will deliver nearly free home and public EV charging stations through ChargePoint America, a \$37 million transportation electrification project through the DoE. The ChargePoint America program will provide a total of 4,800 charging stations to program participants in nine regions in the United States who purchase Ford, Chevrolet, and Smart USA electric vehicles. West Coast cities to benefit include Bellevue/Redmond in Washington and San Jose/San Francisco Bay Area, Sacramento, and Los Angeles, in California. In Washington, AeroVironment will manufacture, supply, install, and operate a network of fast-charging

²¹ See: <http://www.westcoastgreenhighway.com>

stations for EVs, located every 40 to 60 miles along stretches of I-5 between the Canadian border and Everett, and between Olympia and the Oregon border.²²

British Columbia has established MoUs with Mitsubishi, Nissan, Toyota, and GM to be the initial province in Canada to deploy their first EVs. The multi-stakeholder working group “Plug-In BC” has also designed a 1000-point Charging Infrastructure Project that will see the deployment of up to 1000 charging points in residential and commercial locations across the province. California, Washington, and BC also offer point-of-sale incentives for EVs and several cities in the region, including Vancouver, BC, have required EV charging infrastructure to be installed for new building construction as part of their municipal building codes.

Opportunities also exist for clean vehicle and related infrastructure manufacturing throughout the region. At the present time, each West Coast jurisdiction has developed specific strengths with examples such as Tesla in California, United Streetcar in Oregon, BMW in Washington, and the Automotive Fuel Cell Cooperation and Westport Innovations in British Columbia. The 21 companies that comprise Oregon’s EV industry saw employment gains of 9.1% in 2011 with 496 new jobs in total.

Other opportunities for improved efficiency in transportation involve work in ship design and revamping long-haul trucking and ferry fleets to be powered by alternative fuels such as natural gas.

Shifting to More Environmentally Efficient Modes

– Investment in public transport and infrastructure that promotes walking and cycling generates jobs, improves well-being, and can add considerable value to regional economies. The Economic Development Research Group (2009) and the Surface Transportation Policy Project (2004) suggest that \$1 billion spent on public transport generates some 36,000 jobs, which is 9% and 19% higher than the job-creation potential of road maintenance or new road projects. Public mass transit is already one of the largest clean economy segments in terms of existing local jobs in all four West Coast jurisdictions and there is room for further growth.

However, public mass transit tends to be a major issue in North America where, historically, low-density community development makes providing services a challenge to municipalities and operators, especially from a cost perspective. By embracing higher-density urban planning throughout the region, the success rate of public transit initiatives increases, and in turn, so do the employment benefits.

Portland, Oregon, is recognized as a North American model for public transit, due in part to the metropolitan area’s regional master plan which favors transit-oriented development by promoting mixed-use, high-density development around light rail stops and transit centers, as well as the investment of federal tax dollars into multiple modes of transportation that include cycling, buses, light rail, street cars, trams, and commuter rail.



Additional efforts to promote public mass transit initiatives throughout the West Coast region have resulted in success, including implementing dedicated express lanes for buses and adopting smart technologies such as transponders on buses that allow for traffic control in cities such as Los Angeles. High-speed rail corridors have also been identified between Vancouver, BC, and Portland, as well as Los Angeles and San Francisco. Investments in infrastructure and services have immediate pay offs in terms of local job creation.

Intermodal passenger terminals shared among bus, rail, transit, and possibly airports can facilitate shifts away from personal vehicles. This option would improve and expand the options, routes, schedules, and connectivity of the passenger rail system to encourage use of and the associated GHG reductions from more efficient transport.

Other clean transportation alternatives that have job creation benefits include the adoption of different vehicle usage patterns, including more use of car/van pools and car and bicycle sharing. A proliferation of car-sharing cooperatives has emerged in recent years where people rent cars for short periods of time, often by the hour. This provides access to vehicles for those who either cannot afford one, or choose not to own one, with the aim of contributing significantly to sustainable mobility patterns using various transport options rather than vehicle ownership and, in turn, generates jobs related to the operation and maintenance of these vehicle programs.

²² See: http://www.wsdot.wa.gov/News/2011/07/13_ElectricHighways.htm

One example is the Car2Go car-sharing operation that provides a fleet of free-floating, low-emission, self-service smart for two cars distributed throughout the participating cities for on-demand access.²³ Launched by Daimler in the southern German city of Ulm in March 2009, the West Coast region has operations in both Vancouver and San Diego. The program in San Diego is helping to support the city's green mobility strategy, allowing Car2Go to roll out the first zero-emission, electric drive car-share service in the world.



Source: <http://www.car2go.com>

Modal shifts in the goods movement sector also have potential for reducing GHG emissions from truck and car to rail and ship, for example. Increasing rail capacity will enable some freight to shift from trucks to rail as moving freight by rail is much more fuel efficient than by truck. In addition, rail infrastructure improvements could enable more use of the fuel-efficient double-stack rail cars. Economic assistance and regulatory streamlining could improve intermodal rail yards and relieve rail freight bottlenecks. Moving freight from highways to rail would also relieve congestion on highways, improving the fuel economy of the remaining vehicles on the road.

Finally, infrastructure projects that promote walking and cycling, such as designated bike lanes and pedestrian walk ways, have immediate benefits for local job creation.

Each jurisdiction within the PCC has demonstrated strong leadership in developing and integrating clean transportation initiatives. The West Coast Green Highway initiative has laid the groundwork for regional collaboration on several transportation-related market opportunities. The development of a broader West Coast Green Transportation initiative could enable the coordination of both existing and new transportation initiatives focusing on innovation for

moving goods and people within the region. The integration of natural gas vehicles into port activities, inter-regional ferries, high-speed rail, and long-haul trucking operations is an example of a market shift which stands to benefit from coordinating policy development and infrastructure resources.

Summary of Key Opportunities:

CLEAN TRANSPORTATION

- Promoting intelligent transportation systems through initiatives such as New Mobility Hubs to enhance transit-oriented development and create employment throughout the value chain.
- Improving vehicle efficiency and promoting alternative fuels through efforts such as the West Coast Green Highway and the joint procurement of EVs, as well as policies such as low carbon fuel standards, to bring benefits to local industry.
- Promoting a shift to more environmentally-efficient modes of transportation, including truck and car to rail and ship, as well as the greater use of natural gas for long-haul trucking and ferry fleets.
- Adapting building codes to allow for the installation of EV infrastructure to help advance the market adoption of these vehicles.
- Investment in public mass transit to generate higher job-creation spin-offs than new road projects or maintenance, and the further promotion of mixed-use, high-density urban development.

²³ See: <http://www.car2go.com>

ENVIRONMENTAL PROTECTION & RESOURCE MANAGEMENT

Opportunities in the Environmental Protection and Resource Management sector are linked directly to the preservation of clean water, clean air, and unpolluted soil conditions, as well as to the remediation of contaminated sites and the management of waste streams. Environmental protection-related goods and services are used to measure, prevent, limit, or correct environmental damage (both caused naturally or by human activities) to ecosystems. Business in this area is driven in large part by environmental regulations and legislation.

This sector already employs the highest number of clean economy workers in all four jurisdictions, particularly in the areas of conservation, organic food and sustainable farming, sustainable forestry, waste management and treatment, and professional environmental services. While a large amount of new employment growth is not expected from all areas in this sector to 2020, there are a number of key segments which show considerable promise in terms of job creation potential. These areas include GHG management and related services, water management and efficiency, natural resource management, climate adaptation work related to improvements to infrastructure, urban agriculture and forestry, and waste diversion, recycling, and reuse of waste materials for new products.

Air Pollution and GHG Management – In the US, the 1990 amendments to the federal Clean Air Act added provisions for addressing acid rain, ozone depletion, toxic air pollution, and proposed an emissions trading scheme. California's Air Resources Board (CARB), established in 1967, has been that state's clean air agency and a North American leader in limiting GHG emissions from motor vehicles through policies and programs, including its alternative fuel vehicle incentive program, low- and zero-emissions vehicle (ZEV) program, and the low carbon fuel standard (LCFS).



California's Air Resources Board (CARB), has been a North American leader in limiting GHG emissions.

In addition, California's Global Warming Solutions Act (AB-32) requires that the state's GHG emissions be reduced to 1990 levels by 2020, a reduction of approximately 30% from business-as-usual levels. At the core of AB-32 is a cap-and-trade scheme which sets a state-wide limit on sources responsible for 85% of California's GHG emissions and establishes a price signal to drive long-term investment in cleaner fuels and more efficient use of energy. These initiatives have been creating jobs throughout the clean economy supply chain, including in clean energy, energy efficiency and green buildings, transportation, and GHG management and related services.

California has been the driving force behind a proposed regional carbon trading market for GHG emissions, the Western Climate Initiative (now managed by WCI Inc.), with compliance set to start in 2013. The WCI partner jurisdictions have developed a comprehensive initiative to reduce regional GHG emissions to 15% below 2005 levels by 2020 and spur investment in and development of clean energy technologies and jobs.

British Columbia is also showing leadership in this area with a proposed LCFS and legislation targeting to reduce GHG emissions, including a province-wide, revenue-neutral carbon tax on fossil fuels and a mandated carbon-neutral public sector. The province is a committed member of the WCI. These initiatives and public policies are spawning clean economy-related innovation within industry and the public sector, and have created a carbon credit and offset market in the province managed by the Pacific Carbon Trust (PCT).

Washington and Oregon, while no longer part of the WCI, have joined the North America 2050 (NA 2050) Partnership for Progress, which facilitates state and provincial efforts to design, promote, and implement cost-effective policies that reduce GHG emissions and create economic opportunities. NA 2050 is open to all US and Mexican states and Canadian provinces and accomplishes its objectives through working groups that focus on different aspects of energy, climate, and economic challenges facing each jurisdiction.

Washington has adopted a set of coordinated policies to meet its statutory GHG reduction targets for 2020 and beyond while creating clean economy jobs. The adopted policies are mainly focused on transportation and energy efficiency.

Throughout the West Coast region, many economic development and revitalization programs underway target jobs designed that prevent or mitigate environmental pollution or jobs tied to technologies, goods, and services that boost clean energy production, promote energy efficiency, and reduce GHG emissions.

Further opportunities exist for employment creation and investment promotion by strengthening policies and legislation in these areas and linking them directly to economic development initiatives related to clean energy technology development and deployment, clean transportation services and infrastructure, enhanced energy efficiency in the built environment, and green building design, construction, and retrofitting. Employment and investment promotion also exists in the management of GHG reduction strategies and the use of creative financing tools for the initiation and deployment of technologies and demonstration projects that serve these ends.

It should be noted that while some of the air pollution and GHG reduction policies mentioned above overlap with other sectors of the clean economy presented in this report (such as Clean Transportation and Energy Efficiency), job numbers and employment impacts were quantified using the methodology outlined in the Methodology Document that assigns these policies to specific sectors to avoid double counting.

Water Management and Efficiency – There is a need for improved water infrastructure and water-efficient technologies (such as water meters and controls) in order to balance commercial, industrial, and municipal interests for this finite resource.



Jurisdictions such as BC, Washington, and Oregon (which rely heavily on water for their hydropower) and California (which relies on water particularly for its agriculture industry) are preparing for a changing climate by developing adaptation strategies that address water shortages in key areas.

As such, the "Pacific Northwest Regional Water Quality



Program” was started as a partnership among land grant colleges and universities, water research institutes, and the US EPA Region 10 to provide leadership for water resources research, education, and outreach to help communities, industry, and governments prevent and solve current and emerging water quality and quantity problems throughout the Pacific Northwest.²⁴ This partnership is being supported in part by the USDA’s National Institute of Food and Agriculture (NIFA).

In California, the Department of Water Resources is focused on integrated water management with the “California Water Plan” providing a collaborative framework for all stakeholders and the public that evaluates different combinations of regional and state wide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship.²⁵

In Washington, the “Columbia River Water Supply Program” is a good example of a collaborative framework for all stakeholders to aggressively pursue development of water supplies to benefit both in-stream flows and out-of-stream uses.

As a shared resource that crosses jurisdictional borders, a collaborative approach to water management and efforts to improve water access for all users will help to spur investment and employment opportunities throughout the West Coast region.

Natural Resource Management & Climate Resiliency

²⁴ See: <http://www.pnwwaterweb.com/index.htm>

²⁵ See: <http://www.waterplan.water.ca.gov/index.cfm>

– Natural resource management is inclusive of a number of traditional industries that have direct links to the clean economy – in particular, sustainable forestry management, agriculture and horticulture, and fisheries and aquaculture. Protecting jobs through sustainable resource management practices that build resilience into the planning process are seen as essential to the clean economy.

Fortunately, the policy-related clean economy job growth estimates for this study so far suggest the economic and employment gains from the transition to the cleaner economy outweigh displacements. Many new jobs will arise from the more sustainable exploitation of the West Coast region’s natural resources, particularly in the forestry and agricultural sectors.

A more recent area of focus and job creation throughout the West Coast region is the growth of urban agriculture, as well as forestry practices that are increasingly including carbon sequestration benefits into their management strategies.

The impacts of a changing climate are painfully evident in the region’s forestry industries where increasing risks from forest fires and infestations by insects such as the Mountain Pine Beetle have had devastating impacts on some communities. Similar job losses have been felt in the local fisheries and aquaculture industries, due in part to increased ocean acidification and declines in shellfish and wild fish stocks. New opportunities for employment gains in the private and public sectors are linked directly to conservation, ecosystem restoration, and climate adaptation initiatives.

In September 2006, the Governors of California, Oregon, and Washington launched the West Coast Governors’ Alliance on Ocean Health (WCGA), a proactive, regional collaboration to protect and manage ocean and coastal resources along the entire West Coast. British Columbia,

through the February 2010 PCC commitments, has joined the other jurisdictions in many of their ocean and coastal initiatives. Additional examples of collaborative efforts include the scientific research-focused seafloor observatories in BC (e.g., VENUS and NEPTUNE projects) and the US Ocean Observatory Initiative efforts in Washington, Oregon, and California (e.g., RSN and MARS).

While natural capital valuation is a relatively new concept in the business community, recent research clearly points toward the economic and social value of preserving natural resources as whole ecosystems. Several governments and supporting organizations throughout the West Coast region have shown leadership in attempting to quantify and index the capital value of their natural resources. Opportunities exist for the West Coast jurisdictions to coordinate research efforts and to identify priority areas for leveraging the region's environmental assets. These initiatives tie in to current climate adaptation efforts and initiatives to improve regional resiliency, whether it be through shoreline restoration, protecting against tidal surges, or building better cities which appreciate the health benefits and the economic value provided by green spaces and ecological preserves.

Improving the availability of information for local communities to evaluate risks and vulnerabilities to climate impacts is also an important aspect for building stronger communities throughout the West Coast region.

Finally, emergency management response and preparedness with respect to climate-related disasters is another area of opportunity for collaboration that has employment spin-offs and would benefit West Coast jurisdictions through coordinated, preemptive disaster mitigation and response plans focused on floods, droughts, and wildfires. As one example of success in the region, the Pacific Northwest Emergency Management Arrangement (PNEMA), originally signed in 1996, provides for the coordination of resources and support during emergencies.

It is in the area of risk and disaster relief management where preparedness and mutual cooperation are most critical. Under conditions of major calamity, normal channels of communications and relief management may be stressed to the breaking point, inhibiting fast response by emergency personnel and other first responders. The recent tsunami in Japan bears testimony to this tragic reality. Members of the PCC need to anticipate the worst in relation to climate related disasters and to plan ahead to establish protocols for expedited mutual assistance and post disaster impact management.



There are no quick fixes to the problems of climate change; that much is clear. But there are significant opportunities associated with risk reduction initiatives and activities to mitigate the impacts of climate change. And because climate change is a shared, region-wide challenge, great benefit can be derived from shared policies and programs for the proper management of natural resources, collaborative data collection on climate risk minimization initiatives, cooperative research on such matters as marine, coastal, and terrestrial ecosystem restoration, and sustainable forestry and agriculture practices.

Waste Diversion, Recycling, and Green Consumer

Products – Solid waste management is integral to a cleaner economy as the countless by-products of human consumption and economic activity represent an almost unlimited supply of materials that require collecting, processing, and either disposal or repurposing. Waste streams include industrial and municipal solid waste, hazardous wastes, organic wastes, and electronic waste (e-waste).

The bulk of new jobs, however, will come from the recycling and reuse of products and materials. Recycling systems are driven by a number of factors including population growth, public awareness, regulations and legislation concerning waste management, and the availability of recycling infrastructure and services. Consumer demand for recycled products is increasing and businesses are looking to lower costs through reduced packaging, trends that are growing the demand for recycling systems and related jobs.

Recycling systems are increasingly and successfully converting traditional waste streams into profit streams, including bio-chemicals, bioenergy, and manufactured items. Organizations in communities across North America have developed waste-to-profit networks to find new uses for

waste streams and are investigating innovative solutions for turning them into profitable opportunities.²⁶

Within the manufacturing sector, a focus on energy efficiency and lean manufacturing is allowing for considerable cost savings and improved product and packaging design. In addition, firms are now approaching product development by looking at the whole life cycle of the product and considering “closed-loop” or “cradle-to-cradle” processes.

Programs and policies such as Extended Producer Responsibility (EPR) and Recycled Content are encouraging manufacturers to take greater accountability for their products at the post-consumer stage. In 2009, the Canadian Council of Ministers of the Environment approved a Canada-wide Action Plan for EPR and a Strategy for Sustainable Packaging.²⁷

The US EPA, as another example, has recycled content policies that require a certain percentage of products to come from recycled materials.²⁸

Increasingly stringent regulations and policies, combined with industry leadership, will continue to drive product and packaging innovation in the West Coast region. Local municipalities, innovative businesses, and organizations such as the BC, Northwest, and California Product Stewardship Councils are working together to identify opportunities and set up networks to divert waste from landfills and repurpose the materials for businesses in need of resources and inputs. Employment in this area include on-the-ground jobs in managing materials into the reverse distribution chain, jobs in innovation around product redesign and packaging, and jobs in repurposing materials in resource pools to create more value-added, locally manufactured products.

Technology advances are also enabling green product developments. As one example, new technology is now enabling municipalities to convert waste sludge into biogas and fertilizer at wastewater treatment plants. The same technology has the potential to reduce costs for the pulp and paper industry by reducing the nutrients added during anaerobic digestion.²⁹

Summary of Key Opportunities: ENVIRONMENTAL PROTECTION & RESOURCE MANAGEMENT

- Efforts to limit air pollution and GHG emissions have the potential to create a wave of employment opportunities in carbon management and related services and would serve in part to help resolve existing uncertainties in the national and regional policy landscape.
- Projects focused on water infrastructure improvements, land remediation, brownfields redevelopment, and ecosystem restoration show large local employment potential.
- Improving water management and efficiency through the deployment of technologies such as water meters can help build resiliency to climate change and generate jobs.
- Coordinating the collection, monitoring, and sharing of environmental data and information can help build more resilient communities, protect natural resources and related jobs, and help in preparing for climate-related emergencies.
- Promoting new jobs in waste management and diversion related to recycling and reuse, driven in part by industry-led initiatives and public policy requirements such as EPR.

26 The Illinois Manufacturing Extension Center (IMEC) is an organization working to set up waste-to-profit networks across the state of Illinois. See: http://www.imec.org/imec.nsf/All/Waste_to_Profit?OpenDocument

27 See: http://www.ccme.ca/ourwork/waste.html?category_id=128

28 See: <http://yosemite.epa.gov/ee/epa/eed.nsf/a8aa55f234e-6571a852577420067397e/e74cae64d8cd4cef85257746000afeea!OpenDocument>

29 Article published in Canadian Plant West, March/April 2011. See: <http://www.canadianmanufacturing.com/fabrication/pulp-sludge-is-green-gold-29801>

Organizations must embrace a new innovation paradigm that promotes collaboration between all players, fosters creativity, and emphasizes solutions that meet local needs.



KNOWLEDGE & SUPPORT

The Knowledge and Support sector comprises post-secondary educational institutions and training organizations, as well as aspects of government and public service agencies that are dedicated to advancing the transition to a cleaner economy through regulation and compliance, policy design, and program implementation.

It has been said that innovation will be one of the most important drivers of a cleaner economy. Many believe that the greatest innovations of the 21st century will be those that address human needs, such as improved health and environmental quality, better energy security, and increased access to education, with the notion of “doing well by doing good”. Findings from a GE Global Innovation study that was released in January 2011 and involved a survey of approximately 1,000 business executives from 12 countries reinforced the notion of innovation as the main lever for building more competitive economies.³⁰

The study also highlighted the importance of strategic partnerships as a key to innovation. Partnerships will be important to ensure that companies remain competitive and can retain a productive and efficient workforce. As stated in the report: “Innovation in the 21st century requires a new blueprint, one that topples the top-down approach and engenders collaboration among companies, governments, and communities...organizations must embrace a new innovation paradigm that promotes collaboration between all players, fosters creativity, and emphasizes solutions that meet local needs.”³¹

³⁰ See: <http://www.globe-net.com/articles/2011/january/30/how-the-rules-of-innovation-are-changing.aspx?sub=15>

³¹ See: <http://www.globe-net.com/articles/2011/january/30/how-the-rules-of-innovation-are-changing.aspx?sub=15>

All West Coast jurisdictions have been investing in innovation through a variety of programs and initiatives. In Oregon, for example, a partnership between the private sector, state government, and the state's four research universities have created the Oregon Innovation Council, which is working to create jobs, incubate companies, and bring outside dollars to the state.³² It has been estimated that the program generates more than \$7 for every legislatively invested dollar. Increased collaboration and partnerships to this end will only expand the pie further.

In addition, under a federal "Jobs and Innovation Acceleration Challenge" grant awarded recently for clean economy workforce innovation, 20 workforce, economic development, and education providers from the Greater Portland metropolitan region and South-Western Washington will focus on three core economic development strategies: technology commercialization, supply chain development, and product diversification and re-engineering.³³ The "Clean Tech Advance" initiative will further integrate two of the Portland metro region's prominent industry clusters to accelerate clean technology innovation and production to meet growing global demand. This grant will allow the bi-state region to build, support, and diversify the clean technology manufacturing cluster and its workforce in a truly equitable, collaborative, and coordinated way.

In Washington, "Innovate Washington" is working to accelerate technology-based innovation through a highly-collaborative ecosystem that brings together entrepreneurs, large companies, state government, investors, and industry leaders.³⁴ In this environment, the organization creates custom economic development plans for identified technology sectors, helps promising companies receive the growth capital they need, and supports entrepreneurs through an array of focused tools and services. A public-private hybrid, the organization's first sector of focus is clean energy to achieve sustainable job growth for the region.

Creating a network of existing "centers of excellence" could enable collaboration on research and development that would lower the costs associated therewith and help reduce costly duplications of effort. For example, British Columbia's bioenergy test facility at the University of Northern BC in Prince George could be made available to researchers from other jurisdictions, and in return, the door would be open for researchers from Canada at research facilities in California, such as the Agricultural Sustainability Institute at the California State University Institute for Sustainability.

Education and Training – Workforce development, the education of a new generation of managers, and the training of the labor force on low carbon and clean economy practices will also be key factors in society's transition toward systemic changes that promote sustainability. Science and technology graduates will be critical to the knowledge or "innovation" economy and, in combination with increased technology adoption rates and R&D investment, can lead to higher productivity, which will be important for jurisdictions struggling to grow business opportunities with a shrinking labor force. An earlier study by GLOBE in 2010 found that BC could face skilled labor shortages in the range of 60,000 workers if actions are not taken to address the issues.³⁵



West Coast jurisdictions have been supporting education and training through investment in education funds and programs and by providing training tax credits, for example. However, there continues to be a large number of graduates from specialized energy efficiency, renewable power, and green building training programs who are struggling to find work or are under-employed and waiting to apply their skills in well-paid positions within the clean economy. Opportunities exist for a collaborative education and training strategy around clean economy jobs to ensure supply for skilled labor meets demand in potential high-growth sectors.

Public Sector – The public sector also has a large role to play in shaping the opportunities in the clean economy. Through forward-looking, strategic, and broad-based programs and policies, government can instill and inspire positive, sustainability-focused changes within the public at large.

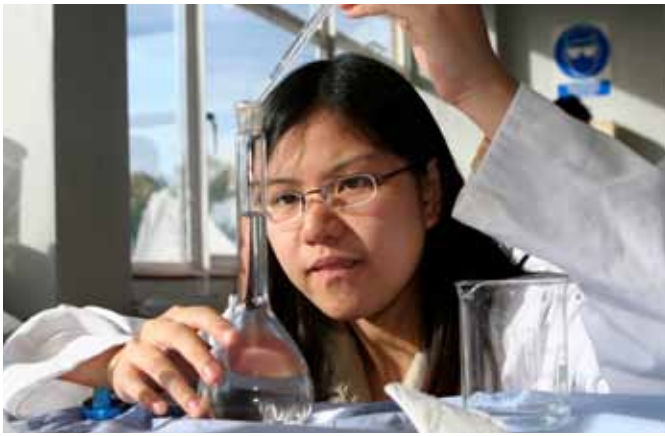
One of the greatest opportunities relates to the facilitation of knowledge sharing and collaboration across jurisdictions.

32 See: <http://www.oregon4biz.com/Innovation-in-Oregon/Oregon-Innovation-Council>

33 See: <http://www.greaterportlandinc.com/news-events/2011/09/23/federal-jobs-and-innovation-grant-awarded-to-portland-vancouver-region>

34 See: <http://www.innovatewashington.org>

35 See: http://bcgreeneconomy.globeadvisors.ca/media/6723/globe_bc_green_economy_report_ii_final.pdf



The PCC is a prime example of how regional collaboration among governments can lead to greater opportunities and benefits which are unattainable by any individual jurisdiction. Through a shared strategic vision and the pooling of human and financial resources, the PCC is able to act as a model for advancing public sector leadership throughout the West Coast region.

The public sector can continue to drive innovation within the clean economy by supporting synergies among local universities, various levels of governments, the private sector, and the NGO community. Enhanced collaboration among the region's public sector institutions has led to thriving networks of innovation, joint research opportunities on emerging clean technologies, the sharing of sustainable design and green building practices, a greater understanding of climate change issues, and progress for the region's collective knowledge on ocean sciences.

West Coast jurisdictions, through various government commerce and innovation agencies, have been integral in developing entrepreneurial talent and fostering commercialization. These agencies have supported entrepreneurs by providing education and training programs, as well as engaging them with their private sector peers through mentorship initiatives. As an example, the California Governor's Office of Business and Economic Development (GO-Biz) provides support to pre-venture and startup firms within the state.

Continued regional cross-collaboration amongst public sector departments could provide greater access to resources to build capacity and leverage region-wide strengths and technical capabilities.

Summary of Key Opportunities:

KNOWLEDGE & SUPPORT

- Promoting innovation as the key driver for change and investment in the knowledge economy through innovative partnerships, as well as strengthening regional collaboration through centers of excellence that can help to grow opportunities in the knowledge sector.
- Strengthening the education and training of the region's skilled workforce to maintain a competitive advantage in the clean economy.
- Promoting clear, consistent policy frameworks and regulatory environments that support key sectors and encourage private sector investment and employment growth in the clean economy region-wide.

Modeled Scenarios to 2020


To assess the potential for the West Coast jurisdictions to capitalize on their existing advantages in the clean economy, preliminary estimates of the size of the clean economy in terms of employment and gross domestic product (GDP) were developed through to 2020.

Making predictions about the future is difficult, especially in a scoping document such as this. To forecast the clean economy market opportunities more authoritatively requires substantial microeconomic and macroeconomic modeling. That being said, the forecasts presented here are based on recent jurisdictional and regional economic forecasts as well as economic modeling that accounts for the tradeoffs, or indirect effects, associated with policy-driven economic changes (see the Methodology Document for more details).

For example, the approach used in this analysis estimates the net jobs created by demand-side management programs after accounting for job losses in the energy production sector associated with less gas and electricity sales. This approach helps to satisfy the criticisms that previous jobs reports have received.¹

Employment – Figure 10 shows the estimated number of net new jobs under each scenario by clean economy sector across the region, including both Business-as-Usual (BAU) and policy-driven scenarios for growth. The analysis indicates that a set of policy actions, combined with BAU growth, can grow the clean economy by nearly 1.03 million new full time equivalent jobs, or a 200% increase over 2010 baseline numbers. Put another way, for every one clean economy job in 2010, more than two *additional* jobs can be created by 2020. It is important to note that some job losses will occur as a part of the growth of and transition to the new clean economy due to investment shifts, but that net expansion of jobs significantly outweighs losses.

¹ See: <http://green.blogs.nytimes.com/2009/03/27/study-forecasts-297000-green-jobs/?scp=1&sq=green%20jobs%202009&st=cse>



The analysis indicates that for every one clean economy job in 2010, more than two *additional* jobs can be created by 2020.

Figure 10: Region-wide increase in new clean-production jobs by sector under BAU and policy-driven scenarios, 2010 - 2020.

Potential Increase in New Clean Economy Jobs by Sector (Region-wide from 2010-2020)	2010	2020		
	Baseline	BAU	Policy Driven	
		Potential New Jobs	Potential New Jobs	% Growth
Clean Energy Supply	56,813	Up to 17,000	Up to 132,000	232%
Energy Efficiency & Green Building	80,806	Up to 24,000	Up to 362,000	448%
Clean Transportation	62,359	Up to 18,000	Up to 174,000	278%
Environmental Protection & Resource Management	290,332	Up to 84,000	Up to 312,000	107%
Knowledge & Support	18,162	Up to 6,000	Up to 49,000	270%
Total	508,462	Up to 149,000	Up to 1,029,000	202%

Source: GLOBE and CCS, 2012

Absolute employment growth is greatest in the Energy Efficiency and Green Building and the Environmental Protection and Resource Management sectors. The Clean Transportation and the Clean Energy Supply sectors also contribute to significant new job growth, but to a lesser degree.

In terms of their growth potential, three sectors stand out relative to the current baseline: the Energy Efficiency and Green Building sector shows the largest percent increase in new employment, followed by Clean Transportation, and finally Clean Energy Supply.²

The Energy Efficiency and Green Building sector is also highest in the net number of new jobs created. Policies targeting building retrofits and high-performance buildings are clearly integral to the region's success in growing the clean economy.

Clean Transportation provides the next fastest-growing segment. The region is poised for success in transportation with its focus on smart growth policies and low carbon fuel standards, as well as natural gas and hybrid/electric vehicles deployment. Clean Energy Supply policies include new renewable energy, as well as electricity transmission and distribution integration and expansion.

While the annual growth rate for Environmental Protection and Resource Management is the lowest of the five sectors, this is partially due to the large 2010 baseline employment figure for the sector. Recycling and waste reduction policies, no-till agriculture, and urban agriculture, forestry, and forest protection policies are likely to provide growth for this critical sector.

Figure 10 above shows large growth in regional market opportunities well above the assumed 3% BAU annual growth rate. However, strong growth in the clean economy over the next 10 years is contingent on leadership in creating demand for goods and services in each of the five sectors. Each of the West Coast jurisdictions has demonstrated considerable leadership and provided a commitment to enabling technological innovation to grow the clean economy.

Optimizing growth in the clean economy will require innovative policies that can leverage public and private capital to provide competitive investment opportunities and a consistent source of demand for clean economy goods and services. The degree to which these policy initiatives are successful will, of course, determine the overall results.

Gross Domestic Product – Estimates were generated using multipliers that represent net jobs created (or lost) per million dollars of gross output based on Canadian and US input-output accounts, which have algorithms to convert gross output to gross domestic product (see the Methodology Document for more details).

The analysis shows that under the policy-driven scenario combined with business-as-usual growth, the West Coast region's clean economy could expand by an additional net \$95.5 billion in GDP by 2020, over the estimated value of the region's clean economy in 2010 of \$47.2 billion (see Figure 11).

Estimates of Regional Investment – The above estimates for growth in GDP contributions and employment also signal massive clean economy investment opportunities for the West Coast region. Based on CCS economic analyses,

² The Knowledge and Support sector is under-represented in the Brookings Institute data as these jobs tend to be rolled-up into production jobs, so the sector has a very small 2010 baseline value that contributes to its rapid annual growth rate. Due to the lack of detailed data on the Knowledge and Support sector, we assume that it grows in the policy case at the average growth rate of the other four sectors.

Figure 11: Region-wide increase in clean economy GDP by sector under BAU and policy-driven scenarios, 2010-2020 (\$ millions).

Potential Increase in GDP by Sector (Region-wide from 2010-2020 in \$ millions)	2010	2020	
	Baseline	BAU	Policy Driven
		Potential Growth in GDP	Potential Growth in GDP
Clean Energy Supply	\$13,757	Up to \$4,100	Up to \$32,000
Energy Efficiency & Green Building	\$5,885	Up to \$1,800	Up to \$26,400
Clean Transportation	\$3,197	Up to \$900	Up to \$8,900
Environmental Protection & Resource Management	\$23,113	Up to \$6,700	Up to \$24,800
Knowledge & Support	\$1,241	Up to \$400	Up to \$3,400
Total	\$47,193	Up to \$13,900	Up to \$95,500

Source: GLOBE and CCS, 2012

estimates of direct investment potential as a function of clean economy job creation were prepared. Preliminary estimates of the cumulative direct investment opportunities through 2020 range between \$147 and \$192 billion (in \$2010).

Next Steps – In this preliminary report, the market opportunities for 2020 are based on results derived from analyses performed outside of the West Coast region. As a result, the macroeconomic indicators of a thriving clean economy – such as GDP, employment, and investment – require further analysis to be quantified for greater accuracy and linkage to specific policy actions and region-specific competitive advantages. Additional time and resources are required to produce estimates of the baseline clean economy growth, as well as the macroeconomic impact of policies aimed at driving the clean economy. Next steps for this study should include:

- An in-depth baselines analysis and decomposition of the existing and BAU future market activities and policy actions in each jurisdiction. This “existing and future baseline action analysis” can help evaluate the benefits of current state low carbon fuel standards, renewable portfolio standards, green building policies, and other current and planned activities, as well as provide baselines for evaluation of incremental new policy actions.
- A list of candidate market and data-driven policy options to grow the entire clean economy needs to be developed and its microeconomic and macroeconomic impacts estimated, along with other key performance metrics such as clean energy advancement, environmental improvements, and regional synergies. This list includes examples of existing actions within the region, as well as innovative new actions that comprise a full range of potential policies to capture and expand the emerging clean economy.

- Priorities for market and policy action focus must be developed to meet job creation objectives, based on performance metrics, benchmarks, and expertise within the region. Priorities must address immediate, mid-term, and long-term actions needed to position the region for maximum benefit from the new clean economy.
- Given the imperative for job creation in the region, a detailed macroeconomic and investment flow analysis is needed to provide economic impact analyses for GDP, income, and employment, as well as detailed inflows and outflows of investments and revenues for specific clean economy market segments and policy actions. The investment patterns within each jurisdiction, as well as trade and investment between jurisdictions, can help to identify how the clean economy market opportunities can be optimized. Distributional impacts, or delineation of winners and losers, is also critical to support equity based policy choices, and will be possible through detailed macroeconomic analysis and supplemental evaluations.

These analyses may be provided for the West Coast jurisdictions individually and/or for the region as a whole. This type of empirical research will help facilitate the conversion of the West Coast clean economy market opportunities into realized clean economy growth.



Policy Issues: Barriers & Enablers

While the previous section illustrates the potential for new employment in the West Coast region's clean economy sectors, it will be essential that barriers and impediments that frustrate the pace of transition be removed to ensure success. In assembling data pertaining to the factors that respectively hinder or enable the achievement of the clean economy, the overarching focus of attention is building on existing strengths in the region and stimulating local job growth.

With respect to job growth, this encompasses both new jobs and jobs that are redefined with new skill sets and/or the use of new technologies and knowledge. While primary job creation is a paramount consideration, secondary and tertiary jobs arising from new investment, trade expansion, and value-added services are also significant considerations.

BARRIERS

Within any economy, there are impediments that can slow or negate structural changes needed to implement clean economy initiatives and accelerate employment growth. Barriers to the realization of the clean economy come in many forms. Lack of financial resources is always a key factor. The most common money-related impediments are budget constraints (particularly at the municipal level); lack of investment capital – both institutional and venture capital; lack of a financial infrastructure; excessive costs of resources and labor restricting living costs; inconsistent or ineffective government incentive programs; and impacts associated with global economic uncertainties and shocks. And, of course, there are always competing priorities that may have a claim on limited financial resources.

Many impediments are non-financial in nature, stemming more from policy or regulatory constraints that must be removed or reduced. Others are embedded in the marketplace or stem from what economists often refer to as “externalities” (e.g., market-based rigidities or political imperatives that impede progress). Non-financial barriers

stem from such factors as: the lack of an over-riding vision or plan; regulatory impediments; policies and programs that work at cross purposes; labor and/or skill set shortages; lack of general public support or “NIMBYism”; competition from other sectors or other countries; lack of appropriate technologies or means of production; and lack of standards that would enable the deployment of new technologies and distributed energy systems.

ENABLERS

Just as barriers to progress come in many forms, measures that can facilitate the transition to a cleaner economy are equally diverse and plentiful. On the financial side, the more common measures that may be considered are actions that create a positive investment climate for investors (domestic or foreign) and include: offering incentives for value-added local businesses; making access to financing for small- and medium-sized enterprises in the clean technology space easier; leveling the playing field between clean and less-clean energy sources by removing outdated subsidies and instituting a realistic price on carbon; greater use of new municipal financing models (including bonds and public-private partnerships); and using the power of public spending to create viable local enterprises that deploy home-grown technologies and new business methods.

Non-financial enablers could involve: articulating clear, stable, long-term policy frameworks and clean industrial strategies that provide greater levels of predictability to business managers and private investors; building the knowledge economy through investments in innovation, education, skills training, and R&D; enabling demonstration projects that showcase innovative products and services; and collaborating with neighboring jurisdictions on program and policy development to maximize public procurement opportunities.

CLEAN ENERGY SUPPLY

IMPEDIMENTS

- The development of district or community-scale renewable energy projects has been negatively influenced by the availability of relatively low-cost, grid-based electricity, either from large-scale hydroelectric sources or from utility-scale electricity generation from high-carbon fossil fuels. In the case of the latter, the negative externalities of GHG emissions are not reflected into price passed on to consumers. Low-cost, grid-based energy is a desired goal, but it can be a disincentive to the development of cleaner alternatives, such as wind, solar, and geothermal, or the deployment of distributed clean energy systems that foster innovation.
- Inefficiencies in the interconnectivity of major components of the electrical grid and the absence of long-term, supply-demand management arrangements encompassing key markets in the West Coast region create uncertainties that limit investment.

ENABLERS

- Early adopter policies for home-grown technologies and the support of demonstration projects for cleaner energy technologies (making use of public facilities ports, hospitals, universities, schools, and colleges) would harness the spending power of governments to facilitate domestic and international sales and the creation of viable, job-creating enterprises.
- An in-depth examination of the feasibility of power sharing arrangements spanning all West Coast jurisdictions could lead to more stable prices and more efficient energy supply management.
- Public awareness campaigns on the benefits of 21st century infrastructure investments, distributed energy systems, and the deployment of energy from renewable sources would dispel resistance to change and promote further investments by large institutional/industrial players.

REGIONAL SUCCESS STORY: California's Million Solar Roofs Initiative



California's Million Solar Roofs Initiative was launched in January 2007 to help drive clean energy generation and is part of a \$3.3 billion investment by the state. California's solar industry is on the cusp of celebrating a major milestone with the installation of more than 1,000 MWs of rooftop solar photovoltaic capacity, and is on track to meet the 2016 goals of 3,000 MWs.

Since the program began, the total cost of installed residential solar energy systems in California has fallen 25%, and the cost of commercial-scale systems more than 40%. California is now home to about 20% of all solar power companies in the US with more than 3,500 firms employing some 25,000 people, more than double its size it was in 2007.

More Information: <http://www.environmentcalifornia.org/energy/million-solar-roofs>

Source: Environment California Research & Policy Center, 2011

ENERGY EFFICIENCY & GREEN BUILDING

IMPEDIMENTS

- The lack of coherent standards and codes for green buildings and existing building codes that do not favor green building practices are a disincentive to public adoption of new energy efficiency technologies and more durable energy saving building products that enable the lowering of upfront construction costs.
- Incentive programs for energy-saving retrofits of homes and commercial establishments are sporadic and inconsistent, resulting in disincentives to trained professionals involved in the process of recycling and upgrading of existing built environment.
- Current financing mechanisms often render upfront costs for building/housing retrofits prohibitive. This is particularly a challenge for rental properties as rent control laws often limit a building owner's capacity to recoup capital investments.
- Deconstruction initiatives are relatively new in practice and lack harmonized standards and protocols to help drive market demand for the industry.

ENABLERS

- Develop long-term incentive programs and building codes that encourage green building processes and greater use of local new or recycled building products and locally manufactured energy saving fixtures.
- Use public buildings to showcase innovative clean technologies in line with public building performance standards.
- Public education and awareness campaigns about the benefits of green building products and methods as a means to adapt to climate change impacts.
- Develop and implement creative financing methods, such as on-bill utility payment or PACE programs.
- Include energy performance in real estate transactions to increase market value of efficient, green buildings and provide valuations with longer-term horizons.
- Work with industry to develop regional deconstruction standards, incentives, and regulations.

REGIONAL SUCCESS STORY: Oregon's Clean Energy Works



Clean Energy Works Oregon (CEWO) is a nonprofit program established to reduce energy waste by encouraging energy-efficiency investments and retrofits among qualified property owners. The program began in Portland in April 2010 when it was awarded \$20 million from the US DOE and has since expanded to the rest of the state.

With CEWO, homeowners can finance up to \$30,000 in energy-efficient upgrades with no money down. Free home energy assessments (worth \$500) are available

for qualified applicants, eliminating the guesswork from potential energy savings, and loans typically can be repaid directly on heating bills.

To date, the program has resulted in 120 direct construction new hires and 700 workers receiving paychecks. By the end of 2013, the program aims to retrofit 3.5 million square feet of commercial space and 6,000 homes, as well as save more than 300,000 MBTUs of energy and reduce CO₂ emissions by 200,000 metric tons.

More information: <http://www.cleanenergyworksoregon.org>

Source: Clean Edge, 2011

CLEAN TRANSPORTATION

IMPEDIMENTS

- Efficiencies in intra-city transportation networks are often impeded by poor land use planning and physical infrastructure constraints that are disincentives to more efficient transit systems or the use of EVs for personal transportation and urban fleet systems.
- Taxation-based municipal budgets make providing more effective public transit services challenging.
- Inter-city mass transportation systems and long-haul trucking in the region are heavily dependent on high cost but heavily subsidized carbon-intensive fossil fuels. If fuel prices reflected their true costs, the impetus for switching to lower cost, lower-carbon alternatives would increase.
- The lack of infrastructure allowing the roll-out of new, cleaner transportation options such as natural gas and hydrogen fuelling stations, as well as EV charging facilities, is a disincentive to change.

ENABLERS

- Improved performance standards and more collaborative approaches to integrated land use planning for transportation.
- Greater use of creative financing mechanisms for public transit and intra- and inter-city rail infrastructure such as public-private partnerships
- Incentives and higher performance standards (e.g., low carbon fuel standards) for promoting alternative fuels and vehicle technologies for passenger car and light-duty vehicle markets, and alternate fuels for long-haul trucking, coastal ferry, and interconnected high-speed rail systems.
- Building code changes for new construction to enable EV charging infrastructure, as well as energy efficiency smart metering installations at malls and public parking facilities to promote the shift toward smarter transportation systems and vehicle sharing programs that reduce congestion and promote non-vehicle mobility options.

REGIONAL SUCCESS STORY: British Columbia's Canada Line



The CAD \$2.05 billion Canada Line rapid transit system opened in Vancouver during August 2009 as a lead up to the 2010 Winter Olympic and Paralympics Games. The trains are fully separated from traffic between the transportation hub at the Waterfront Centre in Vancouver, the heart of Richmond's civic precinct, and Vancouver International Airport, and have transit capacity equivalent to 10 road lanes.

The public-private partnership (P3) business model for the Canada Line has been very successful, according to Translink and InTransit BC, with 2013 ridership goals of 100,000 riders daily already being surpassed by summer 2010.

The success of Vancouver's Canada Line has set high expectations for the next major public mass transit infrastructure project, the Evergreen Line, for which construction began in January 2012.

Sources: Transport Canada, 2007. <http://www.tc.gc.ca/eng/mediaroom/releases-nat-2007-07-h241e-1405.htm>
Translink, 2011. <http://www.translink.ca/en/About-Us/Media/2011/August/Canada-Line-Service-Increase.aspx>

ENVIRONMENTAL PROTECTION & RESOURCE MANAGEMENT

IMPEDIMENTS

- Market distortions that prevent the true cost of resources and carbon from being reflected in the price of basic public goods and services. The fact that consumers are not paying for their inefficient and wasteful use of increasingly scarce natural resources such as water, arable land, and forest products is a disincentive to change.
- Uncertainties in the national and regional policy landscape with respect to GHG emissions create disincentives for businesses and industry to embrace low carbon practices and technologies.
- Competing industry demands for finite natural resources increases the vulnerability of sensitive ecosystems.
- General reluctance to adopt extended producer responsibility and local content rules in products and packaging stems from the risk of differentiating price structures relative to competitors in nearby jurisdictions.

ENABLERS

- Incentives, programs, and codes to promote greater reuse and recycling of scarce urban clean water supplies through the adoption of grey water systems; promotion of urban agriculture and urban forest areas; ecological restoration programs; more intensive solid waste minimization and recycling systems.
- Clear, long-term policies and programs that encourage GHG reduction commitments by businesses and industry.
- A natural capital index for the West Coast region would provide policy makers with a better understanding of the true value that different land uses can provide.
- A common set of guidelines and regulations throughout the West Coast region will help to ensure a level playing field for adopting extended producer responsibility (EPR) and will increase local processing jobs.

REGIONAL SUCCESS STORY:

Washington's Puget Sound Initiative



In many areas, Puget Sound's seemingly clear, pristine waters actually contain a soup of chemicals from runoff which originates from roads, lawns, roofs, farms, fields, and other developments that ring its 2,500 miles of shoreline, that is also home to 67% of Washington's population.

In December 2005, Governor Gregoire and the Legislature launched the Puget Sound Initiative, a comprehensive effort by local, state, federal, and tribal governments, business, agriculture, and environmental communities;

scientists; and the public to restore, protect, and preserve Puget Sound by 2020. The Washington Department of Ecology is a crucial partner in "Saving Puget Sound" and the \$20 billion of economic activities the Sound generates. The approach being used focuses on improving water quality; reducing toxic threats; keeping the waters flowing; protecting shorelines; and restoring and preserving habitats.

By 2009 the project had been successful in cleaning 732 contaminated sites, and was in the process of cleaning 423 more. The Northwest Straits Foundation has also been able to restore more than 645 acres of marine habitat.

Source: <http://www.psp.wa.gov>

KNOWLEDGE & SUPPORT

IMPEDIMENTS

- There is a widespread lack of knowledge about potential benefits of the clean economy which is limiting the full impact that changed consumer behavior and demand would have in terms of creating new markets for a new generation of skilled workers, managers, and professionals.
- A lag time exists between the supply of education and training programs for clean economy jobs in response to the needs of industry. Curriculum standards also vary by region.
- Innovation support programs are sporadic, generally short term in focus, and imperfect in terms of commercializing the innovative technologies that will drive the machinery of the low carbon economies of tomorrow.
- Lack of sufficient private sector R&D investment in the clean economy.

ENABLERS

- Broad-based public awareness and K-12 education programs that build wider appreciation of the importance of the knowledge and clean economy and better prepare today's youth for tomorrow's jobs. Use schools as demonstration sites for clean technologies and practices such as urban agriculture.
- Support programs that are tied to the commercialization of market-ready technologies and that provide for the sharing of research and commercialization demonstration opportunities with the West Coast region.
- Promoting innovation as the driver to change and investment in the knowledge economy through innovative partnerships and regional collaboration through centers of excellence.

REGIONAL SUCCESS STORY:

University of British Columbia's Sustainability Initiative (USI)



The University of BC's Sustainability Initiative (USI) exemplifies the university's commitment to sustainability. Established in January 2010, this strategic management group promotes and unites UBC's sustainability efforts in teaching and learning, research, and campus operations. While the new Center for Interactive Research on Sustainability (CIRS) is a high-performance building and acts as the foundation for

transforming the campus into a "living laboratory", the initiative goes beyond school boundaries. The second part of the initiative sees the university as an "agent of change", and focuses on UBC's role beyond campus in facilitating dialogue and fostering partnerships among individuals, businesses, and governments close to home and around the globe.

Strategic Alliance Partners are involved in many aspects of CIRS, including testing and demonstrating building technologies and systems, training and certification programs, collaborative research, tenancy, and sponsorships. This has attracted involvement from leading organizations, including Honeywell, BC Hydro, Haworth, and Modern Green (One of China's largest property developers). CIRS has also benefitted from collaboration with the provincial government and various other organizations, including Stantec Consulting, the City of Vancouver, and the David Suzuki Foundation.

Source: <http://sustain.ubc.ca>

Financing the Clean Economy

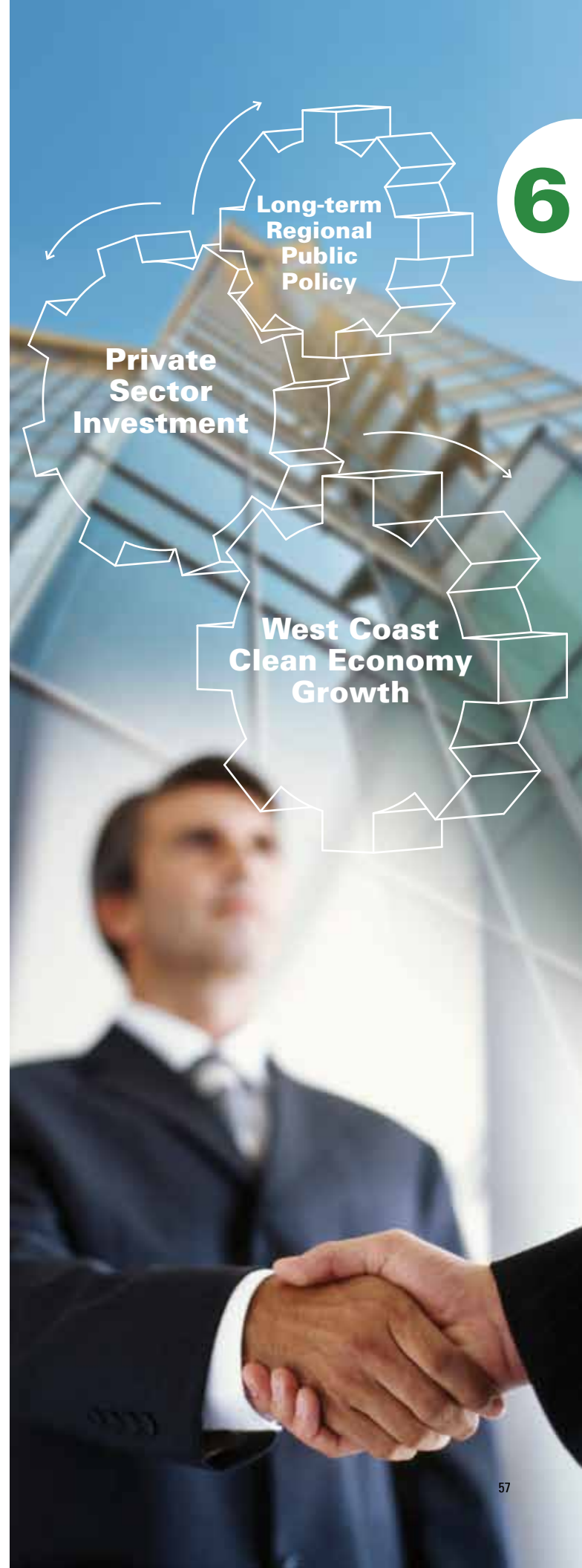
The clean economy is emerging as the world's next major high-growth opportunity area. Recent projections suggest that on a global scale, the clean energy market could have a compound annual growth rate (CAGR) of 11% during the period 2010 - 2020.¹ In dollar terms, this translates to growth from \$500 billion in 2010 to more than \$2.3 trillion in 2020.

Businesses large and small throughout the West Coast region are already seeing positive contributions from the clean economy to their bottom lines. This is further exemplified by the additional \$147 to 192 billion in potential new investment capital within the region by 2020, as described in Section 4.

Traditional resistance to the clean economy by "business-as-usual" interests is slowly dwindling as more and more, the positive benefits are recognized. A report on the green economy by the United Nations Environment Programme (UNEP) reveals that while clean technology investments may involve higher upfront costs, they often lead to significant energy savings, longer durability, and greater resiliency to price shocks, all of which translate into lower operating costs and faster returns on investment.²

¹ HSBC, Sizing the Climate Economy, 2010

² UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers. See: www.unep.org/greeneconomy



The UNEP report also notes that on a global basis, green investments as low as 2% of global GDP would deliver long-term GDP and employment growth over the 2011-2050 period that is at least as high as the most optimistic business-as-usual (BAU) case. In other words, the costs of transitioning toward a cleaner economy is no more expensive than BAU spending. In fact, the transition costs can be considerably lower than BAU when coupled with measures that level the playing field, such as:

- Phasing out antiquated subsidies;
- Reforming policies that limit innovation;
- Providing new incentives for research and development;
- Strengthening market-based pricing mechanisms that reflect the true costs of carbon-intensive industries;
- Redirecting public investments to promote energy efficiency, and
- Greening the public procurement process.³

The Competitive Landscape – West Coast jurisdictions have long played a leading role in establishing a competitive market landscape for clean technology. Many West Coast renewable energy and clean technology companies have become successful in establishing footholds in highly competitive world markets.

Regional policy strategies that enable clean technology companies to compete globally are critically important, particularly given the enormous growth potential of the clean technology sector and its attractiveness for investors.⁴

As such, the West Coast region can offer investors even greater potential for positive returns on their investments, which is a significant comparative advantage relative to other competing locations such as Germany, China, and India.

³ A recent report by Navigant addresses the common misconception that aggressive climate change mitigation will result in economic losses, and that renewable energy is an expensive option for mitigation. To the contrary the economic analysis says a compelling case exists for energy system decarbonization, for its climate change mitigation benefits and the associated reduction in climate change adaptation and damages costs and fossil fuel dependence costs. Climate Change Adaptation, Damages and Fossil Fuel Dependence An RETD Position Paper on the Costs of Inaction, July 15, 2011

⁴ Mossadiq, U. (2005), A Vision for Growing a World-Class Power Technology Cluster in Smart, Sustainable B.C.

The Importance of Full Carbon Costing – While clean energy has a high potential for reshaping the global energy markets, current energy costing structures often do not take into account the high costs of negative externalities such as GHG emissions, air and water pollution, and ecosystem destruction. The failure to account for the true costs of negative externalities, in particular to costs of GHG emissions, creates distortions in the energy marketplace and fosters cost-price disparities between clean technology and conventional fossil fuel-based energy offerings.⁵

Taking into account the full cost of carbon is key to driving clean energy innovation and to establishing parity between clean and conventional energy sources.

A case in point is Kruger Products Ltd., a major Canadian pulp and paper company in BC that commissioned a new biomass gasification system. The facility is expected to reduce CO₂ emissions by 20,000 tonnes per year, which translates into CAD \$600,000 in annual carbon tax savings. This incremental savings, combined with the profits of selling carbon credits, will generate a positive net present value of CAD \$4 million for the company.⁶

Full carbon costing would allow the West Coast region to utilize its abundant natural resources for clean energy generation. This would enable the region to become more self-reliant in meeting its regional energy demands and increasing its resiliency to global economic turbulence caused by energy security concerns. It also provides a unique opportunity to strengthen the region's competitive position as a global clean energy leader.

Public and private sector involvement is essential to enhancing the region's competitive advantages and for driving growth and expansion of the clean economy. The following pages outline financial mechanisms and regional collaboration initiatives that can help increase the region's competitiveness and attractiveness to private capital.

⁵ Clean Edge (2011), Clean Energy Trends 2011

⁶ Sustainable Prosperity (2010), Carbon Pricing, Investment, and the Low Carbon Economy

Public Policy Financial Mechanisms that Spur Innovation

– Public policy interventions in the clean economy can be broken into two main categories: technology-push and market-pull mechanisms. Technology-push mechanisms (e.g., state-level tax incentives, government venture capital assistance, etc.) help to move innovative clean technologies from the research and development phase through to the early commercialization stage. Market-pull type mechanisms (e.g., early adopter financing, feed-in-tariffs, pooled loan programs, etc.) are also useful in the early stages of market development (see Figure 12).

Public sector leadership through the early adoption of clean technologies can create a positive environment for enterprise development. It also motivates the private sector through market-based mechanisms to properly validate and/or incubate clean technologies, transforming them into robust and viable business opportunities.

A study by energy policy researchers Burer and Wustenhagen on clean technology venture capital investor preferences found that funding technology demonstration projects is preferred to all other forms of direct public policy interventions.⁷ This is because demonstration projects allow clean technologies to prove their performance potential and to test business model strategies in real market settings.

Through public demonstration projects, private investors are better able to evaluate potential returns on investment and to carry out longer-term assessments of the business opportunities.

A region-wide strategic approach to foster demonstration projects could allow innovative technologies to be tested on a larger scale thereby strengthening the region's economic power and knowledge base in any and all market segments. Public sponsored loan financing is another example of a progressive market-push policy, one that has the potential to accelerate growth in energy efficiency markets through increased sales and broader consumer acceptance.

⁷ Burer and Wustenhagen, "Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international cleantech investors." *Energy Policy* (37) 2009.



Hydrogen Highway Demonstration Initiative

In BC, the Hydrogen Highway Demonstration Initiative has already attracted Mercedes-Benz to invest CAD \$50 million in BC fuel cell technologies by establishing a fuel cell stacks production facility in 2012.

Source: BC Government, 2011

In British Columbia, recent changes to the province's Clean Energy Act paved the way to enabling utilities to offer on-bill financing for energy efficient upgrades with loans repayable through monthly utility bills. A recent administrative ruling in California has led to the development of larger public energy efficiency financing programs which include investor-owned rate-payer and private capital funds. Drawing on private capital sources to support public initiatives could allow rebate funds to shift into loan financing tools that, in turn, would enable downstream investment multipliers of energy efficient projects.

Large, capital-intensive public green infrastructure projects such as public mass transit, community energy systems, and environmental protection related infrastructure can also raise capital through existing tools such as the issuance of state debentures or bonds.

For example, California's high-speed rail project is being partially financed by the issuance of state bonds as established through Proposition 1A (AB 3034). This proposition guarantees \$9.95 billion in state bond financing for the first phase of this 800-mile interstate public transportation project.⁸

State and provinces have the ability through existing legislative frameworks to establish green bond mechanisms to enable private investors to help finance projects with risk assurances from the issuing government. This would allow both individual and institutional investors to become involved in driving progressive, large-scale projects forward.

⁸ See: <http://www.cahighspeedrail.ca.gov/prop1A.aspx>

Figure 12: Technology-push and market-pull financial mechanisms for the key market opportunity sectors.



Source: GLOBE and CCS, 2011

Public-Private Partnerships – Public-private partnerships (P3s), such as the Pacific Northwest Smart Grid Demonstration Project, are another win-win mechanism for drawing in private sector investment capital and placing less strain on public treasuries. As noted earlier, risks can also be shared and certain P3 models can allow private sector partners to achieve significant economies of scale.

More specifically, a public-private approach to risk management, such as public-backed private insurance, would allow for greater involvement of private industry to share in early stage investor financial risks. This would also allow regional governments to leverage existing private insurance risk transfer frameworks to lower the risk perception of the clean economy.

Recognizing tight government budgets, P3 approaches to financing could also strengthen existing public sector commitments to becoming carbon neutral.

For example, by partnering with financial institutions and other private sector firms, governments could help reduce financial pressures from major infrastructure projects or public building retrofits/upgrades and allow their private partners to operate in their respective areas of expertise. This could, in turn, lead to an enhancement of green building standards within the public sector while remaining fiscally responsible to taxpayers.

Private Sector Investment for Sustained Growth

– Venture capital (VC) and private equity investors are essential to shaping technological innovation and accelerating cash flow throughout the investment cycle. Between 2009- 2010, global VC and private equity investment growth of 19% in renewable energy was observed.⁹ This growth continued into 2011, seeing a 12% increase in capital raised between the second and third quarters.¹⁰

Financial market and venture capital activity in both Canada and the US demonstrates a positive appetite among investors to embrace the clean economy. Since 2000, more than 67% of the world's clean technology venture and expansion capital has been invested into North American companies.¹¹

9 Bloomberg New Energy Finance (2011), Global Trends in Renewable Energy Investments 2011.

10 See: <http://www.cleantech.com/2011/10/05/3q-2011-global-cleantech-venture-investment-up-12-percent-from-previous-quarter>

11 SAM, Clean Tech Private Equity: Past, Present and Future, 2011



Southeast False Creek (SEFC) – Neighborhood Energy Utility

The SEFC Neighborhood Energy Utility project in Vancouver, BC, is North America's first and only low carbon district heating system using sewer heat recovery technology. This system provides space heating and domestic hot water to all new buildings within the SEFC neighborhood with utility rates competitive with traditional forms of heating.

Recognizing the significant up-front capital cost of CAD \$33.8 million¹, the project was financed through contributions from the federal, provincial, and municipal governments. The City of Vancouver will be financing CAD \$16 Million of their contribution through the issuance of 10 or 25-year bonds.

Source: City of Vancouver and Quest Business Case, 2012 Southeast False Creek (SEFC) – Neighborhood Energy Utility.

Photo credit: Ausenco

1 As of 2011, with the cumulative cost of the project is continually growing with project upgrades and expansions.



The Pacific Northwest Smart Grid Demonstration Project

The \$178 million public-private partnership for the Pacific Northwest Smart Grid Demonstration project (including Oregon and Washington) will allow for the validation of new smart grid technologies and act as a showcase to potential investors of the potential returns on their investments.

Source: PNW Smart Grid Demonstration

British Columbia, Washington, Oregon, and California all ranked in the top 20 jurisdictions in North America for attracting VC in 2010, much of which was invested in clean technology. (see Figure 13).¹²

Research undertaken for this report suggests there is no lack of interest in private equity investments in clean technology, which is helping to drive rapid growth in the clean economy. However, there is a need for long-term public policy frameworks that provide the predictable and

stable investment climates needed to attract high-level investments from both local and international sources.^{13,14}

For example, public procurement policies by regional governments to use their considerable purchasing powers to help launch clean technology enterprises could accelerate their growth and encourage downstream expansion capital.

While regional policy incentives have created an ideal landscape for clean technology innovation, these same policies also need to address the needs of long-term industry development. It is critical to recognize that VC support is generally limited to initial stage financing within the investment cycle, and longer term investment vehicles such as loan financing, bonds, private placements, and capital markets are equally as important in developing the clean economy.

In Canada, the federal government's Sustainable Development Technology (SDTC) funding program supports clean technology development without taking ownership of intellectual property or demanding the repayment of funds provided. The program criteria however, require proof that these technologies have the potential to meet a market demand. As a result, those technologies that are supported have a high potential for attracting downstream financing from private investors and loan/debt from equity issuers and financial institutions.¹⁵ Similar models can be integrated in existing West Coast innovation and public funding programs.

Regional Collaboration in Financing the Clean

Economy – The biggest argument for region-wide financing mechanisms center on the potential competitive advantage it would offer in attracting and leveraging capital from the private capital markets and spreading risk factors across a broader economic landscape.

Region-wide clean energy financing mechanisms could allow for the aggregation or bundling of modest investment contributions from a large number of users, thereby leveraging those funds through scalable loans or incentive programs. Such mechanisms can potentially enable significant leveraging of funds from other sources while reducing the risks often associated with isolated incentive programs. They also serve to spread credit risks across a wider range of participating jurisdictions, and allow for certain economies of scale in administrative costs.

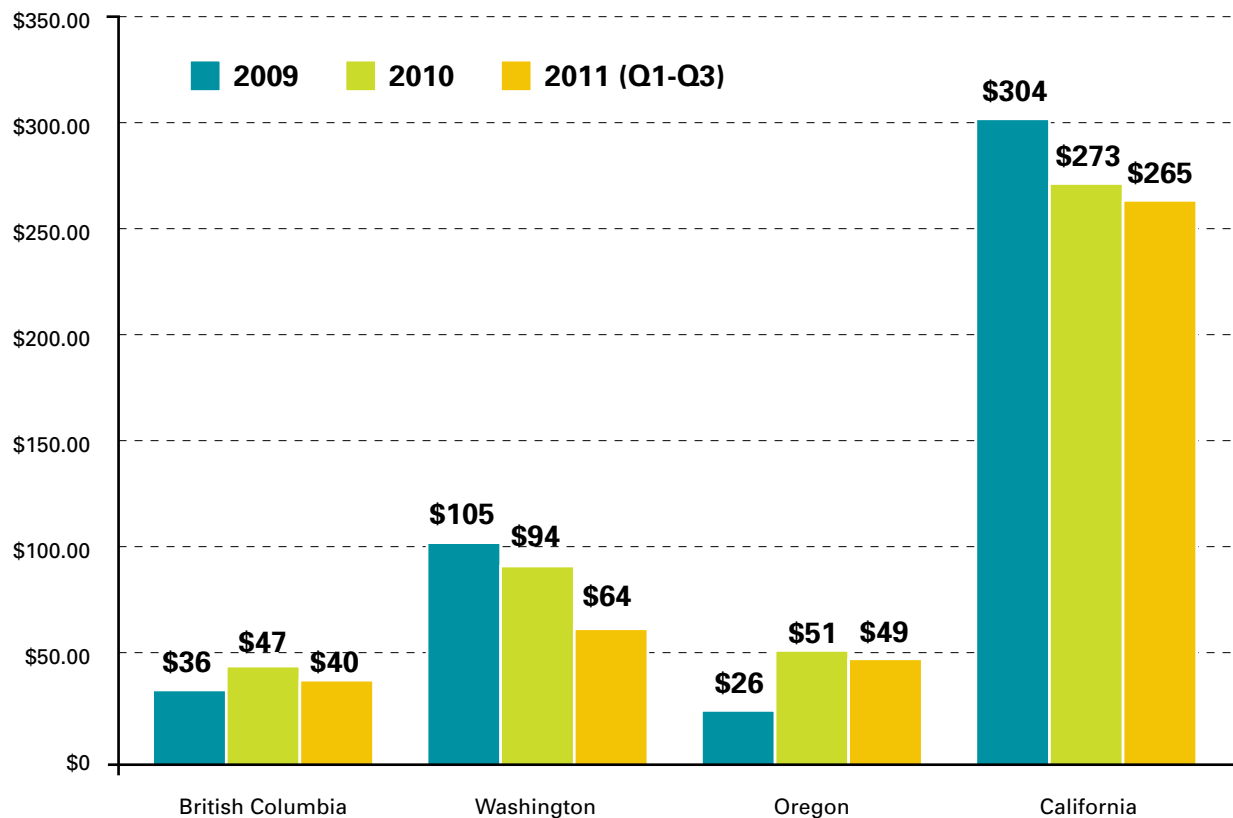
12 Thomson Reuters (2011), Canada's Venture Capital Market in Q1, 2011

13 Burer and Wustenhagen, "Which renewable energy policy is a venture capitalists best friend? Empirical evidence from a survey of international cleantech investors." Energy Policy (37) 2009.

14 Evaluation of private equity investment into renewable energies after the 2008 global financial crisis identifies that well-defined long-term policies are essential to reduce investor uncertainty. Hofman, D and Huisman, H. "Did the Financial Crisis lead to Changes in Private Equity Investor Preferences Regarding Renewable Energy Policies?" 2011.

15 See: http://www.sdtec.ca/index.php?page=sdtech-funding-niche&hl=en_CA

Figure 13: Venture capital disbursements per capita by West Coast jurisdiction (US\$).



Source: Thompson Reuters, 2011

A 2012 Brookings-Rockefeller report reveals that state-based clean energy funds (CEFs) alone cannot spur economic development; but leveraging these funds to encourage both federal and private sector investment can help to integrate innovation into existing value chains.¹⁶ It notes that while CEFs have incubated technologies and make equity investments into clean energy, these funds also have the potential to support industry development along entire clean industry supply chains. This is exemplified through California's CEF funding for its Clean Energy Workforce Training Program.

The Brookings-Rockefeller study further suggests that regional collaboration could allow for the joint study of conventional infrastructure and associated financial mechanisms such as bonds, tax increment finance districts, and new market tax credits which can also be tailored for the clean economy.

For example, modifications of traditional business tax incentives and government business development programs could be used to promote a regional market for recyclables

and deconstruction materials. This could also stimulate market development on par with other economic growth areas.

With respect to climate resiliency and adaptation issues, a regional financial strategy could help to improve efficiencies in program delivery. For example, establishing a Natural Capital Index financed through a regional "climate resiliency and adaptation fund" could help inventory the regions abundant natural resources. Not only would this deliver positive synergies by reducing individual jurisdictional costs, it would also publicly showcase the region's progressive approach in managing its collective interests in a transparent and effective manner.

Region-wide financing mechanisms could offer advantages over single jurisdiction efforts in attracting capital from outside the region.

¹⁶ Milford, L., et al. Leveraging State Clean Energy Funds for Economic Development. Brookings-Rockefeller. 2012.



Clean economy “project exchanges”, for example, could help smaller communities to partner on major project developments and to gain access to high caliber financial expertise at lower costs. In that vein, active development of a West Coast infrastructure exchange has recently begun to take shape.¹⁷

A region-wide commitment to financing initiatives would also send a strong message to the world that the West Coast region is committed to maximizing its position as a clean economic powerhouse and could serve to attract the qualified workforce.

Private investors have long recognized the region’s comparatively optimal investment climate. However, continual growth of the region’s clean economy requires that private sector investment sources, albeit with public policy support, continue to lead in building a robust and vibrant clean economy.

¹⁷ See: <http://www.bizjournals.com/portland/print-edition/2012/01/27/state-explores-private-equity.html>

While the West Coast region has demonstrated significant leadership in recognizing the growth potential of the clean economy and has attracted considerable investment to enhance the region’s competitiveness, this analysis reveals that even greater investment opportunities exist in the clean economy that have yet to be exploited. This is particularly evident in the development of the region’s abundant natural resources and clean energy potential.

It is important to note that many of the financial mechanisms discussed in this report are not new. To varying degrees, many have been tried or are in place throughout the West Coast region. However, many are often sporadic in nature or short term in duration (often tied to political priorities) and fail to provide the required long-term policy frameworks needed to instill investor confidence.

The following table provides a few examples of public policies and programs that have had a significant and positive impact in developing the West Coast region’s clean economy.

EXAMPLES OF PCC MEMBER POLICY INITIATIVES AND FINANCIAL MECHANISMS

ZERO EMISSION NEW BUILDINGS AND WHOLE BUILDING RETROFITS

BC Hydro Power Smart “New Construction Program” – The program encourages energy savings of more than 50,000 KWh in new commercial constructions through energy modeling study reimbursements and tiered capital incentives (up to \$30,000 per 100,000kWh saved) for actual energy savings.

Clean Energy Works Oregon – Available in more than 17 communities across Oregon, this program aimed to encourage renovations and retrofits by providing up to \$2,000 in instant rebates of low-interest financing and free home energy assessments. This program was established with \$20 million in federal stimulus funding and is anticipated to retrofit 6,000 homes and stimulate \$100 million in economic activity over three years.

California AB 758 – Requires the Energy Commission to develop and implement a comprehensive program to achieve greater energy savings in California’s existing residential and nonresidential building stock, including energy assessments, building benchmarking, building energy use ratings and labeling, public and private sector energy efficiency financing, workforce training, and public outreach and education.

Energy Upgrade California – A whole-house efficiency retrofit program launched on a pilot basis in 2010 that combines \$100 million of utility energy efficiency funds with additional American Recovery and Reinvestment Act (ARRA) stimulus funds from the State Energy Program (via CEC). Together with supplemental funds from participating local governments, the program offers assistance in finding contractors and lenders, home energy analyses, whole house retrofits achieving a minimum of 10-15% savings, and tiered incentives that reward achieving far higher savings levels.

DISTRIBUTED ENERGY GENERATION, COMBINED HEAT & POWER (CHP) & BIOMASS-TO-ENERGY

California Solar Initiative – The state has committed more than \$3.2 billion between 2007-2016 to install 3,000 MW of new solar generation capacity. The program provides cash rebates to encourage individuals and businesses to install solar energy equipment on residential and/or commercial properties.

BC Bioenergy Network – As part of the BC Bioenergy Strategy, this network was established with a \$25 million grant in 2008 to promote and fund bioenergy projects across the province. To date, 21 projects demonstrating and supporting CHP and biomass to energy are being funded by this initiative.

Oregon Pilot Solar Volumetric Incentive Rates & Payments Program – Available to Portland General Electric, PacifiCorp, and Idaho Power customers, payments are offered for kilowatt hours (kWh) generated over a 15 year period, at a rate set at the time a system is initially enrolled in the program. The volumetric incentive rates range from \$0.317/kWh to \$0.374/kWh.

ELECTRICITY TRANSMISSION & GRID INTEGRATION, SMART GRID, IMPROVED DISTRIBUTION & METERING

BC Hydro Smart Meter Infrastructure – As part of BC Hydro’s Smart grid roadmap, smart meters are being installed across the province to better manage energy resources with improvements to safety, reliability and customer service. The program is anticipated to pay for itself by delivering \$1.6 billion in benefits over the next 20 years.

Washington Snohomish County Public Utility District No. 1 – In 2009, the utility secured \$15.3 million in federal stimulus funding to modernize its existing grid. In 2012, with basic infrastructure projects completed, the utility will complete installation of a distribution automation demonstration project in the Tulalip/ Warm Beach community. This system will allow the integration of renewables into the existing grid framework.

ELECTRIC PLUG-IN ELECTRIC VEHICLE AND TRANSIT USE

LiveSmart BC Clean Energy Scrap- It Program – BC residents are eligible for up to \$5,000 in point-of-sales incentives for qualifying electric clean energy vehicles and a wide selection of cash public transit incentives for recycling their old vehicles. A \$500 rebate for residential electric vehicle charging station installation is also available.

California Alternative & Renewable Fuel & Vehicle Technology Program (AB118 Nunez) – With a budget of \$100 million, the program provides grants, loans, loan guarantees, revolving loans, or other appropriate measures to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies.

West Coast Green Highway – Upgrades along the BC 99/ Interstate I-5 highway will accommodate quick charge stations every 40-60 miles. With completed and ongoing work, Washington and Oregon will have the most extensive multi-state network of EV charging stations in North America.

INTERCITY INITIATIVES TO REDUCE VEHICLE MILES TRAVELED, MODE SHIFTING

California High Speed Rail – Inspired by other highly successful high-speed train systems around the world, this intercity transit system will initially run from San Francisco to Los Angeles/Anaheim and later to Sacramento and San Diego. This multibillion-dollar project financed through state bonds and federal support is expected to generate 100,000 direct and indirect jobs over five years with social and economic benefits for all Californians.

WASTE GENERATION REDUCTION, INDUSTRIAL WASTE RECYCLING, MSW LANDFILL GAS MANAGEMENT

Washington Environmental Results Program (Auto Body Pilot Project) – This is an innovative compliance model that offers specialized technical assistance, incentives and opportunities for certification under the EnviroStar Program. This voluntary program helps auto body shops to move beyond compliance to become environmental leaders.

California Household Hazardous Waste Discretionary Grant Program – Provides financial support to municipalities and jurisdiction within the state to take on enhanced household hazardous waste collection. Initiatives through this grant, such as the Used Oil Recycling Program, have successfully pushed for more increased public participation in environmentally beneficial behaviors.

JOB CREATION, EXPORT TRADE PROMOTION, CREATION OF VIABLE BUSINESS ENTITIES

BC Innovative Clean Energy (ICE) Fund* – Established under the BC Energy Plan, this fund is aimed to develop and showcase BC clean sources of clean energy and technologies. Since 2008, more than \$72 million has been invested into 56 projects. *The BC government is currently reviewing the source of funding for this initiative.

Oregon's Business Energy Tax Credit (BETC) – Enacted in July 2007, the state offers business tax credits to those who invest in energy conservation, recycling, renewable energy resources, and less-polluting transportation fuels.

Conclusions

The analysis conducted to date in support of this report clearly demonstrates that the members of the PCC have a very strong foundation upon which to build a prosperous and globally competitive clean economy. That being said, it would be wrong to assume that this future will happen of its own accord, or that the region's abundant natural resources will sustain its current high standards of living or insulate it from the stresses and shocks present in the larger global economy. The clean economy and its employment opportunities can be won or lost depending on decisions made now.

As noted earlier, the optimal policy framework needed to achieve the clean economy is more than an energy strategy, or an economic stimulus plan, or a human resource development plan.

Each of these dimensions is involved, but in reality the clean economy is much, much more. In essence it involves establishing a competitive economic position in a resource and carbon-constrained world, a world that must constantly adapt to the realities of shifting trading relationships, accelerating urbanization and population growth, climate change impacts, and geo-political stresses arising from inequities in the availability of life-sustaining basics such as access to clean water and arable land.

Achieving the clean economy requires vision, leadership, and careful planning. It also requires working in concert with the region's trading partners and neighbors. By embracing partnerships and building upon existing strengths of the PCC, the job-creating opportunities are very promising indeed.

Achieving the clean economy requires vision, leadership, and careful planning.

7





Based on the foregoing commentary, the following conclusions are put forwarded:

1. The transition toward a cleaner economy is well under way throughout the West Coast region, and accounts for a significant number of jobs in each jurisdiction today, and demonstrates higher-than-average job growth potential in several key sectors compared to the economy as a whole.

2. Progressive policy actions could expand clean economy GDP contributions in the region to \$142.7 billion by 2020, with investment opportunities ranging between \$147 and \$192 billion (in \$2010) and the potential of capturing significant market share from the estimated \$2.3 trillion in global clean economy revenues in 2020. Clean economy employment could grow by more than 200% to an estimate 1.03 million new jobs (net) by 2020.

3. The areas of highest potential in terms of job growth, investment, and industrial development include the following:

i. Energy Efficiency & Green Building – In particular, related to whole building retrofitting, energy efficient equipment, and new, high-efficiency green building construction.

ii. Environmental Protection & Resource Management – In particular, greater recycling and reuse, more efficient infrastructure, and the enhancement of measures to promote the conservation of natural resources and the restoration of damaged ecosystems.

iii. Clean Transportation – In particular, electric and alternative fuel vehicles, enhanced public transit infrastructure, and lower-carbon intensive fuel sources such as natural gas.

iv. Clean Energy Supply – In particular, distributed energy systems, smart grid infrastructure and transmission, and enhanced integration of energy from clean and renewable sources.

v. Knowledge & Support – In particular, educational institutions for workforce skills development and strengthening centers of excellence that build on the knowledge base of the clean economy.

4. Policy, programming, and financial impediments exist throughout the West Coast region that limit the smooth transitioning toward a cleaner economy. Of these, the most pressing impediments are:

- i. Too few forward-looking strategic plans and long-term public policies that are essential to sustain and grow the clean economy;
- ii. The lack of available financing or equity ownership by households and small commercial establishments resulting in the sub-optimizing of investments in energy efficiency and green building technologies;
- iii. A widespread lack of appreciation of the true costs of inaction in dealing with climate change impacts and of the current availability of clean solutions that would accelerate climate adaptation investments and strengthen climate resiliency across the region; and
- iv. Knowledge gaps about the availability of clean technology solutions for business and government that could dramatically improve economic performance and enhance profitability.

5. The enabling measures best able to remedy these constraints and to facilitate a smoother transition toward a cleaner economy include the following:

- i. Clear and stable policy frameworks that encourage private sector investment and public sector support for demonstration projects and the early adoption of clean technologies.
- ii. Financial assistance programs that facilitate investments in energy efficiency and green building for households, commercial establishments, and public buildings, including greater use of municipal bonds to finance clean economy investments; and
- iii. Broad-based public awareness, post-secondary education and training, and K-12 education programs that build a wider appreciation of the clean economy and better prepare civil society for related employment opportunities.



6. The foregoing analysis has clearly demonstrated that there are important synergies and advantages associated with coordinated joint actions within and across the PCC. Additional opportunity areas for potential future collaboration include:

- i. Recognizing the growing importance of renewable energy to power the clean economy and working cooperatively to encourage further private sector investment in the region's clean energy sector through supportive public policies that facilitate the deployment of clean energy supply throughout the West Coast region.
- ii. Promoting the use of "highest" green building standards for public buildings, particularly with respect to energy efficiency retrofits and new building construction; promoting the use of zero-net energy building design and practices; and encouraging private sector support for innovative financing mechanisms.
- iii. Building on the West Coast Green Highway initiative by expanding on additional, region-wide clean transportation initiatives that include using joint purchasing power for low carbon vehicles where feasible; integrating electrification and/or alternative fuel use in port activities and coastal ferry systems; exploring the regional benefits of high-speed rail corridors; and lowering the carbon footprint of long-haul trucking operations.
- iv. Continuing to collect and share data and information for use in monitoring efforts and for developing the region's climate adaptation and resiliency strategies, including the potential to further develop emergency response plans and create a region-wide natural capital index.

- v. Establishing a resource recovery initiative to develop a market for recycled goods and deconstruction resources, diverting potentially reusable material away from landfills and creating immediate employment and business opportunities.
 - vi. Harmonizing environmental and energy efficiency standards and requirements, where appropriate, to accelerate clean economy initiatives and to provide greater levels of transparency, predictability, and certainty to businesses, entrepreneurs, and private sector investors.
 - vii. Creating a network of existing centers of excellence to facilitate greater collaboration on research and development by lowering associated costs and improving information sharing.
 - viii. Attracting and retaining high caliber workers, researchers, and investors from around the world by developing shared vision and leveraging marketing and branding efforts to promote the strengths of the West Coast region's clean economy.
7. The research supporting this report suggests that the clean economy is the next global economic opportunity and there is nothing else on the near term horizon to match it. For the West Coast region, the clean economy and the policies that drive it are a path to global competitiveness and prosperity.

Deepening the Analysis – Next Steps:

This report provides a glimpse into the West Coast region's potential clean economy future. Further analysis will be needed to develop the specific mechanisms that will accelerate this future and make the region's clean economy a competitive reality.

Modeled scenarios to 2020 for the market opportunities identified in this report derived from previous analyses that are not directly tied to the West Coast region and require further study to link them more clearly with region-specific policy actions. Next steps should include:

- Baseline analysis of existing and BAU activities to assess benefits of current low carbon fuel and renewable portfolio standards, green building policies, and other planned activities, as well as to provide baselines for measuring incremental new policy actions.
- Assessments of market and data-driven policy options to grow the clean economy, including immediate, mid-term, and long-term micro and macroeconomic impacts estimates.
- Investment flow analyses for GDP, income, and employment, as well as detailed assessments of investment and revenues for specific clean economy market segments.

These analyses for individual jurisdictions and for the region as a whole will help turn market potential into economic realities.

Sources for More Information

GENERAL

GLOBE Advisors: <http://www.globeadvisors.ca>

Pacific Coast Collaborative: <http://www.pacificcoastcollaborative.org>

The Center for Climate Strategies: <http://www.climatestrategies.us>

CLEAN ENERGY SUPPLY

BC Bioenergy Network: <http://www.bcbioenergy.com>

BC Hydro: <http://www.bchydro.com>

BC Sustainable Energy Association: <http://www.bcsea.org>

Bioenergy Washington: <http://www.bioenergy.wa.gov>

Clean Energy BC: <http://www.cleanenergybc.org>

Go Solar CA: <http://www.gosolarcalifornia.org>

OR Department of Energy: <http://www.oregon.gov/ENERGY>

OR Renewable Energy Action Plan: <http://oregon.gov/ENERGY/RENEW/index.shtml>

Pacific Northwest Smart Grid Demonstration Project: <http://www.pnwsmartgrid.org>

Pacific Region Bioenergy Partnership: <http://www.pacificbiomass.org>

Solar BC: <http://www.solarbc.ca>

Solar OR: <http://solaroregon.org>

Solar WA: <http://solarwa.org>

The BC Energy Plan: <http://www.energyplan.gov.bc.ca>

The CA Energy Commission: <http://www.energy.ca.gov>

US Department of Energy: <http://energy.gov>

US Energy Information Administration: <http://www.eia.gov>

WA Utilities and Transportation Commission: <http://www.utc.wa.gov>

ENERGY EFFICIENCY & GREEN BUILDING

BC Ministry of Energy and Mines and Responsible for Housing: <http://www.gov.bc.ca/ener>

CA Energy Efficiency Strategic Plan: <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp>

Canada Green Building Council: <http://www.cagbc.org>

Cascadia Green Building Council: <http://cascadiagbc.org>

Clean Energy Works OR: <http://www.cleanenergyworksoregon.org>

Energy Trust of OR: <http://energytrust.org>

Energy Upgrade CA: <https://energyupgradeca.org>

LiveSmart BC: <http://www.livesmartbc.ca>

Northwest Power & Conservation Council's 6th Conservation and Electric Power Plan:

<http://www.nwcouncil.org/energy/powerplan/6/default.htm>

Seattle City Lights Energy Conservation: <http://www.seattle.gov/light/conserve>

US Database of State Incentives for Renewables and Efficiency: <http://www.dsireusa.org>

US DOE Energy Efficiency and Renewable Energy: <http://www.eere.energy.gov>

US Green Building Council: <http://www.usgbc.org>

CLEAN TRANSPORTATION

Amtrak Cascades: <http://www.amtrakcascades.com>
BC Cycling Coalition: <http://www.bccc.bc.ca>
BC Hydrogen Highway: <http://www.poweringnow.ca>
BC Transit: <http://www.bctransit.com>
BC Translink: <http://www.translink.ca>
CA High-Speed Rail Authority: <http://www.cahighspeedrail.ca.gov>
Drive OR: <http://driveoregon.org>
Greater Seattle SoundTransit: <http://www.soundtransit.org>
OR EV Roadmap: <http://www.evroadmap.com>
Tri Met: <http://trimet.org>
WA State Department of Transportation: <http://www.wsdot.wa.gov>
West Coast Collaborative: <http://www.westcoastcollaborative.org>
West Coast Green Highway: <http://www.westcoastgreenhighway.com>

ENVIRONMENTAL PROTECTION & RESOURCE MANAGEMENT

BC Climate Action Secretariat: <http://www.climateactionsecretariat.gov.bc.ca>
BC Ministry of Agriculture and Lands: <http://www.gov.bc.ca/agri>
BC Ministry of Environment: <http://www.env.gov.bc.ca/epd>
CA Air Resource Board: <http://www.arb.ca.gov>
CA Climate Adaptation: http://resources.ca.gov/climate_adaptation
CA Climate Change Handbook for Regional Water Planning: <http://www.water.ca.gov/climatechange/CCHandbook.cfm>
CA Department of Water Resources: <http://www.water.ca.gov>
CA Environmental Protection Agency: <http://www.calepa.ca.gov>
Forest Stewardship Council Canada: <http://www.fsccanada.org>
Forest Stewardship Council US: <http://www.fscus.org>
OR Department of Environmental Quality: <http://www.oregon.gov/DEQ>
OR Global Warming Commission: <http://www.keeporegoncool.org>
Pacific Northwest Regional Water Quality Program: <http://www.pnwwaterweb.com>
Recycling Council of BC: <http://rcbc.bc.ca>
US Department of Agriculture: <http://www.usda.gov/wps/portal/usda/usdahome>
US Environmental Protection Agency: <http://www.epa.gov>
WA Department of Ecology: <http://www.ecy.wa.gov>
WA State Local Clean Air Agencies: <http://www.ecy.wa.gov/programs/air/local.html>
Western Climate Initiative: <http://www.westernclimateinitiative.org>

KNOWLEDGE & SUPPORT

BC Industry Training Authority: <http://www.itabc.ca/site3.aspx>
BC Innovations Council (BCIC): <http://www.bcic.ca>
BC Ministry of Advanced Education: <http://www.gov.bc.ca/aved>
BC Ministry of Jobs, Tourism & Innovation: <http://www.gov.bc.ca/jti>
CA Council on Science and Technology: <http://www.ccst.us>
CA Department of Education: <http://www.cde.ca.gov/index.asp>
Donald Vial Center on Employment in Green Economy: <http://www.irle.berkeley.edu/vial>
Environmental Careers Organization (ECO) Canada: <http://www.eco.ca>
OR Innovation Council: <http://www.oregon4biz.com/Innovation-in-Oregon/About-Oregon-InC>
OR Department of Education: <http://www.ode.state.or.us/home>
OR Sustainability Center: <http://www.oregonsustainabilitycenter.org>
US Bureau of Labor Statistics Green Jobs: <http://www.bls.gov/green>
US Department of Education: <http://www.ed.gov>
WA Clean Technology Alliance: <http://wacleantech.org>
WA Department of Commerce: <http://www.commerce.wa.gov>



Clean Economy Profiles by Jurisdiction

BRITISH COLUMBIA

Key Statistics:

Clean Economy GDP (2010)	\$7.4 billion
Clean Economy Jobs (Direct Production)	62,593 (GLOBE, 2012)
Investment in Clean Technology (2009-2011)	CAD \$843 million (KPMG, 2011)
VC Disbursement per Capita (2010)	\$47

Top 9 Clean Economy Job Segments:

Segment	# of Jobs
Sustainable Forestry Products	10,805
Public Mass Transit & Rail	9,587
Green Architecture & Construction Services	5,468
Hydropower	5,127
Conservation	5,114
Recycling & Reuse	3,731
Professional Environmental Services	3,705
Green Building Materials	3,242
Waste Management and Treatment	2,821

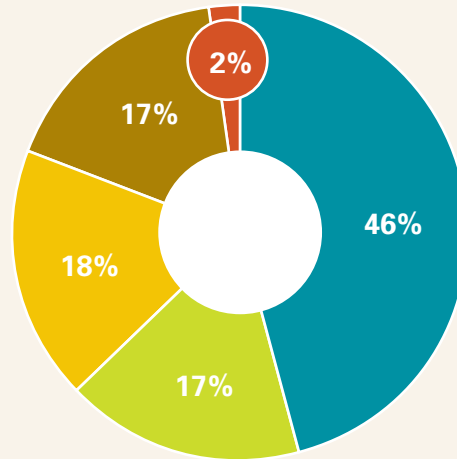


Figure: Direct production jobs in BC's Clean economy sector in 2010.

Strengths & Attributes:

- A well-established and widely dispersed low carbon electricity supply system
- An abundance of underutilized clean energy resources (bioenergy, geothermal, ocean, wind, solar)
- A large natural resource base, including large reserves of natural gas
- 94% of the land in BC is Provincial Crown Land
- The first North American region to put a "price on carbon" through a comprehensive carbon tax, helping to drive innovation and increased efficiency across all sectors of the economy
- Strong and growing clusters of green technology and advanced energy companies with one of the highest ratios of clean technology companies to GDP in Canada
- A widely distributed network of advanced education and skill training institutions
- Innovative clean economy-focused research institutions and facilities such as UBC's Center for Interactive Research on Sustainability (CIRS) and Okanagan College's Green Building Technology Center of Excellence
- A wide array of socially-conscious environmental networks, organizations, and think-tanks

British Columbia - Summary of Key Policy, Program & Investment Initiatives:

Sector	Description
Clean Energy Supply	<p>BC Energy Plan was bolstered by the Clean Energy Act in 2010 which requires that at least 90% of electricity comes from clean or renewable sources and that all new generation projects will have zero net GHG emissions.</p> <p>Bioenergy Strategy establishes funding for a provincial Bioenergy Network, along with biofuel research and production facilities.</p> <p>Smart Grid Investment of \$930million includes the installation of 1.8 million smart meters by December 2012.</p> <p>Power Smart Sustainable Communities provides partial funding towards district energy pre-feasibility and feasibility studies, as well as capital incentives which aid implementation.</p>
Energy Efficiency & Green Building	<p>LiveSmart BC offers \$30 million in support of retrofits for residents and small businesses over 2011-2013.</p> <p>BC Hydro Power Smart provides incentives and assistance to reduce energy consumption for residential, commercial, industrial and community level consumers.</p> <p>Public Sector Building Standard requires that all new government facilities must be built to LEED gold or equivalent standards for efficiency.</p> <p>Public Sector Energy Conservation Agreement (PSECA) provides investments for energy efficiency retrofit projects in schools, colleges, hospitals and social housing.</p>
Clean Transportation	<p>Point of Sale Rebates of up to \$5000 for new battery electric, fuel cell electric, plug-in hybrid electric and compressed natural gas vehicles. Home rebate of up to \$500 for residential EV charging stations.</p> <p>Renewable & Low Carbon Fuel Requirements for 5% renewable content in gasoline starting 2010, diesel 5% by 2012 and overall 10% reduction in carbon intensity by 2020.</p> <p>Public Transportation expansion including Evergreen Line construction beginning in 2012.</p>
Environmental Protection & Resource Management	<p>Brownfields Renewal Program offers \$10million in funding over 5 years ending in 2013.</p> <p>Carbon Tax was phased in at \$10/tonne CO₂e in 2008 and now stands at \$30/tonne CO₂e emissions for 2012.</p> <p>Greenhouse Gas Reduction Targets Act has been the driver behind the Carbon Neutral Public Sector initiative which has seen all government organizations report their GHG emissions annually since 2008, and achieve carbon neutrality since 2010.</p> <p>Zero Net Deforestation Act aims to achieve a balance between deforestation and forestation rates in the province by 2015.</p>
Knowledge & Support	<p>BC Knowledge Development Fund supports priority areas including alternative energy/power technologies, forestry, environmental technologies and aquaculture (approx. \$40-50 million/yr).</p> <p>BC Training Tax Credit provides \$31million in tax credits for employers and apprentices who are engaged in eligible training programs through to 2014.</p>

CALIFORNIA

Key Statistics:

Clean Economy GDP (2010)	\$26.0 billion
Clean Economy Jobs (Direct Production)	308,792 (Brookings, 2011)
Investment in Clean Technology (2008-2010)	\$8,612.0 million (Clean Edge, 2011)
VC Disbursement per Capita (2010)	\$273

Top 9 Clean Economy Job Segments:

Segment	# of Jobs
Waste Management & Treatment	52,225
Conservation	44,443
Organic Food & Farming	34,468
Public Mass Transit	32,487
Professional Environmental Services	19,259
Recycling & Reuse	15,692
Energy-saving Building Materials	11,860
Professional Energy Services	9,495
Green Building Materials	8,878

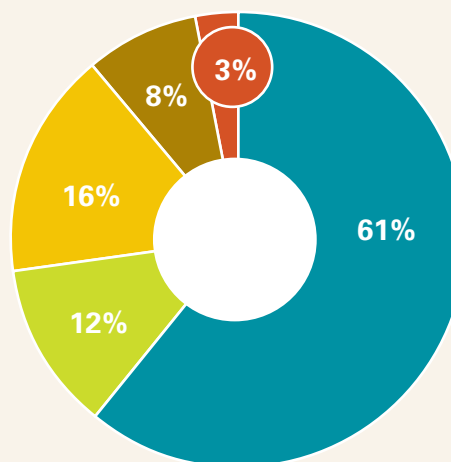


Figure: Direct production jobs in California's Clean economy sector in 2010.

Strengths & Attributes:

- Global hub for renewable energy R&D
- Long-standing public policy leadership and commitment to clean energy, transportation, and environmental resource management
- Enormous network of universities and US DOE laboratories to support R&D for the clean economy
- Pioneer for clean vehicle standards
- Large resource potential for renewable energy, including: solar, wind, geothermal, biomass, and waste (MSW and biosolids) biomass
- Leads US in clean economy jobs, investment, and clean technology patents
- Large number of existing clean technology and high-tech establishments
- Highly educated and skilled workforce
- Public understanding and support of sustainability
- High concentration of existing clean technology and high-tech establishments

California - Summary of Key Policy, Program & Investment Initiatives:

Sector	Description
Clean Energy Supply	<p>Renewables Portfolio Standard requires all utilities providers to procure at least 20% of their electricity from eligible renewable energy by 2010 and 33% by 2020.</p> <p>Renewable Energy Transmission Initiative aims to identify transmission projects and is designed to support California's aggressive renewable energy target of 33% by 2020.</p> <p>Self-Generation Incentive Program is a ten-year program, now extended for five more years, at \$83 million/year to offer incentives up to 3 MW per site for clean, performance-based, self-generation systems.</p> <p>Renewable Auction Mechanism is a competitive procurement program that operates via reverse auction and outside RPS, for wholesale power purchases from smaller systems up to 20 MW capacity, with an initial program capacity of 1000 MW.</p> <p>California Solar Initiative commits over \$3.2 billion between 2007-2016 to install more than 3,000 MW of new solar generation capacity.</p> <p>Feed-in Tariff program requires Investor-Owned Utilities (IOU) to provide payment for small renewable energy generation up to 1.5 MWs, soon to be extended to 3 MWs of capacity.</p> <p>Public Benefit Fund is dedicated to renewable energy (\$540 million), energy efficiency (\$872 million), and research, development & demonstration (RD&D) (\$62.5 million).</p>
Energy Efficiency & Green Building	<p>Energy Action Plan is a strategic plan to address California's growing energy demand sustainably through effective demand and supply side management.</p> <p>CalGreen green building standards require mandatory reduction of indoor potable water use by 20%, and divert 50% construction waste from landfills.</p> <p>PACE Financing offers between \$5,000 and \$75,000 in loan financing anchored to the property tax bill for energy efficiency and renewable energy home projects in participating communities. In addition, the cities of Los Angeles and San Francisco are pioneering the use of PACE loans to obtain comprehensive levels of efficiency in commercial buildings, where the loan obligation is tied to the property, to be borne by successive owners.</p> <p>Title 24 Energy Efficiency Building Code has led the nation for over thirty years in performance-based efficiency levels for both new construction and major renovations of existing buildings. Supporting analysis is provided and paid in part through utility efficiency programs.</p>
Clean Transportation	<p>Clean Vehicle Standard requiring all new vehicles to achieve, on average, an emissions reduction of 30% by 2016 (carbon dioxide, methane, nitrous oxide, and hydro-fluorocarbon).</p> <p>Low carbon Fuel Standard aims to achieve a reduction of 10% (up to 16 million metric tons) in the carbon intensity of California transportation fuels by 2020.</p> <p>Alternative & Renewable Fuel & Vehicle Technology Program authorizes the Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies with an annual program budget of approximately \$100 million.</p>
Environmental Protection & Resource Management	<p>CalRecycle provides integrated waste management through discrete early actions for landfill methane control, pursuing diverting organics from landfills.</p> <p>Assembly Bill (AB) 32 introduces mandatory GHG reporting and 25% reduction by 2020 with mandatory caps for major emission sources by 2012.</p> <p>California Water Plan is an integrated water management and sustainability initiative bringing together members from government, institutions and the public to develop recommendations and informed decision on California's water future.</p>
Knowledge & Support	<p>CleanTech Institute is the first approved and eligible training provider by the state to offer Electric Vehicle Technician, Photovoltaic Systems Specialist and nanotechnology/clean technology professional certification.</p>

OREGON

Key Statistics:

Clean Economy GDP (2010)	\$5.0 billion
Clean Economy Jobs (Direct Production)	57,928 (Brookings, 2011)
Investment in Clean Technology (2008-2010)	\$291.2 million (Clean Edge, 2011)
VC Disbursement per Capita (2010)	\$51

Top 9 Clean Economy Job Segments:

Segment	# of Jobs
Conservation	15,265
Organic Food & Farming	7,429
Public Mass Transit	6,096
Waste Management & Treatment	5,351
Green Building Materials	5,074
Hydropower	4,649
Energy-saving Building Materials	3,276
Sustainable Forestry Products	2,222
Recycling & Reuse	2,111

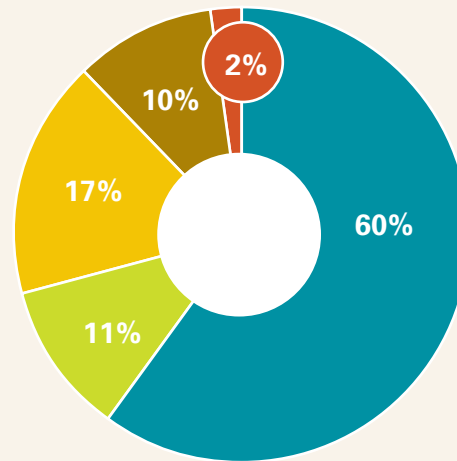


Figure: Direct production jobs in Oregon's Clean economy sector in 2010.

Strengths & Attributes:

- Progressive state and local policies to move Oregon towards a Clean Economy
- Strong network of organizations dedicated to addressing sustainability-related challenges
- Public awareness of the importance of sustainable purchasing and natural resource management
- Ranked 2nd in the US in Clean Edge's Clean Energy Leadership Index, indicating strong framework for clean economy already exists
- Oregon has the most EV charging stations and most LEED projects per capita in the US
- Dense population of high-tech firms and research universities in Portland-Metro area
- High baseline use of public transportation and bicycle commuting (Portland is #1 in the US in bicycle commuting)
- Successful track record of capital attraction and job creation
- Oregon's coast is home to the 1st commercial wave power farm in the US

Oregon - Summary of Key Policy, Program & Investment Initiatives:

Sector	Description
Clean Energy Supply	<p>Mandatory Utility Green Power Option requires each utility to offer electricity generated using qualifying renewables.</p> <p>Net Metering program has been established to support distributed generation from renewables by utilities (up to 2 MW) and residential customers (up to 25KW).</p> <p>Renewable Portfolio Standards ensures that a % of electricity sold by large utilities comes from renewables (5% by 2011, 25% by 2025).</p> <p>Solar Energy Systems on Public Buildings legislation requires that any new public building project or renovation over \$1million includes solar technologies to at least 1.5% of the total contract price.</p> <p>Public Benefit Fund requires Pacific Power and Portland General Electric to collect a 3% public-purpose charge on electricity sales to support renewable energy (17.1%) and energy efficiency (56.7%), with remainder supporting low-income housing, energy assistance and K-12 school energy conservation efforts.</p> <p>Production Incentive provides PV projects under 500KW with select rates for the energy generated.</p>
Energy Efficiency & Green Building	<p>Energy Efficiency Design Program requires all state buildings to exceed the energy conservation provisions of the state building code by 20%.</p> <p>Energy Trust of Oregon administers a wide variety of incentives and programs aimed at promoting energy efficiency to residential, commercial and industrial customers, as well as public and non-profit organizations.</p> <p>Property Assessed Clean Energy (PACE) financing allows property owners to borrow money from cities and counties to pay for renewable energy generation and energy efficiency improvements.</p> <p>State Home Oil Weatherization (SHOW) program provides homeowners and renters who use select fossil fuels and wood to heat their homes with up to \$500 for weatherization rebates.</p> <p>Residential Energy Efficient Appliance Rebate Program is offering assistance to low income households to install Energy Star appliances.</p>
Clean Transportation	<p>Electric Vehicle Charging Station tax rebate for residential units of 25% up to a maximum of \$750 (2012).</p> <p>Oregon Sustainable Transportation Initiative (OSTI) is guiding and enabling efforts to reduce GHG emissions 75% by 2050 below 1990 levels.</p> <p>Renewable Fuels Mandate stipulates that most grades of gasoline and diesel fuels meet minimum renewable content standards.</p> <p>Public Transit Investment is helping to fund various projects including expansion of TriMet's light rail system.</p>
Environmental Protection & Resource Management	<p>Green Remediation Policy encourages responsible parties to implement green remediation technologies (voluntary).</p> <p>Department of Administrative Services Sustainability Plan aims to help make sustainability the focus of all state agencies and support the Governor's vision for sustainability.</p> <p>Mandatory GHG Reporting of select facilities who emit more than 2,500 tonnes CO₂ equivalent annually.</p> <p>2050 Vision for Materials Management is currently being updated and will assess the lifecycle impacts of various materials within the following sectors: green building, packaging waste prevention, life cycle assessment of drinking water systems, and supply chain (consumption-based) inventory of emissions from material production.</p>
Knowledge & Support	<p>Oregon Environmental Council supports sustainable economic opportunities and progressive policies while also helping businesses become more environmentally responsible</p> <p>Oregon Sustainability Center will be home to leaders in sustainable business, government and education and act as a laboratory for green technologies.</p>

WASHINGTON

Key Statistics:

Clean Economy GDP (2010)	\$8.8 billion
Clean Economy Jobs (Direct Production)	79,149 (Brookings, 2011)
Investment in Clean Technology (2006-2008)	\$635 million (Pew, 2009)
VC Disbursement per Capita (2010)	\$94

Top 9 Clean Economy Job Segments:

Segment	# of Jobs
Conservation	12,666
Hydropower	11,769
Organic Food & Farming	10,121
Public Mass Transit	8,571
Waste Management & Treatment	6,547
Professional Environmental Services	4,117
Energy-saving Building Materials	3,815
Sustainable Forestry Products	3,411
Recycling & Reuse	2,563

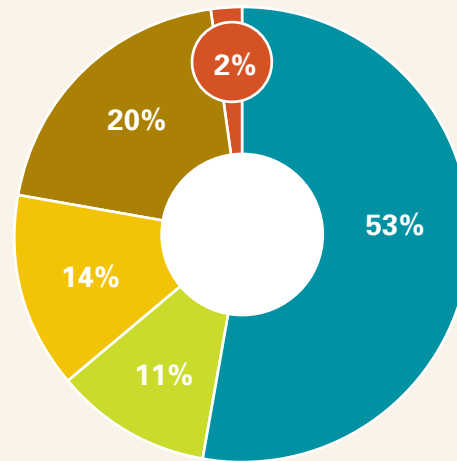


Figure: Direct production jobs in Washington's Clean economy sector in 2010.

Strengths & Attributes:

- High concentration of existing clean technology and high-tech establishments
- Two world-class public research universities (University of Washington and Washington State University) and Pacific Northwest National Laboratory
- Commenced the Nation's first green-jobs training program
- Existing strong network of clean-technology companies (Washington Clean Technology Alliance)
- Ranks second amongst all states in the Information Technology and Innovation Foundation's "2008 State New Economy Index"
- Strong global trading agreements with China, Japan, India, South Korea, and Canada
- Highly educated and skilled workforce
- Implemented strong building codes, Renewable Portfolio Standard, Renewable Fuel Standard, green power option for electricity consumers, and a host of financial incentives promoting renewable energy and energy efficiency

Washington - Summary of Key Policy, Program & Investment Initiatives:

Sector	Description
Clean Energy Supply	<p>Renewable Energy Production Incentives offers \$0.12 to \$0.54 per kWh for individuals, and organizations that generate electricity from solar, wind or anaerobic digesters.</p> <p>State Tax Incentives for Renewable Energy Equipment provides state tax reductions for qualifying renewable energy equipment manufacturing and sales.</p> <p>Net Metering & Interconnection laws requires all utilities providers to provide net metering for renewable energy systems up to 100 kW, until they meet 0.5% by 2014 of its customer peak demand.</p> <p>Renewable Portfolio Standard requires utilities to acquire renewable resources with at least 3% of its load by 2012 through 2015; 9% of load by 2016 through 2019, and 15% of load by 2020.</p>
Energy Efficiency & Green Building	<p>Initiative 937, also known as the Energy Independence Act, requires that the largest utilities in the state to make conservation the resource of choice in utility planning.</p> <p>State Energy Code requires the WA State Building Code Council to develop energy codes that achieve a 70% reduction in building energy use by 2030 relative to the 2006 codes.</p> <p>Electric Utility Grant, Loan & Rebate Programs offered at state and municipal levels provide a wide selection of incentives to individuals and businesses for retrofitting and new construction.</p> <p>Weatherization Program provides energy efficiency upgrades to low-income households, and continues to exceed targets.</p> <p>Jobs Act provides \$100 million in competitive grants to public school districts and public higher education institutions for energy efficient facility improvements.</p>
Clean Transportation	<p>Clean Car Standards adopted from the California Air Resource Board (CARB) Standard for all new vehicles purchased after 2009, requiring lower emissions.</p> <p>Biodiesel & Ethanol Content requires that 2% of annual diesel sales consist of biodiesel content while 2% of annual gasoline sales need to consist of ethanol.</p> <p>Public Sector Biofuel initiative to direct all state agencies and local governments to satisfy 40% of their fuel usage by electricity or biofuel.</p> <p>Sound Transit Commuter Systems Improvements of more than \$700 million (2011) in value for capital projects and light rail/ bus improvements to the Greater Seattle region.</p>
Environmental Protection & Resource Management	<p>Brownfields Redevelopment Loan Fund is a \$5.4 million fund offering low-interest loans to local governments and private owners for site clean-up.</p> <p>Waste Reduction Plan outlines five key priority areas to improve residential, commercial and industrial waste reduction and management practices.</p> <p>Urban Waters Initiative is a \$2.5 million (2007) state-wide initiative which focuses on preventing contamination or re-contamination of waterways.</p>
Knowledge & Support	<p>Washington Clean Technology Alliance supports businesses who wish to take advantage of clean technology industry opportunities.</p>

List of Abbreviations & Acronyms

BAU - Business-as-usual	LNG - Liquefied Natural Gas
BC - British Columbia	MBTU - Million British Thermal Unit
BETC - Business Energy Tax Credit	MoU - Memorandum of Understanding
CA - California	MPOs - Metropolitan Planning Organizations
CAGR - Compound Annual Growth Rate	MW - Megawatt
CAR - Climate Action Reserve	NAICS - North American Industry Classification System
CCS - Center for Climate Strategies	NIFA - National Institute of Food and Agriculture
CEC - California Energy Commission	NIMBY - “Not in my Backyard”
CEWO - Clean Energy Works Oregon	OR - Oregon
CHP - Combined Heat and Power	P3 - Public-Private Partnership
CIRS - Center for Interactive Research on Sustainability	PACE - Property Assessed Clean Energy
CLT - Cross-Laminated Timber	PCC - Pacific Coast Collaborative
CO₂ - Carbon Dioxide	PCT - Pacific Carbon Trust
COI - California-Oregon Intertie	PGE - Portland General Electric
DoE - Department of Energy	PHFA - Pacific Housing Finance Authority
EPA - Environmental Protection Agency	PNEMA - Pacific Northwest Emergency Management Arrangement
EPR - Extended Producer Responsibility	PNW - Pacific Northwest
EV - Electric Vehicle	PUC - Public Utilities Commission
FTE - Full-Time Equivalent	PV - Photovoltaic
GDP - Gross Domestic Product	R&D - Research and Development
GHG - Greenhouse Gas	RGGI - Regional Greenhouse Gas Initiative
GHGe - Greenhouse Gas equivalent	RPS - Renewable Portfolio Standards
HSBC - Hongkong and Shanghai Banking Corporation Holdings plc	SCS - Sustainable Communities Strategy
ICE - Innovative Clean Energy Fund	UNEP - United Nations Environment Programme
IEA - International Energy Agency	US BLS - US Bureau of Labor Statistics
IOU - Investor Owned Utility	VC - Venture Capital
ITS - Intelligent Transportation Systems	WA -Washington
kWh - Kilowatt Hour	WCGA - West Coast Governors Alliance
LCFS - Low Carbon Fuel Standard	WCI - Western Climate Initiative
LEED - Leadership in Energy and Environmental Design	ZEV - Zero Emission Vehicle



www.pacificcoastcollaborative.org



www.globeadvisors.ca



www.climatestrategies.us

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