

CASCADIA VISION 2050:

How the Cascadia Innovation Corridor can serve as a global model for sustainable growth

SUSTAINABLE GROWTH VISION FOR 2050



Cascadia
Innovation
Corridor

Contents

INTRODUCTION	4
---------------------	---

SECTION 1	6
------------------	---

Challenges associated with growth faced by mega-regions around the world



SECTION 2	8
------------------	---

Defining a sustainable mega-region

SECTION 3	10
------------------	----

How other mega-regions have traditionally responded to growth

SECTION 6	21
------------------	----

Next steps

SECTION 4	14
------------------	----

A new vision for a sustainable mega-region

SECTION 7	23
------------------	----

Call to action

SECTION 5	17
------------------	----

Hub cities can help shape a sustainable mega-region

APPENDIX	24
-----------------	----



The Cascadia mega-region, connecting Portland, Oregon, Seattle, Washington, and Vancouver, British Columbia, has enjoyed incredible success over recent decades. Now home to over 9 million people, Cascadia has become synonymous with our natural beauty and spirit of innovation. Our people, companies, and culture are one of a kind, attracting over 1.68 million people since 2005.

This growth has come with corresponding challenges, and, as a result, the way of life and natural beauty that define our mega-region are under threat. A lack of affordable housing, crippling traffic congestion, and unacceptable greenhouse gas emissions are re-shaping life in many mega-regions, including Cascadia. The average commuter spends over 11 full days in traffic each year, and our teachers, nurses, and first responders cannot afford to live in the communities they serve. Meanwhile, scientific consensus has determined that, to do its part in the fight against climate change and preserve the natural beauty we hold so dear, Cascadia must reduce its emissions by nearly 80% by 2050. These are massive challenges that threaten not only our current way of life, but the future of our mega-region for our children and theirs.

Addressing these challenges begins with re-imagining the mega-region of the future: a sustainable mega-region that embraces growth while protecting the environment and providing affordable housing, good jobs, and efficient commutes. This vision is not easily achieved — to date, no other mega-region in the world has done it. But tackling problems others can't or won't is part of Cascadia's DNA. It is precisely the spirit of innovation and collaboration that define Cascadia that will make us successful. But we must act now.

With 3-4 million more people expected to call Cascadia home by 2050, our current growing pains will only worsen if we fail to act. If we are to accommodate this level of growth — a population increase of more than 30% over the next 30 years — incremental improvements to the status quo won't cut it. We need to move quickly to embrace big, bold ideas that will prepare our mega-region for the continued growth to come and preserve it for future generations.

With the goals of focusing attention, stimulating debate, and inspiring action, this report outlines one such idea: a path forward that leverages high-speed transit to connect our existing urban centers to expanded hub cities with good jobs, affordable housing, and world-class culture. This model reduces emissions and offers the flexibility and affordability that are key to our region's future success. It is innovative and thoughtful, and requires bold policy changes and creative capital sourcing. If successful, it would solidify Cascadia as an example to the world of a truly sustainable mega-region, one that prospers economically because of its ability—not in spite of its failure—to provide for its residents and protect the environment.

Our proposed solution is just that — a proposal. Other paths toward success may be viable, and we hope that this report inspires creativity and collaboration to develop additional ideas. While the precise answer may not be clear, one thing is: we need big solutions, and we must act quickly.

As our mega-region, and the world, continue to tackle the current crisis of the COVID-19 pandemic, we cannot lose sight of longer-term challenges and opportunities. It is clear this disease has upended lives, but Cascadia is resilient. While we continue to fight COVID-19 and its consequences, we also need to address the undeniable fact that our mega-region is not prepared for the future to come. Protecting the health of our community and ending this pandemic are paramount, but we cannot deny that the challenges outlined in this report remain, and the responsibility rests with us to ensure Cascadia is ready to address them.

As co-chairs of the Cascadia Innovation Corridor, an initiative that works to connect people, companies, and institutions from across the mega-region, we have seen first-hand what Cascadians are capable of when they come together to solve big problems. This is no different. The challenges that lie ahead of us are substantial, but ours is a mega-region poised to tackle them. If we are willing to come together and act boldly and with urgency, there is no doubt that Cascadia can become an example to the world by preserving this place and way of life we all hold dear.



Chris Gregoire & Greg D'Avignon

Co-Chairs, Cascadia Innovation Corridor

www.connectcascadia.com

Introduction

As the global economy has grown, so too have the urban powerhouses that drive it. Once the centers of economic performance, cities have merged to become regions — interconnected networks of multiple urban centers. Today, regions too are being eclipsed, this time by mega-regions — even larger networks connecting multiple metro areas.

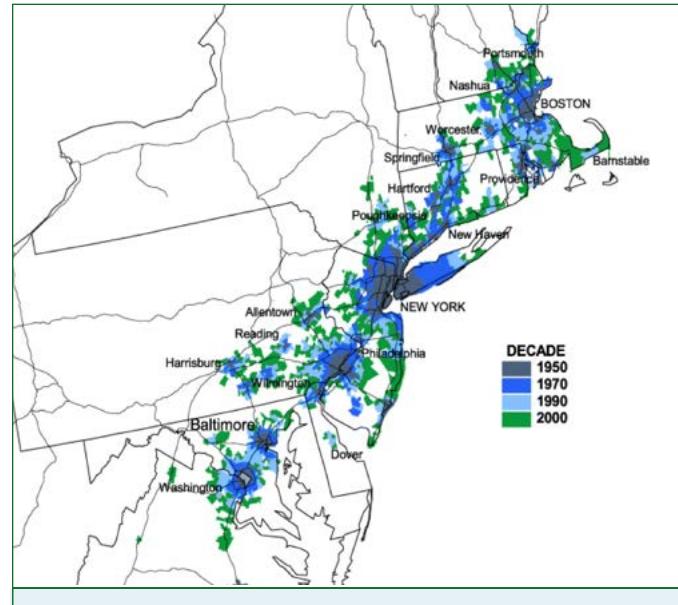
The evolution of mega-regions has happened before our eyes. In response to ballooning urban populations, development spread outward from city centers. What were once remote towns have become affordable and attractive options for commuters, expanding our shared understanding of what qualifies as a region. This expansion has blurred the geographic and economic boundaries between our large cities, spreading people and commerce between them and giving birth to the mega-region. As economies and people have driven the creation of the mega-region, however, planning and investment have not kept pace.

Rather than following the trends of economic and human capital, urban and regional planning have remained focused within their geographic boundaries. Unable to work at a mega-regional level, these jurisdictions struggle to cope with the massive growth many of them have experienced in recent decades. The result? Cities and close-in suburbs without affordable housing. Local and regional transportation systems overwhelmed by those forced to commute from farther than ever anticipated. Congested roadways generating immense greenhouse gas emissions and threatening our global climate. Middle and low-income populations disproportionately impacted and displaced. With growth projected to continue or even accelerate in some mega-regions going forward, these challenges will only get worse.

Clearly, we need a new approach to handling growth, and quickly. While action at the city and regional level is foundational to the success of any mega-region, we cannot expect to solve mega-regional problems without greater collaboration and alignment. Instead, we must expand our thinking to the level at which our people and economies have already begun to operate.

With its culture of collaborative innovation, history of global leadership, and shared love of the natural beauty that defines it, the Cascadia mega-region—connecting Portland, OR, Seattle, WA, and Vancouver, B.C. — is uniquely positioned to tackle these challenges. Through partnership with our cities and regions,

Figure 1: NY- Bos-Wash Mega-region Population and Urbanized Area Growth 1950-2000¹



Characteristics of a Mega-Region

1. Contain at least two existing metro areas
2. Population over 5 million
3. GDP over \$300 billion

¹Taken from Morrill, R. Classic Map Revisited: The Growth of Megalopolis. *The Professional Geographer*, 2006.

we can become an example to the world of the key role mega-regional planning can play in taking a sustainable approach to growth.

This report will look more closely at the challenges faced by today's high-growth mega-regions. It will introduce a new definition of a sustainable mega-region and show that traditional patterns of growth will not meet the needs of the future. It will offer one thought-provoking option for approaching our growth that illustrates the boldness required of us to achieve this new vision of success. And it will present a call to action, outlining the role each of us can play to ensure Cascadia's success as a sustainable mega-region.

The proposed approach includes building hub cities on underdeveloped lands and connecting them to our existing world-class cities via high-speed transit. This model embraces growth, minimizes environmental impacts, creates affordable housing, and reduces congestion on our roadways. Most importantly, it is an example of the tremendous scale and scope of planning and action required to tackle the challenges before us. Our future requires creative thinking to develop additional, equally bold options. While the exact solution may not be clear, one thing is: the consequences of inaction are unacceptable. The future of our mega-region, and the generations to come who will call it home, are at stake. The facts are undeniable, and we must seize this opportunity to engage in crucial conversations and creative problem-solving to develop additional, equally bold options. Solving these mega-regional challenges will require a mega-regional approach, and it will require all of us to play a part. Regardless of the path forward, we must think and act on a bigger scale than ever before, and we must act now.



SECTION 1

Challenges associated with growth faced by mega-regions around the world

The economic success of our cities and regions has attracted massive growth over recent decades. 2007 marked the first time in human history that more than half of the world's population was living in an urban setting. It is estimated that this number will surpass 60% by 2030.² As more people crowd into cities, development has spread outward from city centers, blurring the borders between neighboring metropolitan areas and giving birth to mega-regions.

This urban growth has created jobs and increased access to resources for many, but it has not come without challenges. Long commutes and a lack of affordable housing have come to define successful mega-regions almost as much as their strong economic performance and world-class workforces. A rapidly deteriorating global climate, driven in part by greenhouse gas emissions from large urban centers and car-bound commuters traversing long distances, only adds to the complexity of these challenges.

The Cascadia mega-region is no exception. In the last 10 years, Cascadia has created approximately 800,000 new jobs.³ But, as with other mega-regions, a failure to accommodate that growth has led to strained housing supply and overwhelmed transportation systems. Today, compared to only 32% of US residents, over 50% of Cascadia residents are housing cost-burdened — spending more than 30% of their income on housing.⁴ In fact, the median monthly housing cost across the mega-region is 44% of median income.⁵ This level of financial strain has serious impacts – U.S. Housing and Urban Development emphasizes that housing cost-burdened people “may have difficulty affording necessities such as food, clothing, transportation, and medical care.”⁶

This level of unaffordability has broad impacts across the income spectrum, with low-income families having an increased risk of homelessness. For example, Vancouver and Seattle have experienced a 36% and 13% increase respectively in homelessness since 2008.⁷ Less visible are the impacts to middle-income families – those making 60-120% of median income, a group that includes nurses, teachers, first responders, and many others. A nurse making \$80,000 per year, for instance, has been priced out of countless cities within Cascadia: Seattle in 2013, Portland in 2015, Beaverton and Renton in 2017, and Vancouver, WA in 2018. The nurse has been priced out of the Greater Vancouver area in B.C. since before 2005.⁸

Our transportation systems have also been strained by the growth in population. The average commuter in the mega-region spends 11.1 days per year commuting, an increase of 18% since 2011. And we have seen the rise of “mega-commuters” – those commuting more than 90 minutes each way. According to PSRC, Portland and Seattle have both seen 70-80% growth in mega-commuters from 2010 to 2017.⁹ This equates to over \$7.1 billion of lost productivity per year.¹⁰

²UN World Urbanization Prospects 2018; <http://go.euromonitor.com/rs/805-KOK-719/images/sbMegalopolises-v0.3.pdf>

³Total employment increase according to American Community Survey 2010-2017 (Seattle metro 334,379, Portland metro 202,683) and Statistics Canada 2010-2020 (Vancouver metro 277,581)

⁴U.S. Census Bureau; Real Estate Board of Vancouver; Statistics Canada

⁵U.S. Census Bureau; Real Estate Board of Vancouver; Statistics Canada

⁶U.S Department of Housing and Urban Development

⁷Total increase in homelessness from 2007 to 2017 according to U.S. Annual Homeless Assessment Report 2007-2019, Greater Vancouver Regional Steering Committee on Homelessness 2008, and Metro Vancouver Homelessness Partnering Strategy Community Entity 2017

⁸Year at which \$80k salary became housing burdened (spending greater than 30% of income on housing) for a median priced home

⁹<https://www.psrc.org/whats-happening/blog/regions-workers-spending-more-time-commuting>

¹⁰2019 Urban Mobility Report; Statistics Canada; Tom Tom Traffic Index

The increases in traffic congestion and mega-commuters have also taken an environmental toll. Today, transportation is the largest contributor of greenhouse gas emissions in Cascadia. Single-occupancy vehicles in our mega-region contribute 4.1 million metric tons of CO₂e each year.¹¹

While the explosive growth of our mega-region may seem unique, it is not. Among seven benchmark mega-regions selected for their similarities to Cascadia in population, GDP, and economic makeup, all have experienced pronounced population and economic growth over the last two decades (see figure 1). For example, while Cascadia has experienced 30% population growth between 2000 and 2020, the Texas Triangle grew by 67% and Char-Lanta by 83% — all compared to an average US growth rate of 16%.¹²

Figure 2: Identifying peer mega-regions

Megaregion	Cities	Knowledge economy	International border	GDP per capita (USD) ¹	Population (M) ²	Population growth (2000–2020) ³
Cascadia	Portland; Seattle; Vancouver B.C.	✓	✓	72,804	9.1	30%
Bay Area	San Francisco; San Jose	✓		130,731	6.7	7%
Char-Lanta	Atlanta; Charlotte	✓		66,563	8.5	83%
NY-Bos-Wash	Boston; New York; Washington, D.C.	✓		89,261	31.1	10%
SoCal	Los Angeles; San Diego	✓		77,716	16.6	8%
Texas Triangle	Austin; Dallas; Houston; San Antonio	✓		66,151	19.2	67%
Par-Am-Mun	Amsterdam; Brussels; Munich; Paris	✓	✓	57,586	43.5	15%
Singa-Lumpur	Singapore; Kuala Lumpur	✓	✓	38,819	12.7	72%

1. Bureau of Economic Analysis; Statistics Canada; CityLab 2. US Census; Statistics Canada; CityLab 3. Macrotrends LLC

As we have seen in Cascadia, this growth has strained systems in other mega-regions as well. Commuters in the NY-Bos-Wash mega-region spend an average of 13 days commuting each year. In the Bay Area mega-region, median housing costs are over 8.5 times the median household income.¹¹

Clearly, the housing and transportation infrastructure in our mega-regions has not kept pace with population and economic growth. The result is threatening the very fabric of our communities — nurses, teachers, and first responders forced to live outside the communities they serve. Mega-commuters spending nearly a month each year on the road, overwhelming our transportation systems and contributing to climate change. Without big, bold action, these challenges will only worsen. We are seeing first-hand that responses on the local and regional level are not sufficient, we must address these issues on the same scale they are occurring: mega-regionally.

¹¹ Estimated using Data IO (US Census) and Statistics Canada measurements for percentage of single occupancy commuting vehicles

¹² US Census

SECTION 2

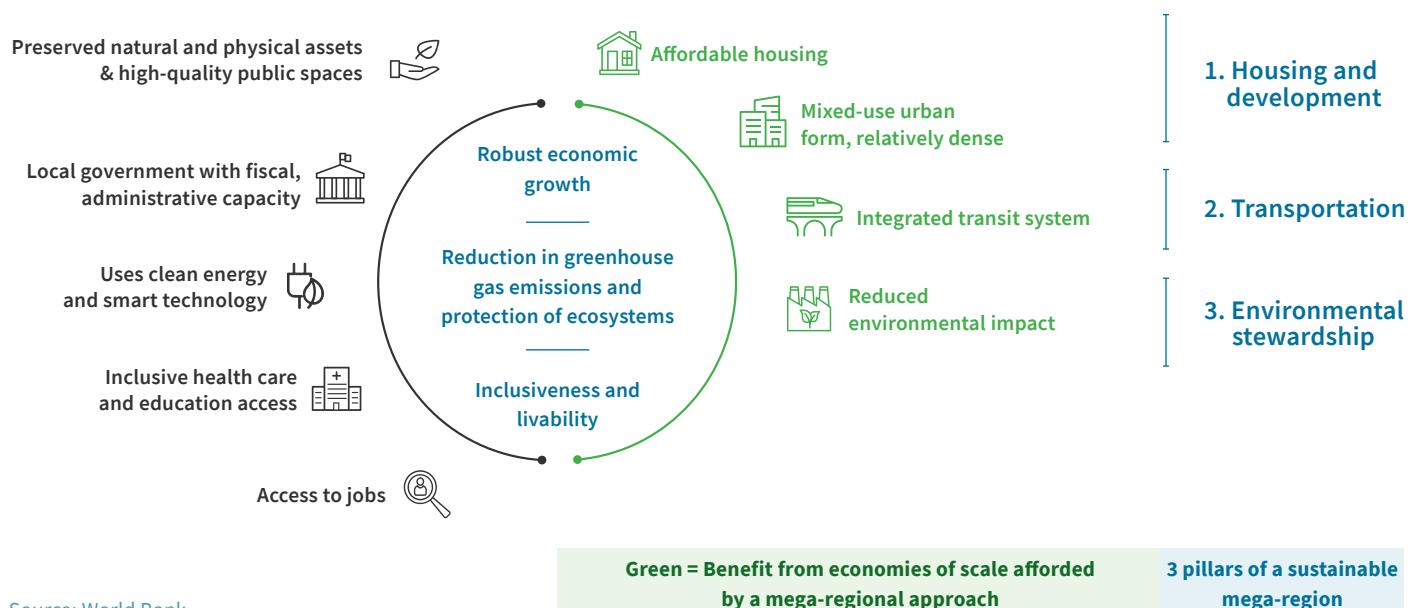
Defining a sustainable mega-region

To date, the challenges associated with growth have not been taken on at the mega-regional level, and therefore no definition of mega-regional success has yet been shaped. What is a sustainable mega-region? To answer, we can begin by looking to frameworks developed to illustrate the concept of sustainable cities.

The World Bank's definition of sustainable cities can be summarized by three key traits: **robust economic growth, reduced greenhouse gas emissions, and livability for all residents**. In its framework, the World Bank outlines nine key characteristics that, together, help achieve those traits.

Figure 3: Characteristics of sustainable mega-regions

The World Bank's definition of sustainable cities offers a foundation for defining a sustainable mega-region



In applying this framework at a mega-regional level, the defining traits of sustainability need not change. Like a sustainable city, a sustainable mega-region should be characterized by robust economic growth, reduced greenhouse gas emissions, and livability for all residents. Rather than considering all nine characteristics, however, achieving this vision for a mega-region will require focusing on a specific subset of the characteristics introduced by the World Bank.

Specifically, we must consider which characteristics most require the economies of scale offered by a mega-regional approach. These inputs fall into three categories, which form the pillars of a sustainable mega-region: housing and development, transportation, and environmental stewardship. The appropriateness of these pillars is further validated by the consistency of challenges being faced by mega-regions around the world: a lack of affordable housing, severe traffic congestion, and excessive emissions.

Looking more closely at each of the three pillars, we can further define sustainability for each individually:

- 1. Housing & development:** across the mega-region, median housing cost is equal to or less than 30% of median income
- 2. Transportation:** projected population growth can be absorbed without an increase in traffic congestion
- 3. Environmental stewardship:** proportional CO₂e emissions reduction of 80%, from 66 to 14 million metric tons by 2050 in order to meet Paris Climate Accord targets for the mega-region

Each of these pillars is critical to building a sustainable mega-region, but none is sufficient on its own. All three must be considered as an integrated unit, each supporting and leading to the others. Affordable housing, for instance, is not useful if it is not connected to anything via a transportation system. A mega-region is only sustainable, then, if it is able to achieve sustainability in all three pillars.

This vision is not easily realized. Our research has shown that to date, no other mega-region has been able to balance all three pillars. Cascadia, with its spirit of innovation and history of taking on big challenges, must lead the way. We must provide an example to the world that, through thoughtful collaboration and bold action, a sustainable mega-region is possible.



SECTION 3

How other mega-regions have traditionally responded to growth

Cascadia is not alone in the challenges it faces; mega-regions around the world have been grappling with similar constraints in housing, transportation, and environmental impact. Their responses illuminate important lessons for Cascadia as it looks to become a sustainable mega-region. Among the seven peer mega-regions introduced in section one, two patterns emerged as common responses to the challenges associated with explosive growth. Mega-regions tend to accommodate growth by either growing “up” – increasing the density of population within a defined urban area – or growing “out” – spreading population across a larger geographical range. Each approach has defining pros and cons:

TRADITIONAL APPROACHES TO MEGA-REGIONAL GROWTH		
	Building Up	Building Out
Main Pro	Reduced emissions	Reduced housing costs
Main Con	Increased housing costs (& follow-on effects, e.g. homelessness, outward migration, etc.)	Increased emissions
Examples	1. SF Bay Area 2. NY-Boston-Washington	1. Texas Triangle 2. Charlotte-Atlanta

To further illustrate these two traditional approaches to growth, we can look more closely at mega-regions that particularly exemplify each pattern:

BUILDING UP: BAY AREA MEGA-REGION (SAN FRANCISCO, OAKLAND, & SAN JOSE, CALIFORNIA)

Mega-regions like the Bay Area have grown through increased densification, or by “building up.” By fitting more people into a small urban area and offering extensive public transportation,¹³ the Bay Area is able to keep emissions per capita at 6.8 tons CO₂e, 12% lower than Cascadia and almost 70% lower than the Texas Triangle and Char-Lanta.¹⁴ This approach is not without its downsides, however. The Bay Area in particular is well-known for its high housing costs, with a median home price of more than 8.5 times the median household income,¹⁵ and extreme traffic congestion.^{16, 17, 18} As a result, highly dense mega-regions like the Bay Area, while continuing to grow overall, have seen many long-time residents leave. In 2019, San Francisco metro ranked second, behind New York metro, for highest out-bound migration within the U.S., with many residents heading out of state to Seattle.¹⁹

¹³ <https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/transit-environmental-sustainability/transit-role>

¹⁴ US Census; <https://www.citylab.com/life/2012/04/which-us-cities-tend-be-greenest/860/>

¹⁵ US Census

¹⁶ <https://www.mercurynews.com/2019/08/22/bay-area-traffic-delays-rank-second-longest-in-nation/>

¹⁷ <https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2019.pdf>

¹⁸ <https://www.kiplinger.com/slideshow/real-estate/T006-S001-most-expensive-u-s-cities-to-live-in-2019/index.html>

¹⁹ <https://www.redfin.com/blog/q2-2019-housing-migration-report/>

BUILDING OUT: TEXAS TRIANGLE MEGA-REGION (AUSTIN, DALLAS, HOUSTON, & SAN ANTONIO, TEXAS)

Mega-regions like the Texas Triangle have grown through increased sprawl, or by “building out.” They offer an abundance of affordable single-family homes — the median home price is only 3.5 times the median household income¹⁵ — built on previously undeveloped land, mostly without access to public transportation — less than two percent of commuters use public transit²⁰. Residents therefore drive their cars across broad areas to schools, home, work, and more.²¹ These regions are attractive to many in search of cheaper homes and less congested roadways; between 2005 and 2013, 4.8 million people moved to Texas from another U.S. state.²² Unfortunately, because of the prevalence of single-occupancy vehicles, these sprawling metros contribute much higher emissions per capita compared to other regions. The Texas Triangle mega-region emits 14.1 tons CO₂e per capita, two times per capita more than Cascadia.

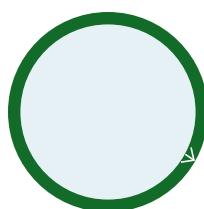
Practically, Cascadia could not embrace the building out approach because of its geographical limitations. The many natural features of our mega-region — the Pacific Ocean to the west and, in several areas, mountains to the north and east — make sprawl much less tenable. As an example, Dallas can grow in 360 degrees from its city center, meaning expanding an additional mile from downtown in every direction adds 138 square miles of developable area. In contrast, Vancouver is largely constrained in all directions except southeast and south (see figure 4). To add the same 138 square miles of development, Vancouver would need to extend an additional five miles from downtown. That equates to five times the increase in commute time and subsequent impact on emissions.

Figure 4: Impact of constrained expansion

Grow in all direction

(e.g. Dallas, TX)

1 additional commute
mile adds 138 mi² in the area



Geographically constrained

(e.g. Vancouver, B.C.)

To gain same 138 mi²,
need to add 5 additional miles

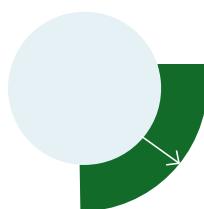


Figure 5, below, plots each of the seven peer mega-regions based on their traffic congestion, housing affordability, and greenhouse gas emissions. Those mega-regions that accommodate growth by “building out” appear in the upper right corner, indicating their affordable housing and lower traffic congestion. The relatively large size of the representative bubbles, however, captures the environmental tradeoff of those advantages — the larger the bubble, the higher the greenhouse gas emissions per person.

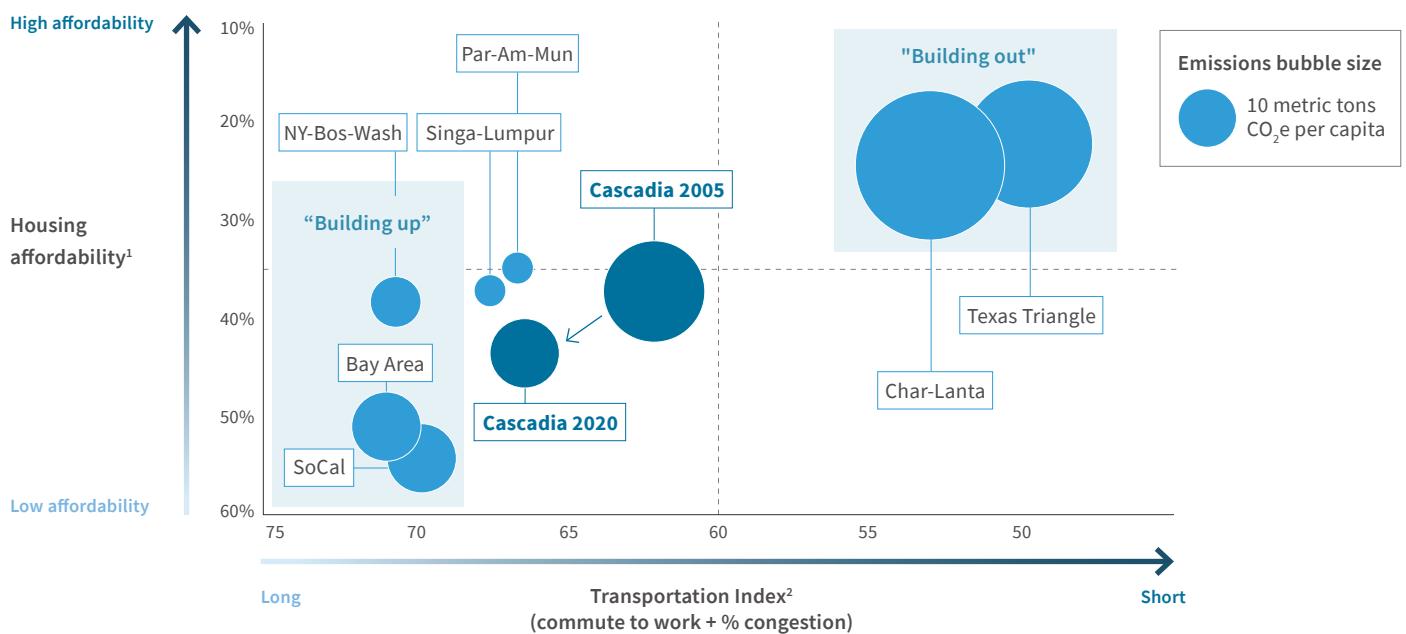
Conversely, those mega-regions that have accommodated growth by “building up” appear in the lower left corner, indicating their expensive housing and congested commutes. The relatively small size of the representative bubbles, however, illustrates that these downsides are bolstered by a smaller environmental footprint. Figure 5 also tracks Cascadia’s changes along these metrics over time, showing that, since 2005, Cascadia has mostly grown “up,” heading in the direction of the Bay Area example.

²⁰ <https://datausa.io/profile/geo/sanantonio-newbraunfels-tx-metro-area#housing>

²¹ <https://www.houstonpublicmedia.org/articles/news/2015/03/16/58608/how-texas-compares-when-it-comes-to-commuting/>

²² <https://www.texastribune.org/2019/05/08/texas-keeps-growing-where-are-newest-transplants-coming/>

Figure 5: Current state of housing affordability, transportation, and emissions



1. Median monthly housing payment (US assumptions) / median monthly gross income 2. Composite of two transportation metrics: mean total commute to work in minutes and percent congestion (ratio of free-flow commute time to peak-hour commute time)

Sources: US Census; Real Estate Board of Great Vancouver; Statistics Canada; TomTom Traffic Index; Texas A&M Travel Institute; Zolo; Numbeo (adjusted); Brussels Institute for Statistics & Analysis; Conseil General de L'Environnement et du Developpement Durable; Department of Statistics Malaysia; The Edge Markets; Department of Statistics Singapore; Today Online; BCG analysis

On our current trajectory, Cascadia will experience significantly worse traffic congestion by 2035 than LA or San Jose have now (see figure 6).²³ By 2040, Cascadia will become less affordable than San Francisco and New York today.²⁴ Even when accounting for the impact of autonomous vehicle adoption²⁵ and increased public transit ridership on Tri-Met,²⁶ Sound Transit,²⁷ and TransLink,²⁸ commutes in Cascadia are projected to get markedly worse over the next 30 years.²⁹ By 2050, both commute times and congestion will have become 50% worse than today – equivalent to the average commuter spending over five additional days per year sitting in traffic.³⁰ Undoubtedly, these impacts will drive many who call Cascadia home today to move elsewhere. Like in the Bay Area,³¹ fewer long-time Cascadia residents will be able to raise families and thrive in the region.

With respect to emissions, broad consensus projects a 20-30% decrease by 2050. While this is important progress, it is well short of the 80% reduction necessary to meet the Paris Climate Accord target for our mega-region.

²³ BCG analysis (see appendix, figure 6)

²⁴ BCG analysis (see appendix, figure 6)

²⁵ BCG Perspectives, Making autonomous vehicles a reality: Lessons from Boston and beyond

²⁶ <https://www.oregonlive.com/news/erry-2018/08/ec30ba366f2435/portlands-next-light-rail-will.html>

²⁷ Washington Department of Transportation

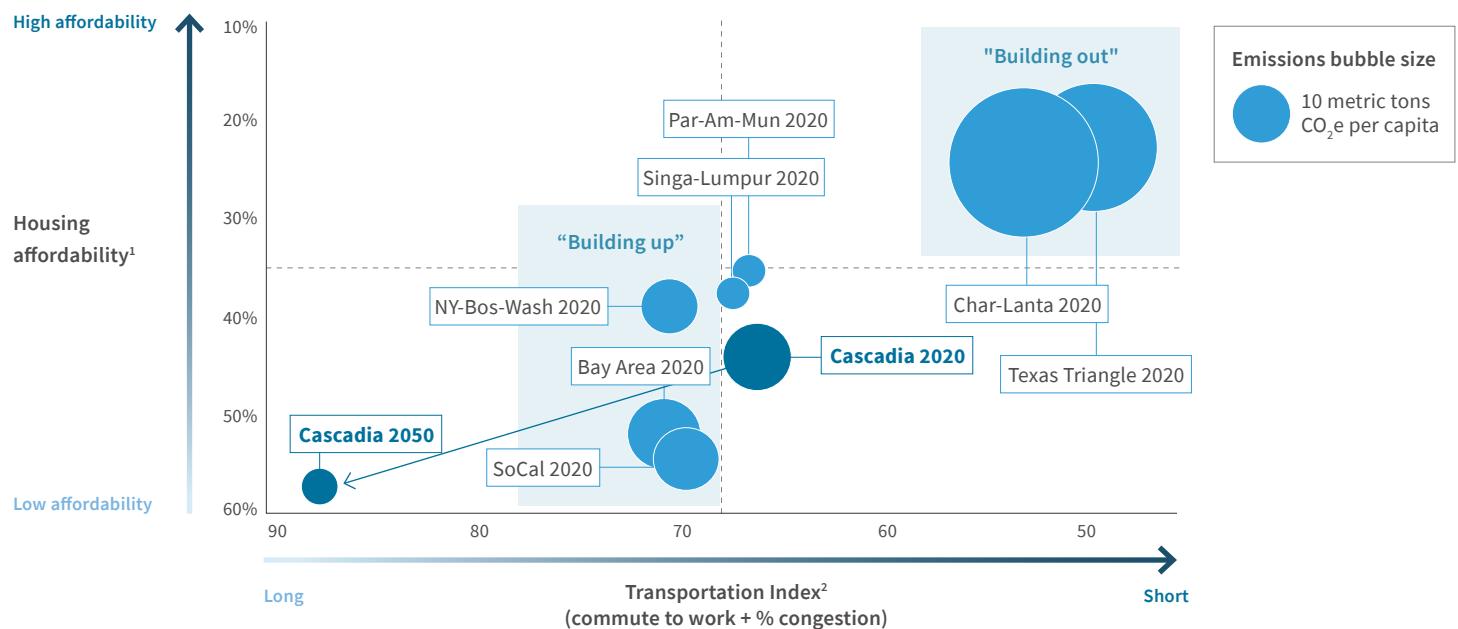
²⁸ TransLink Phase 2 Ten-Year Vision https://tenyearvision.translink.ca/Documents/10-year_vision_phase_2_investment_plan.pdf

²⁹ BCG analysis (see appendix, figure 6)

³⁰ BCG analysis (see appendix, figure 6)

³¹ <https://www.mercurynews.com/2019/08/30/bay-area-exodus-thousands-more-fleeing-region-than-arriving/>

Figure 6: 2050 projections



1. Median monthly housing payment (US assumptions) / median monthly gross income 2. Composite of two transportation metrics: mean total commute to work in minutes and percent congestion (ratio of free-flow commute time to peak-hour commute time)

Sources: US Census; Real Estate Board of Great Vancouver; Statistics Canada; TomTom Traffic Index; Texas A&M Travel Institute; Zolo; Numbeo (adjusted); Brussels Institute for Statistics & Analysis; Conseil General de L'Environnement et du Developpement Durable; Department of Statistics Malaysia; The Edge Markets; Department of Statistics Singapore; Today Online; BCG analysis

With an additional 3-4M people estimated in Cascadia by 2050, it is clear that our current approach will not achieve the vision of a sustainable mega-region. And the alternative seen in other megaregions – accommodating growth through sprawl – would be equally unsuccessful. But there are lessons to be drawn from the traditional approaches taken by other mega-regions. As we see in the Bay Area, increased density helps reduce emissions. And in the Texas Triangle, spreading people out has helped increase housing affordability. While taking either of these solutions to the extreme has clear downsides, we believe there is a middle-ground accessible by combining the strengths of both models (see sidebar below).



SECTION 4

A new vision for a sustainable mega-region

To achieve our vision of becoming the first sustainable mega-region, Cascadia must focus on three pillars: housing and development, transportation, and environmental stewardship. We must also remember that Cascadia will not be striving for these goals in a vacuum – in addition to our current population, a projected 3-4M new residents will be in Cascadia by 2050. Any plans must account for this growth, and further consider ongoing growth past 2050.

Cascadia is blessed with a wealth of world-class cities. In addition to our largest urban centers of Portland, Seattle, and Vancouver, B.C., we have population centralized in mid-sized cities throughout the mega-region. As we look toward the future of our mega-region, the first step in successfully scaling Cascadia is embracing our existing mid-sized cities and supporting their growth and densification. Contributing to their vibrancy and taking advantage of existing infrastructure and housing stock will allow us to accommodate growth without unnecessary destruction of greenspace.

Simply adding more people to those cities will not be sufficient to meeting our goals, however. As the populations of mid-sized cities increase, we must be thoughtful about how that growth impacts the mega-region as a whole. All three of our pillars must be considered: any increase in population must be accompanied by increased housing supply, expanded transit accessibility, and reduced per-capita emissions.

Specifically, to reach our definition of a sustainable mega-region, we must house an additional 800,000 people within Cascadia's existing mid-sized cities. In order to prevent a rise in home prices, an additional 378,000 new housing units will need to accompany that population growth.

Adding more people and housing to our mid-sized cities will not help us progress toward our goal if the majority are commuting to larger cities via car,

SIDE BAR: ACCOMMODATING POPULATION GROWTH IN CASCADIA

3.6M new residents are projected within Cascadia by 2050. Of those, 2.3M will be accommodated through the continuation of current densification trends, or through increased densification around planned transit and in mid-sized cities throughout the mega-region. Specifically, our model anticipates:

- About 850,000 people will be accommodated through continued densification throughout the mega-region. This projection is based on an analysis of historic densification for each city in the mega-region and assumes similar densification rates in the future. It accounts for both the filling in of historic green space and historic upzoning trends.
- About 650,000 people will be accommodated through increased densification around planned transit projects. This projection is based on U.S. national averages for densification rates around new transit, as well as actual historic densification rates near transit in Vancouver, B.C.
- Up to 800,000 people will be accommodated through accelerated densification of mid-sized cities throughout the mega-region. This projection assumes growth rates in those mid-sized cities will equal top quartile densification rates from best-in-class edge cities around the world.

Together, these projections account for 2.3M people, leaving a gap of 1.3M additional residents who would not be accommodated through planned or expected growth within the mega-region.

³² US Census; includes data for Everett, WA, Tacoma, WA, Vancouver, WA, and Beaverton, OR.

clogging our roadways and contributing to emissions. Today, 74% of people living in mid-sized cities in Cascadia commute via single-occupancy vehicle daily.³² As mid-sized cities grow, we must work to lower this percentage in two ways. First, by reducing the number of people who need to travel to urban cores frequently by placing more jobs within the mid-sized cities themselves. Second, by offering a transit option that is both more convenient and more sustainable than driving, meaning a high-speed transit option connecting our mid-sized cities to our urban cores is critical to the sustainability of our mega-region.

Bringing people, jobs, and high-speed transit to our existing mid-sized cities is a foundational step to sustainable growth in Cascadia, but it is not enough. Based on urban development patterns both within our mega-region and across North America, we project 800,000 people could be accommodated within our existing mid-sized cities. 1.5M more will be absorbed through small increases in density in our urban cores and development around existing and planned transit. This leaves an additional 1.3M people unaccounted for – nearly twice the current population of Vancouver, B.C. Our ability to plan for and accommodate this additional population will be the difference between a sustainable mega-region and one that is unaffordable, congested, and contributing to disastrous climate change.

To make room for this additional population, we propose one potential concept for consideration: the creation of newly expanded "hub" cities in currently underdeveloped areas within Cascadia. While there are other solutions, we believe a big, bold option is necessary and we want to encourage other creative alternatives for discussion and debate. Old ways, tinkering at the edge solutions, or inaction will not solve our challenges and will be a disservice to the people of Cascadia.

In our proposed plan, these hub cities will operate much like some of our existing mid-sized cities, but provide additional capacity for the significant growth in our future, through 2050 and beyond. They would provide jobs, affordable housing, and direct and convenient transit to both surrounding neighborhoods and urban cores.

This model takes the strengths of the traditional approaches to growth outlined in section two while avoiding the accompanying pitfalls. By spreading dense cities throughout the mega-region and ensuring they are connected by high-speed transit, our model combines the emissions-limiting power of densification with the affordability of sprawl. Most importantly, it addresses all three pillars of a sustainable mega-region: reducing emissions in our environment, avoiding additional congestion on our roadways, and providing affordable, accessible housing.

SIDE BAR: ULTRA HIGHSPEED TRANSIT (UHST)

With cross-jurisdictional funding from British Columbia, Oregon, and Washington, and private partnership from Microsoft, feasibility studies are already underway for high speed transit in the Cascadia mega-region. Key findings from the first phase of the study, released in July 2019, include:

- UHST would spark up to \$355B in economic growth in Cascadia
- UHST would generate \$160-\$250M in annual revenues
- Construction costs estimated at \$24-\$42B

High-speed transit is a necessary backbone for the future of Cascadia that supports all three pillars of a sustainable mega-region.

By connecting currently underdeveloped areas of our mega-region, UHST would open the door to development of more affordable housing near transit stops. UHST is projected to capture 12-20% of intercity trips or 3 million annual trips by 2040. In addition, it has the potential to fundamentally change commute flows for newly expanded mid-size cities, dramatically reducing transportation emissions and making a marked impact on congestion across Cascadia.

SIDEBAR: WHY CASCADIA NEEDS A NEW SOLUTION (i.e. why traditional growth patterns won't work for us)

Sprawl: Without meaningful changes in mega-regional planning, the majority of these 1.3M people will be housed through sprawl. However, as previously discussed, due to our mega-region's geographic constraints, accommodating this growth through sprawl would require spreading much farther than is necessary in other mega-regions. The resulting damage to our natural landscape and way of life would be significant, requiring the equivalent of 10.5 Vancouver's worth of new land to be developed.

Additional Up-zoning/Densification: An alternative to traditional densification (such as constructing high-rise apartment blocks) or sprawl is upzoning single family housing. Dramatically densifying existing single-family homes has strong transportation and environmental benefits, and cities like Austin and Minneapolis have successfully implemented some up-zoning policy changes. However, up-zoning at scale is a difficult endeavor and most cities and states that have attempted it, such as California, have faced fierce political opposition, limiting their ability to implement these laws. To house 1.3M additional people through up-zoning single family homes to 4-family units would require nearly 40% of single-family homes in Portland, Seattle, and Vancouver, B.C. to be bulldozed.

Figure 7: Impact of sprawl

Cascadia – housing the "gap" of 1.3M people total

	Low density (e.g. Issaquah)	Medium density (e.g. Ballard)	High density (e.g. Downtown Bellevue) ³
Population density (Per square mile)	~3K	~9K	~26K
Land required (Square miles)	~450	~150	~50
Area equivalent # of Vancouver City's ¹			
Building emissions ² Metric tons CO2e / year	3.4M	2.7M	2.0M

1. Based on land area, 44 square miles 2. Ongoing building emissions of 1.5 GHG emissions per person (Metric CO2e/year) for multi-family housing and 2.7 per person for single family housing. Estimates 5%, 50%, and 95% of multi-family housing for low, medium, and high density 3. Density of ~13K in 0.5 sq miles

Source: Washington Census, Life-Cycle Analysis of Energy Use and Greenhouse Gas Emissions

SECTION 5

Hub cities can help shape a sustainable mega-region

Expanded hub cities throughout Cascadia would allow us to accommodate population growth while pursuing our vision of becoming the first sustainable mega-region. To do so, we can envision the need for four hub cities, each of which would need to have a number of specific features.

1. BUILT ON UNDERDEVELOPED LAND 40-100 MILES FROM URBAN CORES

By locating cities in currently under-utilized areas, developers can take advantage of lower land and development costs. The resulting savings can be passed on to consumers in the form of more affordable housing.

2. HIGH-SPEED TRANSIT (HST) AND MULTI-MODAL LOCAL TRANSIT

Centering the hub cities around HST ensures residents can easily access existing urban cores. This provides flexibility for those who need to commute to other cities for work, school, or other needs, but prevents those same commuters from clogging roadways with single-occupancy vehicles. Multi-modal local transit options allow connectivity to nearby neighborhoods, providing additional livability options for those who prefer a more suburban or rural setting without the need for a car.

3. DENSE HOUSING FOR 300K-400K PEOPLE

To sufficiently impact our three pillars of housing affordability, transportation, and emissions, each city would need to house 300k-400k people. This is no small feat and highlights the bold action that is required for our region. To avoid sprawl and take advantage of HST, housing in close proximity to the station should be dense. Farther from the station, high density housing would give way to mid-rise apartment buildings easily accessible by mass transit. Together, this combination of high and medium-density housing could house 1.3 million people across four hub cities using ~90% less land than a “building out” approach would require to house the same number.

4. 200K JOBS

At its core, each city must have an industry cluster with a significant number of jobs. Without sufficient employment, these hub cities will become bedroom communities with large numbers of commuters clogging roads and increasing greenhouse gas emissions. Ideally, a large anchor employer would commit to locating a portion of their workforce within each city, further spurring demand for more office, retail, and residential construction.

Together, the benefits of this approach are far-reaching. As shown in figure 10, these hub cities would help Cascadia achieve affordability akin to the levels seen in sprawling mega-regions like the Texas Triangle while reducing our emissions to levels well below high-density mega-regions like the Bay Area.

Tamara is a software engineer who just moved to a hub city. She had been wanting to move out of downtown Portland for years but was afraid of having to deal with I-5 congestion and delays. Her employer now has several satellite offices throughout the region and her normal commute is a five minute walk from her apartment building to the office by the high-speed station. Once a week she takes a 30 minute high-speed transit ride into Portland to attend meetings at corporate HQ. Her city is walkable and bordered by miles of nature reserves – the perfect place to walk her dog after work.

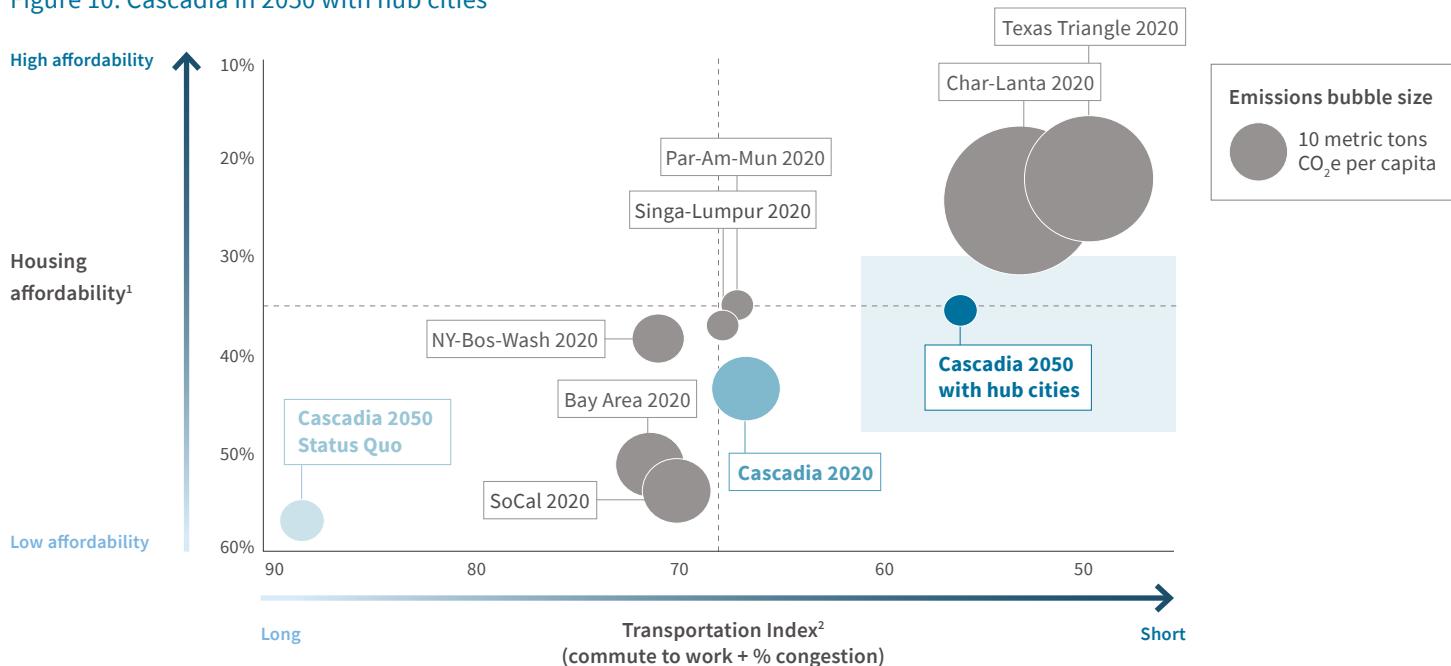
Brian lives with his partner and three children in a hub city. He was having a hard time affording an apartment in Vancouver on his barista salary, especially one he could raise his children in. The hub city he and his family live in has thousands of affordable housing units deliberately placed near high-speed transit. His building is surrounded by pedestrian zones, parks, and the elementary school his children attend is only a 10 minute walk. Brian still commutes daily, leveraging high-speed transit, and his partner works locally.

Figure 9: Impact of hub cities

Cascadia	2005	2020	2050 status quo	2050 with hub cities	Improvement
Housing affordability	36.8	43.6	56.9	35.0	38%
Transportation index	62.2	66.4	87.9	56.0	36%
Emissions (metric tons CO2 per capita)	11.4	7.7	5.2	4.2	19%

Current projections established pre-COVID; assume projections remain valid as data indicates trend toward return to pre-COVID levels

Figure 10: Cascadia in 2050 with hub cities



1. Median monthly housing payment (US assumptions) / median monthly gross income 2. Composite of mean commute & % congestion
Sources: US Census; Real Estate Board of Great Vancouver; Statistics Canada; TomTom Traffic Index; Texas A&M Travel Institute; Zolo; Numbeo (adjusted); Brussels Institute for Statistics & Analysis; Conseil General de L'Environnement et du Developpement Durable; Department of Statistics Malaysia; The Edge Markets; Department of Statistics Singapore; Today Online; BCG analysis

As our model demonstrates, building hub cities would reverse Cascadia's current course toward a congested, unaffordable, high-emissions mega-region, instead preparing us to become an example to the world of a sustainable mega-region. This model has the added benefit of accommodating the lifestyle changes that we may continue to see as a result of the COVID-19 pandemic. While it is unclear how long-lasting shifts caused by COVID-19 will be, this proposal perfectly positions Cascadia to take advantage of some of the ways the pandemic has affected behaviors and economies.

In particular, because of the increase in remote work, we have seen a shift toward living in more suburban and rural areas as employees search for more space and more affordable homes farther from city centers.

As workers appreciate the ability to live affordably in areas farther from urban centers, demand will only grow for mid-sized cities with affordable housing, world-class culture, and easy commutes to Cascadia's larger cities. Perhaps accelerated by this trend, Cascadia will need efficient, accessible transit options that connect our cities to the rest of the corridor. COVID-19 may reduce public transport ridership in the short/medium term, but as our mega-region recovers, we can expect ridership to return to pre-COVID-19 levels.

The economic impacts of the COVID-19 pandemic will also likely drive long-term changes. Specifically, the increase in remote work and learning will accelerate technology adoption, and health and supply chain concerns exacerbated by the pandemic may drive innovation in the movement of people, goods, and capital. While many unknowns still remain, these questions represent opportunities for innovative investments that could further support our efforts to improve sustainability within Cascadia.

Regardless of whether the lifestyle and economic shifts caused the pandemic are permanent, our proposal prepares for the inevitable: a significant increase in population across Cascadia, with increased demand for affordability and connectivity throughout the mega-region.

While this is only one potential path forward, it is clear that any solution that offers such a reversal of our current trajectory will require extraordinary planning and action. We must be clear-eyed about the magnitude of the challenge before us, and the time and effort addressing it will require. But inaction is not an option – failing to act now will guarantee that generations to come will never experience the Cascadia we hold so dear today.



SIDEBAR: HUB CITY EXAMPLE—FOREST CITY, MALAYSIA

Key facts

- 4 reclaimed islands spanning 12 mi²
- Population: 700,000 people by 2050
- 30 miles from Singapore
- Built on planned high-speed rail connecting Singapore to Kuala Lumpur, Malaysia
- Industrial clusters built around finance and biotech
- \$100B+ in investment

Forest City, Malaysia is one example of a nascent hub city. Started in 2014 and aiming for full functionality by 2050, Forest City plans to develop high-density living and knowledge-based industry clusters to provide a strong quality of life for approximately 750,000 individuals. With homes and jobs located in the same city, the average resident will have a 5-10 min walk to public transportation and a relatively short commute. Additionally, the hub city will be connected to major cities like Johor, Malaysia (25 miles away) and Singapore (30 miles away) through high-speed rail, ferry, and other multi-modal transit options.



Building Forest City from the ground up has enabled a highly integrated design focused on quality of life. The new city will be walking-centric, offer multiple forms of public transit, be integrated with nature and ecologically symbiotic, feature vibrant civic venues, and welcome diverse and healthy communities with equitable access to high-quality education and healthcare.

While hub cities have yet to develop in North America, Forest City serves as an example of what could be done with coordinated planning.



Information and graphic courtesy of Sasaki Design

SECTION 6

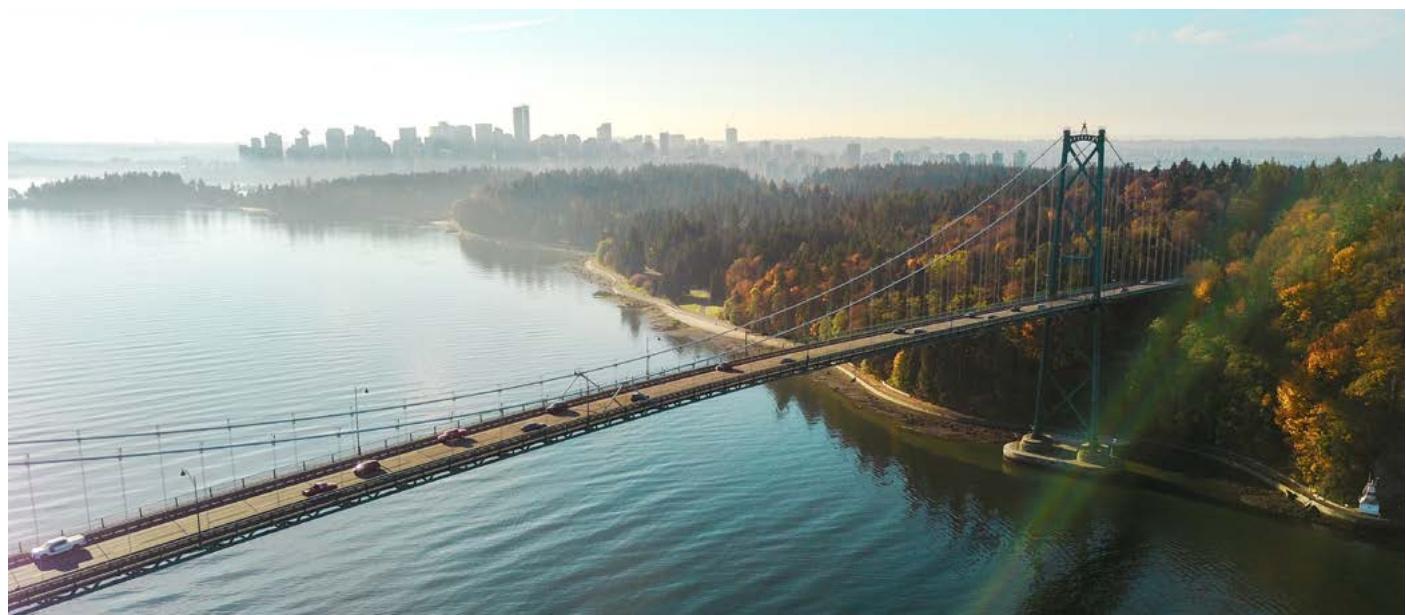
Next steps

Taking a mega-regional approach to the challenges associated with growth opens up potential solutions on a completely new scale. Implementing them, however, will in turn require nearly unprecedented planning, partnership, and resources. We must begin these planning efforts immediately – these projects will take time, and we have none to waste.

Our proposal includes building hub cities within Cascadia to ensure capacity for population growth through 2050 and beyond. Regardless of the exact path forward, we recommend a series of actions to accommodate additional population within our existing urban cores of Portland, Seattle, and Vancouver, B.C., as well as mid-sized cities throughout the mega-region. Leveraging existing urban infrastructure will protect the access to nature that defines Cascadia. We must also bring jobs and efficient, convenient transportation solutions to our mid-sized cities. These will be key to ensuring that additional population growth is not accompanied by a proportional increase in traffic congestion, housing prices, and emissions.

We know, however, that these local and regional steps to increase capacity in our existing cities will not be enough to accommodate the population growth Cascadia is projected to experience in the next 30 years. And growth will not stop in 2050. We must take even bolder action to ensure we have capacity for generations to come. We must establish mega-regional efforts in earnest to identify additional solutions and we urge those planning efforts to consider the proposed solution of building hub cities in currently underdeveloped areas within Cascadia. Those planning bodies must work quickly to identify sites for such cities, and must support the efforts already underway to bring high-speed transit to Cascadia to ensure both existing cities and any future cities are well-connected to the rest of the mega-region.

Together, these efforts to bolster our existing infrastructure and build new infrastructure at a mega-regional scale can help put Cascadia on a path to becoming the first sustainable mega-region.



SIDEBAR: SPECIFIC STEPS WE RECOMMEND INCLUDE

Support the growth of our existing large and mid-sized cities

- Continue to increase density in and around large urban cores through up-zoning initiatives and development incentives
- Increase density and number of jobs in our vibrant mid-sized cities through up-zoning initiatives, development incentives, and employer incentives
- Increase housing and mixed-use development near existing and planned transit stops. Vancouver has already made steps toward this,³³ and Seattle plans to do the same with the Sound Transit 3 project,³⁴ but based on density around transit locations across North America, significant opportunity remains

Foster mega-regional planning

- Create a regional planning entity that enables cross-border and cross-municipality coordination among public and private regional leaders with the authority and resources to enact change. The planning entity must be empowered to act swiftly through policy change and financial investment

Connect our existing urban centers by building high speed transportation

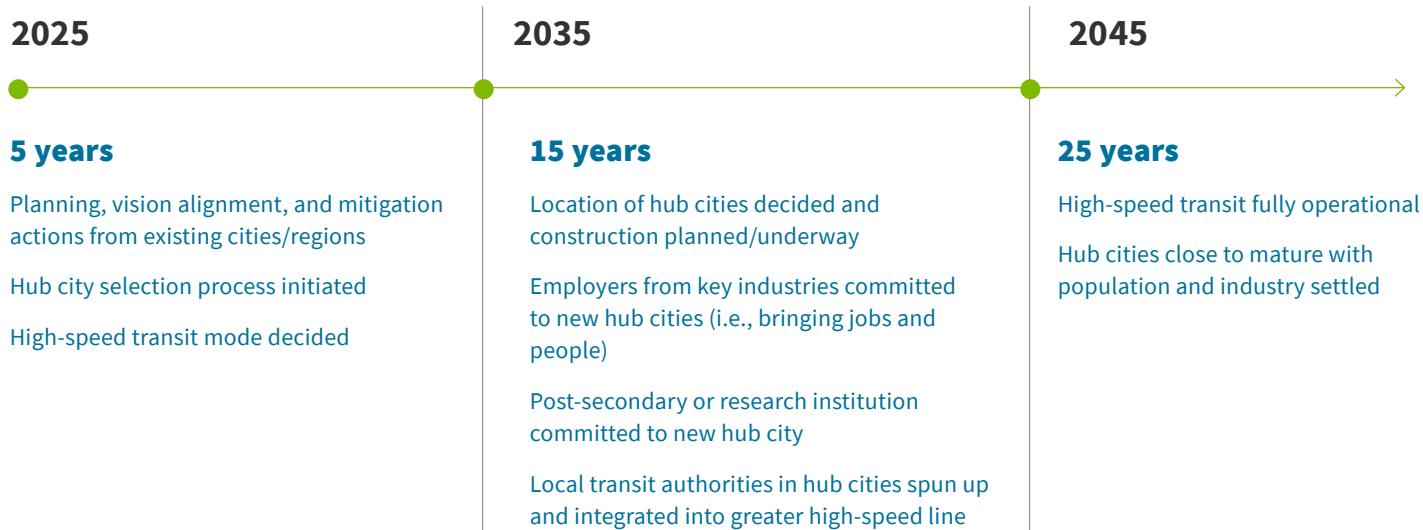
- Finance ongoing feasibility studies
- Create planning body

Create additional capacity by building vibrant hub cities

- Build hub cities on underdeveloped land and next to high-speed transit stops 40-100 miles from existing urban areas
- Secure “anchor” employers to locate significant number of jobs within hub cities and further attract additional employers, commercial activity, and residential development
- Offer integrated, multi-modal transit options connecting city centers to outlying neighborhoods
- Build low-emissions, mixed-use developments and dense housing for 300-400k people near high-speed transit stops

Figure 11: High-level timeline to achieve vision

Timeline: Key actions required to achieve vision



³³ <https://grist.org/cities/how-did-vancouver-get-so-green/>

³⁴ https://www.soundtransit.org/sites/default/files/documents/sound_transit_tod_quarterly_report_q1_2020.pdf

SECTION 7

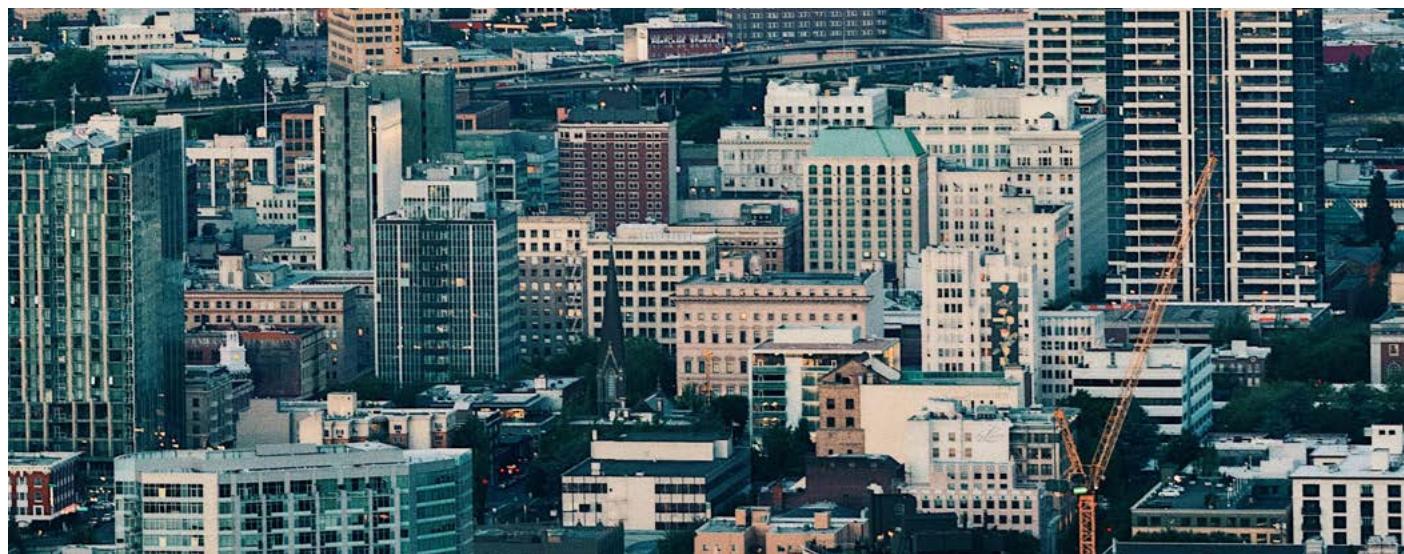
Call to action

Bringing the vision for a sustainable mega-region to life will not be easy, but the alternative is a future devoid of the beauty and livability that defines Cascadia today. Without collaboration and bold action, Cascadia's existing challenges will become untenable. Housing prices will continue to skyrocket, making home ownership a pipe dream for most of Cascadia's young people and driving many farther from our cities, creating more mega-commuters and further clogging our roadways and contributing to disastrous climate change.

If, however, we can come together, abandon the status quo, and open our minds to innovative ideas, we can bring to life a very different future for our mega-region. We can ensure that Cascadia becomes an example to the world of the first truly sustainable mega-region, one that embraces growth and economic success while providing inclusive livability for all of its residents and protecting the environment and natural beauty we hold so dear.

Each of us has a critical role to play. Policymakers must embrace bold plans and collaborate across jurisdictional borders. Employers must continue to support remote and flexible work arrangements when possible and consider new options for in-person job placement, bringing jobs to support hub cities. The private sector must become an active partner in planning and investing in large-scale infrastructure projects. We all must be future-oriented in our thinking, supporting policies that prioritize creative approaches to inevitable growth.

Across the mega-region, we must recognize our current, reactive response to growth is not sufficient. The path we are on today directs us squarely toward a future we cannot accept. Maintaining our way of life, and preserving it for generations to come, will take all of us thinking and acting on an entirely new scale. It will not be easy, but having the courage to take on challenges others deem impossible is the spirit that shaped our great mega-region. Through strong partnership, bold thinking, and collective action, we can once again make Cascadia an example for the world.



Appendix

Figure A1: Growth summary

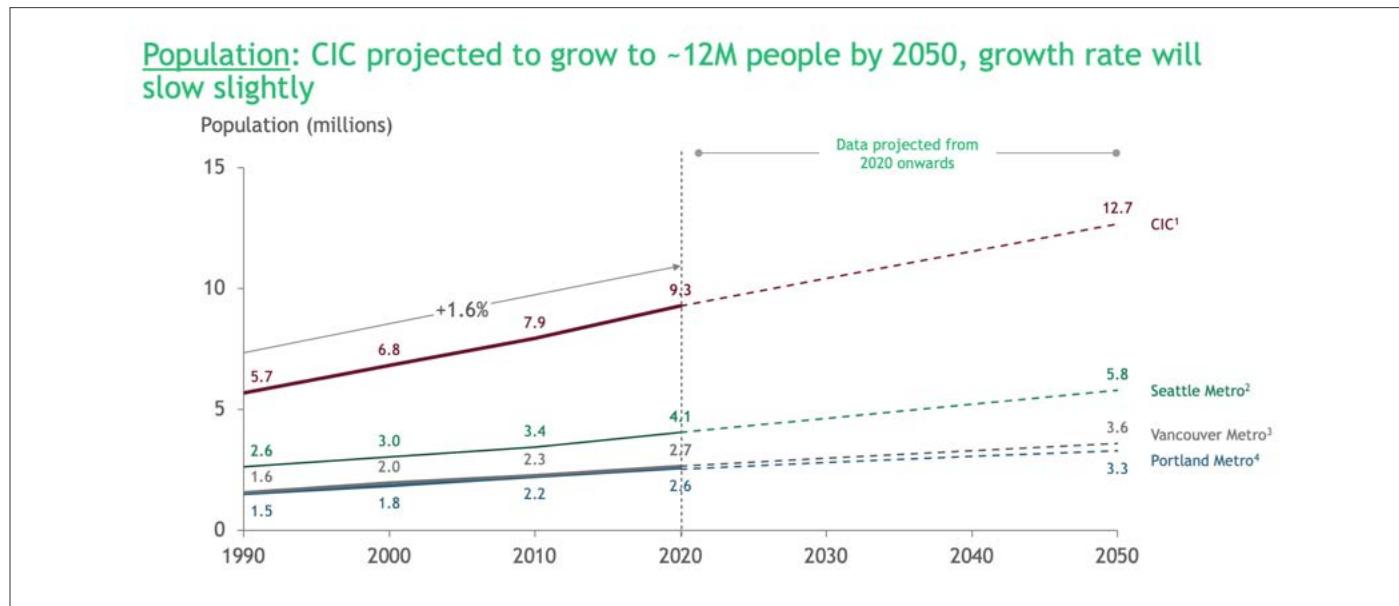
Current projections established pre-COVID; expected negative impact on Cascadia region offset by industry-specific growth



Note: Dollar figures in 2010 real USD

Sources: Statistics Canada, Federal Reserve Bank of St. Louis, US Census Bureau, Bureau of Economic Analysis, Puget Sound Regional Council, Oregon Metro, Government of Metro Vancouver, BCG analysis

Figure A2: Population



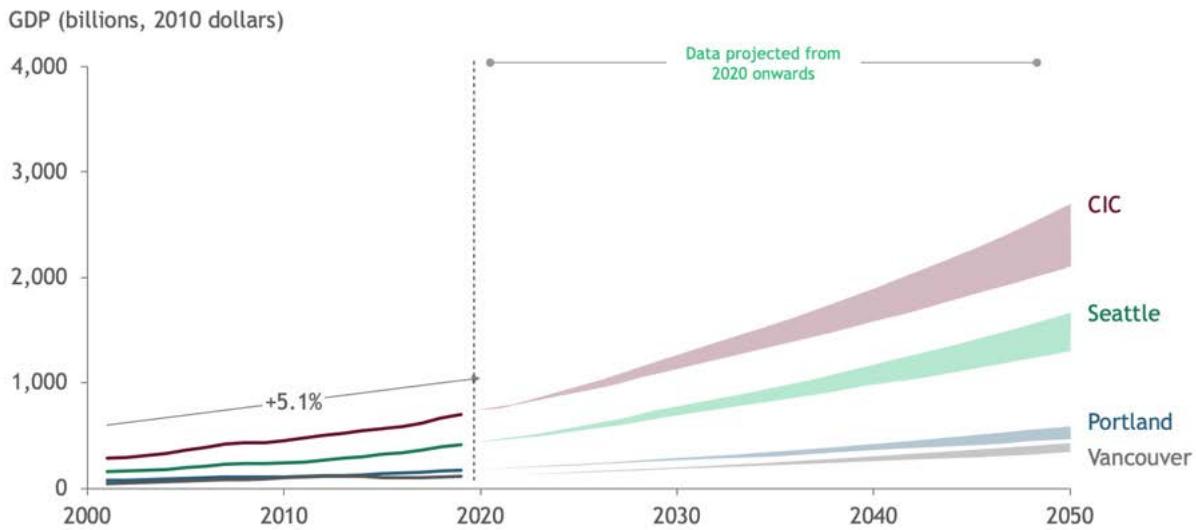
1. Includes Seattle metro, Portland metro, and Vancouver metro. 2. Includes Seattle, Tacoma and Bellevue. 3. Identified according to the UN World Urbanization Prospects' urban agglomeration definition (a city and its surrounding suburbs) 4. Includes Portland (OR), Hillsboro (OR), and Vancouver (WA)

Sources: US Census; World Population Review; projections provided by: Puget Sound Regional Council, Oregon Metro, Government of Metro Vancouver

Figure A3: GDP

Current projections established pre-COVID; expected negative impact on Cascadia region offset by industry-specific growth

Total GDP: growing 2X+ Canadian and US national averages



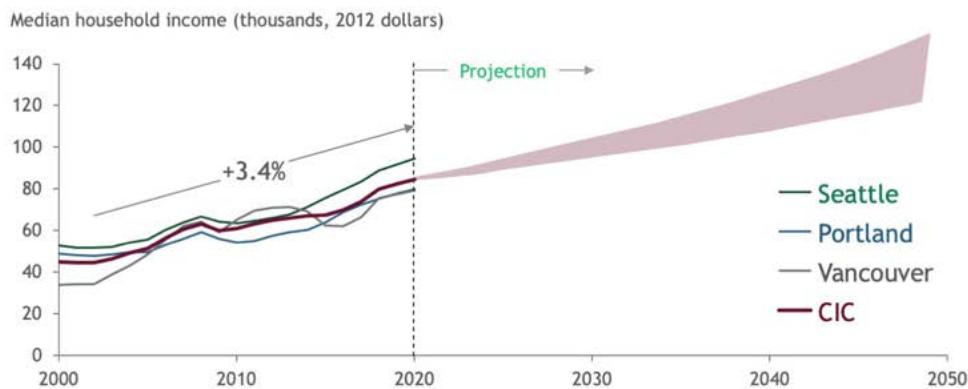
Notes: All named areas are MSA or CMA; forecast assumes historical growth for 2020-2030, average between national and metro growth for 2031-2040, average between 2031-2040 growth and historical average for 2041-2050

Sources: Statistics Canada; Bureau of Economic Analysis; BCG Analysis

Figure A4: Household income

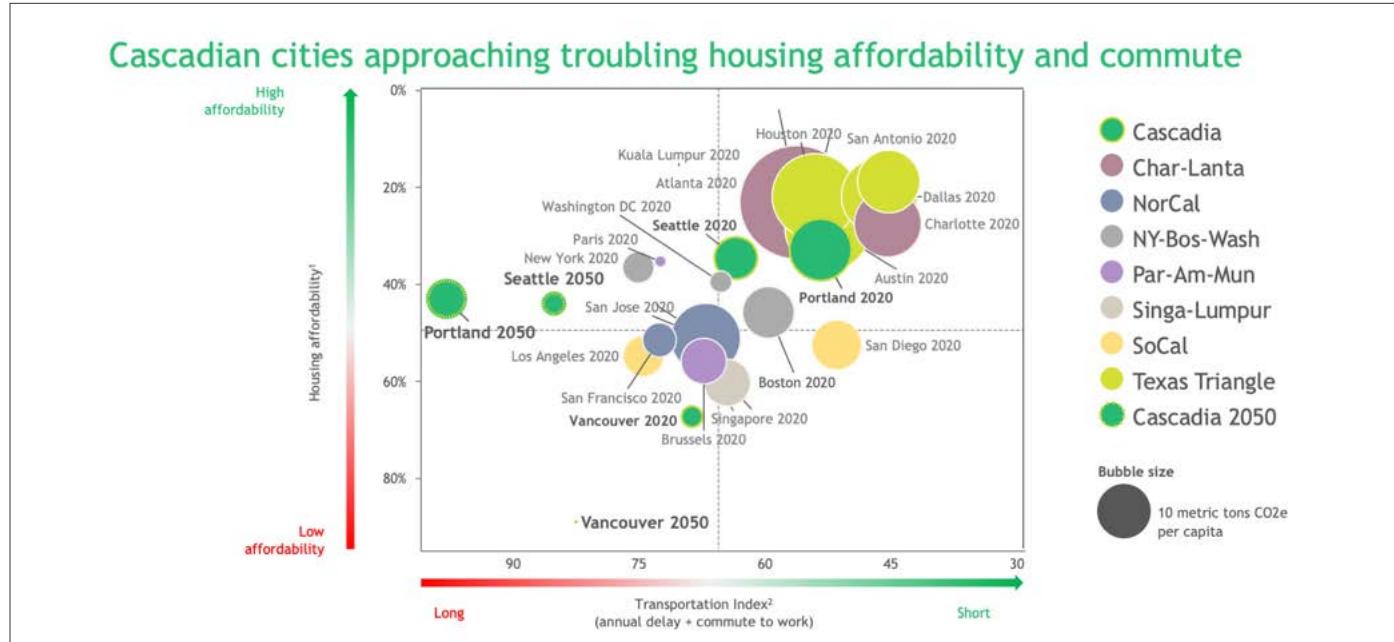
Current projections established pre-COVID; expected negative impact on Cascadia region offset by industry-specific growth

Household income: steady median income growth across the mega-region



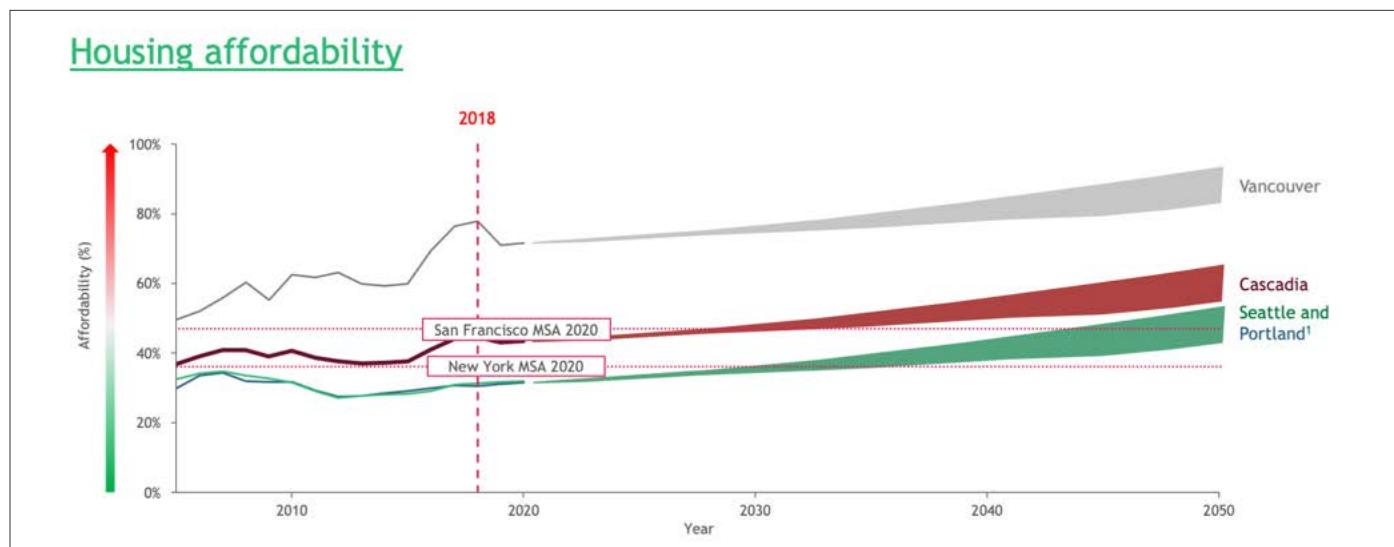
Sources: Statistics Canada; Federal Reserve Bank of St. Louis; US Census Bureau; BCG analysis

Figure A5: City-level data and projections



1. Median monthly housing payment (US assumptions) / median monthly gross income 2. Composite of two transportation metrics: mean total commute to work in minutes and percent congestion (ratio of free-flow commute time to peak-hour commute time)
Sources: US Census; Real Estate Board of Great Vancouver; Statistics Canada; TomTom Traffic Index; Texas A&M Travel Institute; Zolo; Numbeo (adjusted); Brussels Institute for Statistics & Analysis; Conseil General de L'Environnement et du Developpement Durable; Department of Statistics Malaysia; The Edge Markets; Department of Statistics Singapore; Today Online; BCG analysis

Figure A6: Housing affordability projections



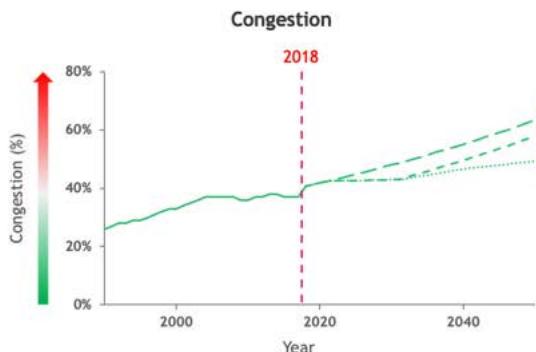
1. Portland and Seattle affordability historically and projected to be within 3% of each other
Note: Projected median home cost and median income independently. Median income projections from figure A4. For each region, median home cost based on linear regression of population as the independent variable and median home cost as the dependent variable. Forward looking population projections from Figure A2. Population may become less explanatory of median home cost if major policy changes come into play (e.g. Vancouver Bill 28).

Source: US Census; Real Estate Board of Greater Vancouver; Statistics Canada

Figure A7: Commute and congestion projections, Seattle

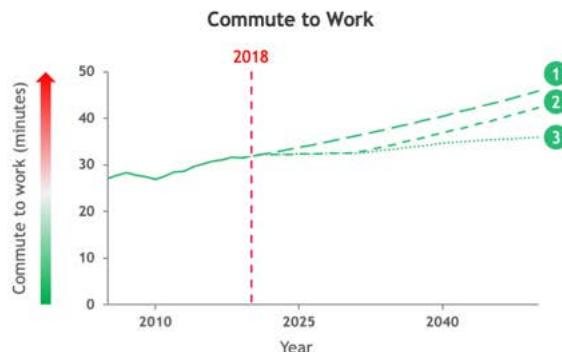
Current projections established pre-COVID; assume projections remain valid as mobility data indicates trend toward return to pre-COVID levels

Commute time and congestion steadily lengthens for Seattle despite ST3 & AV



- ① Effect of population growth across current transport system
- Linear regression of population effect on transportation from 2005 to predict values for 2020-2050

- ② Effect of Sound Transit 3 on current transport system
- Projected incremental impact of 600,000 riders per day on transportation between 2020 and 2031



- ③ Effect of autonomous vehicles and ST3 on current transport system
- Projected incremental impact of 6% throughput increase from 2031-2040 and 15% throughput increase from 2040-2051

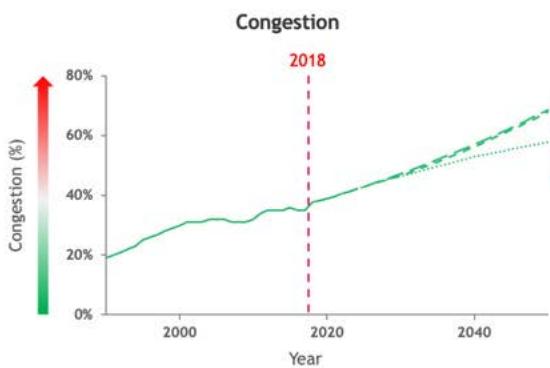
Note: congestion defined as % add'l time during peak rush hour compared to free flowing traffic; commute time is one way

Sources: US Census; TomTom Traffic Index; Texas A&M Transportation Institute; BCG Analysis

Figure A8: Commute and congestion projections, Portland

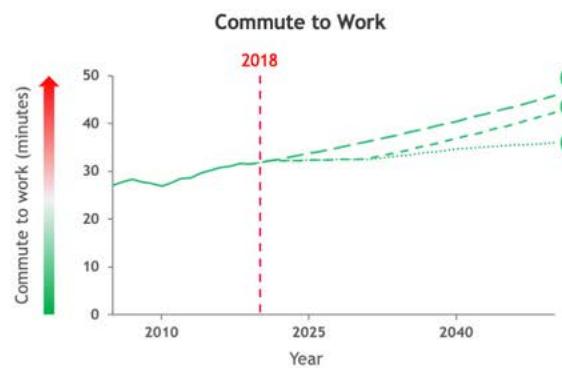
Current projections established pre-COVID; assume projections remain valid as mobility data indicates trend toward return to pre-COVID levels

Commute and congestion steadily lengthens for Portland despite Tri-Met & AV



- ① Effect of population growth across current transport system
- Regressed population effect on transportation from 2005 to predict values for 2020-2050

- ② Effect of Tri-Met proposed additions (SW Corridor) on current system
- Projected incremental impact of 43,000 riders per day on transportation between 2027 and 2031



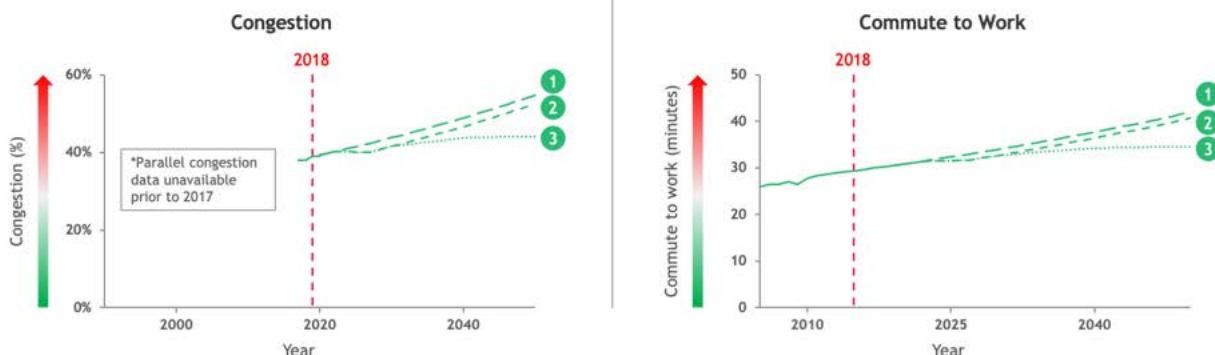
- ③ Effect of autonomous vehicles and Tri-Met on current transport system
- Projected incremental impact of 6% throughput increase from 2031-2040 and 15% throughput increase from 2040-2051

Note: congestion defined as % add'l time during peak rush hour compared to free flowing traffic; commute time is one way
Sources: US Census; TomTom Traffic Index; Texas A&M Transportation Institute; BCG Analysis

Figure A9: Commute and congestion projections, Vancouver, B.C.

Current projections established pre-COVID; assume projections remain valid as mobility data indicates trend toward return to pre-COVID levels

Commute and congestion lengthens for Vancouver despite TransLink & AV



① Effect of population growth across current transport system

- Regressed population effect on transportation from 2005 to predict values for 2020-2050

② Effect of TransLink proposed additions on current system

- Projected incremental impact of 167,000 riders per day on transportation between 2023 and 2026

③ Effect of autonomous vehicles and TriMet on current transport system

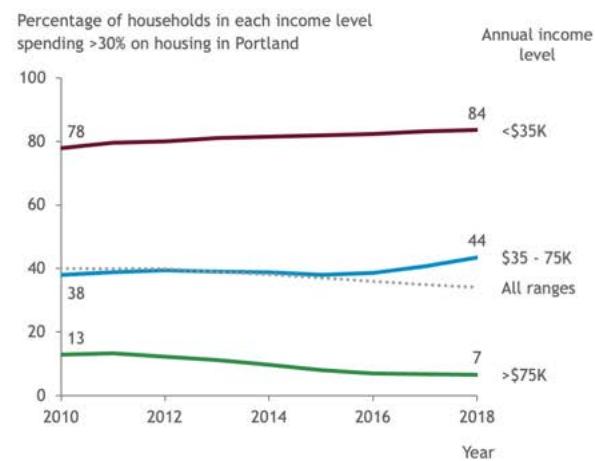
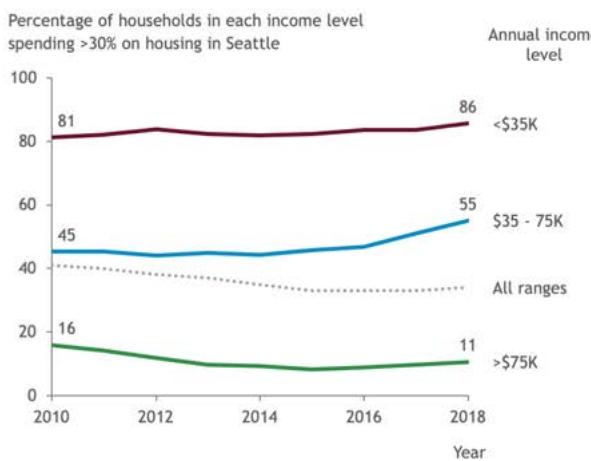
- Projected incremental impact of 6% throughput increase from 2031-2040 and 15% throughput increase from 2040-2051

Note: congestion defined as % add'l time during peak rush hour compared to free flowing traffic; commute time is one way

Source: Traffic Data Program BCG; Statistics Canada; TomTom Traffic Index; BCG Analysis

Figure A10: Housing cost burden

Housing cost burdens: Low and middle income earners left behind as wealth gap increases

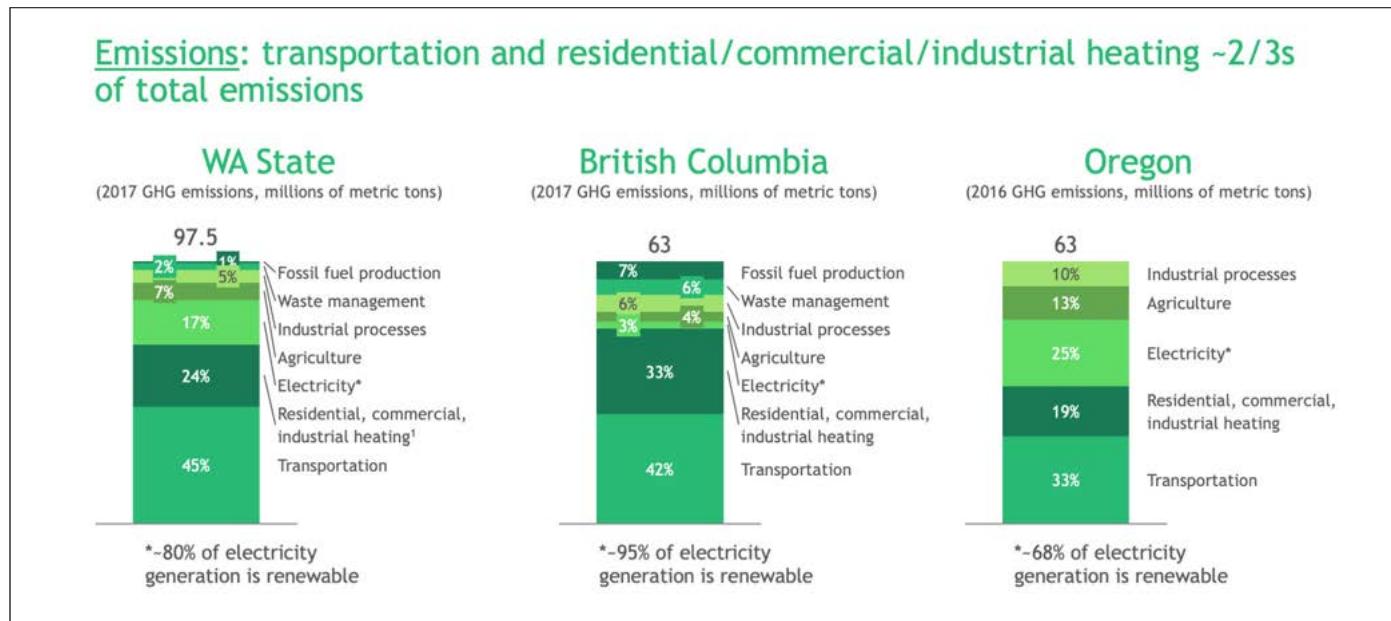


Note: Annual income level is pre-taxes

Source: US Census Bureau; BCG analysis

Figure A11: Emissions distribution

Current projections established pre-COVID; assume projections remain valid as emissions data indicates trend toward return to pre-COVID levels



- Emissions in this sector come from burning fuels to heat homes and workplaces, and the heat needed for industrial processes. This category includes power generated from coal, natural gas, oil, and wood

Source: WA State Dept of Ecology; BC Provincial Report on GHG Emissions; Oregon Dept of Environmental Quality; BCG Analysis

Figure A12: Seattle population growth distribution by region

Greater Seattle (MSA) population has risen faster in non-core cities...

Non-core cities	2005	2017	% growth	Core cities	2005	2017	% growth
Issaquah	20,895	37,487	79%	Seattle	536,946	724,764	35%
Sammamish	41,063	64,548	57%	Bellevue	114,748	144,459	26%
Kent	82,141	128,458	56%	Everett	88,850	110,086	24%
Bothell	30,510	45,533	49%	Tacoma	191,934	213,426	11%
Auburn	58,876	80,776	37%	TOTAL	1,446,105	1,840,856	27%
Renton	75,567	101,379	34%				
TOTAL	309,052	458,181	48%				

Source: US Census Bureau

Figure A13: Seattle job growth distribution by region

...while jobs have grown more in core cities								
Non-core cities	2013	2017	Difference	Core cities	2013	2017	Difference	
Issaquah	16,300	18,500	2,200	Seattle	383,000	452,000	69,000	
Sammamish	22,500	30,800	8,300	Bellevue	66,000	71,800	5,800	
Kent	53,600	62,700	9,100	Everett	48,400	52,200	3,800	
Bothell	17,700	23,100	5,400	Tacoma	88,900	98,100	9,200	
Auburn	33,500	36,500	3,000	TOTAL	586,300	674,100	87,800	
Renton	48,900	54,000	5,100					
TOTAL	176,200	207,100	30,900	Core cities added almost 3x the number of jobs as non-core cities				

Source: US Census Bureau

Figure A14: Hub city example: Sejong, South Korea



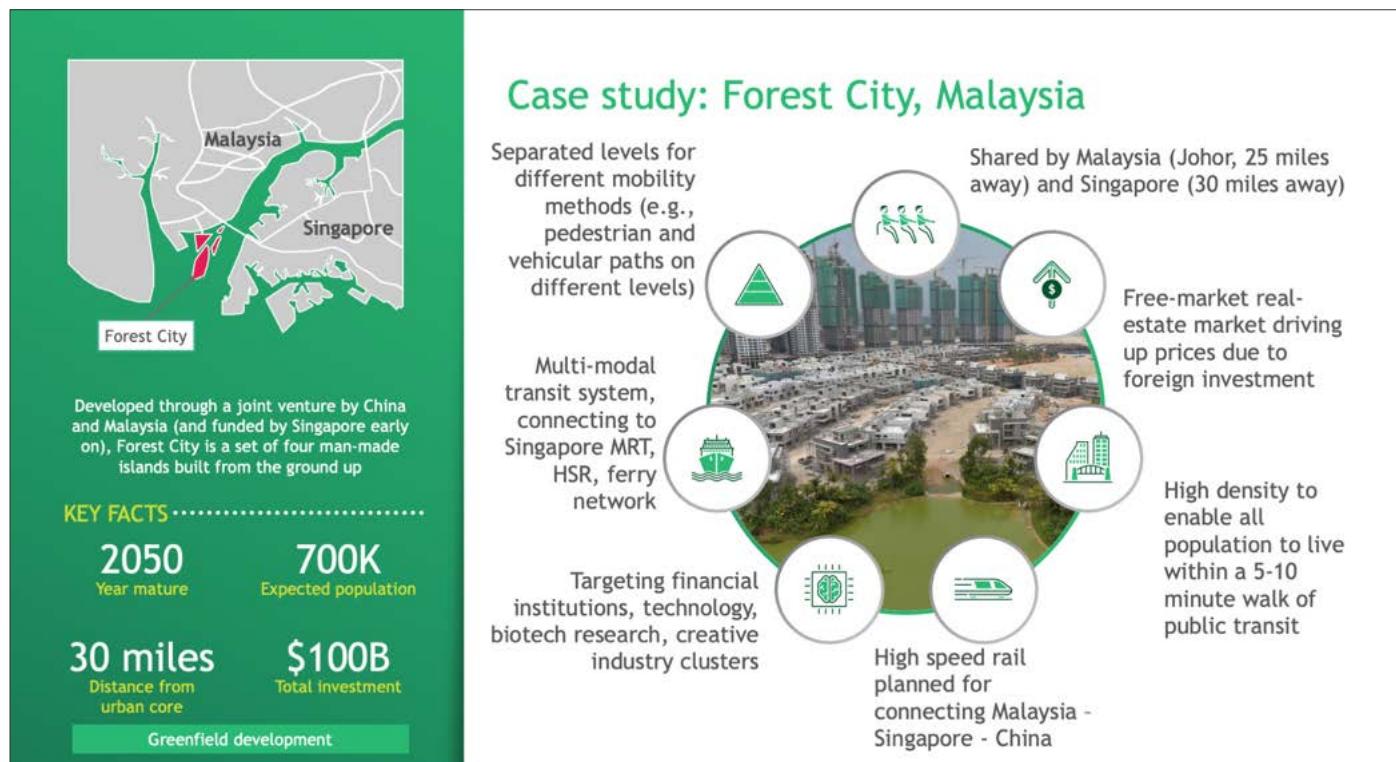
Source: Uppsala University

Figure A15: Hub city example: Xiong'an, China



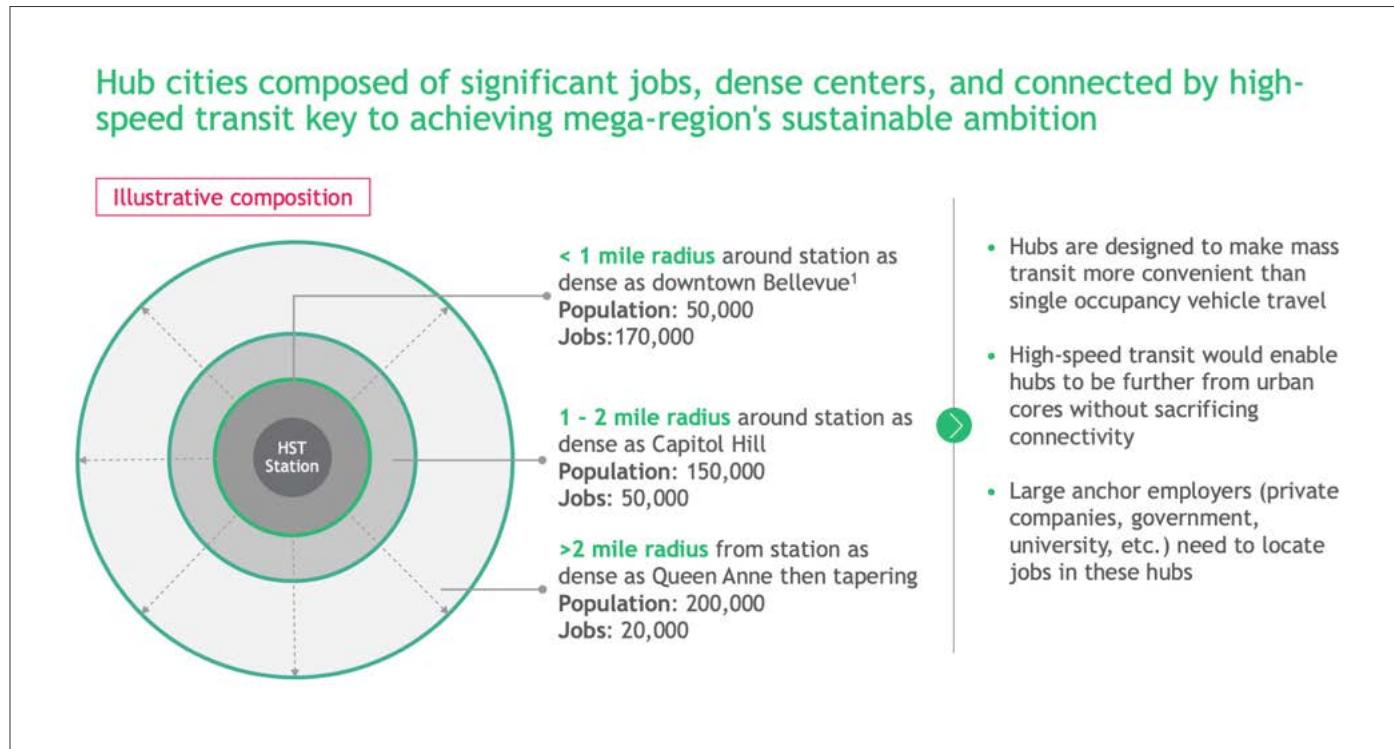
Sources: Brookings, Xinhua News, SOM, TLS

Figure A16: Hub city example: Forest City, Malaysia



Source: The Diplomat, Sasaki

Figure A17: Hub city composition



1. Approximately 12,000 residents and 50,000 jobs over 327 developable acres (0.5 sq mile)

Note: Assumes 60% labor force participation rate

Source: BCG analysis

