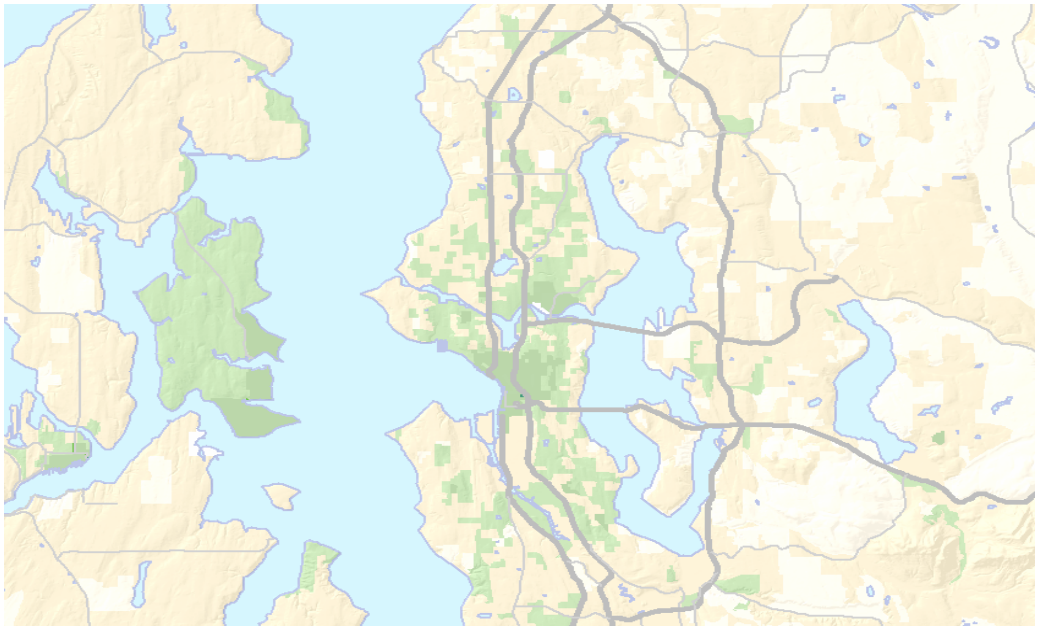
fueling up

Gasoline Consumption in the Pacific Northwest

OCTOBER 2002



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EXECUTIVE SUMMARY

- Gasoline use is a leading indicator of the Pacific Northwest's environmental and economic vitality because it is a principal cause of urban air pollution; the region's largest source of greenhouse gas emissions; and one of the region's most expensive imports, draining tens of millions of dollars from the local economy every week. It's also a proxy for sprawl.

- Over the last decade, from 1992 to 2002, the Northwest's thirst for gasoline grew with population—a 21 percent increase overall but only a 1 percent increase per person. On average, northwesterners each burn 7.7 gallons (29 liters) of gasoline a week—three times the volume of water they drink. Idahoans consume 9.7 gallons (37 liters) per week, Oregonians 8.5 gallons (32 liters), Washingtonians 8.4 gallons (32 liters), and British Columbians 5.5 gallons (21 liters). [1]

- British Columbia's lower consumption results mostly from the province's more compact communities and smaller road network: In greater Vancouver, for example, some 62 percent of residents live in neighborhoods with more than 12 people per acre, compared with roughly 25 percent of residents in greater Seattle and greater Portland. In such neighborhoods driving declines, and use of alternative transportation increases. And, per resident, Washington has a quarter more miles of streets and highways than BC, Oregon has two-thirds more, and Idaho has three times more.

- But British Columbia's fuel-efficiency leadership slipped in the last decade. Shifting demographics and the popularity of larger vehicles boosted per capita consumption 7 percent.

- Idaho, whose vehicles grew the largest and whose cities sprawled, registered a disheartening 12 percent jump in fuel use per resident over the decade. Trucks, including minivans and SUVs, increased from 41 to 56 percent of vehicles.

- In the last decade, Washington trimmed per capita gasoline consumption by 2 percent, trailed closely by Oregon, which logged a 1 percent reduction. These decreases pushed both states below the American average for the first time.

- Efforts against sprawl help explain the reductions. In King County, Washington, and Multnomah County, Oregon, higher neighborhood densities reduced drive-alone commuting and increased commuting by transit. Partly as a consequence, Washington and Oregon were the only two American states to show no significant increase in the share of commuters who drove alone to work in the 1990s.

- Although gasoline is about 10 percent cheaper in the Northwest states than in British Columbia, residents of the Northwest states buy so much more fuel that they spend about one-third more on gasoline each year. British Columbians also put less than half as much money per person into roadwork each year as their American counterparts.

- Within the Northwest states, residents of the most densely settled counties drive alone less. Over the 1990s, for every 100 additional employed residents, King County, Washington, added just 43 drive-alone commuters; next door, sprawling Pierce County added 89. In Oregon, Multnomah County added only 49 drive-alone commuters per 100 new employed residents, while Clackamas County actually added 110 per 100 as existing residents switched from alternatives to driving alone.
- Fuel economy stalled in the last decade after improving in the 1980s. Had northwesterners not traded their cars for trucks in droves in the 1990s, the improvements in vehicle technology would have slashed per capita fuel use.
- The benefits of compact communities and smaller road systems deserve consideration as the region makes big transportation decisions in the months ahead.
- Other innovative ways to reduce gas consumption include distance-based car insurance, variable tolls on urban highways, and incentives to buy efficient vehicles.

WHY GASOLINE MATTERS

Northwesterners' consumption of gasoline—the most common petroleum product, the linchpin fuel of the region's transportation system, and one of the region's most expensive imports—is a leading indicator of the region's progress toward environmental and economic resilience.[2] For this reason, Northwest Environment Watch (NEW) is monitoring gasoline use as one component of a new regional index of sustainability the organization is designing.

Gasoline consumption trends are an excellent indicator of regional progress because:

- **Gasoline consumption reveals whether vehicles and communities are fuel efficient.** It shows if northwesterners are improving our vehicles' fuel economy by, for example, adopting the next generation of efficient technologies such as hybrid gasoline-electric motors and fuel cell engines. It also reveals whether we're creating compact, efficient, mixed-use communities, where driving solo is but one choice among many—along with transit, carpooling, walking, and cycling.
- **Burning gasoline pollutes the air.** Gas-fueled vehicles are a leading source of air pollution in the Northwest's cities. Vehicles that consume more fuel generally send more noxious substances out their tailpipes. Compared with passenger cars, for example, light trucks (including SUVs and minivans) typically consume about a quarter more gasoline per mile than cars and emit roughly one-third more carbon monoxide and nearly 30 percent more cancer-causing particulates. They also emit more of the nitrogen oxides and hydrocarbons that react to form ozone, which causes respiratory illness.[3]

- **Burning gasoline destabilizes the climate.** Gasoline is the single largest source of greenhouse gas emissions from the Pacific Northwest. The carbon dioxide produced by burning gasoline makes up about one-quarter of the region's total climate-changing emissions (and one-third of emissions from fossil fuels).[4]

- **Drilling for and transporting fuel is risky.** Drilling for the oil from which gasoline is made endangers remote and sometimes fragile ecosystems: proposals are circulating to expand oil drilling into the Arctic wetlands of northern Alaska and the rich marine waters off British Columbia and California. Transporting oil and gasoline in ships and pipelines imperils both human and natural communities.

- **Paying for fuel saps the Northwest economy.** Well over half of northwesterners' spending at the pump immediately drains out of the regional economy. Idaho, Oregon, and Washington do not produce crude oil, and British Columbia produces less than a third as much as it consumes. Oregon and Idaho do not refine their own fuel. Dependency on oil also ties the Northwest's economy to politically unstable regions of the world. And the volatility of world oil markets leaves northwesterners vulnerable to recession-inducing price spikes.[5]

FUEL LEVEL

The Pacific Northwest's thirst for gasoline grew 21 percent over the decade ending in June 2002, rising in lockstep with population to 116 million gallons (438 million liters) a week (see Figure 1). At that pace the Pacific Northwest consumes enough fuel to fill the world's largest supertanker every 12 days. With a slowing economy, per capita consumption—up 1 percent over the decade—dipped slightly after spring of 1999, so the region's total consumption has since remained level despite continued population growth.[6]

This steady population-driven rise is remarkable for two reasons. First, thanks to lower consumption in Washington and Oregon, the Northwest's per capita gasoline consumption rose just 1 percent during a decade when incomes soared and fuel prices remained relatively low. Between 1950 and the late 1970s, economic growth and gasoline demand seemed joined at the hip; over the last two decades, in contrast, per capita consumption has seemed only loosely tethered to income trends (see Figure 2). In fact, vehicle numbers per capita stabilized in much of the region during the 1990s, and distance driven per person grew only slowly. Improving transit service and "smart-growth" development patterns interrupted previously unrelenting rises in these two variables.[7]

Second, the region's leveling-off of fuel use occurred during a decade when vehicles grew larger: trucks (including SUVs and minivans) overtook cars in number in Idaho and Oregon and gained on them in Washington and British Columbia. The phenomenal pace of technological innovation during the 1990s and the rapid turnover in the vehicle fleet brought on by a strong economy combined to prevent backsliding in fuel economy. New vehicles rolling out of showrooms in the region are no less efficient than the old vehicles being junked elsewhere in the region.[8]

Figure 1. The Northwest's total gasoline consumption rose in step with population growth over the last decade

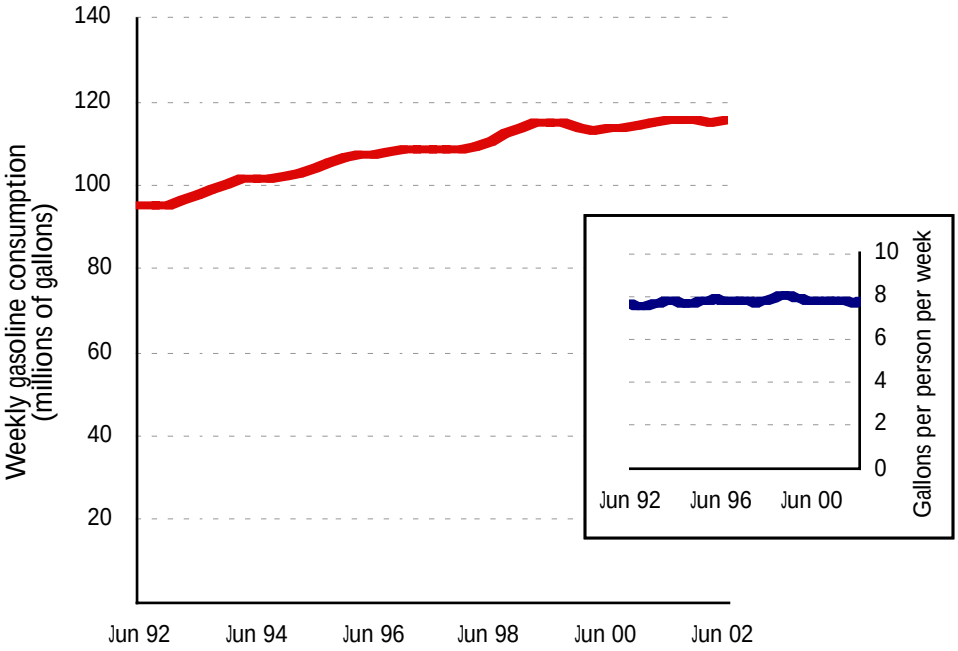
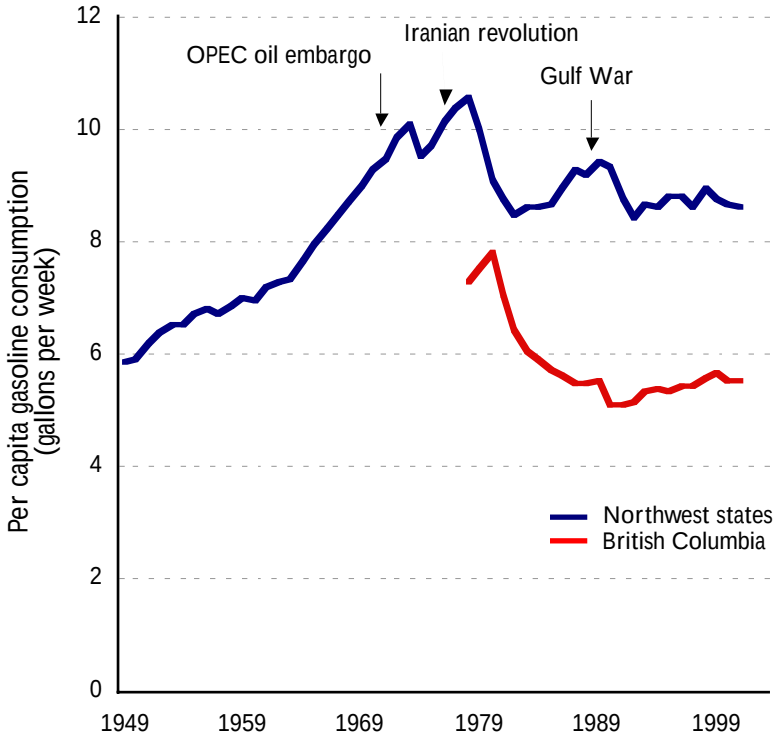


Figure 2. The Northwest's per capita gasoline consumption is lower than it was 20 years ago but still higher than in 1967



Northwesterners consume less gasoline per person than they did 20 years ago (although per capita figures are still higher than in 1967). But had northwesterners not traded their cars for trucks in record numbers, the same pace of technological improvements in fuel economy would have brought steep declines in per capita fuel consumption in the last decade, as it did during the early 1980s. Instead, the average fuel economy of the Northwest states' vehicles improved steadily during the 1970s and 1980s but remained stalled during the 1990s.[9]

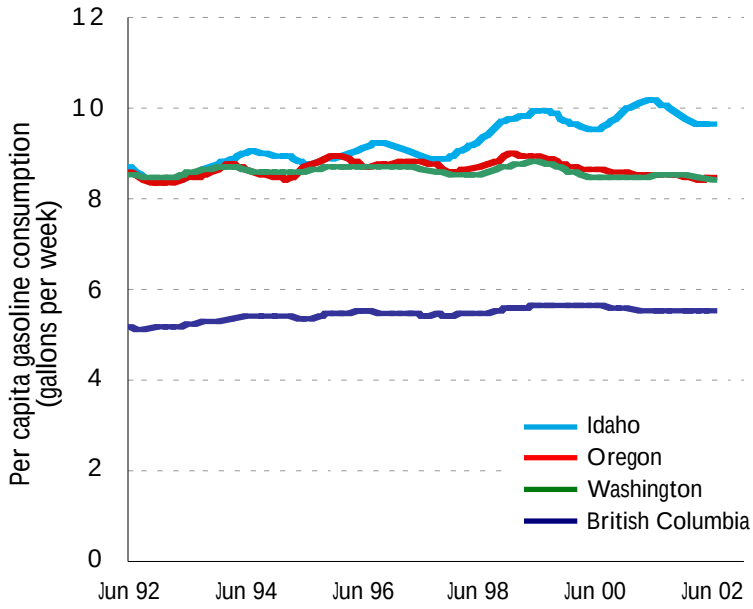
THE BC DIFFERENCE

Regionwide figures conceal radically different patterns of gasoline demand on the two sides of the 49th parallel: Oregonians consume 8.5 gallons (32.1 liters) per week, Washingtonians 8.4 gallons (31.8 liters), Idahoans 9.7 gallons (36.7 liters), and British Columbians 5.5 gallons (20.9 liters). In other words, residents of the Northwest states use fully 56 percent more gasoline per person—and emit proportionately more pollution—than their BC neighbors (see Figure 3).[10]

British Columbia's lower fuel consumption results partly from the province's lower incomes and higher gas taxes. But most of the difference seems to flow from the province's leadership—relative to the Northwest states—in developing compact communities.

Studies of 100-odd cities on four continents have found that neighborhood density is the single most important determinant of how much driving people do—a more critical factor than gas prices, personal incomes, transit service, and details of neighborhood planning. As density tops 12 people per acre (30 people per hectare),

Figure 3. Gas consumption trends varied significantly by location in the last decade



driving declines and use of transit and other alternatives increases. In greater Vancouver—home to nearly half of all British Columbians—some 62 percent of residents live in neighborhoods of more than 12 people per acre, compared with 25 and 24 percent in greater Seattle and greater Portland, respectively. A typical car or truck in greater Vancouver travels 15 miles (24 kilometers) per day; in greater Seattle, its counterpart goes at least 19 miles (31 kilometers).[11]

Behind British Columbia's relative success at concentrating urban growth is, among other things, its smaller road network. High-capacity roads abet sprawling auto-oriented development, while transit investments provide effective alternatives to driving.

Compared with the Northwest states, the province has few urban and suburban freeways. In fact, it has fewer roads of all types (except for logging roads): for each resident, Washington has a quarter more miles of streets and highways than BC, Oregon has two-thirds more, and Idaho has three times more. Their smaller road network saves BC taxpayers a bundle: they put less than half as much money per capita into roadwork each year as their American counterparts and half as large a share of their economic output.[12]

Interestingly, the consequence of more densely settled cities with fewer roads is not a disastrous tangle of gridlock. Vancouver's transportation system, for example, although it leaves much to be desired, may suffer less congestion than Portland's or Seattle's even while costing taxpayers and drivers less (see below). Congestion may be a red herring. In the Northwest's large metropolitan areas, where vehicles typically outnumber licensed drivers, vehicle congestion tends to expand like a gas, filling the space available. Over the long term, seeking to ease congestion by building or widening roads may be self-defeating because of the sprawl—and people and cars—that follows roads.[13]

High-capacity roads abet sprawling auto-oriented development, while transit investments provide effective alternatives to driving

Nevertheless, Vancouver's record in gas consumption—while impressive for a northwestern city or even in comparison with compact, transit-oriented American cities like Chicago and New York—is not the best in Canada and pales in comparison to most European and Asian cities. In 1990 Vancouver used 11 percent more energy to transport each resident than Toronto or Ottawa; it used 50 to 100 percent more than Amsterdam, Copenhagen, London, Munich, Paris, Vienna, or Tokyo.[14] (Vancouver is roughly half as dense as the European cities mentioned and about a third as dense as Tokyo.)

Disturbingly, British Columbia's leadership slipped some during the past decade, when per capita gasoline consumption rose by 7 percent. Total consumption, spurred by surging population, rose 29 percent to nearly 23 million gallons (86 million liters) a week from 1992 to 2002, faster than the population growth rate of 20 percent. But the province's per capita consumption of 5.5 gallons (20.9 liters) per week remained slightly below the Canadian national average of 5.8 gallons (21.9 liters).[15]

The main cause of rising per capita consumption may be shifting demographics. In BC the number of licensed drivers rose 50 percent faster than population—largely

the result of an aging population and fewer children—while in the Northwest states the number of licensed drivers grew more slowly than population. But the growing popularity of larger vehicles in BC also certainly steepened the increase in fuel use, possibly more than in the US Northwest. During the 1990s the number of large vehicles registered in BC increased by nearly half, even as the number of small cars fell by more than a third.[16]

NORTHWEST STATES: DIVERGING

In a welcome shift, Washington and Oregon reduced their per capita gas consumption by 2 percent and 1 percent, respectively, in the last decade. Oregon trimmed its per capita consumption to 8.5 gallons (32.1 liters) per week, and Washington to 8.4 gallons (31.8 liters). At the tail end of the 1990s, both states dipped below the national average for the first time since records have been kept.[17]

This positive trend may be linked to the efforts of Washington's and Oregon's major metropolitan areas to foster compact, "smart-growth" neighborhoods (see next section). Even so, rising populations—a growth rate of 18 percent in both Washington and Oregon over the last decade—added to the total demand for gasoline. Oregon, now burning almost 30 million gallons (112 million liters) a week, consumes 17 percent more than it did a decade ago. Washington, at 51 million gallons (192 million liters) a week, also uses 17 percent more than it did ten years ago.[18]

Idaho, however, topped even BC's increases in per capita gas consumption. After mirroring trends in Oregon and Washington during the 1980s, when its economy was slack, Idaho increased its per capita gasoline consumption by 12 percent in the last decade, a gallon more gas per person, weekly. Total gas consumption in the state grew 41 percent overall—significantly more than the population growth rate of 25 percent—to a total of 13 million gallons (49 million liters) weekly.

Rural residents tend to use more gasoline per capita than do city dwellers, and Idaho is more rural than Oregon or Washington. But this difference cannot explain Idaho's rapid increase in gas consumption during the 1990s, because Idaho also urbanized more rapidly than the other two states. The probable causes for the state's increase lie elsewhere: its cities sprawled more than Oregon's or Washington's, its truck population burgeoned from 41 to 56 percent of all vehicles, and its transit systems languished over the decade. Today, Idaho residents use about 15 percent more gasoline per person than do residents of Washington, as was the case in the 1950s through the 1970s.[19]

DRIVING ALONE

A full understanding of trends in gasoline use requires a look at changes at the local level, neighborhood by neighborhood. Unfortunately, no one consistently gathers data on gasoline consumption at geographic scales smaller than the state or province, but both Canadian and American censuses collect information all the way to the household level on how people commute to work. This information sheds light on

gasoline consumption, because commuting accounts for a larger share of driving than any other single purpose: 28 percent of miles driven in the greater Seattle area, for example.[20]

The 2001 Canadian census data on commuting are not yet published, but the US Census Bureau recently released its relevant data from the 2000 census. These data underline the importance, if the Northwest is to moderate gasoline consumption, of corralling growth into compact, transit-oriented neighborhoods.

As noted earlier, international studies have shown that as density increases, driving declines. And, statistically, in the Northwest states, residential density is an excellent predictor of how people get to work. Northwesterners who live in low-density, auto-oriented communities—those with fewer than 12 people per acre—usually drive alone. But as density increases, so do transit ridership, bicycling, and walking. And car trips get shorter.[21]

The correlation between lower densities and driving alone is strong in all the Northwest counties for which data are available. For example, in the region's two densest counties (King, which includes Seattle and one-third of Washington's population, and Multnomah, which includes Portland and one-fifth of Oregon's population), every additional resident per acre in a neighborhood generally lowers the share of commuters who drive alone to work by an additional percentage point (see Figures 4 and 5).[22]

Sprawling, low-density suburbs (such as Newcastle and much of Redmond in the Seattle area and the Portland zone stretching from Vancouver to Camas, Washington, all of which have below five residents per acre) send more than 80

Figure 4. King County, Washington, commuters who live in more-compact neighborhoods use public transit more and drive alone less

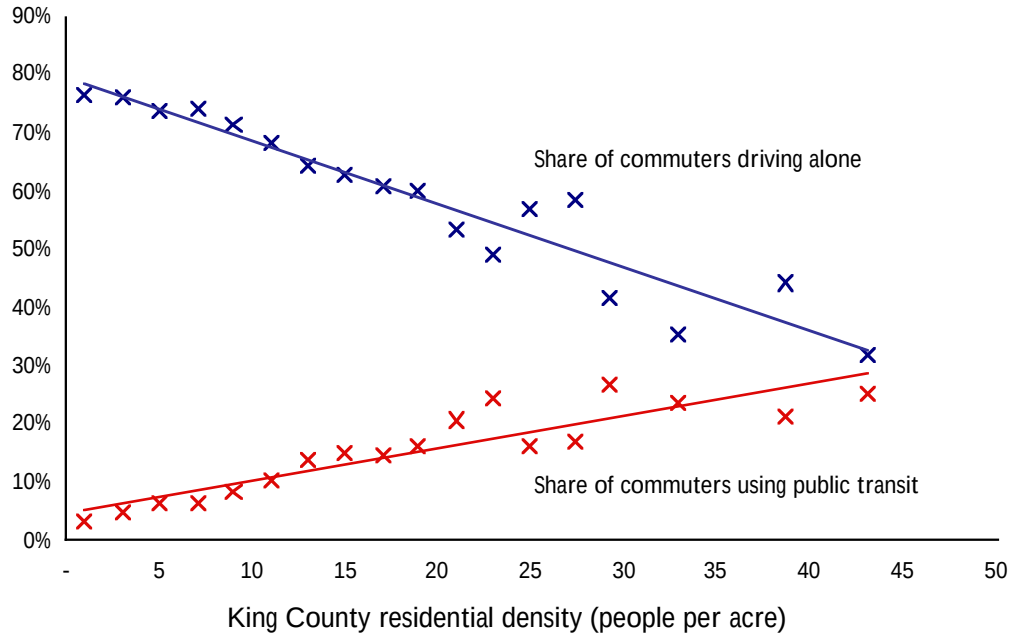
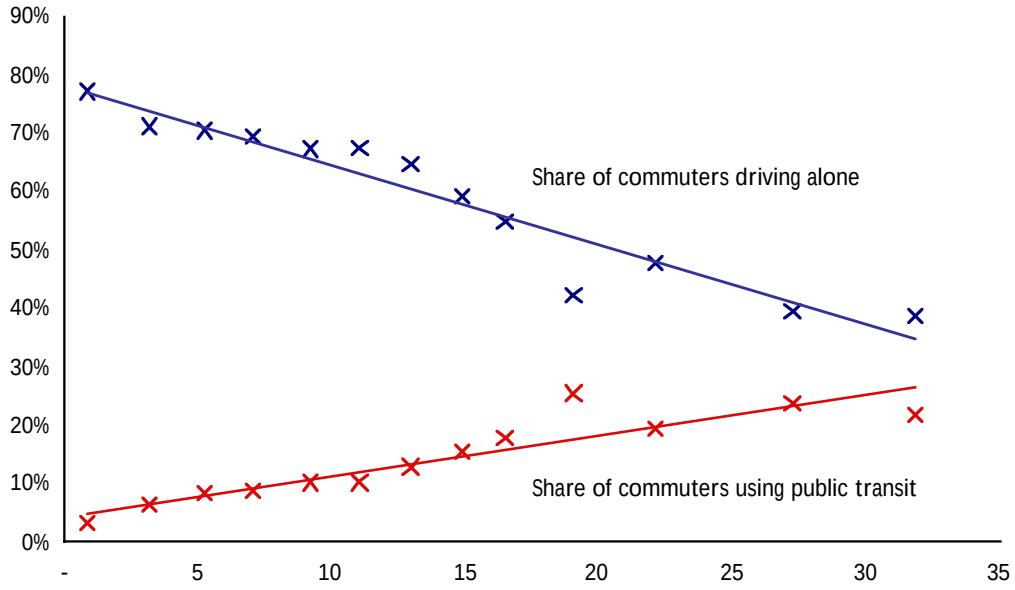


Figure 5. Multnomah County, Oregon, shows the same trend



percent of their residents to work alone by car. In communities with more than about 25 people per acre—the density of neighborhoods such as downtown Portland, Seattle's Capitol Hill, and University District—more than half of commuters use modes of travel besides driving alone (see Maps 1 and 2).[23]

As density varies among Northwest jurisdictions, so do commuting habits (see Table 1). Seattle, where only 58 percent of commuters drive alone, leads the US Northwest in transportation alternatives, and Portland is not far behind. But sprawling suburban Snohomish and Pierce Counties do substantially worse than King County, just as greater Portland's suburban counties—Clackamas, Clark, and Washington—lag behind Multnomah. (On the other hand, greater Vancouver, BC, did better than any of the US Northwest jurisdictions, with roughly only 60 percent of commuters driving alone in 1996, the last year for which data are available. And the city of Vancouver only had 47 percent drive-alone commuting in 1996.)[24]

The variations among Northwest jurisdictions widened over the decade. King and Multnomah Counties, for example, reduced the share of their residents who drive alone, while suburban counties such as Clackamas and Pierce shifted toward more solo commuting. Still, the region's efforts at stemming sprawl and filling in existing communities with new transit- and pedestrian-oriented developments paid off handsomely overall. In the 1990s Washington and Oregon were the only two American states to show no significant increase in the share of commuters who drove alone to work (see Table 2). Among American states Oregon ranks ninth, and Washington tenth, in the share of people who carpool, ride transit, walk, or bike to work. Idaho commuters drive alone at the national rate.[25]

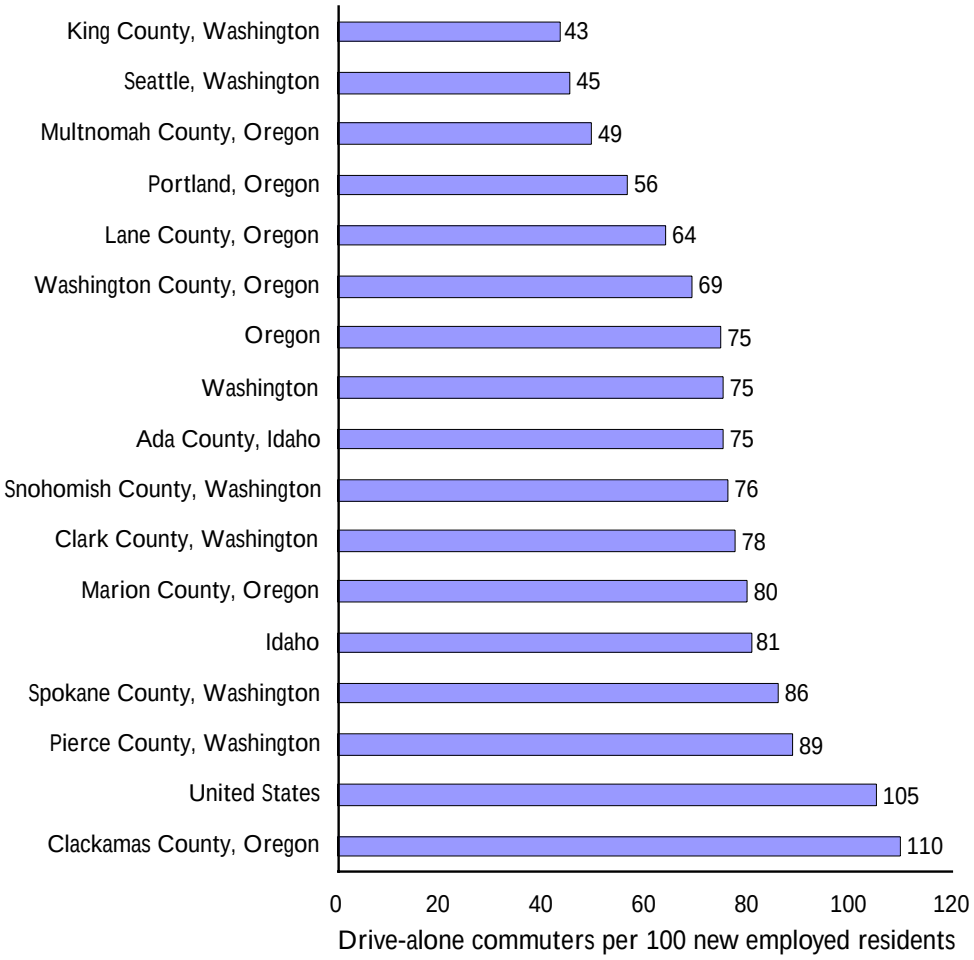
Table 1. Seattle and Portland lead the Northwest at getting commuters out of their cars

County or city (largest city)	State	Percentage of workers driving alone, 2000
Seattle	Washington	58%
Portland	Oregon	63%
Multnomah County (Portland)	Oregon	65%
King County (Seattle)	Washington	69%
Lane County (Eugene)	Oregon	72%
Washington County (Beaverton)	Oregon	75%
Marion County (Salem)	Oregon	75%
Snohomish County (Everett)	Washington	78%
Pierce County (Tacoma)	Washington	78%
Spokane County (Spokane)	Washington	79%
Ada County (Boise)	Idaho	79%
Clark County (Vancouver)	Washington	80%
Clackamas County (Oregon City)	Oregon	82%
State of Oregon		**74%**
State of Washington		**74%**
State of Idaho		**76%**
United States		**76%**

Table 2. The Northwest's major metropolitan areas have reduced drive-alone commuting

County or city (largest city)	State	Change in the percentage of workers driving alone, 1990–2000
King County (Seattle)	Washington	–2.9
Multnomah County (Portland)	Oregon	–2.4
Washington County (Beaverton)	Oregon	–1.9
Ada County (Boise)	Idaho	–1.8
Portland	Oregon	–1.7
Lane County (Eugene)	Oregon	–1.6
Clark County (Vancouver)	Washington	–0.9
Seattle	Washington	–0.8
Snohomish County (Everett)	Washington	–0.4
Spokane County (Spokane)	Washington	1.3
Marion County (Salem)	Oregon	1.8
Pierce County (Tacoma)	Washington	1.8
Clackamas County (Oregon City)	Oregon	3.6
State of Oregon		**0.2**
State of Washington		**0.2**
State of Idaho		**1.4**
United States		**3.1**

Figure 6. From 1990 to 2000, Pierce County, Washington, added twice as many drive-alone commuters for every 100 new employed residents as did King County



Another lesson of these data is that different growth management and transportation patterns yield radically different impacts on rush hour traffic around the Northwest (see Figure 6). During the 1990s, for every 100 new workers added to King County—where growth in compact neighborhoods accounted for 66 percent of total population increase—just 43 new drive-alone commuters made their way onto the roads; in Multnomah County, for every 100 new workers, the rolls of drive-alone commuters grew by 49.

In contrast, adding new people to outlying suburban areas means injecting more cars into the roadways. Places like Clackamas County, Oregon, actually added 110 new drive-alone commuters for every 100 new workers as existing residents switched from alternative transportation to driving alone. Pierce County, Washington—where growth in low-density sprawl accounted for 81 percent of population increase—added 89 new drive-alone commuters for every new 100 workers.

PAYING AT THE PUMP

Changing prices, of course, also explains some of the ups and downs of gasoline use. A 10 percent increase in gas prices typically reduces consumption by about 2.5 percent over the short term (as people reduce discretionary travel and switch to more-efficient vehicles they already own) and by about 9 percent over the long term (as people purchase more-efficient vehicles and adjust their routine travel plans and destinations).[26] High prices were the main cause of the sharp declines in consumption associated with the OPEC oil embargo, Iranian revolution, and Gulf War (see Figure 1). Each dip in consumption also coincided with a recession induced by the price hike. Rising prices also explain some of the decline in consumption per person since 1999.

But, curiously, higher prices within the region—a product of higher gas taxes, since the pretax price of gasoline stays remarkably consistent across the continent—are associated with lower overall spending. Idahoans pay less for each gallon but more over the year, British Columbians vice versa (see Table 3). Overall, spending on gasoline lightened northwesterners' wallets by $9.3 billion (Can$15.4 billion) in 2001, including $4 billion in Washington, $2.3 billion in Oregon, nearly $1 billion in Idaho, and Can$3.1 billion (US $2 billion) in BC.[27]

Table 1. British Columbians pay more for each gallon of gasoline but less each year

	Annual spending on gasoline per licensed driver (US$)	Averagegasoline price per gallon (US$)
British Columbia	$709	$1.65
Oregon	$915	$1.50
Washington	$930	$1.48
Idaho	$1,082	$1.45

Sources: see endnote 27.

EASING OFF THE GAS

In the months ahead, each of the Northwest's jurisdictions confronts decisions on proposals that could shape cities—and trends in driving and gas consumption—for years to come: a $1.75 billion monorail and a $2.5 billion light-rail line in Seattle; a Can$2 billion combined Skytrain/subway to the airport in Vancouver, BC; a Can$700 million highway-widening project from Vancouver to Whistler for a Winter Olympics bid; massive suburban development plans and regional proposals for highway expansions and commuter rail in Idaho; a December decision on expanding the urban growth boundary around Portland; and a $7.7 billion transportation spending referendum in Washington State that devotes almost $6 billion to highway projects.

What do trends in gas consumption and commuting suggest about such decisions? If the BC's example of limiting fuel outlays has a lesson, it is that compact communities are the key to lower fuel use.

Specific methods of making communities more compact include allowing more in-fill development, such as accessory dwelling units; freeing developers from counterproductive regulations like minimum parking requirements; and adjusting zoning codes to allow neighborhood integration of residences and work space. They also include investing in infrastructure that supports close-in neighborhoods, such as parks, bike lanes, and schools, and integrating planning of economic development, transportation, and housing.

Another powerful way to foster compact cities is to restrain the growth of roads. If northwesterners want livable, economically efficient, and sustainable cities, they should judge transportation and land use proposals not in light of their short-term relief of traffic congestion but in light of their impacts on urban form. Transportation investments that foster compact, mixed neighborhoods close to town centers deserve support.

Another effective way to moderate gasoline consumption is to make the costs of driving correspond more directly with the amount of driving we do—to give consumers opportunities to save money by staying off the roads. A promising example of this approach is to sell car insurance by the mile, an idea that has been tested in Texas and will be introduced in the Oregon legislature in its 2003 session.

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Car insurance is currently sold like an all-you-can-eat meal plan: consumers receive only minimal discounts for driving less, even though higher-mileage drivers are more likely to have collisions. Consequently, car insurance overcharges those who drive little and undercharges those who drive much. A proposed bill in Oregon would encourage insurers—through the use of incentives—to offer plans that offer per mile premiums, as well as standard considerations like driving record. The potential gasoline savings are enormous: households that pay for their insurance by the mile reduce their driving by an estimated 10 percent.[28]

The costs of driving can also be made more variable through "value pricing," or variable tolls—a tool that many transportation experts agree is the only real solution to worsening gridlock. "Phantom tollbooth" scanners would deduct tolls from prepaid smart cards posted on cars' dashboards; the tolls would rise as rush hours approach and taper off as traffic dwindles. Demonstrated successfully in Ontario and southern California, such tolls could generate more than $2 billion annually in the Northwest to pay for transportation improvements or offset other taxes. Long debated in the Northwest, value pricing will finally get its first road test soon: the Puget Sound Regional Council is preparing to launch a pilot project in the Seattle area.[29]

A final strategy for slaking the region's thirst for motor fuel is to reinvigorate the process of improving vehicles' fuel economy. Unfortunately, this year, the US Congress declined to lead this process by failing to pass ambitious increases in fuel-economy

standards for new cars and trucks. But the Northwest's state and provincial governments can still proceed, as California has, by promoting highly efficient cars, such as hybrid gasoline-electric vehicles, with tax incentives and state air regulations.

Better, they could implement "feebates"—fees charged to the buyers of less-efficient vehicles and rebates to the buyers of more-efficient ones—that systematically nudge consumers away from gas guzzlers. As average efficiency increases, the feebates reset themselves around the new average, manufacturers raise their wares' efficiency to compete, and consumers set their sights still higher. Efficiency snowballs.

In combination, these strategies—compact communities, by-the-mile insurance, value pricing, and fuel-economy incentives—can help northwesterners slash their eight-gallon-a-week gasoline diet while actually improving their mobility. Along the way, they'll help clear the air, secure the climate, and revitalize the regional economy.

REVIEWERS

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ABOUT NORTHWEST ENVIRONMENT WATCH

Northwest Environment Watch (NEW) is a Seattle-based, nonprofit research and communication center that monitors progress toward an environmentally sound economy and way of life in the Pacific Northwest, a region that includes British Columbia, Washington, Oregon, Idaho, and adjoining parts of Alaska, Montana, and California. NEW has published 13 books since 1993. This analysis expands on research completed for NEW's most recent publication, *This Place on Earth 2002:*

Measuring What Matters, the first product of the group's multiyear project to develop an index of true progress for the Northwest.

In summer 2002 NEW released another component of this index—a measure of the pace of sprawl. Other indicators will follow during 2003, culminating in the unveiling of the full index in early 2004.

Authors of this report include Alan Durning, executive director; Clark Williams-Derry, research director; Eric de Place, research associate; and Dan Bertolet, research consultant. Tim Schaub of CommEn Space, Seattle, conducted geographical information system (GIS) research and analysis. For more information about NEW and NEW publications, please see *www.northwestwatch.org.*

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SOURCES AND NOTES

1. For this report, the Northwest comprises British Columbia, Idaho, Oregon, and Washington. Drinking water consumption estimated as equal to the US national rate (5.3 cups per person per day), reported from a survey by Wirthlin Worldwide for the International Bottled Water Association, "Excerpts from February National Quorum™ Findings," Feb. 22, 2002, at *www.bottledwater.org/public/bwsurvey.htm*. Metric conversions may not appear equivalent to US figures because of rounding.

2. In this report the term *gasoline* includes gasoline and gasoline-alcohol mixtures used on the highway but excludes diesel fuels.

3. Emissions from cars and light trucks from Office of Transportation and Air Quality, "Emissions Facts: Average Annual Emissions and Fuel Consumption for Passenger Cars and Light Trucks," US Environmental Protection Agency (EPA), Apr. 2000, at *www.epa.gov/otaq/consumer/f00013.pdf*. Additional information on the costs of auto-related air pollution available from Victoria Transportation Policy Institute (VTPI), "Air Pollution," sec. 5.10 in *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications* (Victoria: VTPI, 2002), at *www.vtpi.org/tca/tca0510.pdf*.

4. Share of greenhouse gas emissions calculated from sources in notes 63 and 65–67 in *This Place on Earth 2002: Measuring What Matters* (Seattle: Northwest Environment Watch [NEW], 2002); and *Over Our Heads: A Local Look at Global Climate* (Seattle: NEW, 1997).

5. Share of gasoline spending that leaves the region estimated from US Energy Information Administration (EIA), "What We Pay For in a Gallon of Regular Gasoline," *tonto.eia.doe.gov/oog/info/gdu/gaspump.html*, Oct. 2002. Northwest states' petroleum production and refineries from EIA, "Petroleum Profile," by state, *www.eia.doe.gov/emeu/states/_states.html*, Oct. 2, 2002. BC crude oil production and consumption from BC Ministry of Energy and Mines (BCMEM), *Oil and Gas in British Columbia: Statistics and Resource Potential* (Victoria: BCMEM, 2001), at *www.em.gov.bc.ca/dl/Ogi/Oil&Gas_stats99-00.pdf;* Canadian Association of Petroleum Producers, *www.capp.ca/default.asp?V_DOC_ID=674*, Oct. 7, 2002; and StatCan, "Table 128-0002: Supply and Demand of Primary and Secondary Energy in Terajoules, Quarterly," CANSIM II, *cansim2.statcan.ca*, Aug. 17, 2001; data for 2000 estimated from the year's first two quarters.

6. Gasoline consumption in Washington, Oregon, and Idaho derived from Office of Highway Policy Information (OHPI), "Section I: Motor Fuel, Table MF-21" and "Section 4: Highway Finance, Table MF-27," in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: US Federal Highway Administration [FHWA], 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm;* EIA, "Transportation Fuels: Prime Supplier Sales," by state,

www.eia.doe.gov/emeu/states/_states.html, Oct. 2002; and Claudia Hernandez, National Energy Information Center, private communication, Aug. 7, 2002; in BC from StatCan, "Table 128-002: Supply and Demand of Primary and Secondary Energy in Terajoules, Quarterly" CANSIM II, *cansim2.statcan.ca*, Sep. 20, 2002; and Dave Barnett, Tax Policy Branch, Victoria, private communication, July 2002. Contact NEW for details about gasoline consumption estimates in each location.

7. Vehicle miles traveled for Northwest states from OHPI, "Section V: Roadway Extent, Characteristics, Performance, Table VM-2," in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: FHWA, 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm*. Motor vehicle fleet in the Northwest includes passenger cars, light and heavy trucks, and all other commercial, government, and private vehicles intended for roadway use except motorcycles, golf carts, trailers, and farm vehicles. Vehicles in Washington, Oregon, and Idaho from OHPI, "Section II: Motor Vehicles, Table MV-1," in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: FHWA, 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm;* in BC from StatCan, "Table 405-0001: Road Motor Vehicle, Trailer, and Snowmobile Registration, Annual (Registrations)," CANSIM II, *cansim2.statcan.ca;* and BC Stats, "British Columbia Licensed Passenger Vehicles as at December 31" and "British Columbia Licensed Commercial Vehicles as at December 31," at *www.bcstats.gov.bc.ca/data/dd/handout/mvlic.pdf*.

8. Numbers of cars and trucks from sources in note 7. Flattening of average fleet fuel efficiency calculated from sources in notes 6 and 7.

9. Fuel economy of Northwest states' vehicles estimated from sources in notes 6 and 7.

10. Per capita gasoline consumption from sources in notes 6 and 15 and US Census Bureau, "State and County QuickFacts," *quickfacts.census.gov/qfd*, Oct. 4, 2002; US Census Bureau, "Intercensal Estimates," *eire.census.gov/popest/data/counties/tables/CO-EST2001-12.php;* Washington Office of Financial Management, "Forecast of the State Population by Age and Sex: 1990 to 2030," Nov. 2001 at *www.ofm.wa.gov/popagesex19702020/StPopfrcst_1101.pdf;* Oregon Office of Economic Analysis, Oregon Economic and Revenue Forecast, "Appendix C" (Salem: Dept. of Administrative Services, 2001), at *www.oea.das.state.or.us/economic/forecast0902.pdf;* and BC Stats, "BC Level Population Projection – 01/04," *www.bcstats.gov.bc.ca/data/pop/pop/bcproj.htm*, Oct. 4, 2002.

11. Density thresholds from Peter Newman and Jeffrey Kenworthy, *Sustainability and Cities: Overcoming Automobile Dependence* (Washington, DC: Island Press, 1999). Share of residents in compact greater Vancouver neighborhoods from NEW, "Sprawl and Smart Growth in Metropolitan Vancouver, BC," Sep. 2002, at *www.northwestwatch.org/press/vancouvergrowth.html;* in greater

Seattle, from NEW, "Sprawl and Smart Growth in Greater Seattle-Tacoma," July 2002, at *www.northwestwatch.org/press/seattlegrowth.html;* in greater Portland, from "Sprawl and Smart Growth in Metropolitan Portland," May 2002, at *www.northwestwatch.org/press/portlandgrowth.html.* Greater Vancouver refers to the Greater Vancouver Regional District (GVRD). Greater Seattle refers to the urbanized portions of King, Snohomish, and Pierce Counties, Washington. Greater Portland refers to the urbanized portions of Multnomah, Washington, and Clackamas Counties, Oregon, and Clark County, Washington. Vehicle kilometers traveled in greater Vancouver from Policy and Planning Dept., *2001 Annual Report: Livable Region Strategic Plan* (Brunaby: Greater Vancouver Regional District, 2001), at *www.gvrd.bc.ca/services/growth/pubs/LRSP2001.pdf.* Vehicle miles traveled in greater Seattle from Puget Sound Regional Council (PSRC), "Growth in Traffic and Vehicle Miles Traveled," *Puget Sound Trends,* Aug. 2002, at *www.psrc.org/datapubs/pubs/trends/t2trend.pdf;* PSRC, "Traffic Congestion in the Central Puget Sound Region," *Puget Sound Trends,* July 1997, at *www.psrc.org/datapubs/pubs/trends/t6trend.htm;* and Larry Blain, PSRC, private communication, Oct. 11, 2002. FHWA estimates vehicle-miles traveled for the three Northwest states at 26.3 per capita per day from op. cit. OHPI, "Section V. . . Table VM-2," note 7.

12. Roads, transit, and development from Newman and Kenworthy, op. cit. note 11. Road length in BC from BC Ministry of Transportation (BCMoT), *Annual Report 1977–78* to *1993–94* (Victoria: BCMoT [former Ministry of Transportation and Highways], 1978 to 1994); and Debra Crozier-Smith, Communications Branch, BCMoT, Victoria, BC, private communication, July 24, 2001; Dan Carsen, Municipal Financial Services Branch, Ministry of Municipal Affairs, Victoria, private communication, Nov. 9, 1995; Ministry of Community, Aborginal, and Women's Services (MCAWS), yearly *Local Government Statistics,* "Municipal Statistics, Schedule 3," *www.mcaws.gov.bc.ca/lgd/srvs_infra/munfin/index.htm,* July 12, 2001; and Neil Goldie, Municipal Financial Services Branch, MCAWS, Victoria, private communication, July 13, 2001. Road length in Northwest states from OHPI, "Section V: Roadway Characteristics and Performance, Table HM-20," in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: FHWA, 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm*. Road spending in Northwest states from OHPI, "Section IV: Highway Finance, Table FA-21, Table SF-2, Table LGF-2" in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: FHWA, 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm;* in BC from BCMoT, "Financial Report," in *Annual Performance Report 1995–1996* to *2000–2001* (Victoria: Ministry of Management Services, 1997–2002) at *www.publications.gov.bc.ca/queries/cuspubcont.asp?move=1&MIN_Ministry=Transportation;* MCAWS, yearly *Local Government Statistics,* "Municipal Statistics, Schedule 10," *www.mcaws.gov.bc.ca/lgd/srvs_infra/munfin/index.htm;* and Harriet Permut, Union of BC Municipalities, private communication, Oct. 15, 2002.

13. Tendency of congestion to expand with road capacity from Todd Litman, "Generated Traffic: Implications for Transport Planning," *ITE [Institute of Transportation Engineers] Journal,* April 2001, at *www.ite.org/library/itejournal/index.htm*.

14. Transportation energy consumption in world cities from Newman and Kenworthy, op. cit. note 11.

15. Canadian gasoline consumption, for the one-year period ending on Sep. 30, 2001, from StatCan, "Table 128-0003: Supply and Demand of Primary and Secondary Energy in Natural Units, Quarterly," Oct. 3, 2002, CANSIM II, *cansim2.statcan.ca;* Canadian population from StatCan, "Table 051-0001,2,3: Estimates of Population, Canada, Provinces and Territories," Oct. 3, 2002, CANSIM II, *cansim2.statcan.ca.*

16. Changing demographics in BC from StatCan, "Table 051-0001: Estimates of Population, by Age Group and Sex, Canada, Provinces and Territories, Annual," CANSIM II, *cansim2.statcan.ca,* Oct. 2, 2002; in the Northwest states from US Census Bureau, "DP-1. General Population and Housing Characteristics: 1990," by state, and "DP-1. Profile of General Demographic Characteristics: 2000," by state, *www.census.gov,* Oct. 2, 2002. Share of large and small vehicles in BC from sources in note 7.

17. US gasoline consumption from sources in note 6. US population 1949–90 from US Census Bureau, "Historical National Population Estimates, July 1, 1900, to July 1, 1999," *eire.census.gov/popest/archives/pre1980/popclockest.txt,* Oct. 10, 2002; for July 1990 through March 2000, from US Census Bureau, "National Intercensal Estimates," *eire.census.gov/popest/data/national/tables/intercensal/intercensal.php,* Oct. 10, 2002; for April 2000 through July 2002, from US Census Bureau, "Monthly National Population Estimates," *eire.census.gov/popest/data/national/tables/NA-EST2001-04.php,* Oct. 10, 2002.

18. Gasoline consumption from sources in note 6.

19. Pace of sprawl relative to that of population growth in Idaho, Oregon, and Washington from Natural Resources Conservation Service, *Summary Report: 1997 National Resources Inventory (Revised December 2000)* (Washington, DC: US Dept. of Agriculture, 2000), at *www.nhq.nrcs.usda.gov/NRI/1997/summary_report/report.pdf.* Trucks' share in fleet from sources in note 7. Urbanization from US Census Bureau, Selected Historical Decennial Census Urban and Rural Definitions and Data, "Table 1: Urban and Rural Population: 1900 to 1990," *www.census.gov/population/censusdata/urpop0090.txt,* Oct. 16, 2002; and US Census Bureau, *US Census 2000,* "Census 2000 Urban and Rural Classification: Corrected State-Sorted List of UAs" and "Corrected State-Sorted List of UCs," *www.census.gov/geo/www/ua/ua_2k.html,* Oct. 16, 2002.

20. Commuting in Seattle from PSRC, op. cit. note 11.

21. Many of these studies, conducted by Australian researchers Peter Newman and Jeffrey Kenworthy, are summarized in Newman and Kenworthy, op. cit. note 11. See also P. Naess, *Energy Use for Transport in 22 Nordic Towns* (Oslo: Norwegian Institute for Urban and Regional Research, 1993); P. Naess, "Transportation Energy in Swedish Towns and Regions, *Scandinavian Housing and Planning Research* 10: 187–206, 1993; Transit Cooperative Research Program, *Regional Transit Corridors: The Land Use Connection* (Washington, DC: Transportation Research Board, 1995); John Holtzclaw, *Using Residential Patterns and Transit to Decrease Auto Dependence and Costs* (San Francisco: Natural Resources Defense Council, 1994). Residential density is not the only determinant of how people get to work; incomes, the availability of transit, the existence of concentrated job centers, the local balance between jobs and housing, and other factors also influence commuting choices.

22. Relationship between density and drive-alone commuting derived from US Census Bureau, Census 2000, *Summary File 3* (*SF 3),* for Washington and Oregon, *www.census.gov/census2000/states.* Initial data retrieval and analysis performed by CommEn Space, *www.commenspace.org.* Residential density was calculated as total population on April 1, 2000, divided by total land area for each census block-group. To minimize sampling error, block-groups were aggregated by average density to ensure a net population of at least 3,000 workers per aggregate group. Average population density explained at least 90 percent of the variation in drive-alone commuting rates among the aggregated census block-groups (not necessarily individual census block-groups) in both Multnomah and King Counties. In less-urbanized Washington and Oregon Counties, higher neighborhood densities were also associated with lower rates of drive-alone commuting, but increased density appeared to reduce drive-alone commuting to an even greater extent in counties with a dense urban core. At more than roughly 50 residents per acre, the relationships among residential density, drive-alone commuting, and transit commuting were difficult to determine because of small sample sizes; indeed, they may not follow the roughly linear relationship that holds for regions containing fewer than 50 people per acre.

23. Neighborhood densities and commuting pattern from CommEn Space, op. cit. note 22.

24. Mode of commuting to work in 2000 from US Census Bureau American Fact Finder, *US Census 2000: Summary File 3,* "P30: Means of Transportation to Work for Workers 16 Years and Over," *factfinder.census.gov.* Drive-alone commuters in British Columbia and Vancouver (1996 only) estimated from StatCan, "Employed Labor Force by Sex, Showing Mode of Transportation, for Census Metropolitan Areas, 1996," at *www.statcan.ca/english/census96/mar17/trans/mode2.htm,* Oct. 17, 2002; Don Alexander and Ray Tomalty, "BC Sprawl Report 2001," Smart Growth BC, 2001 at *www.smartgrowth.bc.ca/pdf/SpawlReport2001.pdf*; and GVRD, "Demographic Bulletin: The Region at

Work: Labour Force and Related Activities in Greater Vancouver," April 1998 at *www.gvrd.bc.ca/services/growth/stats/Census-bul/9804cb_lf.pdf*. Number of passengers per carpool vehicle in BC estimated by applying average rates for King and Multnomah Counties, from US Census Bureau, "P052. Private Vehicle Occupancy for Workers 16 Years and Over", Census 2000, *Summary File 3 (SF 3) - Sample Data*, in American FactFinder at *factfinder.census.gov*.

25. Mode of commuting to work in 1990 from US Census Bureau, "Travel to Work Characteristics for the United States by State: 1990 Census" *www.census.gov/population/socdemo/journey/state.txt*; in 2000, op. cit. note 24.

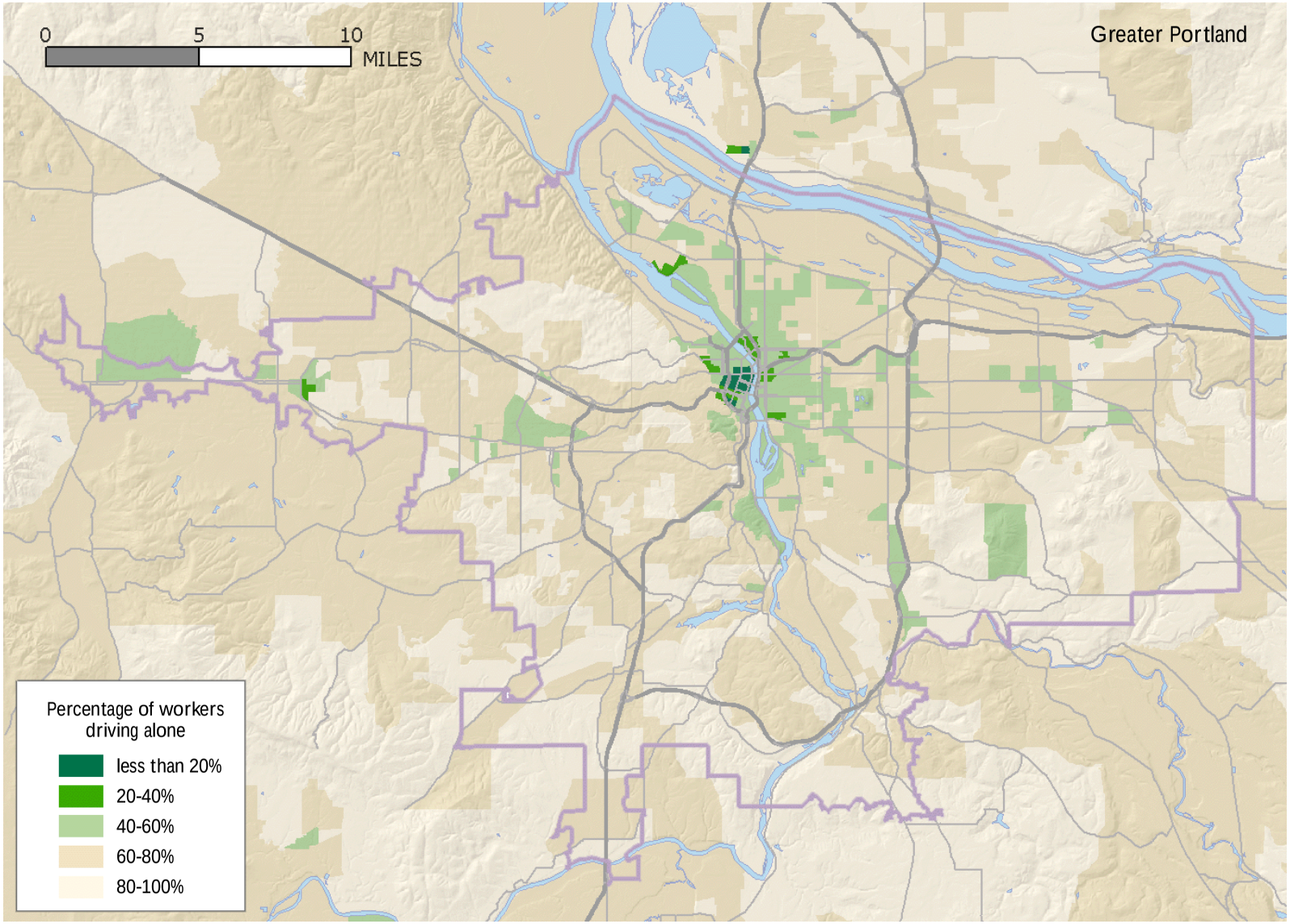
26. Price elasticity of gasoline from J. Agras and D. Chapman, "The Kyoto Protocol, CAFE Standards, and Gasoline Taxes," *Contemporary Economic Policy*, July 1999, cited in Oregon Dept. of Transportation, "A Brief Reference on Fuel Costs and Fuel Efficiency," *Policy Notes*, Jan. 2001, at *www.odot.state.or.us/tdb/policy/Policy_Notes/jan2001.pdf*.

27. Gasoline prices for Northwest states from the EIA State Energy Data System, "Petroleum Product Prices," by state, *www.eia.doe.gov/emeu/states/_states.html*, Oct. 2002; for BC from StatCan, "Table 326-0009: Average Retail Prices for Gasoline and Fuel Oil, by City, Monthly (Cents Per Litre)" and "Table 176-0064: Foreign Exchange Rates in Canadian Dollars, Monthly," CANSIM II, *cansim2.statcan.ca*, Oct. 2002. Spending figures obtained by multiplying gasoline consumption by price for each grade of gasoline and dividing by the number of drivers licensed in each jurisdiction. The ratio of medium-grade to low-grade gasoline in BC assumed to be the same as in the US Northwest. Currency conversions for per capita spending used the daily exchange rate on Oct. 4, 2002, in which US$1 = Can$1.59323. Licensed drivers in Northwest states from OHPI, "Section III: Driver Licensing, Table DL-22" in *Highway Statistics Summary to 1995* and *Highway Statistics 1996* to *2000* (Washington, DC: FHWA, 1996–2000), at *www.fhwa.dot.gov/ohim/ohimstat.htm*; in BC, from Paul Hardy, Insurance Corporation of British Columbia, private communication, Dec. 11, 2001.

28. Driving reduction from *This Place on Earth 2001: Guide to a Sustainable Northwest* (Seattle: NEW, 2001). Oregon initiative from Oregon Environmental Council, "Pay As You Drive Insurance," *www.orcouncil.org/Pollution/PAYD.htm*, Oct. 15, 2002.

29. Variable pricing from NEW, op. cit. note 28; and Matthew Kitchen, PSRC, Seattle, private communication, Oct. 10, 2002.

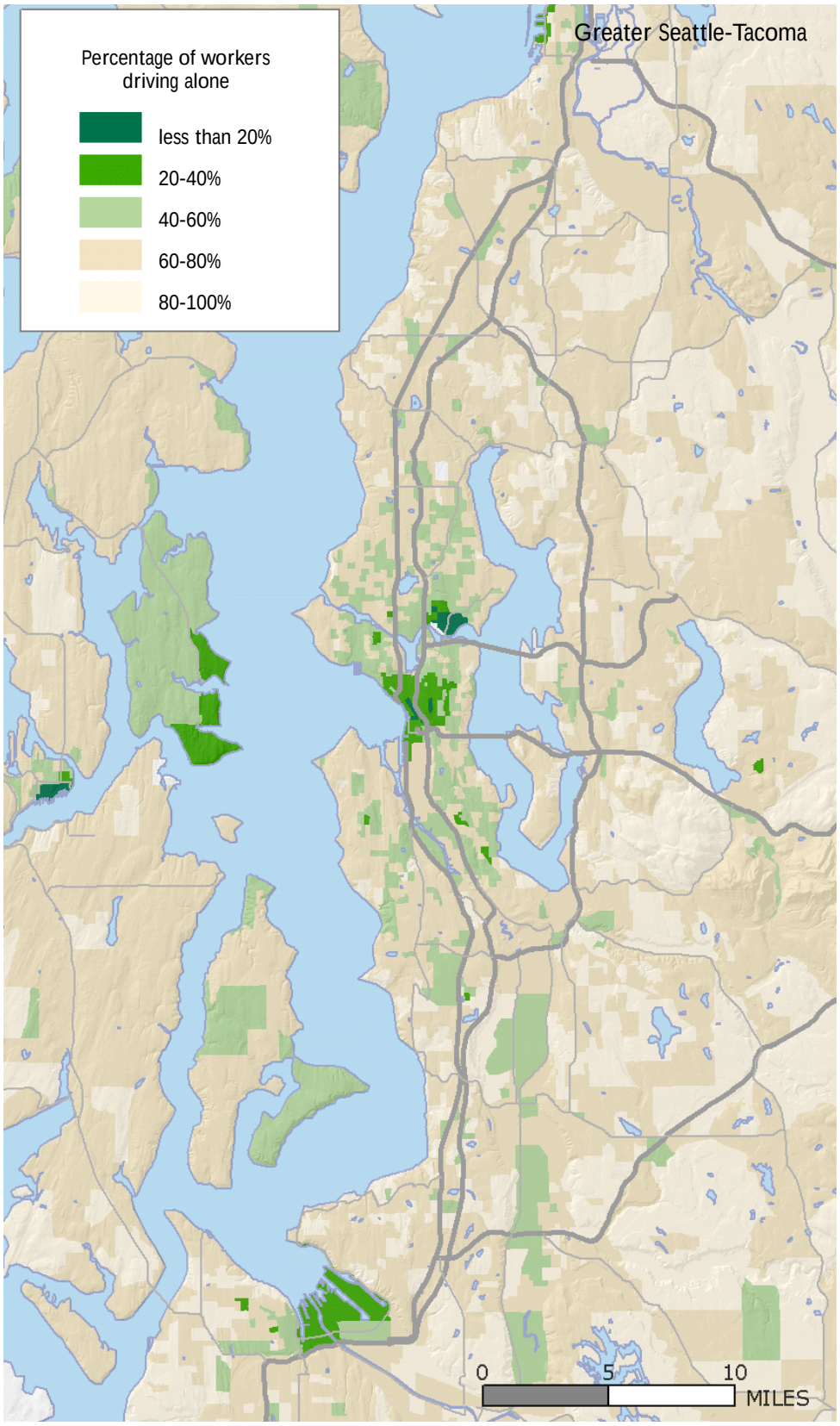
Map 1. More than 80 percent of downtown Portland commuters get to work without driving alone



Map and analysis by CommEn Space, *www.commenspace.org*

Northwest Environment Watch 2002, *www.northwestwatch.org*

Map 2. Sprawling, low-density neighborhoods, like those in Pierce County, send more than 80 percent of residents to work alone, by car



Map and analysis by CommEn Space, *www.commenspace.org*

Northwest Environment Watch 2002, *www.northwestwatch.org*