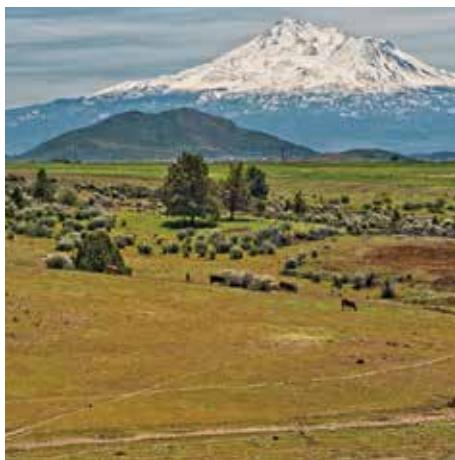


West Coast Tar Sands Invasion



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In addition to the Natural Resources Defense Council, NextGen Climate, and ForestEthics, this report has been endorsed by:



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Acknowledgments

Thanks to the many people who contributed to the research, drafting and review of this report. Any mistakes are wholly the responsibility of the authors and review does not necessarily mean endorsement of the report. The maps were designed by James Henry. We would like to acknowledge the substantive edits and contributions of Devorah Ancel, Diane Bailey, Sven Biggs, Ralph Cavanaugh, Ed Chen, Kristen Boyles, Elizabeth Forsyth, Jana Gastellum, Ross Hammond, Mary Heglar, Bruce Hill, Michael Jasny, Greg Karras, Jason Kowalski, Nick Lawton, Matt Krogh, Jared Margolis, Jeremy Martin, Ross Macfarlane, Bonnie McKinlay, Jeremy Moorehouse, Simon Mui, Marla Nelson, Brian Nowicki, Eric de Place, Rebecca Ponzio, Jackie Prange, Dave Shannon, Richard Simon, Jennifer Skene, Gavin Smith, Lorne Stockman, Christina Swanson, Caitlyn Vernon, and Shayne Wolf.

Special recognition is also due to the many First Nations working daily to uphold their rights and protect their traditional territories from the dangers of oil spills and to the fenceline communities throughout the West Coast that must face the dangers of crude oil transportation and health impacts of refining pollution on a daily basis.

We would also like to thank and acknowledge the many other groups and individuals in British Columbia, Washington, Oregon and California who are working on this issue.

About NRDC

The Natural Resources Defense Council is a international nonprofit environmental organization with more than 1.4 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Montana, and Beijing. Visit us at nrdc.org.

About NextGen Climate

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About ForestEthics

ForestEthics challenges destructive corporate and government practices and creates solutions that protect community health, the climate, and our wild places. We lead the fight to stop dangerous extreme oil pipelines and crude oil trains, shift hundreds of millions of dollars to responsible purchasing, and secure the protection of millions of acres of wilderness. We are three aligned organizations: ForestEthics in the US and ForestEthics Advocacy and ForestEthics Solutions in Canada. Visit us at forestethics.org.

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EXECUTIVE SUMMARY

The West Coast could soon become a destination for huge volumes of tar sands crude oil—one of the world's dirtiest fuels—setting back efforts to combat climate change and exposing communities to significant new health and environmental risks. Call it a tar sands invasion.

The amount of tar sands crude moving through the West Coast could increase by more than 1.7 million barrels per day (bpd) if existing proposals for pipelines and rail facilities move forward. If this happens, tar sands refining on the West Coast could increase eightfold, from about 100,000 bpd in 2013 to nearly 800,000 bpd in coming decades, according to new analysis. That's about as much tar sands crude as the embattled Keystone XL pipeline would carry from Alberta to Texas refineries.

But the industry's eagerness for West Coast expansion has drawn little attention, even though it could lead to increased oil train traffic through residential areas and near homes and schools, and increased barge and tanker traffic in environmentally sensitive and economically important waterways.

The West Coast tar sands invasion is a part of the industry's plan to triple its production in coming years. The tar sands industry views the West Coast as a key to its expansion plans because of California and Washington's refineries' capacity to process heavy crude oils. Meanwhile, the region's ports could export enormous volumes of unrefined products to foreign countries.

The production of tar sands crude causes about three times the carbon pollution of conventional crude.¹ Expanding this industry stands to worsen air pollution and undermine both national and international efforts to combat climate change. Indeed, replacing 800,000 barrels per day of conventional crude from the West Coast fuel mix with tar sands crude would increase carbon dioxide pollution by up to 26 million metric tons (MMT) per year—the equivalent of 5.5 million cars. However, this incremental number downsizes the real climate impact of the tar sands industry's dreams for the West Coast. The total lifecycle emissions for producing, refining and burning 800,000 bpd of tar sands is equivalent to 160 MMT of carbon dioxide, an amount equal to the annual emissions of 33.7 million vehicles. Emissions from all the projects described in this report would more than double these numbers.

Mounting scientific and economic analysis shows that the tar sands industry's expansion plan is incompatible with global efforts to address climate change. The Intergovernmental Panel on Climate Change (IPCC) concludes that 75 percent or more of discovered fossil fuel reserves must remain in the ground in order to limit warming to the international two degrees Celsius goal. It is clear that tar sands reserves—some of the world's most carbon-intensive—are at the top of the list of reserves that must remain in the ground in order to address climate change to prevent the most devastating impacts of climate change.

In addition to the climate impact of the tar sands industry's plan to expand into the West Coast, the vast network of new infrastructure required to move and process the tar sands crude—more pipelines and terminals and greatly increased rail and tanker traffic—will place communities at risk from devastating spills.

These kinds of spills—which could seriously harm human health, local economies, and the environment—are particularly difficult and even more costly to contain and clean than conventional crude oil spills because heavy tar sands has been shown to sink below the water's surface.

In 2010, a pipeline carrying tar sands crude burst, spilling more than 800,000 gallons of the thick oil into Michigan's Kalamazoo River. Nearby residents experienced a variety of health impacts, including hundreds of cardiovascular, dermal, gastrointestinal, neurological, ocular, renal, and respiratory impacts. The cleanup, which has cost more than \$1 billion, is still unfinished.

Even so, the tar sands industry is fighting hard to build two new pipelines in British Columbia that would move more than 1 million barrels of tar sands oil a day to West Coast ports. While the pipeline fights rage on, as many as 11 new terminals² are proposed in California, Oregon, Washington, and British Columbia. These proposed terminals, in combination with existing terminals, could increase the regions' combined crude oil storage and exporting capacity six fold, from 690,000 bpd to almost 4 million bpd. As mentioned above, at least 1.7 million bpd of this increase is devoted solely to tar sands.

Once this invasion of tar sands oil reaches the coast, more than 2,000 additional barges and tankers would be needed to carry the crude to Washington and California ports and international markets across the Pacific. Significantly increased oil tanker and barge traffic would be seen in San Francisco Bay, the Port of Los Angeles, Grays Harbor in Washington, the Columbia River in Washington and Oregon, Douglas Channel out of Kitimat, and the Salish Sea on the border between Washington and British Columbia.

The threat of tar sands on the West Coast is serious, but the public and its elected officials can take action to avert this crisis. Through both opposition to tar sands infrastructure and support for regional clean energy policies, we can prevent the influx of tar sands crude and build the green infrastructure and public support necessary to begin transitioning to a clean energy economy.

In other words, this tar sands invasion can be stopped.

THE NORTH AMERICAN WEST COAST: THE NEXT FRONT IN THE TAR SANDS INVASION



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The land-locked tar sands industry has plans to transport large volumes of tar sands crude oil³ to the North American West Coast, where there is substantial refinery capacity and access to coastal ports. The Canadian Association of Petroleum Producers (CAPP) forecasts that tar sands production will increase from 2.4 million barrels per day (bpd) in 2013 to 6.2 million bpd by 2030.⁴ However, strengthening opposition to the infrastructure necessary to transport this high-carbon crude has become a serious roadblock.

Many refineries throughout Canada and the United States have limited capacity to process additional tar sands crude. Beyond the Gulf Coast—whose significant heavy crude oil refining capacity has been difficult for the tar sands industry to access due to popular opposition to the proposed Keystone XL pipeline—only the West Coast currently has meaningful additional heavy crude refining capacity. Thus far, tar sands industry expansion has depended on Midwestern heavy crude refineries. As tar sands production continues to increase, these refineries are now operating at capacity and cannot absorb additional tar sands. Meanwhile, the industry's attempts to increase its access to the Gulf Coast continue to

be stymied while alternative modes of transportation such as rail are proving too expensive to facilitate any meaningful increase in access to the Gulf Coast.⁵

In response to these constraints, the tar sands industry is attempting to build the infrastructure to dramatically increase volumes of tar sands shipped to the North American West Coast in coming years. The West Coast refining market currently processes 2.5 million barrels of oil per day, with the majority of this capacity located in California.⁶ In the early 1980s, many California refineries invested in infrastructure to process the heavy crude produced in the state. California's heavy crude production peaked at more than 700,000 bpd in the mid-1980s, but has been in constant decline since then.⁷ By 2013, California heavy crude production was only 390,000 bpd. It is expected to decline to 200,000 bpd in 2030 and 120,000 bpd by 2040.⁸ Absent new sources of heavy crude, refineries may switch to processing greater proportions of lighter crude oils instead. Indeed, Shell recently announced a modification to its Martinez, California refinery to allow it to shift to a lighter crude slate, resulting in a carbon emission reduction of 700,000 metric tons.⁹

However, many recent developments suggest the Canadian tar sands industry is actively laying the groundwork to access California's underutilized heavy crude refinery markets via tanker, barge, and rail. If this happens, these recent emission reductions would be lost. At the same time, it is important to note that very limited volumes of tar sands are refined in California and there is reason to believe that policies can be put in place to avoid their becoming an entrenched fuel source in the state.

The tar sands industry is also looking to expand its presence in Washington State, where there is also some heavy oil refining capacity. In its 2014 annual report, the CAPP forecast that the tar sands industry would increase Western Canadian tar sands exports to the state by 88 percent through 2020, from approximately 75,000 bpd to more than 140,000 bpd.¹⁰ A significant portion of that increased volume is likely to be both partially refined synthetic crude oil derived from tar sands and heavy, unrefined tar sands crude oil.

British Columbia's heavy crude refining capacity is currently limited to Chevron's Burnaby refinery, which is able to process 2,000 bpd of heavy crude.¹¹ However, Kitimat Clean Ltd., Pacific Future Energy Corp., and Eagle Spirit Energy have proposed building new heavy crude refineries in Kitimat,¹² Prince Rupert,¹³ and Grassy Point.¹⁴ These projects have a combined capacity of at least 750,000 bpd and would drastically alter British Columbia's place in the tar sands industry's expansion plans.¹⁵ Despite these proposals, the likelihood of major growth in British Columbia's refining capacity is very low, with few members of industry or the public expecting the tar sands industry to pursue any projects beyond the proposal stage.¹⁶

PROJECTIONS OF TAR SANDS HEADED TO THE WEST COAST

The West Coast already processes limited volumes of tar sands—with imports averaging 100,000 bpd in 2013.¹⁷ However, according to a report by the Borealis Centre

for Environment and Trade Research, commissioned by NextGen and NRDC, tar sands crude exports to West Coast refineries could reach 790,000 barrels per day (bpd) by 2040, an eightfold increase relative to current levels.¹⁸ As described in section III of this report, the large influx will create new threats to public health, safety, and the environment in California, Oregon, Washington, and British Columbia if action is not taken. Under this scenario, tar sands crude could eventually comprise more than a third of the region's total crude oil fuel stock.¹⁹

The Borealis Centre forecasted volumes of tar sands crude (which includes synthetic, diluted bitumen, and raw bitumen) that would be transported to (and processed by) refineries in Washington and California by rail, tanker, or barge through 2040 under various scenarios.

Table 1 is a summary of the Borealis analysis of potential pathways for tar sands crude to reach the West Coast's refinery market by rail, tanker, or barge through 2040.²⁰ The Borealis projections include three scenarios based on different levels of tar sands infrastructure development: a constrained infrastructure scenario assuming no additional expansion in tar sands pipelines, a scenario assuming only the proposed Kinder Morgan Trans Mountain pipeline expansion moves forward, and an unconstrained expansion scenario assuming both the proposed Kinder Morgan Trans Mountain and the proposed Enbridge Northern Gateway pipelines move forward. Each of the scenarios assumes some movement of tar sands by rail.

Borealis' analysis did not consider the impact that implementation of clean energy, public health and safety, and energy alternative policies will have on limiting tar sands flows to the West Coast. The West Coast's successful implementation of these types of policies will be a determinative factor in whether tar sands producers will access this market at the volumes considered here.²² Assuming there is some likelihood of the scenarios projected, an influx of tar sands into the West Coast would undermine the region's efforts to reduce its greenhouse gas pollution.

Table 1. Potential Tar sands crude imports to the West Coast (bpd)²¹

	2013	2020	2030	2040
Constrained Scenario	100,000	100,000	100,000 – 135,000	100,000 – 495,000
Kinder Morgan Scenario	100,000	495,000	545,000 – 645,000	495,000 – 645,000
Unconstrained Scenario	100,000	510,000 – 660,000	640,000 – 760,000	740,000 – 790,000

Energy Security: The West Coast Doesn't Need Tar Sands

While tar sands expansion requires access to new heavy crude refinery markets, the West Coast does not need tar sands crude to meet its energy demands. In fact, oil consumption in the West Coast has declined by more than 400,000 bpd—or 14 percent—since 2007 and is expected to continue to fall further in the future, despite recent economic growth.²³ As West Coast residents have reduced their demand for petroleum, the region's refineries are increasingly selling their product on the international market. In recent years, West Coast-refined product exports have reached 400,000 bpd as domestic refined product consumption has declined.

Existing clean energy policies, such as California's clean energy and climate law (AB32), are expected to continue this trend through improved vehicle efficiency, increased transit options, and clean low-carbon fuel substitutes like advanced biofuels and electricity. For instance, California's gasoline consumption is expected to decline by 15 percent—or 140,000 bpd—by 2022 under existing policies.²⁴ Currently adopted climate measures in California are estimated to reduce the need for petroleum by 20 to 25 percent by 2030.²⁵ Additional clean energy policies, as called for by the Governor of California, could reduce its refined product consumption by half (or more than 800,000 bpd by 2030).²⁶ State leaders along the West Coast, including the governors of Oregon and Washington and the premier of British Columbia, are also considering clean energy and climate policies like clean fuel standards that could help similarly reduce the demand for carbon-intensive crude oils like tar sands.²⁷

PATHWAYS FOR A TAR SANDS INVASION INTO THE WEST COAST

Based on an analysis of existing and proposed transportation options, additional tar sands crude oil could reach the West Coast through at least four channels:

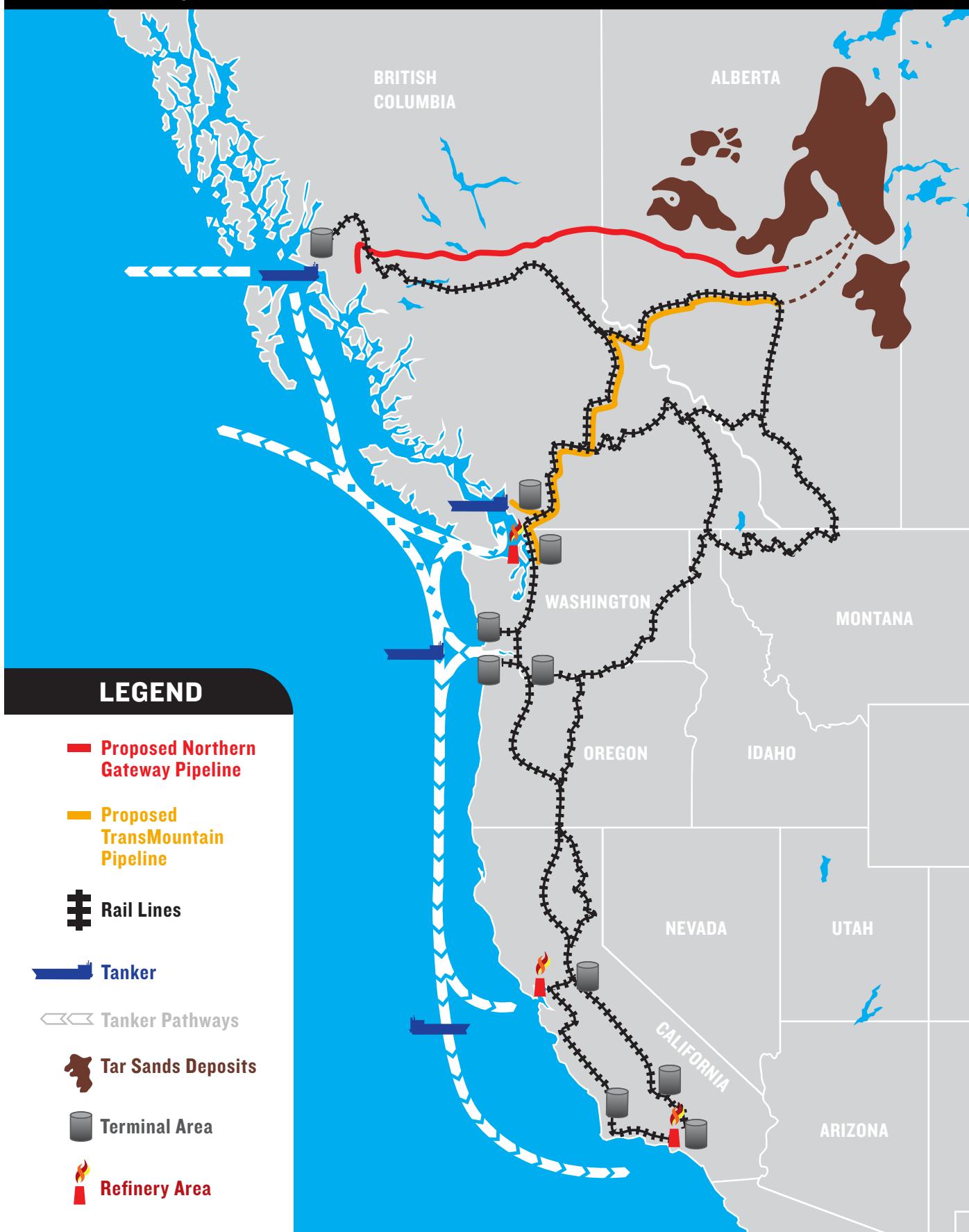
- Tar sands could be transported by train directly to heavy crude refineries in Washington and California.
- Tar sands could reach the British Columbia coast via rail or proposed pipelines, such as Enbridge's Northern Gateway or Kinder Morgan's Trans Mountain pipeline expansion, and be moved by ocean tanker to ports in Washington and California, which have heavy oil refining capacity.
- Tar sands already reach northern Washington refineries via Kinder Morgan's Puget Sound pipeline system, which connects to the existing Trans Mountain pipeline.²⁸ This system, which has a full capacity of 180,000 bpd, is targeted for expansion under the proposed Trans Mountain expansion plan.²⁹
- Tar sands could reach Washington and Oregon by rail before either continuing on to California or being loaded on to barges and tankers for further transport south.³⁰ Terminals proposed for Washington and Oregon could receive crude by rail and trans-ship either Bakken or tar sands.

Tar sands by rail through and to the West Coast

While relatively little tar sands is making it to the West Coast via rail today, industry is pursuing substantial expansion of rail loading infrastructure to facilitate transport of tar sands oil to the West Coast. This infrastructure would allow a substantial increase in access to the region's refineries as well as use of its coastal ports for international export. To make the West Coast a viable market for increased volumes of tar sands crude, industry players are proposing as many as 11 new terminals³¹ in British Columbia, Washington, Oregon, and California that will either bring crude oil directly to refineries by rail, or act as transit hubs for further movement by barge, tanker, or pipeline. This is in addition to 13 terminals already in full operation³² and four others that are operating and expanding.³³

For rail terminals to offload thick tar sands crude moved as "raw-bit" or "rail-bit," specialized steam-heating infrastructure is required to make the crude move easily from tank cars to holding tanks. Though few existing terminals have this capability, many of the new, proposed, or retrofitted terminals along the West Coast are being designed to keep stored crude oils warm.³⁴ As this activity lays the groundwork for bringing large volumes of tar sands crude to the West Coast, Phillips 66 and Valero are publicly considering their options for increasing their West Coast operations' access to Canadian tar sands crude.³⁵

Tar Sands Pathways to the North American West Coast





Tar Sands by Rail to the Gulf is not Economical

While there are strong indications that the tar sands industry plans to use rail to access the West Coast market, there is no indication that this will lead to a similar increase in shipments of tar sands by rail to the Gulf Coast. Shipping crude by rail rather than by pipeline increases costs—and the greater the distance, the greater the cost. Gulf Coast refineries are 3,000 miles from the tar sands-producing region of Alberta, but only 1,000 to 2,000 miles from West Coast refineries and shipping terminals. Washington, for example, is only 1,000 miles away from Fort McMurray—a third of the distance between northern Alberta and the Gulf Coast's refineries.³⁶ Accordingly, the cost of shipping crude by rail to British Columbia and the Northwest United States is nearly competitive with shipping it by pipeline to the Gulf Coast.³⁷

Four very large proposed crude-by-rail transloading terminals are of special concern for the surrounding communities in Prince Rupert, British Columbia; Vancouver, Washington; and Pittsburg and Bakersfield, California. In Prince Rupert, Nexen—now owned by the Chinese National Off-shore Oil Corporation, or CNOOC—is proposing a rail-to-tanker terminal capable of handling nearly 550,000 bpd of tar sands crude (though few expect this idea to be developed beyond the proposal stage).³⁸ In Washington State, the Tesoro/Savage terminal in Vancouver is expected to reach up to 360,000 bpd handling capacity if approved.³⁹ Pittsburg and Bakersfield, California are also confronting large-capacity terminal proposals and expansion projects. In Pittsburg, a new terminal proposed by WesPac could handle up to 242,000 bpd, while two new terminals proposed by Alon and Plains All American are designed to handle a combined 210,000 bpd.⁴⁰ Three other train-to-tanker or barge terminals with a combined capacity of 150,000 bpd have also been proposed in Hoquiam, Washington.⁴¹ If built, these terminals are expected to facilitate the export of tar sands crude oil to Washington and California refineries as well as markets in East and Southeast Asia.

Despite the apparent tidal wave of new crude-by-rail infrastructure on the West Coast, nearly every project discussed in this report is facing significant community opposition. This fact places many of these projects on uncertain footing and could lead to their outright cancellation. In Canada, this has meant preemptive opposition to Nexen's Prince Rupert proposal⁴⁴ and the formal release of the Save the Fraser Declaration, which proclaims opposition to all transport of tar sands through

Table 2: Proposed or Expanding Rail Off-Loading Terminals on the Pacific Coast⁴²

Terminal Name	Location	Volume (bpd)	Status	Tar Sands Equipped
Nexen Prince Rupert	Prince Rupert, BC	546,000	Exploratory	Yes
Shell	Anacortes, WA	60,000	Proposed	Yes
U.S. Development	Hoquiam, WA	50,000	Proposed	Yes
Westway	Hoquiam, WA	26,000	Proposed	Yes
Imperium	Hoquiam, WA	70,000	Proposed	Yes
Tesoro/Savage	Vancouver, WA	360,000	Proposed	Yes
NuStar	Vancouver, WA	50,000	Converting and Expanding	?
Targa Stockton	Stockton, CA	70,000	Proposed	?
WesPac Energy⁴³	Pittsburg, CA	242,000	Proposed	Yes
Valero	Benicia, CA	70,000	Proposed	Yes
Phillips 66	Santa Maria, CA	41,000	Proposed	Yes
Alon	Bakersfield, CA	150,000+	Expanding	Yes
Plains All American	Bakersfield, CA	160,000+	Expanding	Yes
Questar	North Palm Springs, CA	120,000	Proposed	?

the traditional territories of First Nations.⁴⁵ In Vancouver, Washington, the city has passed a moratorium on construction of new terminals⁴⁶ while opposition to the Grays Harbor proposals continues to escalate, with the mayor of Hoquiam recently proposing a similar moratorium on all crude oil storage and shipping facilities.⁴⁷ In California, similar levels of opposition are also present, with communities organizing to successfully oppose new facilities and even stop operations at existing terminal facilities like Interstate Oil's Sacramento rail unloading terminal.⁴⁸ In the coming months, groups in California will also call for a moratorium on all new infrastructure supporting “extreme oil,” including tar sands and other highly polluting crudes.

Shale Oil by Rail

In recent years, the boom in light shale oil production has led to a dramatic increase in U.S. rail transport of crudes, increasing from less than 20,000 bpd in 2008 to nearly 800,000 bpd in 2013.⁴⁹ The majority of crude-by-rail comes from North Dakota’s Bakken formation, with some also coming from Colorado, Wyoming, Utah, and West Texas.⁵⁰ A significant portion of this oil is bound for refineries in Washington and California.⁵¹ As shale oil producers keep choosing to use rail to reach West Coast refineries, communities can expect a continuing stream of crude-laden rail cars through their neighborhoods.⁵²

This increase in crude-by-rail traffic through West Coast communities is of particular concern given the major safety threats and chronic exposure to carcinogenic vapors posed by moving this highly volatile and flammable form of crude oil.⁵³ An explosion in Casselton, North Dakota as well as the Lac-Mégantic disaster in Quebec (in which 47 people were killed) are just two examples of the dangers.⁵⁴ As tar sands producers plan to increase their shipments to West Coast refineries, the volume of crude-by-rail traffic could increase even further. As this happens, the need for common sense safety regulations will become more important than ever.



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Tar sands crude by ocean tanker and barge to the West Coast

In addition to the West Coast’s crude-by-rail boom, transport of tar sands crude to the West Coast would cause a massive increase in the use of ocean oil tankers and barges, which would travel to and from ports in British Columbia, Washington, Oregon, and California, as well as international markets across the Pacific. Currently, the only avenue available for shipping tar sands crude by tanker or barge to the West Coast is via Kinder Morgan’s Westbridge Marine Shipping terminal, which loads 60 oil tankers and 18 barges from the Trans Mountain pipeline annually.⁵⁵ These tankers move limited volumes of tar sands crude—an average of 75,000 bpd—to refineries in California and Washington.⁵⁶ However, proposed pipelines or rail terminals would substantially increase the number of massive tankers transporting tar sands crude along the West Coast’s sensitive waterways.

As outlined below, planned pipeline and rail terminals in Kitimat, Prince Rupert, and Vancouver, British Columbia could send over 1,000 oil tankers carrying tar sands crude from British Columbia to ports in California, Washington, and international markets each year. Use of large numbers of oil tankers and barges is also planned for ports in Washington and Oregon, leading to the threat of more than 1,000 new oil-laden vessels joining those from British Columbia on the region’s waters.

The future volume of tar sands crude reaching the Canadian west coast and eventually loaded onto tankers will depend on whether three highly controversial tar sands infrastructure proposals in British Columbia move forward. Those projects are (1) Kinder Morgan’s proposed expansion of its Trans Mountain pipeline to Vancouver, (2) Enbridge’s proposed Northern Gateway pipeline to Kitimat, and (3) Nexen’s proposed but unlikely crude-by-rail terminal in Prince Rupert. Kinder Morgan’s proposed Trans Mountain pipeline expansion would increase the volume of tar sands crude shipped through Vancouver from 300,000 bpd to 890,000 bpd. This would, in turn, increase annual tanker traffic from Vancouver harbor nearly sevenfold, from 60 oil tankers and 18 barges to more than 400 Aframax⁵⁷-sized oil tankers.⁵⁸ Enbridge’s Northern Gateway proposal envisions 220 tankers accessing the Kitimat terminal area, including



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50 very large crude carriers (VLCCs).⁵⁹ As the second largest crude oil tanker in the world, VLCCs can carry up to 2.2 million barrels of oil. Finally, if ever seriously considered, Nexen's crude-by-rail proposal in Prince Rupert could bring an additional 430 tankers through the region each year.⁶⁰

Many of these departing tankers would travel through the Great Bear Rainforest and the Salish Sea to get tar sands crude to Washington and California refineries. Enbridge's proposed Northern Gateway pipeline would require supertankers carrying up to 2.2 million barrels of oil to navigate through the Douglas Channel and its Pacific approaches—both notorious for unpredictable and dangerous weather and navigational challenges.⁶¹ Meanwhile Kinder Morgan's proposed Trans Mountain pipeline expansion would significantly increase tanker traffic through the Salish Sea region.

At full capacity, these British Columbia projects could send an additional 1.7 million bpd of tar sands crude through British Columbia's and Washington's sensitive waterways.⁶² This threat has been confirmed in a report prepared by the National Oceanic and Atmospheric Administration (NOAA), which found that oil tanker and barge traffic is expected to increase in Puget Sound with barges traveling from Vancouver, British Columbia to refineries in Cherry Point and Tacoma, Washington.⁶³ Half of these 1,000 tankers would likely carry over 700,000 bpd of tar sands crude to refineries in Washington and California.⁶⁴ The remainder would head to refineries elsewhere, likely targeting Asian and other markets outside the United States.⁶⁵

Outside of British Columbia, projects targeting Grays Harbor in Washington and the Columbia River in Washington and Oregon are expected to result in massive increases in oil tanker and barge traffic. Estimates based on the permit applications for the three proposed Grays Harbor oil terminals predict tanker and barge traffic to increase by 293-428 vessels.⁶⁶ Meanwhile, vessel traffic along the Columbia River will increase if plans for new and expanded rail terminals in Vancouver, Washington and Clatskanie, Oregon come to fruition. In its project proposal documents for the Tesoro Savage Vancouver Energy Distribution Terminal in Vancouver, Washington, Tesoro estimates that the project will facilitate the loading of 365 vessels per year. This will result in 730 annual trips between Vancouver and the mouth of the Columbia River.⁶⁷ A recent analysis of all Columbia River fossil fuel export projects found that oil tanker and barge loadings at Global Partner's Clatskanie Terminal could lead to an additional 162-389 vessels per year.⁶⁸ If additional expansion plans and operational changes are approved at NuStar Energy's Vancouver terminal,⁶⁹ and Arc Logistics Partners' Willbridge facility,⁷⁰ additional increases in marine traffic can be expected as crude oil is transferred from rail to barges and tankers destined for either Washington or California refineries.

Tanker Trouble in Busy Waters

On December 9, 2014, a Bangladeshi tanker carrying heating oil collided with another vessel in the Sundarbans, a UNESCO World Heritage site that is home to endangered royal Bengal tigers and Irrawaddy dolphins.^{71,72} The collision released 77,000 gallons of oil into sensitive waterways, now covering 135 square miles of winding river channels and mangrove forests.⁷³ While the spill involved an aging tanker in loosely regulated waters, the immediate damage provides a sobering reminder of the risks oil supertankers could pose to pristine areas throughout Northern British Columbia and the Salish Sea.



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Tar Sands crude by pipeline through British Columbia

There are two proposed tar sands pipelines crossing from Alberta to British Columbia's coast that would, if approved, bring at least 1,115,000 bpd of additional tar sands crude. The first is Enbridge's proposed Northern Gateway project, a controversial 525,000-850,000 bpd⁷⁴ tar sands pipeline across the mountainous terrain and salmon-bearing rivers of north-central British Columbia.⁷⁵ The Canadian federal government approved the pipeline in June 2014, with 209 conditions, but public opposition has strong momentum to stop or delay this project. Polling shows that more than two-thirds of British Columbians oppose Enbridge's Northern Gateway project.⁷⁶ Additionally, more than 130 First Nations with aboriginal rights and title, who would be affected by the pipeline, have publicly opposed both the pipeline and the resulting additional tanker traffic.⁷⁷ There are also more than a dozen lawsuits challenging the National Energy Board's and federal government's approval of Enbridge's project by several First Nations, environmental groups, and a trade union.⁷⁸

The second proposed pipeline is Kinder Morgan's December 2013 proposal to expand its existing Trans Mountain pipeline to increase its capacity from 300,000 bpd to 890,000 bpd.⁷⁹ The pipeline faces substantial public opposition in British Columbia's Vancouver region and along its coast.^{80,81} The expansion would require new permits, renegotiation of landowner agreements along the route, agreements with First Nations, dredging the Vancouver harbor, adjusting the boundaries of British Columbia Parks, and changing regulations to allow increased tanker traffic—all points of potential public intervention. Further, the legal challenges immediately sparked by the proposal, as well as mass civil disobedience around Kinder Morgan's exploratory drill sites on Burnaby Mountain, suggest possible long-term, and potentially permanent, delay.⁸²



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Indigenous Peoples of the West Coast

As the infrastructure that would enable a tar sands invasion of the West Coast is planned, proposed, and built, the traditional lands and protected resources of the region's indigenous people often face the gravest threats. However, indigenous peoples in both Canada and the United States have retained their sovereign rights to use and protect their traditional lands and resources. These legal powers, coupled with a desire among indigenous communities to protect and steward their territories, have meant that many tar-sands-enabling projects have been met with stiff resistance as the full scope of potential impacts from these projects have slowly come to light.

In Canada, the rights of indigenous peoples are recognized and protected by Canada's constitution.⁸³ These rights ensure that federal and provincial governments fulfill their duties to consult and accommodate before taking any action that could adversely affect indigenous people or their rights to hunt, fish, and trap on traditional lands.⁸⁴ As the tar sands industry has pushed to expand its production and export infrastructure, legal challenges from Canadian First Nations have mounted. These challenges have significantly delayed planned projects,⁸⁵ affirmed and expanded the legal force of Aboriginal title,⁸⁶ and inspired a broad coalition of indigenous people who have formalized their opposition to future tar sands expansion projects.⁸⁷

In the United States, many West Coast tribes are signatories to treaties with the federal government in which they reserved a right to take fish at their "usual and accustomed grounds and stations" and the privilege of gathering, among other rights, in exchange for ceding lands they historically roamed freely.⁸⁸ Treaty fishing rights include a right of access to traditional fishing areas.⁸⁹ Treaty rights are not granted to tribes, but rather are "grants of rights from them—a reservation of sovereign rights not granted."⁹⁰

These treaties create a special fiduciary duty and trust responsibility upon all agencies of the United States and states to protect treaty rights, including fishing rights, and cannot be abrogated except by explicit congressional authorization.⁹¹



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Under this legal regime, the rights of 566 federally recognized indigenous tribes are protected by the federal government in a complex trust relationship and federal courts have consistently required federal agencies and states to keep the treaty promises upon which the tribes relied when they ceded huge tracts of land to the United States.⁹² For example, in Washington, a landmark case known as the "Boldt decision" confirmed that Indian tribes have a right to half of the harvestable fish in state waters and established the tribes as co-managers of the fisheries resource with the State of Washington.⁹³

UNDERSTANDING THE CARBON IMPACT OF TAR SANDS

If the tar sands industry succeeds in accessing the North American West Coast's refinery markets, it will undermine the region's efforts to reduce its carbon emissions. Much of the heavy, carbon-intensive tar sands oil imported into the region will fill heavy crude refining capacity that has become available over the years as California's heavy crude production has declined. Over the years, much of the heavy crude has been replaced by light and medium crude oils, which tend to be less carbon-intensive. Tar sands crude is, however, substantially more carbon-intensive than the majority of crudes refined in California and Washington. This will, therefore, increase the overall carbon-intensity of the fuel supply used in the region. This increase would either need to be offset by greater use of lower-carbon alternative fuels or pressure on other industries—like utilities and automakers—to reduce their own carbon footprints even more. Moreover, allowing an influx of tar sands crude access to the West Coast's refinery markets will enable additional expansion of tar sands, locking some of the most carbon-intensive crudes into the global supply for decades to come.

"Producing gasoline or diesel from tar sands crude generates an average of 81 percent more greenhouse gas emissions."

As a starting point, the extraction, production, and refining of tar sands crude is much more energy-intensive than the same processes for conventional oil. Compared to conventional crude, which is pumped from wells, tar sands crude must be mined or steamed out of the ground—processes that are more carbon-intensive.⁹⁴ As a result, on a “well-to-tank” basis—which includes crude oil extraction and upgrading, transport, refining, and distribution—producing gasoline or diesel from tar sands crude generates an average of 81 percent more greenhouse gas emissions than conventional crudes.⁹⁵ In fact, displacing 790,000 bpd of conventional oil with tar sands oil would generate an additional 26.1 million metric tons (MMT) of annual carbon dioxide emissions, or the equivalent of 5.5 million vehicles.⁹⁶ In the broader context of facilitating growth of the tar sands industry, 790,000 bpd of new tar sands production would lead to the equivalent of 160 MMT of carbon dioxide emissions annually.⁹⁷ These emissions equal the annual emissions from 33.7 million passenger vehicles.⁹⁸ Moreover, the average carbon intensity of tar sands production is increasing, as a disproportionate amount of planned expansion will come from more carbon-intensive drilling and steaming or “in situ” tar sands projects.⁹⁹

Mounting scientific and economic analysis shows that the tar sands industry's expansion plan is incompatible with global efforts to address climate change. The Intergovernmental Panel on Climate Change concludes

that 75 percent or more of discovered fossil fuel reserves must remain in the ground in order to limit warming to the international two degrees Celsius goal—a level necessary to avoid some of the most severe impacts of climate change.¹⁰⁰ Recent studies have shown that continued development of unconventional, high-carbon reserves like tar sands is not economical in a scenario where global warming is limited to two degrees Celsius.¹⁰¹

While the West Coast has been a leader in climate action—including adopting cap-and-trade programs and low carbon fuel standard programs in California and Oregon, a carbon tax and clean fuels program in British Columbia, and proposing similar policies in Washington—offsetting the potential emissions from tar sands production could represent significant challenges. For example, the current 10 percent reduction in carbon-intensity by 2020 required by California's low carbon fuel standard would be expected to nominally result in 20.6 million metric tons of carbon dioxide reductions.¹⁰² Increased emissions from tar sands crude would significantly offset the benefits from existing and proposed climate policies, absent significantly higher use of lower-carbon alternative fuels or additional reductions by other industries.

California also produces heavy crude that is more carbon-intensive than the U.S. average.¹⁰³ However, overall carbon emissions from California's heavy crude production are declining as its heavy crude fields are depleted.¹⁰⁴ California's heavy crude production, which has been falling since the late 1980s, is forecast to dwindle from 400,000 bpd in 2013 to 200,000 bpd by 2030.¹⁰⁵ Moreover, rather than displacing California's heavy crude production, tar sands imports into the West Coast are likely to displace lighter, less carbon-intensive crudes.¹⁰⁶

Access to the West Coast's heavy oil refining capacity would remove a critical obstacle to the tar sands industry's expansion plans, and additional proposed extraction projects will be able to move forward. Greater imports of tar sands crude would erode the region's efforts to meet long-term climate reduction targets.

Worst of the Worst: California Heavy Crude Versus Tar Sands?

The tar sands industry often argues that the United States should ignore the carbon impact of tar sands crude because it is no more carbon-intensive than California's heavy crude production. This argument is a red herring. California's heavy crude production is a small fraction of existing tar sands production and is rapidly declining—expected to fall to half of current levels by 2030.¹⁰⁷ On the other hand, the tar sands industry is seeking new heavy crude refinery markets in order to triple its production, locking the most carbon-intensive crude into the world's supply for decades.¹⁰⁸ By 2030, California's heavy crude production is forecast to total only 3 percent of the tar sands industry's planned expansion.¹⁰⁹

RISKS OF TRANSPORTING AND PROCESSING TAR SANDS

HEALTH, SAFETY AND ENVIRONMENTAL RISKS FROM TRANSPORTING TAR SANDS

Transporting tar sands—whether by pipeline, rail, barge, or tanker—poses unique risks to the hundreds of communities, waterways, and critical ecosystems along the route from northern Alberta to refinery and export hubs along the West Coast.¹¹⁰ As tar sands crude moves by rail and is loaded onto tankers, carcinogens and other toxic chemicals are released to the air and can contribute to respiratory illnesses, neurological impacts, or cancer.¹¹¹ In the event of a spill, chemicals typically added to tar sands bitumen rapidly evaporate into the air, leaving behind a toxic sludge that can be nearly impossible to clean.¹¹² As more tar sands crude begins moving through the region, the risk of exposure to these threats increases.

Tar sands diluted bitumen spill risk

Tar sands bitumen has several distinguishing physical characteristics that make managing spills more challenging than spills of conventional crudes.¹¹³ Raw tar sands bitumen is a very thick crude oil that is heavier than water.¹¹⁴ Because of its density and thickness, tar sands bitumen is typically mixed with very light, volatile petrochemicals—creating diluted bitumen—so that it can flow by pipeline from tar sands mines and fields.¹¹⁵ From there, it is shipped to market via pipelines, trains, barges, and ocean tankers.

Tar sands diluted bitumen spills—whether from pipelines, rail cars, or tankers—present exceptional challenges for spill response and cleanup, particularly when they are in or near bodies of water. Following a spill, the volatile petrochemicals in the diluted bitumen typically evaporate, leaving the heavy tar sands bitumen to sink to the lake, river, or ocean bottom.¹¹⁶ Tar sands crude that has sunk below the water's surface cannot be effectively contained by conventional spill response measures, which focus on isolating and removing floating oil. This can lead to long-term contamination, as emergency responders have found that tar sands crude does not appreciably biodegrade over time and is extremely difficult, if not impossible, to completely dredge from river and ocean bottoms.¹¹⁷

This risk of long-term contamination is especially concerning in areas where impacted water systems provide drinking water and food, or are home to species critical to a region's economic vitality. At the same time, the evaporation of the volatile petrochemicals added to tar sands (known as "diluents") into the ambient air has been associated with significant health impacts such as headaches, nausea, and respiratory problems. These impacts were observed following both the 2010 Kalamazoo spill and the 2013 rupture of ExxonMobil's Pegasus tar sands pipeline in Mayflower, Arkansas.¹²³ Given the proximity to vital waterways of a number of expected tar sands transport routes through the West Coast, the risk of a spill in water is an urgent threat that could devastate communities, economies, and the environment.

Kalamazoo: The Anatomy of a Tar Sands Spill

In 2010, an Enbridge tar sands pipeline in Michigan spilled more than 800,000 gallons of tar sands diluted bitumen into the Kalamazoo River.¹¹⁸ Spill responders struggled to contain the heavy bitumen, which sank beneath the water's surface, evading conventional spill response measures designed to contain lighter, floating oil. Nearby communities experienced a variety of negative symptoms, including hundreds of hospitalizations for cardiovascular, dermal, gastrointestinal, neurological, ocular, renal, and respiratory impacts.¹¹⁹

More than four years later, cleanup is incomplete¹²⁰ with submerged oil still contaminating the river bed while costs have soared above \$1 billion.¹²¹ In response to these ongoing impacts, Enbridge agreed in early December 2014 to pay \$6.8 million to settle a class action lawsuit brought by local residents.¹²²



Safety issues with tar sands by rail

The public safety and environmental risks of the recent crude-by-rail boom have been underscored by a series of major accidents across North America. In 2014, 141 incidents with oil trains were recorded.¹²⁴ However, the most devastating incident in recent memory was the catastrophic derailment and explosion that destroyed much of Lac-Mégantic, Quebec in 2013 and resulted in 47 casualties.¹²⁵ These accidents have revealed fundamental weaknesses in the regulatory oversight of crude-by-rail, and a rail industry that is egregiously cutting corners on safety.

The North American crude-by-rail boom has been enabled by the development of the crude oil unit train. Unit trains are loaded with a single commodity and are composed of 80 or more tank cars delivering their cargo to a single destination.¹²⁶ This method lowers cost, as unit trains avoid multiple stops en route to their destinations. However, by concentrating huge volumes of flammable crude oil in a relatively small area, unit trains increase the magnitude and likelihood of explosions in the event of an accident.¹²⁷ This threat hardly needs illustration as a single unit train can carry over 70,000 barrels—or over 3 million gallons—of crude oil.

The safety risks associated with shipping large volumes of crude by unit train are amplified by a number of significant regulatory gaps. For instance, much of the existing rail tank car fleet—comprised of older rail tank cars deemed unsafe by the National Transportation Safety Board (NTSB) in 1991¹²⁸—is defective and prone to rupture in the case of a derailment.¹²⁹ Commonly used rail routes take crude oil unit trains through highly populated areas and sensitive environments. These trains operate at speeds that make rupture likely upon derailment.¹³⁰ In addition, crude oil train operators have been exempt from the requirement to prepare oil spill response plans even as operators of oil tankers, pipelines, refineries, and others who handle or transport oil must, leaving gaps in preparedness and training to clean up a worst-case oil spill.¹³¹ These and other regulatory shortcomings have been recognized by regulators in both Canada and the United States. However, efforts to impose common sense safeguards on the crude-by-rail sector have been slow and met with substantial industry opposition both when federal agencies have proposed stronger regulations and when states have stepped in to fill the gaps.¹³²

Meanwhile, millions of California, Oregon, Washington and British Columbia residents live near crude-by-rail routes.¹³³ Major crude-by-rail terminal proposals are likely to bring more tar sands unit trains through Vancouver, Washington, Seattle, Portland, Sacramento, the San Francisco Bay area, and Los Angeles, as well as hundreds of rural communities. In Sacramento alone, more than 250,000 residents live near rail lines, placing them in harm's way during a crude oil train accident.¹³⁴

States and municipalities have identified major vulnerabilities along many rail corridors. In Seattle, the City Council has expressed serious concerns about crude-by-rail, highlighting threats to thousands of residents, the city's historic downtown, and its major professional sports

complexes.¹³⁵ A recent report from California's Interagency Rail Safety Working Group outlined incidences of proximity to population centers, earthquake fault lines, insufficient emergency response capacity, vulnerable natural resources, and a number of "high hazard areas" for derailments, which are generally located near waterways and fragile natural resource areas.¹³⁶ These water resources, which provide drinking water for millions of Californians, would be particularly vulnerable to heavy tar sands spills (as discussed above and below). This vulnerability was highlighted in late 2014 when a train carrying grain derailed in California's Feather River Canyon, sending freight cars tumbling down the canyon's sides.¹³⁷ The treacherous route, operated by Union Pacific, is already in use by unit trains transporting Bakken crude from North Dakota.

Elsewhere, the lack of emergency oil spill response preparedness is especially concerning for rural communities, where lack of personnel, training, and equipment increases vulnerability to the impacts of an oil train accident.¹³⁸ As these concerns arise, so too have concerns about the actual state of the rail infrastructure upon which the crude-by-rail boom depends. Concerned community members have documented increasing incidences of crumbling bridges, causeways, and other key infrastructure elements.¹³⁹

Tar sands by barge and tanker

Numerous independent studies have found that transporting tar sands crude by barge and ocean tanker poses unique risks compared to conventional oil transport. In a recent lengthy review of transport risks associated with tar sands crudes, the NOAA Office of Response and Restoration found that increased tar sands production will significantly increase marine and barge traffic along the West Coast.¹⁴⁰

The risks posed by increased tar sands oil tanker traffic is the subject of an ongoing study by researchers at George Washington University and Virginia Commonwealth University.¹⁴¹ In their risk analysis of marine transport of oil through the Strait of Juan de Fuca, the San Juan Islands, Puget Sound, and Haro Strait, researchers found that tar sands pipeline expansion plans in British Columbia could increase the region's annual crude oil tanker traffic by more than 800 vessels per year compared to 2010 levels.¹⁴² This extraordinary increase also comes with a "significant increase of exposure, potential accident frequency and potential oil outflow," requiring substantial risk mitigation efforts.¹⁴³ Worse still is a 2013 finding that the U.S. Coast Guard does not have any appropriate equipment for addressing the cleanup of a tar sands oil spill—if cleanup would even be possible.¹⁴⁴

With the hazards posed by increased marine traffic in already-congested West Coast waterways come the additional risks of transporting tar sands crude oil as opposed to traditional crude oils. The behavior of spilled tar sands crude oil in marine environments is complicated, and spills are likely to harm the surface, sub-surface, and ocean bottoms, as well as shorelines and coastlines.¹⁴⁵ This is because the physical properties of tar sands crude oil can lead to floating, submerged, and sunken oil, often as part of the same spill.¹⁴⁶



Though there is little data regarding the behavior of tar sands crude in salt water, a recent study by Environment Canada found that, while tar sands crude oil initially floats in salt water, the likely presence of sediments and wave energy causes it to sink.¹⁴⁷ On top of that, chemical dispersants—products commonly used to break down spilled oil in water and accelerate biodegradation—are ineffective for treating tar sands spills.¹⁴⁸

If Enbridge's Kalamazoo River spill is any indication, the risks posed by increased marine transport of tar sands crude oils through marine ecosystems could be severe. Because current terminal proposals contemplate loading Aframax, Panamax, and even VLCC crude oil tankers,¹⁴⁹ individual shipments of up to 2 million barrels¹⁵⁰ could be navigating West Coast waterways.

An accident involving just one of these tankers could lead to a catastrophic release of tar sands crude oil that would prove exceptionally difficult and costly to contain and clean up, thereby leading to long-term negative environmental and economic impacts. This is true for the Great Bear Rainforest in British Columbia; the Salish Sea in British Columbia and Washington; the Columbia River in Washington and Oregon, the Grays Harbor estuary in Washington, and the coastal regions off British Columbia, Oregon, California, and Washington.

Impacts to protected species living in the region's waters are of special concern. Southern resident orca whales, numerous protected salmon populations, marine fish species like Puget Sound rockfish, diving seabirds such as the marbled murrelet, and many others would all be exposed to the risk of extinction should an oil spill occur in their

habitat.¹⁵¹ Highlighting this risk is NOAA's recovery plan for southern resident orcas, which notes the species' high susceptibility to oil spills and the need to ensure that future spills are prevented if the species is to survive.¹⁵²

While the potential environmental and human health impacts from a tar sands spill are relatively apparent, the regional economic impacts are complex and could harm a number of industries. Commercial fishing along the North American west coast is a \$33 billion industry that employs 250,000 people.¹⁵³ In addition, recreational fishing has been a relatively steady economic driver employing more than 25,000 people with a "sales impact" of more than \$2.5 billion.¹⁵⁴ Finally, tribal fishing contributes millions more dollars to local economies and supports the cultural survival of the region's indigenous peoples.¹⁵⁵

In addition to commercial fishing, the West Coast is a major national and international tourist hub. Tourism at parks, preserves, wilderness areas, and communities along the more than 2,000-mile-long West Coast provides numerous benefits to local economies. Cumulatively, the coastal regions support a tourism industry that employs as many as 700,000 people¹⁵⁶ and encourages more than \$75 billion in spending annually.¹⁵⁷ Further inland, tourism's economic impact on the Columbia River and the Columbia River Gorge is less certain, though data compiled by Oregon and Washington suggest that tourism in the area employs as many as 47,000 people and encourages nearly \$4 billion in spending annually.¹⁵⁸ These figures capture only a snapshot of select tourist areas—in reality, many critical tourist areas throughout the West Coast states and provinces could be touched by the transport of tar sands crudes.

Refinery risks

A significant percentage of tar sands crude traveling to the West Coast via rail and pipeline would be refined in Washington and California refineries. As described above, there are already heavy crude refineries in California and Washington, with some individuals and corporations proposing an additional three in British Columbia. The risks created by refining tar sands crude oil are numerous and complex. Tar sands crude contains higher concentrations of heavy metals than conventional crude oils.¹⁵⁹ The added diluent is composed of a mixture of highly volatile chemicals, many of which are known human carcinogens that rapidly evaporate if exposed to the open air.¹⁶⁰ Finally, tar sands crude oil contains high concentrations of sulfur, which are further concentrated by the addition of diluents, which themselves contain sulfur compounds like mercaptans. Mercaptans are of special concern because they are a highly volatile and odiferous compound linked to adverse nervous system, eye, skin, and respiratory health impacts.¹⁶¹

Within a refinery system, this mixture of metals, chemicals, and other compounds increases health risks. First, the volatility of many of the chemicals added to tar

sands crude oils increases fugitive emissions, many of which are carcinogens.¹⁶² Second, tar sands crude oils are energy-intensive to refine, requiring greater use of heaters, boilers, cracking, coking, and hydro-treating—which in turn significantly increase air emissions.¹⁶³ Third, refining heavy tar sands crude results in substantial production of a byproduct known as petroleum coke.¹⁶⁴ Petroleum coke is a coal-like substance that contains high levels of heavy metals, and is often responsible for the production of huge dust clouds composed of fine particulate matter that can seriously harm the human respiratory system.¹⁶⁵

Refining tar sands leads to additional health and safety concerns. High levels of naphthenic acids in tar sands crude oils, combined with high levels of sulfur compounds and high refinery temperatures, can lead to increased corrosion within a refinery.¹⁶⁶ The increased corrosion associated with refining crudes with high naphthenic acid and sulfur content was cited as a contributing factor in the Chevron refinery accident in 2012 in which 15,000 residents in Richmond, California sought medical attention and 19 workers' lives were endangered.¹⁶⁷

Environmental Justice

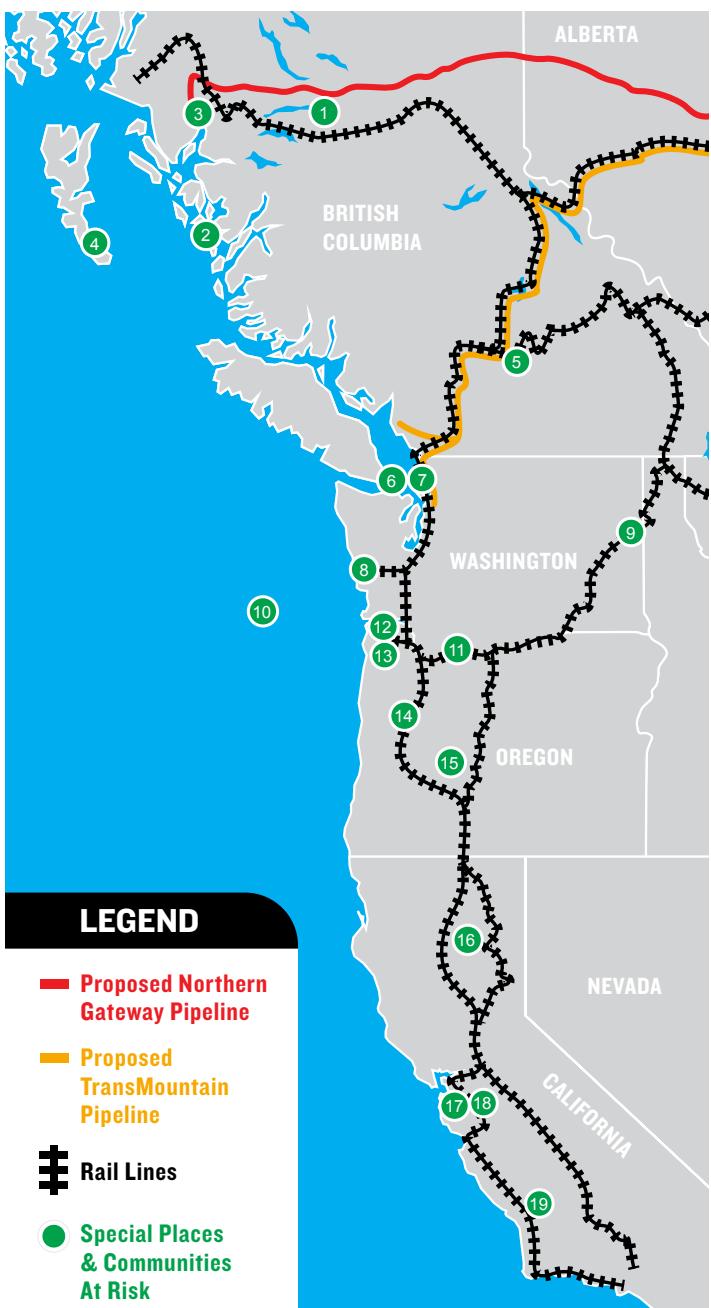
A tar sands invasion of the West Coast threatens communities across thousands of miles, including predominantly First Nations communities at the epicenter of tar sands production in Northern Alberta. In British Columbia, First Nations communities face the potential threat of massive oil tankers in vital marine waters and pipelines and trains snaking through mountains and across hundreds of rivers and streams. An oil spill from any of these sources could devastate the communities' traditions, including important cultural, economic, and subsistence activities that many First Nations have fought hard to preserve.

In the United States, tribal members have shed blood and faced jail time to preserve their right to fish for salmon and other species. An oil spill would devastate the central role salmon play in tribal culture, subsistence, and economies. Communities along the rail corridors of Washington, Oregon, and California are threatened by mile-long unit trains loaded with tar sands crude rolling through their neighborhoods. In Puget Sound, San Francisco's East Bay, and Los Angeles, people living near oil refineries could see significantly increased air pollution (including cancer-causing chemicals like benzene), increased production and storage of coal-like petroleum coke, and an increased risk of refinery accidents.¹⁶⁸ Exposure to these emissions has been linked to increased rates of asthma, cancer, birth defects, and neurological problems—threats that tens of millions of people along the U.S. West Coast could confront every day.¹⁶⁹

In many cases, these communities are already located near rail and refinery infrastructure and have had little power to confront the ever-increasing risks. While these communities are voicing opposition and beginning to see success in their fight against oil infrastructure projects,¹⁷⁰ they remain at ground zero of these threats. California's communities fighting for environmental justice can be a model for reform. Confronted with decades of refinery pollution, they have banded together to set strong refinery emission control standards that have significantly lessened harmful impacts to community members living nearby. Allowing an influx of dirty tar sands creates new burdens that undermine efforts to improve safety, health, and prosperity in these areas. Isolating risky and dangerous activities to communities that have historically borne the brunt of environmental impacts—typically economically depressed communities and communities of color—perpetuates environmental injustice and disproportionately shifts harm away from those who can afford to live, work, and play elsewhere. All along the West Coast, we must recognize that moving these dangerous and destructive resources is affecting those least able to influence the decisions of government and industry. In the face of a tar sands invasion of the West Coast, environmental justice groups must assert their voice and influence to ensure that the safety and general well-being of their communities is a critical factor in decision-making surrounding a threat of an influx of tar sands crude oil.

SPECIAL PLACES AND COMMUNITIES AT RISK

The tar sands invasion to the West Coast could come by pipeline, rail, and tanker. Proposed pipelines across British Columbia from Alberta bring risks of a potential pipeline rupture. Meanwhile, tar sands crude transported across thousands of miles of rail corridors to terminals located up and down the West Coast threaten hundreds of communities and waterways with derailments and spills.¹⁷¹ As tar sands crude reaches terminals serviced by proposed pipelines and existing rail lines, significant quantities will be loaded onto tankers, exposing many sensitive areas to significant increases in tanker traffic that could result in devastating marine accidents. Here are just a few of the special places that are at risk:



1. Upper Fraser, Stuart, Skeena, and Morice Rivers, British Columbia

Enbridge's proposed Northern Gateway tar sands pipeline crosses numerous major rivers, including the Upper Fraser, Stuart, Skeena, and Morice—all of which are critical to supporting British Columbia's wild salmon, sturgeon, and trout fisheries.¹⁷² The Skeena River and estuary is also threatened by rail development and oil tankers.



2. Great Bear Rainforest, British Columbia

Rail terminal proposals and Enbridge's proposed Northern Gateway tar sands pipeline threaten the 15.8 million-acre (6.4 million hectare)¹⁷³ Great Bear Rainforest, which is home to ancient western red cedars, the rare spirit bear, grizzly bears, black bears, wolves, and countless other species.¹⁷⁴ It is the largest intact coastal temperate rainforest left on Earth.¹⁷⁵



3. Douglas Channel, British Columbia

Currently free of any oil tanker traffic, the Douglas Channel is a narrow passage whose coastal approaches are studded with numerous islands and hidden reefs. It is home to fin, orca, and humpback whales; Pacific white-sided dolphins; and Dall's and harbor porpoises—all of which are extremely sensitive to shipping noise and changes in the marine acoustic environment.¹⁷⁶



4. Haida Gwaii, British Columbia

Formerly known as the Queen Charlotte Islands, Haida Gwaii is the historic home to the Haida people who have inhabited the area for as many as 13,000 years.¹⁷⁷ Tanker traffic from ports in Prince Rupert or Kitimat could threaten the waters around the islands, which are home to enormous salmon runs.¹⁷⁸



5. Kamloops, British Columbia

A city of 86,000, Kamloops is traversed by rail lines owned by Canadian National and Canadian Pacific¹⁷⁹ and is the site of infrastructure for the proposed Trans Mountain pipeline expansion.¹⁸⁰ Rail lines travel through residential and business districts on both sides of the Thompson River, and the proposed pipeline would cut through the Lac du Bois grasslands, which would require shrinking the park's boundaries.¹⁸¹



6. Salish Sea and San Juan Islands, British Columbia and Washington

Encompassing the Strait of Georgia, the Strait of Juan de Fuca, and Puget Sound, the Salish Sea is British Columbia and Washington's gateway to the Pacific Ocean.¹⁸² As the busiest shipping route on North America's Pacific seaboard,¹⁸³ it supports migrating salmon, humpback whales, and numerous other species.¹⁸⁴ The region's iconic population of orcas, the "Southern Residents," are on the U.S. and Canadian endangered species lists, as are several runs of salmon that they depend upon, and are already seriously threatened by the degradation of their habitat through noise, chemical pollution, and loss of wild fish.¹⁸⁵ Dotting the central Salish Sea, the San Juan islands consist of 172 named islands and were recently designated as a National Monument by President Obama.¹⁸⁶ A rise in tanker traffic in the area increases the risk of a serious accident causing long term harmful impacts.



© Rossana Dino, 2013

7. Anacortes, Washington

The city of Anacortes, considered the gateway to the majestic San Juan Islands,¹⁸⁷ is also home to two major oil refineries capable of processing tar sands crude oil. As a destination for tar sands crude exports, the community will also bear the brunt of health risks associated with more harmful refinery emissions and increased tanker and rail traffic.



© thatlongyellowline.com, 2013

8. Grays Harbor, Washington

Three new oil terminals have been proposed in Hoquiam, which sits on Grays Harbor at the confluence of the Wishkah and Chehalis Rivers.¹⁸⁸ If built, Grays Harbor will see huge increases in barge and tanker traffic, heightening the risk of serious accidents with long-term ecological consequences.



© Daniel Parks, 2010

9. Spokane, Washington

Spokane, a critical western rail hub, will likely watch as nearly all tar sands oil moved by rail in the western United States passes through. Set at the edge of Washington's vast rolling Palouse and the southern tip of the Selkirk Mountains, Spokane is home to more than 200,000 people.¹⁸⁹



© Movement Six, 2013

10. Coastal Pacific Ocean

The possibility of a significant increase in tanker traffic along the West Coast poses major risks to the coasts of British Columbia, Washington, Oregon, and California. This enormous marine ecosystem hosts six species of wild salmon¹⁹⁰ and includes globally important habitat for blue whales. It is also the migratory corridor for virtually the entire gray whale population and the only habitat for several small resident populations of dolphins and porpoises.¹⁹¹ Recognizing this importance, NOAA has designated a majority of Washington's coastline as the Olympic Coast National Marine Sanctuary and an "Area to be Avoided" due to environmental risks of marine shipping.¹⁹²



© University of Oregon, 2014

11. The Columbia River and Columbia River Gorge, Oregon and Washington

Increasing transport of crude-by-rail is already impacting the Columbia River Gorge, a western icon of unparalleled beauty and importance. Framed by basalt cliffs, steep rolling hills, waterfalls, and distant volcanoes, the mile-wide Columbia River makes its 100-mile journey through the Gorge after traveling nearly 1,000 miles from its source in British Columbia.¹⁹³ The lifeblood of some of the largest salmon runs in the United States, Pacific Northwest tribal groups, millions of acres of agricultural land, and a critical tourism industry, the Columbia River's importance to the western United States cannot be exaggerated.



© Victor Solano, 2014

12. Astoria, Oregon

At the mouth of the Columbia River stands the city of Astoria, where Lewis and Clark's western journey came to an end.¹⁹⁴ Astoria will see the full scope of increased shipping of tar sands crude oil from Washington and Oregon terminals along the Columbia River. Once they reach Astoria, tankers and barges must navigate the Columbia River Bar, one of the world's most dangerous passages,¹⁹⁵ earning it the nickname "Graveyard of the Pacific."¹⁹⁶



© A.F. Litt, 2011

13. Cities of Scappoose, St. Helens, and Rainier

On its way to the Clatskanie terminal, a rail line owned by Genesee & Wyoming (and used by BNSF)¹⁹⁷ runs through downtowns of Rainier, Scappoose, and St. Helens along tracks that sometimes run directly through the main streets.¹⁹⁸ While other rail lines are often at least several feet away from development, residents in these small cities must contend with oil trains cutting off emergency services or passing inches away from their businesses and offices.



© Tom Erickson, 2010

14. Willamette Valley, Oregon

A rail corridor eyed by the oil industry as a useful connection between Washington, Oregon, and California, the Willamette Valley is Western Oregon's agricultural and ecological heart. Traversed by the Willamette River, the valley has long been an important north-south transport corridor.



© Bureau of Land Management, 2014

15. Deschutes River, Oregon

Oil trains are known to run along this critical Central Oregon river, which travels from Little Lava Lake north to the Columbia River and serves as the eastern boundary of the Warm Springs Indian Reservation.¹⁹⁹



© Eric Leslie, 2011

A designated wild and scenic river,²⁰⁰ the Deschutes is known for its world-class rafting, rugged beauty, and agricultural importance.



© Lorin Lagarde, 2013

16. Sacramento Watershed, Oregon and California

The numerous proposed oil terminals throughout California could significantly increase crude-by-rail traffic, all of which passes through the heart of the Sacramento Watershed. The 29 million square mile drainage from Southeastern Oregon to the San Francisco Bay area²⁰¹ supports 75 percent of California's irrigated land—where at least 250 different crops are grown, including 40 percent of U.S. fruits and nuts.²⁰² Not only does this watershed feed the nation, it provides drinking water for communities throughout the entire state.



© Greg Bishop, 2009

17. San Francisco Bay, California

San Francisco Bay could become a major epicenter for tar sands crude shipping by rail, tanker, and barge, since the area's five refineries are continuing to retrofit their operations to accept tar sands crude oil.²⁰³ Home to more than 7 million people,²⁰⁴ the Bay Area's physical beauty attracts admirers from all corners of the world. Offshore, in Cordell Bank and the Gulf of the Farallones, lie two National Marine Sanctuaries, established to protect some of the most productive waters off our shores and an astonishing diversity of sea life.



© Greg Bishop, 2009

18. Richmond, Rodeo, Martinez, and Benicia, California

These four communities host the Bay Area's oil refineries, all of which are expected to be major tar sands oil processors.²⁰⁵ Historically home to people of color and low-income households, these communities would see increased barge, tanker, and rail traffic.



© Loco Steve, 2011

19. Sacramento, Berkeley, Oakland, San Jose, San Luis Obispo, Bakersfield, and Wilmington, California

Existing and proposed crude-by-rail facilities in Santa Maria and Bakersfield would bring tar sands trains through these heavily populated communities to destinations along California's treasured Central Coast and the Los Angeles area.

POLICY RECOMMENDATIONS

1. ADDRESSING THE HEALTH AND ENVIRONMENTAL RISKS FROM TAR SANDS TRANSPORT

Decision-makers at all levels must be informed about the risks posed by an invasion of tar sands and put in place policies to guard against these threats to public health and safety, water supplies, economies, and the climate.

Given the potentially devastating risks of producing, transporting, and refining tar sands crude, decision-makers must take precautionary measures and reject proposals for new tar sands infrastructure.

In light of mounting evidence that 75 percent or more of discovered fossil fuel reserves must remain in the ground, it is imperative that policymakers consider whether infrastructure is consistent with long-term efforts to address climate change.²⁰⁶ This is especially true for infrastructure supporting unconventional, high-carbon reserves like tar sands, which have been recently identified as the type of high-cost reserve that cannot be developed if global temperatures are to be kept within the international two degrees Celsius warming goal.²⁰⁷

Moreover, as proposals are made to increase the volumes of heavy tar sands oil travelling to West Coast ports via rail, tanker, and pipeline, there is still not enough information about the full scope of the associated risks. In addition, we now know that a spill of tar sands crude cannot be addressed by conventional spill mitigation technology.²⁰⁸

Below are some general recommendations for decision-makers at all levels. These recommendations should be seen as a starting point for discussion about how best to address the threats posed to the region by tar sands and other high-carbon fuels. In many cases, one solution will be preferred over another, and this report does not place a greater or lesser value on any one solution proposed. Instead, we see these steps as possible solutions for protecting communities, critical rivers, marine habitats, and the environment from potentially devastating tar sands spills. While these recommendations are far from comprehensive, they provide key starting points and tools for decision-makers, spanning safety measures for rail transport and tanker traffic to air pollution control measures for refineries.

In all cases, these measures are promoted for the protection of communities from the harmful impacts of tar sands crudes. Even if industry and regulators were to adopt every recommendation, it is important to remember that “extreme oil” infrastructure remains incompatible with the region’s climate and pollution priorities.

- **Strengthen environmental review:** A first step for any decision-maker is ensuring thorough environmental reviews and risk assessments for energy infrastructure. This will facilitate a stronger understanding of individual



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and cumulative threats to communities, economies, and the environment. Further, review of any new infrastructure must assess not only the direct climate impacts of the proposed infrastructure itself, but also all cumulative impacts related to upstream production impacts and downstream consumption impacts. Special attention should be paid to communities living near proposed infrastructure.

- **Reject tar sands-related infrastructure:** Because the cumulative risks of transporting and refining tar sands oil are extreme, decision-makers must reject new tar sands infrastructure. This includes the two proposed pipelines cutting through British Columbia and the many proposals for new and expanded storage terminals along the West Coast.
- **Stop tar sands tanker traffic:** The U.S. and Canadian governments should ban tar sands oil tankers until more information is known about the unique risks of tar sands to water resources and how to effectively respond to spills. This is in addition to the need for a general oil tanker ban in the sensitive and treacherous waters of British Columbia’s north and central coasts—including respect of the tanker ban imposed by coastal First Nations—and the Salish Sea.²⁰⁹
- **Respect First Nations and U.S. tribal rights:** Decision-makers must ensure that constitutionally protected treaty and aboriginal rights of First Nations in Canada are honored. Likewise, sovereign tribal nations’ treaty and trust rights in the United States must be honored.
- **Strengthen standards for rail safety:** U.S. and Canadian regulators should immediately ban shipment of crude oil in hazardous tank cars, including aging DOT-111s and the updated CPC-1232s, both of which have proven unsafe for transporting crude oil.²¹⁰ Additional necessary

safeguards include adoption of strict tank car standards (requiring thicker shells, jackets, thermal protection, valve and fitting protections, and state-of-the-art braking), significantly reduced speed limits, disclosure of hazardous cargo (including tar sands) to first responders and other emergency personnel, required environmental impact assessments, demonstrated ability to respond to and pay for worst-case-scenario spills, and development of comprehensive oil spill response plans.²¹¹

■ **Require more robust pipeline maintenance programs:**

In remote areas, ruptures are difficult to detect and address. Maintenance and monitoring programs designed to prevent such occurrences must be required, regardless of cost or logistical challenges.

■ **Understand and prevent air pollution impacts from tar sands refining:**

Decision-makers need to better understand how refining tar sands worsens air quality, particularly in communities already facing air quality impacts from crude oil loading, unloading, and refining. The EPA; Environment Canada; and state, provincial, and other environmental agencies should evaluate these air quality impacts and develop protective standards, particularly in fenceline communities.

2. TURNING THE TIDE WITH CLEAN TRANSPORTATION SOLUTIONS

As illustrated in this report, the West Coast now faces a long-term threat that could bring more tar sands oil imports. This threat conflicts with the West Coast states' leadership around climate action and more sustainable transportation and communities. While the risks of tar sands transport are only just emerging, there is more clarity regarding the troubling climate consequences of tar sands. An influx of tar sands could undermine commitments by West Coast decision-makers to lead efforts to reduce carbon emissions through the Pacific Coast Collaborative.²¹²

To counter these negative climate consequences, decision-makers must ensure climate policies and regulations are in place to slow and phase out an influx of dirtier fuels like tar sands. But more generally, the West Coast must have policies that reduce and phase out fossil fuel use while incentivizing low carbon and carbon neutral transportation solutions such as electric vehicles, renewable fuel sources, and clean fuels. As above, what follows is a set of general and specific recommendations for decision-makers to consider. The challenge of addressing tar sands threats and climate threats is dynamic and the solutions offered are not intended as a one-size-fits-all list. Instead, these policies are often a starting point upon which to build and continue innovating. Though these policies focus on reducing emissions from the transport sector, many should and could be applied across all heavily polluting sectors.

Low-Carbon Fuel Standard

One of the most significant responses to carbon-intensive oils like tar sands is adopting a clean fuels standard—also known as a low-carbon fuel standard (LCFS). In the short term, LCFS laws are intended to incrementally reduce the carbon-intensity of a state's or region's fuel mix. Over the long term, well-designed LCFS laws should contain measures to incentivize the development of alternative fuel sources and the transition to non-fossil fuel dependent modes of transport and commerce (e.g., electric vehicles). A recent report from the International Council on Clean Transportation and E4tech found that LCFS could reduce the demand for gasoline and diesel in California, Oregon, Washington and British Columbia by 25 percent—or 400,000 bpd—by 2030.²¹³

The LCFS, already adopted in California, Oregon, and British Columbia, typically applies to a relatively small number of oil refiners and importers who are responsible for reducing the average carbon intensity of their fuel mix over time. If the carbon intensity worsens (by, for example, increasing use of tar sands crudes), the refiner or importer would need to take specific actions, such as:

- Blending and using lower-carbon fuels (e.g. biofuels that do not undermine food security or exacerbate ecosystem destruction)
- Purchasing low-carbon fuel credits (generated by using cleaner transportation fuels)
- Adopting measures at refineries and crude oil facilities to mitigate negative climate impacts

However, to be effective, a clean fuels standard must appropriately track and account for emissions from crude oil sources to accurately measure the carbon intensity of petroleum-based fuels. Once crude oils are accurately tracked and their emissions accounted for, jurisdictions should:

- **Adopt and strengthen low-carbon fuel policies and comprehensive climate policies.** There are several steps that California, Oregon, Washington and British Columbia could take to ensure carbon-intensive tar sands do not undermine the region's climate progress.

California should:

- Readopt a strong LCFS reducing carbon intensity by 10 percent by 2020 and establish aggressive and more robust 2030 targets.
- Continue accounting for the carbon intensity of crude oils such as tar sands while strengthening current protections by requiring individual refiners or importers to offset any increased emissions.
- Continue to extend policies to meet the governor's goal of halving petroleum use by 2030 and adopt 2030 greenhouse gas reduction targets.
- Reject oil industry attempts to exempt transportation fuels from the requirements of the cap-and-trade program.



Oregon should:

- Vigorously implement (and defend from legal attack) its Low Carbon Fuel Standard.²¹⁴
- Ensure carbon pollution is further limited through statewide policy mechanisms that reduce emissions.
- Work with California and Washington to develop and harmonize low-carbon transportation solutions for the region.
- Improve alternative and mass transportation solutions within and between Oregon and Washington.

Washington should:

- Adopt a strong clean fuels standard that requires refiners and importers to reduce the carbon intensity of their fuels by 10 percent over 10 years.
- Work with California and Oregon to develop and harmonize low-carbon transportation solutions for the region.
- Develop and expand mass transit and alternative transit systems in major metropolitan areas like Seattle.
- Ensure carbon emissions are further reduced and current statutory limits are met by passing measures like the proposed Carbon Pollution Accountability Act of 2015.²¹⁵
- Preserve existing incentives for production of renewable energy.
- Incentivize the “greening” of electric vehicles by expanding investment in low-carbon, renewable energy production.

British Columbia should:

- Confirm and strengthen its existing low-carbon fuel standard policy.
- Harmonize with other jurisdictions by accounting for increased emissions from petroleum and indirect land use emissions from biofuels.
- Resume annual increases in the carbon tax program, targeting a price of at least \$60 per metric ton of carbon dioxide by 2020.
- Expand the carbon tax to cover currently exempt sectors, providing an incentive for these industries to reduce emissions while increasing the competitiveness of renewable alternatives.
- Apply additional revenues from an expanded carbon tax to the promotion of renewable energy, energy efficiency, and sustainable transportation options.
- **Support policies that reduce carbon emissions in the transportation sector.** The West Coast could further demonstrate state and international leadership by dramatically decreasing the carbon emissions from the transportation sector through:
 - Electric vehicle policies that support rapid deployment of vehicles, encouraging a strong utility role and grid support capabilities around vehicle electrification.
 - Sustainable community programs that encourage more walkable and bike-able streets and access to transit.



- Support clean car and zero emission vehicle programs, which are already expanding efficient vehicle options.
- Move goods more efficiently with increased use of rail for human transport and non-oil commodities, as well as expanded use of electric and low-emission trucks.

- **Support policies to spur investment in renewable energy production.** Together with robust efforts to support electric vehicles, renewable energy can further clean the transportation sector and reduce oil dependence. The West Coast already produces significant amounts of energy from renewable resources including wind, solar, geothermal, and hydroelectricity. Decision-makers should continue capitalizing on the region's potential to further decrease dependence on fossil fuels and to act as a successful model for a clean energy future.

Under the Pacific Coast Action Plan on Climate and Energy endorsed by the leaders of California, Oregon, Washington, and British Columbia, the West Coast will set a high bar as a global leader on climate change policy and "transition the West Coast to clean modes of transportation and reduce the large share of greenhouse gas emissions from this sector." The Pacific Coast Collaborative, created as part of this agreement,

made specific commitments to adopt low-carbon fuel standards while also committing to expanded zero-emission vehicle incentives. At a minimum, a tar sands influx to the West Coast would make these commitments more difficult.

While a West Coast tar sands invasion has specific climate implications, as described in this report, there are a range of other health and safety issues at play. Because of this, tools like LCFS cannot confront the full threat of tar sands. Decision-makers must consider the broader issue of North America's dependence on oil. Indeed, as the Pacific Coast Collaborative envisions, the West Coast can become a model for a clean transportation future. Using efficiency to reduce oil demand, expanding public transit infrastructure, making communities more bike- and pedestrian-friendly, and shifting to cleaner fuels will put money back in citizens' pockets and drive innovation. For example, electric vehicles can be recharged for the equivalent of about one dollar per gallon of gasoline.²¹⁶ A more diverse fuel supply can also blunt petroleum price spikes because consumers would be able to choose from an array of energy alternatives.

In the end, the first step toward a solution is discussion. An informed public debate about the threats of a West Coast tar sands invasion is essential. There is still time to avert a massive influx of tar sands. But decision-makers must proactively confront the potential threat.

Endnotes

- 1 As used in this report, “conventional crude” is used to describe light, sweet (low sulfur) crude oils as opposed to heavy, high density, sour (high sulfur) crude oils. It is not used in relation to production method.
- 2 As used in this report, “terminals” refer to any facility capable of handling crude-by-rail, including facilities for accepting crude-by-rail at existing refineries.
- 3 Tar sands crude oil is either a blend of raw bitumen with light volatile petroleum products or bitumen that is partially refined—or upgraded—to be shipped as synthetic crude oil.
- 4 Canadian Association of Petroleum Producers (CAPP), “Crude Oil: Forecasts, Markets and Pipelines,” Canadian Association of Petroleum Producers, June 2014, pg. 40, www.capp.ca/forecast/Pages/default.aspx.
- 5 Stockman, L., “Wrong side of the tracks: Why rail is not the answer to the tar sands market access problem,” *Oil Change International*, September 2014, pgs. 13–22, http://priceofoil.org/content/uploads/2014/09/OCI-Wrong-Side-of-the-Tracks_Final.pdf.
- 6 Energy Information Administration (EIA), Number and Capacity of Petroleum Refineries (Washington), January 1, 2015, http://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_SWA_a.htm; EIA, Number and Capacity of Petroleum Refineries (California), January 1, 2015, http://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_SCA_a.htm; CAPP, “Crude Oil, Forecasts, Markets and Pipelines.”
- 7 Sheridan, M., “California Crude Production and Imports,” California Energy Commissions, Staff Paper, April 2006, pg. 4, www.energy.ca.gov/2006publications/CEC-600-2006-006/CEC-600-2006-006.PDF.
- 8 California heavy crude production data 2013–2040, Rystad Energy UCube Global Database, October 2014, <http://www.rystadenergy.com/Databases/UCube> via Oil Change International.
- 9 Borealis Centre for Environment and Trade Research, U.S. West Coast Refineries, December 3, 2014, pg. 18, weblink.
- 10 Canadian Association of Petroleum Producers, “Crude Oil, Forecasts, Markets and Pipelines” June 2014, pg. 19, <http://www.capp.ca/getdoc.aspx?DocId=247759&DT=NTV>.
- 11 Chevron Canada Limited, “Application for a Priority Destination Designation,” Chevron Canada Limited, June 19, 2012, pg. 8, https://docs.neb-one.gc.ca/ll-eng/lisapi.dll/fetch/2000/90465/92835/552980/954292/825769/836246/825394/B-01b-_Chevron_PDD_Application,_June_19,_2012_%28A2U1Z4%29.pdf?nodeid=825163&vernum=-2.
- 12 Pacific Future Energy, “About Us,” Pacific Future Energy, (accessed Jan. 8, 2015), www.pacificfutureenergy.com/about/; Kitimat Clean, “Fast Facts,” Kitimat Clean, (accessed Jan. 8, 2015), <http://kitimatclean.ca/fast-facts-2/> [Kitimat Fast Facts].
- 13 Jones, J., “B.C. Group Pitches \$10-billion ‘Environmentally Responsible’ Refinery,” *Globe and Mail*, June 10, 2014, [www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/bc-group-pitches-10-billion-environmentally-responsible-refinery/article19092415/](http://theglobeandmail.com/report-on-business/industry-news/energy-and-resources/bc-group-pitches-10-billion-environmentally-responsible-refinery/article19092415/); Pacific Future Energy, “Frequently Asked Questions,” [Where will the refinery be located?], Pacific Future Energy (accessed Jan. 8, 2015), www.pacificfutureenergy.com/faqs/.
- 14 Steel, D., “Proposal For Oil Refinery For Grassy Point Near Prince Rupert, B.C.,” Aboriginal Multi-Media Society, 2013, www.ammsa.com/publications/windspeaker/proposal-oil-refinery-grassy-point-near-prince-rupert-bc; Vocino, N. and Helin, C., “Game Changing First Nations Energy Company Announced,” *Newswire*, September 26, 2012, www.newswire.ca/en/story/1042601/game-changing-first-nations-energy-company-announced.
- 15 Kitimat Clean, “Kitimat Fast Facts,” Kitimat Clean, (accessed February 8, 2015): <http://kitimatclean.ca/fast-facts-2/>. The combined capacity of Pacific Future (200,000 bpd) and Kitimat Clean (550,000 bpd) is 750,000 bpd; Cattaneo, C., “Does This Man Have the Solution Canada’s Oil Sands Has Been Waiting For?,” *Financial Post*, October 15, 2014, http://business.financialpost.com/2014/10/15/does-this-man-have-the-solution-canadas-oil-sands-has-been-waiting-for/?_lsa=aa1e-dbe4.
- 16 Campbell, D., “Amid a Struggle to Ship Crude Oil to the West Coast, Three Crazy Ideas Emerge,” *Alberta Oil*, September 23, 2014, www.albertaoilmagazine.com/2014/09/three-crazy-ideas/.
- 17 NextGen and NRDC commissioned an analysis of the West Coast petroleum market by the Borealis Centre for Environment and Trade Research, a non-profit international investigative research organization. Borealis Centre for Environment and Trade Research, U.S. West Coast Refineries, December 3, 2014, pg. 14, weblink.
- 18 Ibid.
- 19 The West Coast’s net crude oil inputs averaged 2.34 million bpd in 2013. http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=M_EPC0_YIY_R50_2&f=M.
- 20 Borealis Centre, U.S. West Coast Refineries.
- 21 Ibid.
- 22 Muse Stencil, Update of Market Prospects and Benefits Analysis for the Northern Gateway Project, Muse Stencil, August 2012, pg. 4 https://docs.neb-one.gc.ca/ll-eng/lisapi.dll/fetch/2000/90464/90552/384192/620327/624798/858220/B100-3_NGP_-Revised_-_Clean_-_Attachment_1_-_Update_of_Market_Prospects_and_Benefits_Analysis_for_the_Northern_Gateway_Project_-_A2Z7Q4.pdf?nodeid=858227&vernum=-2; Hackett, D. et al., “Pacific Basin Heavy Oil Refinery Capacity,” *The School of Public Policy Research Papers*, University of Calgary, vol. 6, issue 8, February 2013, pg. 19, www.eisourcebook.org/cms/Feb%202013/Pacific%20Basic%20Heavy%20Oil%20Refining%20Capacity.pdf.
- 23 EIA, Annual West Coast (PADD 5) Product Supplied of Crude Oil and Petroleum Products, 1989–2013, (accessed Jan. 8, 2015), www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mttupp52&f=a.
- 24 California Energy Commission (CEC), *Integrated Energy Policy Report*, California Energy Commission, 2013, pg. 279, www.energy.ca.gov/2013_energypolicy.
- 25 California Air Resources Board (ARB), “The California Commitment: Cutting Petroleum Use in Half by 2030,” California Air Resources Board, (accessed February 8, 2015), www.arb.ca.gov/newsrel/petroleum_reductions.pdf. NRDC internal analysis suggests slightly higher values than estimated by ARB for petroleum reductions by 2030 considering implementation of currently adopted measures as well as heavy duty-truck greenhouse gas tailpipe standards currently under consideration.
- 26 Governor Edmund Brown, Inaugural Address, January 5, 2015 <http://gov.ca.gov/news.php?id=18828>. Under California’s Vision for Clean Air, the state could reduce its annual crude oil consumption by 48 percent—from 600 million barrels to about 300 million barrels.
- 27 Ryan McCarthy, Implications of Climate Policies on Oil Demand in California, IEPR Workshop: Trends in Sources of Crude Oil, California Air Resources Board, June 25, 2014, pg. 6, http://www.energy.ca.gov/2014_energypolicy/documents/2014-06-25_workshop/presentations/McCarthy_CARB_6252014.pdf.
- 28 A recent study found that with the adoption of an LFCS by 2026, Washington’s gasoline consumption could be reduced by 30 percent and its diesel consumption by 22 percent; Life Cycle Associates, “A Low Carbon Fuel Standard in Washington State Revised Analysis with Updated Assumption,” Oct. 9, 2014, pp. 55–56, http://ofm.wa.gov/initiatives/cleanfuelstandards/documents/Carbon_Fuel_Standard_evaluation_2014_revised_draft.pdf; Environment Oregon Policy & Research Center, “Getting Off Oil: A 50 State Roadmap for Curbing our Dependence on Petroleum,” Summer 2011, pp. 69, www.environmentoregoncenter.org/sites/environment/files/reports/Getting-Off-Oil-Report--Environment-Oregon.pdf.
- 29 Kinder Morgan, “Puget Sound System,” Kinder Morgan (accessed Jan. 8, 2015), www.kindermorgan.com/business/canada/puget_sound.cfm.
- 30 Kinder Morgan, “Trans Mountain Pipeline System,” prepared for the Oil Sands Product Forum, April 16, 2013, pg. 6, https://crrc.unh.edu/sites/crrc.unh.edu/files/media/docs/Workshops/oil_sands_washington/5.Davies_pipeline_osp04.16.2013.pdf.

30 Carroll, R., "California Getting More Bakken Crude by Barge Than Rail," *Reuters*, October 23, 2014, www.reuters.com/article/2014/10/23/us-california-bakken-barge-idUSKCN0IC17L20141023.

31 This number includes both rail trans-loading or "merchant terminals," barge off-loading terminals, and rail terminals located at existing refineries. The terminals include: Nexen Prince Rupert, Shell Anacortes, U.S. Development Grays Harbor, Westway Grays Harbor, Imperium Grays Harbor, Tesoro/Savage Vancouver, Targa Stockton, WesPac Energy Pittsburg, Valero Benicia, Phillips 66 Santa Maria, Questar North Palm Springs.

32 These include Stanovan Burnaby, BP Ferndale, Phillips 66 Ferndale, Tesoro Fidalgo, U.S. Oil and Refining Tacoma, Arc Logistics Portland, Alon Portland, Tesoro Martinez, NuStar Selby, Kinder Morgan Richmond, Kern Oil Bakersfield, Alon Paramount, and Alon Long Beach. Oil Change International, North American Crude by Rail Map, Oil Change International, (Accessed February 9, 2015), <http://priceofoil.org/rail-map/>.

33 These include NuStar's Vancouver terminal, Global Partner's Clatskanie terminal, Plains All American's Bakersfield terminal, and Alon's Bakersfield terminal. Oil Change International, North American Crude by Rail Map.

34 Small terminals in Burnaby, British Columbia and Portland, Oregon have traditionally handled heavy crude oils like tar sands. However, recent modifications at BP's Ferndale refinery, Tesoro's Fidalgo refinery, U.S. Oil and Refining's Tacoma refinery, Tesoro's Martinez refinery, and Kern Oil's Bakersfield terminal now allow for tar sands processing.

35 Hays, K., "Update 2—Phillips 66 Mulling Options for California Refineries," *Reuters*, January 30, 2013, http://articles.chicagotribune.com/2013-01-30/news/sns-rt-phillips66-california-update-211n0azc0k-20130130_1_crude-imports-california-refineries-canadian-heavy-crude; Phillips 66, "Phillips 66 Delivers on Advantage Crude Strategy," Phillips 66, <http://www.phillips66.com/EN/newsroom/feature-stories/Pages/AdvantagedCrude.aspx>.

36 Ibid., pg. 24.

37 According to TransCanada filings to the Federal Energy Regulatory Commission, the cost of shipping heavy crude oil from Hardesty to the Gulf is \$8.10 a barrel, while the cost of shipping crude from Hardesty to the West Coast by rail ranges from \$8.65 to \$16.05 per barrel. United States State Department, Final Supplement Environmental Impact Statement, Jan. 31, 2014, 1.4-83; CAPP, "Crude Oil, Forecasts, Markets and Pipelines", pg. 33.

38 Canadian National documents indicate that Prince Rupert could handle seven unit trains per day carrying 55,000 barrels of raw bitumen or 78,000 barrels of diluted bitumen. Unit trains are loaded as a single unit composed of 80 to 120 tank cars. These trains deliver their cargo to a single destination. Lorne Stockman, Wrong Side of the Tracks: Why rail is not the answer to the tar sands market access problem, Oil Change International, Sept. 2014, http://priceofoil.org/content/uploads/2014/09/OCI-Wrong-Side-of-the-Tracks_Final.pdf; Stewart, K. "Gateway-sized oil by rail project planned for northern British Columbia," Greenpeace, September 22, 2013, www.greenpeace.org/canada/en/Blog/cn-rail-and-nexen-planning-gateway-sized-virt/blog/46725.

39 Tesoro Savage, Application for Site Certification Agreement, Volume 1, Tesoro Savage, August 29, 2013, pp. 2–86, [www.efsec.wa.gov/TesoroSavage/Application/EFSEC%2013-01%20Volume%20I/EFSEC%2013-01%20-Compiled%20PDF%20Volume%20I.pdf](http://efsec.wa.gov/TesoroSavage/Application/EFSEC%2013-01%20Volume%20I/EFSEC%2013-01%20-Compiled%20PDF%20Volume%20I.pdf).

40 Doan, L., "Alon Paves Way for Shale Oil to Ride Rails to California," *Bloomberg*, September 10, 2014, www.bloomberg.com/news/2014-09-10/alon-s-california-oil-by-rail-project-approved-by-county.html; Burgarino, P., "Pittsburg: WesPac Oil-By-Rail Storage Project Remains on Hold," *Contra Costa Times*, August 2, 2014, www.contracostatimes.com/contracosta-times/ci_26264741/pittsburg-wespac-oil-by-rail-storage-project-remains. Kearn, R., "Greens Fight Expansion of SoCal Oil-Rail Project," Courthouse News Service, February 3, 2015, www.courthousenews.com/2015/02/03/greens-fight-expansion-of-socal-oil-rail-project.htm.

41 de Place, E., *The Northwest's Pipeline on Rail*, May 2014, Sightlines Institute, <http://www.sightline.org/research/the-northwests-pipeline-on-rails/>; State of Washington Department of Ecology, "Imperium Renewables Proposal," State of Washington Department of Ecology, (accessed February 9, 2015), www.ecy.wa.gov/geographic/graysharbor/imperiumterminal.html; State of Washington Department of Ecology, "Westway Expansion Projects," State of Washington Department of Ecology (accessed February 9, 2015) www.ecy.wa.gov/geographic/graysharbor/westwayterminal.html; State of Washington Department of Ecology, "Grays Harbor Rail Terminal (GHRT) Project," State of Washington Department of Ecology, (accessed February 9, 2015), www.ecy.wa.gov/geographic/graysharbor/ghrt.html; Le, Phuong "Proposed Hoquiam Terminal Would Get ND Crude by Rail," *Associated Press*, April 11, 2014, www.theolympian.com/2014/04/11/3081305_proposed-hoquiam-terminal-would.html?rh=1.

42 The information in this table is compiled from more than 20 sources, including the Washington State Department of Ecology, State of Oregon Department of Environmental Quality, California Environmental Protection Agency, media reports, and local and regional air permitting boards. Taken together with existing terminals, the total potential rail handling capacity for the West Coast could be 2.588 million bpd. Coupled with the existing Kinder Morgan Trans Mountain pipeline (300,000 bpd), and the proposed Enbridge Northern Gateway and Kinder Morgan Trans Mountain expansion pipelines (1.115 million bpd), total crude oil export and storage capacity could rise above 4 million bpd.

43 At the time of publication, plans to include rail offloading facilities in the proposed WesPac project have been scrapped. However, the proposal is being resubmitted to Pittsburg environmental regulators to receive shipments via pipeline and barge (which were anticipated sources in the original proposal). Because tar sands could arrive by barge and be stored at a future WesPac facility, we have chosen to keep it on this list. Richards, S., "Pittsburg: WesPac Oil Storage Project no Longer Includes Bakken Crude Trains," *San Jose Mercury News*, April 1, 2015, www.mercurynews.com/my-town/ci_27828700/pittsburg-wespac-oil-storage-project-no-longer-includes.

44 Canadian Press, "Northern Gateway Opponents Target CN Rail," *Financial Post*, January 31, 2014, <http://business.financialpost.com/2013/01/31/northern-gateway-opponents-target-cn-rail/?lisa=0f8b-8672>.

45 Gathering of Nations, Save the Fraser Declaration, Gathering of Nations, (accessed February 9, 2015) <http://savethefraser.ca/>.

46 Rice, S., "Vancouver City Council Passes Oil Moratorium," *The Columbian*, September 11, 2014, www.columbian.com/news/2014/sep/11/vancouver-city-council-passes-oil-moratorium/.

47 Corvin, A. "2nd Thoughts on 3 Oil Terminals," *The Columbian*, July 13, 2014, www.columbian.com/news/2014/jul/13/2nd-thoughts-on-3-oil-terminals/; Mittan, K., "Hoquiam Mayor Calls for Moratorium on all Future Oil Facilities in City," *The Daily World*, March 5, 2015, www.thedailyworld.com/news/local/hoquiam-mayor-calls-moratorium-all-future-oil-facilities-city.

48 James, R., "Richmond Residents, Leaders Warn of Danger From Bakken Crude by Rail Shipments," *Richmond Confidential*, November 1, 2014, <http://richmondconfidential.org/2014/11/01/richmond-residents-leaders-warn-of-danger-from-bakken-crude-by-rail-shipments/>; Bizjak, T. and Tate, C., "Sacramento Crude Oil Transfers Halted; Air Quality Official Says Permit Was Granted in Error," *Sacramento Bee*, October 22, 2014, www.sacbee.com/news/local/transportation/article3229042.html.

49 In 2008 there were 9,500 car loadings of crude compared to 435,000 in 2013, with each car capable of carrying approximately 700 barrels of crude. Congressional Research Service, U.S. Rail Transportation of Crude Oil: Background and Issues for Congress, December 2014, pp. 1, <https://www.fas.org/sgp/crs/misc/R43390.pdf>.

50 Teller, K., Mallik, A., O'Sullivan, J., Crude-by-rail Transportation Provides Bakken Shale Production Access to Major Markets, U.S. Energy Information Administration, June 10, 2014, www.eia.gov/todayinenergy/detail.cfm?id=16631.

- 51 Platts: McGraw Hill Financial, "Oil, Bakken: The King of the North," Platts: McGraw Hill Financial, May 2014, pp. 3, www.platts.com/IM.Platts.Content/InsightAnalysis/IndustrySolutionPapers/special-report-bakken-the-king-of-the-north.pdf; Eggleston, K., Bakken Crude Pushed to West Coast Refining Markets, Bakken Shale, June 4, 2014, <http://bakkenshale.com/news/bakken-crude-pushed-to-west-coast-refining-markets/>.
- 52 Nowatzki, M. "U.S. Energy Secretary Moniz Aware of Bakken Challenges," *Prairie Business*, August 8, 2014, www.prairiebizmag.com/event/article/id/20318/.
- 53 Pipeline and Hazardous Materials Safety and Administration, "Safety Alert: Preliminary Guidance from Operation Classification," Pipeline and Hazardous Materials Safety and Administration, January 2, 2014, [www.phmsa.dot.gov/portal/site/PHMSA/menuitem.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=c6efec1c60f23410VgnVCM100000d2c97898RCRD&vgnextchannel=d248724dd7d6c010VgnVCM10000080e8a8c0RCRD](http://www.phmsa.dot.gov/portal/site/PHMSA/menuitem.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=c6efec1c60f23410VgnVCM100000d2c97898RCRD&vgnextchannel=d248724dd7d6c010VgnVCM10000080e8a8c0RCRD;); Gold, R. "Bakken Shale Oil Carries High Combustion Risk," *Wall Street Journal*, February 23, 2014, <http://online.wsj.com/news/articles/SB10001424052702304834704579401353579548592>; Bailey, D., et al., "The City of Benicia's Draft Environmental Impact Report for the Valero Benicia Crude by Rail Project," September 15, 2015, pp. 13–20, www.ci.benicia.ca.us/vertical/Sites/%7B3436CBED-6A58-4FEF-BFDF-5F9331215932%7D/uploads/NRDC_Comments_on_DEIR.pdf
- 54 Shaffer, D. and Ramstad, E. "NTSB: 400,000 Gallons of Crude Spilled in N.D. Train Wreck," *Star Tribune*, January 13, 2014, www.startribune.com/business/239948631.html; Associated Press, "Lac-Mégantic Oil Train Disaster Inquiry Finds String of Safety Failings," *The Guardian*, August 20, 2014, www.theguardian.com/world/2014/aug/20/lac-megantic-oil-train-disaster-inquiry-finds-string-of-safety-failings.
- 55 Trans Mountain, "Trans Mountain Expansion Project Community Workshop," Trans Mountain, April–June 2013, www.transmountain.com/uploads/papers/1383857223-13-06-07-phase-3-community-workshop-merritt.pdf
- 56 Kinder Morgan Canada, Presentation, March 24, 2011, http://www.jlsreport.com/wp-content/uploads/2012/02/2011_Analysts_Conf_05_KM_Canada.pdf.
- 57 Aframax is a medium-sized crude tanker with a dead weight tonnage (DWT) ranging from 80,000 to 120,000. Maritime Connector, "Aframax," (accessed Jan. 12, 2015), <http://maritime-connector.com/wiki/aframax/>.
- 58 While a portion of TransMountain's current capacity feeds local refineries in the Vancouver area, additional volumes from the pipeline's expansion would go to tankers, disproportionately increasing regional oil tanker traffic. Trans Mountain, "Trans Mountain Expansion Project Community Workshop."
- 59 Enbridge, Inc., "Enbridge Northern Gateway Project: Overview and General Information," vol. 1, 2010, pp. 2–8, [https://docs.neb-one.gc.ca/Ill-eng/Ilisapi.dll/fetch/2000/90464/90552/384192/620327/624798/619886/B1-2__Vol_1_%E2%80%93_Gateway_Application_%E2%80%93_Overview_and_General_Information_%28Part_1_of_2%29_-_A1S9X5.pdf?nodeid=619887&vernum=-2](http://docs.neb-one.gc.ca/Ill-eng/Ilisapi.dll/fetch/2000/90464/90552/384192/620327/624798/619886/B1-2__Vol_1_%E2%80%93_Gateway_Application_%E2%80%93_Overview_and_General_Information_%28Part_1_of_2%29_-_A1S9X5.pdf?nodeid=619887&vernum=-2); National Energy Board, "Connections: Report of the Joint Review Panel for the Enbridge Northern Gateway Project," vol. 1, National Energy Board, 2013, <http://gatewaypanel.review-examen.gc.ca/clf-nsi/dcmnt/rbcmndtnsrprt/rbcmndtnsrptvlm1-eng.pdf>.
- 60 The State Department estimated that at full capacity, Nexen's crude by rail proposal in Prince Rupert would require 430 Suezmax tankers annually. United States State Department, Final Supplemental Environmental Impact Statement, 2.2–27, January 31, 2014, <http://keystonepipeline-xl.state.gov/documents/organization/221155.pdf>.
- 61 Downstream Today, Gateway Pipeline Project, Downstream Today, October 7, 2008, [www.downstreamtoday.com/IS\(spkjtg55iu23we55gsitz55\)/Projects/Project.aspx?project_id=135&AspxAutoDetectCookieSupport=1](http://www.downstreamtoday.com/IS(spkjtg55iu23we55gsitz55)/Projects/Project.aspx?project_id=135&AspxAutoDetectCookieSupport=1); Liquid Fuel Measurements and Conversions, Iowa State University, pp. 2 (using average conversion rate), www.extension.iastate.edu/agdm/wholefarm/pdf/c6-87.pdf; *The Globe and Mail*, "The Problems With Kitimat," *The Globe and Mail*, (accessed January 26, 2015), www.theglobeandmail.com/static/national/kitimat/index.html?id=3.
- 62 This number is based on the proposed capacities of Enbridge's Northern Gateway tar sands pipeline (525,000 bpd), Kinder Morgan's Trans Mountain tar sands pipeline expansion (590,000 bpd), and Nexen's Prince Rupert tar sands-by-rail terminal (546,000 bpd). It does not include the numerous terminals throughout Washington, Oregon, and California that have known tar sands handling capacity.
- 63 NOAA, "Transporting Alberta Oil Sands Products: Defining the Issues and Assessing the Risks," NOAA Department of Commerce, September 2013, pp. 47, <http://depts.washington.edu/poeweb/pdfs/NOAAoilsandsreport.pdf>.
- 64 These terminals can ship 1.7 million bpd—and are expected to require 1,050 tankers per year of various sizes to do so. West Coast refineries are expected to have a market demand of up to 790,000 bpd for Canadian diluted bitumen and SCO. So that would break down to about 600 tankers per year with the remainder (around 400) shipping 600,000 bpd crude to more distant markets.
- 65 *Oil Sands Today*, "Markets," *Oil Sands Today*, (accessed Jan. 8, 2015), www.oilsandstoday.ca/topics/marketsandtransportation/Pages/default.aspx; Dawson, C., "Canada Aims to Sell Its Oil Beyond U.S.," *Wall Street Journal*, June 5, 2014, www.wsj.com/articles/canada-aims-to-sell-its-oil-beyond-u-s-1402019143. Muse Stancil, "Update of Market Prospects and Benefits Analysis for the Northern Gateway Project," July 2012, docs.neb-one.gc.ca/Ill-eng/Ilisapi.dll/fetch/2000/90464/90552/384192/620327/624798/858220/B100-3_NGP_-Revised__Clean__Attachment_1__Update_of_Market_Prospects_and_Benefits_Analysis_for_the_Northern_Gateway_Project_-A2Z7Q4.pdf?nodeid=858227&vernum=-2.
- 66 De Place, E., "Grays Harbor Ship Traffic: The Impact of Oil Plans," *Sightlines*, February 23, 2015, daily.sightline.org/2015/02/23/grays-harbor-ship-traffic-the-impact-of-oil-plans/.
- 67 Tesoro Savage, "Application for Site Certification Agreement."
- 68 De Place, E., "Columbia River Ship Traffic: The Impact of Coal and Oil Plans," *Sightlines*, February 11, 2015, daily.sightline.org/2015/02/11/columbia-river-ship-traffic-the-impact-of-coal-and-oil-plans/
- 69 Payton, L. and Mas, S., "Northern Gateway Pipeline Approved With 209 Conditions," *CBC News*, June 17, 2014, www.cbc.ca/news/politics/northern-gateway-pipeline-approved-with-209-conditions-1.2678285; NuStar Energy, Vancouver (Main), NuStar Energy, (accessed Jan. 8, 2015), http://nustarenergy.com/en-us/OurBusiness/Assets/AssetPDFs/TR_VAN1_WA.pdf; Middlewood, E., "NuStar Wants to Handle Crude Oil Locally," *The Columbian*, April 3, 2014, www.columbian.com/news/2014/apr/03/nustar-wants-to-handle-crude-oil-port-vancouver/.
- 70 Arc Logistics Partners, "Arc Logistics Partners LP Announces Entrance Into West Coast Terminalling Market," Arc Logistics Partners, January 22, 2014, <http://arcxlp.com/arc-logistics-partners-lp-announces-entrance-into-west-coast-terminalling-market/>.
- 71 BBC News, "India on Alert After Sunderbans Oil Spill in Bangladesh," BBC News, December 12, 2014, www.bbc.com/news/world-asia-30448377.
- 72 World Wild Fund for Nature (WWF), "Royal Bengal Tiger," WWF, (accessed January 8, 2015), http://wwf.panda.org/about_our_earth/teacher_resources/best_place_species/current_top_10/royal_bengal_tiger.cfm; WWF, Irrawaddy Dolphin, WWF, (accessed January 8, 2015), http://wwf.panda.org/what_we_do/endangered_species/cetaceans/about/irrawaddy_dolphin/.
- 73 Hance, J., "Children 'Clean' Oil Spill With Kitchen Utensils in the Sundarbans," Mongabay, December 15, 2014, <http://news.mongabay.com/2014/1215-hance-sundarbans-oil-spill.html>.
- 74 For the purposes of this report, we rely primarily on the 525,000 bpd figure used by Enbridge in their project proposals. However, Enbridge has disclosed that its design for Northern Gateway would actually facilitate an expansion of up to 850,000 bpd of tar sands crude. In addition, the Northern Gateway proposal actually encompasses two pipelines using the same right-of-way. The first is a westward traveling tar sands pipeline and the second is an eastward moving pipeline with 193,000 bpd capacity

- for carrying condensate. Thus, the total volume of petroleum products moving through both pipelines could range from 718,000 bpd to 1,043,000 bpd. Enbridge, Inc., "Enbridge Northern Gateway Project: Overview and General Information," vol. 1, 2010, pp. 1-1, https://docs.neb-one.gc.ca/II-eng/llisapi.dll/fetch/2000/90464/90552/384192/620327/624798/619886/B1-2__-_Vol_1_%E2%80%93_Gateway_Application_%E2%80%93_Overview_and_General_Information_%28Part_1_of_2%29__-_A1S9X5.pdf?nodeid=619887&vernum=-2; "Considerations: Report of the Joint Review Panel for the Enbridge Northern Gateway Project," vol. 2, pg. 52, National Energy Board, 2013, <http://gatewaypanel.review-examen.gc.ca/clf-nsi/dcmnt/rbcmndtsnrprt/rbcmndtsnrptvlm2-eng.pdf>.
- 75 Swift, A., et al., "Pipeline and Tanker Trouble: The Impact to British Columbia's Communities, Rivers and Pacific Coastline from Tar Sands Oil Transport," NRDC, November 2011, pp. 3, <http://www.nrdc.org/international/pipelinetroUBLE.asp> [Tanker Trouble].
- 76 *Insights West*, "Your Insights on the Northern Gateway Pipeline," *Insights West*, February 4, 2013, www.insightswest.com/news/your-insights-on-the-northern-gateway-pipeline/.
- 77 Yinke Dean Alliance, "First Nations Gain Powerful New Allies in Fight Again Enbridge Northern Gateway Pipeline and Tankers," Press Release, Yinke Dene Alliance, December 5, 2013, <http://savethefraser.ca/STF-Release-2013-12-05.pdf>.
- 78 Prystupa, M., "Northern Gateway Facing Legal Doom: Eight New First Nations Lawsuits," *Vancouver Observer*, July 15, 2014, www.vancouverobserver.com/news/northern-gateway-facing-legal-doom-eight-new-first-nations-lawsuits-video; Stueck, W., "B.C. First Nations Challenge Northern Gateway Pipeline in New Court Action," *The Globe and Mail*, July 14, 2014, www.theglobeandmail.com/news/british-columbia/first-nations-challenge-northern-gateway-pipeline-in-new-court-action/article19608617/.
- 79 Reuters, "Kinder Morgan files application to expand Trans Mountain pipeline," Reuters, December 16, 2013, www.reuters.com/article/2013/12/16/kindermorgan-transmountain-expansion-idUSL2N0JV1GL20131216. Kinder Morgan proposes to expand the scope of the expansion project to 890,000 bpd from 300,000.
- 80 Lewis, J., "Kinder Morgan's pipeline ambitions on West Coast raises oil tanker concerns," *Financial Post*, March 16, 2013, http://business.financialpost.com/2013/03/16/kinder-morgans-pipeline-ambitions-on-west-coast-raises-oil-tanker-concerns/?_Isa=9fd-09c3.
- 81 Lee, J. and Morton, B., "Vancouver and Burnaby mayors decry Kinder Morgan pipeline expansion," *Vancouver Sun*, April 14, 2012, www.vancouversun.com/business/Vancouver+Burnaby+mayors+decry+Kinder+Morgan+pipeline+expansion/6457014/story.html.
- 82 Khan, Y. "Proposed Kinder Morgan Pipeline Faces Legal Challenges: Part One," Canadian Civil Liberties Association, November 6, 2014, www.ccla.org/rightswatch/2014/11/06/proposed-kinder-morgan-pipeline-faces-legal-challenges/; Thomas, S., "Tsleil-Waututh Nation Launches Legal Challenge of Kinder Morgan Pipeline and Tankers Project," Sacred Trust Initiative, May 2, 2014, <http://tarsandssolutions.org/member-blogs/tsleil-waututh-nation-launches-legal-challenge-of-kinder-morgan-pipeline-pr>.
- 83 *Constitution Act, 1982*, see RSC 1985, App II (No 44), s 35(1).
- 84 Aboriginal Affairs and Northern Development Canada, "Aboriginal Consultation and Accommodation—Updated Guidelines for Federal Officials to Fulfill the Duty to Consult," March 2011, Aboriginal Affairs and Northern Development Canada, [www.aadnc-aandc.gc.ca/eng/1100100014664/1100100014675-chp1_1](http://aadnc-aandc.gc.ca/eng/1100100014664/1100100014675-chp1_1).
- 85 For a summary of the legal proceedings against Enbridge Northern Gateway as of October 2014 see: Smith, G., "Environmental Organizations and Union Get Green Light to Proceed with a Barrage of Court Cases Against Enbridge Northern Gateway Proposal," *West Coast Environmental Law*, October 20, 2014, <http://wcel.org/resources/environmental-law-alert/first-nations-non-governmental-organizations-and-union-get-green-l>.
- 86 *Tsilhqot'in Nation v. British Columbia*, 2014 SCC 44.
- 87 Gathering of Nations, Save the Fraser Declaration.
- 88 Washington Department of Fish & Wildlife, "Tribal Hunting & Co-Management: Treaty History and Interpretation," Washington Department of Fish & Wildlife, (accessed March 31, 2015), wdfw.wa.gov/hunting/tribal/treaty_history.html.
- 89 Ibid.
- 90 *United States v. Winans*, 198 U.S. 371, 380-381 (1905).
- 91 *Seminole Nation v. United States*, 316 U.S. 286, 297 (1942).
- 92 Legal Information Institute, "American Indian Law," Legal Information Institute (accessed Jan. 8, 2015), www.law.cornell.edu/wex/american_indian_law; Bureau of Indian Affairs, "What We Do," Bureau of Indian Affairs, (accessed Jan. 8, 2015), www.bia.gov/WhatWeDo/index.htm; *Northwest Sea Farms v. U.S. Army Corps of Eng'rs*, 931 F. Supp. 1515 (W.D. Wash. 1996); *Muckleshoot v. Hall*, 698 F. Supp. 1504 (W.D. Wash. 1988).
- 93 *United States v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974).
- 94 Grant, J. et al., "Beneath the Surface: A Review of Key Facts in the Oilsands Debate," Pembina Institute, January 2013, pp. 4-6, www.pembina.org/reports/beneath-the-surface-oilsands-facts-201301.pdf.
- 95 U.S. State Department, "Keystone XL Draft Supplemental Environmental Impact Statement Appendix W," pp. 64, <http://keystonepipeline-xl.state.gov/documents/organization/205563.pdf>; EPA, "Letter to Assistant Secretary Jose W. Fernandez," U.S. Department of State, April 22, 2013, www.epa.gov/compliance/nepa/keystone-xl-project-epa-comment-letter-20130056.pdf. Well-to-tank emissions include greenhouse gas emissions from producing, upgrading, refining, transporting, and dispensing at gas stations but do not include combustion emissions in vehicles.
- 96 Relying on NETL studies, the State Department found that displacing 830,000 bpd of light, low-greenhouse gas crude oil with tar sands would generate 27.4 MMT in annual emissions, while the substitution of heavy Mexican Maya crude with tar sands would increase emissions by 18.4 MMT CO₂e. United States State Department, Keystone XL Final Supplemental Environmental Impact Statement, January 31, 2014, pp. 4.4-37, 38, <http://keystonepipeline-xl.state.gov/documents/organization/221190.pdf>; EPA, "Greenhouse Gas Calculator," EPA, (accessed January 12, 2014), www.epa.gov/cleanenergy/energy-resources/calculator.html.
- 97 The total lifecycle emissions from refining and combusting 830,000 bpd of tar sands crude is up to 168 million metric tons CO₂e. United States State Department, Keystone XL Final Supplemental Environmental Impact Statement, January 31, 2014, pp. 4.4-36, <http://keystonepipeline-xl.state.gov/documents/organization/221190.pdf>.
- 98 EPA, "Greenhouse Gas Calculator," EPA, (accessed March 24, 2014), www.epa.gov/cleanenergy/energy-resources/calculator.html.
- 99 Parrington, P., "Oilsands talking point collides with reality," Pembina Institute, April 16, 2014, www.pembina.org/blog/787.
- 100 Intergovernmental Panel on Climate Change, "Climate Change 2014: Synthesis Report," page 63, http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf.
- 101 McGlade, C. & Paul Ekins. "The Geographical Distribution of Fossil Fuels Unused When Limiting Global Warming to 2° C," *Nature*, January 8, 2015, http://www.nature.com/articles/nature14016.epdf?referrer_access_token=6avCiKqAoP-QlhdPZMRhxtRgn0jAjWeI9jnR3ZoTv0MEzzy4w-DROte5fViQxiPJd2pVn_VElJXUlpIA0k52au177nPq6MK1EoZ4XWQoqKvi-WFcWiotwOKaqMCCDQwv5MxrZGFxcncDB9ccGFis7YH2s39Ho2Z7p-0b9lYK_MARdeXuDq8xxhmAWrlot5xnQgJeOSfHkyc-1jKtKlwFrKoRfzyu-vsCYqVo9h7QACajF7-kGrLxxr9_3rAHbz96ndtV2W33PhnibyVL2NryO-irl0_AEY0XGRc_34L8Dc%3D&tracking_referrer=www.theguardian.com.
- 102 California Air Resources Board, "Report: Initial Statement of Reasons for Proposed Rulemaking," Appendix B-39, California Air Resources Board, December 2014, www.arb.ca.gov/regact/2015/lcfs2015/lcfs15isor.pdf.

- 103 California's Air Resource Board puts the average carbon-intensity of California's production at 99.8 grams CO₂e per megajoule (gCO₂e/mj) — 7 percent higher than the U.S. 2005 average of 93 gCO₂e/mj. Including California's exports lowers this carbon-intensity to 98.4 gCO₂e/mj, or 6 percent above the U.S. average. California Air Resources Board, "Supplement Version 2.0 to Detailed California-Modified GREET Pathway for California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB) from Average Crude Refined in California," California Air Resources Board, www.arb.ca.gov/regact/2011/lcfs2011/carbob.pdf; Moreover, numerous technologies are available to reduce emissions from the existing petroleum supply chain. Law, K. et. al., "Carbon Reduction Opportunities in the California Petroleum Industry," NRDC, October 2013, www.nrdc.org/energy/california-petroleum-carbon-reduction.asp.
- 104 Rystad forecasts California heavy crude (with API of 23 or lower) to steadily decline from 400,000 bpd in 2013 to 200,000 bpd in 2030. Rystad Energy UCube Global Database, October 2014, <http://www.rystadenergy.com/Databases/UCube> via Oil Change International.
- 105 Ibid.
- 106 Borealis report, pg. 17.
- 107 California's heavy crude production, currently at 400,000 and forecast to decline to 200,000 bpd by 2030. Oil Change International, Rystad Energy UCube Global Database, October 2014, <http://www.rystadenergy.com/Databases/UCube>; CAPP, "Crude Oil, Forecasts, Markets and Pipelines," June 2014, pp. 40, www.capp.ca/forecast/Pages/default.aspx.
- 108 Tar sands production reach 2.4 million bpd in 2014 and industry plans call for an expansion to 6.2 million bpd by 2030. Ibid.
- 109 The tar sands industry's expansion plans call for production to reach 6.2 million bpd by 2030, compared to the 200,000 bpd of California heavy crude production forecast by Rystad. Oil Change International, Rystad Energy UCube Global Database, October 2014, <http://www.rystadenergy.com/Databases/UCube>; CAPP, "Crude Oil, Forecasts, Markets and Pipelines," CAPP, June 2014, pp. 40, www.capp.ca/forecast/Pages/default.aspx.
- 110 Tanker Trouble at 6-8.
- 111 Bailey, D. and Droitsch, D., "Tar Sands Crude Oil: Health Effects of a Dirty and Destructive Fuel," NRDC, February 2014, pp. 4–5, <http://www.nrdc.org/energy/files/tar-sands-health-effects-IB.pdf>.
- 112 Ibid.
- 113 Swift, A. et al., "Tar Sands Pipeline Safety Risks," NRDC, February 2011, www.nrdc.org/energy/files/tarsandssafetyrisks.pdf.
- 114 Ibid.
- 115 Ibid.
- 116 EPA, "Oil Cleanup Continues on Kalamazoo River," EPA, June 2013, <http://www.epa.gov/enbridgespill/pdfs/enbridge-fs-20130624.pdf>; Government of Canada, "Properties, Composition, and Marine Spill Behavior, Fate, and Transport of Two Diluted Bitumen Products from the Canadian Oil Sands," Government of Canada, November 30, 2013, www.ec.gc.ca/scitech/6A2D63E5-4137-440B-8BB3-E38ECED9B02F/1633_Dilbit%20Technical%20Report_e_v2%20FINAL-s.pdf.
- 117 Giles, C., Letter to U.S. Department of State, Environmental Protection Agency, April 22, 2013.
- 118 Max Paris, "Enbridge's Kalamazoo Cleanup Dredges Up 3-Year-Old Oil Spill," Canadian Broadcasting Corporation (September 13, 2013), www.cbc.ca/news/politics/enbridge-s-kalamazoo-clean-up-dredges-up-3-year-old-oil-spill-1.1327268.
- 119 Stansbury, M., "Acute Health Effects of the Enbridge Oil Spill," Michigan Department of Community Health, December 20, 2010, www.michigan.gov/documents/mdch/enbridge_oil_spill_epi_report_with_cover_11_22_10_339101_7.pdf.
- 120 EPA, "EPA's Response to the Enbridge Oil Spill," EPA, (accessed July 29, 2014), www.epa.gov/enbridgespill/.
- 121 Smith, L., "Enbridge Unveils New Plans to Dredge Oily Sediment From Kalamazoo River," Michigan Radio, February 13, 2014, <http://michiganradio.org/post/enbridge-unveils-new-plans-dredge-oily-sediment-kalamazoo-river>.
- 122 Vancouver Observer, "Enbridge to Pay Nearly \$6.8 Million to Settle Class-Action Lawsuit Related to Michigan Spill, Vancouver Observer, December 11, 2014, www.vancouverobserver.com/news/enbridge-pay-nearly-68-million-settle-class-action-lawsuit-related-michigan-spill.
- 123 Song, L., "What Sickens People in Oil Spills, and How Badly, Is Anyone's Guess," InsideClimate News, June 18, 2013, <http://insideclimatenews.org/news/20130618/what-sickens-people-oil-spills-and-how-badly-anybodys-guess?page=show>; Stansbury, M., "Acute Health Effects of the Enbridge Oil Spill."
- 124 Dokoupil, T., "Oil Train Spill Hit Record Level in 2014," NBC News, January 26, 2015, www.nbcnews.com/news/investigations/oil-train-spills-hit-record-level-2014-n293186.
- 125 Mackrael, K., "Lac-Mégantic Derailment: Anatomy of a Disaster," Globe and Mail, August 19, 2014, www.theglobeandmail.com/news/national/lac-megantic-derailment-anatomy-of-a-disaster/article20129764/.
- 126 Congressional Research Service, "U.S. Rail Transportation of Crude Oil: Background and Issues for Congress," Congressional Research Service, December 4, 2014, pg. 7, <http://fas.org/sgp/crs/misc/R43390.pdf>.
- 127 Crude oil unit train derailments and explosions have thus far been associated with Bakken crude, which is currently the largest source of crude shipped by rail in North America. However, diluted tar sands crude is classified as an "extremely flammable" substance and likely poses similar risks when shipped via rail. Imperial Oil, "Dilbit—Material Safety Data Sheet," Imperial Oil, September 27, 2002, pg. 3, www.ceaa.gc.ca/050/documents_staticpost/cearref_21799/3139/responses_to_j_wier-att4.pdf.
- 128 Kolstad, J., "Safety Recommendation," National Transportation Safety Board, July 1, 1991, www.ntsb.gov/safety/safety-recs/recletters/R91_20.pdf.
- 129 Podkul, C. and Schneyer, J. "DOT-111 Oil Tank Cars, Like Those In Lac-Mégantic, Quebec Disaster, Long Seen As Flawed," Reuters, July 9, 2013, www.huffingtonpost.com/2013/07/09/dot-111-oil-tank-cars_n_3568287.html.
- 130 National Archives and Records Administration, "Federal Register," Table 18, Vol 79, No 148, August 1, 2014, pg. 45054, www.gpo.gov/fdsys/pkg/FR-2014-08-01/pdf/2014-17764.pdf.
- 131 Sobczak, B., "Oil-by-rail Loophole Keeps U.S. Emergency Response Plans in the Dark," E&E Publishing, April 22, 2014, www.eenews.net/stories/1059998222.
- 132 Cook, L., Tita, B., and Morris, B., "Energy, Rail Firms Fight Some Crude-Train Rules," Wall Street Journal, September 30, 2014, <http://online.wsj.com/articles/energy-rail-firms-unite-against-some-crude-train-rules-1412119895>.
- 133 Forest Ethics, "25 Million Live in Oil Train Blast Zone: New Online Mapping Tool Shows Threat to Homes, Schools, and Cities," Forest Ethics, (accessed April 1, 2015), www.forestethics.org/news/25-million-live-oil-train-blast-zone-new-online-mapping-tool-shows-threat-homes-schools-and.
- 134 Bailey, D. "It Could Happen Here: The Exploding Threat of Crude by Rail in California," NRDC, June 2014, www.nrdc.org/energy/files/ca-crude-oil-by-rail-FS.pdf.
- 135 Seattle City Council, "Oil Trains," (accessed April 1, 2015), www.seattle.gov/council/issues/oiltrains/default.html; Seattle City Council, "Resolution Number: 31504), Seattle City Council, Office of the City Clerk, March 10, 2014, clerk.seattle.gov/~scripts/nph-brs.exe?s1=&s3=31504&s2=&s4=&Sect4=AND&l=20&Sect2=THESON&Sect3=PLURON&Sect5=RESNY&Sect6=HITOFF&d=RESF&p=1&u=%2F~public%2Fresny.htm&r=1&f=G.

- 136 California Interagency Rail Safety Working Group, "Oil by Rail Safety in California: Preliminary Findings and Recommendations," California Interagency Rail Safety Working Group, June 10, 2014, pp. 4-5, [http://www.caloes.ca.gov/HazardousMaterials/Documents/Oil By Rail Safety in California.pdf](http://www.caloes.ca.gov/HazardousMaterials/Documents/Oil%20By%20Rail%20Safety%20in%20California.pdf).
- 137 Marquis, D., "Derailment Sends Section of Train Into the Feather River Canyon," KXTV News, November 26, 2014, www.news10.net/story/news/local/california/2014/11/26/train-derailment-feather-river-canyon/70133634/.
- 138 CBS News, "Proposed Rail Safety Measures Concern Greater Sudbury Residents," CBC News, April 24, 2014, www.cbc.ca/news/canada/sudbury/proposed-rail-safety-measures-concern-greater-sudbury-residents-1.2620290; Straw, R., "Firefights Will Sometimes Stand Back and Let an Oil Train Fire Burn Itself Out," *Benicia Independent*, November 13, 2014, <http://beniciaindependent.com/firefighters-will-sometimes-stand-back-and-let-an-oil-train-fire-burn-itself-out/>.
- 139 Gafni, M., "Crude-by-rail: One Federal Inspector Oversees all California's Railroad Bridges, No State Oversight," *Contra Costa Times*, September 12, 2014, www.contracostatimes.com/breaking-news/ci_26525724/crude-by-rail-one-federal-inspector-oversees-all; Malone, R., "Infrastructure: The Weakest Link," *Inbound Logistics*, October 2005, www.inboundlogistics.com/cms/article/infrastructure-the-weakest-link/.
- 140 Crosby, S. et al., "Transporting Alberta Oil Sands Products: Defining the Issues and Assessing the Risks," NOAA Technical Memorandum, Sept. 2013, <http://depts.washington.edu/poeweb/pdfs/NOAAoilsandsreport.pdf>.
- 141 Van Dorp, J. and Merrick, J., "Vessel Traffic Risk Assessment (VTRA): Preventing Oil Spills from Large Ships and Barges in Northern Puget Sound & Strait of Juan de Fuca," Puget Sound Partnership, January 2014, [www.seas.gwu.edu/~dorpjr/VTRA/PSP/FINAL REPORT/PSP FINAL REPORT - DRAFT 012214 - HQ.pdf](http://seas.gwu.edu/~dorpjr/VTRA/PSP/FINAL%20REPORT/PSP%20FINAL%20REPORT%20-%20DRAFT%20012214-HQ.pdf).
- 142 Ibid.
- 143 Ibid.
- 144 Crosby, S. et al., "Transporting Alberta Oil Sands Products: Defining the Issues and Assessing the Risks."
- 145 Ibid. at 5-6.
- 146 Ibid.
- 147 Government of Canada, "Properties, Composition and Marine Spill Behaviour, Fate and Transport of Two Diluted Bitumen Products From the Canadian Oil Sands."
- 148 Ibid.
- 149 General Maritime Corporation, "Types of Tankers," General Maritime Corporation, (accessed January 5, 2014), www.generalmaritimemc.com/the-industry/types-of-tankers.aspx.
- 150 Iowa State University, "Liquid Fuel Measurements and Conversions," Iowa State University, pp. 2 (using average conversion rate), www.extension.iastate.edu/agdm/wholefarm/pdf/c6-87.pdf.
- 151 National Oceanic and Atmospheric Administration, "How Oil Affects Fish Populations: 25 Years of Research Since Exxon Valdez," National Oceanic and Atmospheric Administration, (accessed April 1, 2015), www.nmfs.noaa.gov/stories/2014/03/3_24_14exxon_valdez.html; National Oceanic and Atmospheric Administration, "Chinook Salmon (*Oncorhynchus tshawytscha*)," National Oceanic and Atmospheric Administration, (accessed April 1, 2015), www.nmfs.noaa.gov/pr/species/fish/chinook-salmon.html; National Oceanic and Atmospheric Administration, "Coho Salmon (*Oncorhynchus kisutch*)," National Oceanic and Atmospheric Administration, (accessed April 1, 2015), www.nmfs.noaa.gov/pr/species/fish/cohosalmon.htm; National Oceanic and Atmospheric Administration, "Sockeye Salmon (*Oncorhynchus nerka*)," National Oceanic and Atmospheric Administration, (accessed April 1, 2015), www.nmfs.noaa.gov/pr/species/fish/sockeyesalmon.htm; Fry, D., "USDA Forest Service General Technical Report, Chapter 25: Pollution and Fishing Threats to Marbled Murrelets," United States Department of Agriculture, 1995, gis.fs.fed.us/psw/publications/documents/psw_gtr152/psw_gtr152_chap25.pdf.
- 152 National Marine Fisheries Service, "Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*)," National Marine Fisheries Service, Northwest Regional Office, January 17, 2008, www.nmfs.noaa.gov/pr/pdfs/recovery/whale_killer.pdf.
- 153 BC Stats, "British Columbia's Fisheries and Aquaculture Sector, 2012 Edition," Department of Fisheries and Oceans Cadana, January 29, 2013, www.bccstats.gov.bc.ca/Files/0c4250f8-e4ee-45b9-b1fa-247ae1a98590/BritishColumbiasFisheriesandAquacultureSector2012Edition.pdf; National Marine Fisheries Service, "Regional Summary: Pacific," National Marine Fisheries Service, 2012, www.st.nmfs.noaa.gov/Assets/economics/documents/feus/2012/FEUS2012_Pacific.pdf.
- 154 BC Stats at 1, 3; U.S. Stats at 26.
- 155 Tiller, V. and Chase, R., "Economic Contributions of Indian Tribes to the Economy of Washington State," 1997, pp. 10-14, www.goia.wa.gov/images/pdf/iacbook.pdf.
- 156 Dean Runyan Associates, "Oregon Travel Impacts, 1991-2013p," Dean Runyan Associates, April 2014, pg. 18, www.deanrunyan.com/doc_library/ORImp.pdf; Dean Runyan Associates, "California Travel Impacts by County, 1992-2012," Dean Runyan Associates, May 2014, pp. 19, [http://industry.visitcalifornia.com/media/uploads/files/editor/CAImpacts13\(2\).pdf](http://industry.visitcalifornia.com/media/uploads/files/editor/CAImpacts13(2).pdf) (CA Travel Stats); Dean Runyan Associates, "Washington State County Travel Impacts, 1991-2009," Dean Runyan Associates, September 2010, pp. 7, www.deanrunyan.com/doc_library/WAColmp.pdf; Destination British Columbia, "Regional Tourism Profile: Northern British Columbia," Destination British Columbia, (accessed February 9, 2015) www.destinationbc.ca/getattachment/Research/Research-by-Region/Northern-BC/RegionalProfiles_Northern-BC_Apr23.pdf.aspx; Destination British Columbia, "Regional Tourism Profile: Vancouver Island," Destination British Columbia, (accessed February 9, 2015), www.destinationbc.ca/getattachment/Research/Research-by-Region/Vancouver-Island/RegionalProfiles_Vancouver-Island.pdf.aspx; Destination British Columbia, "Regional Tourism Profile; Vancouver, Coast & Mountains," Destination British Columbia, (accessed February 9, 2015) www.destinationbc.ca/getattachment/Research/Research-by-Region/vancouver-coast-and-mountains/RegionalProfiles_Vancouver-Coast-and-Mountains.pdf.aspx.
- 157 CA Travel Stats at 19; OR Travel Stats at 18; WA Travel Stats at 7; Northern BC Stats; Vancouver Island Stats; Vancouver Stats.
- 158 OR Travel Stats at 56; WA Travel Stats at 8.
- 159 Meyer, R. et al., "Heavy Oil and Natural Bitumen Resources in Geological Basins of the World," *U.S. Geological Survey*, 2007:14, Table 1, <http://pubs.usgs.gov/of/2007/1084/OF2007-1084v1.pdf>.
- 160 Fox, P. "Comments on Initial Study/Mitigated Negative Declaration (IS/MND) for the Valero Crude by Rail Project," July 1, 2013, www.ci.benicia.ca.us/vertical/sites/%7B3436CBED-6A58-4FEF-BFDF-5F9331215932%7D/uploads/Report_by_Dr._Phyllis_Fox.pdf
- 161 U.S. Dept. of Health and Human Services, Occupational Safety and Health Guidelines for Methyl Mercaptan, U.S. Dept. of Health and Human Services, 1988, pg. 2, www.cdc.gov/niosh/docs/81-123/pdfs/0425.pdf.
- 162 Fox, P. "Comments on Initial Study/Mitigated Negative Declaration (IS/MND) for the Valero Crude by Rail Project."
- 163 Turini, K. et al., "Processing Heavy Crudes in Existing Refineries," prepared for spring 2011 meeting of AIChE, Chicago, 2011, <http://www.aiche-fpd.org/listing/112.pdf>; Karras, G., "Combustion Emissions From Refining Lower Quality Oil: What is the Global Warming Potential?" *Environ. Sci. & Tech.*, 2010, www.cbecal.org/wp-content/uploads/2012/05/Combustion-Emissions-from-Refining-Lower-Quality-Oil.pdf.
- 164 American Fuel & Petrochemical Manufacturers, "Petroleum Coke Overview," American Fuel & Petrochemical Manufacturers, (accessed August 29, 2014), www.afpm.org/policy-position-petroleum-coke/.
- 165 EPA, "Anthracite Coal Combustion 1.2-1, 1.2-10-11," EPA, October 1996, www.epa.gov/ttnchie1/ap42/ch01/01/c01s02.pdf; Gearhart, J., "Ecology Center, April 2, 2013, <http://docs.housedems.com/district/006/CokeAggregateCombined.pdf>.

- 166 Kanukuntla, V. et al., "Experimental Study of Concurrent Naphthenic Acid and Sulfidation Corrosion," *NACE International*, 2009, www.corrosioncenter.ohiou.edu/documents/publications/8214.pdf.
- 167 U.S. Chemical Safety and Hazard Investigation Board, *Regulatory Report: Chevron Richmond Refinery Pipe Rupture and Fire*, U.S. Chemical Safety and Hazard Investigation Board, January 2014, www.csb.gov/assets/1/19/CSB_Chevron_Richmond_Refinery_Regulatory_Report.pdf; U.S. Chemical Safety and Hazard Investigation Board, *Interim Investigation Report: Chevron Richmond Refinery Fire*, U.S. Chemical Safety and Hazard Investigation Board, April 2013, www.csb.gov/assets/1/19/Chevron_Interim_Report_Final_2013-04-17.pdf; Greg Karras, Chevron fire exposes unsafe crude switch, Communities for a Better Environment (CBE), March 2013, <http://www.cbecal.org/wp-content/uploads/2013/03/Chevron-fire-exposes-unsafe-crude-switch.pdf>.
- 168 Bailey, D., "Valero's Proposed Crude-by-Rail Project in Benicia: Community, Air Quality, and Health Impacts," NRDC, July 2013; Julia Brody et. al., Linking Exposure Assessment Science With Policy Objectives for Environmental Justice and Breast Cancer Advocacy: The Northern California Household Exposure Study, *Am J Public Health.*, pg. 600-608, Nov. 2009, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2774181/>.
- 169 Walke, J., "EPA Proposes to Limit Cancer-Causing Toxic Air Pollution from Petroleum Refineries," NRDC Switchboard, May 16, 2015, http://switchboard.nrdc.org/blogs/jwalke/epa_proposes_to_limit_cancer-c.html.
- 170 Lee, H. "Richmond Sues Chevron Over Refinery Fire," *San Francisco Gate*, August 2, 2013, www.sfgate.com/bayarea/article/Richmond-sues-Chevron-over-refinery-fire-4703370.php; Lopez, A. et al., "Richmond Health Survey Report," prepared for Communities for a Better Environment, 2009, <http://www.cbecal.org/wp-content/uploads/2012/05/Richmond-Health-Survey1.pdf>.
- 171 Davis, R. "With 18 Oil Trains Weekly, Columbia River Gorge Is the Key Route for Pacific Northwest's Crude-by-rail," *The Oregonian*, June 24, 2014, www.oregonlive.com/environment/index.ssf/2014/06/with_18_oil_trains_weekly_colu.html; Davis, R. "Oil Train Traffic Increases Through Bend, Klamath Falls and Along Deschutes River, BNSF Says," *The Oregonian*, October 10, 2014, [www.oregonlive.com/environment/index.ssf/2014/10/oil_train_traffic_increases_th.html - incart_story_package](http://www.oregonlive.com/environment/index.ssf/2014/10/oil_train_traffic_increases_th.html).
- 172 Swift, A., et al., "Pipeline and Tanker Trouble."
- 173 Rainforest Solutions Project, "Great Bear Rainforest: A Global Treasure," Rainforest Solutions Project, (accessed January 6, 2015), www.savethegreatbear.org/region/global_treasure.
- 174 Swift, A., et al., "Pipeline and Tanker Trouble."
- 175 The Nature Conservancy, "Canada: Great Bear Rainforest," The Nature Conservancy, (accessed January 6, 2015), www.nature.org/ourinitiatives/regions/northamerica/canada/placesweprotect/great-bear-rainforest.xml.
- 176 Swift, A., et al., "Pipeline and Tanker Trouble."
- 177 Go Haida Gwaii, "Cultural History: The Haida," Go Haida Gwaii, (accessed January 6, 2015), www.gohaidagwaii.ca/our-islands/cultural-history.
- 178 Lukacs, M., "World's Biggest Geoengineering Experiment 'Violates' U.N. Rules," *The Guardian*, October 15, 2012, www.theguardian.com/environment/2012/oct/15/pacific-iron-fertilisation-geoengineering.
- 179 City of Kamloops, Census and Population Estimates, City of Kamloops, (accessed January 6, 2015), www.kamloops.ca/demographics/pdfs/12-population.pdf; Oil Change International, "North American Crude by Rail," Oil Change International, (accessed January 6, 2015), <http://priceofoil.org/rail-map/>.
- 180 Trans Mountain, Proposed Trans Mountain Expansion Project Description Overview, Trans Mountain, (accessed January 6, 2015), www.transmountain.com/uploads/pages/1392758910-14_02_17_Project_Description_Infographic_LR_Fotor.jpg
- 181 CBS News, "Kinder Morgan Pipeline: Kamloops Votes for Lac Du Bois Grassland Option," CBC News, October 8, 2014, www.cbc.ca/news/canada/british-columbia/kinder-morgan-pipeline-kamloops-votes-for-lac-du-bois-grassland-option-1.2792266.
- 182 Western Washington University, "Map of the Salish Sea (Mer des Salish) & Surrounding Basin," Western Washington University, (accessed January 6, 2015), http://staff.wwu.edu/stefan/salish_sea.shtml.
- 183 Orca Spirit Adventures, "Local Geography & Landmarks: Strait of Juan de Fuca," Orca Spirit Adventures, (accessed January 6, 2015), www.orcaspirit.com/vancouver-island-marine-wildlife/victoria-geography-landmarks/item/straight-of-juan-de-fuca.
- 184 Washington Department of Fish & Wildlife, Marine Area 6: East Juan de Fuca Strait, Washington Department of Fish & Wildlife, (accessed January 6, 2015), <http://wdfw.wa.gov/fishing/washington/MarineArea/10006/>; North American Marine Protected Areas Network, "Barkley Sound/Pacific Coastal Washington," North American Marine Protected Areas Network, (accessed January 6, 2015), www2.cec.org/nampan/pca/barkley-soundpacific-coastal-washington.
- 185 National Marine Fisheries Service, "Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*)," National Marine Fisheries Service Northwest Region, Seattle, WA, 2008.
- 186 Guide to the San Juan Islands, (accessed Jan. 6, 2015), <http://www.guidetosanjuans.com/>; U.S. Department of the Interior Bureau of Land Management, San Juan Islands National Monument, U.S. Department of the Interior, (accessed January 6, 2015), www.blm.gov/or/resources/recreation/sanjuans/.
- 187 Visit San Juans, "Getting Here," Visit San Juans, (accessed January 6, 2015), www.visitsanjuans.com/getting-here.
- 188 Le, P., "Proposed Hoquiam Terminal Would Get ND Crude by Rail," *The Olympian*, April 11, 2014, www.theolympian.com/2014/04/11/3081305_proposed-hoquiam-terminal-would.html?rh=1; Washington Department of Ecology, "Westway Expansion Projects," Washington Department of Ecology, (accessed January 6, 2015), www.ecy.wa.gov/geographic/graysharbor/westwayterminal.html; Washington Department of Ecology, Imperium Renewables Proposal, Washington Department of Ecology, (accessed January 6, 2015), www.ecy.wa.gov/geographic/graysharbor/imperiumterminal.html.
- 189 U.S. Census, "State & County Quick Facts: Spokane (city), Washington," U.S. Census, (accessed January 6, 2015), <http://quickfacts.census.gov/qfd/states/53/5367000.html>.
- 190 NOAA Fisheries, "West Coast Salmon & Steelhead Listings," NOAA Fisheries, (accessed Jan. 6, 2015), www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/salmon_and_steelhead_listings.html.
- 191 NOAA Fisheries, "Blue Whale (*Balaenoptera musculus*)," NOAA Fisheries, (accessed January 6, 2015), www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bluewhale.htm; NOAA Fisheries, Gray Whale (*Eschrichtius robustus*), NOAA Fisheries, (accessed January 6, 2015), www.nmfs.noaa.gov/pr/species/mammals/cetaceans/graywhale.htm; NOAA Fisheries, "Pacific White-Sided Dolphin (*Lagenorhynchus oili*)," NOAA Fisheries, (accessed January 6, 2015), www.nmfs.noaa.gov/pr/species/mammals/cetaceans/whitesideddolphin_pacific.htm.
- 192 Olympic Coast National Marine Sanctuary, National Oceanic & Atmospheric Administration (last accessed March 10, 2015), olympiccoast.noaa.gov/protect/incidentresponse/atbampmap.html.
- 193 Washington Department of Ecology, "Columbia River Facts and Maps," Washington Department of Ecology, (accessed January 6, 2015), www.ecy.wa.gov/programs/wr/cwp/cwpfactmap.html; Columbia River Gorge, "Facts," Columbia River Gorge, (accessed January 6, 2015), www.columbiarivergorge.info/facts.html.
- 194 National Park Service, "Lewis and Clark: History & Culture," National Park Service, (accessed January 6, 2015), www.nps.gov/lewi/historyculture/index.htm.

- 195 Columbia River Bar Pilots, "The Columbia River Bar Pilots," Columbia River Bar Pilots, (accessed January 6, 2015), www.columbiariverbarpilots.com/.
- 196 Oregon State Parks, "Columbia River Bar: Graveyard of the Pacific," Oregon State Parks, (accessed January 6, 2015), www.oregonstateparks.org/index.cfm?do=main.loadFile&load=_siteFiles/publications/37441_Graveyard_of_Pacific_%28lowres%29032248.pdf.
- 197 Genesee & Wyoming Inc., "Portland & Western Railroad (PNWR)," (last accessed March 17, 2015), http://www.gwrr.com/operations/railroads/north_america/portland_western_railroad_inc; Burlington Northern Santa Fe, "Crude-by-Rail Facilities Map," (last accessed March 17, 2015), <https://www.bnsf.com/customers/oil-gas/interactive-map/pdfs/BNSF-OG-Overview-Map.pdf>.
- 198 Toledanes, L., "Rainier Resisting Plan to Increase Train Traffic," *The Daily News*, November 7, 2013, http://tdn.com/news/local/rainier-resisting-plan-to-increase-train-traffic/article_4bc33a2e-4847-11e3-a015-001a4bcf887a.html.
- 199 Deschutes River Conservancy, "Deschutes River," Deschutes River Conservancy, (accessed January 6, 2015), www.deschutesriver.org/about-us/rivers-streams/deschutes-river/; Interior Columbia Basin Ecosystem Management Project, "Confederated Tribes of the Warm Springs Reservation: Map 1," Interior Columbia Basin Ecosystem Management Project, (accessed January 6, 2015), www.icbemp.gov/spatial/pubdoc/ueis/img/warm_int.gif.
- 200 National Wild and Scenic Rivers System, Deschutes River, Oregon, National Wild and Scenic Rivers System, (accessed January 6, 2015), www.rivers.gov/rivers/deschutes.php.
- 201 Sacramento Watershed Program, "Sacramento River Basin," Sacramento Watershed Program, (accessed January 6, 2015), www.sacriver.org/aboutwatershed/roadmap/sacramento-river-basin.
- 202 U.S. Geology Survey, "The Central Valley: Sacramento Valley," U.S. Geology Survey, (accessed January 6, 2015), <http://ca.water.usgs.gov/projects/central-valley/sacramento-valley.html>.
- 203 Valero Energy Corporation, "Wilmington: Overview," Valero Energy Corporation, (accessed January 6, 2015), www.valero.com/ourbusiness/ourlocations/refineries/pages/wilmington.aspx.
- 204 Bay Area Census, "Population by County, 1860-2000," Bay Area Census, (accessed January 6, 2015), www.bayareacensus.ca.gov/historical/copop18602000.htm.
- 205 Oil Change International, "Refinery Report," Oil Change International, (accessed January 6, 2015), <http://refineryreport.org/>.
- 206 Intergovernmental Panel on Climate Change, "Climate Change 2014: Synthesis Report," page 63, http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_Topic_2.pdf.
- 207 McGlade, C. & Paul Ekins. "The Geographical Distribution of Fossil Fuels Unused When Limiting Global Warming to 2° C," *Nature*, January 8, 2015, http://www.nature.com/articles/nature14016.epdf?referrer_access_token=6avCiKqAoP-QlhdpZMRhxtRgN0jAjWeI9jnR3ZtTv0MEzzy4w-DRQte5fViQxiPJJD2pVn_VEiJXUlpvIA0k52au177nPq6MK1EoZ4XVOqKvi-WFcWiotwOKaqMCCDQwv5MxrZGFxchcDB9ccGFis7YH2s39HoZ7p-0b9IYK_MARdeXuDq8xxhmAWrlot5xnQgJEjOSfHkyc-1jKtKlwFrKoRfzyu-vsCYqVo9h7QACajF7-kGrZLxxr9_3rAHbz96ndtv2W33PnPnNubyVL2NryO-irI0_AEY0XGRe_34L8Dc%3D&tracking_referrer=www.theguardian.com.
- 208 Giles, C., Letter to U.S. Department of State.
- 209 Swift, A., et al., "Pipeline and Tanker Trouble."
- 210 Podkul, C. and Schneyer, J. "DOT-111 Oil Tank Cars, Like Those in Lac-Meganitic, Quebec Disaster, Long Seen As Flawed," *Huffington Post*, July 9, 2013, www.huffingtonpost.com/2013/07/09/dot-111-oil-tank-cars_n_3568287.html; National Transportation Safety Board, "Derailment of Canada Freight Train U70691-18 With Subsequent Hazardous Materials Release and Fire," National Transportation Safety Board, February 14, 2012, www.ntsb.gov/investigations/AccidentReports/Pages/RAR1201.aspx; "West Virginia Train Derails, Sending Oil Tanker Into River," *New York Times*, February 17, 2015, <http://www.nytimes.com/aponline/2015/02/16/us/ap-us-train-derailment.html>.
- 211 Senator Maria Cantwell's March 25, 2015 bill covering crude-by-rail safety represents a good first step toward addressing many of these necessary regulatory changes. Nonetheless, far more is needed to ensure that a tragedy like that in Lac Megantic, Quebec does not strike another community in the future. Cantwell's bill is available here: www.baldwin.senate.gov/download/?id=5a77b1fd-7aab-472c-9127-b4e5444213fa&download=1.
- 212 Pacific Coast Collaborative, "Pacific Coast Action Plan on Climate and Energy," Pacific Coast Collaborative, October 28, 2013, www.pacificcoastcollaborative.org/Documents/Pacific%20Coast%20Climate%20Action%20Plan.pdf.
- 213 C. Malins et. al., "Potential Low-Carbon Fuel Supply to the Pacific Coast Region of North America, International Council on Clean Transportation and E4tech, January 2015, pg. xv, http://www.theicct.org/sites/default/files/publications/PacificCoastRegionLCF_Jan2015.pdf.
- 214 Theriault, D. "Kate Brown and Low-Carbon Fuel Standards: This Week in New Oregon Laws," *The Oregonian*, March 14, 2015, http://www.oregonlive.com/politics/index.ssf/2015/03/kate_brown_and_low-carbon_fuel.html.
- 215 "Policy Brief: Carbon Pollution Accountability Act of 2015," Governor Jay Inslee, December 2014, www.governor.wa.gov/sites/default/files/policy_briefs/pb_Carbon_market_policy.pdf.
- 216 Tillemann, L., "eGallon and Electric Vehicle Sales: The Big Picture," U.S. Department of Energy, August 19, 2013, www.energy.gov/egallon.

