

Transporting Undiluted Bitumen by Rail in Alberta: Current Regulatory Framework and Gaps

Using BitCrude and CanaPux as a Case Studies

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Abstract

Alberta's crude oil resources are constrained by a lack of pipeline capacity. The transportation of undiluted bitumen by rail is one proposed solution to these market access challenges. Undiluted bitumen is an extremely heavy form of crude oil that has not been diluted with diluent; it is colloquially referred to as solid crude. The benefits of using undiluted bitumen for transport include improved transport efficiency, fewer environmental concerns, and increased safety. Several different producers are developing technologies to solidify bitumen for rail transport. We use the BitCrude and CanaPux technologies as examples of undiluted bitumen to complete our analysis while acknowledging that other technologies exist.

In this paper, we reviewed the federal and provincial (Alberta) regulatory framework in an endeavour to determine how transported undiluted bitumen by rail would be regulated. Our research question is: what regulations would transporting undiluted bitumen by rail be subject to in Alberta and are there gaps or areas of uncertainty in the regulatory framework? We find that undiluted bitumen is not specifically addressed in any legislation pertaining to its transport. Undiluted bitumen is grouped together with crude oil in some instances but not in others. Additionally, we identified two areas of gaps and uncertainties in the regulatory framework: (1) there is no explicit definition or criteria delimiting undiluted bitumen from other kinds of crude oil in the legislation; (2) there is no fit-for-purpose regulatory framework providing guidance for the regulation of transporting undiluted bitumen by rail. If these gaps and uncertainties are addressed, it would aid the development and commercialization of undiluted bitumen by rail technologies.



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40 **1.0 Introduction**

Market Access Constraints

42 Alberta's oil sands resources are facing market access constraints primarily due to insufficient
43 pipeline capacity. Development of Alberta's oil sands resources has steadily increased with the
44 production of crude bitumen growing by almost 2 MMbbl/d in the last ten years (AER 2019).
45 However, export capacity via pipelines has been unable to keep pace with the increased
46 production of crude bitumen and other oil and gas resources. Historically, pipeline capacity has
47 expanded to accommodate increased production but several major pipeline projects out of
48 Western Canada have been cancelled or face ongoing legal and regulatory delays (NEB 2019).
49 This lack of takeaway capacity is one contributor to depressed Western Canadian Select (WCS)
50 prices that have subsequently reduced revenues for upstream producers, shippers, and
51 governments in the form of resource royalties. (Neb 2019). WCS is the heavy oil benchmark in
52 North American that is produced exclusively in Western Canada (OSM 2020).

54 Producers are increasingly looking to rail to fill the export gap caused by the inability to increase
55 pipeline capacity. Prior to 2012, less than 6,000 tank cars of crude oil were moved by rail each
56 year; however, demand for crude-by-rail dramatically surged beginning in 2013 (RAC 2019).
57 The most significant factor causing producers to use rail transportation is the ability to
58 circumvent pipeline bottlenecks and increase market access. Rail is capable of either supplying
59 new routes to the same refining destinations, or opening up new markets via coastal access to
60 fetch higher prices (Byblow et al. 2015). There are also other advantages to crude-by-rail as
61 producers anticipate further pipeline delays. As mentioned, rail can provide producers with the
62 opportunity to avoid deep discounts on WCS by accessing markets with increased demand.
63 Second, rail is capable of transporting a wide variety of oil products and does not necessitate the
64 addition of diluent as is required for transport by pipeline. Finally, crude-by-rail makes use of
65 existing infrastructure and existing rights-of-way. This is valuable because it means crude-by-rail
66 can be deployed faster and cheaper than a pipeline stuck in regulatory purgatory.

Benefits of Undiluted Bitumen

68 In recent years, there have been many studies that conclude that transporting crude oil by
69 pipeline is cheaper, safer, and less environmentally damaging than rail (Clay et al. 2017; Frittelli
70 et al. 2014; Green and Jackson 2015; Vragov 2018). In particular, Vragov et al. found that
71 pipelines outperformed rail on air pollution, greenhouse gases, and costs associated with spills
72 and accidents in an amount close to 2.5:1 in Canadian dollars (2018). These studies have varying
73 parameters and assumptions and they typically compare the transport of light conventional crude
74 oil or diluted bitumen. This paper adds a unique perspective to the discussion as it specifically
75 considers the transportation of undiluted (or solid) bitumen by rail. This type of bitumen has
76 been largely unaddressed in the literature.

Undiluted bitumen, or solid crude, offers many unique benefits to the crude-by-rail context.

- 78 1. The lack of diluent means that the volume of bitumen that could be transported would
80 increase by ~30%, depending on how much diluent the original blend would have
82 contained (NEB 2019). In this way, the transportation of undiluted bitumen by rail is
84 more efficient than transporting other crude oil blends either by pipeline or rail.
- 86 2. The absence of diluent means that undiluted bitumen is non-flammable and consequently,
88 would not be classified as a dangerous good according to Transport Canada (BitCrude
2020). This classification significantly reduces the number of regulations undiluted
bitumen is subject to when being transported by rail.
- 86 3. Undiluted bitumen is a solid mass that floats in water, so it is easier to recover after spills
88 compared to traditional dilbit. In the event of a spill, undiluted bitumen is non-toxic to
marine life, as demonstrated by an LC50 test on fish (Triton 2016).

Thus, undiluted bitumen has the potential to offer meaningful economic, safety, and
90 environmental benefits when transporting the product by rail.

Report Outline

92 In this paper, we examine the existing regulatory framework to answer the question: **What**
94 **regulations would transporting undiluted bitumen by rail be subject to in Alberta and are**
96 **there gaps or areas of uncertainty in the regulatory framework?** The paper begins by
providing further background and context for transporting undiluted bitumen by rail. This is
98 followed by a description of existing regulatory approval processes, applicable legislation, and
governing authorities that are relevant to the transportation of undiluted bitumen by rail. Based
100 on this examination of the regulatory framework, gaps and areas of uncertainty in the framework
are identified and described. Finally, the paper concludes by identifying opportunities to address
102 the aforementioned gaps and uncertainty to aid the commercialization of transporting undiluted
bitumen by rail. This paper is relevant for policymakers in the transportation space, oil sands
104 producers, and transportation regulators. It is the first paper to discuss the regulatory framework
for transporting undiluted bitumen by rail using up-and-coming technologies, BitCrude and
CanaPux, as case studies.

2.0 Background

What is Undiluted Bitumen?

Alberta's oil sands are an unconventional petroleum deposit that contains a mix of sand, clay,
108 water, and bitumen (AER 2020b). Bitumen is an extremely heavy form of crude oil that cannot
be pumped through a well because it is too viscous. Instead, bitumen is mined when the reserves
110 are close enough to the surface or extracted using in situ technology which involves applying
heat or injecting steam into the reservoir. This process makes bitumen less viscous and able to be
112 pumped to the surface (AER 2020a). The bitumen/water mixture is then separated and

transported to a refinery for further processing. More than half of producers opt to dilute bitumen with condensate, known as diluent, so that the resulting diluted bitumen, or dilbit, is able to flow through the pipeline (AER 2020a). Dilbit typically contains a 70:30 bitumen to diluent ratio. The remaining producers use on-site upgrading facilities that turn bitumen into synthetic crude which is also capable of flowing through a pipeline.

Undiluted bitumen is simply bitumen without the added diluent. It can be acquired at two different stages in the process. First, it can be acquired at the bitumen production site prior to being diluted or upgraded. Second, it can be acquired at the facilities in Edmonton or Hardisty where diluent recovery units (DRUs) could be installed in order to return dilbit to its raw form.

Transportation Strategy

While acknowledging that there are several companies pursuing different strategies and proprietary technologies for undiluted bitumen, this paper will specifically compare two different technologies to produce undiluted bitumen- BitCrude and CanaPux. BitCrude utilizes intermodal transportation while CanaPux intends to use bulk rail transportation.

A. BitCrude Transportation Strategy

Dilbit is produced in the Alberta oil sands and transported by pipeline to Edmonton, where the central storage tanks are located. A DRU will remove the diluent from dilbit to create 100% pure bitumen (BitCrude 2020). The recovered diluent is sent back to the oil sands for re-use by upstream producers. While the undiluted bitumen is still hot, it is poured into custom intermodal containers where it cools to become a solid again. These shipping containers are designed specifically for the BitCrude product with a top-loading door and proprietary electrical device that heats the product. The containers are transported by rail terminals on the West Coast where they are loaded onto cargo ships that take them to markets overseas. Once at the refineries, the electrical device heats the bitumen so it can be emptied from the container. The custom containers are then shipped back to Canada for re-use. Chinese refineries have shown interest in this product with the intent to turn bitumen into low-sulphur diesel or asphalt.

B. CanaPux Transportation Strategy

CanaPux pellets are solid pucks of bitumen approximately the size of a bar of soap. They are formed by blending bitumen with polymers and then encasing it in containers made of the same polymer to form a solid pellet (CN Innovation 2020). After the pellets are processed, they are taken from the processing facility and loaded into standard top-top gondola cars using a conveyor belt. These are the same railcars used for transporting coal. They are transported by rail to port terminals where they are loaded onto ocean freighters to be transported to international markets. Once at the refineries, the pellets undergo further processing to remove the polymer from the bitumen. The bitumen undergoes further refining while the polymers are sold back into the market for reuse.

152

If the proposed pellet processing plant is situated in close proximity to oil sands mine, then the transportation strategy requires that rail loading infrastructure is also available in the near vicinity. Otherwise, the pellets may need to be transported by truck to existing rail terminals. If the proposed pellet processing plant is situated more centrally, near the Edmonton or Hardisty rail terminals, then a DRU will be required to transform dilbit into raw bitumen.

158 *What infrastructure is required to facilitate commercialization?*

While transporting undiluted bitumen by rail primarily exploits existing infrastructure, some additional infrastructure will need to be built in order for the process to become commercially viable. DRUs will need to be implemented at a commercial level in order to process sufficient quantities of dilbit. BitCrude requires custom shipping containers to be manufactured and CanaPux may require specialized loading infrastructure to efficiently fill the rail cars. Additionally, it is possible that the railway operators will need to scale up their infrastructure to accommodate the commercial transport of a new commodity. Rail carrier tracks usually operate at, or near capacity, particularly during harvest season (NEB 2019). Thus, competition for space may necessitate the construction of new tracks. However, Alberta's coal phase-out by 2030 may open up approximately 5-12% of capacity on the tracks that were previously utilized by the coal industry (Alberta 2020b, CN 2019, CP 2019). If fewer coal hoppers are required in upcoming years, they could be replaced with shipping containers filled with BitCrude's product or repurposed for transporting CanaPux.

172 *Regulatory Uncertainty*

The regulatory framework for transporting crude-by-rail is incredibly dynamic (Byblow et al. 2015). Immediately following the 2013 Lac-Mégantic rail disaster, Transport Canada issued a variety of targeted amendments to section 33 of the *Railroad Safety Act* that impacted the transportation of crude-by-rail with more stringent operating rules. Transport Canada also implemented additional testing, labelling, and containment requirements for crude-by-rail under the *Transportation of Dangerous Goods Act, 1992*. Currently, there are ongoing regulatory developments for crude-by-rail in an effort to ensure uniformity between Canadian and American jurisdictions. More recently, in 2017, the Minister of Transport announced an initiative to modernize regulations across the transportation sector including rail transport (Canada 2019c). These are just a few examples to demonstrate the dynamism of the regulatory framework for transporting crude-by-rail in Canada.

184

The Canadian Energy Research Institute (CERI) recently identified regulatory uncertainty as the biggest hurdle to business success in the oil and gas industry (CERI 2020). Of primary concern is how often new regulation is introduced and how often changes to regulatory processes and requirements are implemented. As inferred above, the regulatory framework for crude-by-rail is

190 subject to considerable uncertainty. Regulatory uncertainty has the potential to increase costs to
191 firms, deter outside investment, and prevent the commercialization of new technology (Winter et
192 al. 2019). Pipelines, in particular, are subject to a significant regulatory burden as the volume,
193 complexity, and duplication of regulations have steadily increased (CEPA 2019). Uncertainty
194 regarding the timing of new pipeline infrastructure has had a broad effect across the industry
including hampering private investment in the development of crude-by-rail infrastructure (NEB
2019).

196 **3.0 Review of Regulatory Framework**

3.1 Diluent Recovery Units

198 While DRUs are not directly part of the transportation process, they are a key process
199 immediately preceding transportation by rail. Moreover, DRUs are necessary components for the
200 commercialization of BitCrude’s technology and a possible requirement for the production of
201 CanaPux depending on where the pellet processing facility is located. Thus, it is worthwhile to
202 describe the key components of the regulatory framework pertaining to DRUs.

Relevant Legislation

204 DRUs are considered an oil sands processing plant under Alberta law and are subject to relevant
205 regulations concerning oil sands projects. The rules governing DRUs are derived from the *Oil*
206 *Sands Conservation Act (2002) (OSCA)* and its supporting rules and the *Environmental*
Protection and Enhancement Act (2000) (EPEA).

208
209 *OSCA* applies to projects involved in exploring or developing the oil sands in Alberta. This Act
210 is designed to conserve resources, ensure safe and efficient development practices, control
211 pollution, and govern information collection and dissemination. Approval to construct and
212 operate DRUs are subject to approval pursuant to Section 11 of *OSCA* and Part 2 and Part 5 of
213 the *Oil Sands Conservation Rules*. Section 11 of *OSCA* describes the approval of a processing
214 plant, Part 2 of the corresponding rules describes general requirements, and Part 5 further
215 describes the operation of a processing plant.

216
217 *EPEA* applies to energy resource activities as they are defined in the *Responsible Energy*
218 *Development Act (REDA)*. This Act is designed to support and promote the protection,
219 enhancement, and wise use of the environment while acknowledging a variety of factors
220 including the need for Alberta’s economic growth, the polluter-pays principle, and the
221 importance of comprehensive and responsive action. *EPEA* approval is required for the
222 construction and operation of infrastructure, including DRUs, that may cause harm to the
environment pursuant to Part 2, Division 2, Section 70 of *EPEA*.

224 *Responsible Authorities*

226 *OSCA* grants the Alberta Energy Regulator (AER) the power to examine, inquire, hear, and
 228 determine all matters relating to the Act; make any orders or directions that are not specifically
 230 authorized by the act; and perform inspections or investigations at oil sands sites. The AER is a
 provincial regulatory agency and is responsible for ensuring the “safe, efficient, orderly, and
 environmentally responsible development” of Alberta’s energy resources (AER 2020c, AER
 2020f).

232 *EPEA* grants the Minister of Environment and Parks the power to take any action under the act
 but also indicates which projects require AER approval. The AER is responsible for reviewing
 234 applications related to energy resource development and assessing the potential impacts of these
 projects. The AER ensures that environmental protection remains a focus during the lifecycle of
 236 the asset (AER 2020d).

Regulatory Approval Process

238 The regulatory approval process for the construction and operation of a DRU will be summarized
 in this section as it relates to the AER requirements under *OSCA* and *EPEA*. The AER document,
 240 Directive 023: Guidelines Respecting an Application for a Commercial Crude Bitumen Recovery
 and Upgrading Project, has more detailed information about the process on their website. The
 242 directive contains requirements for the project description, technical information, economic
 information, impact assessments, environmental protection plans, reclamation plans, and waste
 244 management (AER 2020e). As of February 2020, there were two applications submitted to the
 AER for the construction and operation of a DRU and both applications are under review. The
 246 regulatory requirements of these applications are summarized in Table 1.

248 Table 1. The regulatory requirements of pending DRU applications to the AER.

Regulatory Component	DRU Applications
Responsible Regulatory Authorities	The AER Potential Federal Requirements under <i>CEPA</i>
Types of Approval Required	<i>OSCA</i> - new approval required <i>EPEA</i> - amendment to the approval required Water Act- new approval required. A license may be required if groundwater is utilized. Public Lands Act - approval possibly required
Environmental Impact Assessment	AER determined that an EIA is not required
Stakeholder Involvement Program	AER Directive applies Stakeholders: Indigenous individuals/communities, municipalities, local landowners/residents

Public Hearing	Possible
Air Quality	Assessments completed and measured against AAAQOs

Source: Cenovus Energy 2019; Gibson Energy ULC 2019.

250 Table adapted from Winter et al. 2019.

252 The regulatory approval process for DRUs is as follows (AER 2020d; Alberta 1993) :

- 254 **1. Application Submission** to the AER with the required information.
- 256 **2. Application Review** by the AER to ensure compliance under OSCA and EPEA.
- 258 **3. Public Notice of Application** to encourage public participation. Statements of concern may be filed by those who believe they will be adversely impacted by the project.
- 260 **4. Additional Information Request** if necessary to complete review.
- 262 **5. Approval Decision** by AER if adequate public and Indigenous consultation were carried out.
- 264 **6. Decision Appeal** if the decision is deemed to be appealable and the party wishes to appeal.

262 3.2 Crude-by-Rail Transportation

Relevant Legislation

264 A. Transportation of Dangerous Goods Legislation

266 The piece of federal legislation conventionally most applicable to crude-by-rail transport is the *Transportation of Dangerous Goods Act, 1992 (TDGA)* and the *Transportation of Dangerous Goods Regulations (TDGR)*. The purpose of the *TDGA* and the *TDGR* is to promote public safety when transporting dangerous goods by aviation, marine, road, and rail. To achieve public safety, the Act prescribes rules and regulations regarding safety standards and shipping requirements for all goods that are classified as dangerous under the Act. These requirements address packaging, labelling, and containment in addition to training obligations, emergency response plans, and penalties for compliance failures (Byblow et al. 2015). A product is considered a dangerous good if it is listed in Schedule 1 or Schedule 3 of the Act. If a product is not listed in either of these schedules, it must be tested against Schedule 2. If a product meets any of the criteria in Schedule 2, then it will also be regulated as a dangerous good. Liquid crude oil (such as dilbit) generally falls under Class 3, “Flammable and combustible liquids” in Schedule 1. As of April 2020, BitCrude is the only undiluted bitumen product that has been transported by rail. Transport Canada has assessed that BitCrude is not a dangerous good and thus, Transport Canada has no authority over the transport of the commodity by rail (Transport Canada 2020; True Crude 2019). Other non-regulated goods include things like sulphur pellets, coal, potash, and canola oil.

282 Alberta also observes its own provincial legislation pertaining to dangerous goods. The *Dangerous Goods Transportation and Handling Act* and its regulations aim to protect the public

284 and the environment by promoting the safe transportation of dangerous goods and providing
 286 information to first responders (Alberta 2020a). The Act gives the Minister of Transportation the
 288 authority to issue permits, make stop orders, appoint inspectors, and conduct public inquiries.
 290 The federal government and the provincial government entered into an agreement whereby they
 292 acknowledge that the safe transportation of dangerous goods can be best achieved through the
 combined efforts of both jurisdictions (Canada 2009). The federal minister and the provincial
 minister will make efforts to ensure the uniformity and consistency of the legislation and
 regulations. The following table summarizes the allocation of duties between the federal
 government and the provincial government in relation to the transportation of dangerous goods.

294 Table 2. Level of government having the primary role in areas of activity relating to the
 transportation of dangerous goods by rail.

Activity	Jurisdiction with primary responsibility
Amendment of the <i>TDGA</i> and <i>TDGR</i>	Canada
Amendment of the <i>Dangerous Goods Transportation and Handling Act</i> and regulations	Alberta
Inspection and enforcement for provincially regulated railways	Alberta
Inspection and enforcement for federally regulated railways	Canada
Dissemination of permits and directions in effect in Alberta under the federal Act	Canada
Dissemination of permits and stop orders under the provincial Act	Alberta
Response to incidents involving provincially regulated railways	Alberta
Response to incidents involving federally regulated railways	Canada
Initial notification relating to the accidental release of substances on rail	Canada

296 Source: Canada 2009.
 298 Table adapted from Canada 2009.

298 B. Environmental Protection Legislation

300 At the federal level, the *Canadian Environmental Protection Act, 1999 (CEPA)*, is the
 302 cornerstone of environmental legislation in Canada. The Act aims to prevent pollution and
 304 protect the environment and human health. The Act is guided by the concept of sustainable
 development such that it works to meet the needs of the present generation without undermining
 the ability of future generations to meet their needs. It establishes rules and tools for the

306 regulation of toxic substances and the management of pollution. *CEPA* gives the Minister of
Environment and Climate Change and the Minister of Health the responsibility for creating the
308 New Substances list to identify substances that are new to Canada. The two federal ministries
must then determine if a substance is “toxic” or capable of becoming “toxic”. After assessment,
if a substance satisfies the definition of “CEPA toxic”, they are added to the List of Toxic
310 Substances in Schedule 1 of the Act. Liquid crude oil is categorized in Schedule 1 under no. 134,
petroleum and refinery gasses. After examining the safety data sheet (SDS) for BitCrude,
312 undiluted bitumen could reasonably expect to qualify as a “toxic” substance under *CEPA* for its
inclusion of polycyclic aromatic hydrocarbons (PAHs) and asphalt (True Crude 2019). PAHs are
314 categorized under no. 43, polycyclic aromatic hydrocarbons, in Schedule 1 of *CEPA* and asphalt
is categorized under no. 88, naphthalene.

316
The remediation of spills is usually governed at the provincial level. In Alberta, the
318 *Environmental Protection and Enhancement Act, 2000 (EPEA)* governs the release of substances
into the environment under Part 5 of the Act. *EPEA* sets out rules for reporting and remediating
320 spills and prohibited releases of substances. The entity that causes or permits the release of a
substance is the entity that has a duty to report the release subject to section 110(1). Thus, in
322 spills occurring during the transport of bitumen by rail, the railway operator is the likely entity
responsible for reporting any spills. On the other hand, the responsibility for remediation falls to
324 the “persons responsible” for the substance according to section 112(1). The *EPEA* casts a wide
net for potentially responsible entities in regard to remediation with no prescribed hierarchy of
326 liability ownership. Thus, the responsibility could fall to the railway operator, transloader,
container owner, or owner of the substance. Under the *EPEA*, the Minister of Environment and
328 Parks may issue administrative obligations in the form of a Ministerial Orders to any “persons
responsible” even if the party is relatively blameless (Byblow et al. 2015). This is because the
330 legislation prioritizes the environmental protection objective over the polluter pays principle
(Byblow et al. 2015, 300).

332 C. Rail Safety Legislation

334 The *Railway Safety Act (RSA)* is the primary legislation that gives Transport Canada the
responsibility for overseeing rail safety. A central tenet of the *RSA* is that railway companies are
336 responsible for the safety of their operations, while Transport Canada is responsible for
protecting people, property, and the environment by providing a national framework (Canada
338 2019b). The purpose of the *RSA* is to promote the safety and security of the public, personnel,
property, and environment; encourage cooperation amongst groups to improve railway safety;
340 recognize the responsibility of rail companies in safety management; and facilitate a regulatory
framework that is modern, flexible, and efficient (Canada 2019b). The *RSA* gives the Governor-
342 in-Council power to make regulations pertaining to matters governed by the Act including the
construction and maintenance of buildings or structures, the development of safety management
344 systems, engineering standards, and personnel training.

346 Alberta also has its own provincial railway safety legislation in the form of the *Railway (Alberta)*
348 *Act* and its regulations. This Act applies to provincially regulated railways whereby most of the
348 provisions of the *RSA* have been incorporated by reference (Canada 2007). This ensures that
provincially regulated railways adhere to the same rules as federally regulated railways.

350
352 The *Canada Transportation Act* is an umbrella legislation for Canada’s national transportation
352 system and covers rail, aviation, and marine transport. It serves to support a competitive,
354 economic, and efficient national transportation system while simultaneously ensuring high safety
354 standards and sustainable environmental practices (Canada 2017). Of particular importance to
354 this paper is the “common carrier” obligations found in sections 113-115 of the Act. This
356 provision means that railways must agree to carry any goods offered to them and charge a
356 reasonable rate. Railways are compelled to carry a range of freight including bulk commodities
358 and dangerous goods such that they meet the needs of all shippers (RAC 2016). In 2015, the
358 federal government established minimum insurance requirements for railways including strict
360 liability for rail accidents involving crude oil (RAC 2016). The government also created a \$250
360 million fund intended to compensate crude oil accident victims for damages that the rail
362 insurance does not cover. Crude oil shippers contribute to this government fund by a levy per
362 metric tonne of crude oil (RAC 2016).

364 D. Bulk and Intermodal Rail Transport Legislation

366 Bulk and intermodal transport are regulated at the level of the railway operator. A discussion of
366 both is warranted as BitCrude will utilize intermodal container transport while CanaPux can
368 utilize intermodal container or bulk transport with open-top gondola cars. The following
368 discussion relates to the rules and guidelines pertaining to bulk and intermodal transport by CN.
370 Some of the rules and guidelines applied are broadly adopted across railway companies while
370 others are company-specific. As one of Canada’s largest railway companies, CN’s documents are
372 discussed as an example under the assumption that other railway companies have similar rules.

374 The intermodal rules at CN are governed by CN Tariff 6800. The tariff sets out the conditions
374 governing the acceptance of intermodal containers and loading requirements. CN will only ship
376 containers that meet the AAR’s Mechanical Division Specifications for intermodal containers
376 (AAR-600, M930, and M931). Contents in intermodal containers must be loaded in accordance
378 with the AAR Intermodal Loading Guide. CN Tariff 9100 is a supplementary tariff that describes
378 the bill of lading information requirement. This document is legally required for CN to transport
380 the shipment and primarily includes commodity identification and consignee contact
380 information.

382
384 The loading rules for bulk transport using open-top gondola cars are governed by AAR’s Open
384 Top Loading Rules. CN Tariff 9000 is a supplementary tariff that describes the bill of lading

386 information requirement. This document is legally required for CN to transport the shipment and
387 primarily includes commodity identification and consignee contact information.

388 E. Miscellaneous Legislation

389 The recently enacted *Oil Tanker Moratorium Act* prohibits vessels, including oil tankers,
390 carrying more than 12,500 metric tonnes of crude oil or persistent oil from stopping, loading, or
391 unloading at any ports along BC's north coast. Crude oils are defined according to the
392 International Convention for the Prevention of Pollution from Ships and include partially
393 upgraded bitumen and synthetic crude oil (Canada 2019d). The Act also designates fourteen
394 distinct persistent oils that are covered by the moratorium and the Governor in Council is given
395 the power to amend the schedule of persistent oils. The Act establishes an enforcement regime
396 that includes penalties of up to \$5 million for persons or vessels in contravention of the act.
397 BitCrude's recent test shipment demonstrated that undiluted bitumen does not qualify as crude
398 oil under the Act and is able to be loaded onto ships off BC's northern coast.

Responsible Authorities

400 A. Federal Departments and Agencies

401 Transport Canada is the federal authority responsible for developing transportation policies,
402 regulations, and programs as they relate to road, rail, marine, and air transportation (Canada
403 2020b). Their mandate is to ensure that transportation is safe, secure, efficient, and
404 environmentally friendly. Transport Canada is primarily responsible for inspections, audits,
405 emergency response planning, and public education (Canada 2007). In regards to rail
406 transportation, federal regulations apply when railways operate in more than one province,
407 operate from the US, or when parliament declares that the railway operates for the benefit of
408 more than one province. The acts that Transport Canada administers that are of relevance to this
409 paper include the *Canada Transportation Act* and the *Transportation of Dangerous Goods Act*,
410 1992.

411 The *Canadian Transportation Act* (CTA) grants the Canadian Transportation Agency the
412 authority to implement federal government policy and regulate federal air, rail, and marine
413 transport (Padova 2015). The Canadian Transportation Agency acts as an independent
414 administrative tribunal and has powers over things like licensing, cost apportionment, and
415 competitive access (Canada 2007). The agency is also responsible for issuing a Certificate of
416 Fitness to begin the operation of a railway under federal jurisdiction (Canada 2007). They also
417 address issues such as the right of access for landowners, potential safety concerns, complaints,
418 and disputes (Canada 2007).

419
420 The Transportation Safety Board of Canada created by the *Canadian Transportation Accident*
421 *Investigation and Safety Board Act*. It is an independent agency responsible for advancing
422 transportation safety by investigating incidents on all modes of transportation including by rail.

424 In addition to investigating accidents, the agency identifies safety deficiencies, makes
426 recommendations to address deficiencies, and reports its findings to the public (Canada 2007).

B. Provinces

428 Railways are primarily regulated at the federal level. However, there are some short-line
430 railways that fall under provincial jurisdiction. The Ministry of Transportation and the Ministry
432 of Environment and Parks will often work in tandem with federal legislation and regulations to
coordinate the safety and efficiency of rail transport in the province.

C. Railway Operators and Industry Associations

434 While railway safety is primarily regulated by Transport Canada, the Minister of Transport may
436 delegate specific safety concerns to the railways to regulate (RAC 2020). In addition to this
438 delegated authority, railway operators can take the initiative to draft their own rules and
440 regulations. They are given this power under the *RSA* and may develop rules pertaining to
442 matters governed by the Act (Canada 2007). The two major railway operators in Canada CP and
CN; together they represent more than 95% of Canada's annual rail tonne-kilometers (Canada
2012). Both CP and CN have their own tariffs describing the rules and regulations for the
acceptance of intermodal traffic.

442 The Railway Association of Canada (RAC) represents over 60 federal and provincial railways
444 including CP and CN. RAC often undertakes the responsibility of developing rules under the
authority of the *RSA* on behalf of its member railway companies. RAC has developed rulebooks
446 including the Canadian Rail Operating Rules and Instructions for the Transfer of Dangerous
Goods in Bulk on Railway Property. While the *RSA* only refers to railway companies as having
448 the power to develop rules, the RAC completes a lot of this work and member railway
companies opt to adopt these rules (Canada 2007).

450 The Association of American Railroads (AAR) is the American equivalent of the Railway
452 Association of Canada in that they are both industry associations. The AAR has an extensive
policy department dedicated to developing economic and operational regulations. For some areas
454 of rail transport, Canadian railway operators opt to adopt some of the regulations that the AAR
sets as there is no Canadian equivalent. For example, intermodal container specifications are set
456 out by the AAR and the AAR is responsible for issuing test certificates. Additionally, the AAR
regulations are used for the loading, blocking, and bracing of freight in intermodal containers.

Regulatory Approval Process

460 The regulatory approval process for the transport of undiluted bitumen by rail constitutes fewer
462 regulatory requirements and more procedural requirements. First, it must be established whether
the product is to be a regulated or non-regulated good by Transport Canada as determined by the
TDGA. If a substance is determined to be a non-dangerous good, it is not regulated by Transport

464 Canada but instead by the rules set out by the railway company. The rail companies require an
466 approved SDS for the commodity and the commodity must be shipped in an AAR approved
468 container. As long as the commodity and the container is approved and properly labelled, the
466 railway company has an obligation to ship the good as set out by the “common carrier”
468 obligation in the *Canada Transportation Act*.

470 A good that is new to Canada must also comply with the New Substance Notification (NSN)
470 Regulations of *CEPA*. To reiterate, these regulations ensure that new substances undergo
472 ecological and human health assessments so that appropriate measures can be taken prior to
474 introducing these substances to the marketplace. An NSN reporting form must be completed with
474 the following information: substance identity; physical and chemical information; ecotoxicity
476 information; health toxicity information; genotoxicity information; manufacture, import, use,
476 exposure and release information; and transportation, storage, and disposal information (Canada
2020a). New undiluted bitumen products such as BitCrude and CanaPux will need to comply
with these NSN regulations.

478 **4.0 Gaps and Areas of Regulatory Uncertainty**

480 This section adds to our review of the regulatory framework for transporting undiluted bitumen
480 by rail by identifying areas in the regulatory framework that may pose challenges to the
commercialization of this transportation strategy.

482 *Defining Undiluted Bitumen*

484 Undiluted bitumen is not explicitly addressed or defined under provincial or federal law.
484 Although raw bitumen is a substance that is extracted at field sites, it has not been widely
transported in that form. Rather, bitumen has been transported as a liquid, either as dilbit or a
486 partially upgraded crude oil. As such, legislation has developed robust regulations surrounding
the transport of liquid crude oil but has seemingly left undiluted bitumen unconsidered.

488 One of the most critical pieces of legislation regulating how crude oil must be transported in
490 Canada is the *TDGA*. Liquid crude oil generally falls under Class 3, “Flammable and
combustible liquids” in Schedule 1 of the *TDGA*, meeting the criteria for being classified as a
492 dangerous good. Class 4 of Schedule 1 has provisions for flammable solids. This class includes
substances that are readily flammable, subject to spontaneous combustion, or water-reactive to
494 produce toxic gases. When examining the composition of BitCrude on the SDS, it includes
variable levels of PAHs (True Crude 2019). PAHs are solid and flammable at room temperature
496 (CDC 2009). PAHs also emit toxic fumes when heated (CDC 2009). Despite the presence of
flammable substances, the SDS categorized BitCrude as non-flammable and non-combustible.
498 However, the SDS did acknowledge the possibility of toxic gases being produced when exposed
to heat (True Crude 2019). While toxic gases as a result of heat do not meet the criteria of Class

500 4 (gases must be the result of water, not heat), it is possible that BitCrude meets the flammability
requirements of Class 4. While Transport Canada has designated BitCrude a non-flammable and
502 non-dangerous good, the ‘variable’ levels of PAHs leaves room for the possibility that BitCrude
may be readily flammable. Alberta’s provincial dangerous good legislation, the *Dangerous*
504 *Goods Transportation and Handling Act*, adopts the same schedule as the federal act. Thus, the
above discussion on the treatment of undiluted bitumen in the legislation applies to the provincial
506 level as well.

508 The 2015 amendments to the *Canada Transportation Act* introduced enhanced minimum
insurance requirements for federally regulated railways that included specific requirements for
510 railways that transport crude oil. The minimum insurance levels would vary depending on the
type and quantity of crude oil being transported annually. Despite the fact that undiluted
512 bitumen is a type of crude oil, it does not fall under the crude oil insurance requirements in the
Canada Transportation Act. The Act views crude oil from the perspective of the *TDGA* where
514 crude oil is classified as a dangerous good. However, this classification does not negate the
potential environmental impacts or other liabilities associated with a rail spill. The SDS for
516 BitCrude advises that the product should be kept out of waterways as an environmental
precaution and that PAHs have been associated with several chronic effects including skin and
518 lung tumours, anemia, and disorders of the liver, bone marrow, and lymphoid (True Crude
2019).

520 The above discussion mentions BitCrude specifically because of the availability of a third-party
SDS. However, the discussion can also be expected to be applicable to other undiluted bitumen
522 technologies particularly due to the expected inclusion of PAHs in other products. PAHs are
chemicals that are naturally occurring in crude oil (CDC 2009).
524

526 In summary, the definition of or consideration for undiluted bitumen is absent in the legislation
at both the federal and provincial levels. While crude oil, and indeed different types of crude oil,
528 are delineated in various laws, they do not account for undiluted bitumen or bitumen in solid
form. In the absence of focused rules, undiluted bitumen is subject to be overlooked by
530 potentially important pieces of legislation or pigeonholed into legislation that does not
adequately address the unique properties of undiluted bitumen.

532 *A Regulatory Regime to Accommodate Innovation*

As alluded to above, there are several up-and-coming undiluted bitumen products currently in
534 development that utilize different technologies and produce slightly different products. Slightly
different products require different rail transportation strategies. For example, BitCrude is
536 transported as a solid block in intermodal containers while CanaPux can be transported as solid
pellets in open-top gondola cars. Intermodal and bulk transported are regulated at the level of the
538 railway operator and both modes of transport are subject to different rules. Another key

540 difference between the various technologies is their physical state. Although BitCrude and
542 CanaPux are both marketed as solidified bitumen, they may not be solid-state substances.
544 BitCrude’s technology relies on heating the substance so that it flows into and out of an
546 intermodal shipping container. According to the American Society for Testing and Materials,
548 BitCrude is not a solid substance, but a highly viscous liquid (LCS 2019). On the other hand,
548 CanaPux takes raw bitumen and blends it and then encases it with a polymer to create a solid
548 pellet. Although the technical information for CanaPux was not available for this paper, it is
548 possible that CanaPux is considered to have a solid physical state but might not be classified as
548 bitumen since it is blended with a polymer.

550 As more undiluted bitumen products are developed for commercialization, it is likely that they
552 will all vary in important ways including but not limited to their transportation strategy (bulk or
554 containerized), the additives included in the product, and the physical state or off-gassing of the
554 undiluted bitumen. If there is no fit-for-purpose regulatory framework for undiluted bitumen
554 products, each new technology will have to be individually assessed, subject to different
554 approval requirements, and forced into a regulatory regime that does not explicitly acknowledge
554 what undiluted bitumen is.

556 **5.0 Policy Opportunities**

558 This paper has identified areas of gaps and uncertainty in the regulatory framework for
560 transporting undiluted bitumen by rail. These areas have the potential to not only negatively
562 impact investor confidence but also impede the effective and responsible execution of undiluted
562 bitumen by rail technologies and strategies. We identified two policy opportunities that can be
562 implemented with relative ease to reduce gaps and increase certainty in the regulatory
562 framework.

564 **Opportunity: Explicitly define undiluted bitumen in this legislation and describe the**
566 **relevant similarities and differences between undiluted bitumen and liquid crude oil. This**
566 **definition should be common across legislation and adopted at each level of jurisdiction.**

568 This will give undiluted bitumen producers the ability to better determine how their product will
568 be regulated prior to acquiring regulatory approvals. It will also provide regulators with a basis
568 for developing rules on how to manage undiluted bitumen.

570 **Opportunity: Design a fit-for-purpose regulatory framework for transporting undiluted**
572 **bitumen by rail to reduce regulatory uncertainty.**

574 This will provide stakeholders with a streamlined policy that addresses the unique characteristics
574 of undiluted bitumen. It will provide guidance to railway companies and insurance companies on
574 how to best approach regulating undiluted bitumen.

576 **6.0 Conclusion**

578 Transporting undiluted bitumen by rail presents an opportunity for Alberta to address market
580 access constraints caused by the inability to build more pipeline capacity. The primary benefit of
582 using rail is that we can utilize existing railway infrastructure to transport heavier crude oils
584 while pipelines continue to move light and medium crude oils. Undiluted bitumen is an
innovative technology that comes with efficiency benefits, it does not require diluent;
environmental benefits, it floats in water and is non-toxic to marine species; and safety benefits,
it is non-flammable and non-combustible (BitCrude 2020, NEB 2019, Triton 2016).

586 In this paper, we have reviewed the current federal and provincial regulatory framework that we
588 expect undiluted bitumen to be subject to when it is transported by rail from Alberta. We found
590 that undiluted bitumen is not explicitly addressed in any piece of legislation. Instead, undiluted
592 bitumen is either included in the definition of liquid crude oil and regulated as such or excluded
from the definition of liquid crude oil. If undiluted bitumen by rail is to become a commercially
viable and widely used strategy, then the regulatory framework should be adapted to specifically
address undiluted bitumen.

594 Our paper identified two areas of gaps and uncertainties in the regulatory framework as they
596 apply to transporting undiluted bitumen by rail: (1) there is no explicit definition or criteria
598 delimiting undiluted bitumen from other kinds of crude oil in the legislation; (2) there is no fit-
for-purpose regulatory framework providing guidance for the regulation of transporting
undiluted bitumen by rail. We suggest that these gaps and uncertainties can be addressed without
substantial effort and will contribute to a regulatory framework that supports the development
and commercialization of undiluted bitumen by rail.

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Appendix

Abbreviation	Definition
AAAQOs	Alberta ambient air quality objectives and guidelines.
AAR	Association of American Railroads
AER	Alberta Energy Regulator
Bbl/d	Barrels per day
CERI	Canadian Energy Research Institute
CN	Canadian National Railway
CP	Canadian Pacific Railway
<i>CTA</i>	<i>Canadian Transportation Act</i>
Dilbit	Bitumen that is diluted with a diluent in a 70:30 bitumen to diluent ratio.
DRU	Diluent recovery unit
<i>EPEA</i>	<i>Environmental Protection and Enhancement Act (2000)</i>
LC50	Lethal concentration. A measure of the required toxicity that will kill 50% of a sample population in a given period of time.
MMbbl/d	Million barrels per day
NSN	New Substance Notification
<i>OSCA</i>	<i>Oil Sands Conservation Act (2002)</i>
PAHs	Polycyclic aromatic hydrocarbons

RAC	Railway Association of Canada
REDA	<i>Responsible Energy Development Act</i>
RSA	<i>Railway Safety Act</i>
SDS	Safety Data Sheet
TDGA	<i>Transportation of Dangerous Goods Act</i>
TDGR	<i>Transportation of Dangerous Goods Regulation</i>
WCS	Western Canadian Select. Reference price for heavy crude oil delivered at Hardisty. WCS naturally trades at a discount to lighter crudes because it takes more energy to refine.

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808 **Explanation for Divergence**

Word count restrictions

810 This paper exceeds the word count for the entire paper (4500-5000 words). We deemed that the
812 maximum cap of 5000 words was insufficient to give an adequate exploration and description of
the regulatory framework as it pertains to crude-by-rail transportation (section 3.2). This section
814 alone constitutes just over 2500 words. As this section conveys much of the research that was
done for this paper and answers the first part of the research question (What regulations would
transporting undiluted bitumen by rail be subject to in Alberta?), we believe this is space that is
816 worth taking.

818 *Integration of Indigenous perspective*

This paper does not include an integration of the Indigenous perspective. For our larger
820 REDEVELOP project, we choose to discuss opportunities for Indigenous participation in the
economic benefits of energy projects. Because the policy paper focuses on regulatory
822 frameworks, our topic for Indigenous integration does not fit with the research of the paper.
Instead, we felt that the integration of Indigenous perspectives was best conveyed through the
824 presentation component of the ReDevelop project.