December 20, 2019

Re: Docket Number PHMSA–2018–0025 (HM–264)

Delaware Riverkeeper Network (DRN) submits this comment in opposition to the proposed rulemaking by the Pipeline and Hazardous Materials Safety Administration (PHMSA), with the Federal Railroad Administration (FRA), to change the Hazardous Materials Regulations to allow for the bulk transport of Methane, refrigerated liquid, commonly known as liquefied natural gas (LNG), in rail tank cars. The proposal would authorize the transportation of LNG by rail in the DOT-113C120W specification rail tank car. DRN opposes the proposed Hazardous Material Regulation changes and calls for the denial of the proposed rulemaking and the Proposed Alternative.

PHMSA received a Petition for rulemaking from the Association of American Railroads (AAR) and President Trump's April 10, 2019, "Executive Order on Promoting Energy Infrastructure and Economic Growth," which orders "The Secretary of Transportation shall propose for notice and comment a rule, no later than 100 days after the date of this order, that would treat LNG the same as other cryogenic liquids and permit LNG to be transported in approved rail tank cars."[1] According to the Executive Order (E.O.), the rulemaking is to be finalized within 13 months after April 10, 2019, the date of the E.O. (Sec. 4(b)).[2] DRN points out that neither the Petition nor the E.O. can violate current laws, rules, or regulations. Our nation's laws are in force to protect the public and the environment and the environmental rights of all, including generations yet to come.

PHMSA and the FRA jointly hold the mission "…to manage, and reduce, the risk to people and the environment by the transport of hazardous material by rail."[3] The current prohibition of transport of bulk LNG by rail car is based on the lack of necessary provisions in current regulations to provide for the safe transport of LNG by rail car and a lack of perceived need for the use of the railways for LNG transport. Neither of these circumstances has changed. Therefore, DRN

[1] https://www.whitehouse.gov/presidential-actions/executive-order-promoting-energy-infrastructure-economic-growth/

[2] Ibid.

[3] NJDOT, Pipeline and Hazardous Materials Safety Administration, Docket No. PHMSA-2018-0025 (HM-264) RIN 2137-AF40, Hazardous Materials: Liquefied Natural Gas by Rail, NPRM Preliminary Regulatory Impact Analysis, October 2019, Executive Summary.

DELAWARE RIVERKEEPER NETWORK
925 Canal Street, Suite 3701
Bristol, PA 19007
Office: (215) 369-1188
fax: (215)369-1181
drn@delawareriverkeeper.org
www.delawareriverkeeper.org

concludes that LNG should not be allowed to be transported by rail car on the nation's railways; the proposed rulemaking and Proposed Alternative are unsubstantiated and must be rejected.

The rulemaking proposal is described by PHMSA as "deregulatory". PHMSA seems to use this description to avoid performing certain analyses, including those required by applicable environmental laws and regulations, such as a full Environmental Impact Statement under NEPA. In fact, PHMSA seems to bend over backwards to make no substantial changes to the current regulations such as operational controls for safety purposes and specific controls for the use of "unit trains" (20 rail cars or more of the same material), stating they lack information.[4] They state that there is not enough data on the transport of LNG by tank cars to inform what additional safety controls should be imposed. They also state that they do not know when "unit trains" would be used and initially expect only a few tank cars as part of manifest trains. This is then used as an excuse for not requiring further testing and regulatory controls on LNG in DOT-113C120W specification rail tank cars, which are proposed by PHMSA to be used to transport LNG.[5]

In comment submitted to PHMSA December 5, 2019, the National Transportation Safety Board (NTSB) questions this rationale and PHMSA's lack of specific operational controls in the proposed rulemaking, such as those used for high-hazard flammable trains.[6] NTSB states that President Trump's Executive Order suggests a need for a much greater deployment of LNG by rail than a few cars in manifest trains and references the application from Energy Transport Solutions (ETS) for PHMSA Special Permit SP 20534 that projects unit trains of 50-100 shipments (rail cars) per day.[7]

Additional evidence that unit trains would be employed as soon as possible is the economy of scale presented in PHMSA's Cambridge Systematics Risk Assessment ("Risk Assessment") issued in March 2019. In discussion of LNG Mode Choice, it is stated that rail delivery takes longer due to operational imperatives when rail cars are sorted into manifest trains. The Risk

[4] Notice of Proposed Rulemaking, U.S. DEPARTMENT OF TRANSPORTATION, Pipeline and Hazardous Materials Safety Administration, 49 CFR Parts 172 and 173, [Docket No. PHMSA-2018-0025 (HM-264)], RIN 2137-AF40, Hazardous Materials: Liquefied Natural Gas by Rail, p. 21. "PHMSA recognizes that there may be other operational controls or combinations of controls to consider and encourages comments on such controls. However, for this rulemaking, PHMSA and FRA decided not to propose additional operational controls because there is not sufficient data about the potential movements of LNG by tank car."

[5] Ibid, p. 21-22. "While PHMSA expects LNG will initially move in smaller quantities (i.e., a few tank cars) as part of manifest trains, it is uncertain whether LNG will continue to be transported in those quantities or if LNG by rail will shift to be transported using a unit train model of service, and if so, how quickly that shift will occur."

[6] National Transportation Safety Board, letter to U.S.D.O.T., RE. Docket No. PHMSA -2018-0025 (HM-264), d. 12.5.2019.

[7] Ibid, p. 4. "The urgency provided by the President's Executive Order suggests that LNG transportation by rail as a viable alternative to highway transportation is envisioned to entail greater amounts than mere incidental numbers of tank cars in manifest trains. Additionally, the August 21, 2017, ETS application for a special permit to transport methane, refrigerated liquid in DOT-113 tank cars (just one potential LNG by rail shipper), states that it anticipates operating two LNG unit trains, 50 to 100 tank cars, per day. Therefore, the NTSB disagrees with PHMSA's assertion that the number of LNG shipments would be minimal and that proposing additional operational controls in this NPRM is unnecessary".

Assessment states, “This would be different if unit trains were employed, in which only LNG railcars were transported from origin to destination without required railyard sorting”.[8]

DRN agrees with the conclusion by NTSB that the evidence does not support PHMSA’s assertion that the volume and frequency of LNG transport by rail would be minimal to start and therefore does not require operational controls. NTSB points out that even if there is a gradual increase in the transport of LNG by rail in these tank cars, the risk of catastrophe is too great to justify not imposing operational controls.[9]

The proposed rulemaking allows unit trains with no new required operational controls and since PHMSA imposes no limits on ramp-up, the deployment of unit trains and frequent, large rail shipments will be allowed to occur before adequate safety controls. Without any LNG-specific operational controls, public safety, worker safety, and the environment are put at great risk. Similar to the speedy ramp-up of the use of rail cars for the transport of crude oil, communities along the railways will be used as guinea pigs to test in real time if the DOT-113C120W is safe to carry LNG.

This is an outrageous circumstance and cannot be allowed. We only have to witness the catastrophic loss of 47 people’s lives, devastating environmental damage, and tremendous economic harm of the train derailment in Lac-Mégantic, Canada in 2013 to recognize the consequences of the lack of adequate safety controls. Additionally, numerous derailments and disastrous incidents occurred on the railways across the U.S. when the industry deployed crude oil trains without adequate safety controls.

NTSB questions PHMSA’s determination that DOT-113C120W specification rail tank cars are safe for LNG transport without a comprehensive review of the cars regarding the potential for release of LNG in an accident. NTSB points out that puncture and thermal exposure resistance of these tank cars needs to be evaluated if they are to be used for LNG transport. Furthermore, they question PHMSA’a reference to the information presented in the Exponent Report submitted by ETS for PHMSA Special Permit SP 20534 as sufficient, stating that it is only “anecdotal” and that Exponent states that there is no loss of containment probability data available. Drawing conclusions about these essential questions based on reference or proxy data from other types of hazardous substances without knowing how the properties of these substances compare with LNG is not defensible. PHMSA also does not offer any applicable data.

In fact, PHMSA’s Risk Assessment states “when the probability of LNG tank car derailment is understood, better decisions can be made regarding crashworthiness, placement, and operation

[8] Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., “Risk Assessment of Surface Transport of Liquid Natural Gas”, *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. ES-5.

[9] Ibid, p. 4, “A gradual initial ramp-up of LNG rail transportation would likely occur because of the limited availability and high cost of DOT-113 tank cars. Nonetheless, we believe the risks of catastrophic LNG releases in accidents is too great not to have operational controls in place before large blocks of tank cars and unit trains proliferate.”

of rail cars and the potential consequences from an LNG release due to a derailment".[10] The National Association of State Fire Marshals (NASFM) has gone on the record with PHMSA opposing the Proposed Rulemaking based on "the lack of evidence and research that allowing such an action as proposed in the docket is safe either for America's first responders or the public".[11] Clearly, those who respond to incidents and events on the railways are in a position to know when safety is being adequately addressed and when it is not. Mr. Narva of the NASFM goes on to state, "The combination of a lack of information with no increased safety measures is a dangerous proposition. This only serves to put the public and our first responders at even greater risk."[12]

It is inarguable that testing of DOT-113C120W specification rail tank cars for transport of LNG must be required prior to their use. PHMSA does not have sufficient information to assert any findings regarding safety of DOT-113C120W specification rail tank cars for transport of LNG. Without this research, the use of DOT-113C120W rail cars must be denied.

NTSB urges PHMSA to require train crew separation from potential LNG release locations due to the particular properties of LNG. Odorless and colorless, those close to the source of release could be unaware of a release and could lack sufficient warning to protect themselves. Asphyxiation, freeze burn, and exposure to a fire and explosion can occur quickly and be fatal.[13] These properties mandate worker protections that cannot be ignored.

DRN points out that proximity to populations, occupied structures, sensitive environmental features and vulnerable operations/facilities must be considered based on LNG's properties. PHMSA's reference to some jurisdiction's codes that occupied structures can be as close as 50 feet from a railroad track illustrates the lack of adequate separation.[14] These features are all at risk due to the unique and highly dangerous properties of LNG releases, supporting the denial of the proposed rulemaking and PHMSA's Proposed Alternative.

NTSB states that large quantities of LNG can be released in a rail car derailment, warning "…such a release could be more severe than releases from cargo tank motor vehicles. Recent history with unit train shipments of ethanol and crude oil demonstrate how unprepared federal regulators were

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[10] Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., "Risk Assessment of Surface Transport of Liquid Natural Gas", *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. ES-9.

[11] Comment submitted by James D. Narva, Executive Director, National Association of State Fire Marshals to PHMSA re. Docket Number PHMSA-2018-0025 (HM-264) – LNG by Rail.

[12] Ibid.

[13] Ibid, p. 6. "Given the potential hazards of LNG when released, as described in the Exponent, Inc. quantitative risk analysis report and the NPRM regulatory analysis as including fireballs, flash fire, and explosions from ground-level vapor clouds that may vigorously expand far beyond the point of release to an ignition source, cryogenic material thermal exposure hazards, and asphyxiation hazards for a colorless and odorless gas that lack sufficient warning properties, the NTSB urges PHMSA to implement appropriate train crew separation distance requirements…"

[14] NJDOT, Pipeline and Hazardous Materials Safety Administration, Docket No. PHMSA-2018-0025 (HM-264) RIN 2137-AF40, Hazardous Materials: Liquefied Natural Gas by Rail, NPRM Preliminary Regulatory Impact Analysis, October 2019, p.43.

to address the spate of fiery flammable liquids accidents that occurred between 2009 and 2015 until regulations for HHFTs were published."[15]

The NPRM, the Preliminary Regulatory Impact Analysis and PHMSA's Risk Assessment discuss the known hazards of LNG, should the liquid be released from a container. Also examined are operational and material challenges such as the stress that containers undergo to hold the super-cooled LNG and the embrittlement of the materials holding it. It is well documented that catastrophic events can result from release of LNG.

One problem with these described potential disasters is the lack of acknowledgement of the potential for explosion of the vapor cloud even without an ignition source, if containment is present. The evidence of a BLEVE is also compelling but is not acknowledged. That type of incident must be assessed and taken into consideration by PHMSA.

New information has shown that LNG can cause a catastrophic BLEVE or Boiling Liquid Expanding Vapor Explosion if the vessel is exposed to high temperatures or a fire. The expansion of the liquid LNG in a vessel causes the pressurized liquid to boil, and the gas takes up more room than the liquid, stressing the container as pressure builds. Relief valves are only designed to release pressure slowly to keep equilibrium in the pressurized container. Exposed to high heat, the valve will fail to keep up and the metal will weaken, cracks will result in the container, causing LNG to be released with an explosion. The result is a BLEVE and a catastrophic failure of the container. There are many incidents over the years of BLEVE catastrophes, some as recent as 2019, but the fact that a BLEVE can occur with LNG has only recently been established.

When the gas or vapor cloud in the container is released, because it is flammable it is likely to ignite after the BLEVE, typically causing a fireball that burns fast, hot and wide. A fuel air explosion can also occur, known as a "vapor cloud explosion". A vapor cloud explosion is the mechanism used in a thermobaric weapon that uses air to generate a high-temperature explosion, producing a long duration blast wave. These weapons are also termed a fuel-air bomb. A BLEVE where there is no liquid in the local environment to absorb the heat can rupture even faster than a vessel on water. This is the threat that transport brings, in a rail car, truck or other type of container.[16] The potential impacts of a BLEVE resulting from a release of LNG during transport in DOT-113C120W specification rail tank cars must be fully assessed for this proposed rulemaking.

[15]National Transportation Safety Board, letter to U.S.D.O.T., RE. Docket No. PHMSA -2018-0025 (HM-264), d. 12.5.2019, p. 6.

[16] In 2002, an LNG truck in Spain flipped over, burned, then exploded into a 500-foot fireball that killed the driver and burned two others. 'The severity of this kind of explosion is something people haven't usually considered applicable to LNG trucks,' says Jerry Havens, former director of the Chemical Hazards Research Center at the University of Arkansas. 'But what happened in Spain changes that picture. It shows you've got the potential for a massive explosion'. In the accident in Spain, a BLEVE occurred, which resulted in death to the driver and burns to two people approximately 650 feet away, and threw large flaming debris, including the truck's diesel engine, for 853 feet. A similar LNG truck accident with a catastrophic fire occurred in Spain in 2011, killing the driver.

The DOT-113C120W rail tank car has a LNG capacity of ~30,680 gallons or up to 142,500 lbs. of LNG.[17] A typical "semi-truck" tank car holds 9,000 gallons and 80,000 lb. gross weight. [18] Tank trucks cars can hold up to 12,000 gallons of product.[19] According to PHMSA's Risk Assessment dated March 20, 2019, a truck with a cryogenic container can haul about 9,300 gallons of LNG; a rail car can hold approximately 30,000 gallons of LNG.[20] The Risk Assessment states in a different section of the report that a tank truck holds 10,943 gallons of LNG, which is equal to 0.9 million cubic feet of natural gas.[21] LNG expands to a gas 600 times larger than the volume of liquid that is contained. The potential for a large release with greater impact is more likely from a rail car carrying LNG than a truck carrying LNG. DRN does not support either of these modes of transport due to unresolved and unknown safety risks but there is no evidence presented to support PHMSA's conclusion that rail car transport is safer than truck transport.

One reason PHMSA offers for trucks being less safe is that there are reports made to PHMSA of truck accidents transporting LNG (8 reported between 2005 and 2017). PHMSA states, "While PHMSA understands there are limited rail shipments of Methane, refrigerated liquid, compared to highway transportation, PHMSA and FRA have no record of any reported incidents involving Methane, refrigerated liquid in portable tanks transported by rail since 2005."[22] It is patently ridiculous to conclude anything about the likelihood of derailments, accidents or releases of LNG transported by rail car without any meaningful statistical data. The fact is there is no data because there has been minimal transport of LNG by rail and no transport of LNG in DOT 113 rail cars is undeniable. The lack of data and research to support a conclusion that LNG can be safely transported by rail is a valid basis for denial of the proposed rulemaking and Proposed Alternative.

PHMSA has provided a look at the safety history of DOT 113 rail cars and discusses some incidents with other types of cargos or liquids. PHMSA concludes: "It is difficult to estimate the failure rate of the DOT-113 tank car in derailments because railroads are not required to report incidents to PHMSA or FRA unless they meet a baseline threshold. 49 CFR 171.16 and 225.19. Incident data suggests that incidents involving rail tank cars can lead to higher consequence incidents; however, PHMSA believes that rail transportation is advantageous considering the quantity transported compared to miles traveled."[23] The history is, by PHMSA's own admission, incomplete due to the threshold for reporting. PHMSA also admits higher consequence incidents can occur but dismisses that danger by saying less trips will be made. There is no factual basis presented for this conclusion, however.

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[17] http://files.chartindustries.com/14722936_LNG_Railcars.pdf

[18] https://en.wikipedia.org/wiki/Tank_truck

[19] CENAP-OP-R-2016-0181-39 -- Gibbstown Logistics Center Port Expansion, Supplemental Public Notice, 7.16.2019, p. 2.

[20] Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., "Risk Assessment of Surface Transport of Liquid Natural Gas", *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. 24.

[21] Ibid, p. 40.

[22] Notice of Proposed Rulemaking, U.S. DEPARTMENT OF TRANSPORTATION, Pipeline and Hazardous Materials Safety Administration, 49 CFR Parts 172 and 173, [Docket No. PHMSA-2018-0025 (HM-264)], RIN 2137-AF40, Hazardous Materials: Liquefied Natural Gas by Rail, p. 34.

[23] Ibid, p. 35-36.

In examining truck transport frequency and volume today, PHMSA's Risk Assessment states that there is "limited ability to capture current truck movements".[24] DRN points out that this once again calls into question the substantive data that proves a need for LNG to be transported by rail. Section 4 of the Risk Assessment analyzes the LNG supply chain, showing that of the 65.1 MMCF moved in 2016, trucks moved 0.004 percent.[25] Trucks are the mode of transport currently being used to deliver LNG domestically and much of the need is seasonal and dependent on very cold weather when regions such as New England need supplemental heating fuel. This is a very limited demand that cannot justify the risks posed by the large scale transport of LNG by rail cars that would be allowed under the Proposed Rulemaking and Proposed Alternative.

The information provided seems to show that this seasonal, occasional need is being adequately met by small truck movements, undermining the argument that there is need for quantities of LNG to be moved by rail. In discussion about the economic competitiveness of LNG using rail versus road, PHMSA's Risk Assessment states, "Over distances greater than 300 miles, rail transport of bulk materials becomes competitive with road, provided that the shipments are not time sensitive".[26] That is hardly a reasonable rationale for the huge investment that would need to be made by industry to manufacture the rail cars, make the investments necessary in operations and management, and gear up in myriad ways necessary to use rail cars for LNG transport, especially considering that the use of LNG domestically is usually time-sensitive, struggling to meet changing and labile weather conditions that dictate that market.

Further, the shipments overseas of domestic natural gas are very large volumes that do not, as a rule, use intermodal transport of truck or rail but are exported directly from the liquefaction plant to shipping vessels; most LNG liquefaction plants are located on waterfronts and coasts. DRN does not support LNG export facilities at any location due to public health, safety, and environmental considerations, but certainly, PHMSA fails to prove a need for rail transport from liquefaction plants across the nation. In the Risk Assessment, it is stated that LNG by rail "could provide duplication and redundancy".[27] Such cursory and limited purpose cannot justify the dangers involved.

This expansion of LNG surface transportation entails substantial and unwarranted threats. There is no evidence presented that there is stranded LNG waiting for rail transport, no unmet demand. The proposed rulemaking can be more accurately described as an attempt to assist an ailing natural gas industry looking for markets and a fresh raison d'etre; another way to induce more gas drilling and natural gas development. Yet the favor being shown to the special interests who will profit imposes heavy burdens on the public and environment. These impacts are discussed later in this comment.

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[24] Ibid, p. 38-39.

[25] Ibid, p. 38.

[26] Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., "Risk Assessment of Surface Transport of Liquid Natural Gas", *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. 50.

[27] Ibid, p. ES-5.

DRN has compiled a history of LNG accidents, shared in this comment as **Appendix A**.

Lack of Need, Weak Demand, Negative Economics

PHMSA has not provided a case for bona fide need for transport of LNG by rail. For instance, the framing of the proposed rulemaking assumes unbridled exponential growth of natural gas in the coming years to meet electricity generation demand. While the U.S. Energy Information Administration forecasts an increase of natural gas power plants and states such as Pennsylvania are permitting dozens of new natural gas-fired electric facilities, these forecasts are in many ways self-fulfilling prophecies. Many of the sources cited in PHMSA's Risk Assessment are "industry", who are certainly not independent analysts.[28] It is assumed by PHMSA that as other fossil fuels and nuclear generation are phased out, natural gas is the preferred, even inevitable, choice.

This is simply not true. This biased narrative by PHMSA ignores several realties: the growth and displacement of fossil fuel and nuclear energy sources by renewable, clean, less risky, greenhouse gas-free sources of energy; the lack of stability and reliability of the natural gas industry due to poor economic footing; and the increasing awareness by communities and decisionmakers of the enormous negative public health, safety, and environmental burdens imposed by natural gas development, making its future trajectory tenuous. These issues are outlined in the following section of comments.

Furthermore, the assumption that LNG exports will be in demand is also unfounded in light of the fierce competition for markets with foreign LNG generators and global politics that make these markets uncertain. The fact that there is currently an LNG glut and prices are "underwater" does not bode well for LNG's future viability as an export commodity.

Again, PHMSA's proposed rulemaking and their Risk Assessment frame the LNG market as an ever-expanding market, ignoring that there are highly competitive world resources that have been in place and in use for decades. In fact, that is why the U.S., until recently, was a net importer of LNG; the production of LNG by foreign nations is well developed. PHMSA's Risk Assessment verifies exports from Qatar, Australia, Malaysia, Nigeria, and Indonesia as top exporters, with the U.S. third from the bottom in terms of LNG export volumes.[29] Additionally, the proximity of point of origin/production to point of use is much more economically advantageous when overseas shipping is avoided or reduced, such as within continents. This is further discussed in these comments below.

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[28] For instance, The Cambridge Systematics Risk Assessment states, "Altogether, between exports and gas-fired generation, industry analysts predict just over 13 Bcf/d of new gas demand in 2022." Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., "Risk Assessment of Surface Transport of Liquid Natural Gas", *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. 13.

[29] Cambridge Systematics, Inc. *with* MaineWay Services, LLC, Rutgers University, Transport Analytics, LLC., ScienceSmith LLC., "Risk Assessment of Surface Transport of Liquid Natural Gas", *prepared for* U.S. DOT Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, 3.20.2019, p. 20.

From OilPrice.com: Nick Cunningham, "Shale Pioneer: Fracking Is An 'Unmitigated Disaster', OilPrice.com, June 24, 2019.

"Fracking has been an 'unmitigated disaster' for shale companies themselves, according to a prominent former shale executive: 'The shale gas revolution has frankly been an unmitigated disaster for any buy-and-hold investor in the shale gas industry with very few limited exceptions,' Steve Schlotterbeck, former chief executive of EQT, a shale gas giant, said at a petrochemicals conference in Pittsburgh. 'In fact, I'm not aware of another case of a disruptive technological change that has done so much harm to the industry that created the change.'[30]

"The message is not a new one. The shale industry has been burning through capital for years, posting mountains of red ink. One estimate from the Wall Street Journal found that over the past decade, the top 40 independent U.S. shale companies burned through $200 billion more than they earned. A 2017 estimate from the WSJ found $280 billion in negative cash flow between 2010 and 2017. It's incredible when you think about it – despite the record levels of oil and gas production, the industry is in the hole by roughly a quarter of a trillion dollars.

The red ink has continued right up to the present, and the most recent downturn in oil prices could lead to more losses in the second quarter."[31]

"Meanwhile, as the financial scrutiny increases on the industry, so does the public health impact. A new report that studied over 1,700 articles from peer-reviewed journals found harmful impacts on health and the environment. Specifically, 69 percent of the studies found potential or actual evidence of water contamination associated with fracking; 87 percent found air quality problems; and 84 percent found harm or potential harm on human health."[32]

From Wall Street Journal: Bradley Olson and Rebecca Elliott, "Frackers Face Harsh Reality as Wall Street Backs Away", Wall Street Journal, Feb. 24, 2019.

"But in 2016, federal regulators concerned about banks' exposure to shale drillers tightened standards for lending to oil-and-gas companies after dozens went bankrupt amid the drop in commodity prices. The U.S. Treasury Department guidelines require lenders to regard loans as troubled if a company's total debt reaches more than 3.5 times a producer's earnings, excluding interest, taxes and other accounting items.
Many banks now prefer to keep operators below 2.5 times earnings, bankers and lawyers said. Still, 20 companies were at 2.5 times or higher in the third quarter, and the industry remained more indebted at that time than during the same period three years ago, according to S&P Global Market Intelligence."[33]

[30] https://oilprice.com/Energy/Energy-General/Shale-Pioneer-Fracking-is-an-Unmitigated-Disaster.html
[31] Ibid.
[32] Ibid.
[33] https://www.wsj.com/articles/frackers-face-harsh-reality-as-wall-street-backs-away-11551009601

An E and E News article quoted the Wall Street Journal and industry analysts saying that a glut of natural gas with few customers was causing a downturn in 2017. "Many investors were betting that new gas-fired power plants and a historic level of exports would help take care of excess supply. But that hasn't been the case in a market whose main drivers are weather and massive new supplies of shale gas."[34] This undermines the claim that the natural gas industry is economically viable and in need of expansion through the transport of LNG by rail.

From FreightWaves, American Shipper: Greg Miller, Senior Editor, "A massive floating LNG stockpile has just been unloaded", Nov. 18, 2019.
The news article reported on weak demand for LNG and ships from the United States that have become "floating storage" sailing the seas, looking for a buyer. "Exceptionally weak demand for liquefied natural gas (LNG), coupled with a surge in U.S. exports, led to an unprecedented bottleneck in global shipping flows in late October, according to S&P Global Platts".[35] 60% of the shipping vessels were from the United States.

"The massive liquid cargo logjam — which spawned a flotilla of fully laden vessels hunting for somewhere to unload — is a bearish sign for LNG demand, said Josh Zwass, managing director of LNG Analytics at S&P Global Platts, in an interview with FreightWaves."[36] "For LNG shipping demand, it's more of a mixed bag. On one hand, slow steaming and floating storage are positives for spot rates because they remove ships from the market. On the other hand, weak global demand for LNG is a bad omen for future shipping demand."[37]

The article goes on to discuss the reason for the weak demand for LNG, ending with, "Finally, numerous market prognosticators have pointed to an oversupply of LNG that could last through at least 2020. This could fuel future floating LNG storage simply because there's no place left to put the cargo. "A vessel is expensive but available [storage] capacity,' said Zwass, who emphasized, 'The global gas market is oversupplied and there's a struggle to consume it.'"[38] This is evidence that the demand for LNG is being far outpaced by a glut of the product, undermining the claim that there is a need for rail transport of LNG for export. Certainly, it is clear there is no justification for PHMSA to rush to increase LNG shipments overseas.

From Bloomberg: Vanessa Dezem, Mathew Carr and Anna Shiryaevskaya, "A Natural Gas Glut Grows in Europe and Prices Hit 10-Year Low", Bloomberg, Sept. 3, 2019
This article examines the falling price of natural gas in Europe and the over-abundance of LNG that is flooding the market. "Supplies continue to exceed demand. Inventories across northwest

[34] EENEWS, NATURAL GAS, "Supply glut reverses profitable gas trade", March 15, 2017, http://www.eenews.net/energywire/2017/03/15/stories/1060051489
[35] Greg Miller, Senior Editor, "A massive floating LNG stockpile has just been unloaded", FreightWaves, American Shipper, 11/18/2019. Retrieved from https://www.freightwaves.com/news/a-massive-floating-lng-stockpile-has-just-been-unloaded?p=236598.
[36] Ibid.
[37] Ibid.
[38] Ibid.

Europe, Italy and Austria hit 62.3 billion cubic meters, or 94% of capacity, on Aug. 28."[39] "The only way for European prices to recover would be to scale back flows from Russia or Norway or halt more arrivals of cargoes liquefied natural gas, said Norbert Ruecker, head of economics at Julius Baer Group Ltd."[40] Again, what's the rush to push LNG for export without basic safety controls and rail car testing?

From the New England Journal of Medicine: Landrigan et al., "The False Promise of Natural Gas", *The New England Journal of Medicine*. Massachusetts Medical Society, 2019.
Another fact that undermines the need for LNG transport by rail is the uncertainty of the industry's economic future considering its rapidly growing costs, including immediate and long-term societal costs, and its liabilities due to the dangers and harms that fracking is delivering where it and its operations occur. In summarizing this paper, DRN points out that the authors state that production of natural gas has grown by nearly 400% in the United States since 1950, and gas is now the country's second-largest energy source, mainly driven by fracking.[41] This sets up reliance on a shaky energy source, rife with problems that are inherent in the fracking process.

The dangers of fracking have been well documented, including explosions and fires at natural gas pipelines. In addition, the paper states that many fracking chemicals are toxic: 25% are carcinogens; 75% are dermal, ocular, respiratory, and gastrointestinal toxins; 40 to 50% have toxic nervous, immune, cardiovascular, and renal effects; 30 to 40% are endocrine disrupters.[42]

The paper states that the health effects from fracking impacts include lung cancer, asthma, COPD, cardiovascular disease, sleep disturbance, stress, and anxiety.[43] Fracking also exacerbates climate change. As much as 4% of all gas produced by fracking is lost to leakage, and these releases appear to have contributed to recent sharp increases in atmospheric methane. Methane is a potent contributor to global warming, with a heat-trapping potential 30 times greater than that of carbon dioxide over a 100-year span and 85 times greater over a 20-year span.[44]

Despite these dangers, fracking is continuing and its liabilities are expanding. The authors state that it does not make sense economically to continue fracking, as the Energy Information Administration estimates that by 2023 it will cost $36.60 per megawatt-hour to produce electricity from wind and $37.60 to produce solar energy, versus $40.20 to produce energy from gas.[45]

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[39] Vanessa Dezem, Mathew Carr and Anna Shiryaevskaya, "A Natural Gas Glut Grows in Europe and Prices Hit 10-Year Low", Bloomberg, September 3, 2019. Retrieved from: https://www.bloomberg.com/news/articles/2019-09-03/gas-prices-poised-to-fall-in-europe-as-producers-keep-taps-open.
[40] Ibid.
[41] Landrigan et al. (2019). The False Promise of Natural Gas. *The New England Journal of Medicine*. Massachusetts Medical Society. Retrieved from https://www.nejm.org/doi/pdf/10.1056/NEJMp1913663?articleTools=true
[42] Ibid. page 2.
[43] Ibid, p. 2.
[44] Ibid, p. 3
[45] Ibid, p. 3

The authors also point out that a recent study recommends that state and federal subsidies for natural gas be reduced over the next 2 years and then eliminated.[46] This will remove current prop-ups that are helping to artificially keep the industry going. Additionally, they recommend new residential or commercial gas hookups should not be permitted, new gas appliances be should removed from the market, further gas exploration on federal lands should be banned, and all new or planned construction of gas infrastructure should be halted.[47] At the same time, they recommend the EPA proposal to roll back limits on methane pollution should be blocked.[48]

Deregulation of the gas development industry (such as the removal of methane pollution limits) is a subsidy in itself, making it more profitable due to the removal of environmental requirements that do not make companies money. Today's federal administrative agencies and the President are catering to the industry to help make a case that it will expand and need to move LNG to fill growing demand. Extraordinary efforts are being made to force gas development and induce new markets to attempt to save a failing business model – a model that requires enormous resource consumption and leaves a legacy of pollution, environmental degradation and ruinous health effects. Deregulation and other "favors" to the gas industry unlevel the playing field amongst industrial sectors and give advantages to natural gas that are not enjoyed by most other industries or by competing renewable energy sources. Removal of subsidies and halting the rolling back of regulatory controls would bring the industry closer to reality and the economic hardships this resource-intense and expensive endeavor requires.

The authors also call for the creation of new tax structures, subsidies, and incentives such as carbon pricing that favor wind, solar power, and other nonpolluting, renewable energy sources and policies that support energy conservation, clean vehicles, and expansion of public transit.[49] They state that other countries and even states such as New York and Idaho have existing models in place for effective climate action and it would be beneficial for the entire United States to do its part.[50]

There are costs attached to natural gas development that are crippling to the industry and subvert the claim of need for LNG to be transported by rail car. The very future of natural gas is in question.

Climate change costs

The approval of the movement of LNG on the nation's railways will induce natural gas development, at least in the short term, and may also buoy the industry from economic collapse for a period of years. Unfortunately, even a short-term gas boom can have significant negative climate effects, especially when added to the years of emissions that have preceded; there is a price being paid now that will be exacerbated by more natural gas development. The potential consequences of this must be considered in this proposed rulemaking. PHMSA does not

[46] Ibid.
[47] Ibid.
[48] Ibid.
[49] Ibid.
[50] Ibid.

recognize any of the costs that will burden the public or the cumulative environmental costs that the Proposed Alternative will impose. Climate costs that accompany the Proposed Alternative must be fully assessed.

Of great importance to the nation's economic health and energy security are the costs of climate change. To effectively limit the devastating impacts of climate change, there must be a national-scale campaign to immediately take action. This means shifting from greenhouse gas-emitting energy sources – i.e. fossil fuels - to greenhouse gas-free energy sources – i.e. clean and renewable sources, energy efficiency and conservation - starting today. This is necessary to avoid the critical environmental tipping points that will not be able to be undone and to avoid and reduce the devastating impacts of climate change, including hazardous air pollution and disasters that routinely disproportionately harm poor, minority, and vulnerable populations across the nation and the globe.

Scientists in the most recent Intergovernmental Panel on Climate Change (IPCC) Report estimate that at least 45% - 50% reduction of greenhouse gases must be achieved by 2030 in order to effectively limit atmospheric warming. "Emissions need to be halved by 2030 to limit warming to 1.5 degrees Celsius but temperatures are on track to reach double that by the end of the century even if countries' current plans are fully implemented, research by scientists shows."[51] The IPCC Report says limiting warming to 1.5 degrees C will require reducing greenhouse gases by 45% from 2010 levels by 2030 and that there can be no carbon emissions from energy production by about 2050.[52]

We know the composition of natural gas is about 95% methane. Methane leaks or is vented or flared at all stages of the natural gas process (extraction/production, gathering, processing, transmission, storage, local distribution and consumption). Methane is 86 times more efficient than CO2 at trapping heat over a 20-year period and 34 times more efficient over a 100-year period.[53]

Natural gas is not a bridge fuel because methane is the most powerful greenhouse gas over the time scale during which reductions must be made – over the next two decades and particularly over the next 10 years. The proof of the ineffective strategy of replacing coal and oil with natural gas in terms of thwarting atmospheric warming can be found in recent tracking greenhouse gas reports: "However, energy-related carbon dioxide emissions were at a record high last year and new renewable power capacity has stalled after years of strong growth. At the same time,

[51] https://climateactiontracker.org/publications/warming-projections-global-update-dec-2018/

[52] *Intergovernmental Panel on Climate Change, Summary for Policymakers, Revised on January 2019 by the IPCC, Switzerland, ISBN 978-92-9169-151-7*, downloaded at: https://www.ipcc.ch/sr15/

[53] Myhre, G. et al. 2013. Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., D. Quin, G.K. Plattner, M.Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midglet (eds). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. and https://en.wikipedia.org/wiki/Global_warming_potential

methane, a more potent greenhouse gas than carbon dioxide, has risen in recent years due to oil and gas production, including fracking."[54]

To achieve accuracy in calculating the effect of methane on heating the atmosphere and subsequently feeding climate change, it is essential to consider the greenhouse gas impacts from methane from a full life cycle perspective. That means calculating the emissions from gas extraction wells, storage units, compressor stations, pipelines, gas processing facilities, including LNG processors, modes of transport such as truck, rail, and shipping vessels, transloading of natural gas, natural gas liquids, and LNG, and, finally end use. The planet's atmosphere is receiving emissions from these sources and more (such as orphan and abandoned wells); to not count all sources would result in inaccurate conclusions of the contribution of natural gas development to climate change.

Atmospheric methane levels rose steadily during the last few decades of the 20th century before leveling off for the first decade of the 21st century.[55] Since 2008, however, methane concentrations have again been rising rapidly. This increase, if it continues in coming decades, will significantly increase global warming and undercut efforts to reach the COP21 target of < 2 degrees C above the pre-industrial baseline by 2021.[56] Limiting warming to 1.5 degrees C will be even more difficult, if not impossible.

30% to 60% of the global increase in atmospheric methane between 2010 and 2014 was due to emissions in the lower 48 U.S. states and 63% of the increase in gas production over the past decade has been from shale gas.[57] Natural gas systems emit more anthropogenic methane than any other source in the United States, and are the third highest source for carbon dioxide emissions nationally.[58] Natural gas, considered "clean" or a "bridge fuel" is, in fact, a bigger problem than other fossil fuels due to uncontrolled and uncontrollable leaks, intentional flaring and venting. "Methane is far more potent than carbon dioxide in contributing to climate change. That makes it particularly harmful to the environment when it is discharged into the atmosphere. In the U.S. alone, the methane that leaks or is released from oil and gas operations annually is equivalent to the greenhouse gas emissions from more than 69 million cars, according to a Wall Street Journal analysis using conversion formulas from the Environmental Protection Agency and emissions estimates for 2015 published last year in the journal Science."[59]

The damaging changes that are already occurring and can be expected to occur in the near term are extremely costly. As the nation looks to meeting our energy needs in a way that engenders

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[54] https://www.insurancejournal.com/news/international/2019/06/19/529839.htm

[55] Howarth, R. (2019). Ideas and perspectives: is shale gas a major driver of recent increase in global atmospheric methane? *Biogeosciences* (16), 3033-3046. Retrieved from https://www.biogeosciences.net/16/3033/2019/bg-16-3033-2019.pdf

[56] Ibid.

[57] Dr. Robert Howarth, Cornell University, https://www.youtube.com/watch?v=1NPuYr1LGMI

[58] EPA 2016.Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014

[59] Wall Street Journal, *The Leaks That Threaten the Clean Image of Natural Gas*, https://www.wsj.com/articles/the-leaks-that-threaten-the-clean-image-of-natural-gas-11565280375

wealth and prosperity for the public, it becomes clear that avoiding the harms of natural gas development is essential. Switching to natural gas is counter-productive in terms of energy security and sustainability due to the unavoidable negative impacts that accompany methane emissions. Attempting to mitigate the harmful impacts of methane cannot be successful because the harms will always outpace the mitigation, especially in the 10 and 20-year time frame that is so critical.

Because of the potent global warming potential of methane, natural gas substitution for other fossil fuels does not avoid substantial damages to the economy, environment, and human health over the coming decades.[60] Rising air and water temperatures and changes in precipitation are intensifying droughts, increasing heavy downpours and flooding, reducing snowpack, and causing declines in surface water quality, with varying impacts across different regions of the country.[4] Changes in temperature and precipitation are increasing air quality and health risks from wildfire and ground-level ozone pollution. These impacts include an increase in heat-related deaths, allergic illnesses like asthma and hay fever, and vector-borne diseases such as Lyme disease from ticks.[61]

Climate change has already had observable impacts on biodiversity, ecosystems, and the benefits they provide to society. These impacts include the migration of native species to new areas and the spread of invasive species, which will worsen and could affect the ecological balance in the long term.[62] Yields from major U.S. crops are expected to decline as a consequence of increases in temperatures and possibly changes in water availability (drought conditions), soil erosion, and disease and pest outbreaks.[63] Expected increases in the severity and frequency of heavy precipitation events will exacerbate flooding and affect inland infrastructure in every region, including access to roads, the viability of bridges, and the safety of pipelines and other facilities.

The Fourth National Climate Assessment looks at the Northeast region climate impacts. These are among expected changes in the near term:

- Less distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and environments in ways that adversely impact tourism, farming, forestry, and other economies.[64]
- Warmer ocean temperatures, sea level rise, and ocean acidification threaten ocean habitats, ecosystem services, and livelihoods.[65]

[60] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp. Retrieved from https://nca2018.globalchange.gov/ at 14.
[61] Ibid, p. 15.
[62] Ibid, p. 16.
[63] Ibid, p. 16.
[64] Ibid, p. 116.
[65] Ibid, p. 117.

- Major negative impacts on critical infrastructure, urban economies, and nationally significant historic sites are already occurring and will become more common with a changing climate.[66]
- Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise.[67]

From Nature: Burke, M., Davis, W.M., & Diffenbaugh, N.S. (2018). Large potential reduction in economic damages under UN mitigation targets. *Nature*, Vol. 557, 549 – 557. Retrieved from https://www.nature.com/articles/s41586-018-0071-9.

The United Nations Paris Agreement increased the need for quantitative analysis of uncertainties in the costs and benefits of holding global warming to "well below 2 °C above pre-industrial levels" and pursuing a 1.5 °C target.[68] A 2018 Research Letter addresses this by examining the global and country-specific economic impacts of limiting warming to 1.5 °C relative to 2 °C, as well as the global impacts of projected warming under current mitigation commitments. The researchers used annual measurements of average temperature and growth in gross domestic product (GDP) per capita from 165 countries over the years 1960–2010.[69] Most response functions generated more negative global impacts at 2 °C than at 1.5 °C.

The results indicated that limiting warming to 1.5 °C instead of 2 °C by mid-century would lead to an increase in global GDP of 1.5%–2.0% and US $7.7–11.1 trillion in discounted avoided damages under a 3% fixed annual discount rate.[70]

The report states that meeting these targets at the end of the century was estimated to lead to median gains in global GDP per capita of 3.4% and discounted avoided damages of US $36.4 trillion.[71] Achieving the 1.5 °C target at mid-century (2046–2065) would lead to a 68%–76% chance of overall cumulative net benefit relative to 2 °C under a fixed 3% discount rate.[72]

Under the same discount rate, there was a 43%–53% chance of discounted cumulative benefits exceeding US $10 trillion and a 4%–8% chance of exceeding $30 trillion, which is about 40% of current global GDP.[73] For the end of the century (2081–2100), there was a >75% chance of net gain in per capita global GDP, an approximately 38% chance that benefits would exceed US $50 trillion, and an approximately 5% chance that benefits would exceed US $100 trillion.[74]

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[66] Ibid, p. 117.
[67] Ibid, p. 117.
[68] Burke, M., Davis, W.M., & Diffenbaugh, N.S. (2018). Large potential reduction in economic damages under UN mitigation targets. *Nature*, Vol. 557, 549–557. Retrieved from https://www.nature.com/articles/s41586-018-0071-9.
[69] Ibid, p. 549.
[70] Ibid, p. 550.
[71] Ibid, p. 550.
[72] Ibid, p. 550.
[73] Ibid, p. 550.
[74] Ibid, p. 550.

On a country scale, the researchers found that 71% of countries (approximately 90% of the projected global population) exhibited a >75% chance of experiencing positive economic benefits at 1.5 °C relative to 2 °C , and 59% of countries exhibited a >99% chance.[75] These countries include the three largest economies (the USA has a 76% chance of positive benefits; China 85%; Japan 81%).[76]

They also include a large fraction of the world's poorest countries, with the likelihood of economic gains rising rapidly at lower levels of GDP per capita.[77] In contrast, under current national global warming commitments (2.5 to 3 °C), there was a 15%–25% reduction in per capita output by 2100, and reductions of more than 30% for 4 °C warming.[78] These results therefore suggest that achieving the 1.5 °C target is likely to reduce aggregate damages and lessen global inequality, and that failing to meet the 2 °C target is likely to increase economic damages substantially.[79] The most vulnerable and poorest communities would suffer even more.

Health, community, and environmental costs

From ECONorthwest: "The Economic Costs of Fracking in Pennsylvania", May 2019. Available at: https://bit.ly/2JCO7yz

A study of the economic impacts of Unconventional Oil and Gas Development (UOGD) in Pennsylvania authored by ECONorthwest was published by Delaware Riverkeeper Network in May 2019. The report found annual costs of current fracking activity over $1 billion, with cumulative costs given continued fracking activity over the next 20 years of over $50 billion in net present value. This estimated annual cost is roughly equivalent to 0.3 percent of the state's Gross Domestic Product.[80] The report evaluated the health, community, and environmental costs of fracking in the state.

> "UOGD in Pennsylvania has transformed the state in a relatively short amount of time. While this boom is creating economic activity in the state, it is doing so by imposing large and long-term costs on residents on the state. If fracking continues at current rates, the economic, social, and environmental costs for Pennsylvania are estimated to be at least $54 billion over the next twenty years. Increases in the rates of fracking in the state will increase these costs."[81]

In addition to mounting and devastating health impacts and costly impacts to communities and other industries such as tourism and agriculture, there are costs associated with the environmental resources used and impacted by UOGD. These include but are not limited to: land changes; wetland, vernal pool, stream and river degradation; air pollution; water consumed for

[75] Ibid, p. 552.
[76] Ibid, p. 552.
[77] Ibid, p. 552.
[78] Ibid, p. 549.
[79] Ibid, p. 549.
[80] ECONorthwest, "The Economic Costs of Fracking in Pennsylvania", May 2019. Available at: https://bit.ly/2JCO7yz, E.S. p. vii.
[81] Ibid, p. 61.

fracking; water and soil contamination; bioaccumulation of contamination; healthy habitat loss such as forests, natural vegetation, land forms, geologic features; and in-water habitats for species; noise, light, and traffic impacts; infrastructure construction and operation; wastewater discharged from fracked wells; and community and social costs.

The report explains that other costs result from violations by operators in the fracking industry. Violations of permits and management practices that are not protective of the environment nor public health and safety have come with the rise of UOGD. For instance, in 2017 in Pennsylvania there were 821 violations at unconventional wells and 3,273 violations at conventional wells. Almost all (92 percent) of the unconventional well violations were environmental health and safety-related.[82] The number of unconventional well violations for all wells (821) exceed the number of unconventional wells drilled in Pennsylvania in 2017 (810) (Figure 11). Well violations occur for wells at all stages of its lifespan.[83]

The researchers found that many of these costs can be monetized but some cannot be "bought and sold". Nonetheless, these costs are real and paid for by those who are impacted, primarily the public. In many cases, there is no effort made to measure or limit the "externalized costs" of an activity and the costs are not included in a typical cost-benefit analysis but are nonetheless carried on the shoulders of the public - taxpayers, residents, workers, and generations yet to come. The report examines and evaluates all costs that can be accounted for, to provide a more accurate and unbiased view of the economic costs of UOGD, primarily "fracking" ["UOGD represent the activities involved with hydraulic fracturing, which allows access to "unconventional" oil and gas reserves that are not possible to extract without the horizontal drilling associated with hydraulic fracturing][84].

> "In the United States, it is estimated that the annual ecological costs of fracking are over $1.52 billion per year.[85, 86] This value includes the economic value associated with "ecosystem services" that are damaged by UOGD. Ecosystem services are the benefits that natural capital provides to people, such as carbon sequestration, flood mitigation, food security, recreation, and genetic diversity. These benefits are not bought and sold in markets, but economists derive and measure their value using various methods, including estimating the cost to replace the service with built infrastructure, asking people about their willingness to pay to protect or enhance services, and revealed social preference based on regulatory costs and government spending to sustain and protect scarce resources. UOGD directly impacts water and air resources, producing many of the health and community effects described in previous sections. It also affects the integrity of ecological systems, which in turn reduces the quantity and quality of terrestrial and aquatic habitat. People derive value both from the species that depend on the habitat, and from its

[82] Ibid, p. 14.
[83] Ibid, p. 14.
[84] Ibid, p. 1.
[85] The original 2015 values have been inflated to 2019 dollars.
[86] Moran, M. D., Taylor, N. T., Mullins, T. F., Sardar, S. S., & McClung, M. R. (2017). Land-use and ecosystem services costs of unconventional US oil and gas development. *Frontiers in Ecology and the Environment*, 15(5), 237–242. doi: 10.1002/fee.1492

aesthetic character. Greenhouse gas emissions impose costs on human communities now and in the future. Geologic destabilization produces increased risks to physical infrastructure."[87]

"The costs of fracking primarily affect vulnerable populations such as children, elderly, and low income people, due to economic inequities and health risks. If fracking in Pennsylvania increases, then the total costs will also increase since they are rooted in per-well estimates. If fracking in Pennsylvania decreases these costs will decline, although some impacts like the loss of habitat will take years to restore. Even if fracking in Pennsylvania were to cease today, legacy wells will continue to pose risks to local communities and the broader region from health, community, and environmental impacts."[88]

"In addition to the monetized costs, other economic costs should also be considered as resulting from UOGD in Pennsylvania. These non-monetized costs include:

- Increases in fatal traffic accidents, primarily in high well-density counties;
- Detrimental effects to the water resources of the state from the high volumes of fresh water and groundwater being used for extraction of natural gas;
- Long-term economic effects from lower educational attainment, primarily among men;
- Lack of economic resiliency from reliance on natural resource commodity subject to boom and bust economic cycles;
- Long-term health effects, including increased cancer rates;
- Environmental effects from the accumulation of chemicals and pollutants over time;
- Impacts to recreational hunters and fishermen due to declining wildlife populations;
- Fiscal risk to the state from inadequate bonding requirements which could transfer the costs of clean-up to the state;
- Loss of land for agriculture and recreation due to creation of well-pads and inadequate restoration once drilling is completed; and
- Perpetuation of reliance on U.S. energy on fossil fuels that delays and impedes transitions to renewable energy."[89]

"Hydraulic fracturing primarily impacts human health through the pathways of air quality, groundwater contamination, surface water contamination, occupational hazards, and soil/agricultural contamination. The drivers of this risk are the chemicals and materials used in the fracking process, as well as the subterranean materials brought to the surface through extraction. The support infrastructure to the fracking process including compressors, pipelines, and trucks also produces health impacts through air quality impacts, noise, and safety issues. The health effects of UOGD are exacerbated by leaks, improper storage, and negligence associated with natural gas infrastructure, as well as by the intensity of nearby operations.[90] Health effects that have been linked to fracking include

[87] ECONorthwest, "The Economic Costs of Fracking in Pennsylvania", May 2019. Available at: https://bit.ly/2JCO7yz, p. 44.
[88] Ibid, E.S. p. ix.
[89] Ibid, E.S. p. x.
[90] ProPublica. (2009). *Officials in Three States Pin Water Woes on Gas Drilling*. ProPublica. Retrieved from www.propublica.org/article/officials-in-three-states-pin-water-woes-on-gas-drilling-426.

> low birth weight, preterm births, infertility, asthma, respiratory diseases, cancer, liver damage, silicosis, cardiovascular diseases, migraines, anxiety, insomnia, depression, and other mental health problems.[91] The most commonly reported health symptoms of people living within one kilometer of a well include sleep disruption, headache, throat irritation, stress or anxiety, cough, shortness of breath, sinus problems, fatigue, nausea, and wheezing.[92]
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> Of the 685 papers published between 2008 and 2015 on fracking, 226 studies investigated the link between adverse health effects and fracking.[93] The exact causes of the illnesses are often unclear because of the unknown chemicals that are used in the fracking process.[94] In 2005, the U.S. Environmental Protection Agency (EPA) enacted regulations, commonly known as the Halliburton Loophole that exempts oil and gas companies from federal oversight under the Safe Water Drinking Act. This exemption means that oil and gas companies do not have to disclose the chemicals used in hydraulic fracturing production."[95]

The costs of climate change are examined in the report as well. These costs are directly relevant to the proposed rulemaking, even though some figures are calculated for Pennsylvania. Considering that Pennsylvania is the second largest producer of natural gas in the country and it is developing gas processing and end uses within its borders, its greenhouse gas emissions are substantial and contribute to the national problem of overproduction of greenhouse gases. The costs of climate change are directly relevant to the viability and security of the natural gas industry, undermining a false narrative of an energy source with a growing, beneficial future. The lack of benefits for the public and the environment thwart its expansion as problems multiply and compound and subvert the need for developing another mode of transport for LNG. The public and some regulators and policy makers are becoming more and more intolerant of the unmitigatable impacts. This is especially true for such a dangerous and untested Proposed Alternative, rushed through without LNG-specific controls and analyses.

> "The EPA has estimates for the value of social costs of GHGs, which represent the long-term costs based on damages due to GHG-caused changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs. The effects of climate change in Pennsylvania include changes in precipitation and

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[91] Concerned Health Professionals of New York & Physicians for Social Responsibility. (2018). *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction).*

[92] Weinberger, B., Greiner, L. H., Walleigh, L., & Brown, D. (2017). Health symptoms in residents living near shale gas activity: A retrospective record review from the Environmental Health Project. *Preventive medicine reports*, 8, 112-115.

[93] FracTracker Alliance. (2019). *Categorical Review of Health Reports on Unconventional Oil and Gas Development; Impacts in Pennsylvania.* FracTracker Alliance Issue Paper.

[94] Hays, J., & Shonkoff, S. B. (2016). Toward an understanding of the environmental and public health impacts of unconventional natural gas development: a categorical assessment of the peer-reviewed scientific literature, 2009-2015. *PloS one*, *11*(4), e0154164.

[95] ECONorthwest, "The Economic Costs of Fracking in Pennsylvania", May 2019. Available at: https://bit.ly/2JCO7yz, p. 18.

runoff that will increase flooding and drought, as well as increases in temperature and frequency of temperature extremes.264 Additionally, water resources will be impacted by sea level rise which could cause salt water intrusion to Delaware River Estuary water supplies, the drinking water source for millions of people. Salt water intrusion, floods, and droughts will also lead to loss of habitat and degradation of water quality. Agricultural costs and health costs are also anticipated to be large due to climate change in Pennsylvania. Using a three-percent discount rate, the social cost of carbon is $39, and the social cost of methane is $1,088.265.

Pennsylvania accounted for 19 percent of total U.S. marketed natural gas production in 2017. Applying that percentage to the total U.S. natural gas emissions for methane and carbon dioxide emitted in 2016 (the most recent data available*)."*[96]

"The estimated annual cost due to natural gas production in Pennsylvania are estimated as $1.3 billion for methane and $11.2 billion for carbon dioxide."[97]

"The EPA estimates that the social cost of GHGs will increase over time due to the cumulative effects. ***If Pennsylvania continues to produce a similar level of natural gas as in 2016, in twenty years that production is estimated to result in a social cost of methane of $28.4 billion and a social cost of carbon dioxide of $21.5 billion."*** These estimates for the social costs of GHG emissions are lower bound estimates. Research suggests that by 2025 GHG emissions from Pennsylvania's natural gas sector will be at least three times higher than emissions in 2012. Social costs of GHG emissions also increase over time as the cumulative level of GHGs in the atmosphere increases."[98]

Health Costs

The health costs of natural gas development are also jeopardizing the future viability of the industry. These cost are externalized costs that the public must bear even though they have not chosen to do so, in opposition to their and future generations' environmental rights. There is a growing recognition among health professionals, scientists and government agencies of the health impacts that are harming people who are exposed to natural gas development operations. PHMSA must consider these costs in its determination regarding the proposed rulemaking. The growing evidence of significant health costs that are demanding accountability from the industry cannot be swept under the rug. They must be realized in terms of the industry's future and its stability as a viable energy source.

From Fractracker Alliance: "Categorical Review of Health Reports on Unconventional Oil and Gas Development; Impacts in Pennsylvania", authored by Kyle Ferrar, Erica Jackson, Samantha Malone, Fractracker Alliance, May 2019. Available at: https://bit.ly/30kqe4u

"This infrastructure is increasingly encroaching on communities and residential areas. The Oil and Gas Threat Map, a joint project of FracTracker Alliance, Clean Air Task Force, and

[96] Ibid, p. 54.
[97] Ibid, p. 54.
[98] Ibid, p. 54-55.

Earthworks, estimated that 12.6 million people live within the half-mile threat radius of active oil and gas wells, compressor stations, and/or processing stations.[99] The proximity of homes to development has raised significant public health concerns and community resistance since communities started raising concerns of exposure to groundwater and air contamination, beginning in 2007 and 2008."[100]

"Of the 142 studies in our sample population (including 5 published in 2019), a total of 127 reports 89.4%) indicated a positive relationship of UOGD with health impacts. There were a total of 106 articles that published new, original research, with 104 focused on health impacts. Of these 104 articles, 94 indicated a positive relationship with health impacts (90.3%)."[101]

"Important Health Impact Findings:

- Cancer outcomes, including Non-Hodgkins lymphoma [62], and urinary bladder cancer [61]
- Impacts on pregnancy and development, including association with early infant mortality, pre-term birth, and poor infant health [24, 35, 36, 58]
- Impacts on mental health and well-being, including depression, self-reported stress, worry about health, and sleep disturbances [20, 43, 44]
- Pneumonia hospitalizations rates in elderly populations [49]
- Increased risk of asthma exacerbations [31, 33]
- Skin-related hospitalizations [50]
- General health symptoms, such as headache, fatigue, nasal and sinus impacts, and throat irritation [51, 60]
- Impacts on sexual health, in particular gonorrhea and chlamydia rates, which may be driven by demographic and population changes where unconventional oil and gas development occurs [47, 59]
- A Delphi study to determine adequacy of current setback distances from unconventional oil and gas development found that current distances do not protect public health [10]
- Radon concentration at wellheads is strongly correlated with production rate, and poses hazard to the public and environment [67]
- Risk assessment of residential exposure to contaminated drinking water from a modeled spill of flowback water poses cancer risk from radionuclide exposure and non-cancer risk from barium and thallium exposure [63]
- Risk assessment of exposure of contaminated drinking water from a spill of flowback water poses excess lifetime cancer risk and exposure to barium and lithium in drinking water pose non-cancer risk [64]
- Exposure to contaminants in unconventional oil and gas wastewater spread on roads, poses a health risk from release of salt, radioactivity and organic contaminants into the environment, at concentrations above drinking water

[99] *Oil and Gas Threat Map*. FracTracker Alliance, Clean Air Task Force, Earthworks.
[100] Fractracker Alliance, "Categorical Review of Health Reports on Unconventional Oil and Gas Development; Impacts in Pennsylvania", May 2019. https://bit.ly/30kqe4u p. 3.
[101] Ibid, p. 7.

standards. Toxicological studies indicated that the organic micropollutants in wastewater caused toxicity to aquatic organisms like Daphnia magna [65]
- Chemical characterization and toxicologic research of fracking fluids and wastewater pose the possibility of "toxicity to human organs, sensitization, irritation, developmental effects, and tumor promotion" [66]
- A modeled scenario of exposure patterns of volatile organic compounds (VOCs), particulate matter (PM) and diesel found periods of extreme exposure which correlate with the documented peaks in reported health complaints [68]"[102]

"Well pads and infrastructure degrade air quality, surface water quality, have the potential and have already contaminated groundwater sources as well. From the primary research conducted in the Marcellus Shale and specifically in Pennsylvania, we find that impacts are not just anecdotal or segregated to a particular region. Wherever there is a dense concentration of UOGD in the shale play, public health assessments are documenting community and environmental health impacts."[103]

"The sources of pollution are not limited to just oil and gas well pads either. Expansive infrastructure is necessary to support the transmission, processing and even petrochemical manufacturing that constitute the fossil fuel extraction economy. In addition to natural gas liquids (NGL) pipelines, cryogenic plants, and fractionation facilities in shale plays, plans for ethylene cracker projects are also in the works.

The international shale boom has depressed both oil and gas prices, but the decrease in natural gas prices has been most substantial domestically. As the price of natural gas continues to fall operators are looking for ways to balance profits. What materials were once considered production by-products – the longer chain hydrocarbon condensates, have become valuable raw materials for ethane production. Major operators such as Shell, Exxon, and BP have the capacity to make use of these byproducts. The Ohio River Valley is becoming a hot bed for new ethane "cracker" facilities, starting in Pennsylvania, leading to the development of a new major industrial corridor on the Ohio River[104]."[105]

"The results of this study indicate that a variety of health impacts in every major organ system are being experienced by individuals living near UOGD. Furthermore, these impacted communities clearly attribute declines in health to the presence of the oil and gas industry. Additionally, the epidemiologic studies with a longitudinal aspect that tracked the inclement growth of the industry show a response to increased development and additional drilling."[106]

[102] Ibid, p. 9.
[103] Ibid, p. 16.
[104] Jackson, E., *Ethane Cracker Project: Risks of Bringing Plastic Manufacturing to Ohio.* 2018: FracTracker Alliance. https://www.fractracker.org/2013/09/swpa-preta/.
[105] Ibid, p. 16.
[106] Ibid, p. 17.

From: Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction) Sixth Edition, June 19, 2019

The *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (*the Compendium*)* is a fully referenced compilation of evidence outlining the risks and harms of fracking.

> "In our review of the data, seventeen compelling themes emerged; these serve as the organizational structure of the Compendium. Readers will notice the ongoing upsurge in reported problems and health impacts, making each section top-heavy with recent data. The Compendium focuses on topics most closely related to the public health and safety impacts of fracking. These include risks from fracking infrastructure, including compressor stations, pipelines, silica sand mining operations, natural gas storage facilities, the manufacture and transportation of liquefied natural gas (LNG), and, for the first time, gas-fired power plants."[107]

From: *Nature Sustainability*. Mayfield et al., (2019). "Cumulative environmental and employment impacts of the shale gas boom", 2019.

> "The cumulative impacts over the boom-and-bust nature of the natural gas supply chain are still largely unexplored and unaccounted for in public and private decision-making. A new study analyzed the shale gas boom (and decline) in the Appalachian basin with respect to both reserves and production.[108]
>
> Impacts across the regional supply chain from preproduction to end use from 2004 to 2016 were modeled. It was estimated that 1,200 to 4,600 premature mortalities were associated with air pollutant emissions from shale gas activity between 2004 and 2016.[109] Annual mortalities (439) and damages ($3.7 billion) peaked in 2014, and air pollution damages from natural gas electricity generation are around 5% that of coal.[110]
>
> Methane emissions from natural gas-related sources within Pennsylvania, Ohio, and West Virginia (1.25 million tonnes in 2015) accounted for 10% of U.S. emissions, while carbon dioxide in these states (134 million tonnes in 2016) accounted for 9% of all emissions in the country.[3]
>
> End use processes contributed most CO2 (85%) emissions across the supply chain, with remaining emissions attributable to well development (2%) and fuel consumption for production, processing, transmission and distribution (13%).[3] Cumulative climate damages from natural gas activity over the period 2004 to 2016 range from $12 billion to 94 billion, depending on assumptions regarding social costs."[111]

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[107] Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction) Sixth Edition, June 19, 2019. http://concernedhealthny.org/compendium/

[108] Mayfield et al. (2019). Cumulative environmental and employment impacts of the shale gas boom. *Nature Sustainability*.

[109] Ibid, p. 2.

[110] Ibid, p. 3.

[111] Ibid, p. 4.

From: Pittsburgh Post-Gazette. The Southwest Pennsylvania Environmental Health Project. The Editorial Board, "Fear and frustration: Fuel for solving the Ewing sarcoma mystery", Pittsburgh Post-Gazette, 11.10.2019. The Southwest Pennsylvania Environmental Health Project, "EHP Addresses Childhood Cancer Issue in SWPA", THE YEAR IN REVIEW Term: Winter, Issue 5, Dec. 2019.

There is emerging evidence of childhood cancers in southwestern Pennsylvania, one of the most active and concentrated Marcellus Shale development regions in Pennsylvania. A shocking expose by the Pittsburgh Post-Gazette (PG) revealed an aggregation of childhood cancers in the region, many concentrated in one school district. The area has a concentration of natural gas extraction wells that employed fracking.

From the paper's Editorial: "In March, the PG documented six Ewing sarcoma cases within Canon-McMillan (comprising Cecil and North Strabane townships and Canonsburg) as well as an additional nine Canon-McMillan preschoolers and students who during the 2018-2019 school year had cancer. Those cases include two cases each of osteosarcoma (bones) and leukemia (blood), and one case each of liposarcoma (connective tissue), rhabdomyosarcoma (soft tissue), neuroblastoma (nerve cells), liver cancer and Wilms (kidney) tumor. Additionally, a teenage student died in February from astrocytoma, a brain and spinal cord cancer."[112]

The Southwest Pennsylvania Environmental Health Project YEAR IN REVIEW newsletter reported on the childhood cancer cases and the ongoing investigations, including Pennsylvania government-funded study. "In 2019, EHP found itself on the front line of a disturbing controversy surrounding the rise in childhood cancers in SWPA. According to a series published in the Pittsburgh Post-Gazette, there have been a total of 67 rare childhood cancers from 2008-2018 in 4 SWPA counties, including a total of 27 cases of a rare bone cancer, Ewing sarcoma (ES). In the last decade, 6 children in the Canon-McMillan School District alone have been diagnosed with ES. At least 10 additional children attending this school district have been diagnosed with other rare cancers during the same time period."[113]

The fallout from the investigation that is now underway may impact the region that is one of two most productive natural gas producing areas in the Commonwealth. Obviously, the tragedy that is unfolding in this part of the shale play will have far-reaching effects should a connection be found between the cancers and fracking and natural gas operations. These findings directly affect the viability of natural gas as an energy source.

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[112] The Editorial Board, "Fear and frustration: Fuel for solving the Ewing sarcoma mystery", Pittsburgh Post-Gazette, 11.10.2019. Retrieved from: https://www.post-gazette.com/opinion/editorials/2019/11/10/Ewing-sarcoma-cancer-mystery-fear-frustration/stories/201910240049. Further information at: https://newsinteractive.post-gazette.com/ewing-sarcoma-cancer-cluster-pittsburgh-washington-westmoreland/

[113] The Southwest Pennsylvania Environmental Health Project, "EHP Addresses Childhood Cancer Issue in SWPA", THE YEAR IN REVIEW Term: Winter, Issue 5, December 2019. Retrieved from: https://www.environmentalhealthproject.org/sites/default/files/assets/resources/winter-2019-newsletter.pdf.

In conclusion, Delaware Riverkeeper Network disagrees with PHMSA's proposed finding that the proposed regulations allowing the transport of LNG via DOT-113C120W tank car will not result in a significant environmental impact. There are significant environmental, public health, and safety impacts that will occur if the proposed regulations and the Proposed Alternative are adopted.

For this reason, DRN opposes the proposed Hazardous Material Regulation changes and calls for the denial of the proposed rulemaking and the Proposed Alternative.

Thank you for the opportunity to comment.

Respectfully submitted,

Maya van Rossum
the Delaware Riverkeeper

Tracy Carluccio
Deputy Director

Imbedded Attachment: DRN Appendix A

APPENDIX A

History of LNG Incidents
December 2019

1. History of LNG Accidents[114]

- *The Cleveland Disaster, U.S.* 1944. The very first commercial LNG facility built in the United States in 1941, caused a major industrial accident known as the "The Cleveland Disaster." Where, in 1944, according to the U.S. Bureau of Mines report, LNG holding tanks failed and released their contents into the streets and sewers and their vaporous cloud ignited and fire engulfed the nearby residents and commercial establishments. LNG destroyed 79 Homes, 2 Factories, 217 Cars, 7 Trailers, Left 680 Homeless, Injured 225 and Killed 131. The fiery LNG inferno devastated one square mile of Cleveland, Ohio.
- *Methane Princess* Spill, 1965. The LNG discharging arms on a vessel which were disconnected before the liquid lines had been completely drained – caused another LNG accident
- *Jules Verne* Spill, May 1965. Failure of the liquid level instrumentation – caused another LNG accident
- La Spezia, Italy, 1971. Phenomenon called rollover, where two layers of LNG having different densities and heat content are allowed to form back flow of natural gas from the compressor to the nitrogen line – caused another LNG accident
- Montreal East, Quebec, Canada, 1972. Explosion occurred in the LNG liquefaction and peak shaving plant of Gaz Metropolitan in Montreal East, Quebec. The accident occurred in the control room due to a back flow of natural gas from the compressor to the nitrogen line.
- Staten Island Tank Fire, USA, 1973. A fire erupted at an out-of-service LNG tank that was being repaired. Forty workers then inside the tank were killed. LNG, which had leaked through the liner during previous fillings, had accumulated in the soil below and around the concrete tank wall berm. It has been assumed that an electrical spark in one of the irons or vacuum cleaners ignited the flammable gas reentering the tank.
- Massachusetts Barge Spill, July 1974. After a power failure and the automatic closure of the main liquid line valves, a small amount of LNG leaked from a 1-inch nitrogen-purge globe valve on the vessel's liquid header - pressure surge caused by the valve closure induced the leakage of LNG – caused another LNG accident
- *Aquarius* Spill, September 1977. Difficulties in the liquid level gauge system – caused another LNG accident
- Das Island, United Arab Emirates, March 1978. Failure of a bottom pipe connection of a LNG tank– caused another LNG accident
- Cove Point, Maryland, 1979. LNG leak from a high-pressure pump found its way into an electrical conduit – caused another LNG accident
- *Mostafa Ben Bouliad* Spill, April 1979. A check valve in the piping system of a 125,000 cubic meter vessel failed – caused another LNG accident
- *Pollenger* Spill, April 1979. Leaking from a valve gland – caused another LNG accident

[114] https://www.timrileylaw.com/LNG.htm

- Bontang, Indonesia, 1983. Rupture of a heat exchanger in an LNG plant and resultant explosion – caused another LNG accident
- Nevada Test Site, Mercury, NV, 1987. An accidental ignition of an LNG vapor cloud occurred at the US Department of Energy (DOE) Nevada Test Site in August 1987.
- *Bachir Chihani,* Hull Cracking, 1990. Inner hull fracture occurred in a 130,000 cubic meter vessel at a part of the ship's structure that is prone to the high stresses that accompany the complex deflections that the hull encounters on the high seas – caused another LNG accident
- *Mediterranean Off Gibraltar, Minor LNG Carrier "Collision," November 13, 2002.* LNG carrier Norman Lady was struck off Gibraltar by the USS Oklahoma City, a Navy nuclear submarine. Minor damage to both vessels was caused by submarine periscope. The company said the vessel, had already unloaded its LNG cargo in Barcelona, Spain.
- *Algeria, LNG Facility Explosion, January 19, 2004.* LNG port facility designed to load only small LNG Tankers for short distances exploded; death toll: 27; workers injured: 74; blast felt miles away; facility destroyed; fires raged for 8 hours; property damage: approx. $ 1 Billion; cause: (initially believed: "defective boiler" which had earlier received "superficial repairs;"); insurance investigation determined cause: liquefied natural gas leak in pipe
- *Trinidad Tobago,* June 13, 2004. LNG turbine explodes, workers evacuated. Scores of workers had to be evacuated after a gas turbine at Atlantic LNG's Train 3 facility exploded. *Details Still Unfolding...*
- *Belgium,* July 31, 2004. Fluxy's LNG gas pipeline explosion kills 15 in Belgium. It was the deadliest gas blast in Belgium since 1967, when a tanker truck carrying liquid gas blew up, killing 22 people. "Debris from the initial explosion was found up to four miles away" (BBC video)
- *Norway,* September 20, 2004. LNG tanker adrift north of Bergen. A fully loaded LNG tanker with a crew of 14 was adrift west of Fedje, on the west coast of Norway, north of Bergen. The ship's engines had stopped, and the anchors were useless in the stormy weather. Tugboats could not get the tanker undertow until the ship was only 30 yards from hitting rocks. There was strong wind and bad weather conditions in the area, and preparations were made to evacuate the 800 persons living on the island of Fedje, for fear that the tanker would explode if it grounded, NRK reports.
- *USA, March 2005.* LNG Causes Pipeline Leaks and house explosion. On July 7, 2005, a company-sponsored study, launched after a District Heights house exploded in late March, found that subtle molecular differences in the imported liquefied natural gas the utility began using in August 2003 were drying the rubber seals of aging metal couplings that link sections of pipe. The breakdown of seals in the couplings of gas pipelines led to about 1,400 gas leaks during the past two years, and has required the company to launch a $144 million project to replace lines and equipment. Two other house explosions in the area are now under investigation.
- *Nigeria, August* 2005. 28-inch Liquefied Natural Gas underground pipeline exploded - Wild inferno engulfed an estimated 27 square kilometers. Eleven persons are feared missing and aquatic life completely destroyed when a 28-inch Liquefied Natural Gas underground pipeline exploded at Kalakama, an Ogoloma fishing community in Okrika Local Government Area of Rivers State. The incident, which occurred at the weekend, resulted in a wild inferno that engulfed an estimated 27 square kilometers of the once rich Kalakama

mangrove, killing seafoods and cash crops. So huge, the impact of the explosion was felt on the Okrika Island and the Borikiri area of Port Harcourt where, residents were forced into a stampede for safety. Nigeria LNG pipeline explosion

- *India, September 17, 2005*. Winds just over a mere 40 knots led to an accident at Petronet LNG Ltd.'s terminal at Dahej when the tugboats of LNG carrier "Disha" hit Dolphin Piles of the jetty. The LNG ship was casting off after unloading the cargo. Petronet LNG Ltd.'s is evaluating the extent of damage. Mishap at Dahej LNG unit, supply hit
- *Savannah, GA March 14, 2006.* A potentially disastrous spill was averted early Tuesday morning when the liquefied natural gas tanker Golar Freeze discharging its load at the Southern LNG terminal on Elba Island broke from its moorings and pulled away from the pier. The dock was shut down for about 36 hours while representatives from the Coast Guard and an LNG engineer from the Federal Energy Regulatory Commission investigated the incident. Near-miss shuts down LNG imports on Elba
- *Trinidad & Tobago May 18 & May 21 & June 6, 2006.* Fire at LNG Plant - "YET another blowout has occurred at Atlantic LNG in Point Fortin. On Tuesday, fire broke out at the base of a Flame Pole when a seal broke loose. The incident that occurred around 8.30 pm did not result in any injuries to employees or damage to the plant. According to a report from the Point Fortin sub-fire station, the seal popped and fire shot out. An employee nearby alerted a safety officer who quickly extinguished the fire. On May 21, Atlantic LNG employees had to evacuate the plant after a plug blew out and struck an employee in the chest. Three days before that incident, Train 11 plant had to be shut down for six hours when a natural gas leak was discovered in a two-inch pipeline." FIRE AT LNG PLANT Trinidad News, Trinidad and Tobago
- *Ship carrying liquid gas burns off Jordan July 13, 2006.* "AMMAN, Jordan -- A tanker carrying liquefied natural gas caught fire as it unloaded Thursday in Aqaba, injuring 12 people, the manager of the Jordanian Port Said. Four of the injured were firefighters, who needed an hour to bring the blaze under control, said Awwad al-Maaytah, the director general of Aqaba Port Authority. The other injured were crewmembers. The ship was promptly evacuated and towed away from the pier in the Red Sea port having unloaded only half of its cargo. Al-Maaytah said the cause of the fire was under investigation." Seattle Post Intelligencer. Jordan Liquid-Gas Ship Mishap Injures 19
- *LNG Tanker Adrift Off Cape Cod Needs Rescue February 11, 2008.* Coast Guard and tugboat crews rescued a liquefied natural gas tanker crippled off Cape Cod after many hours of drifting at sea at the mercy of powerful winds and high waves. Just 5-years-old, the fully laden LNG carrier was corralled by four tugboats about 25 miles east of Provincetown. Apparently, about 3 a.m. Monday its propulsion system shut down because of a computer malfunction according to the Coast Guard. The 933-foot Spanish-flagged LNG tanker Catalunya Spirit was heading from Trinidad to the LNG facility in Everett. 2/15/08. After several days of troubleshooting, repair specialists determined a malfunctioning boiler feed pump, which supplies water to the main propulsion boilers, caused the Catalunya Spirit's loss of power and propulsion. Captain of the Port of Boston reviewed and approved the final repair certification presented by Lloyd's Register and Teekay Corporation. The LNG delivery through Boston Harbor was cancelled.
- *Washington, March 31, 2014* U.S. LNG Explosion "Early Monday, a "processing vessel" at the Williams facility near the small town of Plymouth, Washington, exploded, spraying

chunks of shrapnel as heavy as 250 pounds as far as 300 yards, according to local emergency responders.

- The flying debris pierced the double walls of a 134-foot LNG tank on site, causing leaks. Five workers were injured, and local responders warned that vapors from the leaks could trigger a more devastating, second explosion. A county fire department spokesperson said authorities were concerned a second blast could level a 0.75-mile 'lethal zone' around the plant.
- Everyone within a two-mile radius of the site was evacuated..."

2. On June 21, 1970 in Crescent City, IL, 16 railcars derailed and 10 of them contained 34,000 gallons of liquid propane. As a result of the derailment, one of the propane tank cars was punctured by a coupler of another car, causing a leak that ignited almost immediately, engulfing the other nine derailed propane cars. Flame impingement on the uninsulated tank cars caused an increase in pressure inside the tank cars from impingement on the liquid space. Impingement on the vapor space caused weakening of the steel that resulted in the BLEVEs (boiling liquid expanding vapor explosions) that occurred. Flames reached several hundred feet into the air and a nearby house and business were set on fire by radiant heat. The heat from the incident could be felt from three blocks away. A total of 66 people (fire, police and press personnel) were injured by the explosions and 11 required hospitalization.[115]

3. On June 22, 2002, an LNG tanker truck near Tivissa, Spain lost control on downhill section of the road, probably due to speeding. The truck flipped over on its left side and immediately ignited in flames. The flames grew and burned for 20 minutes before the tank violently exploded. The explosion broke the tank and the truck into several pieces, distorting some of them considerably, ejecting them over considerable distances and causing a pressure wave. The driver died and two people 200 meters away were burned.[116]

4. On January 19, 2004, the Skikda LNG plant in Algeria exploded and set off a chain reaction that damaged surrounding structures and facilities — including a nearby power plant, one of the berths at the Skikda harbor, and numerous homes and other buildings in the community. At least six people died instantly in the explosion. The shockwave leveled the maintenance, security and administrative buildings nearby, trapping workers under the debris. The force of the blast overturned security vehicles and ambulances that were parked near the facilities, and the heat was so intense that it melted the vehicles' metal structures. Several people died in the ensuing fire, with some reportedly trapped by a chain-link fence that surrounded a fire-engulfed area.[117]

5. On June 29, 2009, a 14-car train carrying liquefied petroleum gas (butane, propane) derailed and crashed into nearby neighborhood in Viareggio, Italy. The train exploded, collapsing five

[115] https://www.firehouse.com/home/article/10467137/crescent-city-train-derailment-40-years-later
[116] https://www.academia.edu/7741565/Explosion_of_a_road_tanker_containing_liquified_natural_gas
[117] https://us.evershedssutherland.com/mobile/portalresource/lookup/poid/Z1tOl9NPluKPtDNIqLMRV56Pab6TfzcRXncKbDtRr9tObDdEuW3Cu0!/fileUpload.name=/PGJLNG.pdf

buildings and setting fire to the surrounding area. At least 12 people were killed on 50 injured in the blast.[118]

6. On October 20, 2011, an LNG tanker truck in Murica, Spain, collided with another vehicle that was stationary on the side of the road. A fire started immediately, igniting plastic and rubber materials and the fuel tank that which finally engulfed the cargo tank. The cargo tank was of a single wall construction with polyurethane insulation and aluminum cladding. The inlet and outlet pipes for both liquid and gas were fitted with valves flush with the tank wall but there were other connections from the tank leading to the exterior. One of these connections was broken as a result of the accident and this allowed the tank contents to leak and feed the fire. The fire was burning for 71 minutes at which time the tank exploded and collapsed. The fireball that resulted was ~100 meters high with a radius of ~75 meters. Further damage was caused by thermal radiation, a pressure wave (broken windows at a nearby gas station) and debris being thrown over a distance of 200 meters. The driver of the tanker was killed in the explosion.[119]

7. On March 31, 2014, gas processing equipment at Plymouth LNG in Washington exploded into a towering, mushroom-shaped cloud. Nearby residents saw flames shoot into the air, and people living three to six miles from the plant could feel the explosion. The blast sent 250 pounds of debris and shrapnel flying as far as 300 yards, damaging buildings and equipment and puncturing one of the large LNG storage tanks. Shrapnel injured four of the fourteen employees on duty, and a fifth worker was hospitalized for burns.[120]

8. In 2018, about 0.6 Bcf of U.S. LNG exports were by truck to Canada and Mexico, with 97% going to Mexico.[121]

9. The rail incident rate per mile is approximately five times higher than the rate for road tankers.[122]

10. There have been two accidental releases of cryogenic liquids approved for U.S. rail transport in DOT-113 tank cars in the past 16 years.[123]

11. However, there is a low quantity DOT-113 tank cars carrying LNG, which lowers the accident rate. In 2015, there were under 13,000 carloads of product moved using DOT-113 tank cars. To put that in perspective, according to a 2014 AAR document, U.S. railroads were transporting 9,500 carloads of crude oil in 2008 but by 2013, that number skyrocketed to 407,761 carloads.[124]

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[118] https://www.theguardian.com/world/2009/jun/30/train-crash-viareggio-lucca

[119] https://www.gti.energy/wp-content/uploads/2018/12/Safety-4-Juan_M_Bonilla-LNG17-Poster.pdf

[120] https://www.sightline.org/2016/02/08/how-industry-and-regulators-kept-public-in-the-dark-after-2014-lng-explosion-in-washington/

[121] https://www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php

[122] https://www.exponent.com/knowledge/alerts/2015/08/bulktransportation/~/media/03b73782ec76446798c70f6ac403ef84.ashx

[123] https://fortune.com/2019/04/11/trump-natural-gas-ship-rail/

[124] https://www.desmogblog.com/2019/04/17/trump-executive-order-lng-rail-bomb-train-risks

12. Derailments involving DOT-113 tank cars can result in large quantities of hazardous materials released, which can result from venting or breach of the inner tank shell.[125]

13. A “roll-over” in an LNG tank can occur if the liquid at the bottom becomes lighter than that at the top, and rapidly rises to the surface. The liquid that moves to the top of the container experiences a drop in pressure equal, to a first approximation, to the head of liquid. It may therefore be above its boiling point at that pressure. In such an event, the vapor pressure within the tank may be as high as the liquid pressure at the bottom of the tank, whence the liquid came, and so the resulting pressure spike might overwhelm the pressure relief systems in place and if pipe work is not designed, constructed and maintained to cope with these, then they might fail.[126]

14. There were 73 incidents involving cryogenic ethylene DOT-113 tank cars between 1977 and 2015 reported by PHMSA. Of these 73 incidents, only 5 were listed as “HMS Serious Incident.” Of the 5, 3 included one incident in Moran, KS in which three DOT-113 tank cars containing liquid ethylene derailed and burned. The incident in Brunswick, MD was due to a broken line in the piping cabinet. Another incident resulted from loss of vacuum in the annular space, due to a failure in the outer tank. After reviewing the description of each incident, several are related to venting from residue cars. In these cases, a 15 psi (20 percent) increase in the start-to-discharge pressure of the main safety relief valve could have a significant benefit by reducing the number of times cars vent and the amount they vent. There are no reports of inner vessel punctures. In some cases, railcars may be delayed in transit or on a siding or at a plant location. In these situations, there is a chance of venting or the need to flare gas to maintain vapor pressures within acceptable limits.[127]

15. On May 23, 2011, three DOT-113 tank cars containing liquid ethylene derailed and caught fire near Moran, KS. No injuries were reported.[128]

[125] https://www.federalregister.gov/documents/2019/10/24/2019-22949/hazardous-materials-liquefied-natural-gas-by-rail
[126] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106029/jrc106029_online.pdf
[127] https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/research-and-development/hazmat/reports/71651/fr2-phmsa-hmtrns16-oncall-20mar2019-v3.pdf
[128] https://kansaspublicradio.org/kpr-news/train-derailment-sparks-grass-fire-allen-county