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Ineos' Chequered Environmental Track Record in Europe

The petrochemical company Ineos is transforming into a dominant UK fossil fuel firm with oil and gas extraction, storage, processing and pipeline assets. Since its 1998 inception, Ineos has rapidly assembled a sprawling corporate empire by snapping up chemical factories and companies. But it also has garnered a chequered environmental record in its aggressive climb to become one of the world's largest chemical conglomerates.

Ineos' current drive to use hydraulic fracturing, known as fracking, to drill for shale gas across the UK brings into sharp focus the company's questionable environmental record. In 2014, Ineos announced a planned £640 million investment to "kick-start a shale gas revolution", according to *The Guardian*.[1] By 2017, Ineos was by far the biggest holder of UK shale licences.[2] Fracking injects large volumes of water, sand and chemicals deep underground, at extreme pressure, to create fractures in targeted rock formations to release the oil and gas.

Fracking has become an internationally recognised threat to human and planetary health and safety. In 2012, the United Nations Environment Programme (UNEP) issued a "Global Alert" on fracking. According to UNEP hydraulic fracking may result in "unavoidable environmental impacts", even if unconventional gas is extracted properly.[3] In the United States, the fracked gas and oil industry has polluted the water supplies of heavily drilled communities, produced massive volumes of toxic waste, caused earthquakes and imperiled vital aquifers from poorly constructed gas wells; meanwhile, oil and gas operations have become the second greatest global source of the potent greenhouse gas methane, threatening the climate and the planet.[4]

Ineos downplays the environmental risks of fracking, despite the fact that the company has never drilled a producing oil or gas well in the UK.[5] Ineos has operated chemical plants for nearly two decades, but in that short time many of its facilities have been bedeviled by environmental problems. Its dozens of manufacturing facilities across Europe have been responsible for releases of toxic chemicals, leaks, fires and explosions that have endangered workers, communities and the environment.

Food & Water Europe examined Ineos' European environmental record, including government and media reports of its plants in the UK, Belgium, France, Germany, Italy, Norway and Sweden, and found that many of the facilities had accidents, safety lapses,

chemical leaks, substantial pollutant releases and even fires and explosions, including:

- **United Kingdom:** Ineos' Grangemouth plant in Scotland has repeatedly received poor environmental assessments for "unabated emissions" and accidental discharges, has received a string of workplace safety notices and has had a series of safety lapses that have leaked oil and gas.
- **Germany:** Ineos' Cologne complex was the site of a towering industrial fire in 2008 and has repeatedly activated emergency safety equipment to accommodate over-pressurisation that has released smoke and even sent workers to the hospital on at least one occasion.
- **Plastic pollution:** Ineos has admitted that its manufacturing is the likely source of plastic pellets that have washed up on beaches near its plants in Italy, Norway and Scotland.
- **Sweden:** Ineos kept a plastics pressure vessel in operation months after regulators demanded that it be shut down for failing to meet safety standards.
- **Accidents:** Ineos plants have had accidents including leaks (oil in Norway, naptha in France and hydrochloric acid in Italy), fires (Belgium, France and Norway) and a release of the toxic gas boron trifluoride that sent workers to the hospital (Belgium).

There is too much at stake to allow a company with Ineos' dubious environmental track record to pursue fracking for shale gas. The European Union (EU) and UK should be charting a course for a clean, renewable future, not allowing companies to relentlessly pursue a fossil-fuelled race for profits that imperils communities, workers and the environment.

Introduction

From its 1998 founding, Ineos has grown to be one of the top five global chemical companies — behind only industry titans like BASF and Dow Chemical.[6] By mid-2017, Ineos had 71 manufacturing facilities and dozens of sales offices with over 17,000 workers in 18 countries across Europe, North America and Asia, with a substantial footprint in the UK (see Map 1).[7]

Ineos manufactures an array of chemicals and products, largely refined and processed from oil and natural gas.[8] The company's refineries, crackers, chemical plants and manufacturing operations produce

MAP 1: Ineos Manufacturing Sites in Europe

Table 1. European Chemical Authority assessment of chemicals used by Ineos[11]

Chemical	Flammability	Human health risk
acetone	highly flammable	causes serious eye irritation
acetonitrile	highly flammable	harmful if swallowed or inhaled
ammonia	flammable	toxic if inhaled
benzene	highly flammable	may cause genetic defects or cancer
butadiene (1,3-butadiene)	extremely flammable	may cause genetic defects or cancer
ethylene	extremely flammable	
hydrogen cyanide	extremely flammable	fatal if swallowed, inhaled or comes into skin contact
propylene oxide (2-methyloxirane)	extremely flammable	may cause genetic defects or cancer
vinyl chloride (chloroethylene)	extremely flammable	may cause cancer; suspected of causing genetic defects; harmful if swallowed

plastics, coatings, lubricants, solvents, acids and more.[9] The Ineos plants handle, process and manufacture many chemicals that can be dangerous, toxic, volatile and explosive, including acetone, acetonitrile, ammonia, benzene, butadiene, ethylene, hydrogen cyanide, propylene oxide, vinyl chloride and more (see Table 1 and Appendix Table A on page 18).[10]

Petrochemical and plastics manufacturing plants emit massive amounts of air and climate pollutants including polycyclic aromatic hydrocarbons, carbon dioxide, particulate matter, ozone-creating volatile organic compounds (VOCs, such as benzene and toluene) and nitrogen oxide.[12] Exposure to petrochemical facility pollutants is associated with heightened cancer risks, acute irritative symptoms (such as nausea and eye and throat irritation) and respiratory-related illnesses, especially for children.[13]

Ineos admits that "risks are inherent in the chemical and petrochemical businesses, particularly risks associated with safety, health and the environment…".[14] The company delineates a long list of hazards that can include:

> [E]xplosions, fires, severe weather (including but not limited to hurricanes on the U.S. Gulf Coast or other adverse weather that may be increasing as a result of climate change) and natural disasters, accidents, mechanical failures, discharges or releases of toxic or hazardous substances or gases, transportation interruptions, human error, pipeline leaks and ruptures and terrorist activities. These hazards can cause personal injury and loss of life, severe damage to or destruction of property and equipment as well as environmental damage.[15]

Ineos is now transforming itself from a chemical company into a formidable fossil fuel force in the UK. Ineos' founder and CEO, Jim Ratcliffe, claimed he wanted Ineos "to become the biggest player in the UK shale gas industry".[16] By 2017, Ineos held exploration licences covering over 1.2 million acres in Cheshire, East Midlands, South and North Yorkshire and Scotland and hoped to submit 11 planning applications to begin drilling on all of its English licences.[17]

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The documented environmental risks of fracking

Although the fracking industry and its supporters contend that fracking can be done safely,[18] shale gas development is inherently environmentally and climate destructive. In the United States the fracking industry has fragmented forests, produced massive volumes of toxic wastes, jeopardised food and water, and caused earthquakes (as one UK fracked well did in 2012); meanwhile, oil and gas operations have become the second greatest global source of the potent greenhouse gas methane, threatening the climate and the planet.[19]

The reckless fracking for oil and gas also has caused thousands of accidental leaks, spills and discharges in the United States. Shale gas wells are proven to be more prone to construction "impairments" and integrity problems, compared to so-called conventional wells.[20] A 2017 10-year study of more than 31,000 frack wells in Colorado, New Mexico, North Dakota and Pennsylvania found that up to 16 percent of wells spill annually.[21] In a single year in Colorado — from 2015 to 2016 — wells, pipelines, and other oil and gas infrastructure had nearly 1,200 accidental spills or releases.[22] A decade of Marcellus shale gas wells in Pennsylvania — the main source of Ineos' imported shale gas — caused over 3,100 environmental, health and safety violations from 2005 to 2016.[23] On top of the drilling, well and pipeline discharges, lorry traffic accidents have spilled fracking wastewater into nearby lakes, streams and private property.[24]

Despite the existing evidence from the fracking boom in the United States, Ineos has been dismissive of the environmental and public health costs of fracking. Ratcliffe has said that fracking's "so-called problems are all myths".[25] The chief executive of Ineos Shale said that the public was being misled by "scare stories", and an Ineos advertising supplement emphasised "a huge amount of misinformation" about the dangers of fracking.[26]

Ineos has admitted that fracking caused "some issues — but they happened in the early days of US shale exploration".[27] Despite recognising fracking's environ-

mental failures in the United States, Ineos has tried to reassure UK residents by trumpeting its recruitment of three US shale experts from Mitchell Energy to help the company develop its fracking business.[28]

But importing fracking talent from Mitchell Energy only imports the US fracking catastrophe. Devon Energy Corp., which bought Mitchell in 2002, paid £10.2 million in fines from 2000 to 2015 — including nearly £255,000 for environmental, offshore drilling, worker safety and railroad safety violations.[29] Between 2002 and 2016, Devon Energy was responsible for nearly 440 oil- and gas-related spills and incidents, including over 300 releases of fracking wastewater in New Mexico alone.[30] These are the experts that Ineos is bringing to lead safe fracking in the UK.

MAP 2: Ineos' global footprint

Table 2. Manufacturing sites by country

Country	Manufacturing Sites	Percent
EUROPE	**43**	**60.6%**
Germany	10	14.1%
Belgium	8	11.3%
UK*	7	9.9%
France	5	7.0%
Italy	3	4.2%
Norway	3	4.2%
Spain	3	4.2%
Sweden	2	2.8%
Netherlands	1	1.4%
Switzerland	1	1.4%
NORTH AMERICA	**20**	**28.2%**
United States	17	23.9%
Canada	2	2.8%
Mexico	1	1.4%
ASIA	**8**	**11.3%**
India	5	7.0%
South Korea	2	2.8%
Thailand	1	1.4%

** UK facilities does not include five offshore drilling platforms.*

SOURCE: Food & Water Europe analysis of Ineos plant locations.

The company also contends that its UK fracking will be safe based on its record in the chemical industry. The director of Ineos' UK shale business said that the company's fracking would be safe because "we have managed other businesses for many years, safely and properly" and "we have demonstrated that we are safe".[31] Ineos contends that its "experience in operating complex chemical plants" transfers to fracking, even though it has never drilled a producing oil or gas well in the UK.[32]

Ratcliffe himself has exhibited an almost casual disregard for the impact that his company has on the environment. In a 2016 *BBC* interview he sloughed off concerns about environmental safety, comparing these problems to getting a flat tyre: "It is like a puncture in your car — occasionally you get a puncture and occasionally we have an accident in chemicals."[33] In a 2015 interview at the London Business School, Ratcliffe suggested that the "symbiotic relationship between the local community and the chemical plant" was important because "occasionally things go wrong and you need, they need, you know we need their sort of sympathy from time to time".[34]

Unfortunately, Ineos' record at its European chemical plants is far from pristine, and transferring this chequered environmental record to fracking would only expose UK communities to unnecessary pollution and environmental degradation. The UK and the EU should not allow Ineos to import the very environmental destruction that has plagued the US fracking industry.

Ineos' chequered environmental record

Food & Water Europe examined Ineos' European environmental record, including government and media reports of its plants in the UK, Belgium, France, Germany, Italy, Norway and Sweden, and found that many of the facilities had accidents, safety lapses, chemical leaks, substantial pollutant releases and even fires and explosions. This indifferent environmental track record does not suggest that Ineos should expand to fracking, an extraction technique that is prone to environmental accidents.

Ineos lists 71 worldwide manufacturing facilities on its website (see Map 2 and Table 2). Nearly two-thirds of these petrochemical plants, plastics manufacturing

ethylene crackers, polystyrene and nitrile factories, and oil and gas refineries are in Europe.

As in Europe, the Ineos facilities in the United States have racked up a laundry list of violations that threaten the environment and human health. Ineos paid nearly £3 million in environmental and workplace penalties and fines from 2003 to 2016.[35] Most Ineos plants have failed to comply consistently with US environmental law. During the three years between April 2014 and March 2017, 12 of Ineos' 14 plants in the US Environmental Protection Agency's (EPA's) Enforcement and Compliance History Online (ECHO) database were noncompliant with a major environmental regulation for at least one three-month period.[36] Over the three-year period, two Ineos plants (the Bayport and Chocolate Bayou Works in Texas) were out of compliance with the US Clean Air Act every quarter, and four of the plants (Addyston, Ohio; Channahon, Illinois; La Porte, Texas; and Plaquemine, Louisiana) were out of compliance with the Clean Air Act half the time.[37]

Ineos' plants also have had a string of similar environmental accidents and safety lapses in the United States. A 2002 explosion at the company's phenol plant in Mobile, Alabama resulted in an estimated £6.6 million in total damages and a four-month shutdown.[38] A 2015 hydrogen cyanide leak in Port Lavaca, Texas led to the death of a worker and to £114,000 in fines.[39] In 2009, Ineos' Green Lake, Texas facility spilled 7.5 litres of the highly toxic chemical acetone cyanohydrin — used in plastics manufacturing — and killed thousands of fish.[40]

Fracking is fundamentally environmentally unsafe. But Ineos' questionable environmental record in Europe and the United States calls into question the company's pledge to pursue fracking safely in the UK or anywhere else.[41] These chemical leaks, accidents and fires have ranged from minor to significant environmental incidents and violations, but some facilities have exhibited a pattern of environmental lapses.

Shoddy safety record in Scotland and England

Ineos has a substantial manufacturing base in the UK, with seven facilities including at the Grangemouth complex near Falkirk in Scotland, the Salt End plant in Hull, the Seal Sands plant in Middlesbrough, Newton Aycliffe in County Durham, Northwich in Cheshire, and two facilities in Runcorn on the River Mersey near Liverpool.[42]

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These major industrial facilities have been a major source of pollution. In 2007, the charity Christian Aid estimated that Ineos was one of the UK's biggest polluters, possibly responsible for tens of millions of tonnes of carbon dioxide greenhouse gas emissions — but the lack of data made it impossible to know the scale of Ineos' pollution.[43] These greenhouse gas and other pollutant discharges have continued. According to data from the European Pollutant Release and Transfer Register (E-PRTR), Ineos facilities in Scotland and England released over 14.7 million tonnes of carbon dioxide, 29,500 tonnes of sulphur oxides, 23,000 tonnes of nitrogen oxides and 680 tonnes of particulate matter between 2011 and 2015 (see Table 3).[44]

Some of the facilities have had repeated safety and environmental problems. Ineos facilities in Scotland and England have been hit with 24 improvement and prohibition notices from the UK's Health and Safety Executive since 2006 for issues such as failing to implement risk management and reduction for major accidents, lack of appropriate pipeline inspections and more.[45]

The Ineos polyvinyl chloride (PVC) facility in Newton Aycliffe released 50 tonnes of vinyl chloride into the air from 2011 and 2015.[46] Ineos paid £16,000 in fines and costs for releasing 56 tonnes of particle-laden gases and steam into the air from the Aycliffe plant in 2010, which left white dust containing PVC and vinyl chloride on nearby homes and gardens.[47] The Seal Sands plant discharged 17 tonnes of heavy metals into the water, including more than 1,000 kilograms of lead, and released more than 63 tonnes of hydrogen cyanide into the air and nearly 1.4 tonnes of cyanide compounds into the water from 2011 to 2015.[48]

Grangemouth complex in Scotland: There have been repeated environmental and safety lapses at Ineos' Grangemouth complex — the largest industrial site in Scotland[49] — at the mouth of the Firth of Forth. Ineos bought the Grangemouth facility as part of its £5.1 billion purchase of BP's specialty petrochemical business, Innovene, in 2005.[50] In 2014, the Grangemouth complex alone refined 210,000 barrels of crude oil daily and supplied 80 percent of Scotland's fuels.[51]

Grangemouth is also Ineos' hub for its proposed fracking empire. In 2016, Ineos imported its first shipment of US shale gas-based feedstocks for its chemical plants and ethylene crackers at Grangemouth.[52] By 2016, the Grangemouth cracker had an annual capacity to produce 1 million tonnes of chemical products.[53] It

Table 3. Selected Ineos UK air emissions, 2011 to 2015

	2011	2012	2013	2014	2015	Five-year total
Carbon dioxide (CO_2) total	**2,262,000**	**3,671,000**	**3,484,000**	**2,572,000**	**2,775,000**	**14,764,000**
Ineos Nitriles (Seal Sands)	378,000	359,000	443,000	318,000	269,000	1,767,000
Ineos (Grangemouth)	1,650,000	3,090,000	2,904,000	2,254,000	2,506,000	12,404,000
Inovyn (Runcorn)	234,000	222,000	137,000	-	-	593,000
Methane (CH_4) total	**-**	**1,340**	**1,260**	**1,100**	**159**	**3,859**
Ineos (Grangemouth)	-	1,340	1,260	1,100	159	3,859
Nitrogen oxides (NO_x/NO_2) total	**4,353**	**5,512**	**4,922**	**3,679**	**4,539**	**23,005**
Ineos Nitriles (Seal Sands)	1,630	1,350	1,220	818	1,450	6,468
Ineos (Grangemouth)	2,020	3,493	3,210	2,455	2,687	13,865
Inovyn (Newton Aycliffe)	164	147	147	155	155	768
Inovyn (Runcorn)	539	522	345	251	247	1,904
Sulphur oxides (SO_x/SO_2) total	**6,630**	**7,040**	**6,392**	**4,673**	**4,771**	**29,506**
Ineos Nitriles (Seal Sands)	1,100	859	559	323	264	3,105
Ineos (Grangemouth)	5,530	6,181	5,833	4,350	4,507	26,401
Particulate matter (PM_{10}) total	**77**	**170**	**148**	**130**	**155**	**680**
Ineos (Grangemouth)	77	170	148	130	155	680

SOURCE: Food & Water Europe analysis of European Pollutant Release and Transfer Register (E-PRTR).

also is ground zero for Ineos' fracking ambitions; by 2015, the company held shale drilling licences covering 700 square miles in Scotland near Grangemouth.[54]

In 2016, Ineos' Grangemouth complex was Scotland's top emitter of the greenhouse gas carbon dioxide.[55] The Grangemouth complex also releases a vast spectrum of other pollutants, including VOCs, carbon dioxide, methane, particulate matter and more.[56] These chemicals can endanger both the environment and public health. Both 1,2-dichloroethane and tetrachloromethane are VOCs and, like vinyl chloride, may cause cancer in humans.[57] With increased ethylene production, it is conceivable that emissions could compound and worsen.

The Grangemouth complex reported several accidental chemical releases in 2012 to the Scottish Environment Protection Agency (Sepa), including of benzene, butane, ethylene, methane, non-methane VOCs, pentene, propylene, toluene and xylene.[58] Many of these substances are harmful to human health and the environment, such as benzene, a human carcinogen.[59] In 2016, the air quality management area including the Grangemouth complex reported sulphur dioxide emissions that exceeded legal limits.[60]

The Ineos Grangemouth facility has repeatedly received low environmental ratings by Sepa. In 2006, the year after Ineos purchased Grangemouth, Sepa identified the plant as one of 17 facilities that failed to meet pollution abatement requirements.[61] In 2009, Sepa found that Grangemouth's oil depot facilities posed a "medium risk" for creating a significant environmental accident if there were an oil leak.[62]

Sepa rated Grangemouth's pollution compliance as "poor", the second lowest rating, for six of the seven years from 2010 to 2016. The low ratings were for activities including "unabated emissions" in 2012 and a substantial breach of the plant's permits in 2011.[63] In 2016, Sepa rated Grangemouth's overall compliance performance "poor" yet again over nine incidents including six separate sulphur releases — including one that emitted 40 tonnes of sulphur — as well as a pollution tank that overflowed and a carbon monoxide release that exceeded standards.[64] Ineos has downplayed the "poor" Sepa ratings, arguing that the plant did well on some components of Sepa's assessment and attributing the focus on the overall poor ratings to "bias of the reporting".[65]

The complex also has received a string of safety notices for workplace hazards — and the problems appear to be worsening. The UK Health and Safety Executive (HSE) agency filed three improvement notices in the four years from 2007 to 2010.[66] But Grangemouth received four times more improvement notices (12) in the four

Notable safety lapses at Grangemouth

2007: Ineos claimed that a flooded Ineos stormwater channel contributed to an oil spill that created oil slicks that polluted several square miles of the Firth of Forth.[69]

2008: In 2008, Grangemouth had an uncontrolled crude oil release after an over-pressurised pipeline sprayed flammable crude oil that could have caused a dangerous explosion.[70] Government investigators found that Ineos knew that the thermal expansion risks warranted installing engineering controls, but Ineos relied on staff manually draining the pipeline to reduce pressure.[71] Ineos pled guilty to a criminal safety breach and was fined £100,000.[72]

2014: In September 2014, Ineos asked police to close roads and schools to keep children indoors after an early-morning butane gas leak mobilised multi-agency emergency services.[73]

2017: In May 2017, the Grangemouth complex was partially evacuated after ethylene gas leaked from a pipeline at Kinneil Gas plant.[74] Ineos asked police to close local roads, police asked schools to keep children inside, and more than 40 firefighters were deployed.[75] This was the second gas leak in three years that forced school children to shelter in place.

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years from 2011 to 2015 to address safety lapses including failing to properly assess the risks posed to refinery workers from "dangerous substances".[67] A 2015 HSE inspection found that a Grangemouth propylene tower posed risks of "a leak or rupture" that could cause "a fireball or vapour cloud explosion" that could result in multiple fatalities.[68]

Runcorn complex near Liverpool: The former Imperial Chemical Industries Runcorn facility is the oldest chemical complex in the UK, and its chlorine factory dwarfed rival manufacturers and contributed to what *The Telegraph* called "pungent odours", pollution in the Mersey River and other environmental troubles.[76]

Ineos bought the ICI facility as part of a £325 million acquisition in 2001.[77] Ineos later spun off or shut down the PVC and chloromethanes operations at Runcorn and reconfigured the facility's vinyl chloride monomer production to manufacture ethylene dichloride.[78] Today, the Ineos joint venture at the Runcorn facility produces caustic soda and the chlorine used in 95 percent of the UK water supply.[79] It also operates the UK's largest municipal waste incineration power plant.[80]

The facility sits on the Mersey River estuary, once deemed one of the most polluted rivers in Europe.[81] Recently, there have been reports of increasing mercury concentrations there that exceed standards.[82] Ineos released over 5.1 tonnes of heavy metals such as arsenic and lead into the air and water from its Runcorn facility from 2011 to 2015 — including 2.2 tonnes of mercury.[83]

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The complex also has had some significant environmental accidents. In 2012, a Runcorn pipe burst spilling 3.8 tonnes of caustic soda while loading a ship; one-fourth of the hazardous material went into the Manchester Ship Canal, and more was washed into the waterway when the clean-up crew rinsed off the deck and jetty.[84] Ineos paid more than £195,000 in fines and costs after admitting it had violated its permits (it previously had received three warnings about water discharges).[85] In 2015, the Ineos division that operated Runcorn reported £300,000 in costs to cover an unnamed and undescribed "environmental incident".[86]

Ineos supplemented the Runcorn chlorine and caustic soda operations with the UK's biggest rubbish incinerator. In 2007, Ineos announced plans to build a municipal waste incinerator to power 20 percent of the Runcorn complex — which used as much energy as the entire city of Liverpool.[87] The controversial project site was surrounded on three sides by residential areas, and the community worried about the impact that the smoke from the towering chimney would have on human health and quality of life.[88]

The £452 million facility was an Ineos joint venture with Viridor Waste Management and was part of a Greater Manchester Waste Disposal Authority project to reduce municipal waste.[89] The plant had a permitted capacity to burn 850,000 tonnes of waste from greater Manchester, Merseyside and Cheshire.[90] The rubbish incinerator solves the local municipalities' trash disposal problem — and Ineos kicks in 60 pence per tonne of rubbish to the Halton Borough Council, amounting to £427,000 by the end of 2016.[91] In 2015, the facility burned over 638,000 tonnes of rubbish.[92]

The project was plagued by industrial accidents before it went fully into operation. In 2014, the Runcorn incinerator had two separate accidents that sent workers to the hospital. In March, the local hospital's accident and emergency department was put on "lock down" to accommodate nearly 20 workers exposed to a hydrated lime spill that required decontamination and treatment for minor respiratory problems and eye irritation.[93] In October, six people were treated at a hospital after a second hydrated lime leak.[94]

The *Liverpool Echo* reported that the incinerator has drawn "a steady stream of complaints over noise, smell and steam".[95] Residents faced increased noise from the lorries and trains that delivered garbage to the

incinerator until late in the evenings.[96] In 2014, a local member of Parliament asked regulators to shut down the incinerator to investigate the workplace accidents and the community complaints over noise and odours from the plant.[97]

Promoters of incinerators contend that modern facilities present little health risk, but in an already heavily industrialised area like Runcorn, the incinerator only adds to the pollution burden. A 2011 study found that incinerators emit nearly 14 times more mercury than coal per megawatt.[98] At full capacity, the Runcorn incinerator would release 19 percent of the cadmium of a typical coal-fired power plant and as many nitrogen oxides as a 16-mile stretch of motorway.[99]

The Runcorn incinerator was not regulated for emissions of dioxin-like PCBs (polychlorinated biphenyls) and polycyclic aromatic hydrocarbons.[100] These compounds are likely to be released from large incinerators like Runcorn. A 2017 Imperial College study (which did not include Runcorn) found that one-half of UK incinerators exceed particulate matter limits on some days and that higher particulate matter emissions were correlated with more emissions of heavy metals, PCBs and polycyclic aromatic hydrocarbons, and some research has associated these incinerator releases with adverse birth outcomes.[101]

Ineos' terrifying fire and repeated blow-outs in Germany

Ineos has 10 manufacturing sites in Germany, including the Cologne complex, Frankfurt, Gladbeck, Herne, Ludwigshafen, Mainz, Marl, Moers, Rheinberg and Schwarzheide.[102] These plants can be major polluters, and some have had substantial environmental problems.

The Cologne, Moers and Rheinberg plants alone emitted 15.1 million tonnes of carbon dioxide between 2011 and 2015.[103] Several of the Ineos plants in Germany have had dramatic environmental incidents. In 2012, the Ineos ChlorVinyls plant in Wilhelmshaven (which was subsequently sold to International Chemical Investors Group) released chlorine gas that resulted in an immediate shut-down of the plant.[104] In 2016, the Moers plant had a cable fire started by a leaking gas flange that required the plant to be shut down.[105] In 2017, the Moers plant's safety valves were opened several times in one evening as the result of a malfunctioning steam power system.[106]

Cologne complex: The Cologne complex has an ethylene cracker that manufactures polyethylene as well as facilities that produce ethylene oxide, ethylene glycol, propylene and acrylonitrile.[107] The former Bayer and BP-owned facility has been producing polyethylene since 1967.[108] It is the largest chemical company in the city and also one of the largest Ineos complexes.[109] In 2010, Ineos CEO Ratcliffe said "Cologne is our flagship".[110]

The complex also has been a substantial polluter that released 14.8 million tonnes of carbon dioxide, nearly 2,100 tonnes of sulphur oxides and 8,150 tonnes of nitrogen oxides, along with ammonia, benzene, hydrogen cyanide and other chemicals between 2011 and 2015 (see Table 4).[111] The facility also had an ammonia leak that injured two workers in 2009, gas leaks in 2009 and 2011 and a cooling tower fire

Table 4. Selected Ineos Cologne air pollutant releases, 2011 to 2015

Air pollutant (metric tonnes)	2011	2012	2013	2014	2015	Five-year total
Carbon dioxide (CO_2)	3,180,000	3,010,000	2,790,000	2,840,000	2,980,000	14,800,000
Nitrogen oxides (NO_x/NO_2)	1,640	1,700	1,540	1,600	1,670	8,150
Sulphur oxides (SO_x/SO_2)	396	415	353	374	547	2,085
Non-methane volatile organic compounds	361	392	381	305	277	1,716
Ammonia (NH_3)	0	0	18.6	13.4	16.1	48.1
Benzene	2.95	2.95	2.69	2.95	2.46	14.00
Ethylene oxide	1.1	0	0	0	0	1.1
Hydrochlorofluorocarbons (HCFCs)	0.050	0.048	0.050	0.046	0	0.194
Hydrogen cyanide (HCN)	1.26	1.02	1.05	1.01	0	4.34

SOURCE: Food & Water Europe analysis of European Pollutant and Transfer Register (E-PRTR).

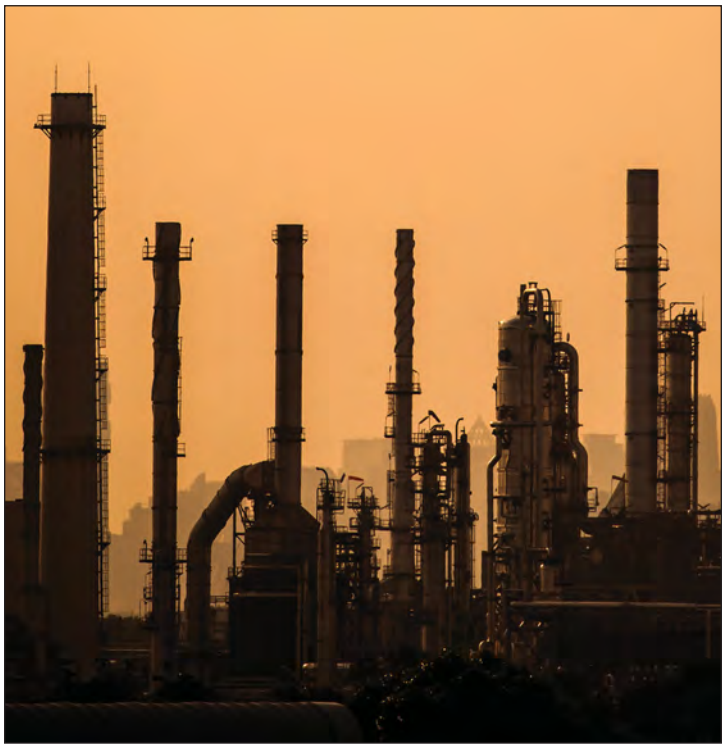
in 2010.[112] In 2015, the Cologne government ordered Ineos to reduce its discharge of the chemical pyrazole into the Rhine River, after higher concentrations were found of the chemical that can cause skin and eye irritation and blood disorders at longer exposures.[113] Ineos had called pyrazole "indispensable" in its production process.[114] It also has had recurring problems with blow-outs and one of the biggest fires in decades.

The 2008 fire: In 2008, the Cologne complex erupted in fire. A leak from an ethylene pipe ignited, setting off a chain reaction that ultimately engulfed a nearby acrylonitrile tank; it resulted in jet flames up to 130 feet high that lit up the sky and a more than 750-yard tower of smoke soaring from the site.[115] Nearly 1,200 firefighters battled the blaze, the largest fire-fighting operation since World War II.[116] The leak that started the fire was likely caused by a mistake during maintenance of a pipeline flange, very similar to a maintenance error in 2007 that caused another ethylene leak that did not ignite.[117] But there also was insufficient distance between the pipeline and the acrylonitrile tank to prevent the fire from spreading.[118]

Ineos reported that the pipeline burned for over four hours and the acrylonitrile tank burned for nearly nine hours.[119] The fire shut down a nearby motorway and railway line, forced the evacuation of nearby buildings, and residents were urged to remain indoors with their windows and doors shut.[120] Three people were treated for skin irritation from exposure to the fire.[121] Ineos was forced to shut down production, and ultimately the fire cost €53 million (£42 million) in damage to the plant, lost productivity and decontamination.[122]

The fire burned 300 tonnes of ethylene and 1,200 tonnes of acrylonitrile — ranking very high on the European scale for measuring the release of dangerous materials.[123] Local residents were worried about their potential exposure, because although almost all of the highly toxic acrylonitrile burned off, traces remained in the air.[124]

Ongoing decompression blow-outs: The Cologne complex also has had frequent and occasionally dangerous emergency venting of ethylene gas when pressure in the crackers rapidly increases, breaking an emergency safety seal known as a rupture disc to release the built-up pressure. These pressure relief systems are meant to prevent disasters, but they should be the "last line of defense".[125] The breaking



of a rupture disc might mean that there is a control problem, that the plant is operating very close to the safety limits of the equipment or that the reactions are heating or catalysing too quickly.[126] Engineered safety back-up systems such as rupture discs can fail, and relying on these emergency devices can risk hazards and accidents.[127] These seemingly smaller incidents can cascade into larger-scale industrial accidents that can put human health and the environment at substantial risk.[128]

The activation of rupture disc safety systems should be a relatively rare occurrence.[129] Ineos has suggested that these safety systems typically are resorted to infrequently (once or twice a year),[130] but at some plants — such as Cologne and the Rafnes complex in Norway (see page 12), these incidents have happened more frequently and sometimes with more alarming results. A pattern of recurrent minor accidents and near-misses may suggest indifferent safety oversight that can lead to larger accidents.[131]

In 2006, one of the polyethylene units had to be shut down after the sudden release of pressure caused an explosion when the vented ethylene ignited over the plant.[132] In September 2017, 14 workers were hospitalised when the over-pressurised ethylene ignited, which also created a loud bang and a column of smoke.[133] Ineos initially downplayed the incident, releasing a

statement that said "there is no danger to the population" but admitted to the workplace injuries a few hours later.[134] Ineos has often issued statements that these rupture disc events present "no danger to the population at any time".[135]

From 2006 to early November 2017, the Ineos Cologne complex has appeared to rely on rupture discs to relieve over-pressure at least 11 times, according to newspaper accounts of known events.[136] A 2014 rupture disc pressure release caused an explosion and fire that shook windows and released a smoke cloud visible for miles — the flames were as tall as a house.[137] In 2016, when two rupture discs broke in a single evening, Ineos' spokeswoman said "this is not an unusual incident, but it is always happening again and again".[138] A March 2017 over-pressure event broke a rupture disc causing a loud bang that was heard across the Rhine River, shook residences and ignited a three-foot-high fire.[139]

Leaks, fires and pollution in Belgium

Ineos has eight manufacturing facilities in Belgium including four near Antwerp (in Doel, Lillo and Zandvliet and Zwijndrecht), Feluy, Geel, Jemeppe and Tessenderlo.[140] These plants include assets purchased from BP, Solvay and others and manufacture PVC, polyethylenes and chlorvinyls.[141]

Between 2011 and 2015, just the plants at Doel, Feluy, Tessenderlo and Zwijndrecht released over 2.6 million tonnes of carbon dioxide as well as other air pollutants (see Table 5).[142] The Belgian emissions included 28 accidental releases, including 17 kilograms of hydrochlorofluorocarbons (a group of greenhouse gases that are 400 to 1,800 times more powerful than carbon dioxide over a 100-year timescale[143]) from Lillo and 345 tonnes of non-methane VOCs from Zwijndrecht in 2013 alone.[144]

Some plants are significant emitters of dangerous chemicals. The Jemeppe plant alone emitted into the air, water or both an estimated 89.4 tonnes of ammonia, 39.7 tonnes of 1,2-dichloroethane (classified by the US EPA as a probable carcinogen), 74.4 tonnes of the carcinogen vinyl chloride, 38 kilograms of mercury and over 34 kilos of lead between 2011 and 2015.[145]

The Belgian operations also have been plagued with accidents, including leaks and fires. The Feluy plant had an aluminium alkyl cell leak in 2007.[146] In 2012, three access roads at Feluy were closed after the plant leaked the toxic gas boron trifluoride, sending two workers to the hospital; after firefighters diluted the gas, the cloud drifted about a mile from the plant.[147] In 2014, the Tessenderlo plant had two hydrochloric acid leaks within one month.[148]

Table 5. Selected air emissions from Ineos' facilities in Belgium (metric tonnes)

	2011	2012	2013	2014	2015	Five-year total
Carbon dioxide (CO_2)	**371,000**	**371,000**	**660,000**	**518,000**	**754,000**	**2,674,000**
Ineos Enterprises (Tessenderlo)	151,000	144,000	158,000	174,000	176,000	803,000
Ineos Oligmers (Feluy)	-	-	130,000	111,000	129,000	370,000
Ineos Oxide (Zwijndrecht)	-	-	207,000	-	228,000	435,000
Ineos Phenol (Doel)	220,000	227,000	165,000	233,000	221,000	1,066,000
Hydro-fluorocarbons (HFCs)	**1**	**2**	**2**	**5**	**2**	**13**
Ineos Enterprises (Tessenderlo)	1	2	2	5	2	13
Nitrogen oxides (NO_x/NO_2)	**193**	**183**	**138**	**159**	**461**	**1,134**
Ineos Oligmers (Feluy)	-	-	-	-	283	283
Ineos Phenol (Doel)	193	183	138	159	178	851
Non-methane volatile organic compounds	**525**	**450**	**694**	**304**	**216**	**2,189**
Ineos Enterprises (Tessenderlo)	-	-	-	100	-	100
Ineos Olefins & Polymers (Geel)	352	298	204	204	216	1,274
Ineos Oxide (Zwijndrecht)	-	-	368	-	-	368
Inovyn (Antwerp)	173	152	122	-	-	447

SOURCE: Food & Water Europe analysis of European Pollutant and Transfer Register (E-PRTR).

Fires also have been more common than would seem prudent in facilities with highly flammable chemicals. In 2002, an explosion and fire at the Zwijndrecht plant sent two workers to the hospital with minor injuries.[149] A fire occurred at the Doel plant in 2006.[150] In 2016, the Zwijndrecht plant was evacuated after an ethylene tank caught fire, injuring two workers.[151] The Feluy plant had two back-to-back fires within weeks in both 2007 and 2014.[152] There also appear to have been decompression safety-valve associated flaring or fires at both the Feluy and Geel plants in 2007.[153]

Ineos' record in Norway and Sweden

Ineos operates three facilities in Norway at Bamble and Rafnes near Strathelle and another plant at Porsgrunn and two in Sweden at Helsingborg and at Stenungsund. These plants are substantial emitters of risky chemicals and have a history of pollution, accidents and fires.

Bamble-Rafnes complex in Norway: Ineos purchased the Norwegian plants as part of its £540 million purchase of Norsk Hydro's century-old business in 2008 and the £1.2 billion purchase of Borialis in 2007.[154] Ineos owns a 50 percent stake in the Rafnes cracker as well as three polyolefin plants at Bamble — a location that Ineos dubbed a "petrochemical cluster".[155] The Rafnes cracker can process up to 650,000 tonnes of ethane annually to create ethylene. The ethylene is manufactured into plastics at both the Rafnes and Bamble facilities.[156] This petrochemical cluster is also one of the sites importing fracked gas products from the United States. In March 2016, the first shipment of ethane arrived at the Rafnes complex.[157]

FLARE AT RAFNES-BAMBLE, 2016. PHOTO © TELEMARKSAVISA / USED WITH PERMISSION

These facilities have been substantial polluters. The Rafnes plant alone released 102,000 tonnes of carbon dioxide in 2015.[158] The Bamble plant released 539 tonnes of non-methane VOCs into the air between 2013 and 2015, and Rafnes released nearly 61 tonnes of 1,2-dichloroethane, hydrochlorofluorocarbons, tetrachloromethane and trichloromethane between 2011 and 2015.[159]

The Rafnes-Bamble complex also has had repeated blow-outs that have frightened locals with loud noises and smoke, as have occurred at the Cologne plant (see above). Ineos has repeatedly downplayed community concerns about these smoke plumes. In 2010, it stated that one of the events was "going to be completely harmless".[160]

These safety decompressions have been substantial enough to be reported regularly in local newspapers. In 2010, the Rafnes plant released powerfully smelling smoke.[161] In 2014, an emergency decompression was violent enough to shake nearby homes and released a fast-moving cloud of smoke with a detectable smell.[162] In 2015, a controlled cooling of the Bamble ethylene plant released smoke plumes seen across the community.[163] In 2017, the Bamble plant had three rapid pressure increases in a single week accompanied by loud bangs and strong odours that had to be remedied by emergency decompressions, far greater than the typical one or two decompressions a year.[164]

Power outages also have caused Ineos facilities to flare gases that have made residents nervous. In 2012, the Rafnes plants was forced to flare ethylene gas after a regional power disruption.[165] In 2016, Bamble had visible flames and released a large plume of black smoke in April, and power problems caused another smoke cloud that dominated the horizon in October.[166]

The complex also has suffered from various accidents. In January 2009, the Ineos' Rafnes facility caught fire when ethylene from a leaking valve caught fire after plant maintenance.[167] Police, ambulance and fire services responded to the blaze, which was quickly brought under control, but one worker was hospitalised with moderate burns to his hands and face.[168]

In 2009, a compressor pump at the Rafnes plant leaked lubricating oil; 200 to 400 litres ultimately reached the fjord, creating an oil film on the coast.[169] Rafnes also

had a small chlorine gas leak in 2010 that it reported to the police.[170] Between 2011 and 2015, the Rafnes plant released nearly 15 tonnes of vinyl chloride gas and the Porsgrunn plant released more than 129 tonnes, according to European registry disclosures.[171] In 2013, an emergency preparedness instructor accidentally ignited gas during a training at Rafnes that hospitalised one worker with burns to his face and body.[172]

Ineos plant at Stenungsund in Sweden: The Ineos facility at Stenungsund, Sweden, also was purchased in the Norsk Hydro deal, and by 2011 the plant produced 215,000 tonnes of PVC annually, destined to be made into pipes, floor tiles and other products.[178] The facility has had a series of leaks and accidents since Ineos bought it. The plant at Stenungsund released over 100 tonnes of 1,2-dichloroethane, hydrochlorofluorocarbons and trichloromethane into the air between 2011 and 2015.[179]

The most serious incident was Ineos' failure to shut down a dangerous pressure vessel even after ordered by Swedish authorities. In 2010, Sweden's Work Environment Authority (WEA) found that a Stenungsund facility pressure vessel used to treat large amounts of flammable and toxic substances developed cracks; if the system failed, it would have exposed the community to risk of chemical exposure.[180] Sweden's WEA ordered Ineos to shut down the facility until equipment that met requirements could be installed, but at a visit four months later, the authorities found that Ineos had resumed production without replacing the equipment.[181] The WEA supervisory director said that a failure of the pressure vessel could have released large volumes of flammable gas that "could have developed into a major disaster".[182] The WEA threatened to fine Ineos a record 15 million Krona (£1.3 million) to get the company to shut down operations and replace the substandard equipment (ultimately it imposed a fine of 20,000 Krona for restarting the damaged pressure vessel — only about £1,800).[183]

The Stenungsund plant has had ongoing releases of vinyl chloride and other chemicals. From 2011 to 2015, the Stenungsund plant released 202 tonnes of vinyl chloride into the air and more than 20 kilograms into the water, according to E-PRTR.[184] In 2008, an incorrectly installed safety valve at the Stenungsund plant released 11 tonnes of vinyl chloride and 16 tonnes of hydrochloric acid into the ocean; the release was below the plant's permit level but the highest discharge in the plant's history.[185] Eleven workers, several without any respiratory safety equipment, were exposed to the potentially cancer-causing vinyl chloride at elevated levels, although the length of the exposure was considered to pose a negligible risk according to Swedish authorities.[186] In 2012, the plant leaked a small amount of the flammable liquid dichloroethane before emergency services helped the company stop the leak.[187] In 2013, the plant again leaked vinyl chloride gas from an open valve for 15 hours before the company could halt the accidental release.[188]

Plastic pellets pollute shorelines near Ineos plants

Ineos' plastic production, largely in the form of pellets that are used to further manufacture plastics, has most likely polluted beaches and threatened the marine environment near several of the company's facilities. In Norway, one local man has found millions of plastic pellets, like the ones manufactured by Ineos at Bamble, washed onshore at high tide near Strathelle, Norway, and the local Ineos CEO admitted that the pellets in the environment may have come from Ineos.[173] In Italy, Ineos admitted that the 300 kilograms of plastic pellets that littered the beaches near the company's Rosignano facility in 2017 were probably from that facility.[174]

This plastic pollution has been widespread near the Grangemouth facilities in Scotland. The Firth of Forth's beaches have been polluted by "worryingly large" amounts of plastic pellets, and scientists have found that 15 percent of endangered puffins in the area contain these pellets in their stomachs.[175] A 2017 study found that plastic — mainly in the form of small pellets called nurdles — has littered 73 percent of the UK's 279 shorelines.[176] In 2017, one scientist filmed the moment when plankton ingests plastic, documenting how it enters the food chain.[177] The fracking-driven industry expansion will likely generate even more coastal and ocean plastic pollution as ethane crackers produce more plastic resins.

PHOTO CC-BY-NC © SUSTAINABLE COASTLINES / FLICKR.COM

Ineos also uses mercury in the production of PVC, and the mercury is ultimately shipped for disposal in German salt mines.[189] Sweden pushed for all facilities to become mercury-free by 2009, but Ineos received two extensions until 2016.[190] Ineos received an exemption despite the fact that existing technologies were available to manufacture chlorine without mercury.[191] According to European release data, the Stenungsund plant released 77 kilograms of mercury into the air between 2011 and 2015.[192]

Accidents and fires in France

Ineos has five manufacturing sites in France at Lavéra, Sarralbe, Tavaux, Verdun and Wingles.[193] The French Ineos plants have emitted substantial airborne pollutants, including 8.8 million tonnes of carbon dioxide, nearly 12,800 tonnes of nitrogen oxides, and over 34,000 tonnes of sulphur oxides from 2011 to 2015 (see Table 6).[194] Some plants have had substantial water releases as well. For example, the Tavaux plant had water releases of over 200 tonnes of chlorinated organic chemicals from 2011 to 2015, including 525 kilograms of 1,2-dichlohroethene and 220 kilograms of vinyl chloride, as well as over 1,000 kilograms of arsenic compounds, 413 kilograms of lead and 30 kilograms of mercury.[195]

Series of accidents at Lavéra complex: In 2005, Ineos acquired the Lavéra BP complex that included a refinery and plastics manufacturing facilities.[196] The complex also includes an olefin plant, known as Naphtachimie, that Ineos bought in 2017 from its former joint venture partner, Arkema.[197] The complex has had a series of serious accidents and leaks. In August 2009, a hydrocarbon leak at the Lavéra Naphtachimie caused a fire that sent two workers to the hospital with burns.[198] A month later, the facility was shut down after a steam pipe ruptured that also caused a brief ethylene leak.[199] The union representing the workers attributed the ongoing safety problems in 2009 to staff cutbacks.[200]

In 2010, the underground storage facility near Lavéra, in which Ineos had a 19.9 percent ownership stake, leaked 200 cubic metres of the volatile and poten-

Table 6. Selected air emissions from Ineos facilities in France (metric tonnes)

	2011	2012	2013	2014	2015	Five-year total
Carbon dioxide (CO_2)	**1,856,000**	**1,657,000**	**1,922,000**	**1,983,000**	**1,394,000**	**8,812,000**
Inovyn (Tavaux)	418,000	437,000	545,000	526,000	-	1,926,000
Ineos Enterprises (Verdun)	1,310,000	1,100,000	1,250,000	1,330,000	1,260,000	6,250,000
Ineos Polyolefin Catalyst (Sarralbe)	128,000	120,000	127,000	127,000	134,000	636,000
Nitrogen oxides (NO_x/NO_2)	**2,966**	**2,572**	**2,849**	**2,930**	**1,467**	**12,784**
Inovyn (Tavaux)	603	694	777	921	-	2,995
Ineos Enterprises (Verdun)	2,070	1,640	1,790	1,710	1,170	8,380
Ineos Polyolefin Catalyst (Sarralbe)	293	238	282	299	297	1,409
Non-methane volatile organic compounds	**3,057**	**3,309**	**2,506**	**2,263**	**2,347**	**13,482**
Inovyn (Tavaux)	116	118	117	106	-	457
Ineos Enterprises (Verdun)	862	877	772	775	764	4,050
Ineos Oxide (Lavéra)	394	359	349	270	237	1,609
Ineos Polyolefin Catalyst (Sarralbe)	1,550	1,840	1,150	994	1,230	6,764
Ineos Styrolution (Wingles)	135	115	118	118	116	602
Sulphur oxides (SO_x/SO_2)	**10,780**	**6,890**	**6,102**	**6,499**	**3,914**	**34,185**
Inovyn (Tavaux)	1,250	1,200	1,530	1,860	-	5,840
Ineos Enterprises (Verdun)	8,920	5,060	4,170	4,280	3,520	25,950
Ineos Polyolefin Catalyst (Sarralbe)	610	630	402	359	394	2,395

SOURCE: Food & Water Europe analysis of European Pollutant and Transfer Register (E-PRTR).

PHOTO CC-BY-NC-ND © SIMONE GIRLANDA / FLICKR.COM

tially explosive naptha that forced the evacuation of around 100 people from 60 homes and blocked several roads, and clean-up efforts failed to prevent some of the naptha from polluting the Largue River.[201] In April 2011, a hydrocarbon leak was detected at Ineos' Lavéra facility, and in June 2012, the Lavéra refinery was shut down due to a fire at an electrical substation at the chemical plant entrance.[202]

Sarralbe leaks and fires: The Sarralbe site manufactures polypropylene and polyethylene.[203] In 2015, a late-night pipeline leak released 15 kilograms of propylene gas at the Sarralbe facility, forcing the evacuation of 19 people.[204] In 2015, a tanker railcar destined for the Sarralbe facility leaked propylene and shut down all rail traffic after firefighters established a 650-yard safety perimeter until they stopped the leak.[205]

In January 2017, a Sarralbe alkyls storage area caught fire, shutting down production at the plant and releasing hydrochloric acid fumes in low concentration.[206] Another Sarralbe alkyls fire occurred in 2006.[207] In May 2017, a Sarralbe hydrocarbon tank fire sent three workers to the hospital with burns to their hands, neck and face.[208] In 2017, Ineos finally agreed to a new safety plan to reduce the risk of industrial accidents to the community.[209]

Ineos sells facilities that leave a toxic stain in Italy

There are three Ineos facilities in Italy: the Ferrara PVC recycling plant; the Rosignano chlorine, caustic soda and solvent plant; and the Tavazzano chlorine derivatives plant.[210] Some of these plants have had recent accidents. In 2016, the Tavazzano plant accidentally released hydrochloric acid that required the plant to be shut down for two hours, but the local government was not informed of the accident for several weeks.[211]

In 2015, at least three incidents occurred at the Ineos Rosignano facility. In July, a problem at the plant's ethylene storage tank caused a loss of control of its cooling circuit, releasing smoke from the facility.[212] In August, the plant had to flare ethylene gas while it was attempting to repair the problem that caused the smoke cloud the previous month.[213] In December, the plant released a column of smoke and visible flames from an ethylene storage chimney, again related to the failed cooling system from July.[214]

Toxic legacy at former Ineos facilities at Porto Marghera and Porto Torres: Two of Ineos' former facilities remain mired in environmental controversy, but Ineos has largely avoided responsibility for these

sites. In 2006, Ineos released five or six tonnes of vinyl chloride from the Porto Marghera site without alerting the local authorities or community.[215] The now-abandoned industrial site manufactured vinyl chloride and PVC for half a century, and efforts to dismantle, decontaminate and reclaim the land have been stymied because the post-Ineos owners could not find buyers willing to dispose of the toxic material.[216] After the current owner went into bankruptcy, the local government has been forced to pay for the clean-up.[217]

The former Ineos plant in Porto Torres on Sardinia was embroiled in a long-standing lawsuit over illegal chemical dumping, but in the end Ineos was not held accountable. The former Ineos Vinyls Italia case involved the dumping of large quantities of toxic chemicals into the Gulf of Asinara.[218] In 2007, Ineos sold its ethylene-PVC plant in Porto Torres.[219] In 2009, the families of 40 workers that died of cancers they attributed to their chemical plant employment in Porto Torres sued companies including Ineos for alleged violations of environmental standards and for contaminating the community with benzene, heavy metals, chlorides and dioxins.[220] At the same time, public prosecutors brought charges for illegal chemical discharges into the ocean and the sewage system.[221]

In 2012, Ineos tried to evade local efforts to get chemical companies including Ineos to pay for dumping heavy metals and solvents into the ocean and damaging the marine environment.[222] The 2012 civil case was derailed on a technicality, and efforts to bring criminal cases against Ineos and the other companies appeared to exceed the statute of limitations; in 2014, all the companies including Ineos escaped without paying for the documented pollution.[223]

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Conclusion and recommendations

The petrochemical industry, plastics production and fracking are innately risky to the environment and public health. Methane leaks from oil and gas infrastructure are a leading contributor to global warming, and in the United States the fracking industry has been responsible for thousands of spills and accidents that have contaminated groundwater resources. The plastics industry has reaped under-the-radar benefits from the environmentally destructive fracking boom.

As with fracking, transforming ethane into plastics and other products can be toxic, polluting the environment and exposing workers and nearby communities to public health risks. European countries must protect the environment and public health and reject America's headlong rush to fracking and cracking pollution and environmental damage.

Ineos is pushing to frack the UK, but its troubled environmental and safety record at its chemical manufacturing plants makes the company a risky bet for UK communities and the environment. The Ineos chemical plants have released millions of tonnes of the greenhouse gas carbon dioxide as well as other hazardous pollutants. The company's plants have had a string of accidents, leaks and fires that have imperiled workers, communities and the environment across Europe.

Fracked gas is incompatible with EU and UK climate objectives, with the Paris Agreement obligations and with the need to act quickly to tackle climate change. Instead, Ineos is doubling down on fossil fuels and petrochemical plants when we know that we cannot afford more plastics, petrochemicals or fracked hydrocarbons. What we do need is fresh air, clean drinking water and an intact environment. Rather than continually investing in fossil fuels and chemical industries, we must act swiftly and with determination and invest in clean, renewable energy.

Climate change demands action, and here are our recommendations:

- Fracking should be banned everywhere: in the United States and across Europe. The UK should follow Scotland's lead and ban fracking in England, Wales and Northern Ireland.
- Ineos should not be permitted to expand its petrochemical empire as long as the company is not

willing to put climate and environmental protection and workers' safety standards first. Taking into account the evidence concerning the negative impacts of fracking and the bad environmental record of Ineos, the company's applications to kick-start hydrocarbons exploration should be rejected, and the existing licences should be revoked.

- The UK, the EU and the United States as well as governments worldwide should strengthen enforcement of workers' safety rights as well as clean air and water standards to further restrict accidents and emissions from petrochemical plants as well as discharges of toxic chemicals and improve the transparency and access to public disclosure of chemical pollutant release data. A constant independent monitoring and a regular cross-border informational exchange of the supervisory authorities and trade unions is required.
- The United States must stop fossil fuel exports, the UK and the EU should not accept fossil fuel imports, and the construction of infrastructure to support this global gas and oil trade must be halted.
- People should limit their purchases of non-biodegradable plastic products that effectively support and finance the oil and gas industry, and also should work for public policies that discourage the use of these plastics.
- The United States, the UK and the EU should enact aggressive energy conservation policies, including large public transport investments and widespread deployment of other energy-saving solutions.
- The United States, the UK and the EU should establish ambitious programmes for deploying and incentivising existing renewable energy and energy efficiency technologies in order to slash fossil fuel demand to reach 100 percent clean renewable energy by 2035, while modernising electrical grids to cater to distributed renewable power generation.
- The United States, the UK and the EU should invest in research and development to overcome technological barriers to the next generation of clean energy and energy efficiency solutions.

Appendix Table A. European Chemical Agency assessment of selected Ineos chemicals[224]

Chemical	Flammable	Human health risk	Environmental risk
1-chloro-1,1-difluoroethane	extremely flammable		harmful to aquatic life with long lasting effects, ozone level depleting
1,2-dichloroethane (ethylene dichloride)	highly flammable	potentially fatal if swallowed; toxic if inhaled; may cause cancer, serious eye irritation, skin irritation, respiratory irritation	
2-butoxyethanol (ethylene glycol)	N	harmful if swallowed; harmful and irritating in skin contact; causes serious eye irritation; harmful if inhaled	
acetone	highly flammable	causes serious eye irritation; may cause drowsiness or dizziness	
acetonitrile	highly flammable	harmful if swallowed; harmful if skin contact; causes serious eye irritation; harmful if inhaled; causes severe skin burns and eye damage; may cause cancer; may cause an allergic skin reaction	toxic to aquatic life, with long-lasting effects
acrylonitrile	highly flammable	toxic if swallowed; toxic in skin contact; toxic if inhaled; causes serious eye damage; may cause cancer; may cause skin irritation; may cause allergic skin reaction; may harm fertility or unborn children	toxic to aquatic life, with long-lasting effects
aluminium alkys	may ignite spontaneously if exposed to air	severe skin burns and eye damage	
ammonia	Y	toxic if inhaled; causes severe skin burns and eye damage	very toxic to aquatic life
arsenic	N	toxic if swallowed or inhaled	very toxic to aquatic life, with long-lasting effects
benzene	highly flammable	may be fatal if swallowed; may cause genetic defects; may cause cancer; causes organ damage through prolonged or repeated exposure; causes serious eye irritation; causes skin irritation	
boron trifluoride	may explode if heated	fatal if inhaled; severe skin burns, eye damage; causes organ damage through prolonged or repeated exposure; may cause respiratory irritation	
butadiene (1,3-butadiene)	extremely flammable	may cause genetic defects; may cause cancer; suspected of damaging fertility or unborn children	harmful to aquatic life, with long-lasting effects
cadmium	catches fire spontaneously if exposed to air	fatal if inhaled; may cause cancer; causes organ damage; suspected of causing genetic defects; suspected of damaging fertility or unborn children	very toxic to aquatic life, with long-lasting effects
caustic soda (sodium hydroxide)	N	causes severe skin burns and eye damage	
chlorine	may explode if heated	toxic or fatal if inhaled; causes serious eye irritation; causes skin irritation; may cause respiratory irritation	very toxic to aquatic life, with long-lasting effects
ethylene	extremely flammable	may cause drowsiness or dizziness	
ethylene oxide	extremely flammable	toxic if inhaled; may cause genetic defects; may cause cancer; causes serious eye irritation; causes skin irritation; may cause respiratory irritation; harmful if swallowed; causes damage to organs through prolonged or repeated exposure	
hydrochloric acid (hydrogen chloride)	N	severe skin burns and eye damage; toxic if inhaled; may damage fertility or unborn children; organ damage through prolonged or repeated exposure; respiratory damage.	
hydrogen cyanide	extremely flammable	fatal if swallowed or inhaled; fatal in skin contact; causes organ damage through prolonged or repeated exposure	very toxic to aquatic life, with long-lasting effects
lead	N	harmful if inhaled; harmful if swallowed; may damage fertility or unborn children; causes organ damage through prolonged or repeated exposure; may harm breast-fed children	very toxic to aquatic life, with long-lasting effects
mercury	N	fatal if inhaled; may damage fertility or unborn children; causes organ damage through prolonged or repeated exposure	very toxic to aquatic life, with long-lasting effects
naptha	extremely flammable	may be fatal if swallowed; may cause genetic defects; may cause cancer; suspected of damaging fertility or unborn children; causes skin irritation	toxic to aquatic life, with long-lasting effects
pentene	extremely flammable		toxic to aquatic life, with long-lasting effects
phenol	N	toxic if inhaled or swallowed; toxic in skin contact; causes severe skin burns and eye damage; suspected of causing genetic defects; may cause organ damage through prolonged or repeated exposure	toxic to aquatic life, with long-lasting effects
propylene oxide (2-methyloxirane)	extremely flammable	toxic in skin contact; toxic if inhaled; may cause genetic defects; may cause cancer; harmful if swallowed; causes serious eye irritation	harmful to aquatic life
pyrazole	N	toxic in skin contact; causes organ damage through prolonged or repeated exposure; harmful if swallowed; causes serious eye damage	harmful to aquatic life, with long-lasting effects
tetrachloromethane (carbon tetrachloride)	N	may cause cancer; fatal in skin contact; toxic if swallowed; causes serious eye irritation; suspected of damaging fertility or unborn children; may cause allergic skin reaction	ozone layer depleting
toluene	highly flammable	may be fatal if swallowed; suspected of damaging fertility or unborn children; causes serious eye irritation; causes skin irritation	harmful to aquatic life, with long-lasting effects
trichloromethane (chloroform)	N	suspected of being damaging to fertility and unborn children; suspected of causing cancer, drowsiness or dizziness; harmful if swallowed; skin irritation; toxic if inhaled; causes damage to organs through prolonged or repeated exposure	
vinyl chloride (chloroethylene)	extremely flammable	may cause cancer; suspected of causing genetic defects; harmful if swallowed	harmful to aquatic life, with long-lasting effects
xylene	Y	harmful in skin contact; harmful if inhaled; may be fatal if swallowed; causes serious eye irritation; may damage organs through prolonged or repeated exposure	

Endnotes

Note: *Food & Water Europe translated news accounts from original Flemish, French, German, Italian, Norwegian and Swedish using Google Translate supplemented with other translation services. Citations are translated into English, and the headline in the original language is included.*

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2-butoxyethanol (ethylene glycol, EC List No. 203-905-0, updated 10 August 2017), acetone (EC List No. 200-662-2, updated 10 August 2017), acetonitrile (EC List No. 200-835-2, updated 10 April 2017), acrylonitrile (EC List No. 203-466-5, updated 28 September 2017), aluminum alkys, updated 13 May 2017); arsenic (EC List No. 231-148-6, updated 6 February 2017), benzene (EC List No. 200-753-7, updated 10 June 2017), boron trifluoride (EC List No. 231-569-5, updated 7 June 2017), butadiene (1,3-butadiene, EC List No. 203-450-8, updated 10 August 2017), cadmium (EC List No. 231-152-8, updated 8 March 2017), caustic soda (sodium hydroxide, EC List No. 215-185-5, updated 30 September 2017), chlorine (EC List No. 231-959-5, updated 27 September 2017), ethylene (EC List No. 200-815-3, updated 10 August 2017), ethylene oxide (EC List No. 200-849-9, updated 10 June 2017), hydrochloric acid (hydrogen chloride, EC List No. 231-595-7, updated 10 April 2017), hydrogen cyanide (EC List No. 200-821-6, updated 28 August 2017), lead (EC List No. 231-100-4, updated 9 September 2017), mercury (EC List No. 231-106-7, updated 7 June 2017), naptha (EC List No. 273-271-8, updated 23 August 2017), pentene (EC List No. 246-916-6, updated 12 July 2017), phenol (EC List No. 203-632-7, updated 10 August 2017), propylene oxide (2-methyloxirane, EC List No. 200-879-2, updated 28 September 2017), pyrazole (EC List No. 206-017-1, updated 9 July 2017), tetrachloromethane (carbon tetrachloride, EC List No. 200-262-8, updated 11 July 2017), toluene (EC List No. 203-625-9, updated 28 September 2017), trichloromethane (chloroform, EC List No. 200-663-8, updated 19 September 2017), vinyl chloride (chloroethylene, EC List No. 200-831-0, updated 26 September 2017), xylene (EC List No. 215-535-7, updated 10 August 2017); ECHA. Info card. Ammonia (CAS No. 913-720-3, updated 13 July 2017).

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