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Special Issue: Making the Petrochemical Connection

Grangemouth refinery and old BP social club, April 2019. Photo credit: Alice Mah

Alice Mah, Professor of Sociology, University of Warwick

I have been researching the petrochemical industry for more than five years now. Day in and out, this behemoth industry, with its toxicity, controversies, and sprawling network of activities around the globe, has been looming in the back of my mind. Whenever I am gripped by an idea or question, I am sobered by the nineteenth century psychological concept of the *idée fixe*. Research can be an obsessive practice, driven by our fixed ideas about the world.

Since I started my research, I have become increasingly concerned about toxic threats: chemicals infecting our house in paints, cleaning products, and carpets; smells of burnt plastic wafting up our street from the printing warehouse; suspected asbestos at every corner in our old house; and, underlying virtually every aspect of everyday life: the petrochemical industry. I have not always been preoccupied with toxic hazards, my husband reminds me, as I eye the leaky old locomotives suspiciously on a family visit to a railway museum.

Yet, mild toxic paranoia aside, studying the petrochemical industry across multiple sites and perspectives has also led me to question fixed ideas, including my own assumptions about industrial practices and consequences. When the stakes are high, impacting powerful elites as well as ordinary people's health and livelihoods, one needs to tread carefully.

This special issue showcases research findings from our European Research Council-funded Toxic Expertise project on environmental justice and the global petrochemical industry (2015-2020). When I tell people about this project, I get two typical responses.

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The first is, quite simply: “What is the petrochemical industry?” The second is the opposite. People with their own ideas about the petrochemical industry often ask: “What could you possibly find out that is not already common knowledge?”

What is the petrochemical industry? This is a very good question. It is not common knowledge. In fact, it is difficult to define. The industry has incredibly porous boundaries, operating across the oil, gas, chemical, and plastics industries, amongst others. Even the main corporate petrochemical players span different industries, including: vertically integrated oil and gas companies (multinational and state-owned); large chemical companies; specialty petrochemical companies; and integrated chemical and plastics companies.

Petrochemicals are derived from fossil fuels, used to make plastics and other synthetic materials, such as paints, rubber, and solvents. Originally, the petrochemical industry grew out of the oil and gas industry in the late nineteenth century as by-product of the waste streams from oil refining. In the first half of the twentieth century, the polymer revolution in the chemical industry brought a number of new plastic materials to market (Bakelite, vinyl, nylon, polyethylene, Tupperware, et al), synthesized to replace natural products with cheaper alternatives. During the Second World War, the petrochemical industry became an industry its own right, fuelled by demands for high-octane gasoline, synthetic rubber, and chemical weapons. Governments appealed to women to contribute nylon stockings during the war effort for parachutes and other military uses.

Today, plastics drive petrochemical production, representing eighty per cent of end markets. No wonder, then, that the industry is worried about the public image of plastics.

What could we possibly find out about the petrochemical industry that is not common knowledge? This, too, is a good question. The petrochemical industry is a classic contested industry, alongside the oil, pharmaceutical, tobacco, and sugar industries, all known for manufacturing doubt about the harmful effects of their products.

Yes, the petrochemical industry is a major polluter, dependent on fossil fuels, and the subject of numerous controversies, accidents, and disasters. As such, many people think our interest must be in fingerprinting dirty companies for their negligence: think *Erin Brockovich*. But unfortunately, such cases are rare and costly, and beyond the scope of our study.

In the Toxic Expertise project, we are interested not only in the extreme cases, but also in the ordinary cases of “structural and slow forms of violence in toxic landscapes”. We also highlight cases outside the legal and political frameworks of western liberal democracies. For example, there have been violent crackdowns on environmental protests over petrochemical plants in China and police shootings and human rights abuses of migrant petrochemical workers in Saudi Arabia.

When it comes to questions of corporate sustainability, people often wonder how we can get beyond the wall of corporate public relations. Indeed, I have been hitting my head against this wall for some time now.

The problem with such a complex object of study is the difficulty of getting inside— or above, or around— for an alternative view. Even up close, petrochemical complexes are alienating structures.

Last month, I walked with a local environmental activist on a “toxic tour” of Bo’ness Road, which runs through the Grangemouth refinery and petrochemical complex in Scotland. Somewhat unusually, Bo’ness road cuts directly through the middle of the industrial area and is open to the public. The corporate giant INEOS plans to close the road, a move that has been met with local opposition. As we walked along the “dirty oil road”, the environmental activist pointed out several of the top polluters in Scotland. Recently, he said, there has been renewed interest from journalists in Grangemouth because of the plastics issue. However, it has been difficult for him to convey the connection between industry and marine plastic litter, beyond pointing out the polluting industrial facilities and noting their end markets.

Top of Bo’Ness Road, Grangemouth, April 2019

Towards the end of the Bo’Ness toxic walk I could smell a familiar pungent aroma. Maybe it was psychological; the activist told me that the industries increased in toxicity as we walked along the road. The strength of petrochemical smells depends on emission levels, wind direction, and the person doing the smelling. Smells can also be misleading. Some of the most toxic chemicals have none at all.

Last spring, the anthropologist Loretta Lou and I travelled to petrochemical villages on the outskirts of a major city in South China. From the moment we stepped out of the nearest underground station, about five kilometres away from the nearest petrochemical plant, I felt like I had entered an acrid chemical cloud, which was magnified by the high urban air pollution that day.

Loretta couldn’t smell anything. As she tried to tune into the smell that I described, she asked me questions: what kind of smell was it, exactly, and where did it sit on my tongue and throat? This tuning in exercise reminded me of high-pitched sounds, which irritate some people, but which I cannot hear unless I concentrate. As we approached the

petrochemical villages, the smell became more like a total body experience. The roads were narrow, dusty, and unpaved, filled with workers on bicycles and enormous trucks. This landscape was strangely familiar, resembling the polluted peri-urban petrochemical villages in Nanjing, China that Xinhong Wang and I researched in 2016.

Petrochemical workers on bicycles, South China, March 2018

In our research, it has been important to get close to petrochemical facilities, to breathe the air, witness the landscapes, and talk with people. But it has also been important to investigate the industry beyond the fenceline: listening to keynote talks and panel discussions in petrochemical industry conferences; attending industry training sessions and stakeholder engagement events; reviewing corporate investment plans and sustainability reports; and looking systematically at regional petrochemical emissions, related health inequalities, and networks of corporate power.

As our multi-scale, multi-site, and multi-method research on the petrochemical industry comes together, we are beginning to make connections between the different parts and the whole: the corporate drivers; the investment flows; the chemical properties of carbon; the geopolitical significance of shale gas; and the risk perceptions and environmental injustices in different "fenceline" petrochemical communities.

In 2013, the environmental health leader Theo Colborn argued that "we've got to make the fossil-fuel connection" between fossil fuels and petrochemicals, particularly the violence of US shale gas extraction and toxic exposures. We need to extend this call to make the "petrochemical connection:" the crucial link between fossil fuels and plastics, underlying the global health and environmental crises of toxic pollution, climate change, and plastic waste. This is the focus of the book I am currently writing, a critical investigation of the *petrochemical value chain*: or, how the petrochemical industry creates value across its

commodity chain, from fossil fuels to basic petrochemicals to plastics and other end markets.

With more plastic produced in the past ten years than ever before, and climate change reaching the brink of submerging small island nations, it is clear that "business as usual" within the global petrochemical industry is unsustainable.

After decades of navigating environmental controversies, the petrochemical industry has become adept at the business of corporate social responsibility. In particular, industry is worried about the plastics crisis. It threatens their social license to operate, as David Brown describes in this special issue in an account of the 2019 World Petrochemical Conference in Texas. However, as I have seen over the past five years, the industry is always poised to tackle another crisis, a recurrent theme within global capitalism.

With all the crisis talk, environmental "bads" are easily played off against one another. Plastics are pitched as the saviour in the fight against climate change: "higher value" (fossil fuels are captured in plastics rather than burned directly as fossil fuels); lightweight (in transportation materials, reducing emissions); insulating (for energy use in buildings); and part of the green transition (a key material in solar panels, wind turbines, and electronic vehicles). And if we don't want the microplastics from fleece choking our marine wildlife, then what about the plight of the merino sheep?

Technological solutions to fix problems abound, another recurring theme within our modern risk society. Chemical recycling is one recent controversial example: the proposal to create even more petrochemical plants to reduce plastics back to chemicals, rather than relying on current mechanical recycling, which cannot meet global plastics demand.

While the solutions may seem obvious— good, bad, or inevitable— they are not. We rely on the petrochemical industry and other polluting industries for our modern lifestyles, including medicine and urban infrastructure. It is difficult, if not impossible, to disentangle "essential" from "non-essential" petrochemical products and processes. When we focus on one problem, such as climate change, the unintended consequences of the proposed solution throw up yet another problem. What will we do with our discarded solar panels and electronic cars in the future? Electronic waste frequently tops the list of global toxic threats.

The underlying problem goes back to the Club of Rome's 1972 report on the Limits to Growth: the enduring myth of unlimited growth. As a world fuelled by an obsession with growth, we are caught in the societal *idée fixe* that we can endlessly increase our consumption without ruining the planet.

This special issue brings together research by the Toxic Expertise research team on the global petrochemical industry in relation to corporate responsibility and environmental justice. Each article contributes to making the petrochemical connection, using different methods, sites, and perspectives to shed light on part of the complex industrial system.

In an evocative article tracing petrochemical connections with Franco's legacy in Spain, Chris Waite reflects on the troubled past and uncertain future of a petrochemical refinery in Santa Cruz de Tenerife. The geographer and urban planner Thomas Verbeek presents the findings of a spatial network analysis of top petrochemical companies, which demonstrate shifting elite power constellations. Reporting on insights

from the 2019 World Petrochemical Conference in San Antonio, Texas, David Brown discusses the "existential crisis of the petrochemical industry" in the aftermath of the marine plastics crisis. Next, the environmental scientist Calvin Jephcote discusses the historical emergence and endurance of regional health inequalities in the European petrochemical landscape. Finally, in an insightful book review of an Italian book about autonomous workers' collectives in the petrochemical complex of Porto Marghera in Venice, Lorenzo Feltrin introduces English audiences to the case where he will conduct field research this summer.

To round off this issue, we are republishing three articles from our research team about different petrochemical landscapes and lived experiences: Loretta Lou's 2018 article "'Village Besieged': An Elegy for Victims and Protest Against Taiwan's Petrochemical Pollution," a moving account of the role that music can play in raising awareness about the injustices of petrochemical pollution; Thom Davies' 2017 article "Toxic Geographies: chemical plants, plantations, and plants that will not grow" about the "noxious residues" of "living intimately with chemicals" in Cancer Alley, and Cynthia Wang's 2015 "Reflections on the Tianjin Explosions" written in the aftermath of the Tianjin chemical explosions in August 2015, and an important reminder of the ever-present dangers of living alongside toxic hazards.

Santa Cruz Verde 2030: A new dawn for Tenerife?

Main image credit: Tenerife Island (Canary Islands, Spain) from LANDSAT7 satellite of NASA [Public domain]

Chris Waite, University of Warwick

When Alexander von Humboldt reached the peak of *El Teide* in June 1799, he described how the 'prodigious transparency of the atmosphere' contributed to 'the magical effect' of Tenerife's landscape[1]. Humboldt was on route to what would become an extraordinary Latin American expedition that saw him scale higher peaks than the 3,718 metres of *El Teide*. Andrea Wulf's 2015 biography of Humboldt describes the adventurer's 1802 ascent of *Chimborazo* in the Andes as an epiphany that brought together everything he had experienced earlier in his trip:

> *"Everything that he had ever observed fell into place […]. Nature, Humboldt realized, was a web of life and a global force"*[2]

Humboldt got within 300 metres of the 6,283 metre summit of *Chimborazo*, and despite his exhaustion, bleeding feet and altitude sickness, was formulating ideas that would

become his new interconnected concept of nature. As Wulf suggests 'Humboldt gave us our concept of nature itself'[3] – a potentially fragile 'web of life' where nothing can be studied in isolation, where 'everything hangs together'[4]. These ideas are threaded through our current understandings of climate change.

On approaching Santa Cruz de Tenerife via the TF-1 motorway that leads from the airport in the south, the sight of the *Refinería* is a curious one. I am offered glimpses of chimneys and spherical storage tanks, painted in pastel shades of blue, peeking through the dense urban-industrial landscape. It is hard to distinguish the boundary of the refinery: it has now been enveloped by the municipal tangle and palm trees of the city of Santa Cruz. And there was the *smell* – heady, strangely floral, and – it is hard not to use the word – *toxic.* Which I didn't expect: in terms of actual refining activity this site has been idle since 2015. The refinery currently provides storage and distribution facilities for CEPSA (*Compañía Española de Petróleos S.A.U*) and still produces asphalt. I pass by an open air olympic-size swimming pool, which for a moment seems to be part of the refinery. I wonder how different my olfactory experience would be if the refinery was at full capacity – some 92,000 barrels per day. I'm also struck by the parallel between Humboldt's description of the 'transparency of the atmosphere' on *El Teide* and a strangely beautified refinery, cleansed by the shimmering blue sky. Searching this sky, I cannot find a trace of *El Teide*, the highest point on Spanish territory. I later learn it is hidden from view by the massive crater wall of *Las Cañadas.* I recall Wulf highlighting Humboldt's understanding of nature as requiring a perspective from above[5] that would allow all connections to be seen. I feel frustrated that on my planned climb of *El Teide* the refinery would be out of view. This feeling – of being unable to establish a perspective that offers insights – became a familiar one when later carrying out research (for the *Toxic Expertise* project) into other petrochemical sites in Spain and Latin America. I found myself wading through impenetrable corporate websites with sparkling night-time images of refineries, often with little hope of discovering meaningful data on what was actually produced there, and how.

Refinería Tenerife. Photo credits: CEPSA (left) Benjamín Núñez González (right)

The history of *Refinería Tenerife* is a long one: it is the oldest refinery in Spain, with production beginning in 1930[6]. The decision to locate a refinery in Tenerife was an indirect result of the authoritarian nationalism of Miguel Primo de Rivera's dictatorship: the 1927 *Ley del Monopolio de Petróleos* (The Petroleum Monopoly Law) restricted the activity of the oil industry in mainland Spain to state owned companies only. The private company CEPSA was undeterred and found in Santa Cruz de Tenerife a seemingly perfect confluence of features: a strategic position on Atlantic shipping routes, existing port infrastructure, the availability of land and water, low taxes and quick planning processes[7].

Some six years after the arrival of Spain's first refinery to Tenerife arrived another exile: General Francisco Franco. Rivera's dictatorship had been overthrown in 1930 and replaced by *La Segunda República Española* (The Second Spanish Republic). In a failed attempt to disarm right-wing threats, Franco was one of two Generals sent to 'remote' postings in March 1936. Franco's putative exile to Tenerife was futile and from here he continued to plot the uprising that became the massacre of the Spanish Civil War. The refinery in Tenerife proved indispensable to Franco, which by some accounts provided 70% of the fuel needed by the war machinery of Franco's nationalists[8]. In a visit to Tenerife in 1950 Franco inaugurated an extension to the refinery. His visit is documented in this short film.

> *Translated transcript of film extract: "One thriving Tenerife industry is the oil refinery, where Franco inaugurates the new installations and extension and commemorates the 20th anniversary of the initiation of industrial activity by this Spanish Company. This refinery will now be able to produce lubricants for both home and export markets. Accompanied by ministers and company directors it is explained that the refinery processes 20 thousand barrels of crude oil per day – one million tons per year. Another site visited by Franco is that of the monument erected in memory of the fallen, where he lays a wreath and prays for those who gave their lives for God and for Spain"*

Later in the footage he visits the *Monumento a los caídos* (Monument to the Fallen) and in a grotesquely ironic act lays flowers – as the narrator tells us – '*por los que dieron su vida por dios y por España*' (for those who gave their lives for God and for Spain). Haunted by this perverse act of remembrance, and curious as to what it represents, I visit the monument. This still stands in *Plaza de España*, some two kilometres from the refinery. I find the experience of the visit numbing – I left it feeling empty and unable to formulate any thoughts at all. Later I realise the classical colonnade surrounding it is reminiscent of Italian fascist architecture. I wonder if Spain's speedy transition to democracy after the death of Franco in 1975 – and the '*pacto de olvido*' (pact of forgetting) that underpinned it – has left the past and, and monuments to it, in an unreadable, unknowable form.

Monumento de los caídos. Plaza de España, Santa Cruz de Tenerife. Photo credit: Christian Köppchen

Refinería Tenerife now faces a transition of its own: in June 2018 CEPSA and the local council of Santa Cruz signed an agreement titled 'Santa Cruz Verde 2030'[9] that will see the closure of the refinery and the regeneration of the 573 thousand metre square refinery site into '*el nuevo pulmón verde de la ciudad*' (the new green lung of the city). The visceral metaphor '*pulmón verde'* is striking, and a realistic hope given the fact that since refining stopped at the site air quality measures quickly fell back within WHO guidelines[10]. However, I wonder how easy erasing 90 years of industrial activity will be, and whether in the rush to transition something toxic will be left behind. Contaminated land can, with time, be recovered. Whether time can offer a resolution to the troubling history of the oil that powered the Spanish Civil War is less certain.

As I make my ascent of *El Teide* the thinning air does strange things to my thought processes. I clamber up the well-marked route of monotonous grey lava rock formations and I'm taken back to the bleak grey of the *Monumento* in Santa Cruz. I had caught a programme on *Televisión Canaria* the previous night which considered the role late-Francoism played in the development of mass tourism in the Canaries. The unconstrained

development of resorts in the Canaries appears inextricably part of the legacy of the dictatorship, where the natural capital of the temperate climate and extraordinary landscape were exploited for their income generating potential. On recalling Wulf's description of Humboldt's excitement at the sight of *El Teide*[11] I briefly recover a sense of purpose. I wanted to experience the inspirational transparency of the atmosphere that Humboldt had found so enchanting. I wanted to marvel, like he did, at being able to see all of nature from above to appreciate its interconnected web. However, until I left the *Refugio Altavista* at 5.30am the following morning for the final 1000 metre climb to *El Pico del Teide* for sunrise, I had just felt uncomfortably entangled in Franco's legacy. I had hardly slept, drifting in and out of nightmares of having unwittingly become part of a terrible fascist conspiracy. As I finally reached the summit the sun appeared and the chill in the air disappeared. Momentarily, at least, I thought I knew what Humboldt had found so magical.

Dawn on el Pico del Teide – the view south-east to Gran Canaria. Photo credit: Chris Waite

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This article was inspired by reading *The Invention of Nature: The Adventures of Alexander von Humboldt, the Lost Hero of Science* by Andrea Wulf, 2015.

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[1] Humboldt & Bonpland, 1814, pp.180-181
[2] Wulf, 2015, p.87
[3] Wulf, p.8

[4] Wulf, p.5
[5] Wulf, p.88
[6] CEPSA
[7] Pérez-Hernández, 2010, p.101
[8] Rivas García, 2007 p.28
[9] Ayuntamiento de Santa Cruz de Tenerife, 2018
[10] Baldasano & Massagué, p.201
[11] Wulf p.46

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Places of decision and flows of power: Disentangling petrochemical corporate networks

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In our contemporary globalized economy, it is increasingly complex to disentangle the relationships between different places, different companies and different products. Through global production networks, globally operating conglomerates, global elite networks as well as through all kinds of inter-firm alliances such as joint ventures and license agreements, different companies and different places are invisibly tied together across time and space.

Multinational corporations play a substantial role in this networked global economy, operating at the intersection of a global reach and local embeddedness. For industries that are dominated by relatively few global players, such as the (petro)chemical industry, these multinational corporations often consist of a hierarchical network with hundreds of subsidiary companies, all over the world. This means that a chemical production plant in Antwerp, the biggest petrochemical hub in Europe, will probably be part of a multinational

corporation with other plants in Europe, the US, China, and other parts of the world. How these different subsidiaries and places are connected in a global corporate network, and where ultimately the decision-making strategic power is executed, is not easy to unravel.

It becomes particularly interesting to look into these spatial corporate networks considering the profound changes that are taking place in our global economy today. China and other emerging economies – like India and Brazil – are reshaping the flows of production, labour and capital around the world (Morgan & Whitley, 2012). While this applies to many sectors, in the context of our "Toxic Expertise" research project we particularly look into the petrochemical industry.

Despite globalization, until recently the global (petro)chemical industry had been remarkably stable in terms of the geographical and corporate leadership of the US and Western Europe, especially when compared with other knowledge-based, high technology industries (Chandler, 2009). The major enterprises in 2002 still included some of the traditional leaders that had secured their market dominating positions well before the Second World War (such as BASF in Germany and Dow Chemical in the US), joined by some early Asian competitors that emerged in the 1970s and 1980s (such as Saudi Arabia's Sabic and Japan's Mitsubishi Chemical). It is only in the past decade that we have seen profound geographical changes, with China overtaking the US and Europe as the largest chemical producer, and other emerging markets (India, Brazil) also expanding rapidly.

While the European Union, NAFTA and Japan maintained global dominance in 2007, with a combined share of 57.8% in world chemicals sales, this share plummeted to only 35% in 2017. In the same decade, China has grown to be the largest petrochemical producer, with its share having increased from 14.8% to 37.2%. While still lagging behind substantially, also India saw a relatively big increase from 2.1 to 2.9% (CEFIC, 2018).

These numbers show that (petro)chemical production is undeniably moving away from its traditional heartlands. However, this does not mean that patterns of Western corporate leadership and decision-making power are also shifting. Taking a look at the list of the world's biggest (petro)chemical producers in 2016, we see that for the most part the traditional companies from established high income economies dominate the list. However, we also see China's state-owned petrochemical producer Sinopec taking third place, and five other companies from so-called Newly Industrialized Countries (NICs) or Emerging Economies (EE) making the Top 50 list. This shows that change in global corporate leadership is following the change in places of production, but at a much slower pace.

Table 1. Top 10 (petro)chemical companies in 2016 and 5 additional Top 50 companies from Emerging Economies (Note: Dow Chemical and Du Pont considered as a merged company) (Source: Chemical & Engineering News)

2016 ranking	Company	HQ location	Chemical sales ($ millions)
1	DowDuPont	US	$67,837
2	BASF	Germany	$60,654
3	*Sinopec*	*China*	*$42,815*
4	SABIC	Saudi Arabia	$30,986
5	Formosa Plastics	Taiwan	$27,141
6	ExxonMobil	US	$26,058
7	LyondellBasell	Netherlands	$24,624
8	Ineos	Switzerland	$23,530
9	Mitsubishi Chemical	Japan	$23,358
10	Air Liquide	France	$19,554
…	…	…	…
17	*Reliance Industries*	*India*	*$13,769*
18	*Braskem*	*Brazil*	*$13,692*
40	*Indorama*	*Thailand*	*$7,220*
42	*Sasol*	*South Africa*	*$7,148*
48	*PTT Global Chemical*	*Thailand*	*$6,151*

However, these rankings do not give a full picture of the situation. A further exploration of the spatial, social, and organizational networks behind the figures would provide more

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insight in the changes that are taking place or that are on the way. In a forthcoming publication, we apply social, spatial and inter-firm network analysis to provide a detailed overview. In this supplementary contribution, we focus on mapping the spatial corporate networks, as a way of visually analysing the geographical scope and spatial structure of individual and combined corporate networks.

Spatial Network Analysis

To entangle the complex spatial relationships of multinational global corporate networks, different fields of economic geography have applied network analysis, examining global production networks (e.g. Bridge, 2008) and world city networks (e.g. Alderson & Beckfield, 2004). We particularly build on techniques developed in the latter field, where networks based on headquarter-subsidiary ties of transnational corporations enable researchers to identify the most powerful or strategic cities or countries. The results usually show that a few global cities and a few predominantly Western countries have a disproportionate importance in the global economic network (Wall, Burger & Van der Knaap, 2011).

However, these analyses usually focus on large samples of multinational service sector firms. Research on the spatial corporate networks of resource dependent and capital-intensive manufacturing industries, as well as analysis of the spatial network within a large corporation, is still rare. A particular exception is the spatial network analysis applied to multinational oil corporations in a study by Yang and Dong (2016), showing that international oil companies and (state-owned) national oil companies had different location preferences and different spatial networks.

In this contribution, we want to map the spatial corporate networks of the petrochemical industry. We want to visually examine (1) how individual spatial corporate networks differ from each other in terms of complexity, geographical scope and centralization; (2) where the decision-making power of the Top 10 companies is concentrated; and (3) whether and how spatial networks of corporations from emerging economies integrate with the established network. Thus, our analysis does explicitly not want to uncover patterns of production, but focuses on revealing the power structures and places of strategic importance in the global petrochemical network.

We focus our analysis on the ten largest (petro)chemical companies in sales value in 2016, expanded with four companies from emerging economies (Table 1) (Note: we omitted Indorama to retain only one company from Thailand, ensuring a varied sample). For every corporation, we exported the hierarchical structure of all subsidiaries from Orbis, a global company database with information on around 300 million companies worldwide, all standardised for cross-border comparisons. For each corporation, the exported network contained all subsidiaries that are majority-owned (thus excluding 50:50 joint ventures and other entities with less than 50% shares). To correctly map the corporate networks, subsidiary location data was validated and completed. It should be noted that setting up subsidiaries can have different motivations (e.g. availability of resources, production costs,

access to markets, tax evasion) and not always equals production activity. Moreover, registered addresses of subsidiary companies are not always the places where most activity of the subsidiary is carried out (though usually this is the case). Finally, locations were aggregated at the metropolitan level, if applicable, to allow for a functional rather than an administrative or political interpretation of a city. These limitations mean that the spatial corporate networks should be interpreted with caution and can only be used to gain a general overview, not as a base for detailed examination of specific locations.

The final dataset allows to map the spatial network of every corporation, based on the location of all subsidiaries, and the ownership ties between different subsidiaries. By combining in- and outgoing ownership ties for every city, a *degree* can be calculated. It can be interpreted as a measure for the strategic importance of a city for the corporate network, with global and regional headquarter locations having the highest degree. When the networks of corporations are combined, the degree equals the significance of particular cities as powerful hubs for the flows of capital.

Results

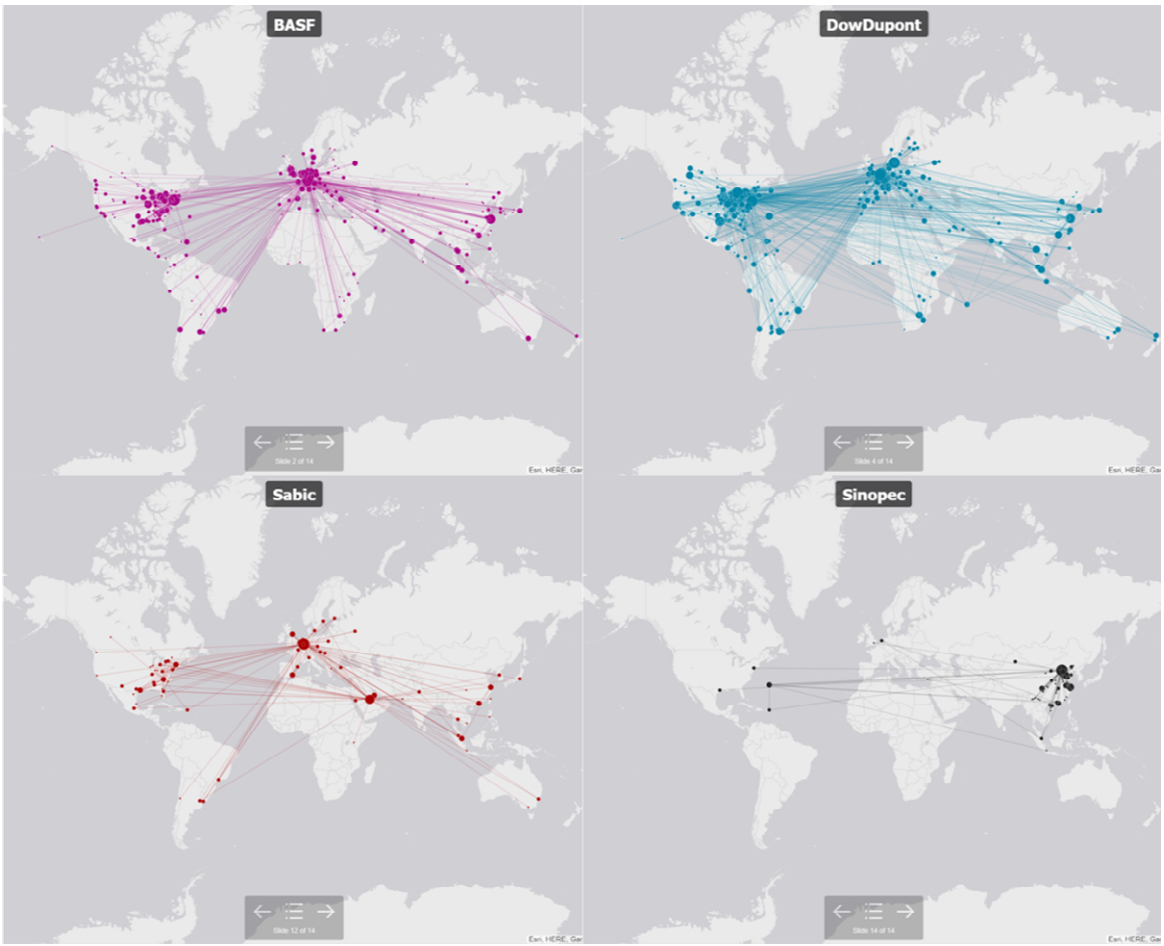

Figure 1. The different spatial extent and complexity of the corporate networks of BASF, DowDupont, Sabic and Sinopec. Node size represents degree of a city, edges represent ownership ties. (click here for the online interactive maps of the fourteen corporations)

In a first series of interactive maps we map the fourteen spatial corporate networks individually. For every corporation, these maps give an idea of the spatial reach of their activities, the location of the most important places of decision and the flows of power within their network (Figure 1). A comparison of these maps shows interesting similarities and differences in terms of spatial extent, complexity and hierarchical structure of the corporate networks. The traditional corporations like BASF and DowDupont, with their roots in the early 20th century or before, generally have a truly global reach with hundreds of subsidiaries in a complex corporate network. While their global headquarters locations and home countries capture a big part of their decision power, this power is for a substantial part distributed across secondary strategic locations, mainly situated in the traditional "petrochemical heartlands" of Europe and North America. Another group of companies consists of the early Asian competitors that emerged in the 1960s and 1970s, with Saudi Arabia's Sabic and Japan's Mitsubishi Chemical being the best examples. While still having a large part of their activities and decision power centred on their home regions, their corporate networks resemble the networks of the traditional corporations, having spread out to other parts of the world with a strong presence in Europe and North America today. Finally, the five emerging economy corporations in our sample show a varied picture. For all five corporations, their spatial reach goes beyond their home country, but Reliance Industries and Sasol are clearly the most global, with an extensive network of subsidiaries that is largely controlled from their home base. Sinopec has a comparable hierarchical network with many subsidiaries, but almost all activity is situated within China's borders, controlled from Beijing. Finally, Braskem and PTT Global Chemical have a limited local and global network with few subsidiaries. Overall, we find that high income economy corporations generally have a less hierarchical corporate network with many subsidiaries, centred on Europe and North America, with South and East Asia playing an important secondary role. Their international strategy and flat organizational structure is in most cases not only the result of natural growth of the company, but also reflects a long history of mergers and acquisitions. On the other hand, most companies from emerging economies have a more hierarchical and less complex corporate structure, with different spatial strategies but always a strong presence in the home region.

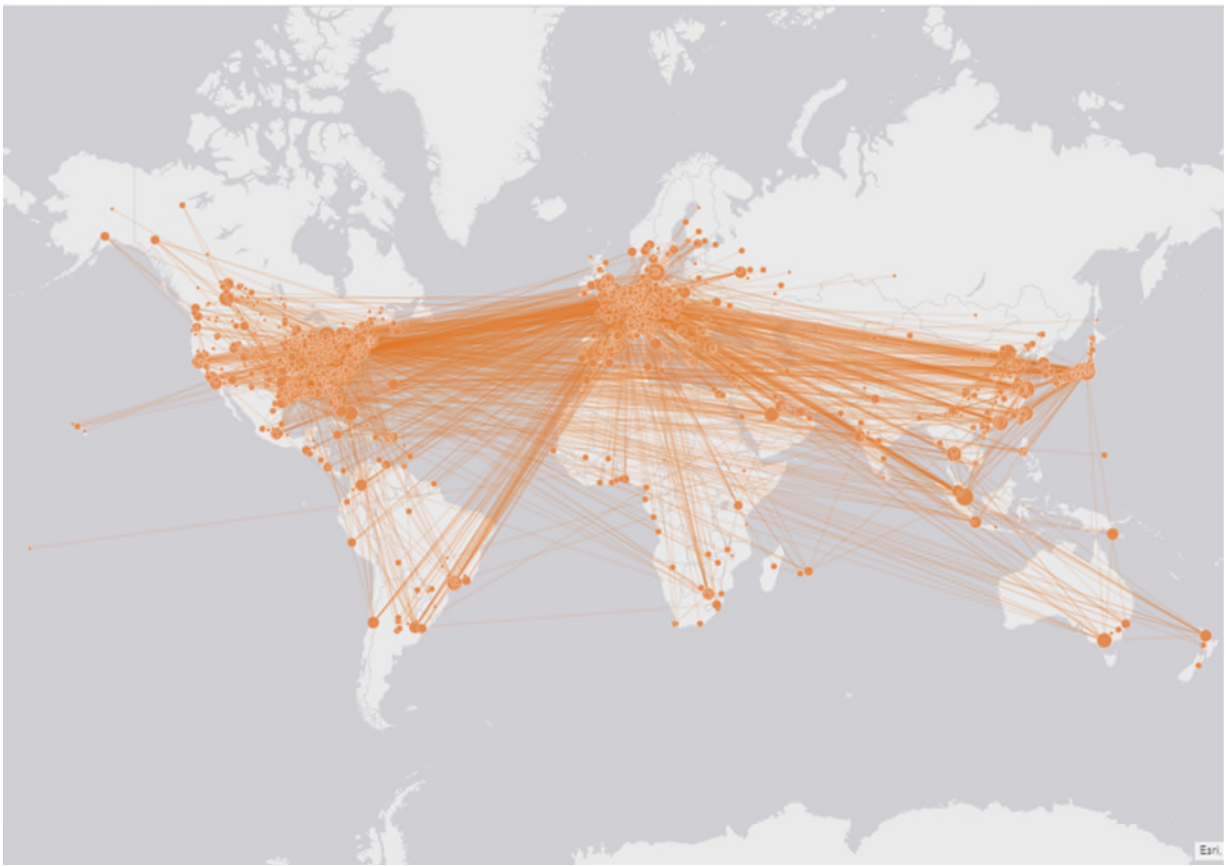

Figure 2. The combined corporate network of the global Top 10 petrochemical corporations (click here for the online interactive map)

A second map looks at of the combined network of the Top 10 petrochemical corporations in 2016, representing a combined sales value of almost $350bn. This combined network gives an idea of the most powerful and strategic regions and cities in today's petrochemical industry. The network is dominated by Western Europe and the Eastern part of the United States, the two regions where the petrochemical industry originated. We also see a secondary regional hub of power in Eastern Asia, centred on China, Japan and Taiwan. Apart from the three core regions, many important regional poles can be discerned, but Africa, South America and Oceania clearly have limited power in the global petrochemical network.

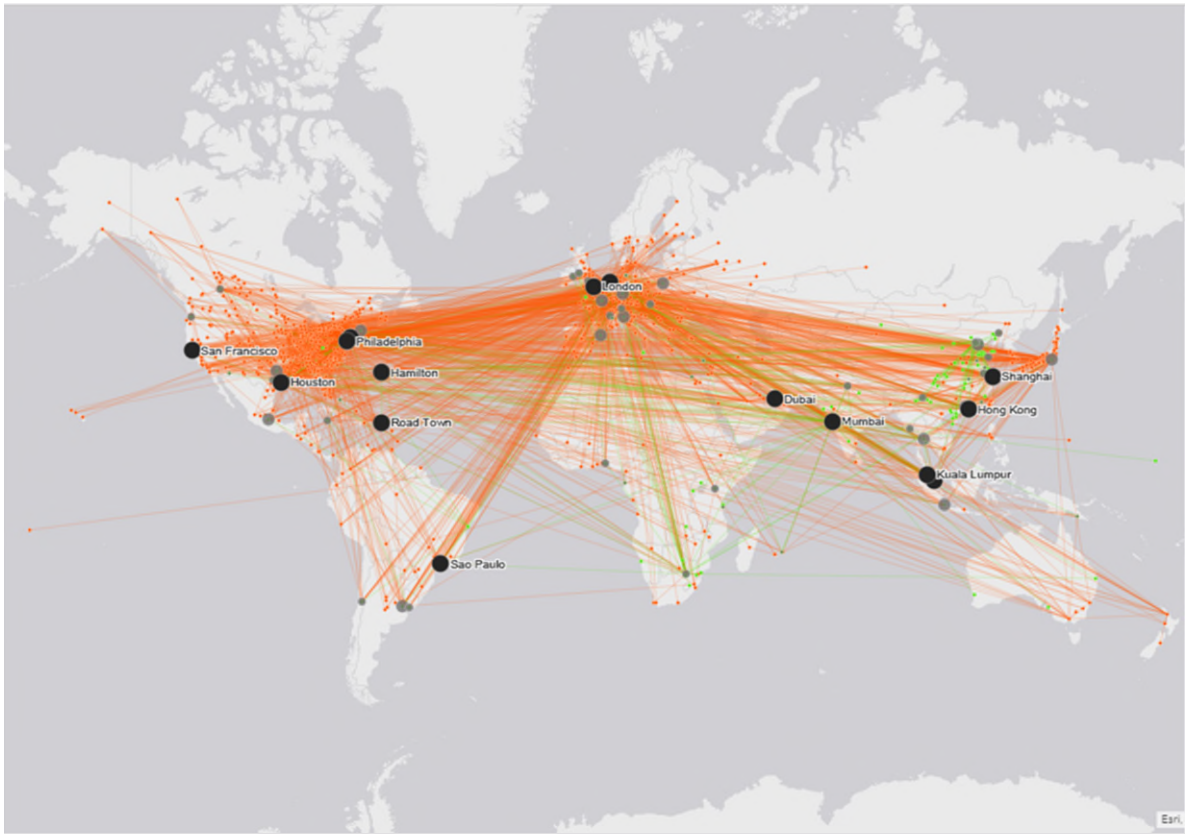

Figure 3. The integration of High Income Economy corporate networks (red) and Emerging Economy corporate networks (green) with indication of the fifteen most important "connection nodes" (black) and other "connection nodes" of lesser importance (grey)

While the situation today might still reflect the traditional patterns and power relations that are rooted in the early twentieth century, a look at the networks of corporations from emerging economies might give a glimpse into the future. In a final map we examine the overlap and integration between the networks of high income economy corporations (red) and emerging economy corporations (green). We particularly focus on the strategic "connection nodes", where both networks integrate with each other (grey dots). We highlighted the fifteen most important connection nodes, where at least two high income economy corporate networks "meet" with two emerging economy corporate networks. If the growth of emerging economy corporations persists, these places might play a key role in the coming decade. Remarkably, the most important "connection node" is Houston, where all fourteen corporate networks have at least one subsidiary, ensuring its future importance as the unofficial capital of the petrochemical industry (and still home to one of the largest petrochemical complexes). Other strategically important places are traditional global power hubs like London and New York, some offshore tax havens (Hamilton (Bermuda) and Road Town (Virgin Islands)), but also a range of hubs in the Emerging Economy countries (such as Shanghai, Sao Paulo and Mumbai). Thus, the places where both networks integrate with each other are located partially in the traditional high income economies of Europe and North America, and partially in the emerging economies of (particularly) Asia and South America. It shows that old networks and structures remain relevant today, aligning with the idea of the continuing Western corporate dominance of

the global economy against the background of shifting global production centres. However, our analysis shows this traditional network is definitely supplemented by new spatial structures with new strategic power hubs, allowing for incremental yet transformative change in the global corporate power networks of the petrochemical industry.

It needs to be stressed again that these maps should be interpreted with some caution. Not only is the data itself not completely accurate (because of outdated or false information in the company data set), the analysis itself provides a one-sided perspective on corporate networks. It does not show how important certain ties or places are in monetary terms, nor where the main production centres are located or where most added value is created. However, even though the maps should only be used to get a general overview and observe some global trends, they still provide an interesting insight into the spatial strategies and changing power structures of this polluting but economically important industry.

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The Existential Crisis of the Petrochemical Industry and Discourses of Sustainability: Reflections from the 34th World Petrochemical Conference

*Dr. David Brown, University of Warwick @**browndee17***

In recent years, a backlash against plastics has been observed in the public sphere, with plastics as a commodity seen to be losing its 'social licence'. Plastic waste has emerged as an environmental crisis in public discourse, considered to be pervasive and indomitable. According to the UN (2017), around 8 million tons of plastic waste are dumped every year into the seas, destroying marine wildlife and habitats. Plastic waste risks "near permanent pollution of the Earth", as scientists have recently suggested (The Guardian, 2017). The public is increasingly of the view that plastics production and consumption is unsustainable in its current state.

In response to this public backlash, governmental, non-governmental and corporate actors have made pledges to significantly reduce levels of plastic waste. A number of countries have committed to phasing out plastic packaging and single-use plastics. The EU has set

a target of all plastic packaging in Europe being recyclable by 2030. In the corporate world, numerous initiatives and alliances have emerged to combat plastic waste. Notably, the Alliance to End Plastic Waste launched in early 2019, as a coalition of companies across the plastic waste chain, including 'chemical and plastic manufacturers, consumer goods companies, retailers, converters, and waste management companies'. Thus far, over 25 multi-national companies have participated in the Alliance, including Procter & Gamble, Shell, BASF and ExxonMobil. Together, the Alliance has committed $1 billion over the next 5 years to combat plastic waste (Alliance to End Plastic Waste, 2019).

Given its dependence upon plastics production and consumption, an existential crisis of sorts has emerged in the petrochemical industry. The industry has begun to shift towards a discourse of sustainability, increasingly talking about the circular economy and recycling initiatives. But, what is behind this discourse and what does this conversational shift really mean? I considered these questions, among others, at this year's 34th World Petrochemical Conference (WPC) in San Antonio, an annual petrochemical industry event organised by IHS Markit and aimed at providing critical insight and analysis into industry trends across the supply chain.

Sustainability was a key theme of this year's WPC event in San Antonio, Texas. For the first time in its history, there was a 'Sustainability Forum' at the conference on Day 1, devoting an entire afternoon session to questions of sustainability, recycling and the circular economy. Meanwhile, the 'Executive Panel' on Day 2 was strongly driven by discussions of the plastic waste crisis and how the industry can best respond to it, notably including chemical recycling, waste management infrastructure and clean-up operations.

Outside of the presentations, the conversations with delegates also reflected a shift in the conversation at the WPC, with many commenting on the stark change in this year's thematic agenda. While previously the WPC was almost purely an exercise in market forecasting, this year's focus had significantly shifted towards sustainability discussions. To varying extents, issues of sustainability were present in most discussions at the conference. As would be expected, the sustainability challenges were often couched in economic terms and considered in relation to future market trends and opportunities. However, during the 'Sustainability Forum' and the 'Executive Panel', plastic waste issues were discussed to some extent in their own right, as part of an open and 'bigger picture' discussion.

Networking break at the WPC, 2019 *Credit: David Brown, 2019*

One speaker at the WPC commented that this does not constitute a plastics 'crisis', but rather a 'moment of reflection' or 'turning point' for the petrochemical industry; however, the distinct and significant shift in discourse among industry actors at the conference suggests otherwise. Almost all industry speakers agreed on the urgent need to advance sustainable solutions to managing plastic waste. The Alliance to End Plastic Waste was presented as being key in responding to the crisis. Emphasis was placed on the Alliance's 'ambitious' targets and there was a general feeling among conference delegates that the movement and momentum surrounding the Alliance is unprecedented, after having formed and rapidly developed in a matter of months.

The largely uncritical praise generally heaped on the Alliance is evidently closely tied to the prominent position adopted by those who founded the Alliance at the WPC, with many of these presenting during the 'Sustainability Forum' and the 'Executive Panel'. However, the positivity surrounding the Alliance had also clearly percolated among delegates. I got the sense at the conference that delegates generally liked the idea of the industry, rather than regulators, leading the discussions on ending plastic waste. The Alliance presents an opportunity for the petrochemical industry to become perceived leaders in the conversation and action on plastic waste sustainability, rather than having regulations and legislation imposed on them.

Speakers and delegates at the WPC often brought up the argument that simply setting ambitious targets is insufficient if companies do not know how to achieve these and do not know the next steps in responding to these. There was a subtle critique of the EU's 2025 plastic waste targets in some of the sustainability conversations here (see here: http://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf): that these are set too high, aren't realistic, and haven't sufficiently involved firms in setting these. Industry actors at the WPC tended to pitch themselves as more 'pragmatic' and 'reasonable' than regulators, suggesting that their enhanced involvement in regulatory conversations and establishment would engender further movement on tackling plastic waste. It was left implicit that if the petrochemical industry was involved in discussions around plastic waste regulation or the setting of associated targets, that these would be less strict or ambitious.

During the 'Sustainability Forum' and 'Executive Panel', conversations indicated forthright responses to the existential crisis faced by the industry. On numerous occasions, speakers and delegates attempted to aggressively justify the use and production of plastics. Emphasis was consistently placed upon the perceived comparative sustainability of plastics, notably their efficiency, light-weightedness and cost-effectiveness. Plastics were promoted as a 'sustainable solution' and as having a lower carbon footprint than other more intensive and heavier materials, related to transport fuels efficiency and reducing food waste.

Sustainability Forum and Executive Panel at the WPC, 2019 *credit: David Brown, 2019*

While accepting the need to effectively respond to the public backlash against public waste, some kind of advocation for plastics was brought up in almost every presentation and in many conversations. There was a sense that the industry feels it need to justify and rationalise its existence from a societal perspective, putting the growth of the industry in the broader context of the benefits that plastics has provided to society. Thus, the idea that this is an existential threat to the petrochemical/plastics industry holds some weight, considering that industry actors are making arguments for the existence of the industry that they have likely rarely made before, or at least for a long time.

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The positive narrative on plastics at the conference was closely tied to a framing of the public as unreliable, irrational or lacking in critical knowledge. In a number of the sustainability talks, the public was depicted as 'emotionally' responding to pictures of plastic waste, but not knowing the 'real story' about plastics. Notably, one speaker argued that the public does not understand the 'life cycle' of plastics, its sustainability benefits or the waste from other kinds of products, intimating that the public backlash against plastics is grounded in 'emotion', not 'data'. It was pointed out by another speaker that plastic waste has emerged as a key issue of sustainability in the public sphere because of its visibility (i.e. floating debris in the ocean), rather than it actually being the biggest issue.

Indications from the WPC were that the petrochemical industry's shift in conversation has been fundamentally driven by responding the public backlash against plastics, as a way of maintaining their 'social licence' in plastics production, and to emerging regulations around plastic waste management, rather than addressing the environmental challenges for their inherent worth. The narratives elsewhere at the WPC indicate that the industry would not be seeking to change practices otherwise.

Indeed, the industry's priorities were prominent in the other sessions at the WPC. A significant proportion of these were devoted to market forecasting and to assessing future opportunities for specific chemicals, e.g. styrene, benzene. This would have been an uninterrupted discussion at previous WPC events. Here, growth is king, with the conversation starkly shifting away from sustainability towards opportunities for expansion: increased integration, the expected development of 'mega refinery/petrochemicals' projects and the further growth of crude-to-chemicals technology in China.

As a Guardian (2019) report recently detailed, many of the same companies supporting an 'alliance to end plastic waste' are among those behind the largest investments in new plastic production plants (e.g. ExxonMobil, Shell) and depend on the continued growth of plastics production. The lack of fundamental change offered by the industry is reflected in the Alliance's primary proposed project areas (and focuses of discussion at the conference): new recycling technologies (including chemical recycling), recycling infrastructural developments and plastic waste clean-ups (Alliance to End Plastic Waste, 2019). All of these allow, and perhaps even facilitate, the continued growth of petrochemical and plastics production and do not address the fundamental issues of sustainability in the industry (e.g. short lifespan of products). I get the sense that the industry is having its cake and eating it: shifting the conversation towards recycling and sustainable waste management solutions, but fundamentally persisting with its growth-oriented market strategies.

The drive behind the discursive shift at the WPC was also reflected in the largely narrow definition of sustainability at the conference, with conversations almost entirely dominated by plastic waste management and recycling. There was little mention of other relevant topics of sustainability. Climate change was much less prominent at this year's WPC, but regulations surrounding it have evidently been a key driver of the industry's actions and strategies over the last few years. At this year's conference, the need for the industry to

keep in line with the GHG emissions targets set at the Paris COP was highlighted on occasions.

It is notable that other forms of environmental crises were not considered in the industry's analysis at the WPC, pertinently the significant levels of air and water pollution associated with petrochemical facilities. Indeed, during the conference itself, over 8 million toxic pollutants had been emitted from a large-scale fire at a Houston petrochemical facility (Grist, 2019). In fenceline communities over the world, the toxic pollution from petrochemical sites is closely linked to local environmental degradation and negative health outcomes on proximal residents, incorporating respiratory conditions (e.g. asthma), cardiovascular conditions, headaches and a raised risk of various forms of cancer. In 'sacrifice zones' (Lerner, 2010), such as Cancer Alley, an 85-mile stretch of land from New Orleans to Baton Rouge notable for its dense concentration of industry from the petrochemical sector, low-income, marginalised and minority communities have disproportionately borne the brunt of the everyday environmental and health impacts of living in close proximity to petrochemical sites, considered a form of 'slow violence' (Nixon, 2011).

Although we are dealing with different scales of concern, there is a notable disconnection between the localised health and environmental concerns of fenceline communities throughout the world, and the discourses of sustainability emanating from the petrochemical industry. The industry is concerned with responding to the existential crisis it faces around plastic waste and maintaining the social licence of plastic production, with other forms of environmental degradation and injustices effectively side-lined, removed as they are from public and media conversations. Equally, the unsustainable practices and strategies of the petrochemical sector can continue under the industry's narrow and bounded framing of sustainability.

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Petrochemical Landscapes: A European Perspective

Image credit: J McSporran CC BY 2.0

Dr Calvin Jephcote, University of Warwick

Petroleum has been the fuel for dramatic change in the twentieth century, as a source of energy it has revolutionised transport and powered technological advances, but as a chemical it has also enabled humankind to engineer synthetic environments. The petrochemical industry was initially created from the desire to commoditise (the potentially toxic) by-products of the oil-refining industry, and has relatively recent origins, dating back to the manufacture of Bakelite plastic in 1907 and synthetic rubber in 1909. Petrochemicals are now classified as intermediate products of refining fossil fuels and form the building blocks for a host of essential everyday commodities, such as adhesives, detergents, fertilisers, pharmaceuticals, plastics, preservatives, and textiles.

The petrochemical industry remained a relatively experimental sector until the end of World War II (post-1945), as socioeconomic reconstruction projects urgently demanded access to inexpensive synthetic materials. Companies from the United States controlled 71% of the worlds refining capacity prior to 1945, establishing themselves as clear leaders in the emerging field of petrochemicals (Felton 2004).

For many years, the market dominance of these Anglo-American oil companies known as "the seven sisters" – BP, Chevron, Esso, Gulf, Mobil, Shell and Texaco – was maintained through vertical integration, and their ability to maintain high technological and geopolitical entry barriers for would-be competitors. Oil prices were set through their control of upstream exploration activities, which in turn limited the profit margin for potential competitors in down-stream activities (vertical integration). However, by 1970 the thirst for oil had begun to exert huge pressure on existing supply structures, as levels of global consumption rose to 46.2 million barrels per day – a 115% increase on levels reported in 1960 (Llewellyn et al 2013). In an increasingly globalised market, producing nations began to reclaim control of their oil resources and established an independent oil trade, which led to >300 private and 50 state-owned firms operating by 1972 (Llewellyn et al 2013).

European refining industries had previously been limited in size, restricted by the continents lack of crude-oil deposits – before the discovery of commercially viable North Sea oil in 1969. However, this period of rapid economic growth and an ample supply of cheap crude imports saw oil consumption in Europe rise from 12% of the global total in 1950, to 27% by 1970 (Molle 1984). Following this period of rapid growth, the European petrochemical industry has been challenged by periods of economic downturn and competition from emerging markets with access to low-cost 'feedstock'. To remain economically viable, the European market was streamlined and sought to diversify its production from commodity to speciality chemicals.

The current landscape of the European petrochemical industry remains in part reflective of its historical roots, which in the 1950's saw the strategic location of refineries around seaports receiving feedstock from overseas, later supplemented in the 1970's by North Sea petroleum reservoirs.

This legacy is observed by the presence of petrochemical clusters in six out of the ten most active European ports, where upper estimates indicate that the industry is accountable for 34-64% of handled cargo (Eurostat 2015). These core locations include the historically important North Sea trade ports of Antwerp, Le Havre, Rotterdam and Immingham, and the Mediterranean ports of Algeciras and Marseille. Three ports contain chemical parks registered by the European Chemical Site Promotion Platform (ECSPP), which promotes integration and innovation across the industry.

FIGURE 1 illustrates this tendency for facilities to cluster either around historically important trade ports, or close to existing coastal industrial infrastructure in less affluent regions (Jephcote & Mah 2019). The petrochemical industry is also prominent within the Mediterranean islands of Malta and Sardinia, which are strategically positioned to process crude from Northern Africa and the Middle East for markets in mainland Europe. At present, 66% of European refineries are located within 10km of major trade ports (Jephcote & Mah 2019). Although coastal ports still dominate the petrochemical landscape, there has been a gradual shift towards inland markets –15% of European refineries were located at inland sites from 1950 to 1960, 28% in 1980, and approximately 44% by 2010 (Molle 1984, Jephcote & Mah 2019). For instance, the port of Genoa has

become an important terminal that feeds refineries within the Milan-Turin-Genoa industrial triangle of north-western Italy, via a complex network of pipelines.

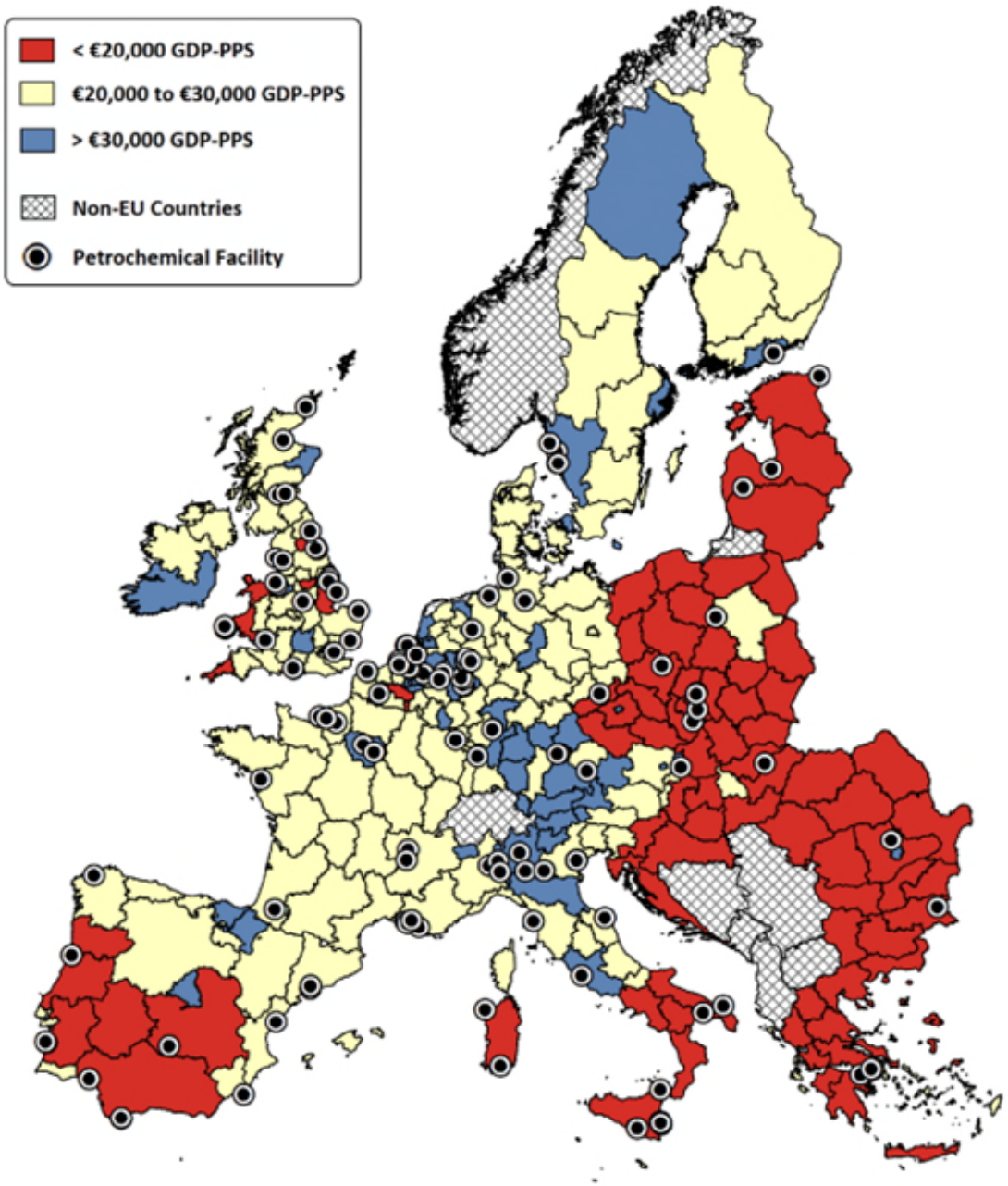

FIGURE 1: *European petrochemical facilities operating between 2007-15 in relation to regional socio-economic status, as recorded by Gross Domestic Product per capita in Purchasing Power Standards (Jephcote & Mah 2019)*

Jephcote & Mah (2019) identified the core of the European petrochemical network from 'European Pollutant Release and Transfer Register' (E-PRTR) records of 31,753 industrial operations, located within EU-28 Member States for the reporting period of 2007-15. This was achieved using a bottom-up approach, whereby a facilities involvement in the petrochemical industry was identified through releases of a tracer pollutant, benzene. Benzene is a natural component of crude petroleum at levels up to 4 g/l and is one of the elementary petrochemicals used to chemically synthesise new products, which may contain up to 15% volume benzene (WHO 2010a, IARC 1989). The World Health Organisation guidelines state that there are no safe levels of exposure to benzene (WHO 2010b).

Of the 156 identified petrochemical facilities, 28% operate in affluent regions (GDP-PPS > €30,000 per capita) and 27% are situated within relatively disadvantaged regions (GDP-PPS < €20,000 per capita). The most polluting facilities tend to be located within these financially disadvantaged regions, which report median benzene emissions of 12.6 tonnes per annum, compared to facility emissions of 5.1 tonnes per annum in affluent regions. 60% of the facilities in disadvantaged regions are near ports, compared to 47% of the facilities within affluent regions. In these affluent regions, 34% of the petrochemical industry focuses on manufacturing and 66% involve the refining of raw materials. In contrast, operations in disadvantaged regions are evenly split between manufacturing and refinery processes.

While petrochemical facilities in all European Union regions are regulated to be compliant with the annual average benzene limit of 5 μg/m^3, uneven exposures prevail and often coincide with regional health inequalities (Jephcote & Mah 2019).

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Book Review: Quando il potere è operaio: Autonomia e soggettività politica a Porto Marghera (1960-1980)

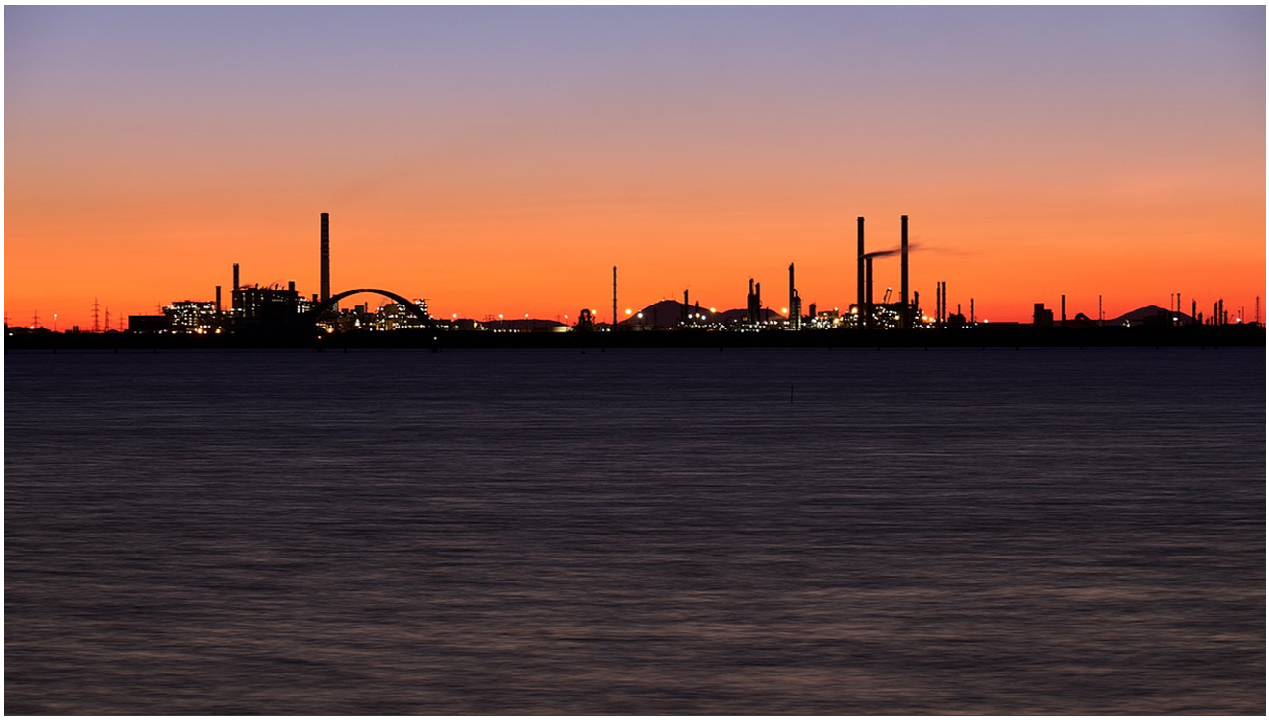

Image 'Porto Marghera – Tramonto' credit: Roberto Busatto CC BY 2.0

Dr Lorenzo Feltrin, University of Warwick ***@lorenzo_feltrin***

This year marks the tenth anniversary of the publication of *Quando il potere è operaio: Autonomia e soggettività politica a Porto Marghera (1960-1980) (*edited by Devi Sacchetto and Gianni Sbrogiò, 2009, Roma: Manifestolibri), translatable as "When Power is Workers' Power: Autonomy and Political Subjectivity in Porto Marghera (1960-1980)". The book deals with the experience of the *operaista* and autonomist workers' collectives in the industrial complex of Porto Marghera, Venice. It contains a historical account by labour leader Gianni Sbrogiò based on the Augusto Finzi Workers' Archive,[i] a sociological analysis by Prof Devi Sacchetto based on in-depth interviews with workers and activists, the "Refusal of Work" manifesto published in 1970 by the Workers' Committee of Porto Marghera[ii] as well as articles by intellectuals Antonio Negri, Massimo Cacciari, and Karl Heinz Roth. It also includes a DVD with the documentary "Gli anni sospesi: Movimenti e percorsi a Porto Marghera" by Manuela Pellarin.[iii] As political ecologist Emanuele Leonardi wrote: "In Italy, environmental issues became politicised *through* workers' struggles, and not *in spite of* them. […] The paradigmatic [case was] the dispute over

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workplace harmfulness in Porto Marghera's petrochemical hub, since 1969" (Leonardi 2017). The materials contained in the book under review are thus of great interest for researchers on environmental justice and the petrochemical sector. Unfortunately, the volume was published in Italian only. This review, therefore, summarises its contents to provide the core information to the English-language reader.

The industrial complex of Porto Marghera was established in 1917 in the mainland side of the lagoon of Venice. In 1955, the Milanese company Edison opened its petrochemical plant there. Production increased enormously after Edison merged with Montecatini in 1966 to become Montedison. In the mid-1960s, the industrial complex reached its peak of employment, with about 40,000 workers. The first decades of Porto Maghera were characterised by a situation of labour weakness and relative social peace, accompanied by appalling health and safety conditions (see also Zazzara 2009). In the 1960s, however, Porto Marghera became the major labour stronghold of North Eastern Italy. While the communist-led Confederazione Generale Italiana del Lavoro (CGIL) was dominant, Porto Marghera was also the main base for the activities of more radical and libertarian leftist groups, particularly Potere Operaio and later Autonomia Operaia. *Quando il potere è operaio* focuses on the latter groups.

In the early 1960s, a group of intellectuals based in nearby Padua, including Antonio Negri, began to collaborate with the review *Quaderni Rossi*, carrying out participative workers' enquiries – called co-research – in local factories and publishing a local bulletin titled *Potere operaio* (Workers' Power). These workers and intellectuals would soon become known as *operaisti*. These were the beginnings of a tradition of heretical and anti-authoritarian Marxism that would later gain some notoriety in Anglophone critical theory too (see Wright 2002). In 1967, Potere Operaio fully became a political organisation and a group of Porto Marghera workers founded the Workers' Committee of Porto Marghera in connection to it. In the summer of 1968, the Workers' Committee led a hard campaign for equal pay raises at Montedison including "checkerboard" strikes, pickets, marches, and the occupation of the Mestre train station. In 1969, Porto Marghera was – together with Milan and Turin – one of the capitals of the strike wave known as Italy's *Autunno Caldo* (Hot Autumn). In 1970, the main Workers' Committee leaders were expelled from the CGIL union. In 1972, the Workers' Committee distanced itself from Potere Operaio (which would dissolve in 1973) to constitute the Autonomous Assembly of Porto Marghera, with its own journal, *Lavoro Zero*, to be later accompanied by the bulletin *Controlavoro*.

As Gianni Sbrogiò writes:

> *1968 was the year when the Workers' Committee started to intervene decisively on the problem of the* nocività *(harmfulness) inherent to the products and the methods of work, starting with the VC plants (vinyl chloride monomer, chlorine compounds and derivatives), then the TDI plants (phosgene and toluene diisocyanate) and – even before that – the San Marco furnaces (acetylene from calcium carbide). […] The Workers' Committee opposed the idea that harmfulness was unavoidable and that allowances could settle the matter, while the unions had been accepting this and negotiating on such bases for long. The slogan was "Health can't be paid for" and we stated that harmfulness should be removed*

> *by modifying the plants and decreasing exposure to toxicity through a reduction of working hours [without wage cuts]. (p. 33)*

In the 1970s, there were numerous strikes and demonstrations with explicit demands over health and toxicity, encompassing the surrounding territory. These featured the collaboration between workers and experts, particularly doctors, in studying and opposing industrial contamination. *Lavoro Zero* broadened the scope of analysis from the health of the workers to broader questions of the capitalist use of life and the territory, so that it has been called the first environmentalist journal in Italy (see Borio *et al.* 2002). Harmfulness constituted a further wedge between the unions and the autonomists. While the former included the safeguard of health in their platforms to negotiate with the employers the reform of the labour process, the latter added to this the "refusal of work", i.e. the rejection of work ethics and the demand for an equal reduction of work time with no wage cuts as an anti-capitalist response to automation an unemployment.

With the 1973 economic crisis, Porto Marghera entered a process of restructuring and downsizing that would erode workers' militancy, first in a slow manner and precipitously since the end of the 1970s. In the decades following the period covered by the book, Porto Marghera underwent a steady decline, so that today less than 1,000 workers are employed in its petrochemical industries. A group of Montedison and Enichem managers would be tried in one of Italy's most famous environmental justice trials with the accusation of knowingly neglecting CVM's toxicity, despite being informed of it since 1972, causing the death of at least 157 workers.[iv] On 2 November 2001, the first sentence acquitted all defendants, while the final sentence in 2006 had some light convictions. In 2002, a large explosion in Dow Chemical's TDI plant (where phosgene was also stored) spurred an environmentalist movement against hazardous chemical production in the area. In 2006, a consultative citizens' referendum voted with an 80% majority against the permanence of the chloride cycle in Porto Marghera. In the same year, Dow Chemical divested from its plant in the area.

Quando il potere è operaio is a precious documentation of a landmark – if scarcely known outside of Italy – instance of working-class environmentalism. If today the so-called "employment blackmail" – i.e. the notion that the workers of toxic factories should leave health and environmental concerns aside to protect their income – is more effective than in times of quasi-full employment, this experience, and the theoretical elaborations that surrounded it, is still important for those who think that class and environmental politics should go together rather than being at odds with each other. Particularly interesting in this respect is the work of *operaista* feminists like Mariarosa Dalla Costa and Leopoldina Fortunati (see Dalla Costa 2019; Fortunati 1988), whose activism was immersed in the working-class communities of the area. Their expansion of the notion of work and working class and their theorisation of power at the point of reproduction provide an invaluable toolbox to analyse in class terms today's community struggles against toxicity. *Quando il potere è operaio* is also a crucial document to understand the social context in which such perspective emerged.

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[i] Augusto Finzi (1941-2004) was a leader of the Workers' Committee and of the Autonomous Assembly. Born of a Venetian Jewish family, he spent part of his childhood in a refugee camp in Switzerland to escape the holocaust. The Augusto Finzi Archive was created in 2006 and is hosted by the Marghera public library.

[ii] An English translation of the manifesto can be found here: https://libcom.org/library/refusal-work-workers-committee-porto-marghera-1970 (retrieved 8 May 2019).

[iii] Another documentary on the topic, with English subtitles, is "Porto Marghera: The Last Firebrands" (2004) by Manuela Pellarin and Enrico Soci. It is available on YouTube: https://www.youtube.com/watch?v=CiplVIxrgdc (retrieved 8 May 2019).

[iv] Later research has shown that at least 248 Montedison/Enichem workers died (especially by liver cancer) as a result of exposure to vinyl chloride monomer (Pirastu *et al.* 2003).