Hazardous Chemical Releases at Large:

An Investigation at the Lianyungang Chemical Industrial Park, Jiangsu Province, China

Greenpeace East Asia

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Contents

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Acronyms

BHT	Butylated hydroxytoluene
CAS	Chemical Abstracts Service
CLP	Classification, Labelling and Packaging in European Union
CMR	Carcinogen, Mutagen, Toxic for Reproduction
COD	Chemical oxygen demands
CODCr	Chemical oxygen demands determined by the method using potassium dichromate
DBP	Dibutyl phthalate
DEHP	Di-(2-ethylhexyl) phthalate
DEP	Diethyl phthalate
DIBP	Diisobutyl phthalate
EDC	Endocrine disrupting chemicals
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GIS	Geographic Information System
GDP	Gross Domestic Product
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
IUCN	International Union for Conservation of Nature and Natural Resources
MEP	Ministry of Environmental Protection of the People's Republic of China
MIIT	Ministry of Industry and Information Technology of the People's Republic of China
NDRC	National Development and Reform Commission of the People's Republic of China
PBT	Persistent Bioaccumulative Toxic
PCB	Polychlorinated biphenyl
PeCB	Pentachlorobenzene
POPs	Persistent Organic Pollutants
PRTR	Pollutant release, transfer and registration
PVC	Polyvinyl chloride
REACH	Registration, Evaluation, Authorisation and restriction of CHemicals
SAWS	State Administration of Work Safety of the People's Republic of China
SIN list	Substitute it Now! list by Chemsec
SVHC	Substance of Very High Concern under the European Union REACH regulation
SVOCs	Semi-volatile organic compounds
VCM	Vinyl chloride
VOCs	Volatile organic compounds
vPvB	Very persistent and very bioaccumulative
WWSD	World Summit on Sustainable Development
WWTP	Wastewater treatment plant

I. Introduction

> *"As the largest developing country, China has around 25,000 chemical enterprises producing and using over 50,000 kinds of chemicals, and its production or consumption of over 20 of them ranks among the greatest in the world."*
> *– CHEN Jining, Minister of Environmental Protection, People's Republic of China, OurPlanet September 2015, United Nations Environment*

Among the existing chemicals registered in China, 2,828 chemicals are currently categorized as "hazardous chemicals" and subject to safety production permit management[1]. The listing of these chemicals considers not only their physical properties, but also the intrinsic hazards they pose to human health and/or the environment[2]. Yet the scope of chemicals sharing these hazardous properties are broader than what is currently listed in the Catalogue of Hazardous Chemicals in China, and that in the absence of a so called "sound chemicals management" system, namely one that integrates environmental, health, and safety management in practice, hazardous chemicals are becoming increasingly present in water, air, soil and living organisms as a result of being released during manufacturing, use and/or disposal in China[3].

This report examines hazardous chemicals released by a typical chemical industrial park, the main modality of the development of the chemical industry in China[4]. The investigation and sampling results indicate the presence of chemicals which as a group include the following properties, that are consistent with the definition of hazardous chemicals as set out by Greenpeace[5], including:

- Persistence (`chemicals that do not readily break down in the environment as the result of biodegradation or other processes);
- Bioaccumulation (chemicals that can accumulate in organisms, and whose concentration can even increase further along the food chain);
- Carcinogenic properties (chemicals that can cause cancer);
- Mutagenicity (chemicals that have the capacity to induce mutation and genetic defects);
- Toxicity towards the reproductive system (chemicals that can harm the reproductive system, including its development) or the nervous system; or
- The capability to disrupt endocrine (hormone) systems.

The report also shows the alarming fact that industries discharging these hazardous chemicals do so beyond the realm of current environmental regulations and standards, especially with regard to

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[1] Catalogue of Hazardous Chemicals, 2015, State Administration of Work Safety, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm

[2] ibid

[3] Poisoning the Pearl: An investigation into industrial water pollution in the Pearl River Delta (2nd Edition, January 2010), http://www.greenpeace.org/eastasia/publications/reports/toxics/2010/pearl-river-report-2009-2nd/

[4] Ministry of Industry and Informational Technology (MIIT), December 10, 2015, http://www.miit.gov.cn/n1146295/n1652858/n1652930/n4509650/c4533643/content.html

[5] See "Hazardous Chemical Pollution of the Pearl River", Greenpeace, 2009, page 10, http://www.greenpeace.to/publications/hazardous-chemical-pollution-o.pdf

safety management of chemicals. This reflects a gross negligence of safety concerns needed to protect workers, public health, and the environment from chemical harm.

Since 2010, China has become the world's largest chemical manufacturer and user, and its chemical production is predicted to grow 66 % annually between 2012 to 2020 to maintain a rank as the highest worldwide (in comparison, the total growth of chemical production in North America and Western Europe over the same period was predicted to be about 25 and 24 per cent, respectively)[6]. Given this growth, and with green and innovative development identified as new development outlooks for the Thirteenth Five-Year-Plan period (2016-2020)[7], an integrated approach to the "sound management of chemicals" is urgently needed in China. "Sound chemicals management" aims to prevent, where it is not feasible, to reduce or minimize the potential for exposure of people and the environment to toxic and hazardous chemicals as well as chemicals suspected of having such properties. The application of sound management of chemicals is based on the following principles[8]:

- Pollution prevention: Rather than reply on treatment and control technology to prevent the release or exposure to chemicals, it looks at the ways to prevent the use of hazardous chemicals and the production of pollutants, including wastes.
- The precautionary approach: It encourages the use of cost-effective measures to prevent potential negative health and environmental impacts even if there is lack of full scientific certainty.
- Internationalization of environmental and human health costs: This can be achieved through the use of economic instruments such as the "polluter pays" or the facilitated "extended producer responsibility".
- Right-to-know: This encourages access to information on chemicals, their safe use and releases to the environment in a timely fashion to workers and the public, including vulnerable groups.

Sound chemicals management has been widely recognized since the adoption of Agenda 21 (Chapter 19) in 1992, and highlighted at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 with governments' renewed commitment to sound management of chemicals throughout their life cycle for the protection of human health and the environment. The WSSD set the goal that by 2020 chemicals are used and produced in ways that lead to the minimization of significant adverse efforts on human health and the environment[9]. Such an integrated approach to chemicals management has been seen by many as contributing to production efficiency and competitiveness for chemical industry and businesses, including on international markets[10]. Fortunately, there is rising recognition for the need of sound management

[6]Swift, T.K., Gilchrist Moore, M., Bhatia, S. et al. (2011). Mid-Year 2011 Situation & Outlook. American Chemistry Council.

[7]http://www.sdpc.gov.cn/zcfb/zcfbghwb/201603/P020160318573830195512.pdf

[8] "Practices in the Sound Management of Chemicals", UNDESA, Stockholm Convention, UNEP, 2010, https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=41&menu=35

[9] "Practices in the Sound Management of Chemicals", UNDESA, Stockholm Convention, UNEP, 2010, https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=41&menu=35

[10] Various papers on this, e.g.: Strategy on Sound Chemicals Management for the 5th Replenishment Period of the Global Environment Facility, 2010, https://www.thegef.org/sites/default/files/council-meeting-documents/C.39.Inf_.11_Strategy_on_Sound_Chemicals_Management_1.pdf; Capacity Building for Sound Management of Chemicals, Swedish Chemical Agency, 2010, http://www.kemi.se/global/pm/2010/pm-1-10.pdf;

of chemicals in China. For example, China's National Plan of 2030 Sustainable Development Agenda[11] has made the commitment that by 2020 environmentally sound management of chemicals and all wastes throughout their life cycle will be achieved. What is now needed is action that is both far-sighted and implemented immediately.

Greenpeace has been campaigning on the issue of hazardous chemicals for over three decades. Based on a series of investigation on the releases of hazardous chemicals and their management at the level of chemical industrial parks in Jiangsu and Shandong provinces, this report calls for a hazard-based transparent and preventative sound chemicals management system be adopted in China in line with its development strategy and commitment to improving the quality of the environment while upgrading its economy. This report also contains recommendations for closing the gap between the widespread chemical crisis[12] and the pathway to sustainable chemistry in China.

Towards Integrated National Implementation of International Obligations in respect of Chemicals Management: An Industry Perspective on Synergies for Capacity Building under International Agreements Addressing Chemicals, Chemical and Allied Industries Association, South Africa, http://cwm.unitar.org/publications/publications/cbl/synergy/pdf/cat1/submission/caia.pdf.

[11] Sustainable Development Goal 12. Ensure sustainable consumption and production patterns, Goal 12.4 "Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, and minimizing their adverse impacts on human health and the environment. Substantially improving the level of green chemical industry technologies", China's National Plan on Implementation of the 2030 Agenda for Sustainable Development, September 2016, Ministry of Foreign Affairs of China.

[12] See http://www.greenpeace.org/eastasia/press/releases/toxics/2016/China-averaged--29-chemical-accidents-per-month-so-far-this-year---Greenpeace/, China Chemicals Accident Counter of Year 2016 released by Greenpeace East Asia (http://api.greenpeace.cn/upload/file/533596c578caf3cf9c273e6d6f00864b.pdf); and China Chemical Accidents Counter 2016, 2017, Greenpeace East Asia, http://api.greenpeace.cn/url/fYl2itmU

II. Executive Summary

A chemical industrial park is found discharging hazardous chemicals without proper control in Lianyungang, Jiangsu province, China.

Industrial pollution, especially from the chemical industry, comes as no surprise in China. Greenpeace East Asia (hereafter referred to as "Greenpeace") has noted some 468 reported chemical accidents occurring in 2016 alone in China[13]. As the chemical industry expands across the country, especially along coastal areas, the concentration of chemical facilities and industrial parks is highly correlated with population density. Rapid urbanization also leads to many cities being besieged by chemical installations[14]. It is acknowledged in China's Thirteenth Five-Year-Plan for Environmental Protection that there is distributional environmental risk resulting from the increasing number of toxic and hazardous chemicals in China[15].

This report shows the extent and complexity of hazardous chemicals found in the discharges of a chemical industrial park in Lianyungang, a historical city along the coast of Jiangsu province that serves as a major chemical industry manufacture base in China. Hazardous chemicals released by the chemical industrial park concerned are found transmitted into the local environment, where no effective policy monitors or controls such practices in spite of the current and long-term threat these chemicals pose to human health and the environment.

The serious gaps and lapses in current government policies and practices of the chemical industry in China are alarming. Current chemical management systems in China comprise patchy and permissive chemical policies and inconsistent chemical industry practices, all of which contradict the vision of green development and improvement of environmental quality detailed with in China's Thirteenth Five-Year-Plan[16].

Greenpeace collected a total of ten samples from or near to Lianyungang Chemical Industrial Park following an environmental inspection led by the central government of China in 2016. Seven samples, including wastewaters and sediments, were collected from a discharge channel receiving effluence from the central wastewater treatment plant of Lianyungang Chemical Industrial Park, and from a small river running cross the discharge channel between the industrial park and local village. In addition, three air samples were collected from the same industrial park and nearby village in November 2016.

Key findings of the investigation:

1. The results of the four water and three sediment samples from the two different locations on the Lianyungang Chemical Industrial Park provide evidence for contamination of both the Small

[13] China Chemical Accidents Counter 2016, Greenpeace East Asia, http://api.greenpeace.cn/url/fYl2itmU
[14] See "Spatial Distribution Mapping of China's Chemicals Industry", Greenpeace, September 2016, https://secured-static.greenpeace.org/eastasia/Global/eastasia/publications/reports/toxics/2016/A%20Spatial%20Distribution%20Mapping%20of%20China%E2%80%99s%20Chemicals%20Industry%20-%20GPEA%20media%20briefing.pdf
[15] The Thirteenth Five-Year-Plan for Environmental Protection of China, http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm
[16] Thirteenth Five-Year-Plan for National Economic and Social Development of China, http://www.gov.cn/xinwen/2016-03/17/content_5054992.htm

River and the Wastewater Discharge Channel with complex mixtures of numerous hazardous chemicals, many of them halogenated (chlorinated or fluorinated) and some highly persistent upon reaching the environment.

2. A total number of 226 organic chemicals were identified across the samples collected from Lianyungang Chemical Industrial Park Wastewater Discharge Channel or its conjunct Small River. Among which, 26% are listed as “hazardous chemicals” according to China’s Catalogue of Hazardous Chemicals (2015 Edition).
3. The mixtures of contaminants present include many chlorinated and fluorinated compounds used in the manufacture of pesticides, pharmaceuticals or specialist industrial chemicals, as well as of vinyl chloride (VCM) used in the production of PVC plastic. Residues of a total of 15 different pesticides were found in the water system of Lianyungang Chemical Industrial Park.
4. The presence of a diverse range of organic compounds in the water, as well as the sediment, including high concentrations of a number of volatile organic compounds, which indicates substantial ongoing discharges of contaminated industrial wastewaters to these channels, rather than just reflecting historic inputs.
5. The preliminary air sampling result shows that air samples collected in the Lianyungang Chemical Industrial Park contained eight VOCs of higher concentrations than the background levels, and that are listed in the Catalogue of Hazardous Chemicals (2015 Edition) as hazardous chemicals. In addition, all 8 VOCs were also identified in one or more water samples collected from the Industrial Park.
6. As both the Small River and the Wastewater Discharge Channel connect to the GuanHe River and, ultimately, to the Yellow Sea, the presence in both water and sediments of such complex mixtures of toxic or hazardous organic compounds, including a number of persistent organic pollutants (POPs) and carcinogenic chemicals, is clearly cause for high concern in terms of both environmental pollution and public health.
7. Lianyungang Chemical Industrial Park has evidently already created a hotspot of toxic chemical pollution, and one that may be expected to continue to worsen over time unless action can be taken to prevent further discharges of hazardous chemicals to the channels and to contain and deal with the contaminated sediments.

Greenpeace calls for a preventative chemicals management policy and a “zero discharge” plan of hazardous chemicals to be urgently implemented in China. As it economy restructures across different sectors, China is facing a unique opportunity to incorporate such a sound chemicals management system. In the longer term, this is the most cost-effective solution to truly sustainable innovation and hazard elimination in China. The time to leapfrog is now.

Greenpeace calls for immediate action on the following:

- The examination of the means of release and the extent of pollution with regard to hazardous chemicals perpetrated by chemical industrial parks across China, in order to identify hotspots for decontamination.
- The establishment of a pollutants’ release, transfer and registration (PRTR) system, as a basis for a precautionary approach to prevent the release of hazardous chemicals and the resulting harm.
- The improvement and incorporation of sound chemicals management by chemical

industrial parks and local governments in aspects of design, establishment, and operations of chemical parks as a substantive approach to mitigating the environmental risks of aggregated chemical industrial sites, and promoting green chemistry.

- Transparency and proactive communication of hazards of chemicals manufactured, used or released, and potential risks from installations during the relocation process.
- Any newly established chemical industrial park should incorporate sound chemicals management as a requirement and to incentivize other parks.
- Development of a dedicated legal instrument to ensure the implementation of a sound chemicals management scheme in China.

III. Background of the Investigation

The development of chemical industrial parks in China

With more than 25,000 sizable chemical enterprises[17], since 2010 China has become the world's largest chemical manufacturer and user[18], and there are 45,643 chemical substances registered as produced, processed, sold, and used in (or exported to) China for commercial purposes by 2016[19]. As a powerful economic player, the chemical industry[20] in China registered a turnover of RMB 8.7 trillion (USD 1.26 trillion), and a total profit of RMB 498.32 billion (USD 72 billion) in 2016, an increase of 10.7% over 2015[21]. The industrial added value of chemical raw materials and chemical manufacturing increased by 7.7%[22]. There are 2,828 substances listed as "hazardous chemicals" in the "Catalogue of Hazardous Chemicals (2015 Edition)" issued by the State Administration of Work Safety (SAWS) together with nine other Chinese ministries[23]. As of 2016, there are 18,208 enterprises registered in the manufacture of hazardous chemicals in China[24].

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17 "sizable" in this report refers to enterprises with annual revenue of RMB 20 million yuan or more, similarly hereinafter.

18 Ministry of Environmental Protection's Chemicals Environmental Risk Prevention and Control 12th Five Year Plan, published in 2013, http://www.zhb.gov.cn/gkml/hbb/bwj/201302/t20130220_248271.htm

19 Inventory of Existing Chemical Substances (2013 Edition), http://www.zhb.gov.cn/gkml/hbb/bgg/201301/t20130131_245810.htm, and Supplementary Notice issued by the Ministry of Environmental Protection of China, 2016, http://www.mep.gov.cn/gkml/hbb/bgg/201603/t20160315_332884.htm; Ministry of Environmental Protection, Chinese Chemical Inventory of Existing Chemical Substances (2013 Edition), http://www.zhb.gov.cn/gkml/hbb/bgg/201301/t20130131_245810.htm, and its Supplement Notice, http://www.mep.gov.cn/gkml/hbb/bgg/201603/t20160315_332884.htm.

20 "Chemical industry" here refers to chemical raw materials and chemical manufacturing used in China's National Statistics.

21 Statistics from website of Central People's Government of the People's Republic of China http://www.gov.cn/xinwen/2017-01/26/content_5163619.htm

22 National Bureau of Statistics, Statistical Communiqué of the People's Republic of China on National Economic and Social Development in 2016, http://www.stats.gov.cn/tjsj/zxfb/201702/t20170228_1467424.html

23 Catalogue of Hazardous Chemicals (2015 Edition), State Administration of Work Safety (SAWS) with nine other Chinese ministries, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm

24 Changes in Number of Hazardous Chemicals Manufacturers across China in 2016, State Administration of Work Safety,

Policy provisions and developments

With the rapid growth of the chemical industry in China in the past decade[25], chemical industrial parks have quickly emerged across the country. By the end of 2014, China had a total of 1,186 chemical industrial parks registered at or above the provincial level[26], including at the 235 national level and 951 at the provincial level[27].

Policies play a critical role in the developments of chemical industrial parks in China. In 2008 the Safety Production Committee of the State Council announced that all new chemical projects must enter chemical industrial parks or industrial clusters[28], and in 2012 the Ministry of Industry and Information Technology of China (MIIT) specified that all new hazardous chemical manufacturing enterprises must be located in chemical industrial parks following a set of strict entry requirements[29]. Those hazardous chemical manufacture or storage enterprises with high safety and environment risk outside need to be relocated into industrial parks or phased out or transited into other sectors within a specific timeline[30].

In December 2015, MIIT for the first time pointed out the development red-line and principles in the "Guidelines for the Development of Chemical Industrial Parks", prohibiting the planning or building of chemical industrial parks within designated ecological conservation areas, nature reserves, drinking water source protection areas, basic farmland protection areas and other environmentally sensitive areas[31].

Underpinning these policy changes on the development of chemical industrial parks are concerns over safety and environmental risks and their spatial conflicts with urban planning[32]. As urbanization sets in, some residential areas are now in close proximity to the chemical industrial sites, which were originally located farther from urban areas. Poor site selection has also lead to some newly established chemical industrial parks clashing with populated areas[33]. Existing chemical industrial parks involving hazardous chemicals in production, storage, use or transport could lead to incidents at one facility causing incidents at other adjacent ones given their

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http://www.chinasafety.gov.cn/newpage/Contents/Channel_21117/2017/0308/284428/content_284428.htm

25 Page. 1386, Geographical Research, Vol 28, No.5, Sept., 2009, Development and evolution of spatial distribution of Chinese petrochemical industry, see http://www.dqxxkx.cn/EN/article/downloadArticleFile.do?attachType=PDF&id=8789

26 Referring to those named as Chemical Industrial Park in the list of National Development Zone, or industrial parks, development zones and chemical industry gathering area, etc. involving chemical, pharmaceutical and other industries.

27 An Analysis on the 13th Five-Year Plan on Development of Petrochemical and Chemical Industries: Chemical Industrial Park as a Major Highlight, http://tbd.jusfoun.com/news/3000125.html

28 Guiding Opinion of State Council's Security Committee on Improving Work Safety of Hazardous Chemicals, 2008, http://www.chinasafety.gov.cn/Contents/Channel_21135/2008/1007/199991/content_199991.htm

29 Petrochemical and Chemical Industry Twelfth Five-Year Plan, 2010, http://www.miit.gov.cn/n11293472/n11293877/n13434815/n13434832/n14473959.files/n14450225.pdf

30 The 12th Five-Year Plan on Development of Petrochemical and Chemical Industries, 2010, http://www.miit.gov.cn/n11293472/n11293877/n13434815/n13434832/n14473959.files/n14450225.pdf

31 Ministry of Industry and Information Technology, Opinion on Promotion of Orderly Development of Chemical Industrial Parks, 2015

32 Ministry of Industry and Information Technology, Development Plan for Petrochemical and Chemical Industries (2016 - 2020), 2016; State Administration, 12th Five-Year Plan for Work Safety of Hazardous Chemicals, 2011; State Council, 13th Five-Year Plan for Environmental Protection, Development Plan for Petrochemical and Chemical Industries (2016 - 2020)

33 Report on Implementation of Laws and Regulations on Work Safety, Zhejiang People's Congress, 2006, Issue 5

concentration of enterprises of different sizes and safety management levels.

In comparing the industrial policy and various policy provisions on the safety management of hazardous chemicals, the overarching challenge of rapid expansion and overcapacity of the chemical industry in China has recently been increasingly realized by policy makers[34]. In August 2016 the State Council of China issued "Guiding Opinions on the Adjustment of Structure and the Promotion of Transformation and Efficient Improvement of the Petrochemical Industry (Guiding Opinions No. 57)"[35]. These guidelines set out a strategic plan to eliminate outdated and excessive capacity within the chemical industry, with a focus on risks of high safety and environmental concerns; to shut down or relocate hazardous chemical manufacturing companies in close proximity to densely populated areas and environmentally sensitive areas; and to require all new chemical projects to enter normative chemical industrial parks[36].

Following this overarching strategic guideline, MIIT issued the "Development Plan for Petrochemical and Chemical Industries (2016-2020)" in October 2016 detailing the specific plan of action for the chemical industry's transformation during the Thirteenth Five-Year Plan period. It highlighted the plan of relocation and building an integrated information platform for the supervision of hazardous chemicals throughout the entire industry value chain.

One month later, the State Council issued the "Comprehensive Management Program of Hazardous Chemicals", which marked a critical step towards a holistic approach to strengthen the existing framework of hazardous chemicals management in China[37]. At the same time, the State Council also issued the "Thirteenth Five-Year Plan for Environmental Protection" in December 2016[38], pointing out that as a major chemical manufacturer and user, China is facing increasingly prominent regional, structural, and distributed environmental risks as the variety of toxic and hazardous pollutants increases, and the fact that many chemical enterprises are built nearby water sources or cities multiplies such risks. The Plan also highlights the importance of addressing the pollution at source in order to achieve the overarching goal of effectively controlling the environmental risks by 2020[39]. To prevent and control risks from chemicals, the Thirteenth Five-Year Plan requires a priority chemical control list to be published by end of 2017 to strictly restrict the production, use, and import of high-risk chemicals and gradually phase out or substitute. It has also mandated to implement the phase-out, restriction and substitution of endocrine disrupting chemicals (EDC) by the end of 2017[40].

Despite critical policy progress unfolding at central government level, greater challenges lie in the integration and implementation of these plans and policies at local and corporate levels. As put by CHEN Jining, the Minister of Environmental Protection, "at present, chemicals management

34 Ministry of Industry and Information Technology, "Operation of Petrochemical Industry in 2015", http://www.miit.gov.cn/n1146312/n1146904/n1648355/c4636154/content.html

35 Guiding Opinions on the Adjustment of Structure and the Promotion of Transformation and Efficient Improvement of the Petrochemical Industry, http://www.gov.cn/zhengce/content/2016-08/03/content_5097173.htm

36 Guiding Opinions on the Adjustment of Structure and the Promotion of Transformation and Efficient Improvement of the Petrochemical Industry, http://www.gov.cn/zhengce/content/2016-08/03/content_5097173.htm

37 2016, Planning for Comprehensive Management of Hazardous Chemical http://www.gov.cn/zhengce/content/2016-12/06/content_5143965.htm

38 State Council, 13th Five-Year Plan for Environmental Protection http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm

39 ibid

40 ibid

is rather fragmented across the nation and across departments, which may call for an institutional reform”[41].

IV. Lianyungang Chemical Industrial Park

This chapter introduces the specific local context for the development of chemical industrial parks in Jiangsu province as a case study, and unveils the releases of hazardous chemicals by Lianyungang Chemical Industrial Park located along the east coast of Jiangsu province. As an example of over 40 chemical industrial parks located along rivers, coastlines, or around the Taihu Lake in Jiangsu[42], this investigation in Lianyungang, Jiangsu province, shows these specific challenges faced by local chemical industrial parks and the environmental and human health risks they expose arguably across China.

Developments of chemical industry in Jiangsu province

The chemical industry is one of Jiangsu’s pillar industries[43], contributing to 3.71% of Jiangsu’s Gross Domestic Product (GDP) in 2015, reaching RMB 7.01 trillion[44]. Jiangsu province plays a critical role in China’s chemical industry. It is the second largest chemical manufacturing province in China, home to 50 of China’s top 500 chemical enterprises[45] as well as to 2,425 registered hazardous chemical manufacturing companies in 2016[46]. In 2014, the output value of Jiangsu’s chemical industrial parks accounted for about 50% of the total industry value of Jiangsu province[47]. The main business income[48] of Jiangsu’s chemical industry contributed to 15.37% of the national total in 2015[49]. By the end of 2008, Jiangsu had 40 chemical-related coastal industrial parks (11 in Lianyungang, 16 in Yancheng and 13 in Nantong), with a total planning area of 484.36 km^2 and a developed area of 257.92 km^2[50]. As of 2014, Jiangsu had 77 chemical industrial parks registered at

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41 CHEN Jining, “Slow and Steady”, OurPlanet, September 2015, UNEP

42 Ran Lijun, Liang Peng, Liang Rui and Cui Jishan, “Environmental Risks of Chemical IndustrialParks in China and Countermeasures”, Environmental Protection of Chemical Industry, 2016, Vol.36, Issue 6.

43 The official reply of Jiangsu Provincial Government to the Central Government Environmental Protection Inspection Comment, Apr 28 2017, Ministry of Environmental Protection of the People’s Republic of China ,http://www.zhb.gov.cn/gkml/hbb/qt/201704/t20170428_413172.htmhttp://www.jsdpc.gov.cn/gongkai/wjg/gyc/gzdt/201602/t20160225_416496.html

44 Jiangsu Provincial Bureau of Statistics, Yearbook 2016. http://www.jssb.gov.cn/2016nj/indexc.htm

45 Official website of China Chemical Industry Management Association, China’s Top 500 Chemical Companies [EB/OL].http://www.maigoo.com/news/461986.html

46 Changes in Number of Hazardous Chemicals Manufacturers across China in 2016, State Administration of Work Safety,2017, http://www.chinasafety.gov.cn/newpage/Contents/Channel_21117/2017/0308/284428/files_founder_285181742/219757654.doc

47 Development and Reform Commission of Jiangsu Province, Economy and Information Technology Commission of Jiangsu Province, Planning and Layout of Petrochemical Industry of Jiangsu Province, 2015, http://www.jsdpc.gov.cn/gongkai/wjg/gyc/gzdt/201602/t20160225_416496.html

48 “main business income” is also called as “operating revneue”

49 Economy and Information Technology Commission of Jiangsu Province, Development Plan for Petrochemical and Chemical Industries in Jiangsu Province (2016 - 2020), http://www.jsjnw.org/news_zcfg/newsId=98ca7f8e-1714-43da-a9f7-9036a20afc25.html

50 Yin Rongyao, Sun Xiang, Xu Wenwen and Zhu Xiaodong, “Spatial Layout, Environmental Response and Strategic Countermeasures for Rapid Development of Chemical Industry in Jiangsu’s Coastal Areas”, Journal of

or above provincial level[51] and has continued expanding especially along coastal areas. According to information compiled by Greenpeace, chemical industrial parks along these three coastal cities in Jiangsu reached 91 in 2016[52]. If such a trend continues, it will make the coastal areas of Jiangsu one of the main destination of new and/or relocated chemical industrial parks and the center of the chemical industry in China in the near future[53].

As Jiangsu provincial government outlined in the "Opinions on Promoting Transformation of Chemical Industry in Jiangsu Province", the overall capacity of the chemical industry in Jiangsu will be capped to only allow for the growth of high-end chemical industry whilst limiting the increase and gradually downsize the outdated capacity in order to transform its chemical industry into a sustainable and competitive one. The restructuring of the chemical industry will target phasing out excessive capacity in areas along the Yangtze river and Taihu Lake, whilst shifting and upgrading high-value added capacity in the coastal areas and the north of Jiangsu[54]. It also restrains the establishment of any new chemical projects (including to strictly restrict the relocated ones). These projects can only be installed in chemical industrial parks that have fulfilled the planning environmental impact assessment.

In addition, the Jiangsu government is pushing forward the progressive relocation of chemical enterprises from the vicinity of urban areas or rivers to coastal areas with higher environmental capacity. Chemical manufacturers along rivers or around the Taihu Lake are encouraged to relocate to coastal chemical industrial parks[55]. A breakthrough of Jiangsu's chemical industry transformation plan issued in 2016 is to prohibit chemical projects releasing carcinogenic, teratogenic, and mutagenic substances or odor pollutants[56].

The government of Jiangsu has progressively integrated its industry transformation policy and work safety management of hazardous chemicals into the "Implementation Plan of Jiangsu Province for Safety Management of Hazardous Chemicals" in January 2017[57]. This three-year plan delegates tasks to various local authorities in Jiangsu aiming to enhance the safety performance within the chemical industry.

Challenges faced by chemical industrial parks along the coast in Jiangsu

Over the past decade, current industrial zones and chemical parks along the coast of Jiangsu have placed severe stressed on the local environment due to insufficient efforts on preventing the release of chemicals, inadequate implementation of operation standards and regulations on hazardous chemical management, and weak environmental awareness of enterprises. The huge

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Environmental Science, Issue 5, Vol. 31, 2011

51 An Analysis on the 13th Five-Year Plan on Development of Petrochemical and Chemical Industries: Chemical Industrial Park as a Major Highlight,China Petroleum and Chemical Industry Federation ， http://tbd.jusfoun.com/news/3000125.html

52 Greenpeace, GIS Map of Guanhe River Estuary and Three Coastal Cities. (to be release)

53 Thirteenth Five-Year Plan of Jiangsu Province for Coastal Development, http://zwgk.rudong.gov.cn/yhb/zcwj/content/44138E4BA5685322E050007F01000E57.html

54 Opinions on Promoting Industrial Transformation of Chemical Industry in Jiangsu Province, http://www.js.gov.cn/jsgov/tj/bgt/201610/t20161026509134.html

55 ibid

56 Opinions on Promoting Industrial Transformation of Chemical Industry in Jiangsu Province, http://www.js.gov.cn/jsgov/tj/bgt/201610/t20161026509134.html

57 Implementation Plan of Jiangsu Province for Safety Management of Hazardous Chemicals 2017, http://www.chinasafety.gov.cn/newpage/Contents/Channel_22203/2017/0207/282936/content_282936.htm

size of chemical industrial parks complicates the pollution control and safety management measures needed. For example, due to the common practice of using combined wastewater treatment plants (WWTP) that simultaneously treat mixed wastes waters from multiple facilities/sub-sectors, the industrial mix of sub-sectors such as petrochemicals, dyes, pharmaceuticals, pesticides and others handling substances of diverse properties make sewage treatment much more difficult, often resulting in pollution of sea water[58].

Jiangsu's coastal area has becoming increasingly ecologically sensitive and vulnerable. It is home to China's first rare bird nature reserve, the Yancheng National Nature Reserve for Rare Birds, which is home to 14 endangered species under Class I national protection, including the red-crowned crane, and another 85 species under Class II national protection[59]. It is a natural habitat for some of the rarest species in China, as well as 29 severely-endangered species listed by the International Union for Conservation of Nature and Natural Resources (IUCN)[60]. The coastal wetlands in northern Jiangsu, as one of the three key areas of coastal biodiversity conservation in China, are also an important stop and winter habitat for migrant birds traveling between Northeast China and Australia. However, the "Marine Environment Quality Bulletin of Jiangsu Province" of 2014 and 2015 show that the environmental quality of monitored areas of the coastal wetlands is into sub-health[61]. The vulnerable ecology of the area demands higher standards and challenges for the industrial development around it (see Figure 1)[62].

[58] Liu Zhanxin and Zhou Deshan, "Impact of Jiangsu's Coastal Development Parks on Fishery and Countermeasures", Journal of Huaihai Institute of Technology, 2013

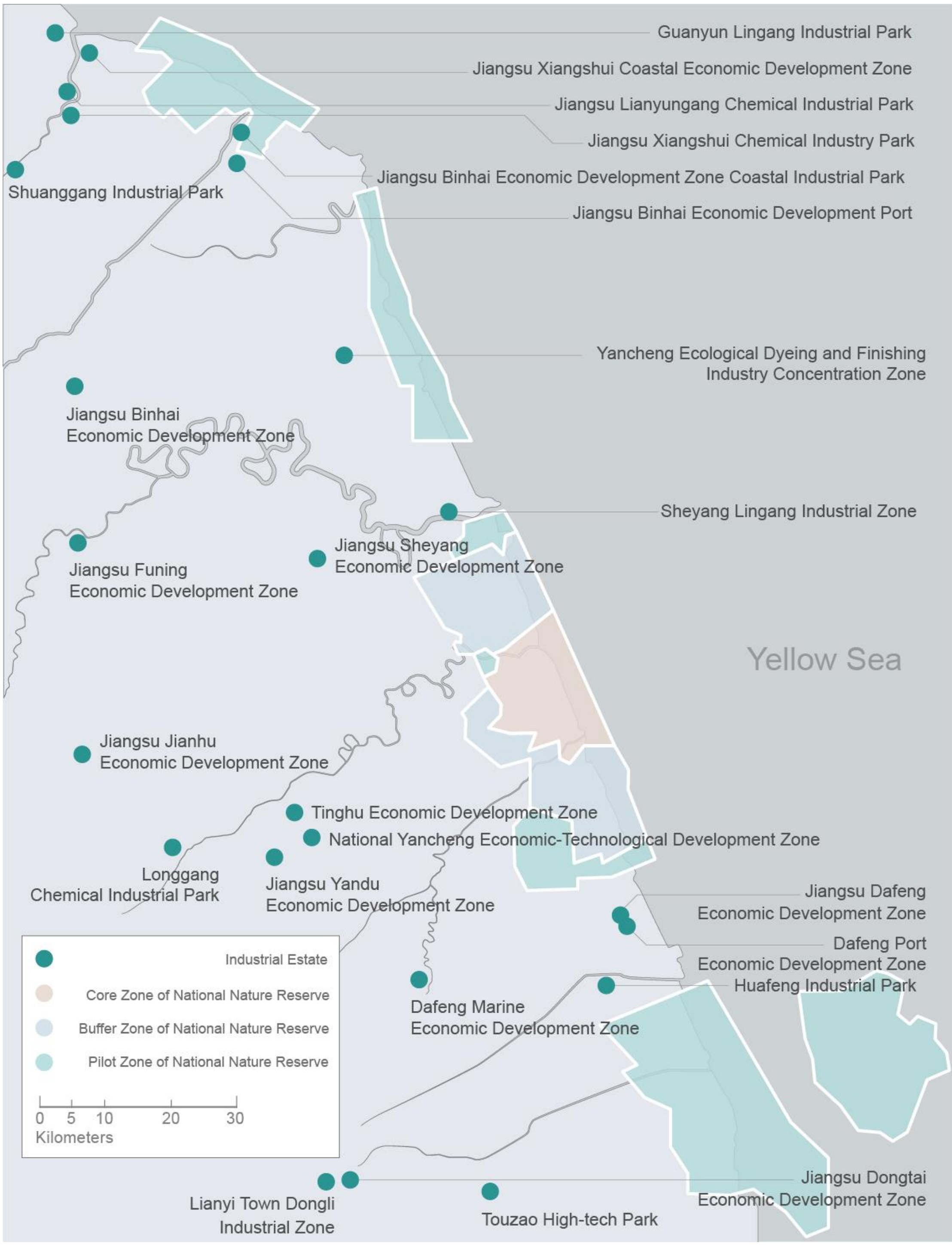
[59] The state shall give special protection to rare and endangered species of wildlife. The wildlife under special state protection shall consist of two classes: wildlife under first class protection and wildlife under second class protection. Lists or revised lists of wildlife under special state protection shall be drawn up by wildlife protection authorities under the State Council and announced after being submitted to and approved by the State Council. http://www.npc.gov.cn/npc/xinwen/2016-07/04/content_1993249.htm

[60] http://www.iucnredlist.org/; Official website of Yancheng National Nature Reserve for Rare Birds http://www.yczrbhq.com/about.asp?id=28

[61] Bulletin of Marine Environmental Quality of Jiangsu Province, 2014, http://www.jsocean.cn/jcpjnews_details.html?action=2029; Bulletin of Marine Environmental Quality of Jiangsu Province, 2015, http://www.jsocean.cn/jcpjnews_details.html?action=1984

[62] Ling Hong, Sun Xiang, Zhu Xiaodong, Wang Huizhong and Li Yangfan, Study on Lianyungang's Ecological Precaution Based on Chemical Threats, Journal of Safety and Environment, 2010

Figure 1. Industrial Zones surrounding Yancheng National Natural Reserve Area in Jiangsu Province



Lianyungang Chemical Industrial Park

Lianyungang Chemical Industrial Park is located in Guannan County, north of the Guanhe River, in Jiangsu province. With a total planning area of 22.46 km², the park has around 100 enterprises[63], the majority of which produce pesticides, dyes, pharmaceuticals, and bio-

[63] Chinese Communist Party News Website, Shi Taifeng'sUnannounced Visits to Lianyungang's Chemical Industrial Park, 2016, http://cpc.people.com.cn/n1/2016/1105/c64102-28837469.html

chemical materials[64]. Since its establishment in 2003[65], this chemical park has expanded and has been registered at the national level. Approved by the National Development and Reform Commission (NDRC) and the provincial government in May 2006, it became the only provincial-level chemical industrial park in northern Jiangsu at the time, and in 2009, it became a designated pesticide manufacturing park at national level[66]. In 2012, it was listed as a provincial demonstration base of industrial products and export innovation. In 2015, its gross output of sizable enterprises[67], which stood at RMB 52.5 billion, increased 13.8% since 2014[68].

Guannan County was listed as a national demonstration base for ecological agriculture and forestry in 2012[69]. Its Guanhe River, along which Lianyungang chemical industrial park is built, is a "golden waterway" for river transport, ports, and shipbuilding in Jiangsu province[70] and has attracted chemical industries whose production and operation is heavily reliant on water-resources (see Figure 2 below).

64 websites of Lianyungang Chemical Industry Park http://js.zhaoshang.net/yuanqu/detail/4045/intro.

65 Guannan County Local Chronicle Compilation Committee, Guannan Yearbook, Jilin People's Publishing House, 2004.

66 http://js.zhaoshang.net/yuanqu/detail/5373/intro.

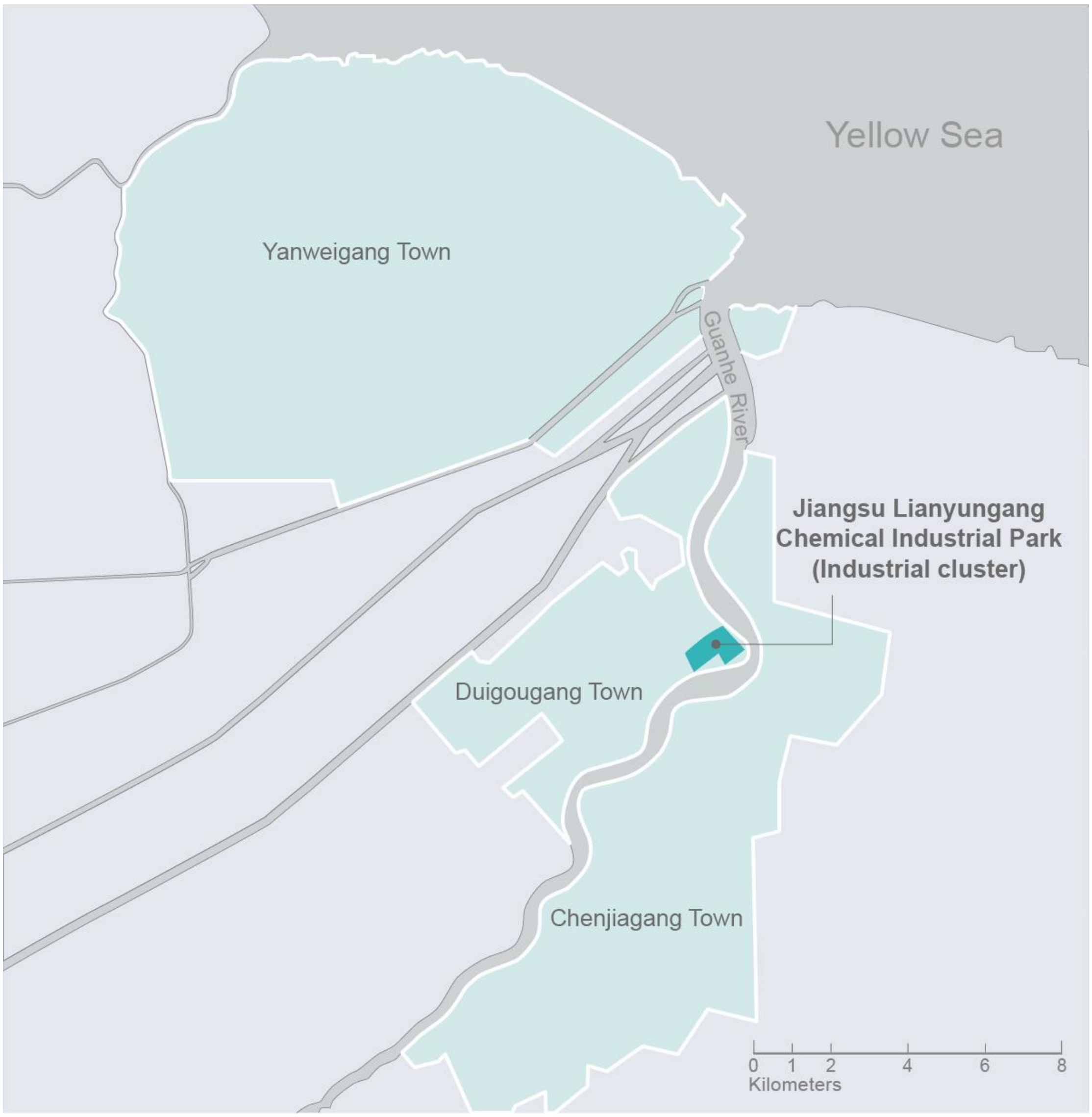
67 "sizable enterprise" is a statistical definition for enterprises earning operating revenue over RMB 20 million per year, see http://www.stats.gov.cn/tjzs/cjwtjd/201311/t20131105_455942.html

68 Lv Weiguang, "Overview of Lianyungang Chemical Industrial Park", Lianyungang Yearbook, 2016.

69 National Ecological Demonstration Zones listed by China's Ministry of Environmental Protection in 2012,http://sts.mep.gov.cn/stsfcj/mdl/201201/t20120110_222401.htm

70 Official website of Guannan County Land and Resource Bureau, http://www.jsmlr.gov.cn/lyggn/gtzx/ztzl/kxpj/201702/t20170220_78899.htm

Figure 2. The location of Lianyungang Chemical Industrial Park in Jiangsu Province



Since the construction and expansion of the Lianyungang Chemical Industrial Park along the Guanhe River and the Yellow Sea coastline[71], it has become a chemical park at Jiangsu provincial level[72], whilst the quality of the surrounding offshore marine environment has seen deterioration[73]. Flowing into the Yellow Sea, the volume of chemical oxygen demand (COD) in Guanhe River increased 16 times reaching nearly 200,000 metric tons per year in 2014[74], up from its level of 12,345 metric tons per year between 2004-2006[75]. The monitoring of the Guanhe River's overall pollutant concentration level carried out by the Municipal Oceanic and

71 Greenpeace,Dynamic Diagram of Coastal Chemical Industrial Parks in Jiangsu Province over Past Decade, 2017.

72 Invest in Lianyungang, "Lianyungang Chemical Industry Park", http://www.tzlyg.gov.cn/detail.jsp?id=19

73 Environmental operation management of Lianyungang Environmental Protection Department, http://xxgk.lyg.gov.cn/xxgk/jcms_files/jcms1/web39/site/col/col39507/index.html

74 Bulletin of Marine Environmental Quality of Jiangsu Province, 2014

http://www.jsocean.cn/jcpjnews_details.html?action=2029

75 Ma Hongrui, Chen Jufa, Cui Yi, Zhao Jun, Ma Shaosai and Yang Feng,"Analysis of Water Quality of Guanhe and Sheyang Rivers and Estimation of Main Pollutants into Sea", Progress in Fishery Science, Issue 3, Vol. 31, 2010

Fishery Administration of Lianyungang in 2007, 2014 and 2015 concluded[76] that the marine environments in areas adjacent to the discharging point from a chemical industrial park area of Guanyun Country have been severely polluted[77].

In tracking the possible causes of the environmental degradation in the area, Greenpeace found that the Lianyungang Chemical Industrial Park received extensive penalties for environmental non-compliance in recent years, including 177 times from the environmental administration of Guannan County and 20 times from municipal environment bureau of Lianyungangin 2014-2016 (see Figure 3 below)[78]. There is a wide range of causes for these environmental penalties, including: the lack of environmental impact assessment; operating major installations without environmental inspection; excessive discharge of air or water pollutants; abnormal, idle operation or lack of appropriate pollutant treatment facilities; illegal disposal of solid and hazardous wastes; and discharges without treatment or through unpermitted discharging points or channels. All these violations of environmental standards or regulations were committed by the resident enterprises of Lianyungang Chemical Industrial Park[79]. Considering the end products manufactured in the park, among 106 enterprises whose information is available in the National Enterprise Credit Information Publicity System[80], 32 products manufactured by 20 resident enterprises are listed as “Highly Polluting and High Environmental Risks Products (2015 edition)” by MEP[81]. That is, the mass production of products listed are considered to cause accumulative damages and risks to the environment[82].

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[76]Bulletin of Marine Environmental Quality of Jiangsu Province, 2014 http://www.jsocean.cn:8080/uploadfile/16-12-02/2014 年江苏省海洋环境质量公报 20150225.pdf Lianyungang Municipal Marine and Fishery Bureau, Bulletin of Marine Environmental Quality of Lianyungang City, 2015http://xxgk.lyg.gov.cn/xxgk/jcms_files/jcms1/web41/site/art/2016/9/5/art_39484_117132.html

[77]Water Quality Failed to Satisfy the Requirement in 14 Sea Sewage Outfalls of Jiangsu Province, http://news.xinhuanet.com/energy/2017-01/23/c_1120365454.htm

[78]Environmental operation management of Lianyungang Environmental Protection Department, http://xxgk.lyg.gov.cn/xxgk/jcms_files/jcms1/web39/site/col/col39507/index.html

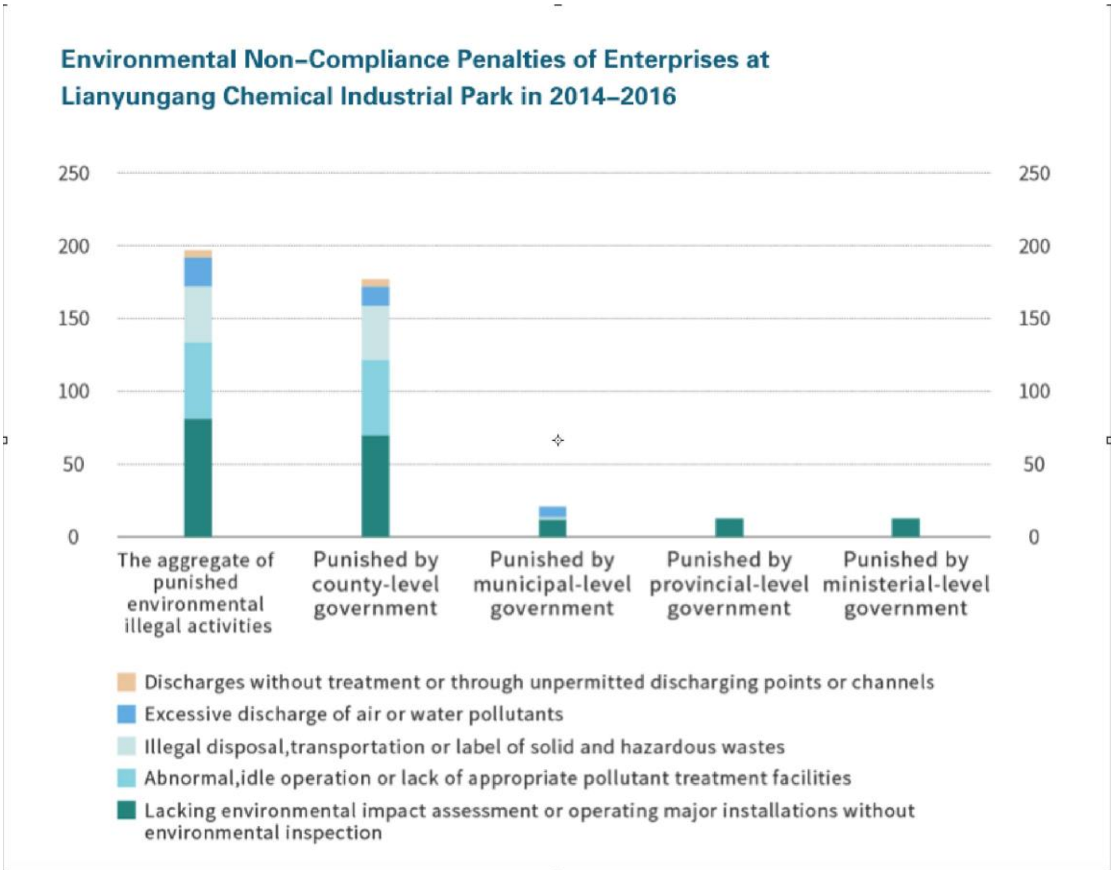
[79]Records of Environmental Administrative Punishment of Lianyungang Municipal Government http://xxgk.lyg.gov.cn/xxgk/jcms_files/jcms1/web39/site/art/2016/11/21/art_39507_120005.html

[80]National Enterprise Credit Information System, http://www.gsxt.gov.cn/index.html; Tianyancha Information System, http://www.tianyancha.com/

[81]On Provision of a Comprehensive List of Environmental Protection (2015 edition) http://www.mep.gov.cn/gkml/hbb/bgth/201512/t20151231_320861.htm; “Double high"products include more than 50 kinds of products whose production processes produce sulfur dioxide or nitrogen oxides, or have high chemical oxygen demands orammonia nitrogen; more than 30 kinds of products which produce large amounts of volatile organic pollutants (VOCs); more than 200 kinds of products involving heavy metal pollution; Ministry of Environmental Protection , "Ministry of Environmental Protection Issued a Comprehensive List of Environmental Protection (2015)”, http://www.zhb.gov.cn/gkml/hbb/qt/201512/t20151231_320845.htm

[82] Ministry of Environmental Protection Issued a Comprehensive List of Environmental Protection (2014), http://www.gov.cn/xinwen/2014-12/24/content_2795927.htm

Figure 3. Environmental Non-Compliance Penalties of Enterprises at Lianyungang Chemical Industrial Park in 2014-2016



Despite the environmental administration and penalties charged by the environmental bureaus at the county and municipal levels, the environmental inspections carried out at provincial and national level have shown companies inside the Lianyungang chemical park find ample space to evade regulations. For example, Jiangsu Provincial Environmental Protection Bureau inspected hotspot areas unannounced, including Lianyungang Chemical Industrial Park, in May 2016 and found serious violations of environmental regulations, and subsequently ordered a six-month ad hoc rectification in the park[83]. From July 15 to August 15, 2016, an environmental protection inspectorate led by high-level officials from the Central Government, inspected Jiangsu, and the environmental pollution issues of its chemical industry caught their attention. On 22 July, 2016, the Central Government inspectorate notified Guannan County government regarding the complaints of local residents on pollution, safety distance, and credibility of the environmental impact assessment of Lianyungang Chemical Industrial Park[84]. As of November 2016, the group of high-level environmental inspectorates led by the central

[83]Website of Environmental Protection Department of Jiangsu Province, Guanyun County Coastal Industrial Zone and Lianyungang Chemical Industrial Park Fined for Major Environmental Problems http://www.jshb.gov.cn/jshbw/xwdt/slyw/201605/t20160505_348524.html

[84]Public Notice No. 6 on Implementation of Remedial Actions for Problems Found by Central Environmental Protection Inspectorate, website of Lianyungang Municipal Government, http://www.lyg.gov.cn/zglygzfmhwz/gsgg/content/5B09171EFCF043A8BB2677BCED6214A9.html; Third Central Environmental Protection Inspectorate Gives Feedback on Inspection in Jiangsu Province, http://www.mep.gov.cn/gkml/hbb/qt/201611/t20161115_367497.htm

government concluded its work and cautioned that the conflict between economic growth and environmental and resource capacities of Jiangsu is outstanding, and that the environmental issues and risks of its chemical industry had yet to be addressed[85]. More specifically, among over 6,300 chemical manufacturing enterprises in Jiangsu, only 30% are currently located in chemical parks. Problems also occur with in chemical parks, for example, illegal discharges by enterprises in Lianyungang Chemical Industrial park has contaminated surface water in the surrounding areas. The COD concentration at two rivers running through the industrial park (namely at Qiweizha floodgate and Dajudagou) were respectively 50 times and 8 times higher than the standard for surface water[86] at Grade IV level[87].

[85]General Office of CPC Committee and People's Government of Guannan County, Plan of Guannan County for Rectification of Environmental Problems Found by Environmental Protection Inspectorate from Central Government, http://news.xinhuanet.com/politics/2016-11/15/c_129364881.htm

[86]ibid

[87] Grade IV level indicates the water is only suitable for industrial use and other amusement purposes that do not involve the liquid in contact with skin. Environmental quality standards for surface water: http://kjs.mep.gov.cn/hjbhbz/bzwb/shjbh/shjzlbz/200206/W020061027509896672057.pdf

V. Investigation and Findings

Background

Greenpeace launched a preliminary investigation into two of the largest chemical manufacturing provinces in China, Jiangsu and Shandong, in March 2016 to observe the operations of chemical industrial sites on the ground. The investigation covers ten chemical industrial parks in nine cities and towns in these two provinces. Given limited resources and access, Greenpeace carried out sampling activities at two parks, namely Lianyungang Chemical Industrial Park in Jiangsu and Qilu Chemical Industrial Park in Shandong. This report focuses on the investigation of Lianyungang Chemical Industrial Park.

Greenpeace carried out sampling activities in Lianyungang Chemical Industrial Park between September and November 2016. This was just after the environmental protection inspection led by the central government from July to August 2016 in Jiangsu, and Lianyungang Chemical Industrial Park was also inspected during this period. Hence, the results of this independent investigation provide further evidence for the releases and discharges of hazardous chemicals of Lianyungang Chemical Industrial Park and without adequate controls.

A total of ten samples, including water, sediment, and air samples, were collected from Lianyungang Chemical Industrial Park between September and November 2016. Four water and three sediment samples were collected from two different locations in the Lianyungang Chemical Industrial Park. All water and sediment samples were sealed *in situ* and stored under consistent temperature, and sent to the Greenpeace Research Laboratories at the University of Exeter, UK, for chemical analysis. Three air samples were collected from the same chemical park and the nearby village, and sent to Analyse Labor Berlin, Germany, for initial indicative testing of volatile organic compounds (VOCs) in the air.

All wastewater and sediment samples were analyzed qualitatively for the presence of semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs); and quantitatively for the presence of a range of metals and common VOC environmental contaminants (see analytical result[88]). All air samples were examined quantitatively for organic compounds.

The goals of the investigation include:

a) To identify whether the industrial park concerned was releasing hazardous substances into the environment in the neighborhood;
b) To examine whether the concerned hazardous substances identified in the samples are regulated under the current discharge standards in China; and

[88] Greenpeace Research Laboratories Analytical Results: Analysis of wastewaters and associated sediments collected from two industrial parks in China for the presence of metals and organic chemical contaminants, 2017-01, http://www.greenpeace.to/greenpeace/wp-content/uploads/2017/04/GRL-AR-2017-01.pdf

c) To identify any gaps among the current chemicals safety management system in China[89], international practice[90], and SIN list[91] regarding the chemicals concerned in this case study.

Sampling locations

Figure 4. Sampling locations in Lianyungang Chemical Industrial Park

Greenpeace collected samples from a water channel named "Erdaopaihe" adjacent with the only centralized wastewater treatment plant of Lianyungang Chemical Industrial Park, as well as a parallel small river inside the Lianyungang Chemical Industrial Park[92]. "Erdaopeihe" channel flows from its northern end into the Guanhe River, which meets the Yellow Sea approximately 8 km to the north. It was reported that this channel received wastewater from some plants located on the territory of the park[93]. All watercourses at this location experience variable directions and rates of flow due to tidal processes.

Due to low accessibility to the wastewater discharge pipes from individual enterprises and the wastewater treatment plant located within this area, three water samples and two sediment samples were collected directly from the Erdaopaihe Channel at its northern end (so called

[89] Regulation on the Safety Management of Hazardous Chemicals (2011 Revision), State Council of China, 2011, http://www.lawinfochina.com/Display.aspx?lib=law&Cgid=146325 (translation in English); http://www.gov.cn/zwgk/2011-03/11/content_1822783.htm (official document in Chinese)

[90] International practice here refers to substances contained in the Stockholm Convention, the Montrol Protocol, and the E.U. REACH Substance of Very High Concern (SVHC) candidate list and Authorization list.

[91] The SIN list is developed by International Chemical Secretariat (Chemtrac), is known and used globally for chemicals management. Regulators and authorities use the SIN List in the EU, the US, and Asia in legislative processes. http://chemsec.org/business-tool/sin-list/about-the-sin-list/

[92] Environnemental impact assessment report for Saike Campany, 2014, http://www.lyghb.gov.cn/html/upfiles/20140710110703250000.swf, pp. 24-30.

[93] http://www.cqn.com.cn/news/xfpd/szcj/dflb/875113.html

"Wastewater Discharge Channel" below), close to the point where it joins with the Guanhe River, at different times and states of the tide. Two samples, one water and one sediment, were collected from the northern end of the small river (so called "Small River" below) running across the industrial park and local village.

Table 1. Description of Sampling Locations, Time, and Sample Types

Location	Sample code and type	Date of sampling	Description
Wastewater Discharge Channel	Discharge Channel water 1 (16005)	11:00, 2016.09.19	Collected from Erdaopaihe Channel running through the Lianyungang Chemical Industrial Park[81]. Sampling was done at a discharge sluice gate at the northern end of Erdaopaihe channel, where wastewater enters into the GuanHe River. The wastewater treatment plant (WWTP) is approximately 700 meters southwest from the sampling point.
	Discharge Channel Water 2 (16007)	13:00, 2016.09.20	
	Discharge Channel Water 3 (16009)	13:30, 2016.09.20	
	Discharge Channel Sediment 1 (16006)	16:00, 2016.09.19	
	Discharge Channel Sediment 2 (16008)	13:00, 2016.09.20	
Small River	River Water (16003)	15:00, 2016.09.19	Collected from a Small River running through the Lianyungang Chemical Industrial Park. Sampling was done at the northern end of the small river between a steel factory and a chemical factory.
	River Sediment (16004)	15:00, 2016.09.19	
Air	3 Air Samples	2016.11.09–2016.11.19	2 air samples were placed at the fences of different companies within the Lianyungang Chemical Industrial Park. 1 control sample was placed outside a resident's house in Xinggang residential area of Duigougang Town, which is approximately 8 km in the west of the industrial park. Wind direction during the sampling period was mainly northwest wind[94].

Highlights of results

- A total of 226 organic chemicals were identified across the samples, including air, water and sediment, collected from Lianyungang Chemical Industrial Park. Despite the limited

[81] Environnemental impact assessment report for Saike Compnay, p. 102, http://www.lyghb.gov.cn/html/upfiles/20140710110703250000.swf.
[94] Ibid, p.128

sample size, 61 chemicals (26%) are listed in China's Catalogue of Hazardous Chemicals (Edition 2015) subject to chemical safety management requirements.

- Analysis of the samples of water from the Wastewater Discharge Channel and the Small River revealed the presence of complex mixtures of contaminants in each case, with between 74 and 151 individual compounds resolved per sample, and with roughly only half (47-56%) of those being identified in each case.
- Analysis of the sediment samples collected from the Wastewater Discharge Channel and the Small River also revealed complex mixtures of organic contaminants in each case, with between 39 and 127 individual compounds resolved per sample, and with roughly only half (56-65%) of those being identified in each case.

- Analysis of the preliminary air sampling identified 8 VOCs with higher concentrations compared to the background sample and all of them are listed in China's Catalogue of Hazardous Chemicals (2015 Edition). These chemicals were also consistently identified in the samples of wastewaters collected from Lianyungang Chemical Industrial Park.

Small River:

- The sediment sample collected from Small River was found to contain a diverse range of organic chemicals, including 21 chlorinated chemicals, 3 fluorinated compounds and a further 2 mixed halogenated chemicals. All indicative of the presence of wastes from industrial processes using chemicals containing chlorine and fluorine.

- Among the diverse range of organic chemicals found in this sediment sample were a number of pesticides, or residues of the pesticides (including *lambda* –Cyhalothrin, Bifenthrin, Benthiocarb, Buprofezin, Diflufenican, Oxadiazon, Difenoconazole, Fenclorim, hexachlorobenzene, and pentachlorobenzene). While it cannot be ruled out that some of these residues may have arisen from the application of pesticides in upstream agricultural areas, a local manufacturing source would seem to be a more likely source.

- Particularly prominent in the sediment sample of the Small River were: a) residues of the mixed chlorinated and fluorinated pesticide *lambda* –Cyhalothrin, a toxic and bioaccumulative synthetic pyrethroid insecticide identified as a candidate for substitution within the European Union[95]. However, *lambda* –Cyhalothrin is not listed in China's Catalogue of Hazardous Chemicals (Edition 2015) as a hazardous chemical; and b) residues of the persistent chlorinated pesticide, hexachlorobenzene, and the fungicide, pentachlorobenzene, were also found. These two are compounds formerly used as fungicide, but banned from use globally as a Persistent Organic Pollutant (POP) under the Stockholm Convention.

Wastewater Discharge Channel:

- All three water samples taken from the Wastewater Discharge Channel contained more than 130 individual organic chemicals, of which around one quarter were chlorinated.

[95] Commission implementing regulation (EU) 2016/146, Feb 04 2016, http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0146&from=EN

Therein, six pesticide residues (including Oxadiazon, Metribuzin, Molinate, Butachlor, Malathion and Triallate) were also found in one or more of these samples.

- All three water samples taken from the Wastewater Discharge Channel contained notably high concentrations of several VOCs, including two suspected human carcinogens 1,2-dichloroethane (710-1630 ug/l), and dichloromethane (794-1000 ug/l)[96]. Eight of the VOCs detected in the wastewater were also identified in the two onsite air samples with high concentrations in comparison with the background sample. Therein, 1,2-dichloroethane and toluene showed particularly high concentrations compared to the background sample.

- The two sediment samples collected from Wastewater Discharge Channel contained complex mixtures of hazardous organic chemical contaminants, including polycyclic aromatic hydrocarbon (PAH) derivatives, chlorinated and other substituted benzenes, chlorinated phenols and a number of pesticides.

Table 2. Key Organic Contaminants and their Concentrations in the Samples Collected from Lianyungang Chemical Industrial Park

Number	Chemical name	Presence and Concentration (μg/L)				Concentration (μg/m³)
		Wastewater Discharge Channel		Small River		Air
		Water samples	Sediment samples	Water sample	Sediment sample	Air samples
1	1,2-Dichloroethane	710-1630	N.D	34	N.D	403-795
2	Dichloromethane	794-1000	N.D	<5	N.D	N.D
3	Benzene	166-279	N.D	N.D	N.D	38-43
4	Toluene	90-197	N.D	<5	N.D	229-414
5	Chlorobenzene	69-101	N.D	<5	N.D	18-25
6	Chloroform	43-65	N.D	20	N.D	N.D
7	o-xylene	26-45	N.D	8	N.D	7-15
8	1,3-Dichlorobenzene	13-20	Present	<5	N.D	N.D
9	1,2-Dichlorobenzene	12-18	N.D	<5	Present	N.D
10	m- p-xylene	10-16	N.D	19	N.D	13-34
11	Cyclohexane	Present	N.D	Present	N.D	13-14
12	Hexachlorobenzene	N.D	Present	N.D	Present	N.D
13	Bifenthrin	N.D	Present	N.D	Present	N.D
14	Oxadiazon	Present	Present	Present	Present	N.D
15	Cyhalothrin	N.D	Present	N.D	Present	N.D
16	Benthiocarb	N.D	N.D	Present	Present	N.D

"N.D" means not detected in the sample, "Present" indicates the chemical was detected in the

[96] 1,2-dichloroethane and dichloromethane are classified as "carcinogenicity category 2 (suspected human carcinogen)" in Harmonized Classification of Hazardous Chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, see http://www.chinasafety.gov.cn/Contents/Channel_21111/2015/0902/257323/content_257323.htm

sample, but no concentration was measured. "<x" indicates that the chemical was detected but at a concentration below the limit of quantification

Summary of results for organics and for metals

<u>Organic contaminants in water and sediment:</u>

The results of the four water and three sediment samples from the two different locations on the Lianyungang Chemical Industrial Park provide evidence for heavy contamination of both the Small River and the Wastewater Discharge Channel with complex mixtures of hazardous chemicals, many of them halogenated (chlorinated or fluorinated) and some highly persistent once they reach the environment. The presence of diverse organic compounds in the water and the sediment, including high concentrations of a number of volatile organic compounds, strongly indicates substantial ongoing discharges of contaminated industrial wastewaters to these channels, rather than just reflecting historic inputs.

More specifically, the following contaminants [97] were found at Lianyungang Chemical Industrial Park as result of the investigation:

- **3 persistent organic pollutants (POPs)**[98]- hexachlorobenzene (HCB), hexachlorobutadiene (HCBD), and pentachlorobenzene (PeCB) were identified in one or more sediment samples from either the Wastewater Discharge Channel or the Small River.
- **16 known, presumed, or suspected** [99] **human carcinogens** - including: HCB, 3,3'-dichlorobenzidine, tetrachloroethene, naphthalene, 1,2-dichloroethane, tetrachloromethane, dichloromethane, 4-chloroaniline, 2-methoxyaniline, chloroform, benzene, trichloroethene, benzo[a]pyrene, ethylbenzene, 2-nitroanisole and Michler's Base[100], were identified in a number of water and sediment samples from either the Wastewater Discharge Channel or the Small River. Therein, benzo[a]pyrene and Michler's Base are not listed in the Harmonized Classification of Hazardous Chemicals in China.
- **10 presumed or suspected** [101] **reproductive toxicants**– including HCBD, diisobutyl

[97] See more specific information of the contaminants in the appendix table.

[98] Persistent Organic Pollutants (POPs) are listed in Stockholm Convention, http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx, accessed 30.03.2017

[99] "known" human carcinogen here refers to those chemicals classified as **1A: Known** to have carcinogenic potential for human. "Presumed" human carcinogen here refers to those chemicals classified as **1B: Presumed** to have carcinogenic potential for humans; "Suspected" human carcinogen here refers to those chemicals classified as **2: Suspected** human carcinogens, in "Rules for classification and labelling of chemicals – Part 23: Carcinogenicity" at http://www.sdaj.gov.cn/uploadfiles/day_150410/201504101010506540.pdf, and China's Harmonized Classification of Hazardous Chemicals, http://www.chinasafety.gov.cn/newpage/Contents/Channel_5330/2015/0902/257317/content_257317.htm; and for chemicals not listed in China's Harmonized Classification of Hazardous chemicals, the Classification, Labelling and Packaging (CLP) in European Union if applied, see http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1272.

[100] For chemicals not listed in China's Harmonized Classification of Hazardous chemicals, see http://www.chinasafety.gov.cn/newpage/Contents/Channel_5330/2015/0902/257317/content_257317.htm, the Classification, Labelling and Packaging (CLP) in European Union if applied, see http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1272.

[101] "Presumed" human reproductive toxicant here refers to those chemicals classified as **1B: Presumed** human reproductive toxicant; "Suspected" hazardous properties here refer to those chemicals classified as **2: Suspected** human reproductive toxicant in the "Rules for classification and labelling of chemicals – Part 24: Reproductive toxicity", see http://www.foods-info.com/upload2012/201405/20140531111845861.pdf, and China's Harmonized classification of Hazardous chemicals, see

phthalate (DIBP), toluene, dimethyl disulfide, carbon disulfide, molinate, dibutyl phthalate (DBP), chloroform, di-(2-ethylhexyl) phthalate (DEHP), benzo[a]pyrene, were identified in a number of water and sediment samples from either the Wastewater Discharge Channel or the Small River. Therein, benzo[a]pyrene DBP, and DEHP are not listed in the Harmonized classification of Hazardous chemicals in China.

- **6 should be regarded as, or cause concern as, mutagens[102]**– including HCBD, benzene, trichloroethene, benzo[a]pyrene, 1-chloro-4-nitrobenzene and 2-methoxyaniline, were identified in a number of water and sediment samples from either the Wastewater Discharge Channel or the Small River. Therein, benzo[a]pyrene is not listed in the Harmonized classification of Hazardous chemicals in China.
- **2 Persistent Bioaccumulative Toxic (PBT) chemicals[103]**, benzo[a]pyrene and anthracene, were found in sediments from either the Wastewater Discharge Channel or the Small River.
- **1 very Persistent very Bioaccumulative (vPvB) chemical[104],** named benzo[a]pyrene, was found in one sediment from the Wastewater Discharge Channel.
- **5 endocrine disrupting chemicals (EDCs)[105]** – tetrachloroethene, carbon disulphide, naphthalene, diethyl phthalate (DEP) and butylated hydroxytoluene (BHT), were identified in a number of water and sediment samples from both the Wastewater Discharge Channel and the Small River.
- **Furthermore, 52 chemicals are hazardous to aquatic life[106]**, which were found in a number of water and sediment samples from both the Wastewater Discharge Channel and the Small River.
- **1 chemical - carbon tetrachloride, is hazardous to ozone layer[107]**, was found in two water samples from the Wastewater Discharge Channel.
- Each of four wastewater samples collected from the industrial park contained a range of 31-54 volatile organic compounds (VOCs), and over 80% of the identified VOCs are "hazardous chemicals" as listed in the Catalogue of Hazardous chemicals (2015 Edition). 8 of the same VOCs were also identified in the air samples, including 1,2-dichloroethane

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http://www.chinasafety.gov.cn/newpage/Contents/Channel_5330/2015/0902/257317/content_257317.htm; and for chemicals not listed in China's Harmonized Classification of Hazardous chemicals, the Classification, Labelling and Packaging (CLP) in European Union is applied, see http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1272.

102 "Should be regarded" mutagen here refers to those chemicals classified as **1B: should be regarded** as if they induce heritable mutations in the germ cells of humans; "Cause concern" mutagen here refers to those chemicals classified as **2: cause concern** for humans owing to the possibility that they may induce certain hazards in human in the "Rules for classification and labelling of chemicals – Part 22: Germ cell mutagenicity", and in China's Harmonized classification of Hazardous chemicals, see http://www.chinasafety.gov.cn/newpage/Contents/Channel_5330/2015/0902/257317/content_257317.htm; and for chemicals not listed in China's Harmonized Classification of Hazardous chemicals, the Classification, Labelling and Packaging (CLP) in European Union is applied, see http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1272.

103 PBT is listed in REACH Substance of Very High Concern (SVHC) candidate list, https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list

104 vPvB is listed in REACH Substance of Very High Concern (SVHC) candidate list, https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list

105 EDC is defined in SIN list by Chemsec, http://chemsec.org/business-tool/sin-list/about-the-sin-list/

106 Chemicals are "**hazardous to aquatic life**" are defined using Harmonized classification of Hazardous chemicals in China, http://www.chinasafety.gov.cn/Contents/Channel_21111/2015/0902/257323/content_257323.htm

107 "Hazardous to ozone layer" is defined based on China's Harmonized Classification of Hazardous Chemicals, see http://www.chinasafety.gov.cn/Contents/Channel_21111/2015/0902/257323/content_257323.htm.

and toluene, both with relatively high concentrations.

Metals in water and sediment:

- The four wastewater samples collected in this area were not notably contaminated with dissolved heavy metals in comparison with typical background concentrations for uncontaminated surface freshwaters[108]. However, to compare with China's Integrated Wastewater Discharge Standard (GB8978-1996) [109], the concentrations of arsenic, chromium, nickel in the unfiltered sample (16005) from the Wastewater Discharge Channel were slightly over the allowed limits.
- For one sediment sample (16004) collected in the Small River, the concentrations of certain metals were higher than concentrations typically found in uncontaminated freshwater sediments, by approximately 2 times for nickel, 3 times for chromium and lead, and 5 times for copper and zinc[110] .

Air:

- Two air samplers (Draeger ORSA 5) were installed within the territory of the industrial park in November 2016. One background sampler installed in a village approximately 8 km west from the industrial park. The preliminary air sampling result identified 8 VOCs with higher concentrations for the samples within the park, all of which were also identified in one or more wastewater sample from the industrial park. More systemic air-quality testing is required to indicate the substances emitted by Lianyungang Chemical Industrial Park.

Comparing to the background value, high concentrations of **toluene and 1,2-dichloroethane** were found in the air, which were both present in all the water samples from the Wastewater Discharge Channel at relatively high concentrations.

As the cornerstone of China's chemicals management system, its Catalogue of Hazardous Chemicals (2015 edition) considers 81 hazard categories including the physical, environmental and health hazards of chemicals the criteria for listing hazardous chemicals, whereby subject to the Regulation on the Safety Management of Hazardous Chemicals in China[111]. At present detailed instruction on the identification and classification of hazards of chemicals is mainly

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108 Salomons, W. & Forstner, U. (1984) Metals in the hydrocycle. Springer-Verlag, Berlin, Heidelberg, New York, Tokyo, ISBN 3540127550

109 GB8978-1996 Integrated wastewater discharge standard of the People's Republic of China, Ministry of Environmental Protectiaccumulative and toxic) or vPvBon of the People's Republic of China, 1996, http://kjs.mep.gov.cn/hjbhbz//bzwb/shjbh/swrwpfbz/1998 01/W020061027521858212955.pdf

110 ATSDR (2004) Toxicological Profile for copper. United States Public Health Service, Agency for Toxic Substances and Disease Registry, September 2004; ATSDR (2005a) Toxicological profile for zinc, United States Public Health Service, Agency for Toxic Substances and Disease Registry, August 2005; ATSDR (2005b) Toxicological profile for nickel. Agency for Toxic Substances and Disease Registry, US Public Health Service, August 2005

111 Background Note of the Catalogue of Hazardous Chemicals (2015 edition), State Administration of Work Safety, http://www.chinasafety.gov.cn/Contents/Channel_4140/2015/0401/248295/content_248295.htm

focusing on physical hazards to define hazardous chemicals[112]. Table 3 shows in addition to the physical hazards, the health and environmental hazards for several examples of hazardous chemicals to illustrate the importance to consider health and environmental hazards in the chemical management system.

Table 3. Examples of Hazardous Chemicals Identified in the Samples

Chemical selected[113]	Use and Physical hazards	Health hazards	Environmental hazards	Where Greenpeace found it
Hexachlorobenzene (HCB)	HCB was formerly used as a fungicide and can also be formed as a by-product of the manufacture of certain industrial chemicals and pesticide formulations[114]. HCB is a combustible substance, and poorly flammable[115].	Exposure to HCB for a short or long period of time can cause damage to the liver, kidney and thyroid[116]. It may also cause cancer[117].	HCB is a persistent organic pollutant (POP), and is banned from production and use globally as POPs under the Stockholm Convention[118]. POPs remain in the environment for a long period of time, and accumulate in the living organisms. HCB is very toxic to aquatic life with long lasting effects[119].	From the sediment of the Wastewater Discharge Channel (sample 16006) and the Small River (sample 16004)
Benzo[a]pyrene		Benzo[a]pyrene is classified to be reprotoxic, carcinogenic, and	Benzo[a]pyrene is classified to be very persistent, very bioaccumulative toxic	From the sediment of the Wastewater Discharge Channel (sample

112 Ibid; Measures for the Administration of Identification and Classification of Physical Hazards of Chemicals,

113 These chemicals are selected as examples to highlight their CMR, POP, or EDC hazards; and CMR examples are those with 1A/1B rating (i.e. not CMR class 2)

114 ATSDR, Toxic substances portal, hexachlorobenzene, https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=115, Accessed 30.03.2017.

115 European GHS classification and labelling, http://gestis.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates&fn=default.htm&vid=gestiseng:sdbeng Accessed 05.05.2017.

116 ATSDR, Toxic substances portal, hexachlorobenzene, https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=115, Accessed 30.03.2017.

117 Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

118 Persistent Organic Pollutants (POPs) are listed in Stockholm Convention, http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx, Accessed 30.03.2017.

119 Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

		mutagenic[120]. Exposure to Benzo[a]pyrene in the air, eat food contains it, or long period of skin contact may cause cancer. It may cause heritable genetic damage to human germ cells. Animal tests show that this substance possibly causes toxicity to human reproduction or development[121].	chemical [122]. It is hazardous to the aquatic environment with acute and chronic effects[123].	16006)
Benzene	Benzene is widely used in chemical industry. It is a highly flammable liquid, and vapours form explosive mixtures with air[124].	Long-term exposure to benzene can cause cancer of the blood-forming organs [125]. It may also cause heritable genetic damage to human germ cells[126].	It is hazardous to the aquatic environment with long-term effects[127].	From the water of the Wastewater Discharge Channel with high concentrations (Sample 16005,16007,16009)
Carbon disulfide	Carbon disulfide is used as a raw material to produce pesticides, it is a highly flammable liquid,	Long-term exposure to carbon disulfide can affect the normal functions of the brain, liver, and heart.	It is hazardous to the aquatic environment with long-term effects[131].	From the water of the Wastewater Discharge Channel (Sample

120 REACH Substance of Very High Concern (SVHC) candidate list, https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list, Accessed 30.03.2017.

121 Support document for identification of SVHC – Benzo[a]pyrene, European chemicals agency, https://echa.europa.eu/documents/10162/13638/SVHC_SUPDOC_benzo%28a%29pyrene_3891_en.pdf/985e117f-38e2-4d45-9d0c-94413dd0462e.

122 REACH Substance of Very High Concern (SVHC) candidate list, https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list, Accessed 30.03.2017.

123 European GHS classification and labelling, http://gestis.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates&fn=default.htm&vid=gestiseng:sdbeng Accessed 05.05.2017.

124 Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

125 ATSDR, Toxic substances portal, benzene, https://www.atsdr.cdc.gov/phs/phs.asp?id=37&tid=14, Accessed 05.04.2017.

126 Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

127 Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

131 ATSDR, Toxic substances portal, Carbon disulphide, https://www.atsdr.cdc.gov/phs/phs.asp?id=472&tid=84, Accessed 05.04.2017.

	vapours form explosive mixtures with air and can easily be ignited by weak shock waves[128].	It could also lead to the death of the newborns if pregnant female exposes to it[129]. Carbon disulfide also has the potential to interfere with endocrine (hormone) systems.[130]		16005,16007,16009) and the Small River (Sample 16003)
1,2-dichloroethane	1,2-dichloroethane is a manufactured chemical used in many industries, including making plastic products. It is highly flammable liquid, and vapours form explosive mixtures with air[132].	Exposure to 1,2-dichloroethane can cause nervous system disorders, liver and kidney diseases, and lung effects. This substance may also cause cancer in human[133].	The substance is hazardous to the aquatic environment with chronic effects[134].	From the water and sediment of the Wastewater Discharge Channel (Sample 16005,16007,16009) and the water from the Small River (Sample 16003) with high concentrations
Toluene	Toluene is highly flammable liquid and vapours form explosive mixtures with air [135].	The substance is suspected of damaging the unborn child. It may cause damage to central nervous system through prolonged or repeated exposure. It also causes skin irritation, may cause drowsiness or dizziness. [136]	The substance is hazardous to the aquatic environment acute and chronic effect [137].	From the water and sediment of the Wastewater Discharge Channel (Sample 16005,16007,16009) and the water from the Small

[128] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[129] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[130] Endocrine disrupters are identified using the SIN list: http://sinlist.chemsec.org/, Accessed 28.03.2017

[132] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[133] ATSDR, Toxic substances portal, Ethylene dichloride, https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=591&tid=110, Accessed 05.04.2017.

[134] European GHS classification and labelling, http://gestis.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates&fn=default.htm&vid=gestiseng:sdbeng , Accessed, 05.05.2017

[135] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[136] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[137] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015,

				River (Sample 16003) with high concentrations
Hexachlorobutadiene (HCBD)	Hexachlorobutadiene is a colorless liquid with an odor similar to turpentine, and it evaporates easily.	HCBD is suspected of causing cancer, and of damaging fertility or the unborn child[138].	The substance is very toxic to the aquatic life with long lasting effects[139].	From the sediment of the Wastewater Discharge Channel (sample 16006)
Diisobutyl phthalate (DIBP)	DIBP is a clear colorless liquid with and odor similar to ester.	DIBP may damage the unborn child, and is suspected of damaging fertility[140].	The substance is very toxic to the aquatic life with long lasting effects[141].	From the sediment of the Wastewater Discharge Channel (sample 16004, 16006) and water of the Wastewater Discharge Channel (Sample 16005,16007)

Goal a) To identify whether the industrial park concerned was releasing hazardous substances to the environment in the neighborhood

- As both the Small River and the Wastewater Discharge Channel connect to the Guanhe River and, ultimately, to the Yellow Sea, the presence in both water and sediments of such complex mixtures of toxic or hazardous organic compounds, including a number of POPs and carcinogenic chemicals, is clearly cause for high concern in terms of both environmental pollution and public health.

- Lianyungang Chemical Industrial Park has evidently already created a hotspot of toxic chemical pollution, and one that may be expected to continue to worsen over time unless action is taken to prevent further discharges of hazardous wastes to the channels and to contain and clean up the contaminated sediments.

http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[138] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[139] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[140] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

[141] Harmonized classification of Hazardous chemicals in China, published along with the Catalogue of Hazardous Chemicals, 2015, http://www.chinasafety.gov.cn/Contents/Channel_5492/2015/0309/247026/content_247026.htm.

- Based on the above findings, Greenpeace cautions that when faced with such complex mixtures of chemical pollutants, especially given that chemicals can have different toxic effects singly and potentially in combination, and when a high proportion of which simply cannot be readily identified, any attempt to assess the precise health and environmental risks associated with exposure to the chemicals in the water or sediment, or their subsequent contamination of fish and other river and seafood that may be harvested downstream, will clearly remain extremely challenging if not impossible. Therefore, a precautionary and hazard-based chemicals management system should be adopted at the chemical park level to prevent the releases of hazardous chemicals at source.

Goal b) To examine whether the concerned hazardous substances identified in the samples are regulated under the current discharge standards in China.

Wastewater:

According to the approval document of the Environmental Impact Assessment Report of Lianyungang Chemical Industrial Park authorized by Jiangsu Provincial Environmental Bureau[142], the Integrated Wastewater Discharge Standard (GB8978-1996) is applied in the case of monitoring the discharges and releases of contaminants in water. The Standards stipulates that the concentration of certain chemicals in the discharge from this industrial park should not exceed those listed in the 1st class of the Standard. For chemicals regulated in the Integrated Wastewater Discharge Standard:

- The concentrations of **benzene** found in Wastewater Discharge Channel are approximately **two times** higher than that is listed in the national standard.
- The concentrations of **toluene** in two samples from Wastewater Discharge Channel are approximately **1.5 times** higher than that is listed in the national standard.
- **Malathion**, a pesticide, was present in two of the wastewater samples from Wastewater Discharge Channel, which is listed as "should not exist" in the national standard (see Table 4 below).

Table 4. The comparison between hazardous chemicals identified in water samples and their permitted discharge limits as regulated in Integrated Wastewater Discharge Standard (GB8978-1996).

Chemical name	Samples				Allowed 1st class concentration (ug/L) in *Integrated Wastewater Discharge Standard (GB8978-1996)* *
	Small River	Wastewater Discharge Channel			
	CN16003	CN16005	CN16007	CN16009	
	Wastewater concentration (ug/L)				
1,2-Dichloroethane	34	710	1200	1630	-
Dichloromethane	<5	943	794	1000	-
Benzene	N.D	166	175	279	100

142 Obtained by Greenpeace from local government upon request.

Toluene	<5	90	139	197	100
Malathion	N.D	N.D	Present	Present	Should not exist
Chlorobenzene	<5	101	69	90	200
Chloroform	20	43	51	65	300
m-/p-Xylene	19	16	10	12	400
o-Xylene	8	28	26	45	400
1,1-Dichloroethene	N.D	<5	<5	<5	-
Carbon disulfide	<5	<5	<5	<5	-
1,2-Dichloroethene	N.D	<5	N.D	<5	-
Cyclohexane	69	<5	<5	6	-
Tetrachloromethane	N.D	N.D	<5	<5	30
Trichloroethene	N.D	<5	<5	<5	300
1,2-Dichloropropane	<5	<5	<5	<5	-
Methylcyclohexane	N.D	<5	<5	<5	-
1,1,2-Trichloroethane	N.D	<5	<5	<5	-
Tetrachloroethene	<5	<5	<5	<5	100
Ethylbenzene	7	7	<5	5	400
Bromoform	N.D	N.D	<5	<5	-
Isopropylbenzene	N.D	<5	<5	<5	-
1,3-Dichlorobenzene	<5	13	15	20	400
1,4-Dichlorobenzene	<5	<5	<5	<5	-
1,2-Dichlorobenzene	<5	12	13	18	400
1,2,4-Trichlorobenzene	N.D	5	<5	5	-

N.D stands for not detected in sample. “Present” indicates the chemical was detected in the sample, but no concentration was measured. “<x” indicates that the chemical was detected but at a concentration below the limit of quantification. “-“ shows the chemical is not included in the Integrated Wastewater Discharge Standard.

Sediment:
Because we cannot justify the purpose in which the sediments can be used, no standards were applied to the tested concentrations.

Air:
3 VOCs present in our air samples are included in the national standard as listed in the national integrated emission standard of air pollutants (GB16297-1996)[143]. However, since only preliminary test were undertaken for air, no comparison was made between the tested concentrations and emission standard.

Conclusion:

[143] Integrated emission standard of air pollutants (GB16297-1996), http://www.zhb.gov.cn/gkml/hbb/bgth/201112/W020111230544195394010.pdf

- Based on the standards applied in the environmental impact assessment [144] of Lianyungang Chemical Industrial Park, Integrated Wastewater Discharge Standard (GB8978-1996) covers little of these chemical contaminants identified in the wastewater samples of Small River and Wastewater Discharge Channel. No standards were applied to sediment or air results.

- As provincial governments can issue wastewater discharge standards stricter than national ones according to the Water Pollution Prevention and Control Law of the People's Republic of China[145], the newly updated provincial discharge standard of main water pollutants for the chemical industry by Jiangsu province in 2006 (DB32/939-2006)[146] was applied and found out that: although the 2006 provincial standard updated maximum limit allows for several general contaminants of specific chemical industries, it reduced the number of contaminants in the 2nd category to 12 items, 56 in the national standard in 1996. Unfortunately, certain chemicals[147] found in our samples, which are regulated under the national standard, are among the removed items. In addition, to monitor and eventually regulate the wastewater and to standardize the monitoring procedures, a national standard in monitoring wastewater - Technical Specifications Requirements for Monitoring of Surface Water and Waste Water (HJ/T91-2002) was published in 2002[148]. Contaminants in this technical standard were grouped into "Required Monitoring" and "Selected Monitoring". Most hazardous chemicals found in this study are not listed under the Requirement Monitoring group, neither are they listed under the Selected Monitoring group.

Goal c) To identify any gaps between Chinese chemical management system (State Council Decree 591), international practice[149] and SIN list[150] regarding the chemicals concerned in this case study[151].

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144 Approval document of the Environmental Impact Assessment Report of Lianyungang Chemical Industrial Park authorized by Jiangsu Provincial Environmental Bureau, obtained by Greenpeace from local government upon request.

145 Water Pollution Prevention and Control Law of the People's Republic of China, Chapter 2, Article 13, http://www.gov.cn/flfg/2008-02/28/content_905050.htm

146 DB32/939-2006, Department of Environmental Protection of Jiangsu, 2006, http://www.jyepb.gov.cn/xxgk/zdgkxx/zcfg/hjbhbj/shuihjbhbz/200

147 "certain chemicals" here refers to 12 removed items, including malathion, chloroform, tetrachloromethane, trichloroethene, tetrachloroethene, benzene, toluene, ethylbenzene,
o-/m-/p-xylene, chlorobenzene
o-/m-/p-xylene, chlorobenzene.

148 HJ/T 91-2002, Technical Specifications Requirements for Monitoring of Surface Water and Waste Water, Ministry of Environmental Protection of the People's Republic of China, 2002, http://www.sepa

149 International practice here refers to substances contained in the Stockholm Convention, the E.U. REACH Substance of Very High Concern (SVHC) candidate list and Authorization list.

150 The SIN list is developed by International Chemical Secretariat (Chemtrac), is known and used globally for chemicals management. Regulators and authorities use the SIN List in the EU, the US, and Asia in legislative processes. http://chemsec.org/business-tool/sin-list/about-the-sin-list/

151 Because large amount of chemicals contained in the samples, the online chemical substance database Chemtrac (https://www.chemtracglobal.com/) was used to screen our tested results with related regulations; and among the total 2276 organic chemicals identified in our samples, 170 chemicals were recorded in the Chemtrac database. The rest are beyond our methods to identify its related regulation/hazardous status.

A total number of 226 organic chemicals were identified in all samples collected from the Lianyungang Chemical Industrial Park Wastewater Discharge Channel and its conjunct Small River. Among which, 61 of these identified chemicals (26% of total chemicals identified) are listed in China's Catalogue of Hazardous Chemicals (2015 Edition) as "hazardous chemicals". The foundation of hazardous chemicals management system operating in China is based on the Regulation on the Safety Management of Hazardous Chemicals (State Council Decree 591) revised in 2011[152]. Pertaining to this regulation, the Catalogue of Hazardous Chemicals (Edition 2015) provides a list of 2,828 substances and the defining principles of "hazardous chemicals" in China. The table below lists 24 chemicals found in the samples collected from Lianyungang Chemical Industrial Park, and included in either Stockholm Convention, E.U. REACH SVHC candidate list, and Authorization list, or SIN list because of their environmental or health hazards. These hazard properties include persistence, bioaccumulation, carcinogenic properties, mutagenicity, toxicity towards the reproductive system, or the capability to disrupt endocrine (hormone) systems.

As shown in the table below, all three POPs identified in this study that are listed under the Stockholm Convention have been included in the Catalogue since the Convention came to force for China in 2004. However, the Catalogue still shows some gaps compared to the REACH SVHC candidate list or SIN list, which was developed following a preventative and precautionary approach.

International practice referred in the comparison entails the following:

- Stockholm Convention[153] is an international convention on Persistent Organic Pollutants, which was signed by the Chinese government on May 23, 2001. The Convention entered into force for China on November 11, 2004. The Chinese government commits to fulfilling the obligations specified by the Convention, and "will establish and improve corresponding administrative systems and develop and implement related policies and necessary action measures so as to achieve the control objectives required by the Convention"[154].
- Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) is a European Union regulation dated 18 December 2006. REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment. REACH SVHC candidate list[155] includes candidate substances with very high concern, for possible inclusion in the Authorization list under REACH. The inclusion of a substance in the Candidate List creates legal obligations to companies manufacturing, importing or using such substances, whether on their own, in preparations or in articles.

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152 http://www.gov.cn/zwgk/2011-03/11/content_1822783.htm

153 Stockholm Convention, http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx, Accessed 30.03.2017.

154 The People's Republic of China National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants, April 2007

http://www.pops.int/documents/implementation/nips/submissions/china_nip_en.pdf

155 REACH Substance of Very High Concern (SVHC) candidate list, https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list, Accessed 30.03.2017

SVHCs from the candidate list may be included in the Authorisation list[156] after a two-step regulatory process to ensure proper control of the risks from these SVHCs. Substances included in the Authorization list cannot be placed on the market or used after a given date if no exemption is given. Furthermore, if a chemical presents an unacceptable risk which needs to be addressed on a EU-wide basis, it may be included in the Restriction list[157] following proposals from the EU member state or the commission.

- REACH SVHC candidate list is used in this report because it was developed following a preventative and precautionary hazard-based approach which could be a good example for the improvement of Chinese chemical management system. Authorization list is used in this report to demonstrate the range of chemicals of which hazards have been identified and have been prohibited using on the EU market after a given date. REACH Restriction list is not included in this report because each of the substances included in the list are restricted under certain conditions, which may not be applicable to the case introduced in the report.
- The criteria for a SVHC are described in REACH article 57. In general terms an SVHC is a substance meeting one or more of the following criteria:
  1) Class 1 or 2 carcinogen, mutagen, or toxic for reproduction (CMR);
  2) Substance which is PBT (persistent, bio-accumulative and toxic) or vPvB (very persistent and very bio-accumulative) in accordance with Annex XIII of REACH;
  3) Other substances for which there is evidence of equivalent degree of concern (e.g. endocrine disruptors).

The SIN list is not created under government regulations. It consists of chemicals that have been identified by the NGO ChemSec as being SVHCs based on the criteria defined within REACH (see Table 5 above), but not yet included in the SVHC Candidate list. Because the process of regulating specific chemicals within the scope of REACH is slow, the existing of SIN List aims to speed up the legislation process on chemical management. It is used in this report as a reference list for EDC or potential EDCs as it is well documented and provides accessible information detailing the methodology, criteria, and sources used to recognize included chemicals as an EDC or potential EDC[158]. Also, it is continuously updated for adding or removing chemicals as new information becomes available.

156 REACH Authorisation list, https://echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list, accessed 20.05.2017

157 REACH Restriction list, https://echa.europa.eu/addressing-chemicals-of-concern/restrictions/substances-restricted-under-reach?p_p_id=disslists_WAR_disslistsportlet&p_p_lifecycle=1&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=1&p_p_col_count=2&_disslists_WAR_disslistsportlet_javax.portlet.action=searchDissLists, accessed 20.05.2017

158 Endocrine disrupting chemicals (EDCs) on the SIN list, 2014, ChemSec, http://chemsec.org/wp-content/uploads/2016/03/EDC_factsheet_October_2014.pdf.

Table 5. List of the Chemicals with High Environmental and Health Concerns

No.	Chemical name	REACH SVHC list[159] - reason for inclusion	REACH Authorization list[160]	Stockholm Convention (POPs)[161]	Listed hazardous properties in SIN list[162]	Catalogue of Hazardous Chemicals (China)
1	Hexachlorobenzene (HCB)			POP	C 1B	Listed
2	Hexachlorobutadiene (HCBD)			POP	PBT, vPvB	Listed
3	Pentachlorobenzene (PeCB)			POP		Listed
4	3,3’-dichlorobenzidine				C 1B	Listed
5	Michler’s Base	C			C 1B	Not listed
6	Benzo[a]pyrene	C, M, R, PBT, vPvB			C 1B, M 1B, R 1B	Not listed
7	Dibutyl phthalate	R	Y		R 1B	Not listed
8	Di-(2-ethylhexyl) phthalate (DEHP)	E, R	Y		R 1B	Not listed
9	Diethyl phthalate (DEP)				E	Not listed
10	Butylated hydroxytoluene (BHT)				E	Not listed
11	Diisobutyl phthalate (DIBP)	R	Y		R 1B	Listed
12	Trichloroethene	C	Y		C 1B, M 2	Listed
13	2-Methoxyaniline	C			C 1B, M2	Listed
14	1,2-Dichloroethane	C	Y		C 1B	Listed

d regulation/hazardous status.

159 REACH Substance of Very High Concern (SVHC) candidate list, "https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list" https://echa.europa.eu/regulations/reach/authorisation/the-candidate-list

160 REACH Authorization list, https://echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list

161 Persistent Organic Pollutants (POPs) are listed in Stockholm Convention "http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx" http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx.

162 SIN list: http://sinlist.chemsec.org

15	Anthracene	PBT			PBT	Listed
16	1,2,3-Trichlorobenzene				PBT	Listed
17	1,2,4-Trichlorobenzene				PBT	Listed
18	1,2-Dichlorobenzene				vPvB, very toxic to aquatic species	Listed
19	Naphthalene				C 2, very toxic to aquatic species, E	Listed
20	Carbon disulfide				E	Listed
21	Tetrachloroethene				E	Listed
22	2-Nitroanisole				C 1B	Listed
23	4-Chloroaniline				C 1B	Listed
24	Benzene				C 1A, M 1B	Listed

**** (C)**arcinogenic, **(M)**utagenic, toxic for **(R)**eproduction, PBT, vPvB, **(E)**quivalent level of concern

Conclusion:

Since the Stockholm Convention came to force for China in 2004, all three POPs identified have been included in the Catalogue of Hazardous Chemicals (Edition 2015). However, the Catalogue still shows the gap with the REACH SVHC candidate list, Authorization list, or SIN list, which was developed following a preventative and precautionary approach.

VI. Discussion and Suggestion

"Given that 90 per cent of the enterprises are small and medium-sized with backward technology and processes, there is a great need to enhance supervision for better and sound chemicals management. Yet at present, chemicals management is rather fragmented across nation and departments, which may call for an institutional reform."
– CHEN Jining, Minister of Environmental Protection, People's Republic of China, OurPlanet September 2015, United Nations Environment

Analysis in previous chapters has shown that the seemingly advanced chemicals management regulations and environmental standards in China may have made modest impact in monitoring and controlling the releases of hazardous chemicals identified in the investigation.

The current chemicals management system in China is far from a sound management one. It mainly focuses on import and export registration of toxic chemicals and environmental monitoring of new chemical substances. It leaves a huge gap in regulating existing chemicals and eliminating or substituting hazardous chemicals with safer alternatives. As the concept of "environmental risk assessment and management" comes into the scene, as far as many hazardous chemicals are concerned, there is no safe limits in the environment. A risk-based approach is costly and endless as among 50,000 chemicals exist in China only less than 3,000 are subject to safety permit management. The vast majority of existing chemicals are not fully assessed and are effectively presumed non-hazardous and permitted for use until proven otherwise in China. The current chemicals management system in China offers little incentive for the provision of additional information from the market on which risk-assessment can be based. Despite the more precautionary regulation of new chemicals in China - some calling it "China REACH" - the greater part of the problem undoubtedly lies with existing chemicals. Therefore, current regulation of overall chemicals management must not be considered adequate.

In recognition of the substantial and, to a large degree, inherent limitations in the identification of exposure pathways and the accurate quantification of exposure to chemicals, a hazard-based approach to chemicals management must be adopted. This alternative approach accepts that exposure of one or more ecosystem compartments to a chemical will be a possible and, in many cases, likely consequence of the manufacture, use or disposal of that chemical. It must be recognized that even for chemicals used in "closed" applications, the potential exists for release to the wider environment through catastrophic accidental releases or through contamination of products with process chemicals.

Furthermore, current regulation on pollution control focuses on generic measurements of pollutants, such as CODCr, phosphate, suspended solids and ammonia nitrogen. There is lack of mandatory requirements for monitoring the use and releases of hazardous chemicals in China. As the world's largest chemicals manufacturer and user, such phenomena of releasing hazardous chemicals without adequate control may well be widespread across China. It is time to address the distributed environmental and health risks of chemical parks and industry. China can learn from enacted regulations by other countries to limit and eliminate the production, use, and release of hazardous chemicals defined in a broader sense.

To unleash the potentials of upgrading the structure and competitiveness of the chemical industry in China, the dividend from economic restructuring should be fully tapped into. For instance, in November 2015, the Ministry of Industry and Information Technology (MIIT) issued a relocation and reconstruction plan of high-risk hazardous chemicals producers in densely populated areas, followed by a guideline to standardize future development of chemical industrial parks in China. To this day, there is no policy matched with the need for environmental management of chemicals at the industrial park level. Ironically, in July 2016, the MEP revoked the Measures for the Environmental Management Registration of Hazardous Chemicals (MEP Order 22) leaving a vacuum for addressing the environmental and human health challenges posed by hazardous chemicals.

The proposed hazard-based approach would effectively replace the current instruments with one based on the regulation of chemicals according to hazard. Chemicals or groups would be subject to an “evaluation” procedure, in which the central element would be a process of hazard identification considering the intrinsic properties of chemicals or groups. Action would be required to address all chemicals identified as hazardous within a restricted timeframe. Information on production volumes and uses would only be used to accelerate rather than avoiding or delaying restrictive measures and substitution for chemicals present widespread and/or direct hazards due to their scale of production or modes of use.

Greenpeace proposes the following approaches[163]:

- To unify the evaluation and regulation of all chemicals, encompassing both new and existing chemicals, along with the intermediates, contaminants, by-products and degradation products associated with them, in order to ensure that not only the manufacture, marketing and use of all chemicals is properly controlled, but that all discharges, emissions and losses arising from manufacture, use or disposal are also properly addressed.
- Regulate chemicals base on their intrinsic properties of hazards, and not rely on the prediction of exposure and the calculation, assessment, and management of risks.
- Consider persistence an indication of the potential for long-term and widespread contamination of, and possibly impacts on, environmental compartments, and therefore as a key criterion in the hazard identification process.
- Presume that chemicals are hazardous until demonstrated otherwise, chemicals must be assumed to present hazards of unknown proportions (the precautionary approach).

Recommendations for a transparent and preventative hazard-based chemicals management approach in China

1. The widening gap on chemicals management in China is underpinned by the structural and invisible risks due to the way chemicals are currently manufactured and used. In the restructuring of the chemical industry, these risks must be recognized and future chemicals management policy must be based on the intrinsic hazards of chemicals to ensure not only production safety, but also health and environmental safety.

[163] The Way Forward: Out of the Chemical Crisis, 1999, Greenpeace International, http://www.greenpeace.org/international/Global/international/planet-2/report/1999/4/the-way-forward-out-of-the-c.pdf

2. Coherent industrial and environmental policies must be developed to enable the sound managements of chemicals and the sustainable growth of chemistry in China without the potential of harm to human health and the environment. The industry must embrace and be managed from a long-term perspective, preventing harm to the environment and to local populations. Hazardous chemicals facilities should be moved away from densely populated urban and environmentally sensitive areas, and current sites must be cleaned up with caution. Current and newly developed “chemical parks” must operate a precautionary and transparent chemicals management system, and keep safe distance from areas of potential environmental and human risk.
3. In conjunction with other departments, the Ministry of Environmental Protection (MEP) and the State Administration of Work Safety (SAWS) must work to improve transparency in the chemicals industry. The MEP should lead the way in publicly and proactively publishing hazard-related information such as the location of chemical enterprises, information on chemical substances, risk prevention, and control in environmental management of chemicals.
4. Both the Ministry of Industry and Information Technology and the MEP should promote the transformation and upgrading of the chemical industry, including downstream chemical users, to eliminate or substitute hazardous chemicals with non-regrettable alternatives.
5. China should play a leadership role in the use and production of chemicals in ways that lead to the minimization of the potential for adverse effects on human health and the environment. By 2020 (the end of the Thirteenth Five-Year Plan period), China should show progress and deliver its commitment to the international society on the sound management of chemicals and all waste throughout their lifecycles by 2020.

Greenpeace calls for immediate action to be taken by chemical industrial parks and local governments in China:

- Examine the releases of, and pollution of the environment with hazardous chemicals around chemical industrial parks in China, to identify the hotspots for decontamination and, most importantly, to act in precaution to prevent chemical harm by following pollutant release, transfer and registration approach (PRTR).
- Chemical industrial parks and local governments should improve the incorporation of sound chemicals management into the design, establishment and operation of chemicals parks as a substantive approach to mitigating the environmental risks of aggregated chemical industrial sites, whilst promoting green chemistry.
- Be transparent and proactively communicate the hazards and risks of chemical installations during any relocation process.
- Any newly established chemical industrial park should incorporate sound chemicals management as a requirement or to incentivize those taking lead on this.
- Develop a dedicated legal instrument to ensure the implementation of a sound chemicals management scheme in all parts of China.

Greenpeace proposes the following steps to be taken for the evaluation of the environmental and health risks of existing chemicals and EDCs to be completed by end of 2017 by the Ministry of Environmental Protection as part of the Thirteenth Five-Year Plan for Environmental

Protection and its related Plan for National Environmental Standards during the Thirteenth Five-Year Plan[164]:

1. To organize chemicals wherever possible into groups on the basis of similarity in chemical structure, presence of active groups or chemical properties, so that the need for evaluation on a substance-by-substance basis may be minimized in order to increase efficiency and allow more simple, effective and timely regulation[165];
2. To avoid regrettable substitution of one chemical with another very closely related one that is likely to have similar hazardous properties;
3. To collate existing information from a wide range of validated sources, or obtain new information (within a limited timeframe), based on the hazards presented by chemicals or groups that can be identified. For example, the information that has already been submitted as part of the EU REACH regulation;
4. To evaluate chemicals or groups in a precautionary manner, leading to a decision either: a) to substitute the chemicals, if hazardous, within a specified and limited timeframe, along with the introduction of interim measures to restrict applications and control discharges, emissions and losses where possible; b) to permit the continued use of chemicals which do not have unacceptable hazards is identified for defined applications and for a specified period, after which the permitted uses should be re-evaluated. Earlier re-evaluation of permitted chemicals may be necessary in light of new information of relevance becoming available.
5. To allow consideration of use patterns and the role served by the chemicals in question within society in order to guide the timing of substitution and the need to introduce other restrictive measures in the interim.

[164] Thirteen-Five-Year Plan for Ecological Environment Protection, http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm, and National Environmental Protection Standards for the Thirteenth Five-Year Plan, http://www.mep.gov.cn/gkml/hbb/bwj/201704/t20170414_411566.htm

[165] Chemicals or groups for which evaluation is not possible, due to poor availability of information, would be considered to present unknown hazards, classified as “unevaluated” and targeted for substitution accordingly.

Appendix 1: List of Chinese Chemical Policy

	Regulation	Issued by	Time	Higlights
1	Catalogue of Hazardous Chemicals (2015 Edition)	SAWS (with 9 ministries)	2015.02.27	Provide a list of 2,828 substances and the defining principles of "hazardous chemicals" in China
2	Harmonized Classification of Hazardous Chemicals	SAWS	2015.08.19	Provide the hazard classification of chemicals listed in the Catalogue of Hazardous Chemicals (2015 Edition) in the light of China's national standards on GHS
3	Catalogue of Priority Hazardous Chemicals for Environmental Management (trial)	MEP	2014.04.03 (repealed by State Council on 2016.07.13)	Prioritize 84 substances from the Catalogue of Hazardous Chemicals subject to environmental management
4	List of Hazardous Chemicals for Priority Management (safety)	SAWS	1st batch: 2011.06.21 2nd batch: 2013.02.05	74 substances prioritized from the Hazchem catalogue for enhanced safety management in production
5	List of Priority Chemicals for the Prevention and Control of Environmental Risks (as part of the 12th Five-Year-Plan, 2010-2015)	MEP	2013.02.07	Prioritize groups of chemicals to be controlled for their environmental risks exposed through accumulation, incidents, and released into water and air (excl. POPs and heavy metals as subject to other regulations)
6	Inventory of Enterprise Risk Assessment for Environmental Incident	MEP	2014.04.03	Specify 310 chemicals and their threshold quantities for enterprises to identify and assess environmental risks in the case of incidents.

Appendix 2: Greenpeace Research Laboratories Analytical Results: Analysis of wastewaters and associated sediments collected from two industrial parks in China for the presence of metals and organic chemical contaminants, 2017-01, http://www.greenpeace.to/greenpeace/wp-content/uploads/2017/04/GRL-AR-2017-01.pdf

Appendix 3: Chemicals with certain health and environmental hazards identified in one or more of the seven water and sediment samples from Lianyungang Chemical Industrial Park. The table includes chemical name, CAS number, hazard information, EU REACH list or international convention used to identify hazards, and crosscheck with Chinese regulation lists, 2017-05, http://api.greenpeace.cn/url/XE45Du2A