

## **Sino-German Innovation Networks in the Wind Power and Electric Vehicles Sector**

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## In Focus

### Sino-German Innovation Networks in the Wind Power and Electric Vehicles Sector

A contribution by Lars Oehler, Copenhagen Business School and Primoz Konda, Aalborg University

## 风电和电动汽车领域的中德创新网络

来自哥本哈根商学院的Lars Oehler和奥尔堡大学的Primoz Konda的客邀文章

Within the last decade, China has experienced an unprecedented growth in low-carbon technologies. Since 2009, it has been the largest market and producer of wind power and accounts for 35.7 percent of the world's installed capacity today. Similarly, it has been solidifying its leadership position in electric vehicles (EV) over the past five years, accounting for 55.5 percent of global sales. This green transformation has not only been the result of a series of domestic policies that were boosting market demand and providing financial security for investors. China's path to green leadership was also considerably paved through strategic networks with other countries. This article reflects on China's knowledge-sourcing strategies and particularly focuses on Sino-German innovation networks in the wind and EV sector. We use patent data and deploy new natural-language-processing techniques to measure knowledge networks with regard to technological novelty and impact.

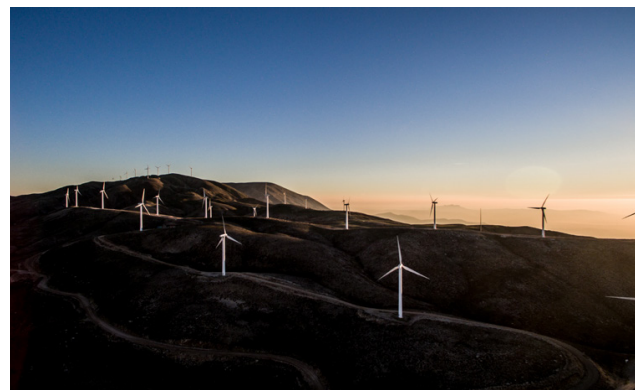
#### Innovation networks in wind power

During the initial stage of market formation (pre-2005), China's wind power sector was still largely fragmented. At that time, strategic networks were established with South Korea and Japan. After the Renewable Energy Law had been passed in 2006, China diversified its network towards Germany, Denmark and the United States and intensified its collaboration with South Korea and Japan. Particularly striking is the central position of Germany during the first and second stage, taking an important intermediary position in the global innovation network. Until today, German engineering and design firms play a substantial role for the development of China's wind turbine sector.

#### Innovation networks in EV

Interestingly, China's EV sector had already established networks with South Korea and Japan and

在过去十年中,中国在低碳技术方面经历了前所未有的增长。2009年以来,中国一直是风电的最大市场和生产者,占当今全球装机容量的35.7%。同样,它在过去五年中巩固了在电动汽车(EV)市场上的领导地位,占到全球销售额的55.5%。这种绿色转型一方面得益于一系列刺激市场需求并为投资者提供金融安全保障的国内政策,另一方面也得益于与其他国家的战略合作网络,由此奠定了通往绿色领导者的道路。本文主要介绍中国的知识获取策略,特别是风能和电动汽车领域的中德创新网络。我们使用专利数据并部署新的自然语言处理技术来衡量知识网络的技术新颖性和影响。



*Until today, German engineering and design firms play a substantial role for the development of China's wind turbine sector*

*直到今天,德国工程设计公司仍在中国风力发电机行业的发展中发挥着重要作用*

Source / 图片来源: pxhere.com

#### 风电创新网络

在市场形成的初始阶段(2005年前),中国的风力发电行业仍处于分散状态。当时,中国与韩国和日本建立了战略合作网络。2006年《可再生能源法》通过后,中国将网络扩展到了德国,丹麦和美国,并加强了与韩国和日本的合作。尤其引人注目的是德国在第一和第二阶段的中心地位,它在全球创新网络中占据重要的核心地位。直到今天,德国工程设计公司仍在中国风力发电机行业的发展中发挥着重要作用。



the United States long before its market expansion took off. Similar to wind, China diversified its network towards Germany during the second stage (post-2005). However, compared to wind power, Germany's position in EV shows considerably less centrality in the global network. South Korea and Japan can be clearly identified as the two central economies during the 2006-2017 period, which is likely to become an "Asian triangle" including China in the future.

### Comparing overall patent and market development in wind and EV

Despite similar levels of patenting activity, we can observe that wind power started to develop 15 years before EV, with the latter taking off post-2010. This can be attributed to three main reasons. First, as EV technology develops through science-technology-based (STI) innovation modes, time-to-market takes considerably longer than clean technologies that are based on doing, using, interacting (DUI) innovation modes such as wind power. Second, there are still various technologies competing for a dominant design in EV – comprising a range of alternative sub-types such as hybrid-electric, battery-electric, range-extended and fuel-cell vehicles. Varying policies in different countries led to the emergence of different EV solutions. For instance, in 2016 the share of plug-in hybrids as of total EVs was 27 percent in Norway and 88 percent in the Netherlands. Third, despite having the potential assets to exploit innovations, incumbent countries leading the automotive sector such as Germany had relatively little incentives to introduce novel technology at the risk of potential market cannibalizations. Research has shown that large car manufacturers accounted for major patents of EV R&D activity, yet without exploiting their knowledge. Hence, it is likely that incumbents used their patent activity for strategic non-use purposes to block other parties. The global post-2010 production surge mostly correlates with China's market development in EV.

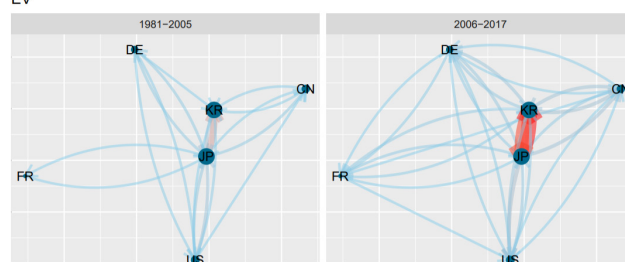
### Key insights

- China has successfully established networks with leading "countries of excellence" in both the wind power and EV sector. South Korea and Japan remain the two central partners for China's knowledge sourcing in both sectors.

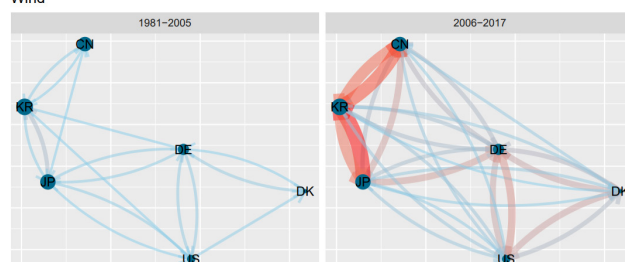
### 电动汽车创新网络

有趣的是,中国的电动汽车行业早在其市场扩张开始之前就已经与韩国、日本和美国建立了合作网络。与风力市场类似,中国在第二阶段(2005年后)也将网络扩展到了德国。但是,与风能相比,德国在电动汽车领域并没有在全球网络中占据显著的中心地位。在2006年至2017年期间,可以清楚地确定韩国和日本为两个核心经济体,未来很可能会形成包括中国在内的“亚洲三角”。

EV



Wind



Knowledge networks in EV and wind power (pre/post-2005)  
电动汽车和风力发电知识网络(2005年前/后)

Source / 图片来源: Copenhagen Business School and Aalborg University

### 风能和电动汽车的专利和市场发展整体比较

尽管专利活动水平相似,我们可以观察到,风力发电在电动汽车之前15年就开始发展,而电动汽车则在2010年后起飞。这一现象主要可归于三个原因:首先,电动汽车技术通过基于科技(STI)的创新模式发展,需要花费比基于“做用互动”(DUI)创新模式的清洁技术(如风能)更长的上市时间。其次,仍然有各种技术在竞争电动汽车的主导设计模式,包括一系列可互相替代的子类型,例如混合动力电动、电池电动、增程式和燃料电池汽车。不同国家不同的政策导致出现了不同的电动汽车解决方案。例如2016年,插电式混合动力车在电动汽车总数中占到的份额在挪威为27%,在荷兰为88%。最后,尽管拥有开发创新的潜在资本,但德国等汽车行业的领先国家在面临潜在市场被蚕食风险的情况下少有引进新技术的动力。研究表明,大型汽车制造商占据了电动汽车研发活动的大部分专利,但并未充分利

- Sino-German innovation networks have been strong in both sectors. Yet, in 2018, there was no German manufacturer among the top-15 brands in terms of EV sales in China. This means that Germany's position in EV is likely to be further marginalized in the future. This bears a particular risk for Germany's automotive sector given that in 2018 almost every fourth car sold in China was German (with BMW/Daimler selling more than 30 percent and VW even 40 percent of their global share in the Chinese market).
- We observe sector-specific innovation network patterns. In EV, China was connected with other countries at the time of market entry (second stage) to a considerably lower degree, which was followed by a very fast-paced ascent. The post-2010 surge was sparked by a combination of institutional support and international partnerships.

#### Implications on a firm and country level

- Low-carbon sectors can display positive network externalities, particularly if balanced on the demand (EV) and supply side (wind power). China is increasingly taking advantage of such externalities, leading in both the supply and demand of clean technologies. Other countries like Germany should follow China's fast market scale-up in low-carbon technologies, especially in EV to enable such network externalities.
  - The number of countries involved in both sectors is steadily increasing. Therefore, knowledge-sourcing strategies should not be limited to a few incumbent countries, but enable global partnerships and open technological leapfrogging opportunities for developing and emerging economies.
  - Both sectors strongly depend on government support. Public policies are not only crucial to trigger but also to scale-up the development of low-carbon technologies. Unexpected and frequent changes in the underlying policy regime pose a risk to the long-term maturation of low-carbon technologies. Such investment uncertainties should be avoided by clear and long-term investment strategies both on a national and multilateral level.
- 用他们的知识。因此，市场领导者可能将其专利活动战略性地用于非使用目的，以阻止其他市场参与者。2010年后的全球产量激增主要与中国的电动汽车市场发展有关。
- #### 重要观点
- 中国已成功与风能发电和电动汽车领域发展领先的“卓越国家”建立了合作网络。韩国和日本仍然是中国在这两个领域进行知识采购的两个主要合作伙伴。
  - 中德创新网络在这两个领域都很强大。然而，就中国的电动汽车销量而言，2018年排名前15的品牌中没有德国制造商。这意味着德国在电动汽车中的地位将来可能会进一步被边缘化。鉴于2018年在中国销售的汽车中几乎有四分之一是出自德国品牌（中国市场占宝马/戴姆勒全球销售份额的30%以上，而大众占40%），这给德国汽车业带来了特殊的风险。
  - 我们观察到行业特定的创新网络模式。在电动汽车领域，中国在进入市场（第二阶段）时与其他国家的联系程度较低，其后是非常快速的上升。2010年后的激增是由机构支持和国际伙伴关系共同引发的。
- #### 对企业和国家层面的影响
- 低碳行业可以表现出积极的网络外部性，尤其是在需求方（电动汽车）和供应方（风能发电）保持平衡的情况下。中国越来越多地利用这种外部性，在清洁技术的供求两方面都处于领先地位。其他国家如德国应该跟随中国在低碳技术尤其是电动汽车方面快速扩大市场规模，以实现此类网络外部性。
  - 越来越多的国家在参与风能发电和电动汽车这两个领域。因此，知识获取战略不应仅限于少数几个现有国家，而应为发展中国家和新兴经济体提供全球伙伴关系和开放的技术跨越式机遇。
  - 这两个领域都强烈依赖政府的支持。公共政策不仅对启动阶段至关重要，而且对于扩大低碳技术的发展也非常重要。基本政策制度的意外变化和频繁变化对低碳技术的长期成熟发展构成了威胁。应通过国家层面和多边层面的明确的长期投资战略避免此类投资的不确定性。

# Building

## German Smart Manufacturing Comes to Xiong'an

### 德国“智”造 跑进雄安

In order to get first-hand insights into the future development of Xiong'an New Area and to discover opportunities for German companies coming to Xiong'an, the German Chamber of Commerce in North China together with the Xiong'an Green Development Research Institute jointly held the forum "German Smart Manufacturing Comes To Xiong'an" on September 6 in the heart of Xiong'an New Area Citizen Service Center at Oscar Studios.

The forum focused on the topic "Exploring Innovative Concepts & Boosting the Future of Smart Cities" and was attended by 160 company representatives, including German Chamber members as well as representatives of Chinese companies located in the area. The event was supported by Tonghe Times Beijing Investment Management and Wilo China, long-term and very active member of the German Chamber in North China, as well as one of the worldwide leading manufacturers of high-tech pumps, pump systems and premium supplier for building services, water management and industrial sectors.

The forum put a spotlight on various ways to achieve Sino-German cooperation in Xiong'an. German companies are strong in fields like equipment manufacturing, environmental protection as well as energy development and therefore can contribute to the development of smart cities such as Xiong'an.

Smart Watch, Smart Home and Smart TV are just a few terms representing the sheer connectivity of advanced technologies. Smart Cities outstand by simplifying everyday objects, taking the connection of complicated technology to another level with the objective to create cities that provide core infrastructure and ensure a decent quality of its citizens' life, clean and sustainable environment and application of different types of electronic Internet of things (IoT) sensors to collect data and use these data for managing assets and resources efficiently. Xiong'an New District is currently building a new smart green city, providing a unique opportunity for German enterprises to explore a new path for the construction of global smart cities, which not only conforms to the development

2019年9月6日上午,由中国德国商会与雄安绿研智库主办、德国威乐集团和通和时代投资管理有限公司共同承办的“德国智造,跑进雄安”论坛,在雄安市民服务中心奥斯卡影城成功召开,来自中德两国的政府、知名企业、专家160余人共同参加了本次创新论坛。



160 company representatives took part in a forum on "Exploring Innovative Concepts & Boosting the Future of Smart Cities" in Xiong'an  
160位公司代表参加了在雄安举行的“探索创新概念,推动智慧城市未来”论坛

论坛以“探索创新理念,助力智慧城市未来”为题进行交流讨论。雄安新区管委会改革发展局杨如副局长、中国德国商会华北及东北地区执行董事晏恩(Jens Hildebrandt)先生分别发表欢迎致辞。住房和城乡建设部科技与产业化发展中心建筑节能发展处刘幼农处长、威乐集团欧亚地区副总裁 Jens Dallendörfer先生、欧博迈亚工程咨询(北京)有限公司建筑设计与城市规划副总监 Juergen Kunzemann先生等嘉宾就活动主题进行了主题演讲。在论坛讨论环节来自威乐集团、欧博迈亚、欧绿保再生资源技术服务有限公司、中国雄安集团数字城市科技有限公司、华为数字政府智慧城市业务部的企业代表就智慧城市改变未来、推动产业创新转型、雄安新区智慧城市建设等话题进行充分讨论与交流,讨论环节由雄安绿研智库有限公司总经理徐小伟主持。

杨如副局长在致辞中表示,雄安新区承载着打造新时代高质量发展全国样板的重要历史使命,将按照



trend of innovative technologies but also adheres to the people's desire for a better quality of life.

It was the very first time that the German Chamber has organized an event in Xiong'an. After the welcoming addresses of Yang Ru – Vice Director of the Development Reform Bureau of Xiong'an New Area Administration Committee and Jens Hildebrandt – Executive Director & Board Member of the German Chamber of Commerce in North China, the attending participants of various industries had a chance to enjoy the three keynote speeches of Liu Younong – Division Director, Ministry of Housing and Urban-Rural Development, who illustrated China's national smart connectivity and building energy efficiency; Jens Dallendörfer – GVP Sales Eurasia, Wilo SE, who showed Wilo's ways of supporting the development of smart cities with high-tech pumps; Jürgen Kunzemann – Associate Director of Architectural Design & Urban Planning, Obermeyer Engineering Consulting Beijing, expressed his company's ambition to create a human-scaled city in harmony with nature and topography.

Dr. Xu Xiaowei – General Manager of Xiong'an Green Development Research Institute led and moderated the following panel discussion, joined by panelists: Jens Dallendörfer (Wilo SE), Jürgen Kunzemann (Obermeyer), Lu Liang (ALBA China Recycling Solutions), Wang Zhen (China Xiong'an Group Digital City Technology) and Wu Xin (Huawei) who elaborated on further possibilities of applying German smart urban area concepts for the green and sustainable development of Xiong'an.

The forum ended with a sponsoring ceremony, which was held by Wilo China and Tonghe Times Beijing Investment Management, who provided marathon runners – the Xiong'an Craftsmen Spirit Run Group – with the necessary equipment for the third Xiong'an Marathon, that took place two days later on September 8 with more than 10,000 participants.

After lunch, a personal guide led the participants through the Xiong'an Citizen Center and guided them into the Planning Exhibition Hall, providing an even deeper insight into the current state and future plans of Xiong'an New Area, which is President Xi's large-scaled initiative aimed to serve as a long-term project for generations to come. We sincerely thank our partner Xiong'an Green Development Research Institute for the great organization, all keynote speakers and panelists for their interesting insights and Wilo China and Tonghe Times Beijing for their substantial support, as well as all participants for attending the event.

创新、智能、绿色的要求，高标准高质量建设，打造世界级高端高新产业群，加快形成以知识、技术、信息、数据等新生产要素为支撑的经济发展新动能，建设数字孪生城市。



*Xiong'an the new smart and green city is combining technology and ecology for a better quality of life*

雄安新的智慧绿色城市，将技术与生态相结合，改善了生活质量

Source / 图片来源: xiongan.gov.cn

中国德国商会华北及东北地区执行董事晏思 (Jens Hildebrandt) 先生在发言中提到：中国是德国最大的贸易合作伙伴，德国在华投资也屡创新高。德国以装备制造闻名，尤其是在智能制造、绿色建筑等领域，德国拥有一大批世界知名的企业，例如今天参会的大陆集团。希望在不久的将来，更多德国企业能“跑”进雄安。

与会企业家与学者一致认为，智慧城市理念为城市转型升级及未来创新发展提供了一种全新的模式和路径。雄安新区提出建设绿色智慧新城，坚持数字城市与现实城市同步规划、同步建设，打造数字孪生的城市，中德企业应抓住这一良好契机，探索全球智慧城市建设新路径，这不仅顺应了创新技术的发展趋势，也符合这一时代人民对美好生活的愿望。



*Panel discussion on German smart urban area concepts with representatives of German and Chinese companies*

德国和中国公司代表就德国智慧城市和区域概念进行小组讨论

论坛最后德国威乐集团、通和时代投资管理有限公司对雄安工匠精神晨跑团进行了赞助，赠送马拉松选手跑步物资，助力第三届雄安马拉松赛事的顺利召开。



# Energy

## Resource Recovery: Joint German-Chinese Concepts for Thermal Sewage Sludge Treatment

A contribution by Prof. Dr. Markus Engelhart, Technische Universität Darmstadt and Prof. Dr. Xiao-Hu Dai, Tongji University

### 资源回收：德国－中国污泥热处理理念

来自达姆施塔特技术大学的Markus Engelhart教授和同济大学的戴晓虎教授的客邀文章

Resource recovery in general, as one basis for sustainable and modern societies, has become more and more essential in recent years to overcome future challenges. Driven by local shortages and increasing global greenhouse gas emissions, awareness of alternative sources for various raw materials and energies is growing. Regarding waste materials, a paradigm shift is taking place, in which they are not only disposed of but also used as a source of nutrients and energy.

#### Sewage sludge as a resource for energy and nutrients

One building brick to reclaim these resources is the use of the potential of waste materials like sewage sludge. The use of anaerobic digestion allows to produce energy and, if sufficient qualities regarding heavy metals and pathogens are met, the agricultural reuse of sewage sludge to return nutrients to the materials cycle. In Germany, technologies like anaerobic diges-

资源回收作为可持续发展和现代社会的基础，对于克服未来资源短缺的挑战显得越来越重要。受地区性资源短缺和温室气体排放不断增长的影响，寻找传统能源的替代方案势在必行。人类对于处理“废物”的认知也从单纯填埋渐渐变为将其加以回收利用，用以生产养料与能源。

#### 污泥作为能源与营养资源

资源回用的基石是将一些“废物”如污泥加以利用。通过污泥厌氧消化可以产生能源物质。如果污泥中重金属及病原体物质含量能达标，可将污泥农用，进而将污泥中的营养物质循环利用。污泥厌氧消化技术在德国已经十分成熟并在过去几十年中被广泛应用，相反这种技术在中国的运用正在起步阶段。对此，中国在2017年开展了污泥处理项目。该项目由

#### Sewage Sludge Treatment and Disposal / 污水污泥处理与处置

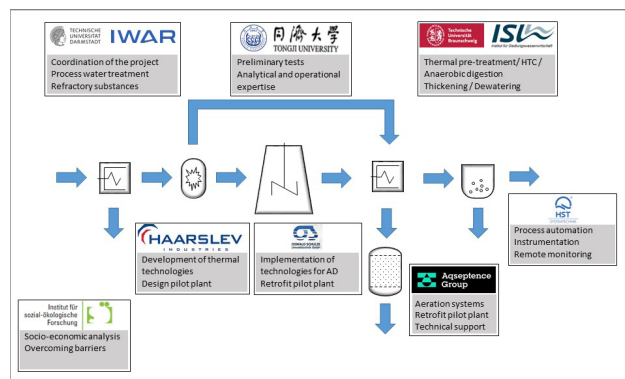
Since the 1990's waste water treatment capacities in China have been growing continuously which brought along a growing amount of sewage sludge generated in the waste water treatment process. As waste water treatment capacities still increase the sludge amount also still increases. In 2015 over 40 million tons of sludge was produced per year. Experts estimate an amount of 60 million tons of sludge being generated per year by 2020. Due to the high water content (~80 percent) and the content of pathogen and harmful substances, sludge treatment is challenging. Up till now there is a lack of sewage sludge treatment facilities in China, that leads to improper treatment and disposal and often causes secondary pollution. New regulations prohibit the illegal sludge stacking, future sludge disposal in landfills and aim at increasing the sludge treatment ratio in China. Another goal is to increase energy and nutrient recovery from sludge. These topics are essential objectives of the here described Sino-German cooperation project IntenKS.

自20世纪90年代以来，中国的污水处理能力不断增强，在污水处理过程中产生的污泥越来越多。由于污水处理能力仍在持续增加，污泥产量也在相应增加。2015年，中国全国产生超过4000万吨的污泥。而据专家估计，到2020年，中国污泥的年产量将达到6000万吨左右。由于高含水量（+80%）以及病原体和有害物质的含量，污泥处理具有挑战性。目前中国还缺乏污泥处理设施，导致处理和处置不当，往往造成二次污染。新的法律法规禁止非法污泥堆放和未来的污泥填埋，旨在促进提高中国的污泥处理率。其另一个目标则是增加污泥中能源和营养的回收率。这些课题也正是本文介绍的中德合作项目IntenKS的研究主题。

tion are widely spread and have been used for several decades, while in China the progress of reusing the potential nutrients and energies of sludge is at the beginning stage of comprehensive application. Following this, a Chinese project for sewage sludge treatment started in 2017. The project is funded by the Ministry of Science and Technology (MoST) and Ministry of Housing and Urban-Rural Development (MoHURD) and two universities as well as six industrial partners are involved. It's main objectives are: to evaluate the feasibility of the implementation of several sludge treatment technologies like anaerobic digestion, composting or combustion in China and to develop innovative technologies or processes to reuse and recover the potential nutrients and energies of municipal sludge and biowaste. The Chinese project aims to end the current practice of sewage sludge dumping and landfilling, and to establish sustainable concepts and solutions to save resources and restrict environmental impacts. This is where the Sino-German research project "Intensification of sewage sludge treatment for energy and resource recovery in China by means of thermal processes" (IntenKS) comes in, in order to support this development with novel approaches for increasing the resource recovery of Chinese sewage sludge with German know-how. On the German side two universities and five industrial partners, which are funded by the Federal Ministry of Education and Research (BMBF), participate.

### An innovative and integrated concept for residual treatment

Within the project "IntenKS", two thermal processes are studied: Firstly, the thermal pre-treatment of waste activated sludge before anaerobic digestion to increase the biogas output and therefore the energy production. Secondly, the hydrothermal carbonization of waste activated sludge to produce biochar with improved combustion characteristics. Since thermal processes entail high organic loads in the sludge liquor, an adequate and adjusted treatment with optimized aeration systems is investigated. IntenKS considers thermal processes in their entirety by not only highlighting advantages but also revealing and erasing associated drawbacks. The close cooperation between the research institutions involved is encouraged to exchange the results and progress from one country to another: Preliminary studies on lab-scale make it possible to record process parameters, to compare different construction methods for thermal processes and to evaluate the transferability to Chinese conditions. For this purpose, Chinese and German experimental procedures are classified and assessed. Those results will be verified and optimized in pilot plants, which are currently built in Germany and will be operated



Project cooperation and process chain of IntenKS

IntenKS的项目合作与过程链

Source / 图片来源: Technische Universität Darmstadt / 达姆施塔特技术大学

中华人民共和国住房和城乡建设部资助,并由中国两所高校与其他六个单位共同参与实施。项目主要研究目的为:评估几种污泥处理处置技术路线,如厌氧消化、堆肥、焚烧在中国应用的可行性,开发创新有关污泥与厨余垃圾协同处理、能源与资源再生利用的技术与工艺。结束目前将污泥脱水后直接填埋的处理方式,发展可持续的污泥处理理念用以解决日益紧张的资源与环境问题。中德合作科研项目“用热工艺强化中国污泥处理处置及实现能源与资源回用(IntenKS)”通过运用德国的技术与工艺用以提高中国污泥资源回收利用率。来自德国的两所高校与工业界的五个合作伙伴在德国教育与研究部的资助下共同参与该项目。



Thermal pre-treatment of waste activated sludge before anaerobic digestion can increase the biogas output and is one of the processes studied in the "IntenKS" project

在厌氧消化之前对活性污泥进行热预处理可以提高沼气产量,这是“IntenKS”项目研究的过程之一

Source / 图片来源: pxhere.com

### 一种创新综合的废物处理理念

“IntenKS” 科研项目将研究两个热水解过程: 1. 污泥厌氧消化前通过高温预处理活性污泥用以提高沼气产量。2. 通过活性污泥的热碳化生产具有改善燃烧特性的生物炭。由于污泥热处理意味着污泥渗出液中的高有机负荷,因此需要进一步研究使用优化的曝气系统对污泥渗出液的处理。IntenKS项目考

in China. The pilot scale study targets to evaluate the feasibility of a thermal approach for sewage sludge treatment in China. The pilot plants will be located at a major waste water treatment plant (WWTP) in Shanghai. This WWTP has already applied anaerobic digestion for sludge treatment, which allows for transfer of pilot scale results directly to full scale. Suggestions for further procedures aiming to establish sustainable sewage sludge treatment are thus possible.

### Chinese-German cooperation as a key element

Long-term cooperation and partnerships between German universities of TU Darmstadt and TU Braunschweig with Tongji University in Shanghai enable transfer of knowledge as well as experiences and to discuss scientific issues concerning thermal treatment processes on an international level. This is a key feature of the joint project, since environmental impacts and resource recovery are global challenges, which can only be overcome transcending national borders. In future, the outcome of the pilot studies will also contribute to the use of thermal processes in Germany by expanding the general knowledge about their applicability.

考虑整体污泥热处理过程，既充分利用该处理方式的优点又研究其缺点及相应对策。两国各科研院所间密切合作，相互分享科研成果：实验室的初步研究成果记录了工艺参数，比较热工艺的不同构造方法以及评估将其转移到中国污泥处理工况条件下的可能性。这些结果将在中试设备中得到验证和优化，中试设备目前在德国加工建造并将在之后运往中国上海最大的污水处理厂运行。该污水处理厂运用厌氧消化工艺处理污泥，中试实验结果可直接转移到实际生产中。这使得进行可持续污泥处理成为可能性。

### 中德合作作为关键因素

德国达姆施塔特工业大学、不伦瑞克工业大学与上海同济大学长时间的合作使项目可以从国际视角出发讨论污泥热处理，这是合作项目的一大亮点。环境问题与资源回用是全球面临的挑战，只有通过国际间的合作才能克服。未来项目的研究结果还将推动高温污泥处理在德国的应用。

#### Sino-German Water Research / 中德水研究

The background of the Sino-German Water Research has been shortly described in the Econet Monitor, June 2019.

Currently there are five cooperation projects under the joint water research. Current topics are the sponge city concept (KEYS, see Econet Monitor, June 2019); sludge treatment (IntenKS); optimization of municipal waste water treatment (PIRAT-Systems); drinking water safety (SIGN-2); and the removal of organic components in municipal waste water treatment plants (PEPcat). Today's article introduces the project IntenKS, other projects will be explained in later editions of the Econet Monitor.

在2019年6月份的Econet Monitor期刊中，我们介绍了德国和中国在水研究领域合作的背景。

当下中德联合水研究有五个合作项目正在运行中。这五个项目对应的主题分别是：海绵城市概念 (KEYS, 详见Econet Monitor, 2019年6月刊)、污泥处理 (IntenKS)、城市污水处理优化 (PIRAT-Systems)、饮用水安全 (SIGN-2)、去除城市污水处理厂中的有机成分 (PEPcat)。本文中介绍污泥处理项目 IntenKS，其他项目将在接下来的Econet Monitor中陆续介绍。

#### BMBF-Project Office "Clean Water" / 德国联邦教育研究部 (BMBF) "清洁水" 创新研究项目办公室

The BMBF-Project Office "Clean Water" at Tongji University Shanghai has supported the Water Research Cooperation between BMBF and MoST and the joint water research projects since July 2012.

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自2012年7月起，位于上海同济大学的BMBF "清洁水" 项目办公室协助 BMBF 与 MOST 之间的水研究合作以及联合水研究项目。

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# Politics

## China's Renewed Campaign for Waste Sorting 中国新的垃圾分类运动

Picking up from its 2010 pilots, China is now rolling out waste sorting and disposing policies on a national scale. Instead of voluntary, new policies are now mandatory, with penalties for individuals and companies, including fines and credit reductions. With mounting pressure on China to cut waste and pollution, especially plastics, individual behavior changes will make a key difference in the success of China's movement.

Although Shanghai recently caught domestic and even global attention due to strict new sorting rules, China has still a long way to go when it comes to garbage sorting and waste disposal. From 2010, eight pilot cities were designated to implement garbage sorting, including Beijing, Shanghai, Shenzhen and Guangzhou. In 2014, a new set of demonstration pilots was launched in 26 urban districts and cities. Marking a new era in environmental protection and after unleashing countless policies, garbage sorting was eventually made compulsory in September 2015. Then, at the Communist Party's 19th National Congress in October 2017, improving solid waste and garbage disposal were written into the Party Report for the first time in China's history. More importantly, as President Xi Jinping has put his name behind this initiative, all the efforts came together from 2017, when comprehensive moves were launched from central to local levels. As waste classification is now written into law, its implementation seems to be inevitable.

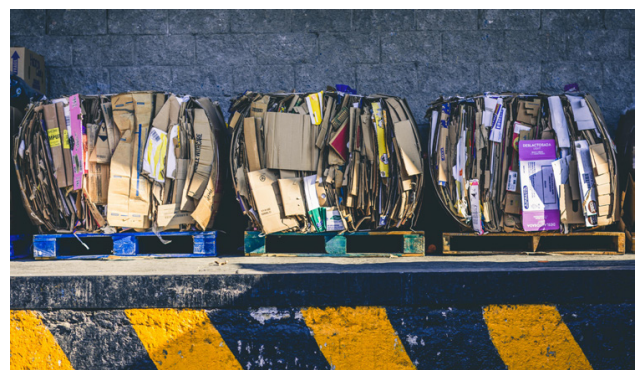
To raise public awareness and participation, critical to the campaign's success, President Xi has supported the initiative repeatedly. In a central meeting at the end of 2016 for instance, he reviewed several documents, covering a range of related issues such as garbage sorting and waste recycling in rural areas. While visiting Shanghai in November 2018, he stressed garbage sorting should become a new fashion, and at the beginning of June 2019 he issued further instructions, calling garbage sorting highly important to the level of China's civilization.

Against this background, a State Council document of March 2017 outlined the scope and scale of the new

中国从2010年的试点项目开始,现在正在全国范围内推行垃圾分类处理政策。以前是自愿的,现在新的政策是强制性的,对个人和公司的处罚包括罚款和信用扣分。随着中国减少垃圾污染(尤其是塑料)的压力越来越大,个人行为的改变将对中国垃圾分类运动的成功产生重大影响。

尽管由于严格的新分类规则,上海最近引起了国内乃至国际上的关注,但在垃圾分类和废物处理方面,中国还有很长的路要走。从2010年开始,中国指定了8个试点城市进行垃圾分类,其中包括北京、上海、深圳和广州。2014年,在26个市区和城市启动了一组新的示范试点。在推出了许多政策之后,垃圾分类最终于2015年9月成为强制性的措施,这标志着环境保护的新纪元。之后,在2017年10月的中国共产党第十九次全国代表大会上,中国历史上第一次将加强固体废弃物和垃圾处置写入报告。更重要的是,随着习近平主席多次强调这一倡议,各方面努力汇集到2017年,从中央到地方层面全面启动了行动。由于垃圾分类已被写入法律,因此其实施似乎是不可避免的。

为了提高公众的意识和参与度,习近平主席一再支持该倡议,这对于运动的成功至关重要。例如在2016年底的一次中央会议上,他审查了几份文件,涵盖了一系列相关问题,例如农村地区的垃圾分类和废物回收。他于2018年11月访问上海时强调,垃圾分类应成为一种新时尚,2019年6月初,他发布了进一步的指示,称垃圾分类对中国文明水平至关重要。



*Garbage sorting will become a mandatory initiative with a reuse rate of at least 35 percent by 2020*

垃圾分类将成为一项强制性举措,到2020年垃圾回收率至少达到35%  
Source / 图片来源: unsplash.com

mandatory initiative. Waste sorting will become compulsory in Beijing, Shanghai, Tianjin, and Chongqing, provincial capital cities, other cities under the central planning, as well as the 26 demonstration pilots. All public institutions and enterprises are being subjected to mandatory classification of harmful waste. Local authorities should make own calls on sorting garbage such as perishables and recyclables. Dictating a reuse rate of 35 percent of residential garbage by 2020, local authorities are expected to work out legal and regulatory systems with adoptable models. While this document demanded the establishment of facilities for garbage sorting and disposal in 46 cities by 2020, in June 2019 the government expanded the demands to cities on prefecture-level and above by 2025.

As plastic waste causes global concerns, China's authorities are taking actions too. After China's ban of imported wastes in 2017-18 on a national level, Hainan province for the first time in China issued a plastics ban, eliminating production, sales, and uses of plastic bags and cutlery by 2020 and all government-listed plastics products by 2025. Unreleased but deliberated in early September 2019, a milestone document is in development, limiting plastic production and uses while promoting biodegradable plastics alternatives nationwide.

The outcome of China's ambitious goals still depends on several factors. The infrastructure upgrading would be fundamental, including well-equipped facility networks, designated transportation routes, and disposal sites for classified waste. In the past, when urban facility developments were slower than policy, residents were very discouraged after seeing well-sorted trash ending up mixed together again in trash carts and dumped at landfills. Therefore, authorities adopted a systemic approach this time, requiring the establishment of designated facilities, transportation means, and disposal sites for different types of trash. It remains to be seen, if the central requirements will be properly met.

More importantly, habit cultivation by individuals and behavioral changes will be more challenging and time consuming. For societal changes, authorities would need to be more patient, while also empowering the private sector and including it into the process.

The introduction of penalties, especially in connection with the many new laws and regulations, is aimed at promoting and discouraging certain behaviors for

在此背景下, 2017年3月的国务院文件概述了新的强制性倡议的范围和规模。在北京、上海、天津和重庆, 省会城市, 计划单列市以及26个示范试点中, 强制进行垃圾分类。所有公共机构和企业都被要求进行有害垃圾的强制分类。地方政府应自行呼吁对诸如易腐和可回收的垃圾进行分类。地方政府将制定采用合适模型的法律法规体系, 使得2020年居民垃圾再利用率达到35%。该文件要求到2020年在46个城市建立垃圾分类和处置设施, 2019年6月政府进一步将该要求扩展到所有地级以上城市, 截止日期是2025年。

由于塑料垃圾引起了全球关注, 中国政府也在采取行动。自2017-18年中国在全国范围内禁止进口垃圾以来, 海南省首次在中国颁布了禁塑令, 到2020年取消塑料袋和餐具的生产、销售和使用, 并在2025年之前取消所有政府列出的塑料产品。另外还有一部尚公布但于2019年9月上旬审议通过的文件, 其发布将具有里程碑的意义。该文件限制了塑料的生产和使用, 同时在全国范围内推广了可生物降解的塑料替代品。



*The South Chinese Hainan province takes on the war against plastics*  
中国海南省为反塑料而战  
Source / 图片来源: pxhere.com

中国雄心勃勃的目标的结果仍然取决于几个因素。基础设施的升级将是至关重要的, 包括设备完善的设施网络, 指定的运输路线以及分类垃圾的处置场所。过去, 当城市设施的发展慢于政策时, 居民们看到各种各样分类的垃圾最终又被混入垃圾车并扔到垃圾掩埋场后, 感到非常沮丧。因此, 政府这次采取了系统的方法, 要求建立指定的设施、运输工具和处置场所, 以处理不同类型的垃圾。是否能够正确满足中央的要求还有待观察。

更重要的是, 个人养成良好习惯、改变原有行为将更具挑战性, 并且更耗时。对于社会变革, 政府需要更加耐心, 同时还应赋予私营部门权力, 并将其纳入流程。



Chinese society in order to make waste sorting a new habit nationwide. However, China's authorities put too many efforts into propaganda as well as forceful measures, overlooking social changes like awareness promotion and habit cultivation. Instead of being thoroughly informed about the importance of garbage sorting and the considerations behind different classifications, the public is threatened with fines and other penalties.

In the case of Shanghai, household trash is supposed to be sorted into four groups: dry garbage, wet garbage (kitchen waste), recyclables, and hazardous waste. Failures to comply may lead to fines up to 200 CNY for individuals, and 50,000 CNY for companies. However, the government should further increase its efforts to educate the public about these categories and how they work.

While recyclables and hazardous waste are more straightforward, residents in Shanghai find the differentiation between wet and dry garbage very confusing. Wet garbage means organic waste that will rot and thus can be composted, dry garbage could be best explained as "none of the above". Dry garbage will not rot, unlike wet garbage, it is also not toxic, which distinguishes it from hazardous waste, nor can it be recycled, as opposed to recyclables. Environmental experts therefore suggest, that the public would understand and cooperate better, if an explanation would be given of how the different categories are designated and handled.

To further improve the system, the government should not only adopt less of its current top-down approach but also encourage the business community to find solutions. In fact, many technology companies are finding their ways into this field. Mobile applications are now launched for instance to support waste classification or tracking of disposal. A reward system is also being developed, assigning small rewards for accurate disposal of recyclables.

As China puts more efforts into waste disposal and environmental protection, opportunities for Sino-German cooperation are expected to grow as well. In fact, many German enterprises in the environmental sector are deeply involved in China's cause. Since several years, German companies such as Alba, Remondis or Steinert have been increasingly introducing advanced solutions to support China's waste management and recycling process.

引入处罚,特别是与许多新的法律法规相关的处罚,旨在促进和阻止中国社会的某些行为,以使垃圾分类在全国范围内成为一种新的习惯。但是,中国政府在宣传和采取有力措施方面投入了过多精力,却忽视了诸如意识增强和习惯养成等社会变革。公众没有完全了解垃圾分类的重要性以及不同分类背后的考虑因素,而是受到罚款和其他处罚的威胁。



*The government should further increase its efforts to educate the public about its new garbage sorting system and the waste categories involved*  
政府应进一步加大力度,向公众宣传其新的垃圾分类系统和涉及的垃圾类别  
Source / 图片来源: ehangzhou.gov.cn

以上海为例,生活垃圾应分为四类:干垃圾、湿垃圾(厨房垃圾)、可回收垃圾和有害垃圾。未能遵守规定可能导致个人最高罚款200元人民币,公司最高罚款50,000元人民币。但是,政府应进一步加大力度,向公众宣传这些类别及其运作方式。

尽管可回收垃圾和有害垃圾更为直接,但上海居民发现湿垃圾和干垃圾之间的区别非常令人困惑。湿垃圾意味着会腐烂、可以堆肥的有机垃圾,干垃圾最好被解释为“以上皆非”。干垃圾与湿垃圾的区别是不会腐烂,与有害垃圾的区别是没有毒性,与可回收垃圾的区别是不可回收。因此,环境专家建议,如果对不同类别的定义和处理方式做出详细解释,公众应该能更好地理解和合作。

为了进一步完善该系统,政府不仅应该减少目前的自上而下的方法,而且应该鼓励企业界寻找解决方案。实际上,许多技术公司正在寻找进入这一领域的方法。例如,人们启用了移动应用程序,以支持垃圾分类或跟踪处理,还开发了一种奖励系统,分配少量奖励以准确处置可回收物。

随着中国在垃圾处理和环境保护方面做出更多努力,中德合作的机会也有望增加。实际上,许多在环境领域的德国企业都深深地参与了中国的事业。这些年来,Alba, Remondis或Steinert等德国公司越来越多地引入先进的解决方案来支持中国的垃圾管理和回收过程。



## Fairs & Events 展会与活动

China Mining 2019  
Tianjin, China 09.10.2019 - 11.10.2019  
2019中国国际矿业大会  
天津, 中国 · 2019年10月9日 - 10月11日  
[chinaminingtj.org](http://chinaminingtj.org)

China International Circular Economy Exhibition & Circular Economy Development Forum  
Nanjing, China 20.10.2019 - 22.10.2019  
2019中国国际循环经济展览会  
南京, 中国 · 2019年10月20日 - 10月22日  
[www.chinacace.org](http://www.chinacace.org)

China Wind Power 2019  
Beijing, China 22.10.2019 - 24.10.2019  
2019北京国际风能大会暨展览会  
北京, 中国 · 2019年10月22日 - 10月24日  
[www.chinawind.org.cn](http://www.chinawind.org.cn)

FENESTRATION BAU China  
Shanghai, China 05.11.2019 - 08.11.2019  
中国国际门窗幕墙博览会  
上海, 中国 · 2019年11月5日 - 11月8日  
[bauchina.com](http://bauchina.com)

International Biomass Energy Innovation Development Forum 2019  
Beijing, China 06.11.2019 - 07.11.2019  
2019全球生物质能创新发展高峰论坛  
北京, 中国 · 2019年11月6日 - 11月7日  
[tim.nees@giz.de](mailto:tim.nees@giz.de)

AHK Business Delegation: Energy Efficient Components and Charging Solutions for Electric Mobility  
Beijing, Tianjin & Hebei, China 11.11.2019 - 14.11.2019  
德国工商大会代表团: 电动汽车的节能组件和充电解决方案  
北京、天津和河北, 中国 · 2019年11月11日 - 11月14日  
[felizeter.bernhard@bj.china.ahk.de](mailto:felizeter.bernhard@bj.china.ahk.de) / [peng.qize@bj.china.ahk.de](mailto:peng.qize@bj.china.ahk.de)

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ESCO Committee of China Energy Conservation Association  
中国节能协会节能服务产业委员会  
emca.cn

Alternative Energy 替代能源网  
alternative-energy-news.info

China Energy Web 中国能源网  
china5e.com

China Greentech Initiative 中国绿色科技  
china-greentech.com

China Renewable Energy Society (CRES) 中国可再生能源学会  
cres.org.cn

China Renewable Energy Centre 国家可再生能源中心  
cnrec.org.cn

German Energy Agency 德国能源署  
dena.de

German Federal Ministry for Economic Affairs and Energy  
(BMWi) 德国联邦经济和能源部  
bmwi.de

Energy Efficiency Export Initiative 能效解决方案倡议  
efficiency-from-germany.info

Renewable Energies Export Initiative 可再生能源解决方案倡议  
export-erneuerbare.de

Europe-China Clean Energy Centre 中欧清洁能源中心  
ec2.org.cn/en

RETech 回收技术  
retech-germany.net

Renewable Energy World 可再生能源世界研讨会暨博览会  
renewableenergyworld.com

Renewables International 国际可再生能源  
renewablesinternational.net

### Environment 环境

German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety  
德国联邦环境、自然保护与核安全部  
bmu.de

Federal Agency for Nature Conservation 联邦自然保护局  
bfn.de

Sustainable China 可持续发展的中国  
nachhaltiges-china.de

Federal Environmental Agency 德国联邦环境局  
umweltbundesamt.de

The Guardian 卫报  
guardian.co.uk/environment

### Climate Protection & CDM 气候保护与清洁发展机制

CDM in China 中国清洁发展机制  
cdm.ccchina.gov.cn

China Climate Change Info-Net 中国气候变化信息网  
en.ccchina.gov.cn

Chinese Renewable Energy Industries Association (CREIA)  
中国可再生能源行业协会  
creia.net

Climate Focus 气候聚焦  
climatefocus.com

Climate Works Foundation 气候工作基金会  
climateworks.org

CO2 Trade 二氧化碳交易  
co2-handel.de

German Emissions Trading Authority  
德国温室气体排放量交易处  
dehst.de

United Nations – CDM 联合国-清洁发展机制  
cdm.unfccc.int

JIKO BMUB 德国联邦环境部 联合履约处  
jiko-bmub.de

KfW Carbon Fund 德国复兴信贷银行碳基金  
kfwdcarbonfund

### Studies & Publications 研究报告与出版物

Asian Development Bank 亚洲开发银行  
adb.org/publications

Economist Intelligence Unit 经济学人智库  
eiu.com

International Energy Agency 国际能源机构  
iea.org/publications

World Bank - East Asia & Pacific 世界银行-东亚及太平洋地区  
blogs.worldbank.org/eastasiapacific

### Economy, Finance & Law 经济、金融与法律

Germany Trade & Invest 德国联邦外贸与投资署  
gtai.de

Caijing 财经网  
english.caijing.com.cn

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