



Sino-German Innovation Platform

Policy Briefs 2019 by the German expert group

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Sino-German **Innovation Platform**

With these “Policy Briefs” the experts of the Sino-German Innovation Platform (SGIP) would like to contribute to informing and sensitizing for the current trends and developments in the Chinese innovation landscape.

For Germany China is a strong and important partner in science and innovation. On its path to becoming one of the leading scientific nations in the world, China is systematically and rapidly expanding its research and innovation capabilities. At the same time the German-Chinese science cooperation has intensified during the past years. However, the cooperation with China does not only offer opportunities, but also poses challenges at times. In order to build up a sustainable and successful cooperation with China, it is necessary to closely monitor, analyze and understand its science and innovation policy as well as the frame conditions for cooperation. The SGIP expert group’s policy briefs are meant to contribute to this.

The expert group has been appointed as an independent working group by the German Federal Ministry of Science and Education (BMBF) in spring 2017. Their task is to connect the China expertise within Germany and at the same time contribute with their expertise in the innovation dialogue between Germany and China. The expert group is supposed to give impulses for the development of the science and innovation cooperation with China, to pool relevant knowledge on China’s innovation development and contribute to its dissemination. The expert group consists of Prof. Dr. Doris Fischer (University of Würzburg, Head of the expert group), Prof. Dr. Michael Dowling (University of Regensburg), Dr. Rainer Frietsch (Fraunhofer ISI), Dr. Thomas Pattloch (TaylorWessing), Prof. Dr. Ulrike Reisach (University of Applied Sciences Neu-Ulm), Dr. Margot Schüller (GIGA Hamburg), Dr. Kristin Shi-Kupfer (MERICS), Friedolin Strack (BDI) und Prof. Dr. Markus Taube (University of Duisburg-Essen).

The DLR Project Management Agency has been the organizational office of the SGIP since April 2014 and is also responsible for the support of the expert group and their work.

The expert group of the SGIP points out that the expressed positions do not necessarily reflect the positions of the Federal Ministry of Science and Education or the DLR Project Management Agency.

Innovative and Sustainable Mobility – Learning from China?



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China invests in innovative and “green mobility” in urban transportation as well as in long-distance transportation. It uses central planning, standardization, and economies of scale to achieve efficient metro and e-bus as well as railway systems. In an amazingly short time, China managed to move huge numbers of people effectively. According to the World Bank, China’s high-speed trains are a model for developing and newly industrialized countries (Lawrence et al. 2019).

This policy brief addresses two fields in which governance and learning have created opportunities for the Chinese transportation system. So far, it seems that differences in framework conditions and concepts such as system, efficiency and sustainability have kept Europe from seeking strategic opportunities to learn from China. Nevertheless, an increasing number of achievements in China’s transportation planning and practice could be insightful cases for Europe, as are the shortcomings and incremental improvements in its implementation. Defining Europe’s goals and advantages in co-operation projects could help to achieve at better results in negotiations and joint innovation in this field.

Urban Transportation

China’s mega cities have long been suffering from congestion combined with high amounts of fine dust. This has led to determined efforts to improve this situation. At the same time, China uses this challenge to re-define the future of urban mobility and to fulfil long-term goals such as innovation and leadership in new technologies.

China’s focus on e-mobility

Thirty years after the opening for foreign partners, China shifts from “learning from the West” to establishing their own industrial realm. Its prioritizing of e-mobility follows Porter’s theory of national competitive advantages through using the basic factor and advanced factor endowments of their huge country which have been fostered by state policy and financial resources (Porter 1985). The main competitive advantages of China are listed below:

1. Cheap energy from manifold local sources such as coal, water power, solar energy, nuclear power and low prices through state-owned energy providers and price control;
2. Megacities with a steadily further extended public transportation system. Advantages:
 - a) The growth of the megacities allows planning ahead for huge new housing districts;
 - b) Political system: benefits for the whole society enjoy a higher priority than individual (property) rights. Therefore infrastructure developments can take place with few legal restrictions or debates;
3. Digitalization: Real-time information for public transport users through an advanced digital infrastructure and 5G connectivity;
4. Education and technophilia – fascination for high tech, innovations and digital advancements:
 - a) A strong (Confucian) belief that learning pushes careers and societal status;
 - b) A very competitive system for university access (gaokao) in schools;
 - c) Increasingly good universities in the megacities and a high number of foreign teachers and students;
5. Market: Sophisticated consumers/passengers in the huge cities, welcoming autonomous driving and online support such as Baidu as a search engine and WeChat for finding their ways in the megacities, and appreciating innovative digital entertainment features in cars and public transportation (CNNIC 2018);
6. The companies’ size, strategy and rivalry: state-owned and hybrid conglomerates, implementing the government’s plans: more than 60 Chinese e-car manufacturers;
7. Capable suppliers in the field of electric cars, such as the world’s biggest battery manufacturers: BYD („Build your Dream“) and CATL („Contemporary Amperex Technology Co“); Only batteries from those two companies are allowed in China (Hua 2018) which means a duo-poly for those in China and discrimination of foreign suppliers.

8. Potential for using batteries for peak power generation and transmission capacity through state-regulated monitoring of charging patterns and location power levels (IEA 2019);
9. Access to raw materials for batteries through ownership/partnerships for rare metal mines like cobalt, lithium, manganese and nickel (IEA 2019) in several parts of the world (Australia, Africa, Central Asia);
10. Sufficient staff and space to deal with the recycling or end-of-life management of batteries.

The combination of the listed advantages turns China from a pioneer to a **leader in the market for e-mobility**. It reveals China's unique advantages in e-mobility compared to Europe. Europe's car manufacturers can build e-cars, but without joint governance and without their own capable battery provider, European vehicle manufacturers will not be able to reach China's prices and economies of scale, even though supported by the EU and national subsidies (see BMWi 2019). Volkswagen started a pilot line for the manufacturing of their own battery cells (Vetter 2019) and Volvo Automotive, owned by the Chinese e-car pioneer Geely, signed multi-billion USD battery supply deals with CATL and LG Chem (Volvo 2019). In parallel, the Chinese battery giant CATL received government support for a battery factory in Erfurt and co-operates with BMW and potentially more car manufacturers.

The existing co-operations show that Europe is already teaming up with China. But since they bring knowledge and money, the Chinese partners have a better position in the team and can, for example, decide with whom they cooperate and under which conditions. A **local content requirement**, reinforced by European/state regulation, for corporations which, in their home countries, impose the same requirements on European enterprises, would make it easier for European companies to have an equal or 51% stake in the business. This would mean a shift in Europe's open market philosophy, but one which is more future-oriented than the existing screening system for Chinese investments in Europe (Hanemann, Huotari & Kratz 2019).

Market economies count on private companies and competition to be the main drivers of innovation. But through regional experimentation and differentiation of approaches, China also has a good chance of achieving a variety of situation-adapted innovations. The central government takes its time to design a plan, consult with manifold internal and external experts in the provinces, companies and universities (Reisach 2013), and then uses top-down decisions, combined with regionally aligned approaches, to get ideas implemented. The dominance of the Communist Party in decision making and the **pragmatism in trial and error procedures**, create a system advantage in infrastructure development.

Several governance actions are working in parallel and are mutually amplifying their impacts. Among them are non-traffic-related measures such as moving factories with high CO₂ emissions to locations outside the city, requesting the use of filter technologies, banning coal ovens and providing gas for heating and cooking, regulations for covering fine sands at construction sites with plastic material and many more. Among the directly and indirectly **traffic related measures** are the following:

- 1) Requesting 5 % (2020) and 20 % (2025) of e-cars in local and foreign car manufacturer's fleets (GI&C 2016),
- 2) Limiting access to city traffic rings for gasoline driven passenger cars, vans and busses,
- 3) Rising the number of charging stations for e-cars and e-busses to **1.08 million charging posts** and 245 power stations for electric vehicle drivers to change batteries across the country by the end of August 2019 (China Electric Vehicle Charging Infrastructure Promotion Alliance, quoted by Xinhua 2019) through state-owned providers such as Potevio which co-operates with State Grid (Potevio 2018), the Chinese (state owned) energy provider (Reisach & Stirzel 2019), and with the cities' (state owned) transportation planning centres,
- 4) **Subsidizing** e-cars and e-taxis through tax advantages and preferences in city traffic,
- 5) **Subsidizing Battery manufacturers** like BYD and CATL (Masiroa et al. 2016) and preferencing their own battery manufacturers instead of, e.g., South Korean competitors,
- 6) With more than **400,000 electric buses** (about 99% of the world's total), China is a pioneer in e-busses for public transportation, especially in Southern Chinese cities such as Shenzhen,
- 7) **Keeping energy prices low**, since energy prices are a strategic field where the government, respectively state-owned companies, set the price (not competition and market forces),
- 8) **Using different forms of alternative energy production** such as nuclear energy, wind, water and solar energy and liquid gas for electricity and charging of batteries,
- 9) **Fostering the standardization of batteries** in order to reduce cost, improve battery energy density and safety and promote energy storage technology (Delfs 2019); Standardization of charging stations for usage through different car types,
- 10) **Supporting the research and manufacturing of hydrogen cars** in Zhangjiakou, the cost city of the Winter Olympics in 2022 (Delfs 2019),
- 11) Establishment of a **Technological Innovation Centre for New Energy Vehicles** (NEV) in Beijing, to boost the supply of key new energy vehicle technologies to meet the growing demand (Ministry of Science and Technology, quoted by State Council/Xinhua 2018)
- 12) **Providing incentives for research on alternative energies for cars**, including R&D funding
- 13) Increasing the speed of construction of new metro lines,
- 14) **Optimizing city traffic flows** through extensive usage of public transportation data and pedestrians/passengers WeChat location data in so-called Urban Transportation Planning Centres (e.g. the SUTPC in Shenzhen).

The above-mentioned measures show how many different initiatives jointly facilitate the politically desired change to cleaner cities and less congestion. With favorable funding and state-owned companies, the Chinese government helps transforming city traffic and establishing new business models and multi-modal mobility services. A **key facilitator will be the Technological Innovation Centre for NEVs and EU policy is strongly encouraged to ask China for co-operation in this field.** This time, Europe could learn from China, e.g. in battery technology, but could help in other fields such as an efficient manufacturing organization. And Europe needs to adapt the learnings to their own system which differs in several aspects: Many of the measures only function because **crucial actors are state-owned** or mixed ownership companies. The competition in market economies makes it difficult to, for example, standardize the charging stations and to build a joint charging network which would help all users. Democracy in general and the EU with their complex decision-making processes have the tendency to slow down the speed of decisions because compromises need to be negotiated and to be approved by national governments which are elected through regional and national elections that cause changes of political priorities and people in charge.

The Chinese city authorities address the challenges of urban mobility in megacities with priority, establish **urban transportation planning centres** for network planning, congestion avoidance, passenger flow forecast, as well as traffic and pedestrian flow simulation in model cities such as Shenzhen (SUTPC 2019 and Nedopil 2018). Using sensors for weather, air quality, and location data from the search engine Baidu, from train, metro, bus, taxi and car passengers, as well as from the messenger app WeChat, they can provide a comprehensive planning framework that goes far beyond the existing traffic management technologies in Europe. While Europe's private companies collect vehicle data to improve their engineering and customer service, China is able and willing to establish holistic mobility systems.

Some of the measures in the list of urban transportation measures could also work for Europe, such as **standardizing charging stations and optimizing city traffic flows** through the usage of public transportation data and anonymized pedestrians/passengers' location data, e.g. from Google maps. A modernized public transportation system in European cities would also allow to use chip cards for their passengers and thus be able to get the number of persons e.g. in a city train or bus, as some European cities already do. For new mobility solutions such as e-busses, a whole city's (bus) routes need to be reorganized and optimized, using (anonymized) data on passengers' starting points and destinations – rather than letting the manufacturers and city administrations guess and debate how the existing lines and routes could be equipped with charging stations. Way too many actors such as city governments, energy providers, charging station operators and manufacturers of means of transportation, are working isolated and un-coordinated in European urban traffic management.

European car/bus manufacturers and suppliers need to partially re-define their business models in order to arrive at a competitive mixture of mobility solutions like hybrid, e- and fuel cell cars, combined with public transportation and short-distance vehicles like e-scooters and bicycles. Their role might be different than it was

previously because China is already leading in battery- and e-car innovation (Floercke 2019) and almost all e-busses worldwide are made in China (Fichtner et al. 2019: p. 17). Innovation policy for European automotive industries should focus on research in the next generation of mobility, e.g. in hydrogen/fuel cell transportation for long-distance transportation of busses and vans and multimodal planning and transportation system optimizing. In those fields, Europe has some competitive advantages through engineering and previous knowledge. If the European interests and goals are clearly defined, European and Chinese researchers and companies might benefit from funding from both sides to engage in joint research on hydrogen energy and intermodal mobility solutions.

Long-distance Transportation

The rise of China Railway Rolling Stock Corporation (CRRC)

Based on the Treaty of Rome, the intra-European transport was a pre-condition and consequence of the European Single Market. The four freedoms (free movement of goods, services, capital and labour) required transportation and the first mentioning of a **Trans-European Networks (TEN)** was in the Maastricht Treaty and the Whitepaper on the Future Development of the Common Transport Policy (Commission of the European Communities, 1992). With the goal of a stronger economic and social cohesion, interconnectivity was sought for passenger traffic as well as freight transport.

Those goals were quite similar to China's goals, following their **Medium and Long-term Railway Plan (MLTRP)** which was approved in 2004. While European companies tried to convince China to use the magnetic elevated train ("Maglev"), when the route from Shanghai Airport to Pudong was ready for the Olympic Games in Shanghai, the Chinese train ministry decided to be "... as self-sufficient as possible in high-speed rail (HSR) technology by mobilizing research and development resources on a massive scale to **establish China's own systems and standards.**" (Lawrence et al. 2019: p. 10). In 2009, the first major long-distance route from Guangzhou and Wuhan started operating, followed by the Beijing-Shanghai and Beijing- Guangzhou line in 2012. The HSR network was expanded up to 25,000 route-km by the end of 2017 and by 2020 the national railway operational mileage shall reach 120,000 km (Tan et al. 2016). This includes conventional lines with a 160–250 km/h speed, secondary speed trains with a speed of 200–299 km/h, and full high-speed trains with a velocity above 300 km/h. In their "Advanced Rail Transit" program of the 13th Five-Year Plan, safety assurance and emergency management should be improved, high energy efficiency of traction power supply realized, life cycle maintenance and environmental friendliness implemented. Beyond that, ambitious goals such as key technology for 400 km/h and above high-speed passenger transport equipment as well as space-air-train-ground integrated rail transport safety and control technology are foreseen (Tan et al. 2016). The **magnetic levitation train** idea has been revitalized in China and a new 600 km/h prototype has been presented in Qingdao in May 2019, integrated certification is expected in 2021 (Xinhua 2019). A track between two megacities in Southern China and Central China, Guangzhou and Wuhan, is planned. This time the whole CRRC project runs completely without European participation – a pity for the previous partners, but maybe a topic to re-negotiate in a science and innovation dialogue with China.

The state-owned Chinese railway companies learned from the leading European train manufacturers, Alstom, Bombardier and Siemens and from Japan's Kawasaki and their Shinkansen train which started construction in 1967 and ran the first lines in 1975 (Nippon.com). Like car manufacturers, the foreign train manufacturers needed to follow the Chinese **"local content"** requirements. They needed to establish joint ventures together with Chinese (state owned) partners that were holding the majority of shares and were in the lead position. The World Bank acknowledges that the first Chinese trains were imported or built under technology transfer agreements with European and Japanese companies, but adds that China rapidly adapted and improved the designs for local use (Lawrence et al. 2019: p.18). In addition, they joint forces through **mergers and standardizations**.

China Northern Railway (CNR Corporation Limited, CNR) and China Southern Railway (China South Locomotive & Rolling Stock Corporation Limited, CSR) merged in 2014 to a state-owned conglomerate, the China Railway Rolling Stock Corporation (CRRC), now the biggest railway technology conglomerate worldwide (Railway Gazette 2014). Between 2012 and 2014 the design plan on a Chinese high-speed train was finished and the two merged companies started implementing the joint plans. For building their first Chinese "Fuxing" train which runs at 350 km/h and is the pride of the Chinese high-speed trains now, the Chinese Ministry of Science and Technology and the former Ministry of Railways had joined forces for a **China High-Speed Train Independent Innovation Action Plan** (Tan et al. 2016). It comprised six large-scale enterprises, 25 key universities, 11 first-class scientific research institutes, 51 national laboratories and engineering centres, in total 500 professors, more than 10,000 engineers and technicians (Lawrence et al. 2019: p. 18). This development comprised engineering, operation and management and not only required train and signal technology but also track construction, pile building and stabilizing on sandy grounds along rivers or coastal lines, and tunnel building to overcome geographical challenges in mountain areas.

Controlling 99 percent of China's train industry (Yu, quoted by Smith 2016), CRRC is benefitting from **economies of scale and large state orders** and is now serving increasingly large markets in Central Asia, Eastern Europe and Africa along the Chinese new "Silk Road" (BRI). The China Railway Signal & Communication Co., Ltd. (CRSC) has a similarly strong presence on the highly standardized Chinese and BRI railway infrastructure. They standardized not only trains but also designs for embankments, tracks, viaducts, electrification, signalling and communication systems which cut costs and duplication of effort (Sweet 2014). Through this standardization, prices are low and infrastructure can be built fast. Chinese railway manufacturers have a comparatively comfortable position within the huge Chinese train market and along the BRI.

Despite governmental subsidies, (Hillmann 2018) CRRC and CRSC so far have not been able to conquer European markets significantly (Kaiser 2019). Along with the British fear of increasing prices after a merger, the lack of evidence that China would be a serious competitor for European rail companies was one of the main reasons why the European cartel authorities did not permit the merger of Siemens (Germany) and Alstom (France). A focus on the competition within the European market ignores the business interests of global players which gain a significant part of their revenues on interna-

tional markets. CRRC Zhuzhou Locomotive Company has meanwhile reached an agreement with the German train manufacturer Vossloh in Kiel (Barrow 2019) and might thus be able to enter the European train market – if they are allowed to do so. Agreements on the mutual opening of public procurement in this market would establish reciprocity and would be part of the requirements: If European companies may purchase a Chinese company in the railway sector and qualify for public procurement in China, then Chinese companies can do the same in Europe.

Suggestions for project learning exchanges

Many of the technologies and skills for the Chinese railway development were provided and taught by European experts, by their activities in China and through the many Chinese students who studied in the relevant European universities. It would be a kind of "giving back", if European students and researchers could be part of new technology projects in China in order to learn from China. European universities that have high numbers of Chinese students in technology fields which are close to Chinese showcase projects should consider balancing the number of incoming and outgoing students or ask for exchange programmes for professors, research assistants and PhD candidates. European science and education ministries could support that with signing bilateral partnership agreements which also include language assistance or courses and project work in English as a joint language. Funding for research on how Europe and China could both benefit from a Eurasian connectivity network would encourage researchers on both sides to think of potential solutions. In cooperating with the modern China, we should be pragmatic in negotiating to achieve results which clearly also serve the EU's strategic interests.

Summary

The strategic approach in mobility reflects characteristics of the Chinese system and culture: First, the long-term thinking and industrial policy are based on China's "Socialist Market Economy" which forms a synergy between two dialectic poles. It is reinforced by the Communist Party's leadership and long-term planning (von Senger 2008, pp. 115). Those plans set a general guideline, an innovation path, an appellative call to follow the party's direction. Details of the implementation are in the hands of provinces, municipalities, state-owned and private corporations. The standardization of the most successful technologies and procedures (Lawrence et al. 2019: 3), and own improvements based on local conditions and skills, help to reach their mobility goals. Issues such as sustainability and support for local partners are increasingly considered, but executed in a flexible way.

Secondly, "Learning from the West" has been the path of modernization since the Communist Party's opening up in 1978 (Goodman 1990: p1). While the West dreamed of China's transformation to a full market economy ("change through trade"), Chinese see themselves as the world's next leading economy. Their dialectic thinking enables them to see synergies and interconnections between several technologies and to establish more holistic innovations. Flexibility, illustrated through the "flowing like the water" analogy (Sun Tzu), frequently lead to adaptations of regulation to current and situational needs. By using competitive advantages and learning from Europe, China challenges assumptions such as the clinging to established models and lengthy (democratic) processes in debating on

transportation infrastructure. China's government grasps opportunities and encourages its researchers to join forces in order to develop and implement technological innovation and thus also foster social cohesion.

Maybe that is one of the major lessons we should take along from China and its many provinces: In all our European diversity and manifold challenges that we face, we should join forces and develop plans for a modern European transportation infrastructure, in the cities as well as on the long-distance transportation. In the cities, a comprehensive traffic planning for multi-modal mobility, based on real-time data, should be introduced and public transportation made more attractive. Growing urban population requires a faster planning and implementing of new public transportation facilities. The Trans-European Network has been improved but still could be better, with fully standardized gauges, interoperable rail traffic management and advanced train control systems (using existing models and implementing them sooner), with more reliable passenger trains, more silent freight trains, a more efficient operation and predictive maintenance, a joint digitalized planning system in Europe and more environmentally conscious rail transportation, rather than truck congestion and CO₂ emissions on the motor highways. China started its modernization after the 2008 financial market crisis and maybe Europe could do so now in a phase of an economic slowdown. Even though the EU might not agree to some of the Chinese views, it can learn from the Chinese long-term thinking and strategic planning.

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