Spontaneous emergence versus technology management in sustainable mobility transitions: Electric bicycles in China


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Abstract
This paper seeks to understand how and why the electric bicycle sector has emerged in China, and the prospects for learning from the sector for applications in other countries around the world. Drawing on secondary data and interviews with electric bicycle users and producers, this paper charts the development of the electric bicycle sector in a policy vacuum. The paper integrates theoretical perspectives on cultures of mobility with transitions
theory to explain the process of change outside of the traditional reference context of technology policy and management. It is concluded that transitions theory has a greater flexibility and adaptability than previously shown, but the e-bike is a weakly-embedded alternative to mainstream automobility.

**Keywords**

Electric bicycles; China; automobility cultures; socio-technical change.

1. **Introduction**

Generally, those working with sustainable production and consumption frameworks or theories of sustainable transitions do so with a distinct policy orientation in which forms of governance intervention are anticipated to be fundamental to a successful migration away from currently unsustainable practices. The underlying assumption is that purposive policy interventions are necessary in order to stimulate and nurture new production-consumption modes, resulting in a concern for fiscal and other incentives, learning from socio-technical experimentation, consensus building, R&D support, infrastructure development and other features.

Such concerns are strongly evident with respect to mobility, perhaps all the more so because of the perceived economic significance of emergent automobility technologies. Despite a plethora of interventions, support and experimentation it is reasonable to conclude that the prevailing automobility paradigm remains virtually intact.

However, it is striking that in China the electric bicycle (e-bike) sector has grown very strongly from almost nothing to being a substantial activity in a little over 10 years. China is both the largest producer and largest market for electric bicycles in the world. Yet this sector has received none of the
attention, protection and support given to ‘new energy vehicles’ in China; and in some cities the authorities have actively sought to discourage the use of (electric) bicycles.

This paper therefore seeks to address the urgent need to understand how and why the electric bicycle sector has emerged in China, and the prospects for learning from the sector for applications in other countries around the world. Drawing on secondary data and interviews with electric bicycle users and producers, this paper seeks to chart the development of the electric bicycle sector in a policy vacuum. The paper integrates the multi-level perspective from Geels (2002; 2005), Kemp and others with theoretical perspectives on cultures of mobility (deriving from Urry 2004; 2007) in order to use transitions theory to explain the process of change outside of the traditional reference context of technology policy and management.

The paper commences with a short account of transitions pathways and the definitional issue of whether e-bikes constitute an emergent niche to challenge the existing mobility regime. Thereafter the paper provides an historical account of the shifts in pathways that could be attributed to e-bikes in China with attention paid to the rapidity of change and its spontaneous character. It is concluded that the balance of product advantages and disadvantages has provided an historical moment in which electric bicycles have flourished despite neglect from traditional policy interventions, but it is rather less certain that they are understood culturally as an environmental alternative to the car.

2. **Spontaneous emergence or purposive nurture: the perspective of transitions theory**

It is interesting to note that while transitions theory has embedded within it a distinctly managerial and governance perspective, some of the initial examples used to establish this increasingly prevalent theoretical framework did not
necessarily display purposive interventionism. Rather, an extended moment of historical and spatial serendipity appears to be crucial in allowing technological innovations, entrepreneurial guile and consumer bravery to create the basis of a new socio-technical regime. The typology from Berkhout et al. (2004) offers a framework in which there are four potential transition pathways depending upon the degree of planned coordination involved and the extent to which external or internal resources are deployed. Spontaneous emergence in their typology is uncoordinated as opposed to a vision-driven centrally planned transition that is purposive in character. Geels and Schot (2007) offer a more nuanced interpretation of transition pathways in which outcomes are not assumed to be either ‘planned’ or ‘unplanned’, but are rather an emergent mixture of the two. The Geels and Schot (2007) framework thus identifies six possible theoretical pathways arising out of grounded analysis of actual cases: Reproduction of the existing regime; the transformation pathway undertaken primarily by the regime actors; the de-alignment and re-alignment pathway triggered by significant landscape level changes; the technological substitution pathway in which niches are the main vector for change; the reconfiguration pathway in which symbiotic niche and regime interactions underwrite the transition process; and a sequence of transitions from transformation and reconfiguration to others of the above possible pathways.

**P0. Reproduction process:** If there is no external landscape pressure (‘regular change’ in Suarez and Oliva’s typology), then the regime remains dynamically stable and self-reproducing.

**P1. Transformation path:** If there is moderate landscape pressure (‘disruptive change’) at a moment when niche-innovations have not yet been sufficiently developed, then regime actors will respond by modifying the direction of development paths and innovation activities.

**P2. De-alignment and re-alignment path:** If landscape change is divergent, large and sudden (‘avalanche change’) then increasing regime problems may
cause regime actors to lose faith. This leads to de-alignment and erosion of the regime. If niche-innovations are not sufficiently developed, then there is no clear substitute. This creates space for the emergence of multiple niche innovations that co-exist and compete for attention and resources. Eventually, one niche-innovation becomes dominant, forming the core for re-alignment of a new regime.

**P3. Technological substitution:** If there is much landscape pressure (‘specific shock’, ‘avalanche change’, ‘disruptive change’) at a moment when niche innovations have developed sufficiently, the latter will break through and replace the existing regime.

**P4. Reconfiguration pathway:** Symbiotic innovations, which developed in niches, are initially adopted in the regime to solve local problems. They subsequently trigger further adjustments in the basic architecture of the regime.

**P5.** If landscape pressure takes the form of ‘disruptive change’, a sequence of transition pathways is likely, beginning with transformation, then leading to reconfiguration, and possibly followed by substitution or de-alignment and re-alignment.

**P6.** Performance enhancement pathway (a tentative possible alternative pathway): niche develops by assimilating and absorbing innovation accumulative clusters. If there exists a landscape pressure which creates spaces for the niche innovation, this innovation will break out of niche level and enter the existing regime.

The transitions process occurs over geographic space, but the definitions of landscape, regime and niche are ambiguous in practice (Coenen et al. 2012).
For example, can a city with millions people be considered as a landscape or a niche? Furthermore, the operation of the transition process in which a new regime is embedded is also one in which the spatial scale changes (Hodson and Marvin, 2012). In effect then, transitions theory is multi-scalar with regard to transitions pathways as is illustrated in Figure 1. In this view of transitions theory each embedded regime system at the macro-scale is comprised of numerous sub-systems or constituent elements in micro-scale, and each constituent element has its own micro-structure with a self-contained multiple perspectives. Hence, at the macro-level, the coupling and de-coupling between the sub-systems is seen as the primary mechanism underpinning the transition process in the global system. Transition theory applied in this multi-scalar manner is especially useful for a large and complicated system like that represented by China. While the unitary nation state is often the logical empirical forum for analysis, the geo-political structures within the nation state can be of great significance. For example, large cities in China have a population that rivals or surpasses many nation states, and those cities are economically and socially diverse. City and provincial authorities have relatively independent policy-making power in certain key areas, notably in this case transportation. In combination, however, the cities also serve as constituent elements of China from a macro-viewpoint. As we discuss below, the transition to e-bikes in China is not ‘homogeneous’ and ‘synchronous’. Instead it is influenced by different transition processes in various cities in which outcomes are both uncertain and contested.

**Figure 1 Transition theory in Multi scalar manner**
An aspect of this spontaneous emergence that we can only touch upon here is that of the proliferation of vehicle designs in a process that has made the definition of an ‘e-bike’ somewhat problematic. In essence, the addition of a battery and a motor to a range of two- or three-wheeled vehicles has resulted
in a broad spectrum of applications from relatively powerful, fast electric motorcycles and scooters, to simple, crude and slow machines that resemble a child’s stand-on scooter. As we note below, part of the process whereby the state has sought to bring governance to the e-bike or e-wheeled vehicle sectors is to define what is, and what is not, considered in each sub-category.

An important question is the extent to which electric bicycles, however defined, represent an alternative to the existing mobility regime or an addendum to it. In other words, does the rapid and substantial uptake of e-bikes contribute to more sustainable mobility, and simultaneously undermine the viability of the existing (less sustainable) mobility regime? In seeking a perspective on this a consideration is whether the principle actors are central to the existing mobility regime, and further whether e-bikes represent a complementary or competitive mobility solution. In this respect, the perspective adopted here is that, akin to many treatments of the electric car sector, there is sufficient significant difference in the technology, the use patterns, the actors and the attitude of government for e-bikes to constitute the basis of (part of) an alternative mobility regime, but that equally it is not a foregone conclusion that such a displacement will occur. Significantly, e-bikes in China appear not to compete with the private car per se, but with traditional motorcycles and, probably, public transport.

3. Electric bicycles in China as a case of spontaneous emergence

There are three pathways in the e-bike transition on nation level over time (see Figure 1). These are described as P0, the regime reproduction phase (1995-2000); P6, the symbiotic evolution phase (2001-2005); and P2, the de-alignment and re-alignment phase (2006-2010). The basis of these phases and their constituent pathways is discussed below.
3.1 Pathway P0: Self-reproduction 1995-2000

An example of the transition process P0 (self-reproduction) is that of the motorcycle industry which occupied the market and was a constituent element in the dominant mobility regime, leaving no space for e-bike development for an extended period of time. Tracing back to 1978, at the very beginning of the China's reform and opening-up policy, the central government established the motorcycle industry as a priority to develop the transport system. With the strong support from landscape and regime actors, the motorcycle industry increased sharply from 0.1354 million output in 1981 to 11.534 million in 2000
(see Figure 2), by which time the motorcycle industry could be considered as part of the existing mobility regime level, and reproducing itself along with reinforcing landscape developments.

**Figure 2: Output and sales of motorcycle in China**

(Source: Chen, 2006)

In terms of the e-bike industry, it started to develop with niche innovations during the 1980s. Several small e-bike manufactures were established around the Shanghai, Zhejiang and Tianjin areas. In 1988, 40,000 e-bikes were produced in Shanghai (Yang, 2010). However, these e-bikes used dilute lead-acid batteries which had the nature of heavy weight, low battery efficiency and liability to leakage, resulting in e-bikes failing to satisfy practical requirements (Huang, 1999). Fundamentally, these machines were traditional pedal bicycles with batteries and motors added, and hence drew from a separate constituency than the mainstream mobility regime actors. In addition, some critical technology problems with the motor, motor assembly, assist and throttle were still impeding market development. With limited technology and customer service e-bikes remained of negligible significance. This situation
started to change in 1995, when some manufacturers produced rear-wheel motor electric bicycles with a capability to achieve 20kph, thereby beginning to arouse some attention (Huang, 1999). Furthermore, and crucially, e-bikes were granted permission from central government to travel on roads and as such opened a niche market with 54,500 output in 1998, 126,000 output in 1999, and 276,000 output in 2000 (see Table 1).

### Table 1: Output of motor bicycles and e-bikes from 1997-2000

<table>
<thead>
<tr>
<th>Date</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorcycles</td>
<td>10,039,362</td>
<td>8,793,443</td>
<td>11,269,136</td>
<td>11,533,848</td>
</tr>
<tr>
<td>e-bikes</td>
<td>---</td>
<td>54,500</td>
<td>126,000</td>
<td>276,000</td>
</tr>
<tr>
<td>e-bikes/motorcycles</td>
<td>---</td>
<td>0.62%</td>
<td>1.11%</td>
<td>2.39%</td>
</tr>
</tbody>
</table>

(Source: Liu, 2008)

However, generally e-bike development was still blocked by the blooming motorcycle industry. The above table shows that e-bike output in each year from 1998 to 2000 were only 0.62%, 1.11%, and 2.39% of motorcycle output, respectively. Reinforcing landscape developments helped stabilise the motorcycle as a constituent of the prevailing dynamically stable regime. This situation was altered when the central government decided against further support for the motorcycle industry.

3.2 Pathway P6, the performance enhancement phase (2001-2005)
An example of the transition process P6 (the performance enhancement phase) is that the e-bike models try to break out of niche level by assembling innovation accumulative clusters arising from other industries in the dominant mobility regime. The very first e-bike modes resembled normal pedal bicycles with a chain-driven rear wheel. The e-bike reduced user effort and effectively increased range at relatively modest additional cost, and so were readily accepted by customer. Moreover, in the event of battery or motor failure, it was still possible to ride the bicycle on pedal power alone.

In this situation, a flood of companies entered the e-bike markets, including some famous bicycle companies (Yongjiu, Phoenix) and motorcycle companies (Sundiro, Qianjiang Motorcycle). In 2003, more than 1,000 companies sought market share, ending up with fierce competition. In order to occupy the market, the companies focused on technology innovation, price, and customer service. Core technologies (motor, battery) were significantly improved. The E-bike industry accelerated its growth, hastening marketing expansion. During 2003, the first e-scooter model was developed, signifying a great technology improvement. It is noted that an e-bike model with fake pedals became prevalent, because of its lighter weight (see Figure 3). Both of the models carry more cargo and passengers, and are much faster, establishing the dominant designs and providing clear directions for further improvement and process innovations. For example, by 2010, only 16.1% of electric 2-wheel vehicles in the market were e-bikes, 26.2% were e-scooters, and 57.7% were models with fake pedals (National Bike Industry Information Centre 2011, cited in Ruan et al. 2012, p.449).

Figure 3: Electric 2 wheel vehicle models
The P1 transformation pathway with respect to e-bikes largely happened at the micro-scale, i.e. the cities, rather than the national scale. An example is that of the transition of the local policy on banning e-bikes to that of accepting them. In this, the crucial regime actors are local government and local transport management departments. Table 2 shows the treatment of e-bikes in Beijing, and Fuzhou.

Table 2: City-level policy on e-bikes, Beijing and Fuzhou 2002 to 2010

<table>
<thead>
<tr>
<th>City</th>
<th>Initial E-bike policy</th>
<th>Second E-bike policy</th>
</tr>
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<tbody>
<tr>
<td>Beijing</td>
<td>Complete ban of e-bikes on 1st, Jan, 2006</td>
<td>Issue licenses for e-bikes and permit licensed e-bikes to travel in the city.</td>
</tr>
<tr>
<td></td>
<td>08/2002</td>
<td>01/2006</td>
</tr>
<tr>
<td>Fuzhou</td>
<td>Ban the sale of e-bikes.</td>
<td>Issue licenses for e-bikes and permit licensed e-bikes.</td>
</tr>
<tr>
<td></td>
<td>06/2003</td>
<td>04/2010</td>
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e-bikes to travel in the city.


Outside criticism firstly came from journalists who reported that regime actors (in the form of the city authorities) failed to respond to the considered will and travel requirements of the people, with the evidence that the penetration of e-bikes in Beijing was 60,000 at the end of 2001, followed by 36,000 sales in 2002 (Gao, 2002; Fan, 2004; Zhang, 2004). Moreover, the Beijing News conducted a poll on purchase intentions with respect to e-bikes, whose results evidenced that 2.117 million people stated a purchase intention in the future (Zhang, 2006). However, the city authorities insisted on eradicating e-bikes in the transport system on the grounds that it would make traffic management easier and release more urban road space that was beneficial for constructing the domestic automobile era. The regime actors paid most attention to mainstream automobile industry, for example by hosting Beijing International Auto Show, involving automobile industry in the 10th five year plan, and in constructing a new 128km highway (Bai, 2002).

Since Beijing as a city authority banned motorcycles as well in 1985, citizen personal mobility problems were exacerbated with landscape developments. Industrialisation, for instance, drew more workers to cities like Beijing, leading to accelerated urbanisation. These newcomers could not afford the high living costs in central Beijing and thus rented accommodation in the suburban districts: thereby extending the commuting distance beyond that which could be achieved with bicycles. In the meantime, the public transport system could not keep pace with demand. Conversely, the low cost e-bikes which provided for longer travel distance and flexible accessibility went well with citizens’ needs. These e-bike users voiced their concerns through the media to increase pressure on the regime. Moreover, academicians from social science research, city planning and law published many papers to argue against the inappropriate e-bike ban policy (Zong, 2002; She, 2002). Besides, e-bike manufactures linked up with energy companies, and the battery industry to
strongly oppose the e-bike ban (Zhang, 2006). In response to increased pressures, local government and the standing committee of Beijing Municipal People’s Congress held a first public legislative hearing to discuss the e-bike issue on 3rd September, 2004 (Beijing People’s Congress, 2004). After that, Beijing proposed to lift the e-bike ban on 13th January, 2006.

The penetration of e-bikes in Beijing was 180,000 at the end of 2005, which was three times more than that of the penetration in 2001 (Liu, 2008). By contrast, the penetration of private cars in China was 1.54 million in 2005 (Rong, 2006) which indicated that e-bikes remained at niche level and had not yet been sufficiently developed in Beijing. After Beijing lifted the e-bike ban policy, a citizen said ‘I bought an e-bike before. Now that the government lifts the e-bike ban, I am going to buy another one for my child. His working place is very far away from home. In the past, when I was riding the e-bikes, I was always worried about the traffic policeman asking me to pull over. I am happy to ride my e-bikes now’ (Ma, 2006). Also, the manager of the E-bike World Shopping Mall said that the sales increased by 50% after the lifting of the e-bike ban (Ma, 2006). Because the city government altered the strategies on e-bike ban policy, it became possible for the penetration of e-bikes to reach 700,000 in 2012 (Zhen, 2012), thereby stimulating the e-bike sector as a whole.

3.3 Pathway P2 de-alignment and re-alignment 2006-2010

An example of transition pathway P2 (de-alignment and re-alignment) is the 2-wheel vehicles from gasoline motorcycle to electric 2-wheel vehicles in China in the period 2006 to 2010. China was a society in bloom in the early 21st century, with major political, social and economical changes, such as industrialisation, urbanisation, and policy reform movement. China became more international in focus and sensitivity while retaining the one party state system, but equally became concerned with key environmental problems such as deteriorating air quality in major urban areas. This latter issue was highlighted during the 2008 Olympics in Beijing.
These ‘avalanche changes’ brought numerous problems into the existing motorcycle urban transport regime, especially from the regime actors’ view. In particular 1) motorcycles disrupted traffic and caused unwanted accidents, hampering the embrace of a ‘modernist’ automobile era, 2) millions of motorcycles produced contributed tailpipe emissions every year, leading to creeping environmental deterioration, and 3) motorcycles were treated as obstacles in the intensive city construction.

Therefore, since 1997, many Chinese cities started to completely ban or partially ban motorcycles and scooters (see Table 3). Some cities released a limited number of motorcycle licenses every year or even suspended the issuance of new motorcycle licenses. Some cities banned motor bicycles from entering the city centre or major roads in the city. As of 2009, motorcycles and scooter were banned or restricted in over 170 cities (Cao and Fan, 2009). While these bans did not challenge the core mobility regime premised on the private car, they did create an opportunistic space for the spontaneous emergence of the e-bike alternative.

Table 3: Cities banning or restricting motorcycles.

<table>
<thead>
<tr>
<th>Province-level cities</th>
<th>Beijing, Tianjin, Shanghai</th>
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The local motorcycle bans created opportunities for niche activities, including for example the growth of 3-wheel vehicles in taxi applications. The primary beneficiary, however, appears to have been the e-bike sector (Ji et al., 2012).

The groundwork for this spontaneous emergence had already been undertaken. In 1999, an e-bike national standard was established by the central government, which for the first time to specified the speed, weight and power of e-bikes. In the following year, the Department of State Traffic Control Bureau drafted a ‘Road Traffic Safety Law’ to allow e-bikes travel on bike lanes. In 2004, this law was passed, defining e-bike as a non-motorized vehicle and permitting an e-bike user to use it without a driver’s license. The national standard became the trigger boosting the initial (pedal cycle derived) e-bike market. Importantly, the Chinese government had set bicycle production as a national priority and established bicycle lanes in cities since 1949 and so some minimal but important infrastructure and manufacturing provisions were already in place.
Industrial concentration accompanied the process of market expansion and the shift to mass production. With low cost, fast speed, personal mobility and convenient accessibility, electric 2-wheel vehicles further diffused into the market, particularly in urban areas. In 2005, the sales of e-bikes exceeded that of the gasoline motorcycle in China (seen Figure 4). After that, the electric 2-wheel vehicle market continued to expand, with much higher sales than that of motorcycles.

Figure 4: Sales of e-bikes and motorcycles in China, 1993 to 2009 (million units per annum)

(Source: Adapted from Ruan et al., 2012)

Additionally, we notice that from Figure 4 the motorcycle sales trend is one of fluctuation after the imposition motorcycle bans but without a significant decline. This is mainly attributed to ‘The home appliances going to the countryside plan’ by Ministry of Finance and Ministry of Commerce for stimulating the sales of household appliances (including motorbikes) in the country’s vast rural areas at prices 13% lower than those in cities in 2008. Another possible reason for production to have stabilised is the export of
motorbikes. In most of cities, however, motorbikes experienced a de-alignment process.

Hence the e-bike ‘story’ and that for traditional motorbikes are closely intertwined. This example shows de-alignment of the motorcycle transport component of the established mobility regime, because of many landscape developments and regime actor views. In parallel, multiple niche markets emerged and co-existed after the motorcycle bans were imposed. However, electric 2-wheel vehicles rapidly became dominant from 2006 to 2010, potentially forming the core for re-alignment of a new regime.

As mentioned above, electric 2-wheel vehicle transition is following P2 (de-alignment and re-alignment pathway). Whether its transition process followed P3 (technological substitution) or not depends on whether it can replace the motorcycle regime or not. Adopting multi-scale transition perspective, in some south part cities, e-2-wheelers have already replaced motorcycles. For example, the e-2-wheeler and private car ownership rate per 100 household is 34.56 and 37.97 in Nanjing, respectively (Nan, 2013). By contrast, in a view of national level, the e-2-wheeler has not become as broadly established.

Apart from this, the Ministry of Public Security, Ministry of Industry and Information Technology, State Administration for Industry and Commerce, and the General Administration of Quality Supervision, Inspection and Quarantine (4-ministry) published a ‘Notice of Strengthening E-bike Regulation’ requiring provincial governments to strictly follow the 1999 e-bike national standard and remove all the e-bike that were not to meet the standard criteria in 2011. Meanwhile, the Ministry of Environmental Protection and the 4-ministry issued a notice to regulate pollution from the lead-acid batteries and the lead recycling industry. Furthermore, the new national standard of electric 2-wheel vehicles is under development. These regime actions put electric 2-wheel vehicles in unclear future.
The e-2-wheel vehicle transition does not follow P4 (reconfiguration pathway), because neither the motorcycle regime nor automobile regime adopted the innovations from e-2-wheel vehicle. Additionally, because the e-2-wheel vehicle transition does not trace P4 (reconfiguration pathway), so ‘a sequence of transition pathways’ does not trigger as described in P5. Therefore, e-2-wheel vehicle transition does not trace P5.

4. Conclusions

This paper illustrates some interesting novel perspectives on transitions. First, that the rapid uptake of a new transport form was not the direct result of positive, purposive policy intervention at national or sub-national government level, nor the result of nurturing nascent niches. There was no significant government-sponsored R&D programme in support of the e-bike sector, nor any financial or other incentive offered to consumers to encourage the adoption of these vehicles. Faced with the de facto existence of these e-bikes, government first reacted negatively, by banning them, and then acquiesced to the reality by regulating them. Second, this transition process has occurred with remarkable rapidity under the particular conditions prevailing within China as compared with the historical cases of transitions discussed in the majority of the literature. In part this might be due to the transport vacuum caused by the outright ban on traditional motorbikes, a policy that less centralised and autocratic governments might struggle to enact. Third, it could be argued that the transition is weakly embedded, however, as illustrated by the lack of support or outright antagonism initially shown by government, and because the technology itself requires little or no special infrastructure. The forces required to create a strong new mobility regime are not present, while the political and economic power of traditional mobility remains substantial. Finally, we have shown that transitions theory has a greater flexibility and adaptability than previously shown in that there are pathways other than those outlined by Geels and Schot (2007) that are certainly possible, in time periods that are considerably condensed.
In terms of further research there may be potential in exploring further the interaction of technologies within distinct spatial areas of governance, particularly in terms of diverse cultures of consumption and varieties of capitalism. It is intriguing that, anecdotally at least, the markets outside China that have most embraced the e-bike are those that use existing pedal bicycles as a means of transport (the Netherlands and Germany for example), whereas others such as the UK and the USA where the bicycle is a form of leisure pursuit have been far less enthusiastic. Alternatively, in the account provided here it is notable that the political system in China is able to enact abrupt and comprehensive shifts in policy that might not be so readily achievable elsewhere. The initial bans on motorcycles provided an empty niche, a transport vacuum that e-bikes were quickly able to fill, and hence the growth of the e-bike segment was effectively an accidental by-product of rather draconian policy. Subsequent shifts in e-bike policy continue to illustrate the perspective that e-bike users and manufacturers could easily be the collateral victims in the future.

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