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Role of Users in the Developing Eco-Innovation: Comparative case research in China and France

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Abstract:

This article proposes a model of eco-innovation that emphasizes the role of users and regulation in the development and diffusion of eco-innovation products, by comparing the diffusion of two e-bike companies, CEP and Lvyuan, from China and France. These cases show that diffusion of eco-innovation in China and France is strongly linked to the institutional context and specific consumer needs, highlighting the importance of involving users in the development and diffusion of eco-innovation in order to satisfy market demand, and increase profit and competitiveness in niche markets. It also shows that, to achieve a comprehensive picture, institutions and policy makers should adopt a coevolutionary approach to regulation that includes consideration of technology, uses and practices. The case of CEP reveals that regulation appropriate to the market fosters companies' eco-innovation; compared to the case of Lvyuan which shows that irrelevant regulation can become a barrier to the diffusion of eco-innovations such as the e-bikes. The superior 'snob effects' of the French market are discussed and compared with the 'bandwagons effects' noted in the Chinese market.

Résumé:

Cet article propose un cadre d'analyse de l'éco-innovation, mettant l'accent sur le rôle des utilisateurs et des réglementations dans son développement et sa diffusion à partir d'une comparaison des trajectoires de deux firmes du secteur du vélo électrique, Lyyuan (Chine) et CEP (France). Ces cas mettent en exergue le rôle du contexte institutionnel et des besoins spécifiques de consommateurs dans la trajectoire de l'éco-innovation. Une approche en termes de co-évolution entre la technologie, les usages et les

pratiques est mise en avant pour expliquer les différences de trajectoire. Les effets de « snobisme » sur le marché français sont discutés et comparés aux effets « boule de neige » (bandwagon) observables sur le marché chinois.

Keywords: eco-innovation, user, e-bike, France, China

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INTRODUCTION

How can we spur eco-innovation in order to improve its adoption and diffusion? Underlying this question, is the continual balance that policy makers try to achieve between promoting eco-innovations and supporting the companies that are part of this process, and satisfying users. Policy makers, eco-innovation firms and users are the key actors in the dynamic described in [Rennings, K. , 2000], and the main problem is predicting *ex ante* elements in the national system of innovation (NSI) that coevolve and may be mutually reinforcing [Foxon, T. 2011]. For instance, in the field of transportation, the visions of China and Western countries differ in relation to governance of the ecosystem, based on prior institutional contexts (i.e. transportation behavior history, user practices, biking behavior, attitudes to energy use, individual values and leisure activities, market size, etc.). Beyond historical differences in institutional contexts, a main driver of eco-innovation is the potential increasing returns of adoption that accompany increased demand [Arthur, B. 1989]. However, the diffusion of eco-innovation is not driven automatically, and users play an important role. We argue that the role of the user in eco-innovation has been under-investigated despite its significance. We are interested in the role of users in eco-innovation in different countries, and the institutions and others mechanisms that shape users' practices.

We apply user innovation theories, and apply the case of diffusion of e-bikes in China and France to observe and compare the role of user practices in eco-innovation in these two countries [Von Hippel, E. 1986, 2005; Witt, U.2001; Maréchal K. and Lazaric N., 2010]. Both countries consume in different ways, engage in different leisure activities, have distinct environmental values, and different transportation

histories. The consumption of goods was discussed by Leibenstein [Leibenstein, H., 1950] who outlined potential 'snob effects' that may confine some goods and services to being luxury products, and 'bandwagons effects' that cause demand to rise with increasing consumption of a product. As consumption increases, even initially reluctant followers will begin to espouse new behaviors and new forms of consumption thereby enforcing some kind of in-group cohesion, mirroring the psychological theory of normative conformity [Leibenstein, H. 1950; Rogers, E. 1962; Kahle and Kim, 2006].

The case of the development of e-bikes provides a good example of this dynamic; electromobility shows a distinct development path which is linked to transportation, the presence of infrastructures, and also values and practices related to biking. Comparing France and China could be informative for the governance of eco-innovation. Despite some clear divergences between these two countries mainly related to market size, both nations adopt some common means to push technologies, and in both the role of policy makers and important public-private partnerships to promote technologies and uses are crucial [Altenburg T. et al., 2012].

The paper is organized in five sections. Section 2 provides a framework for the research on eco-innovation based on a review of the literature. Section 3 describes the historical context promoting eco-innovation and presents the research method used to observe the development of two business strategies related to e-bikes, shaped by users and institutions. The role of users is analyzed in Section 4 and Section 5 discusses some implications of this research.

SECTION 2. RESEARCH FRAMEWORK FOR OBSERVING ECO-INNOVATION

2.1. Three Pillars of Eco Innovations

Rennings's insights might suggest that eco-innovation is similar to classical innovations in that they *"can be developed by firms or non-profit organizations, they can be traded on markets or not, their nature can be technological, organizational, social or institutional"* [Rennings, K. 2000: p.322]. From this perspective, eco-innovation should not be viewed as isolated but as the product of social innovation and institutional innovation because *"effective environmental policy requires understanding not only technological but also lifestyle dynamics"* [Duchin, 1999 cited in Rennings K., 2000: p.323]. Thus in the context of sustainable development, eco-innovation should not be reduced to a solely Schumpeterian dynamic in which technological factors are prominent, but should integrate demand – such as lifestyles, values, preferences – and the way it is mediated *via* social institutions. In this context, the path to adoption of eco-innovation, and its wide diffusion may be more complicated compared to 'other kinds of innovation' because *"eco-innovations are, in contrast to such technologies as microelectronics and telecommunications, normally not self-enforcing. Because factors of technology push and market pull alone do not seem to be strong enough, eco-innovations need specific regulatory support."* [Rennings, 2000: p. 326].

Eco-innovators must also be aware of regulation and grasp potential opportunities enabled by the introduction of new rules. Eco-innovation has three main dimensions, technological, market, and regulatory, which coevolve and promote its diffusion. The

technological and demand components of eco-innovation are important but not always sufficient; for example a large contribution to emissions reduction was triggered by environmental regulations that affected the decisions of households and their practices [Jorgenson et al., 2009; Popp, 2001 and Bergh et al., 2011].

These considerations led to the definition of an eco-innovation in the context of the European Project MEI (Measuring Eco-Innovation): *“The production assimilation or exploitation of a product, production process, service or management or business methods that is novel to the organization (developing or adopting it) and which results, throughout its life cycle , in a reduction of environmental risk pollution another negative impacts of resources use (including energy use) compared to relevant alternatives”* [Kemp K. and Pearson, P., 2008: p.7]. This definition embraces all those innovations that enable a firm to reduce its negative environmental impact through products, services or methods. Given the numerous environmental criteria, it is difficult to assess the global environmental impact, and because of potential rebound effects, use of an eco-innovation may not lead to an absolute reduction in environmental harm. Thus, eco-innovations cannot be considered in relation to their absolute environmental impact, but must be considered more broadly in terms of their relative impact compared to alternative technologies.

2.2. Scrutinizing the Role of Demand and Lead Users

Economic analysis of eco-innovation is based mainly on evolutionary theory, especially the bounded rationality of agents, system failures such as lock-in and unpredictability, and network interactions among agents [Bergh et al., 2011]. We draw also on sociological theories of consumption, and classical views of demand such as the insights developed by Leibenstein [1950], to enable a richer understanding

of the development of eco-innovation and its diffusion. Eco-innovation should not be confined to niche markets and use. In order to increase adoption, social mechanisms are critical, notably to the presence of a critical mass of specific users to increase this process.

The sociologic literature on demand emphasizes the role of social norms and status seeking behaviors. The literature on status-seeking consumption originated with Veblen's [1894, 1899] work on "conspicuous consumption" and Duesenberry's [1949] "relative income hypothesis". In contrast to the individual maximization of utility according to exogenous preferences, as posited by the neoclassical approach, Veblen developed an evolutionary framework where preferences are generated and shaped in interaction with the social structure. According to Veblen's theories, individuals emulate the consumption patterns of other individuals at higher levels in the social hierarchy [Trigg, 2001]. Social norms appear, or what Veblen called conspicuous consumption, are important for explaining how consumption is used to gain and signal social status. More recently, the importance of social norms for environmentally responsible behaviors has been documented, and social context and personal norms appear to be relevant for transport issues [Bamberg et al., 2007].

Veblen's insights have been applied in economics to demonstrate inertia in demand and consumption [Duesenberry, 1949] and the existence of externalities and the bandwagon effect described by Leibenstein [1950]. Increasing returns from adoption are necessary for the development of these externalities. As has been shown in the case of innovation, the scale of adoption is determined largely by the success of a novelty, while positive externalities are generated as soon as the newness extends beyond a restricted community of users [Arthur, B. 1988; Maréchal K. and Lazarc,

N. 2010]. Network externalities are generated by increasing returns from information (Katz and Shapiro, 1985): being surrounded by people who have adopted new behaviors and new practices reinforces the willingness to adopt similar behaviors, through a contagion effect. From a different standpoint but producing rather similar outcomes, network externalities have been discussed in sociology [e.g. Campbell, 1997 and Bourdieu, 1984] to explain importance of “the social mirror” [see also Trigg, 2001]. Also, Witt [2001] suggests that consumers acquire new behavioral repertoires either by individual trial-and-error learning, or by communicating with and imitating others (social learning process). The latter is very important for eco-innovation which is characterized by uncertainty compared to ‘normal innovation’. Consequently, the dynamic of imitation and adoption is extremely dependent on the “early adopters” who may trigger a larger dynamic depending on their positions in the social structure [Wörsdorfer and Kaus, 2011]. Early adopters are those consumers who play the role of opinion leaders and contribute to the dissemination of information concerning the new product. They have the potential to mobilize other groups of buyers who may react by delaying adoption or “jump onto the bandwagon” and become part of an “emergent majority” [Wörsdorfer and Kaus, 2011]. Early adopters play a critical role by enrolling “laggards” who are more skeptical and more reluctant to adopt novelty because of its unfamiliarity compared to their current consumption. Early adopters in Rogers’s (DATE) terminology or “lead users” according to von Hippel [1986, 2005], are decisive for diffusing information and enhancing imitation. Von Hippel describes them as highly motivated adopters with significant intrinsic motivation, able to decrease the level of doubt inherent in novelty. Indeed, under-used innovation requires lead users to reduce risk aversion and diffuse information on the characteristics of the good or service. However, as specific actors

who have vested interests, their enrolment is not neutral. Indeed, “lead users” are far in advance of the general market and they expect direct personal benefit from the innovation are positioned to benefit significantly by obtaining a solution to those needs” [von Hippel, E. 1986: p. 796]. Consequently they can orient technical solutions according to their specific and personal needs which may be in harmony with or detrimental to consumers’ requirements. For instance, leads users in France and China may support different visions of the product and may push their design towards some technological trajectories that are decisive for design, perception, etc. For this reason, in the context of biking, [von Hippel, E. 2005: p. 957] notes that: “*users developing innovations reported that they gained a high personal benefit from using their innovations in their own mountain biking activities*”. If lead users anticipate large benefits from a solution that fits their specific and local needs, producers may be trapped by these needs into supplying niches thus impeding the wider diffusion of eco-innovation. In short, lead users are decisive actors that can constrain the development of the product according their own vision of eco-innovation. Thus they may create potential snob effects rather than the bandwagons effects needed for broader diffusion.

2.3. Users, institutions and beyond

User practices appear to be critical for eco-innovation especially in the emerging market phase when an understanding of users’ needs is required to shape the future product or service. Users are rarely isolated; their needs are intertwined within institutions, business strategies, technologies, and ecosystems. These factors coevolve to produce a model for eco-innovation, defining its boundaries and content. For instance, regulation such as the maximum speed authorized for e-bikes (between 20km/h and 26km/h) may have a critical impact on business strategies and the path of

this eco-innovation because users in China could switch to another option such as scooters or some other two wheeled vehicle. Institutions can both constrain and enable human interactions. Nelson [Nelson R.R., 2005] defines institutions as ‘social technologies’, i.e. ways of structuring and organizing human interactions. In this perspective, institutions express socially acceptable ways of acting, and enable behavior by providing social contexts for acting which do not need to be continuously negotiated. Foxon [2011] argues-after Beinhocker [2006]- that *“the coevolution of physical technologies, social technologies and business plans has driven the creation of wealth in Western industrialized countries, crucially through the development of property-right based market economies which encourage the innovation of physical and social technologies for more efficiently and effectively meeting (and creating) consumer demands”* [Foxon, T. 2011, p. 2261].

Coevolution is defined by Murmann [Murmann, J.P. 2003: p.22] as a process of causal and cumulative influence that has an impact on the final system, i.e.” *two evolving populations coevolve if and only if they both have a significant causal impact on each other’s ability to persist”*. This societal embedding is reflected in the capacity of the institutional framework to influence user practices relating to the use of the new technology but also, more generally, the ability of each NSI to define key technological trajectories that have an impact on business strategies. E-bike products and services are linked to position of e- mobility in the NSI which delineates the interactions between vehicles and energy systems, and the interface between the production of innovative electric vehicles and urban mobility planning [Altenburg T. et al., 2012]. The coevolution of these various systems is summarized in Figure 1.

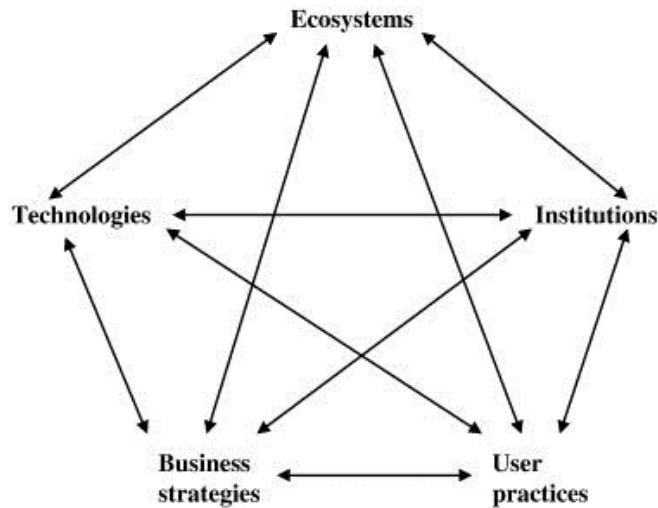


Figure 1: Eco-innovations in a coevolutionary framework adapted from Foxon [2011: p.2262]

In this perspective, France and China have some similarities related to spurring increasing returns from adoption of e-vehicles; both have created large public-private partnerships to promote their e-mobility innovation policies: “*the distinctive feature of the French strategy for electric vehicles is the key role of the state and national programmes. The orientations and selected players are defined by administration*” [OECD, 2011, p.208]. China’s strategy related to e-vehicles seems to be in the direction of developing indigenous technology. However both countries have in common long term government involvement to promote battery technology and lower battery costs in order to achieve mass production and lower overall costs. China has a much larger market than France which has shaped its user practices and technologies. Indeed “*China has the largest market for e-bikes in the world. This market is supplied by Chinese firms based on mainly indigenous technology. It also accustomed Chinese*

consumers of the idea of e-mobility" [Altenburg T. et al., 2012, p. 11]. We study this divergence at the macro level to observe how institutions shape business strategies and user practices, and at the meso level to show how two firms, in France and China, coevolved according to various causal influences.

SECTION 3. USERS PRACTICES AND INSTITUTIONS AS SEEDS FOR ECO-INNOVATIONS

3.1. E-bike market in China and France

The institutional contexts for the development of e-bikes in China and France are completely different. Perception and use of e-bikes rely on historical attitudes to bicycling. China is the largest producer and the largest consumer of bicycles in the world. But the adoption of bicycles has followed different development trajectories. The rapid growth in use of bicycles occurred during the Maoist period, and increased with improvements in living conditions. This growth was disrupted during the 1990s when use of automobiles increased [Allaire, G., 2007] In the 2000s, the increased automobile traffic in big cities, and congestions problems, have promoted renewed interest in bicycles and opened opportunities for e-bikes in various provinces and cities. In 1998, 40,000 e-bikes were sold in China, this rose to 10 million in 2005 with the number of users calculated as 22 million (with 1 million in Shanghai alone). In 2011, the size of the e-bike market in China was predicted to be 23 million compared to Europe at 1.35million [Presto report, 2010].

During the 1990s, e-bikes were promoted as a clean and cheap mode of transportation by China's local governments in a bid to reduce congestion in its urban areas. The price of e-bikes is much lower and more affordable than the price of a car, and the

speed that can be achieved by an e-bike is much faster than that of an ordinary bicycle. Thus e-bikes were welcomed by rural-urban immigrants and citizens and gained an increasing share of two-wheeled transportation in China. In some cities, such as Chengdu and Suzhou, e-bikes have even exceeded the share of traditional bicycles [Weinert et al, 2007]. The national standard for e-bikes was enforced in 1999. Approved in 2004, the Road Transportation Safety Law describes e-bikes as non-motorized vehicle, giving their riders the same rights as bicyclists [Weinert et al, 2007]. However, in practice this law is applied differently according to the regulations applying to individual cities, and the willingness to promote (or not) this type of transport. Beijing's local government does not support this eco-innovation while Shanghai and Chengdu are pro-e-bikes.

E-bikes call into two categories: scooter style electric bikes and bicycles style electric bikes. The latter use smaller batteries and have lower powered motors, can achieve speeds of 30km/h on average, and weigh between 40kg and 60kg [Cherry and Cervero, 2007]. Where e-bikes and traditional bikes use the same cycle lanes, safety is an important issues for e-bike growth. They are much faster but make no sound. In China, many e-bikes and e-scooters can achieve top speeds of around 50km/h and can carry heavy loads. This has led many to associate the e-bike with accidents, crime (theft of both bikes and batteries), and even congestion. Some local regulations prohibit e-bikes or regulate their specification in their cities; e.g. Beijing in 2002, Fuzhou, Shenzhen, and Guangzhou. The recycling of batteries is also a barrier to the development of e-bikes in China. Speed is a focus of new Chinese regulation¹ on e-bike currently being discussed.

¹ The regulation was due to be published in 2010 but has been postponed. The key change in this regulation is to limit e-bikes to a maximum speed of 20km/h and maximum weight of 40kg. E-bikes exceeding these limits will be reclassified as e-motorcycles and will require a driving license.

In France, the development of e-bikes is in its infancy and the technology is not well diffused. France has limited development of this eco- innovation with only 47,000 e-bikes sold in 2012, compared to sales in the Netherlands of 300,000 in the same period [Figaro Le, 2013]. However the rate of growth of this novelty has been significant in France at more than 20% per year since 2005.

Traditional bicycles have been used for leisure activities in France since the Second World War. Bicycles were considered to be exclusive to weekend and sport activities. However, there has been a shift to their use in cities and municipalities have introduced policies to promote the reintroduction of bicycles in city centers. Along with production firms they have been the key actors in the new vision of transport and provision of rental systems such as '*velo bleu*' in Paris and Nice and '*Velos v*' in Lyon [Bouf and Hensher, 2007]. Municipalities have been decisive also in providing bike lanes to protect cyclists (especially important in Paris) and promoting new kinds of bicycles (traditional or e-bikes). '*Velo v*' in Lyon exemplifies this scheme for renting bikes inside cities and promoting new transport services based around cars and bikes. In line with this 'green policy', habits and practices are changing and use of e-bikes in cities is receiving more interest. Employers and municipalities are promoting their use e.g. in Sceaux near Paris and in Monaco and the South of France). Experience is confined mostly to small communities of users and lead users. Despite some interest from users, and the incentives provided by some municipalities, take-off of e-bikes is confined to specific uses. Table 1 compares the development of e-bikes in China and France.

Table 1 Triggers and Enablers for the Development of E-bikes in China and France

Seeds and pillars for eco innovation	China	France
Technological side (functionalities emphasized by producers)	Speed; Battery for long distance riding; Competition with cars in some cities; Heavy goods carrying ability	Enabling the traditional virtue of biking; Sport and commuting activities; Transport in large cities; Business model for producers oscillates between goods and services; Sophisticated products and technologies
Demand side (values and preferences asked by users and demand)	Large demand; Values and preferences: safety, speed, cost; Battery recharge	E-bikers are highly motivated as a new visions of transports; Small communities of users largely dependent of municipalities facilities; Values: sport and transport in cities; No dominant design, various ways of charging
Regulatory side	Coexistence between traditional bikes and e-bikes has to be clarified; Ban or not in local cities	No clear regulation except the need of decreasing traffic in large cities
Macro- economic landscape	Long tradition of biking; New regulation if forced, new	Need to decrease the use of cars in cities may triggers e-bikes;

	definition of the market; New regulation on battery	More infrastructures for biking
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Source: our research

3.2 Research methods

Case study is considered a suitable methodology for explorative and comparative research [Yin, R. 1984]. Our aim is to conduct an in-depth investigation and comparison of the role of users in the eco-innovation industries in China and France. A case study provides an in-depth understanding of a specific context. The case of e-bikes was selected, first, the cases illustrate the business strategies related to eco-mobility. Second, e-vehicles and thus e-bikes are embedded in the NSI and promote developments related to batteries and infrastructures. Third, user practices shaped by social technologies are decisive for the industry dynamics. Our cases are two producers of e-bikes, Lvyuan in China and CEP in France, which are used to explain the development of e-bikes in these countries, and contribute to a framework for studying ecological innovations. The data were collected during site visits, from semi-structured interviews, and in informal meetings with company managers and CEOs. Secondary information sources include annual reports, press releases, presentations to customers and stakeholders, media material, etc.

3.3. Two contrasting paths for e-bikes: co-evolution of users and institutions for shaping e-bike opportunities

Despite quite divergent trends related to market size and diffusion of e-bikes, France and China share similar policy making to promote coordinated investments at central

and regional levels. State intervention includes subsidies for the diffusion of e-vehicles and provision of infrastructures [Altenburg T. et al., 2012]. China has clear economies of scale advantage and benefits from complementarities between e-vehicles and e-bikes. In France, the complementarity between e-vehicles and e-bikes is less significant with the result that policy is promoting e-bikes at the regional level but is not being accompanied by local infrastructure initiatives.

Lvyuan

Lvyuan (meaning 'green energy' in Chinese) is one of the oldest and strongest competitors in the Chinese e-bike market. In 1996, Mr. Jie NI recognized e-bikes could be a potentially profitable market after visiting an institute in Beijing that was working on electric vehicles; he founded Lvyuan in 1997 in Jinhua, Zhejiang Province on China's east coast. In 2012, Lvyuan had six manufacturing bases in China employing more than 4,000, offering a range of e-transport, from scooters to bikes, and producing over 300 parts and accessories for the Chinese market for distribution via individuals or agencies. Lvyuan has the capacity for annual production of 3 million e-bikes in over 300 models, and 5 million batteries for e-bikes. The company's innovation system is based on several R&D centers in its headquarters, the Fuzhou subsidiary, and other bases. Lvyuan conducts research on electric motors, paints, batteries, etc. Up to March 2011, the firm had 70 Chinese patents and 29 patent applications. In order to improve the quality of its process line, the firm operates also a Just-In-Time system, and uses robots on the production line. Lvyuan publishes technical information manuals as part of its effort to diffuse professional information on e-bikes and to train its employees. The firm has participated in professional committees to formulate a set of e-bike product standards and regulations

for the manufacture and use of e-bikes in China [Tyfiled et al., 2010] and has experienced strong and stable growth since 2001. The brand 'Lvyuan' is recognized as a famous Zhejiang brand which was in the top 500 Chinese brands in 2007, and one of the most reliable low carbon brands in 2010. The firm is in the list of the top 50 'fastest-growing' companies published by *Fast Company* magazine in 2007 and was awarded the 'SEE-TNC Enterprise Ecology Award'.² Lvyuan's business strategy includes competing in the electric car industry based on its experience and technology in batteries and e-bikes and it has entered a partnership with Beijing University for battery development.

CEP

Clean Energy Planet or CEP, is an innovative French company committed to sustainable mobility and specialized in the development and implementation of charging stations for e-bikes. This innovative small firm was founded in 2006 and is located in Sophia-Antipolis in the South of France, and is the French leader in two-wheeled electric vehicles. In 2007, CEP set up a resellers' network and implemented the first fleets of e-bikes for self-service use in Monaco. In 2008 the company introduced the first electric docking station at the Sophia-Antipolis Technology Park. Currently the firm has more than 15 docking stations located mostly in the South of France, Paris, and Monaco. CEP has forged partnerships with leading technological firms to share knowledge for the development and industrialization of its products. CEP is an active member of several associations keen on electric transport developments (e.g. AVEM: Association for the Future of the Mediterranean Battery-driven vehicle). These partnerships are critical for actors in the field of electric

² Data and information available at the official website of Lvyuan (in Chinese) :<http://www.lvyuan.cn/page.php?mod=introduction>, accessed 2013-02-12.

mobility such as manufacturers of electric vehicles, providers of services and electrical energy (batteries, loading systems...), operators of mobility (suppliers of public transports, car sharing, renters, taxis...) and public institutions (universities, associations, municipalities...). CEP's business strategy relies on the open model described in Chesbrough [2003] which includes key technological partnerships and protection of core competencies via patents. Balancing internal and external activities is critical for innovative firms [Berchicci, L., 2013] and is particularly important in emerging markets such as e-bikes. CEP's strategy also includes interactions with users related to customized docking stations according to specific needs, and for obtaining tacit knowledge for the development of future generations of e-bikes. Thus, its business strategy is co-shaped by permanent feedback from users and lead users used to design new products and to leapfrog technologies for integration in future production.

CEP's innovation capacity has been recognized and it has received several national prizes in France for innovation and ecological innovation in particular, and has technology patents in the areas of securing and charging e-bikes. It has several patents in a system for recharging and automatic locking by electrically assisted jacks on the front wheels of bikes. CEP's users are private and public organizations and schools keen to reduce CO₂ emissions and to improve transport for their inhabitants. Most recharging stations are bought by municipalities or firms for either private or public use in particular areas (e.g. for municipal workers).

In 2012, CEP entered in collaboration with Peugeot Scooters to launch a charging station for bikes and scooters. Customers can now choose to use a scooter or an e-bike. Table 2 compares the business strategies of Lvyuan and CEP.

Table 2: Comparison between business strategies in two institutional contexts

Comparative Items	Lvyuan (China)	CEP (France)
Firm's foundation and technological alliances	1997 Strong partnerships with Universities or research institute	2006 Collaborative agreements with suppliers and others private firms
Location	Jinhua, China	Sophia Antipolis, France
Market Demand	A normal transportation method	Sport or a new vision of transportation Sophisticated product and service
Customers	Individual customers	Organizations such as firms, schools or municipalities
Providing Service	Thousands agencies in 29 provinces in China Fleet of bikes but no services concerning e-bikes Product or services of bikes but no renting of e-bikes	Fifteen docking stations in France and Monaco E-bikes with charging station or fleet of e-bikes to rent Product or services

Source: our research

SECTION 4. DISCUSSIONS

Based on the cases of Lvyuan and CEP, in this section we discuss the role of users in the adoption and diffusion of eco-innovation, and in companies' competition strategies.

4.1. Role of users in the adoption and diffusion of eco-innovation

We use the cases of Lvyuan and CEP to describe the adoption and diffusion of an eco-innovation. The technological dimension is critical to both Lvyuan's and CEP's development. For instance, CEP's patented technology has made the company the main actor in electric mobility in France. Similarly, the patents filed by Lvyuan reinforce its place as leader in the Chinese e-bike market. However this technological input is only one facet of the process, namely the technology push dimension. There are other important factors such as the role played by context (regulatory side) and users (market side) in the development and acceptance of the product. Users play an important role in the development, adoption and diffusion of eco-innovation products, e.g. e-bikes.

Concerning the market side, there is growing interest among consumers in China and France for more environmentally-friendly products. Both individuals and groups in France are worried about the damage to the environment and are trying to change their ways of consuming [Belin J. et al, 2013]. Transport is at the center of these efforts which has provided a window of opportunity especially for biking and e-mobility. Thus, e-bikes benefit from positive social norms [Veblen T. , 1994, 1899] which may create externalities in the future and potential bandwagon effects especially in France where electric vehicles leave a smaller carbon footprint than nuclear energy [Altenburg T. et al., 2012].

In the Chinese case, the success of Lvyuan mirrors the widespread growth of e-bikes in this country as an important alternative to classical vehicles such as automobiles. Since end November 2008, Lvyuan has emphasized the ecological benefits of e-bikes and e-scooters and their contribution to climate change. The authorities assume that in the near future, the ecological benefits of e-bikes will emerge in the market, especially in cities where there is serious air pollution (e.g. in January 2013 in Beijing). In addition, e-bikes are seen as a solution to traffic congestion in Chinese cities. Despite the effective presence of increasing returns from adoption in China in contrast to France, the local authorities continue to advertise these products heavily. The recent promotion of e-bikes by the Chinese Minister of Technology Wang Gang during President Obama's visit to China in 2009, shows how much local governments concentrate on may create events by acting on the increasing returns of information and by trying to enroll laggards (Presto, 2010).

The cases of CEP and Lvyuan show that users are sources of product/technology innovations and development of eco-innovation products in line with theories of user innovation [von Hippel, E. 1986, 2005]. For example, lead users in Monaco have pushed the design of e-bikes along a specific luxury goods and services trajectory. These lead users, who were very active in the earlier stages of development, have influenced e-bike design and promoted establishment of docking stations as sophisticated and secure commodities. For this reason, CEP's products and services remain relatively costly confining their development to small niches such as municipalities, business schools, and luxury hotels, hampering the wider diffusion of eco-innovation. CEP customers are mostly private or public organizations that decide to install charging stations in order to improve transport for their local inhabitants and

workers. E-bikes developed by CEP can be locked and recharged in one step. This very simple use and practice was a specific requirement of CEP's lead users. This concept is unique in offering protection against theft thanks to the drive cylinders, enabling automatic charging when the bicycle is locked on the docking point, and adaptation of to any electric bicycle model. The hiring stations function as follow: users who want to hire an e-bike must present their customer card to a card reader. The bike is then released, and can be returned to any hiring station, where it placed on a vacant stand where it is locked and recharged. Note that in some areas, the same card provides access to bus, electric car-sharing, and electric cycle transport. The combination of design and high technology creates novelty for CEP e-bikes and new inter modality. Each fleet of e-bikes is designed to provide the best 'local' solution for the customer. The docking in Monaco can be moved (thus, accommodating to the Formula One Monaco Grand Prix held every May). Thus, the users are the source of technological improvements In France, price is a problem for CEP and other e-bikes companies because the size of the market precludes them from being cheap, and the combination of a small market and new technology developments increases their costs impeding the creation of increasing returns from adoption and economies of scale [Figaro Le, 2013]. The sophistication of its product may confine CEP to a niche strategy and potential snob effects rather than the bandwagons effects required for large adoption.

Unlike the case of CEP, Lvyuan's customers are individuals rather than organizations. Therefore, it is not easy to find lead users in the market. Lvyuan defines the market according to user types - ladies, rural-urban immigrants, etc.. For example, Lvyuan develops types of e-bikes for rural-urban immigrants to carry heavy goods, and types

of e-bikes that can carry small packages for express couriers. In order to attract ladies, Lvyuan has introduced smaller e-bikes painted in bright colors and attractive patterns. Although the e-bike target markets of Lvyuan and CEP differ, the latter's designs for niche markets within their market confirms von Hippel's [2005] theory of using tacit and local consumer knowledge in the design of eco-products.

4.2. Role of users in the companies' strategies

The growth of Lvyuan and CEP reveals that users have had an impact not only on the development, adoption, and diffusion of new eco-innovation products but also on these companies' strategies. Lvyuan's strategy is aimed at individual users, for example. Lvyuan's lead users might seem difficult to identify compared to CEP's. The companies apply different user innovation strategies. For instance, Lvyuan has set up agencies and distributors around China that provide comprehensive after-sales services including maintenance, inspection, repair, and 24-hour telephone customer service, as well as roadside assistance and home repair.³ In addition, Lvyuan advertises in the media.

In contrast, CEP provides a customized service. It is not confined to development of classic eco-innovation goods such as e-bikes; much of its added value comes from the design of services related to renting bikes. For example, CEP offers automated collection and return of bikes by means of a RFID tag or swipe card. The interface is available in several languages (and use of extranet to manage the fleet remotely). The extranet allows private or public customers to obtain comprehensive monitoring and analysis of their fleet to observe its routes and history. It provides statistics related to

³ Information available from the official website of Lvyuan (in Chinese): <http://www.lvyuan.cn/page.php?mod=introduction>, accessed 2013-02-12.

use of the bikes and status of each docking point allowing the company to adjust to users' needs. As already noted, CEP not only develops products it also provides services (e.g. extranet) that clearly respond to demand. Users obtain huge benefits from a customized solution which also acts as input to future designs and sophisticated products. In line with von Hippel [2005] eco-innovation in the CEP case is triggered by recurrent and repeated personal experience that allows the accumulation of local knowledge for the design of future products.

Users of e-bikes in China enjoy their speed and weight bearing capacity. However, their speed is becoming one of the main causes of traffic accidents and some cities are banning e-bikes. There is also a central government law that limits e-bikes to a maximum speed of 20km/h and classifies e-bikes exceeding these speeds as e-motorcycles, which is introducing uncertainty among users about driving license requirements. Regulation announced in 2009 supposed to come into force in 2010, has so far not been implemented opening a window of opportunity for this eco-innovation at a new authorized speed of 26km/h. To anticipate future problems related to speed, Lvyuan has developed new technology to restrict the maximum the speed, improve the safety of e-bike transport, and reduce the possibility of illegal reequipping of e-bikes [Tyfield, D. et al., 2010]. Lvyuan publishes manuals on e-bike standards, and the environmental benefits of e-bikes, and is developing new products for new niche markets, such as e-patrols the local police; it has plans to develop electric cars. It would seem that user behavior can be a barrier to company development, as well as the source of eco-innovation and influence on strategy.

SECTION 5. CONCLUSIONS

This paper examined the role of users in the development and diffusion of eco-innovation and firms' eco-innovation strategies, comparing the cases of Lvyuan and CEP. Our cases show that diffusion of eco-innovation in China and France is strongly linked to the context and specific needs of consumers. Market expansion is based on expanding niche markets rather than band wagon effects. To benefit innovative firms such as Lvyuan and CEP have to cope with sticky local information [von Hippel, E., 2005]. This implies that new product development will rely on the needs of local users which are strong linked to the use environment. This study indicates that it is crucial to involve users during the development and diffusion of eco-innovation in order to match market demand and increase profit and competitiveness in niche markets. It has revealed also that government should consider context, uses, and practices when formulating regulation. The behavior of users can be a barrier to developments (e.g. un-enforced regulation in China) and a driver of eco-innovation. Companies should consider the impact on users of their eco-innovation strategies.

Different people have different practices and the interplay with users is essential for a nascent technology to mature. Thus "lead users" who are quick to adopt a new technology (i.e. who look for novelty), are important. As shown in Buenstorf and Cordes [2008], social groups play an important role in introducing change given the tendency for imitation of prestigious individuals. Policy-makers should take account of the role of these groups which create favorable conditions for the emergence of new niches and may facilitate the transition to new eco-innovations. In this context, policy-makers should create conditions that favor the emergence of lead users because

these highly, intrinsically motivated individuals can play a decisive role in technological development. Public authorities also play a part in modifying intrinsic and extrinsic motivations through the development of large and visible public investments that may instill new values in social groups [Maréchal K. and Lazaric, N. 2010]. The use of only two comparative cases limits this research. Future work should include more cases, and more field work to test the framework proposed in this paper.

References:

Allaire, J. [2007], « L’histoire de la petite reine dans l’empire du milieu », *Transports*, vol. 52, n° 442, p. 77-86.

Altenburg, T., Bhasin, S., Fischer D. [2012], « Sustainability-oriented innovation in the automobile industry: advancing electromobility in China, France, Germany and India », *Industry and Development*, vol. 2, n° 1, p. 67-85.

Arthur, B. [1989], « Competing technologies, Increasing Returns and Lock in by Historical Events », *Economic Journal*, vol. 99, March, p. 116-131.

Bamberg, S., Moser, G. [2007], « Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour », *Journal of Environmental Psychology*, vol. 27, n° 1, p. 14-25.

Beinhocker, E. [2006], *The Origin of Wealth: Evolution, Complexity and the Radical Remaking of Economics*, Random House, London.

Belin, J., Lazaric, N., Douai, A., Lavaud, S., Le Guel, F., Oltra, V. [2013], « Imitation and social norms in sustainable consumption: Theory and evidence from consumer’s green behaviour in France », *Paper presented at the EAEPE conference Paris, 7-9 November*.

Berchicci, L. [2013], « Towards an open R&D system: internal R&D investment, external knowledge acquisition and innovative performance », *Research Policy*, vol. 42, n° 1, p. 117-127.

Bergh (van den), J.C.J.M. [2008], « Environmental regulation of households: an empirical review of economic and psychological factors », *Ecological Economics*, vol. 66, p. 559-574.

Bergh (van den), J.C.J.M., Truffer, B., Kallis, G. [2011], « Environmental innovation and societal transitions: Introduction and overview », *Environmental Innovation and Societal Transitions*, vol. 1, p. 1-23.

Bouf, D., Hensher, D.A. [2007], « The dark side of making transit irresistible: The example of France », *Transport Policy*, vol. 14, n° 6, p. 523-532.

Buensdorf, G., Cordes, C. [2008], « Can sustainable consumption be learned? A model of cultural evolution », *Ecological Economics*, vol. 67, n° 4, p. 646-657.

Cherry, C., Cervero, R. [2007], « Use Characteristics and mode Choice behavior of electric bike users in China », *Transport Policy*, vol. 14, n° 6, p. 247 -257.

Chesbrough, H. [2003], *Open Innovation – The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston.

Duesenberry, J.S. [1949], *Income Saving and the theory of consumer Behaviour*, Cambridge University Press, London

Foxon, T.J. [2011], « A coevolutionary framework for analysing a transition to a sustainable low carbon economy », *Ecological Economics*, vol. 70, n° 12, p. 2258-2267.

Franke, N., von Hippel, E., Schreier, M. [2006], « Finding Commercially Attractive User Innovations: A Test of Lead-User Theory », *Journal of Product Innovation Management*, vol. 23, n° 4, p. 301-315.

Katz, M.L., Shapiro, C. [1985], « Network Externalities, Competition, and Compatibility », *The American Economic Review*, vol. 75, n° 3, p 424-440.

Kemp, R., Pearson, P. [2007], « Final report: MEI project about measuring eco-innovation », *Measuring Eco-Innovation (MEI)*, Project n°044513.

Hippel (von), E. [1986], « Lead Users: A Source of Novel Product Concepts », *Management Science*, vol. 32, n° 7, p. 791-805.

Hippel (von), E. [2005], « User-innovators and “local” information: the case of mountain biking », *Research Policy*, vol. 34, p. 951-965.

Jorgenson, D., Goettle, R., Sing Hoc, M., Wilcoxon, P. [2009], « Cap and trade climate policy and U.S. economic adjustments ». *Journal of Policy Modeling*, vol. 31, p. 362–381.

Leibenstein, H. [1950], « Bandwagon, Snob, and Veblen Effects in the Theory of Consumers' Demand », *Quarterly Journal of Economics*, vol. 64, n° 2, p. 183-207.

Maréchal, K., Lazaric, N. [2010], « Overcoming inertia: insights from evolutionary economics into improved energy and climate policies », *Climate Policy*, vol. 10, n° 1, p. 103-119.

Murmann, J.P. [2003], *Knowledge and Competitive Advantage: The Coevolution of Firms*, Cambridge University Press, Cambridge, MA.

Nelson, R. [2005], *Technology, Institutions and Economic Growth*, Harvard University Press, Harvard, MA.

OECD [2011], *Better policies to support eco-innovation*. OECD Studies on Environmental Innovation, OECD Publishing.

Popp, D. [2001], « The effect of new technology on energy consumption », *Resource and Energy Economics*, vol. 23, p. 215–239.

Presto report, [2010], « Presto Cycling Policy Guide. Electric Bicycles », *Report from The Intelligent Energy*, EACI European Programme.

Rennings, K. [2000], « Redefining innovation: Eco-innovation research and the contribution from ecological economics », *Ecological Economics*, vol. 32, p. 319-332.

Rogers, E.M. [1962], *Diffusion of Innovations*, Glencoe, Free Press.

Trigg, A. [2001], « Veblen, Bourdieu and Conspicuous Consumption », *Journal of Economic Issues*, 35: 99 -115.

Tyfield, D., Jin, J., Rooker, T. [2010], *Game Changing China: Lessons from China about Disruptive Low Carbon Innovation*, NESTA, London.

Unruh, G. [2000], « Understanding carbon lock-in », *Energy Policy*, vol. 28, p. 817-830.

Veblen, T. [1994, 1899], *The Theory of the Leisure Class*, Macmillan, New York.

Weinert, J., Ma, C., Cherry, C. [2007], « The transition to electric bikes in China: history and key reasons for rapid growth », *Transportation*, vol. 34, p. 301-318.

Witt, U. [2001], « Can Sustainable Consumption Be Learned », *Journal of Evolutionary Economics*, vol. 11, p. 23-36.

Woersdorfer, J.S., Kaus, W. [2011], « Will imitators follow pioneer consumers in the adoption of solar thermal systems? Empirical evidence for North-West Germany », *Ecological Economics*, vol. 70, n° 12, p. 2282-2291.

Yin, R. [1984], *Case study research: Design and methods* (1st ed.), Sage Publishing, Beverly Hills, CA.