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## **Sustainable Innovation:**

### **From Policy Intervention to Stakeholder Coalition**

#### **ABSTRACT**

In this paper I compare two alternative models of innovation. One focuses on technological innovation and the other on sustainable innovation. In the automotive industry, technological innovation to reduce CO<sub>2</sub> emissions has been primarily driven by policy interventions as exogenous forces. An alternative approach to innovation to reduce CO<sub>2</sub> emissions and urban congestion is taking place in the transport sector. This kind of sustainable innovation is motivated by stakeholder coalition and sustainable entrepreneurship, which are a combination of both exogenous and endogenous forces to firms' innovation. Considering the relative efficiency of innovation development by product producers vs. product users (Hienerth, von Hippel and Jensen, 2014), I contend that stakeholder-coalition model is more effective and efficient than policy-intervention model in stimulating firms' technological innovation. I use both model delineation and preliminary data analysis to support my propositions.

Keywords: sustainable innovation, sectoral system of innovation, intermediate user-led innovation, policy intervention, stakeholder coalition

## **Introduction**

...starting to converge into...a new worldview, shared by leading executives and investors and shaped by an unlikely alliance of customers, employees, campaigners, academics and regulators...based on the watchwords of purpose, inclusion and sustainability.

Andrew Edgecliffe-Johnson, FT's US business editor

January 4, 2019

Our business world is changing and therefore the management of our organisations needs changing accordingly. As clearly stated in this year's All-Academy Theme "Inclusive organizations are open systems of opportunity in which all stakeholders have access to information, resources, and the capacity to fully contribute to their functioning" (Roberson, AOM AAT). It is towards building such inclusive organisations that I attempt in this paper to compare two innovation models aiming to achieve sustainable mobility in the global transport sector. My focus is on two types of innovation representing two approaches to innovation management. One is technological innovation and the other sustainable innovation, defined broadly as any innovation for sustainability. In the automotive industry, vehicle producers' technological innovation in low-carbon propulsion technologies to reduce CO<sub>2</sub> emissions has been primarily driven by policy interventions, which are regarded as exogenous forces to firms' innovation. In recent years an alternative approach to innovation to reduce CO<sub>2</sub> emissions and urban congestion is taking place in the transport sector. Leading this approach to innovation development are not large vehicle producers, but intermediate users of vehicles for delivering goods or providing services to end users. This kind of innovation to achieve sustainable mobility at the sectoral level is motivated by stakeholder coalitions, which are a combination of both exogenous and endogenous forces to the intermediate users' innovation.

Considering the relative efficiency of innovation development by product producers vs. product users (Hienerth, von Hippel and Jensen, 2014), I contend that stakeholder-coalition model is more efficient than policy-intervention model in stimulating vehicle producers' technological innovation. Further, the stakeholder-coalition model is more effective than the policy-intervention model in inducing changes in vehicle producers' innovation strategy to align their corporate responsibility with the articulated strategic purpose. I use both model delineation and preliminary data analysis to support my propositions.

The paper is organised as follows. After introducing the context and motivation of this paper, I will use the extent review of the literature streams on technological innovations and policy interventions, climate change and vehicular CO<sub>2</sub> emissions to delineate a technological innovation model moderated by policy intervention in the next section. This is followed by another extent review of the literature streams of intermediate user-led innovation, sectoral system of innovation, and sustainable entrepreneurship in the transport sector to depict a sustainable innovation model driven by a coalition force. In the first part of the model development I rely on secondary data to support my arguments. The second model of sustainable innovation model is inspired by the insights drawn from my recent research projects on sustainable mobility. This work is at its early stage and ongoing, there I can only present some preliminary findings from research notes without systematic analysis of the primary data. The two research projects are examining new approach to innovation on sustainable mobility by two sustainable entrepreneurial firms in England, Logico and Shareco. In conclusion I will discuss the findings and implications for future research.

## **Technological innovation and policy intervention**

### *Locus of Innovation*

Innovation and entrepreneurship are regarded as the engine of economic growth and development (Dosi, 1988; Nelson and Winter, 1982; Schumpeter, 1934). Until recently manufacturing in developed economies has been “rooted in technological innovation” (Spring et al., 2017: 6). Manufacturing companies in the automotive industry have invested in both product innovation to sustain market competition and in process innovation to improve operational efficiency and product quality (Clark and Fujimoto, 1991; Womack et al., 1990). In the field of operations management, innovation development is linked with manufacturing strategy (Spring et al., 2017; Skinner, 1969). Spring et al. (2017) argue that the intensified competition by manufacturing companies from developing economies, in particular from Japan in the 1970s and 1980s, caused changes in policy and strategy in the US and UK. Manufacturing companies followed Japanese innovation approaches and invested in process innovation focusing on quality control and waste reduction, of material in terms of Lean principles and of time in terms of JIT (Oehmen and Reberich, 2010; Voss, 2005). This is followed by a strategic move from the 1990s onwards to improve managing resources and capabilities (Barney, 1991; Teece et al., 1997) for knowledge generation, entrepreneurial orientation, and organisational learning, in companies big and small (Grant, 1996; Lumpkin and Dess, 1996; Nonaka, 1994; Zhang et al., 2006). More recently in light of the current debate of corporate responsibility strategy for sustainability, which is derived from the concept of sustainable development as a national development framework, firms start to re-assess their strategic purpose and formulation (Haigh and Hoffman, 2012; Smith et al., 2010), which was “all but irrelevant in the 1980s” according to Spring et al. (2017).

### *Innovation strategy and policy intervention*

Not only do firms regard innovation as a strategic objective to enhance competitiveness, governments also recognise the pivotal role played by innovation for economic development. However, they approach to innovation development differently. In direct response to the exogenous force of market competition, firms' capital investment in resources and capabilities such as R&D expenditure is an endogenous force for innovation development. In contrast, governments apply policy interventions to improve the wider socio-technical system, which in turn indirectly supports the firms to sustain competitiveness (Smith et al., 2010; Spring et al., 2017). Governments can also use policy interventions as regulatory power to change firms' behaviour and strategy if and when the latter's activities create social inequality and environmental pollution (Penna and Geels, 2015; Spring et al., 2017). Penna and Geels (2015) documented detailed changes in firms' innovation strategies and government policies in the US automotive industry during its sustainability transition in the years between 1979 and 2012. They note that the US big three preferred 'self-regulation' to government policy intervention regarding technological innovation in response to climate change and reduction of vehicular emissions. They defended that any change in their core technology, internal combustion engines (ICEs), is risky and costly given the firms' capital-intensive "sunk investments in factories, skills and supply chains" (Penna and Geels, 2015: 1029).

Since the early 1970s US regulators, the Environmental Protection Agency (EPA) in particular, exercised various policy interventions in the automotive industry only to see incremental changes and innovations by the US automakers. In 1955, the Department of Health, Education, and Welfare started to study the impact of air pollution on public health. And it was revealed in 1962 that the automobile engine emissions were the source of more

than 40% of airborne pollutants, making the automobile the largest single contributor to air pollution. In 1963, the US Congress passed the Clean Air Act. Subsequently the Environmental Protection Agency promulgated automotive emission standards to regulate automotive engine fuels and fuel additives.<sup>1</sup> In essence US policy interventions focused primarily on fuel economy, by measuring fuel consumption in unit of miles per gallon (mpg) following the Corporate Average Fuel Economy (CAFE) test procedure. An et al. (2007) report that in the US CAFE standard for passenger cars was set at 27.5mpg in 1985 and has since remained unchanged. Following the principle of public-private partnership (PPP), in 1993 the US government and the big three automakers formed an alliance, Partnership for a New Generation of Vehicles (PNGV), to develop more fuel-efficient vehicles. PNGV's aim was extremely ambitious with a technical target of achieving up to 80 mpg fuel efficiency between 1993 and 2003, almost three times the CAFE standard set in 1985. As a result of changes in political and economic circumstances in the United States, the 300 million US dollars programme failed to complete its term and was terminated in 2001.

Another broad approach to setting vehicle standards is from the European Commission. European policy goals aim to measure the reduction of CO<sub>2</sub> emissions from passenger vehicles in unit of grams of CO<sub>2</sub> equivalent per kilometre (g/km), following the New European Drive Cycle (NEDC) test procedure. The European Commission and members of the European Automotive Manufacturing Association (ACEA) concluded a voluntary agreement on vehicular CO<sub>2</sub> emissions in 1998 and set a target of 140 g/km by 2008. In 2009 a new regulation (EC Regulation No. 443/2009) became effective with a measure of CO<sub>2</sub>

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<sup>1</sup> Source: McGraw-Hill Encyclopaedia of S&T, Vol. 2, 7th ed. *Automobile and Automobile air pollution*.

emissions reduction to 130 g/km by 2015, and 95 g/km by 2020 (Department for Transport, 2014).

Following the influential Stern Review (Stern, 2007) the U.K. government adopted a low-carbon agenda for economic growth and development. The UK government and the automotive industry formed a government-business partnership, similar to the US PPP mentioned above, whilst a New Automotive Innovation Growth Team (NAIGT) was established in 2008 (BERR, 2009). NAIGT envisaged Technology Roadmaps delineating U.K. low-carbon automotive technology innovation paths to 2040 and beyond. NAIGT (ibid.: 90) acknowledged that most vehicles in the U.K. could not meet the EU 2012 regulatory requirement of CO<sub>2</sub> emissions reduction to 130 g/km. Further, they proposed a new method to measure new car registration taking into consideration of the increasing use of alternative fuels.<sup>2</sup> Examining the evolutionary path of innovation in low-carbon automotive technologies, NAIGT compared emerging competing technologies for engine development such as battery-powered electric vehicles (BEVs), fuel cell vehicles (FCVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs) against the conventional dominant Internal combustion engine vehicles (ICEVs).

Banister (2008) notes that in the UK the persuasion and promotion of using public transport, cycling and walking has not achieved the expectant result of reducing car dependence.

Neither has incremental technological innovation in engine development and car design helped to reduce the accumulative CO<sub>2</sub> emissions. This is due in part to the fact that both

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<sup>2</sup> In the U.K. new car registrations are measured using Tank to Wheel assessment of CO<sub>2</sub> emissions over NEDC. The newly proposed method is to measure CO<sub>2</sub> emissions using Well to Wheel assessment by 2020 (BERR, 2009: 48).



travel distances and travel speeds have increased whilst travel time have remained for the most part constant in the cities (ibid.: 73).

Across the OECD, negotiations on flexible mechanisms for emissions reduction became intensified during and after the Kyoto conference in December 1997. In the words of the OECD, “although approximately one-third of all emissions from fossil fuel combustion are attributable to transport activity, OECD countries are struggling to find policies to effectively curb emissions from this sector.” (OECD, 1998: 11)

As a latecomer in mass-production of automotive vehicles, China’s automotive industry developed rapidly since the mid-1990s. In 1995 China produced 1.45 million vehicles in total including only 325,400 cars. In 2009 total output of automotive vehicles reached 13.8 million units taking over both Japan and the US as the largest automotive producing country in the world. China’s vehicle stock grew from 16 million in 2000 to 154 million in 2014. However rapid industrial development has also caused increase in environmental degradation such as air pollution. By 2007 China overtook the U.S. as the world’s largest CO<sub>2</sub> emitting country. Deteriorating air quality in many parts of the country in general, and in big cities in particular, pushed the government to revise their policy interventions and investment priorities. The government issued fuel economy standards in 2004 and revised in 2011 (Beijing Municipal Environmental Protection Bureau, 2014). In 2009, the government invested 5 billion yuan (\$806.5 million) in accelerating the scrappage of old inefficient vehicles. In 2012 the government promulgated the Industry Development Plan for Energy Saving and New Energy Vehicles (NEVs) to promote sales of battery electric vehicles and plug-in hybrid electric vehicles (Chinese State Council, 2012). In 2013 It was reported that China invested 275 billion US dollars over five years with a specific focus on mitigating

smog and stimulating the development of China's low-carbon automotive technologies (The Economist, 2013).

*Vehicular CO<sub>2</sub> emissions and climate change*

Notwithstanding the producers' investment in technological innovation and government policy interventions, at times with huge amount of financial support to the industry, the world witnessed a continuous trend of increase in CO<sub>2</sub> emissions, which largely contribute to climate change. I report the trends of CO<sub>2</sub> emissions, in national total and sectoral share of the transport industry, from 1971 to 2013 in China and the US, the two largest contributors of CO<sub>2</sub> emissions in the world.

-----insert Figure 1 about here-----

As the figure shows US total CO<sub>2</sub> emissions slightly increased from 4356.8 million tonnes in 1971 through 4823.6 million tonnes in 1990 to 5186.2 million tonnes in 2013. In contrast, CO<sub>2</sub> emissions from transport as percentage of total fuel combustion significantly increased from 25.3% in 1971 through 29.7% in 1990 to 33.2% in 2013.

While CO<sub>2</sub> emissions in China registered a very low level of 876.6 million tonnes in 1971, the speed of increase accelerated from the late 1990s till 2006 when China's CO<sub>2</sub> emissions surpassed the US', with a continuous increase to 10249.5 tonnes, accounting for 197.6% of the US figure. This is against the background in which CO<sub>2</sub> emissions from transport as percentage of total fuel combustion account for merely 7.5% in 2006 and 8.4% in 2013.

The newly published Synthesis Report (SYR) on Climate Change by the Intergovernmental Panel on Climate Change (IPCC, 2015) shows that there is increasing scientific evidence of anthropogenic impact on global climate change. Of particular concern are the continued increases of CO<sub>2</sub> emissions and CO<sub>2</sub> concentration in the atmosphere. The magnitude of annual CO<sub>2</sub> emissions was 30.3 gigatonnes in 2010 and the level of CO<sub>2</sub> concentration reached 400 parts per million (ppm) in 2013 (IEA, 2012; IPCC, 2013). Over the period of 23 years between 1990 and 2013 the level of CO<sub>2</sub> concentration rose from 353 ppm to 400 ppm giving it an average annual increase of 2.04 ppm/yr. The IPCC experts estimate with high confidence that about 50 percent of the cumulative CO<sub>2</sub> emissions generated by human activities during the industrial period between 1750 and 2011 occurred in the last 40 years (IPCC, 2015: 45). Indeed, in the last 30 years we have seen marked increase in CO<sub>2</sub> emissions by some leading nations. As the leading industrialised country the US had been the largest CO<sub>2</sub> emission contributor until 2007, overtaken by China.

From the foregoing literature review and discussion, I construct an innovation model delineating the relationship between producers' innovation strategy and government policy interventions as shown in Figure 2 below.

-----insert Figure 2 about here-----

As the model shows, manufacturing producer's innovation strategy is fundamentally rooted in technological innovation, initially aiming to satisfy users' needs. Users in this scenario consist of both end consumer users and intermediate users. When the use of producers' products generates environmental pollution such as CO<sub>2</sub> emissions, government will attempt to regulate the industry with policy interventions. As elaborated above, in market-based

economies, policy interventions are likely to meet resistance from the producers lobbying for voluntary self-regulation. Even when producers and the government agreed to establish a public-private partnership, often the result cannot be satisfactory for various reasons, not least because of the changes in the very policy interventions the government initiated in the first place. As a result, the goals of meeting regulatory standards cannot be achieved within the timeframe, which in turn can be costly for the producers as well as the government.

Following Hienerth et al. (2014) I contend that the relative efficiency of innovation development by the intervention model is low.

*Proposition 1:* Efficiency of innovation development with a focus on technological innovation under policy intervention is low and more likely to cause negative response.

Due largely to producers' innovation strategy which is technology-oriented, the goal of satisfying the end-users is prioritized over the responsibility to meet regulatory standards.

Therefore I have the following two propositions:

*Proposition 2:* Producer's technological innovation is aimed at satisfying end-users' needs which help build positive relationship between the producer and the end-users.

*Proposition 3:* Caused by producer's negative response to policy intervention ( $P_1$ ) producer is reluctant to implement strategies to meet regulatory standards, and therefore results in negative relationship.

To improve innovation development efficiency and foster a positive relationship between partners involved in achieving sustainable mobility, we need to search for alternative innovation models, and it is to this end I will now turn next.

## **Sustainable innovation and stakeholder coalition**

### *Intermediate users and sectoral system of innovation*

Within the literature on innovation, von Hippel's (1986) research sheds light on the contribution by product lead users in the producers' innovation development. He argues that lead users can "serve as a need-forecasting laboratory" (ibid.: 791). Further, Bogers et al. (2010) differentiate users into two groups, one group of end-consumer users and the other intermediate users. They define the former as consumers who use the products to satisfy their personal needs, whereas the latter as business users who use the products as inputs to their own production processes (ibid.: 857). The concept of intermediate users as innovators is pertinent to my research on sustainable mobility but the scope of inference is rather limited. I argue that the literature on sectoral system of innovation will enhance our conceptual development.

Following the research on national systems of innovation (Freeman, 1995; Lundvall, 1992), a number of streams of literature emerged at different analytical levels including sectoral system of innovation (Breschi and Malerba, 1997), regional systems of innovation (Cooke et al., 1998), and technological systems of innovation (Jacobsson and Bergek, 2004). In all systems of innovation at various levels, actors, networks, and institutions are key elements. There are three main elements in sectoral system of innovation: the knowledge base, actors and their networks; and institutions (Malerba, 2004; Smith and Zhang, 2014). The knowledge base and institutions are well covered in the discussion of policy-intervention model of technological innovation in the prior section. More attention and discussion is required on the element of actors in our debate.

Although all actors are regarded as key players for change, the sectoral system of innovation framework does not help identify the initial driver moving the system. Recent research on sustainable entrepreneurship sheds light on this critical issue (Dean and McMullen, 2007; York and Venkataraman, 2010; Zhang, 2018). The process of entrepreneurial discovery (Kirzner, 1997; Shane and Venkataraman, 2000) emphasises three interrelated concepts of the entrepreneurial role, the role of discovery, and rivalrous competition. On the role of entrepreneur, Kirzner notes that entrepreneurs possess natural alertness to possible opportunities. In addition, knowledge or knowledge base is critical during the discovery process (Hayek, 1948). It is the process of entrepreneurial opportunity creation (Aldrich and Fiol, 1994; Sarasvathy, 2001) that sustainable entrepreneurs contribute to creating new knowledge, new businesses and new markets for sustainability-oriented products and services.

As elaborated above, automotive producers' reactive response to government policy interventions and slow progress of innovation development in the market for sustainable mobility products has rendered market opportunities for sustainable entrepreneurs in the transport sector. Pure electric cars designed and arguably mass-produced by Tesla Motors are to cause disruptions to the more conservative automotive industry. Capital investment in Tesla Motors is significant and a 350 million US dollars loan-guarantee was provided to Tesla in 2009 from the Department of Energy. The innovation efficiency debate remain unanswered.

In addition, the anticipated disruptive impact has not been materialised due to a number of reasons, amongst them range anxiety is one. And some initiative solutions have taken place. In the US there were more than 6,000 public charging stations in 2013. In addition, some

private companies provided their employees with free charging spaces (van den Steen, 2015). This change of business model involving various stakeholders, be it public or private, is an innovation in its own right. Furthermore, it is argued that for electric vehicle drivers 'range anxiety' is a barrier of psychological fear rather than a real travel constraint. According to the 2009 data from the US Department of Transportation the average trip was less than 10 miles, with less than 1% of trips exceeding 100 miles (van den Steen, 2015). Therefore changing motorists' behaviour and adopting multimodal transport systems are as important as investing in the development of new technologies to expand the driving range.

In reviewing and researching on sustainable mobility I have been inspired by some new initiatives taken by some unlikely actors and networks of actors in the transport sector. My current ongoing research projects on last mile goods delivery and urban car sharing by two entrepreneurial firms in England, Calmsco and Shareco, shed light on our discussion and can potentially corroborate my theoretical and conceptual development in this paper.

Last mile delivery service is to change the way in which goods are transported. Goods have been hitherto transported using heavy goods vehicles (HGVs) into cities and urban environment, which causes significant level of congestion and air pollution. The design, planning and provision of last mile delivery systems in cities and densely populated areas using alternative modes of transportation such as EVs will help in no small measure reduce congestion and pollution at local and national levels. In a similar vein, vehicle sharing by commuters in urban centres will also achieve the same effect for urban office workers as last mile delivery services do for goods delivery. Logico and Shareco have just started to make such innovative changes in multimodal transport systems and drivers' behaviour.

Preliminary data have shown a clear improvement in the reduction of CO<sub>2</sub> emissions in urban centres as well as traffic congestions. Both companies are small entrepreneurial businesses with passionate leadership for sustainable transport solutions and innovations. Being small in size, as in any small business, the companies face severe challenges of resource constraints. The sustainable entrepreneurs use the knowledge and skills base, accumulated in the sector from the past experience, to augment and develop networks of stakeholders including existing and potential customers, suppliers, and local authorities. As a result, unlikely stakeholder coalitions have been formed, to many parties' surprise including the entrepreneurs themselves. Nonetheless, as low-carbon vehicles require heavy capital investment, both companies are faced with a critical question: How can we grow the economies of scale to become competitive in the emerging market? To help answer this question, I have developed a conceptual framework, a coalition-led intermediate user' innovation model as shown in Figure 3, as Banister (2008: 79) envisaged that car users significantly change their behaviour and a network of stakeholder coalitions develops, including "specialists, researchers, academics, practitioners, policy makers and activists".

-----insert Figure 3 about here-----

In the proposed model, the driving force of the innovation development is the intermediate users of producers' products. This is not because they can become a need-forecasting laboratory as delineated by Borger et al. (2010), but more critically they can help form a stakeholder coalition as an initial force or catalyst, leading to the formation of a sectoral system of innovation.

*Proposition 4:* Intermediate user's innovation strategy aims to create sectoral system of innovation for sustainable mobility by forming a stakeholder coalition.



*Proposition 5:* Stakeholder coalition contribute positively to the sectoral system of innovation due largely to their strategic goal alignment.

The sectoral system of innovation will perform three functions simultaneously: (1) satisfying the end-consumer users' needs; (2) helping the producers to engage in cost-effective innovation development; and (3) ultimately accomplish the transition to sustainability of the sector as a complete system. Therefore,

*Proposition 6:* The sectoral system of innovation satisfy the end-consumer users' needs with value-added cost benefit.

*Proposition 7:* The sectoral system of innovation will help producer's technological innovation development with increased efficacy than in the policy intervention model.

*Proposition 8:* The sectoral system of innovation will help achieve the desired sustainability transition in the transport sector.

We note that in the user-led coalition one missing actors are the vehicle producers and large logistics companies. This is so in this research context because the focus is on small sustainable entrepreneurial firms. And it is revealed that it is one of the great challenges facing the sustainable entrepreneurs to persuade them join the coalition. This is also a future research direction.

If Tesla and other EV automakers can join force to manufacture low-carbon vehicles at a much lower cost for last mile delivery services companies and urban car sharing services

providers to purchase, the 'range anxiety' will be conveniently eliminated. At the same time production costs can also be markedly reduced. By the same token, large logistics companies such as DHL can also contribute to the sectoral system of innovation on sustainable mobility by joining the coalition to help small goods delivery companies to embark on a healthy growth trajectory, which in turn will help the large companies to generate more innovative services through a positive feedback loop.

### **Discussion and contribution**

In this paper I have attempted to compare two alternative models of innovation. In the first part I have elaborated an innovation model with a focus on technological innovation and policy intervention. I conceptualise the model in the context of developing low-carbon propulsion technologies to help reduce CO<sub>2</sub> emissions, which contribute to global climate change. This is an important subject for discussion given the recent conclusion from IPCC's scientific panel that there is increasing scientific evidence of anthropogenic impact on global climate change (IPCC, 2015). Of particular concern are the continued increases of CO<sub>2</sub> emissions and CO<sub>2</sub> concentration in the atmosphere. I have used data from the World Bank and other national and international bodies to show that China and the US are major contributors in this regard and for this reason I have chosen the two countries for comparison in the first part. The US automotive producers are one of the oldest as well as technologically most competitive players in the world. Technological innovation has been the root of their competitiveness. From the 1970s onwards they have been bargaining with the US regulators, represented by the EPA, to reinforce their technological advantages with technological innovation, primarily on fuel efficiency. In so doing they have managed to avoid committing their R&D investment in more radical innovations for the development of low-carbon

propulsion products. Although the relationship between the Big Three and the regulators remain more negative than positive, the resultant innovative products satisfied the end-users in terms of quality, fuel consumption, and driving experience.

In stark contrast, Chinese automotive producers are relatively late-comers in both production and design. Along with its China's rapid economic development since the mid-1990s, its automotive industry grew from producing 1.45 million vehicles in 1995 to becoming the largest automotive producing country in the world with outputs of 13.8 million units in 2009 taking over both Japan and the US. China's vehicle stock grew from 16 million in 2000 to 154 million in 2014. Consequently, rapid industrial development has also caused increase in environmental degradation such as air pollution. Data show that China overtook the U.S. as the world's largest CO<sub>2</sub> emitting country in 2007. Chinese government promulgated policies and standards to regulate the sector's industrial development, in a similar manner of the US policy interventions. In addition, the governments, at both the national and the local levels, invested in technological innovation such as the Industry Development Plan for Energy Saving and New Energy Vehicles (NEVs) to promote sales of battery electric vehicles and plug-in hybrid electric vehicles (Chinese State Council, 2012). It is again not unlike the US approach to technological innovation. Without a new approach to innovation for sustainable mobility, I contend that neither China nor the US will succeed in decarbonisation in the transport sector.

In the second part of my conceptualisation, I have proposed an alternative approach to innovation, which is intermediate user-led coalition model. This approach put the intermediate users at the centre of innovative activities, supported by a stakeholder coalition.

And the coalition is primarily formed by various stakeholders related to an industry sector or a small number of related sectors. The context of this conceptual development is set in the UK as my two research projects involve two sustainable entrepreneurial businesses, Logico and Shareco. Using the two cases I demonstrate the feasibility and applicability of the new approach to achieve the transition to sustainability in the transport sector, not only in the UK, but also replicable to China and the US.

Two limitations are present in this paper. One is that the paper and my research remain still at the early conceptual stage. It is my hope that this paper will generate critical discussion on this important topic with colleagues in the same field and to invite constructive feedback my further conceptual and theoretical development. The other is the national context. In comparison to China and the US, UK is a relatively small country in geographical terms. Applying the innovation model to large cities in China and the US may be problematic without revision and adaptation.

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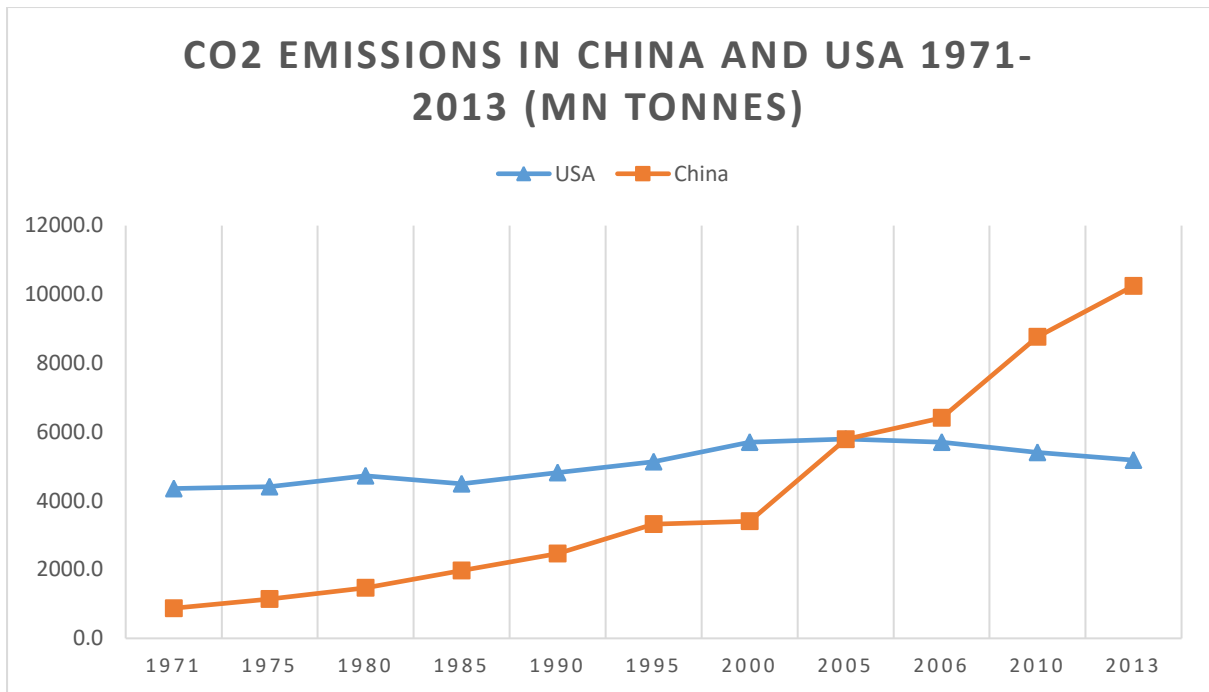
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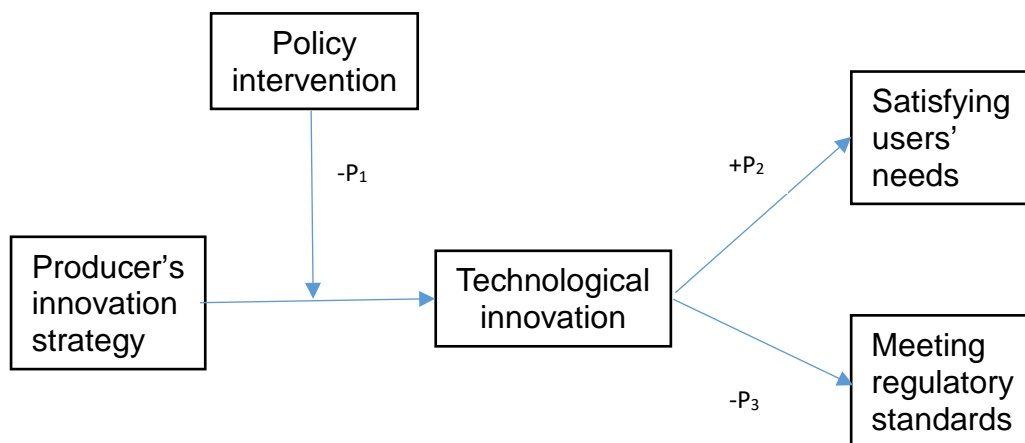
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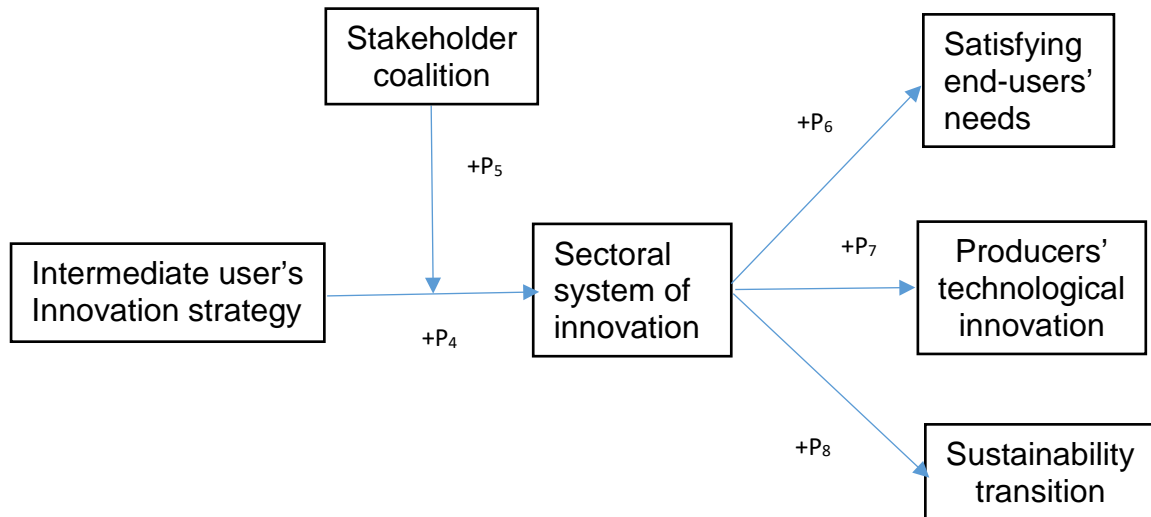
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**Figure 1. CO<sub>2</sub> emissions in China and USA 1971-2013**



**Figure 2. Policy intervention model**



**Figure 3. Intermediate user-led stakeholder coalition model**