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A Missing Link to Sustainable Mobility:

Connecting Public Transportation to Car and Bike Sharing Programs

Best practice examples from Europe and the U.S.

Max Grünig and **Dominic Marcellino**

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Editor: Till Kötter. For questions or comments, contact till@boell.org
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please visit our web site: www.boell.de/climate-transatlantic/

Heinrich Böll Stiftung

Washington D.C. Office
1638 R Street, NW
Washington, DC 20009
United States
T +1 202 462 7512 **F** +1 202 462 5230
www.hbfus.org

Berlin Office
Schumannstr. 8
10117 Berlin
Germany
T +30 285 34 0 **F** +30 285 34 109
www.boell.de

Brussels Office
Rue d'Arlon 15
B-1050 Brussels
Belgium
T +32 2 743 41 00 **F** +32 2 743 41 09
www.boell.eu

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SUMMARY

The world currently faces three global challenges that relate to the way we travel and commute: global warming, peak oil[1] and energy security. In order to overcome these challenges, municipalities will need to rethink current public transportation systems. This paper assumes that integrated transportation planning (involving public transportation, bicycles, walking and cars) will be key to enabling mobility while addressing greenhouse gas emissions, fuel consumption and energy usage. Working from that assumption and building on a previous study of the Heinrich Böll Stiftung (*Green Solutions to the Auto Crisis*[2]), this paper highlights examples of successful car and bike sharing programs in the US and Europe and explores how both can be integrated into sustainable transportation systems to relieve some of the environmental and structural pressures cities face. The end goal of such an integrated transportation system would be to provide exactly what private car ownership does: freedom of movement, flexibility, and convenience. This paper concludes that station-based and flexible car and bike sharing programs can contribute to sustainable transportation and that context should determine which programs are implemented. Such sharing programs can quickly and efficiently offer additional sustainable transportation choices, thus making the decision not to own a personal car more attractive and clearing the way for an integrated sustainable urban transport system.

1. Peak oil refers to maximum global production of petroleum, after which point production declines. This is pertinent in light of relatively steady demand for petroleum products in developed countries and expanding demand in developing countries.
2. See Canzler and Knie (2009) www.boell.de/economysocial/publications-7795.html

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MAX GRÜNIG, FELLOW, ECOLOGIC INSTITUTE, BERLIN, AND
DOMINIC MARCELLINO, FELLOW, ECOLOGIC INSTITUTE, WASHINGTON DC

1. Urban Areas, Transportation and Global Challenges

Transportation is an integral part of life in the United States and the European Union. Transportation systems link cities, allow people to travel and commute to work and enable goods to cross borders and reach markets. The transportation systems that have developed in the US and the countries of the EU since the early 1950s have national characteristics, but also share one common element—a rooted and often increasing reliance on the personal automobile for transportation. Transportation systems in many cities and regions are already strained and will be under more pressure as cities keep growing and urban populations increase.

On a global level, the world currently faces three challenges that directly relate to the way we travel and commute: global warming, peak oil and energy security.

Public transportation provides an energy efficient means of mobility for many who cannot afford a personal car and for those looking to live without one. Yet, many commuters and others appear unwilling (or unable) to end their dependence on private automobiles. Long commutes and traffic jams aside, cars offer three important things: freedom of movement, flexibility, and convenience. To move more commuters away from cars, municipalities may have to rethink current public transportation systems, which usually consist of bus, subways, and commuter rail. Innovative options, like new light rail systems and bus rapid transit, can offer expanded options. Still, these transport modes are very different from individual transport solutions (i.e. use of the personal car or private bicycles) and cannot offer the same flexibility and convenience. New developments in car and bicycle sharing can bridge the gap between communal and individual transport modes.

Integrated transportation planning, involving public transportation, bicycles, walking, and cars, will be key to providing mobility while also addressing problems of energy usage, greenhouse gas emissions, and noise and air pollution. This paper explores whether new approaches to urban

transport integrating car sharing and bicycle sharing systems can contribute to relieving the pressures that cities face today. Integrating car and bike sharing into transportation plans and combining them with public transportation could go a long way toward providing what private car ownership does: freedom of movement, flexibility, and convenience. Moreover, cities and regions have limited budgets but need immediate solutions.

To explore this question, section 2 begins with a short description of the car dependence of current transportation systems in the US and the EU. Section 3 looks at examples of successful car sharing programs in both regions, while section 4 describes bike sharing programs. In section 5, the possibilities of integrating transportation systems with bike and car sharing is explored; section 6 concludes with several recommendations from best practice examples and notes outstanding research questions.

2. The Car Society

In their own ways, the US and European countries have developed transportation systems which depend largely on private passenger cars for personal transportation. In the US, the modal share of passenger cars is 87% of passenger kilometers traveled, while in the EU-15 it was 76% in 2005 (OECD 2006). At the same time, the trend towards urbanization continues unstopped both in the US and in the EU. Some 80% of the US population now lives in metropolitan areas, although density levels continue to decline at the urban fringe. In the EU, approximately 75% of the population lives in urban areas (EEA 2006). The construction and expansion of road networks over the decade has enabled urban sprawl, which contributes strongly to road congestion, air pollution, noise, and road accidents. As the extent of settled regions expands, centers of population, employment, culture, and leisure have become more diffuse requiring more driving. In some ways, a feedback loop has been established: more development requires more roads, which in turn encourages more development, exacerbating pollution and congestion issues.

The transportation of people and goods is responsible for between a fifth and a third of national greenhouse gas (GHG) emissions: In the US, this share is slightly higher than in most European countries (about 30%, see EIA 2008). In the EU, transport GHG emissions represented 22% of total EU-27 emissions in 2005 (EEA 2008).[3] CO2 emissions from transport are rising very quickly on both sides of the Atlantic: average annual growth in the US between 1990 and 2006 was 1.5% (EIA 2008), resulting in an accumulated growth of 27.2%. In the EU, growth of total transport GHG emissions over the period was 28%.

The transition to a more sustainable transportation system will involve less dependence on private automobiles, though they will most likely continue to be the dominant means of transportation for some time. To envision a transition away from "The Car Society" to an integrated transportation system first requires an assessment of where things stand in both the US and the EU.

2.1. The US

Suburbanization in the US has evolved in tandem with increased use of the personal car, making it possible to commute longer distances from sparsely populated areas with little or no public transportation to the workplace and back. An extensive highway network of 46,873 miles of Interstate Highway, 115,500 miles of other National Highway System roads and 3,849,259 miles of other roads facilitates the use of cars for daily commutes and other travel in the US.

3. This discrepancy does not necessarily indicate an actual difference between the US and the EU, as aviation and maritime travel between EU Member States are counted as international transportation and thus not included in the national inventories. In contrast, all transportation between states in the US, including domestic aviation, is included in these accounts.

American households spent on average $8,758, or 18% of the disposable income, on transportation in 2007 (RITA 2009). Out of this amount, $8,220 went to private vehicle expenditures with only $538 for non-car transportation, which included $360 on airline fares. Households on average spent only $69 for local public transportation services. These expenditures mirror the commuting modal share in the US. As with expenditures, commuting is heavily skewed toward driving. In 2007, 86.5% of commuters drove to work, with over 76% driving along. Public transportation had a commuting mode share of 4.9%, walking 2.8%, and bicycles 0.7% (DOT 2008). It is not surprising, then, that public transportation systems often run deficits, struggle to maintain operations, and need public subsidies.[4] Only 9% of American households have no car at all, while 58% have at least 2 vehicles (RITA 2008).

In addition to direct cost, spending time driving to and from work results in substantial opportunity costs. The Bureau of Transportation Statistics reports that 2.9 billion gallons of petroleum were wasted in 2005 due to congestion—enough to fuel the entire transportation fleet for over 6 days. The Texas Transportation Institute (TTI) found in 2005 that "traffic congestion continues to worsen in American cities of all sizes, creating a $78 billion annual drain on the US economy in the form of 4.2 billion lost hours and 2.9 billion gallons of wasted fuel." (Memmot and Young 2008)

The built environment has a major impact on how citizens use the various modes of transport. A recent study by the Transportation Research Board finds that more compact and mixed-use development would reduce vehicle miles traveled, energy use, and C02 emissions between 1% and 11% by 2050.[5] The report finds that policies that support more compact, mixed-use development should be encouraged—where mixed-use refers to the co-location of residential and commercial development, especially essential services, which allows for the integration of work and homes in the same neighborhood. Furthermore, mass transportation options fare much better in areas with higher population density as the potential ridership base is greater. Obviously, it is not possible to transition from current land use planning to this vision overnight. Planning and legal changes, among others, will have to be implemented over many years. Additionally, the transition will need a number of very flexible approaches that can precede mass transportation developments.

2.2. European Union

The countries of the European Union have developed their own car society, though the average commute differs quite significantly from Member State to Member State. While Hungarians have daily commutes of 51.2 minutes, Portuguese get to work in only 29.2 minutes.[6]

Recent data on travel in Germany[7] illustrate transportation choices in Europe's largest economy and leading auto manufacturer. According to the data, six out of ten German commuters use a private car to get to work (59.6%). Just 3.5% commute to work in a car pool. In contrast to the statistics for the United States mentioned above, a much higher percentage of workers commute using public transportation (13% use the bus or commuter rail), ride their bikes to work (8.3% and increasing), or walk (9.5%). The data provide reasons for both hope and concern. Short distances are increasingly covered by bike and foot, but the length of the average commute in Germany is increasing. Inducing greater modal shift should be a clear policy objective.

4. Calculations of the cost of driving neglect the cost and maintenance of roads, which are also not many making enterprises, but require dedicated revenue (derived in part from gasoline taxes, for example, in the US).
5. TRB (2009)
6. EFILWC (2002)
7. Statistische Bundesamt (2009)

In the UK, road traffic increased by 87% from 1980 to 2007. In 2006, 85% of commuter and business car trips had only one occupant. The share of households without a car dropped from more than 40% in 1980 to 24% in 2006. While the total distance travelled by car rose 66% between 1980 and 2006, the use of bicycles fell by 17% in the same timeframe. One factor explaining these trends is the underlying costs: the real costs of car travel fell over the decade from 1997 to 2008, while the price of bus and rail fares increased. As a result, total bus and light rail journeys decreased between 1985 and 2008. Today, 71% of commuters in the UK reach work by personal car. The average commute length increased from 8.2 to 8.7 miles between 1995 and 2006. At the same time, the average commuting time increased from 24 to 27 minutes on average.[8]

Though the EU has a deserved reputation of greater public transportation use vis-à-vis the US, the EU's policy focus on the sustainable use of resources, including attention to transportation,[9] has not stopped urban sprawl in any of the EU Member States.[10] Even in Germany and the UK, the need for new ideas to better integrate public transportation and other non-auto means of transportation to create a sustainable system is clear.

2.3. Mapping sustainable urban transport

Despite the figures of opportunity costs, longer commutes, and congestion, the car is still the overwhelmingly preferred means of transportation in the US and Europe. Among other reasons, cars are driven because they provide (or are perceived to provide) freedom of movement, flexibility, and convenience. Further, driving is often perceived as an inexpensive means of transportation, and perceptions matter. An assessment of actual driving costs in Germany reveals a different reality: a recent study found a kilometer by public transport in Germany costs on average 0.15 Euro, while a car kilometer comes to 0.60 Euro.[11] One reason for the continued preference of the automobile is the fact that the car owner usually only faces singular expenses—such as the annual insurance premium or the bill at the gas station—but never the costs of each actual trip. Thus, any incremental trip is perceived as free. Moreover, the high costs of car ownership may tend to induce owners to maximize the use of their investment by increasing their car use. Utilizing public transport often takes the form of a monthly bill or even a per trip payment. Car and bike sharing programs usually translate into direct payments per trip, making the price of each trip clearer to consumers.

Commuting not only costs money, but is also a major health hazard in terms of: stress, risk of accidents and depression. Stutzer et al. found in 2004 that the benefits of commuting are usually far outweighed by its negative impacts, stating that commuting is the daily activity with the lowest positive economic effect (Kahnemann et al. 2004).

These trends merge with the numerous pressures facing municipalities and regional governments arising from the high relevance of cars for the daily commute: air pollution, noise, road accidents and most of all congestion. At the national level, high car dependency has strong implications for climate change policy, peak oil and resource dependency.

It is therefore imperative to look for innovative approaches to urban transport that work with the infrastructure that exists today, while moving toward different models of transport in the future that give prominent roles to public transportation, bikes, walking, as well as cars. Most scholars agree that there is no silver bullet, i.e. no ultimate mode of transport, and the transport community

8. Department for Transport (2008)
9. EU (2006)
10. EEA (2006)
11. Allianz pro Schiene (2009)

is accordingly looking for an optimal mix of modes, i.e. an integrated sustainable urban transport approach.

Planners can use or combine approaches: 1. improve system efficiency by fostering the use of more energy efficient modes of transport; 2. change the profile of fuels used; and 3. reduce transportation demand. These strategies are not mutually exclusive. However, rebound effects may occur if the improvement in the system efficiency is such that total transport demand increases beyond the business-as-usual case.

The range of possible measures is quite broad, as the basic idea of integrated sustainable planning includes all aspects of the system. Thus, transport planning does not simply ease the pressure from demand but rather anticipates and acknowledges impacts on all areas.

A study by the Center for Clean Air Policy finds that smart growth measures and increased transportation choice reduce emissions and result in net savings.[12] The report further finds that applying best practices could reduce vehicle miles travelled by 10% by 2030 and thus contribute 6% to the necessary GHG emission reductions in the US. Buehler et al. (2009) divide the task into five steps. For purposes of this brief, the second step[13]—coordinating public transportation, cycling, and walking as a viable alternative to driving—is the starting point for the consideration of the contribution car and bike sharing plans can make to an integrated transportation network.[14]

Building on the fact that both the EU and the US are predominantly car-based societies, we will look into options that offer flexibility and convenience similar to owning and driving a personal car, but have fewer negative impacts on the environment and urban living.

Both car and bicycle sharing systems augment traditional mass transportation options, which can be characterized as rigid, but can reduce the need for personal car and bicycle ownership.

Car sharing programs can offer optional car access. In combination with public transportation options, they can achieve a level of service that matches or even outpaces the performance of a personal car: The combination of car sharing and mass transportation is less expensive overall than owning a personal car and using it as a sole means of transportation. Further, it provides the commuter and traveler with flexibility and convenience, which is lacking in some transportation systems. Using mass transportation can be faster and more convenient in many situations, but some commuters are understandably wary of reducing their options for mobility to public transportation alone. With integrated car sharing, a car can be booked for trips that leave the grid of public transport or for transporting purposes. Offering car sharing, thus, reduces the need to own a car in an urban environment.

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12. Winkelmann et al. (2009). This result may be surprising, especially since transport measures very often feature rather high GHG reduction costs. However, taking into account all costs and benefits (such as health, road safety, avoided infrastructure costs, consumer savings, projected tax revenue growth and higher quality of life) results in fairly positive returns.
13. Get the price right: Prices that reflect the true costs of transport will allow customers more informed decision making; 2. Integrate transit, cycling and walking as viable alternatives to the car: create an integrated transport network; 3. Fully coordinate and integrate planning for land-use and transportation to discourage further urban sprawl; 4. Distribute public information and education to make changes feasible; 5. Implement policies in stages with a long-term perspective.
14. The other four measures outlined by Buehler et al., (2009) should be considered together for a comprehensive outcome, but doing so is beyond the scope of this paper.

Bicycle sharing services, similarly, function best as an add-on to the existing public transportation network. Very often, the bicycle will allow a faster and more convenient journey. Cycling infrastructure, such as bicycle lanes and bicycle traffic lights, is imperative to the expansion of bike sharing programs and biking in general. However, in adverse weather conditions and for longer distances, mass transportation will be the preferred option. The addition of a car sharing program can cover longer distances or the transportation of goods.

The experience of car and bike sharing programs in the US and the EU, as we will explore below, points to the promise of these systems in creating this integrated network – especially when combined and integrated with pedestrian options and reliable public transportation.

3. Car sharing programs

When calling for an integrated sustainable urban transportation network, cars cannot be left out of the equation. However, as examples in the EU and the US demonstrate, the role of the automobile does not need to be constrained to private cars. Strategies aimed at reducing car use have had a difficult time on both sides of the Atlantic. A better strategy may involve accepting a prominent role for cars while attempting to better understand and react to the transportation situations where cars are preferred. One cannot lose sight of the main advantages of cars vis-à-vis other modes—freedom, flexibility, and convenience. Car sharing systems can offer these advantages, but do not require car ownership. At the same time, the shared car will attach a price to each trip which in turn reduces the tendency for car overuse. Though the costs of using a car with a car sharing program are lower than car ownership, the pricing structure combined with the lack of ownership in a car sharing program will lead to members using cars less often than those who own their car. Car sharing is an option to address some of the issues mentioned in the previous section on the Car Society. First of all, it delivers a true price for car use, reflecting the full costs of car ownership and use through the usage fee. Secondly, it can be a solution to integrating cars into the network of urban mass transportation modes; car sharing offers more flexibility as well as the capacity to transport goods or passengers and to reach destinations outside the public transportation grid. Furthermore, car sharing has functioned best in compact urban environments. Car sharing may not be a solution for addressing suburban commuting, though this is not certain. [15]

Car sharing programs have been around since the 1970s. Despite recent growth, acceptance has been limited. This section will showcase examples of successful approaches to car sharing. Different types, models, and scales of car sharing programs exist. Most are station-based, where users pick up and return the vehicle at designated rental stations. In some instances, it is possible to rent the car at one station and to drop it at another; in others, it is necessary to return the car to the same location. Recently, flexible car sharing programs have been introduced, where cars can be rented and parked independently of stations.

Although car sharing programs reduce the need for car ownership—reducing trips, lowering environmental impacts, and taking pressure off urban parking—the environmental impact of a car sharing program depends largely on the fuel type and efficiency of its fleet. Some car sharing programs have dealt with this issue directly, while others focus simply on reducing car ownership—pointing to an area where continued improvements can be made.

15. Zipcar's experience at four suburban transit stops in New Jersey (in a cooperative agreement with New Jersey Transit Authority) may serve as a model for integrating car sharing in less-densely populated areas. See Schweber (2008).

As mentioned above, driving can be more expensive than other modes of transportation, but the choice to drive is not solely a rational, economic one. Kahnemann et al. (2004) found that commuting is the economic activity with the lowest positive economic effect. Moreover, driving and owning a car is frequently an emotional topic. Car owners identify themselves through the model they own, and driving is perceived as being synonymous with autonomy and flexibility (Steg and Tertoolen 2004). It is important to acknowledge these emotional factors when offering alternatives to the passenger car. This implies that shared cars have to be attractive (aesthetically and not just in terms of price), and participation must be an act whereby one can convey personality, autonomy, and a particular image.

The following sections will look at examples of different types of car sharing programs and begin to assess the extent to which car sharing can meet driver's expectations, while providing flexibility, freedom, convenience, and reducing environmental impacts.

3.1. Station-based car sharing

All the early approaches to car sharing used a station-based model. There are a number of separate efforts and organizational structures. The following paragraphs will highlight the diversity of programs: from the one-ticket integrated system in La Rochelle, France, to the plans for an electric car sharing fleet in Paris; from for-profit Zipcar, to the myriad non-profit companies offering service. With this diversity, cities and municipalities have a number of options and can learn from experience in towns and large cities.

One of the earliest examples of station-based car sharing can be found in La Rochelle, France. Since 1971, the city of La Rochelle—with 78,000 inhabitants—has sought an integrated approach to public transportation: The entire transport system is accessible through a single electronic ticket —the "yélo" card – which allows its users to ride buses and the ferry, and also to rent bicycles, taxis and electric vehicles, and to pay for the park & ride and all other services.[16] Customers can add value to their accounts online.[17] Also, the online-service offers a very wide array of information. Most services can be either paid on a subscription or pay-per-use basis. Moreover, subscribers benefit from a vast range of savings on all included transport modes.

Since 1999, a station-based car sharing system has been part of La Rochelle's transportation plan. The electric car sharing fleet—Liselec—offers 50 cars at 7 stations. Liselec is a public-private partnership, and the city is a major stakeholder. The service had 485 users by the end of April 2002 (Bacchus 2002); most users are male and young, and 33% are students. Each month, 2,500 trips are made with an average duration of 30 minutes over 6 km. Most users make direct point-to-point journeys. While there are parking fees in the center of La Rochelle, Liselec drivers can park for free throughout the city, which adds to the attractiveness of Liselec versus using a private car.

The Syndicat mixte Autolib' is currently developing a system of electric car sharing for the city of Paris (Fierling 2010). A fleet of approximately 3,000 cars will be deployed to 1,000 rental stations throughout Paris and some neighboring cities. The service is set to begin in mid 2011. The large number of rental stations will require vast investments in infrastructure, as each station will have to feature charging outlets for the electric vehicles. The rental rates have not been finalized, but they are expected to be between 4 to 5 Euro per half hour rental with a monthly subscription of 15 to 20 Euro (Fierling 2010). The scheme will allow users to rent a car at one station and to drop it at any other station. Autolib' will be a public service operated by a subcontractor for ten

16. La Rochelle (2009)
17. La Rochelle (2009a)

years. The subcontractor will earn revenue through subscriptions and rentals, but Syndicat mixte Autolib' will provide initial support for the rental stations. This agreement will ensure access to attractive locations for rental stations.

The large-scale introduction of electric vehicles in a car sharing program can help solve numerous issues simultaneously: it will both lower local air pollution and reduce GHG emissions, and also help to create a market for these emerging vehicles. Electric cars will probably be very expensive due to the high battery costs and may, thus, face serious obstacles preventing their widespread adoption. Electric car sharing fleets could help these cars move down the production cost curve.

In the US, the car sharing universe is populated by for-profit and non-profit firms offering station-based programs. As of July 2009, there were 26 car sharing programs in the US, with over 7,700 vehicles and over 320,000 members.[18] The for-profit side is dominated by Zipcar, while there are city-specific non-profit companies as well. Both models have proven successful, giving commuters and cities alternatives when it comes to station-based car sharing models.

Portland was home to the first car sharing program in the United States: Carsharing Portland, which started business in 1998. A series of mergers led to Zipcar—a for-profit company with car sharing programs in dozens of cities and universities—running the main car sharing system in Portland. The Zipcar website boasts "hundreds of Zipcars in Portland."[19] The vast majority of the cars are downtown in the central business district. This puts the cars within easy walking distance of the high density of jobs downtown. Further, they are clustered around the Transit Mall (the conjunction of Portland's bus and light rail lines) and the Portland Streetcar, directly linking Zipcars for short daily use with public transportation to get into town and for some direct trips. Zipcar offers only roundtrip rentals where the cars are returned at the point of lease. This precludes the use of Zipcars for daily commuting, but allows it to remain an option for business-related trips during the work day. Zipcar offers drivers a range of cars for different purposes—from passenger cars, to trucks and crossovers for large loads, and even convertibles and higher end models. Furthermore, with plans to continue expanding and its presence across the United States, Zipcar will be a potential partner for many different municipalities.

The non-profit car sharing model has also been developed successfully in several American cities. I-GO Car in Chicago, PhillyCarShare in Philadelphia, hOurcar in Minneapolis/St. Paul, and City CarShare in San Francisco and Oakland compete directly with Zipcar and offer cars at similar daily and hourly rates in numerous locations. In Boulder and Denver, Colorado, eGo CarShare rents 15 cars—many of them donated by members. Like other non-profit car share companies, eGo CarShare is mission-based—the intent of the program is to reduce car ownership and driving by offering alternative transportation. For eGo CarShare, the non-profit model was chosen to enable the company to pursue its vision and not to have to respond to investors or profits. The location of cars is based on proximity to public transportation, bike and pedestrian paths, and pockets of population. The company's model has worked well enough that it expanded to Denver in early 2009 and plans to add more cars there soon.[20]

The relative success and extent of car sharing programs in American cities correspond with particular characteristics: concentrated centers of population and employment and the availability of other transportation options. The cost of vehicle ownership and the availability of parking are also

18. Carsharing.net (2009)
19. Zipcar (2009)
20. Worminghaus (2009)

factors. Unlike in the EU, US car sharing programs have been privately run to this point, underscoring the need for more formal integration of availability and location of cars in order for car sharing to integrate fully with a sustainable transportation system.

Station-based car sharing models have been successful in many different settings with different business models. Station-based models do require substantial investment in rental stations and incur operating costs for maintaining the rental stations. Furthermore, having to rent and return cars to a particular place can reduce the flexibility and convenience of the system—especially if cars are concentrated in one area of town.

One of the core advantages of car use is its door-to-door operability. The advent of new technologies such as the internet and satellite geo-positioning enables the creation of more flexible car sharing schemes. At the same time, station-based models have advantages of experience and lend themselves better to electric fleets, meaning these firms and models will continue to play a leading role in car sharing.

3.2. Flexible car sharing

Flexible car sharing is a new approach to car sharing that is expanding quickly. In 2008, Daimler introduced its flexible car sharing program (car2go) in the German city of Ulm, a city of 120,000 inhabitants. The service relies on a fleet of 200 Smart Cars stationed throughout the city. Users have to register with the service in order to receive an RFID chip on their driver's license. The chip then opens any of the fuel efficient Smart Cars (3.4l per 100 km). Pre-booking or reservations are not necessary, but are possible. Users can either simply find one of the specially-painted cars on the streets of Ulm, or they can locate the next available car2go on the internet. Service fees are only 0.19 Euro per minute and include all costs, from fuel to parking fees.[21] The Smart Cars are permanently monitored and can be relocated, if they are found unused in their current location.

The scale of interest in car2go has outstripped expectations: More than 10,000 citizens of Ulm have registered for the program—over 10% of the driving population.[22] Within the first three months, there were more than 50,000 rentals, and the capacity of the fleet to meet demand was being strained. Usage rates are high enough that Daimler will increase the number of available cars in the near future. The success in Ulm has lead to many other German and European cities requesting car2go for their municipalities.

Spurred by the positive response in Ulm, car2go decided to launch a flexible car sharing program in Austin, Texas, with a fleet of 200 Smart Cars in late 2009. The project in Austin will be a trial run in the US to test the potential of the model in American cities.

Car2go has succeeded by providing a positive, innovative, and unique image to car sharing. Users can thus combine the emotional aspects with the practical advantages of sharing a car. Further, car2go benefits from broad support by the city of Ulm. Parking is available free of charge, and special parking spaces are reserved for the Smart Cars. Other than this structural support, car2go is a completely corporate-funded scheme and exists because it is profitable—and, therefore, economically sustainable. The system relies on relatively little physical infrastructure besides repair shops and relocation teams. Like Zipcar and other car sharing programs in the US, but unlike the systems in La Rochelle and Paris, car2go offers an approach to car sharing that is very attractive to municipalities facing limited or shrinking budgets. For car companies such as Daimler, car2go

21. car2go (2009)
22. Daimler (2009)

is an important first step in the transition from selling automobiles towards becoming a mobility provider.

Flexible car sharing schemes as well as station-based schemes depend on the degree of integration with the existing transport network. Measures to foster the integration can include: linking to all modes of public transport; incentives such as free parking and access to restricted areas for users of car sharing; as well as linking car sharing with other novel approaches such as bicycle sharing.

4. Bicycle sharing

While car sharing offers access to cars to car owners and non-owners alike, the intent of bicycle sharing is to introduce and enable bicycle use to non-owners. Further, bike sharing and car sharing can complement each other—with cars for longer trips and trips for multiple people or with large loads—and bikes for shorter and individual trips.

As bicycle sharing programs look foremost at encouraging new bicycle users, it is crucial to ease the transition by making biking safe and enjoyable. In the first place, this implies the extension (or creation) of bike path and bike lane networks; it also entails conveying the positive effects of using shared bicycles. Bike sharing can be combined with public education campaigns encouraging less driving. A very successful campaign in Germany is encouraging car owners to walk and bike for short distances below 6 km—bicycle sharing opens this option to those who do not own their own bicycle. The main focus is personal health and fitness, but also highlights the monetary benefits of not driving. The campaign uses very provocative slogans and employs unorthodox measures such as hugging bikers and pedestrians.[23]

Shared bicycles are specially designed to prevent theft and ensure that users can easily identify the rental bikes. Furthermore, a special design provides free marketing through the visibility of the bikes in the cities. Most bicycle sharing programs rely on a grid of rental stations. In most cases, it is possible to rent a bicycle at one station and to return it at another. Recently, flexible bike sharing programs have emerged which do not rely on rental stations for their operations.

In the following section we explore examples of station-based and flexible bicycle sharing platforms.

4.1. Station-based bicycle sharing

Just as with cars, the first approaches to bicycle sharing used a station-based model. In La Rochelle, rental bicycles were introduced more than 30 years ago: Since 1976, 150 bikes can be rented at 26 self-service stations throughout the city. The service will soon reach 250 bikes at 50 stations. Users can rent a bike at one station and return it at any other rental station. The rental requires a yélo card. However, tourists can rent a bike at a specially-dedicated station. The first half hour is free of charge (2 hours for tourists). It is also possible to rent the bikes long term, from 2 months up to a full year. The city boasts 150 km of bike paths in addition to several secure bike parking locations.

Bicycling has been identified as a major opportunity to improve urban transport conditions in Paris, France. The total length of Paris' bike paths is 400 km in 2007, up from 8.2 km in 1995. The number of bikers was 100% higher in 2007 compared to 1997. In order to increase the modal share of bicycling, Paris introduced a station-based bike sharing scheme in 2007.

The bicycle rental system "Vélib" debuted in 2007 with over 18,000 rental bikes and over 1,000 of rental stations. Bicycles can be rented on a one-way basis, i.e. do not need to be returned to the

23. See BMU (2009)

same rental station. A user can pay an annual membership fee ($35), but one day and one week passes are also available; for each rental, the first 30 minutes are free of charge, and fees are time-dependent after that. However, the project is mainly financed through advertising on the stations and bikes. Daily use averages 60,000 to 95,000 trips. Moreover, Vélib has contributed to changes in commuting behavior in Paris. Where bikes were formerly used primarily for sport or excursions, Vélib has led a wave of commuters choosing bicycles for commuting; based on their experience, many riders have chosen to purchase their own bicycles. The system has had issues with vandalism and theft, but operator JC Deceaux has attributed much of this to social unrest unrelated to bicycling itself and has improved security over time.

In Washington, DC, a small-scale bike sharing program (SmartBike) was introduced in 2009. With 120 bikes and ten parking stations, SmartBike offers an additional mobility option in the central business district of Washington. SmartBike is a system developed by Clear Channel Outdoor, whose first bike sharing program began in Rennes, France, in 1998. Interested riders register online and pay an annual subscription fee. Subscribers receive a SmartBike card, which can be used to rent a bike on demand from any of the stations. The subscription costs $40; a replacement fee of $550 is charged if a bike is not returned within 24 hours. Available bikes can be located online.

Another bicycle sharing program is the Bixi model from Montreal, Canada. The city developed its own proprietary system with modular, off-grid parking units that can be moved and removed based on usage. Moreover, the success of Bixi, also called the Public Bike System, enabled the organization to win bids for bike sharing programs in London and Boston, Massachusetts. The Boston system will open in spring 2010 with a large number of bikes and stations with the particular number to be determined. Starting with a modular system with a large scale provides immediate infrastructure and a variety of drop-off options to commuters and riders who would be interested in using a bike, but who might be unable to in a small-scale fixed system like that in Washington, DC.

The potential for bike sharing to increase the modal share for bikes may be best tested in Boulder, Colorado and Portland, Oregon. Neither city has a bike sharing program, but both boast a large percentage of the population who already uses bikes, they have strong bicycle infrastructure, and integrated transportation planning. Boulder is considering the introduction of a bicycle sharing program with a series of stations integrated over the internet. Initial funds (federal, local, and private) would establish the program, but the intention is to create a self-funding program in the long run—this is critical in light of Boulder's strained financial resources for public transportation. In addition to reducing the need for personal vehicles, the plan is also intended to encourage the linking of public transportation and bikes for commuting; bikes would serve as the means of transportation for the first or last mile of a commute. Boulder already has a bike modal share of 8.9%, over 12 times the national average 0.7%.[24] GO Boulder also launched the GoBikeBoulder.net site in 2007 to aid riders by providing turn-by-turn directions. Portland shares many of the same characteristics and considered introducing a bike sharing program in the past. The cities would be key testing grounds for the contribution bike sharing can make to a sustainable transportation system in the US.

Station-based bike sharing programs rely on significant investments in rental stations and can offer only as much convenience and flexibility as there are rental stations. Still, the success of programs in Paris and Montreal, the introduction of a system in Washington, DC, and plans for introducing a large system in Boston demonstrate that bike sharing systems have clear appeal to cities, commuters, and riders. With an extensive and integrated system—as in Paris—bike sharing can even change transportation behavior.

24. City of Boulder (2009)

4.2. Flexible bicycle sharing

Building on the idea that shared bicycles should be available everywhere in the city center and not just at rental stations, Deutsche Bahn introduced its bike sharing Call-a-Bike in 2001, first in Munich, then in Berlin, and now in many other German cities. In 2009, there were over 110,000 registered users, and they are projected to rent the bikes about 800,000 times. Clients are mostly male (77%) and young (55.5% under 35 years). 68% have a higher education degree and 41% a net income above 2,000 Euro per month. 82% used the bikes in the spare time, 42% were tourists (Knie 2009). Most customers are satisfied with the service.

Users have to register once to join the program. From then on, a phone call with their mobile phone provides them with a one-time access code to the chosen bike to unlock the bicycle's electronic lock. Users can then park the bike anywhere in the city and are charged based on the time used. Deutsche Bahn frequently collects bikes that are unused and relocates them to transport hubs such as railway and metro stations.

The program has been very successful both with tourists and locals. Flexible bike sharing could be further improved by incorporating satellite geo-positioning technology which would have two benefits: users could locate the next bicycle very easily using their mobile phone or from a desktop computer, and the service operator could easily retrieve lost or stolen bikes.

Call-a-Bike is a 100% subsidiary of Deutsche Bahn and operates the service on a for-profit basis. Deutsche Bahn views its activities as a mobility provider, whose services encompass rail, car sharing, cargo and other forms of transportation (Canzler and Knie 2009).

Flexible bike sharing is certainly only an option in high-use cities where a considerable number of bikes can be deployed. The users will then spread the bicycles randomly and achieve a more or less even distribution over time. This system can be extremely successful, as can be seen by the sheer numbers, and does not rely on major infrastructure investments, making it an option for financially restricted cities.

5. Integration with mass transit systems

Bicycle and car sharing programs will provide the largest benefits when they are conveniently integrated into the existing transportation network. This implies both that the new transportation choices offered have to take into consideration existing traffic flows, and that those other transportation modes have to adapt to the newly created services.

Both car sharing and bicycle sharing programs can effectively improve current existing public transportation networks or services. These services do not need to compete with each other or public transportation. Instead, they can complement each other: Car sharing allows access to areas that are not served by mass transportation and facilitates the transportation of goods and passengers (especially young children); bicycle sharing can help avoid complicated transfers and bicycles are often faster than public transportation or cars over short distances.

At the same time, public transportation remains vital: Even shared cars can get stuck in traffic congestion, while trains and bus rapid transit can quickly and easily move large numbers of passengers. Similarly, adverse weather conditions will limit bike riding; public transportation provides travelers with an option other than driving.

The single integrated electronic ticket (yélo) as introduced in La Rochelle can play a major part in integrating all transport modes and allow simple connections between transportation options.

In this section, we look at various options for integrating car and bicycle sharing programs with mass transportation systems.

5.1. Linking car sharing with mass transportation

Station-based car sharing systems are relatively easy to integrate into the existing transport network. Rental stations can be located at major transport hubs: railway stations, metro stops, bus terminals etc. Coordination with and support from the municipal government and the public transportation authority enhances the integration. Offering space for rental stations and parking at transportation links will be a significant factor in successful integration.

In Portland, for example, Zipcar locations closely mirror transportation links and concentrations of population and employment. The great majority of cars are located in the central part of Portland roughly in tandem with streetcar, bus, and light rail stops—overlapping with Portland's bike path network, as well. This convergence makes business sense to Zipcar, but it also satisfies the important need of linking the public transportation system with car sharing—reducing the need to drive into town, but enabling people to use cars when necessary. These examples illustrate that station-based car sharing programs can function in tandem with mass transportation services.

In Europe, there are several models of successful integration. For example, the Liselec stations in La Rochelle are all linked to other transportation modes. Furthermore, Liselec cars are paid for using the yélo card as well.

Deutsche Bahn offers a station-based car sharing service at train stations in 120 cities throughout Germany with over 1,600 cars. These cars connect directly with regional and national train services.[25] Holders of Deutsche Bahn discount passes pay lower rates for car sharing. Also, as Deutsche Bahn owns the real estate, it can easily offer good access to its car sharing services.

Similarly, Project Better Place has just announced a cooperation project with the Danish railway provider DSB to establish rental stations for electric cars at rail stations starting in 2010.[26] The integration of electric trains with electric cars offers the potential for significant GHG emissions reductions, especially if the systems are powered with renewable electricity.

Car sharing companies are not the only options for introducing shared electric cars; municipalities can support the transition as well. In fact, providing charging stations and parking space is a major factor in making these schemes successful. Projects such as ProjectGetReady[27] help stakeholders implement measures at a local scale.

Flexible car sharing programs have clear advantages, but they may prove more complicated to integrate into existing transportation systems as the program's cars will be distributed across a city based on use. The system operator can regularly relocate vehicles to major transportation hubs, but this will not always guarantee availability. Station-based cars appear to be better suited for links to transportation hubs.

Clearly, both station-based and flexible car sharing programs have advantages, and an ideal system may combine both—to provide flexibility and ensure access for commuters, especially at major transportation points.

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25. Deutsche Bahn (2009a)
26. Better Place (2009)
27. ProjectGetReady (2009)

5.2. Linking bicycle sharing with mass transportation

Like station-based car sharing, station-based bicycle sharing can link closely with existing transportation networks. In La Rochelle, 24 out of 26 existing rental stations link to other transportation modes. This includes bus, ferry boat, train, Liselec car sharing, taxi, and park and ride.

Flexible bike sharing schemes can also link very closely to mass transportation options. Deutsche Bahn bike sharing relocates its bicycles frequently, such that users can expect to find rental bikes at major rail stations. Furthermore, users tend to combine bicycles and mass transportation, which also leads to more bikes being stationed next to transport hubs.

The SmartBike system in Washington, DC has 10 stations, and all are within walking distance of a subway stop—most are less than a block away. The stops chosen for the stations are in the central business district and closely linked with one another.

The proposed scale of the Bixi bike sharing program in Boston—based on its success in Montreal—enables wide integration of bike sharing with the public transportation system as well as flexibility for riders throughout the city.

Intermodality also means that bicycles can travel for free or for small fees in trains and buses. While it is often possible to take bikes on the front-racks of US buses, bikes are usually denied transportation on buses in Europe.

Unlike car sharing, bike sharing programs may face some constraints that will take time to resolve. For example, though Boston's Bixi program has great promise, bike lanes must continue to be developed; drivers in Boston may not be prepared for the influx of riders, nor new bike riders prepared for a daily commute. Further, as a cold weather city, bike sharing is likely not a commuting or travel option for several months of the year. In cities with hot summers, a lack of showering facilities in businesses may constrict the number of people willing to consider riding a bike to work—even if they are sharing it. These issues require planning and coordination with drivers and employers. Moreover, bike sharing currently looks to be a viable, additional option and positive contribution to a sustainable transportation network, but not a solution to all problems.

6. Conclusions

We have examined both station-based and flexible car and bike sharing schemes. The analysis has shown that both station-based and flexible schemes each have advantages and disadvantages. Most importantly, it has demonstrated that both have significant potential to change behavior and reduce driving when integrated with public transportation options to produce a more integrated transportation system. The addition of bike and car sharing move strongly in the direction of meeting needs of flexibility, convenience, and freedom of movement.

Flexible car sharing has the advantage of enabling point to point travel, similar to the use of private cars by their owners. However, the location and availability of cars is less certain than a station-based car sharing program. Unless the flexible system is large enough, it will not always be able to ensure strong integration with the public transportation system. An ideal system would appear to be one with a large number of flexible cars throughout a city with a certain portion of cars—likely different models for different purposes—stationed at particular places, especially close to transportation links and hubs.

Car sharing schemes can lower the number of car trips made by affecting usage habits. Their main advantage, however, lies in the fact that car sharing services can offer fuel efficient and up-to-date cars, especially if cars are chosen with a lower emissions profile than the average personal car. Moreover, electric car sharing offers an opportunity to introduce a new technology to widespread use that would otherwise continue to reside in a niche market, due to the high costs of the cars. Electric vehicles could fit nicely in a station-based system—as they will require dedicated and predictable access to electricity. While electric cars still suffer from range limitations, this impasse can be overcome by using them in an urban environment where average trip lengths are shorter and where users can swap their car against a fully loaded vehicle at the next available rental station. In fact, it may very well be that car sharing offers the best prospect of all options to achieve a widespread introduction of electric vehicles in urban areas. This links very closely with the findings of Canzler and Knie (2009) on the future of the environmentally friendly car.

The success of both station-based and flexible car sharing as well as car sharing's viability in many arrangements (i.e. for-profit, non-profit, public private partnership) demonstrate the economic potential for car sharing. More data and analysis of different approaches are needed to best assess which models might function best in which contexts.

Bicycle sharing differs quite fundamentally from car sharing. First, bicycles do not need to recharge or refuel. They can operate autonomously for a very long time before requiring maintenance. Moreover, bike users tend to also use public transportation, ensuring that bikes accumulate around mass transportation hubs even in a flexible scheme. The Paris example shows the significant potential for station-based bike sharing to not only augment the existing transportation system, but also contribute to changed behavior. Flexible bike sharing can enable travel at any time, but availability could remain an issue. Station-based bike sharing should have a role, as commuters willing to try bicycles will demand reliable access to bikes—perhaps even the capacity to reserve them in advance. Both bicycle and car sharing systems can profit from easy access solutions, especially in the form of a single electronic ticket that integrates all transport modes. By combining car, bike and mass transportation on one ticket or card, one barrier for switching between services is lowered and users could choose according to costs and benefits.

In summary, both car and bike sharing systems offer a very cost-effective solution in offering better and more sustainable choices in urban transportation. In particular, the use of public-private partnerships as seen in Paris (JC Deceaux), Berlin (Deutsche Bahn) and Ulm (Daimler) strongly underscores the fact that municipalities can effectively contribute to cutting transportation emissions without large-scale investments in new infrastructure. In this regard, flexible programs allow even more cost savings, as they can operate without the need for fixed rental stations.

New technologies, such as mobile phones, satellite geo-positioning, and RFID, expand the opportunities for car and bike sharing, making these approaches more consumer friendly, but also less costly to operate for the service provider. Additional research is needed to prevent vandalism and theft of these new transportation methods.

Lastly, the integration of both car and bike sharing programs on a scale that will produce significant modal shifts to public transportation and non-car use will require planning and changes to public policy. Public education campaigns will be needed—to inform commuters and residents about new options, but also, especially in the US, to instruct riders and drivers how to respond to more bicyclists. Further, cities will have to build and maintain bicycle paths and lanes. Also, employers should be included in planning—Boulder and other cities have good models—as they can provide shower and parking facilities that enable alternative modes of transportation as well. Car and bicycle sharing programs have already proven profitable in many settings and they can

be implemented quickly without large outlays of public funds. They provide important additions to a sustainable transportation system—particularly by offering some features only private cars used to provide (i.e. flexibility, convenience). The formal integration of these systems on on a large scale will take time and planning, but car and bicycle sharing programs help make the choice not to own a car more attractive and will pave the way to an integrated sustainable urban transportation system.

In the course of completing this study, we identified three important areas for future research in developing sustainable transportation systems that integrate bike and car sharing with public transportation. First, new funding and regulatory changes are needed. Exploring new sources of public funding as well as identifying areas where private firms can be engaged will be imperative. The legal and regulatory changes may be extensive and will differ across the Atlantic from country to country and state to state. Second, the integrated model in La Rochelle with one card for access to all means of transportation was the most innovative and complete program we explored. There will be clear challenges in replicating the program in other countries, especially in contexts where travelers would cross jurisdictions—i.e. the New York and Washington, DC metropolitan areas. The promise of an integrated system, however, is clear, which begs further research into methods of overcoming barriers to replication. Lastly, bike and car sharing will have to be integrated into the specific context of each metropolitan area. Yet, the vast majority of decisions, infrastructure, and support will be the same from case to case. An overarching framework in the form of a tool kit for municipalities would be useful. A tool kit for municipalities looking to develop an integrated system with bike and car sharing would: preclude each city from having to research the ideas anew; help cities identify the best choices for each context and outcome; and expedite implementation.

REFERENCES

Allianz pro Schiene (2009): Für einen Masterplan Personenverkehr—5 Gründe warum Verbraucher von mehr öffentlichem Verkehr profitieren, http://www.allianz-pro-schiene.de/publikationen/masterplan-personennahverkehr/masterplan-personenverkehr.pdf.

Bacchus, Penelope (2002): Liselec—Self-service electric cars, http://www.energie-cites.org/db/la_rochelle_569_en.pdf.

Better Place (2009): http://www.betterplace.com/company/press-release-detail/dsb-and-better-place-denmark-partn/.

British Broadcasting Company (BBC) (2009): Fresh violence hits Paris suburbs, http://news.bbc.co.uk/2/hi/europe/4401670.stm.

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (2009): Satteln wir auf. http://www.kopf-an.de/

Canzler, W. and A. Knie (2009): Grüne Wege aus der Autokrise—Vom Autobauer zum Mobilitätsdiensteister (Green Solutions to the Auto Crisis: From Auto Makers to Mobility Service Providers), Heinrich Böll Stiftung, Schriften zur Ökologie, Band 4. www.boell.de/economysocial/publications-7795.html

Carsharing.net (2009): http://www.carsharing.net/where.html.

car2go (2009): www.car2go.com.

City of Boulder (2009): Request for Information No. 30-2009, "Public Bike Share Program." http://www.bouldercolorado.gov/files/Finance/Purchasing/Open%20Bids/2009_30_rfi.pdf.

Council of the European Union (2006): The renewed European Sustainable Development Strategy 2006, http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/90111.pdf.

Daimler Corporation (2009): car2go mobilizes Ulm, Press release, http://www.daimler.com/dccom/0-5-886397-1-1223373-1-0-0-0-0-0-9293-7145-0-0-0-0-0-0-0.html.

Department for Transport (2008): Transport Trends: 2008 Edition, National Statistics, United Kingdom. http://www.dft.gov.uk/adobepdf/162469/221412/190425/220778/trends2008.pdf.

Deutsche Bahn (2009): Neues Mobilitätskonzept "Flinkster": Deutsche Bahn setzt exklusiv auf den MiTo, Press release, http://www.deutschebahn.com/site/bahn/de/unternehmen/presse/presseinformationen/ubd/ubd20090202,variant=pdf.pdf.

Deutsche Bahn (2009a): http://www.deutschebahn.com/site/nachhaltigkeitsbericht__2009/de/unsere__produkte/nachhaltiger__verkehr/flotte/flotte.html.

Erlanger, Steven and Maia de la Baume (2009): French Ideal of Bicycle-Sharing Meets Reality, New York Times, October 30, 2009, http://www.nytimes.com/2009/10/31/world/europe/31bikes.html?_r=2&hp.

European Environment Agency (EEA) (2006): Urban sprawl in Europe—The ignored challenge, EEA Report 10/2006. http://www.eea.europa.eu/publications/eea_report_2006_10/eea_report_10_2006.pdf.

European Environment Agency (EEA) (2008): Climate for a transport change- TERM 2007—Indicators tracking transport and environment in the EU, EEA report 01/2008, http://www.eea.europa.eu/publications/eea_report_2008_1.

Energy Information Administration (EIA) (2008): Emissions of Greenhouse Gases in the United States 2007, http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/0573(2007).pdf.

European Foundation for the Improvement of Living and Working Conditions (EFILWC) (2002): European Survey on Working Conditions.

Fierling, Matthieu (2010): Chef de Projet, Syndicat mixte Autolib'. Email correspondence with authors.

Kahnemann, Daniel, Alan Krueger, David A. Schkade, Norbert Schwarz, and Arthur Stone (2004): A Survey Method for Characterizing Daily Life Experience: The Day Reconstruction Method (DRM). Science, Vol. 306, no. 5702, pp. 1776-1780.

Knie, A. (2009): Call a Bike—Öffentliche Verleihsysteme als Bestandteil des traditionellen ÖPNV?, edoc.difu.de/edoc.php?id=V5AUK4Z1.

La Rochelle (2009): http://www.yelo-larochelle.fr/.

La Rochelle (2009a): http://www.civitas-initiative.org/city_sheet.phtml?id=7&lan=en.

Le Parisien (2009): Après le Vélib', Delanoë annonce l'Autolib', http://www.leparisien.fr/paris-75/apres-le-velib-delanoe-annonce-l-Autolib'-11-09-2009-635324.php.

Memmot, J and Young, P. (2008): Bureau of Transportation Statistics Technical Report—Seasonal Variation in Traffic Congestion: A Study of Three US Cities.

Organization for Economic Co-operation and Development (OECD) (2006): Decoupling the environmental impacts of transport from economic growth.

ProjectGetReady (2009): www.projectgetready.org.

Research & Innovative Technology Administration (RITA) (2009): Pocket Guide to Transportation 2009.

Schweber, Nate (2008): Zipcar Offering Transit Riders a Supplemental Way to Travel, New York Times, June 22, 2008, http://www.nytimes.com/2008/06/22/nyregion/nyregionspecial2/22zipnj.html?_r=4&ref=nyregionspecial2&oref=slogin.

Statistisches Bundesamt (2009): STATmagazin – Arbeitsmarkt – Pendler: Die Mehrheit nimmt das Auto, Destatis.

Steg, L. and G. Tertoolen (2004): Sustainable Transport Policy: The Contribution from Behavioural Scientists, in Turning the Corner?, A reader in contemporary transport policy, ed. F. Terry.

Stutzer, A. and B. Frey (2004): Stress That Doesn't Pay: The Commuting Paradox, IZA DP No. 1278.

Transportation Research Board (TRB) (2009): Special Report 298: Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use and CO2 Emissions.

United States Census Bureau (2002): 2002 American Community Survey.

United States Department of Transportation (DOT) (2008): National Transportation Statistics, 2008, U.S. Department of Transportation, Research and Innovative Technology Administration, and Bureau of Transportation Statistics. http://www.bts.gov/publications/national_transportation_statistics/2008/pdf/entire.pdf

Winkelmann, S., A. Bishins. and C. Kooshian (2009): Cost-Effective GHG Reductions through Smart Growth & Improved Transportation Choices—An economic case for investment of cap- and-trade revenues.

Worminghaus, Karen (2009): Email interview with authors.

Zipcar (2009): http://www.zipcar.com/portland/find-cars.

ABOUT THE AUTHORS

Max Grünig

Fellow
Ecologic Institute Berlin

Max Grünig joined the Ecologic Institute Berlin as a Fellow in May 2007. He focuses on the economic evaluation of costs and benefits associated with climate change and the use of environmental goods, especially with regard to the implementation of the Water Framework Directive. He has extensive knowledge in the field of transport, its environmental impacts and relevant measures, including market based instruments.

In the field of transportation, Max has developed a survey on businesses in the automobile and aviation industry, assessing their stance on international environmental governance. He also contributed to ETTAR (Environmental Technologies, Training and Awareness-Raising), an FP6 transport research project coordinated by Ecologic, and to a project assessing the sectoral costs of environmental policy. Furthermore, he formulated the transport-related aspects of the position paper on the EU budget review.

In 2004, Max Grünig earned his degree in economics at Humboldt-University Berlin. He completed his degree with a final paper on mechanisms for the allocation of tradable fishing rights. He can be reached at max.gruenig[at]ecologic.eu.

Max Grünig

Fellow
Ecologic Institute, Washington, DC

Dominic Marcellino is a Fellow at Ecologic Institute in Washington, DC. Since joining Ecologic Institute, Dominic has co-authored an analysis of the technology transfer negotiations in the UNFCCC process. Dominic has also worked on IN-STREAM, a multi-year project looking to combine traditional economic indicators with sustainable development objectives, and other projects.

From 2002 to 2004, Dominic was a Fulbright Scholar studying Environmental Ethics at the University of Augsburg in Augsburg, Germany. He also was a Robert Bosch Fellow in Germany from August 2008 to May 2009. As part of his Fellowship, Dominic spent four months working at the German Federal Environment Ministry. Dominic worked from 2004 to 2008 as a Policy Analyst for the Environmental Defense Fund, where he focused on the political and economic aspects of international and U.S. climate change policy and emissions trading systems. Dominic graduated summa cum laude from the University of Dayton in 2002 with a Bachelor of Arts in Philosophy and a minor in Economics. He can be reached at dominic.marcellino[at]ecologic-institute.us.

The **Heinrich Böll Stiftung** is a non-profit political foundation affiliated with the German political party of Alliance 90/The Greens. Since 1998, HBS has an office in Washington, DC. HBS North America focuses its work on the issues of global governance and transatlantic dialogue in the fields of climate and energy policy, foreign and security policy, sustainable development, social equity and gender democracy. www.boell.org

The **Transatlantic Climate Policy Group** was a two year program by the Heinrich-Böll-Stiftung, fostering transatlantic dialogue and cooperation on climate and energy policies. The final report of the TCPG Toward a *New Climate Network-Transatlantic Solutions for a Low Carbon Economy*, including a foreword by Governor Schwarzenegger is now available at www.boell.de/climate-transatlantic/index-134.html. The Heinrich-Böll-Stiftung will continue its work on transatlantic dialogue in 2010-2011 with a new program: The Climate Network -Transatlantic Solutions for a Low Carbon Economy. www.boell.org

The **Ecologic Institute** is a think tank for applied environmental research, policy analysis and consultancy. It is dedicated to bringing fresh ideas to environmental policy and sustainable development. Launched in 2009, the Ecologic Institute in Washington DC marks the culmination of the *Ecologic Transatlantic Program*. Its work focuses on transatlantic environmental relations, European environmental policy and integration, energy and climate policy, and environmental services and infrastructure transformation. http://ecologic.eu/washington

The world currently faces three global challenges that relate to the way we travel and commute: global warming, peak oil and energy security. In order to overcome these challenges, municipalities will need to rethink current public transportation systems. This paper assumes that integrated transportation planning (involving public transportation, bicycles, walking and cars) will be key to allowing mobility while addressing greenhouse gas emissions, fuel consumption and energy usage. Working from that assumption and building on a previous study of the Heinrich Böll Stiftung (*Green Solutions to the Auto Crisis*, available at www.boell.de/economysocial/publications-7795.html), this paper highlights examples of successful car and bike sharing programs in the US and Europe and explores how both can be integrated into sustainable transportation systems to relieve some of the environmental and structural pressures cities face.

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