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Planning for Sustainable Transport in Germany and the USA: A Comparison of the Washington, DC and Stuttgart Regions[†]

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ABSTRACT *Federal, state, and local governments in Germany and the USA strive to make passenger transport more sustainable to combat oil dependence, climate change, local pollution, and negative public health outcomes. This paper compares the Washington, DC and Stuttgart regions to demonstrate differences and similarities between the German and US land-use and transport planning systems. To illustrate local planning for more sustainable transport, we compare two best-practice examples for integrating transport and land-use planning: the Rosslyn–Ballston Corridor in Arlington County in the DC metro region and Scharnhauser Park in the City of Ostfildern in the Stuttgart region. In spite of significant differences in motorization, travel behaviour, sustainability, and planning systems, both Arlington County and the City of Ostfildern promote sustainable transport using comparable strategies: (1) mixed-use development around public transport stations; (2) comprehensive long-range plans; (3) citizen participation; and (4) coordinated transport, housing, and economic development policies.*

1. Introduction

Federal, state, and local governments in Germany and the USA strive to make passenger transport more sustainable to combat oil dependence, climate change, local pollution, and negative public health outcomes. This paper compares the Washington, DC and Stuttgart regions to illustrate differences and similarities between the German and US systems of land-use and transport planning. To highlight local planning for sustainable transport, we compare two examples of best practices for integrating transport and land use: the Rosslyn–Ballston Corridor in Arlington County in the DC metro region and Scharnhauser Park in the City of Ostfildern in the Stuttgart region.

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The paper has three main goals. First, we document differences between the two countries and regions in motorization, travel behaviour, and sustainability of transport systems. Next, the analysis identifies structural differences in transport and land-use planning systems at national, regional, and local scales. Last, the paper demonstrates that in spite of significant differences in motorization, travel behaviour, sustainability, and transport and land-use planning systems, German and US local governments that seek to promote sustainable transport rely on comparable strategies and planning goals to increase the sustainability of their transport systems.

Germany and the USA present an opportunity for meaningful comparisons of travel behaviour and planning policies for several reasons. First, both are affluent, western countries with market economies and a high standard of living. Over the last 40 years, the two countries have experienced similar growth rates in per capita gross domestic product (GDP) (OECD 2005), and in 2011, GDP per capita levels were comparable at $45,500 in Germany and $48,200 in the USA (World Bank 2012). Second, Germany and the USA are democratic countries with a federal system of government in which the interaction among federal, state, and local levels of government shapes transport policies (Wentzel and Wentzel 2000). Third, both countries have large automobile industries and cultural recognition of automobiles as important status symbols (Wachs et al. 1992; Schmucki 2001). Finally, both countries contain large networks of limited access highways and have among the highest motorization rates in the world. In addition to these similarities, a comparison of travel behaviour is also facilitated by the high degree of comparability between recent American and German national household travel surveys (National Household Travel Survey/Mobilitaet in Deutschland).

Despite these similarities, there are significant differences between the two countries in terms of automobile dependence and sustainability of the transport system. Germany and the USA are among the most motorized countries in the world. However, in 2010, Americans owned 30% more cars and light trucks per capita than Germans (766 vs. 585) (see Table 1). Americans also drove for a much higher share of daily trips (83% vs. 58%) than Germans. By contrast, Germans were four times more likely to ride public transport (9% vs. 2%), 2.5 times more likely to walk (24% vs. 11%), and 10 times more likely to cycle (10% vs. 1%). A higher share of trips by automobile in the USA is related to greater annual driving distances for Americans than Germans (21,500 vs. 11,000 km).

Table 1 also compares indicators for the sustainability of the transport systems in Germany and the USA. Driving for fewer trips and shorter distances contributes to more sustainable transport in Germany. As shown in Table 1, overall travel and especially walking and cycling, are safer in Germany than the USA. Moreover, higher levels of walking and cycling in Germany contribute to more physical activity and lower obesity levels in Germany than the USA. Compared to Germany, households and the public sector in the USA spend more on transport (see Table 1). Moreover, governments in the USA spend more on roadways than they collect in taxes and fees from roadway users. In Germany, roadway users pay more in fees and taxes than governments spend on roadways. Public transport operation is more financially efficient in Germany. Finally, Germany's transport system is also more sustainable from an environmental perspective when comparing transport energy use and CO_2 emissions (see Table 1).

Table 1. Sustainability indicators for US and German transport systems

Selected sustainability indicators		USA	Germany
Automobile dependence	Automobile ownership (per 1000 population)	766	585
	Annual distance travelled by automobile per capita (km)	21,500	11,000
	Share of all trips by car (%)	83	58
	Share of all trips by public transport (%)	2	9
	Share of all trips by walking (%)	11	24
	Share of all trips by cycling (%)	1	10
Safety and health	Traffic fatalities (per 100,000 population)	11.1	5.1
	Traffic fatalities (per 1 billion vehicle km)	7.1	5.9
	Cyclist fatalities (per 100 million km cycled)	5.5	1.6
	Pedestrian fatalities (per 100 million km walked)	9.7	1.9
	Per cent of the population considered obese (BMI $>$ 30; self-reported data)	23.9	12.1
Cost	Share of household expenditures for transport (%)	17.0	14.6
	Annual household expenditures for transport ($)	7677	5117
	Total government expenditures for roads and public transport by all levels of government (per capita in 2006) ($)	625	460
	Ratio of roadway user fees and taxes vs. roadway expenditures by all levels of government	0.6	2.2
	Government subsidy as share of public transport operating budgets (%)	59	25
Environment	Annual ground passenger transport energy use per person (million BTU)	55	18
	Transport sector share of CO_2 emissions (%)	32	19
	Kg of CO_2 equivalent emissions per capita from ground passenger transport	3800	1200
	Grams of CO_2 equivalent emissions per passenger km	210	110

Source: Buehler, Pucher, and Kunert (2009), BLS (2010), UBA (2010, 2012), Buehler and Pucher (2011), VDV (2011), APTA (2012), EPA (2012), IEA (2012), IRTAD (2012), Pucher and Buehler (2012), and USDOE (2012).

2. Transport in the Washington, DC and Stuttgart Regions: Differences and Similarities

In this paper the Washington, DC region and the Stuttgart region together serve as a basis for comparing similarities and differences between Germany and the USA in terms of transport systems, land-use planning, coordination of transport and land-use planning, and sustainable transport. Although there are many differences between the regions, they also share many similarities that render a comparison meaningful (see Table 2).

Both are among the wealthiest regions of their country with strong economies and labour markets and highly skilled workforces. Both regions showed relative economic stability during the recent economic crisis and experienced strong population in-migrating. The core cities of both regions, the District of Columbia and the City of Stuttgart, have about 600,000 inhabitants. The DC metro region has a larger government sector and more industries associated with the federal government, while Stuttgart has a stronger manufacturing and industrial engineering base. Both regions have regional planning organizations: the Metropolitan Washington Council of Governments (MWCOG) and the Verband Region Stuttgart (VRS).

Table 2. Socioeconomic, demographic, and travel data for the Washington, DC and Stuttgart region

	DC metro region	Stuttgart region
Name of regional governing body	MWCOG	VRS
Number of jurisdictions participating in regional governing body	22 jurisdictions including: District of Columbia, 8 counties (Charles, Frederick, Montgomery, Prince George's, Arlington, Fairfax, Loudoun, Prince William), and 13 municipalities	184 jurisdictions including: City of Stuttgart, 5 counties (Böblingen, Esslingen, Göppingen, Ludwigsburg, Rems-Murr), and 178 municipalities
Land area (per square mile)	3967	1411
Population (million)	5.58	2.67
Population core city	~600,000	~600,000
Gross population density (inhabitants per total land area in square miles)	1406	1875
Net population density (inhabitants per urbanized/settled land area in square miles)	3401	8267
GDP ($/inhabitant)	71,000	45,000
Car ownership (per 1000 inhabitants)	744	544
Cars per household	1.8	1.1
Trips per person per day	3.9	3.5
Median trip distance (km)	5.6	5.0
Total travel distance per person per day (km)	44	40
Daily travel time per person (min)	80	75
Average trip speed (km/h)	28	27
Share of all trips by car (region) (%)	81	57
Share of all trips by car in the central city (%)	51	44
Share of all trips by car in inner suburbs (%)	70–85	~60
Share of all trips by car in peripheral areas (%)	>90	70–75

Source: MWCOG (2010), TPB (2010), USCB (2010), Zumkeller (2011), IEA (2012), Statistisches Landesamt Baden-Württemberg (2012).

Many key differences remain as well. The VRS region is administratively more splintered than the MWCOG region. The VRS comprises 178 member municipalities, the City of Stuttgart, and 5 counties. The MWCOG has only 22 member jurisdictions, including 8 large counties that are not subdivided into municipal governments. In the Stuttgart Region virtually all residents live in areas administered by municipalities. Municipalities in turn are part of a county. Moreover, the DC metro region has about twice as many inhabitants as the Stuttgart region (5.58 vs. 2.67 million inhabitants). The DC metro region covers a

land area that is about 2.8 times the size of the Stuttgart region (3967 vs. 1411 square miles of land area). Gross population density is about 25% lower in the DC metro region (1406 vs. 1875 inhabitants per square mile). Net population densities — just accounting for settled/urbanized land area — yields a 59% lower population density in the DC metro region (3401 vs. 8267 people per square mile). Moreover, the DC metro region is wealthier than the Stuttgart region — at least when measured as GDP per capita which is $71,000 vs. $45,000. In the Stuttgart region, the City of Stuttgart is the wealthiest municipality. By contrast in the DC metro region, the central city — the District of Columbia — is poorer than the surrounding counties of Arlington, Fairfax, Loudon, Prince George's and Montgomery.

In terms of travel outcomes, the DC metro and Stuttgart regions reflect the similarities and differences discussed for travel behaviour at the national level above. Car and light truck ownership levels are higher in the DC metro region than in the Stuttgart region: 744 vs. 544 cars and light trucks per 1000 persons. The average Stuttgart household owns 1.1 cars or light trucks compared to 1.8 for Washington households. Travellers in the DC metro region make about 3.9 trips per day compared to 3.5 trips per day in the Stuttgart region. Average trip distances (~11 km) are similar in the two regions and median trip distance was only slightly longer in the DC metro region (5.6 vs. 5.0 km in the Stuttgart region). With slightly longer trip distances and a greater number of daily trips, inhabitants of the DC metro region travel longer total distances per day (44 km in the DC metro region vs. 40 km in the Stuttgart region). Similarly, self-reported total daily travel time is slightly longer in the DC metro region than in the Stuttgart region (80 vs. 75 min of travel per day). Average trip speed was 28 km/h in the DC region and 27 km/h in the Stuttgart region. It is surprising that average trip speed as well as average travel distance and daily travel time per person are similar, because the DC metro region is larger and its residents drive for a much larger share of trips and are less likely to walk and cycle — which typically cover shorter distances and have lower average speeds than the car.

Regionally, residents of the DC metro region make 81% of trips by car compared to 57% in the Stuttgart region. The larger size of the DC metro region and slightly longer trip distances there cannot fully explain the difference in transport mode choice between the regions. In both regions a similar share of trips was shorter than 2 km (29% of trips in the Stuttgart region and 25% of trips in the DC metro region). However, in the DC metro region more than 2/3 of trips shorter than 2 km were made by automobile. By contrast less than 25% of these short trips were by car in the Stuttgart region. Transport and land-use policies that make walking, cycling, and public transportation more attractive, and restrict car use, may help explain this dissimilarity in mode choice.

Comparing travel in the core of the two regions shows that car use is higher in the District of Columbia than in the City of Stuttgart: 51% vs. 44% of all trips by car. Arlington County and the City of Alexandria, which are adjacent to the District of Columbia and considered part of the urban core of the region, display car usage rates of 70% and 73% respectively (see Figure 1). Car use in these urban core jurisdictions is equal to or greater than car use in most municipalities in the entire Stuttgart Region. Only the two most car-dependent suburban municipalities in the Stuttgart Region — the municipalities of Nürtingen and Geislingen — have car mode shares as high as 70% and 75% (VRS 2011; Siedentop, Roos, and Fina 2013). Other inner suburbs adjacent to the District of Columbia displayed higher rates of car use: Montgomery County (80%), Prince George's County

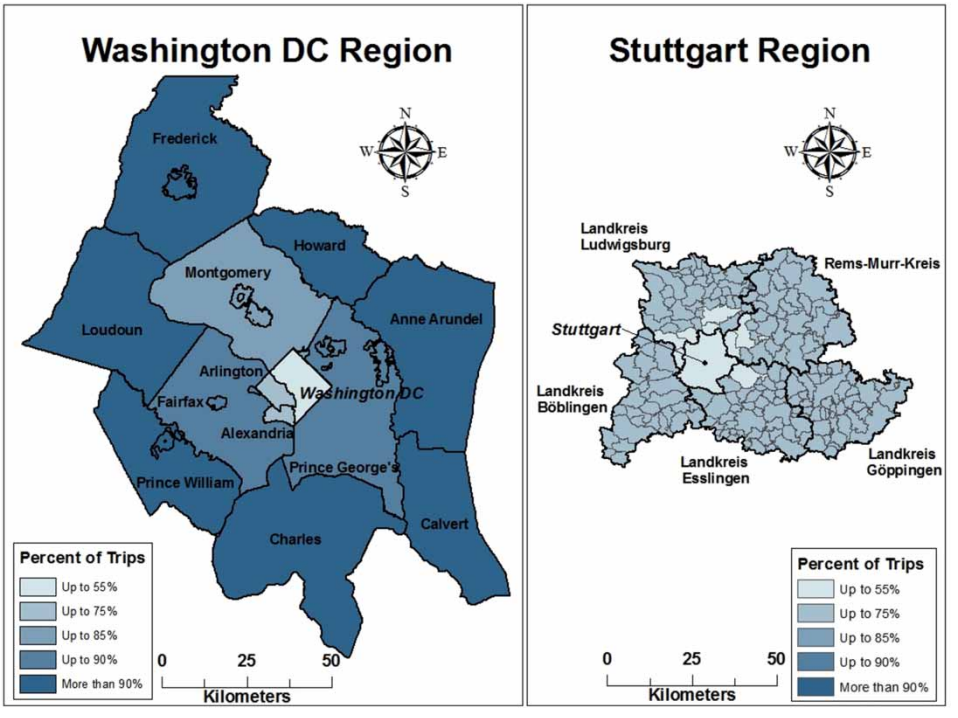

Figure 1. Shares of trips by automobile in jurisdictions of the Washington, DC and Stuttgart Regions, 2008.
Source: MWCOG (2010), TPB (2010), VRS (2011), and Broeg and Erl (2012).

(83%), and Fairfax County (86%). In the outer suburbs of Fauquier, Prince William, Prince Georges, Anne Arundel, and Charles counties in the DC metro region, the automobile accounted for more than 90% of all trips (MWCOG 2010). Walking and cycling only accounted for about 6% and public transport for less than 2% of trips in most suburban jurisdictions in the DC metro region. Even in the most car-oriented jurisdictions of the Stuttgart region, walking and cycling account for more than 22% of trips and public transport's mode share was above 3%.

3. Transport and Land-Use Planning in the USA and Germany: Differences and Similarities

Differences in travel behaviour observed above can be explained by socio-economics, demographics, culture, and diverging transport and land-use policy and planning systems in Germany and the USA. The following discussion focuses on transport and land-use planning systems. Detailed discussions why other factors do not fully explain differences in travel behaviour can be found in other publications (Buehler and Pucher 2011; Buehler and Jung 2013). The remainder of this paper will introduce transport and land-use planning systems in Germany and the USA using the DC metro and Stuttgart regions as examples. Best practice case studies from both regions highlight similarities in planning for sustainable transport.

3.1. Comparison of Land-Use Planning Systems in the USA and Germany

The federal governments in both Germany and the USA impact land-use planning through environmental, housing, and transport policies (Kayden 2001). In addition, in both countries land-use planning is primarily implemented at the local level. However, the federal role is much more extensive in Germany than the USA. For example, in Germany the federal government prescribes an overall land-use planning process at lower levels of government through the Federal Spatial Planning Act (Bundesraumordnungsgesetz) and the Federal Building Code (Baugesetzbuch). The German federal government defines the legal framework for land-use planning, ensures consistency of planning techniques, and — in collaboration with the states — sets broad strategic goals for spatial development, such as sustainability (Wiegandt 2004). As a result, German federal, state, regional, and local governments interact in a bottom-up and top-down land-use planning process, coordinating their spatial plans in an interactive way (BMVBS 2000).

Municipalities in Germany generate and administer local plans and delineate allowable land uses. Local plans in Germany, however, are restricted by regional and state plans and must be in compliance with federal land-use, transport, and environmental laws (Kunzmann 2001). In contrast, there is no federal legislation in the USA that connects federal, state, regional, and local levels of land-use planning. Thus, most land-use planning in the USA is fragmented, uncoordinated, and almost always in the domain of local government jurisdictions (Schmidt and Buehler 2007).

Most local governments in the USA have passed zoning ordinances that limit the use of land in the entire jurisdiction, and zoning has emphasized the separation of all types of land uses. In contrast, German residential zones can include such varying uses as doctor's offices, apartment buildings, businesses, small shops, and restaurants (Hirt 2012). As a result, many German 'residential' areas would be considered 'mixed-use' in the USA. Additionally, German municipalities apply their zoning to smaller land areas — sometimes as small as a block — while US municipalities typically apply their zoning to larger areas of land (Hirt 2012). Strict separation of land uses, exclusion of apartment buildings, doctor's offices, corner stores, and small businesses from single family residential zones, and larger areas of single-use zoning result in longer trip distances in the USA — which in turn necessitate more trips by car. Thus, Germany's practice of zoning for smaller land areas and the more flexible zoning code has helped to reduce trip distances and car dependence — even when planners did not explicitly coordinate transport and land use.

Finally, land-use planning in both countries is influenced by the need to achieve development patterns that support fiscal needs. In Germany, local jurisdictions mainly compete for business and income taxes, while in the US local governments focus more on property taxes to fund local expenditures, such as police, water and sewer, or court services (Orfield 2002; Schmidt and Buehler 2007).

In contrast to the fragmented system in the USA, coordination and negotiation of different levels of planning authorities for land use in Germany facilitates coordination with transport planning. For example, development can more easily be concentrated along public transport routes to provide high capacity public transport connecting to the centres of the region. The Stuttgart Regional Plan allots higher growth rates to communities with rail public transport than for those without. In the DC metro region individual

municipalities decide how to connect their land use to the metrorail system. For example, Arlington County built high density mixed use around its metrorail stops in the Rosslyn–Ballston Corridor, while Fairfax County chose to build car parking lots next to its metrorail stops.

3.2. Comparison of Transport Planning Systems in the USA and Germany

Transport planning in Germany at the national level is guided by a national transport strategy codified in the Federal Transport Plan, while in the USA it is guided by surface transport authorizations, which delineate the types of investments eligible for federal transport funds as well as the amounts available. After World War II both German and US federal governments favoured the building of highways over support for other modes of transport. In Germany this included rebuilding and completing the Autobahn system. In the USA, the interstate highway system (authorized in 1956) was similar to the German Autobahn system (Weiner 2013), but in contrast to the Autobahn (which mainly runs between cities), the interstate highway system also crisscrosses most cities and urban areas. During this period, planning for transport focused on highways in both countries. Since the 1970s, however, the transport planning environments for the two countries have increasingly diverged.

In 1973, Germany's Federal Transport Plan began including societal goals, such as open space preservation, traffic fatality reduction, and energy use and emissions reduction (Koeberlein 1997). Moreover, since the mid-1970s, the German federal government has also provided dedicated matching funds to state and local governments for public transport capital investments that are part of local comprehensive transport plans, comply with land-use plans, and consider the needs of the disabled and the elderly (BMVBS 2005). Since the 1970s, there has also been some movement towards funding for other modes of transport in the USA, but at a much smaller scale than in Germany. For example, the Federal-Aid Highway Act of 1973 allowed a part of the Highway Trust Fund revenue to be used for public transport (Weingroff 2013). However, federal transport funding in the USA is still predominantly dedicated to roadways (Weiner 2013).

Despite shifts to broader transport planning goals in both countries, Germany has committed to support alternatives to the automobile more completely and has made car use more expensive. For example, over the last 40 years Germany has raised its gas tax more frequently and to higher levels than the comparable US tax; gasoline taxes in Germany are about nine times higher than in the USA (Buehler 2010). The goal of Germany's gas tax increases has been to fund government expenditures — making driving more expensive even if the explicit purpose of the tax increases has not been to curb driving. By contrast, low taxes on gasoline in the USA have supported federal and state transport plans with a long tradition of prioritizing highways over other modes of transport (Weiner 2013). In 2013, a gallon of premium gasoline cost about $8 in Germany compared to $4 in the USA (EIA 2013).

More recently, both Germany and the USA have encouraged walking and cycling via flexible funding that allows federal monies to be used for roadways or non-motorized modes. In the USA, the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) made walking and cycling eligible for Highway Trust Fund revenue for the first time. However, ISTEA's attempts to promote alternatives to driving were accompanied by simultaneous increases in federal roadway funds (Weiner 2013) and barriers to intermodal

coordination have persisted (TCRP 1996). In contrast, Germany has a longer tradition of funding for non-automobile modes (e.g. Municipality Transport Financing Act of 1971 — Gemeindeverkehrsfinanzierungsgesetz). Moreover, Germany's federal traffic laws protect cyclists and pedestrians, and pedestrian and cyclist safety is part of the German driver's licence test. Since the early 2000s, the German government has also published a national bicycle master plan (FahrRad!) (BMVBS 2002). In Germany, as in the USA, most innovations, such as integrated city-wide bicycling networks, were pioneered and then widely implemented at the local level (Buehler and Pucher 2011).

Overall, German federal government policies have made car use more expensive and supported alternatives to the car earlier and more comprehensively, while in the USA restraint of automobiles and support for alternatives have been much lower and lagged in timing.

3.3. Transport and Land-Use Planning in the Washington, DC and Stuttgart Regions: Differences and Similarities

In both the Stuttgart and Washington, DC regions, short-range transport plans outline specific projects that are guided by strategic goals defined in long-range transport plans. In the Stuttgart region, the General Transport Plan of the State of Baden-Württemberg acts as a framework for the Regional Transport Plan of the VRS. VRS is a corporation of public law, responsible for (inter alia) regional spatial planning, regional transport planning, and regional business development in the Stuttgart region. The responsibilities of the VRS go beyond those of the other 11 regional planning associations in Baden-Württemberg and indeed most other planning associations in Germany. Moreover, the Regional Parliament gives regional planning in the Stuttgart Region much more public legitimization and political power compared to other regions in Germany. The state transport plan lists projects for roads and railways, but does not prioritize them. The state plan also provides non-binding suggestions for planning for non-motorized transport for the regions and municipalities. The regional plan is an integrated concept for mobility in the Stuttgart Region that provides guidelines for transport planning. Transport planning at the regional level is further guided by the Local Transport Plans of the municipalities, which outline policies relating to infrastructure projects and the quality of transport services.

In the Washington, DC region, the Departments of Transport for Maryland, Virginia, and the District of Columbia each develop short- and long-range transport plans to comply with federal requirements for state planning funds. In addition, the MWCOG develops short- and long-term regional transport plans through its Transportation Planning Board (TPB). MWCOG essentially functions as the regional metropolitan planning organization (MPO) empowered with administering certain portions of federal surface transport funds and represents 22 local jurisdictions as well as Maryland, Virginia, and the District of Columbia (MWCOG 2013a). An incentive for consistency among plans is provided in the federal legislation, which requires projects seeking federal funding to be included in both state and MPO short-range transport plans.

Both the Stuttgart and Washington, DC regions make efforts to plan for public transport and non-motorized transport. In the Stuttgart region, public transport provision is coordinated by a single entity, the Stuttgart Regional Public Transport Organization (Verkehrsverbund Stuttgart (VVS)). Forty-one transport companies, either private or government

owned, collaborate in the VVS to jointly serve jurisdictions in the Stuttgart region besides the county of Goeppingen. The state, regional, and local governments issue requests for proposal that stipulate requirements for the quality and frequency of public transport services and provide funding if ticket revenues do not fully cover operating costs. Service is provided by different (often publicly owned) transport companies, but coordinated by VVS. In addition, VVS also contributes to the planning and building of new railway lines.

The VVS system provides one comprehensive network for all public transport in the Stuttgart region, such that ticketing is uniform across commuter rail, metro rail, light rail, and bus services, timetables are coordinated, and information about services is centralized in one integrated trip planning database. This integrated system also allows for discounted daily, weekly, monthly, and annual passes, as well as discounts for students, seniors, and commuters via company tickets.

In the Washington, DC region, public transport provision is much more fragmented. Regional bus and rail services are provided by the Washington Metropolitan Transit Authority. In addition, commuter rail is provided by the Virginia Railway Express and the Maryland Area Regional Commuter rail. A number of local and independent bus services also operate, including the DC Circulator, the Ride On bus service in Montgomery County, and the Arlington Transit bus in Arlington County. Nevertheless, the region is a national leader in terms of overall regional integration of public transport, including cross-service fare payment via the SmarTrip card valid for many providers (Miller et al. 2005; Rivasplata, Smith, and Iseki 2012). Still, in general fares and timetables remain much less coordinated than in Stuttgart.

In both the Stuttgart and Washington, DC regions, regional plans generally provide non-binding suggestions in terms of planning for walking and cycling, while individual jurisdictions are left to develop travel networks for these modes. The TPB in the Washington, DC region developed a 'Bicycle and Pedestrian Plan for the National Capital Region' in 2006 (MWCOG 2006), but implementation is left to local jurisdictions and has varied significantly. The 2001 Regional Transportation Plan of the VRS integrates all modes of transport and gives suggestions for fostering walking and cycling (VRS 2001). The Regional Transport Plan is currently being revised to stress non-motorized modes of transport and enhance the regional cycle network. In general, the development of dedicated facilities for cycling and walking is much more extensive across the Stuttgart region than the Washington, DC region, reflecting the travel trends seen at the national level.

In terms of land-use planning, local jurisdictions in both the Stuttgart and Washington, DC regions have the main responsibility for regulating land-use. In the Stuttgart region, the main instruments for local land-use planning are the Land-Use Plan (Flächennutzungsplan) and Local Building and Construction Plan (Bebauungsplan). The Land-Use Plan is a preparatory plan laying out the general outline of existing and future land use by type (general types of use include housing, mixed use, industrial and commercial, special purpose). Furthermore, the Land-Use Plan defines (to a certain extent) the so-called 'inner zone' (Innenbereich) and 'outer zone' (Außenbereich) of a municipality. In the outer zone, no construction is allowed, besides those types of typical uses for outer zones, such as agriculture or energy production. The Local Building and Construction Plan consists of legally binding urban development ordinances. In the Local Building and Construction Plan, the specific categories of land uses, defined by the Land Utilization Ordinance, are constituted for small areas. Although both documents traditionally separate land uses (Albers 1992), all categories have some flexibility to allow other uses.

Additionally, there are binding stipulations in the Regional Plan regarding the planning of new zones for housing, business, etc.

In the Washington, DC region, there is no comparable binding land-use planning process. However, in 2006 the MWCOG launched the 'Transportation/Land-Use Connections Program' to provide a way for the TPB to assist local jurisdictions in implementing coordinated efforts for concentrated mixed-use development in regional activity centres (MWCOG 2013b). In general, local jurisdictions throughout the region each develop their own comprehensive master plans that are then implemented through binding zoning ordinances (Hirt 2012). Although the DC area local governments exert considerable control over land-use decisions, that authority is not absolute. Both state and regional governments also influence planning and land-use decisions. For example, in Virginia the state requires localities to update their comprehensive plans every five years. A Maryland statute limits the spending of state funding for water and sewerage programmes to designated priority areas.

Both the Stuttgart and Washington, DC regions have pursued transit-oriented development (TOD) to varying degrees (Leach 2004; TCRP 2011). In Stuttgart, the regional plan delineates 'growth poles' (Siedlungsbereiche) or 'spokes' (Entwicklungsachsen) that are located along public transport lines and are designated for future growth concentration. These areas stand in contrast to areas designated for lower levels of growth (Eigentwicklung) that are typically not connected to public transport lines. Housing development is concentrated in the growth poles and additional 'regional centres for housing' within the growth poles. It is a regional goal to reduce land used for settlements and to curb sprawl in the Stuttgart region. The high degree of regional planning coordination fosters this concentrated growth around public transport. In contrast, while regional plans make land-use recommendations, the MWCOG land-use vision is not legally binding for member jurisdictions. As a result, individual municipalities in the Washington, DC region decide if and how to connect their land use to public transport systems. As mentioned above, Arlington County chose to concentrate high density mixed-use developments around metrorail stations in the Rosslyn–Ballston Corridor, while Fairfax County chose to build park-and-ride car parking lots next to its metrorail stops.

4. Comparison of Regional Best-Practice Developments for Integrating Land-Use and Transport Planning: Arlington County's Rosslyn–Ballston Corridor and Scharnhauser Park in the Stuttgart Region

Both Arlington County's Rosslyn–Ballston Corridor and Ostfildern's Scharnhauser Park in the Stuttgart Region are best-practice cases for integrating land-use and transport planning in their respective regions. This section provides a comparison of local government policies in both regions. In spite of large structural differences in transport and planning systems, these cases share many similarities in their efforts to coordinate transport and land use at the local level to achieve more sustainable transport.

Table 3 provides information about Arlington County and its Rosslyn–Ballston Corridor as well as the City of Ostfildern and its Scharnhauser Park development. Arlington County is located immediately adjacent to Washington, DC and has about 212,000 inhabitants living on 26 square miles of land. Ostfildern is about 10 km (6 miles) from Stuttgart City Center, has 36,000 inhabitants and a land area of 8.8 square miles. Population density of Arlington County is twice as high as population density of the City of Ostfildern: 8171 vs. 4155 persons

Table 3. Comparison of the Rosslyn–Ballston Corridor and Scharnhauser Park

Jurisdiction	Arlington County	City of Ostfildern
Distance to central city of region	Immediately across the Potomac River from the District of Columbia	About 6 miles from the city centre of Stuttgart; public transport travel time to Stuttgart Central Station is 23 min
Population	212,470	36,093
Population growth 1990–2011 (%)	24	26
Land area (square miles)	26.0	8.8
Gross density (inhabitants per total land area in square miles)	8171	4155
Development	**Rosslyn–Ballston Corridor**	**Scharnhauser Park**
Population	41,372	7,108
Share (%) of jurisdiction population	21	19
Land area (square miles)	1.50	0.54
Gross density (inhabitants per total land area in square miles)	27,581	13,150
Year construction began	1979	1994
Number of rail stops	• 5 with a total distance of 2.5 miles	• 3 with a total distance of about 0.75 miles
Financing	• Mix of federal, state, and county funds; Arlington County issued over $100 million in bonds for construction/maintenance of underground metrorail	• Mix of federal, state, county and City of Ostfildern funds
Main planning goals	• Clearly defined boundaries of the Rosslyn–Ballston Corridor with targeted 'bull's eye' development around metrorail	• New development of former military site
	• Increase in density; concentration of density within walking distance of metrorail	• Build urban quarter of high density
	• Mixed use development; commercial revitalization	• No part of the settlement to be farther than 1500 feet from closest railway station
Long range and comprehensive plans	• Comprehensive Plan served as a blueprint for the corridor's development	• Master Plan guided the development of the area and determined several planning procedures in advance to create a 'regional centre for housing'
	• Establishes 'the overall character, extent, and location'	
Citizen involvement	• 'The Arlington Way' defined as 'inclusive, accessible, respectful, constructive, persistent, and purposeful dialogue' guides county government initiatives	• Two-tiered participation process for the land-use plan and local building and construction plan
	• Continues to be reinvigorated	• Public participation and citizen meetings for the Master Plan
Coordinated programming and policies that together support diverse transport, housing, and business opportunities	• Public transport service, pedestrian and bicycle facilities, parking regulations	• Intensive coordination of land-use and transport planning
	• Transport demand management programmes and marketing in order to encourage and enable use of alternatives to the automobile	• Reduced parking standards
		• Bike and ride and car-sharing facilities

per square mile. Both Arlington and Ostfildern experienced a 25% increase in population between 1990 and 2011 — large shares of those increases were concentrated in the Rosslyn–Ballston Corridor and Scharnhauser Park respectively.

The Rosslyn–Ballston Corridor and Scharnhauser Park account for roughly 20% of their jurisdiction's population (41,372 vs. 7108). Similar to the Arlington County and City of Ostfildern comparison, the Rosslyn–Ballston Corridor's population density is about twice as high as the density of Scharnhauser Park. The Rosslyn–Ballston Corridor was built around five subway stations spanning a total of 2.5 miles. Average station spacing is about 0.5 miles. Scharnhauser Park's three rail stations are about 0.25 miles apart. Both developments were financed using a mix of federal, state, and local funds. In the case of Arlington, the local role in financing was larger, because the County issued bonds to finance the construction and maintenance for putting metrorail underground. Both developments have seen sharp increases in public transport usage. Differences and similarities in histories, planning goals, citizen involvement in planning, and accompanying policies are described in detail below and listed in Table 3.

4.1. Arlington County's Rosslyn–Ballston Corridor

Like many urban areas in the USA, Arlington County experienced an influx of residents and development after World War II, and then steady decline as the 'postwar boom' receded. During the 1960s and 1970s local opposition to the construction of Interstate 66 through Arlington County led to a scaled-down version of the highway and the location of five stations of the new regional Metrorail directly under the declining Rosslyn–Ballston Corridor (TCRP 2011). Plans focused redevelopment within a quarter-mile walking radius of stations to allow for easy pedestrian access. Metrorail service between Rosslyn and Ballston began in 1979. Despite a quadrupling of office space and housing units since the late 1970s, redevelopment has only generated modest increases in car traffic on local streets (Leach 2004). Many of the newly generated trips are by public transport. Between 1990 and 2012, average weekday passenger trips by public transport in the Rosslyn–Ballston Corridor rose by 42% from 67,600 to more than 96,000. Approximately 16% of corridor households do not own a vehicle, and in some residential developments in the corridor, an estimated 40–60% of residents do not use a vehicle on a daily basis (Arlington County 2008). Single occupancy vehicle commuting has been declining in the corridor, while commuting by walking, biking, and public transport has been increasing. For example, between 2000 and 2006, the share of commuters driving alone to work decreased from 55% to 47% and the share using public transport increased from 18% to 27% for Arlington County as a whole.

4.2. Ostfildern's Scharnhauser Park

Scharnhauser Park, belonging to the City of Ostfildern, is a former US military site — Nellingen Barracks — that housed approximately 7000 US soldiers until it was abandoned in 1992 (Stadtchronik Ostfildern 2011). Enhancing the transport infrastructure, especially public transport, was a precondition for development voiced by politicians and planners at regional and local levels. For example, the mayor of Ostfildern stressed that the development of Scharnhauser Park would only take place given the extension of light rail to the area (Stuttgarter Nachrichten 1993; Bender 2004). Based on the Master Plan's estimate of

10,000 passengers per day, the Stuttgart Straßenbahnen AG (SBB) decided to extend the existing railway line from Heumaden to Nellingen via Scharnhauser Park. Thus, Scharnhauser Park would not have been built without rail access and the rail line would not have been extended without development plans for Scharnhauser Park ('No light rail without Scharnhauser Park, no Scharnhauser Park without light rail') (Bender 2004). Starting in the year 2000, just one line served the extension from Heumaden to Nellingen, but that same year the City of Ostfildern and the SSB decided to establish a new line, the U8. Initially, the U8 ran only during peak hours; however, due to the success of public transport within Ostfildern and the popularity of connections to Stuttgart, the schedules were eventually extended to the entire day and the line was further extended using previously abandoned tracks. From its founding in 1975–2011, the City of Ostfildern grew by 8500 inhabitants, from 28,000 to 36,500 inhabitants. Most of these gains were due to the development of the settlement of Scharnhauser Park: more than 70% of this increase occurred after the development of Scharnhauser Park started in 1994 (Statistisches Landesamt Baden-Württemberg 2012).

4.3. Comparison of Local Policies to Coordinate Transport and Land Use

The wide array of policies and programmes utilized in support of the development of the Rosslyn–Ballston Corridor in Arlington County and Scharnhauser Park in the City of Ostfildern are characterized by four key features that have contributed to their success in planning for sustainable transport:

4.3.1. First, planning goals focus on dense and mixed land uses around public transport stops. In Arlington, this meant targeting 'bull's eye' zones of mixed-use and high density development around public transport stations (see Figure 2). The stations are about 0.5 miles apart so that access to a station is within a 10–15-min walk from anywhere in the corridor. Density around the stations is planned so that the highest intensity development is in the immediate vicinity of the stations, while development density 'tapers' down progressively as the distance from a station increases. The stations also serve as focal points for distinct neighbourhoods with mixed land uses and varying emphases on government, educational, retail, and business development that foster a balance of land uses throughout the corridor.

Scharnhauser Park is not a typical suburban, low-density settlement with single and semi-detached housing, but urban in character and comprised of a mixture of low, medium, and high-density housing (single and semi-detached houses, row houses, town houses, tower blocks, see Master Plan Figure 3). There are also areas of mixed uses and areas for commercial activities. The settlement pattern is characterized by short distances to the stops of public transport — no part of the new town is more than 0.3 miles from the new railway station.

Conceived and built about 10 years prior to the Leipzig Charta (BMVBS 2007), Scharnhauser Park nevertheless exhibits some important aspects of the Charta, which was written by ministers responsible for urban development in European countries. The City of Ostfildern as well as the County of Esslingen and the Stuttgart Region used an approach similar to an Integrated Urban Development Program (as recommended by the Leipzig Charta) by coordinating and bundling funds across different sectors (e.g. transport, water, etc.) and spatial plans as well as encouraging citizen participation. Environmental, economic,

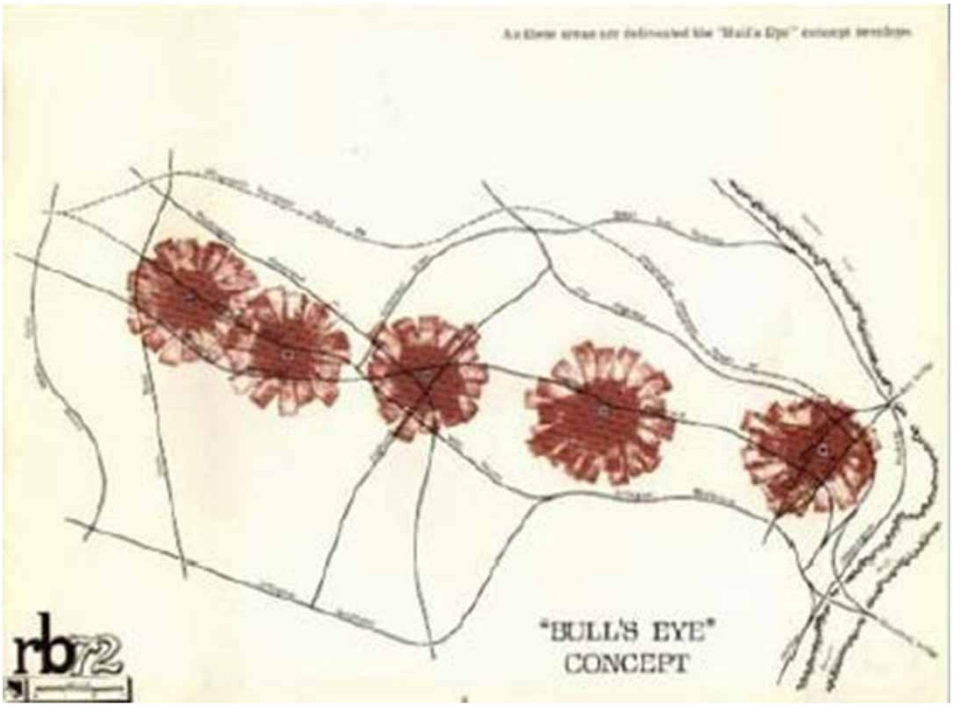

Figure 2. The 'bull's eye' concept of TOD as envisioned in early Rosslyn–Ballston Corridor planning (Leach 2004).

social and transport aspects were taken into account, leading to the new development of Scharnhauser Park being characterized by high density, mixed use, and public transport orientation. An important feature was to centre the new development area around three new regional railway stops. Moreover, the high density of the new settlement as laid out by the Local Building Plan resulted in a high number of potential passengers for the railway line. At the same time the Land-Use Plan was revised to channel most new housing development to Scharnhauser Park — aligning with the Transport Plans of the region and the county.

Both case studies show that car dependency can be lowered by concentrating development around public transport. This proximity of mixed-use development to public transport enables residents to reach everyday life activities without the use of a car or need to travel greater distances. This illustrates the concept of the 'City of short distances' (Jessen 1997; BBR 1999).

4.3.2. Second, long-range and comprehensive plans are important to assure sustained success. Arlington County's Comprehensive Plan served as a blueprint for the corridor's development. As the main policy guide for development of the county, it establishes 'the overall character, extent, and location' of development (Arlington County 2012). In conjunction, Sector Plans outline the overall vision of development around each metrorail station, including design standards, public improvements to the streetscape and open

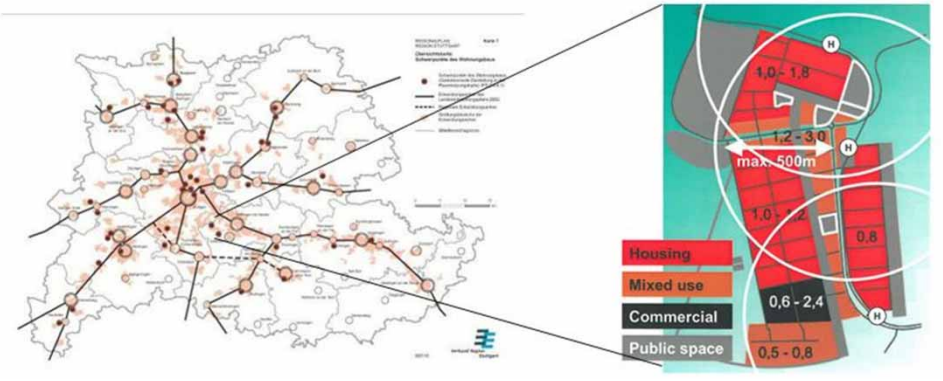

Figure 3. Central places, axes, growth poles, and regional centres envisioned for housing in the Stuttgart Region, Master Plan of Scharnhauser Park.
Source: VRS (2009) and Stadt Ostfildern (2012).

space, as well as locations of various development uses. The result of this multi-faceted body of planning documents and adjoining processes is a cohesive planning vision for the corridor that is both reliable and adaptable.

In the case of Scharnhauser Park, the establishment of the Master Plan guided the development of the area and determined several planning procedures in advance. Both the local and regional plans were changed to identify Scharnhauser Park as a 'regional centre for housing' (see above). In 1992 a first feasibility study and urban design competition started to develop new ideas for how to re-use the site. After an interim use for the athletes of the World Athletics Competition in 1993, the City of Ostfildern bought the whole area and a development statute (Entwicklungssatzung) was enacted to give the municipality the property value gains for parcels of land. These gains were to be used to build infrastructure. In 1994, a master plan for the re-use of the land was created and the first developments underwent construction. The master plan foresaw about 3000 housing units for about 9000 new inhabitants along with retail and office/commercial space for about 2000 employees on an area of 141.3 ha (349.2 acres). The new housing area is seen as a city quarter on its own, rather than as an addendum to Scharnhausen or as the new centre of the City of Ostfildern.

Long-range, comprehensive plans cannot guarantee coordinated development, but they do serve as an important foundation for building the necessary political and public commitment, independent of election cycles.

4.3.3. Third, citizen participation is key. Arlington's plans have been developed through extensive outreach efforts to the community, developers, and other stakeholders. As a result, policymakers, developers, and community members have been able to work together using a broad and stable understanding that is also conducive to refinements to the planning principles as well as innovations. The County government is committed to 'The Arlington Way' — characterized by 'inclusive, accessible, respectful, constructive, persistent, and purposeful dialogue'- and periodically updates its outreach efforts with initiatives such as 'PLACE — Participation Leadership and Civic Engagement' (Arlington County 2014). Public participation also played a major role in Scharnhauser Park: besides

the two-tiered participation process for the Land-Use Plan and Local Building and Construction Plan as outlined in the Federal Building Code (Baugesetzbuch), the development of the Master Plan was accompanied by public participation and meetings, which involved discussing critical aspects of new roads, 'social infrastructure' like kindergartens and schools, and the design of public space. This last aspect was seen as a key feature for the new quarter.

A consensus of politicians, developers and citizens is important for successful coordinated development. Other projects, such as the controversial Stuttgart21 project – to turn the terminus station of the Stuttgart main railway station into an underground through-station — have demonstrated that consensus and participation is important and not necessarily common in the Stuttgart region.

4.3.4. Fourth, coordination of programming and policies that together support diverse transport, housing, and business opportunities is important. In terms of transport, Rosslyn–Ballston Corridor planners leverage public transport service, pedestrian and bicycle facilities, parking regulations, transport demand management programmes, and marketing in order to encourage and enable use of alternatives to the automobile. The corridor offers a wide array of housing and transport options that are centred around the five metrorail stations. Additional transport options include local and regional bus service via Metrobus and Arlington Transit, bike-sharing through Capital Bikeshare, and car-sharing. Scharnhauser Park also provides diverse transport and housing options centred around the railway stations. The development supports alternatives to car use, with facilities for bike-and-ride and car-sharing established at the new railway stops. In addition, the development features reduced car parking standards for housing, office and retail space.

Overall, the policies shaping both the Rosslyn–Ballston Corridor and Scharnhauser Park illustrate the importance of mutually consistent transport policies that also support the larger policy framework. The results have been increasing levels of public transport use, cycling, and walking.

Key challenges for both the Rosslyn–Ballston Corridor and Scharnhauser Park include affordable housing, historic preservation, cohesive design of the built environment, and the continued improvement of facilities for pedestrians and bicyclists (Leach 2004). Housing affordability in particular is one of the greatest challenges facing the Rosslyn–Ballston Corridor. The primary tool to preserve affordable housing is the zoning framework, which provides a variety of incentives for affordable units, including density bonuses and a requirement of one-for-one replacement of affordable units in a designated area called the Special Affordable Housing Protection District (Dawkins and Buehler 2010). In addition, the county has established a revolving loan fund, the Affordable Housing Investment Fund, which finances affordable housing development in the county (Dawkins and Buehler 2010).

Housing is one of the major concerns in the Stuttgart region, as well. On the one hand, there is still a significant amount of in-migration to the Stuttgart region; on the other hand, land is a scarce resource in the region, resulting in relatively high population densities and real estate prices. Politics and planning have to deal with the conflict of offering enough parcels of land for the population while at the same time protecting the landscape and nature from exhaustive land claims and reducing traffic caused by commuting. With the conversion of the former Nellingen Barracks military site to the Scharnhauser Park development, a unique but challenging opportunity arose for the City of Ostfildern and the

region as a whole. For the rather small City of Ostfildern, undertaking this development alone was not financially feasible. However, through negotiations with various levels of government (District, State, Federal), a financial agreement was achieved, which included the use of different funds (e.g. the State Rehabilitation Program or grants for the State Garden Exhibition) to buy the military site and invest in the required infrastructure.

5. Conclusion

The Washington, DC and Stuttgart regions mirror national differences in travel behaviour between the USA and Germany. Dissimilarities in transport and land-use policies and planning can help explain these differences in travel behaviour. Since the 1970s all levels of government in Germany have increasingly implemented policies that raise the monetary and time cost of car travel. Moreover, many German cities and regions have promoted walking, cycling, and public transport as attractive alternatives to the car. Compared to Germany, US federal, state, and local transport policies during the last 60 years have been more favourable for the automobile. Moreover, land-use policies in the USA more strictly separate land uses and increase distances between trip origins and destinations.

In contrast to the USA, Germany has a long tradition of coordination of transport and land use within the country's planning system across administrative levels. As long as there is consensus across levels of government about policies, like reducing land claims, limiting GHG emissions, promoting public transport, or decreasing car dependency, plans are easier to implement on the local level in Germany than the USA. As the case study of Scharnhauser Park highlighted, the existing land-use planning system facilitates coordination of transport and land-use planning if there is a mutual interest for (re-)development between local transport agencies, local governments, and developers. Germany's planning system can help facilitate the coordination of transport and land use. However, the final initiative has to come from the local level. Scharnhauser Park exemplifies how public transport and development can mutually catalyse one another.

In the USA, land-use planning remains fragmented across jurisdictional boundaries, uncoordinated between levels of government, and typically not integrated with planning for transport. Thus, for local governments achieving coordination of transport and land-use planning is institutionally more difficult in the USA. In contrast to Scharnhauser Park, Arlington County, Virginia could not rely on the help of a proven system of coordinated planning for land use and transport. The Rosslyn–Ballston Corridor case study shows how a local jurisdiction can overcome major obstacles to the integration of transport and land use posed by a system of splintered responsibilities and planning authorities. Arlington County was able to locally focus mixed-use, dense development around the Rosslyn–Ballston Corridor stops of a new metrorail system by bargaining with other governmental agencies and levels of government. Arlington County is still an atypical case in the USA and has been a leader showing the way for other US communities who wish to successfully coordinate transport and land use.

In spite of the large differences in planning, land-use, and transport systems between Germany and the USA, the developments of the Rosslyn–Ballston Corridor and Scharnhasuer Park share many similarities in planning goals, the use of comprehensive plans, citizen involvement, and packaging of mutually beneficial policies. These similarities

may be best practices for the successful coordination of transport and land use, because they seem to have worked successfully in two different contexts.

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