

Vienna's Path to Sustainable Transport

by Ralph Buehler, John Pucher, and Alan Altshuler

Abstract

Vienna, Austria reduced the car share of trips by a third between 1993 and 2014: from 40% to 27%. The key to Vienna's success has been a coordinated package of mutually reinforcing transport and land-use policies that have made car use slower, less convenient, and more costly, while improving conditions for walking, cycling, and public transport. During 32 in-person interviews in Vienna in May 2015, a wide range of politicians, transport planners, and academics almost unanimously identified the expansion of the U-Bahn (metro) and parking management as the most important policies accounting for the reduction in car mode share since 1993.

Implementation of sustainable transport policies in Vienna has been a long-term, multi-staged process requiring compromises, political deals, and coalition-building among political parties and groups of stakeholders. This consensual approach to policy development has been time-consuming. Vienna has not been the first city to introduce any particular policy, but it has masterfully adopted successful policies from other cities.

The continuity of Social Democratic governments in Vienna since 1945 has provided a crucial political basis for long-term implementation. The Greens have vigorously pushed for accelerating implementation of sustainable transport policies since becoming part of the ruling coalition government in 2010. The progressive political environment in Vienna has been essential to its increasingly sustainable transport system.

Other major cities in Western Europe have also reduced the share of trips by car since 1990. Together with Vienna, they provide useful lessons for other cities throughout the world on how to reduce car dependence.

Key Words: sustainable transport, cycling, walking, public transport, car dependence, politics

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1. Introduction

Several studies suggest a stagnation or decline in car ownership, use, and driver licensing rates in recent years in high-income countries in Western Europe, North America, and Australia. Millard-Ball and Shipper (2011) examined annual national data from 1970 to 2008 for the USA, Canada, Australia, France, the United Kingdom, Sweden, Germany, and Japan. Controlling for income levels, they found steady increases in car ownership and use per capita until about 2000, but a leveling off or decline since 2000. Kuhnimhof et al. (2012) compared car ownership and driver licensing rates across generations in Germany, France, Great Britain, Japan, Norway, and the USA, finding that for the first time, the younger generation is driving less than previous generations and using public transport, walking, and cycling more. In 2013 Transport Reviews published an entire issue examining the topic of peaking of car ownership and use (Goodwin & van Dender, 2013). Most of the articles confirmed the recent leveling off or much slower growth in car ownership and use in Western countries.

Data on travel mode choice for some specific high-income cities also reveal a decrease in the share of trips by car and an increase in the mode share of walking, bicycling, and public transport over the past two decades (Cervero, 1998; Newman & Kenworthy, 2015; UN Habitat, 2013). Vienna, Austria, for example, reduced car mode share by a third—13 percentage points—more than any other major city in Western Europe for which travel surveys are available over the past 25 years (see Figure 1). By comparison, the next largest reductions in car mode share were in Paris (-10 percentage points) and Copenhagen (-9 percentage points). Reductions in the other eight cities were, in order: Amsterdam and London (-8 percentage points); Munich,

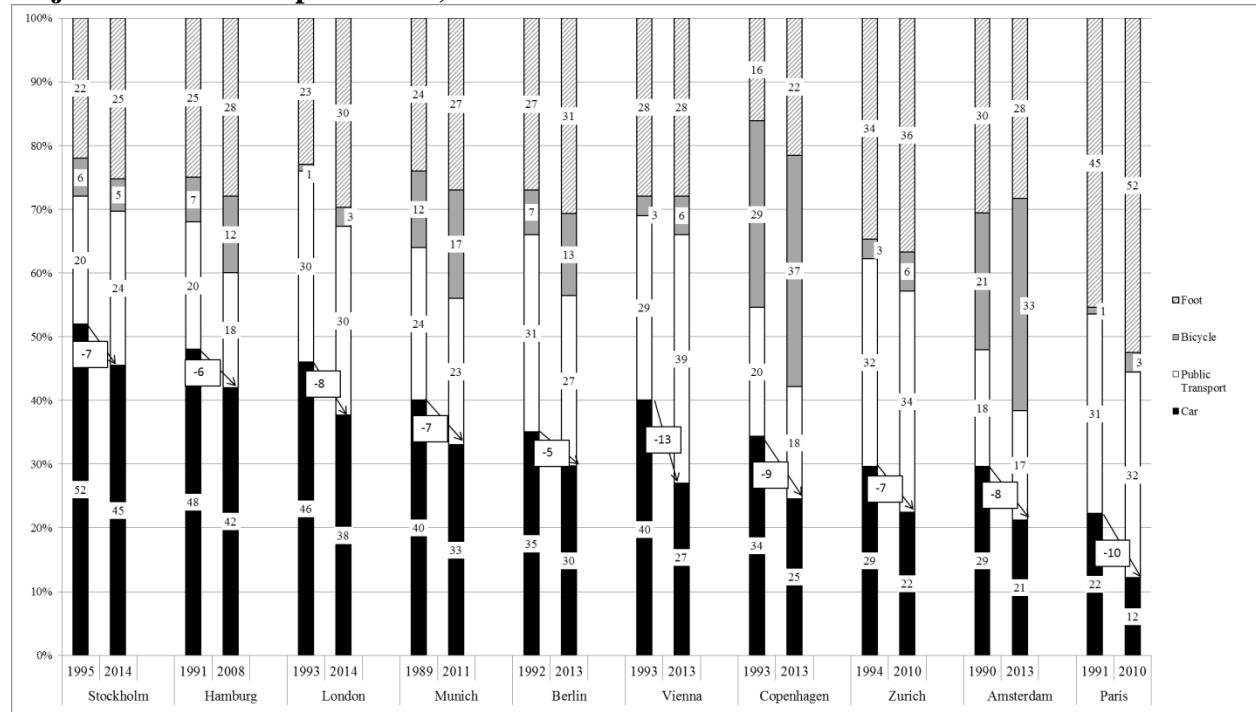
Stockholm, and Zurich (-7 percentage points); Hamburg (-6 percentage points); and Berlin (-5 percentage points). It is impressive that so many major cities in Western Europe (including seven national capitals) have significantly reduced car mode share since 1990. Although these reported reductions are derived from travel surveys that are only roughly comparable (see footnote to Figure 1), they all point in the same direction of declining car mode share. Table 1 provides a general overview of the types of policies the cities have implemented to reduce car mode share while promoting public transport, cycling, and walking.

It is noteworthy that both the Mercer and Monocle quality of life indices (based on very different criteria) rank eight of the ten cities in Figure 1 among the twenty cities in the world with the highest quality of life (Mercer, 2005-2015; Monocle Survey, 2010-2015). In 2015 Vienna was ranked #1 by Mercer and #3 by Monocle. Vienna's ranking has improved as its car mode share has fallen, suggesting that its increasingly sustainable transport system may have contributed to rising quality of life. The falling car mode shares in all ten of the cities in Figure 1 suggest the same positive impact on quality of life.

Such indices comparing quality of life among different world cities are inherently controversial and incomparable, since they rely on different measures: overall quality of life survey assessments as well as measures of employment possibilities, quality and cost of housing, mobility options, accessibility, and environmental quality. Nevertheless, there appears to be a correlation between virtually all such indices and having a well-balanced transport system, where walking, cycling, and public transport are convenient and safe alternatives to the private car and account for a majority of total trips (Smart City Index, 2015; Monocle Survey, 2010-2015; EU, 2009 & 2012; Siemens Green City Index, 2009; Mercer, 2005-2015).

This article focuses on a detailed analysis of Vienna because it has reduced car mode share more than any of the other cities. It examines not only the range of policies implemented but also the political process that enabled their implementation. As shown in this article, the implementation of sustainable transport policies has been a long-term, multi-staged process requiring compromises, political deals, trial and error, and coalition-building among political parties and groups of stakeholders.

Figure 1. Trend in percentage of daily trips by car, public transport, bicycle, or foot in major Western European cities, 1990-2014



Source: City of Amsterdam, 2015; City of Berlin, 2015; City of Copenhagen, 2015; City of Hamburg, 2015; City of Munich, 2015; City of Zurich, 2015; Kalender, 2012; Krause, 2009; Omnitrend, 2015; ONIL, 2011; Pirhofer & Stimmer, 2007; Socialdata, 2015; Trafa, 2015; Transport for London, 2011, 2015.

Note: These travel surveys only report trips made by city residents, thus excluding suburban residents as well as visitors to the city. Car use is considerably higher in the suburbs than shown here for city residents alone. The mode distributions for Paris and Zurich are somewhat incomparable with those of the other cities. The City of Paris accounts for only one-sixth of the population of the Greater Paris region, and the City of Zurich for only one-fourth of its metro area. The other cities in Figure 1 generally include over half of the metropolitan population. Thus, the car shares of trips for Paris and Zurich are especially low because their city limits exclude virtually all car-dependent outlying areas. Thus, only approximate comparisons can be made among the cities because the available travel surveys vary in methodology and timing. Moreover, the travel surveys only report the main mode of transport for a trip and not the short access trips by other modes. This especially under-estimates the share of walk trips in all cities.

Table 1. Overview of similarities in transport and land-use policies implemented in major Western European cities

Policies that restrict car use	
<i>Price of gasoline</i>	In 2015, the retail price of gasoline in most Western European countries was more than twice the price in the United States and over half of the retail price was due to taxes
<i>Traffic calming & speed limits</i>	Residential streets in many Dutch and German cities are traffic-calmed at 30km/h or less, with speeds reduced to 20km/h on shared streets, and to 7 km/h on some residential streets (home zones). Except for motorways and major arterials, the general speed limit on urban streets is 50km/h
<i>Road supply</i>	Motorways rarely penetrate into city centers; many neighborhood streets discourage through-traffic by 30km/h speed limits and infrastructure modifications, such as narrowing roads and installing curves, diverters, chicanes, speed bumps, raised intersections, and artificial dead ends
<i>Parking</i>	Many European cities have reduced car parking supply in downtowns, increased parking fees, and imposed time limitations for on-street parking since the 1960s
<i>Driver licensing</i>	Strict and expensive driver training and licensing; probationary licenses for young drivers
<i>Road revenues & expenditures</i>	Revenue from roadway user taxes and fees are higher than roadway expenditures by all levels of government, providing an important source of revenues for every European national government
<i>Congestion charging</i>	In London and Stockholm, fees imposed on motor vehicles to drive in designated central zones
<i>Environmental zones</i>	In many German cities, only certified low-emissions vehicles allowed in designated central zones
Policies that promote public transport	
<i>Quantity of service</i>	Most cities have increased public transport service since 1990: expanded route network, increased operating hours, and more frequent service
<i>Quality of service</i>	Public transport systems have modernized their vehicles and stations and better coordinated schedules, fares, and routes across modes and operators, enabling quicker and easier transfers
<i>User information</i>	Online information about regional, state-wide, & national routes, timetables, and fares; real-time information at most rail & some bus stops, and on-board most trains & buses
<i>Discounts</i>	Discounts for children, university students, and seniors; deeply discounted monthly and annual tickets available to all groups
<i>Region-wide integration</i>	Most large cities have regional public transport authorities which integrate fares, ticketing, operations, & financing across operators and jurisdictions
Policies that make walking and cycling more attractive	
<i>Car-free zones</i>	Many cities have pedestrianized large areas of their city centers that are off-limits for automobiles with parking garages at the periphery
<i>Traffic calming</i>	As noted above, many residential streets discourage through-traffic and greatly reduce car speeds
<i>Pedestrian facilities</i>	Widening, curb cuts, and improved pedestrian amenities on sidewalks; pedestrian priority in car-free zones, traffic-calmed streets, and shared streets
<i>Bikeway networks</i>	Expanding networks of paths and lanes for cyclists, including special provisions at intersections (traffic signals, advanced stop lines); extensive bike parking on sidewalks and on-street bike-corral; bikesharing systems in most cities
<i>Integration with public transport</i>	Walking and cycling routes that lead to bus stops and rail stations; improved bike parking at public transport stations
<i>Traffic education</i>	Especially in northern European cities, traffic education is offered in many schools, with emphasis on safe walking and cycling from home to school; avoiding endangerment of pedestrians and cyclists included in drivers' training and testing
Land-use planning and policies that facilitate compact, mixed land-uses	
<i>Coordination with public transport</i>	Scandinavian countries, the Netherlands, Germany, Switzerland, and Austria impose strict land-use controls that help limit low density sprawl and encourage compact development around public transport stops; provision of public transport services to new compact developments
<i>Planning process</i>	Especially Scandinavian countries, the Netherlands, and Germany coordinate land-use plans among levels of government and across jurisdictions; and integrate land-use, transport, and environmental planning at all levels of government

Sources: Alterman, 2001; Buehler et al. 2017; European Driving Schools, 2015; IEA, 2015; and information collected by the authors from local governments in each of the ten cities.

2. Data sources and methods of analysis

The research team assembled information about transport policy and politics in Vienna from numerous articles, books, and online documents. Additional unpublished information was obtained directly from the City of Vienna's transport planning office and the Vienna transit system.

The information obtained from these sources was supplemented by 32 in-person 60-to-90-minute semi-structured interviews conducted in Vienna in May 2015. To facilitate the interview process, an identical set of written questions was submitted to all persons interviewed roughly two weeks before the in-person interviews. A broad range of interviewees were chosen: elected city officials, political party representatives, and political appointees; city planners, transport planners, and regional planning directors; transit agency officials; transport consultants for the City of Vienna; federal transport and finance officials; non-governmental organizations (NGOs) and lobbying groups; transport journalists; and senior professors of transport at Vienna universities. The interviewees were contacted through a snowball sampling process, where one contact led to another. Initial contacts were established through the Austrian Embassy in Washington, DC, the Austrian Chamber of Commerce, two Vienna transport professors (already known by the authors), and internet searches. Follow-up questions were posed when necessary, either in additional personal interviews or via email or phone.

In instances where interviewees were the sources of specific information reported in the text, they are cited by their last names and included in the alphabetical listing of references at the end of the article. In many cases, the majority of interviewees provided similar information. In such cases, only the most important interviewees are listed as sources. In the few cases where

information was conflicting, follow-up questions were posed and additional sources consulted in order to clarify and/or resolve the differences.

Finally, self-guided site visits were made throughout Vienna in May 2015 to examine the various types of public transit, pedestrian facilities, cycling facilities, parking management, and transit-oriented developments. Those site visits provided a visual, qualitative perspective and personal experience to supplement the information supplied by other sources.

3. Overview of Vienna's transport history, demographics, and economy

Vienna has long been reluctant to adapt to the car. Most streets in the historic central city have remained narrow. The main exception is the monumental Ringstrasse, a 19th century boulevard, which replaced the historic city walls, encircling the oldest part of the city (District 1). Throughout its history, Vienna has been a compact, monocentric city with mixed-use development, generating many trips short enough to walk and placing most locations within easy walking distance of public transport (Sammer, 2015; Pirhofer and Stimmer, 2007; Csendes and Opll, 2006). It has also protected large areas from development, for use as parks, forests, and even working vineyards within the city (Schicker, 2015). As a result, the share of land area used for urban development and transport infrastructure has remained below 50% (City of Vienna, 2015a).

Increasing affluence from 1960 to 1990 (roughly a tripling of real per-capita income) led to a quadrupling in motorization rates, from 90 to 357 cars per 1,000 population (Pirhofer and Stimmer, 2007; Csendes and Opll, 2006). The result was worsening roadway congestion, parking problems, air pollution, noise, and traffic injuries and fatalities (Knoflacher, 2015). Transport plans from the 1960s and 1970s envisioned the construction of high-speed motorways (autobahns) in the city, but widespread public opposition—including anti-highway

demonstrations in the 1970s and 1980s—blocked nearly all of these proposals (Sammer, 2015; ASFINAG, 2012; Pirhofer and Stimmer, 2007; Csendes and Opll, 2006). The main exception was the 18km Südosttangente, a cross-town motorway (A23) in the southeastern part of the city, which at its closest passes 5 km from the historic city center (ASFINAG, 2012). Starting in the late 1960s, preservation of the old town, with its extremely narrow roadways and historic squares, became a top priority—supported by the public and by the ruling coalition parties, the Social Democrats and Conservatives—leading to the city’s first car-free pedestrian zone there in 1974 (Pirhofer and Stimmer, 2007; Csendes and Opll, 2006).

Vienna’s population shrank from 1.63 million in 1961 to 1.49 million in 1990, but then increased to 1.80 million in 2015 (City of Vienna, 2015b). Currently, the City of Vienna accounts for 70% of the 2.6 million residents of the metropolitan area (City of Vienna, 2015b). Part of the recent population growth has been due to immigration from other countries. As of 2012, according to official Austrian statistics, more than one-third of Vienna’s residents were of full or partial immigrant origin, including 460,000 with foreign citizenship (Statistics Austria, 2015). Over 90% of Vienna’s immigrants and foreign residents come from eastern and southeastern Europe, reflecting Vienna’s location southeast of Europe’s center and its historical ties to that region during Vienna’s days as capital of the Austro-Hungarian Empire (Statistics Austria, 2015). The influx of immigrants from eastern and southeastern Europe—with much lower rates of car ownership than Austrians—may have contributed to the growth in public transport use and cycling since 1993.

4. Continuity of politics, policies, and transport plans

Vienna has a special governmental status as both a city and federal state, with a unicameral parliament serving both as city council and state legislature. The mayor of the city is

also the prime minister of the state (City of Vienna, 2015c; Pelinka, 2013). Vienna is the capital of Austria and seat of the Austrian federal parliament.

Table 2 provides a chronological overview of key politicians in Vienna over the past five decades and their specific roles in the evolution of Vienna's transport policies. The listing starts with Mayor Bruno Marek because it was under his leadership that the construction of the U-Bahn (metro system) was finally approved in 1968. The table ends with the current coalition government of Social Democrats and Greens lead by Mayor Michael Häupl.

As shown in Table 2, all mayors of Vienna have been Social Democrats since 1945, and all transport ministers were Social Democrats until 2010, when a Green became transport minister and vice-mayor (City of Vienna, 2015c). In the 16 elections since 1945, the Social Democrats have always won the highest percentage of votes, but they formed coalition governments with the Conservative Party (ÖVP) from 1945-1973 and from 1996-2001, and with the Green Party since 2010 (City of Vienna, 2015c). As part of the coalition negotiations in 2010 and 2015, the Greens won control of the Ministry of Transport (indeed the only ministry they control), with Maria Vassilakou appointed both Minister of Transport and Vice-Mayor.

Table 2. Key politicians in evolution of Vienna's sustainable transport policies, 1965-2015 (continues on next page).

Person	Official Role	Influence on Transport Policy
Marek, Bruno (SPÖ)	<i>Mayor</i> (1965-1970)	<ul style="list-style-type: none"> ◦ Oversaw construction of underground tunnels for the tramway, expansion of the S-Bahn (regional rail), removal of some tramway lines in favor of buses, underpasses for pedestrians, and construction of a few urban motorways (based on transport plans from the late 1950s). ◦ During his tenure, the Vienna City Council voted for the construction of the U-Bahn (metro) in January 1968.
Slavik, Felix (SPÖ)	<i>Finance Minister</i> (1957-1970) <i>Vice Mayor</i> (1959-1970) <i>Mayor</i> (1970-1973)	<ul style="list-style-type: none"> ◦ Supported financing, construction, expansion, and modernization of the federally-owned and operated S-Bahn. ◦ Oversaw initial construction of the U-Bahn during his 3-year term as mayor, but as finance minister for 13 years was long-time opponent of the U-Bahn until the late 1960s--mainly because of its high cost. Favored less expensive alternatives like underground tunnels for the tramway or a monorail system. ◦ Negotiated with the federal government in December 1968 to provide limited federal funding for U-Bahn construction over the first 12-year period (2.4 billion Schillings). ◦ As mayor, opposed urban motorways (<i>Gürtelautobahn</i>; <i>Donaukanalautobahn</i>).
Gratz, Leopold (SPÖ)	<i>Mayor</i> (1973-1984) <i>Head of Vienna SPÖ</i> (1976-1988)	<ul style="list-style-type: none"> ◦ Oversaw completion of Vienna's main Autobahn (A23) in the southern part of the city (Südosttangente). ◦ Called attention to the many problems being caused by increasing car use. Commissioned 1980 Transport Plan, which has provided the basis for all subsequent transport plans (1993, 2003, 2014) and thus for future improvements to walking, cycling, and public transport while restricting car use. ◦ Instituted the first car-free zone in Vienna in 1974. ◦ Oversaw completion of the basic 30km U-Bahn network (lines U1, U2, U4) in 1982, setting the stage for future expansions. ◦ Increased citizen participation in the political process in the late 1970s and decentralized some city government functions to the district level, such as parking and traffic calming. This was crucial for the later implementation of parking management, which was thus decided at the district level.
Mayr, Hans (SPÖ)	<i>Finance Minister</i> (1973-1994) <i>Vice Mayor</i> (1984-1994) <i>Head of Vienna SPÖ</i> (1988-1993)	<ul style="list-style-type: none"> ◦ As a very powerful finance minister and vice-mayor, his approval was crucial for financing U-Bahn extensions and other large infrastructure projects. ◦ In 1978, he secured long-term commitment from the federal government to finance 50% of future construction costs for U-Bahn extensions. ◦ The 1978 agreement he negotiated was crucial even to the completion of the basic 30km U-Bahn network in 1982. Without his negotiated federal share the U-Bahn system would never have reached its current 80km length. ◦ Both Mayor Gratz and Zilk had to negotiate with Mayr to obtain funding for all major projects.
Busek, Erhard (ÖVP)	<i>Vice Mayor</i> (1978-1987) <i>Head of Vienna ÖVP</i> (1976-1989)	<ul style="list-style-type: none"> ◦ Supported car-free zones, traffic calming, environmental protection, preservation of Vienna's green space, and revitalization of the central city. ◦ Opposed construction of additional motorways and new greenfield developments. ◦ Even though a politician of the conservative party, many of his positions were parallel to those of the emerging Green Party. ◦ Not re-elected as ÖVP party head after the share of Vienna ÖVP votes fell from 34% in 1983 to 28% in 1987. As a result many members and voters in the environmental wing of the ÖVP subsequently switched to the Green Party, boosting its share of the vote from 4% in 1987 to 9% in 1991.

Table 2. (continued).

Person	Official Role	Influence on Transport Policy
Zilk, Helmut (SPÖ)	<i>Mayor</i> (1984-1994)	<ul style="list-style-type: none"> ◦ Vigorously pursued policies recommended in the 1980 Transport Plan, including both U-Bahn expansion and parking management. ◦ Co-opted the sustainable transport policies advocated by the ÖVP and the Greens at the time. ◦ Started big surge in building cycling facilities (bike paths, lanes, and parking); pushed hard to improve pedestrian facilities (e.g. car-free zones expanded); expanded traffic calming in residential neighborhoods; and expanded the U-Bahn network.
Häupl, Michael (SPÖ)	<i>Mayor</i> (1994-today) <i>Head of Vienna SPÖ</i> (1993-today)	<ul style="list-style-type: none"> ◦ Häupl has guided overall policy, but he has left specific transport policy development and implementation to his transport ministers. ◦ Powerful and influential during his 22+ years as mayor: Transport policies have not been adopted or implemented without his support. ◦ Approved the continuation of sustainable transport policies initiated by his predecessors (e.g. expansion of parking management from only 1 to 16 districts; further expansion of the U-Bahn to 78km by 2015, with more expansion currently underway). ◦ Häupl has adopted many aspects of the Green transport agenda in order to gain the Green Party's support in parliament to remain mayor, including formal coalition governments in 2010 and 2015. ◦ Called for a public referendum in 2012 on whether to centralize control of parking management. To avoid political risk, he did not express a preference and accepted the result, which was to leave the decision about parking management at the district level.
Vassilakou, Maria (Green Party)	<i>Vice Mayor & Transport Minister</i> (2010-today)	<ul style="list-style-type: none"> ◦ Negotiated with her Social Democratic coalition partners to drastically reduce the cost of the annual transit pass in 2011 (from €149 to €365). ◦ Has strongly supported U-Bahn expansion, vast improvements in cycling facilities (bike paths and lanes, bike parking, and bikesharing), improved walking conditions (car-free zones, shared streets, traffic calming of residential streets), and on-street parking management, while opposing new motorways. ◦ Advocated central control of parking management throughout the city, but lost public referendum on this issue in 2012. Thus, parking management has remained at the district level. ◦ As Green minister of transport, she has taken the lead in actively implementing sustainable transport policies.

Sources: Blum, 2015; City of Vienna, 2015e; Gansterer, 2015; Herry, 2015; Hödl, 2015; Knoflacher, 2015; ÖVP, 2015; Schicker, 2015; Snizek, 2015; SPÖ, 2015; Wetz, 2015; Technical Museum Vienna, 2015; Pirhofer and Stimmer, 2007; Csendes and Opll, 2006; Grüne Wien, 2002; Arbeiterzeitung, 1958.

Social Democrats (SPÖ) have been strong, long-time supporters of labor, social housing, and public transport (Lindenmayr, 2015; Schicker, 2015; Zabraná, 2015). Their core base of support has been the working class and labor unions. The Greens (part of the governing coalition since 2010) have been most committed to environmental protection and promoting bicycling, public transport, and walking (Jens, 2015; Maresch, 2015; Vassilakou, 2015). They have also strongly favored restrictions on car use and parking, about which the Social Democrats have been far more hesitant for fear of losing working class votes (Blum, 2015; Gansterer, 2015; Rohracher, 2015). The role of the Greens has recently been crucial in transport policy, and they have sometimes proposed extreme policies to prod their Social Democratic partners at least part way in their preferred policy direction (Maresch, 2015; Vassilakou, 2015). The Social Democrats, in turn, have sometimes allowed the Greens to serve as a lightning rod for criticism of new policy proposals while taking credit for such policies if they later win broad acceptance (Wetz, 2015). Even in 1994, long before the Greens became part of the governing coalition (2010), the current mayor Michael Häupl made concessions to the Greens to obtain their support in the city parliament for his first-term candidacy (Lindenmayr, 2015; Grüne Wien, 2002).

The Conservative Party (ÖVP) supported the construction of a U-Bahn already in the 1950s and 1960s. The Social Democrats, who were in power, opposed the U-Bahn until 1968, when they reversed their position and joined all other parties in a unanimous parliamentary vote for the U-Bahn (Pirhofer and Stimmer, 2007). Especially in the late 1970s and 1980s, the ÖVP had a strong environmentally-oriented wing that opposed construction of more autobahns while supporting public transport, car-free zones, traffic calming, parking restrictions, greenspace protection, and inner city re-development over new developments on the urban fringe (Cséndes

and Opll, 2006). Parking management was first implemented in 1993 in Vienna's 1st District, then led by the ÖVP (Schmitz, 2015; Herry, 1997).

When the Social Democrats and Conservatives were overwhelmingly dominant and often allied in a governing coalition (1945-2010), controversies were resolved behind closed doors. The leadership strategy was to seek internal consensus before inviting public and parliamentary discussion. Many key decisions are still made in this fashion (Faast, 2015; Gansterer, 2015; Rohracher 2015; Wetz, 2015). These internal deliberations are typically informed by private consultations with all key stakeholders (e.g. unions, chambers of commerce, neighborhood groups) (Herry, 2015 and 1997). The SPÖ is particularly committed to this approach (Lindenmayr, 2015; Zabrama, 2015), which complicated the research for this case study. Politicians, agency directors, and government bureaucrats were generally accessible but unwilling to talk about conflicts, controversies, mistakes, and the inevitable give-and-take of the political process of implementing policies. It was difficult to elicit criticisms of any kind. This has been less true of the Greens, even though they have been members of the governing coalition (with the Social Democrats) since 2010.

The Freedom Party (FPÖ), populist and right wing in its orientation, has strongly opposed any restrictions on car use (including traffic calming and on-street parking fees) while supporting expansion of the U-Bahn (Knoflacher, 2015). The FPÖ has not yet had an impact on actual transport policy because it has never been part of the governing coalition. However, it has won a sharply increasing percentage of votes in recent elections (from 26% in 2010 to 31% in 2015).

Almost all of Vienna's suburbs are in the state of Lower Austria, which surrounds Vienna on all sides. In contrast to the City of Vienna, its suburbs are much less dense and more car-

oriented. Correspondingly, public transport service and facilities for walking and cycling are much less available and less attractive than in Vienna. That is partly the result of car-oriented policies throughout the state of Lower Austria, which has been governed by the Conservatives (ÖVP) for over 50 years (Zibuschka, 2015). The Conservative government in Lower Austria has invested heavily in autobahns and only weakly supported public transport investments, which are mostly targeted to benefit commuters from Lower Austria to Vienna (Blum 2015; Russ, 2015; Sammer, 2015). As a result, the car accounts for 64% of daily trips in Vienna's suburbs, compared to only 27% in the city itself (Omnitrend, 2015). Several of our interviewees emphasized the very different land use pattern, transportation system, travel behavior, and transport policies in Vienna's suburbs (Sammer 2015; Ossberger, 2015; Wetz, 2015).

When asked what they considered the most important explanations for the dramatic modal shift within the city since 1993—away from the car and toward public transit—nearly all our informants highlighted public transport improvements, in particular expansion of the U-Bahn, and parking management. Both of these policies had been evolving over several decades (Knoflacher, 2015). The expansion of the U-Bahn since 1990, for example, would not have been possible without construction of its initial segments during the 1970s and 1980s. Similarly, the city had experimented with various kinds of parking time limits, mainly in commercial areas, long before parking management was implemented in its current form (Faast, 2015; Sammer, 2015; Riedel, 2014).

Table 3 provides a chronological overview of the most important transport policy developments in Vienna since 1968, starting with the decision to build the U-Bahn. As is evident in the table, transport policies have evolved gradually over time in Vienna, with one policy building on another. Figure 2 quantifies the expansion of public transport service, parking

management, and traffic calming from 1990 to 2014, and declining car mode share over the same period.

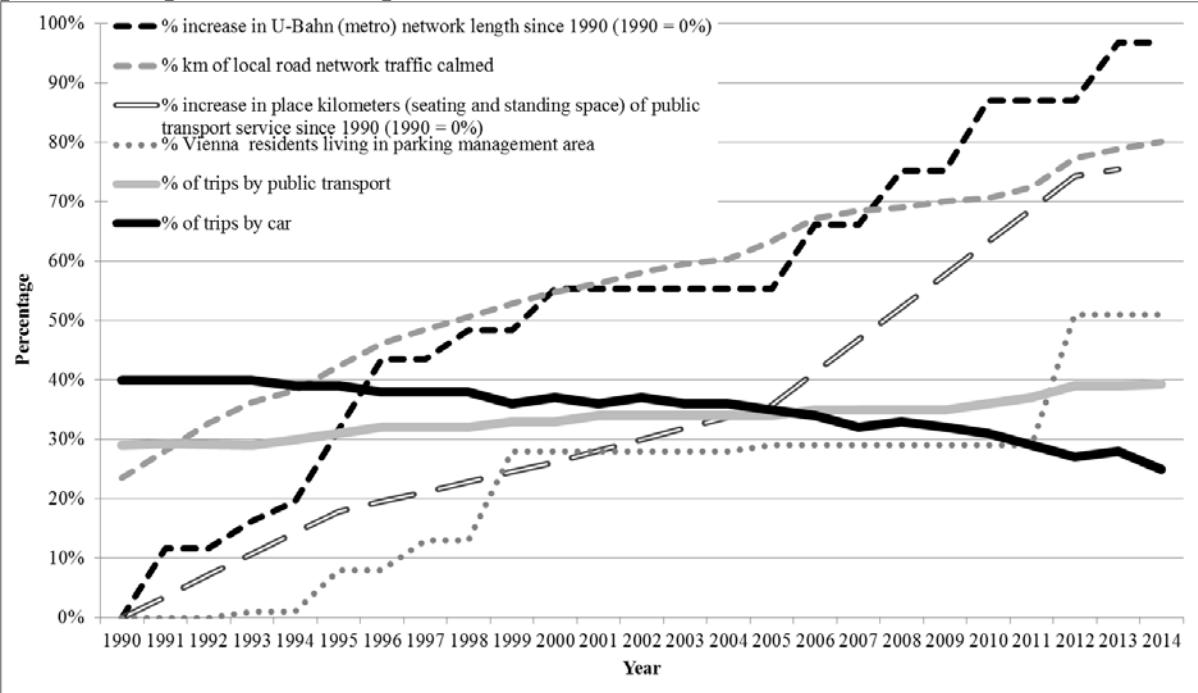
The continuity of transport policy is evident in the city's Transport Plans of 1980, 1993, 2003, and 2014 (see Table 3). These plans were mainly conceptual. Nevertheless, they were formally adopted by Vienna's parliament and have served as important policy guides (Rosinak, 2015; Schicker, 2015; Snizek, 2015). The 1980 plan was the most important because all subsequent plans built upon it (Knoflacher, 2015; City of Vienna, 1980). Its main stated goals were to expand and speed up public transport, to limit roadway expansion, to restrict on-street parking, to move through traffic out of residential neighborhoods, to improve walking and cycling facilities, and to expand both car-free zones in commercial areas and traffic-calmed zones in residential neighborhoods (City of Vienna, 1980). The 1993, 2003, and 2014 transport plans established specific percentage targets for successively reducing the car share of trips over time. Each encouraged further expansion of the U-Bahn and parking management, improvements in walking and cycling conditions, and better regional coordination of public transport, including suburban rail lines into Lower Austria. Roadway recommendations have been focused on diverting traffic around the city center (City of Vienna, 2014).

Table 3. Timeline of key transport developments in Vienna, 1968-2016

- 1968: Vienna city council voted unanimously to build a U-Bahn (metro system).
- 1969: City negotiated with federal government to contribute 2.4 billion Schillings toward construction of first phase of U-Bahn (only 20% of actual costs due to inflation).
- 1974/1975: First car-free pedestrian zone implemented in historic old town (1st District).
- 1975: First charges for on-street parking (on busiest commercial streets).
- 1978: First segment of U-Bahn line U1 (3km) opened for passenger service.
- 1978: City re-negotiated with federal government to cover 50% of actual U-Bahn construction costs (vs. fixed amount).
- 1980: Transport Plan of 1980, adopted by city council, laid groundwork for sustainable transport and future transport plans.
- 1982: First phase of U-Bahn network completed (30km).
- 1984: Vienna Regional Public Transport Association (VOR) began operations, coordinating public transport in Vienna and two surrounding states (8,900 sq. km service area; 2.4 million population).
- 1987: Traffic calming first implemented on 33km of local streets.
- 1993: Transport Plan of 1993 expanded on main goals of 1980 plan, but added a new goal of reducing the car mode share of trips in Vienna to 25% by 2010.
- 1993: Parking management first implemented: in 1st District (historic city core).
- 1995-1999: Parking management implemented in Districts 2-9, and 20 (inner districts).
- 2000: Second phase of U-Bahn extension completed (61km).
- 2003: Transport Plan of 2003 re-iterated themes of 1980 and 1993 plans but delayed achievement of 25% car mode share goal to 2020.
- 2003: Bike-sharing system (CityBike) opens.
- 2007: Hours of operation for parking management extended from 8pm to 10pm.
- 2010: Third phase of U-Bahn extension completed (75km).
- 2012: Introduction of €65 annual ticket for unlimited public transport travel within city boundaries.
- 2012: Five additional districts (12 and 14-17) adopted parking management.
- 2013: Decision on adoption of parking management kept at the district level as result of city-wide referendum in which voters overwhelming preferred retaining district control.
- 2013: U-Bahn extended to new town of Seestadt (79km).
- 2014: Transport Plan of 2014 adopted new goal of reducing car share of trips to 20% by 2025.
- 2014: Almost 80% (1,657km) of local roads in Vienna traffic calmed.
- 2016: VOR expanded to 23,500 sq. km service area and 3.8 million population.
- 2016: 18th district adopted parking management (16 of 23 districts).

Sources: *City of Vienna, 2015b, 2014, 1980; Csendes and Opll, 2006; Hödl, 2015; Knoflacher, 2015; Kurier, 2015; Pirhofer and Stimmer, 2007; Prillinger, 2015; Riedel, 2014; Sammer, 2012.*

Figure 2. Time-trend comparison of key transport policies and falling car share vs. rising public transport share of trips, 1990-2014



Sources: City of Vienna, 2015b; Csendes and Opll, 2006; Herry, 1997; Hödl, 2015; Pirhofer and Stimmer, 2007; Prillinger, 2015; Riedel, 2014; Sammer, 2012; VOR, 2015.

5. Improving Public Transport

Vienna has one of the best public transport systems in the world. The construction and expansion of the U-Bahn since 1968 has been central to its improvement, but Vienna already had an extensive tramway system by 1910 (Hödl, 2015; Knoflacher, 2015; Sammer, 2015). The tramway provided most public transport services for decades and is still a key part of Vienna's transit system (Ossberger, 2015). Tramway tracks, stations, and vehicles have been thoroughly modernized in recent years, including protected, separate rights of way on many routes (Knoflacher, 2015). The tramway provides extensive service outside U-Bahn corridors, and on feeder routes to U-Bahn stations. It is an integral part of the streetscape in Vienna, and no political party advocates its elimination. Tram ridership has actually risen during the expansion

of the U-Bahn, from 242 million in 1990 to 294 million in 2013 (Wiener Linien, 2000-2015). Over the same period, U-Bahn ridership has risen from 246 million to 429 million. Mainly due to its greater speed, the U-Bahn has superseded the tram as Vienna's main transit mode and is currently considered the backbone of its public transport system (Ossberger, 2015; Steinbauer, 2015).

Construction of the Vienna U-Bahn started in 1969. The first line was opened in 1978, and the basic 30km network of three U-Bahn lines (U1, U2, and U4) was completed by 1982 (Höfling, 2010). The U-Bahn was further expanded to 41km during the 1980s. From 1990 to 2015, the period of special interest for this article, the U-Bahn network almost doubled again in length, to 80km (Prillinger, 2015). In addition, headways were reduced to only 2-3 minutes between trains on each line during the peak, and peak service hours were expanded. Frequencies and hours of service were also increased during off-peak, especially on weekends and at night (Faast, 2015; Steinbauer, 2015; Vassilakou, 2015). Additional improvements during this period included new, more comfortable vehicles and modernized, more accessible stations (Maresch, 2015; Ossberger, 2015; Rohracher, 2015).

The U-Bahn cannot be viewed in isolation from the tramway, bus, and regional rail systems (S-Bahn and Regionalbahn) (Bohrn, 2015). They form an integrated network of complementary services coordinated by the Vienna Verkehrsverbund (regional transit association). All types of public transport have been improved since 1990: new bus and rail vehicles; modernized rail stations; better bus and tram shelters; shorter headways; separate rights of way for trams and buses (tram tracks grade-separated from the roadway; exclusive bus lanes); signal priority at some intersections; and real-time information, both on-line and at stations (including bus stops) (Bohrn, 2015). Both the Vienna Verkehrsverbund and Wiener Linien (city

transit agency) have improved the coordination of schedules, routes, and fares among different lines, different kinds of transit, and different parts of the region (Bohrn, 2015; Steinbauer, 2015).

5.1 Funding

Funding for construction and expansion of the U-Bahn has always been an important issue (Madreiter, 2015; Schicker, 2015; Steinbauer, 2015). In 1978 Hans Mayr, Vienna's SPÖ finance minister from 1973-1994, was able to negotiate a 50% federal share of funding for future U-Bahn investments. This federal contribution was facilitated through the support of Mayr's SPÖ colleagues federal chancellor Bruno Kreisky (1970-1983) and finance minister, Hannes Androsch (1970-1981) (Hödl, 2015; Mayerhofer, 2015; Schicker, 2015; Snizek, 2015). The agreement of 1978 remains in effect to this day (Bohrn, 2015; Sammer, 2015; Schalko, 2015).

Whereas the City of Vienna owns and operates the U-Bahn, the federal government owns and operates the regional S-Bahn rail system. It also finances 80% of S-Bahn capital costs, excluding station upgrades, and 100% of S-Bahn operating subsidies for a basic level of service, defined by the 1999 Federal Public Transport Act as the level existing in 2000 (Mayerhofer, 2015; Schalko, 2015; ÖVG, 2009). All other costs are borne by the City of Vienna and the State of Lower Austria, which have been reluctant to pay for service increases above the basic level (Bohrn, 2015; Ossberger, 2015; Zibuschka, 2015). Although the S-Bahn mainly provides longer-distance service to the surrounding suburbs, its nine lines include 49 station stops within the city limits of Vienna; thus, it also serves many shorter trips within Vienna. The main problem with the S-Bahn is that it is greatly in need of modernization to bring it up to current standards (Faast, 2015). Austrian Railways, with limited funding and other priorities, has been hesitant to make the necessary investments.

There are three sources of federal government support for public transport. Federal subsidies cover 100% of the cost of public transport fares for daily commutes of school students and apprentices (Bohrn, 2015; Zibuschka, 2015). Second, the federal government pays for the administrative and planning costs of the regional coordination of public transport provided by the Vienna Verkehrsverbund (Mayerhofer, 2015; Schalko, 2015). Third and most significantly, the city receives general revenue sharing funds from the federal government, which levies all major taxes in Austria (most notably, income and value-added taxes) and distributes most of the proceeds to states and localities (Rohracher, 2015; Sammer, 2015). Because it is the national capital, Vienna receives twice as much revenue sharing per capita as the average for the rest of Austria (Wetz, 2015). This is officially justified with reference to the many nation-wide services—governmental, cultural, and educational—located in the city. Overall, 90% of Vienna's revenue derived from taxation comes from the federal government: about €6.4 billion vs. €0.8 billion in locally raised tax revenue (City of Vienna, 2015d). Thus, even U-Bahn operating subsidies, and the city's 50% share of U-Bahn capital costs, are financed mainly with federal revenue sharing funds, although indirectly through allocation from the city's general budget.

There are three local sources of public transport finance. Passenger fare revenues (€480 million) cover about 55% of transit operating costs (Ossberger, 2015). The City of Vienna levies a public transport tax on large employers (roughly €100 per employee per year) producing annual revenue of €70 million (City of Vienna, 2015d; Snizek, 2015). Finally, revenues from on-street parking and city-owned parking garages (roughly €100 million per year) are earmarked for public transport, park and ride, parking garages, and bicycling (Vassilakou, 2015).

5.2 Fare policy

In contrast to most other major European cities, Vienna has for many years had a policy of charging low transit fares, but these have recently been reduced even further (Civity, 2011). In 2012, Vienna reduced its price for an annual ticket for unlimited travel within the city boundaries by 20%, from €449 to €365 (Ossberger, 2015; Vassilakou, 2015). Maria Vassilakou, the vice-mayor for transport (Green Party), was the principal advocate of this price reduction (Maresch, 2015; Vassilakou, 2015). Indeed, she initially proposed reducing the price to €100. The €365 price emerged from the Social Democrat-Green coalition negotiation following the election of 2010. The renewal of this negotiation following the 2015 election included an agreement to maintain the €365 annual ticket price.

In 2012 as well, Vienna reduced the price for monthly passes by 10%, from €49.50 to €45. Moreover, the age requirement for senior discounts was reduced from 65 to 60 years, enabling more of Vienna's population to take advantage of the further 40% senior discount on the annual ticket (€224). School students pay €60 per year, and university students €75 per semester (5 months) (Maresch, 2015; Vassilakou, 2015). Overall, 92% of all transit trips in Vienna are paid for with annual, monthly, weekly, or semester passes. Only 6% of trips are taken with single trip tickets (Wiener Linien, 2000-2015). The Vienna mode share of public transport rose three percentage points (36% to 39%) from 2011 to 2013, the years immediately before and after the fare reductions. That was five times the annual rate of increase during the previous decade (2001-2011).

There was some opposition to these fare cuts from managers of the city's public transport system until the city government pledged to cover any revenue losses (Steinbauer, 2015; Vassilakou, 2015). In fact, ridership grew so much that total fare revenue increased. But

operating costs increased as well because of services added to accommodate the increased demand. As a result, the percentage of operating costs covered by fares fell from 60% in 2011 to 55% in 2015 (Die Presse, 2012, 2015; Ossberger, 2015; Sammer, 2015).

5.3 Public and political support

Support for public transport in Vienna is strong and widespread (Gansterer, 2015; Rohracher, 2015; Steinbauer, 2015; Vassilakou, 2015). Even the right-wing Freedom Party (FPÖ) supports further expansion of the U-Bahn system, probably because it is widely believed to have reduced roadway congestion, which appeals to FPÖ's motorist constituency (FPÖ Wien, 2015). The business community and labor unions have been vigorous supporters (Faast, 2015; Schicker, 2015). Many public transport construction firms and suppliers are located in Vienna and the surrounding area (Knoflacher, 2015; Rosinak, 2015; Snizek, 2015). Moreover, public transport is itself a major employer, whose unionized employees are central to the political base of the SPÖ (Lindenmayr, 2015; Rosinak, 2015; Schicker, 2015; Zabraná, 2015).

As previously noted, the public transport mode share for trips within the City of Vienna rose from 29% in 1993 to 39% in 2014. In addition, annual passenger trips in the regional Vienna Verkehrsverbund as a whole increased by 44% from 1990 to 2012 (22% increase per capita) (Bohrn, 2015; VOR, 2015). In a 2014 survey, 98% of Viennese residents described public transport service as either good or very good (Omnitrend, 2015). Moreover, 52% of residents reported using transit daily, 76% at least once a week, and 88% at least once a month (Omnitrend, 2015).

6. Parking management

Although short-term parking zones along commercial streets were introduced in 1959, no charges were imposed until 1975 (Riedel, 2014). In 1986, federal transport law was revised to

allow exemptions for neighborhood residents from the short-term parking requirements (Riedel, 2014). This enabled the implementation of parking management in Vienna as it exists today (Faast, 2015; Herry, 2015 and 1997). Entire city districts are short-term parking zones with district residents having access to exemption passes for a fee that varies by district (€90-€120 per year in 2014) (Riedel, 2014). From 1975 to 2015, hourly fees for short-term, non-district-resident parking have more than doubled (+140%) in real, inflation-adjusted Euros. On-street parking is generally limited to 2hrs (€2 per hour) for non-district residents, while there are no time limits or hourly charges for residents who display an annual parking decal (Herry, 2015; Riedel, 2014; Sammer, 2012).

Parking management was first implemented in 1993 in the city's 1st District (historic city core) because it had the most severe parking and roadway congestion problems. Even there, controversy about its introduction was intense until it went into effect. Acceptance then rose quickly, however, because parking management sharply reduced traffic volumes and made it much easier to find a parking space (City of Vienna, 2015f; Herry, 1997; Lindenmayr, 2015; Rosinak, 2015; Schmitz, 2015). By 2016, parking management had spread to 16 of Vienna's 23 city districts, covering 34% of the developed land of Vienna but 54% of its population (City of Vienna, 2016). From 1995 to 2013, as parking management spread, the percentage of residents reporting severe problems finding parking during the day fell from 47% to 27%, and during the evening, from 58% to 37% (City of Vienna, 2015f).

For motorists without resident decals, there are variations among districts in the parking time limit and the specific hours of enforcement. In general, longer parking duration is permitted in the outer districts (3hrs) than in the inner districts (1.5hrs to 2hrs). In addition, on-street

parking regulations are in effect for a shorter time period in the outer districts (9am to 7pm) than in the center (9am to 10pm) (Raab, 2015; Riedel, 2015; Zibuschka, 2015).

6.1 Garnering public support

Developing the system of parking management, generating political support for it, and implementing it have been time-consuming and difficult. It took many revisions and compromises to overcome the opposition of key groups and politicians. Before parking management was introduced in 1993, the measured parking occupancy rate in the 1st District was 121% between 9am and 11am (more than 100% because of illegal parking) and 95% between 8pm and 10pm (Herry, 1997). The average time to find an on-street parking space was 15 minutes (Herry, 2015). District residents provided the main impetus for action. They wanted priority access to the district's limited on-street parking spaces, which had been largely occupied by non-resident commuters and shoppers (Schmitz, 2015). At first, most local businesses were opposed, anticipating that their employees and customers, as well as the operators of delivery, service, and company vehicles, would have greater difficulty parking. The district government, led by the business-oriented Conservatives, took this objection seriously (Faast, 2015; Herry, 2015).

In 1991 a commission was formed to address these concerns. Seeking consensus, it included representatives of all local political parties, the chamber of commerce, the unions, and city planning staff (Herry, 1997). The concerns of local businesses were addressed by offering them special parking permits. In addition, resident exemptions from parking time limits were not applied to commercial streets, thus freeing up more spaces for businesses and their customers (Faast, 2015; Schicker, 2015). There were still numerous points of detailed contention, but sufficient agreement to move forward with a pilot project (Herry, 1997).

6.2 Initial implementation and expansion

Parking management in the 1st district began with a pilot project, during which the measured occupancy rate of on-street parking fell from 121% to 82% between 9am and 11am, and from 95% to 87% from 8pm to 10pm (Herry, 1997). Thus, there were almost always a few empty parking spaces available (Herry, 1997). Daily traffic counts showed a reduction of 20% in km of car travel within the 1st District, including a two-thirds reduction in cruising to find parking spaces (from 10 million to 3.3 million vehicle km per year) (Herry, 1997). Air pollution and noise also decreased (Lindenmayr, 2015; Schmitz, 2015; Zabraná, 2015). With these findings in hand, the 1st District government adopted parking management as a policy for the long term.

On the other hand, adjacent city districts suffered from the overflow of motorists formerly parked in the 1st District (Schicker, 2015; Zabraná, 2015). Consequently, a second commission was formed in 1994 to consider expanding parking management to districts 2-9 and 20 (Herry, 1997). Its recommendations expanded upon those of its predecessor. Most notably, it urged that the city build off-street, self-financing parking garages to supplement available on-street parking. The city has, in fact, built 25 such garages as of 2015, with 18 more planned (Herry, 2015). The commission recommended additional concessions to local enterprises: special curbside spaces reserved for truck deliveries and certain types of business parking, and the elimination of resident exemptions from time limits and hourly charges on busy commercial streets (Authried, 2015; Faast, 2015). The commission also urged the construction of more and larger park-and-ride lots at outlying rail transit stations to facilitate transit use by those diverted from travel into the city by car (Schicker, 2015; Vassilakou, 2015; Zibuschka, 2015; Herry, 1997).

Parking management was subsequently implemented in Districts 2-9, and 20 between 1995 and 1999 (Raab, 2015; Riedel, 2015; Herry, 1997). In Districts 2-9, the average occupancy rate of on-street parking fell from 100% before parking management to 70% after implementation (Herry, 1997). As in the 1st District, vehicle traffic also fell due to reduced cruising in search of parking spaces (Herry, 2015). Studies found that the number of on-street parked cars with non-Vienna license plates dropped by two-thirds (Raab, 2015, Riedel, 2015). Most of those diverted from driving into central Vienna came by transit instead (Herry, 2015; Rosinak, 2015).

6.3 Public acceptance due to success

Opinion surveys in the 6th and 9th Districts prior to and after implementation showed significant increases in support for parking management, both among residents and non-residents, since even the latter found it easier to park with the new arrangement (City of Vienna, 2015f). Among district residents, the percentage approving of parking management rose from 46% before implementation to 67% afterward. Among non-district residents, approval rose from 16% to 40%. In contrast to pre-implementation forecasts, a greater share of district residents bought the parking pass, fewer residents parked illegally, more non-residents switched to public transport, and fewer drivers shifted to parking in other districts. In 2007, the hours of operation were extended from 8pm to 10pm in all ten districts with parking management. The aim was to keep more spaces available for residents needing to park overnight (Raab, 2015; Riedel, 2015).

In 2011/2012 the City mounted an informational campaign to encourage the adoption of parking management by additional districts (Raab, 2015; Riedel, 2015; Sammer, 2015). There were town-hall style meetings in local neighborhood restaurants, with exhibits portraying the advantages of parking management and how it would operate. Planning staff were available to

answer questions at such events, including one-on-one consultation with individual residents (Raab, 2015; Sammer, 2015; Snizek, 2015; Vassilakou, 2015).

As a result of feedback from these community outreach efforts, several alterations were adopted. For example, parking management now includes resident-only parking zones. Previously, all curbside spaces had been available to non-residents, though subject to time limits and hourly charges (Vassilakou, 2015; Bubak, 2014; Raab, 2014). In response to these concessions, five additional districts (12 and 14-17) adopted parking management in 2012. Most of these are adjacent to the districts that had adopted it earlier (Maresch, 2015; Riedel, 2015).

6.4 Prospects for further expansion

Seven districts continued to reject parking management as of September 2016. These are mostly outlying districts with lower-density development, longer trip distances, higher motorization rates, ease of free curbside parking, and less public transport service (Faast, 2015; Zibuschka, 2015). Of the 16 districts that had implemented parking management as of September 2016, twelve are governed by the Social Democrats, two by the Conservatives, and two by the Greens. Thus, the acceptance of parking management is determined not simply by party affiliation but other factors as well. Of the seven districts still without parking management, four are run by the Social Democrats, three by the Conservatives, and one by the FPÖ (City of Vienna, 2016).

The Greens have strongly advocated extension of parking management to the entire city, but they are minority members of the governing coalition, and the Social Democrats have been unwilling to alienate their constituencies in outer districts (Gansterer, 2015; Maresch, 2015; Rohracher, 2015; Vassilakou, 2015; Wetz, 2015). In 2013, Mayor Häupl called for a non-binding referendum to determine public opinion about whether decisions to adopt parking management

should remain with the districts; 64% of Vienna's residents voted in favor of continued district control (Sammer, 2015; Wetz, 2015). Since then, Mayor Häupl has strongly supported continued decentralized control of parking management (City of Vienna, 2013). With similar intent to minimize political risk, some local district councils held referenda on the adoption of parking management before deciding to implement it, even though they were not required to do so.

7. Other policies contributing to declining car use

Other policies have reinforced the impacts of public transport improvements and parking management. As previously noted, these include improvements in pedestrian and cycling infrastructure, transit-oriented development, and various measures to restrict motor vehicle travel (Blaha, 2015; Blum, 2015; Gansterer, 2015; Jens, 2015; Knoflacher, 2015; Vassilakou, 2015). As shown in Table 1, many other European cities have undertaken the same sorts of policies. The following sections provide further detail on Vienna's implementation of these policies.

7.1 Improving walking conditions

Over 95% of access trips to and from bus stops and rail stations in Vienna are by walking. Thus, the provision of safe, convenient, and pleasant walking facilities is crucial to facilitating public transport use (Jens, 2015). Moreover, walking accounts for over a fourth (28%) of all trips, so it is clearly an important travel mode in its own right (Jens, 2015). Vienna established its first car-free zone from 1974 to 1975, including much of the historical core in the 1st District. It was adopted in the context of intense concern, across party lines, that rising traffic levels, congestion, pollution, noise, and illegal parking (usually on sidewalks) were destroying the unique character of the historic city core (Schicker, 2015).

Between 1990 and 2013, Vienna roughly tripled the total area of its pedestrian zones from 102,126 to 295,938 square meters (from 25 to 73 acres) (City of Vienna, 2015a). In addition, 3

km of major streets were converted to shared streets (“Begegnungszonen”), with a 20km/hr speed limit, and with pedestrians and cyclists having the same right as motorists to use the entire street surface. Motor vehicle parking on shared streets is prohibited except while loading and unloading (Jens, 2015; Lindenmayr, 2015; Maresch, 2015; Vassilakou, 2015). Even more significantly, 75% of all other city streets (mainly residential) were traffic-calmed, with a 30km/hr speed limit. Starting in 1979, there was a gradual decentralization of decision-making on certain issues from the city level to the district level (Herry, 2015). Since 1988 decisions on car-free zones, shared streets, and traffic calming have been made at the district level—although often implemented and coordinated with planning assistance at the city level.

Traffic calming began in the late 1980s on a small scale, with only 30km of traffic-calmed streets in 1987. By 2014 there were 1,600km of traffic-calmed streets—a 50-fold increase in 27 years (Die Presse, 2014). Traffic calming spread rapidly because through traffic diverted from one traffic-calmed residential street was largely displaced to adjacent streets without traffic calming. Thus, one neighborhood after another was essentially forced to adopt traffic calming because of the overflow effect. Even more so than with parking management, traffic calming has been a bottom-up movement. The demand for traffic calming emanated primarily from neighbors on local residential streets, with the necessary measures then approved by the district governments.

Except for the FPÖ, which opposes nearly all restrictions on car use, traffic calming is now widely accepted (Knoflacher, 2015). By comparison, shared streets are controversial because some are major commercial streets (1.4km in 2015). The Vienna public transport system initially opposed shared streets because they slow down buses, but it solved that problem by rerouting buses to parallel streets with higher speed limits (Raab, 2015). The first shared

street in Vienna was implemented on a major commercial street connecting the 6th and 7th districts. Although the decision was made formally by their district councils, it was supported by the majority of residents in a non-binding public referendum. The Greens have been the principal advocates of shared streets, and are eager to expand the current network. Their governing coalition partners, the Social Democrats, on the other hand, allowed creation of the existing shared streets only with reluctance and have made clear their reservations about further expansion (Maresch, 2015).

7.2 Improved cycling conditions

While support for improved pedestrian facilities has been widespread and long-standing, only recently has Vienna made serious efforts to improve cycling conditions (Knoflacher, 2015). By comparison, cycling facilities in Dutch, Danish, and German cities were initiated decades ago and on a far more extensive scale than in Vienna (Pucher and Buehler, 2008; Buehler et al. 2017). Business groups and motorists have long opposed the installation of bike lanes on major streets because they compete for limited space with traffic lanes and parking spaces (Authried, 2015; Gansterer, 2015; Rohracher, 2015). In 2013, Mayor Häupl commented publicly that he did not believe any sensible person could think of cycling as a major mode of transport in Vienna. He also advocated stricter enforcement of traffic regulations for cyclists as well as banning cyclists from pedestrian zones (Wetz, 2015; Wiener Zeitung, 2013).

Nevertheless, advocates of cycling among the Greens, the SPÖ, and in Vienna's transport planning department (which has a special division for cycling) have succeeded in vastly improving cycling conditions in recent years. Between 1990 and 2014 the bikeway network expanded six-fold from 190km to 1,200km (Blaha, 2015; Winkler, 2015). During the same period bike parking increased from 3,700 to 36,400 spaces (Blaha, 2015). While the city builds

and maintains bike facilities on major streets, implementation of facilities on local neighborhood streets is left to the discretion of district governments. As a result, there is much variation from district to district in the extent and quality of bikeway and bike parking facilities (Blaha, 2015; Winkler, 2015). The Greens have been enthusiastic supporters of cycling not just because of its environmental benefits but also because their voters tend to be young and among the most active cyclists (Faast, 2015; Vassilakou, 2015).

The expansion of traffic calming to 75% of streets provides a vast network of cycling routes on lightly traveled neighborhood streets without any special facilities such as bike lanes or paths. To further facilitate their usefulness for cycling, bi-directional travel is officially permitted (as in most Dutch and German cities) on almost all one-way neighborhood streets, as well as on shared streets, increasing the route flexibility and convenience of cycling (Blaha, 2015). Vienna also has a modest bike-sharing system (CityBike), first introduced in 2003, which as of 2014 included 96 docking stations and 1,200 bikes (Blum, 2015). The net result of these policies has been a doubling in the share of trips by bike, from 3% in 1993 to 6% in 2014.

7.3. Transit-oriented development

The modernization and expansion of Vienna's main train station (2007 to 2012) were combined with extensive mixed-use development in and around the renovated station (City of Vienna, 2015a; Madreiter, 2015; Sammer, 2015). That, in turn, has spurred even more urban redevelopment in adjacent areas, which is still continuing. On a much larger scale, the City of Vienna is currently building a completely new district (Seestadt)—2.4 square km in area—on currently undeveloped land 7km east of the city center (City of Vienna, 2015e). When completed, Seestadt is projected to house about 20,000 residents and offer about 20,000 jobs clustered around 3 rail transit stations, and will restrict car use while promoting walking and

cycling (City of Vienna, 2015e; Herry, 2015; Winkler, 2015). These two ongoing developments will probably encourage continued growth in public transport ridership in future years (Schicker, 2015). However, they do not explain the growth from 1990 to 2014.

7.4 Car-restrictive measures

Politically, the most challenging approach to reducing car use is to make it more difficult or more expensive (Knoflacher, 2015 and 2007). In Austria as throughout Western Europe, high taxes and fees on car purchases, ownership, use, and parking provide strong incentives to drive less and to walk, bike, and take public transport more (Authried, 2015). It is perhaps the main reason that policies to promote walking, cycling, and public transport have been so much more effective in Western Europe than in the United States. Since 1990, for example, the price of gasoline in Austria has averaged more than twice the price in the US (IEA, 2015). Moreover, taxes and fees on car purchases are much higher than in the United States, ranging from 20% to 52% of the retail price, with the tax rate depending on fuel efficiency and CO₂ emissions (Authried, 2015). Obtaining a driver's license is also expensive in Austria (about €1,500 in 2015), mainly due to the cost of mandatory lessons at private driving schools (European Driving Schools Association, 2015). As most other European countries, Austria has to import almost all of its petroleum from abroad. High taxes, first imposed when few Austrians owned cars, are viewed as essential instruments to limit petroleum consumption and help manage the national balance of payments, and are also major sources of general government revenue.

The City of Vienna has imposed its own restrictions on car use and parking, as discussed above. In addition to traffic calming, shared streets, and car-free zones, a few districts have recently banned vehicular traffic from some neighborhood streets at certain times so that they can be used by children for play (Madreiter, 2015). Another restriction on car use since the

1970s has been the limited construction of new high-speed motorways, with a virtual moratorium in the central city since 1993. In general, new motorways are viewed as being too disruptive, too expensive, and environmentally unfriendly in a dense city like Vienna (Knoflacher, 2015). The one motorway still under consideration in Vienna would tunnel underneath a nature preserve to minimize its disruption at the street level. It would provide a key connection to autobahns in Lower Austria, the state surrounding Vienna. Its fate, however, is uncertain because it is supported by the SPÖ but opposed by the Greens (ORF, 2015; Zibuschka, 2015).

8. Political Lessons from Vienna

The implementation of sustainable transport policies in Vienna has been a long-term, multi-staged process requiring compromises, political deals, trial and error, and coalition-building among political parties and groups of stakeholders. This consensual approach to policy development has been very time-consuming. Thus, Vienna has not been the first city to introduce any particular policy, but it has masterfully adopted and integrated successful policies from other cities. For example, Vienna is one of the last major European cities to have built a U-Bahn, although it is now one of the best. Similarly, parking management had already been implemented in many Dutch, German, and Swiss cities before Vienna started its pilot project in the 1st District in 1993. Vienna's risk-averse approach to adopting new transport policies has delayed their implementation but has increased the probability of success by learning from the experience of other cities. It has also tended to minimize political risk, and may help explain the Social Democrats' continuous electoral success over the past seven decades—which has in turn facilitated the long-term development and implementation of transport policies.

Vienna has cautiously introduced new policies in stages, initially with small pilot projects, later expanded and made permanent only if deemed effective and popular. Vienna has

regularly conducted before and after studies measuring the success of policies as they are implemented, thus providing feedback for future improvements. Parking management is perhaps the best example of this. Only after studies documented its success, and surveys showed overwhelming public approval, was parking management expanded in stages from the 1993 pilot in the 1st District to 16 of Vienna's 23 districts in 2016.

In addition to surveys, advisory public referenda have been used—both at the city and district level—to measure public support for controversial policies. For example, in 2013 Vienna held a city-wide referendum on whether to keep decision-making on parking management at the district level. Moreover, several districts held referenda to poll their own residents on whether to adopt parking management. Similarly, the first shared street in Vienna was implemented only after a favorable outcome of a referendum held in the two districts where it is situated. Such referenda reduce the political risk of introducing new or controversial policies, while at the same time democratizing important policy decisions.

Local political support for neighborhood-level transport policies, such as parking management and traffic calming, has been facilitated by leaving the decisions on those policies to district councils. To enhance citizen participation, the City of Vienna, together with interested district governments, organized town hall meetings to discuss how parking management would work, and to address resident concerns. Similarly, traffic calming has been a response to neighborhood resident demands, with decisions by district councils. Traffic calming has been popular among residents because it reduces through traffic, air pollution, and noise on local streets while improving traffic safety. Thus, the combined length of traffic-calmed streets increased from 33km in 1987 to 1,657km in 2016.

Another key to Vienna's success has been the implementation of a multi-modal package of policies providing excellent alternatives to the car. That coordinated approach has been essential to garner the public and political support for adopting parking management, traffic calming, and car-free zones while greatly limiting construction of new roads. These policy components have been mutually reinforcing. For example, Vienna's U-Bahn provides such convenient, fast, and cheap access the city center that car-free zones and parking management have been widely accepted there. Moreover, with the expansion of the U-Bahn, such policies have been increasingly adopted in other parts of the city.

The package of sustainable transport policies in Vienna has garnered widespread support among the public, key stakeholders, and political parties by offering benefits of some kind to almost all groups. For example, three-fourths of Vienna's residents (and voters) use public transport at least once a week, reaping obvious benefits from good service and low fares. Moreover, businesses rely on public transport to get their employees to work and customers to their stores. Local construction firms, transit vehicle manufacturers, transit workers, labor unions, and even motorist groups (due to reduced roadway congestion) have all supported the further expansion of public transport. Similarly, parking management has spread to 16 of 23 districts because it has succeeded in reducing traffic congestion and noise while making it easier for motorists to find a parking place, even though it has become more expensive and shorter-term for motorists outside the district. Neighborhood residents and businesses, in particular, have benefited from the exemptions that favor them. Since district councils decide, those local benefits are key. The same is true of traffic calming, which mainly benefits local residents.

Finally, the improved sustainability of Vienna's transport system has been greatly facilitated by federal government policies. Without generous federal funding of the U-Bahn, for

example, it probably would not have been built, as that was a pre-condition for the city council's approval. Moreover, the federal government played a crucial role in creating the Vienna Verkehrsverbund and has borne 50% of its ongoing administrative cost. Indeed, the success of Vienna's Verkehrsverbund led the Austrian federal government to pass a law requiring all Austrian states to establish a Verkehrsverbund. The federal government also had to pass a law permitting parking management to be implemented—both in Vienna and other Austrian cities—as it violated existing laws prohibiting preferential treatment of district residents. The extraordinarily generous financial support and regulatory cooperation of the federal government is attributable to Austria's highly centralized fiscal system and Vienna's special place within it as the nation's political, economic, and cultural capital.

Vienna's multi-faceted approach to increasing the political and public acceptance of sustainable transport policies has facilitated the large reduction in the mode share of car use since 1990, from 40% to 27%. Vienna's successful implementation strategies provide useful lessons for other large cities seeking to reduce car use and increase walking, cycling, and public transport use.

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