

Vauban: A European Model Bridging the Green and Brown Agendas

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Introduction

This case study seeks to demonstrate how the green agenda of open space, water and renewables are integrated with the brown agenda of buildings, waste and transport. Central to Vauban's model is the governance system with its emphasis on community engagement and a commitment to the public good elements of the area. The case study of Freiburg's sustainable model district of Vauban, built over a ten-year period and now (in 2008) almost fully developed, will illustrate this specific mix of policy initiatives. Some findings from a residents' survey conducted soon after the establishment of the first sections of Vauban in 2000 will highlight the context of physical provision of built and natural spaces, and the behaviour of residents in an urban laboratory of innovation.

Context

Freiburg is located in the south-western corner of Germany and in European terms, can be regarded as a fast-growing though still quite small city (200,000 inhabitants). Buoyed by a reputation for the country's sunniest climate, a distinctive cuisine influenced by nearby France and accompanied by a strong local wine-making tradition, plus a spectacular setting between the mountain ranges of the Black Forest and the Kaiserstuhl, Freiburg is a significant destination for both tourism and lifestyle migration. This applies not least to the itinerant student population, attracted from all over Germany and abroad by the city's extensive and renowned tertiary education facilities. The presence of the university, in turn, has resulted in clusters of research and development facilities of international stature. Most notable in this context are the Fraunhofer-Institut focussed on renewable energy, the International Solar Energy Society, ICLEI as an umbrella organisation for sustainability policy in local communities, and the Öko-Institut, a non-profit environmental research institution (Landry, 2000). For the community, a crucial cohesive experience occurred in the mid-1970s when plans for a nuclear power station in the nearby village of Wyhl provoked a confrontation between local activists and the authorities on an unprecedented scale. The campaign marked the birth and a formative early success for Germany's powerful anti-nuclear movement and, as critical side-effects, raised awareness on energy policy issues in the region, and highlighted the importance of community participation in political processes. Freiburg's role as a network node of grassroots activism consolidated not least as an identity-building counter culture to Baden-Württemberg's deeply entrenched political conservatism - the state has been run by Christian Democrat-led governments since 1953. The specific socio-cultural milieu created in this climate of dissonance sparked numerous local environmental initiatives to flourish during the following three decades, making Freiburg known as Germany's 'ecological capital', and eventually resulting in the emergence of professional and entrepreneurial networks to capitalise on the economic potential of ecological urban innovation.

On the level of urban development, it is also important to note that Freiburg had, by the early 1970s, implemented a rigorous pedestrianisation and tram priority programme in the city centre, which was rebuilt after 1945 on the pre-industrial pattern and became a benchmark in public space quality both for other cities and for new districts in Freiburg proper (Gehl and Gemzøe, 2000). This showcase of a car-free urban environment, coupled with advanced standards of resource efficiency and renewable energy applications in buildings, ascended to a powerful paradigm outlining an ideal sustainable neighbourhood of the future. The first solar-

powered demonstration building in Freiburg emerged as early as 1978 (Landry, 2000), and by the mid-1990s, the City was ready to address the development of an entire new urban district – Vauban - bringing together best practice and latest innovations in building technology, travel demand management, community orientation and involvement that can illustrate how the green and brown agendas of development can be integrated.

Freiburg-Vauban from Vision to Practice

Planning History

Vauban was developed on the land of a former French military base of the same name, which was handed back from the Federal Government into city ownership in the early 1990s. By 2006, it was anticipated to accommodate housing for 5,000 inhabitants and 600 permanent jobs. A community association (Forum Vauban) was contracted by the city to lead residents' participation, the elaboration of sustainability goals and public relations work, as described in more detail below. A similar model had already been tested successfully in an earlier city extension area at Rieselfeld, though many grassroots activists lamented the lukewarm commitment to environmental and community innovations there. Several funds could be mobilised for the community planning and urban ecology innovations in Vauban, such as from the German Environment Foundation and the EU environment program LIFE; furthermore Vauban was presented as German Best Practice at the 1996 UN Habitat II conference in Istanbul and played a role as an external site at the 2000 World Expo held in Hannover.

Vauban's implementation can be divided into five stages: The first stage includes a student village and the alternative cohousing group Selbstorganisierte Unabhängige Siedlungs-Initiative (SUSI), both largely in converted barracks buildings. The second stage consists of new buildings in the eastern half of the site, either side of the central avenue (Vaubanallee), and was about 90% inhabited at the time of the 2000 survey, which was conducted exclusively in this section. The second stage was later duplicated as a third stage with a similar urban typology in the western half of the site, where the tram terminus opened in 2006 and where a regional rail stop may be built in the future. The remaining two stages are the solar district Schlierberg, east of the present sections and the arterial road Merzhauser Straße, and a final stage at the north of the site designed to integrate residential and commercial/light industrial uses (Sperling, 1999).

Key Elements of the Green-Brown Integrated Vision

Buildings: Dense, energy-efficient, clustered and self-governed

The new district largely consists of two to four storey row houses and walk-up apartments, at a net density of 90 to 100 units per hectare. All buildings meet (and in some cases substantially undercut) a local energy efficiency code known as 'Freiburg Low-Energy Standard', which was pioneered in the earlier city extension of Rieselfeld and later made first into municipal law, then into a federal standard after 2001. This standard caps the permissible heating energy need of new housing construction at 65 kWh per sq m per year. There is a lot of new-generation timber-frame construction of up to four storeys, and some buildings are designed as 'passive houses', i.e. they need no external energy input other than from the sun except in extreme winter conditions (to support an annual heating energy requirement of no more than 15 kWh per sq m). Most buildings feature photovoltaic panels and solar-supported heating systems as well as intelligent ventilation with heat-recapture devices. District heating

and sewage treatment was initially provided through centralised facilities outside Vauban (since most infrastructure was already in place due to the former military use of the site), though most buildings have rainwater collection facilities and run some applications like toilets and garden watering from them. A small number of projects have incorporated innovations such as a vacuum converter for sewage and organic waste, producing reusable biogas.

Most individual blocks within the second and third stages were sold to small cooperatives of owner-occupiers, each comprising between 3 and 21 households (Baugruppen). These cooperatives are responsible for the detailed building design of their shared property, accommodating their specific individual and collective needs and aspirations in a common plan, and frequently pursuing additional environmental and social objectives. This not only generated a remarkable diversity of architectural and open space solutions in a fine-grained mix of lot sizes suitable for varying building types from single-family terrace houses to 20-unit apartment buildings. It furthermore fostered fruitful cooperation and common activities between future neighbours at an early stage, providing ample opportunity to build a robust and conflict-tested community along with the buildings (Forum Vauban, 1999; Wirtschaftsministerium Baden-Württemberg, 1999). Besides the owner cooperatives, there are a number of rental units, both with and without public subsidies (though an earlier plan to incorporate some 25% of social housing into Vauban had to be reduced considerably due to cutbacks in the state of Baden-Württemberg's housing program). Most notably, a share-owned association formed by households short of the means for outright home ownership for the purpose of creating self-governed rental housing on Vauban (GENOVA) built two community-oriented projects totalling some 90 units in two projects in the second and third stages (Buchert et al, 1999).

Waste: Reducing material flow and embodied energy in construction and everyday consumption

Vauban's conceptualisation and practical operation address three critical challenges associated with waste management:

Material flows associated with the buildings themselves, how to reduce them and what measures of reusing or recycling building materials are feasible. Construction waste is a considerable proportion of total waste produced in society, and effective programs for large-scale recycling of such wastes have only recently gained ground in places where concerted efforts have been made to this end. In Vauban, it has been common practice for housing cooperatives to design the most durable components of buildings (the structural shell) with flexibility of usage in mind. The embodied energy of materials used for these components was identified as relatively low in terms of production, but quite high in terms of transport to and from the site. To enhance the longevity of the building shell, buildings were designed to accommodate a wide range of possible future modifications of internal partition and use without requiring full or partial demolition. Materials used for the internal fit-out of the buildings, which are usually lighter and thus easier to transport, but often more environmentally hazardous and energy-intensive to produce, were commonly audited towards energy performance and longevity (Buchert et al, 1999; Jensen et al, 1998).

Consumption of durable goods associated with household use, and how their waste volume can be minimised. In Vauban, most residential clusters were developed by non-profit owner or rental cooperatives, as described below. The community-oriented nature of such tenure forms has allowed for the consolidation of numerous appliances associated with high embodied energy content from the manufacturing process, and which are commonly owned and

operated individually at a household level, into shared facilities. This concerns washing machines and dryers, power tools and even motor vehicles, managed through car-sharing organisations operating at a neighbourhood level. Effectively, the total number of such appliances was reduced, and items of superior energy performance combined with features such as centralised waste-water management were selected for the common facilities (Sperling and Michalke, 1999). In practice, however, the carbon impact of such measures is relatively minor when compared to areas such as personal transport and food consumption (Öko-Institut, 2002).

User-oriented solutions to reduce household waste, and to recycle the components of what still remains. Separation of household waste into recyclable components is common practice in Germany and many other countries; in addition, most housing cooperatives in Vauban have user-operated composting systems, facilitated by the easy access from the dwellings to shared open space under community stewardship.

Open Space: Integrating recreation, water management and biodiversity

Vauban is designed to integrate into a comprehensive network of open spaces, both at the regional scale where important green links exist to nature reserves in the vicinity, and at a local scale, where public, cooperative and private open spaces intimately engulf all buildings and streetscapes, generally without fences or other access barriers. Residents were closely involved in the design of these areas, with emphasis on maintaining a maximum proportion of soft surfaces, rehabilitating a system of natural creeks, swales and wetlands for balancing local water cycles, and using native vegetation to encourage the emergence of complex ecological niches and wildlife corridors. A small number of shared open spaces are cultivated for small-scale food production under permaculture principles (Franz, 1999).

Transport: Saving space for the green by reducing car dependence

Vauban's transport concept is quite exceptional – at the time of its inception, there was only one other project (in the city of Tübingen, also in Baden-Württemberg) making use of a similar model (Soehlke, 1999). Within the second, third and fourth stages of the development, the local structure plan prohibits the construction of parking spaces on the residential lots. Vehicle owners are instead obliged to purchase or lease a parking space in one of two multi-story parking structures at the perimeter (which have photovoltaic panels on their roofs and are hence known as Solargarage Vauban), up to a five-minute walk from the dwellings. Cars may enter the residential streets but only for pick-up and delivery, and visitors, too, are expected to park their car in one of the perimeter garages and pay for the privilege like they would in a downtown car park. Housing units and parking spaces are sold separately, which at the time resulted in extra costs for vehicle owners of approximately €13,500. To make this system work, residents must declare their status of vehicle ownership on a yearly basis, and there is scope to allow for households to increase or reduce their vehicles as long as the transaction also includes a parking space. Carfree households are organised in a special association and are granted exemption from the legal requirement to provide a parking space for each residential unit. However, the car-free association was required to buy a site that could be used for the construction of a third multi-storey parking garage should the number of car-owning households exceed the capacity of the existing garages in the future. Until then – and most locals don't expect this to ever happen - the reserve is being used as public open space. Within the second and third stage, some 60% of household declared car ownership (though none of more than one car per family) and 40% did not. These figures appear to be quite close to the average of all households in Freiburg. Carfree and car-owning households

are mixed liberally throughout the settlement, but the exclusion of parking from the residential areas will encourage that a carfree character is maintained regardless. At the time of completion in 1999-2000, Vauban's second stage had advanced to become the largest carfree housing project in Germany (Nobis, 1999).

At just over 3 km from the city centre in a rather small and compact city of 200,000, Vauban is in a peripheral location in its urban context. There were pre-existing shopping facilities within walking distance, particularly in the neighbouring municipality of Merzhausen. Vauban's anticipated 600 jobs at 5,000 population constitute a well-meaning start at establishing a mixed-use district, but are still a far cry from employment self-sufficiency (which would suggest a need of some 2,000 jobs, see Morris and Kaufman, 1996). The provision of non-residential uses within small owner cooperatives has shown a mixed picture. While some successful examples exist - particularly where members of the cooperative were ready to start a business as they moved in - interest for the sites lining the central avenue, where ground floor non-residential uses are mandatory, was initially quite slow. Consequently, most of these lots were bought by commercial developers who provided conventional rental housing above the shops. A conventional supermarket is located on the ground floor of the Solargarage, and an organic one opened across the street in a mixed-use building on Merzhauser Straße.

Vauban's tram link to Freiburg was not completed until 2006, which was the latest date by which under state legislation, revenue from the sale of land in Vauban could be used to fund some 30% of its total costs. This situation contrasts somewhat with Freiburg's previous city extension in Rieselfeld, where a tram extension was completed almost immediately after the first residents moved in 1996, ensuring that public transit-oriented activity patterns could evolve from the outset.

To make carfree living more attractive while Vauban only had a limited bus service for public transit access, the car sharing association negotiated a package deal with the regional transit operators and German Rail. Members signing up for car sharing qualify, upon payment of a € 350 semi-refundable deposit, for a free annual public transit pass covering the entire Southern Black Forest region and a free BahnCard (a half-price subscription pass of German Rail, valid for a year). A range of different sized car sharing vehicles, located in the Solargarage, as well as bikes and trailers have been made available for hire in Vauban, their numbers growing with the population (Nobis, 1999).

Energy: Renewables in centralised and distributed systems

Energy management in Vauban meets two key objectives:

Improvements in energy generation and distribution. Vauban inherited a functional district heating system from the previous use of the site as a military base. However, the prevailing centralisation of heat and power generation at a regional level did not provide the neighbourhood community with the level of control over energy sources, and particularly over the ratio of fossil and renewable fuels, they were aspiring to. Local advocacy groups lobbied long and hard for a combined heat and power plant specific to Vauban to allow a much higher scope of self-determination about the district's energy supply (Lange, 1999; Steimer, 1999). In 2002, a solution was found when a neighbourhood-scale combined heat and power station, fuelled primarily on forestry waste products, took over the local distribution network and effectively made Vauban a carbon-neutral neighbourhood in terms of stationary energy use.

Improvements in building technology and building design. Vauban's development, as mentioned above, was already subject to a city-wide low-energy building standard pioneered

in Freiburg during the 1990s and adopted at federal level in 2001. But energy efficiency innovations in the neighbourhood, not least fuelled by the inventiveness of a unique coincidence of housing cooperatives, architects and developers with a desire to make a difference, moved beyond this standard during the planning and implementation process. The result is that Vauban now accommodates one of the most significant concentrations of passive houses and plus-energy houses in the temperate climate belt of Europe. The net energy input of these buildings is reduced to zero, facilitated by compact and clustered building envelopes, high insulation, solar thermal and photovoltaic systems on many rooftops, intelligent ventilation systems with heat-recapture devices, and residents with the knowledge and sense of ownership required to operate these features to their optimal performance (Steimer, 1999).

Governance: Community engagement from the beginning

The inception and implementation of Vauban's green and brown innovations needs to be understood in the context of a unique planning culture that has evolved in Freiburg in general, and among the stakeholders involved in the planning of Vauban in particular. Due to the lack of a local residents' community, new neighbourhoods developed from scratch often don't emerge on the radar of public concern until after most of the key decisions have been made. In conventional projects, policy makers often see this circumstance as an excuse to omit the need for community input beyond tokenistic consultation in city extension projects altogether. In Vauban, however, it was understood from the outset that a healthy and liveable neighbourhood on track with environmental innovations and self-governance structures will not thrive if delivered in an exclusively top-down process, and the challenge was catalysed into an exceptionally rich and synergistic participatory planning process.

The most consequential element of Vauban's participation process was its early outsourcing from government to a community organisation (Forum Vauban) acting as an intermediary between planning authorities (who in this case also represented the city in its role as land owner) and future residents (Sperling, 1999). The master plan for the site, following the decommissioning of the former military base, was elaborated on the basis of an urban design competition and approved by the City of Freiburg in 1994. Reflecting a long-standing tradition of sustainable urban development in the region, the document already contained a number of innovations such as diverse, mixed-use medium density design, low-energy buildings, good social infrastructure and priority for non-car access. Most significantly, though, it called for a model of 'extended public participation' that would enable a continuous process of reassessment and improvement through out the planning and implementation period ('planning that learns'), culminating in the nomination of Forum Vauban as its agency.

Forum Vauban launched its activities in early 1995 and received funding from a variety of sources, including the City of Freiburg, the Federal Environment Foundation (DBU) and the European Union LIFE programme. A number of working groups on different topics attracted volunteers from the entire urban region and were facilitated by Forum Vauban and external professionals; additionally, there were various committees of paid experts. These groups progressively elaborated and refined Vauban's specific concepts on mobility management, energy, ecological building, open space, community facilities and other areas. The expertise accumulated during this work and the subsequent implementation of the results led to a string of publications through Forum Vauban and to a strengthened position of community aspirations in negotiations with the city, together making significant strides in furthering the prospects and dissemination of innovative ideas. The city council formed a Vauban committee where Forum Vauban delegates would sit in to advise councillors in advance of any political decision concerning the district.

During 1996, with most sustainability initiatives still at the early conceptual stage, Forum Vauban conducted a major publicity campaign funded by the city council, with brochures, advertisements, information stalls and public meetings to present the concept of the new district to the people of Freiburg. Considerable media attention accompanied the campaign, particularly after Vauban was presented as a 'German Best Practice' project at the 1996 UN Habitat II conference in Istanbul. By the end of that year, some 1,500 households had registered serious interest in building or renting a home in Vauban. These people were subsequently networked through a bi-monthly magazine (*Vauban actuel*), funded largely through ads from the green building industry, and a series of events and workshops instigated by Forum Vauban.

It was this meticulous liaison work with prospective residents that contributed to, and eventually built the necessary popular support for, some of Vauban's most conspicuous innovations - such as the parking-free and carfree models of mobility management, the emergence of owner cooperatives (*Baugruppen*) as self-governed, non-profit developers, and the instigation of building energy concepts far exceeding the already stringent legal requirements. Assisting people to translate their dreams and aspirations about sustainable living into feasible plans, and seeing them through a council planning department that may have been well-meaning in general terms but often sceptical in detail, became an invaluable role that Forum Vauban filled with verve, notwithstanding some inevitable conflict potential. The level of synergy, accrued from such powerful collaboration structures, eventuated in a multiplicity of experimental and daring solutions to planning tasks when Vauban was developed from early 1998 onwards, proving as inspirational to sustainable building as such as requiring ongoing attention and re-evaluation with regard to their long-term viability.

After the first new residents moved in, the focus of Forum Vauban's tasks shifted to include more practical work with the emerging local community. Interactive workshops were held to determine the final design of residential streets and green spaces. Social and cultural initiatives within the neighbourhood were supported logistically by the successive conversion of Forum Vauban's headquarters within a former barracks building into a fully-fledged community centre, accommodating childcare facilities, a mobility office and bicycle workshop, a food cooperative and a farmers' market on the adjacent plaza. Later, as the district neared completion in the mid-2000s, Forum Vauban disbanded and left the field of neighbourhood advocacy to more or less classic residents' associations converging civil society activities within the district and representing local interests.

Evaluation: Is it working?

Vauban was developed from early 1998 onwards as an inspirational project for sustainable urban development. As such it requires ongoing attention and re-evaluation with regard to the long-term viability of its innovations in sustainability, both technically, socially and in governance terms.

The technical aspects of Vauban have been largely successful across the board. The city has achieved its carbon neutral status in stationary energy, it has extremely high water and waste recycling, it has reduced material consumption and highly sustainable buildings within a transport system that is radically less car dependent than most new areas built in the past 50 years. As a model of how to reduce ecological footprint it is a clear success. It has also created an open space system that has vastly enhanced the previous landscape and is the

envy of most new suburbs. It is a model of how the green and brown agendas can be integrated.

But is it popular amongst its residents? Is it a workable option for future sustainable urban development?

In 2000, a sample of 50 households within the second stage of Vauban were interviewed about their household structure and travel behaviour, as well as questioned on general attitudes on sustainability and the Vauban neighbourhood. The results illustrate how residents' everyday lives converge with the green and brown agendas of urban renewal, and where sources of conflict remained.

Demographic data

Notably, Vauban seems to exert considerable attraction to groups known regionally as 'Häuslebauer': families and individuals whose primary interest is to acquire residential property (including many first-home owners) with urban ecology merely added as a bonus. The desire to live in a home in outright ownership was given by more than half of all respondents (52%) as a decisive reason to move into Vauban. These people apparently jump at the opportunity to have influence both on the design of their unit and residential environment, and the evolution of the social community long before moving in. Such options rarely exist in traditional suburban development. Residents also cited Vauban's better local environment (42%) and ecological programme as reasons for moving to Vauban (40%).

It is hardly surprising that the first thing to notice upon entering Vauban is the sheer number of young children roaming around and making the place their home. Almost half of the residents in the survey section were under the age of 18, and this figure still seems to hover around the 40% mark today (Linck, 2006). Less than one quarter of all households were adult- only. The average household size was a staggering 3.34 persons, against a citywide average of less than 2.0 (Stadt Freiburg, 2008), and the average size of the housing units at 115 sqm reflects this. But while the small

Figure 1: Distribution of household sizes

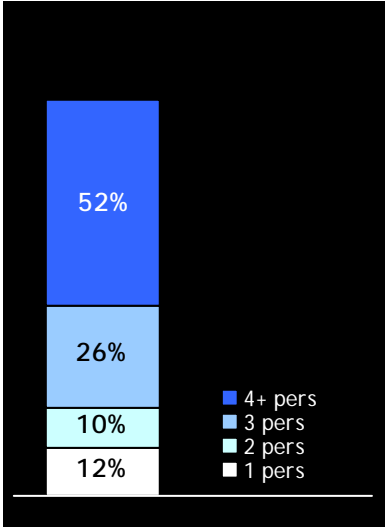


Figure 2: Percentage of households with children under 18 years old

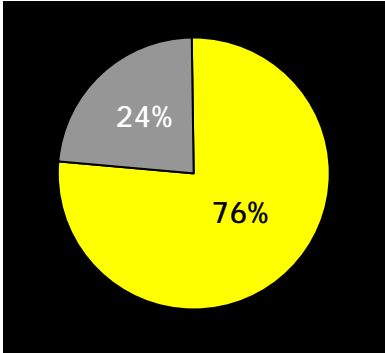
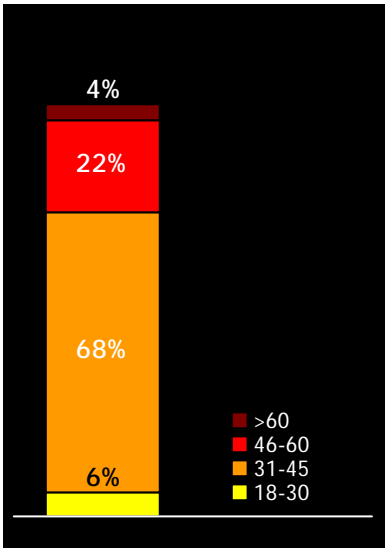


Figure 3: Distribution of age of household head



children are the most visible factor of a family-friendly district, we also encountered a considerable number of households with teenagers.

Vauban's adult population has a strong middle-age focus with those under 30 or over 60 clearly under-represented. 90% of households have an independent income, with 50% doing some or all of their gainful work at home (there are, however, more traditional professionals in this group, particularly teachers, than representatives of the 'New Economy'). Between 75-80% are homeowners. Over two thirds of households fit the definition of a nuclear family (two or more adults and one or more children under 18), though it became apparent in the survey that many of these households are second- or third-round families where not all relations between adults and children are necessarily biological or matrimonial.

Travel Behaviour Data

Forty-six percent of households in the surveyed section of Vauban did not own a car in 2000 (meaning they saved on the cost of the parking facility). In fact, the number of cars in Vauban has declined solidly since people moved in, from 247 to 186 motor vehicles per 1,000 residents (and even more if not counting the motorcycles a small number of residents have obtained to compensate for the barriers to car ownership under Vauban conditions). Freiburg's bicycle facilities and use are unusually extensive for the region, and public transit has a very strong position for a city of that size - notwithstanding the fact that access to Vauban remained bus-based and peripheral until the tram line opened in 2006. We counted an average of 166 trips on public transit per resident per year, which is only about half the city average in 2007 (Stadt Freiburg, 2008) but amounted to 19% of all trips, with 32% of residents holding a periodical public transit pass. The strength of non-motorised transport, accounting for

64% of all trips as well as of journeys to work and school), makes sense when considering that 84% of all trips are no further than 6 km. There is, however, a small but significant share of long-distance commuting, particularly up and down the Rhine corridor, in some cases as far as Switzerland (7% of journeys to work or school are over 25 km). The significance of the regional rail stop planned (but still not built in 2008) at Vauban becomes obvious here. The average distance to work or school is 6.8 km, a range including most relevant destinations within Freiburg (the city centre itself is located 3.5 km north of Vauban).

Figure 4: Modal split in percentage of all trips

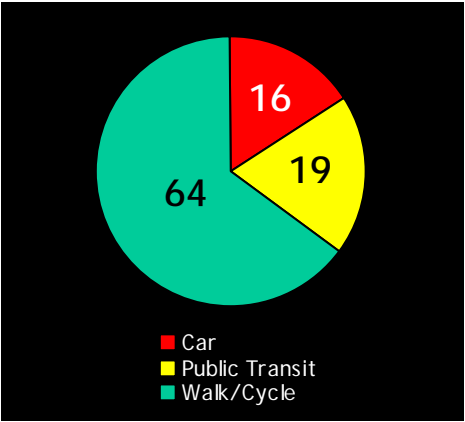
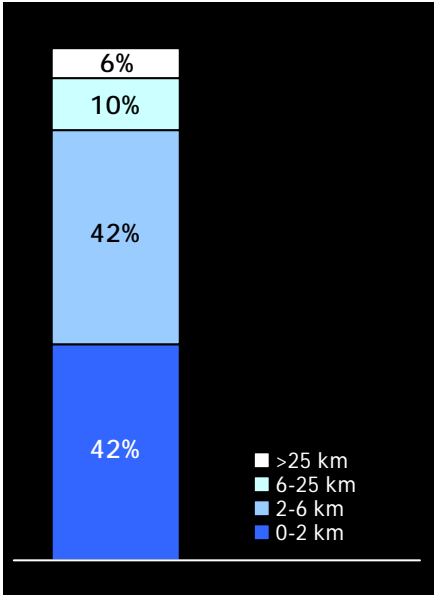
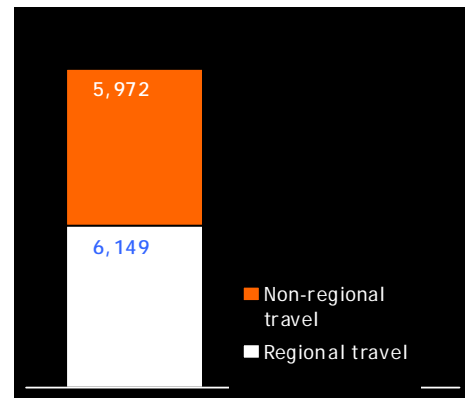


Figure 5: Distribution of trip lengths



Car sharing counts on 46% of Vauban households as members - as elaborated above, this is offered as a package with annual public transit travelcards and rail discount passes and thus becomes an extra attraction. Some 6% of all automobile mileage is done in car sharing vehicles. The remainder - 16% of all trips, almost half of which are for leisure purposes - adds up to an average of 16 weekly passenger trips per private vehicle. In terms of mobility and lifestyles, there is a group with car-dominated activity patterns (more than 50% of all trips by car) but it is marginal (4%). 36% of households, in contrast, live largely carfree (less than 10% of all trips by car).

Figure 6: Annual km of travel per person (all modes)



We asked respondents to assess the innovative elements of their neighbourhood, and were quite surprised to find that in Vauban, a substantial 39% of households expressed disapproval about the mobility management concept as it was initially run. This takes divided opinions into account (counted as a half-vote), and there were a lot of divided opinions indeed. All but a very marginal group support the idea of a traffic-free neighbourhood in principle, and 87% contended that they were particularly attracted to Vauban because of it. But simultaneously, many residents felt that the concept did not operate very well on the ground, for a variety of reasons:

- Enforcement of the rule that the residential streets were open to pick-up and deliveries, but not longer-term parking, was impractical to enforce either through city authorities or among the neighbours themselves;
- Different residents had different practical needs to park in front of their house, and the ban was regarded by some as discriminating against disadvantaged residents such as single parents;
- Suspicions existed, partly fuelled by the popular media, that up to 15% of car owners in Vauban avoided registering their vehicle in order not to have to pay for a parking space, even though our own and subsequent surveys could not establish as high a number (Nobis, 2003);
- Visitor parking was regarded as less than user-friendly, particularly before the tram made the precinct more accessible to public transit. Many visitors were irritated about the unusual experience of having to park in and pay for a multi-storey garage like in the CBD.

In the meantime, it appears that the housing cooperatives themselves have developed the skills to successfully mediate between conflicting parties over such issues, illustrating the robustness of self-governance at the neighbourhood level to instigate a process of communal and institutional learning. This also applies to subsequent reforms to the mobility concept. For example, after completion of the tram line the on-street parking spaces along the central avenue were designated as visitor spaces (and priced like those in the *Solargarage*). Furthermore, a clearer definition was provided about what constituted regular vehicle usage (three or four trips into or out of Vauban per week) to trigger the requirement for residents to buy or permanently lease a parking space (Linck, 2006).

Conclusion – How the Green and Brown Agendas are Synergised in Vauban

Freiburg's sustainable urban development model represents the culmination of a 40-year history of innovative urban planning in the city and region. It is important to note that the integration of the green and the brown agendas in city policy was identified as critical at an early stage in Freiburg's recent history. It became manifest in the reconquest of the historic city for pedestrians and trams, and in the search for energy alternatives against the background of popular concern about the risks associated with nuclear power as well as the impact on sensitive ecosystems such as the Black Forest highlands from coal-fired power generation and other pollutants. It was facilitated by the city's capacity for research and development, and by an entrepreneurial culture ready to capitalise on the commercial opportunities of sustainable technologies and practices. All of these trends were substantially established in Freiburg by the late 1970s and translated into political expectations to governments to achieve world best practice in urban sustainability policy, or in fact to redefine the goalposts of world best practice.

But the most significant factor in enabling the Vauban model to be developed was the use of the PCP process – a public-community-partnership set up with Vauban Forum. This enabled the sustainability goals to be achieved with both technical and social innovation.

The 'seven city' principles for sustainable urban development outlined in chapter 6 can be illustrated in Vauban as a final summary of its key contributions:

1. Freiburg's claim to the Renewable Energy City stems from such early efforts to pioneer a solar industry in the country, which acted as an incubator to the global significance of the renewable energy industry in Germany and across Europe today; it has achieved significant use of solar power and its office district is a net exporter of PV solar power to the grid.
2. The Carbon Neutral City at a neighbourhood scale has been achieved; it is supported by the ability of communities to draw on cycles of material flow that allow a greater degree of decision making about resource use particularly for electricity and heat generation, and for transport, to occur at a local level.
3. Such decentralisation in energy production and distribution goes hand in hand with the goal of the Distributed City. Water and waste management are also largely a distributed function. Another example in this context is the supply of housing, which in Vauban has been brought under control of resident cooperatives to a substantial degree, rather than centralised housing corporations or commercial developers. This has positive flow-on effects on housing affordability, and demonstrably accelerated the pace of other sustainability innovations associated with buildings. The PCP model is a process for creating the distributed city.
4. Vauban has contributed to the Photosynthetic City through intensive local gardens, a biomass combined heat and power system and the hosting of a twice-weekly farmer's market for regional organic producers as a social hub.
5. The reduction of Vauban's metabolism through its energy, water and waste systems as well as its emphasis on reduced household consumption through co-operative means, contributes to the Eco-Efficient City.
6. Freiburg's identity is to no small extent built around its inventiveness in sustainability terms, where the city has carved a unique niche for itself as the country's 'eco-capital'.

Quality of life and a cosmopolitan attractiveness, critical to form lasting bonds to place among lifelong and new residents, are fostered by such identity-building and contribute to the Place-Based City.

7. Lastly, Vauban embodies all contemporary elements of a settlement that makes car use either completely unnecessary or a relatively marginal choice for everyday activities, thus positioning itself as a global demonstration case for the Sustainable Transport City.

The achievement of Vauban in integrating the green and brown agenda is a pointer to how sustainable urban development can occur. It has shown that town planning systems can enable innovation in both technical and social aspects of sustainability. Like the PPP process which has taken off across the world as a means of achieving innovation in infrastructure, the PCP process has the potential to bring the vital community element into the innovation change process in cities, especially at enabling small scale technological change.

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