# Freiburg Green City

A Major Qualifying Project

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By

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**Abstract**

People are now realizing how essential sustainability is to the future of our planet. Unfortunately, many mistake being "green" with being sustainable when in fact "green" only represents environmental interests. Sustainability is the coming together of environmental interests, economic growth and social justice. Cities are becoming more populated and are where sustainable urban development is imperative. City planners must deal with the paradox that sustainability is simultaneously being defined and implemented. As a result, they look to progressive cities for answers on how to implement sustainable policies in their own cities. Freiburg, a small city in the southwest corner of Germany, is often seen as the best example of sustainable urban development practices. This paper examines housing, transportation, and green space in Freiburg to analyze whether the city truly is sustainable or just "green."

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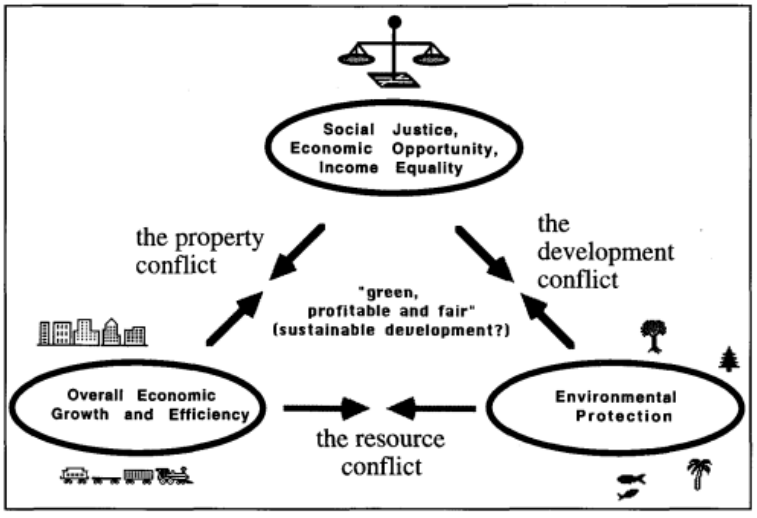
## Introduction

History/Origins of Sustainability

Sustainability has become a common term in planning but it has not always been such a popular concept. The idea of sustainability in the context of development was first introduced at the World Commission on Environment and Development in 1987. Then it was defined as, "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." [28] This broad description, released in Our Common Future by the Brundtland Commission, is often credited as the most popular definition of sustainability to this day.

Sustainability is such a broad concept that there are several other recognized definitions. Another popular interpretation of the term can be seen in the planner's triangle, or the 3-legged stool. [5]. The triangle is made up of three corners: social equity; environmental protection; and economic development, and the center of the triangle is where sustainable policies will land (policies that address all three corners or legs). [5]




(The planner's triangle)[5]

Of course, just as sustainability is a term that can be broken down so too are the three corners of the planner's triangle. Within these three aspects of

sustainability are dozens of important areas that should be addressed as well. Agenda 21, a product of the 1992 Earth Summit, addressed working toward a sustainable future through the avenues of poverty, health, forests, agriculture, and waste management. [31] In 2002 the European Union's Sustainable Development Strategy defined seven major challenges to overcome in order to attain sustainability: climate change and clean energy; sustainable transportation; sustainable consumption and production of food and other goods; conservation and management of natural resources; public health; social inclusion, demography and migration; and global poverty. [31] While there are variations in the definition of sustainability the most widely accepted ones are broad enough to encompass the many issues that fall under it.

Regardless of the exact definition, sustainability has become a widely accepted idea and is advocated by scientists, politicians, corporations, activists and citizens alike. It would be hard to defend the position that ignoring environmental and social issues is in the best interest of the planet and its inhabitants. Sustainability is something most everyone agrees is critical. Yet nearly 30 years after the Brundtland Commission, there are few who actually practice sustainability. If everyone agrees that sustainability is necessary why aren't more communities implementing sustainable policies and practices?

## Challenges in Defining/Implementing

One reason for the lack of implementation may be in the vague definition of the concept. This can be attributed to the complexity of the term. Sustainability spreads across many different disciplines and often interests in one will conflict with others. Because of this, players with invested interests in one or two specific areas will bend their interpretation of sustainability to be advantageous to them. As a result, no clear definition of the term has ever been established. There are definitions that are generally regarded as correct but they offer little insight as to what sustainability should look like in practice. This is unfortunate because then we

all essentially agree on nothing more than the idea of sustainability. The definition we accept gives nothing specific to work toward. Therefore, it is critical to merge the theory and practice of sustainability in order to break it down into small, achievable steps.

We find ourselves in a unique position because we are simultaneously implementing and defining the term sustainability and what sustainable development looks like. [5] On one hand this means that there is still time to merge theory with practice and properly define what the future of sustainability should look like. However, the tenuous state of sustainability means that those who wish to undermine the term and define it to benefit themselves have the opportunity to do so as well.

There is a complex relationship between practice and power across many domains in society. One in particular is the idea that power tends to be linked with knowledge or a certain level of expertise. [5] We can apply this concept to sustainability in our society as well. Because of the societal connection of power to knowledge, it falls to powerful organizations to define what sustainability will look like in practice as these actors implement their own "sustainable" policies. If we think back to the planner's triangle, we can say confidently that the economic development corner of the triangle has received the vast majority of attention and resources over the past several decades. If we become complacent with the current implementation of sustainability then it allows these same powerful players, who have emphasized economy over all else, to define what sustainability looks like in practice for the future.

Now that everyone has accepted the idea of sustainability the discourse surrounding it has all but stopped. This has resulted in "sustainable development" becoming a blanket term used to cover environmental and social issues. Far too often it is used only as a buzzword with rarely any substance or planning behind it. [5] It has become commonplace to claim sustainability by pointing at two corners of the planner's triangle while ignoring the third. None of the three corners can be

forgotten or practicing sustainability incorrectly will become the acceptable norm. Therefore, it is crucial to analyze and challenge all current implementations of "sustainable development practices" in order to reignite the discourse of sustainability. The more debate and conflict there is about sustainability and sustainable practices the more refined the term will become and the better the idea will be in practice. [5]

**How did we get here?**

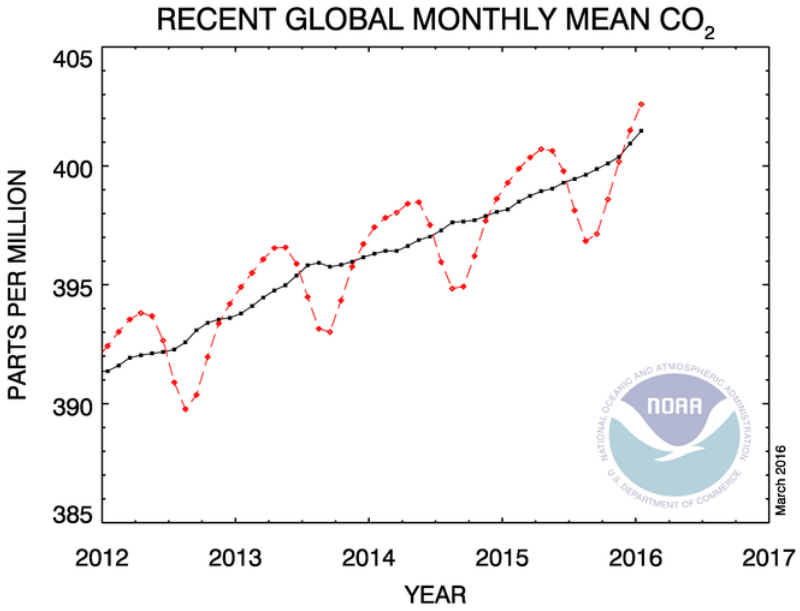
It is essential to properly characterize sustainability and sustainable development practices for the future of the movement. It is also crucial to do so quickly. Right now the world is facing incredible threats that will forever change the face of the planet as well as our global society, and the sooner we respond the better off we will be. Climate change and peak oil are the two biggest problems we face as a species in the 21st century. [18] While more people are aware of climate change than peak oil they are both equally ominous issues that must be addressed now.

Climate Change

Recently the concept of climate change has become much more accepted than it was in the past. Rising temperatures along with changes in phenology and the timing of ecological events have convinced the majority of the very real problems we face. However, there are still those who resist the facts and figures. Climate change is generally seen to be a result of the rising level of greenhouse gases (carbon dioxide, methane, ozone, nitrous oxide, and many synthetic compounds) in the atmosphere. These greenhouse gases make up a very small portion of our atmosphere as a whole, adding up to less than .1% of the composition. [1] It may seem insignificant but the balance is actually incredibly fragile and even small changes can have disastrous effects.

Carbon dioxide is the most abundant of the greenhouse gases, accounting for roughly .04% of Earth's atmosphere. [1] Ever since the beginning of agriculture thousands of years ago, carbon dioxide levels in the atmosphere have been on the rise. Yet the increase was slow and not problematic until the industrial revolution began. Before the industrial revolution atmospheric carbon level was 279 parts per million. In 2007 it was 385 parts per million. [18] This may not seem like a large increase but it actually correlates to a .8 degree Celsius increase globally. [18] Since 2007 carbon dioxide levels have continued to rise. In January of 2016 the

concentration finally topped 400 parts per million (402.59 ppm), and assuming the NOAA is accurate, the concentration will continue to increase. [9]




(Monthly carbon dioxide levels are rising)[9]

Methane levels (a gas that is even more effective at trapping heat) have also increased due to mining activity, drying wetlands, and the massive number of livestock being raised. Nitrous Oxide is another greenhouse gas on the rise thanks to abundant agriculture and airplane use. [18] As the concentrations of all these gases continue to rise massive changes are taking place around the globe. Take the Arctic Sea for example. The increase in temperature from the greenhouse gases is causing glaciers to retreat and sea levels to rise. The Arctic Sea is now 20% smaller and only half as thick as it used to be. [18]

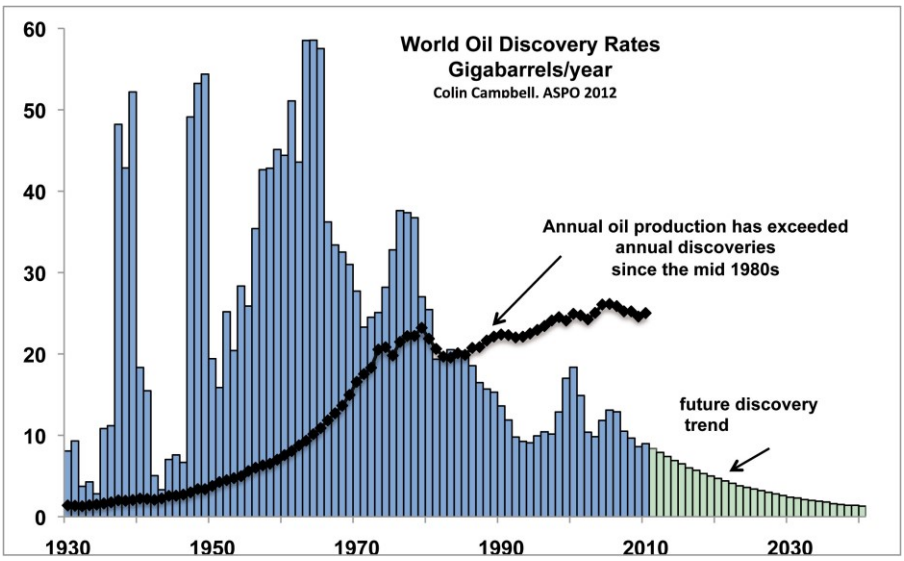
It is evident that even small changes in temperature can have enormous repercussions. Scientists generally agree that a global increase of 2 degrees Celsius is the threshold before extreme changes begin to occur. [18] Unfortunately, the temperature has already increased at least .8 degrees as stated above. Even more unfortunate is the concept of thermal inertia which states that greenhouse gases released now will increase temperatures not right away but in years to come. [18] Right now the world is experiencing the effects of gases released in the 1970s and

1980s. This means that even if the planet cut emissions to zero now, we would still experience an additional .6 degree increase, bringing the total up to at least 1.4 degrees Celsius. [18] This leaves the planet little room to work with and some scientists believe we may have to cut emissions to zero by 2060 if there is any chance of avoiding the 2 degree threshold. [18]

Peak Oil

Peak oil can be defined as "the point when further expansion of oil production becomes impossible because new production flows are fully offset by production declines." [18] Oil is not a renewable resource so eventually we will be producing less than we consume. Even large oil companies cannot deny this fact, but what they can deny is how close we may be to this point. There is evidence to suggest that we are approaching the peak much faster than we realize.

According to the U.S. Energy Information Administration, world oil consumption was greater than world oil production in 2010 and 2013. [19] Many nations have peaked in oil production and the effects are beginning to show in the global market. [18] While global production and consumption hover around the same number from year to year, oil discovery has been consistently much lower. [18] This does not bode well for the future. Much like the delayed effect from thermal inertia, there is a delay between peak oil discovery and peak oil production, with the peak in production coming 30-40 years after the peak in discovery. [18] Peak oil discovery for the entire world happened in the 1960s, which means that the peak in production is already upon us. [18] If we have hit our peak in production and it is barely enough to meet our 90 million barrel a day demand, then the decline from the peak could be extremely difficult. [18]



(World oil discovery, indicated by bars; World oil production, indicated by line)[18]

Remarkably, every oil company claims we are far from hitting our peak. Roughly 80% of the oil companies in the world are federally owned and are therefore not required to release their reserve numbers. [18] This makes it difficult to gauge how much is left but it should not be assumed they have a large stockpile. Indicators from non-federal oil companies also suggest otherwise and the timing is beside the point. Oil may or may not run out soon but it is an undeniable fact that it will. Peak oil is about readying our options in the face of this decline and planning proactively as opposed to reactively. [18]

## Going Forward

Dealing with these two problems is a daunting task but one that must be confronted. It is also important to address these not as separate issues but as interconnected. Solutions should be applicable to both climate change and peak oil or else they could do more harm than good. Take the Hirsch Report for example. The Hirsch Report was made in response to peak oil and offers solutions such as switching to coal and tar sands. But while these solutions could potentially address peak oil they do not address climate change. Conventional coal releases 974 grams of carbon into the atmosphere for every kilowatt hour of energy, and tar sands

release 465 grams. [18] These are not the type of sustainable solutions needed to address these global problems.

## Background

### Transitioning

Given the problems we are facing as a planet right now it therefore becomes necessary to transition to a sustainable society that addresses all aspects of sustainability, not as a choice but as a critical turning point in the history of our species. Transitions, especially those that occur on a large scale, are often very complex and slow going. There are many different factors that influence societal transitions and the transitions required to deal with today's environmental problems will be very complex indeed.

#### Theory of Transitions

Transitions are "shifts or 'system innovations' between distinctive socio-technical configurations encompassing not only new technologies but also corresponding changes in markets, user practices, policy and cultural discourses as well as governing institutions." [6] As this definition explains, transitions involve changes across a large span of dimensions, disciplines, and at all levels of society. Because of this they can take upwards of 50 years to complete. [22] Transitions can be difficult to understand because they occur gradually and over so many aspects of society. However, studying the major factors and influences that cause transitions is critical to identifying when and where transitions may be occurring. This is particularly true for sustainability transitions as they will require significant societal changes and are likely beginning right now. As we try to understand the emerging field of sustainable transitions it becomes necessary to understand the theory behind transitions and how current literature can be connected to sustainability. There are four main schools of thought that have gained prominence in transition studies: transition management; strategic niche management; technological innovation systems; and the multi-level perspective. [22] In the context of sustainability the two that have been applied the most are technological innovation systems and the multi-level perspective.

Technological innovation systems (TIS) holds that transitions emerge when new technologies are introduced into the market. [6] Those who subscribe to this way of thinking believe that technological advancements are the main driver for societal change and that these innovations can occur in three ways. The first is a point source transition, when an entirely new product is introduced and catches on quickly, diffusing from the original point source until it spreads everywhere. [8] An example of this could be the emergence of the World Wide Web and the rapid spread of internet use. The second is in replacement technology, where new technology is released that outperforms older competition in the marketplace. [8] This is based on cost and performance, for example the introduction of the automobile that would outperform the old horse and buggy mode of transportation. The third way is through transformation. In this transition, technology develops slowly over time and each new product improves upon the last. Future products are a result of already existing ones, as the new grows out of the old. [8] A good example of this is the iPhone which improves upon itself with every updated version.

Eco-efficient technology such as LED light bulbs, electric cars, and energy efficient appliances have been introduced into their respective markets and succeeded. Because of this historical success and how these examples fit into TIS theory we must accept that TIS does hold as a legitimate theory in sustainable transition studies. However, what is lost in TIS when applied to sustainability transitions is the role of other institutions. Culture, education, and organizational practices (all of which vary from one region to the next) are certainly factors that affect the adoption of sustainable practices but are not accounted for in TIS theory. [6] The danger of TIS in sustainability transitions is that it can lead to oversimplified conclusions, and sustainability is so complex that we cannot have simple, one dimensional solutions.

The dominant theory in sustainability transitions is the multi-level perspective (MLP). This theory centers on socio-technical regimes which naturally want to retain the status quo and resist change. [6] Socio-technical regimes are, "the coordinated activity of different social groups that results in the elements and links in a socio-technical system." [8] In other words regimes are sets of norms that dictate how society runs that help to stabilize socio-technical systems within society. Socio-technical systems involve many elements including but not limited to technology, regulation, user practices, markets and culture, and when these elements interact they provide societal services. [22] Regimes are referred to as such because they provide a logical direction for incremental development within the regimes which, barring any outside interference, society will naturally follow. [22] Because of this, regimes are fairly resilient to change. The interconnectedness of existing technology, complementary technology, institutional and political structure, and user practices form a stable lifestyle. And in order for the lifestyle to change all the elements that created it must also change. [22] This is why a switch to sustainable practices has not happened overnight and why it will be a slow and challenging transition.

But transitions do happen; regimes are not entirely immune to change. When social groups in the regime start on trajectories that go against the natural progression of the regime the stability of the system is weakened. [8] One way in which a regime can begin on a new trajectory is a niche. A niche is a small area within the regime where radical innovation occurs. In time, a niche can gain power and change the entire regime, sometimes even becoming a regime of its own. [14] Nonetheless, a niche needs a window of opportunity in order to infiltrate the regime and these windows will not exist unless the regime is first weakened. Regimes are destabilized by changes in the socio-technical landscape, or what is going on externally from the socio-technical system. The socio-technical landscape includes normative values, political landscape, economic and cultural developments or in this case, environmental problems. [8] When factors in the landscape change it puts

pressure on the regime, which in turn can open windows of opportunities for niches to trigger shifts and change the system. [22]

Changing environments put pressure on regimes to change. Take transportation as a regime for example. External changes in technology put pressure on the existing system to abandon the horse and buggy and evolve to accept automobiles. [6] However, socio-technic transitions require not only changes to technology but also to the surrounding environment. User practices must change and institutions within and surrounding the system must change. [22] With respect to transportation - cars needed accompanying roads and infrastructure, fuel, and traffic rules to be developed in order for automobiles to become viable. Socio-technic transitions also affect related societal domains: housing, working, trading, planning and policy just to name a few. [22]

One of the reasons sustainability transitions are particularly complex is because they require transitions in many different domains and aim to change notoriously strong regimes such as energy, transportation, and food systems. [14] That is not to say that sustainability transitions are impossible, in fact some have already begun. The most well-known sustainability transition is likely decarbonization. [6] Many institutions now acknowledge and promote transitioning from a carbon centralized society to one that conserves carbon. Other sustainable transitions have begun in agriculture, waste, and water. [6] However the small steps that have been made are exactly that, small steps. Sustainability transitions have more complexities than most transitions and will therefore be more challenging.

There are a several reasons why sustainability transitions will be difficult. One is that many of the goals are normative ones, which lend themselves to associated prisoner dilemma and free riders. [14] Associated prisoner dilemma means that the importance of the transitions and the problems they address will be heavily debated (like climate change has been for so long). [14] Free riding occurs because private actors have no immediate incentive to switch to sustainable

practices because it puts them at a disadvantage if their competition does not switch. This means that governmental authorities and society will be the main drivers behind these transitions. Private actors will only switch to sustainable practices if they are forced to (and then some will cheat the rules) or if consumers change their own practices and expectations. [14]

Another challenge can be seen by examining the energy regime. This regime is one that must change in order to address peak oil and one that in the past decade or so has been challenged by many green niche innovations using wind, solar, hydro, and geothermal energy. While all of these alternatives can certainly be beneficial, they can also become a hindrance when there are too many choices. A niche invention will work if the niche finds a window of opportunity and gains momentum quickly. However, the window is a small space where usually only one niche can flourish. There are so many niche inventions in this particular window that choosing the right one becomes difficult and none of the niche inventions end up gaining momentum. [14] This is made worse by competition amongst the different niche innovations. Because of the competition between these various renewable energy possibilities, the regime has time to react and find alternate sources that will keep the regime in tact (such as tar sands and natural gas). [14]

A third factor facing sustainability transitions is that the environmental problems we face are global problems. This means solutions must also be global which requires cooperation at an international level, and one region's preferred solution may not be another region's. This creates debate and slows down the transition. [14] The scale of the problems also means that there is not one specific cause-effect chain, which makes placing blame on any specific player very difficult. Consequently, societal movements and public voice will have to be the driver behind solving these problems. [14]

Though research on sustainability transitions has increased it is still a new and fairly undeveloped field. Most of the literature has been focused on energy transitions and much of that has been concentrated in Europe, spotlighting

transition towns. [22] While the research is narrow there are still opportunities to evaluate the current sustainability transition initiatives, particularly in cities. Cities as massive conglomerates of people, are an important place to develop and challenge socio-technical regimes. One prominent trend that is developing in cities is a sustainable transition known as the green city movement. [27]

## Green Cities

What is a Green City?

In the past few decades cities have been trending toward green and some have even made it their mission to enact as many green policies as possible. These "Green Cities" have gained prominence in the past few years and cities like Copenhagen, Vancouver, and Freiburg (the focus of this paper) are now being labeled as examples that other aspiring green cities should model themselves after. But what exactly makes a green city? In an ideal world a green city would be carbon neutral and fully sustainable. However this definition is not realistic. Obviously the green cities mentioned above are not perfect but they all employ certain environmentally friendly policies. Therefore, a more applicable definition of a green city may be a city that promotes, "activities that employ, recognize, or conserve nature in its many helpful forms to sustain urban life while limiting or reducing its depletion." [3] This may be an appropriate definition for a green city but a sustainable city must go further than being environmentally friendly. Sustainable cities should enact policies to, "avoid uneven development, housing segregation, unequal property-tax funding of public schools, jobs-housing imbalance, spatial imbalance of economic opportunity, unequal access to open space and recreation." [5]

What then might a sustainable city look like? Going back to our definition of sustainability, the ideal city would promote social justice, economic development, and environmental protection. Society as a whole has been pretty good at sustaining political and economic needs and systems but we often ignore ecological and social issues. Therefore, a sustainable city would likely need to address environmental and social equity more than in the past.

Environmental equity has two major dimensions: the wellbeing of future generations and the wellbeing of the earth itself. Some examples of environmental issues a sustainable city should address are recycling, land use and land use

planning, urban ecology, water and air pollution, renewable energy, and utilization of green spaces.

Social justice issues are more complicated. First it is important to define what social justice is. One way to describe social justice is the, "equal distribution of resources among social groups across the space of cities." [5] It is also important to note the difference between procedural and substantive fairness. For example, minority groups may have the same rights but if they are persecuted or given unequal opportunities then that is not social justice. [5] Minority groups not only refer to ethnic groups but also those economically challenged. The poor are the least capable of relocation and are therefore tied to an area more than those who can afford to move out of a bad environment. It is important to protect those who cannot protect themselves and that is why social justice is so critical.

Keeping this definition of social justice in mind, there are several concerns that a sustainable city should address in the context of societal interests. Sustainable affordable housing is extremely important, particularly in cities where gentrification is becoming a major issue. The encouragement of public health is another crucial topic. Other areas to consider are public education and participation, diversity in services offered, and availability of local jobs at all levels.

In the next section we will go further in depth as we examine Freiburg as a green and sustainable city and look to determine what exactly makes it a green city and if it is in fact the sustainable city it claims to be.

**History of Freiburg**

Freiburg, or Freiburg im Breisgau, is located in the southwest corner of Germany in the state of Baden-Württemberg. It is also the largest city in the region known as the Upper Rhine Valley. [23] The city is 15,306 square kilometers in area, most of which is made up of the nearby Black Forest. [2] The population of Freiburg is around 220,000 people, which makes it one of the smaller cities in Germany. The history of Freiburg as a city goes back to the 11th century when it was founded. It quickly became one of the leading centers for business in the region. [17] In addition to Freiburg's reputation as a business city it would soon become known as a center for academics as well. In 1457 the Albert-Ludwig University was founded and it remains a destination for academic minds today. [17] Because of Freiburg's early reputation for education it did not develop in the same way that many other European cities did. While other cities were experiencing rapid industrialization in the late 18th and early 19th century Freiburg remained relatively unchanged. [2] Because the city had stayed constant for so long and resisted pressure to industrialize, the historical look and feel of the city became a point of cultural pride. Unfortunately, World War II destroyed much of the city. On November 27th, 1944 aerial bombing destroyed 85% of the historic city center and almost all of it had to be rebuilt. [11]

After World War II the city had to decide how they wanted to rebuild, and it was decided that they would try to hold onto their cultural identity. Instead of widening the streets to support the popularity of automobiles they kept the roads the same, even opting to keep them cobblestone. Instead of building skyscrapers like other cities, Freiburg made policies to limit the height of buildings. [2] As the rebuilding of the city was being completed, Freiburg was faced with a new challenge that would set them down the environmentally focused path they are recognized for today.

In the late 1960s the German government finalized plans to build a nuclear power plant in Wyhl, Germany. They had hoped that providing additional power to

the region would stimulate growth and allow for population and business expansion. [24] The town of Wyhl is located 30 kilometers from Freiburg so the nuclear plant would not directly affect the residents of Freiburg. [15] However, when the academics at the University heard about the plans they began protesting. Soon they were joined by local winemakers who worried that the nuclear plant would reduce available sunlight and affect their grapes. The conservative winemakers made for an unlikely partnership with the liberal academics but word of their alliance spread and soon activists from nearby Alsace, France joined in the protests as well. Eventually, the group of protestors numbered 20,000 strong and after a final push in 1975, the German government cancelled the nuclear plant project. [24] Since then, Freiburg has done everything it can to become an environmentally friendly and sustainable city. Coinciding with the success of the nuclear plant protests was the emergence of the Green Party in the Freiburg political world. This is the political party that rose to power, pushing renewable energy and conservation and they still control the city today. [15]

Freiburg has since adopted many green policies and taken part in international environmental initiatives. Starting as early as the 1970s the city was putting in place measures to encourage alternative modes of transportation and in the 1990s they began charging very high parking fees to discourage the use of automobiles. They also banned the construction of new multi-floored parking garages. [28] Freiburg was the first city in Germany to create an environmental protection agency back in 1986. [11] In 1992 the city made its first long term energy plan with the goals of conserving energy, using environmentally friendly technology and transportation, and increasing the use of renewable energy sources. [2] In 1996 they amended this plan to include reducing carbon dioxide emissions by 25% by 2010. [2] The city planned its development by coupling environmental interests with economic progress however they could.

Energy, Pollution, and Waste in Freiburg

One of the areas Freiburg has focused on most is renewable energy. After the nuclear plant protests the city still relied heavily on nuclear power, getting 60% of its energy from nuclear sources in the mid-1980s. As the city began focusing more on environmental goals they vowed to increase the use of renewables and decrease their dependence on oil and nuclear power, which today is down to 15%. [11]

Freiburg currently uses several different types of renewable energy to power the city. The most abundant form of green energy is solar, and many of the buildings and almost all new structures have solar panels lining the roofs. Even the soccer stadium and the train station double as solar farms. In total, Freiburg has 150,000 square meters of solar cells and they produce a combined 10 million kilowatt hours per year of energy. [15] Still, solar energy in Freiburg accounts for only 1.5% of energy use, though this number is much higher than the 0.3% for Germany as a whole. [11] The city also has 6 wind turbines that produce 14 million kilowatt hours of energy per year, and both local and imported biomass energy that accounts for some 16.6 million kilowatt hours per year. [15] The city also produces 1.9 million kilowatt hours a year of hydropower from the Dresiam River that runs through the city, and they import more hydropower from Austria, Switzerland, and Norway. [15]

(Solar panels along a highway near the soccer stadium)

Originally Freiburg had hoped to obtain 10% of its energy from local renewable sources, but by 2010 that number was only at 3.7% and currently it's around 5%. [15] Freiburg also mandated that all new buildings use energy efficiently: no more than 65 kilowatt hours per square meter per year. On top of this, they are promoting the construction of passive homes and buildings. These homes use less than 15 kilowatt hours per square meter per year and, though they cost more to build, can cut energy costs and carbon dioxide emissions by 30%. Starting in 2011 the city required that all new buildings be built to these passive standards. [2] In 2007 Freiburg called for a rapid decrease in carbon dioxide emissions, aiming to cut levels by 1.5% a year. The goal was aimed to help the city with its original goal of cutting carbon dioxide emissions by 25% by 2010, however they fell well short of this goal, only managing a 14% reduction. The number still represented progress and given the 10% increase in population the reduction turned out to be 20% per capita. The new goal is to cut emissions by 40% by 2030. [11] They also have set a goal to increase the renewable share in the energy market from 5% to 20% by 2020. [2]

(Several wind turbines overlooking the Freiburger Münster)

Overall, the electricity consumption in Freiburg increased by 3% from 2004 to 2010, coinciding with a roughly 6% jump in the population and an increase in commercial and tourist activities. The city had originally hoped to decrease their electricity use by 10% in that time frame, but instead must settle for a 1.6% decrease per capita and a decrease in the use of heating oil. [15] The decrease in heating oil is in large part due to combined heat and power (CHP). CHP uses the heat lost in electricity production to generate more energy and heat for district heating systems. In 1993 only 3% of the city's energy was produced with CHP but today that number has risen to 50%. [15]

Freiburg has other initiatives in place as well, including methods to reduce and properly deal with waste. Germany as a whole has an impressive system for discarding waste, recovering 70% of solid waste for reuse and reducing the number of landfills from 5,000 to 200 in 40 years. [15] In Freiburg, the system is the same and is taken very seriously. Trash is divided into glass, plastics, non-recyclables, and compostable waste. Throughout the inner city there are some 350 community bins for waste to be placed. [15]

Becoming a Green City

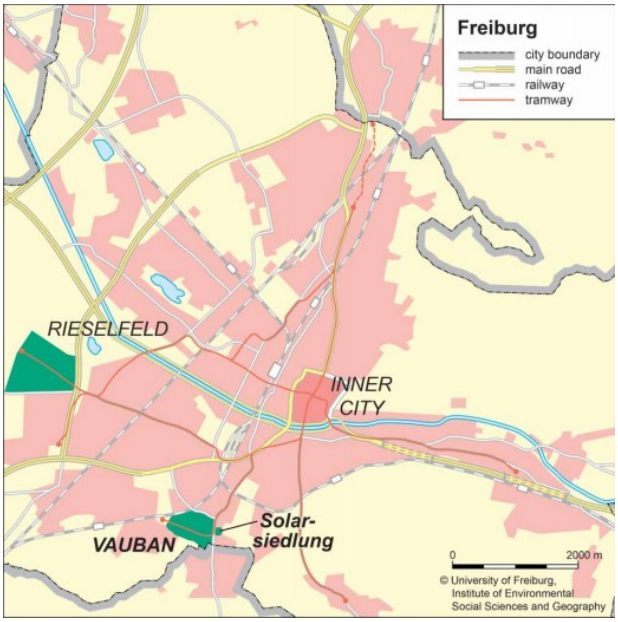
In 2010 Freiburg won the award for European City of the Year for its efforts toward sustainability. [11] We have already discussed many of the energy and conservation efforts they have in place, but Freiburg is most recognized for its new quarters of Vauban and Rieselfeld which are often hailed as the best examples of practicing urban sustainability.

Vauban was originally built in the 1930s as a military base. After World War II it was under French occupation. [24] When the French left Vauban in the early 1990s the city began working to develop the new quarter into a sustainable district. Vauban consists of 38 hectares and was originally designed for 5,000 inhabitants, most of who would be families. [12] The design called for high density, mixed use buildings, reusable rainwater disposal systems, and 3 to 4 story buildings with solar panels lining the roofs. They used the existing infrastructure in the area and repurposed it to function as shops, schools, offices, and student housing. Furthermore, it was required that all buildings consume no more than 65 kilowatt hours per square meter per year of energy. The buildings in Vauban consume 30% less than comparable buildings. The energy to power Vauban is mostly green with 65% of it coming from renewable sources. 67% of the houses in Vauban get power from the nearby CHP plant that burns 80% woodchips and 20% natural gas. [30]

Vauban has become a popular tourist spot in Germany as well as a necessary destination for scholars all over the world interested in sustainable design. In fact, up to 35,000 people a year visit Freiburg just to see Vauban and the attractions it has such as the Heliotrope - a rotating solar house designed by Rolf Disch that produces more energy than it consumes. [11] There is also the very popular Disch-designed Solar Settlement. This consists of the Sun Ship (which hosts the environmental science research institute, Oko-Institut, a bank, a supermarket, and several housing units) as well as a collection of 59 passive solar homes. [24]

(The Heliotrope (left)[33] and Solar Settlement with Sun Ship in the back (right) in Vauban[15])

Rieselfeld was built after Vauban and attempted to improve on the Vauban experience. The area, which is larger than Vauban, consists of 5 square kilometers in the western part of Freiburg and was formerly a city owned sludge farm. [2] The quarter aimed to accommodate the increasing population of the city and was designed to house up to 12,500 residents. The city placed a 5 story limit on building when planning the sector and hoped to make the buildings multi-purpose and merge density with livability. Community groups were asked for their input on what they would like to see in the new quarter and they answered with commercial shops, medical buildings, schools, religious buildings, and residential communities. [2] To go along with the idea of sustainability, the design discouraged car use while maximizing pedestrian and bike use, and placed the tram line in a convenient, central location. [2] Like in Vauban, all the houses are low energy and powered by CHP as well as biofuels and solar power. The housing units produce 20% less carbon dioxide than typical homes. [2] The construction of the Rieselfeld quarter was also completely financed by land sales, development fees, and public funding. The total amount raised was over 1 billion euros: over 145 million euros more than needed. With this extra reserve, the city created a fund and allocated it toward constructing public buildings, streets, utilities, landscaping, planning and marketing costs, and public relations and quarter management. [2]



(Vauban and Rieselfeld in relation to the inner city)[12]

It's clear that in the past 20 years Freiburg has pushed exceptionally hard to become a green city and has marketed themselves as a model of sustainability. But what are their end goals? Cities typically enact sustainable policies regarding green infrastructure, green transportation, brownfield redevelopment, and carbon reduction. Freiburg has taken these initiatives and used them to create and market a "green city" in order to drive urban development. [12] The city reasons that their ecological innovations have allowed them to become environmentally friendly, simultaneously increasing economic prosperity, and deem that their democratic way of developing projects creates a socially inclusive environment: therefore they believe the city to be sustainable. [12] However, social inclusion should always go beyond the planning phase. Sustainable goals improve the biophysical environment and raise public consciousness while keeping in mind the interests of all social groups. Freiburg gets a lot of attention for their use of renewable energy, low carbon rates, and sustainable mindset. They are often referred to as an example of best practice for implementing environmental and sustainable policies for urban development. It is important to analyze these claims as well as Freiburg's sustainable policies in order to determine whether the actions the city has taken have truly made them sustainable or just green.

## Methods

In order to accomplish this study there were two major types of research carried out. The first was a case study of Freiburg which focused on four main topics. The initial topic was the history of Freiburg. The purpose of this was to create a narrative to understand why and how Freiburg began moving toward sustainability. Understanding the history of the city as well as how it operates today will help to build an understanding of the policies and actions they have taken in the areas of sustainable development. This brings me to the next three sections of the case study: housing, transportation, and green spaces in Freiburg. These are the three areas that we will analyze to determine whether Freiburg is truly on a sustainable path. The case study portion of this analysis involves scholarly research regarding the four topics in the context of sustainability. Much of the information sourced for this project consists of journal articles and books about the Green City Freiburg initiative which include overviews of enacted policies as well as analysis of the effectiveness of these policies.

The second type of research was hands-on exploration concerning the broader context of urban development in Europe as well as Freiburg specifically. In order to accomplish this I went to several European cities to build my knowledge of urban development in that area of the world. First I traveled with a group of students and staff from the University of Luxembourg to: Luxembourg City; Namur, Belgium; Louvain-La-Neuve, Belgium; Brussels, Belgium; Antwerp, Belgium; Baarle-Hertog, Belgium/Baarle-Nassau, Netherlands; and Amsterdam. In each location we discussed and analyzed the policies the city had put in place and how they were meant to encourage sustainable growth. At the end of the 10 day excursion we reviewed common themes and problems that arise when trying to accomplish sustainable urban development. With this background I then continued on to Freiburg, Germany where I would stay for 6 weeks to conduct hands-on research of the city and live the Green City experience myself.

In Freiburg I stayed in an apartment in the Stühlinger district of Freiburg. This district has a high student and minority population in relation to the rest of the city so I was able to see how these groups of people lived their day to day lives. While in Freiburg, I took a class at the Albert Ludwigs University of Freiburg about urban geography and sustainability to better understand the development of the city. In class I was able to talk to residents of Freiburg who were young adults and survey their opinions on the city. It was insightful to have people studying urban development give me their thoughts on how Freiburg's sustainability initiatives were going. I was also able to talk to other residents of Freiburg (ranging from students to those in their 50s) and ask them about the city, sustainability, and how they personally thought the changes affected the city.

Most of my other hands-on research in Freiburg was observing and traveling to different neighborhoods and green spaces. I purchased a tram pass and used it to travel to Vauban and Rieselfeld on several occasions. There I examined the residential developments first hand. I also counted traffic numbers for cars, trams, and bikers. I visited Weingarten to see the impoverished area for myself and the difference between the buildings that had been retrofitted and the ones that had not. I also used the tram to travel to several different parks, each of which I visited multiple times both during the week and on the weekend including the Seepark, the Stadtgarten, the Stühlinger Church Square Park, and the Black Forest. At each of these locations I observed how many people were at the park and what activities they were participating in, the rough demographic statistics of the park goers including age and ethnicity, and the physical design of the park such as tree coverage, open space, and aesthetic details like flowers. I also observed park infrastructure including paths, benches, and playgrounds. I used a bicycle whenever I could to get around the city. This allowed me to see the bike highways from a biker's perspective as well as determine how easy it was to get around using alternative transportation.

## Cases and Discussions

Freiburg claims to be a sustainable green city, but how much truth is there to this? To answer this question we will look at three major aspects of Freiburg and relate them to sustainability: Housing, transportation, and green spaces.

### Housing

The issue of housing will be the first topic that we examine in depth. Housing is a critical subject in the context of sustainability because it represents an area where all three legs of the stool come together and must be considered accordingly. Cities in particular, as places of population growth, face the challenge of developing affordable green housing. There is a significant lack of sustainable housing in major cities as developers have generally treated design, affordability, and environmental quality as three separate aspects. [29] Many affordable housing complexes have countless environmental and social problems such as bad ventilation, toxic or hazardous building materials, and problems with pests. There have been several cases where those living in poorly designed affordable housing units over a prolonged period of time have developed asthma. The buildings themselves often use energy inefficiently, which exacerbates the financial crisis of the lower income people who live there. Location can also be an issue as residents may be limited by the transportation options they have. [20] Another popular trend in cities has been the emergence of green housing - that is the encouragement of green building practices and using environmentally friendly materials in building development. Green housing looks to conserve water and energy in the building itself. However, it is not uncommon that these developments forget to address the social aspects of sustainability. When buildings are designed to be environmentally friendly the cost is almost always driven up, making it nearly impossible for those with low incomes to afford a unit. This creates an environment in the development that is fairly uniform - high income, high education, low diversity. That is certainly not what sustainable housing aspires to do.

Sustainable housing, with regard to the three legs of the stool, should not only consider the financial costs associated with environmentally friendly building practices and materials, but also diversity in the community. It should be about, "ecology, environment, technology, social cohesion, community stability, and citizen participation." [29] And just as the reasons and goals behind sustainable housing are cross dimensional, so too are the benefits: resource efficiency, reduced energy and water use, reduced waste generation, use of sustainable materials, lower energy and water costs, lower maintenance costs, improved health, greater diversity, and a stronger sense of community. [20]

Freiburg has tried to create several sustainable housing projects and has done a lot to encourage green building practices. Next we will look at the current housing situation in Freiburg, including policies the city has created in order to move closer to fully sustainable housing, and specifically, examining the situation in Vauban, Rieselfeld, and Buggi 50.

## Housing in Freiburg

Housing is a particularly important issue in Freiburg because of the rapidly growing population in the city. Freiburg's population increased 17% between 1990 and 2007, far greater than the 3% national increase during that same time frame. [4] Since then, the population has grown to about 220,000 people and that number will only trend upward. In order to tolerate the influx of people, Freiburg needs to plan its housing accordingly. If they intend to direct their citizens into sustainable living conditions, then they need to plan intelligently. As a leader in sustainability and a location where people are eager to live, other cities are looking at Freiburg to be the model on how to accomplish sustainable housing practices. Freiburg has responded with several policies mandating green practices throughout the city, as well as the quarters of Vauban and Rieselfeld.

Freiburg began planning for green housing as far back as 1992. Back then they mandated that all new houses built on city land be limited to a maximum of 65 kilowatt hours per square meter per year. The national standard was 75 kilowatt hours. Though the mandate increased housing costs by 3% in new developments it also lowered heating costs, and oil consumption dropped from 12 -15 liters per square meter to 6.5 liters per square meter. Since then there has been a push to lower the maximum to 40 kilowatt hours per square meter per year. [26] Some even believe the number should go down to 15 kilowatt hours. [15] This would qualify as passive housing. Passive housing costs around 10% more to build (a significant increase) but reduces energy and utility bills up to 90%. Though passive housing is not overly abundant in Freiburg, many of the passive structures that do exist are located in the Vauban quarter. [26]

Vauban

Vauban is perhaps the most marketed sustainability initiative in Freiburg. It was designed as a family neighborhood to accommodate roughly 5,000 residents, and was intended, in part, to discourage new citizens of Freiburg from moving out to the suburbs. [4] The settlement was planned with sustainable practices in mind, and was aimed to be diverse, with demographics across all ages and all types of cultural and economic backgrounds. They even planned to include social housing and privately financed homes in order to ensure the diversity they wanted. Today Vauban holds a 1.2 plot ratio with 100 persons per hectare, which accomplishes the density designers of the quarter had hoped for. [30] Within Vauban are several different residential developments that comprise the two main neighborhoods.

The first neighborhood (the West neighborhood) consists of small home owner groups. These complexes were planned by groupings of 10-15 people who had committed to living together. [12] This is unique in that the sense of community living was developing before the housing units were even built. Various architects worked with these groups to create the designs for their own distinct

parcels. [30] The designs the groups came up with allowed for a good amount of green space between the housing units and the parties were able to vote on how to model their specific green spaces in order to create the atmosphere they envisioned. [30] Walking through the area, it's easy to notice the differences among these green spaces with some used for gardening, others as playgrounds, and some just kept as an open field to serve all kinds of uses. These green corridors are where many social interactions take place within the community.

The second, East, neighborhood is more focused on new energy-saving technology. This area, called the Solar Settlement, consists of the Sun Ship (a large building with offices and a supermarket) as well as 59 individual housing units, 9 of which are on top of the Sun Ship, and all of which have solar panels lining their roof. The Solar Settlement was designed by architect Rolf Disch in the late 1990s and constructed between 2000 and 2006. The settlement is protected from the noise and lights of the road by the Sun Ship and feels almost like an island, separated from the rest of Vauban. An average of 2.9 people live in each unit and most residents in the area are between the age of 35 and 50, with children. [12] The houses are a testament to energy-saving technology. Each house in the settlement generates more energy than it consumes. The buildings are insulated with 35-40 cm of mineral wool or polyurethane. The floor to ceiling windows are triple glazed with heat reflective material and ventilation for heat recovery, and are all oriented north-to-south to maximize the amount of sun the solar panels and windows absorb. [30] These passive houses require only 10 to 20 kilowatt hours per square meter per year to heat, and the average unit produces 115 kilowatt hours per square meter - so they produce excess energy. [12] The buildings also recycle rainwater. [12]

(Layout of Solar Settlement)[12]

The environmental benefits of living in the Solar Settlement seem fairly obvious, and there are economic benefits as well. One might think that the energy captured by the solar panels on the roofs would go toward powering the settlement, but this is actually not the case. The solar energy on all residential buildings in Vauban feed back into the regional energy grid. For those who live in the Solar Settlement this means a nice little 6,000 euro per year profit. [26] While the residents do receive some payment for having the solar panels they actually do not own the roofs and therefore do not receive the full benefit from selling the energy produced. This has irritated some and presents problems when there are issues with the roofs. [12] Since they do not own the roofs, when there are leaks or damage they cannot personally arrange the repairs but must inform the city. Still, there are undeniable advantages to living in the settlement such as saving an average of 1.2 euros per square meter on monthly heating and cooling expenses. [12] The question is whether the savings are enough to compensate for the high rent.

The Solar Settlement was not a cheap endeavor. Acquiring the land was an 11.6 million euro investment and the construction cost an extra 40 million. [12] As

a result, when the Solar Settlement was first opened the units were highly priced and were not selling as quickly as hoped. Subsequently, the Freiburg Solarfonds was created by private investors who wanted to see the settlement succeed. This group bought the houses that were not sold in order to rent them out to tenants. [12] But because of the economic benefits received by owners and investors, rent for tenants remained high. This meant only high income and typically highly educated people could afford to live in the settlement, which limited how diverse the area could be. [12] Most of those living in the settlement have been there since the beginning, but those who rent stay on average only 3.8 years.

There are a few reasons for this phenomenon. One obviously is the pricey rent. Another reason is that many of the tenants come to the settlement only by chance or necessity unlike the reason the owners live there. The housing market in Freiburg has some problems, particularly with transparency. Apartments are often brokered via social networks or other avenues on the internet, and apartment tours are either not advertised well or are scheduled on short notice. This makes it difficult to find a place to live in Freiburg, especially for those who are relocating from another city. So for those hoping to move to Freiburg the Solar Settlement is typically one of the best options, as the high rent means they can move in with very little competition. Often families will move to the settlement temporarily, making it easier to play the Freiburg housing market and find a cheaper place eventually. [12] This creates an unfortunate dynamic in the settlement as it is constantly changing. It is difficult to develop a sense of community if that community has a high turnover rate, and the resulting short-term relationships do not lend themselves to many social interactions outside of the occasional chance meeting. Walking around the Solar Settlement it seems odd that there are so many units in such close proximity to each other and yet almost no one outside interacting with one another. Those who live in the settlement feel in many ways the same way I did about the secluded feeling, saying that there is little connection with the rest of Vauban and it sometimes feels like an island with its own odd social dimension. [12] The feeling is of isolation and not at all what the designers of the settlement had hoped for.

Vauban is typically declared to be an example of best practice when it comes to sustainable housing. The problem with this is that most experts who travel to Vauban to see the quarter stay for only a short time, be it a few days or even a few hours, before proclaiming it as the solution to sustainable urban development. People are quick to point out certain positive aspects of the quarter such as its plus energy housing or the technological advancements in the field of green energy. [12] And it is true that on the surface Vauban is a very impressive accomplishment. But it is important to dig deeper to understand the entire story. A day in Vauban cannot possibly present enough information to draw any conclusions about the area, so it is necessary to either live in the city for a period of time or talk to those who have. Many articles encourage investors and other cities to follow suit by pointing to the economic and environmental advantages of the development without ever having mentioned what the residents who live there have to say. In truth, the residents have many positive things to say, praising the friendly and social nature of the neighborhood, particularly those in the West neighborhood. They also enjoy how close the tramline is and the ease and speed at which one can get to the inner-city (only 10 minutes). [12] However, they also say that diversity is lacking as it almost entirely consists of highly educated, wealthy, white families. [12] Vauban resident Barbara Classen believes the mix of people is no mix at all but nearly all middle class. She even goes so far as to say that Freiburg Mayor Dieter Salomon is not doing enough to promote social inclusion but rather promotes private development. [26]

All in all, Vauban is a fantastic example of green technology but environmental benefits without economic or social benefits is not truly sustainable, just green. The living experience in the Solar Settlement and Vauban as a whole does not align with the narrative of perfection and sustainability that surrounds it. A crucial part of sustainable urban living is social integration: a mix of different social, economic, and cultural backgrounds. The quarter clearly lacks this key component. Furthermore, there is little evidence to suggest that the residents of the quarter truly live sustainably. It is assumed that once they have moved to this green

area that they will change their lives to match but this is not exactly the case. The people live fairly ordinary lives even opting to go to typical supermarkets instead of the organic ones, citing money and time as reasons for not changing their dietary habits. [12] Vauban has infrastructure that encourages sustainable life but they leave it at that. There is no further education about sustainable living only what is already there. Another concern is whether the quarter can support growth and still remain green. If they develop more land they would lose green spaces and if they build higher they would render many of the existing solar panels useless by blocking out the sun. This is going to be an important issue going forward as Freiburg is a growing city. While Vauban has certainly taken great steps on the path toward sustainability it cannot truly be considered anything but green until the lack of social inclusion and diversity is addressed along with these other concerns.

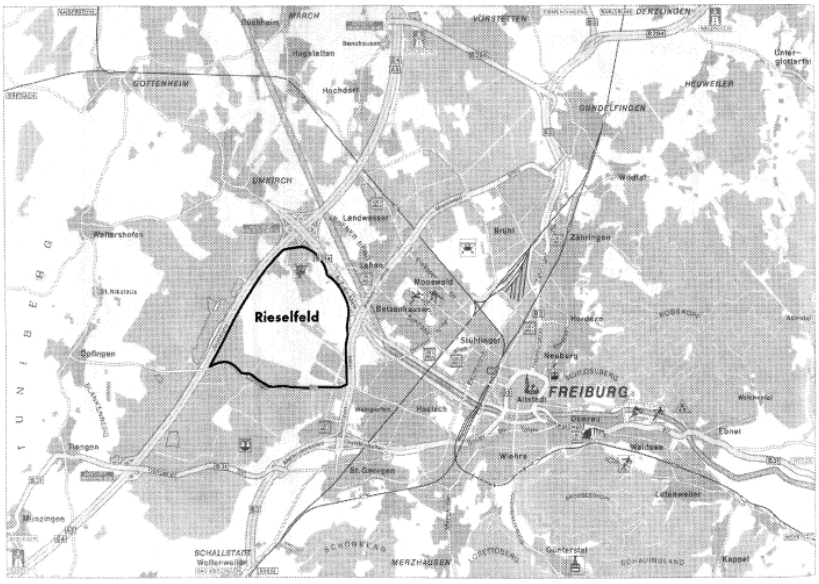
Rieselfeld

Rieselfeld, much like Vauban, is a new quarter in Freiburg that was built to be a model of sustainability. Just like in Vauban, the neighborhoods were developed before the settlement was built. Groups of buyers, typically between 6 and 16 people, worked with architects to design their own plots of land to the group's specifications. This was meant to create a sense of community immediately. [26] Rieselfeld is a bit larger than Vauban as it was designed for up to 12,000 people, 4,500 of which would live in apartments. The land is entirely owned by the city and per their wishes, the residential settlement would be dense (68.5 persons per acre of developed land) and no building would be greater than 5 stories high. [28]

Since Rieselfeld was built after Vauban, the designers were able to learn valuable lessons from the original sustainable quarter and make improvements to make it more energy efficient and socially inclusive. Some of the advancements included sharing building walls, building zero energy buildings, improving the power supply by connecting it to the district heating facility, facilitating the use of alternative modes of transportation, and encouraging residents to purchase energy

efficient appliances. [28] Rieselfeld also was designed to be more accessible to the disabled. It was mandated that 50% of the first floor apartments must be wheelchair accessible, and the tram and street connections had similar rules. [28]

Rieselfeld, unlike Vauban, was actually intended to be aimed at a lower income market, 30% of it in fact. During the first stages of construction 800 subsidized rental apartments were built in addition to 600 owner occupied units, ensuring that some of the first residents in the new quarter would be from a lower income background. [28] The overall plan for the new settlement called for a better balance between low income and high income residents than had been realized in other areas of the city. The case of Weingarten in particular influenced the plan. Weingarten is an impoverished neighborhood in Freiburg that is 80% social housing with a 50% minority population (much higher than the rest of the city.) [28] The designers of Rieselfeld believed that high-rises and the ghettoization of minority and low income groups created a laundry list of social problems for Weingarten and knew it would be important not to replicate the mistakes made in Weingarten or Vauban again.



(Site and size of Rieselfeld quarter)[28]

Despite these efforts, diversity in Rieselfeld remains a challenge and today only 9% of the quarter's population consist of minority groups. What happened is

unfortunately similar to Vauban. The cost of living is fairly high because the buildings have environmentally friendly technology, and the groups that have come into Rieselfeld are non-ethnic families with children. [28] The main employer in the district is the University in downtown Freiburg, indicating a high education/high income population. [26] Another challenge Rieselfeld has in common with Vauban is that most of the residents have not changed their lifestyle to match the goals of sustainability that the development aimed for. Rieselfeld resident Rene Reiche says he sees evidence of this every day including his own hypocrisy. Reiche, who lives in an eco-flat, still owns 2 cars and says his neighbors are similarly not "eco-purists." [26]

Much like Vauban, Rieselfeld has taken important steps toward becoming a sustainable community but it cannot be considered one yet. Many of the same problems discussed regarding Vauban have presented themselves as problems again in Rieselfeld despite attempts to fix them. The lack of diversity in the community and the failure of residents to commit to a sustainable lifestyle are two of the biggest issues that must be addressed. Freiburg cannot simply build a green community and not help educate the citizens on how to live sustainably. Rieselfeld is still a new district with hundreds of hectares still available for development. There is lots of opportunity to correct these problems and create a more diverse and sustainable community.

Buggi 50

Vauban and Rieselfeld are examples of what Freiburg has done to mandate sustainable practices in new developments, but they have also taken steps to improve the existing infrastructure in the city. One way they have accomplished this is by retrofitting buildings to be more energy efficient. Freiburg has invested over 15 million euros into a plan to retrofit many government owned buildings from schools and offices to social housing developments. The retrofits were successful in reducing energy consumption by 38% per building. [15] The most impressive

retrofit completed was the restructuring of the high-rise on Bugginger Straße 50, commonly referred to as Buggi 50.

Buggi 50 is located in Weingarten, the disadvantaged neighborhood with a high minority population. The original high-rise building was constructed in the 1960s and, like many of the buildings in the Weingarten sector, was intended to be rent controlled social housing. Buggi 50 has been hailed by many as a testament to sustainable technology and the ability to improve old housing. It was the first skyscraper in the world to be retrofitted for green purposes and was seen to be a great win for social justice as it brought sustainability into a poor area. [24] And indeed the retrofit was successful in making the building more energy efficient. Solar panels were placed on the roof, windows were replaced with triple glazed heat reflective windows, and after all the renovations, Buggi 50 became the first passive energy skyscraper in the world. [24] However, as stated earlier, it is important to look beneath the surface to get the full story. Upon further investigation, we can find hidden motivation for the retrofit beside the city's green initiative.

(Buggi 50 before (left) and after (right) the retrofit)[35]

The Freiburger Stadtbau housing association owned Buggi 50 at the time of the retrofit and, as housing was becoming more scarce in the city, wanted to raise rent prices. But since it was a social housing building, and therefore rent controlled, they were unable to do so. The green retrofits would allow them to increase their profits in other ways. [24] The change in energy efficiency meant lower utility costs and maintenance on the building. Furthermore, they changed the floorplans in the

building increasing the number of units from 96 to 139. Now tenants pay the same rent as before but the units are smaller so they are paying more per square meter. Also, new rent contracts will allow the rents to increase over time, unlike before. [24] Moreover, many of the tenants in the building are low income families who must now make due with a smaller living space.

Another issue that has been overlooked is the number of families displaced by the project. The retrofit of Buggi 50 began in 2009 and took 2 years to complete. That meant that all the tenants (mostly low income families) were forced from their homes for 2 years and had to find another place to stay. Since the project took so long, many of the former residents found new permanent homes. And indeed, only 4 out of 90 families and 2% of the total residents from the original building returned to Buggi 50 after the restoration. [24] One pivotal reason this displacement occurred was because of poor communication regarding the retrofit.

An essential part of sustainable urban development is community involvement especially in the planning phase. Building planners must consult with all types of different authorities and experts including city planners, land use specialists and government officials, but they must also reach out to those most intimately involved, the residents. That is how the right compromises are reached. [5] This important step in communicating with the community was for the most part ignored in the case of Buggi 50. There was a public participation process in the period before the retrofit began but it was mostly superficial. The residents, primarily minorities, were somewhat taken advantage of in their lack of information about the proposed changes and what the process would entail. The public meetings were not held by Freiburger Stadtbau but rather by a private citizens group who wanted very much to see the retrofit project accomplished. [24] Because the public was technically informed about the changes and any questions or concerns were theoretically addressed, the project was allowed to continue on schedule. Now the project is seen as a huge success and once again the social ramifications are downplayed or ignored altogether.

Housing Conclusions

Freiburg has succeeded in marketing itself as a green city and an attractive place to live. The promise of a high quality of life and the popularity of living in Freiburg have people clamoring into the city. This trend has made for an intensely competitive and therefore expensive housing market. Because of this phenomenon there is little diversity in the people who can essentially afford to live in the city. [23] Even Freiburg's current residents are distressed by the increasing cost of rent. Prices have risen to 10 euros per square meter, the highest in Freiburg's history, and they will continue to climb as long as there is a housing shortage. [23] Freiburg is projected to grow another 10% between 2011 and 2030.

The Freiburg housing situation is one of the most crucial issues the city is dealing with, they have certainly taken significant steps toward providing green housing options. There are typically higher up-front costs involved in green housing as the economic benefits aren't realized immediately but rather over the course of time. People generally don't like waiting for a return on their investment, so it is an encouraging sign that despite this there are many Freiburg residents who have invested in green housing anyway. Still, green housing is not the same as sustainable housing and costs will go up even further when we talk about genuine sustainable housing. It is difficult to quantify many of the benefits of sustainable housing since environmental and social improvements cannot completely be measured in financial terms and that makes the idea a harder sell to investors. Perhaps it comes back again to a poor definition. Like sustainability itself, sustainable housing is simultaneously being defined and implemented. Going forward, the examples presented in Freiburg fit the definition for green housing but do not constitute sustainable housing as social interests continue to take a backseat to environmental and economic concerns.

Perhaps the answer to this chronic dilemma is to try a bottom-up approach to sustainable housing. The Freiburg approach has consistently been a top-down approach where community interests, diversity and ongoing sustainable education

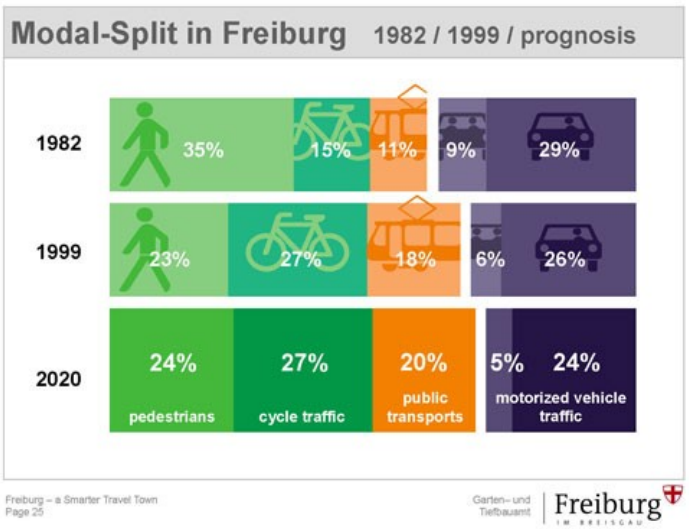
are all but forgotten. A bottom-up approach is important because the focus would shift to the actual residents benefitting both financially and morally. We have seen the top down approach successfully provide green buildings but that's where progress generally stops. There is little communication directed toward the community regarding why sustainability is important or how to take advantage of the green infrastructure. The only way to bring about true change in a community is when the people in it want it. Top-down ventures typically regard residents with little importance. [29] Freiburg tried to address this to some extent in their new quarters. The idea of built-in communities is unique to the planning of Vauban and Rieselfeld and the involvement of the residents in the planning process is an important part of sustainability. While the process needs refining and the planning needs to focus creatively on diversity, a mix between top-down and bottom-up approaches may hold the ultimate solution to the sustainable housing puzzle.

**Transportation**

Transportation has been a major contributor to climate change, primarily due to the massive amount of carbon dioxide emissions released by cars, trucks and other vehicles. Transportation is also fundamental to urban areas, as the various modes of transportation and the networks they compose in many ways determine the physical environment and development patterns of a city. For this reason it is important that transportation networks be developed simultaneously with land use and city planning. [3]

Of course transportation modes have evolved throughout the years and with that, so too must the infrastructure required to support those options. Germany's Federal Transport plan has long been focused on societal goals such as energy reduction, limiting emissions, and the preservation of open space wherever possible. The federal government has even offered to match funds with local governments for aiding public transportation projects dating back to the early 1970s. [4] Freiburg in particular, is very proud of its public transportation and accessibility, considering itself to be a city of "short distances." [15] Such has not always been the case.

In the past, Freiburg's transportation was almost entirely automobile based but in the mid-1980s the public worried that the ensuing acid rain could harm the Black Forest and so changes were made. [28] Since then, Freiburg has emphasized public transportation and considers their multiple modes of getting around town to be one of the city's finest qualities. There are several forms of transportation used in Freiburg, for this study we will focus on the most popular: tram, cars, and bike/pedestrian.




(Distribution and projection of Freiburg transportation trips)[15]

Tram

The history of the current tram lines in Freiburg actually go all the way back to the 1950s. After World War II it was believed that widespread use of automobiles would be the future of transportation inside the city so they began removing the existing streetcar lines. By 1970 only 14 kilometers of the original streetcar tracks remained. Since then the city has had a change of heart and by 2008 the new tram lines topped 36 kilometers, with a new line being added right now. [4]

(Current tram line map in Freiburg)[34]

One of the issues the city wanted to address when installing the new tram lines was convenience. So when designing where the routes and stops would be they tried to make sure that every building in the city was within 500 meters of a tram stop, and today over 70% of the population does live within 500 meters of a stop. [15] In the older downtown part of the city this was challenging as existing infrastructure posed obstacles, but in the newer sections of Vauban and Rieselfeld they made sure the measurements worked out. Even so, when walking around downtown you are never far from a tram stop and the service is definitely convenient. 65% of Freiburg's homes and 70% of all jobs are within 300 meters of a tram stop, and these numbers will increase with the addition of the new line. [4] To add to this, the trams run often, with trains appearing every 7.5 minutes during the day. [15] During the late night hours the rate slows down but trains still run by each stop every 15 to 20 minutes.

The city has also made it easier to ride the trams by creating an assortment of different tickets that are available for purchase. Riders can buy a single ticket, a 24 hour ticket, or purchase the RegioKart which has options for weekly, monthly, and year-long passes available for individual or family use. [28] The RegioKart, introduced in 1991, caught on very quickly and by 2006 92% of public transportation users had purchased some form of the RegioKart. [4] The designers of the tram lines were also thoughtful about potential noise complaints, particularly in the areas outside of the main city district. Though the trains aren't too noisy, many of the tracks have grass underneath them to reduce the noise pollution.

(Tram line with grass to suppress noise)

It is hard to find too many flaws with the tram system. Lines cover most of the city, trains come often and are not overly crowded, purchasing tickets is easy and fairly inexpensive, and the aesthetic of passing trams has become a part of the city itself. Yet, there are some who believe the trams should extend to areas on the outskirts of the city and the rural areas beyond as many in these areas still need to use cars or other modes of public transportation to commute into the city. [28] While there are buses and train stops outside the city they don't appear nearly as often as the trams would, and expanding the tracks would do well to discourage the use of cars. Also, from what I've seen, it's very easy to ride the trams for free. Purchasing tickets is entirely an automated process and at the stops there is no one to monitor tickets upon boarding. Once on the train there are machines to scan tickets but riders rarely use them. Whether this is intentionally lenient or simply a by-product of the quick convenient nature of the tram is hard to tell but it seems clear that the city could be losing a fair amount of money on free-riders.

Cars

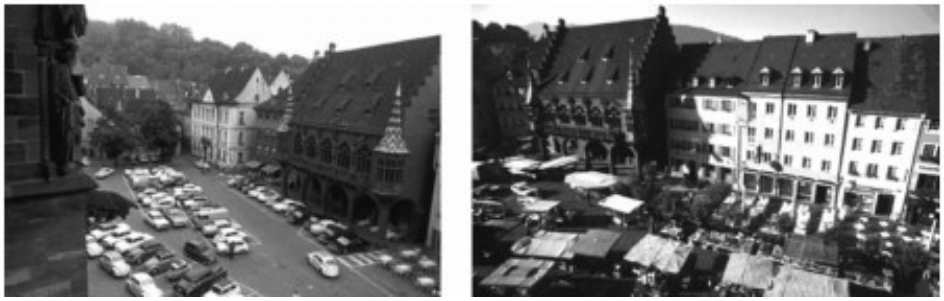
After World War II cars were seen as a necessity in Freiburg and the city began changing to accommodate more vehicles. However, as time went by the city began to break from that stance. As soon as Freiburg became environmentally focused cars became all but taboo. Even though European autos average around 30mpg (significantly more than fuel efficiency in the U.S.) they are still frowned upon in Freiburg. [4] In Germany as a whole, the sales tax on cars is three times what it is in the U.S. and tax on gasoline is nine times higher. But Freiburg goes even further to discourage the use of cars, specifically in the Vauban quarter. [4]

It's been made clear in Vauban, at least on the surface, that cars do not have a home inside the quarter. The only place cars can be parked in Vauban is in the parking garages one the outskirts of the sector. The placement of these garages was not by chance, rather they were purposefully put in inconvenient spots. And if anyone wants to park their car in one of these inconveniently placed garages they have to pay a staggering 18,000 euros a year. [15] Additionally, the speed limits in Vauban are low: only 30 kilometers an hour on the main road and walking speed on the residential lanes. [26] Making driving anywhere a slow process is meant to further discourage the use of cars. For the most part these policies seem to be effective. The number of registered cars per 1,000 habitants of Vauban is around 200. That is less than half of the number of registered cars per 1,000 residents in Freiburg as a whole: 423. [15] Looking at the statistics, one could conclude that the measures taken by Vauban have been successful in deterring car use, but visiting the quarter itself presents a different story.

The main road, on which drivers can only drive 30 kilometers per hour, is actually very large - 35 meters and several lanes wide in fact. [30] For an area that claims to limit the use of cars this seems like a waste of valuable space or contradictory at the very least. Also, it's obvious that the cars are going much faster than 30 kilometers per hour, and even though there may be only 200 cars per 1,000 inhabitants it feels like there are many more. In fact, some estimate that up to 5% of

Vauban residents own cars but don't register them in order to save money. [26] Sitting on the corner for an hour during the week, I counted 509 cars pass me by, most of which were single passenger rides. The impression I got was not very pedestrian-friendly. It begged the question of whether the design of Vauban really does discourage cars as much as the policies and regulations would have one believe. Why build a road wide enough for 4 lanes of traffic and why even build a parking garage if the point is to dissuade its citizens from owning cars? Is the real reason just to charge an insane amount for parking?

Freiburg has similarly created policies to get cars out of the downtown area. The first step was to ban cars from the inner city, creating an entirely pedestrian zone. Most of the city has taken a different approach to parking than Vauban has. In Rieselfeld they also have garages but every 2 or 3 blocks instead of on the edges of the district. [26] The main city area has parking that ranges from .60 euros an hour, to 1.6 euros an hour, to 2.2 euros an hour depending on the location. The closer to the city center you get the more expensive the parking is per hour. [4] Another policy in affect throughout all of Germany is that high speed freeways are not permitted to run through urban areas. [4] This allows for a safer, more pedestrian centered city and even the streets in Freiburg that do allow cars are small and cater more to bikers and walkers.



(Freiburg city center: 1960s (left) and present day (right))[4]

The cumulative effect of Freiburg's anti-car initiatives has been both positive and negative. For starters, car use in the city is down to 32%, which is 6% lower than it was 30 years ago. [4] Providing several methods of public transportation in addition to the added fees has made driving a car less ideal which is exactly what the

city hoped to do. What is strange is that even though the percent of trips are down there has been an increase in registered cars. [28] This probably can be attributed to the population upswing but even so it seems like a step back. Another explanation could be that cars are commonly seen as a status symbol. Owning a car and not using it regularly is something that Freiburg has stood against, claiming that the city can meet all transportation needs with the public options they have. However this is not entirely true. The public transportation in Freiburg does cover a large area but it cannot accommodate long road trips or match the ease of owning a car when people have to move items. The truth is that many people do need to own a car for various reasons. And even if they use public transportation 99% of the time, the policies Freiburg has in place can punish them for the 1% of the time they don't.

So is it fair to punish people for owning cars? It can be frustrating and ultimately cause those living in the city to move out to the suburbs in order to avoid all of the additional fees and inconvenience. This is counterproductive as that creates the need to drive even more. This phenomenon may already be happening as 21,000 new commuters were added to Freiburg's surrounding area between 2005 and 2013, bringing the total up to 71,000 daily commuters driving an average of 31 kilometers. [23] Perhaps instead of punishing car owners Freiburg should simply focus on improving their public transport infrastructure. The city will never be able to eliminate the need for cars altogether but reducing the need definitely cuts down on car use.

Bicycles

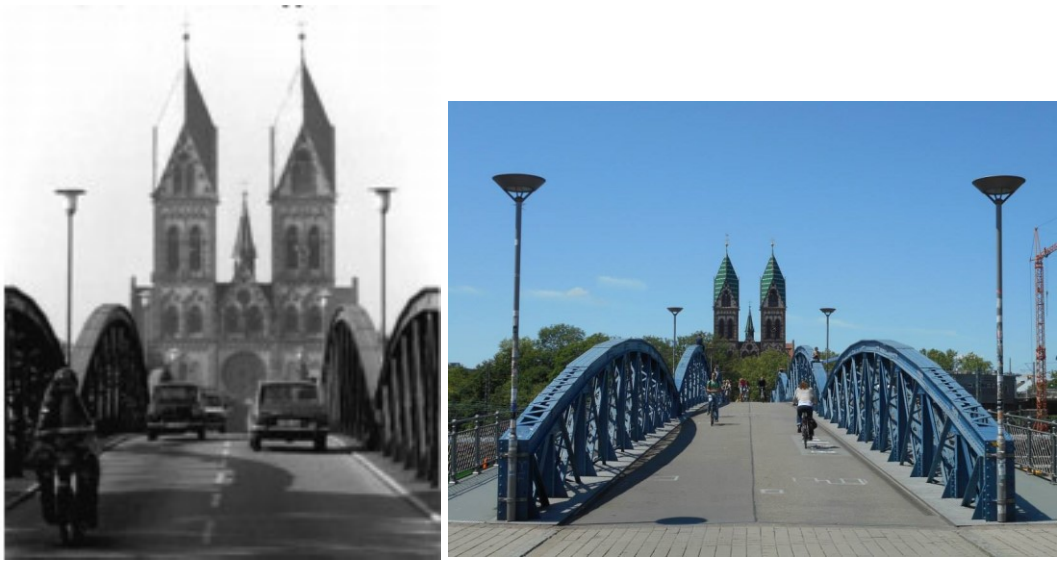
Many European cities are promoting the practice of biking as a means of getting around. Freiburg is no exception to this trend. The city has taken up the biking initiative and has adjusted their infrastructure as well as building new infrastructure in order to accommodate the bikers. Freiburg currently has over 400 kilometers of paths and roads people can ride their bikes on. [15] 160 of those 400

kilometers are separate bike paths and bicycle only lanes on the roads running through and around the city. It's possible to bike just about anywhere you want to go in the city. The downtown area, having outlawed vehicle traffic, is very easy to navigate on two wheels. The same goes for many of the neighborhood blocks outside of the city center. In fact, bicycle traffic far outnumbers vehicle traffic in many residential parts of the city. Of course, the main roads are more difficult to use. There are bicycle only lanes on most of them but the so called "bike highways" are hardly what the city claims them to be. Many of these highways are narrow and run right up against the auto lanes making it difficult and dangerous to ride more than one bike wide. Additionally, the city claims that their traffic laws allow bikers the right of way over cars but in reality it's usually those behind the steering wheel that dictate the flow of traffic and who goes when.

Even so, people choose to bike and the benefits seem to outweigh any conceived negatives. Since Freiburg began encouraging the use of bicycles the number of bike trips in the city have tripled. [4] In order to deal with the popularity of biking, in addition to constructing bike paths, the city has built bicycle parking areas. By 2009 there were 6,040 free spots to park bikes in the city center alone and an additional 1,678 free spots at train and tram stations to keep the bicycles safe while their owners commuted using public transportation. The city even built an indoor bike garage that can shelter up to 1,000 bicycles from the elements for 1 euro a day or 10 euros a month. [4] There are large bike racks all around the entrance to the pedestrianized city center as well, and the total number of bicycle parking spots in the city is up around 9,000. [15]

(Covered bicycle garage)

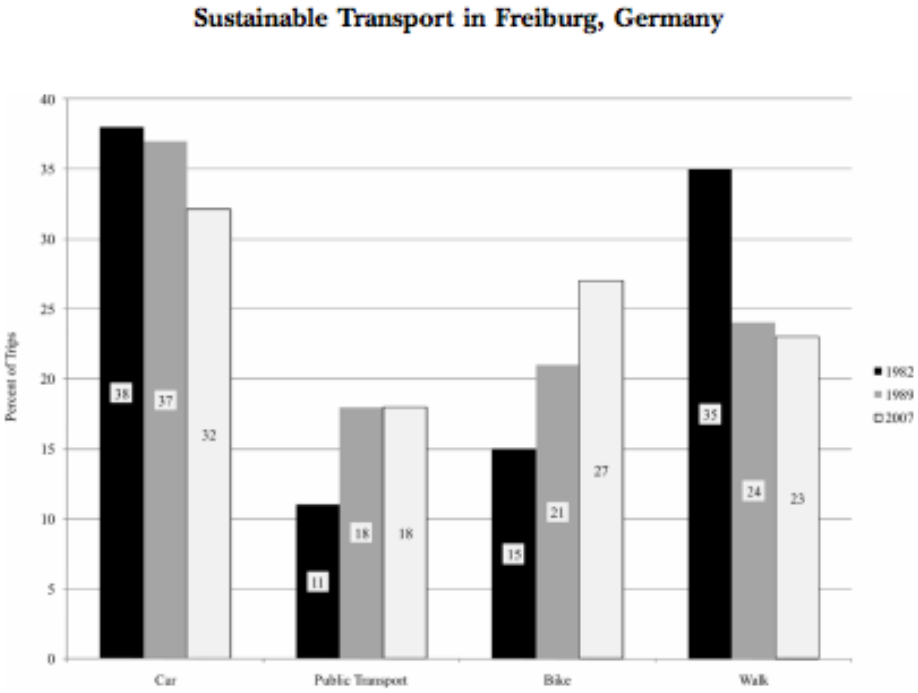
Overall, the number of bikers in the city indicates a successful project to encourage alternative transportation. Estimates have the amount of carbon dioxide saved by biking activity at around 4,100 tons. [10] The success story is perhaps best symbolized by the Wiwili Bridge (more commonly referred to as the Blue Bridge) in the Stühlinger district of Freiburg. The bridge, which crosses over the train tracks and connects Stühlinger to the inner city, was originally used as a bridge for cars. However, in the early 1990s the bridge was converted to allow only biker and pedestrian access. Since then the bridge has seen widespread use including 7.9 million cyclists in the last three years alone. The bridge is typically used most during the week (10,000 people per day) and the use has been growing as biking becomes more popular. [10] The bridge stands as a physical testament to what Freiburg is trying to do as a city: take a historical city and repurpose it to encourage healthy and sustainable activity.



(Blue Bridge: 1960s (left)[4] and present day (right))

Transportation Conclusions

Freiburg has made many changes to its transportation policies since the end of World War II and most of them have been fairly consistent with sustainable goals. The major objectives the city has tried to accomplish have been lowering carbon dioxide emissions, discouraging the use of cars, encouraging the activities of biking and walking, and expanding the infrastructure of its public transportation to be more convenient and cover more of the city. They have been successful in realizing some of these goals. From 1992 to 2005 carbon dioxide levels attributed to transportation dropped 13.4% per capita. [4] Much of this can be attributed to the lower number of car trips, a result of the emphasis the city has put on alternative methods for getting around town. In 2007 public transportation accounted for 18% of all trips within the city, and bikes and pedestrians accounted for 50%. [4] The only area where they have struggled is in the general use of cars, and to be fair, a lot has changed in the past few decades. The city has gone from vehicle-centric to anti-vehicle. It was not that long ago that the city center was filled with cars and now they are completely prohibited in the inner city.




(Changes in percent of trips taken by different transportation modes)[4]

Another area Freiburg has succeeded at within the field of transportation is their planning. It is important to have a transportation plan that dictates the future as transportation is one of the biggest factors in shaping a city. It is also important that the plan be adaptable. The goals of a city can change rather quickly as shown by the removal of the streetcars in the 1950s. Within 20 years of deciding to phase out the system they began expanding it again. The transportation plan was also created in close coordination with the city land use plans, and this cooperation amongst different areas of planning has been a benefit to the citizens. In fact citizen groups took part in planning both land use and transportation, asking for denser development and stricter regulations on vehicles. [4] In the new quarters of Vauban and Rieselfeld, tram lines were being built at the same time the buildings were being constructed so there was no gap in residential access to public transportation. [4] The transportation plan was well thought out to reflect the goals of the city: encouraging biking and walking; expanding public transport; and keeping Freiburg a city of "short distances."

**Green Spaces**

Frederick Law Olmsted once described "equitable access to green and open spaces as part and parcel of the right to life, liberty, and the pursuit of happiness." [3] Today his words ring as true as they ever have. Cities all over the world are acknowledging the benefits of urban green spaces and the effects they have on the landscape of the city and the overall quality of life for its citizens. The idea of quality of life is deeply connected to the concepts of urban green spaces and sustainable urban development. Since cities are all large conglomerates of people, their quality of life is a major factor in the success or failure of a city.

Green spaces take root in the domain of public space which for thousands of years has been a key element of cities. Public spaces link together different areas of the city and act as traffic corridors. They provide areas for leisure activities and socialization. Public areas in many ways form the fabric of community life in a city. The layout of public space in a city develops the manner and how often community members interact with each other. They are very important in creating the social identity of a city. [21] Public space is often where life outside of work takes place. Natural green areas in particular can provide many services when acting as public space. As cities expand and private space dwindles, many people must rely on public green space as a substitute for what would have been their own private green space. [21]

Green space has been proven to be imperative in child development by providing kids a place where they can let energy and imagination run free. The opportunity for recreational use is perhaps the greatest value in urban green spaces. Green spaces are shown to improve health by providing an environment for outdoor exercise and leisure activities, subsequently reducing stress. Green spaces also filter air and remove pollution which is essential in cities where levels of air toxins are high. [32] Green spaces promote physical activity, psychological well-being, and overall public health. [21]

There are many obvious benefits to urban green space but there are also subtle advantages to them as well. Green spaces typically improve the aesthetic of the neighborhoods they are in which can increase the value of nearby housing and attract businesses into the area, especially when they are well maintained. [21] The more attractive the green space the more use it will receive and the more appealing the area becomes to residents, visitors, and business owners. Urban green spaces also benefit the community by suppressing noise, the infiltration of storm water, and providing cooler temperatures on warm days. Treed urban environments can reduce temperatures up to 4 degrees Celsius as well as lower humidity, control wind velocity, and create a microclimate in the city which deters the urban heat island effect. [7] They also increase the perception of safety and foster a sense of belonging and pride in a community. [32]

Because of these communal benefits, it is vital to develop green spaces with input from the community it will be placed in, to evaluate what kind of space it should be. Urban green spaces connect the urban landscape and when designed correctly, can make for diverse community interactions which is a major goal of sustainable urbanism. [21] There are economic benefits as well as green spaces can provide jobs for landscapers and maintenance crews, and even generate revenue depending on the characteristics of the space. [21]

Freiburg is aesthetically a very green city. The Freiburg region consists of 15,306 square kilometers and 47.1% of that land is considered green space. [2] That's .031 hectares of green space per capita. [2] This percentage is made up of multiple types of green space including 600 hectares of parks, 160 hectares of playgrounds, and several public gardening areas. However the vast majority, and over 5,000 square kilometers, consists of forest. [15] Freiburg, which is located in the sunniest region of Germany, can certainly use the shade in the summertime. But how effectively do they use all the green space they have as a city? Measuring urban green space use is difficult but also necessary in determining whether space is used well and situated as to provide easy access to all. In this section we will take a look

at several of the more popular urban green spaces in Freiburg as well as the nearby Black Forest.

Urban Green Space

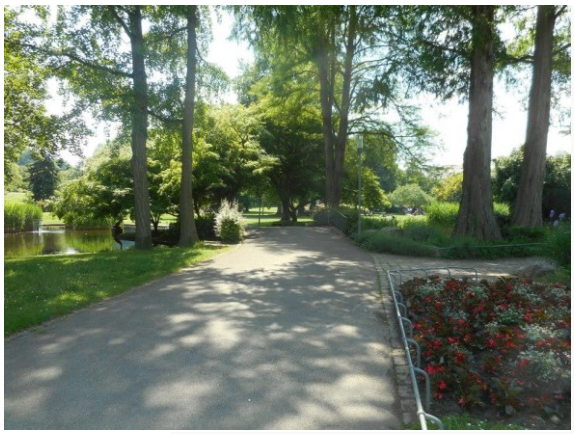
The most popular green space in Freiburg, especially in the summertime, may be the Seepark. The Seepark is located northwest of the city center and can either be reached by a 20 minute walk or a ride on the tram. The park is located between several residential developments, though one probably wouldn't even notice the buildings as there is lots of tree cover. The most notable feature in the park is a lake in the middle which takes up about 10 hectares. The lake is man-made and open for swimming as well as other aquatic activities like kayaking. The presence of the lake makes the Seepark a popular destination in the summertime and as soon as school gets out it often becomes crowded with students looking to cool off. The lake is large enough for teenagers and college students to enjoy themselves on one side and families with younger children do likewise on the other, shallower side of the lake. This is one of the larger green spaces in Freiburg coming in at around 35 hectares. Though the lake takes up a large portion of the space there is plenty to do on land. One side of the lake is lined with large, flat, open fields which are perfect for sports and other physical activities including pickup soccer games and tossing a Frisbee. There is also a dirt path that runs all along the circumference of the lake which is popular with runners, walkers, and bikers. Nearby there is a jogging track with a full length soccer field inside. I observed soccer practice, track and field practice, yoga for adults at night, and other school related activities in this area. All in all, the park has great utility and opportunities for both leisure and physical activities. The side of the lake opposite the open fields was lined with dense tree cover which provides shade and cooling on particularly hot days. The park was also very clean with almost no litter, this was probably because trash cans were abundant and easily accessible. From morning until night this green space is a very popular destination and the large age distribution and good cultural mix suggest that it provides function for people of all ages and ethnic backgrounds. If

there is one flaw it's that the park is out of the way, especially for those commuting from the city center. Taking the tram is an easy and cheap way to remedy this though.

(Left: Seepark. Right: Families enjoying the water at Seepark)

Another popular green space, the Stadtgarten, is located near the base of the Black Forest. This park, at only a few hectares, is much smaller than the Seepark but is still fairly big for an urban green space. The park offers less in terms of physical activity opportunities but provides ample space for leisure. The park is located very close to the city center. In fact, there is an elevated walking bridge over the road that connects the park to the Freiburger Münster and the historic city center. This bridge is nice because it acts as a way to extend the pedestrian city center to the green space without the pedestrians having to interact with any cars. The park has one large open field, many shaded areas with small man-made pools and fountains, and benches for sitting almost everywhere. There are concrete walking paths intertwined through the park, all of them lined with flower beds. There is even a small coffee shop in the park that sells drinks and baked goods. This green space certainly had a different feel to it than the Seepark and the difference in the people and activities was evident as well. Most of the activities were leisurely such as reading, eating, walking, and looking at the flowers. The age group at the park was mostly older folks or families with small children, and compared to the diversity at the Seepark, the Stadtgarten visitors were almost exclusively white. This could be because of location as the city center residents tends to have fewer minorities and be wealthier. There was clearly a lot of design and money that went into creating

this green space so that it looked nice, and that may have been because the target demographic is a higher income group. Additionally, the park is harder to get to from elsewhere in the city. There are no tram stops too close to it and the only real way to access it is through the city center.




(Left: Stadtgarten. Right: Bridge connecting Stadtgarten to city center)

A third popular park is right across from the Blue Bridge in the Stühlinger district. This green space, commonly called the Stühlinger Church Square, is the smallest of the green spaces discussed so far as it is only about the size of a city block. The park also has some of the most interesting and diverse community interactions. Most days on the steps of the Stühlinger Church you can find a large group of alcoholics drinking and listening to music all day. On the other side of the church one can usually find a group of minorities offering to sell drugs to anyone who wants them. And across from these two groups in the small field space next to the church, one can usually find families with small children enjoying the day and playing. The whole scene is very unusual and though everyone there (besides the children) seems to know what is going on, no one seems bothered. All the different factions seem to stick to themselves. But it still begs some questions: How come there aren't any authorities present? Are these families not able to travel to a nicer spot to play with their kids? The area of Stühlinger has a fairly high student and minority population so it could be that the green space is reflective of that and perhaps the city has little interest in helping these people out.

The small field does get a decent amount of mixed use. A little carnival came to town and set up in this green space for about a week. There were food booths and small rides and a large amount of people funneling in and out. After the carnival left there was a free outdoor art exhibit, and the display stayed out on the lawn for about a week. None of the art was ever stolen or damaged even though it was left up all night. At least once a week there would be a farmers market held there, allowing the students and minority groups to also have the opportunity to buy fresh, healthy food. This small green space has a very unique atmosphere and is a perfect example of different groups of people being able to coexist peacefully albeit not always in an ideal way. If the city were to put some effort into the space by cleaning it up and offering some more interactive events, it could be a very successful urban green space. It's located in a part of the city that houses many diverse groups of people, it's easily accessible as there is a tram stop next to it, and even though it is small, there is clearly enough room to enjoy the park.

The Black Forest

Freiburg is located virtually next to the Black Forest, a large evergreen forest in the southwest corner of Germany that extends all the way to the French border. 43% of Freiburg is actually made up of the Black Forest and a third of that area is government owned. [11] For the most part, the government has made it a point to protect the forest land they own, with 56% of it going toward nature conservation and the other 44% being used for environmentally appropriate economic purposes. [15] The Black Forest is a dense forest that is famous for its many hiking and biking trails. The massive amount of tree cover makes it a popular place to visit on hot days and the change in temperature is very noticeable. The Black Forest is visible from almost everywhere in Freiburg as it rises up above the city, looming over it as a constant reminder of how important the idea of "green" is to the city.

(The Black Forest, with Schlossberg Tower, rising above Freiburg)

The Freiburg city center is very close to the Black Forest, while most other residential areas in Freiburg are not that close. In many ways this cannot be helped as the city center was built hundreds of years ago and existing infrastructure and forest conservation regulations would make building residential neighborhoods near the area very difficult. As a result, the Black Forest is not the most accessible place for Freiburg residents to get to but certainly not overly difficult either. Public transportation can bring people to the city center only a couple blocks away from the base of the Black Forest, and there is a gondola in the Stadtgarten Park that can take people up to the top of Schlossberg Hill (the most popular place in the forest to visit).

Schlossberg Hill is the part of the Black Forest nearest to the Freiburg city center and it contains the remains of an old fortress. There are dozens of different hiking trails that wind up and around the hill and there are several points that overlook the city. These lookout points offer beautiful views of Freiburg, the Freiburger Münster, and the Upper Rhine Valley. One of the observation points has a restaurant where people can dine and take in the stunning views. This is also a very popular location during sunset and there are ledges and benches where people

gather to watch the sun go down behind the city. Also on top of Schlossberg Hill is the Schlossberg Tower. The tower is 35 meters high and offers views of the city. It is a popular destination that many residents and tourists alike hike to. The Black Forest is a unique urban green space that is special to Freiburg. While typical urban green spaces can offer some connection to nature the presence of the Black Forest allows for people to be fully enveloped in nature. It is an extraordinary green space that has shaped the layout and identity of Freiburg as a city.


(Left: Top of Schlossberg Hill. Right: Schlossberg Tower)

Green Space Conclusions

The quality of life in cities is becoming more and more important and urban green spaces are a key element in improving quality of life. People need to connect to nature and have room to be physically active as well as to relax and relieve stress. There is no doubt that Freiburg has a lot of urban green spaces. The man-made parks are scattered throughout the city and the Black Forest offers opportunities that most cities in the world don't have in terms of green space. Freiburg's green spaces are excellent. They offer lots of utility and opportunities for all kinds of physical and leisure activity. The presence of good tree cover in most of the green spaces allows for protection on hot days, which is necessary for the sunniest part of

Germany. Free access to a lake also helps, though for those who live on the other side of the city, this may not be so convenient. Uneven access to green space is becoming an environmental justice issue so it is important that Freiburg makes sure their urban green spaces are accessible to everyone. [32] While most of them are located near tram stops or within walking distance, it seems like the most popular ones (certainly the largest ones) are located toward the outer edge of the city. This has the potential to cause problems for those who don't find themselves near at least one of the major parks.

Residents can apply to the Department of Civil Engineering to make their streets recreational areas. [32] In some of the small neighborhoods residents have done this and it gives children room to play without interference from traffic, though it does not wholly remedy the lack of green space. It is difficult, and often impossible, to add green space to existing neighborhoods so it is imperative that good transportation options are available and that green spaces are planned in conjunction with residential neighborhoods. Freiburg has done fairly well with this and they have an opportunity to improve their distribution of green spaces in the new quarters of Vauban and specifically Rieselfeld which has hundreds of undeveloped hectares still. Rieselfeld has several social housing units and if a nice park were to be constructed in the area it would be beneficial to the lower income people in the neighborhood. Of course, they would have to make sure to address the green space paradox. Putting green space in poorer areas does make it nicer, but it can also raise housing prices and attract wealthier people, thus displacing the poor. [32] If Freiburg does plan a future park they should do so in a lower income neighborhood and then must make sure that these are the people who get to enjoy that green space.

**Conclusions/Summary**

If we think back to the planner's triangle we can recall that sustainability is achieved when environmental interests meet economic progress and social justice. Sustainability is a complex term and sustainable urban development is still being defined as it is being implemented. Freiburg, Germany is considered by many to be the best example of sustainable urban development in the world today. In order to analyze this claim we have looked at three critical areas of Freiburg: housing, transportation, and green spaces. We examined both the policies the city has made in these three areas as well as how the city practices them in reality, and then related them back to the ideas surrounding sustainability. What can be concluded is that Freiburg is certainly a green city. The innovations they have made in renewable energy and the steps they have taken toward becoming a carbon neutral city are incredibly unique and at the forefront of the environmental movement.

However, being green and being sustainable are not the same thing, though the terms are used interchangeably far too often. The social aspects of sustainability, at least in Freiburg, seem to end at the planning phase. Many of the projects included community participation initially and some absolutely had the intention of benefitting lower income and minority groups. Unfortunately, in practice most projects such as Vauban have only served to meet environmental and economic interests while continuing to increase the gap between high income and low income citizens. This has led many to believe Freiburg's intentions are not truly focused on sustainability but rather economic growth.

Freiburg's economy is based in education, healthcare, and tourism; all three of which attract wealthy individuals. There are protest groups who accuse the city of using the idea of "green city" to promote the economy. In other words - taking the ideas of being green and sustainable and using it for the wrong reasons. There are examples we have examined that could support this accusation. In the realm of social justice these instances have been made obvious; a lack of affordable housing and social inclusion in developing communities is the major flaw. In the area of

environmental interests there are examples as well. The city may not be discouraging cars in the way they claim to be doing. And the act of discouraging cars at all may ultimately be counterproductive. There are also those who believe Freiburg is guilty of green-washing, or trying to appear green while not actually acting so. The windmills that are stationed outside of Freiburg, for example, have received negative feedback. The placement in such a hilly location is not conducive to harnessing the full potential of wind power, yet they are placed nicely as to be visible throughout the entire city. Furthermore, the windmills are threatening an endangered species of bat that live in the region. [11] It is sadly ironic that a so-called environmental project would simultaneously pose such an ecological threat.

There are many national and international media sources that have created mythical narratives about Freiburg claiming the city is completely free of cars and that it's the perfect answer to all of our problems. This is not the case and such dramatic attention is dangerous to the sustainability movement. The city has made important steps in the field of environmental technology yet there are many aspects of Freiburg that are still not sustainable. Selective sustainability is not total sustainability. Implementing some green programs is not a complete transition. These may be instruments that lead to a full transition but there is more to do. It is important that people continue to challenge the sustainability of Freiburg or else both the city and the sustainability movement will fall into complacency. Once a consensus has been achieved discourse stops. Freiburg may be a best example of environmental practices but they still have expensive housing, high land costs, a lack of social inclusion and diversity, and other issues that have been discussed in this paper. As the population of the city continues to grow these problems will become even more apparent. It is therefore necessary that the practices of sustainable development continue to be clarified, developed and refined.

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