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Barcelona's Sustainability Plan and Solar Programs

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Barcelona is one of the largest cities in the European Union and the capital of Catalonia. Located on the coast of the Mediterranean Sea, it has a population of about 1.6 million, making it the sixth most populous city in the European Union.¹ Despite the sheer number of people within the administrative limits of the urban area, Barcelona still manages to have a strong sustainability program and one of the lowest levels of CO₂ emissions per capita in the world. As the city council's Agenda 21 program states, "Fostering a compact, dense, and complex urban structure is key in achieving such low emissions."² This same dense urban structure makes for strong programs in many sustainability initiatives. In addition, the city's strong Catalan identity and culture create an atmosphere in which a combination of competitive feelings towards a greening Europe and a willing populace ensure environmental concerns are taken seriously and acted upon accordingly by the city government.

The city's plan for sustainable energy, the *Plan for Energy Improvement in Barcelona*, or PMEB, is clear and provides for a solid blueprint for how to move forward with green initiatives. The PMEB was only intended for the years 2002-2010, but its initiatives and vision are still relevant to the city today. The city's

innovative programs and clear, accessible plan make it a portable model for other cities to follow. Barcelona's plan for sustainability is strong and portable, except in the areas of social justice and public health; moreover, the city council's thermal solar initiatives are notable enough to serve as a model for other cities. In this report, I will address the City Council's plan for sustainability; following this will be a discussion of the city's best practice, its solar thermal energy program and the city's Solar Thermal Ordinance.

Barcelona's Sustainability Plan

The PMEB names transportation as an important component of the city's overall sustainability plan. A focus on human-powered transportation sets the tone for both the plan and the programs that grew out of it. This focus makes sense because of the density and flat geography of many of the popular districts within the city. The city council also details plans to improve the efficiency of traffic control and its municipal fleet and to promote car sharing among its residents. A significant part of the city council's implementation of these goals has to do with public relations. The PMEB summary states that "the project places particular importance on public awareness campaigns" of its transportation initiative concerning the promotion of hybrid vehicles; similar language is used concerning the rest of the plan as well. Implementation of the PMEB in the field of transportation has been successful and could easily be modeled by other city governments attempting to soften the environmental impact of the urban residents' commute.³

Barcelona's transportation department promotes the use of bicycles among both residents and tourists visiting the city. One way in which residents can take advantage of the many bike-friendly aspects of the city is through a municipal bicycle rental system called *Bicing*. Users of *Bicing* pay a thirty-euro annual fee that entitles them to use of any of the 418 rental stations located around the city. The first thirty minutes – adequate time to reach any point in the city – are free. After that intended time limit expires, the user is charged a penalty fee for every hour the bicycle is not returned.⁴ This service makes transportation around the city quick, cheap, and sustainable. In 2009, only four years after the inception of *Bicing*, there were 190,000 subscribers to the program.² The city is able to make the program affordable because of an impressive dedication to sustainable transportation; 100% of the surplus from fees collected from on-street parking is used to finance *Bicing*.⁵ These statistics are a testament to the practicality and affordability of the system for users, and also of the city's dedication to sustainable transportation.

The city has also implemented measures that are intended to make commuting by bicycle safer. In 2009 the city had 156 kilometers of one and two-way bike lanes ranging from 1.5 to 2.2 meters in width, with plans to expand to 200 km. The bikes are protected from car lanes by rubber speed bump-like strips, and all areas in which bike and car lanes intersect are painted red in order to remind drivers to be cautious.⁶ These safety measures, combined with the promotion of cycling as a form of transport on the city's web site and through ad campaigns, combine to make cycling a strong element of Barcelona's sustainability program.

Pedestrian transportation is the other form of human-powered transportation promoted by the PMEB.³ One case study on Barcelona's parking program states that for the last decade (about the same time frame of the PMEB), Barcelona has been removing parking in order to make way for more pedestrian streets. Many districts in the city, such as the historic city center, have been made completely off-limits to motorized vehicles.⁵ Famous areas such as Las Ramblas have also been made pedestrian only. In addition to this, the traffic model mentioned previously has been used to manage traffic in such a way that pedestrians have an easier time walking around the city – for example, the “walk” signs at intersections have been lengthened.⁷ In addition to this, the city is in the midst of a strong advertising program with which it hopes to improve and maintain public support for pedestrian initiatives. This is detailed in the PMEB, and is typical of a Barcelona sustainability program.³

In addition to the promotion of cycling and pedestrian transportation, the PMEB also describes plans to use the computer simulation of the traffic in the city to measure the environmental impact and efficiency of traffic regulation in the city with regards to vehicular transportation. The council goes on to state that the information from this model will be used to coordinate variables such as traffic signals in order to maximize the sustainability of motorized traffic in the city. It seems, however, from the rest of the plan that making private transportation sustainable is not as important to the city council as cutting back on the amount of cars on the road. The focus on reducing vehicles makes sense considering

Barcelona's problems with congestion, which are only natural in a city as dense as it is.⁸

The city council is also interested in improving the efficiency of its own municipal fleet of vehicles and that of the private vehicles in the city as well according to its stated goals in the PMEB. The web site states that vehicles such as street cleaners and garbage trucks are powered by more environmentally friendly energy. The "Innovation" section of the city's web site tells of a program called "LIVE," or the "Logistics for Implementation of the Electric Vehicle." This program assessed what was necessary to increase the number of hybrid or electric vehicles on the streets of the city, with regards to both private and municipal transportation. Another way the sustainability of private transportation is being improved is through the city's car-sharing program. The transportation section of the city's website promotes car sharing and states the benefits of the program. These initiatives show that Barcelona, while invested heavily in human-powered transportation, has not necessarily left motorized vehicles behind.¹

Barcelona's energy renewability and conservation is its strongest practice, and within this program, its Solar Thermal Ordinance is arguably the strongest part. The first important part of the city council's plan for energy conservation is its strong retrofit program. The PMEB lists several forms of retrofitting that the city could subsidize and states that any of these plans could be made material with laws or regulations. It recommends sealing window frames and glazing windows in order to improve heat insulation and draft proof homes. In addition, the council states that insulation in existing buildings must be improved, and new building standards

regarding insulation must be made in order to reduce the amount of energy spent on maintaining the temperature of buildings.³ According to one U.S Department of Energy's booklet, insulation has been proven to be one of the most effective forms of reducing energy use, so this initiative is one that should have a great deal of impact on the sustainability of buildings in the city.⁹ The PMEB goes on to recommend such energy-saving techniques as replacing old, inefficient incandescent bulbs with fluorescent ones and promoting what the city calls "rational energy use," which seems to be such easy tactics as switching the lights off when one leaves a room. As usual for Barcelona, these initiatives are accompanied by a corresponding ad campaign. The council states the public awareness campaign should "make the general public aware of the benefits arising" from these energy saving techniques.³ Finally with regards to home retrofits, the city council planned to review energy standards in new and refurbished dwellings in order to find criteria for new bylaws that could improve energy savings even further.³

Another way in which energy use is being improved in Barcelona is through the sustainable production of energy. This is accomplished chiefly through photovoltaic solar, thermal solar, and the use of biogas produced from compost. Thermal solar and the Solar Thermal Ordinance will be discussed later in the "best practice" section of this report, so PV solar and biogas will be discussed in this section.

The city of Barcelona has several solar structures within the city limits, and many buildings have PV solar panels on them as well. One structure that blurs the line between functional sustainability and art is the *Pergola Solar del Forum* in the

Forum 2004 district of Barcelona. With a surface area of 10,500 m², it is the largest such structure in Europe. It produces energy for the public sector in the city, and reduces the city's yearly carbon emissions by 440 tons as a result.¹⁰ This combination of art and function serves to demonstrate the approach Barcelona takes to sustainability, which is one of cultural significance and pride as opposed to only seeing the greening of the city as a way to garner some publicity and increase tourism. The city also has plans to further increase the amount of PV solar used in the city; buildings with over 3,500 square meters of floor space are required to get 10% of their energy from solar power. In addition, the city plans to build even more solar structures within the Forum 2004 district. Some of these, such as the second pergola on top of the sailing school, have already been completed and are supplying a considerable amount of power to the surrounding city.¹¹

Urban Development is another strong element of Barcelona's sustainability program. The 22@ and Forum 2004 districts of the city are excellent examples of the sort of urban renewal the city of Barcelona is interested in. The 22@ district is a former historic cotton district and was renovated into a "knowledge center." According to sustainablecitiescollective.com, "The innovation district already had 114,000 m² of new green space and 7,000 companies, businesses and shops, half of which moved to the district after 2000." The same district has increased its residency by 23% and now has 90,000 people working in it. The 22@ district is focused on creating a living and working space in which international business – a large part of the overall business scene in Barcelona – can participate locally and add to the community with contributions to both the energy and social sides of the

city.¹³ The difference between the ghost town that the area used to be and the progressive urban mecca that it has become is vast.

The other case of urban renewal in the city is that of the Forum 2004 district, located on the coastline of the city. The district is recognized for two reasons: a symbol of Barcelona's sustainable intentions and also a real-life model of those ideals. The pergolas mentioned in the renewable energy section of this report are both located in the Forum 2004 district. In addition to the production of clean energy, the area is also a model for energy conservation. It makes use of a central thermal system powered by the steam generated in the nearby Sant Adrià waste treatment plant. This thermal system reduces the amount of energy needed in the area by 32%, which is the equivalent of 1,850 tons of oil per year.¹¹ These urban development programs, while not as strong as those of the 22@ district, are still symbolically and statistically strong and represent Barcelona's desire to be among those cities in the top tier of sustainability.

The final element of Barcelona's sustainability program is waste management. As mentioned earlier, the city has built two Ecoparks that process a large portion of the city's waste. The Ecoparc de Barcelona has the mission of making "use of organic and undifferentiated waste," for composting and conversion into fuel.¹⁴ Another way in which the city is moving the social and scientific sides of waste management forward is the installation of new selective recycling bins on the streets of Barcelona. These bins are more advanced and also more numerous than the previous ones, which serves to promote their goal of increasing the percentage of waste that is actually recycled. The storage area of these bins are also oftentimes

located underground, which has myriad of benefits such as odor reduction, a less obtrusive design, and a larger capacity that leads to less emissions because of less trips made by garbage trucks. The new bins also address a justice issue, as they are much easier for handicapped people to open than the old ones were; this accessibility also makes it easier to empty the bins.¹

Another form of waste management mentioned in the PMEB is biogas, which can be produced from organic waste compost. This compost is processed by the city's municipal waste services, which have sustainable merits of its own. For example in 2001, the Ecoparks built by the city began to process a significant percentage of Barcelona's total waste. Of this waste, 40% is turned into either biogas or compost. This biogas goes on the power many municipal and public transportation vehicles, performing multiple purposes in the process. By processing the waste that was going to be landfilled, it is being saved from being dumped and left to rot. In addition, it reduces the amount of fuel that would be needed by the municipal fleet thus reducing the demand for petroleum-based fuels.¹²

The weaknesses of Barcelona's plan lie in its omission of the remedying of social justice and public health issues that face the city. There is little mention, if any, of either in the PMEB. Most of the food growing operations in the city, which could possibly remedy food shortages in low-income areas, are guerilla gardens. That is to say, there are some community gardens, such as Can Masdeu (a famous *pirata* garden, or pirate garden); however, there is little endorsed by the city besides a few rooftop gardens that could never supply enough food to feed a significant portion of the low-income population of the city.¹⁵ Public health, another important

issue in most cities, is overlooked in the PMEB as well. The addition of more programs in these fields would certainly benefit Barcelona's population. It would also make Barcelona not only one of the greenest but also one of the most just cities in the world.

Best Practice: Solar Thermal Energy

The "best practice" of Barcelona is undoubtedly its thermal solar program. It is the capstone of the entire PMEB and the strongest energy program put forward by the city. One case study of Barcelona's sustainability initiatives states, "The Solar Thermal Ordinance of Barcelona is the legal instrument that has transformed the city into a solar energy mega power."¹⁶ This initiative was made law by the city's *Solar Thermal Ordinance*. The law itself demonstrates a great deal of commitment to sustainability; it requires businesses to use "the best technology available" to produce 60% of energy used to heat water in buildings and building complexes that require more than 292 mega joules of power to do so per year. The ordinance also requires that all buildings built before the enactment of the law that are undergoing major remodeling or retrofitting must comply with the law.¹⁷ In addition to this, the law is only getting stronger; in fact, the city council is currently in the process of revising the plan in order to lower the threshold of application and increase the amount of buildings that would fall under the OST. The city council formed the Barcelona Solar Energy Bureau in order to monitor this law and rewrite it based on their findings.

Barcelona's location and weather patterns also make the OST an extremely strong program. The average January temperature is fifty degrees, and the average July temperature is 78 degrees. This mild weather makes for a city that does not need a great deal of energy to change the temperature of their homes. These conditions make up for Barcelona's decidedly average amount of sunlight (2,800 hours per year). The fact that the program is as successful as it is with so little sunlight suggests that if put into place in a sunnier city – such as many of the western desert cities in the US – the success of solar thermal energy could be tremendous. The program's portability is a central aspect of why it is a "best practice" among all of the other initiatives in the city.

Unsurprisingly, another component of the OST's success is the awareness campaigns run throughout the city.¹⁶ The web site of the Barcelona Solar Energy Bureau states that the Solar Energy Agency has published a solar energy guide using layman's language and graphics in order to keep the public informed on the goings-on of the OST.¹¹ In addition to this, children in Barcelona are educated at a young age about why solar energy and sustainability is important. By doing so, the city prepares a generation of young people that are already ready to deal with the challenges that the program will face in the future. In addition to this academic perspective given to the children, there are demonstration projects at work in which schools are outfitted with thermal solar panels, giving children a first-hand look at clean energy.¹⁶ More of these demonstration projects include the solar thermal projects on sports stadiums and Olympic swimming pools in the city.²

In 2007, Barcelona won the “MagagEnergy Local Action Award” for its efforts in sustainability, especially solar thermal. According to the committee that gave out the award, the city had installed a total of 14,018 square meters of solar panels by 2007. The city had also saved 11,222-megawatt hours per year and reduced carbon dioxide emissions by 1,973 tons per year. These figures are impressive and testify to the fact that solar thermal and the OST are Barcelona’s best practices.¹⁸

Barcelona’s sustainability initiatives are stronger than its official plan first suggests. As an individual program, thermal solar program is arguably its best practice; however, new developments in photovoltaic solar panels may soon make thermal solar panels obsolete. If Barcelona’s thermal solar program is not phased into a PV-centered system, some of the city’s other notable green practices may need to be perfected in order to maintain Barcelona’s status as one of the top-tier sustainable cities in the world.

Conclusion

An important strength of Barcelona’s sustainability is the multitude of above-average (as opposed to one strong and few if any weak to moderate strength) programs. Transportation, renewable energy, urban development, and waste management are all at a point where more focus from the city government could make them candidates to be a “best practice.” As it stands, however, Barcelona is a city with an above-average sustainability program that has a few omissions.

The city’s weaknesses lie mostly in the field of justice and health, along with the attainability of the goals set forth by the council. There is little mention of any

social justice goals in the PEIB, and the city's various web sites and publications that deal with sustainability do not do much more. In addition to this, some visions given to the public by the city government – especially from those in more politically competitive positions such as mayor – are extravagant and unlikely. Various programs have faults, but these are the only two areas with a serious lack of focus. For the city to move into the elite group of cities that are inspiring further innovation in the field of sustainability, the government must revamp their outdated plan from 2002 to deal with the present day's problems, address health and justice issues, and learn to balance what is reasonable in the short term with what is possible in the long.

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