HCU HafenCity University Hamburg

University of the Built Environment and Metropolitan Development

Sustainability and Urban Regeneration

Transformation of an old factory site in Guimarães

RESOURCE
EFFICIENCY IN
ARCHITECTURE AND
PLANNING

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Introduction

Sustainability and Urban Regeneration

Transformation of an old factory site in Guimaraes, Portugal

Every semester, the Resource Efficiency in Architecture and Planning (REAP) Master's Programme at the HafenCity Universität, has a major project component. This year the task assigned was to assess an old industrial site and propose solutions for its regeneration, paying special attention to the areas of Energy, Water, Noise, and Materials. This booklet is the culmination of work done over the third semester by the REAP Master students.

It is the result of a collaborative effort between students of the HafenCity Universität and the Minho University in Portugal as a beginning of further Erasmus partnership between the REAP Masters in HCU and Integrated Master of Architecture at Minho University.

The industrial site chosen for the project is located in the northwestern part of Portugal in the town of Guimaraes. The historic city, also referred to as "the birthplace of Portugal", has rich cultural roots, earning it the title of European Cultural Capital 2012 by the European Commission. The project site, as the host to four 100-year-old textile factories, embodies the European Cultural Capital 2012 goals to revitalize the historic architecture of the city in vibrant new ways. The site itself is located just outside the city centre to the south, bound by the streets Caldeirôa, Colégio Militar, Manuel Eduardo de Almeida and the Avenues Conde Margaride and D. Afonso Henriques. Numerous amenities surround the site, including the main train station, Vila Flor Cultural Center and a balanced mix of commercial and residential buildings.

This document is the result of work done in three phases: the Analysis Phase, the Concept Phase and finally the Design Solutions. In the first phase, the situation in the site was analyzed with specific focus on the REAP aspects, namely Energy, Material, Water and Noise. In addition, the benefits of urban regeneration and being the European Capital of Culture were also analyzed. The HafenCity Univeresität students conducted a site visit to gain a first hand understanding of the project area and to exchange information with the students of the Minho University. The second phase saw the the presentation of several ideas for the possible regeneration of the site taking into consideration the results from the Analysis phase. The final phase was the presentation of the solutions in the form of a poster. A similar presentation was also done by the Minho University students.

This booklet contains a condensed version of the Analysis and Design Solution phases as prepared by five different groups of students from the HafenCity Universität. However, in contrast to the work of the Minho University students, the proposals shown here focus more on the technical and urban sustainable aspects while the focus of the students at Minho University was more on the Sustainability in Architecture.

REAP Master's Programme

The Masters' Programme Resource Efficiency in Architecture and Planning is a Master of Science Degree programme offered by the HafenCity Universität Hamburg. It started in 2009 and has just welcomed its third group of students in the 2011/2012 winter semester. The programme focuses on the efficient use of resources and sustainability in architecture and urban development in different geographic and cultural contexts. It welcomes students from a variety of professional and academic backgrounds, countries and cultures. The approach can be seen as very international and interdisciplinary and it is all brought together under a single uniting language: English.

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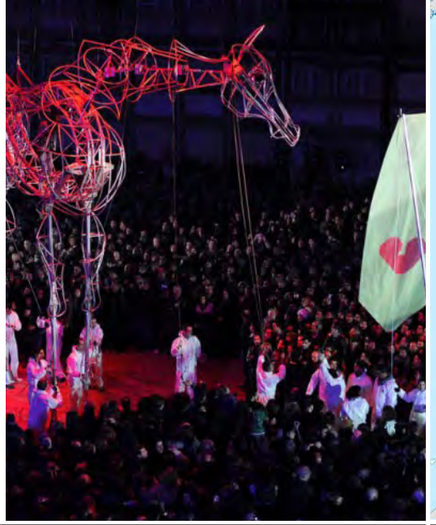
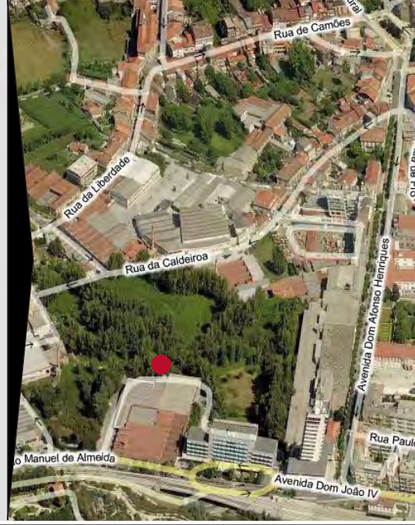
F.1: CONSTRUCTION IN GUIMARAES TOWN SQUARE

GUIMARÃES 2012
CAPITAL EUROPEIA DA CULTURA

F.2: GUIMARAES SYMBOL OF COC



F.3: COC EVENT



F.4-F.6: ZOOMING IN TO THE SITE

European Capital of Culture & Urban Regeneration

European Capital of Culture

Every year, two cities in Europe are selected as European Capitals of Culture (ECoC) - for 2012, the choice came down to Guimarães and Maribor, Spain. The selection is based on the cities' their future plans for that year, and must meet some specific criteria. This initiative started in 1985, and has become the stage for some of the most high-profile cultural events in Europe. According to the European Commission, the purposes of this initiative are:

- highlighting the diversity and richness of the various European cultures;
- emphasizing the cultural ties between all Europeans;
- the promotion mutual understanding and encourage contacts between cultures;
- nurturing a feeling of European citizenship.

A study by an independent expert about the 1995-2004 European Capitals of Culture (cf. Palmer/Rae Associates, 2004)showed that the vast majority of organizers felt the event had been beneficial to the cities both from a cultural point of view and for their long-term development.

Additionally, many studies conducted over the years (e.g. Sapsford & Southern, 2007; Herrero et al., 2006; Deffner & Labrianidis, 2005) have shown that the event can be a driving force, giving an opportunity to regenerate the cities, raising their international profile and boost tourism, enlivening the cities' cultural lives, and enhancing the cities' self-image in the eyes of their inhabitants.

Evidently, it is part of the participating cities expectation that the event and concomitant funding can serve as a catalyst for urban development projects and urban regeneration in a broader sense. The fact that Guimarães is host of the ECoC in 2012 provides an impetus to think of future local urban regeneration projects, resulting in the present brochure.

Culture and Urban Regeneration

Urban regeneration can be defined as the "transformation of a space that has displayed the symptoms of physical, social and/or economic decline breathing new life and vitality into the area [and] bringing sustainable, long-term improvements to local quality of life" (Evans, 2005: 967).

In the context of the ECoC initiative, the concept of culture-led urban regeneration is focused. It assumes that culture and cultural activities can be a driver, catalyst or key player regarding urban regeneration, and may serve as "an insurance policy against future decline" (Shaw & Evans, 2006: 6) and value-added distinction.Culture also acts as collective remembrance and societal identification.

Binns (2005) distinguishes three models of culture-led urban regeneration:

cultural production, which focuses on investing in cultural and creative industries in order to create jobs and prosperity;

cultural consumption, relying on flagship infrastructure and event hosting to provide a knock-on effect for the rest of the economy;

community arts programmes, following a bottom-up approach to build social capital and a sense of community.

These models, however, face certain limitations and weaknesses. They primarily focus on economic aspects, partly because social impacts are difficult to measure and the data basis is often fragmentary. Furthermore, top-down programs can lead to gentrification and cultural alienation, while participatory arts programs may not tackle physical dereliction and social infrastructure.

Considering the Guimarães 2012 main goals (http://www.guimaraes2012.pt/index.php?cat=15), it becomes apparent that all three models of culture-led urban regeneration were at least to a certain extent part of the underlying deliberations. With view to the present project, this provided several aspects and inspirations to be considered in the development of solutions for the project site.

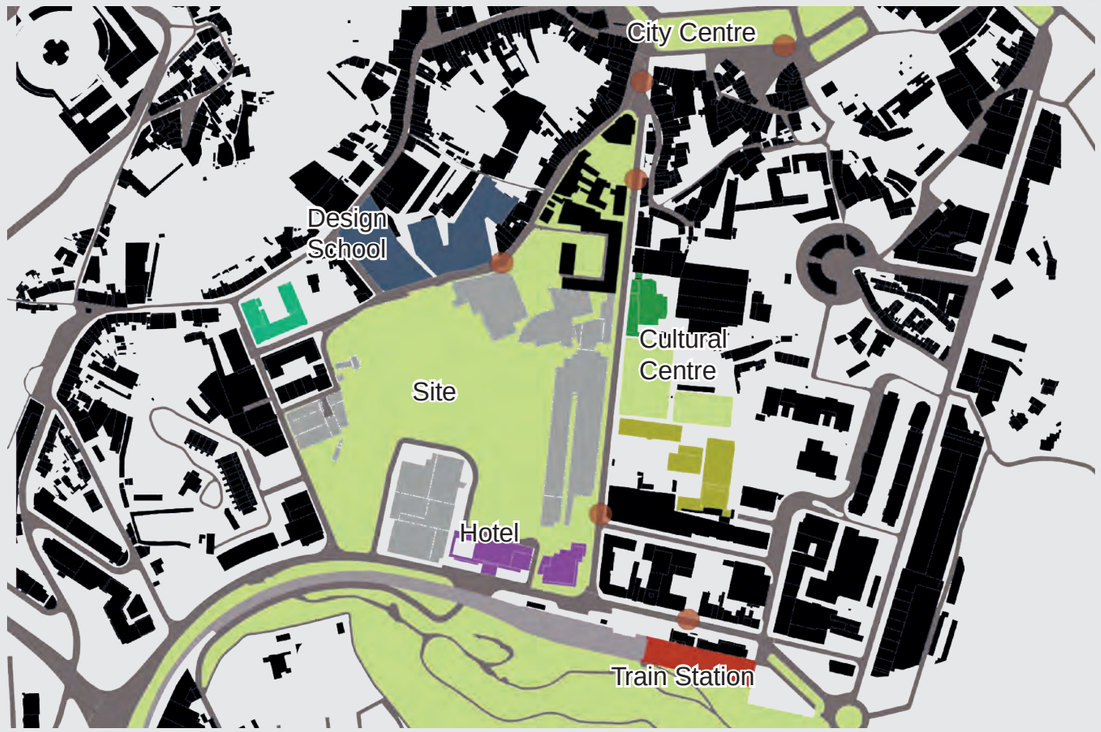
Urban Context

Abandoned in a prime location

The study area of this project is situated in the south of Guimarães. In the east, it borders the Av. Dom Alfsonso Henriques, which is a direct connection between the historic City Centre and the train station. The southern border is the Av. Dom Joao IV, which joins the highway N105 after about half a kilometer. Thus, the overall area serves as an important gateway as it offers quick access from the main train station to the historical city center. Apart from the proximity to the train station and city centre, a cultural centre, a hotel, and design school constitute interesting types of use in the surrounding area.

The streets delimitating the site are supporting both pedestrian and auto activities prioritizing the auto traffic. They have a low permeability, being sealed in percent of 95. The pavement is in most of the cases natural stone on the pedestrian ways and auto ways. Some of the auto routes are built with asphalt. Pedestrian activity, however, seems limited. The actual site is characterized by magnificent industrial buildings which are currently abandoned, left in derelict. Due to the very dense vegetation, the green area in the middle of the site is not accessible. Pedestrian routes were not refurbished over the time as well as the vegetation was not maintained by cleaning.

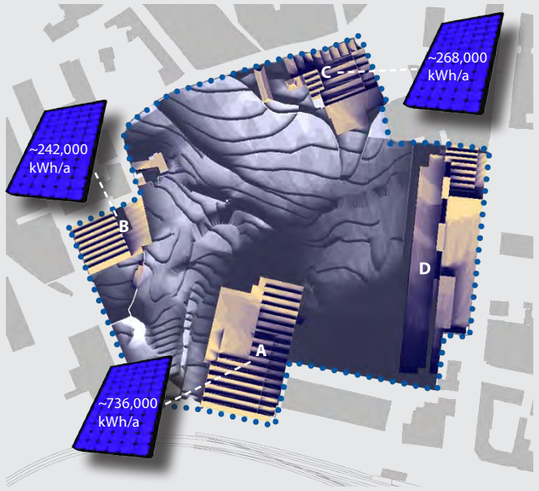
#9: OVERVIEW OF THE SITE



A.1: WEST FACADE OF BUILDING A

A.2: AVENUE DOM AFONSO HENRIQUES

Energy



SOLAR POTENTIAL: SHADOW RANGE ON DEC 21 AND ESTIMATED SOLAR GAIN

Climate

Location: 41°27′ N, 8°18′ W
Climate zone: Csb (temperate, mesothermal climate)

- **Air temperature:** 14°C annual average temperature. Warmest and a coldest month average between –3°C and 18°C.
- **Humidity:** Summer dry, the driest month has precipitation less than 60 mm.
- **Wind velocity and direction:** 4m/s average wind velocity from all directions more or less consistently throughout the year.
- **Radiation:** 1570kWh/m² annual global radiation on horizontal surface, 1197kWh/m² vertically 90°, 1813kWh/m² at 35° (best angle)
- **Climate responsive architecture:** most important design rules are allowing for passive solar direct gains, high thermal storage mass, sun shading of windows (Climate Consultant 5.2)

Solar Potential

The shading analysis illustrates, that even on the darkest day of the year (Dec 21), most of the roof surfaces are entirely exposed to sunlight or only little shaded . Most of the areas are tilted at an optimum angle of 30°-35° facing south (5470m²), others range between 10°-20° (2645m²). The flat roof surfaces (5128m², mostly building D) are less suitable due to partial shading and less radiation on horizontal surfaces. For building A,B and C alone a total harvesting potential of around 1,200,000kWh per year can be expected (with monocristalline PV-modules, efficiency of 12%).

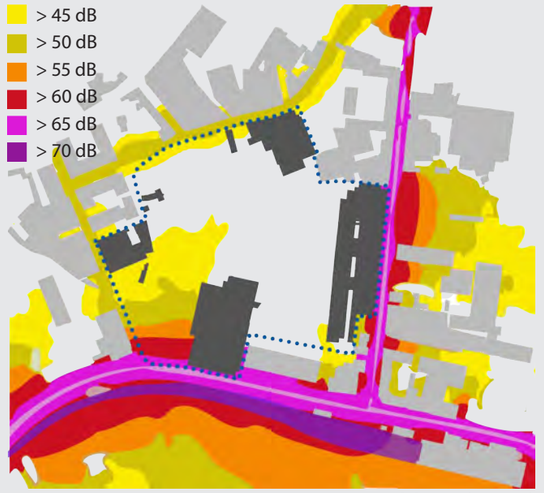
Energy Supply

Energy is needed for different functions of the site. While buildings need to be heated in winter months, a lot of cooling energy is required in summer. Following the aim to reduce heating and cooling demand of buildings by specific measures towards zero energy buildings, thermal energy becomes a smaller share of the energy balance. Accordingly, electricity, that is often connected to cooling devices, and for ventilation and lighting as well, starts to dominate. Looking beyond buildings, the field of traffic, where electricity could play a more important role in the future, is of importance.

The Electricity Production in Portugal is mainly based on coal, gas (since 1997 natural gas was introduced) and oil (together 66%) and hydropower comprises a wide extent, as it covers 16% (IEA 2008). Other renewable sources are waste, biomass and wind which makes up 13% (boom in wind generation since 2004),. From this situation, it can be concluded that the decentralized electricity production has potentials. According to IEA 2008, heat in Portugal is mainly generated by gas and oil. Here the possibility of co-generation becomes aware. However Portugal is highly dependent on electricity imports (19%).

Portugal's National Energy Strategy 2020 (NES 2020) is a continuation of the NEEAP which sets the final energy consumption reduction target of 20 percent by 2020. Renewable energy sources should account for 31% of final energy consumption and 60% of power production.

Noise



NOISE MAP (DAYTIME)

The Site

The Project Site is a hub of activity - from the bustling central train station, to the cultural center and numerous residences surrounding the periphery. A product all of this activity results in various levels of noise emissions, all of which impact the site in various ways. Noise can heavily effect the environment and health of those around it, causing annoyance and in some cases, irreversible health damage.

SWOT

In terms of noise protection, the project site already hosts a few attributes working it its favor. A major contribution to noise reduction is provided by existing buildings onsite, namely Building A and Building D. The former blocks noise emission from the main arterial road, while the latter, Building D, lines the eastern border shielding the site from light traffic noise. Additional strengths include the site's dense greenery coupled with the location of residential buildings in the northern area, resulting in 30-35 dB, roughly as quiet as the average library. It should come as no surprise, the site's major weakness stems from two major noise sources: automobile transport on the surrounding roads, and rail transport from the adjacent railway. The weakest point of the site is the southwestern corner, where wide gaps between buildings allow noise to penetrate the site. Noise levels there, range from 60-70 dB. As revealed in the following sections of the brochure, opportunities to integrate noise protection in responsible urban planning are manifold. Closing the gaps between the buildings and the incorporation of additional noise barriers at the north and western border constructed as natural berms or with reused material can reduce noise while conforming to the site's environmental caliber and tone. On the receiver end, modifying floor layouts can significantly mitigate noise, in turn avoiding the threat of irreversible health effects.

Regulations

In 2006, the European Directive 2002/49/CE issued a decree-law n.o 146/2006, introducing new acoustical parameters for urban occupancy, including three reference periods of the day: (day (7 h – 20 h), evening (20 h – 23 h) and night (23 h – 7 h), strategic noise mapping, action plans and lastly, obligatory public information and participation. (Rocha & Carvalho, 2007)

Portuguese noise legislation approved the new requirements in the 3rd Portuguese Noise Code January 2007 (RGR – Decree-Law n.o 9/2007) to better harmonize acoustical parameters. This means the project sites' day-time levels, along the main arterial road, can at times exceed the limits, as set out in the legislation (detailed in the chart below).

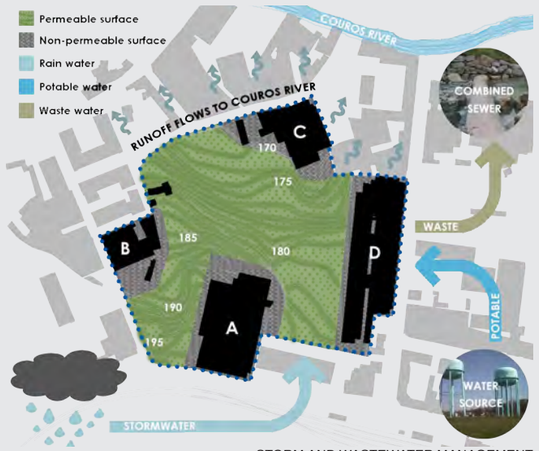
NOISE LEVELS

Form of Occupancy	Full day period (0 h – 24 h)	Nighttime period (23 h – 7 h)
Mixed Zone	L_{den} = 65 dB(A)	L_n = 55 dB(A)
Sensitive Zone	L_{den} = 55 dB(A)	L_n = 45 dB(A)
Sensitive Zone close to an existent major transportation infra-structure	L_{den} = 65 dB(A)	L_n = 55 dB(A)
Sensitive Zone close to a major transportation infra-structure during design stage (not valid for airports)	L_{den} = 60 dB(A)	L_n = 50 dB(A)
Sensitive Zone close to a major airport infra-structure during design stage	L_{den} = 65 dB(A)	L_n = 55 dB(A)
Non classified zones	L_{den} = 63 dB(A)	L_n = 53 dB(A)

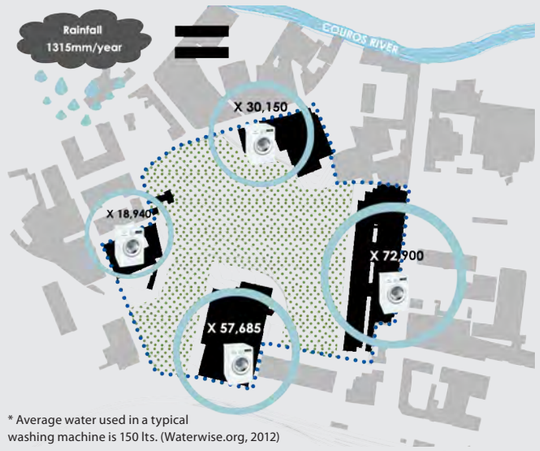
A.3: WATER COLLECTION IN STA. ÁGUEDA, IDANHA-A-NOVA

A.4: LOCAL BUILDING MATERIALS: GRANITE | CERAMIC | CORK | BASALT/LIMESTONE/MARBLE

Water



STORM AND WASTEWATER MANAGEMENT



* Average water used in a typical washing machine is 150 lts. (Waterwise.org, 2012)

STORMWATER HARVEST POTENTIAL

Current Situation

Annual average precipitation in the city of Guimaraes is 1315mm/year (NASA, 2002). The study site has 39,000m2 of open/permeable space and 33,000m2 of non-permeable surface area. Runoff stormwater from the site flows primarily into the northern underground Couros River, tributary of the Aver River Basin, which covers a total area of 458 km2. (Oliveira, Lima, & Vieira, 2005)

Water Supply and disposal in Portugal is managed by the Águas de Portugal Group in partnership with local companies and municipalities. Águas do Noroeste S.A. is responsible of the supply and disposal of water in Guimaraes. This group operates 12 WTP, 570km of water mains. In terms of wastewater it operates 105 WWTP and 721km of sewers (Águas de Portugal, 2012). Guimaraes has a water demand of 120 l/capita/day, which is largely emanated from surface and underground sources.

SWOT

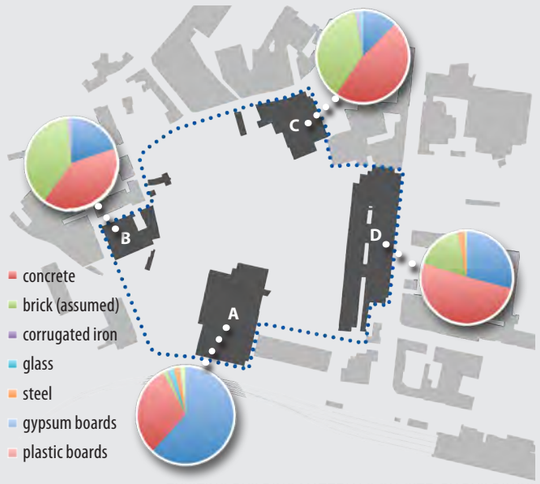
The fact that the site has over 50% permeability (totally unsealed area) is a STRENGHT. The assumed combined sewage and rainwater system is seen as a WEAKNESS. The large amount of roof area can be regarded as an important OPPORTUNITY to harvest and reuse rainwater. Climate change, the city's plan towards densification, the old (centralized) infrastructure and the cost associated with the renovation of the latter are all considered THREATS.

Legal Instruments

The EU Water Frame Directive (WFD) came into force in October 2000 with the aim to improve the aquatic environment of all member states. The WFD promotes decentralized waste and rainwater management with instruments such as the taxation system, which gives incentives to use water resources more efficiently.

In terms of sustainable water management, Portugal launched the National Program for Efficient Water Use (PNEA) in 2005. However, the country still needs to fulfill the EU regulations (EU, 2007): many wastewater treatment plants operate insufficiently and potable water quality also does not always fulfill European standards. Furthermore, there are some legal constraints about the reuse of wastewater and rainwater (iiSBE Portugal, 2009)

Materials



EXISTING BUILDING MATERIALS ON-SITE, BY BUILDINGS

Metal Sheets | Wood | Clay fractions, plastics, wood, brick

Clay, wooden pieces, gypsum boards | Clay pieces, stones

#20: CONSTRUCTION WASTE ON-SITE

Situation in Portugal

Building materials should be suitable and adaptable to the local conditions of the building/site. Portugal has many natural ressources such as cork, iron ore, copper, zinc, silver, gold, marble, clay, gypsum etc. 40% of the world's raw resources are consumed by buildings. At the same time, buildings are one of the main producers of waste, harmful air and CO2 emissions (Maibritt, Pedersen, Zari). Therefore the choice of building materials to be used, as well as their disposal/recycling, is very important.

On-site situation

When analysing the project site, its main advantages regarding materials are the high concentration of reusable materials and the diversity of locally produced building materials. Although only a small part of the four buildings is still in use, a considerable part of the buildings' structure is in good shape.

On the other hand, the waste management system in Guimaraes is still under construction and most waste goes to landfill rather than to composting, recycling or incineration plants. Waste separation is practically nonexistant,and the capacity of the bins in the city is limited. On the site itself there is a high risk, due to the former use for textile and leather production, that the buildings and surrounding soil are contaminated. Furthermore, the buildings have no improvements such as insulation and are still in the same situation since the 1900's.

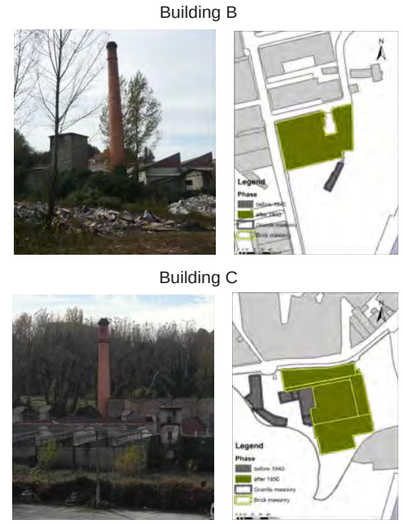
On the other hand, these conditions offer several possibilities of upcycling the buildings and their materials, and reuse of the majority of the structures, materials and existing vegetation. Additionally, the site provides the opportunity to have a pioneer role in exhibiting waste separation and other sustainable ideas.

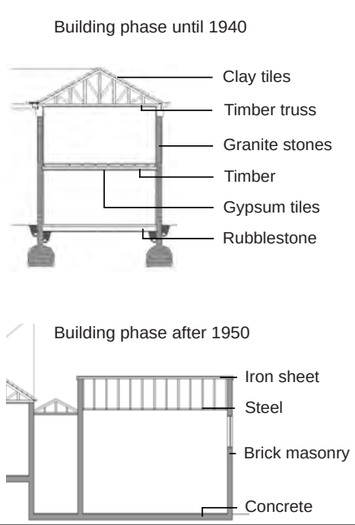
The reuse of the buildings and a change in their uses may entail removal of some of the old structures/materials. Future use of new materials should be balanced and carefully weighed in respect to required functionality, cost and historical value.

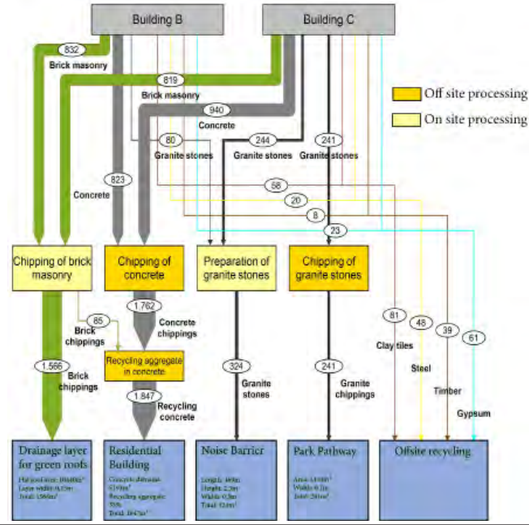
Legal instruments

Several instruments and regulations describe a first step in the direction of waste separation, reuse and recycling. For example, Portugal has developed a National Plan for industrial waste prevention and more focused for municipal waste prevention as well. Additionally, the EU Directive 2010/31/EU ensures the extension of renewable energies.

1.1: LAYOUT: BEFORE AND AFTER







1.2: MATERIAL TYPES AND RECYCLING FLOW CHART

Group 1

Material Use

Vision and Objectives

Transformation of the old factory site

Guimarães was once the heart of Portugal's largest textile-manufacturing industry until global competition drove business elsewhere. (Wilder, 2011). The site echoes the city's traditional significance as the host of four, textile factories, three of which (Building B, C and D) are no longer in use. Building B & C exhibit a largely destroyed roof structures, from rapid deterioration, while Building A is still in use as a storehouse for textiles. In addition to the site's historical industrial architecture, the site encompasses one of the largest green areas in the city. The dense vegetation and lack of access points keep the area fairly unserviceable. The site is located 1km south of the city center, between the central train station, the main arterial road and the Vila Flor cultural center. Many amenities are within walking distance (see table below). The surrounding area serves as a cultural and transportation hub, frequented by numerous tourists and locals alike.

The poor condition of the unoccupied factories, high potential of creating public green space, onsite opportunities for water, energy and material reclamation, central location and the need for affordable housing (Mendoza, 2011) were the basis of the working group's vision: to sustainably transform the former industrial area into a socially valuable space for living, recreation and cultural activity as a role model for the future development of Guimarães and beyond. Based on this vision, objectives were derived, structured according to the three dimensions of sustainability:

Social Objectives
Accessible green space for recreation and cultural activities
Reduction of noise below the annoyance level
Meeting the district need for residential housing, while improving quality of life
Creation of cultural space: museum, library & workshops
Environmental Objectives
All structural intervention with a focus on recycling, waste prevention and environmentally sound material selection
Being an effective showcase of how to build and live sustainably
Efficient usage of energy and water
Economic Objectives
Value creation for the municipality (tourism, population increase, jobs)
Efficient financing and fundraising for all interventions
Providing affordable housing with low maintenance & operation costs

Priority class 1			Priority class 2			Priority class 3		
Amenity	Dist. (m)	Cd	Amenity	Dist. (m)	Cd	Amenity	Dist. (m)	Cd
Café	200	9	Bank	400	7	Hospital	1300	2
Park	50	9	Prim. School	600	5	Theatre	400	4
Supermarket	650	7	Post office	1300	3	Museum	110	4
			Pharmacies	250	7	Restaurant	400	4
			Playground	50	7			
Subtotal		25		29				14
Total				68				

Methodology

The strategy developed for the transformation of the site was determined through the use of assessment tools offered in the REAP MSc program, as well as onsite analyses and data provided by the University Minho students and relevant literature. A major emphasis of the revitalization of the project is placed on material disassembly and the integration of onsite materials in new ways.

The second focus lies on the proposed new residential building: its design and function were based on Climate Consultant data and improved water saving technologies were implemented using the WiseWater tool (Climate Consultant, 2011; Wise Water, 2011). In order to assess the value and benefit of its modifications, the Green Building rating system SB-Tool was applied. Lastly, to evaluate the economic performance of the PV-facility, the project analysis software RETScreen was consulted.

The Layout

Before and After

In the first phase approaching the project site it was vital to have the multi-disciplinary team analyze all the potential and weaknesses of the site, in order to achieve the vision and objectives. The assessment led to the decision to conserve the site's ecological systems, while restoring the deteriorated natural environments and habitats. The outcome being an improved quality of life for the community achieved with the connectivity of outdoor and indoor spaces. Alternative water and energy sources were identified, as well as efficiency measures to compliment passive design. Additionally, a whole-life-cycle material approach was pursued.

Park

Inaccessible green space has been transformed into a multifunctional recreation area. The park offers an array of opportunities and increases residents and visitors quality of life through dining and rest areas, a playground and community gardens. Bike-racks encourage sustainable transportation to the park, whose location next to the museum Building D, makes the park a highly social space for both cultural and fitness-related activities. Beyond that, the park creates new habitat and biodiversity, hosting two catchment ponds and an array of vegetation.

Noise Barrier

The noise barrier built as a screen for the park blocks both rail and main arterial road emissions, lowering noise levels by 13dB. The addition of a 2.3m high, 470m long, 100% recycled granite stone barrier reduces noise below 50.dB, improving health and encouraging recreation.

Building A

As the only one of the four buildings still in use, Building A remains a textile storehouse which fosters an economic cultural tradition, providing revenue and local employment opportunities. Besides carrying on the site's industrial heritage, Building A will benefit from the site's transformation in undergoing modification to attain improved energy and water performances. Measures will include wall insulation, new glazing, PV-modules and a green roof.

Building D

Building D is a historical building in good structural and material condition for modification. It is sustainably refurbished, serving as an extension of the Vila Flor Cultural Center directly on the other side of the street, which offers contemporary art, 18th century royal architecture as well as space for exhibition, theatre and cinema. In its ample space, Building D will host a library, workshops and an exhibition dealing with the site's past of textile industry as well as its exemplary transformation to include new, sustainable features. Besides enhancing social objectives, such as recreation and cultural activities, this encourages further use of the park onsite.

Rainwater Concept

Rather than continuing to discharge the rainwater into a combined sewer, all rainwater will be managed on site. All flat roofs will be covered by extensive greening. Overflow in all buildings, will be collected in a cistern and recycled as service water for toilet flushing and irrigation. The remaining rainwater feeds the lake and is finally directed into the infiltration pond in the north-eastern corner and lowest point of the area.

Tree Species

As some of the invasive plants draw a tremendous amount of water, reduce soil quality and disturb the ecosystem, they will be removed, and replaced by native plants.

Material Disassembly and Recycling

of Buildings B and C

Onsite textile factory Buildings B and C have been out of commission for years and rapidly deteriorated. Based on their condition and structure, potential for reuse was deemed incompatible with achieving our vision. An economical and sustainable alternative was incorporated to disassemble B and C and recycle all usable materials on site. To prepare this, the working group conducted an analysis and quantification of the main material fractions present.

Building B & C each had at least two distinct building phases. The first dates back to an architectural period pre-1940s, characterized by granite masonry, timber trusses and clay tiles. Features of the post-1950s second phase include plastered brick masonry, concrete foundations and gypsum board. The roof consists of steel trusses and clay tiles, whereas the majority of tiles from Building C have been removed.

The available materials were assigned to the following reuse:

- Concrete recycling for the residential building
- Granite stones for the noise barrier
- Granite chippings for the Park Pathway
- Masonry chippings for the drainage layer of the green roof
- Off site recycling of timber, steel and gypsum

The recycling of materials conserves natural resources, avoids transportation and landfilling, as well as decreases emissions and saves energy and costs (EPA, 2011). The largest recycled fraction of Building B and C is concrete. Recycling concrete alone can save approximately 10% energy as well as 10% of CO_2, NOX and SO_2-emissions (Heyn& Mettke, 2010).

1.3: SOUTH WEST ELEVATION

1.4: SOUTH EAST ELEVATION

New Residential Building

Showcase Guimarães 2020

New Residential building

The new "Showcase Guimarães 2020" residential building will provide affordable high quality housing. Additionally, it will serve as one of the first sustainable best practice for the region, thereby attracting broad-based attention and creating value for the municipality.

The building has a wide range of implemented features (see sketches), which aim to attain the sustainability goals through a whole building design approach in accordance with the REAP guidelines and the "Matosinhos SHE" building best practice example.

The new residential building will host 101 dwellings. Improved modifications include a green roof, PV & solar-thermal panels, rainwater cisterns, an energy efficient building envelope and water efficient appliances. Through efficient financing, fundraising and public paticipation, low cost housing will be achieved.

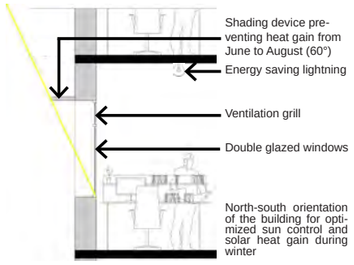
Social Scale

Residents of the Showcase building will uphold sustainability through social and cultural networks provided by themselves.

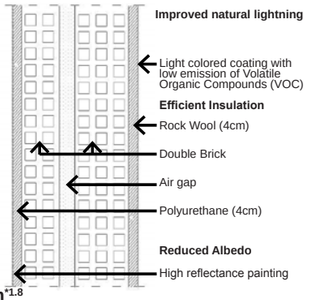
Participatory activities, upcoming events and outings, will be organized through monthly meetings, which will include environmental awareness raising topics such as sustainable user behavior and participation in building maintenance such as tending to the green wall system.

As the Building D neighbors the Showcase Guimarães building, residents will have an opportunity to participate in planning local events such as speakers, music and cultural activities for local residents and tourists in the park. The park will also host as a meeting place for a weekly market with an emphasis on regional products ranging from organic agriculture and produce to furniture and household items. The venue provides additional potential for residents of the New Showcase building to buy, sell or trade items, as well as participate in the planning of the market itself.

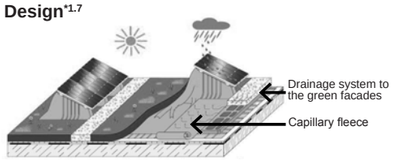
Shading Design



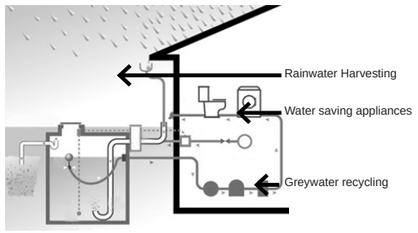
Wall Design*1.6



Roof Design*1.7



Water System*1.8



Solar heat Area: 150m², Eff.: 60%, Supply: 81362,5 kWh/a (=Hot water heat demand)

PV Area: 2940m², Eff.: 12%, Supply: 320000 kWhel/a, Demand: 202000 kWhel/a (2000 kWh per household.)

Green roof Area: 3090m², intensive, sedum vegetation

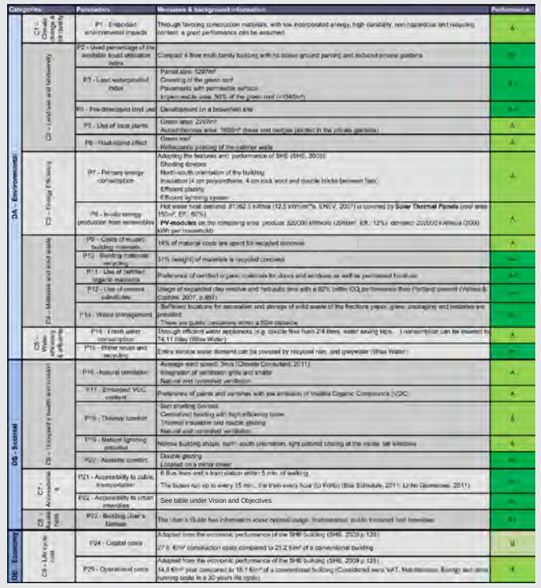
Assessment

SBTOOL©

The Local Assessment

To ensure the Building's sustainable performance the SBTool (Sustainable Building Tool) was implemented. This tool has been initiated by the international initiative for Sustainable Built Environment (iiSBE) and adapted to the Portuguese context in 2009. It aims to "evaluate the performance of buildings in relation to the three dimensions of sustainable development: environment, society and economy" (SB-Tool, 2009). In relation to two national reference levels (best-practice and standard practice), it incorporates 25 parameters. With implementing the measures mentioned below, the Showcase Guimarães residential building is able to achieve an A-certificate.

In order to assess features regarding energy and economic performance, the working group turned to the pilot "Matosinhos SHE" project in Porto, 40km away from Guimarães. The best-practice project was incorporated in the Sustainable Housing in Europe (SHE) initiative funded by the European Commission (SHE, 2003).

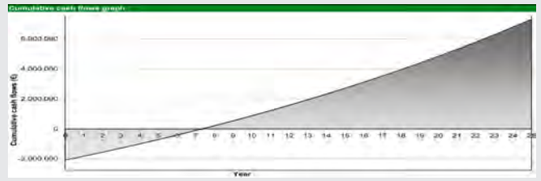


Categories	Parameters	Measures & background information	Performance
A - Environment	C1 - Climate and air quality	P1 - Embodied environmental impacts	Through favoring construction materials, with low incorporated energy, high durability, non-hazardous and recycling content, a good performance can be assumed.	A
	C2 - Land use and biodiversity	P2 - Used percentage of the available buildable utilization index	Compact 4 floor multi-family building with no access ground parking and reduced private gardens	B-
		P3 - Land waterproofed index	Parcel size: 5287m² Covering of the green roof: Pavements with permeable surface: Impermeable area: 50% of the green roof (=1545m²)	B-
		P4 - Pre-development land use	Development on a brownfield site	B+C
		P5 - Use of local plants	Green area: 2200m² Autochthonous area: 1600m² (trees and hedges planted in the private gardens)	A
		P6 - Heat island effect	Green roof Multicoloured painting of the exterior walls	A
	C3 - Energy Efficiency	P7 - Primary energy consumption	Adopting the features and performance of SHE (SHE, 2003): Shading devices North-south orientation of the building Insulation (4 cm polyurethane, 4 cm rock wool and double bricks between two) Efficient plumbing Efficient lightning system	A
		P8 - In-situ energy production from renewables	Hot water heat demand: 81362,5 kWhel (12,5 kWh/m²a, ENEV, 2007) is covered by **Solar Thermal Panels** (roof area: 150m², Eff.: 60%). **PV-modules** on the remaining area: product 320000 kWhel/a (2940m², Eff.: 12%), demand: 202000 kWhel/a (2000 kWh per household)	A
	C4 - Materials and solid waste	P9 - Costs of reused / building materials	16% of material costs are spent for recycled concrete	A
		P10 - Building materials recycling	31% (weight) of materials is recycled concrete	B+
		P11 - Use of certified organic materials	Preference of certified organic materials for doors and windows as well as permanent furniture	A+C
		P12 - Use of cement substitutes	Usage of expanded clay residue and hydraulic lime with a 82% better CO_2 performance than Portland cement (Veiniela & Cadima, 2007, p.857)	-
		P13 - Waste management	Sufficient locations for separation and storage of solid waste of the fractions paper, glass, packaging and batteries are provided. There are public containers within a 50m distance	A
	C5 - Water (& efficiency)	P14 - Fresh water consumption	Through efficient water appliances (e.g. double flow flush 2/4 liters, water saving taps,) consumption can be lowered to 74,11 l/day (Wise Water)	A
		P15 - Water reuse and recycling	Extra service water demand can be covered by recycled rain, and greywater (Wise Water)	B+
B - Economy	C6 - Indoor environment	P16 - Natural ventilation	Average wind speed: 3m/s (Oasis Consultant, 2011) Integration of ventilation grills and shafts Natural and controlled ventilation	A
		P17 - Embodied VOC content	Preference of paints and varnishes with low emission of Volatile Organic Compounds (VOC)	A
		P18 - Thermal comfort	Sun shading devices Centralized heating with high efficiency boiler Thermal insulation and double glazing Natural and controlled ventilation	A
		P19 - Natural lighting potential	Narrow building shape, north-south orientation, light colored coloring of the inside tar windows	A
		P20 - Acoustic comfort	Double glazing Limited use of interior doors	B+
	C7 - Accessibility	P21 - Accessibility to public transportation	6 Bus lines and 1 train station within 1 min. of walking The buses run up to every 15 min., the train every hour (U Porto) (Bus Schedule, 2011; Linha Guimarães, 2011)	A
		P22 - Accessibility to urban amenities	See table under Vision and Objectives	B+
	C8 - Adaptation to users	P23 - Building User's Manual	The User's Guide has information about optimal usage, maintenance, public transport and amenities	B+
	C9 - Life cycle cost	P24 - Capital costs	Adapted from the economic performance of the SHE building (SHE, 2003p.128): 27 € /m² construction costs compared to 25 € /m² of a conventional building	B
		P25 - Operational costs	Adapted from the economic performance of the SHE building (SHE, 2003p.128): 14,6 €/m² year compared to 18,1 €/m² of a conventional building (Considered were VAT, Maintenance, Energy and demolishing costs in a 30 years life cycle)	B

RETScreen©

Project Power Analysis

"RETScreen is an Excel-based clean energy project analysis software tool that helps decision makers quickly & inexpensively determine the technical and financial viability of potential renewable energy, energy efficiency and cogeneration projects." (RETScreen, 2011). RETScreen has been applied to evaluate the Photovoltaic facility on the roof. 2940 poly-silicium PV units from Mitsubishi Heavy Industries require an initial investment of roughly €2 million with €345 of annual operation and maintenance costs. Assuming a price of €18 cents per kWh, 25 years life span and a discount rate of 3%, there is a facility pay back period of 7 years (see figures, RETScreen, 2011). Furthermore it will save over 600t of CO_2 per year, equal to around 1400 liters of crude oil saved.



Conclusion

As a result of all the mentioned measures, it is possible to transform the former industrial area into a socially valuable space for living, recreation and cultural activity. Environmental, social and economic benefits were created through the use of reclaimable materials from buildings B and C for site improvements such as a noise barrier, path, green roof systems and the new Showcase building. In light of the European Cultural Capital goal to revitalize heritage through the built environment, the working group's vision provides residents with a new public space through the integration of a park. The urban greenery and visualized water catchment systems benefit the environment and the residents' quality life. Additionally, the site's architectural and cultural heritage will be preserved through the modernized textile factories buildings D and A. The former will serve as a cultural hub, while the latter will continue to preserve the Portuguese tradition of the textile industry while providing social and economic value for the local residents. Last but not least, the A-rated Showcase Guimarães residential building offers high level of sustainability, affordability and quality of life.

2.1:ENTRANCE'S VIEW

2.2:COURTYARD, ARTS&CRAFTS SCHOOL

2.3:SUSTAINABLE PLAYGROUND

Group 2

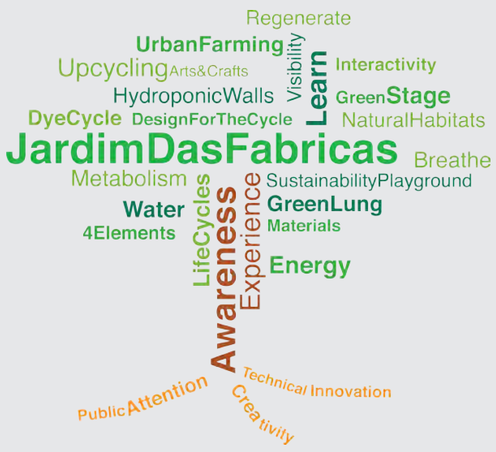
Jardim Das Fabricas

Visibility of sustainability

In various sustainable developments, one of the most significant factors in their success is the visibility of their sustainable aspects, making it accessible to all. This visibility enables an ongoing process of education and progress. The newly-created fabric is interwoven with references to the past industry, the culture and the history of Guimarães.

We see Jardim das Fabricas, with its urban location and natural conditions, as a possible catalyst for such a process. Through various tectonic, intellectual and cultural experiences, people gain knowledge that would further advance them towards vsustainable living:

- the sustainability playground, illustrating energy and water cycles and exhibiting actual electricity production;
- an arts and crafts school referring to the historic textile industry while reverting even farther back to ancient dyeing practices;
- a regional sustainability center with a reuse/recycle center;
- restoration/re-establishment of natural habitats.



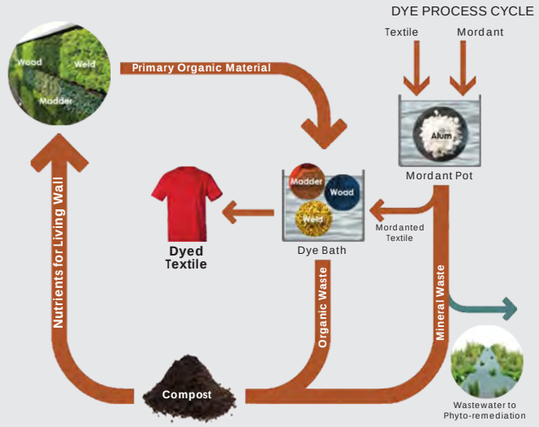
Dye Cycle

Textile and leather have been dyed since ancient times. Historically, the most widely used dyes were grown locally, later replaced by imports and artificial dyes. Natural dyes create no hazardous waste when produced and used, and in some cases may have a good influence on human health.

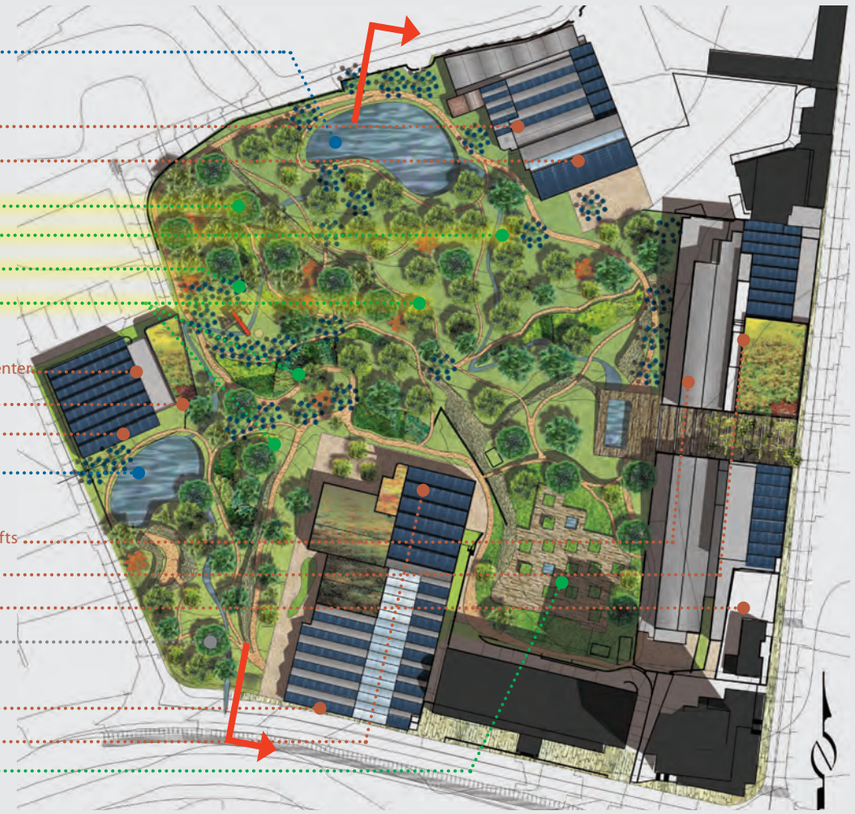
Growing these local dye-producing plants - such as weld, madder and woad - on site, has several benefits:

- restoring locally grown plants;
- enabling local production of natural dyes for textile;
- revival of ancient craftsmanship skills;
- exhibition of natural cycles through the production processes.

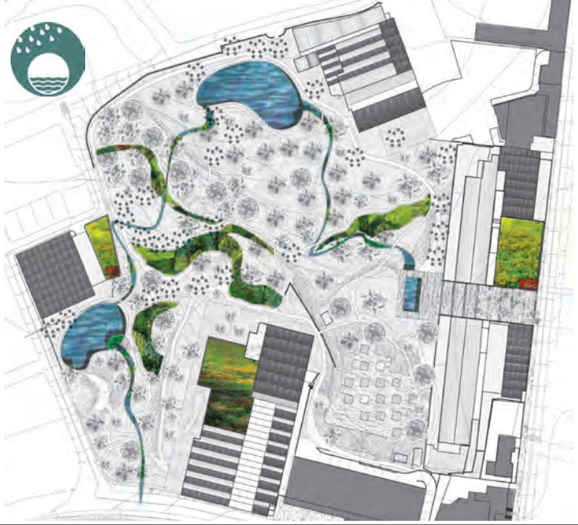
The traditional dyeing process requires relatively large amounts of water; we propose to reuse this water in the process and to connect it to the complete water cycle of the park. The mordant we propose to use is alum, which also used for water purification.



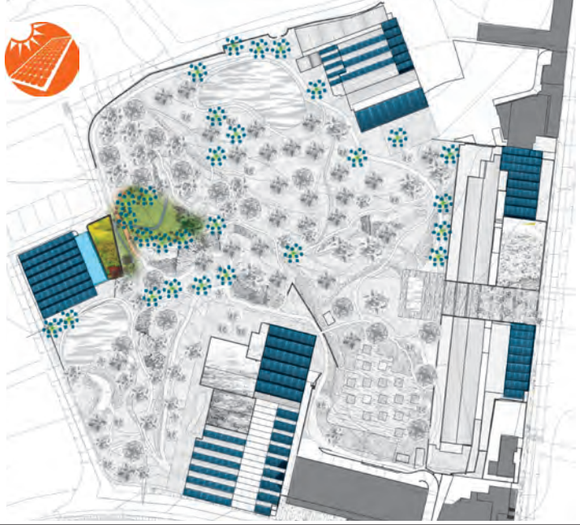
GENERAL SITE PLAN



SITE SECTION



2.4:WATER SCHEME



2.5:ENERGY SCHEME

2.6:MATERIALS SCHEME

2.7

Design for the Cycle

Water

The annual rainfall in Guimarães is around 1515mm, and storm water management will be taken care of by the buildings and the park. On the buildings, green roofs are incorporated on ~16% of the roof areas, retaining 50% of the rainfall and allowing evaporation. The rest of the runoff is collected into water tanks, used for the various water features in the park, irrigation, the dyeing process, and sanitary uses in the buildings.

In the park, 40000m2 are permeable surfaces. Three retention ponds collect rainwater and have a role in water purification using phytoremediation, and trench soak-ways provide infiltration. The park should provide a solution for the surrounding area as well.

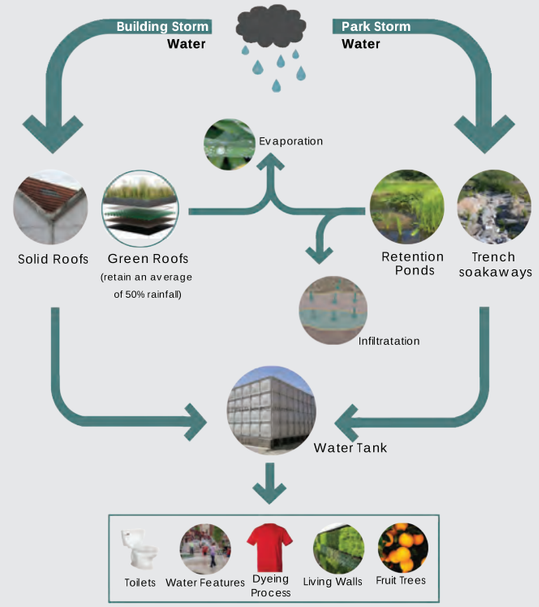
Greywater will be collected and treated with phytoremediation.

Energy

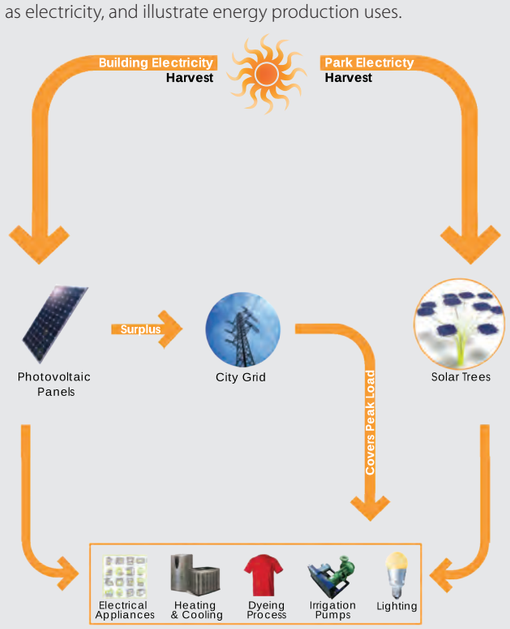
The average annual irradiation in Guimarães is ~1792 kWh/m2. This is potential energy that can contribute to site productivity, and cover the estimated energy demand (estimated according to standards for office use at 1,300 GWh/a for the park and the buildings).

Photovoltaic panels are located on all south-facing rooftops, supplying an estimated 2.3 million kWh/a, and 50 ‚solar trees' are placed in advantageous locations throughout the park, supplying additional 91,000 kWh/a. Surplus electricity will be fed into the grid, which will also cover peak demands when needed.

The sustainability park plays a part in making this cycle visible by exhibiting real-time updated production values. Specially designated playground equipment powered by the visitors will produce energy as electricity, and illustrate energy production uses.



WATER CYCLE



ENERGY CYCLE

Experience Sustainability

Materials

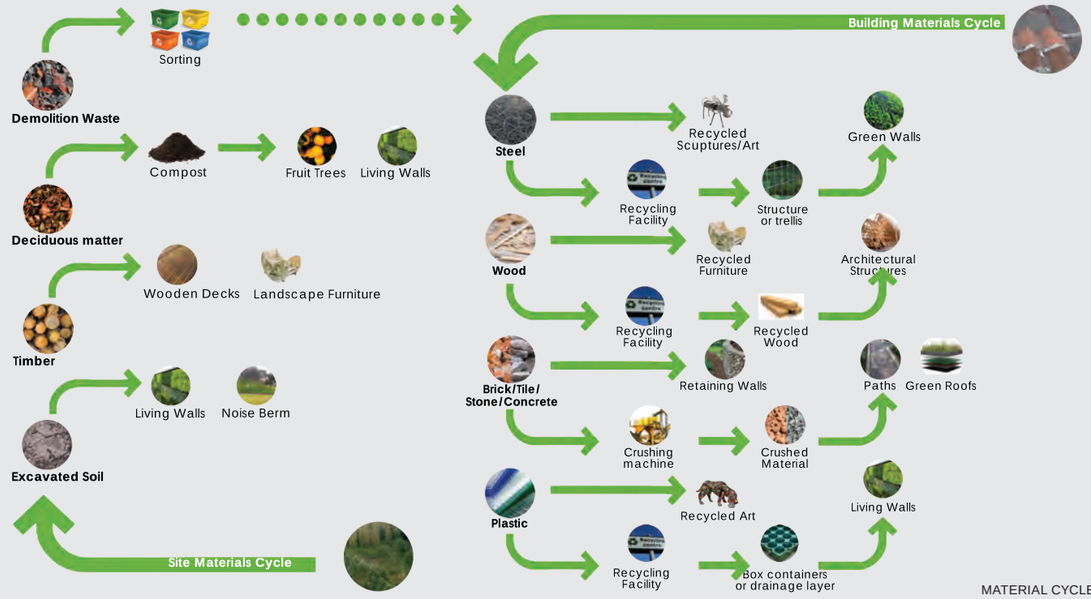
Excavated soil from the ponds and underground parking will be used to create a berm for noise mitigation on the south-west corner and for living walls. Timber from the cleared, forest' will be used for landscape features, such as decks and furniture.

Deciduous matter will be composted, used in the ‚living walls' and fruit orchards. Demolished building parts will be either recycled on-site or transferred to a recycling facility. Some materials can be used for ‚recycled art', displayed in the sculpture garden, or for the playgrounds.

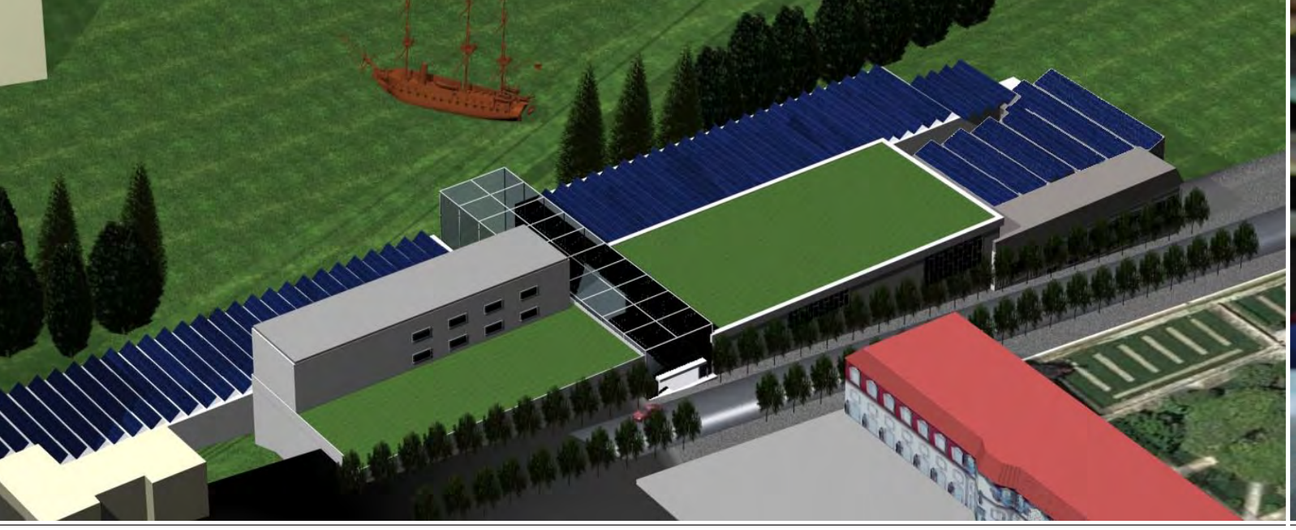
After recycling off-site, there are even more possibilities: steel used for ‚living walls' structure, wood upcycled into new furniture, plastic used for new box containers. Brick, clay tiles and concrete, after crushing, can be used for park paths and for green roof substrate.

Conclusion

Relating to the cultural context while connecting it to the everyday industry offers a new reference layer, enriching the experiences of visitors, students and residents alike. The ‚Jardim das Fabricas' illustrates this connection, creating a landscaped public park drawing its inspiration from the textile industry while implementing innovative sustainable practices. The functions of the buildings surrounding the park further enhance the ideas of production / culture / involvement - the Arts and Crafts school, the Sustainability Center, the student dorms, the Living/Working complex, the library and the museum - all offer opportunities for interrelations and encounters and promote stewardship. We see the Jardim das Fabricas as the new 'fabric' connecting the the past, present and future, while offering a best-practice example of sustainable treatment.



MATERIAL CYCLE



3.1: VIEW OF PROPOSED BUIILDING D

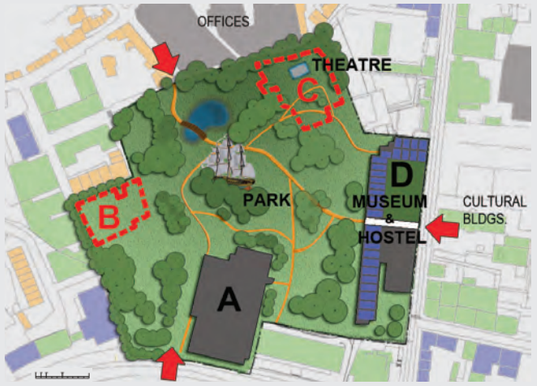
3.5: INSIDE BUILDING A

Group 3

Material Flow & Impact Assessment

General Concept

The general concept proposed focuses on enlightenment with regards to material flows and how someone may participate in 'closing the material cycles'. This is developed within the site by the provision of a Museum , which deals exclusively with visual explanations of material processes and flows, a Park with an interactive 'learning path', an open-air 'puppet' theater, and a 'playing/ learning ship for the children to explore.



3.2: SITE PLAN

WATER: the water concept takes advantage of the slope of the site by channelling the runoff towards the lower end into either a man-made pond or the area around the open theatre. Along with this water, grey water from the proposed Hostel are re-used on the site's vegetation.

NOISE: the major noise issue is the gap in the site to the left of Building A. To 'close the gap' it is proposed to add a fence which overlaps to allow entry by people but block the noise.

ENERGY: In terms of Energy, it is proposed to have the Hostel & Museum produce as much of their own energy as possible with the use of solar panels and geothermal energy.

MATERIALS: a major theme throughout, this concept deals with the flow of materials within the site and how they are re-used and re-cycled and illustrates how to close the cycle.

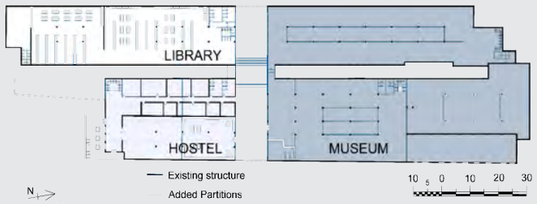
Living Material: Building D

Building D will be renovated to be a multi- functional building; hosting a Museum, a Library and a Hostel. The Museum will be specific to material technologies and life cycles. The hostel and the library will also focus on ways of dealing with materials with the library being an academic source for books dealing with material production, LCA and waste and the hostel being more practical and hands on. The promotion of the concept of material recycling is enhanced by having the hostel in the same building so museum patrons as well as the hostel guests can see directlyhow the separation of waste and water streams work and the benefits.

In the building construction itself, the environmental impact is kept to a minimum by reusing the existing building structure and using recycled material for the additional walls and movable partitions added. These materials will come from Building B and C which are going to be demolished as a part of the closed material cycle to be implemented in the site. The added interior partitions can be disassembled providing flexibility and reducing the waste at the end of the building life.

The building is positioned as a 'gateway' connecting the Cultural Center with the Park through the open Atrium that lures people into the park. There is also the possibility of connecting the two under the street from the parking located below the Cultural Center.

3.3: MAIN BUILDING ENTRANCE



3.4: GROUND FLOOR PLAN

Environmental Impact Assessment

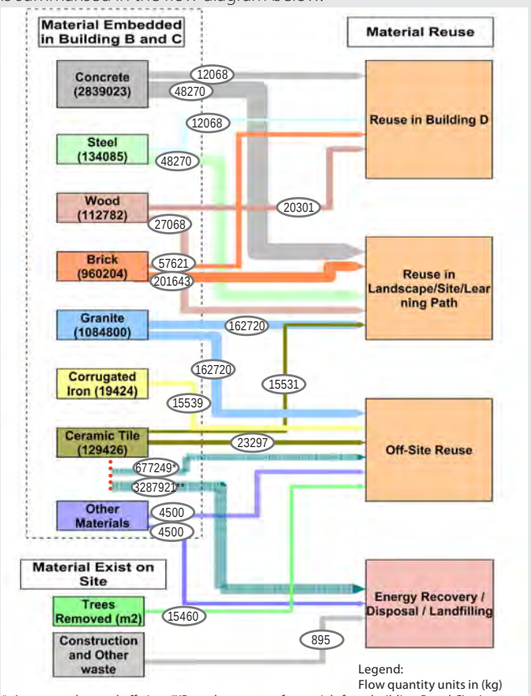
SBTool-PT, The Portuguese local building sustainability assessment tool was used to rate the buildings sustainability performance and thus assess the feasibility of the proposed building D design. The tool assesses three sustainability dimensions; environmental, social and economic. The level of building performance to be reached under this tool is scaled in six levels; from E (less sustainable) to A+(green or more sustainable). The following analysis is only concerned with the environmental aspects, specifically categories C1-climate change and outdoor air quality and C4-material and solid waste, weighing 13% and 29% respectively of the overall environmental performance of a building. The result reached is presented in the table below.

Categories	Indicators	Parameters	Level	Conditions	Level reached (X)
C1-Climate change and outdoor air quality	Environmental impact associated with the life cycle of buildings	P1- annual aggregated values of the environmental impact categories of the life cycle of useful floor area	A+	$P_{LCA} > 1,00$	
			A	$0,70 < P_{LCA} \leq 1,00$	
			B	$0,40 < P_{LCA} \leq 0,70$	X
			C	$0,10 < P_{LCA} \leq 0,40$	
			D	$0,00 \leq P_{LCA} \leq 0,10$	
			E	$P_{LCA} < 0,00$	
C4-Material and Solid Waste	Reuse of materials	P9- Percentage in cost of reused materials	A+	$P_{CRE} > 1,00$	
			A	$0,70 < P_{CRE} \leq 1,00$	
			B	$0,40 < P_{CRE} \leq 0,70$	X
			C	$0,10 < P_{CRE} \leq 0,40$	
			D	$0,00 \leq P_{CRE} \leq 0,10$	
			E	$P_{CRE} < 0,00$	
	Use of recycled materials	P10- percentage in weight of the building´s recycled content	A+	$P_{CRE} > 1,00$	
			A	$0,70 < P_{CRE} \leq 1,00$	
			B	$0,40 < P_{CRE} \leq 0,70$	X
			C	$0,10 < P_{CRE} \leq 0,40$	
			D	$0,00 \leq P_{CRE} \leq 0,10$	
			E	$P_{CRE} < 0,00$	
	storage conditions of solid waste during the building' use phase	P13- potential of the building ´s condition to promote the separation of solid waste	A+	$P_{RSU} > 1.00$	X
			A	$0,70 < P_{RSU} \leq 1,00$	
			B	$0,40 < P_{RSU} \leq 0,70$	
			C	$0,10 < P_{RSU} \leq 0,40$	
			D	$0,00 \leq P_{RSU} \leq 0,10$	
			E	$P_{RSU} < 0,00$	

In summary, the evaluation of the environmental parameters indicate that our focus building `D` attains a green sustainability building performance with regards to major environmental categories, material and solid waste as well as climate change and outdoor air quality. This was achieved through efficient reuse of existing building components, recycling material on-site and by providing suitable conditions of solid waste storage during building use phase.

Material Flow Analysis

In order to teach others about recycling, it was decided to make the site a living example. Thus an onsite material inventory was required, followed by the decision on how best to re-use and or recycle it. This is summarised in the flow diagram below.



Legend:
Flow quantity units in (kg)

* Amount to be used off-site =∑(Recycle amount of materials from building B and C) – (amount reused in building D and on the site reuse

** Amount to energy recovery or disposal =∑(total materials embedded in building B and C)-(total amount of material recycled)

The estimated quantity of material from the demolished buildings B & C and that existing on-site are shown in the left column The quantities on the flow lines indicate the estimated, potential amount of recycled materials available. The right column show possible destinations for the materials.

3.6: VIEW TO LARGO JOÃO FRANCO

3.8: AERIAL VIEW OF SITE SHOWING BUILDING D ROOF

The Park... a Path to Learning

THE PARK

While the Museum is tailored more for the adults, the Park is created especially for the children: the idea is to have a fun yet stimulating environment that teaches about material cycles and how to re-duce, re-use and recycle. It is designed with curving pathways made from recycled concrete, that wind in and around the new trees planted to replaced the Eucalyptus that were removed. At strategic points along this path are interactive exhibits that inform about trees, their processing into other materials and their environmental effects. Located in the centre of the Park is the main attraction, The Ship which is a prime example of a nearly closed material flow loop that with a little effort and ingenuity, can be replicated in the average household. The Park also features a Puppet Theatre with shows featuring the childrens' favourite puppet/cartoon characters doing their bit to reduce and reuse materials to help create a better environment. In addition there are remodeled tree stumps for sitting, public tennis courts and open areas for sports activities and drop-off stations where household material for recycling can be placed. Finally there is a man-made pond created in the lower half of the site to serve as a water catchment area as well as for recreational purposes.

3.7: RECYCLING IDEAS IN THE SHIP

O Navio-The Ship

As the main attraction, a life sized ship is used not only because it symbolises a near complete closed material cycle, but because in addition to cork and textiles, the shipping industry is very important to the portuguese economy. It is a multi-functional exhibit, visible from all parts of the park. It provides a 'how can I recycle everyday items in my environment' platform, by showcasing the dual uses of items as part of the ships interior fittings. As seen in the fig below, items such as broken tile can be made into mosaic table top, or old cupboard doors into, table tops, and old cooking pots into plant pots. Also since ships at sea must find creative solutions to deal with their waste, the exhibit provides the platform for people to view these systems directly. The ship also serves as a playground for children which is safe and has medium supervision. It is a learning platform for the children, since they can take the ideas they see in the ship and implement them at home.

The Learning Path

The learning path as seen in the figure on the right, is created within the park. It comprises three repeated stations, situated at points along the pathways.

Station 1 lets you virtually participate in the conversion of logs into timber by choosing the process and product. Interesting facts are imparted visually and verbally by the station.

Station 2 allows for either the planting or cutting of a user specified holograph tree. During the process, facts about trees and their CO2 contribution are made visible.

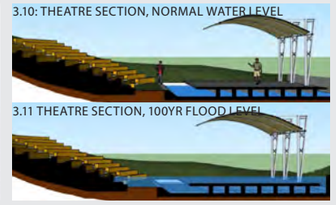
Station 3 is a journey through the making of paper pulp and paper. At the end of which samples of pulp are available for users to actually see and touch. Energy consumption figures are shown depending on the method and other criteria selected by the user.

The Learning Stations

The Open-air Puppet Theatre

This theatre has dual functionality: it educates the children about recycling of materials in a fun environment and also acts as a water catchment area for normal and the 100 year peak run-off. The seating is made with recycled concrete from the demolition of building B & C. The stage has recycled aggregates in the slab and the canvas cover overhead is supported by recycled steel elements.

3.9: VIEW OF THEATRE



3.10: THEATRE SECTION, NORMAL WATER LEVEL

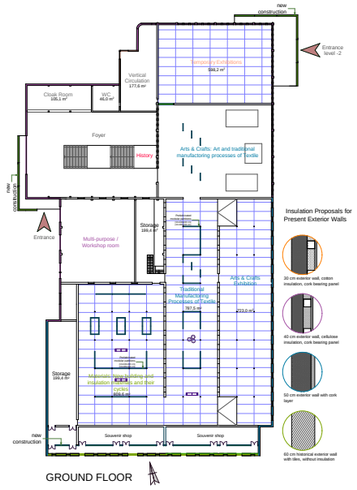
3.11 THEATRE SECTION, 100YR FLOOD LEVEL

3.12: SITE PLAN WITH THE LEARNING PATH

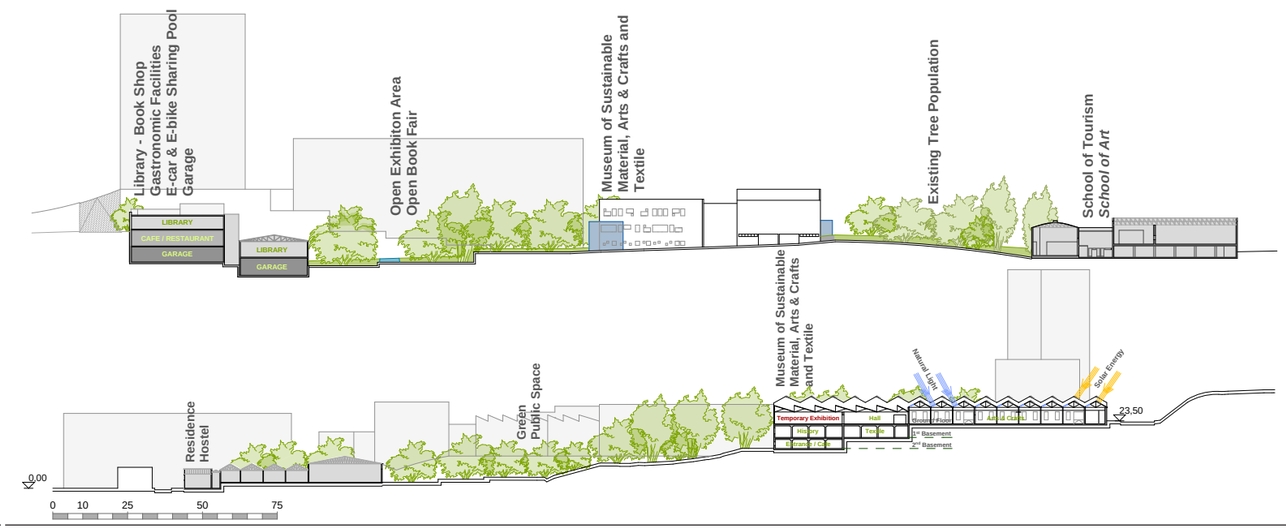
STATION 1: Convert tree to timber

STATION 2: Tree planting/cutting

STATION 3: Tree to Paper conversion



4.1: FUNCTIONAL SITE PLAN | GROUND FLOOR PLAN MUSEUM WITH DIFFERENT RESTORATION MEASURES



4.3: SECTIONS PROJECT AREA: NORTH/SOUTH - WEST/EAST SECTION THROUGH THE MUSEUM

Group 4

Cultural Intervention to a historical Site

Environment and Context

Following the motto „gentle intervention", the project deals with the old existing buildings and natural structures and tries to preserve the identity of the place to a wide extent. Of the four buildings, building A especially has a strong connection to the textile manufacturing, because it is still in use for textile storage. The area is not being maintained, so that wild plants cover much of the inner area of the site. Therefore the project deals with the greenery on site and the natural local conditions as well. Cuts and interventions in the built-up and the green area are done only in specific places, in order to highlight certain aspects, e.g. the connection between building A and D as well as the connection to surrounding buildings. The facade towards the Cultural Centre just next to the site defines the accesses to the place by "carving through" building D. Thus, an important feature of the design is the interaction with other places within the city centre. The topography of the place is dominant, reaching from a relatively high point down to the city centre. So the site can be seen as an opposing attraction to the castle on the other side of the city centre, embracing the cultural heart of Guimaraes.

In the context of mobility, there will also be a link to the city. The concept uses the good accessibility by buses and a regional train and improves alternative traffic means, e.g. bicycles which are rarely seen nowadays, because of the natural slopes. In this way the site plays an important role, as it offers the infrastructure for a bicycle tour through the city with electrical bikes as well as a car-sharing pool.

4.2: MAP OF THE TRANSPORTATION CONCEPT AND THE CULTURAL URBAN CONCTEX

Spatial structure

Because building A and D are especially worth maintaining, the design focuses on these buildings. While building D forms a kind of entrance building with access to the site (providing necessary space for parking and an innovative mobility system, as well as other facilities such as a cafe and a library) building A is transformed into a museum – a cultural highlight offering multifunctional workshop spaces. The focus lies on this museum building - the development of the internal museum concept as well as the development of the outer space. Building B could become a School of Tourism or Art so that the overall concept contributes to the topic of education as well. Out of building C, or instead of it, residential studio houses could be developed along the northern border of the plot, as the actual owner of the plot yearns for residential space.

Except for the identity as a textile manufacturing site, building A (around 6000m2/36.000m3) offers several advantages for museum use: it has several big halls, offering both room heights of about 6 meters and enormous distances. The roof consists of tilted shed lights, which are oriented to north and let natural daylight in. Additionally, it has some characteristics (facades) which are worth conserving, although it is an industrial building.

Social and cultural aspects

The overall concept for the site is to create a sustainable public space for inhabitants and visitors of Guimaraes. It is expected that many new visitors will be attracted in 2012, as there will be a series of events and cultural activities during the whole year (City of Guimaraes, 2012). Within the festival programme, the development of an open space and the refurbishment of the old buildings on site constitute an important contribution. In relation to the museum concept for building A, the whole site will be designed as an open exhibition space.

Thus the open space design offers attractions such as art pieces and fractions of the sustainability topic (e.g. reuse of deconstruction material as semi-permeable ground covering), creating recreation spaces for old and young. The aim is to hold events and create a space for social interaction and communication that fulfils its aims on a long term basis as well, not only during the cultural capital year. In addition to recreation, it is important to involve the people in the concept. Social sustainability is often ignored, but is one of the main aspects of a sustainability. So one of the social components is an awareness-raising campaign, which goes along with the exhibition concept. The sustainable treatment of waste and materials forms one main focus of this programme. Traditionally used materials and new materials should be experienced with all senses in the exhibition as well as outside in the landscape design.

material	locality	recyclability	embodied energy	costs [€/m2]	thermal conductivity (W/mK)	comments
cork	+++*	++	4,0		0,038	* especially for Portugal (due to the scarcity of cork, its price is relatively high in comparison to other materials
cellulose	++	+++	0,93-3,3	10,06	0,033	
wood fibre (loose board)	++	+	10,8-20,0			
sheep wool	++	+++*	20,9	5,98-11,94	0,037	* close-loop recycling
cotton insulation	++	++*		5,23-9,48	0,039	* made from old textile rest fractions
hemp fibre	++	+		5,23-9,48	0,039	
flax	++	++	39,5	5,52-9,48		
straw	++	+				
(expanded) polysterene		+*	88,6	3,14-6,28	0,038-0,033	* can be melted
rock/stone wool	+*	+	16,8	4,40-7,80	0,033-0,034	* possible recycling
cellular glass		+				
flexible melamine foam		---		37,71	0,035	
aerated glass		/				
polyurethane		++	72,1		0,023	
foil insulation		+			0,066	* typically recycled
glass wool		/	28,0		0,037-0,031	

4.4: MATERIALS CRITERIA AND RANKING

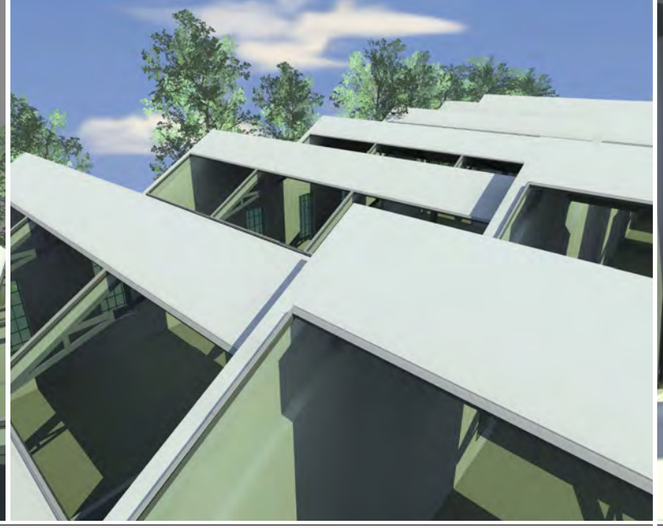
Another aspect will be the mobility features, with the development of the site reaching beyond its single spot. With a guided bicycle tour (about 4 km), it reaches into the city centre, and improves the options to go by bicycle for the citizens as well as tourists, especially in the hilly environment. Building D will provide e-bicycles and e-cars running with the surpluses of electricity produced on-site. In the stations, these e-bicycles have to be recharged for 4-6 hours to run 35 km (Samsung SDI, e-bike battery). The proximity of the car and bicycle station to the regional train station forms a good basis for a sustainable mobility concept.

Material concept

The main material concept relies primarily on maintaining and reusing existing buildings and nature wherever possible. Waste should be first reduced, then reused and then recycled. Since building B and C are in a bad condition, there will be tons of construction and demolition waste that can be recycled and reused on site, creating pavements, sculptures or gravel for the water management systems and the urban design in a creative way. A system of modular interior partition walls is designed to create a flexible exhibition concept. The advantages are that such a system can first be prefabricated and then reused so that it reduces waste.

The project strongly follows the aim to raise awareness regarding material cycles. So the idea of how to treat materials is not only shown in the exhibition, but also applied when retrofitting the museum building. Therefore an analysis of appropriate sustainable materials has been carried out, e.g. for insulation materials. Those materials have to fulfil several sustainable criteria: local production, recyclability and low embodied energy.

For different wall types cork, cellulose and cotton have been chosen (according to Green Public Procurement, 2010 and Passivhaus-Bauteilkatalog, 2008) so that u-values can be improved to a wide extent. Those "new materials" and their cycles make up an important part of the exhibition and a first step for the energy concept. The museum , dedicated to Sustainability, Arts and Crafts and Textile, will also show the history (with its traditional processes) and the identity of the site.



4.5. ROOF DESIGN WINDOWS ON THE NORTHERN ROOFS / PHOTOVOLTAIC PANELS ON THE SOUTHERN ROOFS OF BUILDING A

4.7: INTERIOR DESIGN: SUSTAINABLE MATERIALS EXHIBITION CONCEPT

Energy concept

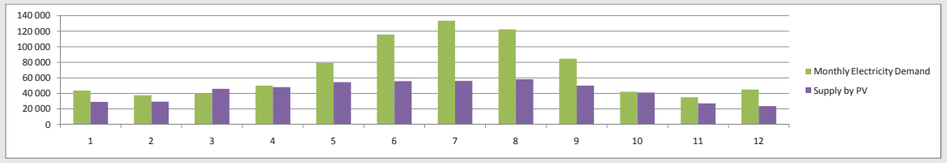
Thermal and electrical energy must be used efficiently, as resources are steadily decreasing. This can be done by using new technologies or by optimising the building using passive measures. The focus lies on a sustainable restoration approach integrating all material visions expressed before. As an example, the energy concept was calculated for building A. Its energy demand consists of thermal energy for heating and cooling and electrical energy for light and ventilation.

To optimise the energy demand and to develop the building towards a zero energy building, renewable energies such as photovoltaic or geothermal energy are introduced. A comparison between the simulated total energy demand (as electricity) and the estimated possible solar energy by PV considering non-shaded roof areas (global radiation on a horizontal surface of 1558 kWh/m2/a is quite high in Portugal) on an annual basis shows that the demand of the existing building is higher than the possible supply: 829 MWh/a > 649 MWh/a.

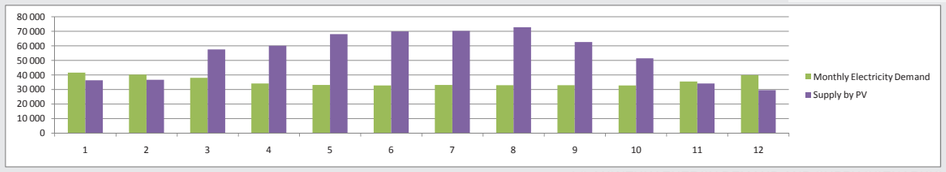
If an additional geothermal system is used to cover the demand of heating and cooling energy (calculated out of the daily peaks: 102 boreholes), only one third of the annual demand has to be covered by electricity to run the system. Thus 538 MWh/a < 649 MWh/a and can be covered by the renewable electricity on the annual basis.

But such a concept only works on an annual basis if summer surpluses can be fed into the electricity grid and if electrical energy can be taken in winter, when there is less solar radiation available. Such concepts are not yet developed in Portugal, so a self-sufficient situation should be developed. Therefore the solar radiation of all months has to cover the specific demand of this month, what would not be the case with the energy demand of the existing building, especially for the winter months.

Therefore the building is optimised according to measures explained in the section about climate protection. When applying the insulation materials mentioned, the energy demand for heating, cooling, light and ventilation is reduced by about 50%, using a geothermal system and PV: 427 MWh/a < 649 MWh/a. The daily peaks in the optimized version requiree about 13 boreholes. In this concept, the solar harvest is defined by the demand in the winter month. Therefore there is an enormous surplus of energy in summer (March - October) which can be used to recharge e-bikes and/or cars on site.



Monthly Electricity Demand		kWh/a												
heating	8 773	7 520	5 346	1 368	414	0	0	0	0	0	2 650	7 100	33 171
cooling	0	0	0	0	0	79	327	191	247	0	0	0	845
light	16 508	16 508	16 508	16 508	16 508	16 508	16 508	16 508	16 508	16 508	16 508	16 508	198 091
ventilation	16 286	16 286	16 286	16 286	16 286	16 286	16 286	16 286	16 286	16 286	16 286	16 286	195 429
sum	41 566	40 314	38 140	34 161	33 207	32 872	33 121	32 985	33 040	32 793	35 443	39 894	427 536 kWh/a



4.6: MONTHLY ENERGY DEMAND AND SUPPY SCENARIOS

4.8: MAP OF SITE DESIGN AND ITS CONNECTIONS

Water Sensitive Urban Design

One of the largest green spaces in Guimaraes is found on the site, allowing the opportunity to create public green areas in the city. Although some of the wild greenery is carved through to create access paths, most of the trees stay as-is and fauna and flora generally protected. To use the open space for bigger events, there have to be some sealed and semi permeable surfaces in the open space design. Nevertheless, infiltration of storm water has to be ensured, so that it would no longer be necessary to use a combined sewage system.

The average amount of precipitation in Guimaraes is 1515 mm annually (I.N.M.G.,1991). During rainfall events, the water will be guided through the topography of the site passing by infiltration swales, open trenches and little ponds to a retention pond on the lowest level in the north, where there is a controlled overflow into a little natural stream. Some of the storm water is also stored in the buildings to compensate fresh water for e.g. toilet flushing, especially for the residential houses.

Climate

To reduce emissions and save energy, the best solution is to use passive design rules to adapt buildings to the climate (in this case Csb acc. to Köppen classification, meaning a temperate, mesothermal climate). The electricity demand for daylight can be reduced by appropriate window sizes and placements; natural ventilation can cover most of the ventialtion needs. Required heating and cooling energy can be limited by e.g. internal gains or insulation layers. Therefore the basic data regarding solar radiation, sky cover range, wind velocities and directions and temperatures are of importance and have to be considered when planning. Obviously, those options are limited when dealing with existing buildings; nevertheless they are applied to a certain extent in the optimized simulation version.

The aim is to retrofit the buildings to a certain extent so that they function self-sufficiently over the year and, because of the climate, produce surplus f energy in summer.

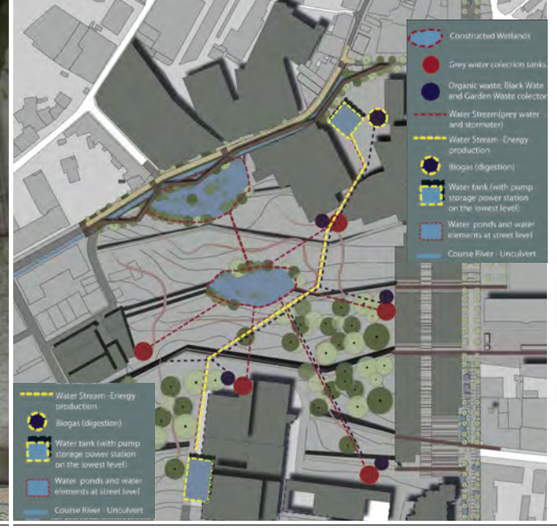
Comfort and Health

The project area is the largest green area in the city centre but it is like a ‘jungle’ that cannot be used as a public space. Our project proposal creates comfortable and nice public spaces by carving that green area like a sculpture without ruining the trees as much as possible. Moreover, natural materials containing no hazardous substances are proposed for the retrofit of the buildings, and the buildings are re-designed to have a more accessible, lighted and environment-friendly urban area.

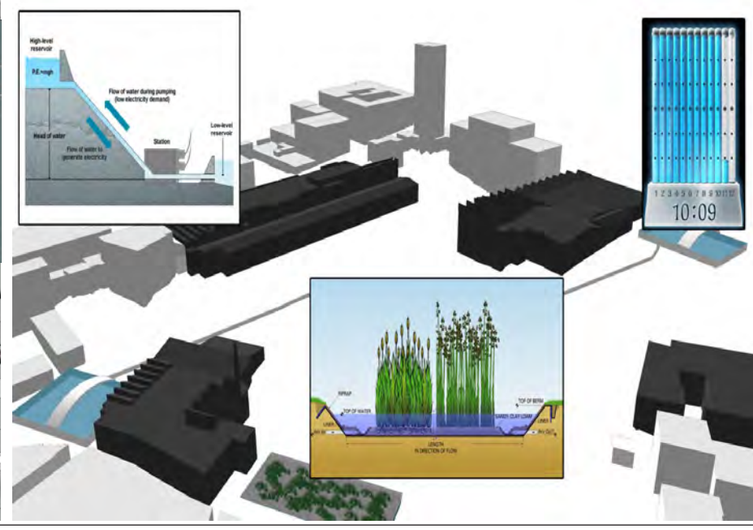
Development potential

The focus of the project was sustainable urban development with a focus on energy and material concepts. Low-waste construction and renovation processes were shown to have a closed material cycle and cause less harm to the environment. However, the common practices of states and user behaviour are the most important factors that can lead to an overall sustainable development. Therefore, awareness raising campaigns for the society and state policies should be developed in parallel with the environmental concerns.

5.1:AVENIDA DOM ALFONSO HENRIQUE



5.2:WATER & ENERGY DIAGRAM



5.3:WATER & ENERGY: PROPOSED FEATURES

Group 5

Water-Energy-Link: A showcase project

Project area as signal Gateway to Guimaraes

The project approach aims to regenerate a derelict area as the southern city gateway to Guimaraes by developing the site with appropriate mixed uses and encouraging permeability through the site. The area contains many structures of historical significance, such as industrial buildings and the green park in the center . These were all to be enhanced and brought back into use.

The proposal creates new routes and enhances existing floor patterns at an urban design level, while providing significant architectural and landscape features which will attract new life into the area.

MORPHOLOGY DIAGRAM

In developing the project concept, initially the most appropriate uses were considered to give a clear character of the spaces within and around the site. The morphology diagram identifies three major uses in the area such as cultural, residential and services and office and landscape use. These uses are to be enhanced by the street design. In this context, three major types of streets were identified: The Green Belt enhancing the cultural and leisure use in the area, The Blue Belt consolidating the office and landscape use, and the Red Belt backing up the commercial and services use in the residential area.

By developing new mixed-uses in the existing industrial areas and connecting them with the new urban design features on the street, the project area is to become a vibrant arterial link within Guimaraes, directing visitors intuitively from the station to the inner city. In the same time, the area will be developed considering the lowest possible impact on the urban environment while helping to reinstate a sense of community and connection to nature by creating a closed, compact system which condenses the place where you live, work and play.

Healthy, supportive,diverse and sustaining relationship between natural and man-made space

Concerning the environmental aspects, the project inspires delight and expresses human design symbiotic with nature. The Guimaraes southern city gate seeks to be a life support system in harmony with energy and water flows, human experinces and other living things.

This is to be achieved by street and green area design features which harvest the energy of the sun, sequester greenhouse gases, harvest and distill water, transform waste water to enegy, and provide habitat.

CONCEPT DIAGRAM

Water Concept

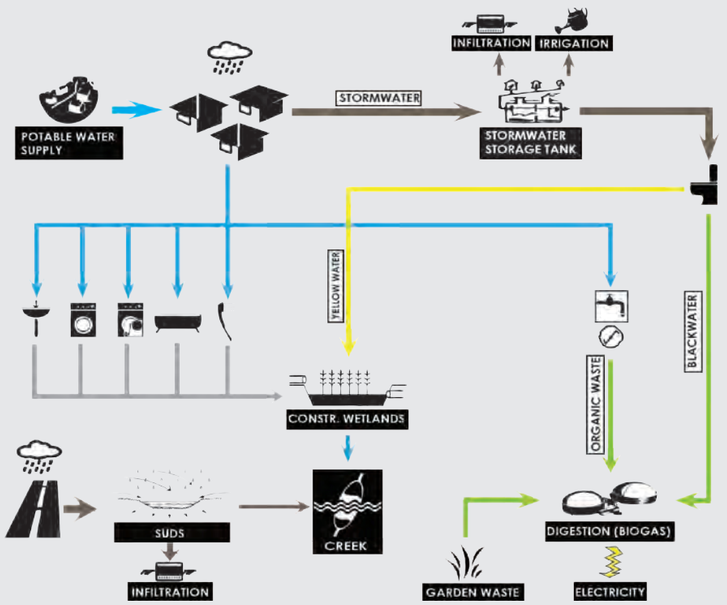
Regarding stormwater, the slope of the site suggests to reduce and retend runoff. The resulting water concept involves rooftop rainwater harvesting on-site, and sustainable urban drainage features in the redesigned streetscape to retend and infiltrate street runoff.

The harvested stormwater is used for toilet flushing. Yellowwater and greywater from the buildings is channeled to constructed wetlands situated in the northern, lower part of the site and eventually discharged into the creek. Blackwater and organic waste from kitchen sink grinders is directed to a small biogas plant. Since most areas on-site are unsealed, some stormwater infiltrates the soil. Excess stormwater from street runoff is also eventually discharged into the creek.

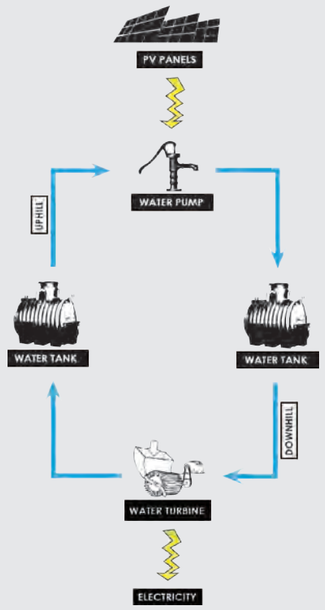
Energy Concept

The underlying principle of the energy concept is to showcase the integration of water and energy aspects. It consists of two parts: a small-scale biogas digestion plant run by blackwater and organic waste, and a pump-storage hydroelectric plant which stores electricity from PV panels on the on-site buildings.

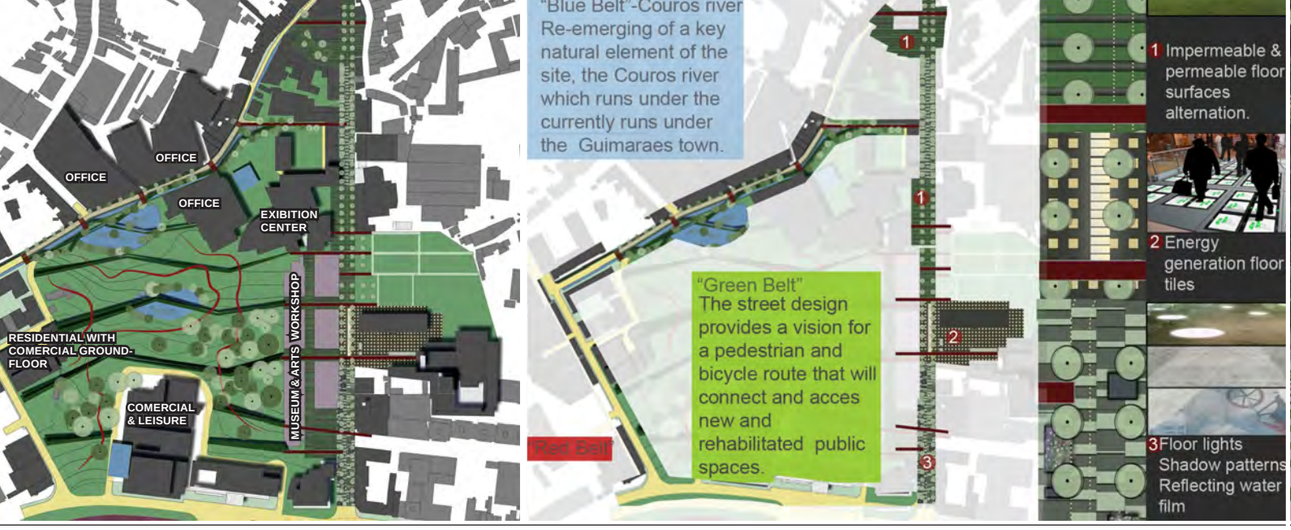
The potential PV production vastly exceeds - on an annual basis - the on-site consumption. Along with the topography of the site, this enables the installation of a pumped-storage hydroelectric plant, serving as a showcase facility for the balancing of fluctuating renewable energy production. With two 3.000.000 L storage tanks in the southern and the northern area (height difference of 30m) and a pump-generator, 212 kWh can be produced over a period of 5h, while 231 kWh are initially required.



WATER CYCLE DIAGRAM



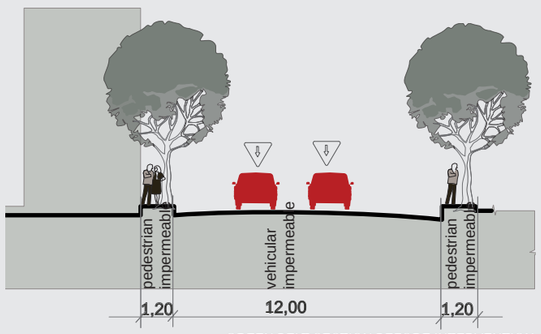
ENERGY PRODUCTION DIAGRAM



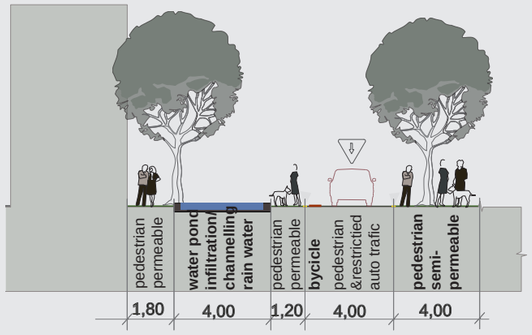
5.4:STREETS DESIGN -GREEN AND BLUE BELT

5.5:AVENIDA DOM ALFONSO HENRIQUE VIEW

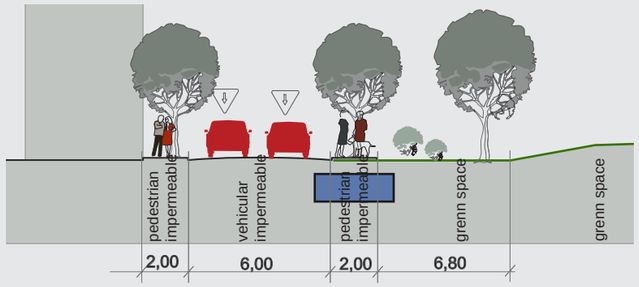
Green connectivity



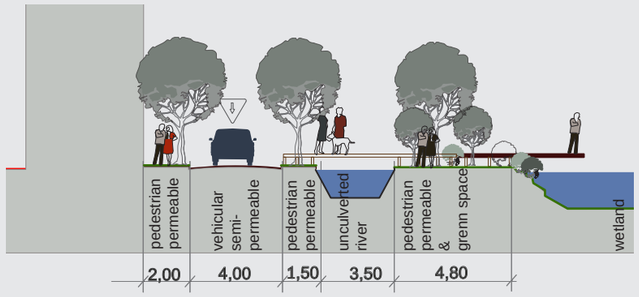
GREEN BELT SECTION BEFORE INTERVENTION



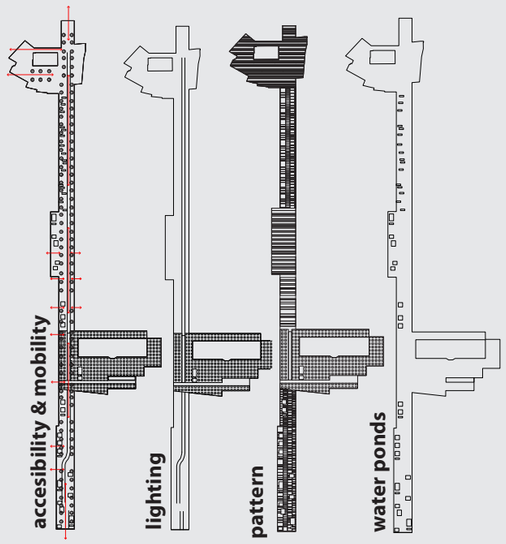
GREEN BELT SECTION AFTER INTERVENTION



BLUE BELT SECTION BEFORE INTERVENTION



BLUE BELT SECTION AFTER INTERVENTION



GREEN BELT DESIGN -CONCEPT DIAGRAM

Visibility of Sustainability

Street design

The Guimaraes southern city gate is a typical transit space to the city center. Everyone moves from A to B - but can it be more?

The streets on the site form a network arround the vast, diverse green area by the Guimaraes main train station. Landmarks for culture, buissness and recreation are positioned as attractive nodes between them.

Green Belt - Avenida Dom Alfonso Henriques

In terms of city level accesibility Avenida Dom Alfonso is one of the main streets on the site providing direct acces from the main train station (city entering point) to the historical city center (main attraction point).

The street character was changed from mixed use (auto and pedestrian) to pedestrian use with limited acces for auto trafic (only for delivery service and residents). The street design provides a vision for a pedestrian and bicycle route that will connect and acces new and rehabilitated public spaces such as the existing cultural center and further existing public institutions as well as a proposed museum, cafés and restaurants.

Permeable (grass surfaces) and impermeable spaces (granite floor) merge into each other giving dynamic to the street layout. The street floor is punctuated with water elements which collect stormwater, partly infiltrating it to the soil and channeling excess water to the creek. Varying water levels leave an impression of constant change and serve as an eyecatcher. Street lighting shows the movement flows direction and also indicates the area that can be crossed by auto traffic. The street lighting in the cultural space plaza consisting from energy generation floor tiles gives life to the area in the evening or night.

The various design elements in the street layout combined give sustainability a human face.

Blue Belt - Rua da Caldeiroa

The key design feature of the Blue Belt was re-emerging the natural element of the street, Couros river, which was culverted and runs under the Guimaraes city. Making the Couros river visible along the street reinforces pedestrian activity in conjunction with the constructed wetlands by providing an inviting environment.

Park as a living system

In the Guimaraes park the existing value of the landscape is the actual attraction. The quality of the landscape is therefore preserved and enhanced. Only soft interventions in terms of re-creating pathways and cleaning the undergrowth are performed. The park becomes a living organism in the city, a place where interaction of matters are made visible: rain water is collected in detention ponds and with varying water levels the experience of the park is constantly changing. Timber made bridges (constructed with local materials) are crossing the park and small local plazas, resting areas are placed freely like islands floating on the undulating surfaces.

Only finding efficient solutions to functional problems is not the final demand on actual urban design appraoch. The demand for unique and sensuous experiences remains at the core strategy of the project. The project's simple goal is to maximise the green amenities in the green area in the middle of the site, transforming it into a big urban garden accessible and visible from everywhere, and giving the buildings which surround it a green skyline. From the upper level one can enjoy the view of a lush and beautiful landscape, teraces and water features. At the upper level, the sensous exploration of the green area starts with the water collection tank which is made visible within the new building design. Part of the water basin is designed to be transparent, showing the water level growing and declining as an easilly perceptable display meter for the stored electricity. The next big attraction is represented by the constructed wetlands which collect and purify waste water from the sourounding buildings. The last water attraction point of the flow of water design spaces is the Couros river which is now made visible along the street by unculverting, reinforcing the desired land use in the area.

Summary and Outlook

As presented in this booklet, five groups from third semester REAP Master's programme students proposed different measures in the old industrial urban space in Guimaraes to reach sustainable development. The analysis phase on material, noise, water and energy set the initial objectives of the proposals. Even though the methodology had variations in each proposal, they were generated to achieve stable and successful solutions to ensure sustainability in this unique urban green space of Guimaraes.

Sustainable Regeneration

All of the five groups developed strategies to ensure stable sustainable growth. In each case, the focus area or topic was different but the main goal was the same.

The majority of the project area was composed of a green space, which was more like a 'jungle' instead of urban greenery. All of the proposals took advantage of these already existing green elements. Green open space design was integrated with other sustainability measures. Decentralized rainwater management could be handled in the project site with increased natural infiltration. Also, proposals to make this greenery a public space are developed. For example, urban farming areas, Botanical Park or open sustainable material exhibition spaces were able to be introduced.

There were mainly two different approaches to handle with the existing industrial buildings on site. First approach was to keep the buildings as much as possible and to retrofit them to ensure energy savings. The second approach was to demolish the buildings which are in a bad condition and reuse r recycle these materials to for retrofitting the old buildings or building new ones. Either way, it was tried to provide sustainable material and water cycles. Integration of green roofs, electrical energy production by solar panels, utilization of local building materials, implementation of energy-efficiency measures were also the common features of the proposals.

Guimaraes, European Capital of Culture 2012

Guimaraes, being the European Capital of Culture in 2012 shaped the outcomes in a positive way. Public participation through cultural events, workshops and campaigns were encouraged. By the same token, in each proposal, there was an attempt to integrate people to the redevelopment project by means of education and awareness rising programs. Likewise, all the proposals dealt with visibility of sustainability, which can also facilitate behavioral changes, improving the site quality in long term. In addition to the European Capital of Culture organizations, many activities and events were offered in the project site. It is important to provide persistence in those activities, especially after the year 2012.

Outlook

The project site is unique greenery with a high potential to be transformed into a green open public space. It is in proximity with public transportation stations and cultural centers. The outcomes presented in this booklet, represents five different views to utilize these potentials; they may not be viewed as either the best or the worst. Nevertheless, it is our view that urban regeneration projects should exhibit best applicable measures to provide cities of tomorrow for the next generations.

In order to assure a sustainable development, a holistic approach is needed considering all aspects. Progress in the national strategy is also needed for this achievement. In case of Portugal, energy and waste management policies should be improved by sustainability and efficiency measures, striving for the best practice in urban scale.

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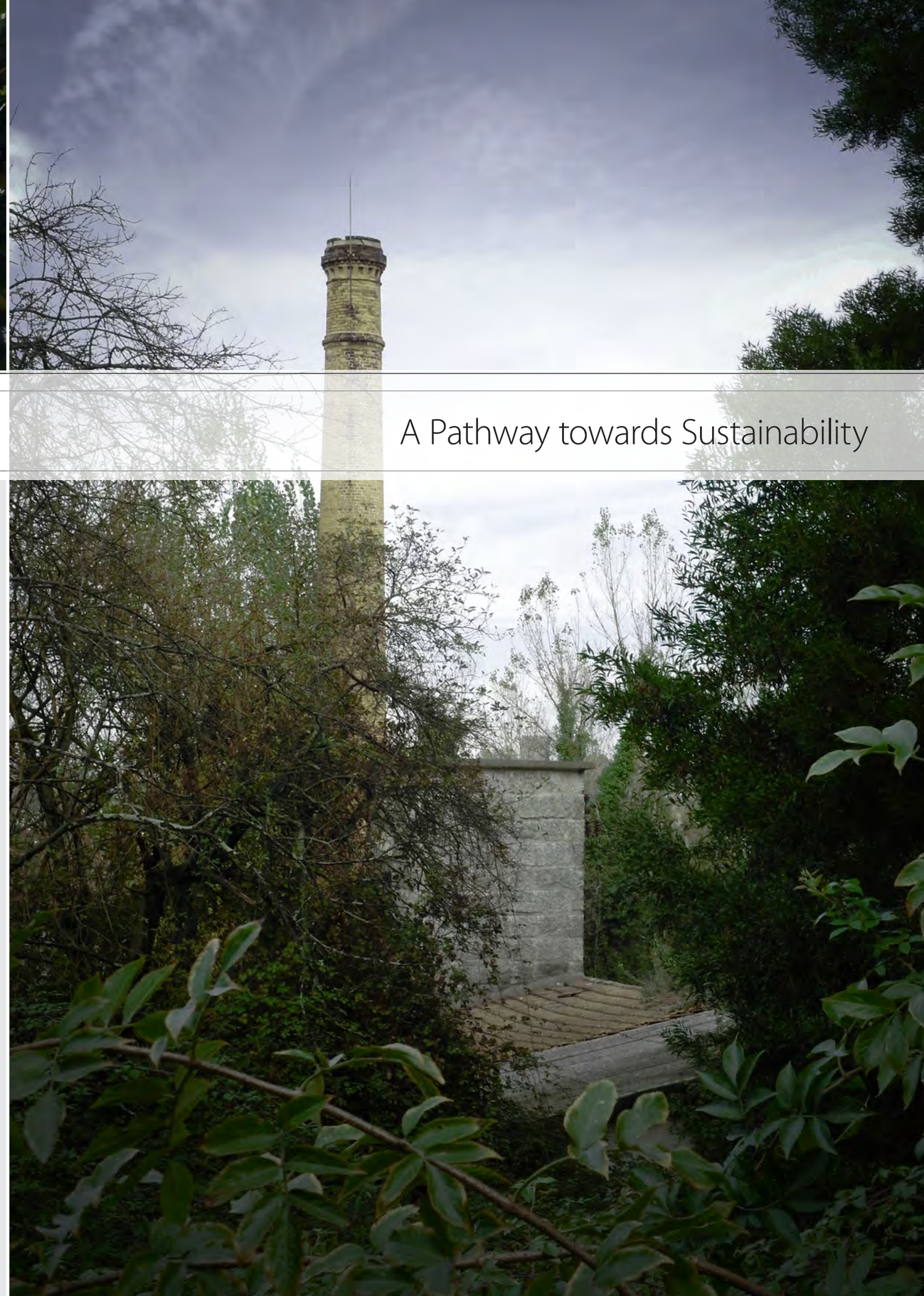

A Pathway towards Sustainability

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