PROGETTO MANIFATTURA

GREEN INNOVATION FACTORY

ARUP + KANSO + KKAA / CRA

ROVERETO, GIUGNO 2010

ABRIDGED VERSION

ARUP · KANSO · KKAA KENGO KUMA & ASSOCIATES · carlorattiassociati walter nicolino carlo ratti

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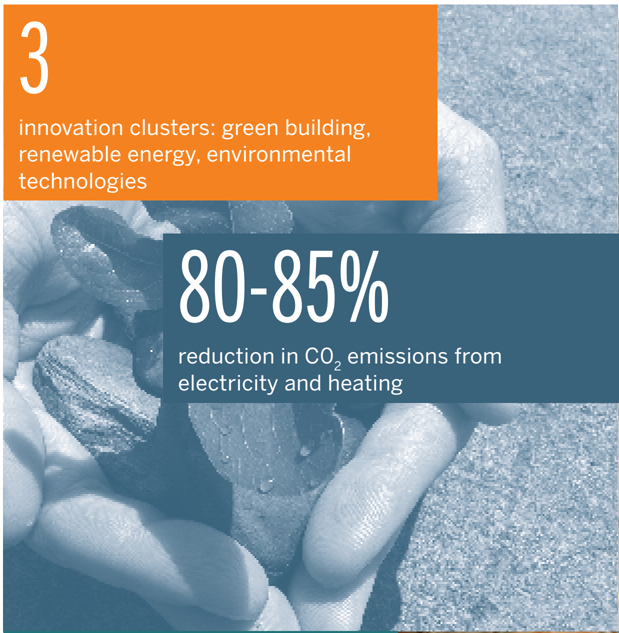
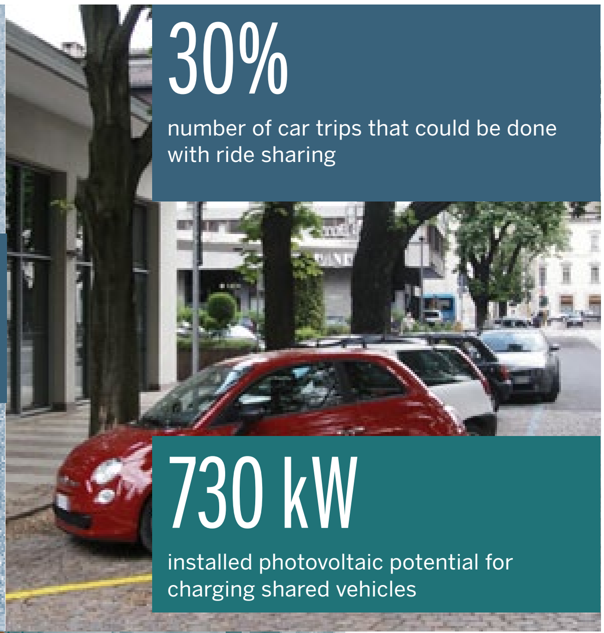


3

innovation clusters: green building, renewable energy, environmental technologies

80-85%

reduction in CO_2 emissions from electricity and heating

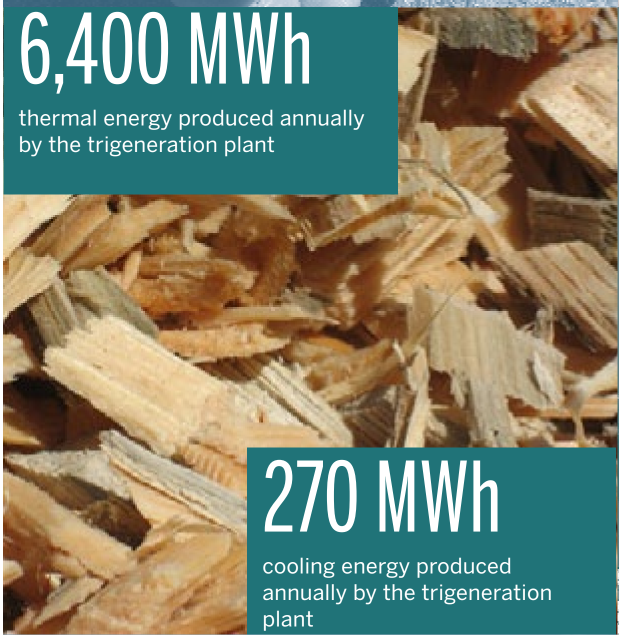


30%

number of car trips that could be done with ride sharing

730 kW

installed photovoltaic potential for charging shared vehicles



6,400 MWh

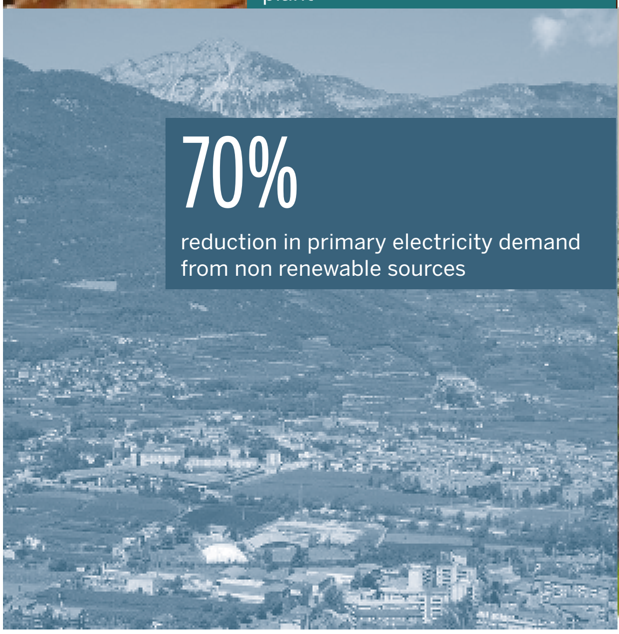
thermal energy produced annually by the trigeneration plant

270 MWh

cooling energy produced annually by the trigeneration plant

1,500 m^2

indoor exposition space

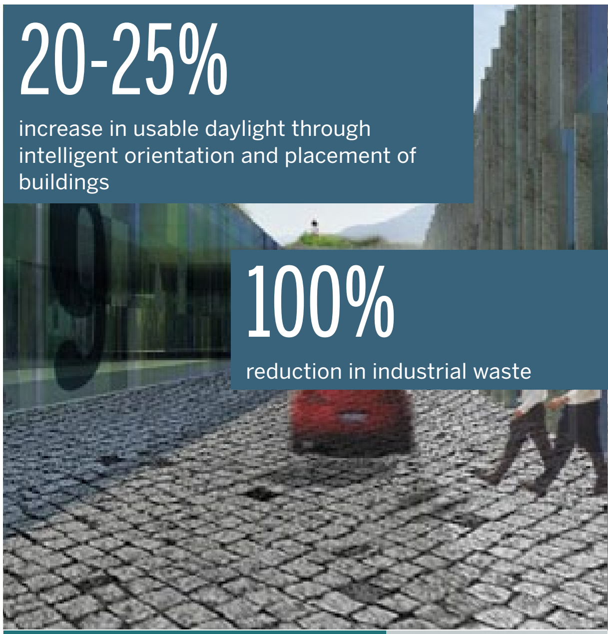


70%

reduction in primary electricity demand from non renewable sources

3

new public plazas

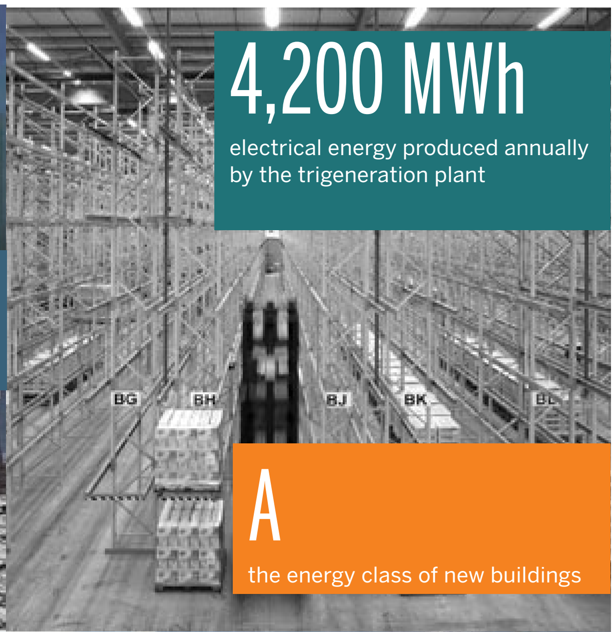


20-25%

increase in usable daylight through intelligent orientation and placement of buildings

100%

reduction in industrial waste



4,200 MWh

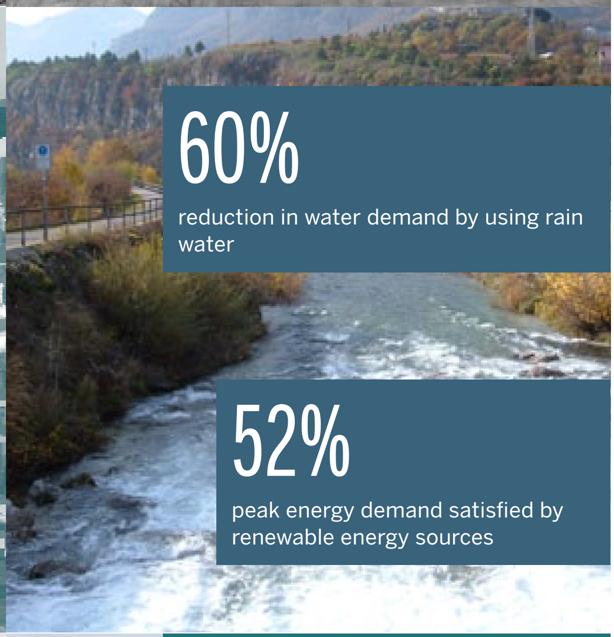
electrical energy produced annually by the trigeneration plant

A

the energy class of new buildings

700 m²

multimedia wall



60%

reduction in water demand by using rain water

52%

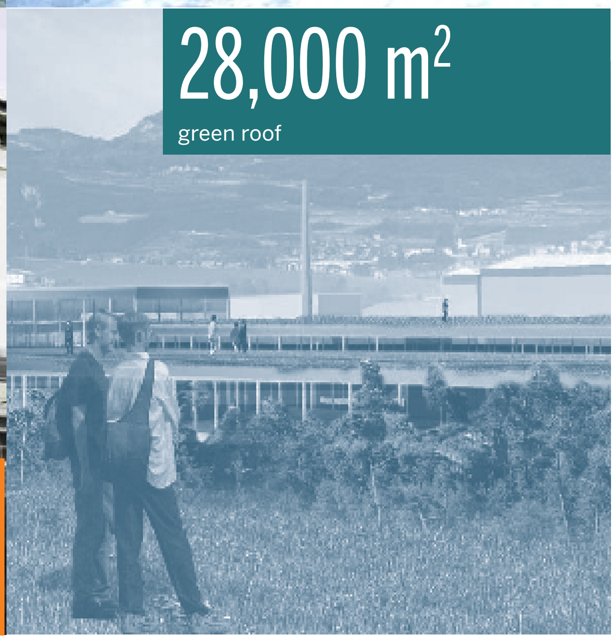
peak energy demand satisfied by renewable energy sources

70%

area allocated to offices, production spaces and services

C/D

the energy class of historic buildings after remodeling



28,000 m²

green roof

Introduction by Gianluca Salvatori

There was once a time when factories were built like monuments, solid and designed to last. The type of architecture and materials employed conveyed a message just as important as the manufacturing processes inside. Factories were constructed on the principle of robustness as a potent demonstration of a commitment to durability, and as a way of conveying a sense of stability on which societies could progress. This was a time when it was a common belief that human progress was inevitable, and moving on an upward, secure path.

Manifattura Tabacchi, located in Borgo Sacco, on the outskirts of Rovereto, was founded by the Austro-Hungarian Empire in response to an economic crisis arising from the decline in the silk production sector and the loss of income from river transport to the new railroad. The Government in Vienna wished to send a signal of its intention and of the power of its public administration to combat economic and social hardship in a territory located on the periphery of the Empire. The Empire's political and economic hegemony was coming to a close and the dark clouds of future turmoil were just over the horizon.

Manifattura Tabacchi symbolizes both the upheavals in and improvements to work and living conditions that these transformations brought. It is the portrait of the industrialization of a fundamentally rural society, the modernization of agricultural practices, the search for solutions that could stem the flow of emigration, the introduction of innovative manufacturing technologies, the creation of employment for women, and the early development of the working class.

In spite of 150 years of radical changes affecting both individuals and families, the outbreak of two world wars, the transfer of Trentino from Austria to Italy, changes in regimes, and a succession of industrial revolutions, Manifattura Tabacchi survived and consolidated its position within the community at large, creating jobs, generating prosperity, altering roles within the family and even re-modelling the landscape. It also saw the dawn of a new age in which the concept of "factory" underwent a fundamental transformation, becoming more like a nomad's campsite, tents to be pitched and then moved to another location according to market and consumer demand.

After producing for one and a half centuries, Manifattura Tabacchi was on its knees, about to suffer the same fate as the majority of other local manufacturing giants that closed production: conversion into museums, university campuses, exhibition centres, and other kinds of redevelopment.

From the last throes of economic decline arose "Progetto Manifattura", an initiative promoted by the autonomous Province of Trento and strongly supported by the Municipality of Rovereto, business and trade associations, research bodies, and public opinion. They share the view that a site dedicated for so long a time to providing jobs must not lose its identity.

Manifattura Tabacchi, an icon of traditional industry, will be transformed into a new kind of "factory" that integrates skilled processes such as research, design, and production, and that offers a new paradigm for economic growth over the next decades. The project's guiding principles are predicated on finding concrete solutions to the need to produce quality products at accessible prices, but that consume far fewer resources, especially non-renewable ones.

The objective of Progetto Manifattura is to create an environment in which it is natural to experiment, create and embed knowledge and innovative practices. Environmental sustainability is a theme that is increasingly a focal point in economic and social spheres. New technologies and enterprises that provide innovative solutions for using energy and natural resources more efficiently are being created daily around the world. Powerhouse industrial economies such as the USA and China are competing to ensure themselves a future in this sector. It is self-evident that if it did not invest in one of the principal engines of growth over the coming decades, Trentino would become increasingly isolated.

Progetto Manifattura is a logical extension of the commitments made in Trentino—witnessed by the foundation of Habitech, an technological cluster specializing in renewable energy—to green building, environmental management technologies, sector specialization, skill and knowledge development, as well as to building the area's reputation for excellence.

The aim of the new "factory" is to create a context for promoting the development of an ecosystem of diverse actors, a symbiosis of enterprises and skilled professionals in environmental sustainability working together to create products and services that meet the requirements of a changed world—transformed in demographics, economics and the social sphere—that necessitates more responsible use of energy and natural resources.

The re-birth of the factory will not be the result of a single action taken by a single entity, but the work of businesses, research bodies, and training centers inspired by a common vision. Together, they will move forward a on common program platform, pursuing shared objectives in an environment designed to promote collaboration, favor innovation and propagate both individual and collective opportunities for growth. To achieve this aim, Progetto Manifattura will employ two-way communication processes between the internal ecosystem and the outside world that will stimulate innovation through dialogue.

An international working group made up of Kengo Kuma and associates, Carlo Ratti Associati, Arup and Kanso took on the task of developing the Master Plan. Working in extraordinary synergy, the team employed its expertise in fields such as macro and micro economic analysis, design of technology and energy systems, and architectural and urban design to achieve the highest standards in sustainability and reach other project goals. The team's mission was to develop a vision and define guidelines for future actions that will involve the cooperative efforts of multiple entities, require the highest skills of a talented work force, and moreover, raise awareness in the local community of the benefits of regenerating a historic factory to take on a fundamentally new role.

The master plan is the conclusion of the first phase of a project that fuses the aims of designing a variety of environments to house actors in innovation and of physically promoting open innovation processes. These objectives will be implemented in successive phases as the project moves step-by-step toward the birth of a new Manifattura.

Gianluca Salvatori

President
Manifattura Domani

Forward by Kengo Kuma

We still haven't invented the right kind of spaces for a new model of working and producing.

What we call an "office" was once just a room furnished with a desk inside a residence. Hense the office was born from a small operational part of the fundamental unit of all architecture: the home. In the 20th century, the office escaped the home, becoming a fundamental unit of the city.

The prosperity of the last century was founded on urban centres consisting of enormous "boxes", office buildings crammed people labouring at their desks in the name of efficiency. You could say that human beings were stuffed like chickens into an overcrowded coop. Mies van der Rohe was the architect of these human coops, designing beautiful glass office buildings, which were, nevertheless, still chicken coops.

Now we're looking for a way to escape the confines of these suffocating coops.

We have developed the communication technologies that will let us escape. And if we don't get out, we know our minds and bodies, and the world as whole, will inevitably deteriorate.

We're not quite sure how we should live, but the new Manifattura is starting to outline the post-box era. The project will show the world an alternative to the chicken coop, where history and advanced technology work together, the "boxes" have been dismantled, and people and the natural environment coexist in harmony.

We don't have to call what comes out of this process architecture. In this place you find people. They start up a conversation. And after a while they discover a new relationship with nature.

Kengo Kuma

Architect
Rovereto, June 2010

The Company

Manifattura domani was established in April 2009 by the autonomous Province of Trento. It's mission is to redevelop a historic tobacco plant into a green technology cluster. The goal is to create a production system of environmental sustainability and clean technologies. The factory, located in Rovereto, is well positioned for doing business in north Italy. However, the intention is to serve Europe in general.

The new "factory" will host and serve small and medium sized enterprises which make up the base of Italy's economic fabric. It will also act as a conduit for doing business with companies around the world.

To reach its goals, Manifattura domani is redeveloping a historic tobacco plant into:

- A production cluster that will conduct research, train professionals, provide technical assistance, and offer networking opportunities.
- An innovation space for designing and engineering buildings, developing heating and cooling systems, producing and distributing energy, and providing solutions for the environment.

Design team

ARUP

As far back as the 1960s, company founder Ove Arup developed an innovative design philosophy based on a multidisciplinary approach and on respect for the environment: "A team capable of achieving a balanced and efficient design contributes to the creation of a better environment".

Over subsequent decades, the firm consolidated its experience in the design of high-quality buildings, with an increasing focus on boosting efficiency and reducing environmental impact.

The firm has over 10,000 staff based in 86 offices in 37 countries, with over 10,000 projects running concurrently. Arup was established in Italy in 2000 in response to an ever-increasing demand for specialist technical consultancy and the number of complex projects being developed in partnership with Italian architects.

TEAM

Alejandro Gutierrez, Florence Collier, Angelo Mussi, Joan Ko, Francesco Petrella, Martin Reed, Andres Luque, Andrea Fernandez, Daniela Delfino, Nico De Santis, Camilla Bevilacqua, Gianluigi Maiorino, Salvatore Settecasi, Chris Burgess, Tiziana Correddu, Lorenzo Allievi. Riccardo Zara.

KANSO

Kanso (a Japanese word that means "essentiality") is a consultancy company based in Rome and focused on innovation and customer experience.

The mission of Kanso is to assist companies, public and private institutions in the development of new products and services, in the improvement of their organizational effectiveness, identifying strategies and setting up strategies that satisfy the customer.

Kanso has extended analysis and research tools beyond the boundaries of traditional consulting practice (economic context analysis, benchmarking, business planning, management models, etc.) to fields like design, human sciences and market research.

Kanso also has a specific expertise in new technologies and in their use as enablers and driving forces for economic, productivity and tourism that strengthen territories.

Kanso works for leading national and international companies and institutions on innovation, development of territories, marketing, business planning, and new business models issues.

TEAM

The Kanso team working on the Progetto Manifattura is coordinated by Andrea Granelli and Stefano Santini (founders and partners of the company) and is composed by Caterina Cittadini and Roberto Pone (senior consultants with specific expertise on the project topics).

KKAA KENGO KUMA & ASSOCIATES

Kengo Kuma was born in 1954. He completed his master's degree at the University of Tokyo in 1979. From 1985 to 1986, he studied at Columbia University as Visiting Scholar. He established Kengo Kuma & Associates in 1990. He taught at Keio University from 2001 to 2008, University of Illinois at Urbana-Champaign in 2008, and in 2009, he became a professor at the Graduate School of Architecture, University of Tokyo.

Among Kuma's major works are Kirosan Observatory (1995), Water/Glass (1995, received AIA Benedictus Award), Stage in Forest, Toyoma Center for Performance Arts (received 1997 Architectural Institute of Japan Annual Award), Stone Museum (received International Stone Architecture Award 2001), Bato-machi Hiroshige Museum (received The Murano Prize). Recent works include Great Bamboo Wall (2002, Beijing, China), Nagasaki Prefectural Museum (2005, Nagasaki) and the Suntory Museum of Art (2007, Tokyo). A number of large projects are now going on in Europe and China, including an arts centre in Besançon City, France, and a development of the Sanlitun District in Beijing, China.

He was awarded the International Spirit of Nature Wood Architecture Award in 2002 (Finland), International Architecture Awards for the Best New Global Design for "Chokkura Plaza and Shelter" in 2007, and Energy Performance + Architectutre Award in 2008

(France), and in 2009, he was given the title d'Officier dans l'Ordre des Arts et des Lettres, from the French Government. Kengo Kuma is also a prolific writer and his books have been translated into English, Chinese and other languages.

TEAM

Roberto Aparicio, Yuki Ikeguchi, Kengo Kuma, Maurizio Mucciola, Georgina Lalli, Ioanna Angelidou.

CARLO RATTI E ASSOCIATI WALTER NICOLINO | CARLO RATTI

carlorattiassociati – walter nicolino & carlo ratti is rapidly-growing architectural practice that was established in the summer of 2002 in Torino, Italy. It consists of two partners and numerous staff. Strongly connected with Carlo Ratti's research at the Massachusetts Institute of Technology, the firm makes the encounter between digital technology and architecture one of its principal focal points.

Its work has been featured at numerous exhibitions, including the Venice Architecture Biennale in 2004, the "Compendium Exhibition" at the Royal Institute of British Architects in London and "Beyond Media," the festival of digital architecture in Florence. In 2006, an exhibition at the MIT Museum brought together the researches, often interconnected, carried out by the design group from Turin and by the SENSEable City Lab directed by Carlo Ratti at the MIT.

The firm's projects were selected by many leading publications worldwide, including the New York Times, Financial Times, Time Magazine, The Boston Globe, Der Spiegel, Discovery Channel, BBC, Domus, Casabella and Abitare.

Among the most recent projects are a number of international architectural projects including: the redevelopment project of "Manifattura Tabacchi", an extension of the headquarters of the luxury fashion house Trussardi in the center of Milan, Italy; 1000 sustainable units for the coastal community in Sri Lanka; a Digital Water Pavilion at the entrance of the 2008 World Expo in Zaragoza, Spain - hailed by Time Magazine as one of the 'Best projects of 2007'. In 2009 the firm, together with an international team of artists and designers, was shortlisted with The Cloud project in the competition for the symbol of the Olympic Games in London 2012. In 2010, the studio was selected to participate in the Venice Biennale of Architecture.

TEAM

Samuel Colle Dominguez Maldonado, Giovanni de Niederhausern, Alberto Bottero, Andrea Cassi, Filipa Carvalho, Alex Haw, Walter Nicolino and Carlo Ratti.

Photos: Olivier Philippe, Agence Ter.

The Process

The master plan for the new Manifattura is the work of an international design team. They were asked to design the spaces for a new kind of factory focused on innovation and sustainability. The process began in fall 2009 and finished in spring 2010.

To get input in defining how the space would be used, the designers and Manifattura domani applied a participative design approach. Input came from potential occupants of the new factory, including companies, research centers, public institutions, and interested citizens. A steering committee comprised of many parties with a direct interest in the project followed developments in the planning. To keep people informed about developments and to collect suggestions and proposals, three public meetings (November 25, 2009 - March 17, 2010 - April 24, 2010) were held and numerous contacts made with the different private and public sector groups. The website www.manifactor.it documented the phases of the process.

In parallel with the urban and architectural design, and with the support of the consulting team Kanso, Manifattura domani identified the types of companies that would be a good match for the project. A series of meetings and presentations identified a core team of players who will become the first occupants of the new Manifattura. At the same time, Manifattura domani devised a strategy to raise awareness and market the project to a range of companies with potential interest in participating.

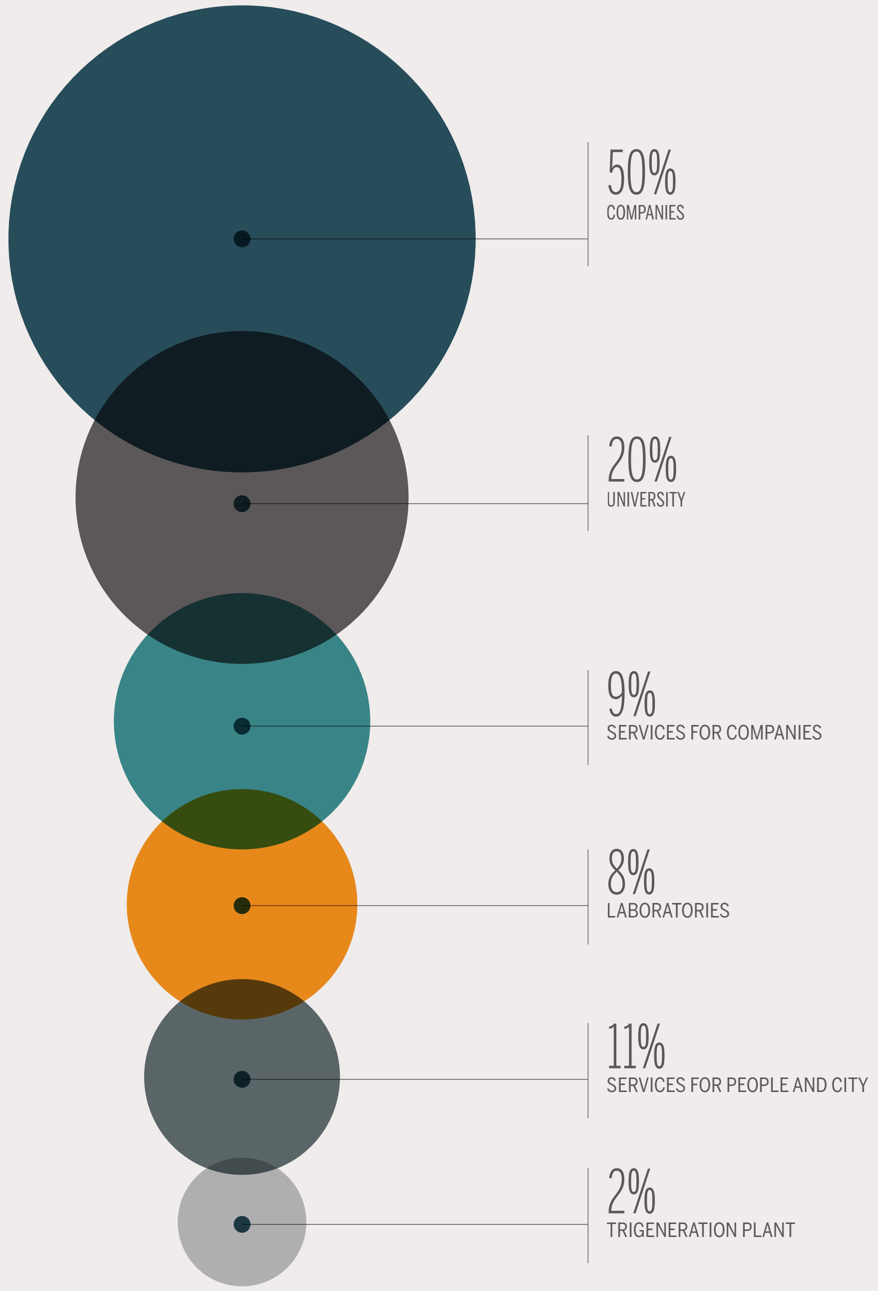
With the autonomous Province of Trento, Manifattura domani defined a public investment plan to redevelop the site and get it running. The estimated resources will total about 110 million euros over a 10-year period and will come from national and provincial sources. A return on the investment is expected from the economic development of the site, the increase of the property's value, as well as from rents and services from participating companies and other users of the project's services.

The master plan provides a vision and guidelines for the development of the site. However, in-depth analysis in later phases may lead to adaptations. Following approval of the master plan, 10 years of work will commence that will restore and restructure existing buildings, and create new structures. Gradually, more and more space will become available for companies and services, although some will be ready as early as 2010.

Manifattura domani is a small development company which operates with the technical and administrative support of Trentino Sviluppo, the province's economic development agency.

1

ECONOMIC CONSIDERATIONS



* The University of Trento will participate with many initiatives, but the largest participant will be **CIMEC**, the Center for Mind/Brain Sciences.

Figure 1.1 - Planned use of space

1.1 Methodology and process

Kanso was tasked with studying how to turn Progetto Manifattura into a growth engine that takes into consideration global economic opportunities and local capabilities. This resulted in a functional model for the project which defined the business focus and the optimal mix of participants.

The company was also asked to assist Manifattura domani in identifying and selecting companies interested in locating at the Manifattura site as well as help in overall promotion of the project.

The process integrated management and design capabilities with active participation of local stakeholders. This bottom-up approach assured that institutional and business leadership was involved. The project benefited from the inclusion of their perceptions, needs, vision, and knowledge, creating a project that is founded on the expectations of the stakeholders.

1.2 Landscape for a green economy

From 2005-2008, the autonomous Province of Trento experienced a growth rate in GDP higher than the national average. The province is acting to make sure this growth scenario continues.

Although characterized in general by rather fragmented business sectors, Trentino is actively trying to create critical mass in its second largest industrial sector, construction (about 20% of GDP).

Along this line, Progetto Manifattura's mission is designed to reinforce specific sectors such as energy and construction.

In 2007, the province created Habitech, the green building and energy technology district. In 2010, Green Building Council Italy became the official LEED (Leadership in Energy and Environmental Design) certification agency for Italy.

The province invests 1.38% of GDP in research, 30% higher than the national average. Examples of research excellence are the Bruno Kessler Foundation; The University of Trento; CoSBi - Center for Computational and Systems Biology; MIT-MEL Mobile Experience Lab; and CRF-Fiat Research Center. These centers contribute to the creation of new business initiatives both locally and elsewhere.

The Province of Trento is energy independent thanks to public ownership of Dolomiti Energia, which supplies 100% renewable energy. Independence means that the province can experiment with innovative methods of supply and distribution.

The Province of Trento is keenly interested in environmental sustainability due to its unique environmental heritage. Recognized by UNESCO in 2009 as a world heritage site, the Dolomite mountains are a prime example of environmental sustainability and growth, with abundant natural resources open to sustainable development.

1.3 Mission

Achieving economic growth and environmental sustainability at the same time represent an opportunity worldwide. Considerable effort is being directed toward development of green technologies. For example, in 2008, global investment in renewable energy outstripped fossil fuel technologies. Furthermore, industry is investing in sustainable processes as a key business strategy.

Progetto Manifattura will act as a catalyst for consolidating and expanding the capabilities of the existing construction sector, aligning it with worldwide growth trends in green building and manufacturing, environmental technologies, and renewable energy.

Progetto Manifattura is responding to the challenge to create a culture of renewable growth that matches the territory's way of life. The project is designed to be the focal point for education, innovation, technology transfer, business incubation, and public education.

Specific actions to coordinate include:

- Work toward aggregating knowledge-based skills and processes to create construction companies and general building contractors capable of handling large-scale contracts.
- Stimulate the birth of new companies and projects, and establish conditions for long-term growth.
- Create services and functions that open up opportunities for SMEs, for example:

training facilities, quality labs, prototype and testing facilities, conference rooms and digital media support.

- Create an environment where innovation results from the interaction that occurs both formally and spontaneously in open spaces between people and companies with similar goals.
- Promote and sustain an ecosystem of companies that complement each other and create integrated production processes.
- Favor location in Trentino of expertise and capabilities not present in the province.
- Promote formation or consolidate existing local companies that can add value to targeted technologies and services.
- Cultivate, incubate, attract, host, research, experiment, create, produce connect, communicate, train, sell, and promote companies and innovative products.

1.4

Keys to effective clusters

To guide development of the project, the team evaluated 14 national and international clusters in terms of innovation, renown, originality, and affinity to Progetto Manifattura.

The results of the study highlighted a number of success factors:

- Explicit support policies for specific sectors with clear benefits for start-ups and for achieving effective consolidation.
- Value added services for companies, including business support, prototyping space and equipment, testing labs, hospitality, etc.
- Networks for promoting products and research in international environments and specific support for integrated operations and sales that favor expansion of start-ups.
- Involvement of local stakeholders (companies, researchers, education) in identifying and proposing solutions that match local needs.

1.5

Stakeholder interests

A series of meetings with the main stakeholders were held to understand their needs and expectations, and to refine the project's goals.

The stakeholders primary interest was for Progetto Manifattura to become an accelerator for the local economy. The project is designed to create mechanisms for technology transfer and industry best practices.

Involving these players early on created a continuing sense of participation that will benefit the project as it moves forward.

The main interests are:

- Develop a green technology cluster for green building and manufacturing, and renewable energy.
- Apply a bottom-up approach to proposed solutions and activities which consider local capabilities and interests.
- Provide modular spaces and flexible work environments.

CLEAN TECH

RENEWABLE ENERGY	GREEN BUILDING MANUFACTURING	TECHNOLOGIES FOR THE ENVIRONMENT
• Tecnologies for producing energy from renewable sources (solar, hydroelectric, etc.) • Methods for saving energy	• Low impact construction • Recyclability and natural materials • Energy efficiency • Quality of life, integration of comfort and savings, trades and new technologies	• Intelligent monitoring and management of the environment, infrastructure, and utilities • New sector-wide solutions for improving economic competitiveness • Intelligent systems for water supply, and for production and transfer of electricity and heat

Figure 1.2 - Principle sectors of interest

GOALS

TRANSFER INNOVATION AND KNOW-HOW TO TRENTINO BUSINESS SECTORS
SUPPORT AND REINFORCE PRIVATE ENERPRISE

LEVERAGE

ENCOURAGE SECTOR AGGREGATION	ATTRACT NEW COMPANIES	ESTABLISH START-UPS	PROVIDE TECHNICAL SUPPORT/SERVICES	COMMUNICATE WITH THE PUBLIC
• Overcome size limits of sector, especially construction • Help companies and general contractors to emerge • Create an integrated sector	• Encourage new companies to locate in Trentino • Create connections with local companies • Support business leadership and innovation	• Create business opportunities from research • Facilitate start-up of new companies • Help start-up companies to grow • Extend innovation to the entire province	• Fill gaps in technical services such as certification laboratories • Provide high quality support services such as meeting rooms, video conferencing	• Create a symbolic facility that expresses the goals and spirit of the project • Encourage free circulation of people and ideas through initiatives and services for the public

Figure 1.3 - Project goals

- Facilitate innovation through know-how transfer between industry and university.
- Support process aggregation and provide a range of services for product development, including laboratories, test facilities, and simulation equipment.
- Generate a long-term benefit to the local economy by creating an equilibrium between companies located at Manifattura and external companies.
- Support the Habitech technology district through targeted development activities and strategic alliances that strengthen the competitiveness of local business.

1.6 The role of Progetto Manifattura

The project has four main functions:

- **Space for companies.** 50% of space in Manifattura will be used for offices and production, including light manufacturing.
- **Laboratories and technology transfer areas.** This includes training facilities, an exposition hall, certification laboratory, and facilities for prototyping, product development and simulation.
- **Services for companies.** Manifattura will provide high-quality services and infrastructure for companies operating on-site such as conference halls, digital communication rooms, meeting rooms, and product exposition areas.
- **Public access and services.** Manifattura will be an important part of the urban environment, and will offer public amenities such as bars, restaurants, leisure activities, recreation facilities, multimedia areas, and a green technology education center.

CLEAN TECH

	RENEWABLE ENERGY	GREEN BUILDING MANUFACTURING	ENVIRONMENTAL TECHNOLOGIES
PROFILE	Start-up companies originating from research centers (e.g. FBK) Existing companies outside of the province that are competitive in specific areas Local business investments in renewable energy	Local businesses with a demonstrated propensity for innovation Aggregations of smaller companies and general contractors Technology districts and certification bodies	Pioneering companies in emerging sectors High-tech spin off companies Branch offices of international companies
OBJECTIVES	ACQUISITION/KNOW HOW	CONSOLIDATION/PROCESS INNOVATION	FIRST MOVERS IN NEW MARKETS

Figure 1.4 - Target companies by sector

1.7

Market offer

Progetto Manifattura will benefit companies by providing appropriate spaces and organization, but more importantly, the synergy inherent in a symbolic space dedicated to eco-sustainable economic activity. Specific benefits are:

- Competitive pricing for equipped commercial space in a structure that inherently showcases clean technology.
- Spacial and functional transparency that promotes the exchange of ideas between on-site participants and external actors.
- Opportunities to develop operational synergies such as strategic and cultural integration with suppliers, localization of products and components, shared logistics and services and more.
- The chance to integrate business development activities: exposure to new opportunities, alliances, client sharing, etc.
- Privileged access to economic incentives provided by the province.
- Ties to the local market with a growing demand for clean technology.
- Membership in a governed system that can assist in finding customers, services, and consultants, and in supporting marketing efforts by accessing contacts in companies and public institutions.

1.8 Next steps

Follow-up to the master plan has two primary facets: preparing the detailed architecture of the site's elements and marketing of the cluster in its early phase of development. Some important steps to take are:

- Expansion and consolidation of relationships with important players in the renewable energy field in order to transform early interest into formal commitments to participate.
- Follow-up in identifying participants in green building and environmental technology sectors. One aspect of this will be to support local green building players through consolidation and process improvement.
- Support start-ups and create growth conditions for first movers in new markets.
- Define the strategy for occupying space in Manifattura by the companies who choose to site there.
- Delineate the mission and business model of Manifattura's laboratories.
- Define the market offer and incentive packages that companies can expect to benefit from.
- Communicate and market the project in Italy and internationally.

CLUSTER

Progressive convergence of business and innovation center, science and technology park incubator. Service and product oriented center designed to support sector-specific companies in a structured, continuous way.

LOCATION

Urban landmark evolves from historic, urban industrial zone. An easy-to-reach, well connected place with advanced services, cultural attractions, and access to research and development.

SERVICES

Incentives, financing, business services, welcome desk, training center, and productivity support, model companies, housing for researchers and students.

TECHNOLOGY

Technology enables the site (illumination, security, communication, IT services, etc.), and even sets it apart (full digital environments, equipped laboratories for test and development, and Web enhanced services).

COMMUNICATIONS / MARKETING

Strong networks of national and international relationships, B2B with major players, events that promote companies and people. Permeated digital presence with tailored information and services.

PROPONENT

An initiative of the autonomous Province of Trento to stimulate economic growth in green technologies. Managed zone that monitors activities and assures coherence. In synergy with the province's goals.

SPACE LAYOUT AND AVAILABILITY

Major role for architectural solutions in modernizing historic buildings. Modular, personalizable spaces and room for expansion. Facilitate internal traffic and provide space for exchanging ideas.

Figure 1.5 - Development indicators from the economic study

2

URBAN CONTEXT

Chapter cover: Piazza Manifattura, photo by G. Basilico

2.1
Technological context

New work spaces

Just a couple of decades ago many urbanists and sociologists were predicting the end of cities. The Internet, they said, would eliminate problems of distance and space.

In 1995, George Gilder wrote: “Cities are a leftover baggage from the industrial era”. In realty, in the last 15 years cities have seen unprecedented growth. China alone is currently building more cities than have ever existed in its history. As recently noted, the urban population of the planet has surpassed rural numbers (UNFPA 2007).

Despite the influence of the global Internet, the physical world is still important and the network functions to strengthen the physical structures. But the digital revolution has significantly changed our reality. A new layer of digital gadgets enrich the urban environment with new functions and offer people new ways of working and organizing.

With tiny electronics so thoroughly embedded and distributed, the built environment (cities, buildings, objects) is learning to talk. Embedded devices, so called “smart dust”, let us collect and analyze data in real time and distribute it to anyone, anywhere. A radical shift in the design and use of space is taking place that will create benefits in terms of economic, social and environmental sustainability.

These changes directly influence how people work. Pervasive connectivity means we aren’t tied to rigid spacial or organization schemes that characterized the office from the 1950s on.

This newfound freedom poses a question: Given a choice, where and how would we like to work?

Projects like MIT’s iSPOT (2005) did real-time analysis of the distribution of people in a defined space, examining each computer connection to a wireless network. The results showed a high concentration of people connecting from outdoors in summer, from cafeterias during lunch breaks, and from the entrances to conference rooms before the start of events.

What the data shows is that until very few years ago we had to be at our desk to get work done, but with the elimination of spacial limitations you can work anywhere, anytime.

Progetto Manifattura is responding to this challenge: We’re reactivating a space once tied to industrial production by adapting it to a new concept of work.

Richard Florida, in “The Rise of the Creative Class” (Basic Books, 2003), shows how creativity is not something that you turn on and off like a switch, but which comes out at moments and times that cannot be squeezed into defined time frames or constrictive work hours. A creative lifestyle does not admit to a distinction between work hours and free time. Both are useful if they feed into creativity. The creativity of Florida’s “creative class” emanates from an individual’s internal process, not from a collective conscience.

MIT researcher Thomas Allen is considered the originator of modern workspace design. His theory underlines the importance of proximity to interaction. Even in the same environment, people more than 20

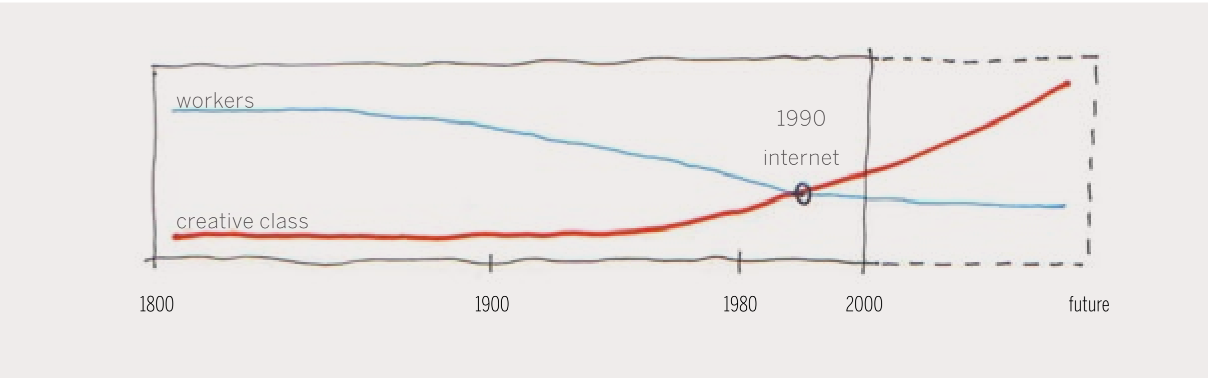


Figure 2.1 - The rise of the creative class

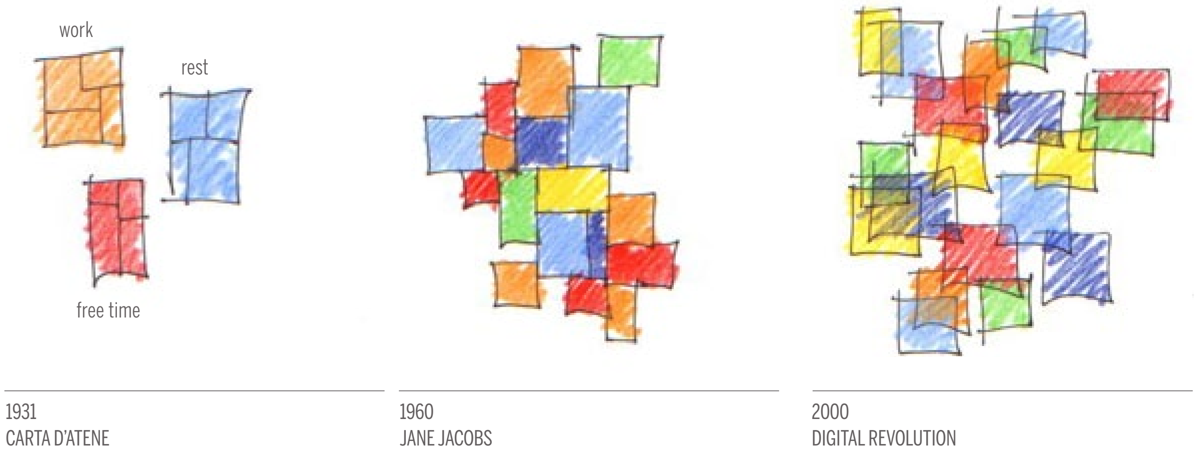


Figure 2.2 - From the Athens Charter to the digital revolution

meters apart are unlikely to interact.

But isolation and privacy are equally important to focused concentration. The need to be near cannot override privacy, but must offer the chance for exchange, encounters, and interaction.

Thus, space must be designed for various levels of privacy: individual offices, shared offices, spaces for shared interaction by multiple actors, and spaces open to the public.

Canadian journalist and sociologist Malcom Gladwell, says that work spaces need social environments in which creativity is stimulated by informal, casual encounters (as theorized by Jane Jacobs).

About social innovation mainly, Gladwell thinks that ideas originate as much from conversations and casual contact as from formal meetings of defined teams. Ideally, interaction actually occurs between people with different assignments and points of view, but who have enough knowledge and common interests to know what might be useful to one another.

Recent research shows that people prefer public socializing spaces such as libraries, cafés, parks, and fitness centers where privacy is respected and varying degrees of concentration and isolation are possible. Other factors that come into play are the comfort of the space, the presence of others, inspiration, and creative stimuli.

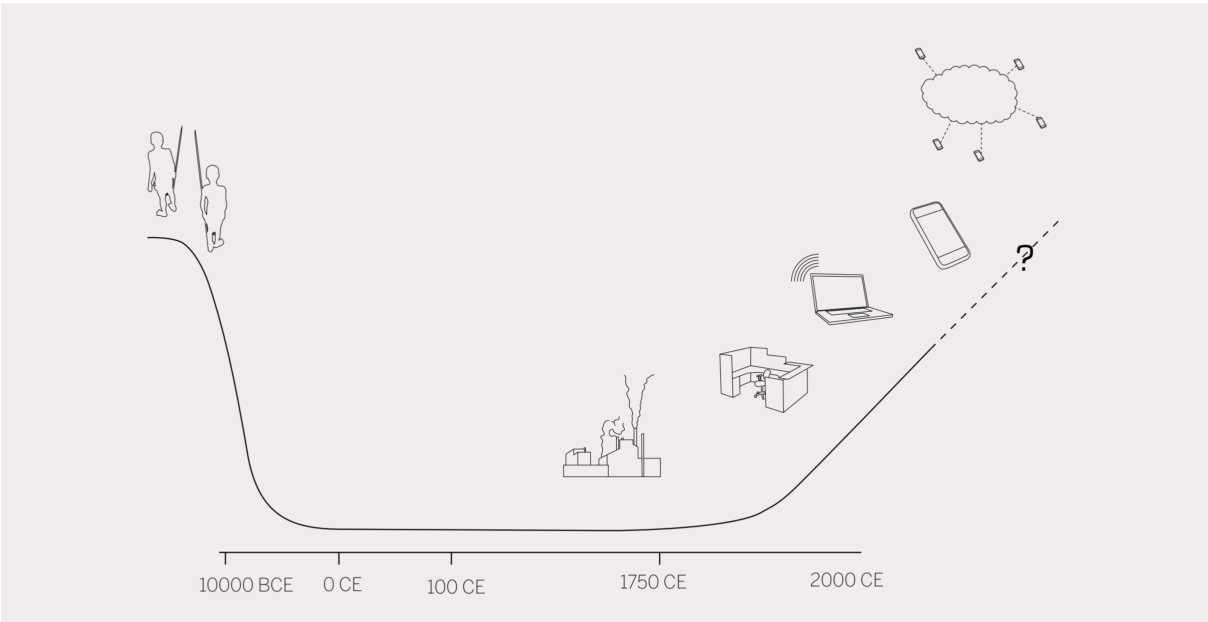


Figure 2.3 - Digital Nomadism, Carlo Ratti, MIT SENSEable City lab.

New kinds of office spaces

Contemporary office spaces are radically different from the hierarchical space that were common following World War II. In small professional studios and large companies, open space is the norm, modelled on traffic patterns and common areas for meetings and breaks with work areas connected to them. In contrast to the old, introverted, standardized offices, these work areas are more open and integrated into a hierarchy of spaces. They can be configured and even personalized in a variety of ways. Great examples include Goldman Sachs, Chrysler, Google, and Pagine Gialle.

Key elements of these new work spaces are:

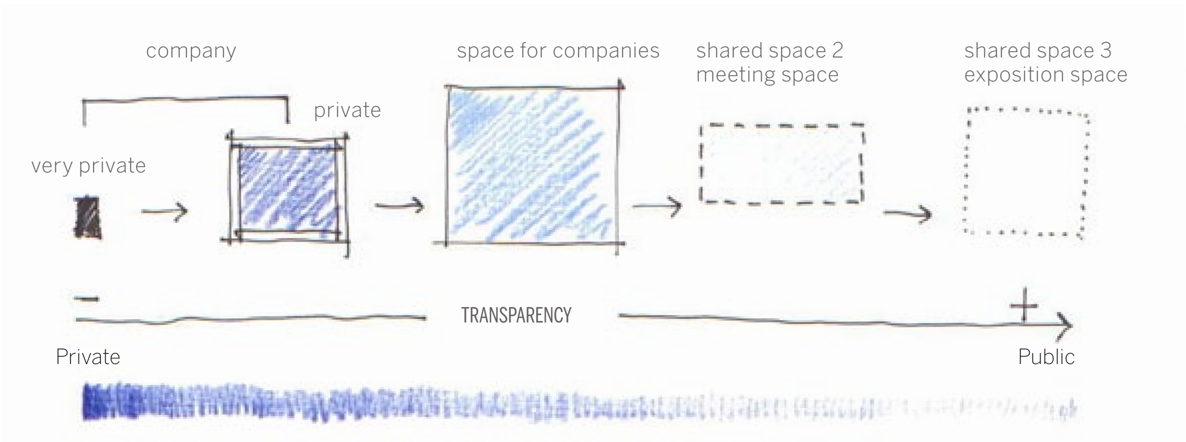
- Configurability.
- Flexibility in space and furnishing.
- Natural lighting.
- Indirect artificial light in halls and transit areas.
- Open office design and layout.
- High ceilings.
- Perimeter circulation.
- Common spaces that are well designed, comprehensible and uniformly distributed.
- Multiple points for casual meetings and socializing.
- Order (lots of spaces for archives and storage).
- Color-differentiated environments.

Different levels of privacy are possible with varying transparency and partitions. Curved glass partitions and elegant work stations give these environments a sense of transparency and openness.

Creativity is stimulated through visual effects, and relaxed informality encourages expression.

Richard Florida calls this new category of worker "no collar". More informal, in dress and work style, they vary their work days and hours. Flexibility is especially desirable for workers with higher levels of training and education.

Flexible spaces and furnishings can be modified for a variety of work groups, events and interaction between individuals.



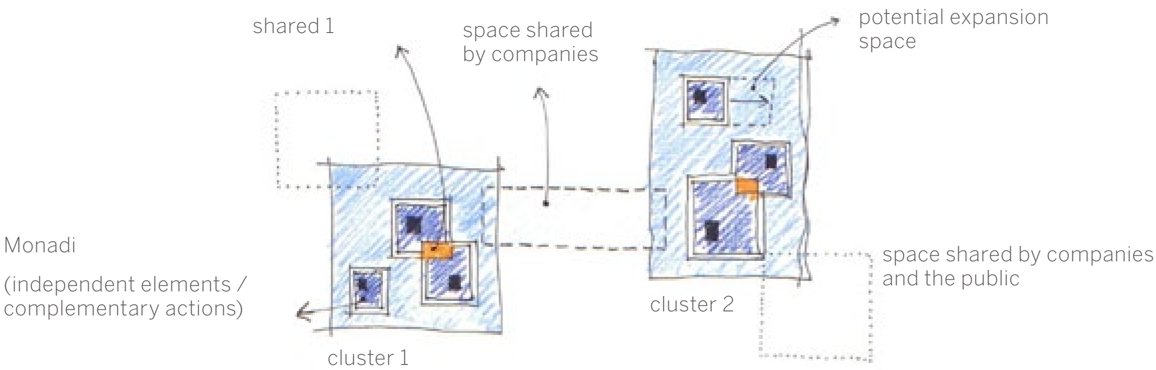


Figure 2.4 - Spacial gradients

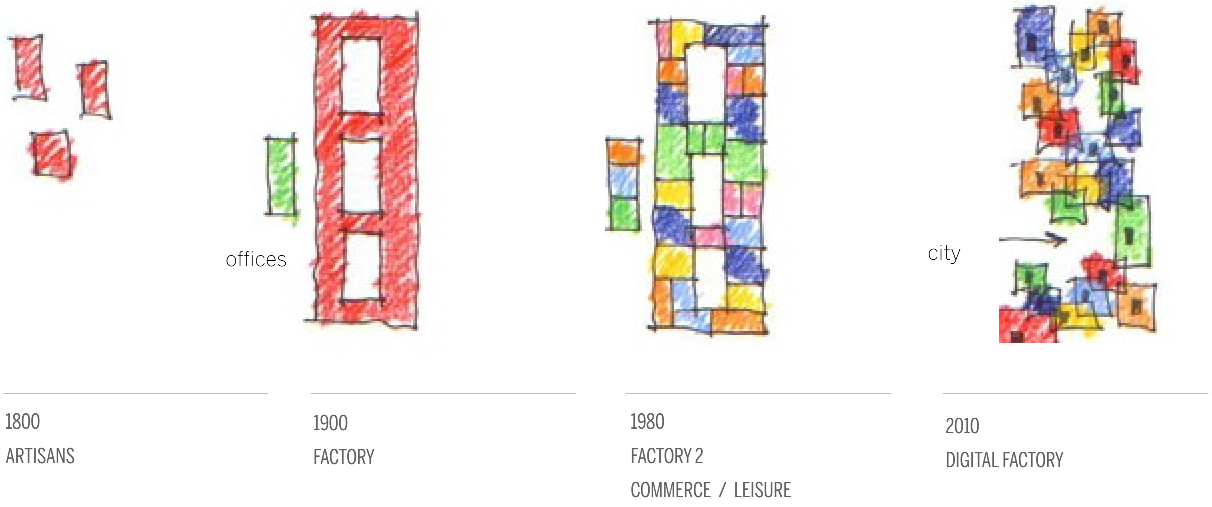


Figure 2.5 - Technological changes in production spaces

Equipped business parks are a kind of modern industrial area for specialized communities. Such parks have a general program that covers internal planning, infrastructure, a mix of functions, and site management.

Progetto Manifattura is an example of a recent evolution in business parks: the science/technology park. Here, scientific activities are the drivers for new products as well as the connective environment.

Prime examples of such environments are Silicon Valley in California and Sophia Antipolis in southern France. They both proved the technology park's capacity to aggregate research and production.

Progetto Manifattura is taking this process to a new level by converting a historic industrial complex into a green innovation factory. "Green" means reinventing the nature of business by putting nature back into the concept of economic development. It's innovative in the sense that people and companies will be part of a community working on a common industrial platform that includes research, testing, quality labs, exhibition space, demonstration areas, training, education, and more. It's also a factory: a place where creativity is fostered and where production builds on new ideas.

Manifattura is literally tearing down the walls of the old industrial box and building a new digital factory that takes advantage of networked environments.

Manifattura isn't limited to innovation for business, it is also reintegrating into the community and the surrounding landscape.

New community spaces

Modern technologies are revolutionizing urban planning and architecture with their immense potential for interaction: living systems inspired by nature and the evolutionary process. Digital technology especially is transforming how people live and interact with cities and among themselves. Thanks to the wireless Internet, people work in parks, cafés or anywhere they like. As the wireless network expands, work and learning will increasingly take place around town, and less often in offices and schools.

Universities, schools and research centers are leaving isolated suburban campuses to move back to urban areas. Seoul's Digital Media City rose in proximity to areas for education, living, shopping, culture and recreation. In Helsinki, the new Arabianranta is dedicated to art and design, attracting commercial activities, schools, and homes in a unique interconnected community.

Wireless technology is redistributing people in profound ways, too. Wireless networks add an information layer which changes as the user moves from place to place. When distributed universally, RFID tags will let people, places, and things recognize each other and interact.

In the context of Manifattura, these technologies will also solve potential issues by giving access according to user need, such as distinguishing between public and private, and between shared areas and transit areas. Invisible barriers will delimit usage zones such as:

- Public spaces with 24/7 access such as plazas and restaurants.
- Semi-public spaces like auditoriums and exposition areas.
- Semi-private spaces for shared use such as meeting rooms.
- Private spaces for purposes such as research, with areas restricted to certain individuals or groups.

Integrated technologies will also allow for on-demand services that will increase efficiency and productivity by personalizing how people interact in public spaces.

Reactive spaces

As digital technologies become more widespread and easier to use, they are being incorporated into surfaces and structures.

This radically changes not just the appearance of buildings and places, but their uses and potential for expression. At Madrid's Langrita Navarro Arquitectos project, a wall of programmable LEDs communicates information and provides entertainment for the city.

Buildings like this are no longer static objects, but actually media that add meaning to places.

New kinds of public spaces can be adapted to individuals and to situations. Milla Digital, an MIT project in Saragozza, Spain, will create an area that can host multiple activities, thanks to reactive installations like:

- Positionable curtains that can provide shade, divide spaces or become projection screens.
- Interactive display surfaces incorporated into café tables and building walls.
- Lighting with sensors that turn on as people pass.
- Digital water in programmable walls where images and messages are created in response to the movement of people.

These kinds of effects can be turned on in different ways and at different times so that buildings and spaces can change according to the weather or the movement of people. The content of the presentations can be created by artists, students, and guests connecting via Web from all over the world.

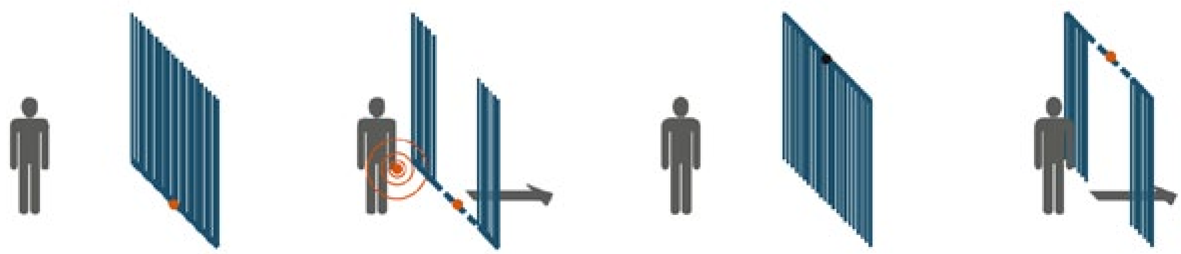


Figure 2.6 - Interactive devices for people

2.2
Geographic context

The European megalopolis is a discontinuous urban corridor that extends from northwest England to Milan.

This corridor, known as the Blue Banana, includes the cities of London, Brussels, Amsterdam, Dusseldorf, Frankfurt, Stuttgart, Strassburg, Zurich, and Milan, one of the highest concentrations of people, monetary capital and industry in the world.

Distance from Rovereto to regional airports:

- 80 km Catullo (Verona)
- 90 km Dolomiti (Bozen)
- 130 km D'Annunzio (Brescia)
- 180 km Marco Polo (Venice)
- 200 km Linate (Milan)
- 300 km Malpensa (Milan)

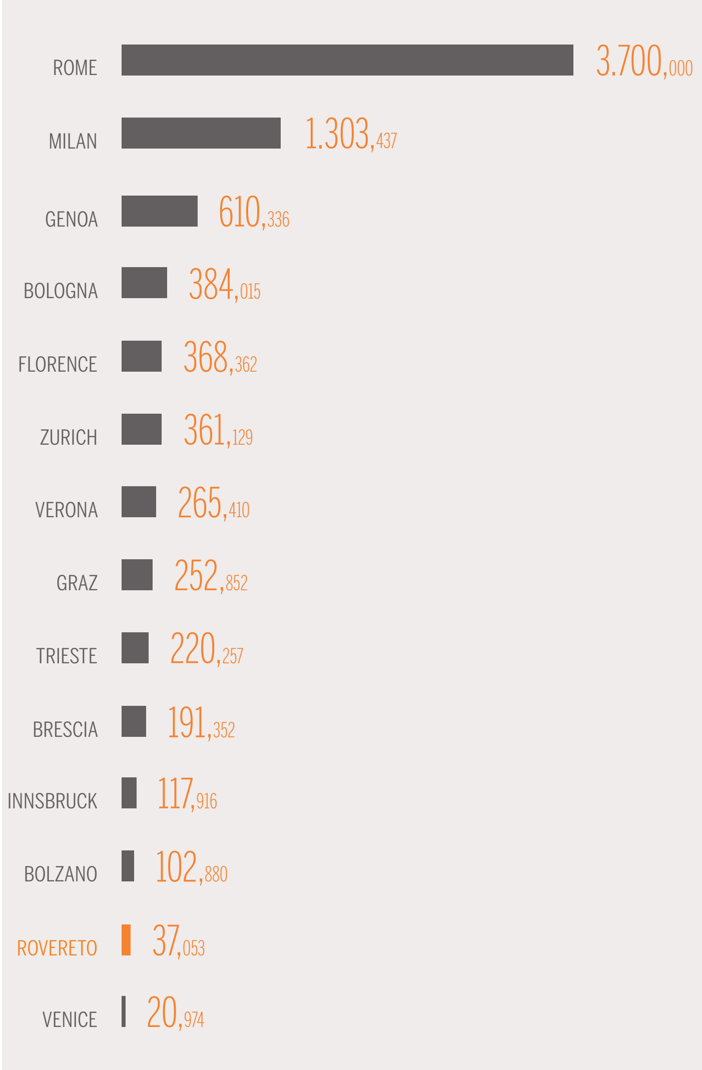


Figure 2.7 - Comparative population

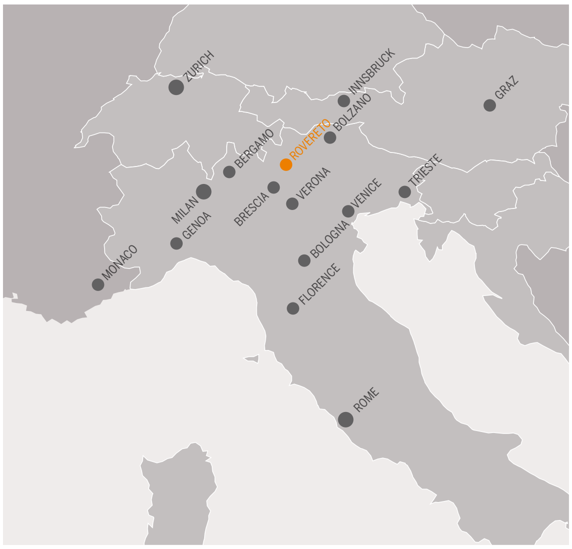


Figure 2.8 - Map showing Rovereto in a regional context

Figure 2.9 - The "blue banana"

2.3 Historical context

The city of Rovereto

Rovereto is the main city in the Vallagarina area of the Adige Valley. It lies 80 km north of Verona and 25 km south of Trento. The area was part of Trento's bishop principality, which became part of the German Holy Roman Empire, then part of the Republic of Venice, then part of Tyrol in the Austro-Hungarian Empire. At the end of World War I, it became part of Italy.

It's most prosperous period was in the 17th century at the height of the Venetian silk industry. The city boasts numerous churches and palaces built in the period under the Habsburg Empire.

Other monuments and buildings from that period include the Manifattura Tabacchi, the Education Palace, a former high-school building, parts of the city's castle, and the municipal building.

The architecture of the ex Manifattura Tabacchi

1851–1900: Early development of area A

In response to the disappearance of the silk industry in the area, the Austrian government decides to construct Manifattura Tabacchi in the Borgo Sacco area of Rovereto. Construction begins in 1851 and is completed in 1854. The buildings are used for warehousing, curing and processing tobacco, mostly for cigars.

Production expands rapidly. New buildings for drying tobacco and curing cigars are constructed and employment increases.

1900–1918: Enlargement of area A

Manifattura continues to grow. From 1908 to 1913 new buildings in the eastern area are built for offices, housing, warehousing, machine shops, and carpentry shops.

Production stops during World War I.

Figure 2.10 - Manifattura Tabacchi in 1920

1920–1945: Consolidation of Area A

Between the two world wars, the factory starts to switch from making cigars to making cigarettes. The factory is highly productive, with no stoppages despite bombing during World War II.

1950–1960: Modernization and construction of area B

The factory starts to produce only cigarettes, a mechanized process that requires new machinery. But buildings from the early period were not designed to withstand vibrations from mechanized processes.

New land is annexed to the site and new production facilities are constructed.

1960–2010: Production, closure, reactivation

The factory functions for many years as one of the most productive facilities in Italy's state tobacco monopoly. But continuing consolidation of the industry leads to its closure.

The autonomous Province of Trento and the City of Rovereto draw up a redevelopment project to convert the site in a way that maintains its economic productivity and, at the same time, takes into consideration the need for environmental sustainability.

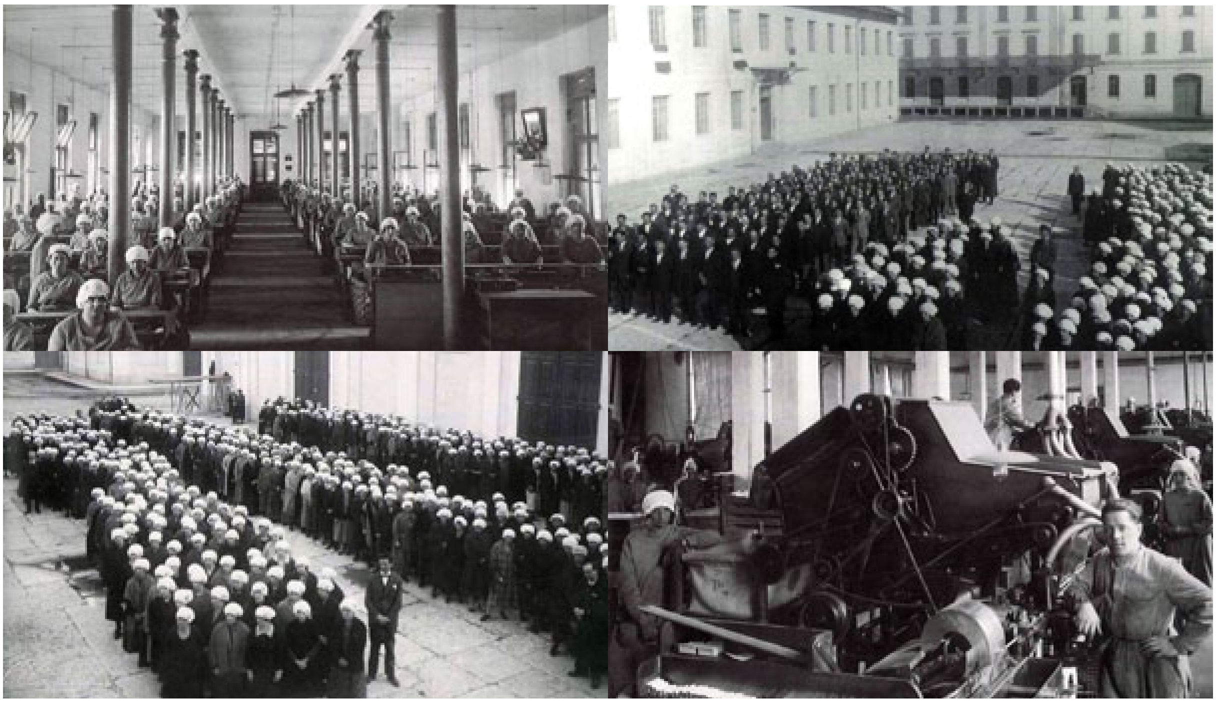


Figure 2.11 - Workers in Manifattura Tabacchi

LISTED BUILDINGS
(surface area)

- **9** Barrel storage 550 m^2
- **1** Main building 7600 m^2
- **3** Bicycle garage 254 m^2
- **3** Garage 77 m^2
- **4** Forms storage 680 m^2
- **2** Showers 1560 m^2
- **7** Palazzo dell'orologio (clock building) 4484 m^2
- **6** Incinerator 518 m^2
- **11** Hydroelectric plant (ex) 69 m^2
- **25** Changing rooms 174 m^2
- **14** Raw tobacco 5605 m^2
- **13** Forklift depot 169 m^2

NON LISTED BUILDINGS
(surface area)

- Barrel warehouse 1445 m^2 **16**
- Materials preparation 6280 m^2 **21**
- Packaging facility 8480 m^2 **19**
- Metal shed 2600 m$^2{}_2$ **10**
- Raw materials shed 960 m^2 **15**
- Parking 610 m^2 **15**
- Machine shop 1990 m^2 **17**
- Canteen 5640 m^2 **18**
- Energy plant 695 m^2 **20**

Figure 2.12 - Existing buildings in 2010

3

DESIGN PRINCIPLES

3.1 Dialogue between technology and the environment

Planning concept

Beyond purely functional design, the project proposal creates an architectural form that reflects the ecosustainability concept of the new production facility. This is achieved through architecture that physically integrates urban and green areas, as well as through the use of sustainable technologies and building materials.

The design attempts to create a clear, visible system that relates to the physical context so that the existing structure emerges and integrates into the environmental context.

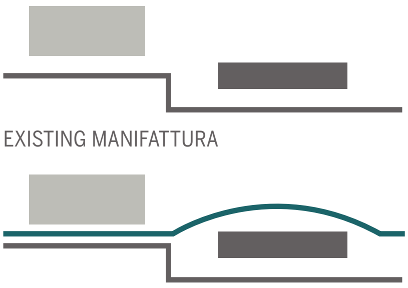
Although behind a perimeter wall, the ex Manifattura is situated in an area used for recreation. It's a place designed for openness.

To create this effect, the project proposes a permeable approach that takes into account both the texture of surrounding agricultural fields that parallel the Leno river and create continuity with the city of Rovereto, as well as opening towards the neighborhood of Borgo Sacco.

Figure 3.1 - Dialogue

Recreation along the Leno river

The Manifattura site is situated along the Leno river, an area already used for recreational activities. In fact, the project foresees a very public area that can be used in conjunction with existing activities every day.



3.2
A new identity

The ex-Manifattura Tabacchi was an important factory for years, one of the most important in Italy, in fact. Thousands of people worked there across generations. It remains a significant reservoir of collective identity, but also a site that holds hope for the future.

The new project is designed to revitalize one of Rovereto's historic civic centers.

3.3
Hands: natural and urban

At the start, Manifattura will be a park, a 5-hectare green area that replaces the warehouses built in the 1960s.

The first phase will also see the refurbishing of Manifattura's historic buildings. In addition, recreational services will be built near the Leno river.

To designate where construction of production facilities will take place, vegetation will outline the footprints of future buildings.

As development begins, the green strips will be "raised" to become green roofs over the new production spaces. The layout of the strips will be east-west, in line with the surrounding vineyards.

This organic development will minimize the inconvenience of

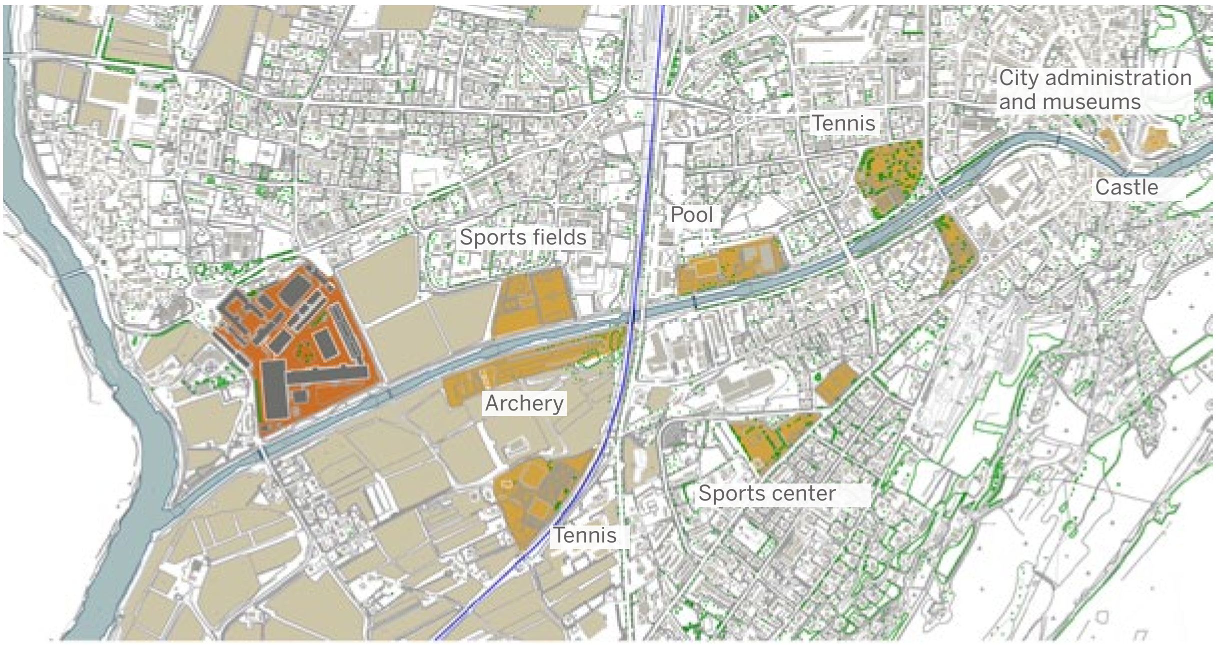


Figure 3.2 - Rovereto's historic centers and **r**ecreational facilities along the Leno

the work in progress as well as guarantee immediate public use of the former industrial site.

Other phases of the project foresee an innovative and sustainable approach, as well. Demolition material will be reused on site. A trigeneration plant will provide clean energy. And locally-sourced, low-impact materials will be used in construction.

The intense green of the production complex will highlight the adjacent historical Manifattura whose rigorous forms will house offices, research labs and design studios. The remodelled existing bridges combined with new structures will connect buildings, creating the conditions for sharing ideas that are the basis of innovative, leading-edge production.

Simple bridges used for tobacco carts until just a few years ago will become places for meetings and informal gatherings. The bright rooms of the historical buildings with their double rows of iron columns will host a new way of working that will be reflected in fluid, open spaces. Light, transparent additions will be inserted into the imposing materials of the existing structures, revealing the processes, experiments, and results of the new Manifattura.

The urban character of the historic portion's open spaces will make it seem like a part of the adjacent Borgo Sacco quarter, which will be connected when parts of the existing wall are torn down.

Manifattura will finally open its austere, rigorous elegance to the public. The neighborhood will acquire new public spaces, services, and recreation areas.

Horizontal landmark

Situated in a valley and surrounded by towering mountains, the architecture of the new production area will be characterized by horizontal lines. It's strips of green roof will reflect the subtle lines of vineyards and rivers.

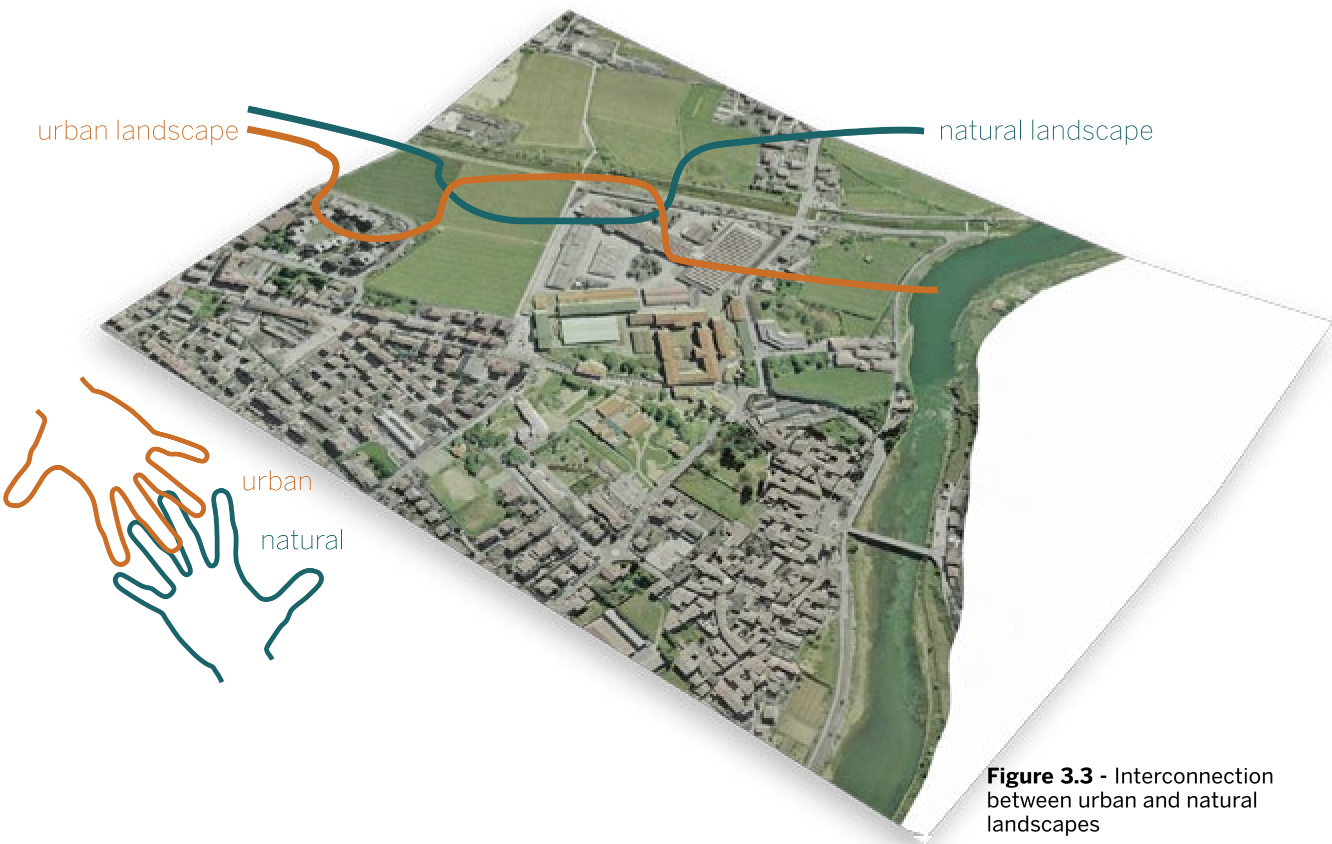


Figure 3.3 - Interconnection between urban and natural landscapes

From park to factory

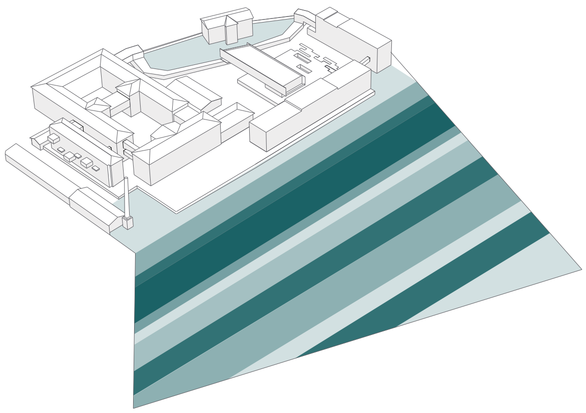
Due to their magnitude, the changes proposed for Manifattura will take time to implement: several years in fact. The master plan takes into consideration not just the final form, but how to use the areas during construction. A green surface will replace the old warehouses, leaving space for a green park that will gradually be transformed into new production spaces.

Funding availability, along with a desire for gradual growth, means that Manifattura will be built in stages: restoration of the historic buildings, construction of restaurants and recreational areas along the river, and finally the construction of new production buildings.

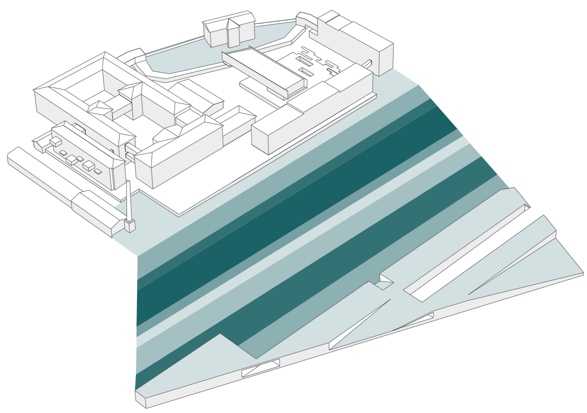
The park's design will conceal the presence of the basic infrastructure, making it possible to speed up the construction process.

The green surfaces will be open for public use. Then, when the production area is completed, instead of disappearing, the park will exist as the green roof over the new production spaces.

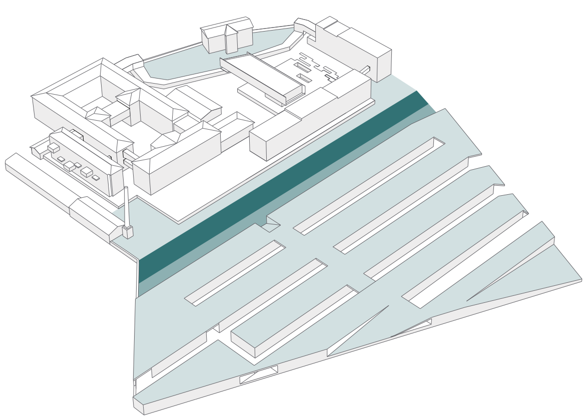
Figure 3.4 - Transition from park to green technology park



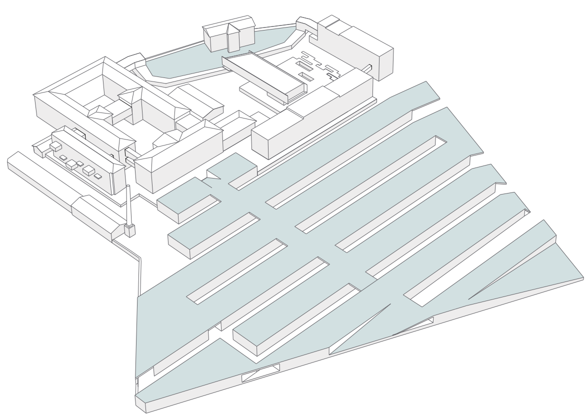
1. MANIFATTURA PARK



2. PARK WITH SERVICES ALONG THE LENO RIVER



3. GREEN BUFFER ZONE BETWEEN ZONES A AND B



4. GREEN TECHNOLOGY PARK

3.4
Green roof

A significant challenge is to connect Manifattura's two heterogeneous environments, one built at the end of the 19th century, the other to be built in the future. One part open to the public with services for the city, the other built for production and closed to the public for safety reasons, their different functions underscore the need to resolve their functional and visual relationships.

Use of a connective fabric like a green roof over the production zone and the pavement of the historic part will help bind the different environments and give the site physical continuity that respects their historic and functional distinctiveness.

The fabric will employ different kinds of materials that will merge the zones, starting with differing kinds of green roof and ending in the stone pavements of the historic zone.

The local landscape will recover a part of its territory through a green roof that intermediates between the new production center and the monolithic historical buildings. Two domains—one public and historic, the other private and productive—forged together by a bridge-like connecting tissue.

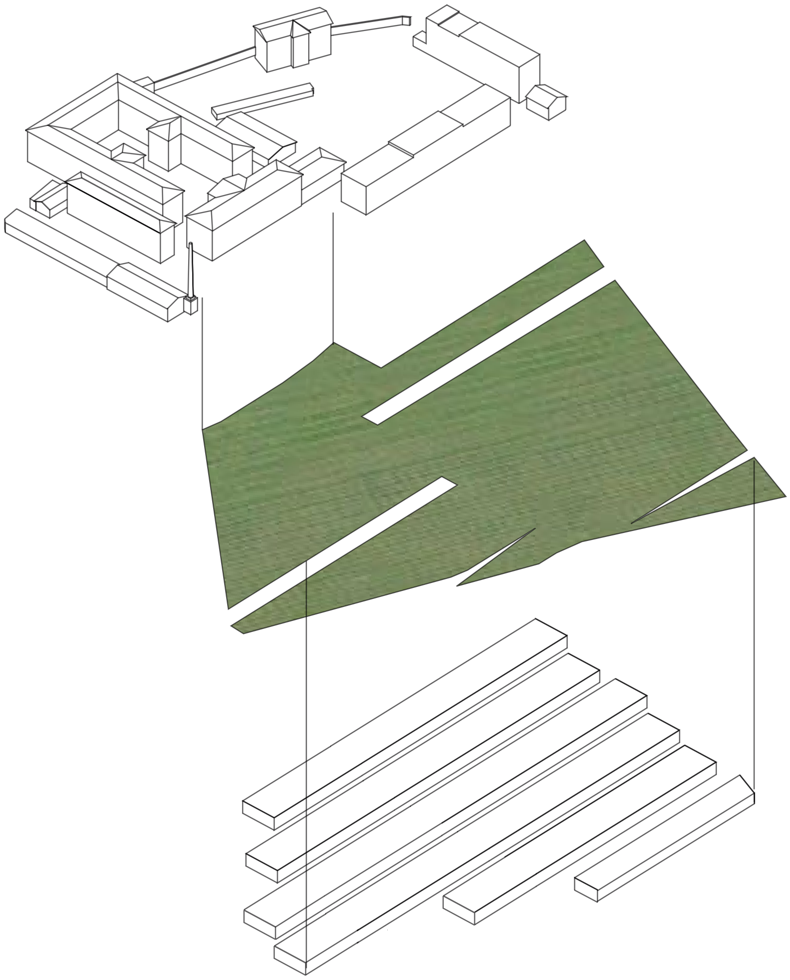
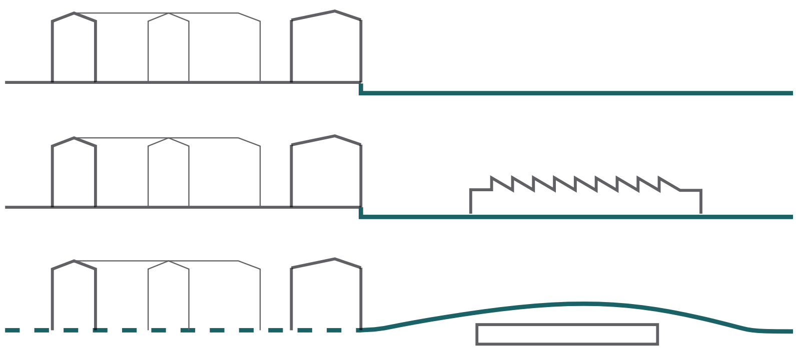


Figure 3.5 - A factory under a green roof



Themes

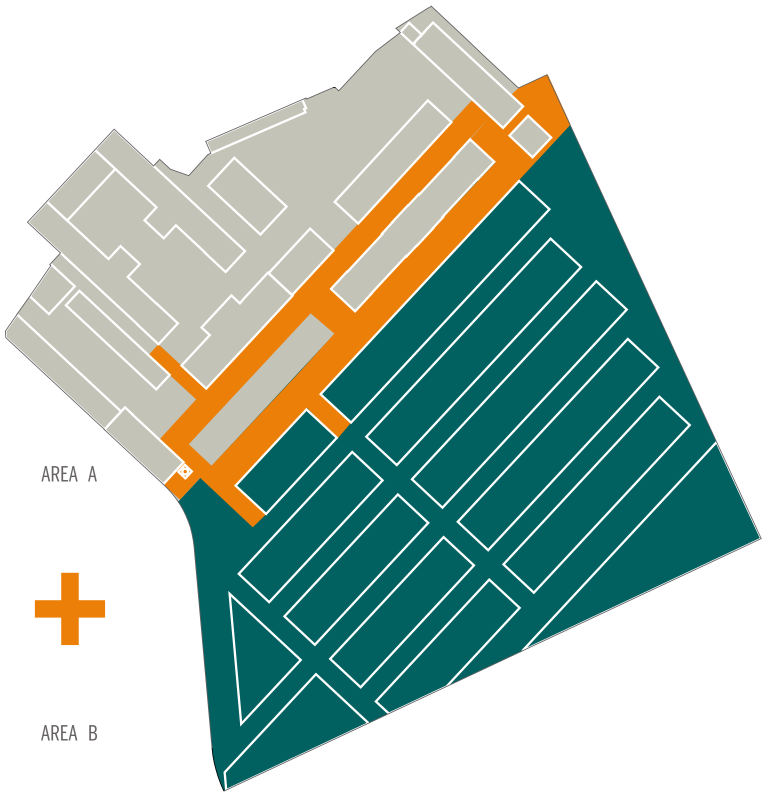
> Positioned like vineyards
> Flexible system
> Functional paths
> Horizontal monument

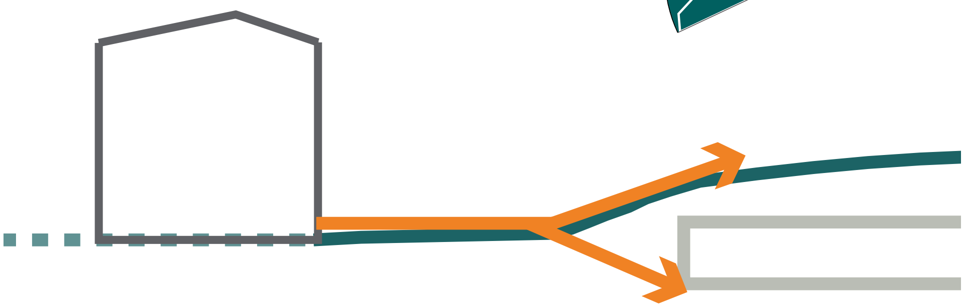
3.5
Deck and relaxation

A deck will connect the private productive zone and the publicly accessible historic zone. And it will link the two areas as well as distribute public and private traffic flows.

The deck will connect the new with the historic using ramps while allowing controlled access to the private production areas and public entry to the walkable areas of the green roof.

Figure 3.6 - Deck between Zones A and B





Recreational area along Leno river

Where Manifattura opens up to the Leno river is the place the public will interact the most. The project foresees a restaurant, fitness center, bar, and other facilities. To underscore the importance of the relationship with the river, the green roof will slope gradually down to ground level to allow pedestrian access.

This part of the Manifattura creates continuity with other recreational opportunities already available along the river.

The backbone

The deck between Manifattura's two distinct areas and the river zone will be connected by a kind of spinal column that allows free movement through the site from Borgo Sacco to the recreational areas along the river and beyond.

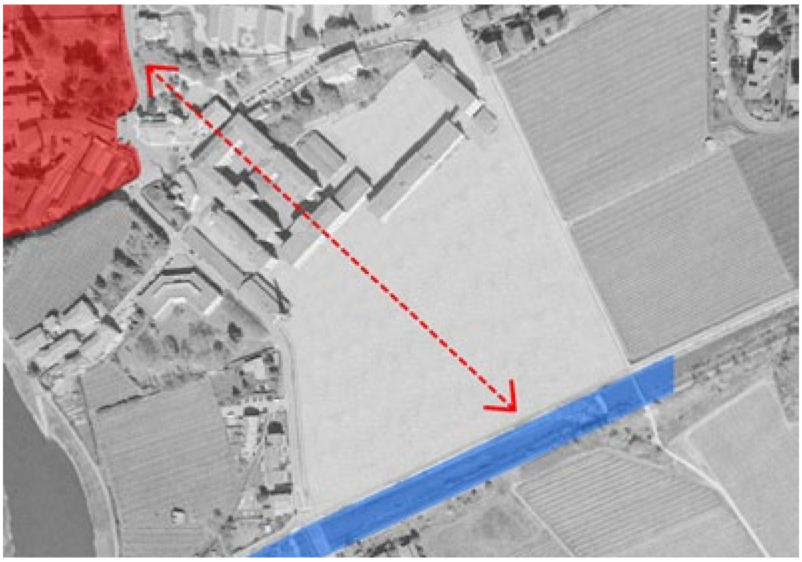


Figure 3.7 - Leno river, backbone, sloping green roof

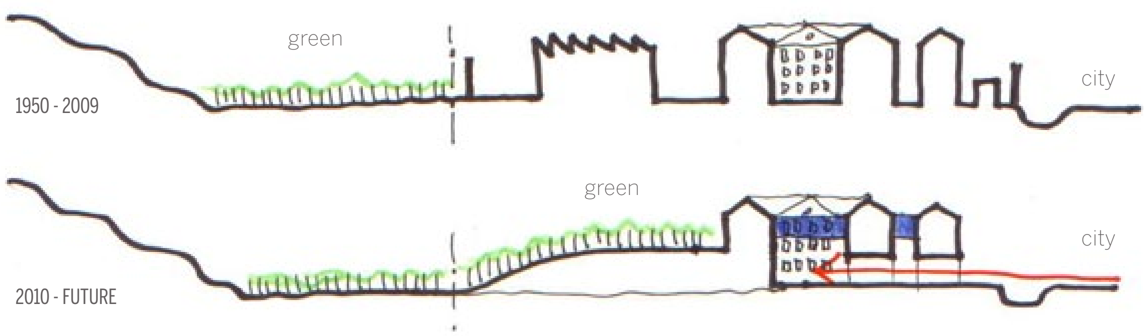
3.6
Green factory strips

Rows of grapevines to one side, the Borgo Sacco quarter to the other. To this day, the two areas have remained separate, almost in contrast: a barrier separating two different functions. Manifattura had a distinct character as a place to work when you enter the gates, but there was no other interchange with the surrounding neighborhood.

The goal is to create dialogue between these areas. Create a green covering that connects the vineyards with the historic Manifattura and open up to inhabited Borgo Sacco.

The factory will no longer be closed behind gates. Manifattura will become a crossroads, a true part of the city and the territory. Here nature and industry will meet, ending a separation that lasted more than a century.

Figure 3.8 - Strips connecting with vineyards: present and future



3.7
Plazas

In a highly articulated system like Manifattura, with its interconnected veins and arteries of production, it is the empty space that will provide new character. The historic core will develop around a large internal plaza comprised of two connected, but distinct courtyards. It is important to emphasize the exclusivity of the area: one of the few outdoor places where you cannot see the mountains that surround Rovereto.

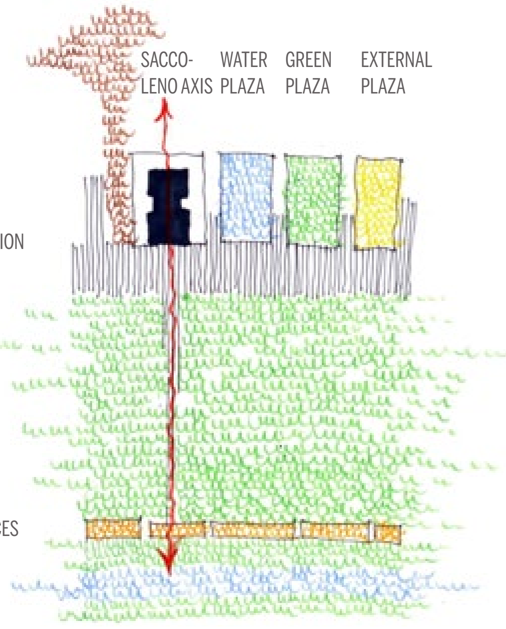


Figure 3.9 - Scheme of public plazas

Manifattura's historic heart will become a place where memories and innovation meet.

The large green platform that covers the new production spaces will represent the new Manifattura. On top, it's an open area that anyone can visit; but underneath, it's a restricted-access innovation zone. Constant dialogue between the production and meeting spaces is the foundation of the redesign.

A new public space for displaying prototypes becomes the hinge between the historic area and the new production zone.

The new CIMEC building creates two public plazas in the eastern part of the historic area. The original configuration of the factory is recreated with a new feature: the two plazas are open to the public.

The creation of a new external plaza comes with the new entrance to the site, completing the design of public spaces and highlighting the connection with Borgo Sacco.

Figure 3.10 - Existing main courtyard

3.8 Bridges

Wedged in between the monolithic historical buildings, the bridges are a fundamental element of the architectural nature of the old production areas. The bridges were an attempt at bringing elasticity and dynamism to spaces that were designed to be rigid, making it possible to move between production zones. The buildings certainly were not designed to adapt to the frequent technological innovations that are endemic to modern manufacturing.

Notwithstanding the attempt to improve communication between spaces, work remained anchored to the old scheme of distinct divisions and well defined spaces with little potential for transformation.

New ways of organizing work require us to take a different path. New spaces are needed that will encourage continuous exchange of ideas, equipment, and people. Work spaces must be thought of as dynamic places. Places where people can meet and exchange ideas.

With that in mind, the idea is to tap Manifattura's historic potential, contrast its rigid elements with new elements that emphasize changes in workplace behavior.

The project's accent on the bridge theme is a step in that direction: with bridges as shared spaces in which to exchange ideas and know-how. The construction of new bridges and the remodelling of some of the existing ones will accentuate this aspect, creating truly dynamic spaces that profoundly effect how people interact while working.

Transparent bridges will create communication between different spaces and will reveal what's going on inside spaces repopulated with new activities.

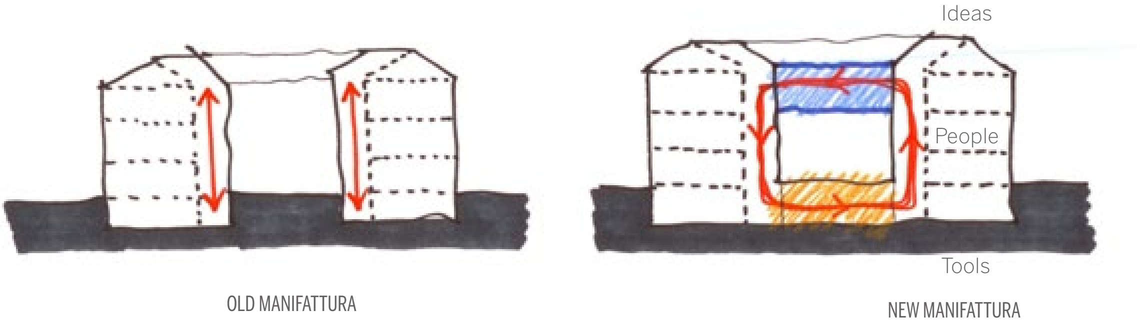


Figure 3.11 - Schematic drawing of communication and bridges

Figure 3.12 - Existing bridges

3.9
360° sustainability

During development of the master plan, work groups focused on producing guidelines for designing the site.

Energy, carbon emissions and the need for buildings to be sustainable had to be considered together with principles of architecture and master planning. Studies and designs then followed which took into consideration not just the microscale issues of the site, but transportation and socio-economic issues.

The following table condenses the main points.

Low emissions	Create a low emissions district that uses energy efficiently. Promote responsibility about climate change by establishing clear carbon reduction goals and transparent mechanisms for measuring emissions.
Promote sustainability	Promote sustainable lifestyles and behaviors that tend to protect the environment and that promote global sustainability.
Building heritage and environmental impact	Preserve heritage by promoting efficient use of space and by reducing the impact of buildings on the natural environment. Adopt evaluation methods and use materials that lower CO_2 output.
New technologies	Promote the use of innovative construction technologies.
Sustainable transport	Create a new Manifattura that is open to people. Reduce impact of transportation for staff and visitors by promoting the use of public transport, ride sharing, etc.

- 50% of buildings will be carbon neutral.
- Reduce greenhouse gas emissions for operations by 70% in the master plan with respect to business as usual (BaU), including emissions generated by buildings, transport to and from the site, and support infrastructure.
- Reduce greenhouse gas emissions for operations by 20% in the master plan with respect to BaU, including emissions generated by construction and demolition, and handling of waste and CO_2 over its lifespan.

- 100% of users and visitors receive information regarding sustainable behavior (through education programs and expositions) and information regarding sustainable configuration of the Manifattura and its reduced environmental footprint (brochures and booklets).
- 75% of transportation by staff and visitors coming to Manifattura will be sustainable.
- 100% of food and beverages served on site in cafés and restaurants will be sourced locally (within 100 km) and be made from local products and as far as possible be of organic origin.
- A child care facility able to handle the needs of the entire zone will be made available for Manifattura staff (later phase).
- An exposition space for art and for monitoring energy consumption and greenhouse gas emissions will be provided.

- 100% of new buildings on the site will be certified LEED “platinum”.
- The target for low emission materials will be defined in the work plan.

- Implement automation and control of buildings using high level systems for performance monitoring as defined in European norm 15232: 2007, Class A.

- 50% reduction in number of parking spaces with respect to base line.
- 75% of staff and visitors use eco-compatible transport to get to and from Manifattura (foot, bicycle, mini-buses using clean energy, and other sustainable transport).

4

ILLUSTRATED MASTER PLAN

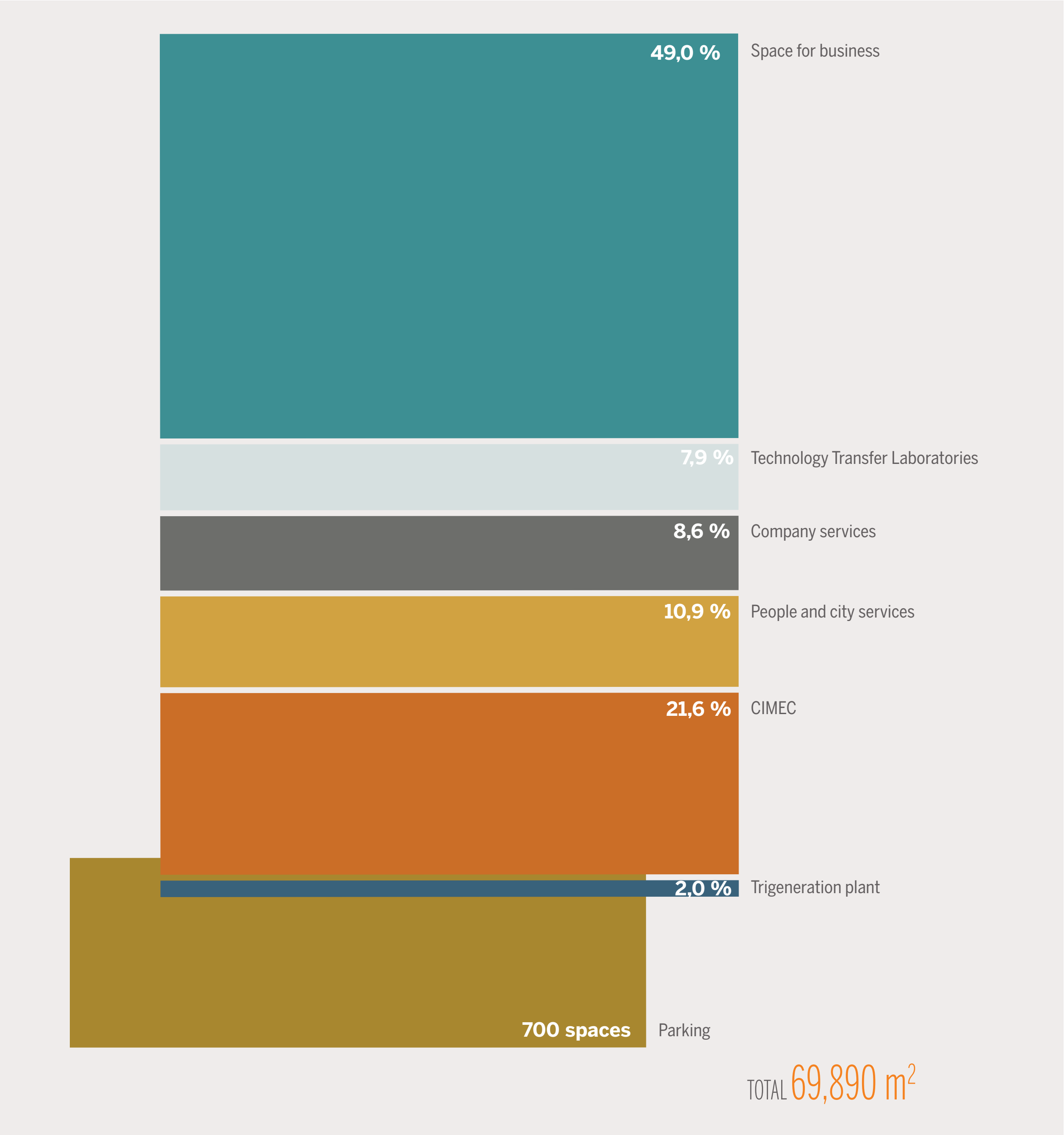
4.1
Production facility

The new architecture of the master plan will create a production and testing cluster with functional interfaces at multiple levels.

Manifattura will evolve into a place where companies can grow and produce in an innovative environment offering both architecture and advanced technology. Unlike other production facilities, it will integrate its open spaces and exhibits into the community.

Manifattura will mostly provide services and functionality for business. But it will also offer services for the city and for the public. That's why the project foresees an environment where businesses can work and promote their ideas directly to people who pass through Manifattura.

Figure 4.1 - Use of space in Manifattura



4.2
Area A - Project vision for the historic section

The goal of the project is to create a constructive dialogue between conservation of the historic buildings and the insertion of modern functionality and new structures.

The original configuration of Manifattura Tabacchi leaves little room for the dynamism needed in modern production facilities. Testifying to the static nature of the historic buildings are the bridges, which made the original configuration more flexible.

The goal was to design cutting-edge spaces that could accommodate new ways of working. This required remodelling buildings originally designed for completely different purposes. To get beyond mere restructuring, the characteristics of the historic factory and its new production spaces have to work together.

Fluid, dynamic spaces interact with the old structure, respecting their integrity yet reviving their historic and cultural value.

Alongside the existing wood bridges are new ones built with modern materials and technological advancements. To reestablish the original division of space, a new building, suspended over water, faces the monolithic original building.

A new skin covers the facade of the shower building: suspended rooms for informal meetings paired with prototypes that seem to grasp onto the new architecture. Lightweight, transparent structures grafted onto the angles of Manifattura look out over the vestiges of past industry. Cultivated fields and mountains communicate with the environs.

A fundamental element of the new Manifattura is its permeability to the Borgo Sacco neighborhood. No longer a closed industrial site, Manifattura becomes a natural part of the urban fabric. The historic buildings of Manifattura become a gateway between the urban and the outdoors. New entry ways cut through the rigid curtain that surrounds the factory, traverse the green roofs above new production facilities, and lead to the Leno river.

The natural surroundings gradually open to the historic buildings. Urban space, production and the landscape engage. A permeable media wall welcomes people to the park, and the austere 19th century buildings return us to the site's industrial origins. The impassive smoke stack watches over metaphoric Italian piazza full of people, tradition, and innovation.

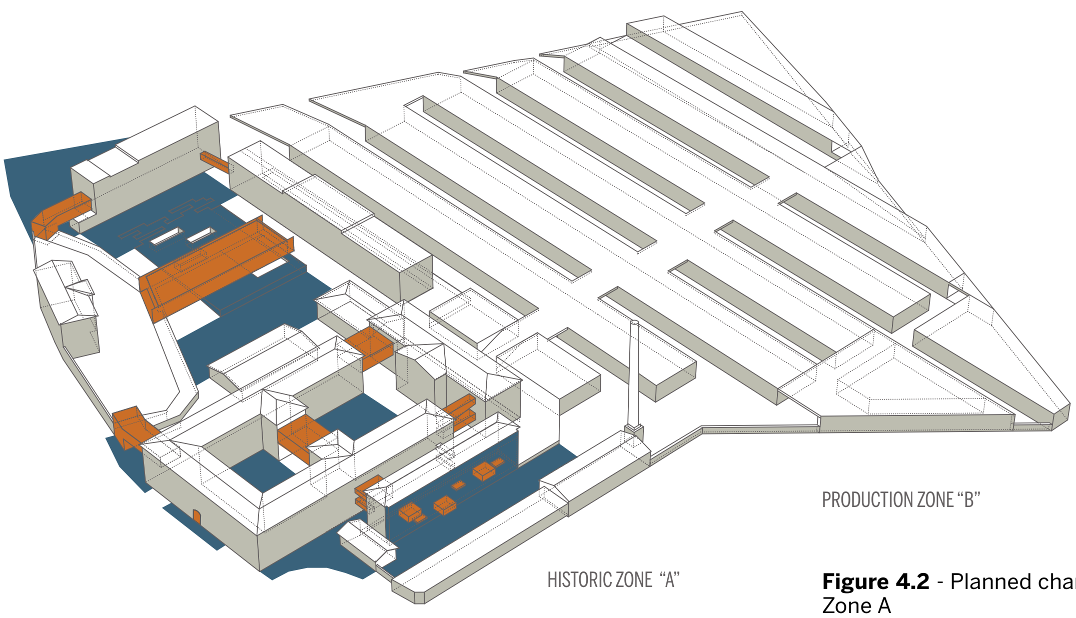


Figure 4.2 - Planned changes to Zone A

The perimeter

The relationship between the Borgo Sacco quarter of Rovereto and Manifattura has always been fundamental. To amplify public access to the spaces inside Manifattura, the project aims to create living space for the entire neighborhood, not just employees. The city will become a filter between the urban and the natural environment.

To integrate the two, four openings in the existing perimeter wall are planned. The original worker's entrance in the main building will still be prominent, the main access point for the work spaces and the main courtyards. The alley between the main building and the shower building will act as a second urban connection axis. Two transparent bridges will characterize two new entry points, one to the left of the main building, the other at the northeast corner of the site. Both will make it easy for the public to access and use a new, two-part plaza. The two entries will be the communication points between the city and the new Manifattura. To the west is a new urban plaza that creates dialogue between urban Borgo Sacco and the public spaces inside Manifattura.

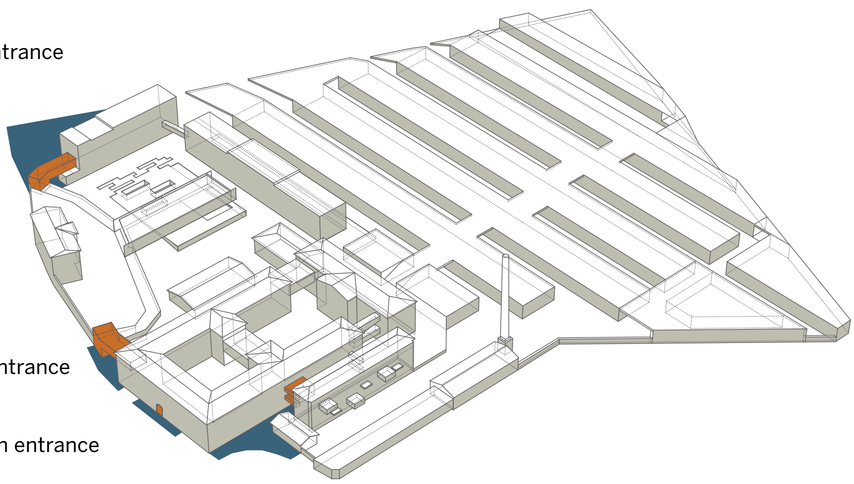


Figure 4.3 - Layout of new entrances

New plazas

The project will remodel the empty spaces between Manifattura's rigid structures, turning them into a public attraction within the site's production spaces.

The core of Manifattura is represented by the two courtyards located between the wings of the original building. Completely open to the public, they will animate the crossroads of new functions. Below the courtyards, will be a new auditorium with access to and from the clock building. A transparent bridge that joins the two wings of the original building will divide the two courtyards and showcase the new ways of working.

In contrast to these courtyards are the other plazas of the historic area, where production and service spaces meet. The "street of prototypes" will be a public road for entering Manifattura. The area will present the fruits of research activities.

A new skin will cover the shower building, highlighting the relationship between the existing and the new. Lightweight elements will interact with existing spaces.

The new "CIMEC building" of the Mind/Brain Department of the University will give life to two new plazas one that opens west toward the main building, at the northeast entrance.

The site will be open on the ground level, yet recreate the original division of space that was lost when an older building was replaced by a metal warehouse in the 1960s. The new building will marry traditional building materials and new technologies: metal beams will extend lines of stone, wood and greenery.

At night, the pavement lights up as people walk through the water plaza: a dynamic pedestrian area made of luminous elements that contrast with the solidness of the paving materials. Yet another way for Manifattura to emphasize the contrast between tradition and innovation.

Figure 4.4 - Layout of new plazas

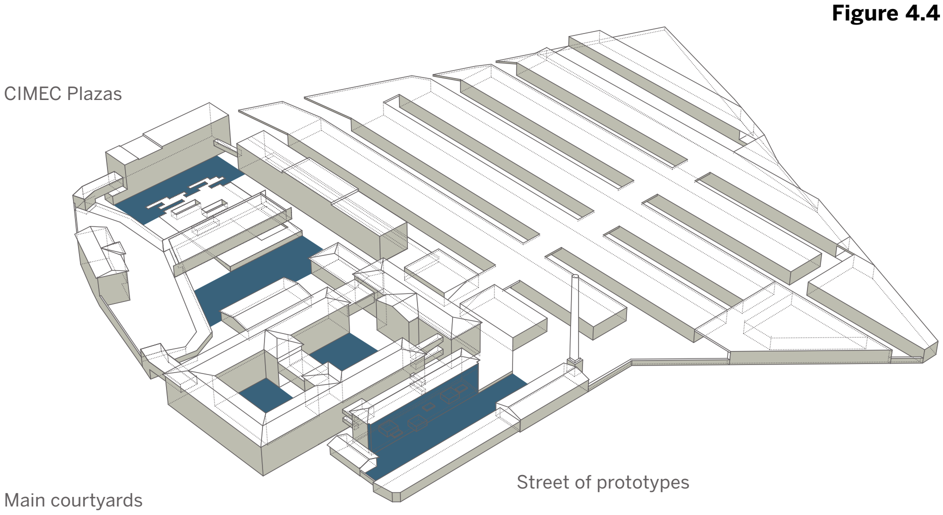


Figure 4.5 - CIMEC Plaza

Figure 4.6 - Transparent bridge between the wings of the main building.

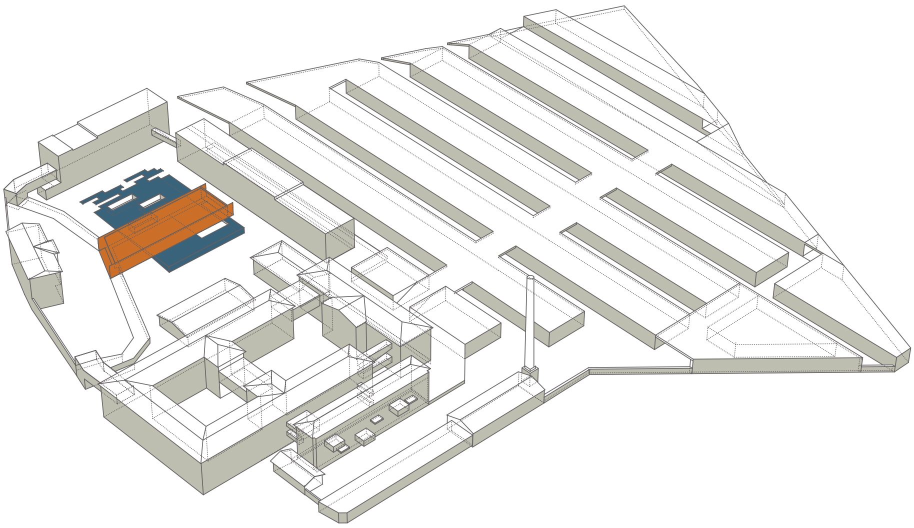


Figure 4.7 - New CIMEC building over water plaza

The Bridges

Changes will follow two complementary lines: functional improvement to and restoration of existing bridges, and construction of new elements suspended between the buildings.

The existing bridges are symbolic of past attempts to make rigid industrial structures dynamic. Built of wood and metal, they connected various production spaces. Today, the bridges will become meeting and exchange zones. They will be shared spaces that represent a dynamic, participatory approach. The new bridges will be placed between the rigid mesh of Manifattura's buildings. Lightweight and transparent, these elements create a dialogue between the early bridges and the austere buildings of the factory. The courtyards of the main building will be characterized by two changes: a central bridge will connect the two wings of the main building, and a new bridge will create a shared meeting area between the main building and the clock building.

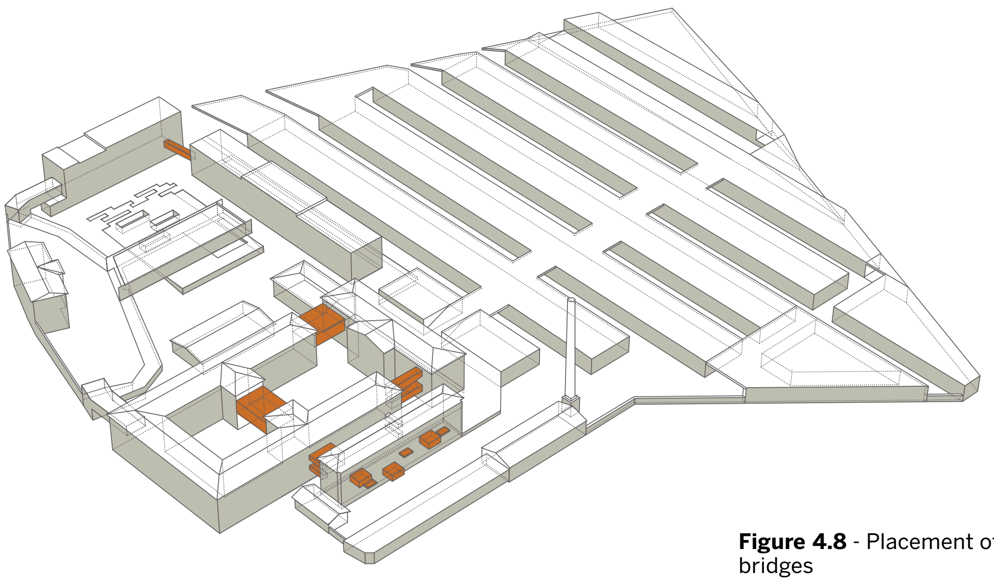


Figure 4.8 - Placement of the new bridges

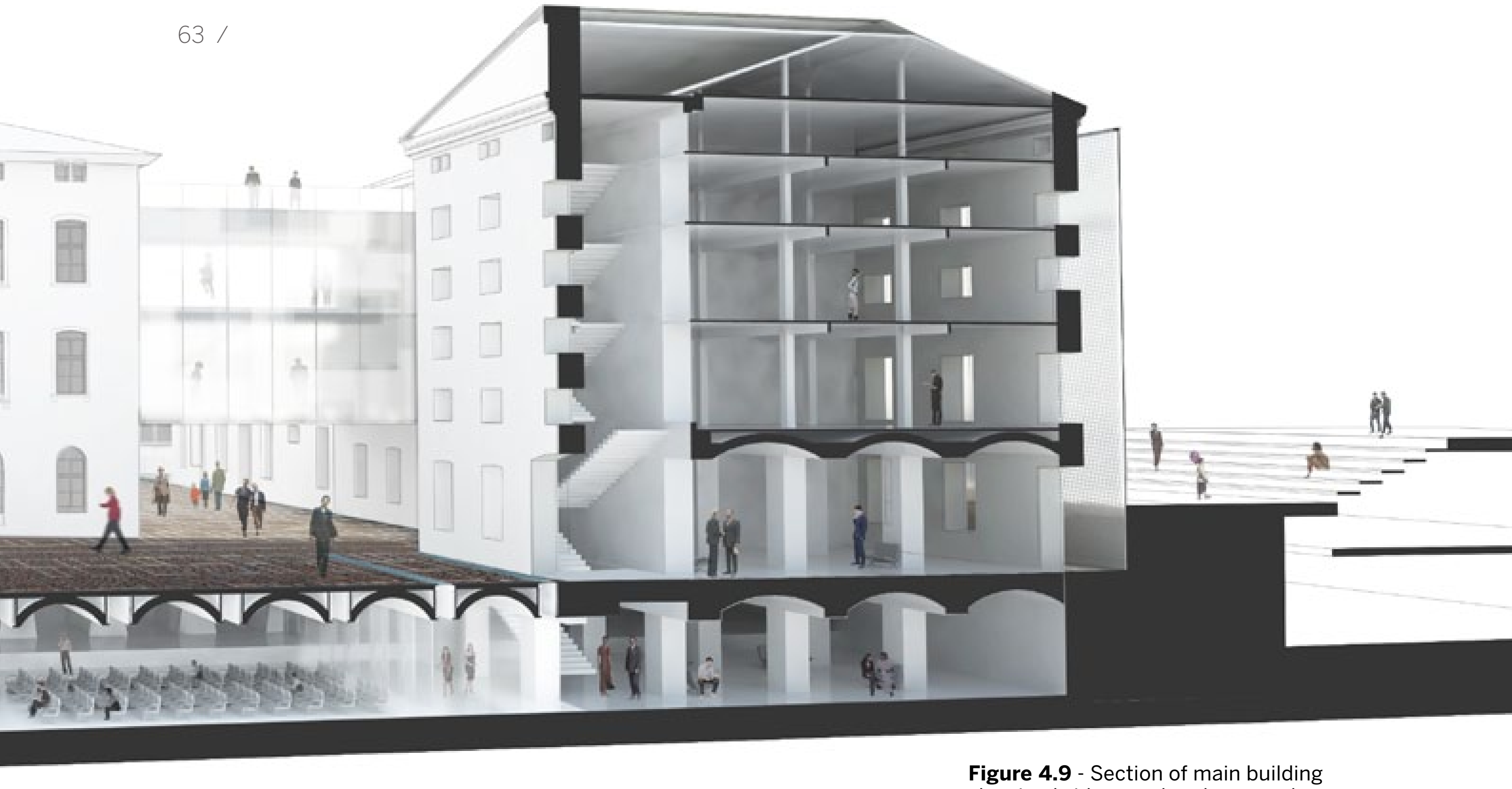


Figure 4.9 - Section of main building showing bridges and underground conference center

Other bridges will be added to complement existing bridges across the narrow alley between the main building and the shower building, creating a corridor of suspended rooms.

Transparent cubes will also extend over the street of prototypes.

The exterior of the new bridges will be of innovative materials such as nanogel which will highlight the exchange between public and private, while providing fascinating, luminous, and very comfortable places to work.

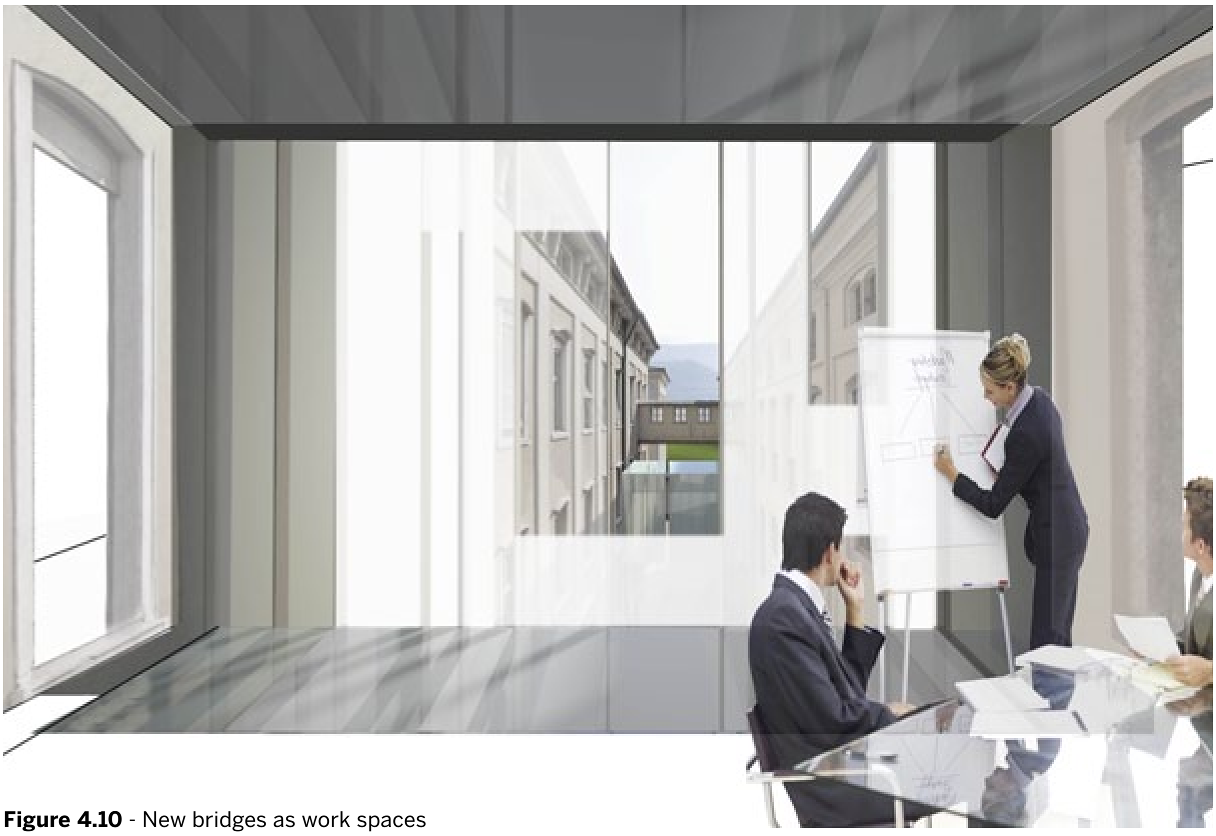


Figure 4.10 - New bridges as work spaces

4.3
Area B - Project vision for the production section

Manifattura's buildable spaces are the true production core of the project. The new buildings and production spaces will be placed below an extensive green roof. The objective isn't to disguise the buildings, but to gain visibility. When the walls that have been hiding the old Manifattura come down, the area will rejoin the natural landscape. But the green cover will make it especially visible: you can look inside the production spaces.

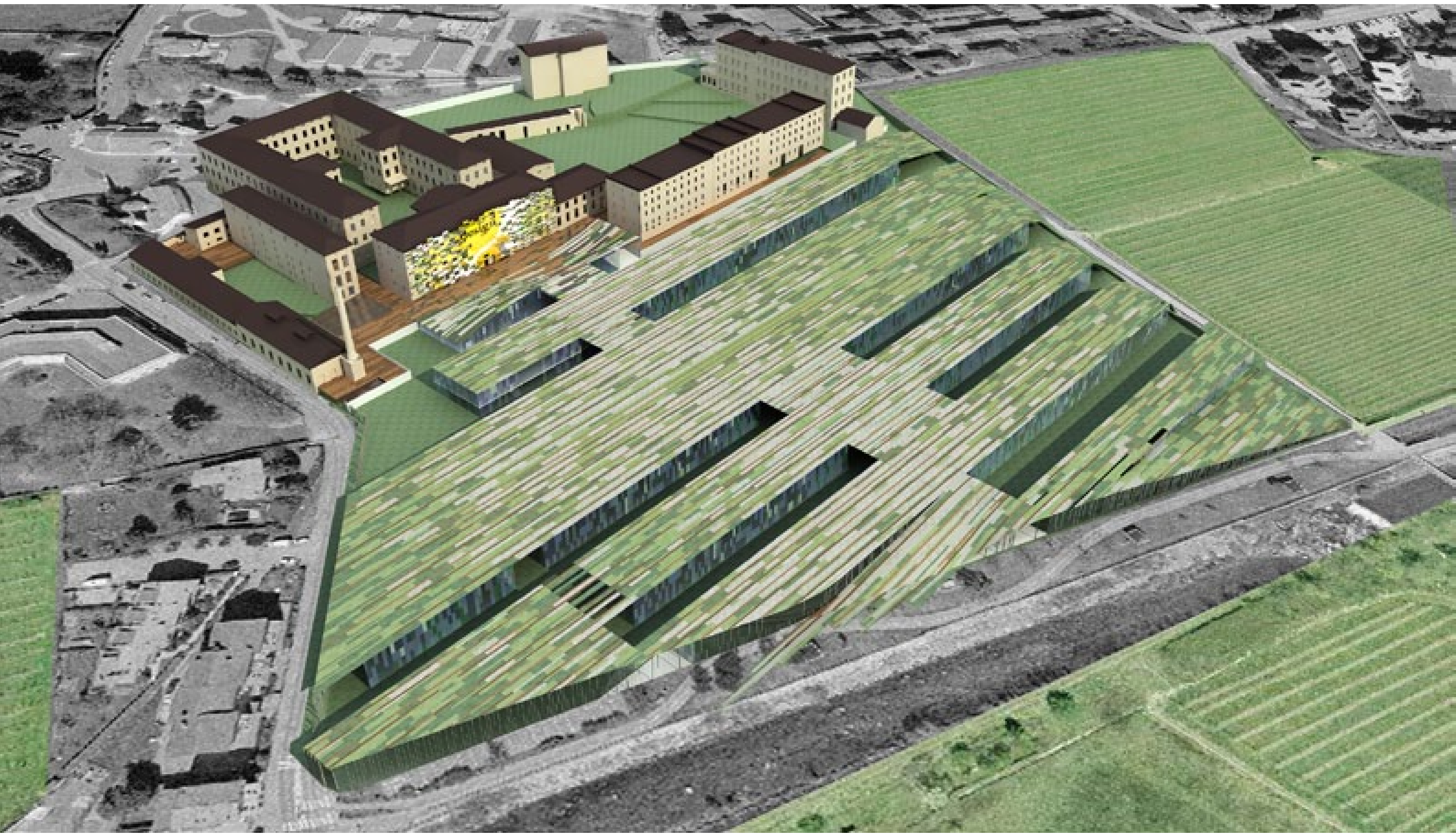
With safety and operations in mind, the roofs will be designed to separate public and private traffic.

The companies that occupy these spaces will be models of transparency, sustainability and technology that don't need to hide. Rather, they will gain by showing themselves and their production processes (where feasible).

This portion of the new Manifattura will maintain the identity of the site as a working factory. It will be a forward looking production zone that adopts modern processes, integrates advanced know-how, and welcomes start-ups and new technologies.

The new trigeneration plant will be built in this area to create clean energy for the entire complex. It is a feature that will define the new Manifattura as a sustainable production zone.

Figure 4.11 - Design of the green roofs



Leno river edge

A public space along the Leno river will be a leisure activities zone. Because of its location and usage, it will be an open invitation to partake in Manifattura experience. The area will have a fitness center, restaurant, exposition space, and training rooms.

Along with the trigeneration plant, these activities will be expressions of sustainability whose presence will guide public understanding.

The green roof will slope gently to the ground here to join with the path along the river and connect public and private environments.

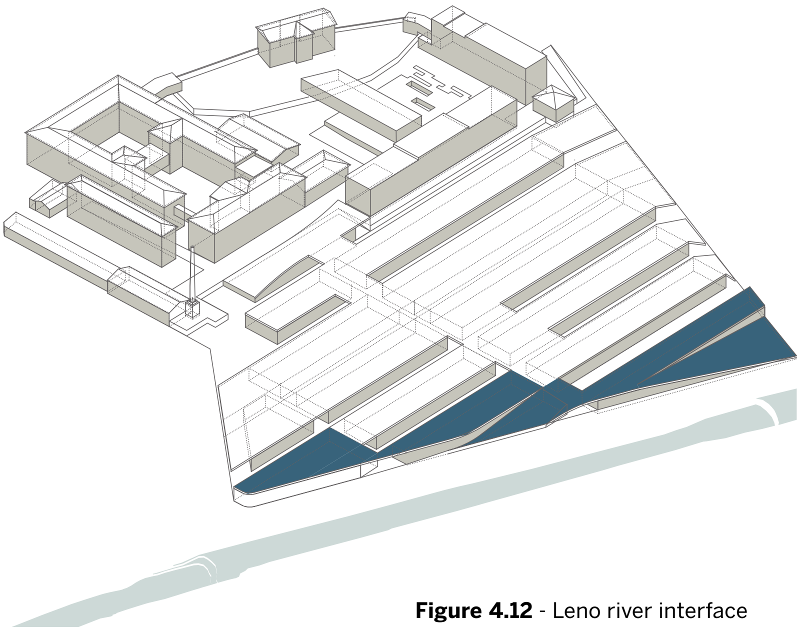


Figure 4.12 - Leno river interface

Figure 4.13 - River path and ramps to the green roof

Green roof: an elevated path

When you reach the top of the green roof, you can walk around looking down into the production spaces from this vantage point. Then go on to cross into the historic Manifattura.

A new multimedia façade will be the background of this point of arrival. This second skin on the rear of the clock building will represent the integration and the synthesis between the historic and technologically advanced buildings.

Figure 4.14 - View from the green roof

Production strips

The production buildings will extend in parallel strips, providing commercial space of various sizes and creating a high level of adaptability and flexibility for differing needs. With an 8-meter height, these structures will give flexibility, making it possible to insert mezzanines and to adapt internal configuration as desired.

Figure 4.15 - Strip configuration

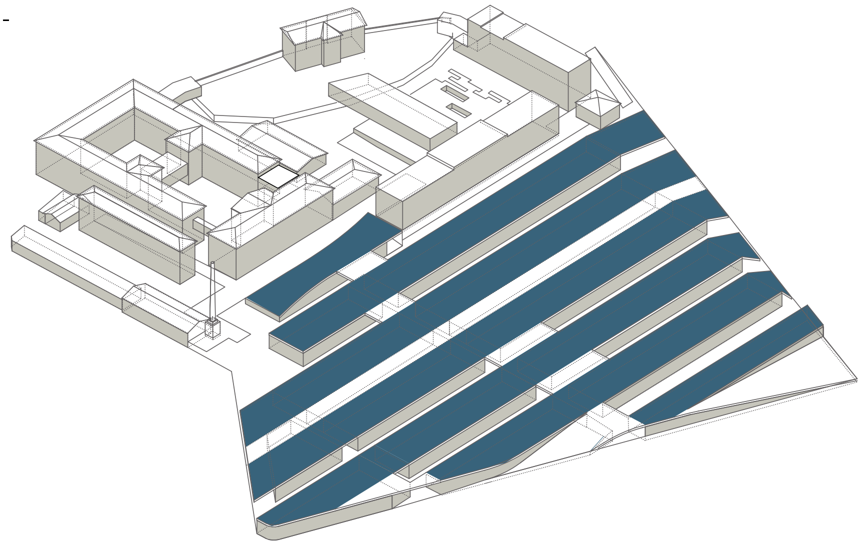
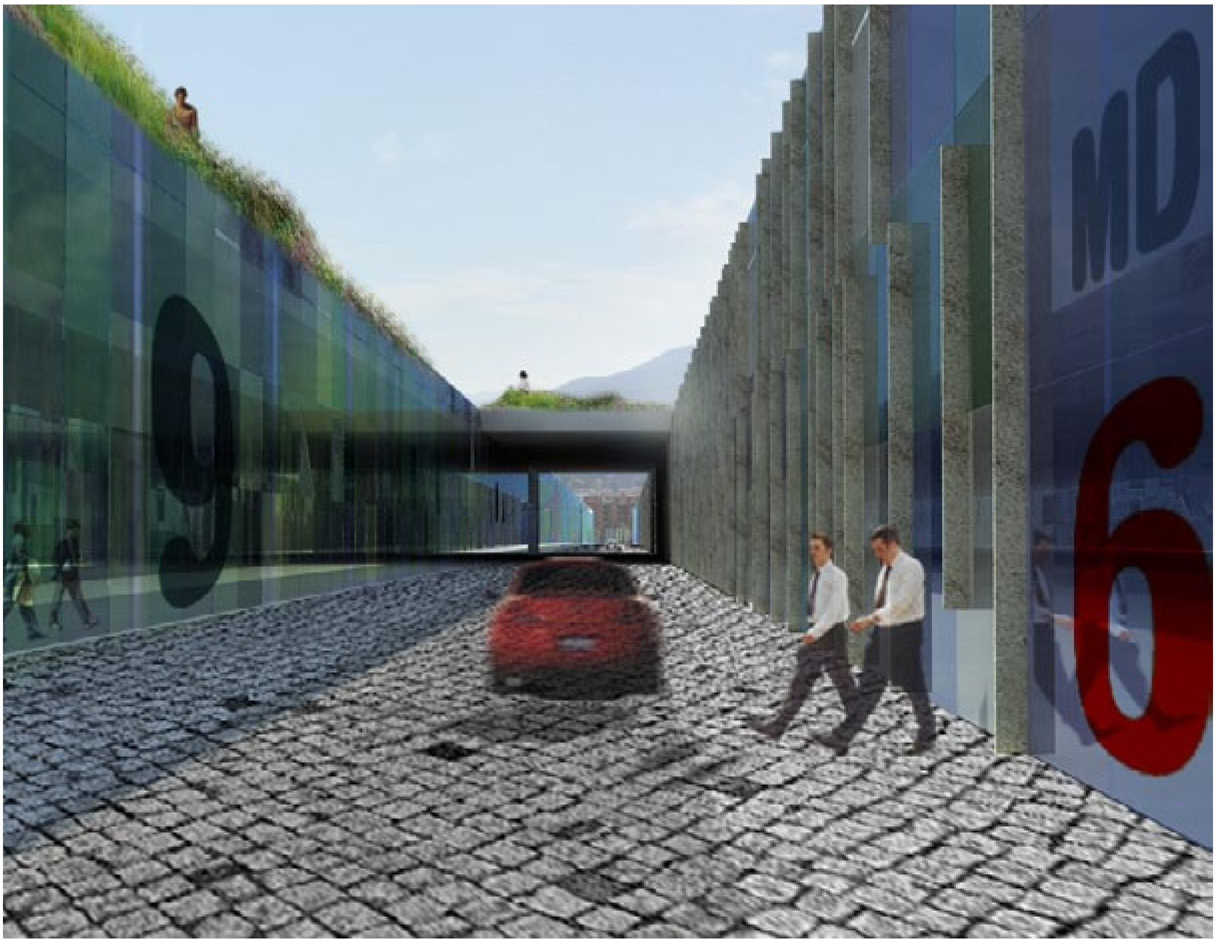


Figure 4.16 - View of the production spaces below the green roof



Deck

A deck, comprised mainly of wood, will bind the green roof production area to the historic area. The material will create a delicate transition between the green of the cover to the earthy, stone composition of the historic zone's open areas.

The green roof will descend to the level of the plazas and, in front of the clock building, will become a broad area for stopping and sitting. It's an informal amphitheater in front of the new multimedia façade built like a second skin on the rear of the clock building. This is a gathering place between the walkway coming from the river and the historic area.

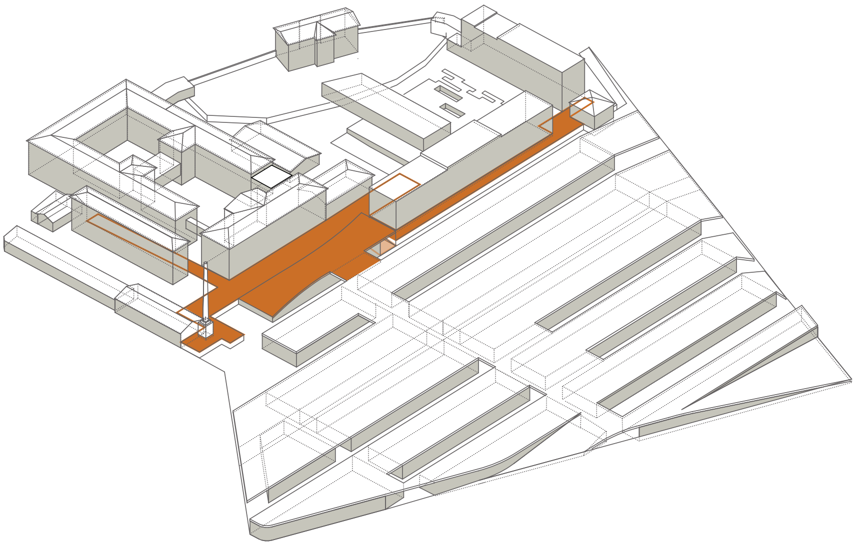


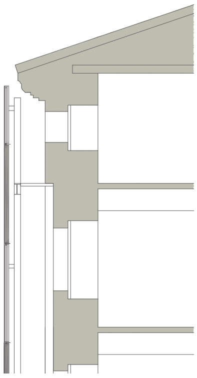
Figure 4.18 - Deck area

Figure 4.17 - View of the deck and façade

Media façade

The multimedia façade will be a layer on top of the rear face of the clock building: a delicate, semi-transparent skin that won't totally hide the existing face. Rather, the new façade will enrich the wall with new possibilities, creating a physical and conceptual transition between the historic and new parts of Manifattura.

"Media mesh" is a well tested technology comprised of a metal grid with LED lights. It acts as semitransparent covering or as a screen for providing information about things like energy consumption or events. But it can also be used for projecting films and performances with the deck acting as an amphitheater.



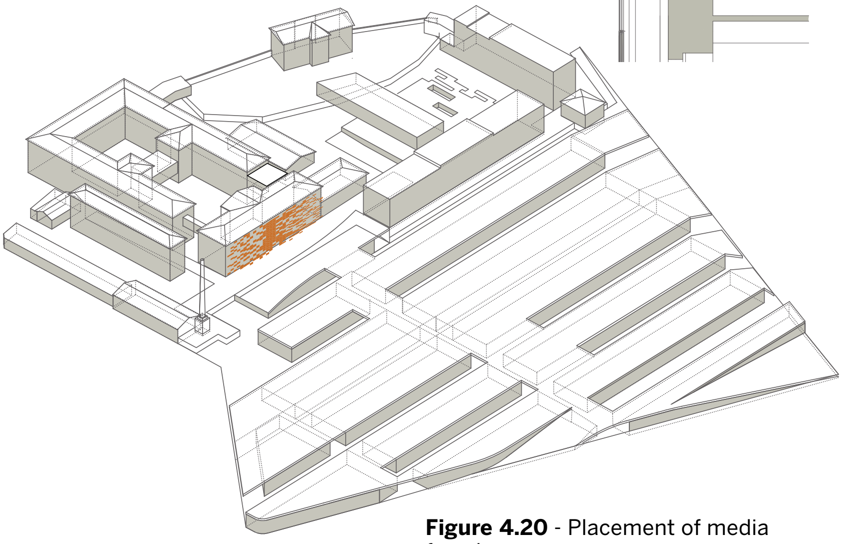


Figure 4.20 - Placement of media façade

Figure 4.19 - View of the media façade

East and west edges

Along the eastern edge with the adjacent vineyard, a green roof will connect with the ground gradually. These green strips will create a physical and visual connection with the existing landscape, but it will not be possible to access the green roof. To guarantee safety and security in the production area, access to the green roof will be permitted only from the river edge where Manifattura's main public activities are present.

The western edge along Via delle Zigherane will have vehicle, foot, and bicycle access limited to employees and users of the production area.

The physical configuration of this edge will provide for controlled access, but also guarantee the necessary visual permeability from the outside into the production zone. Here, the green roof transforms into a light cover that forms a semi-covered pedestrian zone.

Figure 4.21 - View of the eastern and western edges

Planning principles

A variety of public amenities will be placed along the Leno river side of the site, providing functionality such as fitness rooms, restaurant, and training rooms, as well as the trigeneration plant.

The deck zone, where the green roof transforms into an interaction and break area, will be surrounded by research laboratories, creating a conceptual transition between the production zone and the professional zone of the historical buildings.

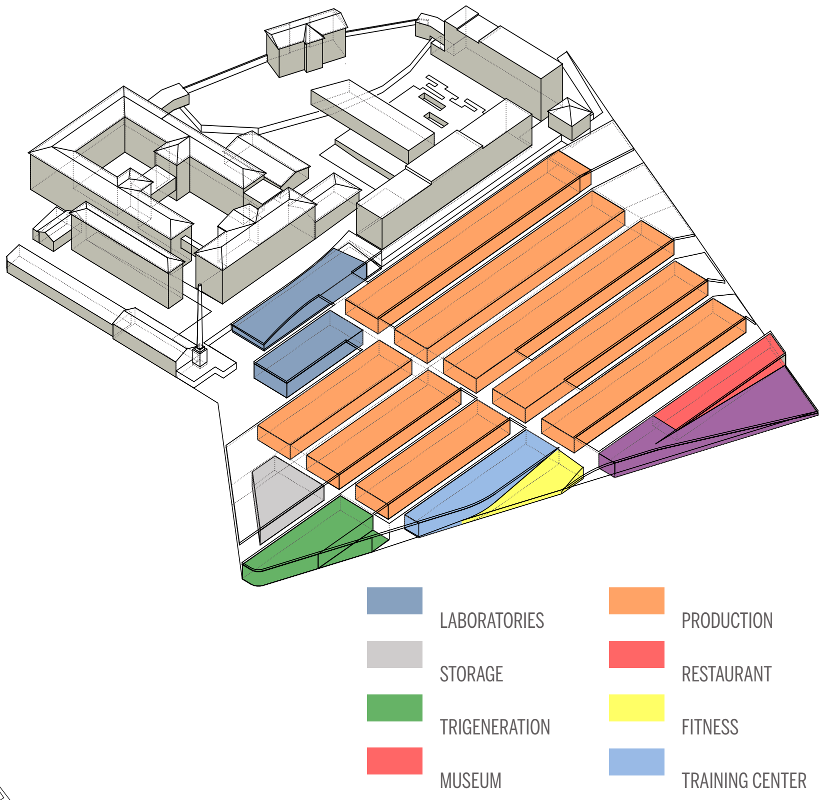


Figure 4.22 - Functional study of production spaces

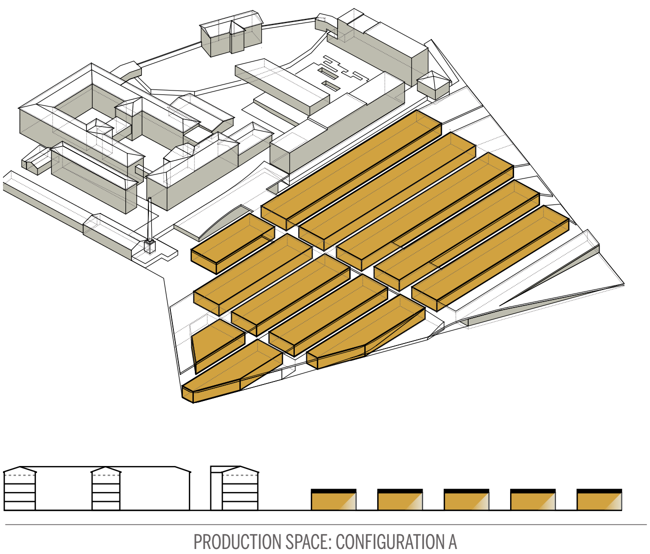
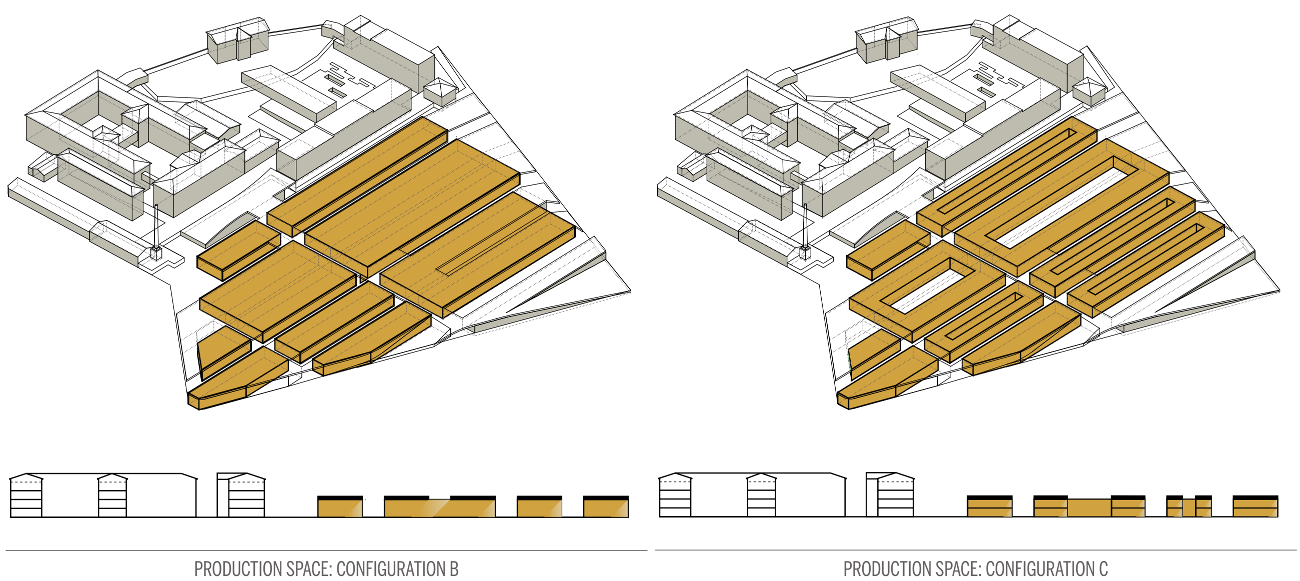


Figure 4.23 - Flexibility: possible space configuration



4.4 Architectural designs

Plans

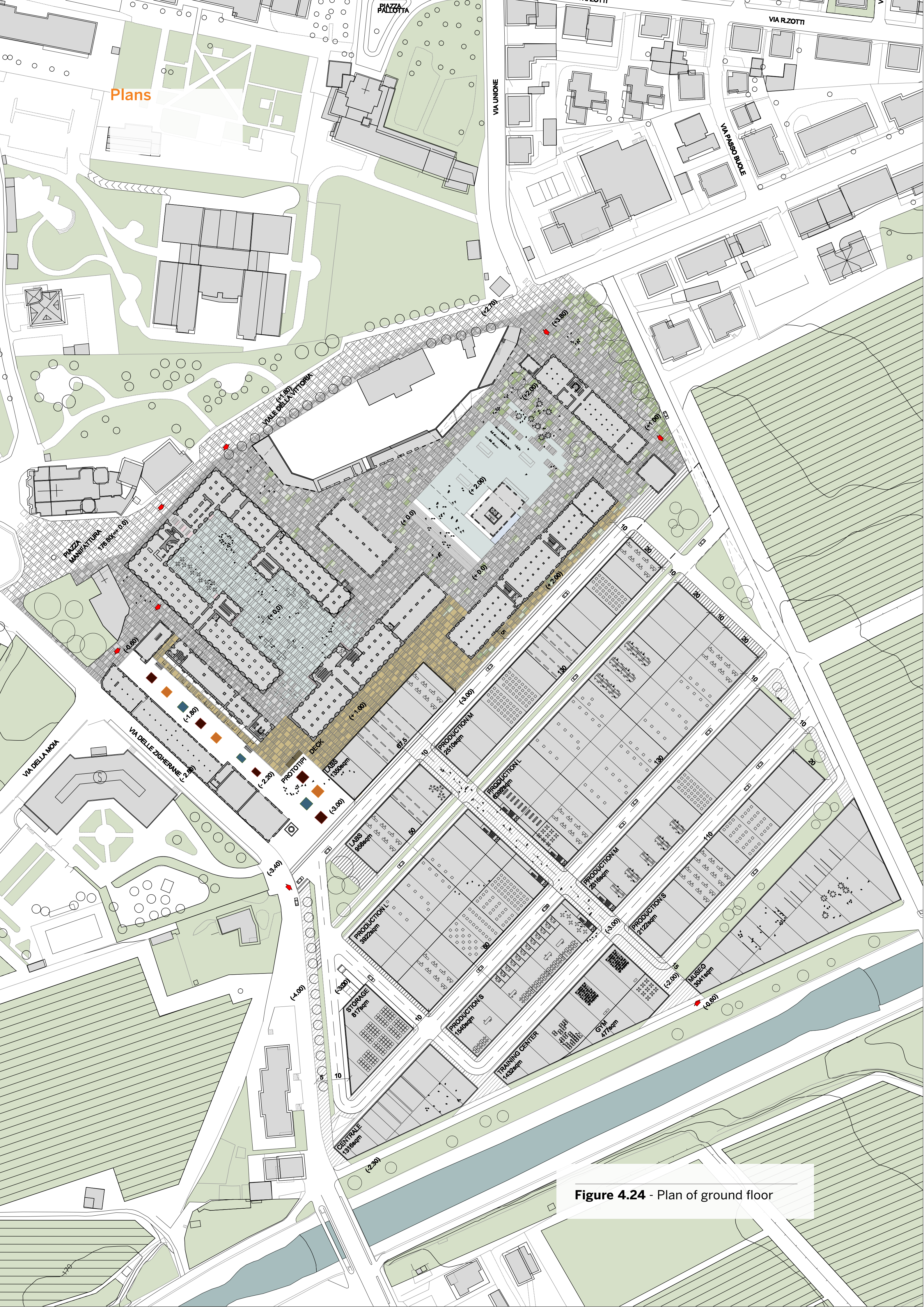
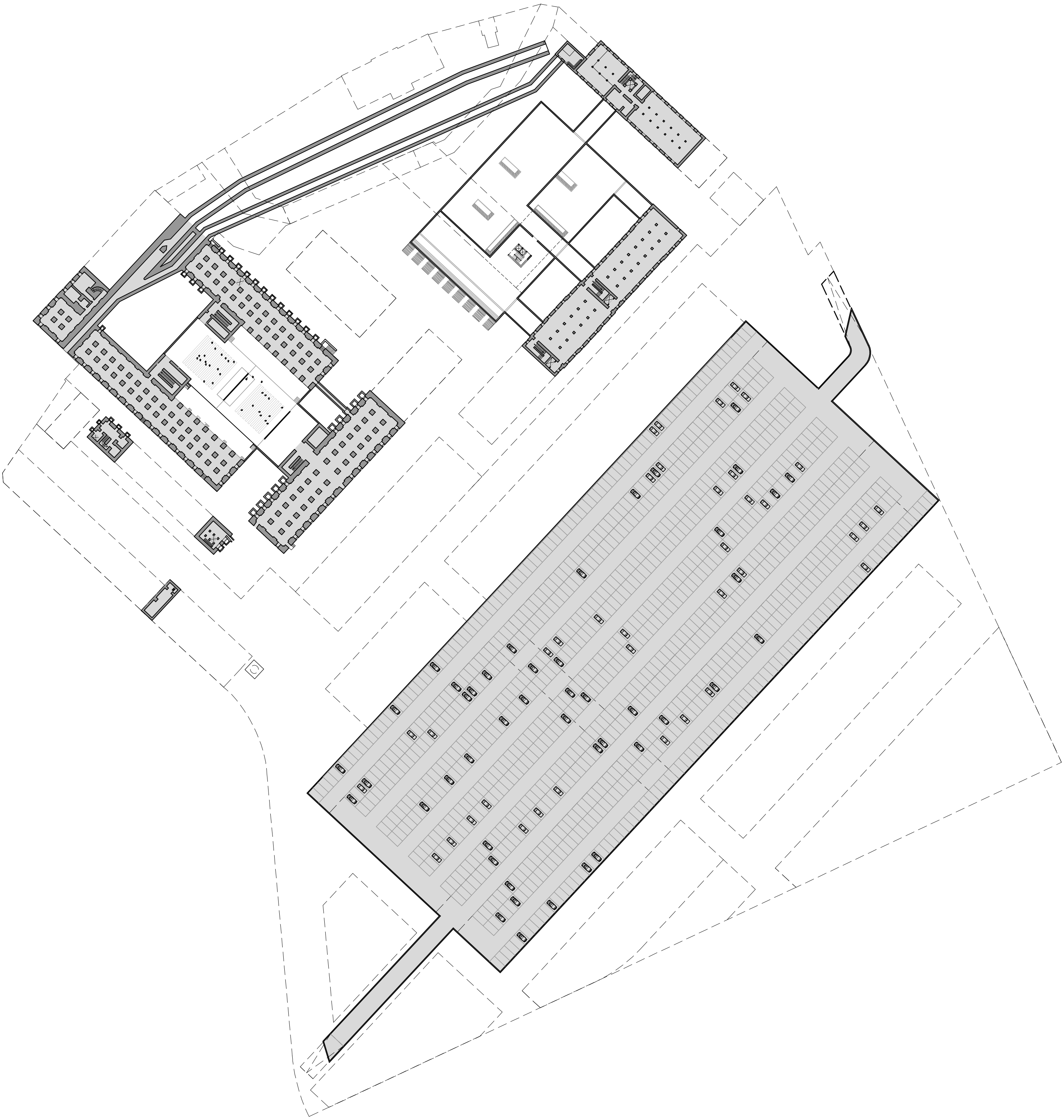


Figure 4.24 - Plan of ground floor

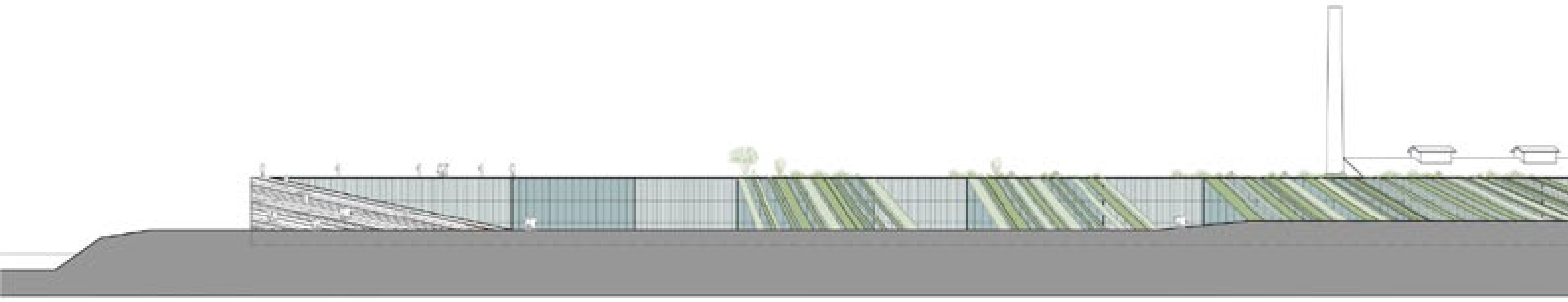
Figure 4.25 - Plan of the underground floor

The number and dimension of parking spaces and ramps to be defined later.

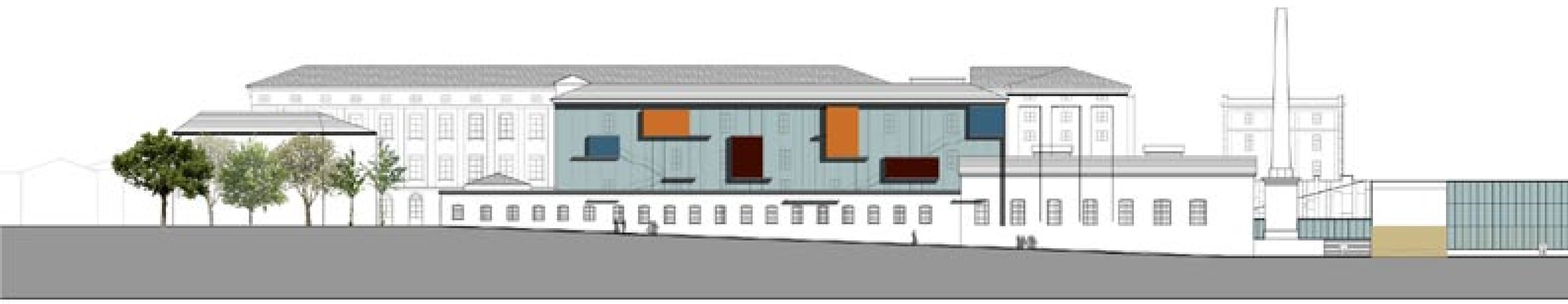


SECTION HH

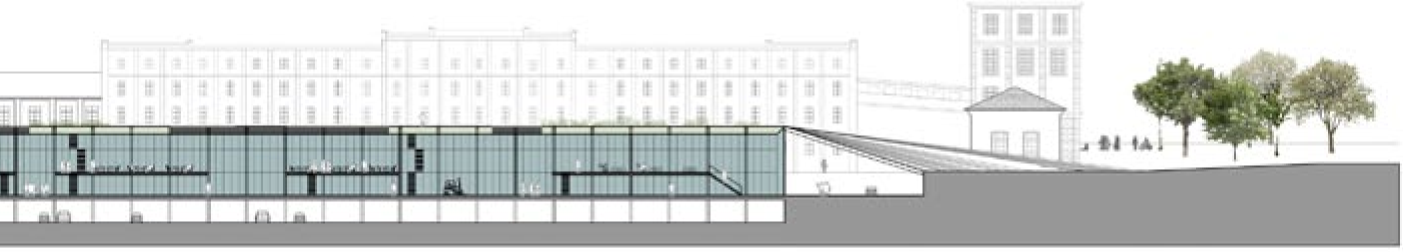
SOUTH PERSPECTIVE

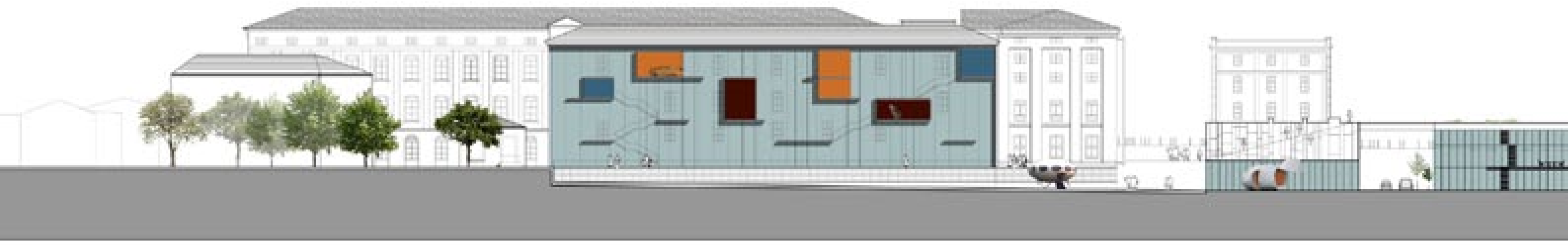


NORTH PERSPECTIVE



EAST PERSPECTIVE





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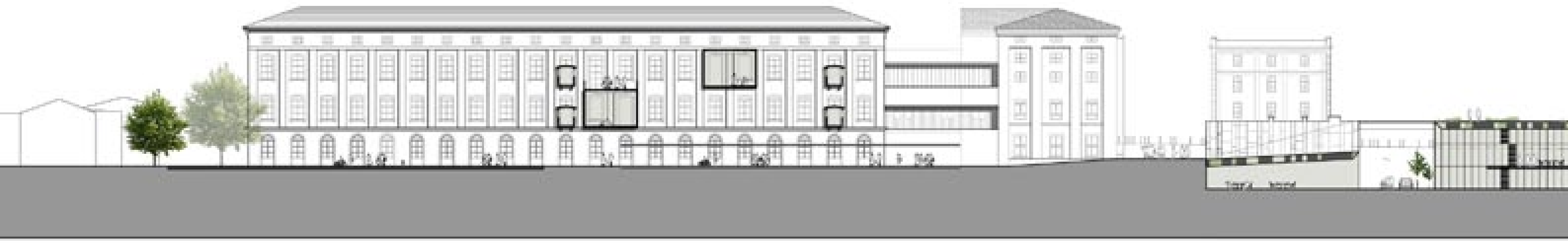

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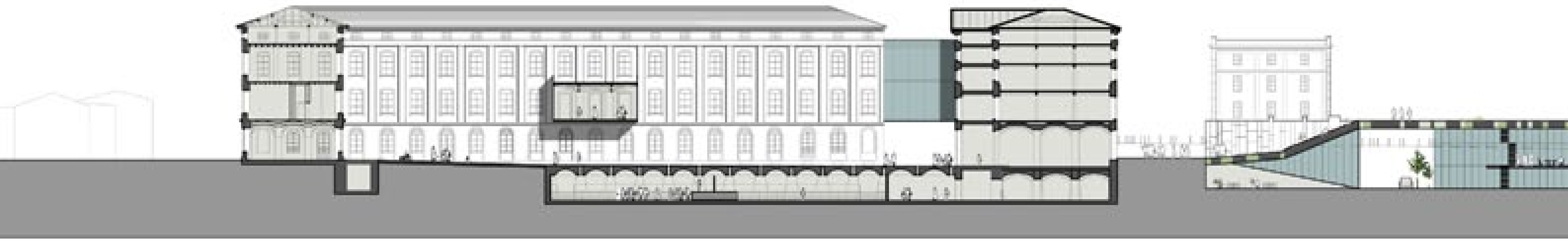

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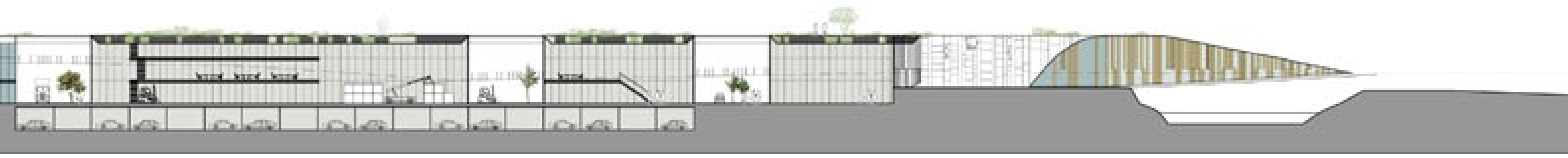

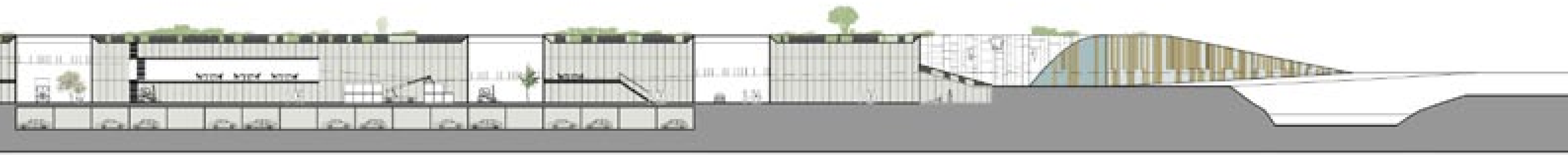

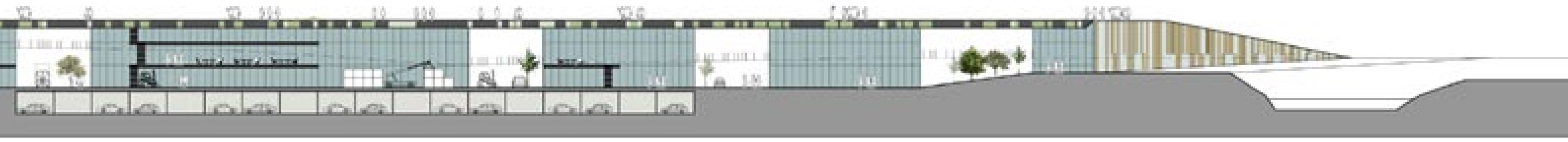

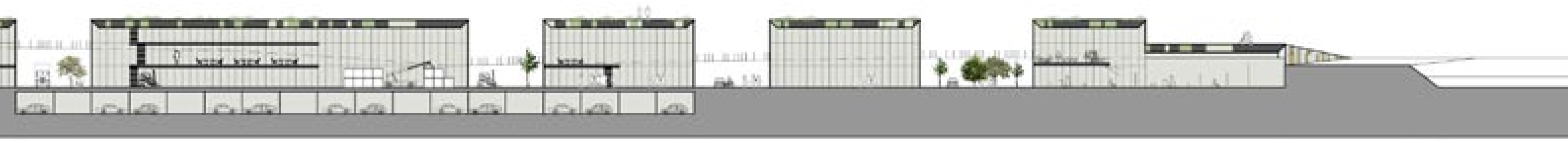

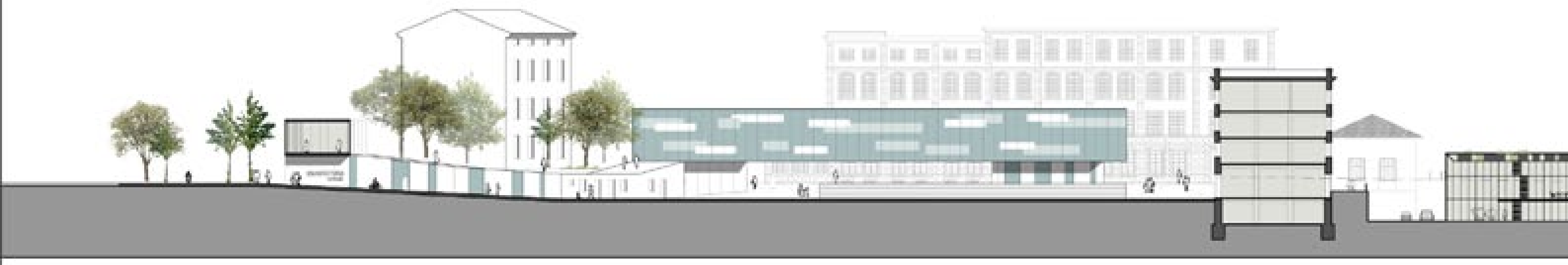

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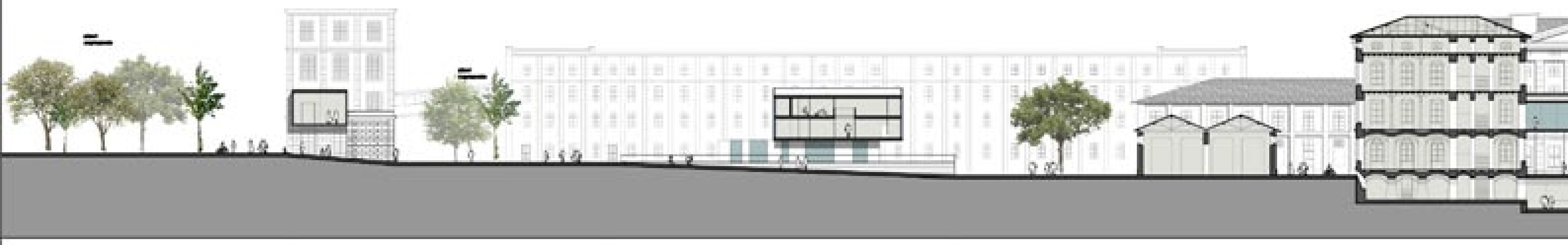

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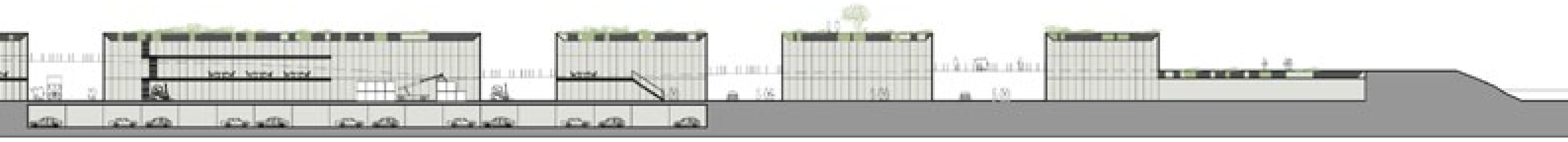

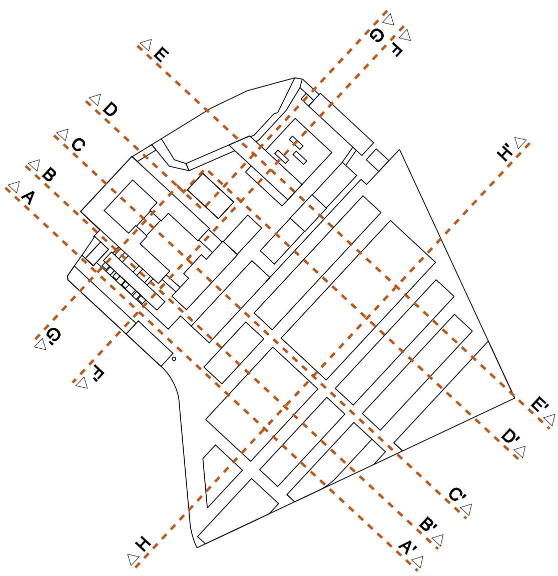
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4.5 Energy strategy

Definition of "Business as Usual"

A sustainable energy strategy will be developed to favor natural building behavior in a system of efficient buildings. It will also define the basic form and orientation of buildings in order to maximize passive strategies that promote an organism that can effectively deal with external climate conditions, limit the size of the climatization system and maximize the use of renewable resources.

To reach this goal, we took an interdisciplinary approach. The strategy started with an analysis of local climate to establish the energy needs of the site and identify energy sources on or close to the site.

Considering standard data, the climate conditions of the site were examined in order to understand peak demand over the course of a year.

The standard winter UNI norms data for Rovereto are Tmin= -12°C, U.R. = 62,5%, and summer Tmax= 31°C, U.R.=45,6%. Analysis of the Energy Plus Data Base shows external temperatures for Trentino province are less than 0°C for 5% of hours annually, 0–22°C for 81%, 22–24°C for 10% and 24–38°C for just 4%. This shows the importance of developing an energy plant and distribution system that is efficient especially in terms of winter heating so as to greatly reduce annual energy consumption. Moreover, an analysis of annual solar radiation shows that the site has peaks of direct incidental solar radiation in the 600–650 W/m² range that are restricted to just a few days per year.

We performed the energy analysis of the master plan buildings first by identifying the state of the art in terms of norms as well as in the energy needs of the existing buildings in their current state.

Both regional and national norms were applied in defining the BaU scenario.

The buildings under the master plan were considered from an historical architectural perspective. Buildings in zone A have heritage status, meaning that only retrofits that would not change their architectural appearance were considered. On the other hand, the new buildings planned for zone B do not have heritage status which means that all new energy norms apply.

To evaluate energy use, dynamic simulations were performed for the existing structures of zones A and B using thermal modelling software. The BaU case was determined based on norms and architectural requirements.

The structures of the buildings in their actual state were estimated according to the thickness of their horizontal and vertical covering surfaces, date of construction, databases referred to in norms (UNI TS 11300-01 2008 Evaluation of energy need for space heating and cooling) and other common databases.

All the buildings were evaluated according to thermal energy demand for heating and hot water as well as for cooling. Only heating and hot water were considered in determining a building's energy class.

The building simulations were conducted using minimum internal loads for winter as necessary for work uses and instrumentation as defined in norm UNI 11300 in relation to uses foreseen in the master plan.

Because the project foresees use mainly in the services sector, all the buildings were considered in terms of kWh/m³ needs per annum.

Zone A

The thermal energy demand of the buildings in Zone A is in the range of 35–70 kWh/m³.

Given the thermal plant's standard global performance of 0.85, the result is a primary energy demand for heat of 45–82 kWh/m³. This need corresponds to energy classes E-F-G. To improve building performance, a retrofit consisting of replacing windows and doors, adding insulation to the horizontal structures and inserting a ground floor insulating slab is planned.

This modification would result in a heating demand of about 40–45% with primary energy demand of 25–44 kWh/m³, given a thermal plant with a standard global performance of 0.85.

This corresponds to energy classes C-D-E. The demand was used as BaU for the heritage buildings of Zone A. It was also established that the proposed modifications would see a return on investment in 2 to 3 years, just in terms of CO_2 emissions for the materials used.

A further simulation on the heritage buildings evaluated additional retrofits: creation of an internal insulating layer over opaque vertical cover elements. This modification reduces the thermal energy demand for heating by an additional 20–25% with an overall reduction of about 50% from the current situation. This modification would not present a substantial reduction in energy demand considering a trade-off of a large amount of CO_2 required to produce the insulating material.

Zone B

Not on the heritage listing, buildings in Zone B were subjected to different analyses in defining BaU. These buildings were determined to have a thermal demand for heating of 50–100 kWh/m³. Considering a thermal plant with a standard global performance of 0.85, the primary energy demand for heating is 60–120 kWh/m³.

Furthermore, the buildings in Zone B could be handled in various ways, from demolition and reconstruction to simple renovation. Considering current norms, these buildings would have to meet the threshold values foreseen by national and provincial law.

A simulation evaluated the idea of substituting the cover of the existing buildings with cover elements that meet the minimum thermal standards of Law 311/2006. The buildings were evaluated using the same surface to volume (s/v) ratio, the same percentage of window area, and the same arrangement of transparent surfaces. With this modification, the thermal energy demand of the buildings would change by 15–25 kWh/m³, reaching a class C or C+. This kind of performance does not meet the minimum requirements required by provincial law as regards building energy class.

Therefore, we studied the thermal performance of a covering capable of achieving a heating energy performance of less than 13 kWh/m³ (see figure below).

Summary

In conclusion, the BaU case foresees heritage buildings being classed in C-D-E, whereas non heritage buildings should achieve B classification for primary heating requirements considering a thermal plant with a standard global performance of 0.85.

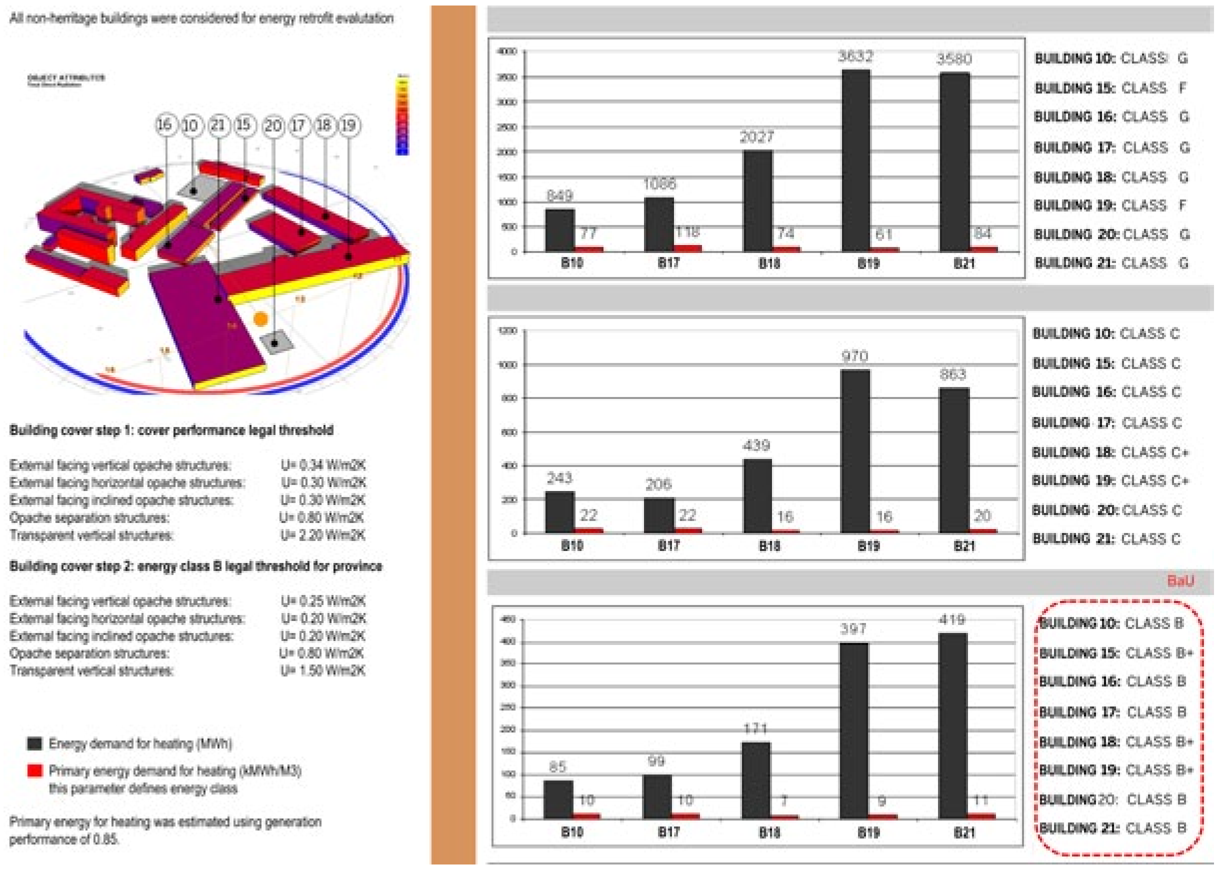


Figure 4.26 - Energy demand for heating of buildings in Zone B

Calculation of BaU energy demand

BaU performance of building cover was dynamically simulated using IES Virtual Environment software to determine the energy demand for heat, hot water, cooling, illumination, and electrical instruments.

The calculation was done according to standard protocols defined in CIBSE and UNI 11300.

The data used for input was based on international standards ASHRAE and CIBSE and on UNI norms relative to the uses foreseen in the master plan. The data include:

- Type of use.
- Parameters for internal loads from illumination, use, and equipment.
- Parameters for air exchange per person.
- Parameters for electrical load for illumination, equipment, small power needs and auxiliary systems of the mechanical plant.

Regarding buildings for light manufacturing, some data was taken from preliminary information provided to Kanso in March 2010 regarding the kinds of companies targeted as tenants.

Preliminary information supplied by CIMEC was used to determine the type of equipment in buildings destined for use by the University of Trento.

The energy demand for heating was calculated considering:

- Energy dispersion through the cover.
- Energy dispersion through thermal sinks.
- Ventilation dispersion as a result of primary air exchange for air quality. (This was calculated using a heat recovery system able to preheat external air with an efficiency of around 50–60%.)
- Free solar contributions using reduction factors.
- Free internal contributions using reduction factors.

The thermal energy required for cooling was calculated using:

- Internal loads from illumination, use, and equipment.
- Solar loads.
- Heat transmission from opaque and transparent coverings.
- Heat contributions from ventilation as a result of pri-

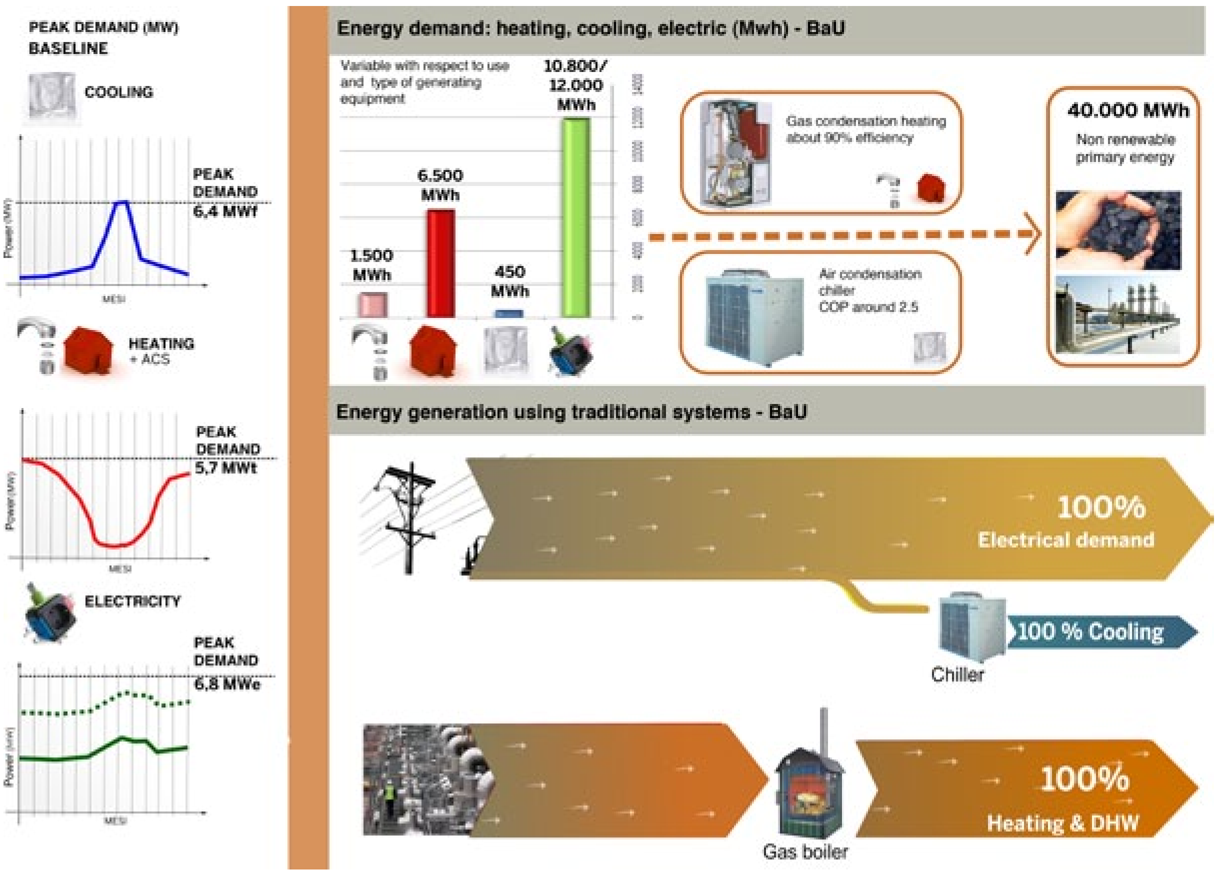


Figure 4.27 - BaU energy demand and typical supply

mary air exchange required for air quality. (This was calculated using a heat recovery system able to preheat external air with an efficiency of around 50–60%.)

Illumination demand was estimated using values for the uses foreseen in the master plan.

The analysis of energy demand was evaluated considering a heating period foreseen by UNI norms and using estimates of daily and yearly operation in relation to the uses described in the master plan.

Typical energy supply for BaU scenario

Analysis of the peak energy demand for buildings under the BaU scenario indicate: 6.4 MWf for cooling, 5.7 MWt for heating and hot water, 6.8 MWe for illumination, small power needs, and equipment, including electrical energy for traditional mechanical systems.

Annual energy demand for the buildings is estimated as:

- 1,500 MWh for hot water.
- 6,500 MWh for heating.
- 450 MWh for cooling.
- 10,800 MWh for electricity for mechanical generation systems.

In this scenario, generation of the energy required was considered to come from traditional systems: gas boilers making hot water with an efficiency of 90% and an air condensation chiller for cooling with a performance coefficient of 2.5. All electrical energy comes from the grid.

This solution—which does not consider high efficiency systems or the use of renewable energy sources—foresees an annual consumption of about 40,000 MWh of non-renewable primary energy.

Sustainable energy mix

Considering the high amount of non-renewable primary energy required by traditional mechanical generation plants, we studied an alternative energy mix that could significantly reduce primary energy demand. The goal was to improve overall efficiency and reduce non-renewable energy demand by employing different generation systems able to exploit local, natural energy sources.

The generation systems were evaluated in terms of their CO_2 emissions compared to traditional systems. The technical feasibility of such systems was also considered on the basis of availability.

Another aspect we considered was the annual profile of energy needs for heat, cooling, and electricity. The objective was to find a mix of generation systems that guaranteed the greatest efficiency in relation to hourly energy demand across an entire year. The basic idea was to find a set of systems able to guarantee synergy between production and demand.

Because Manifattura will be used mainly for service activities, with a part for light manufacturing, the main energy need is electrical. For this reason, we considered systems capable of producing a portion of that need from renewable sources.

A hydroelectric plant could generate electricity with a turbine driven by water flowing from a higher to a lower position. These systems are efficient up to 80–90% and in theory can operate about 4,500 hours per year.

The potential energy and flow of the Leno river was evaluated, but the results were not favorable. However, analysis of the Adige river demonstrated that it was feasible. In fact, historical records indicate that a small generation plant existed at one time.

Analysis shows that, on a daily basis, electrical energy demand is essentially constant. This favors plants that can generate a continuous supply such as trigeneration facilities.

A trigeneration plant produces a combination of electric/mechanical and thermal energy using the same primary energy source. In the summer, using a heat adsorber (the inverse of a refrigerator), the residual heat from same plant can be used to provide cooling.

In comparison to separate electrical and heat systems, this kind of energy production:

- Saves money by using less fuel.
- Reduces environmental impact because it has less emissions and also releases less unused heat into the atmosphere.
- Loses less energy in transmission and distribution because most of the energy is consumed on-site.

With cogeneration technology, electrical and thermal energy are produced in series using a single system, resulting in efficiency that can reach 90%. The method also results in energy savings of about 25–30% with respect to separate production.

Cogeneration systems are favored in the European Union directive 2004/8/CE. It's objective is to increase energy efficiency through a framework for promotion and development of high efficiency cogeneration.

Considering the goal of reducing CO_2 emissions and local availability, the idea is to build a trigeneration facility that uses wood-chip biomass as its primary energy source.

The system employs a diathermic oil heat system to run an ORC turbo generator (Organic Rankine Cycle Turbine generator) that produces electrical energy. Any residual heat is used for on-site heating.

The system foresees an overall efficiency of about 72% for thermal energy, of which 55–60% is used in refrigeration and 15–18% is used to produce electricity.

Beyond providing energy for Manifattura, the trigeneration plant will also be an example of sustainable production whose visibility will be particularly useful in explaining the technology to visitors.

A heat pump is planned to satisfy peak heating and cooling demand. It will function using either an open groundwater system or a closed-circuit geothermal system.

These systems present an overall performance coefficient of 4.5–5.0 in winter and, in summer, an energy efficiency rating of 6.0–6.5.

The difference in the figures is due to the difference in temperature at the surface and the more or less constant year round temperature of groundwater (12–15°C). Put simply, the difference in temperature is greater in winter than in summer.

Applying the sustainable energy mix to the BaU scenario

To reduce non-renewable primary energy demand, we studied a renewable energy mix that would guarantee:

- Safety and functioning during development.
- Adaptability and modularity that consider various master plan development scenarios.
- Architectural requirements.
- Availability of space for the systems and for distribution.
- Energy efficiency.
- Reliability.
- Adaptability to a variety of climate conditions.
- System redundancy.
- Low environmental impact.
- Reduced carbon emissions.

Electrical demand will be met by:

- An off-site hydroelectric plant (Adige river) with a capacity of about 450 kWe, which will meet about 20% of Manifattura's annual electricity needs.
- A trigeneration plant fueled with wood-chip biomass with a capacity of around 580 kWe. The plant will function about 8,000 hours per year and will provide about 38% of demand. The plant will be located along the Leno river in order to simplify resupply of fuel, as well as offer public viewing. Locating the plant on the side of the site will also make it easier to connect electrical production to the grid.

Wood-chip demand will be about 80–90 m³ per day, or about 10–11,000 tons per year. The chips will be stored on-site with a maximum volume of 300–350 m³, which means the plant will need to be resupplied two times per week. About 76 tons of CO_2 per year will be produced by the transport of the chips considering a 200 km route from the supplier to Manifattura. The amount of CO_2 emitted is about 2% of the total CO_2 that would be emitted by a traditional generation system.

The remaining 40% of electrical energy demand will come from the national grid.

Thermal energy demand for heating and hot water will be created by:

- A trigeneration plant fueled by wood-chip biomass with a capacity of around 2.6 MWt. The plant will produce about 80% of the total need, and will have excess capacity that could be used to heat about 30–40,000 m² of new, class B residential homes.
- A geothermal heat pump with a total capacity of about 1.0 MWt. Two possible solutions were identified.

Solution 1 would use three extraction wells with a flow rate of about 30–35 L/s and a thermal differential of about 5°C. There is currently a permit for one well for industrial cooling purposes that allows a maximum of about 32 L/s to extract groundwater with a temperature of about 11–12°C, with re-emission at about 15–16°C. The solution would be technically feasible, but would require an in situ test to ascertain the quality of the water and to evaluate the potential for extending the flow capacity.

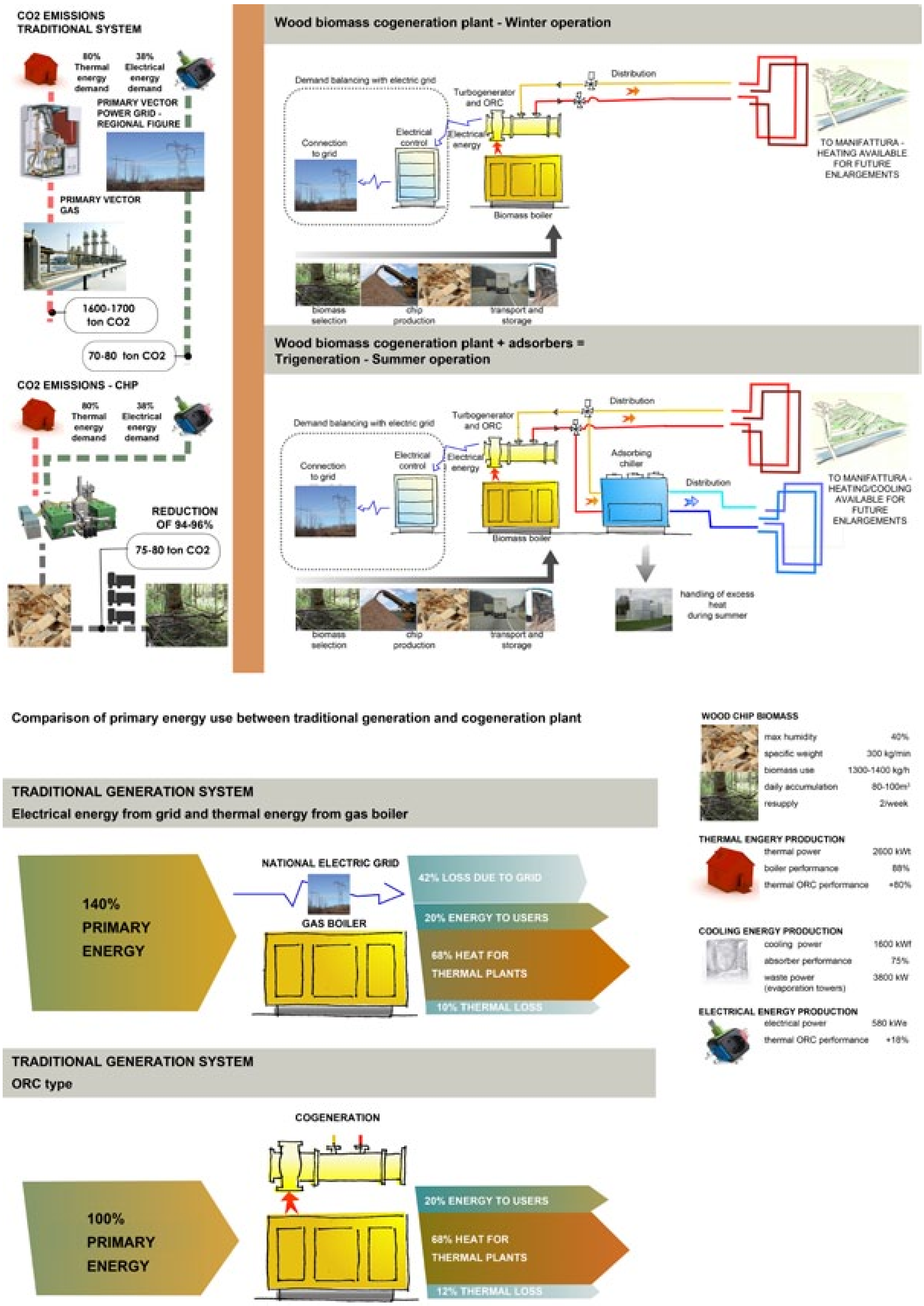


Figure 4.28 - Description of the trigeneration plant

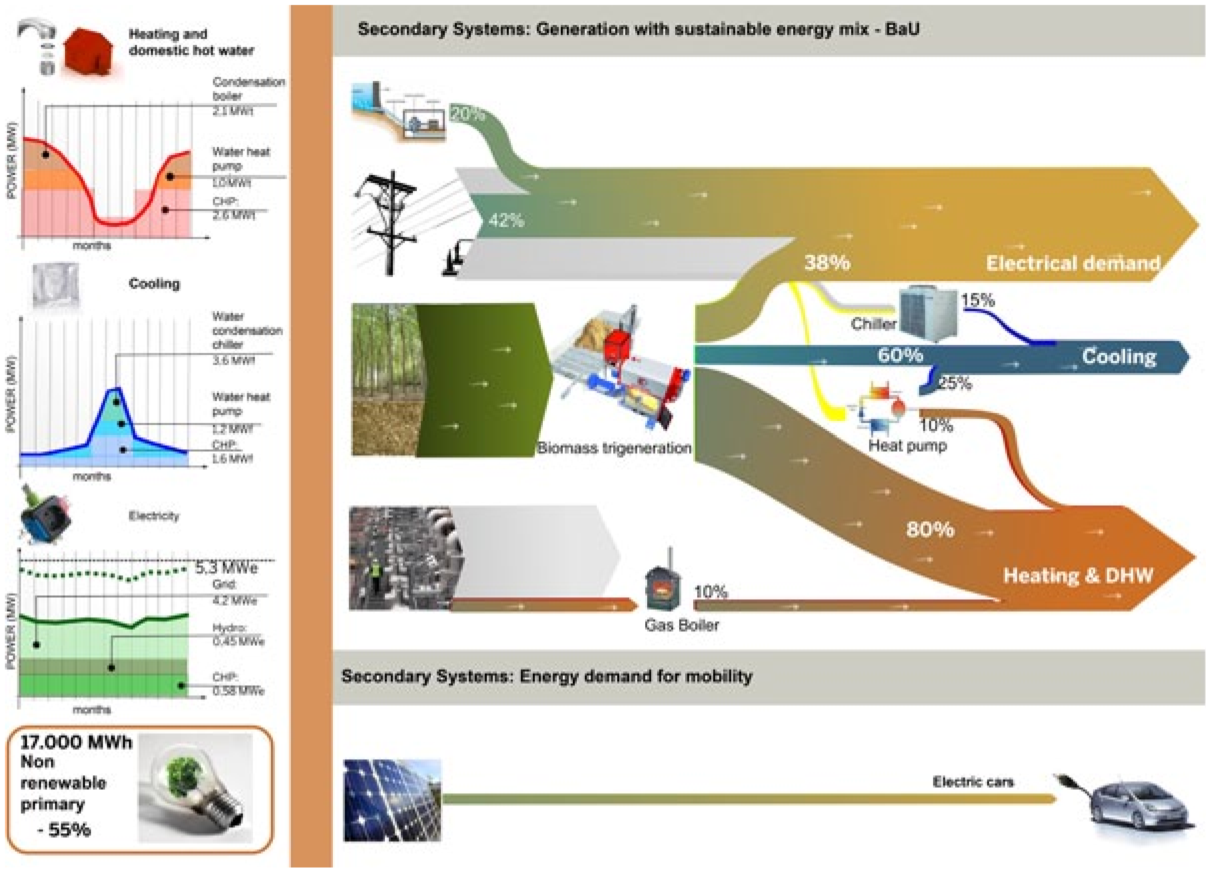


Figure 4.29 - Sustainable energy mix for meeting the energy demand of the BaU scenario

Solution 2 would use from 150 to 170 vertical probes sunk to a depth of about 100 m.

Both solutions would be able to generate about 10% of the total need.

A methane condensation boiler with an output of about 4.7 MWt will produce about 2.1 MWt for around 10% of the total need. It will also be available as a back-up system if there is an interruption in biomass delivery or the trigeneration facility is down. The size of the system could be reduced if the site is attached to the existing tele-heating system.

The demand for cooling will be satisfied by:

- A trigeneration plant fueled with wood-chip biomass with a heat adsorber able to produce around 1.6 MWt of cooling. The plant will meet about 60% of overall need.
- Geothermal heat pumps with a total output of about 1.2 MWf using the systems described previously. The system would cover about 25% of cooling needs.
- Water condensation chiller with evaporation towers with an output of about 5.3 MWf. The chiller will operate at about 3.6 MWf, but will provide back-up to the tri-generation plant as needed.

All the systems were studied so as to assure modularity and back-up in case of maintenance or breakdowns.

In order to meet spikes in demand, a successive design phase will need to optimize the back-up service in accordance with the foreseen uses of the site.

Reducing energy consumption in the final scenario

The final scenario was studied to optimize the shape and orientation of the new buildings in order to:

- Maximize the contribution of free solar energy in buildings with a constant occupancy of offices, laboratories, meeting rooms, etc.
- Maximize the use of natural lighting in the light manufacturing buildings to reduce electrical demand. Various configurations foreseen by the master plan for Zone B were evaluated. The evaluation was based on glass siding covering 100% of the surface and no transparent horizontal cover. The proposed solution can reach a Daylight Factor (DF) of about 0.10–0.11 for an

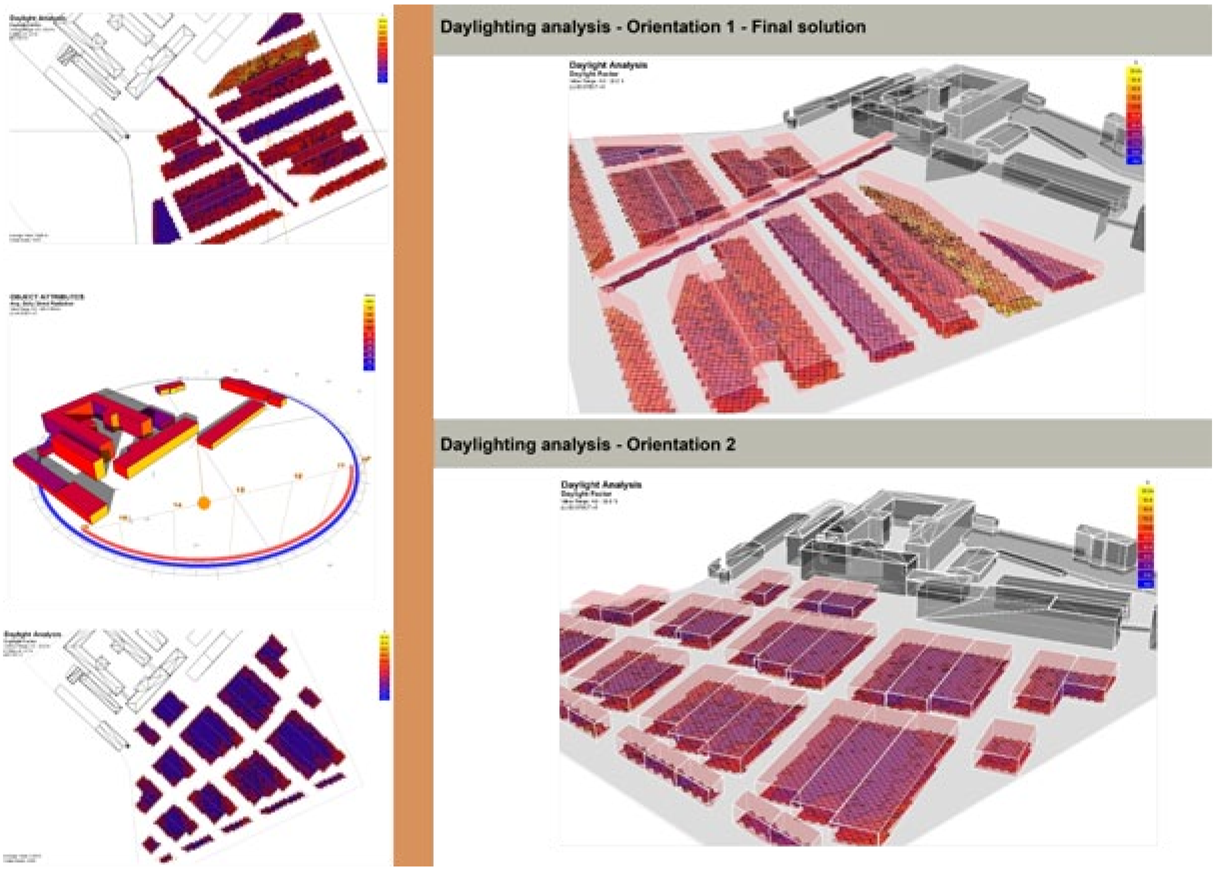


Figure 4.30 - Analysis of building orientation for natural lighting in Zone B

improvement of 20–25% over the second solution. This DF rating could also be maintained in a later design phase by reducing the glass siding and increasing the amount of glass roofing (preferably towards the north) so as to achieve greater uniformity and minimize glare.

- Develop buildings that can be adapted to successive variations in use without changing the status quo.
- Increase the performance of opaque and transparent building cover in order to reach class A efficiency for new buildings in Zone B. This would reduce thermal energy demand for heating by about 18%.

Furthermore, we supposed that the new buildings would be designed to exploit active and passive sustainability strategies such as natural ventilation, heat recovery systems, and the adaptability of people's metabolic behavior to different types of activities.

Sustainable energy mix applied to energy demand in the final scenario

We studied the use of a sustainable energy mix to the energy demand of the final scenario maintaining the same percentages of supply, but reducing the size of the systems that don't use renewable sources.

We managed to reduce the overall amount of non renewable primary energy consumption to 12,000 MWh, a reduction of around 70% with respect to BaU using traditional energy systems.

Another idea was to introduce on-site and off-site photovoltaic plants capable of producing electrical energy for charging electric vehicles as envisioned in the master plan.

The off-site system could be an extension of an existing photovoltaic plant along the A22 motorway which uses panels placed on a sound-proofing barrier.

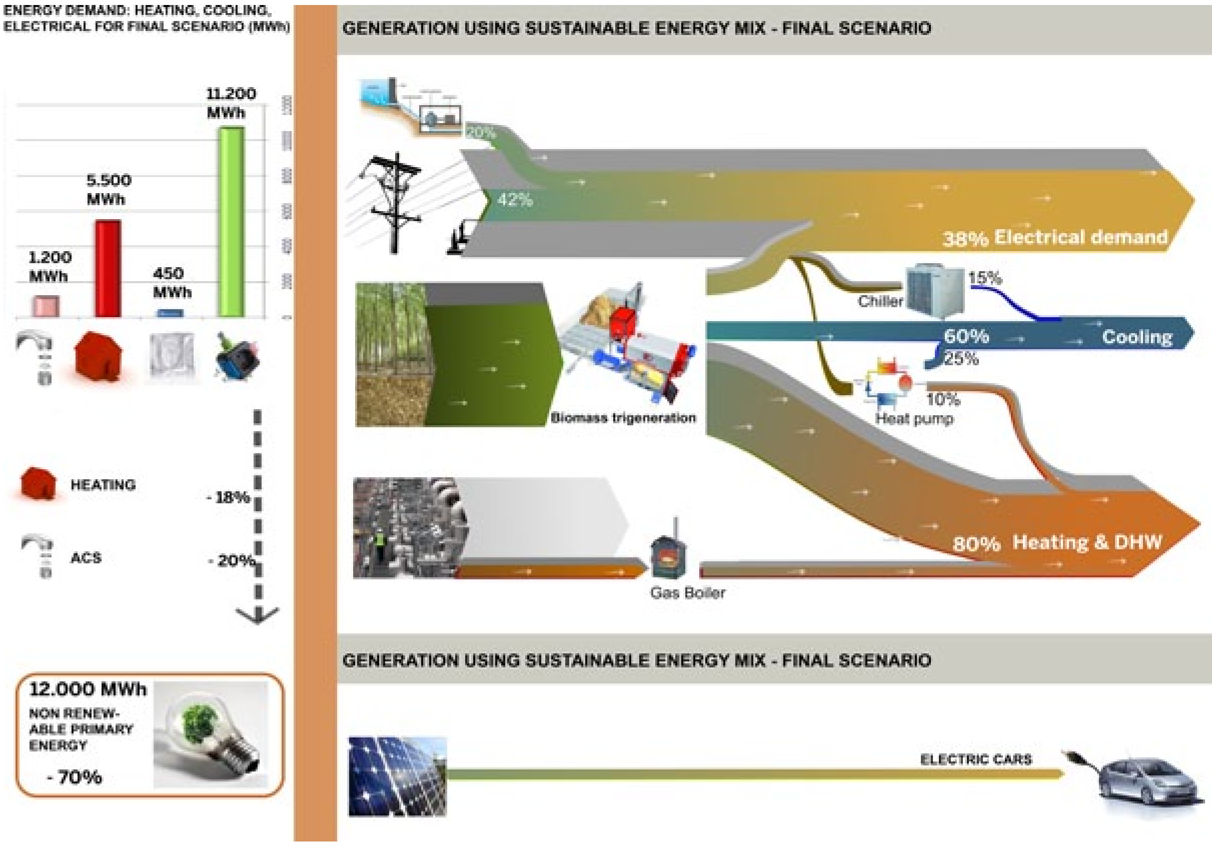


Figure 4.31 - Energy mix for final scenario

Note on the origin of wood chip biomass in the Trentino-Alto Adige region

Following up on the preliminary analysis of Manifattura's trigeneration plan, the annual demand for wood-chip biomass is estimated to be 6–10,000 tons.

Figure 4.32 illustrates the origin and potential of biomass in the Trentino Alto Adige region and current output of the two provinces of Trento and Bolzano.

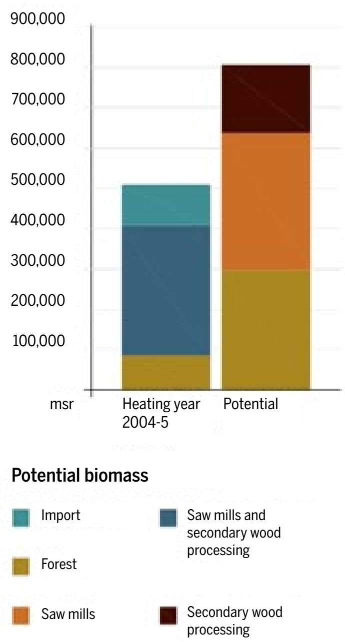
In Trentino, the 2008 production of wood biomass was about 114,000 tons per year. A forest service report estimates a further 80,000 tons of capacity, of which 30% (27,000 tons) could be obtained in a sustainable way. Further production of about 100,000 tons could come from saw mills. Forested area is increasing in the region due to reforestation of pasture land and abandoned mountain farms.

The province of Bolzano produced a report on the use of biomass and its origins for the heating period 2004–2005 which shows that about 20% was imported and shows how local sources could be doubled.

Figure 4.32 - Biomass use and potential in Trentino-Alto Adige region

		Trentino	Alto Adige
Territory	Forest area	56%*	45%
Biomass power plants	Installed potential	24MW 29MW	47.25 MW of which >6MWe
	Planned potential	38.5MW	N/A
Locally sourced	Increased potential	+110-160%	+100%

* increasing



Conclusion and final considerations

The energy strategy follows from a logical analysis of the constrictions and opportunities of the site, review of the current state of the buildings, and the definition of a starting point. From this, we arrived at how to satisfy traditional demand by conducting an evaluation of available technology alternatives. Finally, we considered how to reduce overall demand and arrived at a solution that achieved concrete, sustainability objectives.

One specific study of the existing buildings showed that by following certain guidelines it was even possible to make the relatively modern buildings of Zone B efficient. The decision to opt for their demolition was motivated by functional aspects that would support both socioeconomic goals as well as sustainability ones. The impact of demolition will be ameliorated by other strategies as described previously.

Moreover, we verified that because local norms require high standards of building efficiency, and because of the kind of building use expected, reduction in energy demand had less impact than the kind of supply.

In effect, even considering transport of the wood chips, the proposed biomass trigeneration plant will lead to a 95% reduction in CO_2 emissions with respect to traditional supply at the defined level of demand.

Combined with a system that extracts energy from groundwater (either directly from the water or through closed circuit wells), as well as off-site hydroelectric energy and a photovoltaic systems, the proposal can achieve the predetermined objectives.

The proposed systems are, in any case, well proven technologies in northern Italy, which means they can be phased in over the development period.

For peak demand and back-up, traditional energy generation systems are foreseen, as is hookup to the national electric grid.

The final proposal is based on certain assumptions regarding development of existing buildings in the historic zone and new buildings in Zone B.

The design of individual buildings will have to meet these minimum criteria:

- Retrofit of thermal insulation and windows of the historic buildings (with approval of the heritage council).
- Achievement of class A status for new buildings as defined by the current provincial norms.
- Treatment of south facing windows with the necessary shielding.
- Careful design of openings to allow for natural ventilation and illumination where possible.

To proceed with successive phases of system design, especially regarding use of groundwater, the hydroelectric project, and the biomass trigeneration plant, approval processes of the province and the river basin authority will have to be followed.

In conclusion, the energy strategy has established the following parameters in order to reach the project's preset goals:

- New buildings in Zone B will be designed to attain energy class A in order to reduce thermal energy demand by 18–20%.
- A sustainable energy mix in combination with the final scenario will reduce energy demand by 70% with respect to non-renewable primary energy sources.
- A sustainable energy mix in combination with the final scenario will reduce CO_2 emissions 80–85% for heating, cooling and electricity.
- Orientation of new buildings will increase natural daylight in new buildings by 20–25%.
- Use of rainwater and gray water will reduce demand for water from municipal mains by 60%.
- Studies of generation systems show that the transport of wood biomass creates CO_2 emissions that are just 3% of the emissions of a traditional generation system.

The energy mix strategy was based on contextual and historical considerations regarding hydroelectric generation, groundwater use for thermal exchange, and locally sourced biomass.

4.6
Water management

Figure 4.34 - View of Leno river

Waste water treatment facility

The Manifattura site has a currently inactive waste water treatment facility on the south-west portion of Zone B. In defining the master plan objectives, it was decided not to reactivate or rebuild a new facility. The choice was not incompatible with the future activities of Manifattura and has the advantage of eliminating the adverse environmental impacts typically associated with that kind of system (noise, unpleasant odor, dust, etc.).

Public water resources for hydroelectric power

The energy mix envisages the realization of a small hydroelectric power plant. The decision to use this type of energy source is inspired by Rovereto's network of canals which were used to power Manifattura's machines in the 19th century. Energy demand and new technologies require a more modern solution (such as a Kaplan type system with an inverter).

During the development of the master plan, we studied the feasibility of creating a hydroelectric plant that would use water from the Leno, but the geodetic drop was not compatible with the energy demand.

Consultations with the public water authority of the province of Trento confirmed that there were no laws against diverting Adige River water for hydroelectric generation. Considering the distance of Manifattura from the left bank of the Adige, the plant would have to be located off-site on property owned by Manifattura or on public land granted for the purpose of power generation.

In any case, Manifattura once owned an off-site hydroelectric plant in the locality of Sega in the town of Noriglio. The plant's output was about 187 kW and is now owned by Dolomiti Energia.

The approval process which would follow from a request for water use would be coordinated by the province which would need to provide a favorable opinion and then do an environmental impact assessment.

Evaluation of water needs and rain water use

We evaluated potable water needs for all the buildings in zones A and B according to the final scenario.

The evaluation was based on occupation levels provided by Kanso, the uses foreseen in the master plan, standard data following UNI norms, and standard simultaneous use coefficients (ASHRAE, CIBSE).

The evaluations indicated a daily potable water need of about 250,000 liters.

Potable water for use in bathrooms and for irrigation was estimated to be 30–35% of the total. To reduce the amount of potable water required, treated rain water can be used for these purposes. So, we considered a rain water recovery system, including treatment and storage, that could provide for toilettes and irrigation.

Calculations were made to determine rain water yield, yearly water demand, and usable tank volume as per norm DIN 1989-1. Publicly available rainfall data was used in the calculations (www.eurometeo.com). Rainwater yield was estimated to be about 15,000 m³ per year.

The covered surfaces of the final scenario were used in the calculations as were runoff coefficients for different kinds of roofs, including the green roofs of Zone B.

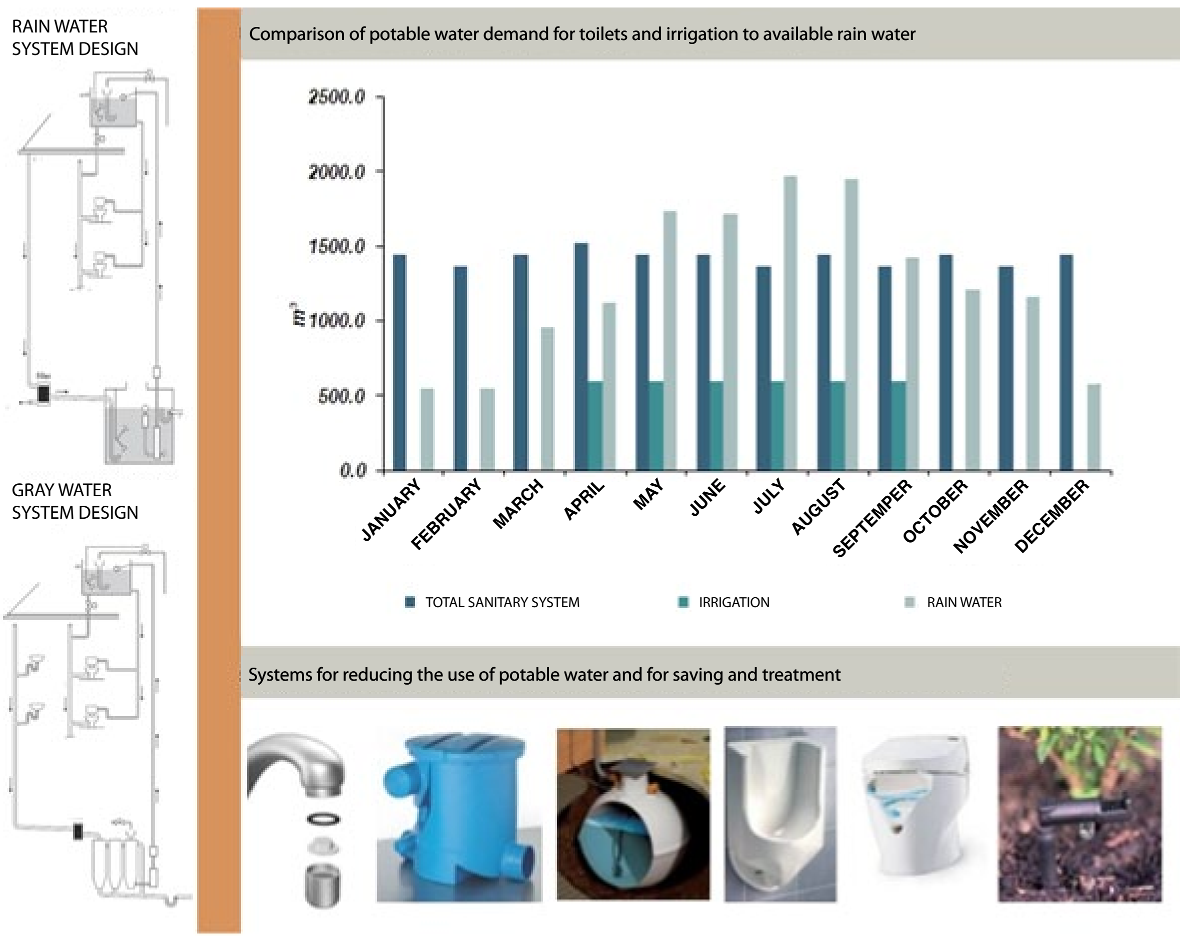
Considering the rainfall data and the kind of roofs, it will be possible to handle 70% of water demand for toilettes and irrigation considering an accumulated volume of around 1,000 m³. The volume would be spread throughout the site in a number of catch basins.

The reduction in potable water use was also taken into consideration in calculating CO_2 emissions.

With appropriate treatment and storage, it will also be possible to meet a portion of bathroom and irrigation demand from reuse of gray water from sinks and showers.

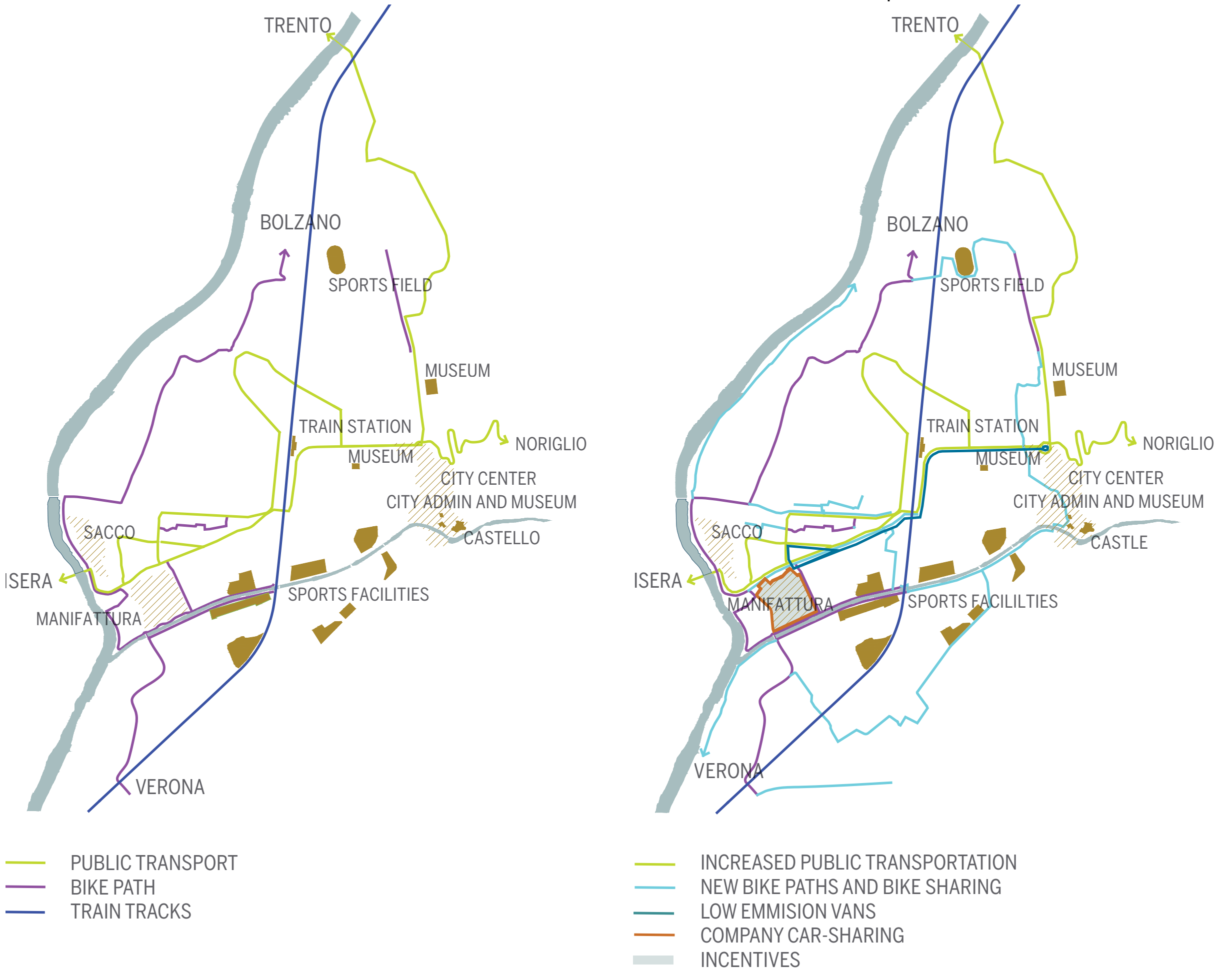
This kind of system will need to be evaluated in a later design phase using more detailed information on building occupancy and use.

Figure 4.35 - Evaluation of a rain water system for reducing use of potable water



4.7
Sustainable mobility

Figure 4.36 - Present and future transportation infrastructure



Progetto Manifattura is based on the idea of protecting natural resources over time in terms of reproduction and quality, improving ecosystems and biodiversity, and preserving the landscape and quality of urban ecology.

Manifattura's integrated strategy aims to provide an adequate level of accessibility to the site for workers and visitors. Its objectives are to promote more sustainable transportation choices and behaviors. The intrinsic complexity of Manifattura's functions required a deep understanding of all the kinds of people who would be going to the site—staff, the public, tourists, business partners, and visitors—in order to define a realistic strategic framework and create tangible changes.

The strategy was developed by combining best practices in similar contexts with the specific characteristics of transport and mobility in the Rovereto area.

Special attention was paid to calibrating the sustainable mobility initiatives and projects to local conditions while keeping in mind planned expansion of local transport networks.

Manifattura's role as a center for research and innovation will be supported by measures designed to reduce the number of trips made by private car or made with cars with just one occupant. Those measures will favor eco-compatible mobility means for commuters and visitors.

The proposed measures need not be considered as immutable over time. On the contrary, they will be subjected to continuous updates and checks to ensure that they stay effective over time, and to make sure they match the mobility needed by Manifattura.

The process of improvements, monitoring, and continuous recalibration of the system will ensure that the level of benefit stays as high as possible throughout the life of the new Manifattura.

Dedicated, low-impact bus service

A minibus service will operate on the main road between Manifattura and the train station to ensure staff and visitors a frequent and reliable link, especially during peak hours in the morning and afternoon.

The role that the train station will take on in the future as an interchange node between an enhanced Brenner rail line and local bus connections is one of the elements that made us consider introducing this service.

The route could be expanded to serve other destinations in the area, especially those that are particularly attractive to staff, visitors, and others who have a choice of transport.

The vehicles—low-impact minibuses—will operate on a periodic schedule with a frequency of 1 bus every 30 minutes. This is considered an optimal way to integrate the existing provision of the local transport network which could guarantee a combined frequency of 1 bus every 15 minutes at peak times in each direction.

The buses will be powered by a recent generation, low-carbon traction system which will generate significant savings in terms of emissions and fuel consumption in comparison with diesel powered versions. This service will allow people to change habits to more sustainable transportation modes and will provide an essential service with advanced, eco-compatible technology.

Bike sharing program

The excellent location of Manifattura, with its proximity to an existing bike path network, makes it an ideal hub for the bicycle paths of the southwest part of the city. And it could transform Manifattura into an attractive destination for tourism as well as bicycle commuting.

Installation of bike sharing racks at the train station and other strategic points in Rovereto, including at Manifattura, is a key point of the transportation strategy. The station as well as cultural attractions are all reachable in just minutes, ideal conditions for catalyzing demand for bicycle mobility for commuting, tourism, and leisure.

Car-sharing and low-carbon company fleet

In Trentino, the overwhelming majority of people commute by private car from home to work, and this is especially true for Rovereto.

With this in mind, we formulated a series of measures to encourage and support sustainable behaviors that are more efficient for staff and visitors to Manifattura.

We designed the solutions keeping in mind the existing infrastructure and the location of Manifattura within the province and the probable origin of trips. In most cases, the layout of the territory does not permit alternative means of transportation for reaching Manifattura except for a few starting points that have good local transportation connections.

These measures are not aimed at using a (unrealistic) top-down approach to reduce the number of visitors and staff who will come to Manifattura by car. Rather, they aim at making people conscious of the existence of different, more efficient means of getting around for work or personal needs, and they provide incentives for good behavior and discourage less sustainable ones.

The creation of an integrated car-sharing program at Manifattura will help to increase the average number of riders per vehicle who come to or leave the site during office hours. In addition, it will help to reduce the number of vehicles parked at or around the site. That will have a positive effect on the environment and on the use of available space.

Staff will be able to offer or accept a ride through Manifattura's internet portal for car sharing by specifying their preferences in terms of point of origin, destination, range of times, and days of the week. A program of incentives—in salary, coupons, and discounts—will support the feasibility of this initiative.

A second phase would involve Manifattura visitors and clients in the scheme and could also include other sites or companies.

Another goal of the program is to create a fleet of low-impact company cars that would be available for work purposes to any company or group actively working at Manifattura. Beyond the obvious advantage of lower costs, the program would further reduce the number of people who come to work in their own vehicle because they need a car for professional reasons during work hours.

Incentive program

The incentives presented earlier could be supported by implementing financial incentives for all workers with the goal of encouraging daily mobility habits. Just as an example, incentives might be given in the form of discounts or zero-interest loans for the purchase of an annual public transport pass, discounts for the purchase of a bicycle to use for commuting, vouchers or cash awards for people who use car-sharing, and other ideas still to be developed.

4.8 Phasing

During development of the master plan, we studied the phasing of the project in order to make each phase complete and immediately usable. The phasing of the project also considered how to make the timing of phases as fluid as possible.

Civil works and infrastructure

For each phase, the master plan defines which works and buildings must be completed in order to make the site functional. It was also necessary to arrange the work in consideration of future expansion or subsequent phases.

Regarding the primary public works and infrastructure, these points are worth highlighting: technology tunnel, underground services, underground parking.

Construction zone

Each phase needs adequate planning from the point of view of the construction site. Starting from the work planned for phase 2, the construction will have to be managed to minimize impacts to the work completed in the previous phases. Each construction phase will have to consider the operational areas of the construction zone as well as areas for storage and transit.

The demolition sequence of buildings in Zone B and the construction of the new buildings will have to follow a precise logic that takes into consideration movement of material, vehicles, construction workers and the people who work at and use Manifattura.

Transportation

In phase 1, private vehicles will enter the north access point and park in temporary parking areas inside Manifattura.

In phase 2, a new parking area in Zone B will be created and sustainable transportation strategies will begin operating. Service vehicles will have a designated entrance along Via delle Zigherane.

In phase 3, a new underground parking area will be built and all of the strategic transportation measures will be implemented and monitored. In the final phase of development, the low environmental impact bus service will begin, and the north access point will be fully operational, as well as the truck access along the western side.

The table shows the number of parking spaces foreseen in each phase according to data provided by Kanso.

The calculation was made on the basis of the atypical aspects of Manifattura. The worst case scenario is BaU: the absence of a strategy for sustainable mobility and travel planning. The best case takes into consideration the progressive implementation of the mobility initiatives described in the previous section.

Phase		Spaces
1		42
2	Penalized version	186
	Optimized version	223
3	Penalized version	167
	Optimized version	329
4	Penalized version	213
	Optimized version	438

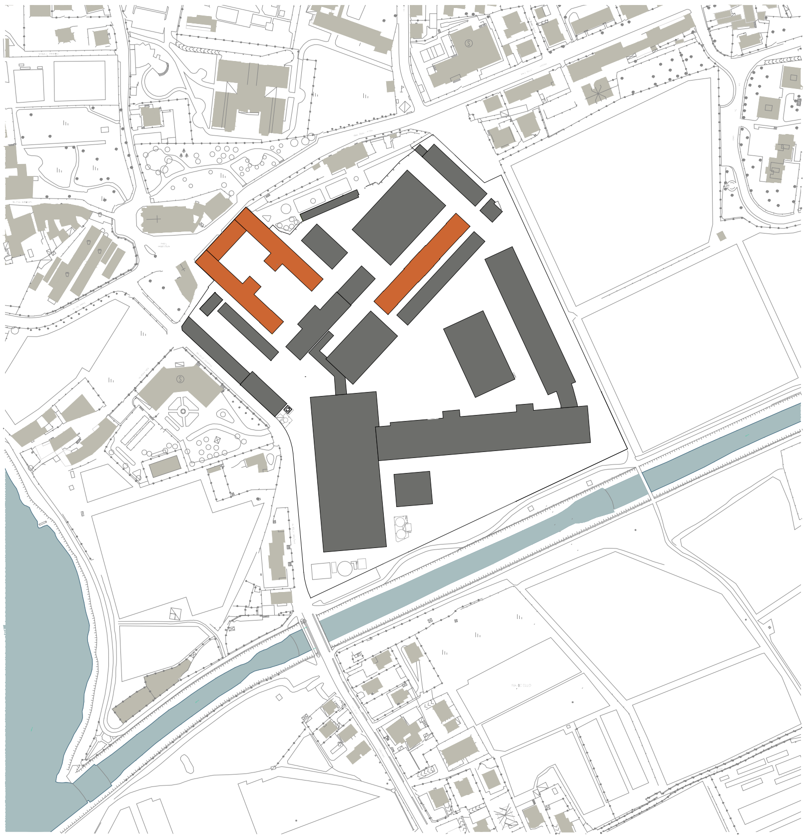
Figure 4.37 - Parking by phase

Energy centre

The trigeneration plant was sized to meet demand of the completed project. The plant will be located in a triangular building on the south edge of the site next to the Leno river. The remaining energy systems will be located in an adjacent building along the Leno in an underground area or at ground level.

The studies will have to be completed and expanded in later design phases in function of more detailed information. It is expected that these buildings will be built in phase 2 to allow the installation of power plants that will serve Zone A which will already be in use. The size of the plant equipment will be studied in a later design phase. The evaluation will establish the potential for using the space currently designated for training and moving this to buildings 1 or 7 in Zone A.

PHASE 1: FIRST OCCUPANCY, BUILDINGS 1 AND 14



Building 1:

Offices	5100 m²
Storage	1300 m²
Office expansion	2150 m²
Welcome desk	400 m²

Building 14:

CIMEC	5605 m²

CIVIL WORKS AND INFRASTRUCTURE

Technology tunnel:

Not foreseen

Underground utilities:

This phase envisages the use or adaptation of the existing networks after evaluation of their integrity and functionality.

Underground parking:

Only ground-level parking is available in Zone A.

TRANSPORTATION AND INFRASTRUCTURE

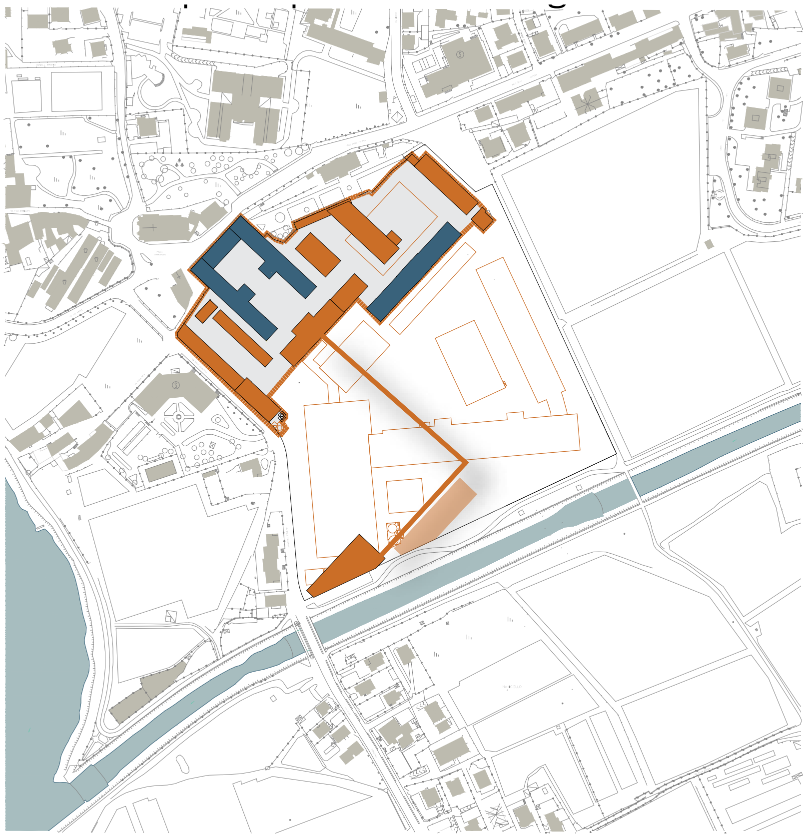
The existing parking areas are used as parking for buildings 1 and 14

All vehicles enter the site through the access along Via della Vittoria

ENERGY CENTER

Not foreseen

PHASE 2: COMPLETION OF ZONE A OCCUPANCY, DEMOLITION OF ZONE B, INFRASTRUCTURE TUNNEL AND PROVISIONAL TRIGENERATION PLANT



Zone A:	
Offices	600 m²
	5100 m²
Light manufacturing	169 m²
Storage	1300 m²
Office expansion	820 m²
	2150 m²
Laboratories	1198 m²
Congress hall	780 m²
Exposition spaces	1510 m²
Welcome desk	400 m²
Housing	1640 m²
Auditorium services	600 m²
Auditorium	1100 m²
Restaurant/bar	1303 m²
Education centre	1130 m²
Multimedia/library	1124 m²
CIMEC	9492 m²
	5605 m²
Trigeneration plant	1368 m²

CIVIL WORKS AND INFRASTRUCTURE

Technology tunnel:

Realization of a technology tunnel is foreseen in this phase. The tunnel will be developed to handle connections between underground parking connections in phases 3 and 4.

Underground utilities:

The main sewer line will be built inside the tunnel to connect secondary access in phases 3 and 4. The phase calls for treating potable water in pipes located in the tunnel.

Underground parking:

Only ground level parking is foreseen in areas A and B.

TRANSPORTATION AND INFRASTRUCTURE

A temporary parking area will be created in Area B to serve buildings in Area A.

The low-carbon bus service will begin operating between Manifattura and the train station.

Experimental phase of implementation of strategic measures for sustainable access.

Automobiles and private cars enter the site only through the north access. Service vehicles and heavy trucks use the new entry along Via delle Zigherane.

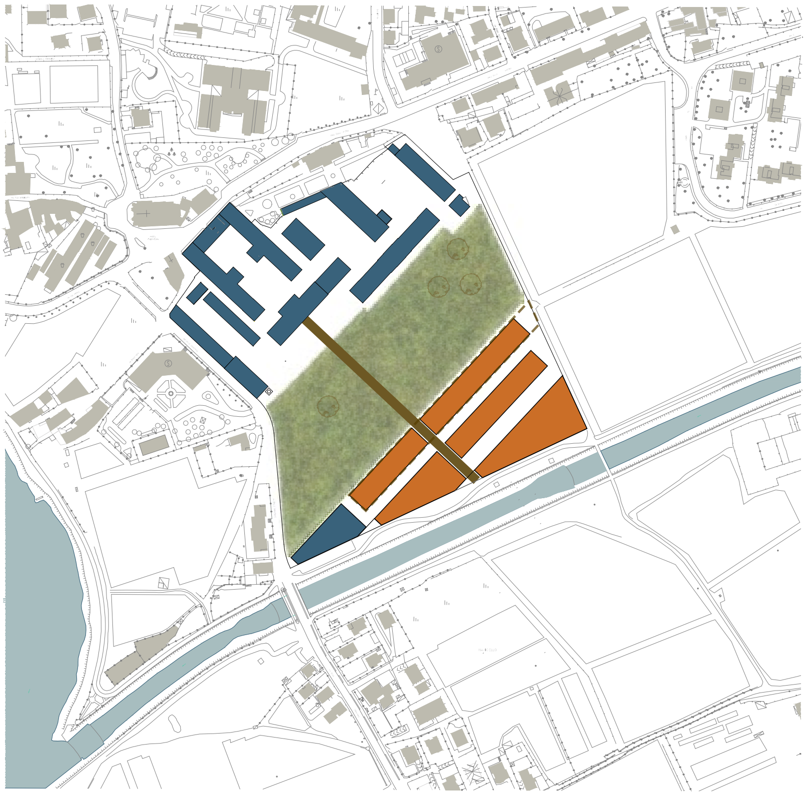
ENERGY CENTER

The buildings for the energy center will be built in relation to the systems foreseen in this phase. The systems will be installed in a modular way in order to provide sufficient energy for the buildings foreseen in the various phases.

An evaluation will be carried out to study the building of a part of the energy center facilities near the trigeneration plant above or below ground.

The feasibility of building the Trigeneration plant will be carried out in consideration of the timing of permitting and authorization procedures.

PHASE 3: REALIZATION OF THE FIRST PART OF THE PARKING AREA AND THE LIGHT MANUFACTURING FACILITIES, TRAINING ROOMS, FITNESS CENTER, MUSEUM, RESTAURANT, CONNECTION WITH ZONES A AND B



Zone A:

Offices	5700 m²
Light manufacturing	169 m²
Storage	1300 m²
Office expansion	2970 m²
Laboratories	1198 m²
Conference hall	780 m²
Exposition spaces	1510 m²
Welcome desk	400 m²
Housing	1640 m²
Auditorium services	600 m²
Auditorium	1100 m²
Restaurant/bar	1303 m²
Education centre	1130 m²
Multimedia/library	1124 m²
CIMEC	15097 m²
Trigeneration plant	1368 m²
Museum	2262 m²
Fitness center	494 m²
Restaurant	1332 m²
Light manufacturing	6200 m²
Parking	4300 m²

CIVIL WORKS AND INFRASTRUCTURE

Technology tunnel:

Starting in this phase, the technology tunnel will act as a pedestrian and automobile traffic connection between the two underground parking garages (east and west wings).

Underground utilities:

Underground utilities for Zone B are foreseen in this phase for the relative areas.

Underground parking:

Underground parking will be built for the use of Zone B in this phase. Passageways for connecting with the parking area foreseen in phase 4 will also be built.

TRANSPORTATION AND INFRASTRUCTURE

Most parking will be moved to the parking spaces of the underground parking area. Some spaces will still be available on the surface.

The entire strategic accessibility program will be implemented in this phase.

Automobiles and private vehicles will enter the site through the enlarged north access point. Service vehicles and heavy trucks will continue to enter through the dedicated access on the western edge.

ENERGY CENTER

Installation of necessary systems in Zone A and separately in Zone B.

PHASE 4: COMPLETION OF PARKING AREA AND LIGHT MANUFACTURING BUILDINGS, WAREHOUSE, ALL THE ENTRANCES TO THE SITE

Zone A:	
Offices	5700 m²
Light manufacturing	169 m²
Storage	1300 m²
Expansion offices	2970 m²
Laboratories	1198 m²
Conference hall	780 m²
Exposition spaces	1510 m²
Welcome desk	400 m²
Housing	1640 m²
Auditorium services	600 m²
Auditorium	1100 m²
Restaurant/bar	1303 m²
Education centre	1130 m²
Multimedia/library	1124 m²
CIMEC	
15097	m²
Trigeneration plant	1368 m²
Museum	2262 m²
Fitness center	494 m²
Restaurant	1332 m²
Light Manufacturing	14100 m²
	6200 m²
Parking	14600 m²
	4300 m²
Warehouse	785 m²

CIVIL WORKS AND INFRASTRUCTURE

Technology tunnel:

Passageways between the parking areas will be completed.

Underground utilities:

A network of utilities will be developed to serve all of the Area B buildings and associated areas.

Underground parking:

The underground parking area bellow the new Area B buildings will be built.

TRANSPORTATION AND INFRASTRUCTURE

The number of parking spaces will increase with the opening of the new parking garage in Area B.

Mini-bus service will be augmented to serve the route between Manifattura and the train station.

Two separate accesses for cars and service vehicles are functioning.

ENERGY CENTER

The installation of the trigeneration plant will be completed and the energy plant will be fully functional.

5

A NEW LANDSCAPE

5.1 Introduction to carbon assessment

Objectives

We calculated CO_2 emissions to assess the climate-change impacts of the master plan. The study:

- Examined whether the master plan represents an improvement in CO_2 emissions (with respect to “business as usual” - BaU) compared to a standard or to a similar project.
- Identified areas of improvement.
- Defined realistic goals for CO_2 emissions for the project outlined in the master plan.

The results are given in terms of tons of CO_2 and the percentage of reduction compared to BaU. The results will allow investors to evaluate whether the master plan can achieve the expectations of a 70% reduction in greenhouse gas emissions during the construction and life of buildings with respect to BaU (including emissions generated during design, construction, and demolition, treatment of waste materials and CO_2 from operations).

Why evaluate CO_2 emissions?

The new Manifattura has the potential to be an outstanding low-carbon project that acts as an example to Europe and the entire world. The objectives are to:

- Demonstrate legal compliance and political will in local and regional planning.
- Increase property value and competitiveness, while reducing costs and improving risk management.

Table 5.1	ON SITE	OFF SITE
Construction Phase	Construction processes	CO_2 produced from production of building materials. Treatment of construction and demolition waste.
Operational Phase	Energy use of buildings. Movement of vehicles on-site. Energy use of public areas (mostly illumination). On-site industrial processes. Change in use of terrain can have a very small impact in terms of carbon emissions.	Water supply and waste water treatment. Recycling and treatment of waste. Travel to and from the site.

Table 5.2	BUSINESS AS USUAL	OFF SITE
Energy demand of existing buildings (Energy Performance Certificate - EPC)	Class C/D for existing buildings	Class B/C for existing buildings
Energy demand (EPC) of new buildings	Class B for new buildings	Class A 18% (kWh/year) improvement with respect to heating and hot water demand for new buildings
Electricity supply	100% from grid	58% from renewable, zero emission sources (20% hydroelectric, 38% biomass Combined Heat & Power CHP) 42% from grid
Heating supply	100% from standard gas boilers	80% from biomass CHP 10% from water-based heat pumps 10% from high efficiency gas boiler
Cooling supply	100% from grid	80% from biomass CHP 10% from water-based heat pumps 10% from electrical chillers
Water supply	100% from public supply	28% from rain 29% from recycled gray water 43% public supply
Waste	Urban waste: 1.4 kg/day/person Other waste (commercial and industrial): 10 kg/day/person	To be done
Transportation management	None	Low emission hybrid buses connecting site with rail station for employee commuting Improvements to local bus transportation system regarding frequency and stops Bike-sharing plan Car-sharing plan Electric cars for company trips
Employee transport modes	47% automobile 5% motorcycle 16% bus 1% train 32% bike/foot (according to census data)	37% automobile 4% motorcycle 33% bus 5% train 22% bike/foot 30% shared automobile
Visitor transport modes	78% automobile 5% motorcycle 10% bus 2% train 5% bike/foot	74% automobile 3% motorcycle 15% bus 3% train 5% bike/foot 30% shared automobile
Mix of automobile fuels	Mix of gasoline/diesel typical of national use	10% electric 90% gasoline and diesel
Bus efficiency	Trentino Trasporti (provincial transport company) owns just 5 “Euro 0” buses.	Low carbon transport vans. Substitution of standard buses with low emission vehicles for 25% of travel distance.

5.2 Results

The results in table 5.1 and figure 5.1 show that there is a significant (70%) reduction in overall CO_2 emissions between BaU and the preferred option. This percentage satisfies the greenhouse gas reduction target defined in the project goals, table 5.4 (page 108).

The reduction is obtained mainly by changing how buildings are heated. The reduction in heat demand between the various scenarios was just 18%. Even so, by moving from standard boilers to CHP with low-carbon biomass cogeneration and efficient gas heaters, the master plan was able to lower heating-related emissions by 93%.

Significant reductions are also possible in electrical energy use. However, their impact is relatively less than the impact from heating. Even if annual electricity demand (10,000 MWh) is higher than the heating demand, the supply source for regional electricity is mostly hydroelectric.

The consequences are that in loco or in district investments in electrical production are less strategic than concentrating on renewable heating sources. The proposed strategy for CHP biomass is advantageous since it produces both heat and electricity from low-emission sources. Nonetheless, to be efficient, it needs to be sized according to heating needs. Remaining electricity needs can be met by the grid.

Efforts to reduce CO_2 impact mean that heating and illumination for buildings is lowered by up to one third of total energy use (down from the initial 81%).

In the final scenario, transportation becomes the most significant impact factor. Table 5.3 illustrates the distribution of emissions for BaU and the preferred option. The data shows that heating is the major factor in the BaU scenario, and that this factor diminishes drastically in the preferred option. It also shows that the main emissions from the preferred option are from gasoline-powered automobiles coming to the site.

If the master plan is realized according to the principles and strategies set forth, management of carbon emissions in the operational phase should concentrate on transportation as much as possible.

In 2004, Italy's carbon emissions were about 8 tons of CO_2 per person, a reasonably good result in comparison to other OECD countries (Organization for Economic Cooperation and

Table 5.3	BAU		PREFERRED OPTION		% CHANGE FROM BAU
Heating of buildings	2000		148		–93%
Cooling of buildings	5.4	81% of total	0.39	33% of total	–93%
Electricity use in buildings	300		126		–58%
Electricity for outdoor lighting	8.0		3.4		–58%
Petrol automobiles	473		327		–22%
Diesel automobiles	46	19% of total	36	67% of total	–22%
Electric automobiles	0		0		n/a
Other motor vehicles	22		20		–9%
Standard buses	9		110		1089%
Low-emission buses	0.0		2.7		n/a
Biomass transportation trucks	0.0		76		n/a
Total	2800		849		–70%
Tons of CO_2 per employee	4.0		1.2		

Development), where the average is 11.5 tons per capita.

Individuals who change from working at existing BaU-style buildings to working at the new Manifattura could reduce their carbon footprint by 2,8 tons. As shown in table 5.3, this supposes a BaU of 4.0 versus 1,2 for Manifattura's preferred option. Thus, the average carbon footprint would be 5.2 tons of CO_2 per user, making their emissions similar to inhabitants of France which uses nuclear power to generate 80% of its electricity (see figure 5.2).

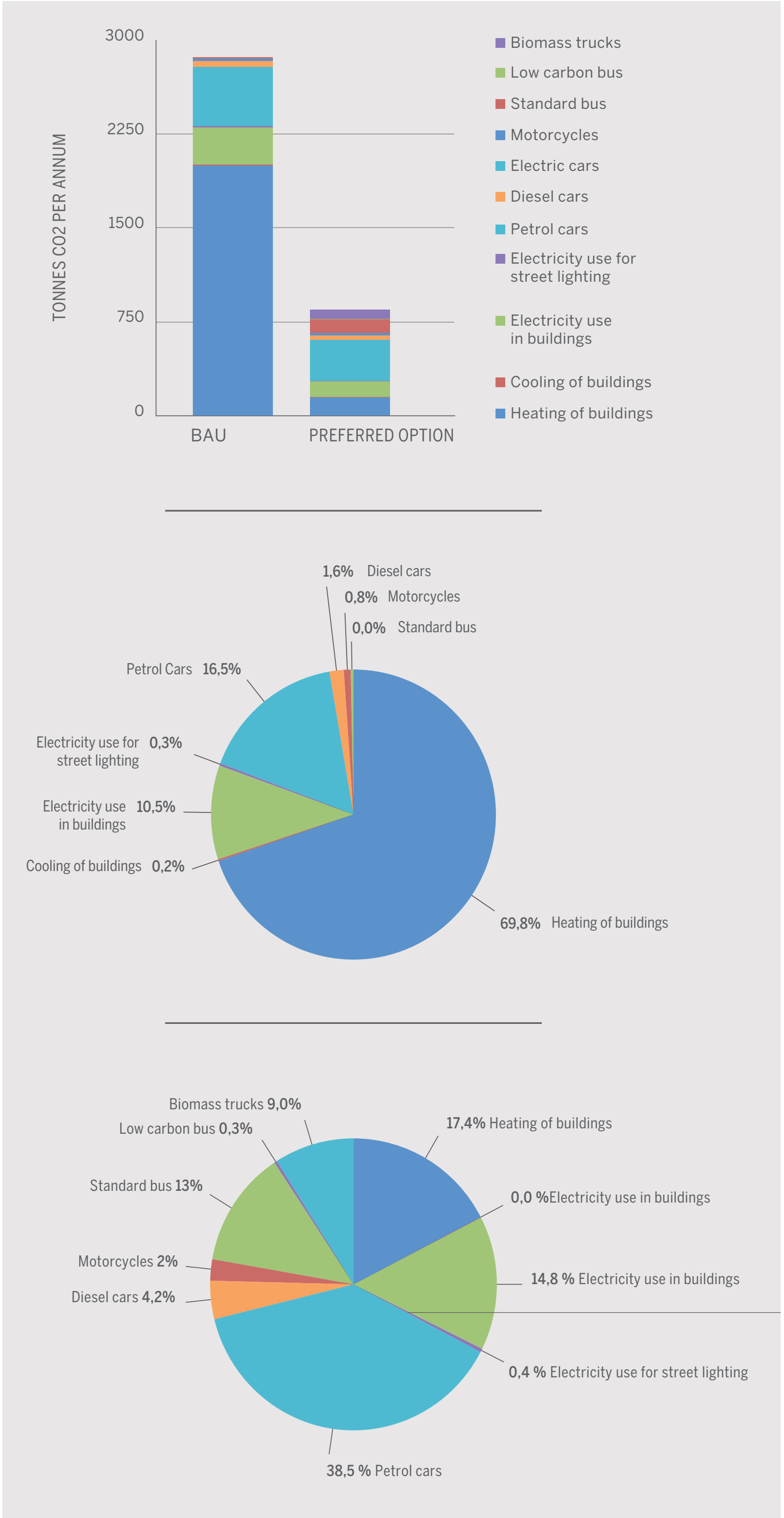


Figure 5.1

A. Annual emissions (tons of CO_2 per year) for BaU and preferred option

B. Distribution of CO_2 emissions for BaU

C. Distribution of CO_2 emissions for preferred option

Data: http://hdr.undp.org/en/statistics/data/climatechange/footprints/

Conclusions

The results of this preliminary evaluation show that the project has excellent potential for demonstrating, at a global level, best practises for managing CO_2 emissions. The carbon-emission results of the master plan can be achieved through:

- Reduction in electrical demand by buildings.
- Low carbon emissions from renewable energy sources, especially for heating.
- Changing to more sustainable transportation means and modes by workers and visitors to the Manifattura, including public transport, car sharing, and electric vehicles.

In a more detailed planning phase, the team highly recommends that the desired target be kept at the level established in the evaluation. For the next phase of planning, it is further recommended that the carbon evaluation be updated so that the strategies can be enriched and refined with more details and more specific data.

The project was developed with sustainability goals in mind. The interdisciplinary approach of the plan did not vary from that overall goal.

This approach can be reaffirmed as local authorities, potential occupants and investors, as well as tenants, prove that the new Manifattura is an example for Italy and the international community.

Table 5.4 - Sustainability goals

1. Create a low emission, high efficiency zone that promotes responsibility toward global climate change by establishing clear objectives and using transparent measuring systems.
2. Educate public about sustainable behaviors that promote global sustainability.
3. Protect heritage buildings while promoting efficient use of space and reduced environmental impact by evaluating uses and use of low impact construction materials.
4. Promote the use of innovative construction technologies.
5. Create a landmark urban zone that highlights and reinterprets the historic nature of the site.
6. Create a flexible, functional space open to a variety of uses and which promotes positive image of development.
7. Create interaction spaces that encourage the exchange of knowledge between users.
8. Reconnect the site with the local landscape while protecting and promoting the local environment.
9. Ensure that the site is usable, but not isolated, so as to integrate with and enrich local interests and livability of the Borgo Sacco quarter and Rovereto.
10. Generate an innovation cluster for scientific and technological innovation as well as for new business ideas, meeting the needs of the local business community with supply chain integration, educational opportunities, and production.
11. Create an interesting work environment that considers production and knowledge so as to attract private industry and promote innovation and new work methods.
12. Develop sustainable transport for internal and external users of the new Manifattura by integrating public and private transportation means.

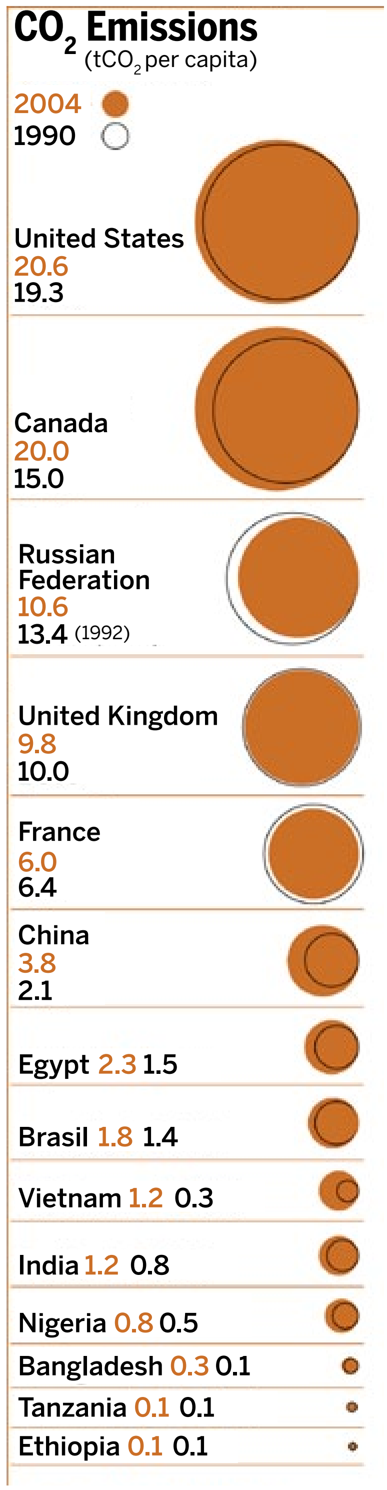


Figure 5.2 - Variation in CO_2 emissions per country (source: CDIAC 2007/12)