POLITECNICO DI MILANO

SCUOLA DI ARCHITETTURA' E SOCIETA

CORSO DI LAUREA MAGISTRALE

KILOMETRO ZERO TOWER

RELATORE

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A.A. 2013-2014

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ABSTRACT

By 2050 over 80% of the world population will reside in urban centers, and the world population will increase about 3 billion. 80% of suitable lands for crops are already in use.

How to feed the planet in the near future?

In another hand like other urban areas around the world, New York City will face dramatic population growth in the coming decades. Demographers predict that New York alone will add one million more residents by 2040. Finding housing will pose a crisis for hundreds of thousands of them.

How to accommodate this amount people in urban centre?

This thesis is going to present an architectural answer to these questions.

First part of the project offers an efficient solution to needs of living in urban centre: co housing.

It represents a different way to share common place and facilities in order to decrease the unsustainable price of accommodating in the Manhattan, New York

Second part of the document explains Km0 tower, an innovative Idea based on cultivation and production crops with vertical farming technology.

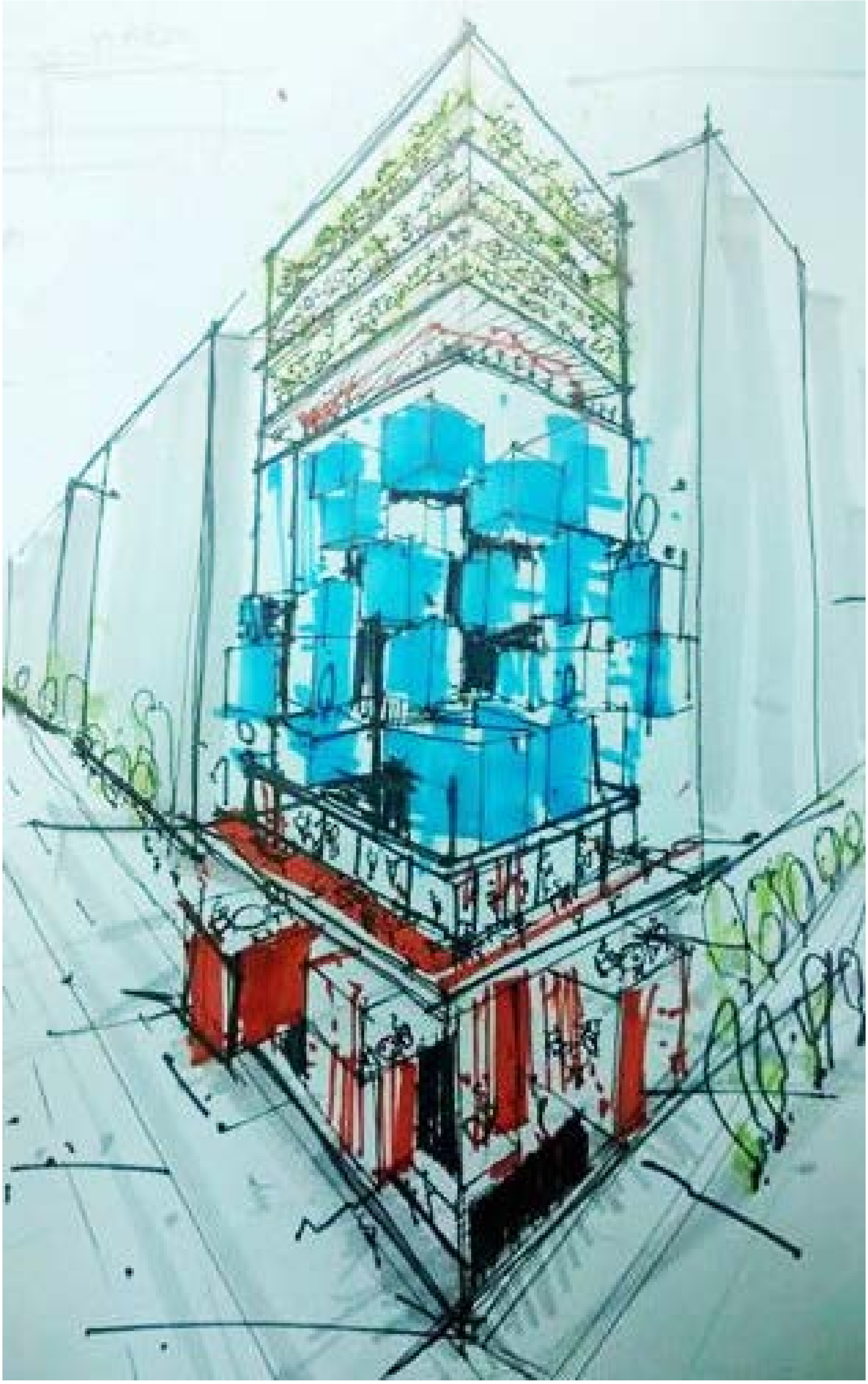
The name of Kilometro Zero underlines the system of consuming and distribute its crops production in lower part of building through restaurant and retail markets.

The benefits of the km0 concept are evident:

Decrease gas emissions (co2) due to food transportation, increase food production .

it shows how a building can be more than a "place to sleep " but can be

an " alive building " strongly connected to need of the city .



Sketch of project

SOMMARIO

Nel 2050 più dell'80 % della popolazione mondiale vivrà in centri urbani , e il suo numero crescerà di 3 miliardi. Attualmente l' 80% della terra disponibile ad essere coltivata è già in uso.

Come soddisfare il bisogno di un' adeguata alimentazione nel prossimo futuro?

Un altro aspetto considerato riguarda le aree densamente abitate che sono investite da questo processo di crescità demografica come New York. Le previsioni affermano che la ciità Americana incrementerà di un milione di abitanti entro il 2040. Questo fenomeno farà scaturire il problema di trovare una casa per centinaia di migliaia di persone.

Come far alloggiare queste persone nei maggiori centri urbani?

Questa tesi propone una risposta architettonica a queste domande.

La prima parte del progetto offre un'efficiente soluzione alla necessità di vivere nei centri urbani :Il co-housing.

Questa proposta rappresenta un interessante modo di condividere spazi e servizi in modo da ridurre drasticamente il prezzo di acquisto per un alloggio in Manhattan, New York.

La seconda parte del progetto tratta Kilometro Zero Tower , un 'innovativa idea basata sulla coltivazione di prodotti con la tecnologia della vertical farm.

Il nome Kilometro Zero Tower è dovuto al processo che si afferma attreverso la vendità e il consumo dei prodotti nella parte più bassa della torre con un mercato ed una serie di ristoranti aperti al pubblico per apprezzare la freschezza dei prodotti .

I principali vantaggi di questo sistema sono evidenti: l'eliminazione di emissioni di Co2 dovute al trasporto di prodotti alimentari e l'aumento di produzione alimentare.

Questo conferma come un edificio non si debba limitare ad essere un luogo "dove alloggiare" ma può essere un'"architettura viva" che si relazioni con le esigenze attuali creando nuove oppurtunità di socializzazione.

INTRODUCTION

Not long time ago a picture of the First Lady, Michelle Obama, immortalized in the Garden of the White House , and on all fours with work gloves , among clumps of salad , zucchini and carrots have been around the world.

Since then, the craze of the gardens , and especially of urban gardens exploded a little everywhere.

As it happens, by 2050 over 80% of the world population will reside in urban centres, so why not bring agriculture into the city ?

Perhaps not everyone knows that, but already more than 40 years, the vacant land in New York are slowly andinexorably transformed into urban gardens in which to grow vegetables and fruits of all kinds.

They are vibrant civic spaces in which they grow colourful plants of fruits and vegetables that serve outdoor classrooms for schoolchildren Yorkers , but also as meeting places for the community and interaction .

Six years after the first farmers' markets were created (" Greenmarket ") with the dual mission of promotingregional agriculture (providing small family farms the opportunity to sell their locally produced products directlyto consumers) and to ensure all Yorkers the possibility to have fresh nutrients.This unique relationship between farmers and city dwellers, has revitalized rural communities and urban spacesimproved the health of consumers, has encouraged the diversity of cultures , has created information for residentsand school students on the importance of the agricultural sector to improve their quality of life .

Why not carry this new way of living within each building?

KM0 tower gives an opportunity to the inhabitants of the building to produce food for themselvesand for others. therefore this new green trend is moved from the city to the house.

For example, in Manhattan last year were distributed state subsidies to $ 941,000 for the creationof urban gardens . These were also facilitated by a new architectural trend (which also includes the " green skyscraper " , with entire floors of skyscrapers cultivated) .

New York City Green is a strategic goal of the administration, and urban gardens are an essential part of the design ofthe new metropolis.

This return to agriculture does not want to be a waiver for the progress so that the binomial GREEN & TECHNOLOGY is exactly the right tool to stimulate new ways of life.

The increase population and the emergency of feeding

World population is expected to grow by over a third, or 2.3 billion people, between

2009 and 2050. This is a much slower rate of growth than the one seen in the past fourdecades during which it grew by 3.3 billion people, or more than 90 percent. Nearly allof this growth is forecast to take place inthe developing countries.

Among the lattergroup, sub-Saharan Africa's populationwould grow the fastest (+114 %) andEast and Southeast Asia's the slowest(+13 %). Urbanization is foreseen tocontinue at an accelerating pace with urbanareas to account for 70 percent of worldpopulation in 2050 (up from 49 percentat present) and rural population, afterpeaking sometime in the next decade,actually declining.

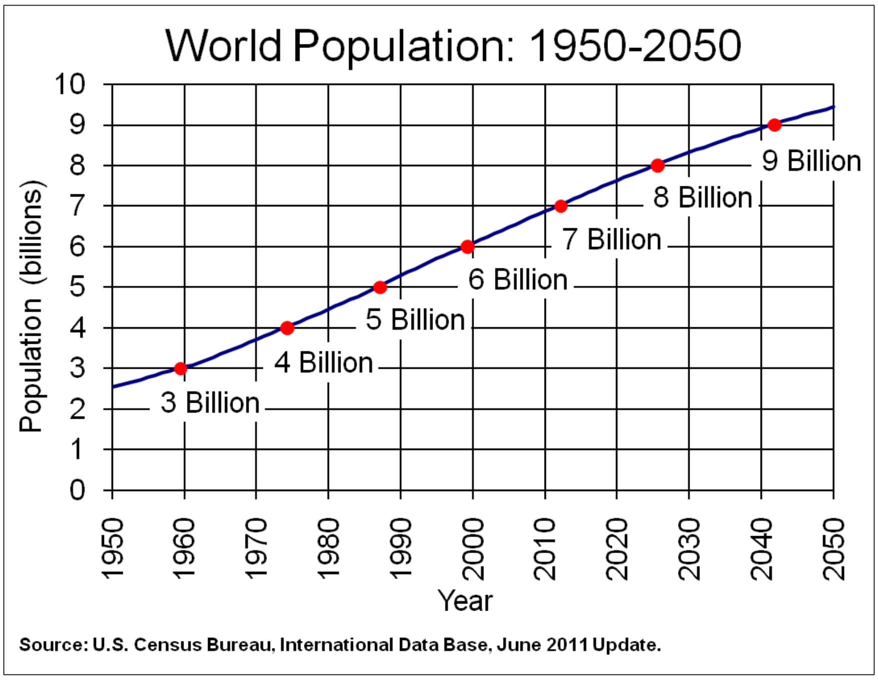


Figure 43. world increasing population –International data base –june 2011

At the same time, per capita incomes in2050 are projected to be a multiple of

today's levels. There is a consensus amonganalysts that recent trends whereby the

economies of developing countries havebeen growing significantly faster that the

developed ones is likely to continue in thefuture. Relative inequality in per capita

incomes would be reduced considerablyby 2050. However, absolute difference would remain pronounced and could evenincrease further, given the current huge gaps in absolute per capita incomes.Moreover, inter-country and inter-regional inequalities within the present-daydeveloping world would tend to become more pronounced.

The projected global economic growthof about 2.9 percent annually would lead to a significant reduction or even nearelimination of absolute “economic” poverty in the developing countries (persons livingon less than US$1.25/day in 2005 prices). Nevertheless, even in 2050 the world willstill be far from solving the problem of economic deprivation and malnutritionof significant parts of the population: the US$1.25/day poverty line is simply toolow. On less stringent criteria, deprivation and undernutrition will remain widespread,though significantly less than today.

These trends mean that market demandfor food would continue to grow. Demand for cereals, for both food and animal feeduses is projected to reach some 3 billion tonnes by 2050, up from today’s nearly2.1 billion tonnes. The advent of biofuelshas the potential to change some of the

projected trends and cause world demand to be higher, depending mainly on energy prices and government policies. The demand for other food products that are

more responsive to higher incomes in the developing countries (such as livestock and dairy products, vegetable oils) will grow much faster than that for cereals.

The projections show that feeding a world population of 9.1 billion people in 2050 would require raising overall food production by some 70 percent between 2005/07 and 2050. Production in the developing countries would need to almost double. This implies significant increases in the production of several key commodities.

Annual cereal production, for instance, would have to grow by almost one billion tonnes, meat production by over 200 million tonnes to a total of 470 million tonnes in 2050, 72 percent of which in the developing countries, up from the 58 percent today. Feeding the world population adequately would also mean producing the kinds of foods that are lacking to ensure nutrition security.

Crop yields would continue to grow but at a slower rate than in the past. This process of decelerating growth has already been under way for some time. On average, annual crop yield growth rate over the projection period would be about half(0.8 percent) of its historical growth rate (1.7 percent; 0.9 and 2.1 percent for the developing countries). Cereal yield growth would slowdown to 0.7 percent per annum (0.8 percent in developing countries), and average cereal yield would by 2050reach some 4.3 tonne/ha, up from 3.2 tonne/ha at present.An estimated 109 hectares of new land (about 20% more land than is represented by the country of Brazil) will be needed to grow enough food to feed them, if traditional farming practices continue as they are practiced today. At present, throughout the world, over 80% of the land that is suitable for raising crops is in use). Historically, some 15% of that has been laid waste by poor management practices. What can be done to avoid this impending disaster

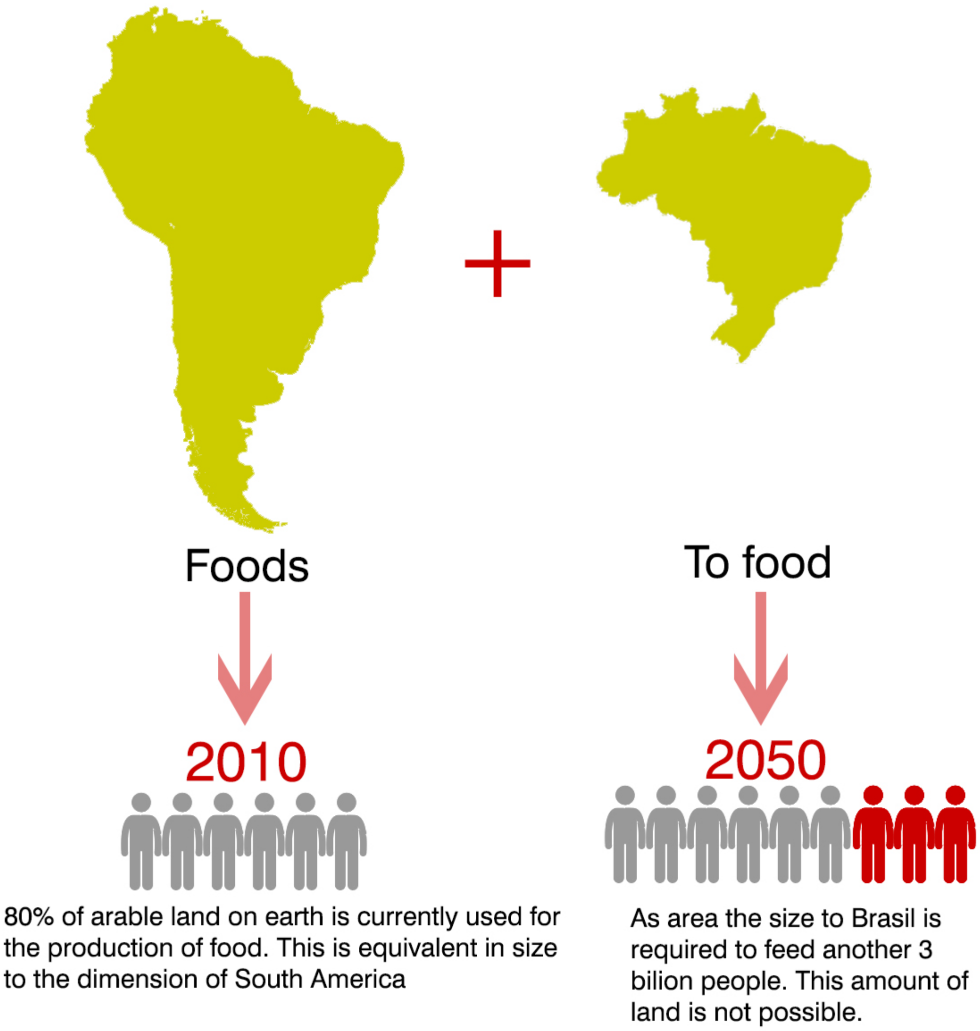


Figure 44.1 agricultural land needs diagram

Urbanization

Urbanization is the increasing number of people that live in urban areas. It predominantly results in the physical growth of urban areas, be it horizontal or vertical. The United Nations projected that half of the world's population would live in urban areas at the end of 2008.

By 2050 it is predicted that 64.1% and 85.9% of the developing and developed world respectively will be urbanized.

Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization. Urbanization can describe a specific condition at a set time, i.e. the proportion of total population or area in cities or towns, or the term can describe the increase of this proportion over time. So the term urbanization can represent the level of urban development relative to overall population, or it can represent the rate at which the urban proportion is increasing.

Urbanization is not merely a modern phenomenon, but a rapid and historic transformation of human social roots on a global scale, whereby predominantly rural culture is being rapidly replaced by predominantly urban culture. The last major change in settlement patterns was the accumulation of hunter-gatherers into villages many thousand years ago. Village culture is characterized by common bloodlines, intimate relationships, and communal behavior whereas urban culture is characterized by distant bloodlines, unfamiliar relations, and competitive behavior. This unprecedented movement of people is forecast to continue and intensify in the next few decades, mushrooming cities to sizes incomprehensible only a century ago. Indeed, today, in Asia the urban agglomerations of Dhaka, Karachi, Jakarta, Mumbai, Delhi, Manila, Seoul and Beijing are each already home to over 20 million people, while the Pearl River Delta, Shanghai-Suzhou and Tokyo are forecast to approach or exceed 40 million people each within the coming decade. Outside Asia, Mexico City, Sao Paulo, New York City, Lagos and Cairo are fast approaching being, or are already, home to over 20 million people.

Figure 45.1 New York city

As more and more people leave villages and farms to live in cities, urban growth results. The rapid growth of cities like Chicago in the late 19th century, Tokyo in the mid twentieth, and Mumbai in the 21st century can be attributed largely to rural-urban migration. This kind of growth is especially commonplace in developing countries. This phenomenal growth can also be attributed to the lure of not just economic opportunities, but also to loss or degradation of farmland and pastureland due to development, pollution, land grabs, or conflict, the attraction and anonymity of hedonistic pleasures of urban areas, proximity and ease of mass transport, as well as the opportunity to assert individualism.

'Urbanization is not about simply increasing the number of urban residents or expanding the area of cities. More importantly, it's about a complete change from rural to urban style in terms of industry structure, employment, living environment and social security.'

The rapid urbanization of the world's population over the twentieth century is described in the 2005 Revision of the UN World Urbanization Prospects report. The global proportion of urban population rose dramatically from 13% (220 million) in 1900, to 29%

(732 million) in 1950, to 49% (3.2 billion) in 2005. The same report projected that the figure is likely to rise to 60% (4.9 billion) by 2030.

According to the UN State of the World Population 2007 report, sometime in the middle of 2007, the majority of people worldwide will be living in towns or cities, for the first time in history; this is referred to as the arrival of the "Urban Millennium" or the 'tipping point'. In regard to future trends, it is estimated 93% of urban growth will occur in developing nations, with 80% of urban growth occurring in Asia and Africa.

Urbanization rates vary between countries. The United States and United Kingdom have a far higher urbanization level than India, Swaziland or Niger, but a far slower annual urbanization rate, since much less of the population is living in a rural area.

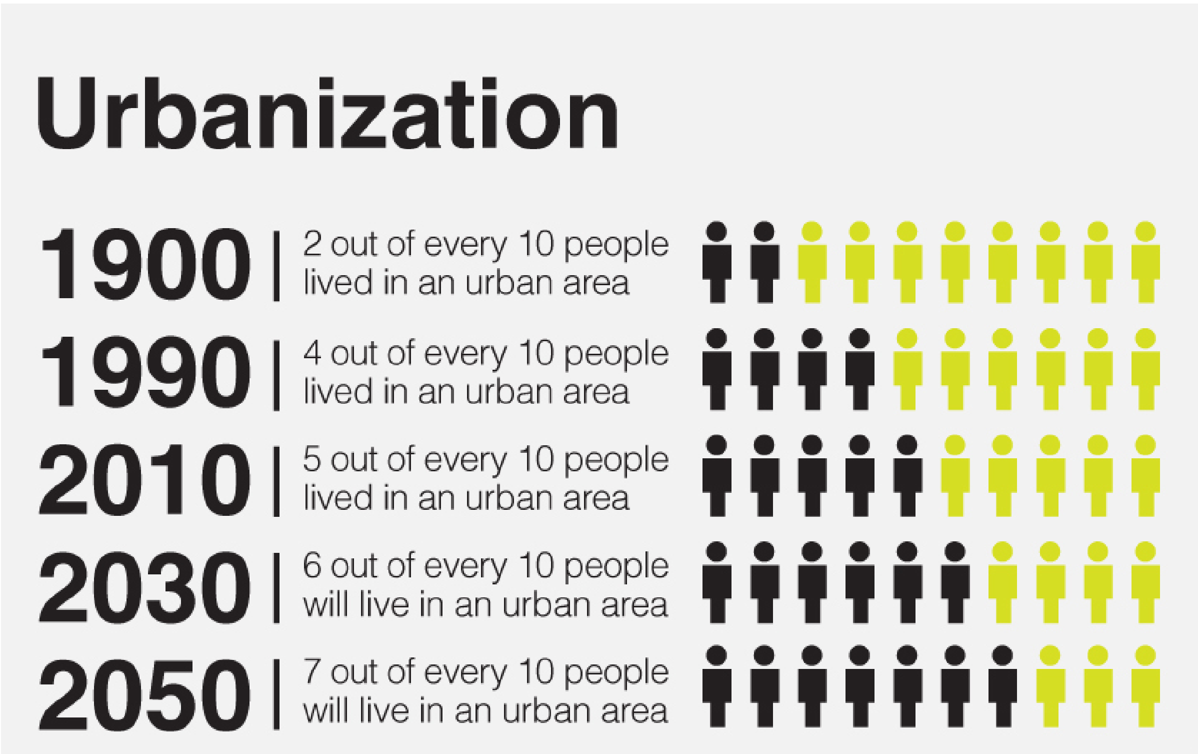
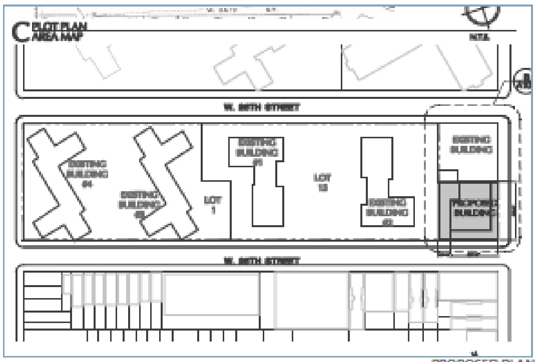


Figure 46.1 1 Urbanization progress diagram –by UN HABITAT

PROJECT_AREA

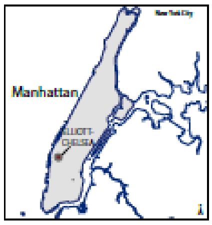
The choice of the site was considered of " living the city" competition that aimed to design a Residential Towers for the 21st Century in one of five boroughs of New York. For this reason we have chosen a site proposed from the New York City housing authority where there are 25 stories of social housing building under construction.

DEVELOPMENT SITE



PROPOSED PLAN

ILLUSTRATIVE RENDERING

Elliott-Chelsea Houses	
Proposed Development	
Acquisition Price	$4,000,000
Number of Units	168
Site Area	9,875 SF
Development Rights	87,600 SF
Status	Closed 6/10
Development Team	Artimus Construction, Inc.
	GF55 Partners LLP
Elected Officials	
Congressional District_8	Jerrold L. Nadler
State Senate District_29	Thomas K. Duane
State Assembly District_75	Richard N. Gottfried
City Council District_03	Christine C. Quinn
Community District	04
Location / Key Plan	
Northwest corner of West 25th Street and 9th Avenue Block 723, Lot 34	

Kilometro Zero is a 40 stories tower in Chelsea district of Manhattan , the site is located in the corner between 9th and 25th street. The basement of the building is used as an integrated urban centre where located market stores, restaurants due to have a good connection to 9th and 25th streets.

Figure 47.2 New York city –Chelsea district

New York City_ Manhattan2

Figure 48.2 Project Area – Chelsea Manhattan

CHELSEA DISTRICT

Chelsea is a neighborhood on the West Side of the borough of Manhattan in New York City. The district's boundaries are roughly 14th Street to the south, 30th Street to the north, the western boundary of the Ladies' Mile Historic District – which lies between the Avenue of the Americas (Sixth Avenue) and Seventh Avenue – to the east, and the Hudson River and West Street to the west. To the north of Chelsea is the neighborhood of Hell's Kitchen, also known as "Clinton," to the northeast is the Garment District, to the east are NoMad and the Flatiron District, to the southwest is the Meatpacking District and to the southeast is the West Village.

Chelsea is divided between Manhattan Community Board 4 and Manhattan Community Board 5. It contains the Chelsea Historic District and its extension, which were designated by the New York City Landmarks Preservation Commission in 1970 and 1981, respectivelyand added to the National Register of Historic Places in 1977, expanded in 1982 to include contiguous blocks containing particularly significant examples of period architecture.

The neighborhood is primarily residential, with a mix of tenements, apartment blocks, city housing projects, townhouses and renovated rowhouses, and its many retail businesses reflect the ethnic and social diversity of the population. The western part of Chelsea has become a center of the New York art world, with many art galleries located in both new buildings and rehabilitated warehouses.

The retail stores of Chelsea reflect the ethnic and social diversity of the area's population. Ethnic restaurants, delis and clothing boutiques are plentiful. Tekserve, a vast Apple computer repair shop, serves nearby Silicon Alley and the area's large creative community. The Chelsea Lofts district – the former fur and flower district – is located roughly between Sixth and Seventh Avenues from 23rd to 30th streets. Chelsea has a large gay population. The McBurney "Y" on West 23rd St., commemorated in the hit Village People song Y.M.C.A., sold its home and relocated to a new facility on West 14th St., the neighborhood's southern border

Most recently, Chelsea has become an alternative shopping destination with Barneys CO-OP - which replaced the much larger original Barneys flagship store - Comme des

Garçons, and Balenciaga boutiques, as well as being near Alexander McQueen, Stella McCartney, Christian Louboutin. Chelsea Market, on the ground floor of the former Nabisco Building, is a destination for food lovers.

In the late 1990s, New York's visual arts community began a gradual transition away from SoHo, due to increasing rents and competition from upscale retailers for the large and airy spaces that galleries require, and the area of West Chelsea between Tenth and Eleventh Avenues and 18th and 28th Streets has become a new global centers of contemporary art, home to hundreds of art galleries and many artist studios.

The neighborhood is reachable by the M7, M10, M11, M14, and M23 New York City Bus routes and the A C E services of the New York City Subway. The 7 trains will open a subway station in the neighborhood by November 2014.

People of many different cultures live in Chelsea. Above 23rd Street, by the Hudson River, the neighborhood is post-industrial, featuring the High Line that follows the river all through Chelsea.Eighth Avenue is a center for LGBT-oriented shopping and dining, and from 16th to 22nd Streets between Ninth and Tenth Avenues, mid-nineteenth-century brick and brownstone townhouses are still occupied, a few even restored to single family use.

Figure 49.2 **InterActiveCorp headquarters on Eleventh Avenue, designed by Frank Gehry**

Figure 50.2 Empire diner

Figure 51.2 The Desmond Tutu Center of the General Theological seminary

Figure 52.2 Chelsea district building

The conversion of the High Line(seen on the right) to an elevated urban park has stimulated much real estate development in West Chelsea, such as these two luxury apartment buildings, "Highline 519" and "HL23" on 23rd Street

Since the mid-1990s, Chelsea has become a center of the New York art world, as art galleries moved there from SoHo. From 16th Street to 27th Street, between 10th and 11th Avenues, there are more than 350 art galleries that are home to modern art from upcoming artists and respected artists as well. Along with the art galleries, Chelsea is home to theRubin Museum of Art - with a focus on Himalayan art, the Graffiti Research Lab and New York Live Arts - a producing and presenting organization of dance and other movement-based arts. The community, in fact, is home to many highly regarded performance venues, among them the Joyce Theater - one of the city's premier modern dance emporiums and The Kitchen- a center for cutting-edge theatrical and visual arts.

With a change in zoning resolution in conjunction with the development of the High Line, Chelsea has experienced a new construction boom, with projects by notable architects such as Shigeru Ban, Neil Denari, Jean Nouvel, and Frank Gehry.

The Chelsea neighborhood is served by two weekly newspapers, the *Chelsea-Clinton News* and *Chelsea Now*.

LANDMARKS AND PLACES OF INTEREST

- Chelsea Piers – The Chelsea Piers were the city's primary luxury cruise terminal from 1910 until 1935. The RMS Titanic was headed to Pier 60 at the piers and the RMS Carpathia brought survivors to Pier 54 in the complex. The northern piers are now part of an entertainment and sports complex operated by Roland W. Betts.

- Chelsea Market – In a restored historic factory, this festival marketplace hosts a variety of shopping and dining options, including bakeries, a fish market, wine store, and many others.

- Chelsea Studios – Sound stage on 26th Street since 1914 where numerous movies and television shows have been produced.

- Church of the Holy Apostles – Built in 1845–1848 to a design by MinardLefever, with additions by Lefever in 1853–1854, and transepts by Charles Babcock added in 1858, this Italianate church was designated a New York City landmark in 1966 and is listed on the National Register of Historic Places. It is Lefever's only surviving building in Manhattan. The building, which featured an octagonal spire, was burned in a serious fire in 1990, but stained glass windows by William Jay Bolton survived, and the church reopened in April 1994 after a major restoration. The Episcopal parish is notable for hosting the city's largest program to feed the poor, and is the second and larger home of the LGBT-oriented synagogue, Congregation Beth Simchat Torah.

- Empire Diner – An art moderne diner designed by Fodero Dining Car Company and built in 1946, altered in 1979 by Carl Laanes. Located at 210 Tenth Avenue at 22nd Street, it has been seen in several movies and mentioned in Billy Joel's song "Great Wall of China". The diner closed its doors for good on May 15, 2010.

- The General Theological Seminary of the Episcopal Church – Its college-like close is sometimes called "Chelsea Square", a city block of tree-shaded lawns between Ninth and Tenth Avenues and West 20th and 21st Streets. The campus is ringed by more than a dozen brick and brownstone buildings in Gothic Revival style. The oldest building on the campus dates from 1836. Most of the rest were designed as a group by architect Charles Coolidge Haight, under the guidance of the Dean, Augustus Hoffman.

- High Line – The High Line is an elevated rail line, the successor to the street-level freight line original built through Chelsea in 1847, which was the cause of numerous fatal accidents. It was elevated in the early 1930s by the New York Central Railroad, but fell out of use. Originally slated to be torn down, it has now been converted into an elevated urban park.

- Hotel Chelsea – Built 1883–1885 and designed by Hubert, Pirsson& Co., it was New York's first cooperative apartment complex[4] and was the tallest building in the city until 1902. After the theater district migrated uptown and the neighborhood became commercialized, the residential building folded and in 1905 it was turned into a hotel. The hotel attracted attention as the place where Dylan Thomas had been staying when he died in 1953 at St. Vincent's Hospital in Greenwich Village, and for the 1978 slaying of Nancy Spungen for which Sid Vicious was accused. The Hotel has been the home of numerous celebrities, including Brendan Behan, Thomas Wolfe, Mark Twain, Tennessee Williams and Virgil Thomson, and the subject of books, films (*Chelsea Girls*, 1966) and music.

- Hudson River Park – The entire Hudson River waterfront from 59th Street to the Battery including most of associated piers is being transformed into a joint city/state park with non-traditional uses.

- Irish Repertory Theatre – An Off-Broadway theatrical company on West 22nd St producing plays by Irish and Irish-American writers.

- London Terrace – The apartment complex on West 23rd was one of the world's largest apartment blocks when it opened in 1930, with a swimming pool, solarium, gymnasium, and doormen dressed as London bobbies. It was designed by Farrar and Watmough. It takes its name from the fashionable mid-19th century cottages which were once located there.

- Penn South – A large limited-equity housing cooperative built by the United Housing Foundation and financed by theInternational Ladies' Garment Workers' Union covering six city blocks, between 8th and 9th Avenue and 23rd and 29th Street.

- Peter McManus Cafe – This bar and restaurant on Seventh Avenue at 19th Street is among the oldest family-owned and -operated bars in the city.

- Pike's Opera House – Built in 1868, and bought the next year by James Fisk and Jay Gould, who renamed it the Grand Opera House. Located on the corner of Eighth Avenue and 23rd Street, it survived until 1960 as an RKO movie theater.

- Rubin Museum of Art – is a museum dedicated to the collection, display, and preservation of the art of the Himalayas and surrounding regions, especially that of Tibet. It is located at 150 West 17th Street between the Avenue of the Americas (Sixth Avenue) and Seventh Avenue.

- Starett-Lehigh Building – This huge full-block freight terminal and warehouse on West 26th Street between Eleventh and Twelfth Avenues was built in 1930-1931 as a joint venture of the Starett real estate firm and the Lehigh Valley Railroad, and was engineered so that trains could pull directly into the ground floor of the building. Designed by Cory & Cory, the industrial behemoth was so architecturally notable that it was included in the Museum of Modern Art's 1932 "International Style" exhibition, one of only a few American buildings to be so honored. It wasdesignated a New York City landmark in 1966.

KILOMETRO ZERO TOWER PROJECT

Figure 53.3 General view of Kilometro Zero Tower

Figure 54.3 Master Plan of the Project

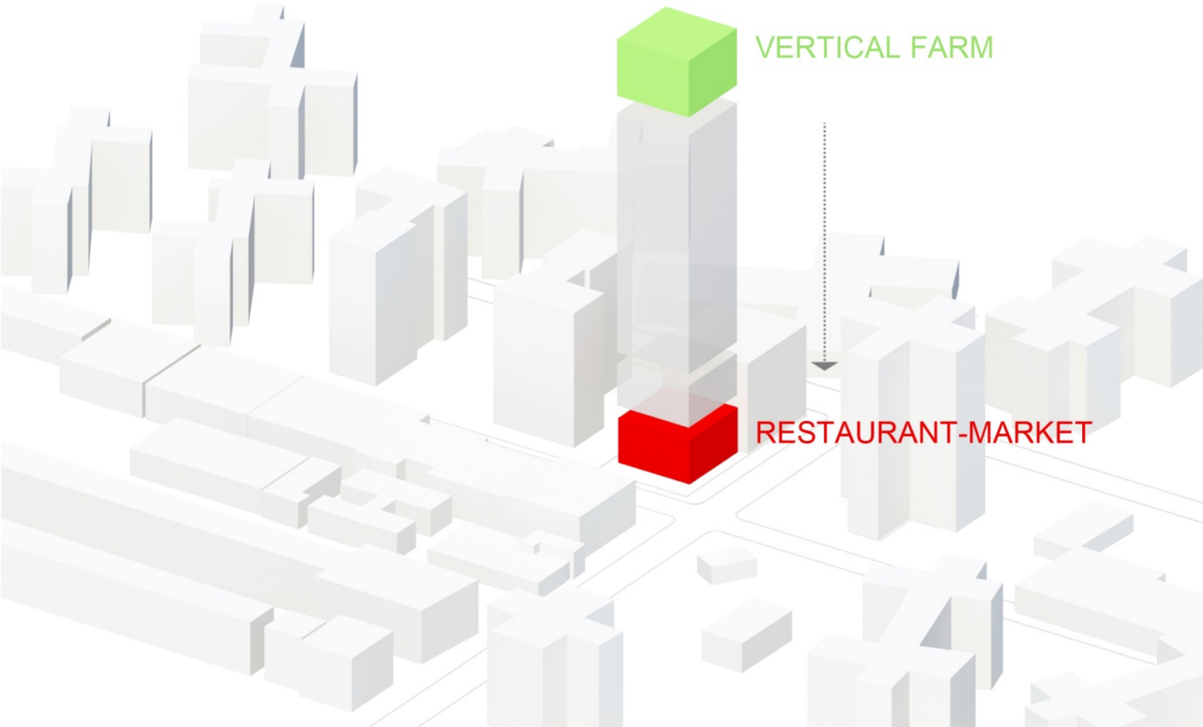


Figure 55.3 concept of connection between Vertical Farm and restaurant – markets

KM0 is a mixed - use program which contains a vertical farm in upper part and restaurant /retail markets in the lower part of building. It means the fresh crops serve

directly in the restaurants and will be sold to local people in retail markets

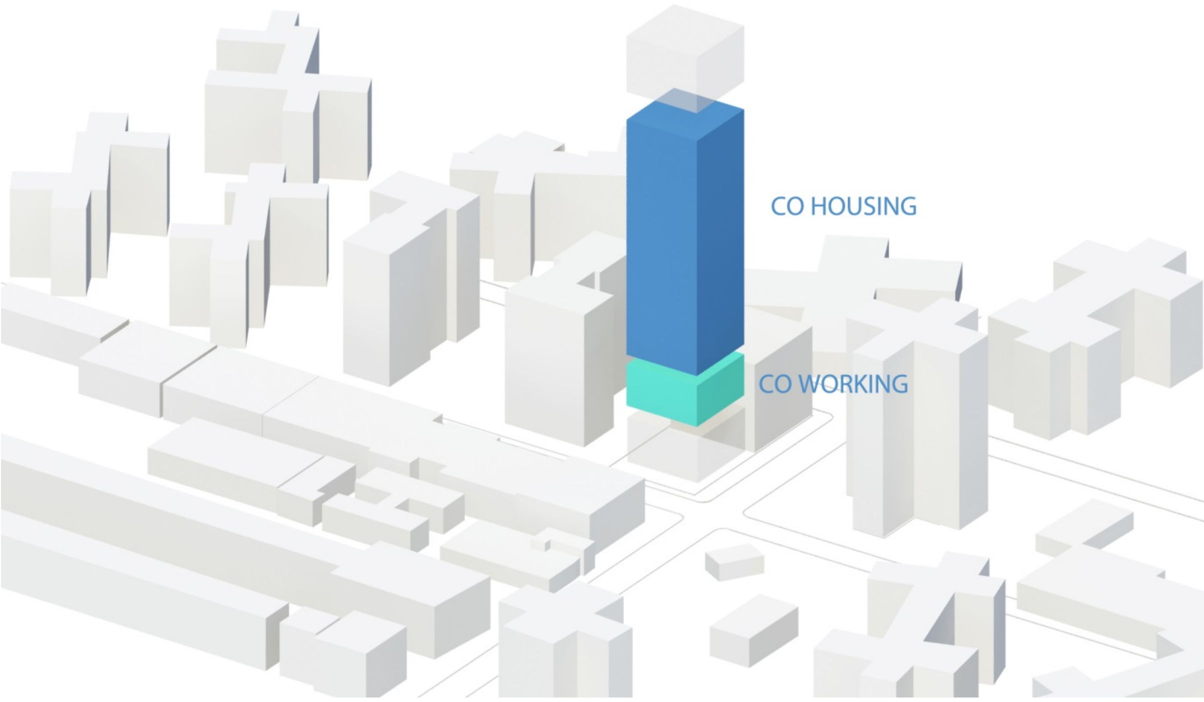


Figure 56.3 concept of Co-working and Co-Housing

The middle part of Kilometro zero contains co-working and co-housing.

Co-working is a public and community working space which serve to freelancers and small offices. Kilometro zero gives to people the opportunity to work in a community urban integrated realm, and they will be hosted in launch time in the mentioned restaurants.Co-housing are modular units which are going to host single people and young family in Chelsea district who wish have a good saving on the apartment prize due to co-housing solution.

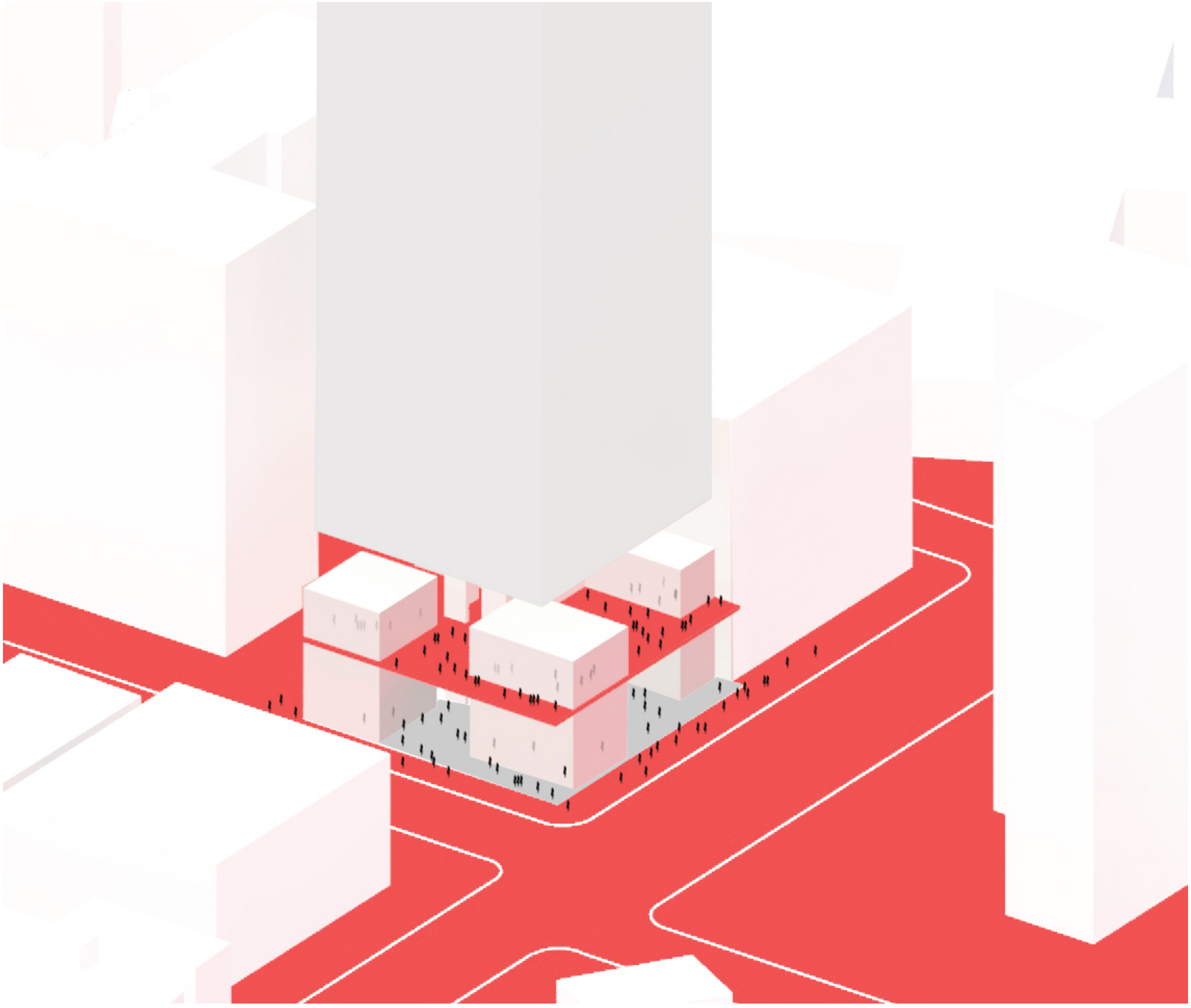


Figure 57.3 Urban Integrated podium

Podium is used as an integrated urban centre where located market stores and restaurants serve to local people and who lives or working in the tower.

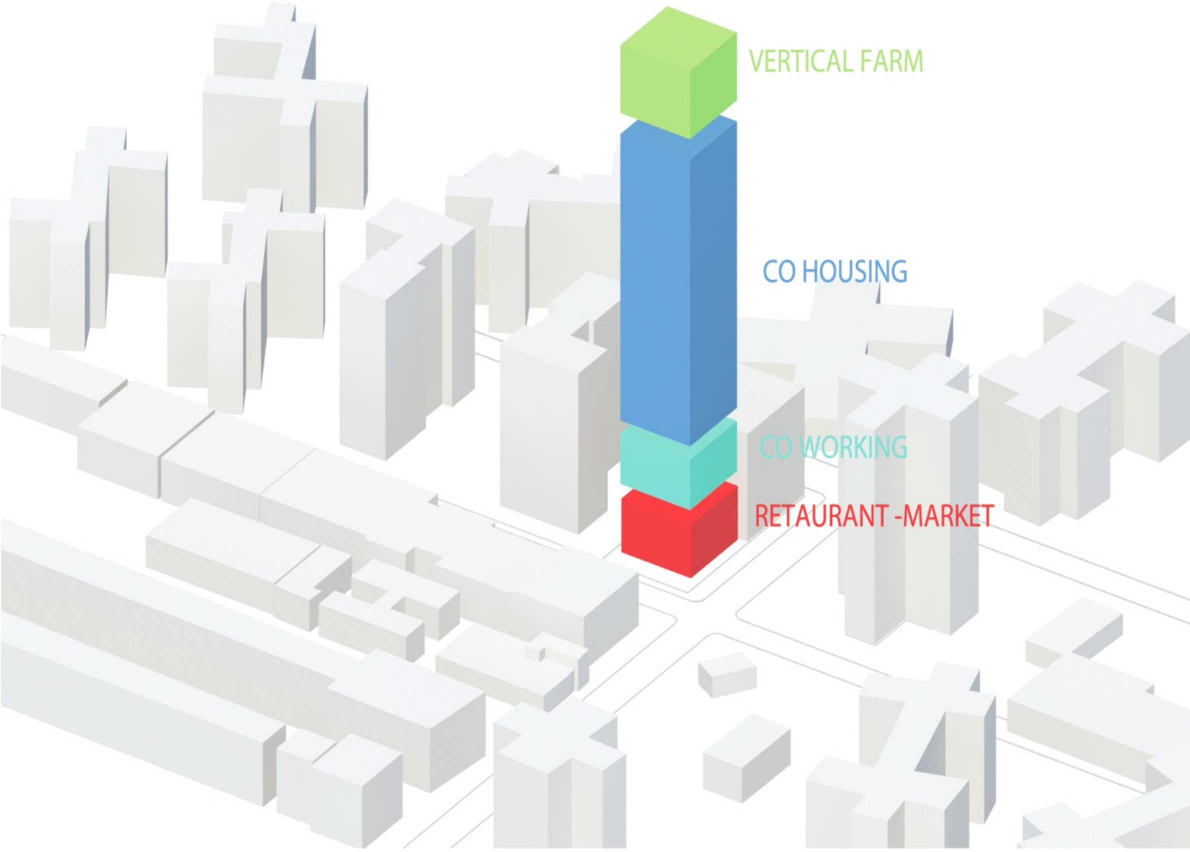


Figure 58.3 Kilometro Zero Program

CO HOUSING

What is co-housing ?

A cohousing community is a type of

international community composed of private homes supplemented by shared facilities. The community is planned, owned and managed by the residents – who also share activities which may include cooking, dining, child care, gardening, and governance of the community. Common facilities may include a kitchen, dining room, laundry, child care facilities, offices, internet access, guest rooms, and recreational features.

Figure 59.4 Co housing community

Cohousing facilitates interaction among neighbors for social and practical benefits, economic and environmental benefits.

In describing NEW YORK citie 's first co-housing project, a recent New York Times article said co-housing "speaks to people who want to own an apartment but not feel shut off by it, lost in an impersonal city.

CO HOUSING BEFITS

Improve community living

Sharing facilities

Reduce building cost

Reduce energy consumption

WHY CO HOUSING ?

Contemporary life , particularly in large cities, imposes rhythms of everyday life away from the demands of well-being and quality to which we aspire .

The balance between private and professional dimension size is made precarious by the organization of services, and this creates a tension that inevitably affects the quality of life.

The co-housing , or choosing to live in a community neighborhood elective major sharing services and their management , is a viable alternative , not an utopian response to the problems that the people live in each metropolitan reality .The reasons that lead to the co-residency is the aspiration to regain the lost dimension of social relations, mutual aid and good neighborly relations and at the same time the desire to reduce the complexity of life , stress and cost of managing daily activities. This is the main reason for which the co-housing are developed mainly in big cities where most urbanized felt a fragmentation of social relations.

“ Co-housing is a relatively new concept in the US, although it has been increasingly popular in Denmark and other European countries since the mid-1960s.

Think of it as expanding upon the simple shared housing concept of New York City “cooperative” apartment buildings. There, residents own shares of the whole complex and the right to live in one of them. It’s an attempt to more closely link mere residency with fellowship and communit ’’

(Robert Moskowitz on Feb 05, 2014 in Independent Living)

CO HOUSING CASE STUDIES

1- **Karawitz Architecture** recently announced the design for their passive co-housing project in Paris. Their principle of a self-governed independent residential initiative with 14 apartments (R+7), commercial premises, gardens (ground floor and roof area), car parks and communal areas (community house, laundry, bike shed and other areas)

Figure 60.4 KarawitzArchitcture cohousing project –archdaily website

aims to reflect a new construction trend: private individual buyers joining together to form a cooperative to fulfil their own property and future housing project, in partnership with the SEMAVIP (ParisSite Manager) and Paris City and to share spaces and equipment.

Figure 61.4 KarawitzArchitcture cohousing plan –archdaily website

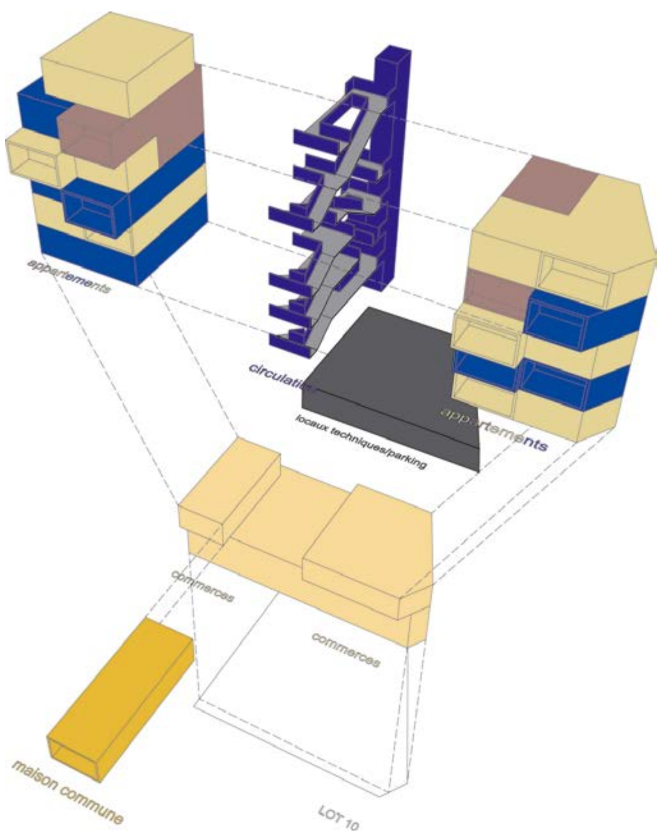


Figure 62.4 KarawitzArchitcture cohousing diagram –archdaily website

2- Social Housing (cohousing) for Mine Workers / Zon-e Arquitectos

The purpose of the project was to design and build state subsidized housing in Cerredo (Asturias), a mining town located in the very heart of the Cantabrian Mountains, where no residential construction had been made for over 25 years.

Figure 63.4 social housing –co-housing ,Spain bye Zone –e-Architecture

The project had two stages that materialized in two perpendicular buildings forming an L shape. In the first stage we undertook the biggest building, which faces the road that crosses the town.

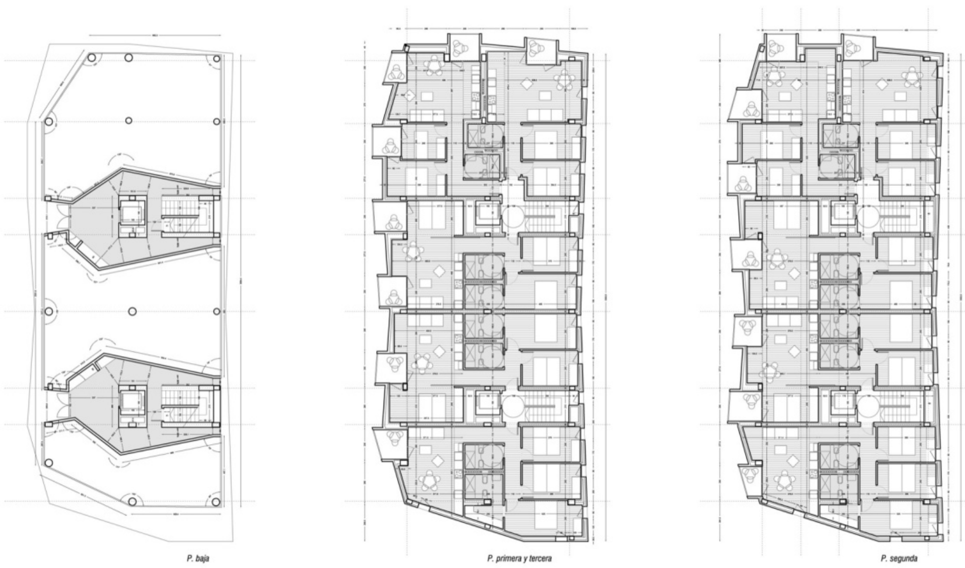


Figure 64.4 4 social housing –co-housing plan ,Spain bye Zone –e-Architecture

The volumetric we propose has an angular shape. It is a geometry crystallized from some elementary laws that are given by the town-planning regulations. The formal result is something halfway between a petrified object, a mountain's shape and a disturbing organism floating over the mountainside.

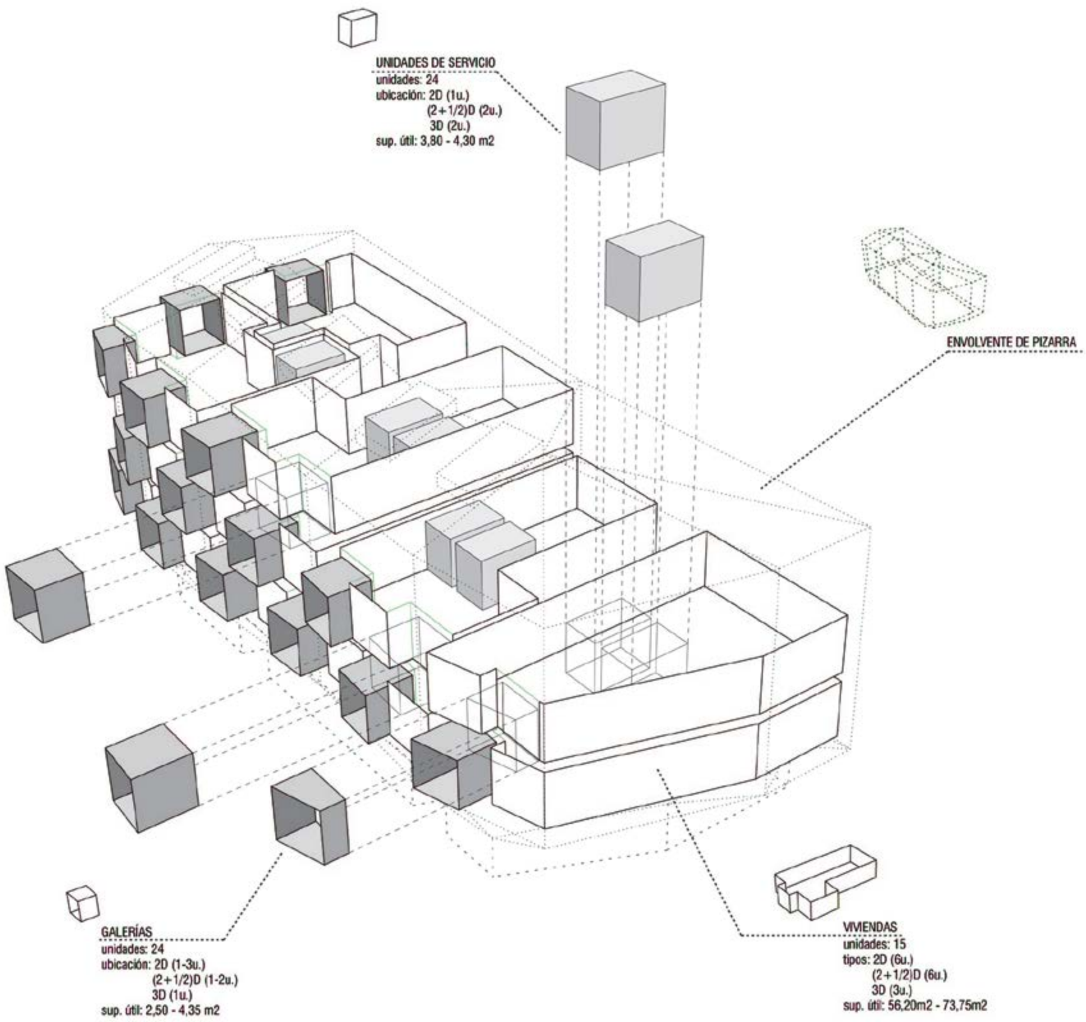


Figure 65.4 social housing –co-housing Diagram ,Spain bye Zone –e-Architecture

KILOMETRO ZERO CO-HOUSING Chelsea underline that the 54 % of population is single and the average household size is of 1.7 people. Km0 tried to answer in a good way to living in this condition , where there are a lot of young single and small families and apartment are very expensive , designing co housing where the people with sharing some spaces with others could make more community and paying less seems very acceptable .

Figure 66.4 Kilometro Zero first Plan typology

Figure 67.4 Kilometro Zero second Plan typology

Figure 68 .4 co-housing Common spaces

KM0 CO-HOUSING AVERAGE SAVING

In our case the Kilometro 0 Tower permits an important saving with the co-housing solution.

For instance an apartment of 90 square meters in Manhattan cost around 772.500 $,

In Km0 Tower the same apartment costs 482.675 $ (around 40 % less).

The achievement is given by different factors:

15 – 20%	15 -20%	20 – 30%	40%	20 – 60%	30 – 50%
Generally due to the fact that co-housing, more than 50% of the apartments are booked before or cohouser that is built in co-op(cooperative) The main factors: the area where you build or buy, or buy into the co-op to developer.	Main factors: the type of spaces and common services, unavailability of cohouser able to devote time to the management of spaces and common services	Main factors: type of common areas and liaison with suppliers; willingness and ability of the group to cohouser reuse of materials, furnishings, facilities, tools.	Main factors: the type of spacers and common services and the quality of construction and system.	Main factors: choices about the kind of common spaces and served, or on self-management choices in outsearching services.	The main factors: choices on the kind of purchase , Self energy using common space and service(dishwasher , laundry, oven , fridge…)

15% that correspond to 115.875 $. This saving represents an advantage for to buy a new apartment before of its construction;

50% of the purchase of furniture for common spaces that correspond to 10000$.

This saving is given by the purchase of furniture for kitchen and bathroom;

- 50 % of saving on idric system, energy and material for common space that correspond to 2.500 $. This saving considers the cost for the system and material of common spaces.

The total of this factors is 128.575 $ but in Km0 Tower another saving is given by the share of square meters for common space like kitchen, bathroom and balconies.

So for the apartment of 90 Square meters there is a saving of 50 % for kitchen and bathroom and 30% for balcony for a total of 161.250 $.

In conclusion 161.250 $ + 128.475 $ = 289.725 $ that is the total saving for an apartment of 90 square meters.

772500 $	90m^2 appartament in Chelsea manhattan NY	
115875 $	Saving by prepurchasing of apparatamentwhich is a characteristic aspect of co housing	15% of total apartment price
161250 $	Saving by sharing kitchen –bathroom –balcony	50% on price of common space an 30%on balcony
10000 $	Saving by kitchen –bathroom fornitures	50% on price of common spaces furniture
2500 $	Saving by energy and material consumption	50 % on price of common Idric system
482775 $	KM0 90m^2 apartment price	38% saving compared to normal apartment in Manhattan NY

VERTICAL FARM

WHAT IS VERTICAL FARM?

Technically, vertical farming is the practice of soil-less/controlled environment agriculture (S/CEA) within the high-density confines of multi-storey buildings. As the name suggests, S/CEA consists of plant cultivation in contained environments where light, temperature, water, and nutrition can be finitely controlled. Until recently this high-tech form of horticulture was primarily utilized for plant study by universities and space agencies due to its high cost. In the past decade, however, improvements to associated technologies and increased awareness of the benefits of S/CEA have enabled it to expand into large-scale operations. Cornell University introduced the first commercial scale S/CEA facility in 1999, producing some 1,245 heads of high-quality lettuce per day. To appreciate the benefits of growing food indoors, consider the incompatibilities of human food production and the temperment of the natural world. Agriculture, whether industrial or organic, is structured to maximize the production of edible biomass (i.e. food), while natural ecosystems are structured to maximize their own stability. These conflicting goals ensure that the success of one impedes the success of the other. Natural succession and climactic variability greatly impede food production worldwide, forcing billions to be spent on pest management chemicals and genetic modification of plant species. At the same time, the high rates of deforestation, desertification, soil erosion, and soil salinization noted previously are principally due to the expansion of farming, while the decline of aquatic ecosystems is largely the result of agricultural fertilizers, pesticides, herbicides, and antibiotics leaching into the water cycle

By segregating crop growth within an in-door environment the temperature, light, water, humidity, and nutrient availability that dictate a plant's success can be finitely controlled, while the negative impacts of an ecosystem's natural succession can be eliminated. This two-fold benefit effectively permits the creation of each plant's ideal growing conditions year-round. Crops grow quicker, larger, and with many more harvests per year than external conditions permit; all without the use of fossil-fuel derived pesticides or fertilizers. Moreover, many agronomists have provided strong evidence indicating the nutritive value of S/CEA crops equals or surpasses that of the most successful field grown crops.

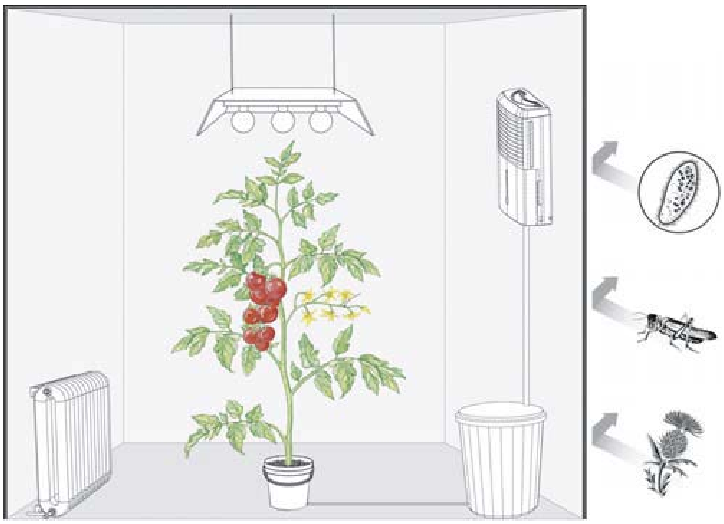
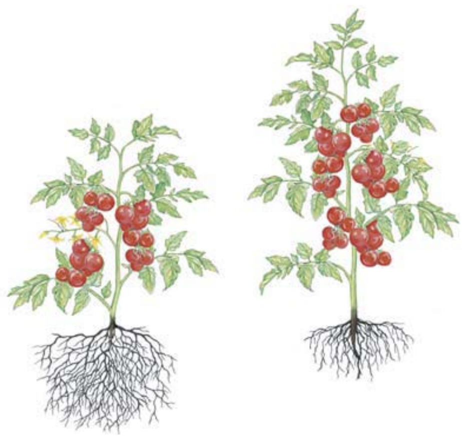


Figure 69.5 Vertical Farm Hydroponic system diagram



Due to the streamlined water-nutrient delivery of hydroponic systems,

hydroponic plants do not have to develop the extensive root structures

required by geoponic plants. This ensures the energy devoted to plant

growth is maximized toward fruit production, therein increasing yields.

WHY VERTICAL FARM?

By the year 2050, nearly 80% of the earth's population will reside in urban centers. Applying the most conservative estimates to current demographic trends, the human population will increase by about 3 billion people during the interim. An estimated 109 hectares of new land (about 20% more land than is represented by the country of Brazil) will be needed to grow enough food to feed them, if traditional farming practices continue as they are practiced today. At present, throughout the world, over 80% of the land that is suitable for raising crops is in use (sources: FAO and NASA). Historically, some 15% of that has been laid waste by poor management practices. What can be done to avoid this impending disaster?

The concept of indoor farming is not new, since hothouse production of tomatoes, a wide variety of herbs, and other produce has been in vogue for some time. What is new is the urgent need to scale up this technology to accommodate another 3 billion people. An entirely new approach to indoor farming must be invented, employing cutting edge technologies. The Vertical Farm must be efficient (cheap to construct and safe to operate). Vertical farms, many stories high, will be situated in the heart of the world's urban centers. If successfully implemented, they offer the promise of urban renewal, sustainable production of a safe and varied food supply (year-round crop production), and the eventual repair of ecosystems that have been sacrificed for horizontal farming.It took humans 10,000 years to learn how to grow most of the crops we now take for granted. Along the way, we despoiled most of the land we worked, often turning verdant, natural ecozones into semi-arid deserts. Within that same time frame, we evolved into an urban species, in which 60% of the human population now lives vertically in cities. This means that, for the majority, we humans are protected against the elements, yet we subject our food-bearing plants to the rigors of the great outdoors and can do no more than hope for a good weather year. However, more often than not now, due to a rapidly changing climate regime, that is not what follows. Massive floods, protracted droughts, class 4-5 hurricanes, and severe monsoons take their toll each year, destroying millions of tons of valuable crops. Don't our harvestable plants deserve the same level of comfort and protection that we now enjoy? The time is at hand for us to learn how to safely grow our food inside environmentally controlled multistory buildings within urban centers.

If we do not, then in just another 50 years, the next 3 billion people will surely go hungry, and the world will become a much more unpleasant place in which to live.

ADVANTAGES OF VERTICAL FARM :

- Year-round crop production; 1 indoor acre is equivalent to 4-6 outdoor acres or more, depending upon the crop (e.g., strawberries: 1 indoor acre = 30 outdoor acres)
- No weather-related crop failures due to droughts, floods, pests
- All VF food is grown organically: no herbicides, pesticides, or fertilizers
- VF virtually eliminates agricultural runoff by recycling black water
- VF returns farmland to nature, restoring ecosystem functions and services
- VF greatly reduces the incidence of many infectious diseases that are acquired at the agricultural interface
- VF converts black and gray water into potable water by collecting the water of evapotranspiration
- VF adds energy back to the grid via methane generation from composting non-edible parts of plants and animals
- VF dramatically reduces fossil fuel use (no tractors, plows, shipping.)
- VF converts abandoned urban properties into food production centers
- VF creates sustainable environments for urban centers
- VF creates new employment opportunities
- VF may prove to be useful for integrating into refugee camps
- VF offers the promise of measurable economic improvement for tropical and subtropical

LDCs. If this should prove to be the case, then VF may be a catalyst in helping to reduce or even reverse the population growth of LDCs as they adopt urban agriculture as a strategy for sustainable food production.

- VF could reduce the incidence of armed conflict over natural resources, such as water land land for agriculture

ECONOMIC OF RATIONALE OF VERTICAL FARM

In light of vertical farming's significant departure from conventional food production it is important to address the economic rationale through which the concept could be realized. Clearly, vertical farming involves a number of expenses not required for conventional farming; the burdens of internalizing the environmental externalities of conventional agriculture. Most of the added expenses are initial capital costs needed to synthesize an ideal growing environment, such as the construction (or renovation) of a multi-level enclosed building, installation of temperature and humidity control equipment, and assembly of a vast hydroponic system. Also, larger vertical farms that utilize artificial lighting would likely necessitate the installation of an on-site power generating system, such as anaerobic digesters with a methane-burning electric generator. These systems are considerable expenses to account for, and as such must be countered with an improved level of profitability to make the concept economically viable.

Fortunately, vertical farming's intensive method of cultivation offers many productivity advantages over conventional farming, presenting the possibility of setting elevated operating costs with increased yields of saleable produce. As mentioned Cornell University's CEA facility produces approximately 23 times more lettuce per acre than the average California lettuce field. This means the facility could be 23 times more costly to operate than a similarly scaled conventional lettuce field while matching its profitability - or 20 times more costly and achieve greater profitability.

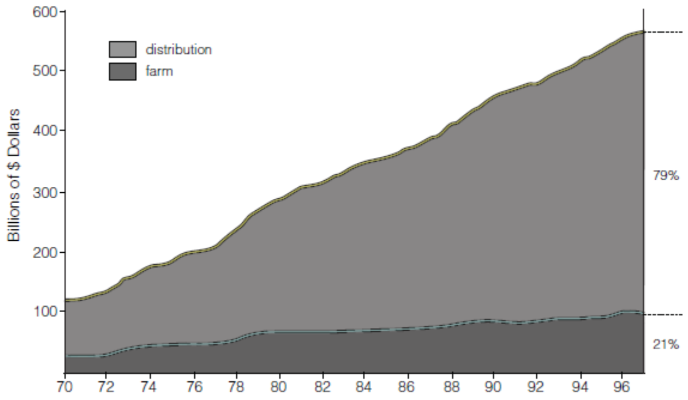


Fig 2.29
Food supply chain expenditures from 1970 to 1997. Note the increasingly diminishing share of food purchase profits being directed to farmers. Source: USDA Agriculture Fact Book 1998

Figure 70.5 , Food supply chain expenditures from 1970 to 1997 . Note the increasingly diminishing share of food purchase profits being directed to farmers. Source: USDA Agriculture Fact Book 1998

Another major advantage is the impact of the controlled environment cultivation method employed by vertical farms to protect crops from events that routinely disrupt conventional production. Such events include all instances of climactic variability and the majority of pest/pathogen infestations, each of which negatively impact a farm's profitability by reducing the volume of saleable produce and increasing its operating costs. A typical example of this impact occurred in 2010 when heavy rains in Saskatchewan, Manitoba, and Alberta caused crop losses valued at approximately $1.5 billion, for which the federal government pledged another $450 million in relief aid for affected farms. Additionally, in the aforementioned example of the U.S. state of Georgia losses and expenses associated with pests and pathogens average $590 million per year, approximately 13% of the yearly agricultural revenue.23 Clearly, avoiding a large portion of these necessary costs of conventional agriculture would be another potential economic advantage for a vertical farm.

IMPROVEMENTS TO INCOME

The most obvious way to improve the vertical farm's return is to increase its operating income, and to this end there are many factors to consider. One strategy could involve establishing a niche market for vertical farm produce for which consumers would be willing to pay a price premium. Selling points to this end could include hydroponic lettuce's superior quality and cleanliness to conventional lettuce, as well as its beneficial impact on the environment (diverting bio waste from landfills and returning organic fertilizers and soil fortifiers to rural lands). Organic produce, which merely boasts a 'reduced' impact on the natural world, currently enjoys a healthy price premium over non-organic produce. Organic lettuce imported from California into Ontario had an average price of $27.75 per 24-head carton for the same period as the Boston variety used in the analysis. If the vertical farm could match this price premium it would generate over $7.3 million more in net operational income and increase the rate of return to just over 15% - likely meeting the projected minimum return to attract investors. The farm's operating income could also increase by diversifying its production with other food services, thus consolidating the multi-step food distribution system. The modern food supply chain currently involves many off -farm sectors, such as wholesalers, processors, and retailers, each of which command a certain portion of the profit from food sales. For example using the typical 20-30% markup for wholesalers and 40-50% markup for retailers, every $1.00 of food sold by a farmer to a wholesaler would be sold for $1.30 to a retailer, who would in turn sell it for $2.42 to the consumer. This example price mark-ups account for the expense of the services offered by each distribution stage (transportation, marketing, refrigeration costs, etc.), as well as their respective profit margins.

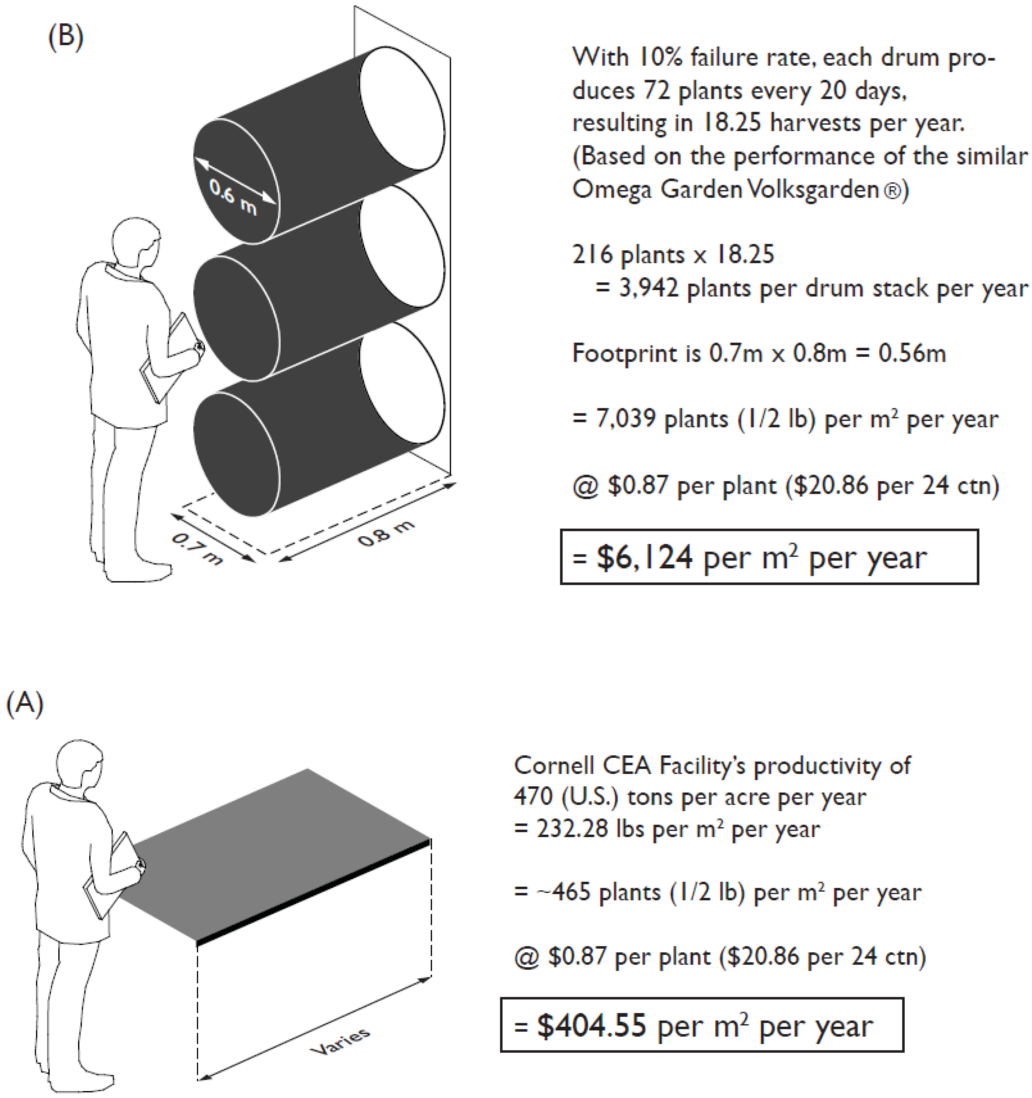


Figure 71.5 A comparison of the revenue generating potential of (a) conventional greenhouse hydroponics with (b) space-efficient system designed for artificial light.

KILOMETRO ZERO VERTICAL FARM

The idea to design a Tower called Km0 is born from different needs of answer to the problems already mentioned above that they are going to increase in the future.

New York city represents an ideal site to develop a building featuring green vertical farm. The reasons are that NY is a metropolis with an incessant population growth and that means increased demand accommodation , services, food, jobs, but also increase traffic , pollution , loss of land on which to grow vegetables, cereals , fruits.

Currently the request of this products is satisfied by the city adjacent land that trigger a mechanism that involves transportation of the product to the consumer. This process has a significantly increased the traffic and air pollution in addiction to an rise of final prize for the customer.

The Km0 Tower eliminates the problem of transport and with it also the wastage of material for packaging offering a fresh product to the consumer.

So Km0 Tower is proposed as a building that provides an answer to these problems , in fact the realization of a vertical farm develops a micro- economy that starts from the creation of new jobs for the cultivation of plants and ends with the sale in restaurants and market products at the base of the building , allowing even the less affluent classes to be able to feed themselves with the products fresh and safe .

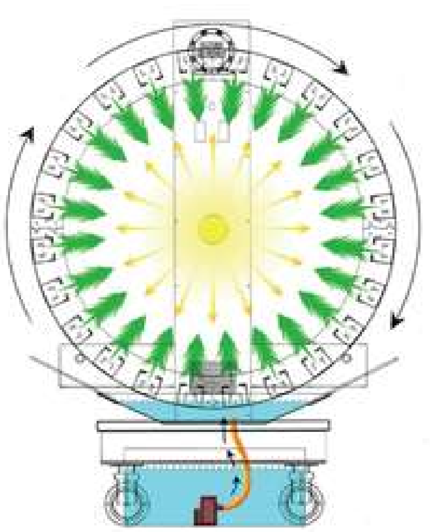
Safety is another advantage to grow produce in an environment of vertical farm allowing you to control the quality of products while avoiding the spread of deases and protecting the crop from weather to avoid serious damage to the crop. This could be an answer to the problems of malnutrition that is constantly growing with the increase in population poorer.

Another important reason to motivate us to design a vertical farm in a mostly residential tower is without a doubt its sustainability . The Km0 Tower has 6 floors dedicated to hosting numerous crops.All the energy needed to operate this process is derived from the technologies used in the project: solar, wind and reuse of wastewater.

KILOMETRO ZERO VERTICAL FARM SYSTEM

STACKED DRUMS / OMEGA GARDEN

the drum design likely offers the most promise for the future of indoor agriculture .It consists of growing plants within the interior of a drum structure positioned around a central artificial light source, resulting in an extraordinarily low space and energy use per unit of production. The first publicized example of this design emerged in the late 1970s from the Environmental Research Laboratory at the University of Arizona. Today the most popular variant is produced by Omega Garden™ of Victoria, B.C., which features a mechanism that rotates the drum through a tray containing nutrient solution.



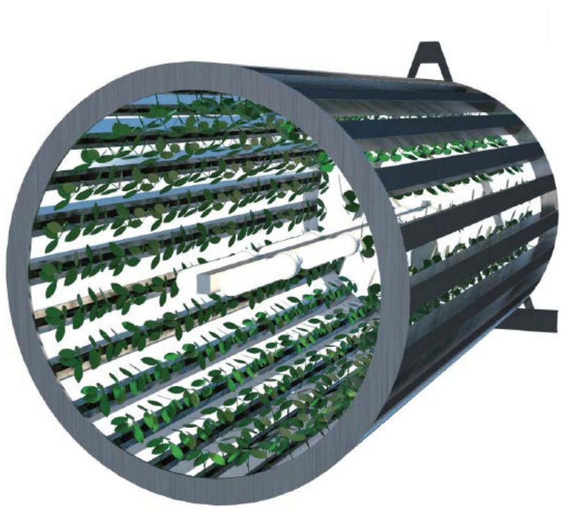


Figure 72.5 Volksgarden food production system. Bye Omega Garden industry firm

THE OMEGA GARDEN

The Omega Gardenis the answer to commercial and industrial-scale urban agriculture. Each horizontal carousel carries 36 Volksgardenmodules.EachVolksgarden module has approximately 20 foot square surface growing area.Rotary motion effect on plants shows an increase in growth rates of up to a factor of five observed. Horizontal carousel frame conforms to intermodal shipping container specs for easy shipping, and stacking.

The Farmdominium TM (like condominium but without the con ;) is designed to be a fully automated system. Each rotating garden is a module that can be removed from the carousel if required. In turn each containerized carousel is a movable module in the larger system.

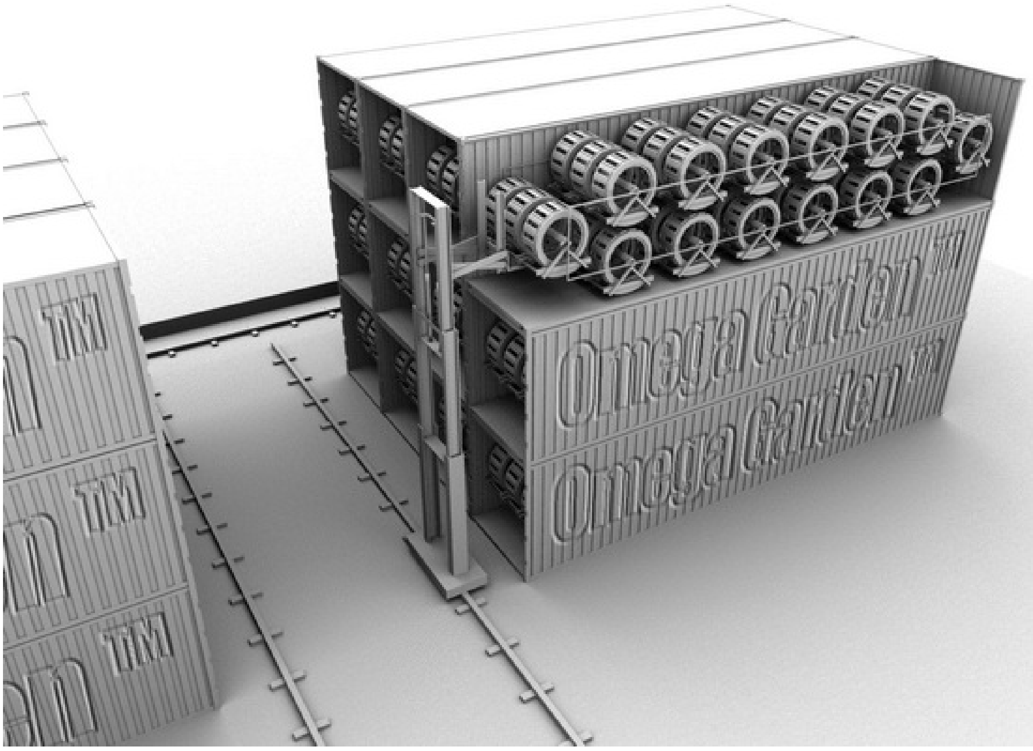


Figure 73.5 Omega Garden , Farmdominium , http://www.omegagarden.com/

Kilometro Zero production estimation based on lettuce production

Yield Per Volksgarden

Crop	Plant Capacity Per Volksgarden Per Harvest	Time to Load and Harvest	Harvests Per Year	Yield Per Year Per Volksgarden
Lettuce	80	20 days	18	1,440

Figura3.1, Yield per volksarden ,source by omega garden overview industry firm

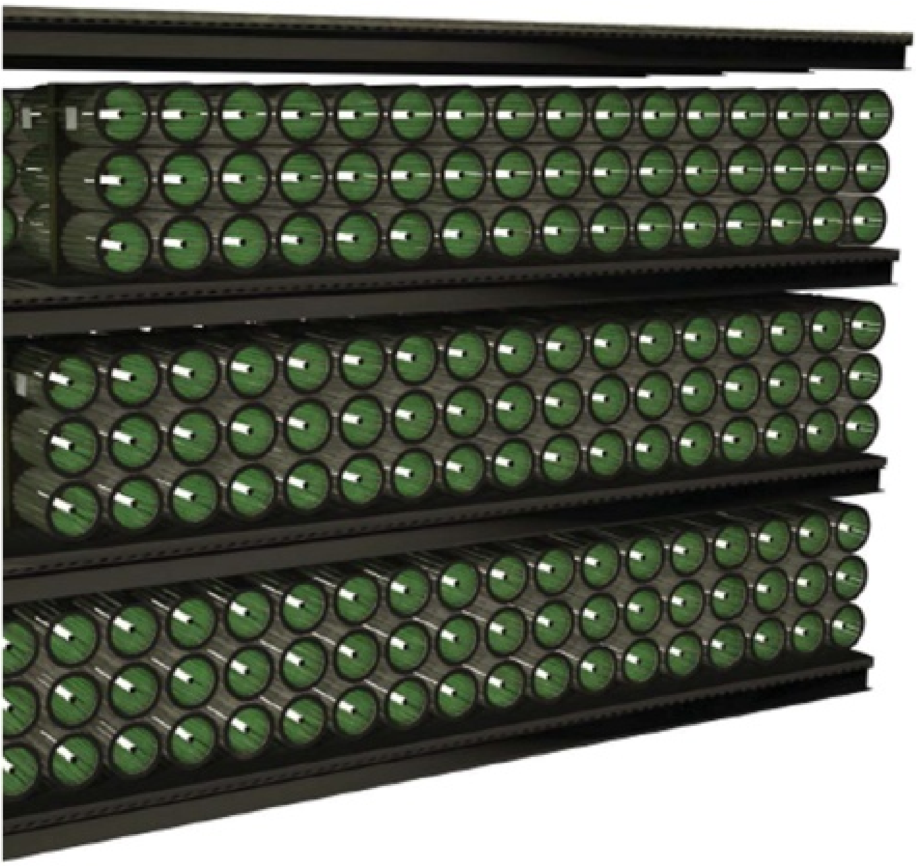


Figure 74.5 arrow volksgardens, omega garden

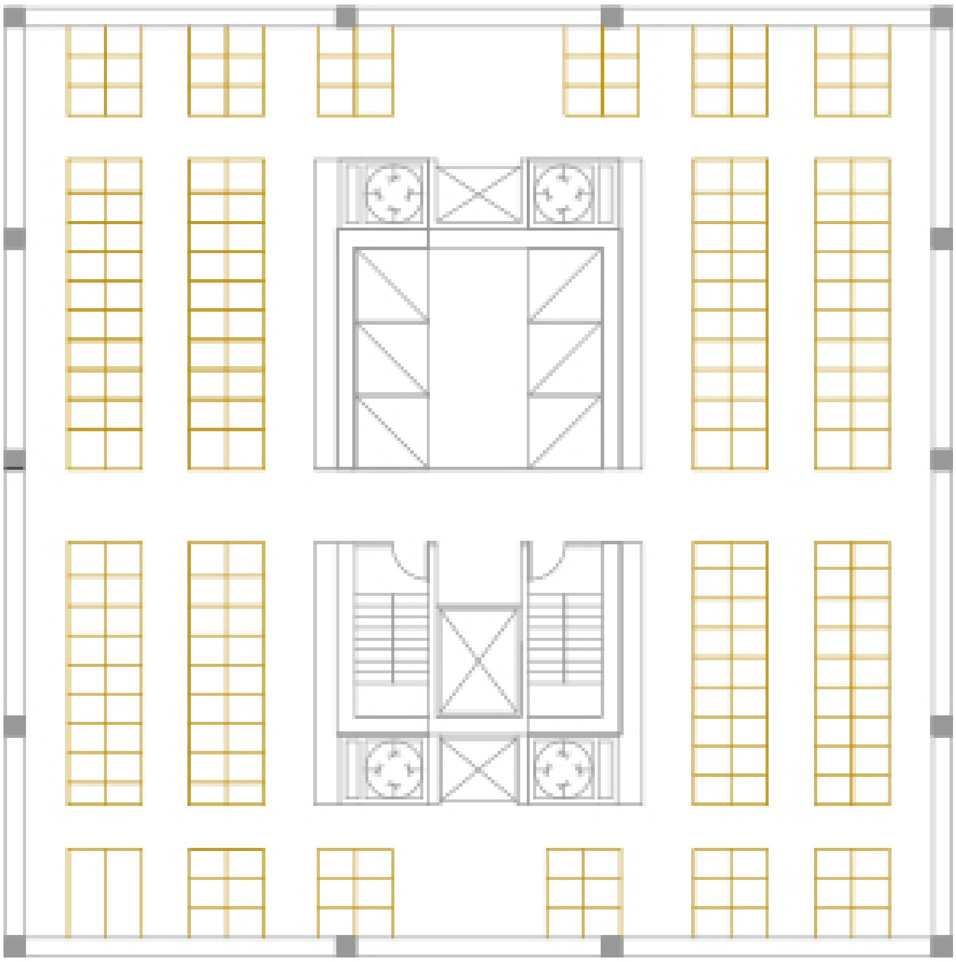


Figure 75.5 volksgardens plan distribution in K0 tower (618 VG per level)

200VOLKSGARDEN x 5 LEVELES =1000

1 Volksgarden yield production per year =1440

1000 x1440 =1440,000 plant per year

an estimation of one lettuce plant is 1/2 (lb)= 0.22 kg

1440000 x 0.22 kg = 316800 kg per year

316800\365 =867 kg per day production

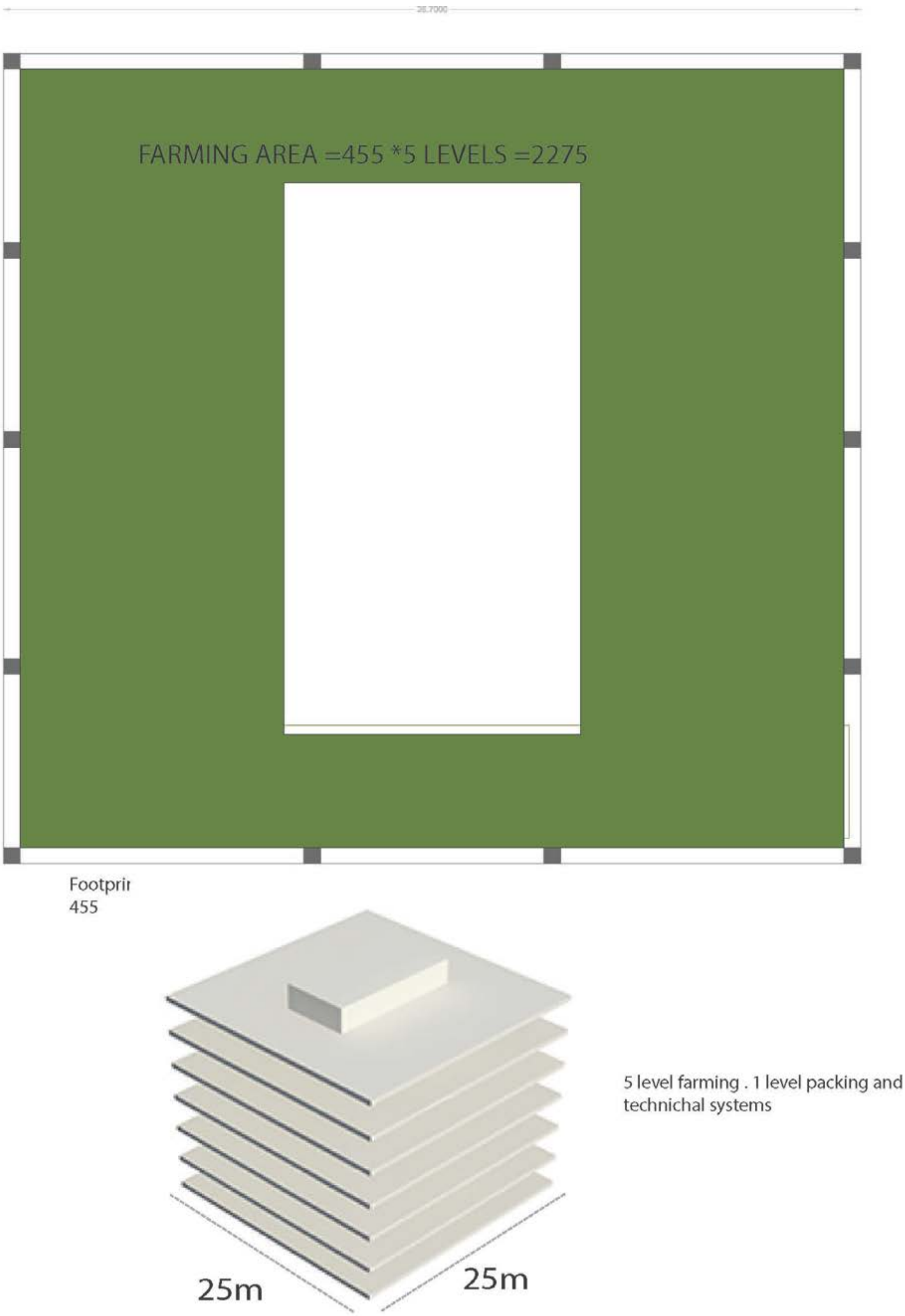


Figure 76.5 Kilometro Zero Vertical Farm Area

COST OF VERTICAL FARM

Annual cost of Vertical Farm:

PRODUCT	QUANTITY	PRICE	TOTAL COST
Energy	533 227 Kwh/a	0,20 $ for Kwh	106 645 $
Fixed charge (maintenance , worker , fertilizer…)	20% on total profit income	------------	314 291 $
			420 936 $

Annual production of lettuce with Vertical Farm :

PRODUCT	QUANTITY	RETAIL PRICE	TOTAL PROFIT
lettuce	316 800 kg/year	5 $ for kg	1 584 000 $

First year Investment cost for Vertical Farm :

PRODUCT	QUANTITY	PRICE	TOTAL INVESTMENT
VolksGarden Omega	1000	2000 $ for each	2 000 000 $

Development initial investment to 5 years :

YEAR	INVESTMENT	FIXED COSTS	TOTAL COST	YEAR PROFIT	NET RETURNS	TOTAL PROFIT
1	2 000 000 $	420 936 $	2 420 936 $	1 571 456 $	-836 936 $	-836 936 $
2	------------	420 936 $	420 936 $	1 571 456 $	1 163 064 $	326 128 $
3	------------	420 936 $	420 936 $	1 571 456 $	1 163 064 $	1 489 192 $
4	------------	420 936 $	420 936 $	1 571 456 $	1 163 064 $	2 622 256 $
5	-------------	420 936 $	420 936 $	1 571 456 $	1 163 064 $	3 815 320 $

COST OF CONVETIONAL FARM

Cost production (4423kg of lettuce) for Conventional Farm :

Table 2. Costs and Returns of Producing Field-Grown Head Lettuce ($/acre)

Total Returns	Unit	Price/unit	Quantity	Total	Note	Your Return
Lettuce	head	$1.75	19,500	$34,125.00	Assumed yield is 26,000 heads and 75% is marketable.	
Variable Costs	**Unit**	**Cost/unit**	**Quantity**	**Total**	**Note**	**Your Cost**
Field preparation and planting						
Chisel plow	hour	$15.00	2	$30.00		
Lime application, custom	acre	$50.00	1	$50.00	Once every 5 years	
Moldboard plow	hour	$15.00	2	$30.00		
Disk	hour	$15.00	2	$30.00		
Fertilize						
Gypsum	acre	$150.00	1	$150.00	Includes labor	
Fertilizer	acre	$100.00	1	$100.00		
Labor	hour	$15.00	2	$30.00		
Rotary till	hour	$15.00	4	$60.00		
Transplanting						
Planting labor	hour	$12.00	45	$540.00	Hand transplanting	
Lettuce transplants	each	$0.01	26,000	$260.00		
Cultivate weeds	acre	$585.00	1	$585.00	45 hours/ac (hand labor); 3 hours/ac (tractor)	
Irrigation						
Labor	hour	$12.00	1	$12.00	1 hour/ac to move lines	
Electricity	acre	$10.00	1	$10.00	Labor cost	
Harvest	hour	$12.00	300	$3,600.00	Harvest by hand	
Packing						
Packing labor	hour	$12.00	300	$3,600.00	Packing by hand	
Cartons	24 ct carton	$2.80	813	$2,275.00		
Delivery to market	hour	$12.00	68	$812.50	Assumed labor is 5 minutes per box	
Maintenance and Repairs						
Machinery Repair	acre	$100.00	1	$100.00		
Fueling and Lubrication	acre	$200.00	1	$200.00		
Irrigation System Maintenance and Repair	acre	$100.00	1	$100.00		
Other Variable Costs						
Organic certification	acre	$250.00	1	$250.00	$250 per farm is minimum certification fee.	
Overhead (5% of variable costs)	acre			$641.23		
Interest on Variable Costs (5%)*	acre			$392.75		
Total Variable Costs				$13,858.48		
Fixed Costs						
Depreciation						
Irrigation System	acre			$43.88		
Machinery and Equipment Annual Replacement Cost	acre			$400.00		
Interest						
Land	acre			$466.50		
Irrigation System	acre			$33.45		
Machinery and Equipment	acre			$224.02		
Other Fixed Costs						
Land and Property Tax	acre			$108.00		
Insurance Cost (on entire farm)	acre			$100.00		
Field Sanitation Equipment	acre			$525.00	Rental = $75/month for 7 months	
Management Cost	acre			$400.00		
Total Fixed Costs				$2,300.85		
Total Cost				$16,159.33		
Estimated Net Returns				$17,965.67		

Cost to produce 316 800 kg of lettuce(compare to Vertical Farm) in a Conventional Farm :

QUANTITY	ACRE	PRICE PRODUCTION FOR ACRE	TOTAL COST
316 800 kg	72	16 159 $	1 163 448 $

First year Investment cost (for 20 Acre) of Conventional Farm :

Table 4. Physical Capital Requirements and Irrigation System for a 20-Acre Farm

	Purchase Price*	Number of Units	Total Cost	Notes
Machinery, Equipment, Building				
50-Horsepower Tractor	$30,000	1	$30,000	
Disk (7 ft)	$4,000	1	$4,000	
Rotary tiller (6 ft)	$3,000	1	$3,000	
Deep chisel (5 ft)	$1,000	1	$1,000	
Harrow (8 ft)	$1,500	1	$1,500	
Mold Board Plow	$1,500	1	$1,500	
Weed cultivator	$500	1	$500	
Fertilizer spreader	$100	1	$100	
Mechanical transplanter	$3,000	1	$3,000	
Seed transplanter	$325	1	$325	
Brush mower	$2,500	1	$2,500	
Sprayer**	$3,200	1	$3,200	
Tools (hand hoe, harvest knives, etc.)	$1,000	1	$1,000	
Pickup	$30,000	2	$60,000	
ATV 4WD	$5,500	1	$5,500	
Trailer (4-wheel pull)	$800	1	$800	
Shop (20'x40')	$20,000	1	$20,000	
Machine shed (20' x 60')	$15,000	1	$15,000	
Walk-in cooler (9' x13')	$10,000	1	$10,000	
Total Cost of Machinery, Equipment and Building			***$162,925***	
Irrigation System—Reel and Microsprinklers				
Reel	$3,000	1	$3,000	
Microsprinklers	$300	1	$300	3 lines at $100/line
Mainline material (poly tubing)	$21,000	1	$21,000	700 ft from source at $30/hundred ft
Installation (labor)	$34	1	$30	2 hours of labor at $15/hour
Total Cost of Irrigation System			***$24,330***	

* Purchase price is approximate and corresponds to new machinery, equipment, building or irrigation system.
** For insecticide and fungicide.

QUANTITY	ACRE	PRICE PRODUCTION FOR 20 ACRE	TOTAL MACHINERY COST FOR 72 ACRE
316 800 kg	72	187 255 $	674 118 $

YEAR	INVESTMENT	FIXED COSTS	TOTAL COST	YEAR PROFIT	NET RETURNS	TOTAL PROFIT
1	674 118 $	1 163 448 $	1 837 566 $	1 571 456 $	-266 110 $	-266 110 $
2	------------	1 163 448 $	1 163 448 $	1 571 456 $	408 008 $	141 898 $
3	------------	1 163 448 $	1 163 448 $	1 571 456 $	1 163 064 $	549 906 $
4	------------	1 163 448 $	1 163 448 $	1 571 456 $	1 163 064 $	957 914 $
5	-------------	1 163 448 $	1 163 448 $	1 571 456 $	1 163 064 $	1 365 992 $

FINAL CONSIDERATIONS:

YEAR	VERTICAL FARM PROFIT	CONVENTIONAL FARM PROFIT
1	-836 936 $	-266 110 $
2	326 128 $	141 898 $
3	1 489 192 $	549 906 $
4	2 622 256 $	957 914 $
5	3 815 320 $	1 365 992 $

VERTICAL FARM ENERGY CONSUMPTION

Here there is the information about energy consumption and a cost estimation of vertical farm ,the data base is referenced to Omega Garden industry firm who produce volksgardens .
200 volksgarden per level= 1000 VG

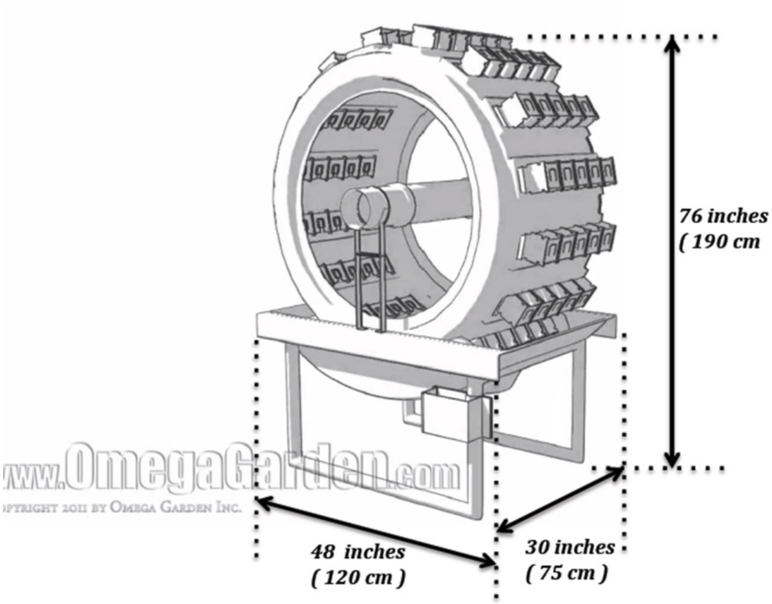


Figure 77.6 Volksgarden dimensions

Volksgardens energy consumption and Annual Operating Cost table (omega garden data base)

	Wattage	daily hour	kwh/year	annuale cost 0/06$ /kwh	annual cost 0,12$ / kwh
Motor	5	24	43.7	2.62	5.24
Pump	25	1	9.13	0.55	1.10
Lighting	**95**	**18**	**624**	**37.44**	**74.88**
	125	18	821.2	49.28	98.56

VERTICAL FARM ENERGY CONSUMPTION

1000vg x (43.7 +9.13 + 624)= 676830 kwh/per year

676830 / 2275= 297.5 kwh/(m^2a)

CO-HOUSING ENERGY CONSUMPTION

Co housing floor plan	625 m^2
Number of floors	26
Total heated area	16250 m^2
The number of units	208
The number of people	486

General data about the building use and boundary conditions

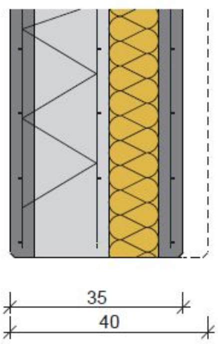
Netheatedfloorarea	$16250m^2$
Indoorairtemperature(heating)	$20C^{o}$
Indoorair temperature(cooling)	$26C^{o}$
SpecificInternalgains	none
People number	485

WALL COMPONENTS

SCHEDA TECNICA

Dimensioni parete:	11,30 m x 3,30 m (dimensione massima)
Spessore parete:	35/40 cm (standard, altre a richiesta)
Spessore lastre:	5 cm (standard, a richiesta fino a 7 cm)
Spessore isolamento termico PUR:	8/10/12 cm
Peso del fabbricato:	circa 260 kg/m²
Armatura parete:	- armatura interna contenuta nella lastra interna - armatura esterna contenuta nel nucleo gettato
Aperture:	realizzate in stabilimento
Casseri in legno per porte/finestre:	inserite in stabilimento
Superficie:	liscia da cassero metallico
Resistenza cls prefabbricato:	C 25/30 (standard, altre a richiesta)
Resistenza cls getto integrativo:	secondo esigenze statiche
Classe di esposizione:	XC1/XC2 (standard, altre a richiesta)
Armatura:	B450C
Marcatura:	CE 1305-CPD-0612 secondo UNI EN 14992:2007

VALORI-U



Spessore parete	Isolamento termico 10 cm PUR, Standard	Isolamento termico 12 cm PUR, Standard
35/40 cm	0,26 W/m²K	0,22 W/m²K
Spessore parete	Isolamento termico 10 cm PUR, Barriera al vapore	Isolamento termico 12 cm PUR, Barriera al vapore
35/40 cm	0,22 W/m²K	0,19 W/m²K

PROGRESS

Figure 78.6 wall detail definition

Component			g-value W/(m^{2}K)	u-value W/(m^{2}K)
Glass	*Material*	*Tripleglazedlow-e glass*	*0.51*	*0.5*
	Air	*Argon*		
	Dimension	*4mm-16mm-4mm-16mm-4mm*		
Frame	*Material*	*Stainless steel*		*0.7*

INPUT DATA

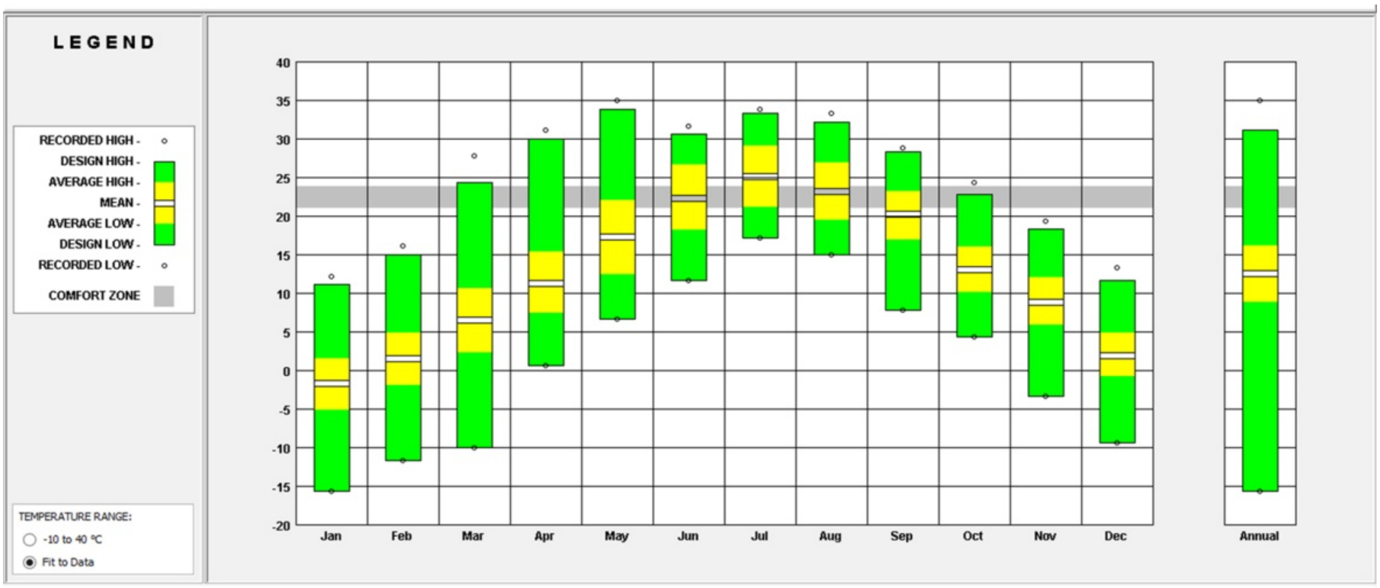


Figure 79.6 New York temperature range during the year

SIMPLIFIED GEOMETRY

Total floor number	26
Floor area	625 m^2
Floor height	3m
Simplified geometry floor	13

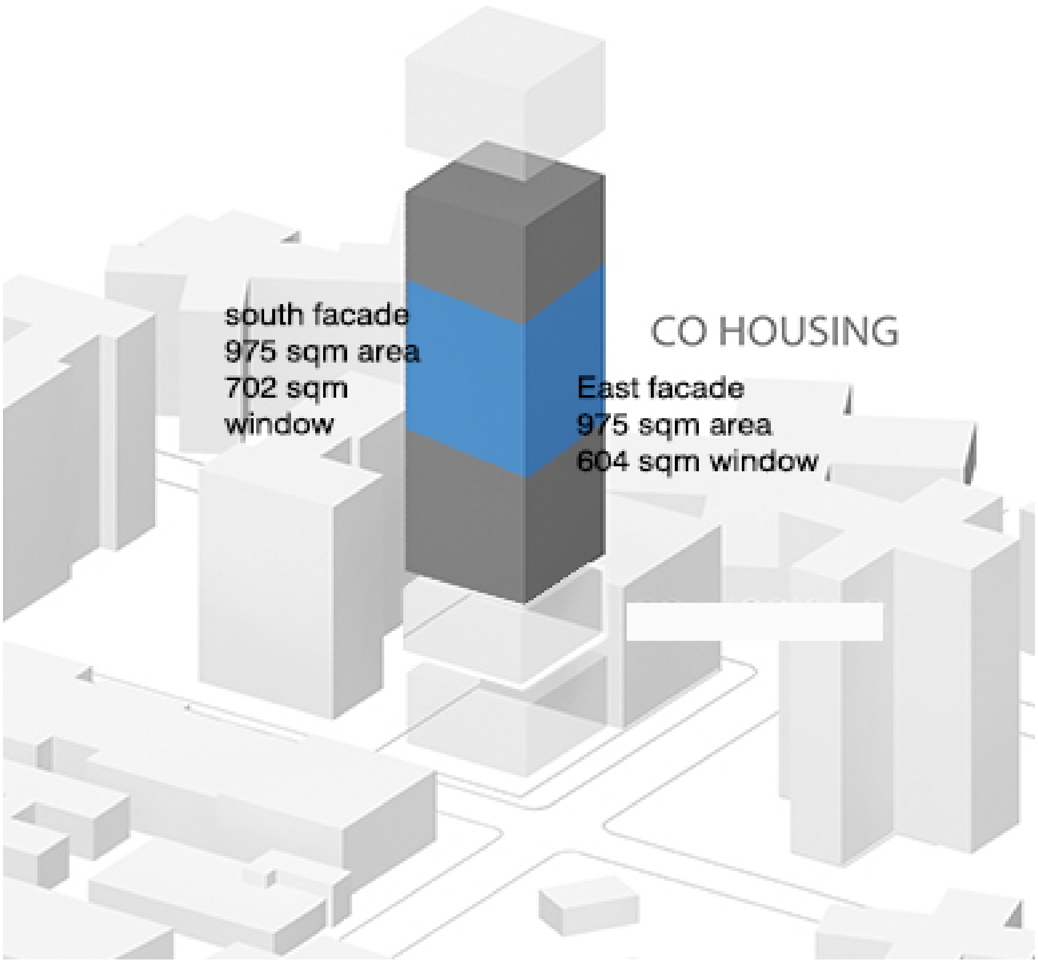


Figure 80.6 Kilometro Zero simplified Geometry for energy calculation consideration

Component	Area[m2]	Façade wall U-Value W/(m2K) 0.221	Windows U-Value W/(m2K) 0.5
North facade	1950	1120m2	818 m2
South façade	1950	546m2	1274 m2
East façade	1950	742m2	1208 m2
West facade	1950	1014m2	936 m2

Summary of the building components' thermo physical features

CASANOVA ANALYSIS

Output: Heat balance

	Transmission losses in kWh/m²	Ventilation losses in kWh/m²	Total heat losses in kWh/m²	Internal gains in kWh/m²	Solar gains in kWh/m²	Usability factor	Heat energy demand in kWh/m²
January	3.9	8.1	12.0	2.9	5.5	0.98	3.6
February	3.4	7.0	10.4	2.6	5.8	0.95	2.0
March	2.9	5.9	8.8	2.3	6.2	0.77	0.3
April	1.7	3.6	5.3	1.2	4.1	0.43	0.0
May	0.6	1.3	1.9	0.4	1.5	0.13	0.0
June	0.0	0.0	0.0	0.0	0.0	0.00	0.0
July	0.0	0.0	0.0	0.0	0.0	0.00	0.0
August	0.0	0.0	0.0	0.0	0.0	0.00	0.0
September	0.0	0.1	0.1	0.0	0.1	0.01	0.0
October	1.1	2.3	3.4	0.9	2.5	0.32	0.0
November	2.1	4.4	6.6	2.3	4.0	0.80	0.3
December	3.4	7.0	10.3	2.9	4.6	0.98	2.8
Total (absolute) in kWh/a	124791	258268	383059	101507	223108		58444
Total (specific) in kWh/(m² a)	19.2	39.7	58.9	15.6	34.3		9.0

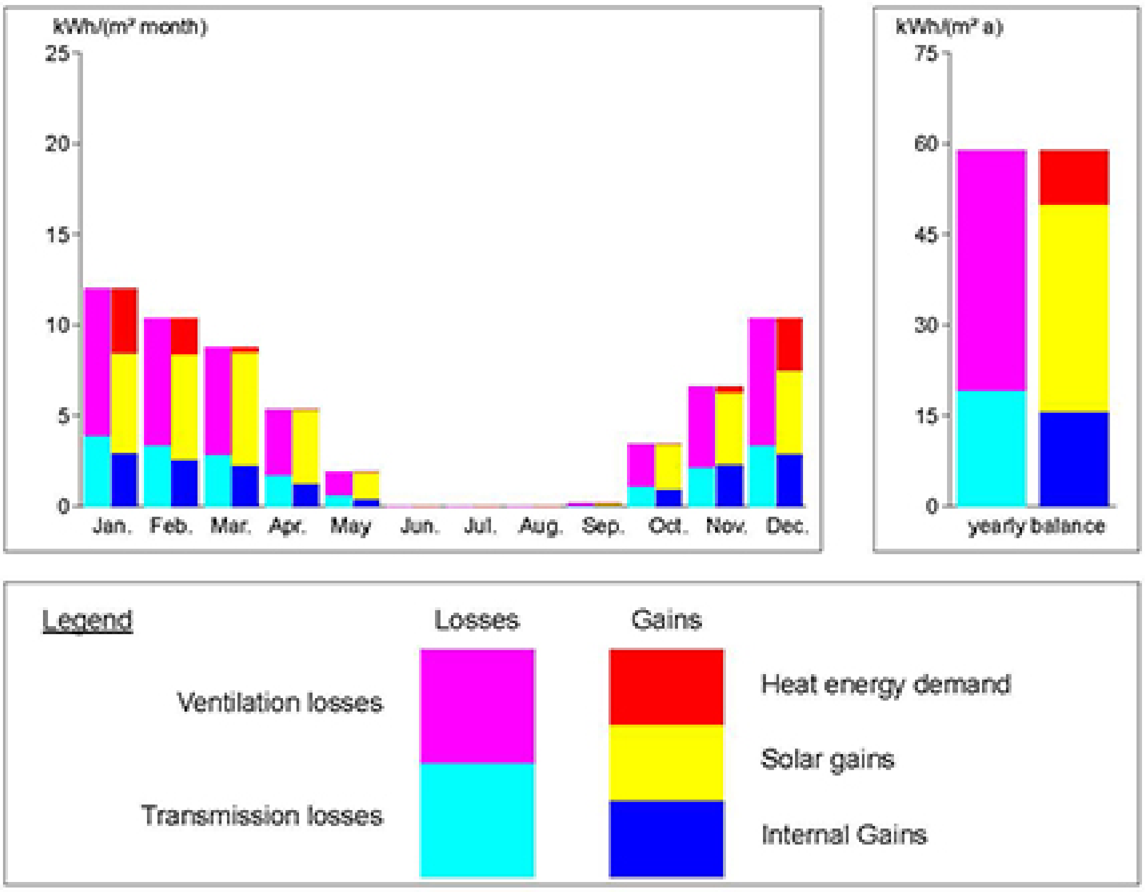


Figure 81.6 casa nova heating season diagram output

Cooling season

Output: Cooling balance

	Cooling demand in kWh/m²	Overheating (hours per day)	Cooling degree hours in Kh
January	0.0	0.0	0.0
February	0.0	0.0	0.0
March	0.4	2.3	66.9
April	1.8	21.4	1720.9
May	5.9	24.0	5788.2
June	8.6	24.0	10082.1
July	10.6	24.0	12454.6
August	9.7	24.0	12426.7
September	6.6	24.0	9104.9
October	2.7	22.3	3668.7
November	0.0	0.7	5.9
December	0.0	0.0	0.0
Mean value / yearly sum	46.3	0.6	55319.0

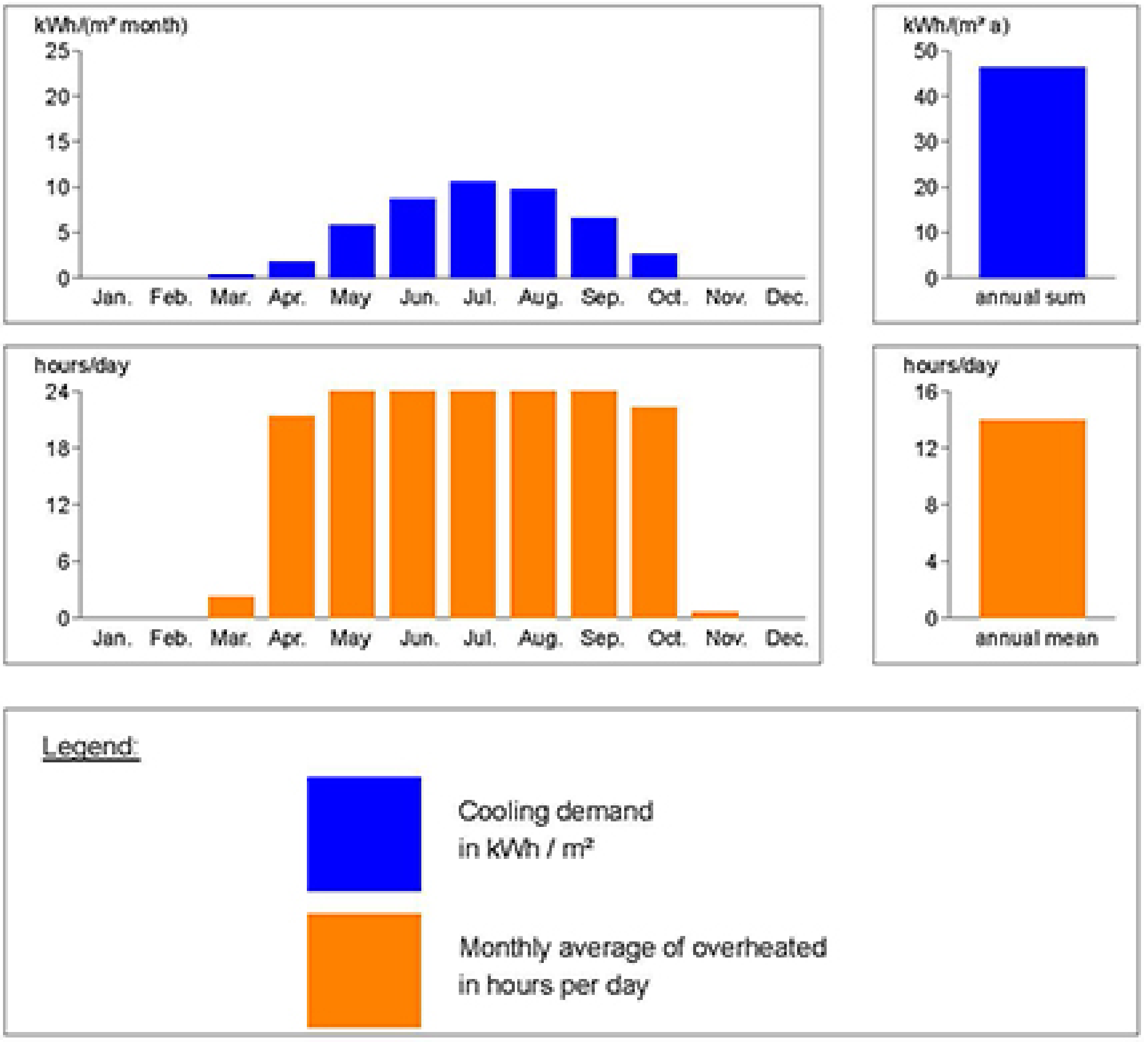


Figure 82 .6 casa nova cooling season diagram output

HEAT PUMP DTATA

		Heating	Cooling	DHW
Watersource heat	Primary energyfrom national electricity	x	x	x
	Photovoltaic system			

	Watersourceheat pump efficiency	Thermal capacityfor generationsystem
Heatingmode	COP3.01	26kW
Cooling mode	EER 5.11	10kW

Generation system efficiency

	15-35 kW	35-100 kW	100-300 kW
Lenght [mm]	600	1200	2000
Height [mm]	900	1400	2200
Depth [mm]	600	700	1000

Figure 83.6 Water source heatpump table

Heath pump dimension	
Length [mm]	1200
Height[mm]	2200
Depth [mm]	100

Emission, control and distribution system

Different emission systems are installed for different types of spaces, according to their needs.

Emission system	Dormitory	Bathroom	Common areas
Radiators		x	
Radiant panels	x		
Fan coils	x		x

Table23:Choicesforemissionsystems

Emission systems efficiency	92– 99%	96%
Control systems efficiency	85– 99%	95%
Distribution systems efficiency	83– 99%	92%
□	96%x95%x92%	0.83%

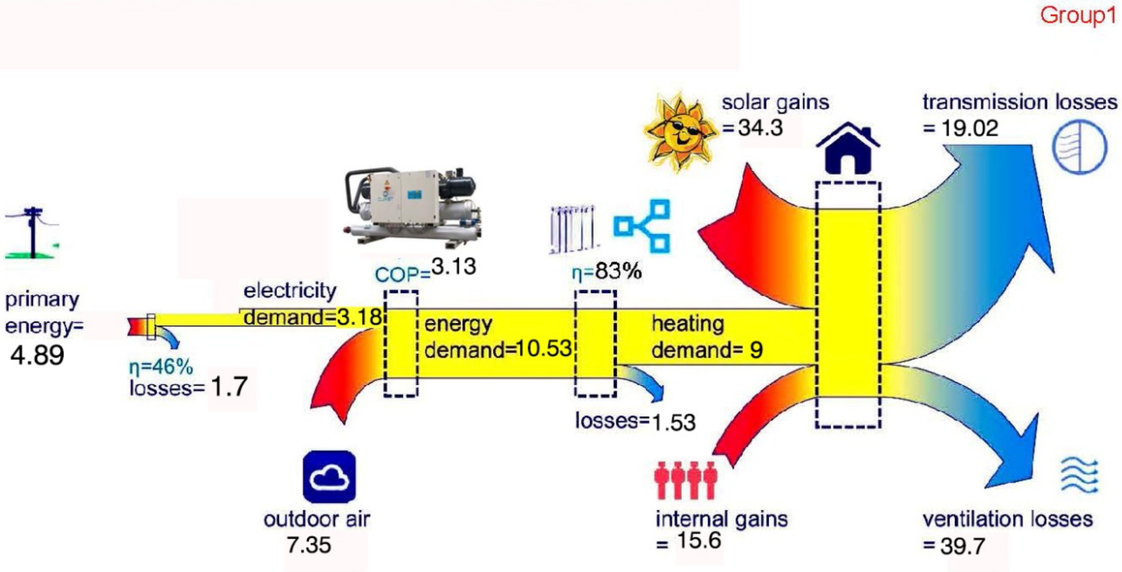
Table24:Systemsefficiencies

Mixed systems

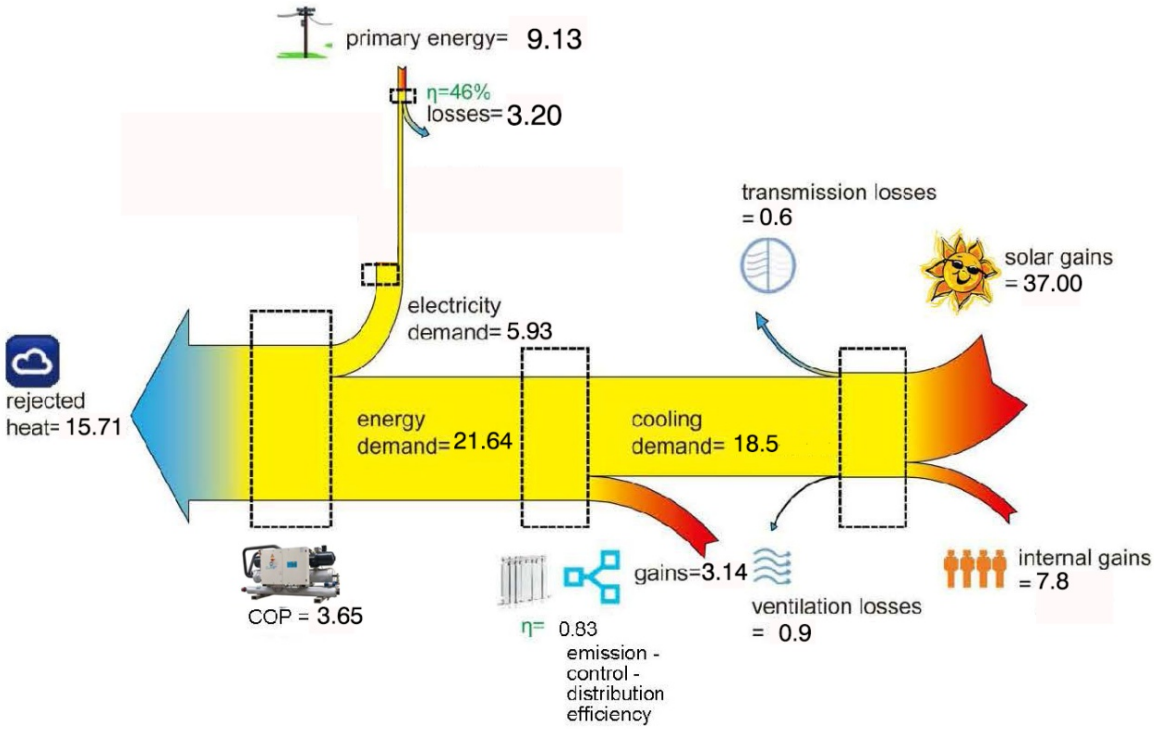
Thermal fluid	Water, air
Indoorthermalunits	Radiators
Temperaturecontrol	Heating mode: Reversible heatpump Cooling mode: Reversible heatpump

Sankey diagrams

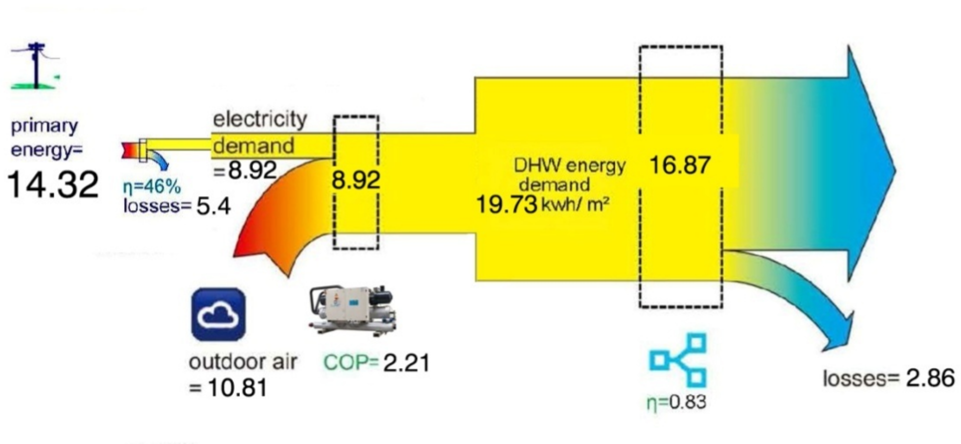
Sankey diagram for heating kWh/m2/a



Sankey diagram for cooling kWh/m2/a



Sankey diagram for DHW kWh/m^2/a



SUMMARY

ENERGYDEMAND

	EnergyDemand		Coveringbyrenewablethermal energies		Covering percentage
	kWh/a	kWh/m2/a	kWh/a	kWh/m2/a	(%)
TOTAL	721012	44.37	471411	29.01	65 %
Heating (reversible heatpump)	146250	9	119437	7.35(by water through heatpump)	81%
Domestichot waterreversible heatpump)	274170	16.87	175662	10.81 (by water through	64%
Cooling (reversible heathpump)	300625	18.5	176312	10.85 (bywater through heatpump)	58%

PRIMARY ENERGY CONSUMPTION (FOSSIL FUEL)

	Primary energy consumption		Limit value
	kWh/a	$kWh/m^2/a$	$kWh/m^2/a$
TOTAL	460525	28.34	50
Heating	79462	4.89	Building class
Domestichot water	232700	14.32	
Cooling	148362	9.13	A

DHW and Electricity energy consumption per person KILOMETRO ZERO ENERGY

DHW	570kwh/(person/year)x485 = 276450kWh/year	17 $kWhm^2$
Electricity appliances	840 kWh/(person/year)	25.07kWh/m^2

ENERGY PRODUCTION

PHOTOVOLTIC SYSTEM

The photovoltaic system will be composed with 2 different kinds of panels : ShucoProsol TF for the residential area and Shuco MPE AL 01 for farm.

SchucoProsol TF

The solution adopted with ShucoProsol TF allows to produce energy from the residential windows exposes to sud and west so as maximized the solar irradiance. Prosol TF is an answer to the problem of illumination for flats infact this panels offers particularly creative design flexibility in windows.The module combines attractive design with energy generation and, due to its extensive transparency, creates a link between the inside and the outside. Incidental daylight creates an agreeable atmosphere.As insulating glass in windows and non-ventilated façades, SchücoProSol TF – the new thin-film photovoltaic module from Schüco – takes on the central functions of the building envelope, innovatively bringing together solar shading, weather resistance, sound reduction, thermal insulation and energy generation in a single building component. The module combines an attractive design with state-of-the-art technology and solar energy generation.

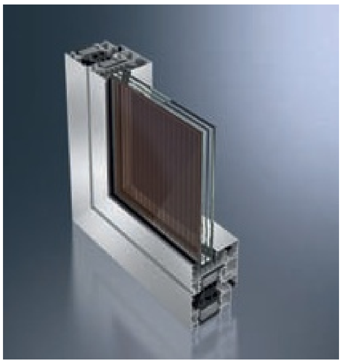
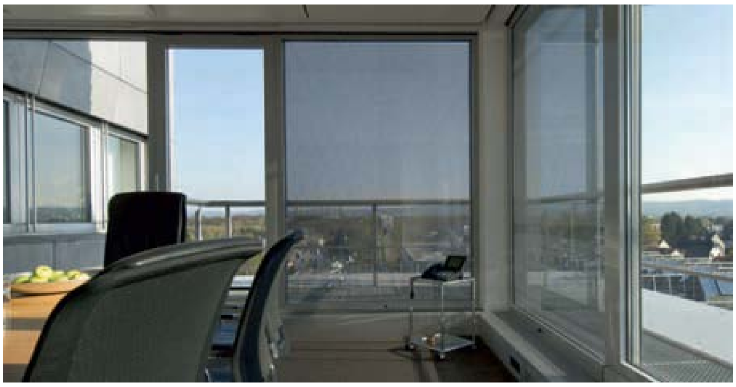


Figure 84.6 prosol TF windows-schucho

Design, efficiency and transparency

ProSol TF is suitable for use as semi-transparent insulating glass or opaque glazing in the spandrel area. SchücoProSol TF allowscreative design freedom in the transparent area of window units and non-ventilated façades. The amorphous thin-film technology makes complex, homogenous surfaces possible. The silicon thin-film cells deliver very good output values even in diffuse light.Degrees of transparency up to 30 % can be achieved by means of laser cutting, thereby creating a close connection with the surroundings. Laser cutting can also be used to generate pattern sand textures.

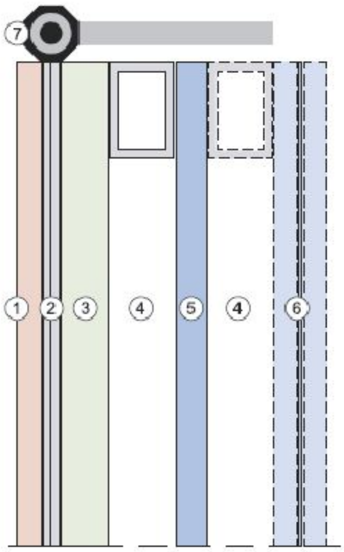


Insulating glass with SchücoProSol TF is suitable for use in a wide range of Schüco façade solutions. All the components and interfaces are perfectly tailored to one another. Specially developed cables and push-in corner cleats make it easy to assemble and dismantle the window and façade modules of ProSol TF in façades as well as in vents or door leaves.In addition to its primary function of generating energy, insulating glass with SchücoProSol TF is also able to perform its energy-generating function as special glazing. Aside from being used as standard insulating glass with double or triple glazing, it can also serve as a safety barrier or for screening and anti-glare protection. Due to its multi-purpose product characteristics, it is also suitable for sound reduction glazing, as burglar resistance or overhead glazing.

Window systems

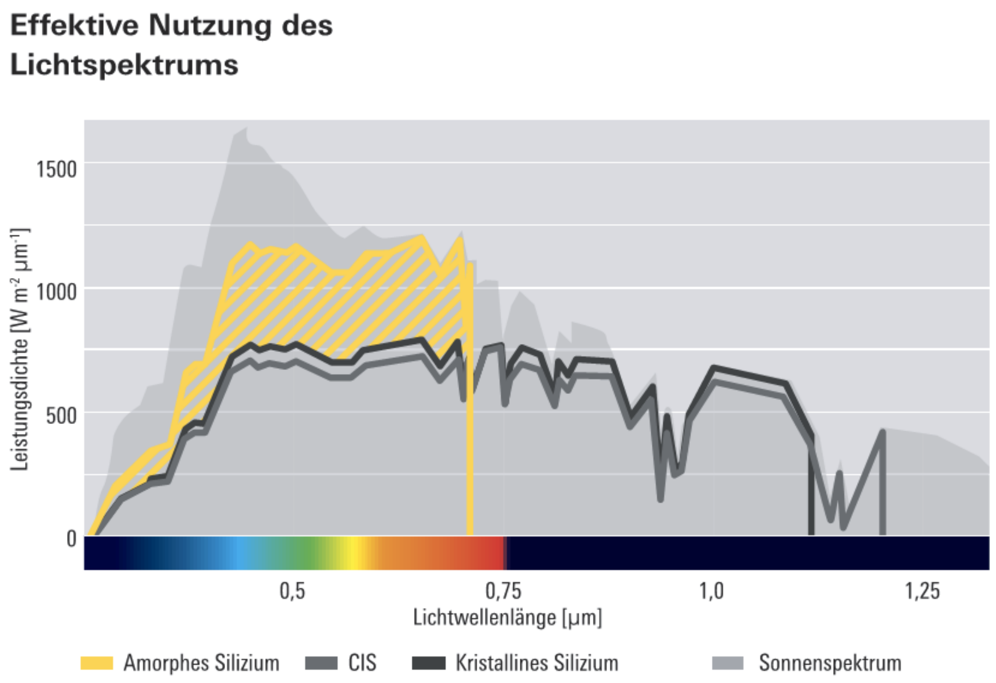
SchücoProSol TF is a multipurpose insert unit for all

Schüco window systems and offers solutions for the future for solar façade architecture. Integrating SchücoProSol TF insulating glass produces an energyefficient, sustainable façade concept which satisfies the most demanding requirements for efficiency and design. SchücoProSol TF can be used as screening in opaque spandrel panels or as solar shading. It is also suitable for fixed fields and in vent frames. The cables are guided through the frame profiles.

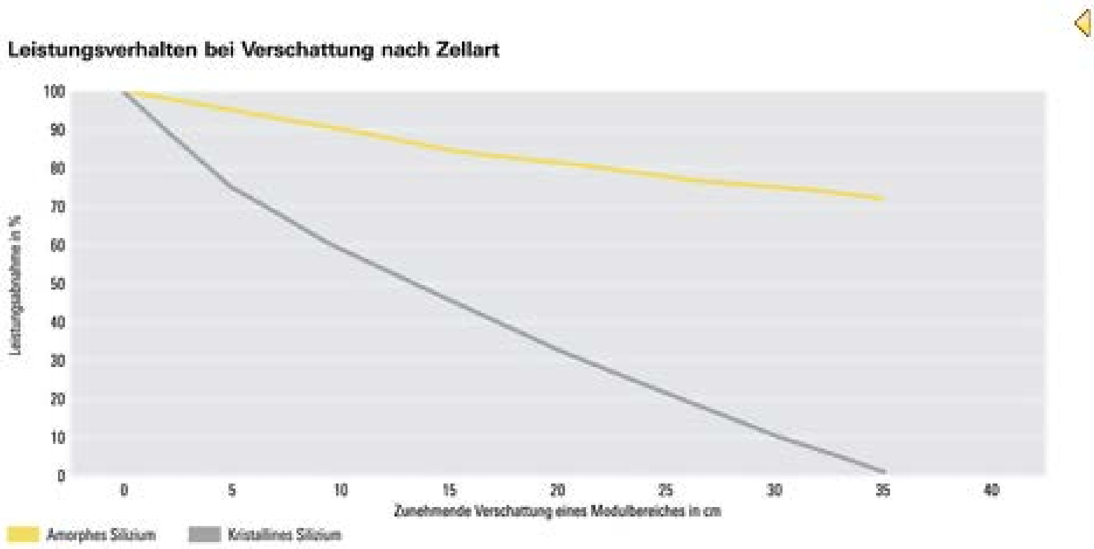


	Position und Beschreibung ***Position and Description***	**Dicke** ***thickness***
1	Photovoltaik Glas *Photovoltaik Glas*	3,2 mm
2	Folie PVB Saflex *Folie PVB Saflex*	2x 1,14 mm alternativ 1,52 mm oder 0,76 mm alternativ 1,52 mm oder 0,76 mm
3	**T**eil**V**orgespanntes **G**las ***T**eil**V**orgespanntes **G**las*	4 - 12 mm, nach statischen Erfordernissen *4 - 12 mm, nach statischen Erfordernissen*
4	**S**cheiben**Z**wischen**R**aum ***S**cheiben**Z**wischen**R**aum*	Individuell, mit Argon oder Krypton-Füllung *Individuell, mit Argon oder Krypton-Füllung*
5	Bei 2-fach Isolierglas individuell, bei 3-fach Verglasung immer ESG *Bei 2-fach Isolierglas individuell, bei 3-fach Verglasung immer ESG*	Individuell, nach statischen oder funktionalen Erfordernissen *Individuell, nach statischen oder funktionalen Erfordernissen*
6	Individuell, nach statischen oder funktionalen Erfordernissen *Individuell, nach statischen oder funktionalen Erfordernissen*	Individuell, nach statischen oder funktionalen Erfordernissen *Individuell, nach statischen oder funktionalen Erfordernissen*
7	Edgeconnector mit 500 mm Zuleitung (standardmäßig oben) Edgeconnector mit 500 mm Zuleitung (standardmäßig oben)	Ø 7 mm x 23 mm

PROSOL Schüco TF is able to exploit the solar spectrum available in non-optimal conditions :



Schüco TF PROSOL affected by the partial shading only in proportion to the areashaded:



Produktdetails und Anwendungen Product details and applications

	Warmfassade Non-ventilated façade Öffnungselemente Opening units	Kaltfassade Ventilated façade	Anlehnfassade Lean-to façade	Sonnenschutz Solar shading
Anwendung Applications				
Produkt-bezeichnung Product designation	Schüco Warmfassaden und Fenster mit ProSol TF (Integration in eine Vielzahl von bestehenden Fassaden- und Öffnungselementsystemen) Schüco non-ventilated façades and windows with ProSol TF (can be integrated in a number of existing systems for façades and opening units)	Schüco Kaltfassade SCC 60 mit ProSol TF Schüco ventilated façade SCC 60 with ProSol TF	Schüco Anlehnfassade FSE 3000 mit ProSol TF Schüco lean-to façade FSE 3000 with ProSol TF	Schüco Großlamelle ALB 550 mit ProSol TF Schüco ALB 550 large louvre blade with ProSol TF
Glasaufbau Glass types	Schüco Fenster- und Fassaden-modul ProSol TF als Isolierglas Schüco window and façade module ProSol TF as insulating glass	Schüco Fassadenmodul ProSol TF als Verbundglas Schüco façade module ProSol TF as laminated glass	Schüco Fassadenmodul ProSol TF als Verbundglas Schüco façade module ProSol TF as laminated glass	Schüco Fassadenmodul ProSol TF als Verbundglas Schüco façade module ProSol TF as laminated glass
Modulgröße Module dimensions	Aufmaß von 0,65 × 0,65 m bis 2,2 × 2,6 m, größere Abmessungen durch Kopplung mehrerer Laminate Dimensions from 0.65 m × 0.65 m up to 2.2 m × 2.6 m, larger dimensions due to coupling of several laminates	Fixmaße Fixed sizes 1,1 m × 1,3 m 1.1 m × 1.3 m 1,3 m × 1,1 m 1.3 m × 1.1 m 1,1 m × 2,6 m 1.1 m × 2.6 m 1,3 m × 2,2 m 1.3 m × 2.2 m Aufmaße Stock sizes min. 0,65 × 0,65 m min. 0.65 × 0.65 m, max. 2,2 × 2,6 m max 2.2 × 2.6 m	8 × 2,2 m × 2,6 m 8 × 2.2 m × 2.6 m	Fixmaß Fixed size 0,55 m × 1,3 m 0.55 m × 1.3 m Aufmaß möglich Various dimensions possible
Transparenz Transparency	Opak und variable Transparenzgrade Opaque and variable degrees of transparency	Opak Opaque	Opak Opaque	Opak und variable Transparenzgrade Opaque and variable degrees of transparency
Farbe Color	aSi-natur aSi-natural			
Struktur Structure	Vertikale und horizontale Linien sowie Semitransparenz möglich Vertical and horizontal lines and semi-transparency possible	Homogene Oberfläche Homogeneous surface	Homogene Oberfläche Homogeneous surface	Vertikale und horizontale Linien sowie Semitransparenz möglich Vertical and horizontal lines and semi-transparency possible
Leistung Performance	Opak: ~ 60 – 70 W_p/m^2 Semitransparent 20 %: ~ 50 – 55 W_p/m^2 Opaque: 60 – 70 W_p/m^2 Semi-transparent 20 %: 50 – 55 W_p/m^2	Opak: ~ 56 – 60 W_p/m^2 (bezogen auf Fixmaß 1,1 × 1,3 m) Opaque: 56 – 60 W_p/m^2 (related to fixed dimensions of 1.1 × 1.3 m)	Opak: ~ 60 – 70 W_p/m^2 Opaque: 60 – 70 W_p/m^2	Opak: ~ 55 – 60 W_p/m^2 Semitransparent 20 %: ~ 44 – 50 W_p/m^2 Opaque: 55 – 60 W_p/m^2 Semi-transparent 20 %: 44 – 50 W_p/m^2
Muster Pattern	Logos, Drucke und Laserungen möglich Logos, prints and laser cutting possible	Logos und Drucke möglich Logos and prints possible	Logos und Drucke möglich Logos and prints possible	Logos, Drucke und Laserungen möglich Logos, prints and laser cutting possible

Shuco MPE AL01

Schüco MPE modules in the series AL 01 have an active layer amorphous silicon and stand , in addition to their quality , also for their returns high energy . the technology of amorphous cells , allows to optimize the production of energy even in case of high temperatures , diffused light, or orientation not ideal modules . It is thus possible to achieve high levels of energy produced annually . Thanks to a tolerance only power positive from 0 to 5 % , the power Rated fact is always reached or exceeded. The performance warranty covers even a period of time considerably more extensive – in first 20 years, the Schüco module still provide at least 80% of the nominal power . optimal staining Prior to delivery, each AL module 01 is subjected to a test of optical quality and electric . High operational safety A junction box with Bypass diode bridge prevents the reduction in yield caused by shading and ensures reliable operation entire system. environmental protection Schüco MPE modules in the series AL 01 are manufactured with a minimum consumption of materials raw and contain no cadmium or lead. The energy consumed for the production of module is recovered within a year and a half. Complete Systems Schüco thin-film laminates meet the highest demands of stability and resistance to corrosion. Together with the mounting system Schüco MSE 100 and inverters SGI form a photovoltaic system comprehensive, flexible, each project.

Parametri elettrici	Classi di potenza				
Specifiche elettriche (tranne NOCT) in condizioni standard di prova (STC)[1]:	MPE 340 AL 01	MPE 350 AL 01	MPE 360 AL 01	MPE 370 AL 01	MPE 380 AL 01
Potenza nominale (P_{mpp})	340 W_p	350 W_p	360 W_p	370 W_p	380 W_p
Tolleranza di potenza (ΔP_{mpp})	+5 %/-0 %	+5 %/-0 %	+5 %/-0 %	+5 %/-0 %	+5 %/-0 %
Potenza minima garantita ($P_{mpp\,min}$)	340 W_p	350 W_p	360 W_p	370 W_p	380 W_p
Tensione nominale (V_{mpp})	142,5 V	145,8 V	149,1 V	152,5 V	155,8 V
Corrente nominale (I_{mpp})	2,39 A	2,40 A	2,41 A	2,43 A	2,44 A
Tensione a vuoto (V_{oc})	188,4 V	189,8 V	191,1 V	192,5 V	193,8 V
Corrente di corto circuito (I_{sc})	3,02 A	3,02 A	3,02 A	3,02 A	3,02 A
Grado di efficienza del modulo	5,9 %	6,1 %	6,3 %	6,5 %	6,6 %
Coefficiente di temperatura α (P_{mpp})	-0,23 %/°C	-0,23 %/°C	-0,23 %/°C	-0,23 %/°C	-0,12 %/°C
Coefficiente di temperatura β (I_{sc})	+0,08 %/°C	+0,08 %/°C	+0,08 %/°C	+0,08 %/°C	+0,10 %/°C
Coefficiente di temperatura χ (U_{oc})	-0,30 %/°C	-0,30 %/°C	-0,30 %/°C	-0,30 %/°C	-0,20 %/°C
Coefficiente di temperatura δ (I_{mpp})	+0,07 %/°C	+0,07 %/°C	+0,07 %/°C	+0,07 %/°C	+0,07 %/°C
Coefficiente di temperatura ε (U_{mpp})	-0,18 %/°C	-0,18 %/°C	-0,18 %/°C	-0,18 %/°C	-0,18 %/°C
Tensione massima ammissibile del sistema	1.000 V	1.000 V	1.000 V	1.000 V	1.000 V

[1] I dati elettrici rappresentati nella tabella si intendono in condizioni STC e con modulo stabilizzato.
Intensità dell'irraggiamento 1000 W/m², massa d'aria AM 1,5, temperatura cella 25°C.
Durante le prime sei settimane il modulo ha un rendimento maggiore (vedi istruzioni per il montaggio e l'uso). I moduli FV presentano una degradazione iniziale dei valori elettrici poco dopo la messa in funzione che successivamente diventa di tipo lineare.

Parametri meccanici			
Dimensioni esterne (BxHxS)	2.600 x 2.200 x 7,3 mm		
Altezza / spessore incluso profilo posteriore	41,7 mm		
Vetro frontale	Vetro solare con strato TCO 3,2mm		
Vetro posteriore	Vetro solare 3,2mm		
Peso	104 kg		
Sistema di collegamento	Scatola di giunzione con diodo di Bypass compatibile Multi Contact Typ 4		
N°art. cavo preconfezionato[2], con sistema di collegamento MC-T4 (2,5mm²)	1 pz 257 210	10 pz 257 211	50 pz 257 212

[2] Da ordinare separatamente

Varie	Serie AL 01
Sistema di montaggio Schüco	MSE 100
Unità di imballo	1 modulo
Schüco N° art. MPE 340 AL 01	258 113
Schüco N° art. MPE 350 AL 01	258 114
Schüco N° art. MPE 360 AL 01	258 115
Schüco N° art. MPE 370 AL 01	258 116
Schüco N° art. MPE 380 AL 01	258 117

Salvo modifiche / migliorie tecniche

Garanzie[3]	
Standard prodotto	IEC 61646, EN 61730
Garanzia prodotto	5 anni
Garanzia di rendimento al 90% $P_{mpp\,min}$	10 anni
Garanzia di rendimento al 80% $P_{mpp\,min}$	20 anni

[3] Secondo le condizioni di garanzia di Schüco International KG

Potenza		
340 - 380 W_p	►	Massimi rendimenti anche in caso di alte temperature esterne e luce diffusa
Tolleranza di potenza positiva	►	La potenza nominale viene sempre raggiunta o superata
Laminati amorfi a film sottile	►	Rendimenti annuali per kWp più alti rispetto ai moduli cristallini
Progettazione e fabbricazione		
Marcatura ottimale	►	Dati relativi alla potenza su ogni modulo e imballaggio
Cavi di collegamento preconfezionati	►	Collegamenti più corti e meno perdite per via dei cavi
Sottostruttura speciale per laminati	►	Riduzione del tempo di montaggio
Massima qualità Schüco		
Conforme a tutti gli standard qualitativi in vigore	►	I dati dei test vengono indicati su ogni modulo
Garanzia del prodotto e del rendimento	►	Sicurezza di investimento e sicurezza operativa

SIZING PHOTOVOLTAIC SYSTEM

New York City Solar Radiation

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	1.9	2.7	3.8	4.9	5.7	6.1	6.0	5.4	4.3	3.2	2.0	1.6	4.0
	Min/Max	1.7/2.2	2.3/3.3	3.3/4.4	4.3/5.5	4.8/6.5	5.0/6.8	5.3/6.6	4.8/5.9	3.9/4.9	2.9/3.8	1.7/2.4	1.4/1.8	3.7/4.2
Latitude -15	Average	2.9	3.7	4.6	5.3	5.8	6.0	6.0	5.7	5.0	4.1	2.9	2.4	4.5
	Min/Max	2.3/3.5	3.0/4.6	3.8/5.5	4.6/6.1	4.8/6.5	4.9/6.7	5.2/6.6	5.1/6.3	4.3/5.7	3.6/5.1	2.2/3.6	1.8/3.0	4.3/4.8
Latitude	Average	3.2	4.0	4.8	5.2	5.4	5.5	5.6	5.5	5.0	4.4	3.2	2.8	4.6
	Min/Max	2.5/4.0	3.2/5.2	3.9/5.7	4.4/6.0	4.5/6.1	4.5/6.2	4.8/6.1	4.9/6.1	4.3/5.8	3.7/5.6	2.4/4.1	1.9/3.4	4.3/4.8
Latitude +15	Average	3.4	4.1	4.6	4.8	4.8	4.8	4.9	5.0	4.8	4.4	3.3	3.0	4.3
	Min/Max	2.7/4.3	3.3/5.4	3.7/5.6	4.1/5.6	4.0/5.4	4.0/5.3	4.2/5.3	4.4/5.5	4.0/5.5	3.7/5.6	2.4/4.3	2.0/3.7	4.0/4.6
90	Average	3.2	3.6	3.5	3.1	2.7	2.6	2.7	3.0	3.4	3.6	3.0	2.7	3.1
	Min/Max	2.4/4.2	2.8/4.9	2.8/4.3	2.7/3.7	2.4/3.1	2.3/2.8	2.4/2.9	2.8/3.3	2.8/3.9	3.0/4.6	2.1/3.8	1.7/3.5	2.9/3.4

Co-housing

Area for panels (South-West) = 2759,23 mq2

Dimension Panel 5,72 mq2

Performance semitransparent panel 55 Wp/m2

Apv : 2759,23 /5,72 = 482 Panels

Inclination 90°

H = 3,1 Kwh/m2/day

Epv = 0,85 x 55 x 482 x 3,1 x 365 = 25496 kwh/year

Farm :

Area for panels : 1665 mq2

Dimension Panel 5,72 mq2

Perfomance 380 Wp/m2

Apv : 1665/5,72 = 291 Panels

Inclination 90°

Epv = 0,85x380x291x3,1x365 = 106353 kwh/year

Roof top

Inclination 0°

H = 4 kwh/m2/day

Apv = 455/5,72 =79

Epv = 0,85x380x79x4x365 = 37254 kwh/year

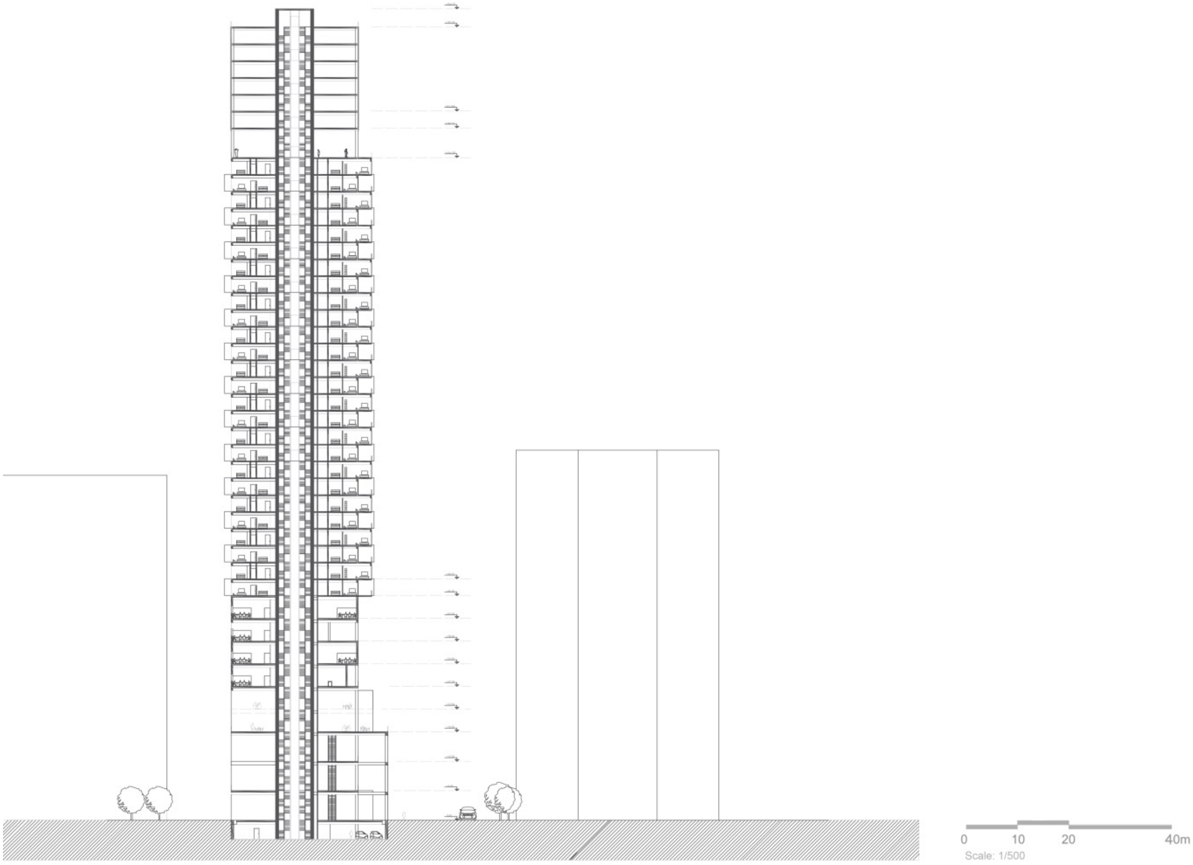
TOTAL ENRGY PRODUCTION :

169103 KWH/YEAR

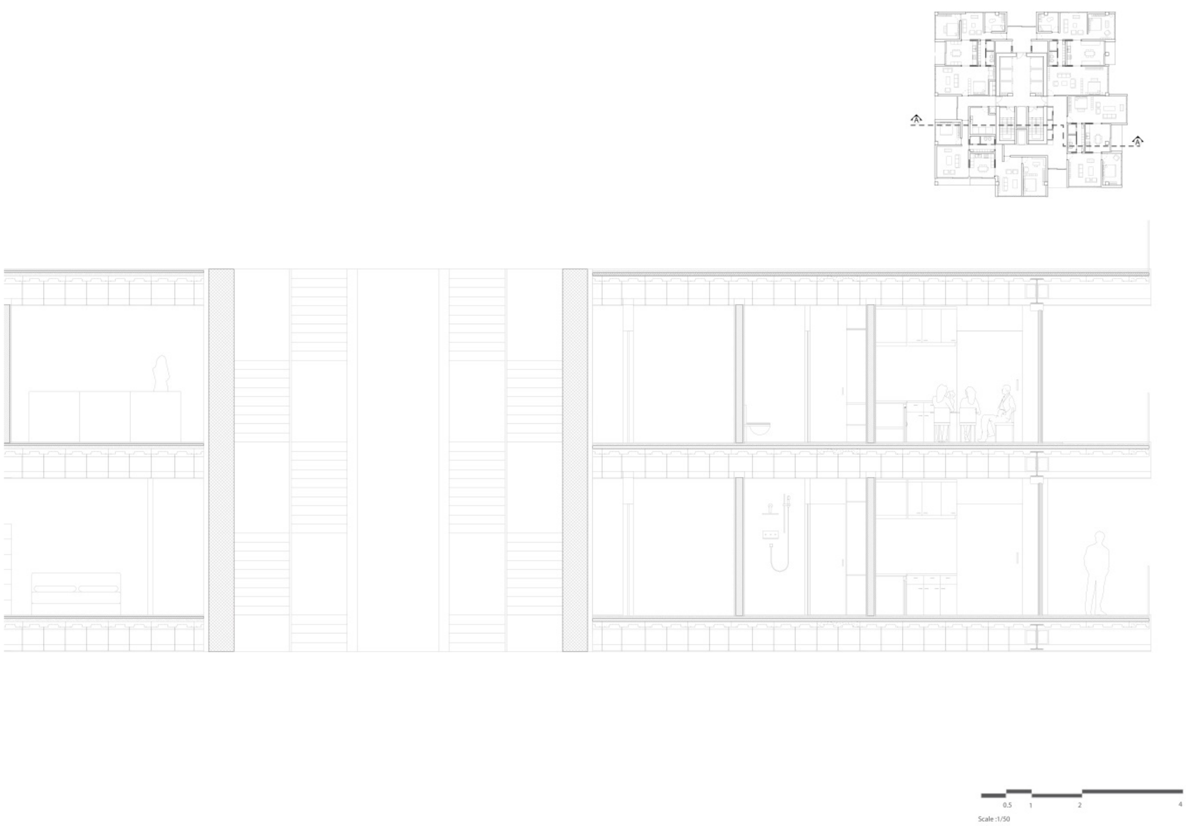
SUMMARY TABLE :

KILOMETRO ZERO	VERTICA FARM Area 2275 m^2	CO HOUSING Area 16250m^2	TOTAL (Kwh/year)
ENERGY CONSUMPTION (Kwh /a)	676830	460525	1137355
ENERGY PRODUCTION PV production (Kwh /a)	143603	25496	169103
FINAL ENERYGY DEMAND	533227 kwh/a 234.3 kwh/(m^2a)	435029 kwh/a 26.70 kwh/(m^2a)	968252 kwh/a 49.26 kwh/(m^2a)

TECHINICAL DETAILS.

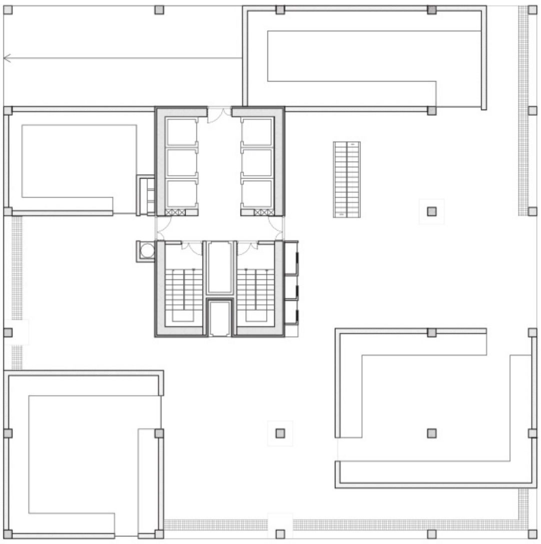


General section

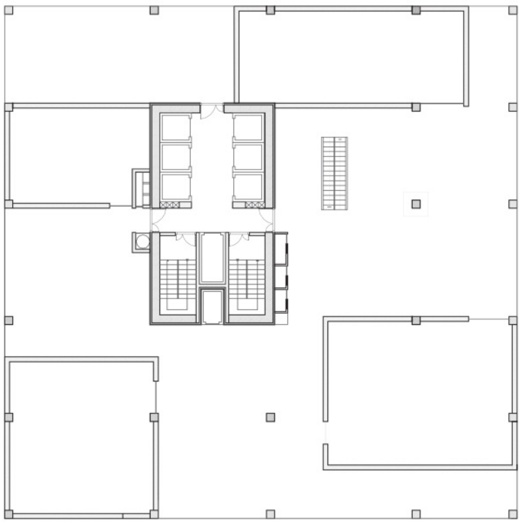


Section detail Co-housing floor

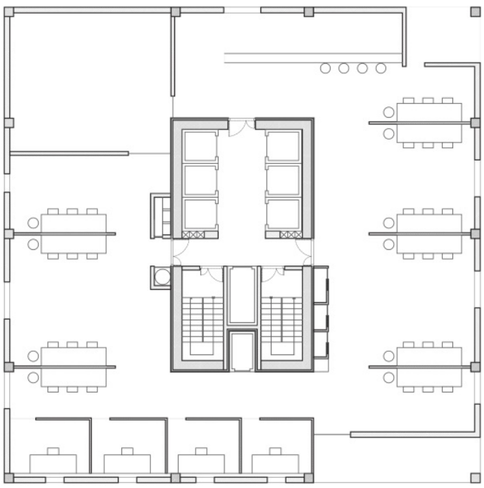
Plan parking floor



Plan ground floor



Plan restaurant floor



Plan Co-working floo

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