Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
A-22 12:20-1:10 ARCH 874 1:25-5:30 Studio	**A-23**	**A-24** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Charrette**	**A-25** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Charette**	**A-26** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Charette**	**A-27** Charette?	**A-28** Charette?
A-29 12:20-1:10 ARCH 874 1:25-5:30 Studio **Classes begin**	**A-30**	**A-31** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-01**	**S-02** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-03**	**S-04**
S-05 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Research [S]**	**S-06**	**S-07** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Research [H/H]**	**S-08**	**S-09** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-10**	**S-11**
S-12 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Pre-Programming [S]**	**S-13**	**S-14** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Pre-Programming [H/H]**	**S-15**	**S-16** 12:20-1:10 ARCH 874 1:25-5:30 Studio **VF Charette**	**S-17**	**S-18**
S-19 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-20**	**S-21** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-22**	**S-23** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**S-24**	**S-25**
S-26 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Concept Schemes[S]**	**S-27**	**S-28** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Concept Schemes [H/H]**	**S-29**	**S-30** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-01** *DESIGN TO ZERO* *Deadline **Phase 1*** *Program / Schematic D.*	**O-02**
O-03 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-04**	**O-05** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-06**	**O-07** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-08**	**O-09**
O-10 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Massing & Bldg Planning [S]**	**O-11**	**O-12** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Massing & Bldg Planning [H/H]**	**O-13**	**O-14** 12:20-1:10 ARCH 874 1:25-5:30 Studio *MIDTERM EVALUATION* **VF Charette**	**O-15**	**O-16**
O-17 **Fall Break**	**O-18** **Fall Break**	**O-19** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-20**	**O-21** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-22**	**O-23**
O-24 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Final Design [S]**	**O-25**	**O-26** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Final Design [H/H]**	**O-27**	**O-28** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**O-29**	**O-30**
O-31 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Structure & Mechanical [S]**	**N-01**	**N-02** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Structure & Mechanical [H/H]**	**N-03**	**N-04** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**N-05**	**N-06**
N-07 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Envelope [S]**	**N-08**	**N-09** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Review Envelope [H/H]**	**N-10**	**N-11** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**N-12** *DESIGN TO ZERO* *Deadline **Phase 2*** *Design Development*	**N-13**
N-14 12:20-1:10 ARCH 874 1:25-5:30 Studio	**N-15**	**N-16** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Comprehensive Exam[S/H/H]]**	**N-17**	**N-18** 12:20-1:10 ARCH 874 1:25-5:30 Studio **Comprehensive Exam[S/H/H]]**	**N-19**	**N-20**
N-21 12:20-1:10 ARCH 874 1:25-5:30 Studio	**N-22**	**N-23** **Thanksgiving**	**N-24** **Thanksgiving**	**N-25** **Thanksgiving**	**N-26** **Thanksgiving**	**N-27** **Thanksgiving**
N-28 12:20-1:10 ARCH 874 1:25-5:30 Studio	**N-29**	**N-30** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**D-01**	**D-02** 12:20-1:10 ARCH 874 1:25-5:30 Studio	**D-03**	**D-04**
D-05 **Final reviews**	**D-06**	**D-07** **Final reviews**	**D-08**	**D-09** **Final reviews**	**D-10**	**D-11**
D-12 **Exams**	**D-13** **Exams**	**D-14** **Exams**	**D-15** **Exams**	**D-16** **Exams**	**D-17**	**D-18** ***Jan 07****DESIGN TO ZERO* *Deadline **Phase 3*** *Final Design*

[charleston] VERTICAL FARM

PROJECT STATEMENT:

The three basic needs for human survival are water, air, and food. As the global population continues to increase, so does the demand being placed on the food and water resources. The scientist, Joel E. Cohen of Rockefeller University, an expert in demography, epidemiology and public health, says that the urban population will double by 2050. Such an increase will require a highly efficient system for food production and transportation within the growing urban environment. Vertical farming serves as a solution to meeting the demands of an ever-increasing global population.

To some, the concept of a vertical farm may seem inconceivable, but through the use of hydroponics and other highly efficient production and distribution systems, vertical farming can be financially viable.

PROJECT INTENT:

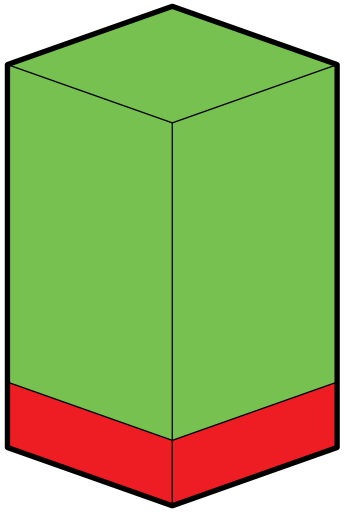
Clemson University's graduate comprehensive Vertical Farm Studio will examine how such a project could be realized in Charleston, South Carolina. The studio was approached with the project when Clemson's Institute of Applied Ecology received EPA funding to develop a design-feasibility studio to build a vertical farm in downtown Charleston. To begin the design process the studio will conduct research on the major topics of vertical farming as well as site specific research for the project in Charleston. In December of 2011 a series of design proposals will be presented and later exhibited for the public in Charleston.

GRANDMA SENTENCE:

"We will be designing a building that can grow food in a city."

[charleston] VERTICAL FARM

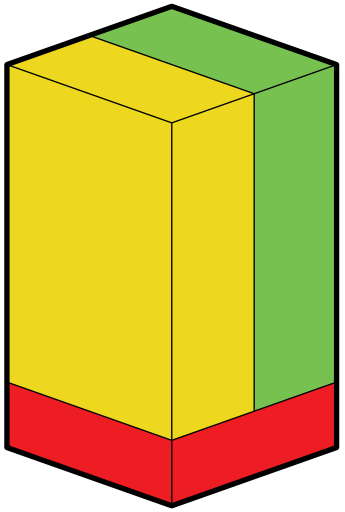
Three Programming Scenarios



1. Maximum Farm

Devotes most space to food production.

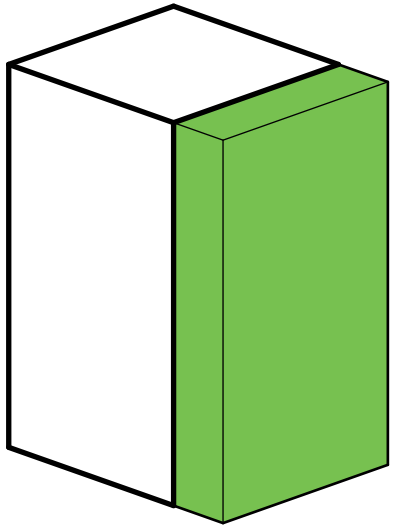
A giant machine or possibly an orgnism that produces food.



2. Mixed Use

Part farm, part residential or office.

Could be hybrid of industrial farm and residential farming.

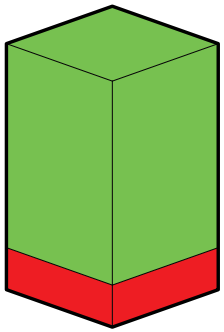


3. Retrofit/Add-on

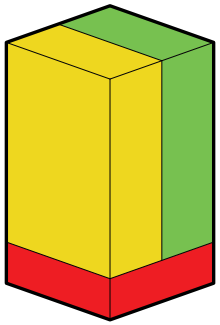
Adds a layer of farm production to an existing building.

[charleston] VERTICAL FARM

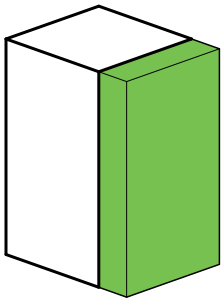
Our Site - a mix of all three?



1. Max Farm:
We wish to demonstrate the maximum food production possible in a vertical farm.



2. Mixed Use:
We have additional program elements, not necessary to a pure food production facility.



3. Retrofit:
We propose to use the air space over the Med-din building, which could be considered retro-fit.

[charleston] VERTICAL FARM

Program (pending group input)

Industrial Food Production
- Grow Rooms
- Equipment/Material Storage
- Processing/Packaging
- Buffer Storage
- Shipping/Receiving
- Restrooms

Administration and Support
- Offices
- Restrooms
- Worker Amenities - Breakroom, Shower/Locker, Safe/dry bike storage

Research Lab Component
- Laboratories
- Seed Bank

Public Components
- Public Gardening
- Greenway
- Bike parking
- Retail - Farmers Market / Organic Café / Juice Bar / Store / Restrooms
- Public Education - Classrooms? Auditorium? Training labs? Observation deck.

General
- Mechanical / Storage
- Vertical circulation - (freight and people)
- ADA compliance and multiple egress routes

[charleston] VERTICAL FARM

Program Details

Industrial Food Production

Grow Rooms
- maximum density food production.
- does it span entire level or hug the south facade?
- how is proper lighting achieved?

Equipment/Material Storage
- adjacent to grow rooms
- robots, hand tools, equipment.
- dirt, compost, plant food, fertilizers

Processing/Packaging
- where picked fruits are cleaned and packaged

Buffer Storage
- where packages wait for shipping

Shipping/Receiving
- what type of shipping? semi, box truck, bike?

Restrooms

[charleston] VERTICAL FARM

Program Details

Administration and Support

Offices
- how many are needed?
- occupancy still yet to be determined.

Restrooms

Worker Amenities
- Breakroom
- Showers/Lockers (since this is dirty work)
- Safe/dry bike storage

Research Lab Component

Laboratories

Seed Bank
- what type of spaces are these?
- are they a requirement of the farm, or just part of our educational program?

[charleston] VERTICAL FARM

Program Details

Public Components

- Public Gardening
  - should we provide community farm possibilities?
- Greenway
  - how to make it a part of our program?
- Bike parking
- Retail
  - Farmers Market
  - Organic Café/Juice Bar/Store w/ Restrooms
- Public Education
  - Classrooms? Auditorium? Training labs?
  - Observation deck to see into industrial farm area.

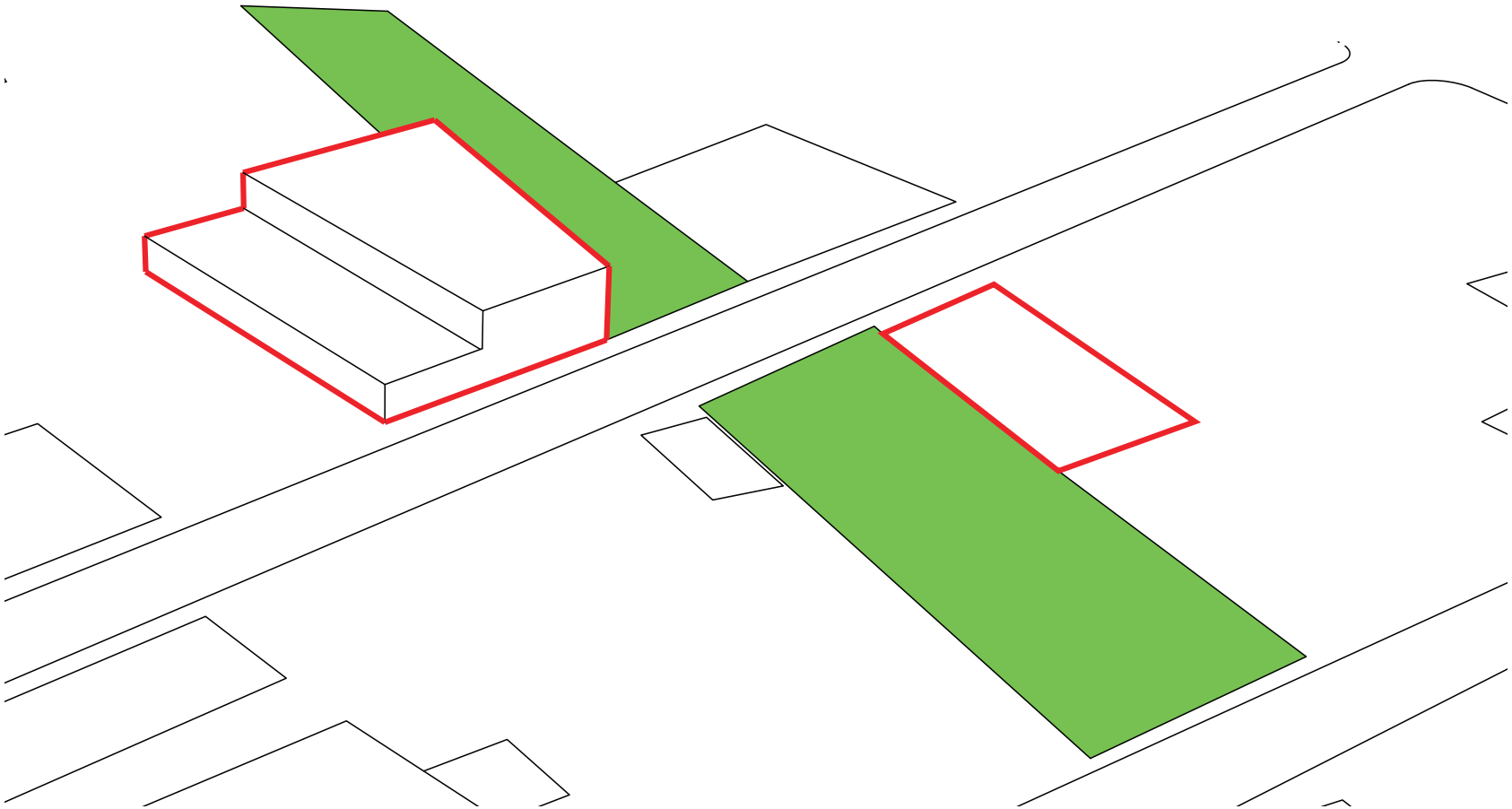
General

- Mechanical / Storage
- Vertical circulation - (freight and people)
- ADA compliance and multiple egress routes

[charleston] VERTICAL FARM

Meddin Site - Available Space

1. Meddin Building - must stay: 7440 sq.ft.
2. Demo Building - rip it down: 4720 sq.ft.
3. Empty Lot - across street: 5210 sq.ft.

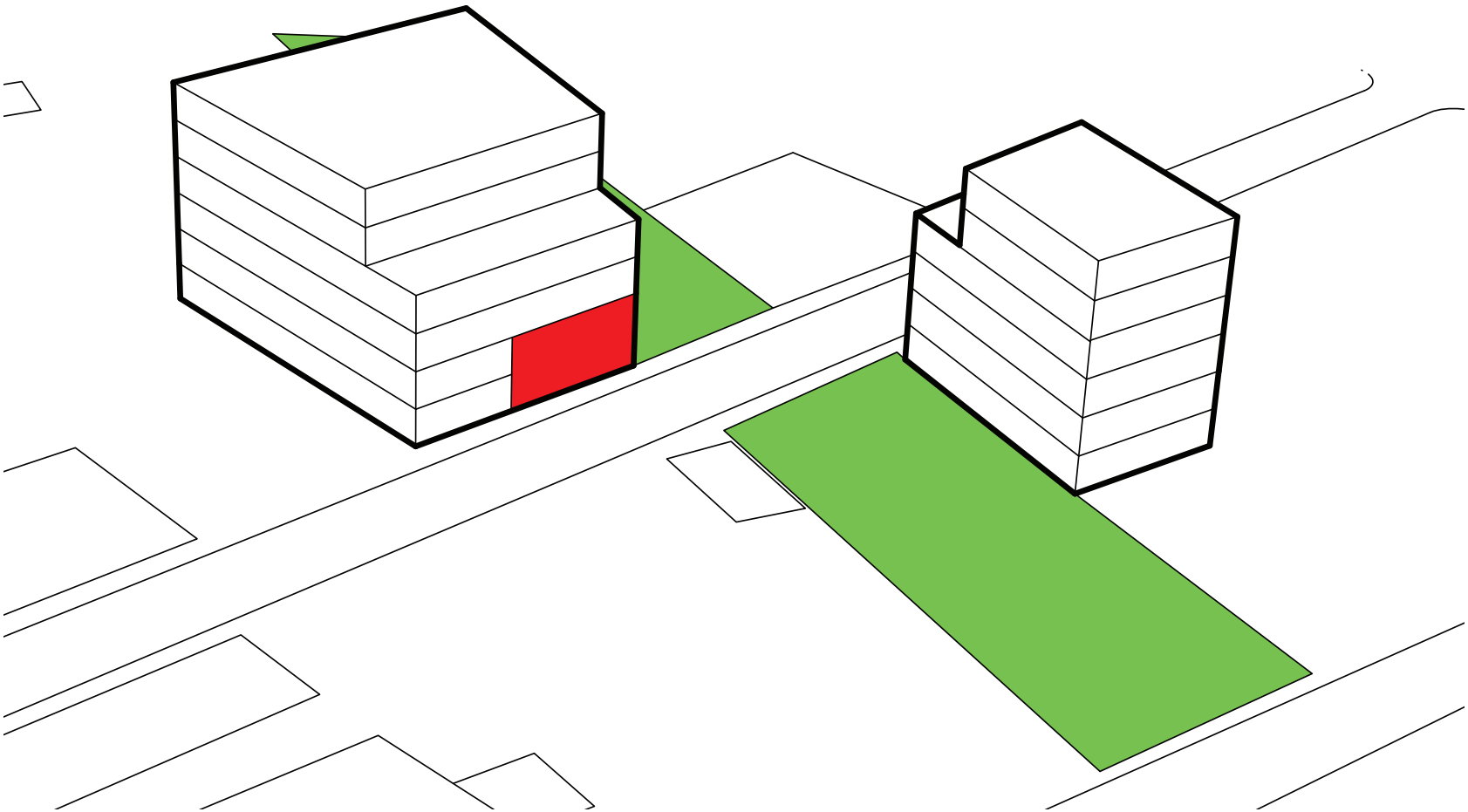


[charleston] VERTICAL FARM

Max Built Area, per Charleston code

- Code: min 30', max 80', 25' setback after 55'
- Using 13' floor spacing gives 6 stories.

Total Square Footage: roughly 100,000 sq.ft.

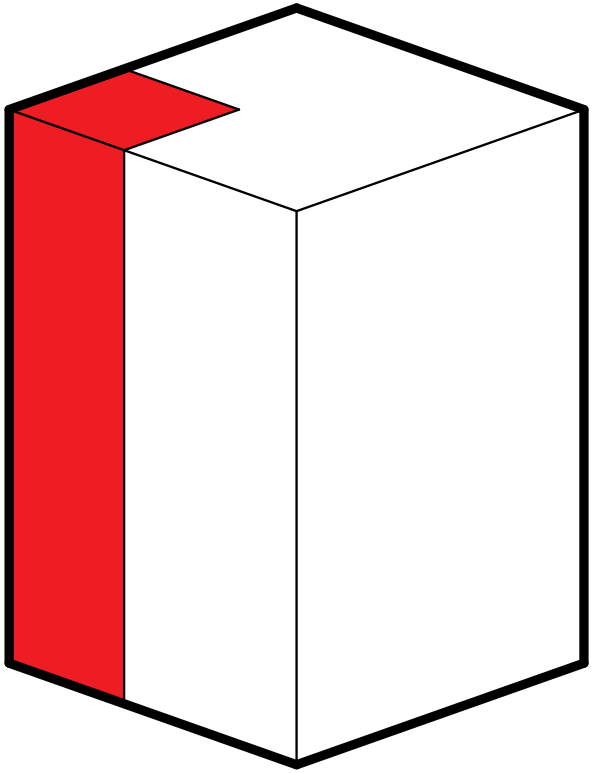


[charleston] VERTICAL FARM

Circulation Space vs Program Space

Assuming 20% for circulation, structure, & mechanical.

Circulation, Structure, Mechanical: 20,000 sq.ft.



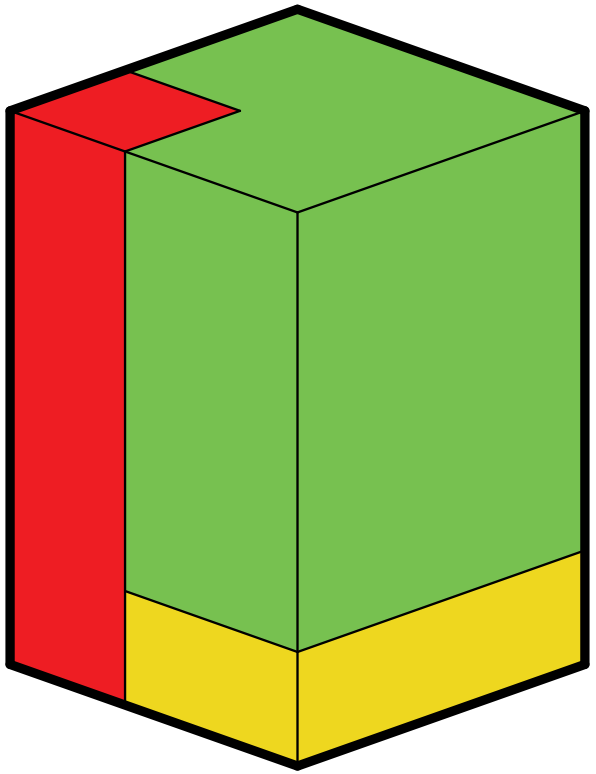
Available for Program: 80,000 sq.ft.

[charleston] VERTICAL FARM

Vertical Farm Program vs Everything Else

Assuming we can fit everything else in 7000 sq.ft.
"Everything Else" being programs not necessary to farm, which includes public education, retail, etc..

Circulation, Structure, Mechanical: 20,000 sq.ft.



Vertical Farm: 75,000 sq.ft.

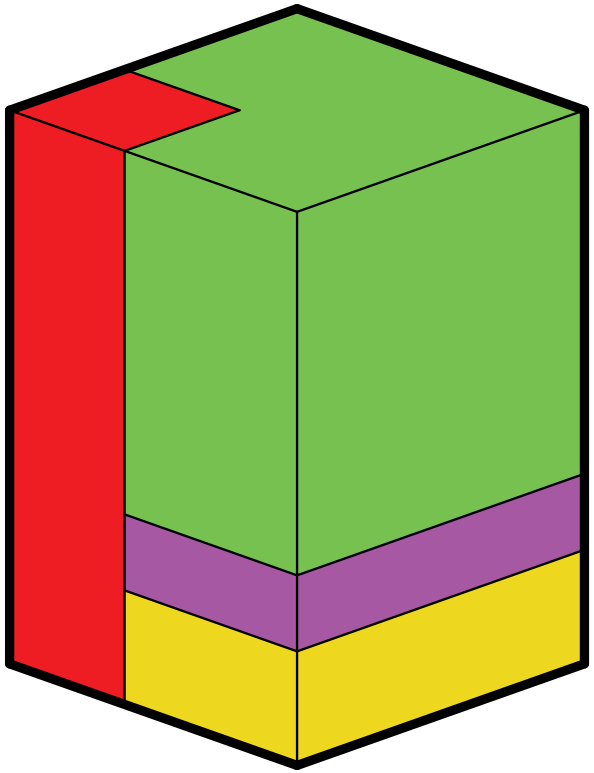
Non-Farm: 5,000 sq.ft.

[charleston] VERTICAL FARM

Vertical Farm - Fixed Space Needs

Certain pieces of the farm program will be sized mostly the same regardless of farming output, such as administration.

Circulation, Structure, Mechanical: 20,000 sq.ft.



Grow Space: 73,000 sq.ft.

Admin Space: 2,000 sq.ft.

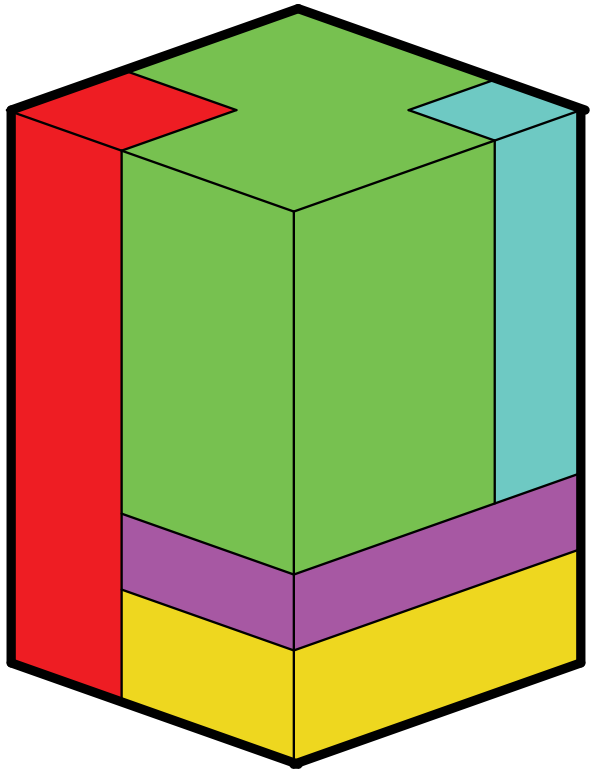
Non-Farm: 5,000 sq.ft.

[charleston] VERTICAL FARM

Vertical Farm - Relative Space Needs

The grow rooms will require a certain amount of space for support, which is a linear relation to the grow space. Let's assume a small amount - only 5% of grow space.

Circulation, Structure, Mechanical: 20,000 sq.ft.



Grow Space: 70,000 sq.ft.

Grow Support: 3,000 sq.ft.

Admin Space: 2,000 sq.ft.

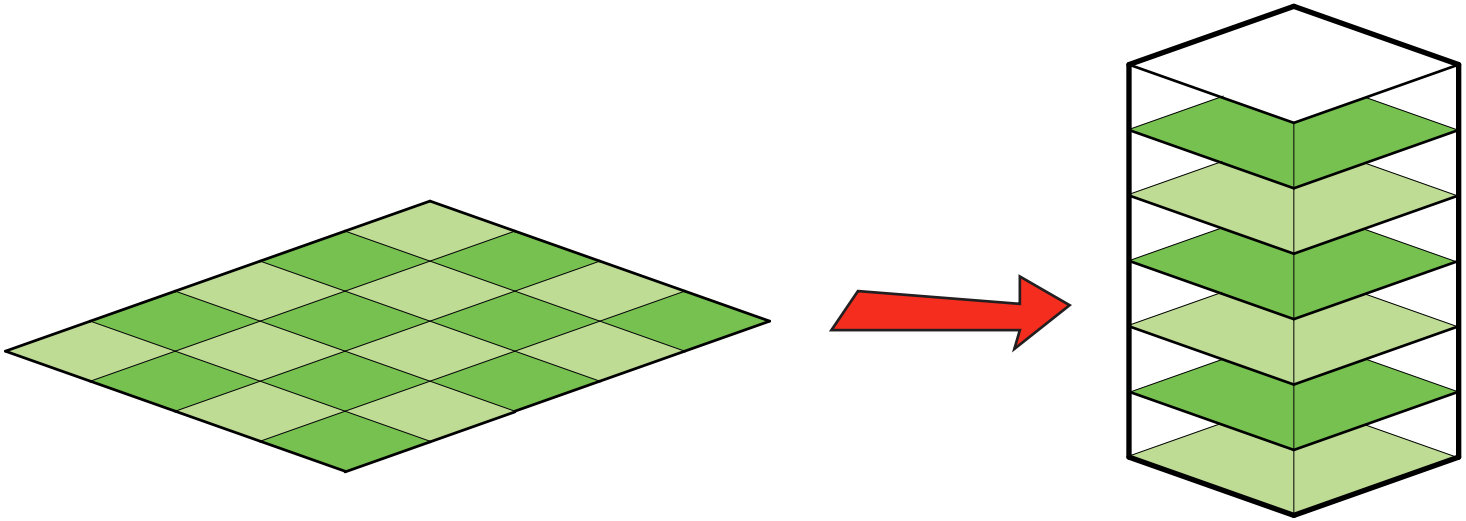
Non-Farm: 5,000 sq.ft.

[charleston] VERTICAL FARM

Farm Yield Analysis - Stacking

We must be able to predict the output of our farm.
We should create a fine-tuned formula for this.

70,000 sq.ft.	Plant Production in Sq.Ft.
43,560 sq.ft./acre	conversion
1.6 acres	**Plant Production in Acres**



Acreage Times 4

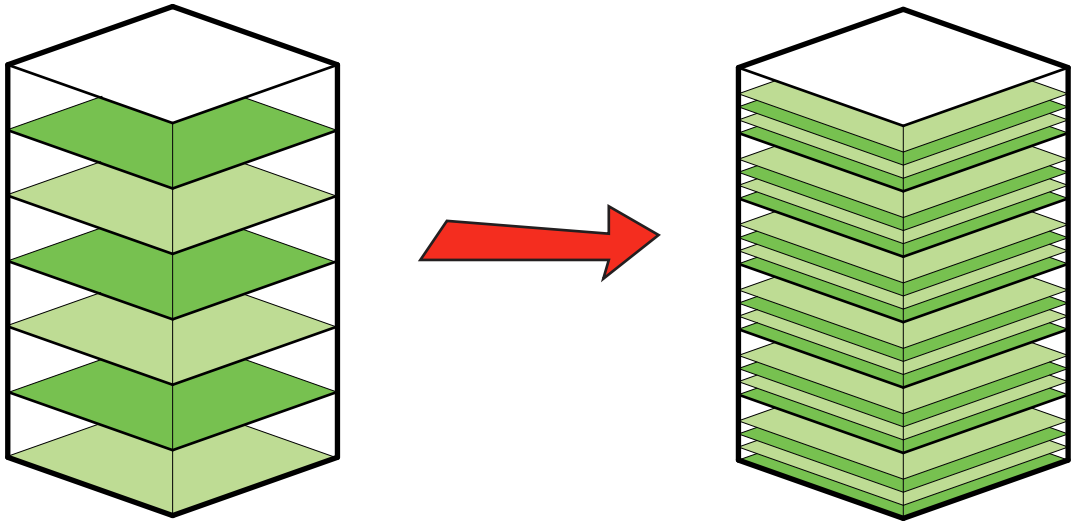
For this site and program, we can get 1.6 acres from 4 tenths of an acre of land.

[charleston] VERTICAL FARM

Yield Analysis - Hydroponics vs Traditional Dirt

Utilizing hydroponics or other non-traditional growing techniques, how much more plants can we get per volume?

1.6 acres	Plant Production in Sq.Ft.
x 4	conversion ASSUMPTION
6.4 acres	**Hydro Production in Acres**



Acreage Times 16

By stacking multiple layers in each story, we get 16 times the output of the property size alone.

[charleston] VERTICAL FARM

Yield Analysis - Annual Sales

Assuming 3 harvests per year for simplicity's sake.
Using horizontal farm yield, while hydro numbers are needed!
Prices are not necessarily right.

veggie	lbs/acre	lbs of food	sales/lb	total sales
carrots	19,400	124,702	$0.75	$93,000
cabbage	13,700	88,062	$0.33	$29,000
onions	19,800	127,273	$0.39	$49,000

Total Sales: $171,000

PROBLEM... How to make this profitable?!?!?
One farmer tending 6 acres with this income could survive.
But this building costs a lot more than 6 acres of dirt.

Construction Costs:

Assume $100/sq.ft. X 100,000 sq.ft. = $10 million.
Monthly Mortgage Payment = $42,000
(assuming $5 million down, 6% interest, 5 year loan)

[charleston] VERTICAL FARM

Program

73000 Industrial Food Production
- Grow Rooms
- Equipment/Material Storage
- Processing/Packaging
- Buffer Storage
- Shipping/Receiving
- Restrooms

1000 Administration and Support
- Offices
- Restrooms
- Worker Amenities - Breakroom, Shower/Locker, Safe/dry bike storage

1000 Research Lab Component
- Laboratories
- Seed Bank

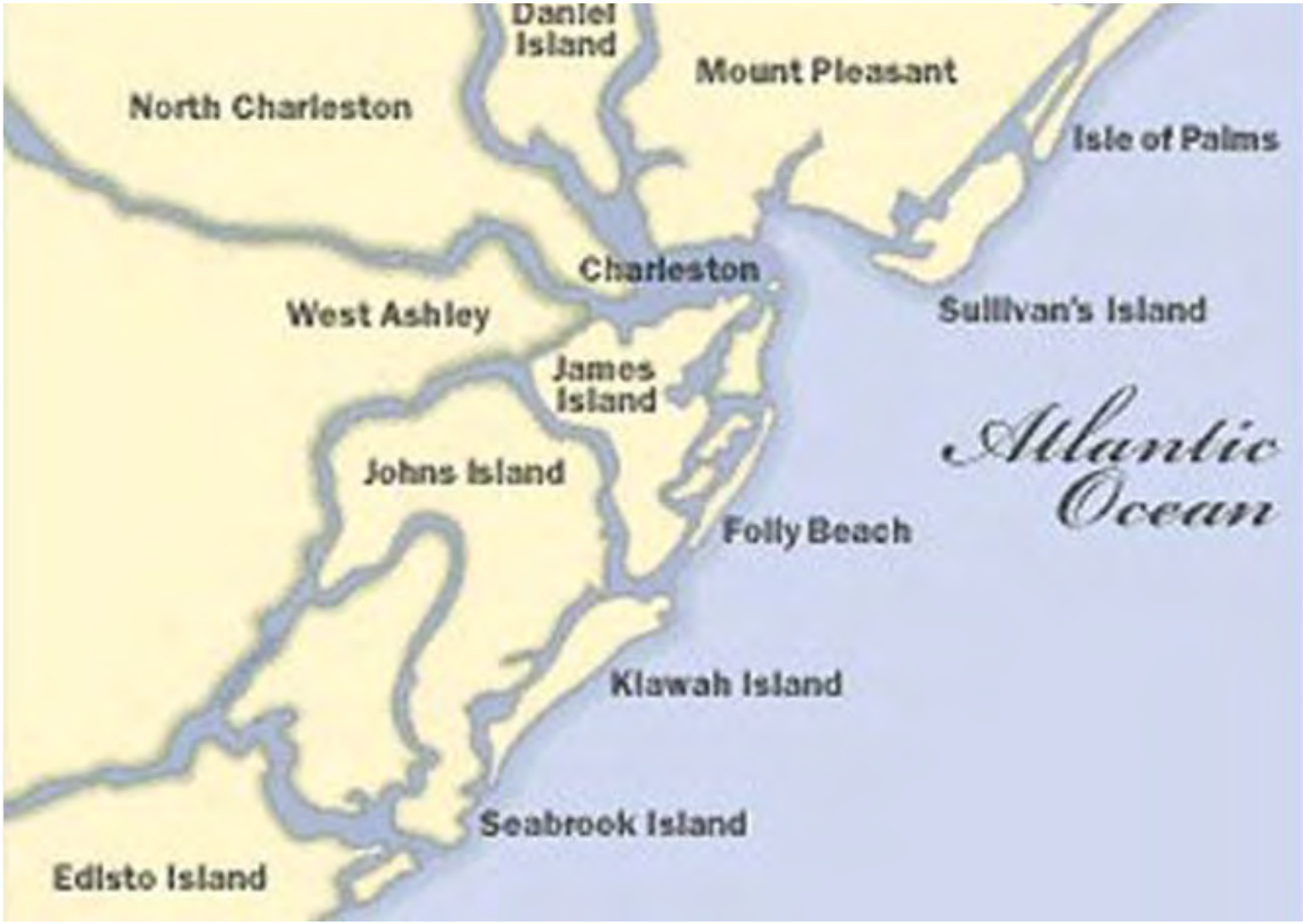
5000 Public Components
- Public Gardening
- Greenway
- Bike parking
- Retail - Farmers Market / Organic Café / Juice Bar / Store / Restrooms
- Public Education - Classrooms? Auditorium? Training labs? Observation deck.

20000 General
- Mechanical / Storage
- Vertical circulation - (freight and people)
- ADA compliance and multiple egress routes

[charleston] VERTICAL FARM

Charleston is the second largest city in the American state of South Carolina. It was made the county seat of Charleston County in 1901 when Charleston County was founded. The city's original name was Charles Towne in 1670, and it moved to its present location (Oyster Point) from a location on the west bank of the Ashley River (Albemarle Point) in 1680. It adopted its present name in 1783. Charleston is included within the Charleston – North Charleston – Summerville metropolitan area and the Charleston-North Charleston urban area.

[charleston] VERTICAL FARM



The city proper consists of six distinct areas: the Peninsula (Downtown), West Ashley, Johns Island, James Island, Daniel Island, and the Cainhoy Peninsula.

[charleston] VERTICAL FARM

Geography

[charleston] VERTICAL FARM

The city of Charleston is located just south of the mid-point of South Carolina's coastline, at the confluence of the Ashley and Cooper rivers, which flow together into the Atlantic Ocean.

_Charleston rivers map

Geography

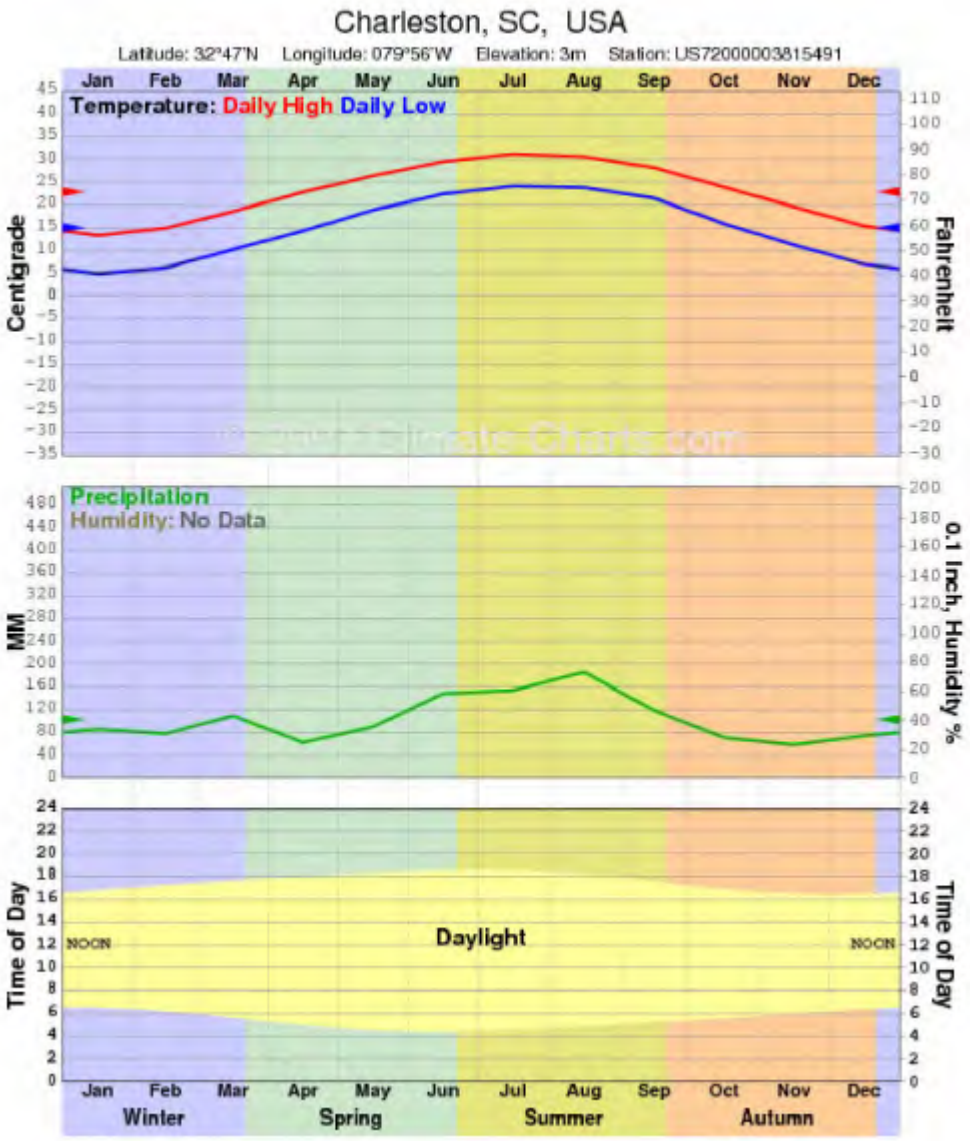
[charleston] VERTICAL FARM

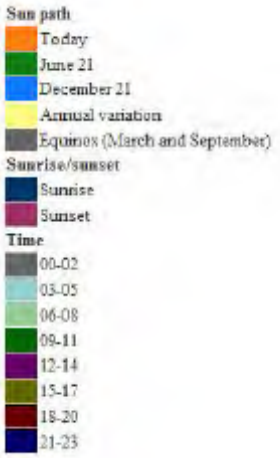
Climate data for Charleston, South Carolina (Airport) 32.8951 North and -80.0275 West [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °F (°C)	57.1 (13.94)	59.8 (15.44)	65.8 (18.78)	72.9 (22.72)	79.6 (26.44)	84.9 (29.39)	88.5 (31.39)	87.1 (30.61)	83.0 (28.33)	75.1 (23.94)	67.6 (19.78)	60.0 (15.56)	73.5 (23.06)
Average low °F (°C)	42.4 (5.78)	44.9 (7.17)	51.5 (10.83)	58.5 (14.72)	67.4 (19.67)	73.8 (23.22)	77.0 (25)	76.1 (24.5)	72.2 (22.33)	61.9 (16.61)	53.4 (11.89)	45.5 (7.5)	60.4 (15.78)
Precipitation inches (mm)	3.62 (91.9)	2.62 (66.5)	3.83 (97.3)	2.44 (62)	2.77 (70.4)	4.96 (126)	5.50 (139.7)	6.54 (166.1)	6.13 (155.7)	3.02 (76.7)	2.18 (55.4)	2.78 (70.6)	46.39 (1,178.3)
Avg. precipitation days (≥ 0.01 in)	10.1	8.0	8.5	7.0	7.6	10.6	11.4	11.9	9.7	6.1	7.0	9.0	106.9
Sunshine hours	179.8	189.3	244.9	276.0	294.5	279.0	288.3	257.9	219.0	223.2	189.0	170.5	2,810.8
Source: NOAA,[19] HKO[20]													

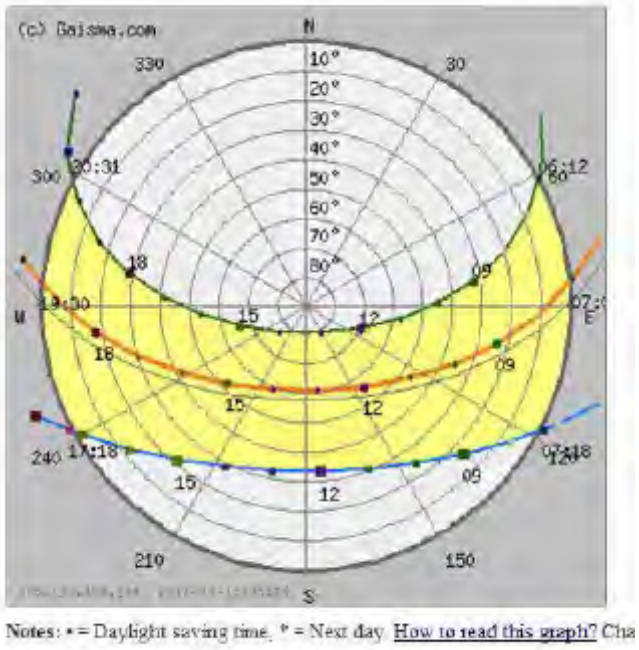
Charleston has a humid subtropical climate , with mild winters, hot, humid summers, and significant rainfall all year long. Summer is the wettest season; almost half of the annual rainfall occurs during the summer months in the form of thundershowers. Fall remains relatively warm through November. Winter is short and mild, and is characterized by occasional rain. Hurricanes are a major threat to the area during the summer and early fall, with several severe hurricanes hitting the area.

_Climate
Geography

[charleston] VERTICAL FARM







_Sun path diagram

Geography

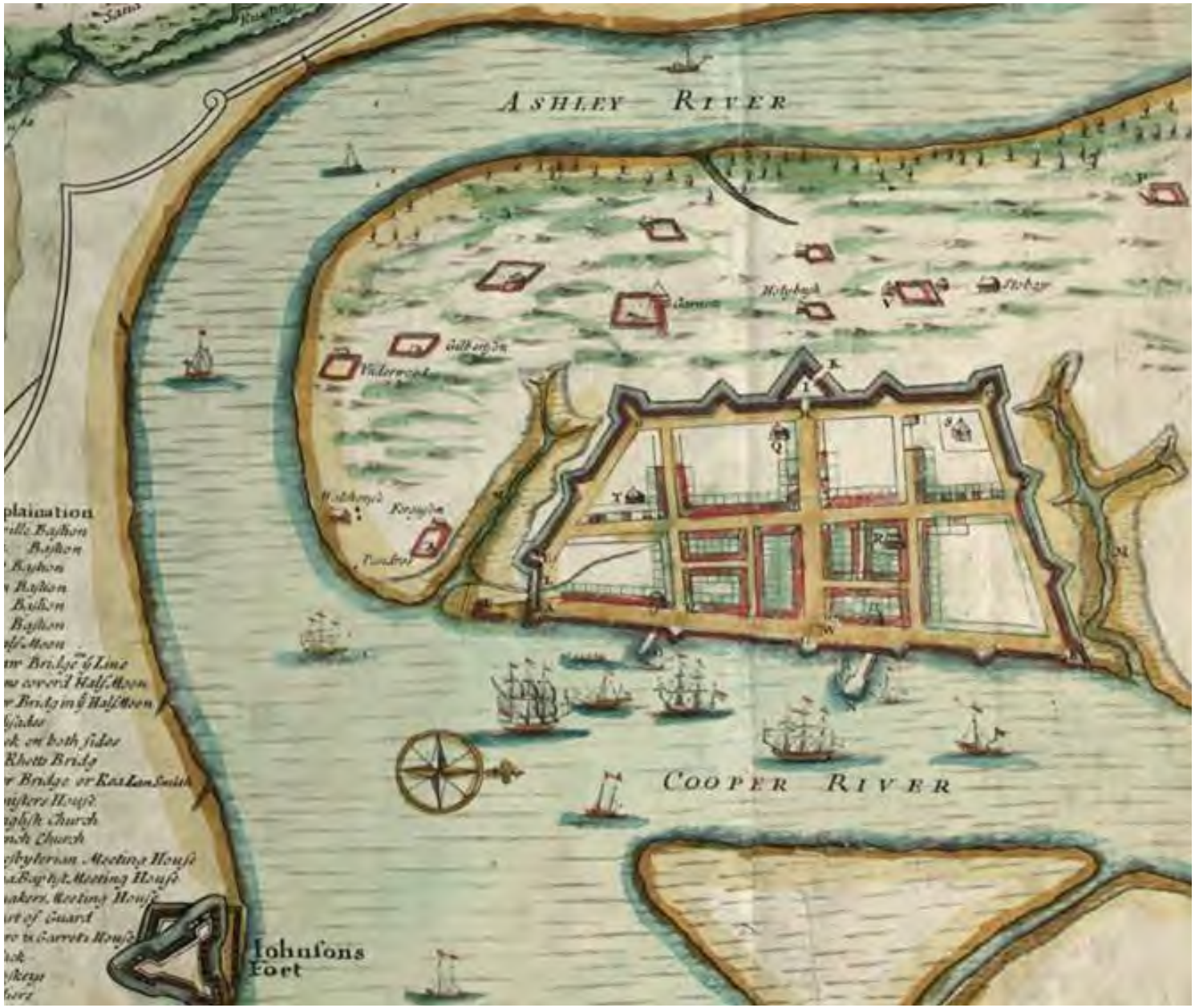
[charleston] VERTICAL FARM

_ *The Peninsula*
Geography

[charleston] VERTICAL FARM

History

[charleston] VERTICAL FARM



The first being of settlement (named Charles Town), was established by English settlers under William Style in 1670 on the west bank of the Ashley River, a few miles northwest of the present city.

_Crisp map of Charles Town 1711

Colonial era (1670–1776)

[charleston] VERTICAL FARM

As the relationship between the colonists and Britain deteriorated, Charleston became a focal point in the ensuing American Revolution. To help defend the city, the construction of Fort Sullivan was built on Sullivan's Island in the harbor. After the British left the city's name was officially changed to Charleston in 1783, naming it after King Charles II of England.

_Sir Henry Clinton's map of Charleston 1780

American Revolution (1776–1785)

[charleston] VERTICAL FARM

Charleston became even more prosperous in the plantation-dominated economy of the post-Revolutionary years. By 1820 Charleston's population had grown to 23,000, with a black majority.

_ plan of Charleston, 1849

Antebellum era (1785–1861)

[charleston] VERTICAL FARM

_ The repeatedly bombarded city

Civil War (1861–1865)

[charleston] VERTICAL FARM

The war had shattered the prosperity of the antebellum city. Industries slowly brought the city and its inhabitants back to a renewed vitality and growth in population.

_ *Map of Charleston 1885*

Postbellum era (1865–1945)

[charleston] VERTICAL FARM

Charleston languished economically for several decades in the 20th century, though the large military presence in the region helped to shore up the city's economy.

_ Map of Charleston 2011

Contemporary era (1945–present)

[charleston] VERTICAL FARM

_ *Downtown Charleston aerial shot*

Contemporary era (1945–present)

[charleston] VERTICAL FARM

Charleston garden Tradition

[charleston] VERTICAL FARM

The term Charleston garden almost universally conveys a visual image of a small private garden enclosed by vine-covered walls and tastefully filled with a profusion of seasonal plants. Wrought-iron gates, old garden walls, antique brick, decorative fountains, statuary, benches, and piazzas are all characteristic features generally associated with a typical Charleston garden. While individual gardens will vary in detail and design, there exist certain basic elements to all Charleston gardens: integration of house and garden, maximum use of limited space, enclosure by protective walls, and a creative use of ornamental plants. These features have evolved over time and have been influenced by a variety of factors including climate, architecture, enclosure, and the city's physical plan.

_ Basic elements of Charleston garden

Charleston garden Tradition

[charleston] VERTICAL FARM

Another factor which greatly influenced the evolution of Charleston's single house and integrated garden plan was the development of the city's overall plan. With limited area in which to expand, high land costs, and the development of a multidirectional street lay-out, a very compact city plan evolved in1779: "the streets from east to west extend from river to river... These streets are intersected by others, nearly at right angles, and throw the town into a number of squares with dwelling house on the front and offices, houses (dependencies) and little gardens behind. "

_ Single house and City planning

Charleston garden Tradition

[charleston] VERTICAL FARM

The rectangular shape of the single house not only appropriately responded to Charleston's climatic conditions but also readily fit it into the space allotted by the city's dense urban plan. To maximize the layout, the long side of the house opposite the piazza was generally located directly on the lot line at the northern or eastern corner of the property in order to provide adequate space for a small side garden and service drive plus ample room at the rear of the property for slave quarters, kitchen, carriage house, stables, privy and well.

_ Single house and City planning

Charleston garden Tradition

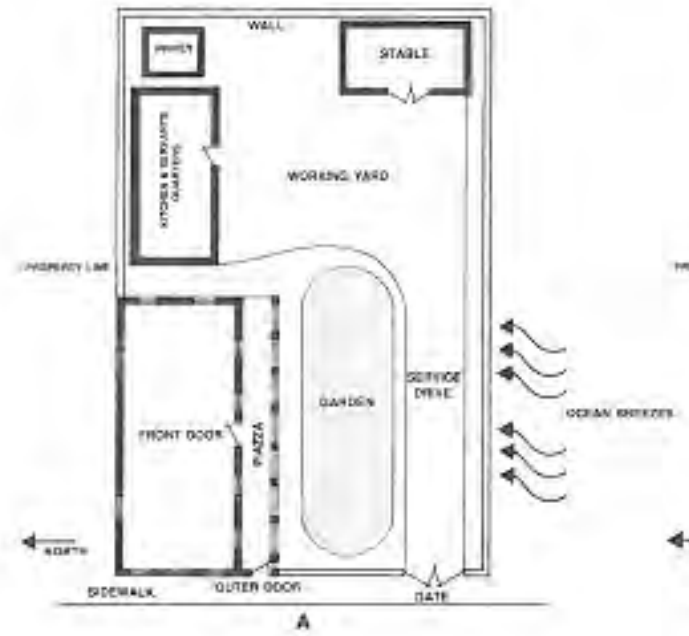
[charleston] VERTICAL FARM

Located on the south or west side of the house to catch prevailing ocean breezes, piazzas serve as cool, outdoor living spaces over-looking small gardens.

_ Single house

Charleston garden Tradition

[charleston] VERTICAL FARM



Access from the street into a single house was provided by an outer door that opened onto a piazza, which traditionally overlooked a small side garden. The street door provided both an element of privacy and surprise. The real front door was located in the center of the pizza facing the garden. The piazza functioned as a transitional element between the house and garden which intimately combined.

Plan A and B depict typical layouts of Charleston house and garden plans. Plan C shows an expansion of the side garden to the rear of the property. This transition occurred during the early part of the twentieth century as the need for service yards gradually disappeared.

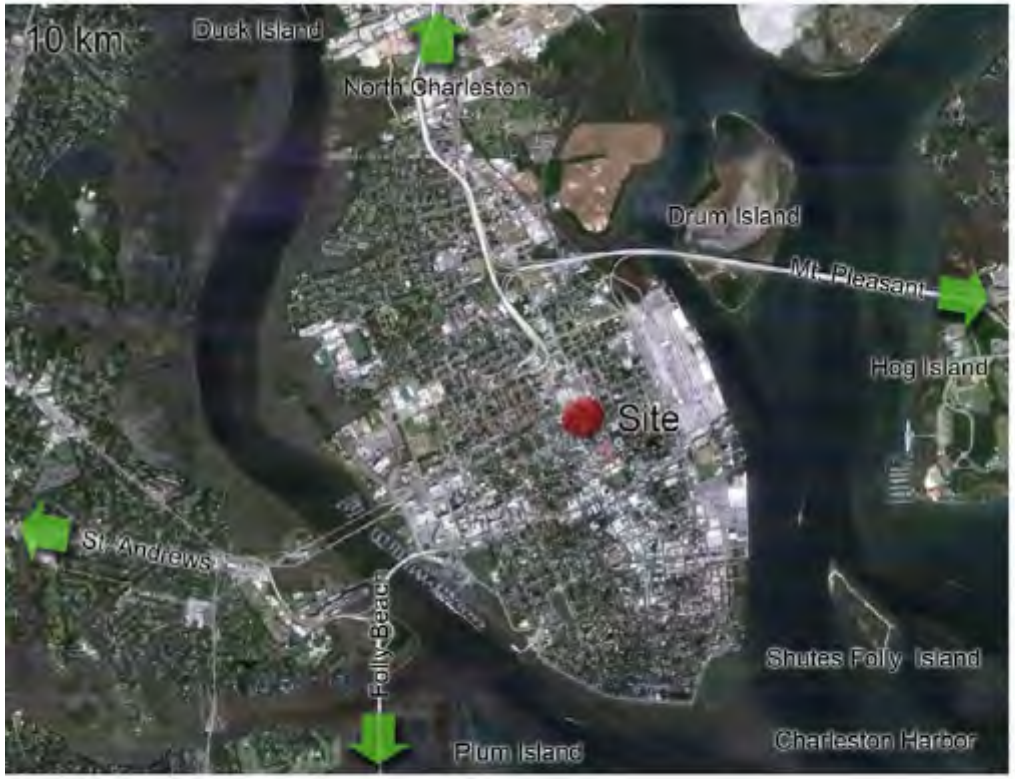
_ Single house

Charleston garden Tradition

[charleston] VERTICAL FARM

Site

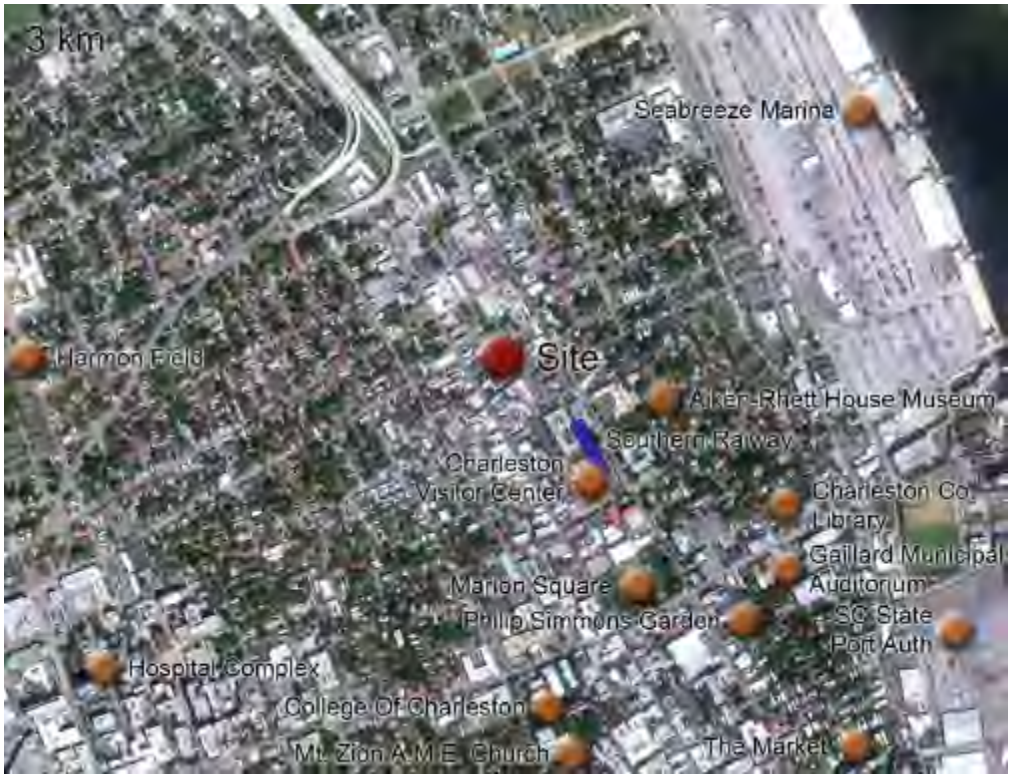
[charleston] VERTICAL FARM



_ Site and traffic

Site

[charleston] VERTICAL FARM



_ Medium scale

Site

[charleston] VERTICAL FARM

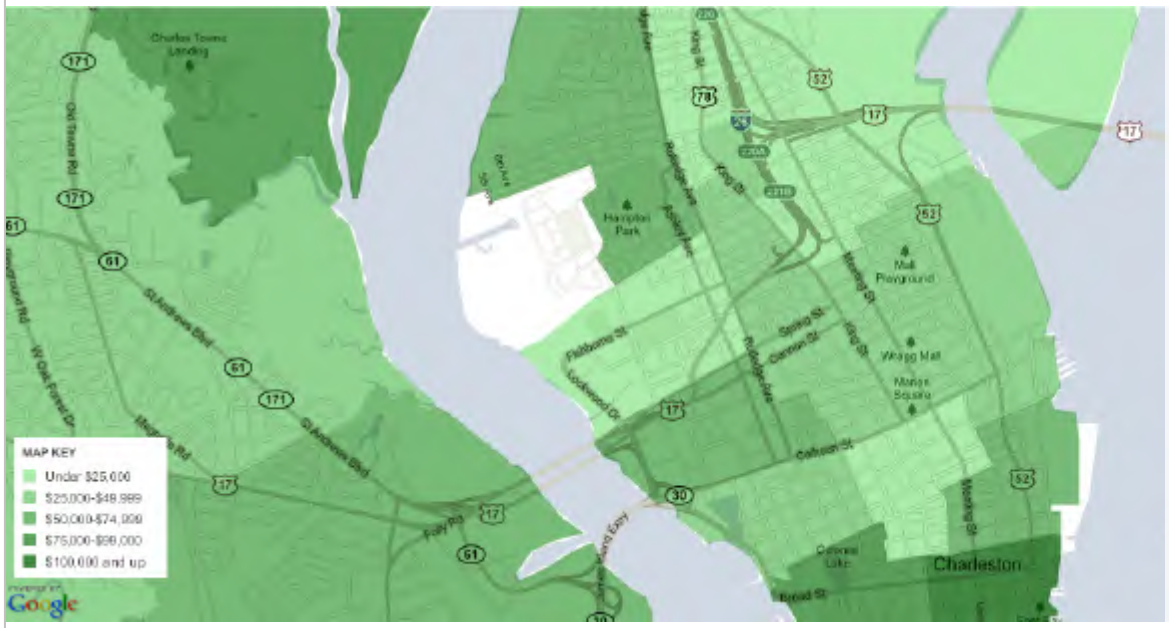
_ Small scale

Site

VERTICAL

income demographics

Median Household Income (2009)



$48,246

MEDIAN HOUSEHOLD INCOME

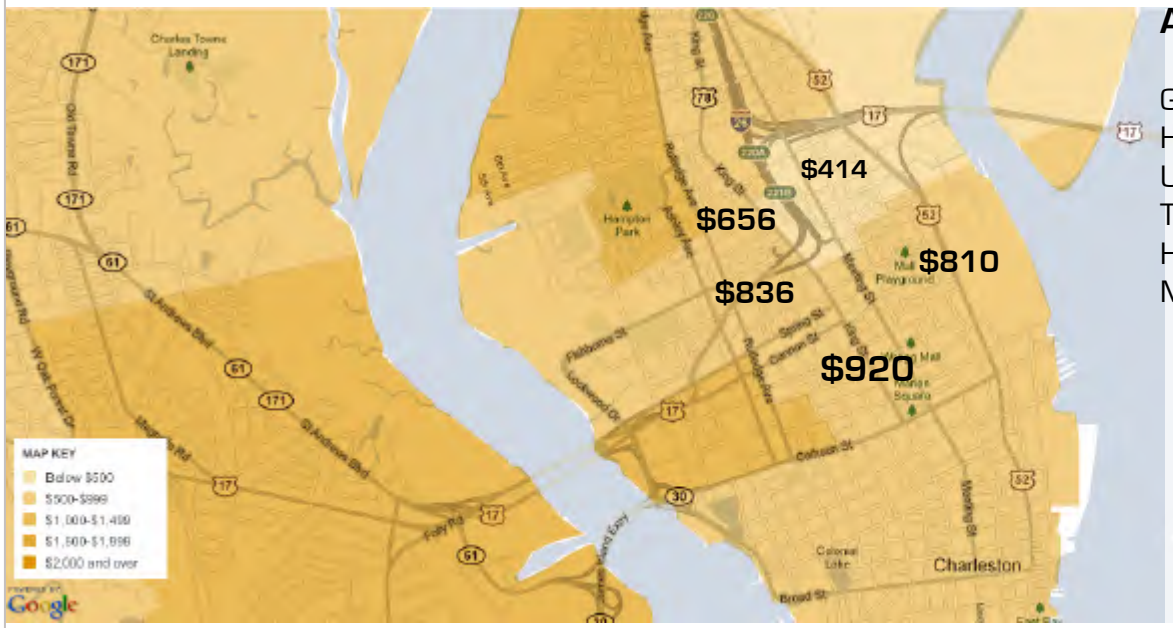
Average Household Income (2009)

$63,686

MEDIAN HOUSEHOLD INCOME

FARMSTUDIO

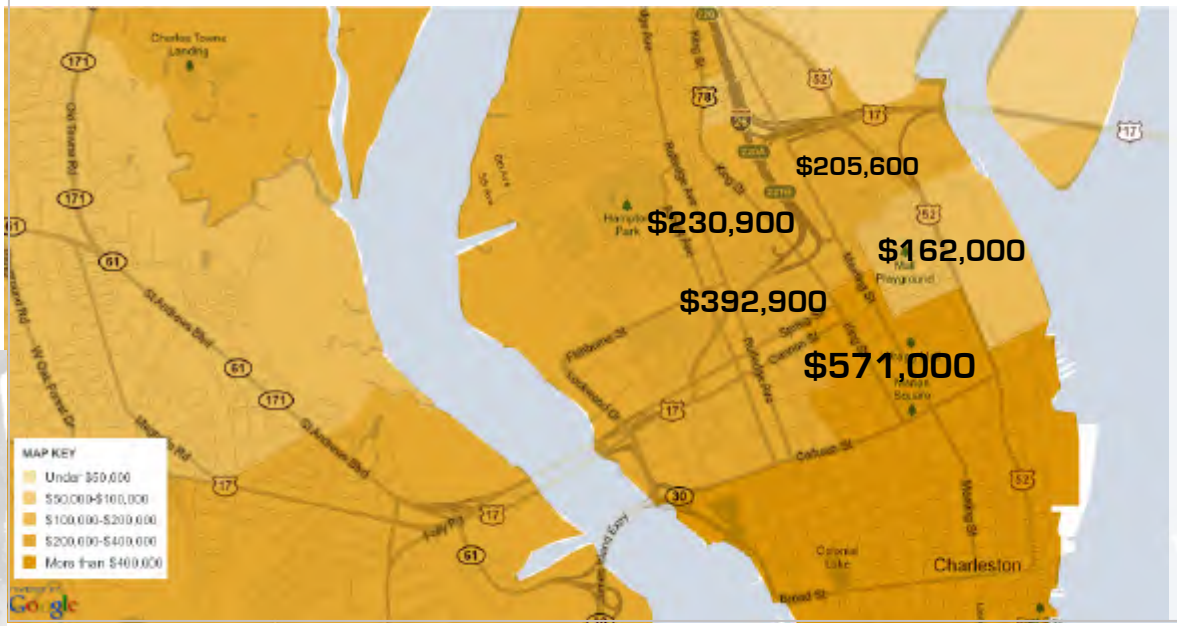
cost of living demographics



All Items (Composite)	98.2
Grocery Items	105.7
Housing	92.3
Utilities	96.8
Transportation	93.9
Healthcare	104.2
Misc. Goods	101.5

US Cities Baseline Index 100

MEDIAN MONTHLY RENT



MEDIAN HOME VALUE

VERTICAL FARMSTUDIO

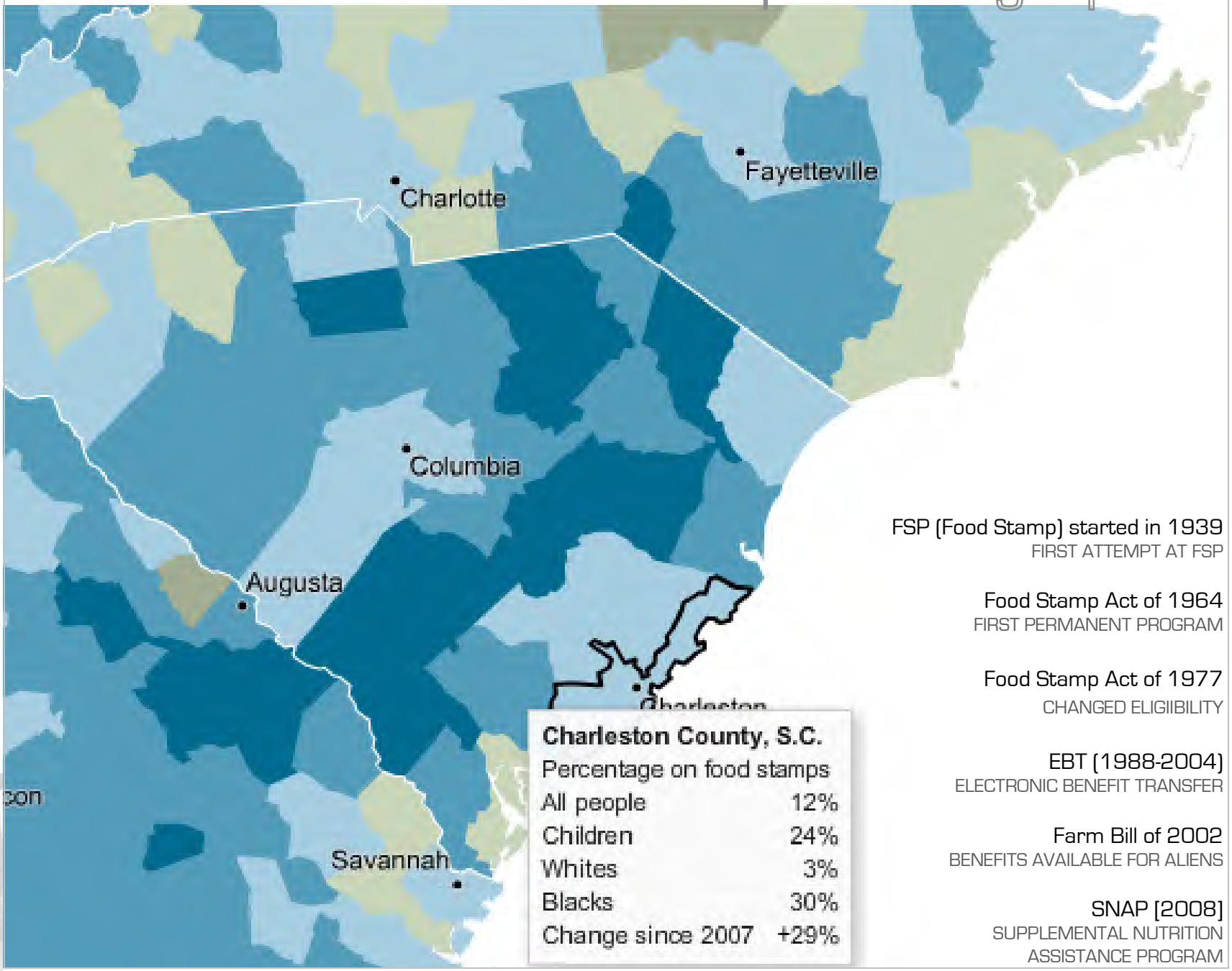
age demographics

	POPULATION BY AGE
0-19	26.2%
20-24	26.2%
25-34	15.1%
35-54	27.2%
55-64	11.8%
65+	11.4%

VERTICAL

FARMSTUDIO

food stamps demographics



FSP (Food Stamp) started in 1939
FIRST ATTEMPT AT FSP

Food Stamp Act of 1964
FIRST PERMANENT PROGRAM

Food Stamp Act of 1977
CHANGED ELIGIIBILITY

EBT (1988-2004)
ELECTRONIC BENEFIT TRANSFER

Farm Bill of 2002
BENEFITS AVAILABLE FOR ALIENS

SNAP [2008]
SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM

VERTICAL

FARMSTUDIO

VERTICAL

buy local neighborhood

LOWCOUNTRY LOCAL FIRST

ADVOCATES THE BENEFITS OF A LOCAL LIVING ECONOMY BY STRENGTHENING COMMUNITY SUPPORT OF OUR LOCAL INDEPENDENT BUSINESSES AND FARMERS.

Farm Fresh Food
LOWCOUNTRY LOCAL FIRST

TOP TEN
REASONS TO EAT LOCAL

1. SUPPORTS LOCAL FARMERS
2. FRESHER & TASTIER
3. BETTER FOR THE ENVIRONMENT
4. SUPPORTS LOCAL ECONOMY
5. SUPPORTS SUSTAINABLE LAND USE
6. EATING SEASONALLY IS HEALTHIER
7. FREE RANGE MEAT TASTES BETTER
8. IT'S OUR HERITAGE!
9. GREAT DINNER CONVERSATION
10. BE THANKFUL FOR THE EARTH

LOWCOUNTRYLOCALFIRST.ORG

VERTICAL

buy local neighborhood

BUY LOCAL

Campaign is a grassroots campaign designed to educate Lowcountry residents to Think Local when they are considering where to make purchases, to Buy Local whenever possible and to Be Local by supporting businesses that keep our community unique.

WHY BUY LOCAL?

1. KEEPS MONEY IN THE LOWCOUNTRY
2. EMBRACES UNIQUE COMMUNITY
3. FOSTERS BETTER SERVICE
4. CREATES MORE JOBS
5. HELPS THE ENVIRONMENT
6. SUPPORTS COMMUNITY GROUPS
7. ENSURES YOU GET WHAT YOU WANT
8. PUTS YOUR TAX DOLLARS TO GOOD USE
9. SHOWS THE COUNTRY YOU BELIEVE IN THE LOW COUNTRY

LOWCOUNTRYLOCALFIRST.ORG

proposed sustainable solutions neighborhood

URBAN FABRIC

PROPOSED & EXISITNG CORRIDORS

DOWNTOWN PLAN

NURTURE INCLUSIVE, VIBRANT NEIGHBORHOODS

PURSUE ECONOMIC DIVERSITY

FOSTER SUSTAINABILITY

REINFORCE THE EXISTING URBAN STRUCTURE

RESPECT THE GRAIN, SCALE AND MIX OF THE PENINSULA'S URBAN FABRIC

ENSURE ARCHITECTURAL INTEGRITY

ENCOURAGE A BALANCED NETWORK FOR MOVEMENT

USE GROWTH STRATEGICALLY

MAINTAIN DOWNTOWN AS THE REGIONAL CENTER OF CULTURE AND COMMERCE

VERTICAL

VERTICAL

midtown development context

King Street elevation

$150 MILLION PROJECT

PRIVATELY FUNDED

INCORPORATES EXISTING HISTORIC BUILDINGS

115 FEET TALL

"THERE'S NO WAY TO STOP INVESTORS FROM DRIVING UP THE PRICE OF THE NEARBY HOUSING... LONGTIME RESIDENTS THAT MIGHT NOT BE ABLE TO AFFORD TO STAY "

REV. SIDNEY DAVIS

midtown development context

Waiting it out

Six major redevelopment projects in the Upper King Street area are on hold while developers wait for economic conditions to improve.

Midtown
Local developer Robert Clement said that financial backers wanted his group to put more of their own money down, which has put his hotel, condo and retail development on hold.

Tara
Charlotte developer Harmukh Patel put his plans for a 180-room hotel, restaurant, spa and 12 condos on hold "indefinitely" after seeing local hotel occupancy rates weaken.

The Green on Meeting
Savannah architect Patrick Shay scrapped his plans to build affordable condominiums over shops, offices and parking after a city planning board wanted him to spend more money on the five-story building's exterior.

Old County Library
Plans for an eight-story, 185-room hotel are on hold not because of the economy but because of a lawsuit filed by preservation groups over the project's zoning approval, according to the developer.

Federal Building
Atlanta developer John Dewberry still hasn't announced his plans for this aging building, which he bought more than a year ago.

Millenium Music site
Developers originally planned to build six floors of condominiums above two floors of office and retail space. Now, they plan to add more office space when they finally break ground.

2009 - MIDTOWN'S GROUNDBREAKING PUSHED BACK TO 2010 BECAUSE OF BUDGET

EXPECTED TO REJUVENATE AREA LIKE CHARLESTON PLACE DID IN THE 1980S

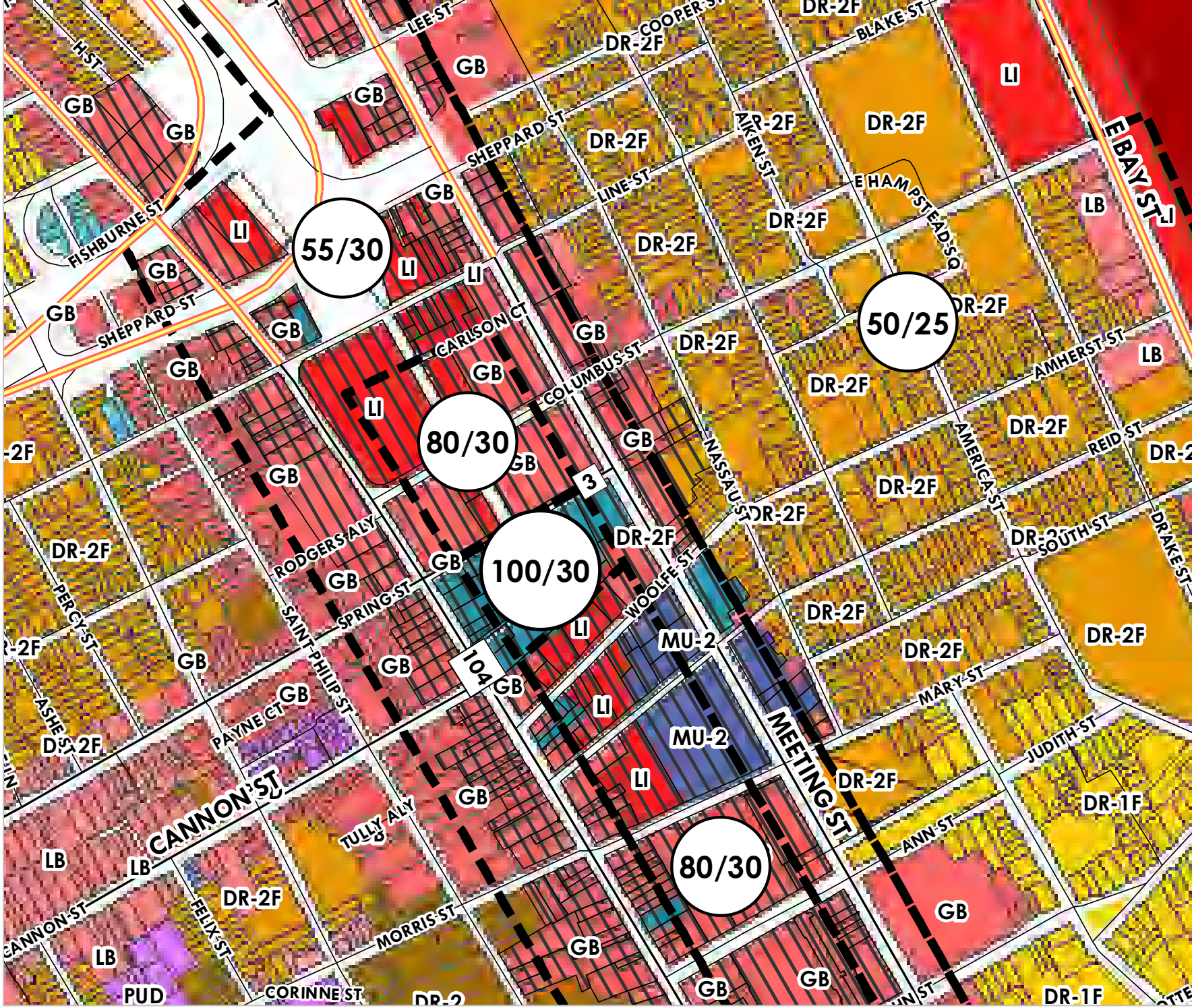
2011 - ALL PROPERTIES IN MIDTOWN HAVE BEEN SOLD

VERTICAL

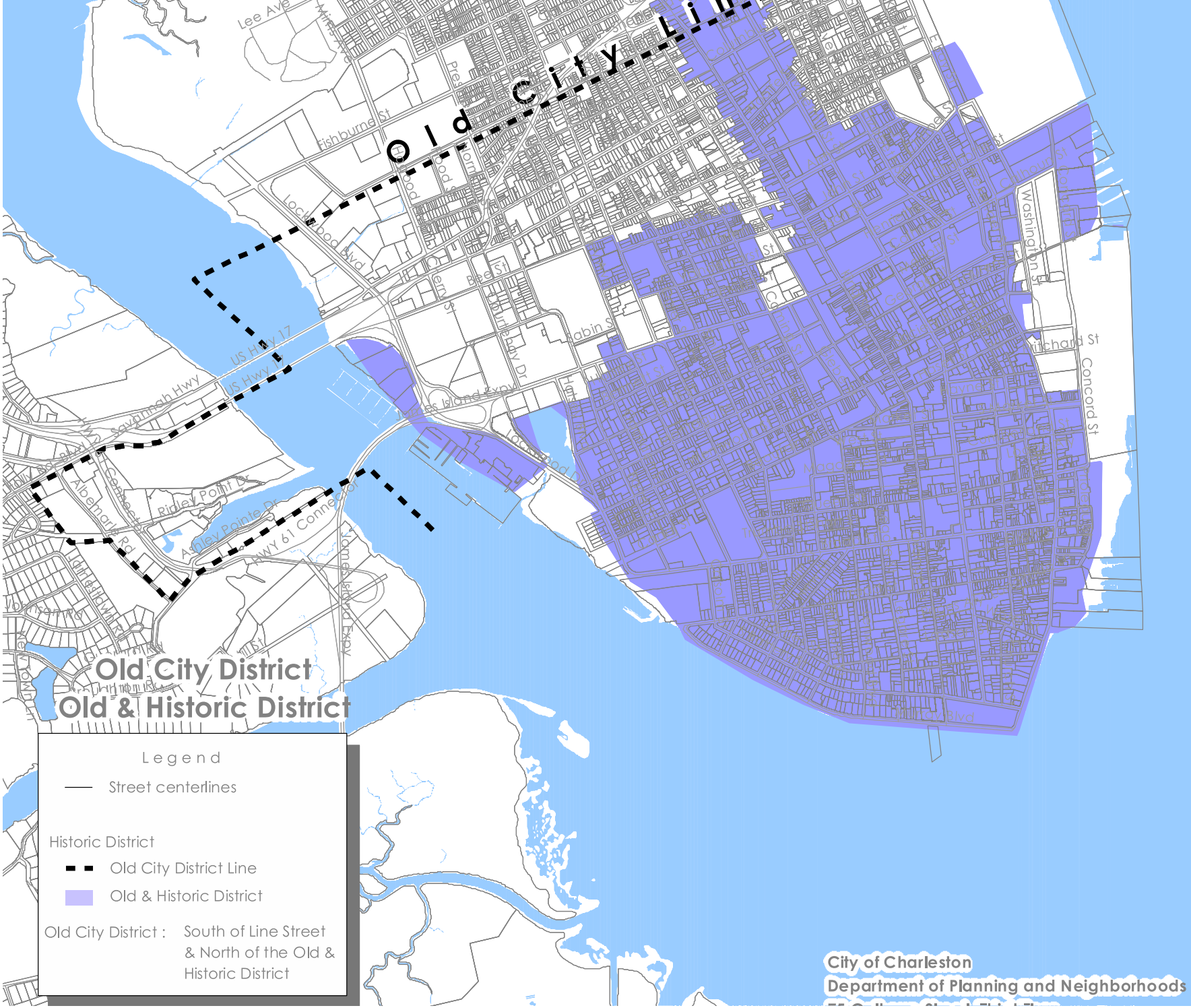
FARMSTUDIO

[charleston]
VERTICAL FARM

[charleston]
VERTICAL FARM



[charleston] VERTICAL FARM



There is a chart in Article 2, Lane Use Regulations, Part 3: Table of Permitted Uses that provides a detailed list of what programs you can have in each district.

SEC. 54-230. - Purpose of Creating Districts

In order to promote the economic and general welfare of the city and of the public generally, and to insure the harmonious, orderly and efficient growth and development of the municipality, it is deemed essential by the city council of the city that the qualities relating to the history of the city and a harmonious outward appearance of structures which preserve property values and attract tourist and residents alike be preserved; some of these qualities being the continued existence and preservation of historic areas and buildings; continued construction of buildings in the historic styles and a general harmony as to style, form, color, proportion, texture and material between buildings of historic design and those of more modern design; that such purpose is advanced through the preservation and protection of the old historic or architecturally worthy structures and quaint neighborhoods which impart a district aspect to the city and which serve as visible reminders of the historical and cultural heritage of the city, the state, and the nation.

[charleston] VERTICAL FARM

Article 3 of BAR: Site Regulations

0. HEIGHT DISTRICT 80/30. IN THIS DISTRICT:

1. No structure, including appurtenant parts of a structure except for elevator penthouses, or mechanical penthouses, shall exceed a height of eighty (80) feet nor shall any structure fronting on any street be lower than the height of thirty (30) feet.

2. All portions of a structure above the fifty-five (55) foot level shall be set back at least twenty-five (25) feet from all street right-of-way lines.

3. Notwithstanding the above, no portion of a structure, which structure is within fifty (50) feet of an existing building rated "exceptional" (Group 1) or "excellent" (Group 2) on the Historic Architecture Inventory adopted by Section 54-235 shall exceed the height of such existing building unless approved by the Board of Architectural Review.

For a Laboratory, research facility there must be 1 off street parking spot for every 2 employees
There are many other site regulations that should be considered such at tree protection requirements, parking regulations, loading zones, landscape buffer requirements, etc.

[charleston] VERTICAL FARM

CHAPTER 6
TYPES OF CONSTRUCTION

SECTION 601
GENERAL

601.1 Scope. The provisions of this chapter shall control the classification of buildings as to type of construction.

SECTION 602
CONSTRUCTION CLASSIFICATION

602.1 General. Buildings and structures erected or to be erected, altered or extended in height or area shall be classified in one of the five construction types defined in Sections 602.2 through 602.5. The building elements shall have a *fire-resistance rating* not less than that specified in Table 601 and exterior walls shall have a *fire-resistance rating* not less than that specified in Table 602. Where required to have a *fire-resistance rating* by Table 601, building elements shall comply with the applicable provisions of Section 703.2. The protection of openings, ducts and air transfer openings in building elements shall not be required unless required by other provisions of this code.

602.1.1 Minimum requirements. A building or portion thereof shall not be required to conform to the details of a type of construction higher than that type which meets the minimum requirements based on occupancy even though certain features of such a building actually conform to a higher type of construction.

602.2 Types I and II. Types I and **II** construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials, except as permitted in Section 603 and elsewhere in this code.

602.3 Type III. Type **III** construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies of a 2 hour rating or less.

602.4 Type IV. Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The

TABLE 1004.1.1
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	FLOOR AREA IN SQ. FT. PER OCCUPANT
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Assembly with fixed seats	See Section 1004.7
Assembly without fixed seats	
Concentrated (chairs only-not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtrooms-other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
H-5 Fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mercantile	
Areas on other floors	60 gross
Basement and grade floor areas	30 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

[charleston] VERTICAL FARM

GENERAL BUILDING HEIGHTS AND AREAS

TABLE 503
ALLOWABLE BUILDING HEIGHTS AND AREAS*
Building height limitations shown in feet above grade plane. Story limitations shown as stories above grade plane. Building area limitations shown in square feet, as determined by the definition of "Area, building," per story

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
	HEIGHT(feet)	UL	160	65	55	65	55	65	50	40
GROUP		STORIES(S) AREA (A)								
A-1	S	UL	5	3	2	3	2	3	2	1
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
A-2	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-4	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-5	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	S	UL	11	5	3	5	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
E	S	UL	5	3	2	3	2	3	1	1
	A	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
F-1	S	UL	11	4	2	4	2	4	2	1
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
F-2	S	UL	11	5	3	4	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	18,000	50,500	21,000	13,000
H-1	S	1	1	1	1	1	1	1	1	NP
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	NP
H-2*	S	UL	3	2	1	2	1	2	1	1
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	3,000
H-3*	S	UL	6	4	2	4	2	4	2	1
	A	UL	60,000	26,500	14,000	17,500	13,000	25,500	10,000	5,000
H-4	S	UL	7	5	3	5	3	5	3	2
	A	UL	UL	37,500	17,500	28,500	17,500	36,000	18,000	6,500
H-5	S	4	4	3	3	3	3	3	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
I-1	S	UL	9	4	3	4	3	4	3	2
	A	UL	55,000	19,000	10,000	16,500	10,000	18,000	10,500	4,500
I-2	S	UL	4	2	1	1	NP	1	1	NP
	A	UL	UL	15,000	11,000	12,000	NP	12,000	9,500	NP
I-3	S	UL	4	2	1	2	1	2	2	1
	A	UL	UL	15,000	10,000	10,500	7,500	12,000	7,500	5,000
I-4	S	UL	5	3	2	3	2	3	1	1
	A	UL	60,500	26,500	13,000	23,500	13,000	25,500	18,500	9,000
M	S	UL	11	4	2	4	2	4	3	1
	A	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000
R-1	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-2	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-3	S	UL	11	4	4	4	4	4	3	3
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
R-4	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
S-1	S	UL	11	4	2	3	2	4	3	1
	A	UL	48,000	26,000	17,500	26,000	17,500	25,500	14,000	9,000
S-2,c	S	UL	11	5	3	4	3	5	4	2
	A	UL	79,000	39,000	26,000	39,000	26,000	38,500	21,000	13,500
U	S	UL	5	4	2	3	2	4	2	1
	A	UL	35,500	19,000	8,500	14,000	8,500	18,000	9,000	5,500

[charleston] VERTICAL FARM

Sprinkler system

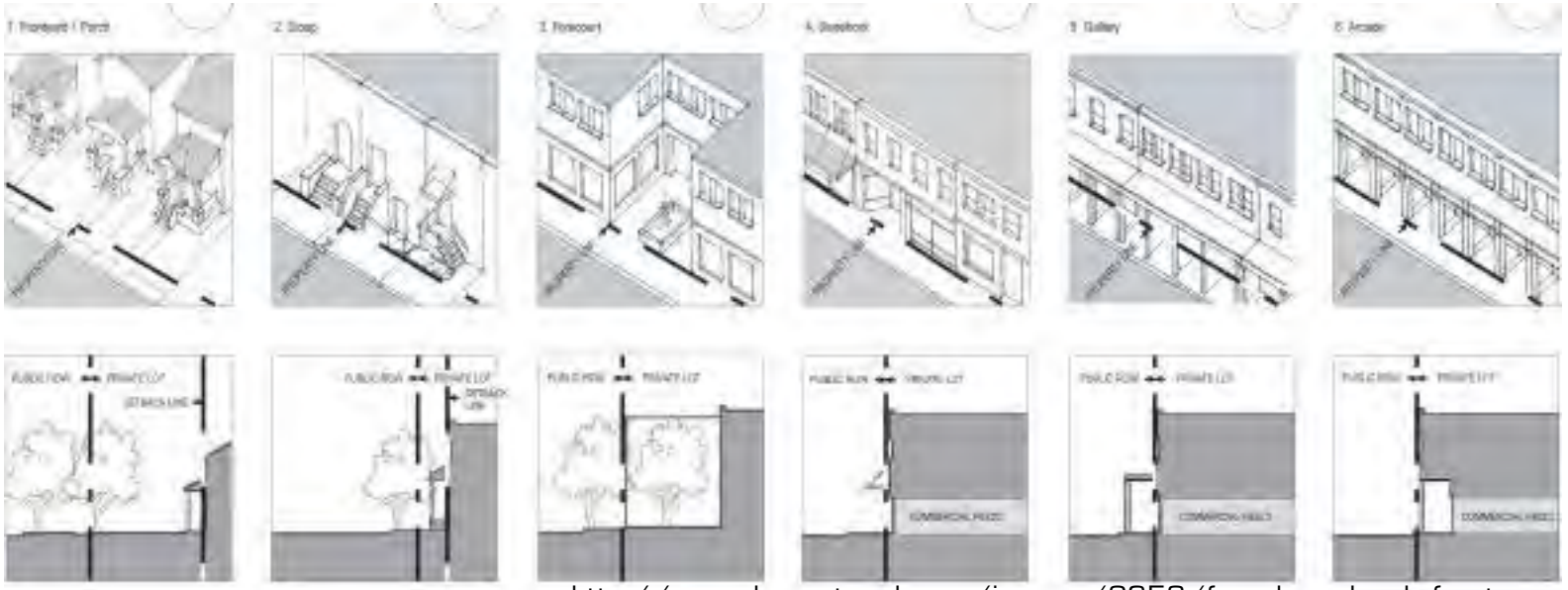
Article 504.2 of the IBC states that if an automatic sprinkler system you may increase the building height stated in Table 503 by 20 feet and the maximum stories can be increased by 1.

A great reference for the construction types to assist in reading the allowable building heights and areas in the Lecture Code 1 (slide 33) from Arch 874.

Occupancy Group B, F-2, U:
A sprinkler system is required throughout any building containing floors 55 ft or more above grade with an occupant load of 30 or more.

For most buildings the allowable exit distance is 200' without a sprinkler system, and from 250' to 300' with a sprinkler system.

[charleston] VERTICAL FARM



http://newurbannetwork.com/images/9653/form-based-code-frontages

Excess Frontage

If more than 25% of the building perimeter fronts on a street or open space at least 20 ft wide that is accessible to firefighting vehicles, the tabulated area limitations below may be increased according to the following table.

I =[F/P–0.25]W/30 f

I= Area increase due to frontage.
F= Building perimeter that fronts on a public way or open space having 20 feet (6096 mm) open minimum width (feet).
P= Perimeter of entire building (feet).
W= Width of public way or open space (feet) in accordance with Section 506.2.1.

Essentially, the more building that fronts a street that allows for emergency access, then the more square footage you are allowed to build on (by percentage per IBC code).

[charleston] VERTICAL FARM

Mixed-use buildings

When two or more Occupancy Groups are combined in one building, the IBC allows these mixed uses to be treated as either nonseparated or Separated Occupancies.

When occupanices are Non-separated, there are no requirements for fire separation between them, and the allowable building height and area are determined for the whole structure by applying the requirements of the most restrictive occupancy throughout.

Separated Occupancies are segregated from one another by fire separations, which may consist of fire-resistant walls, fire doors, and other rated openings, and fire-resistant floor/ ceiling assemblies.

Some combinations need not fully meet requirements of mixed-used occupancies: Assembly areas less than 750 sq. feet or with an occupant load of less than 50 may be considered part of any other occupancy within which they occur.

[charleston] VERTICAL FARM

Vertical distribution of services for large buildings

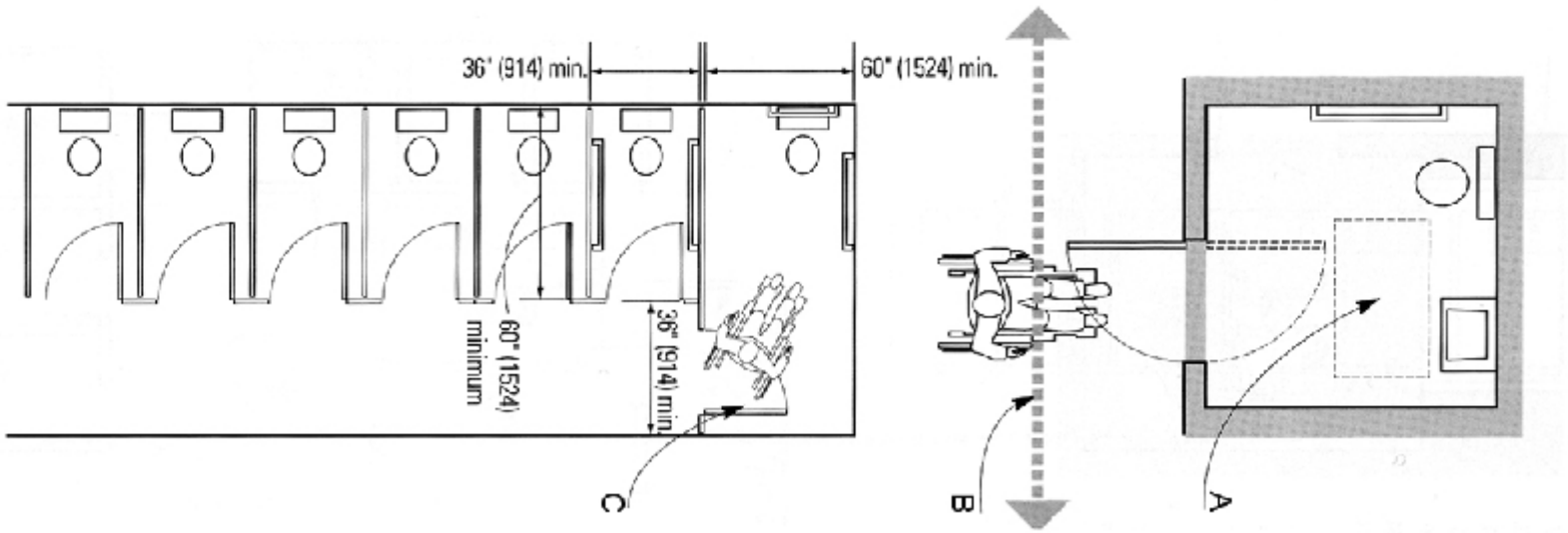
Occupancy Group B

Water closets-		First 50 occupants:	1 per 25
		Remaining occupants:	1 per 50
Lavatories-		First 80 occupants:	1 per 40
		Remaining occupants:	1 per 80
Drinking ftns:	1 per 100		
Bathrooms:	None		

Occupancy Group F

Water closets:	1 per 100
Lavatories:	1 per 100
Drinking ftns:	1 per 400
Bathrooms:	Emergency showers and eyewash station may be required

[charleston] VERTICAL FARM



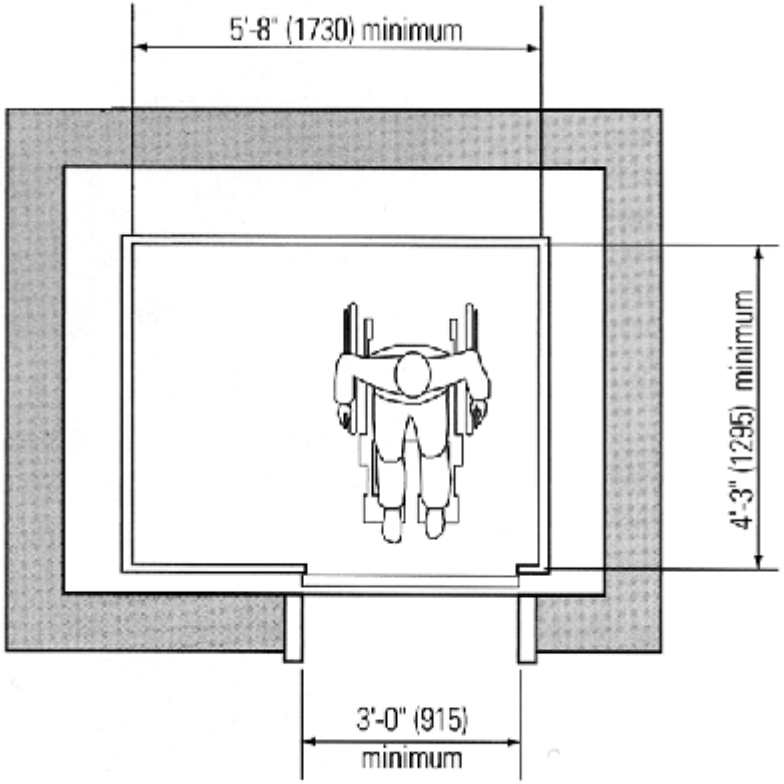
Toilet facilities

A clear space of 30” by 48” is to be provided if the door swings into the room.

In buildings required to provide access for disabled persons, accessible routes must be provided to toilet and bathing facilities, and each facility must have at least one accessible fixture of each type.

Under most circumstance, separate toilet facilities are required for each sex. Separate facilities are not required for private facilities, for areas where the total occupant load is 15 or less, for employee facilities where 15 or fewer persons are employed.

[charleston] VERTICAL FARM



Elevators

Accessible elevators should be installed along the accessible route.
They should have a minimum size of 5'8 by 4'3.
The minimum opening should be 3'.

Freight, service:
Capacity- 4000 to 6000 lb
Inside car dimensions- 8'-4" x 10'-0"
Inside shaft dimensions: 10'-10" x 10'-8"

[charleston] VERTICAL FARM

Occupancy	Per Table 1005.2.1				Per Section 1004.2.5	
	Maximum Occupant Load w/ 1 Exit	Minimum No. of Occupants with 2 Exits	No. of Occupants Requiring 3 Exits	No. of Occupants Requiring 4 Exits	Length of Common Path-of-Egress Travel** before 2 Paths of Egress Travel are Required	
All	–	Up to 500	501–1,000	> 1,000	Nonsprinklered	Sprinklered
A, E	50	51–500	"	"	75 (22 860)	75
B, F	50	51–500	"	"	75*	100
H-1, 2, 3	3	4–500	"	"	25 (7620)	25
H-4, 5	10	11–500	"	"	75	75
I-1	10	11–500	"	"	75	75
I-2	Per § 1004.2.3.2	1–500	"	"	75	75
I-3	10	11–500	"	"	100 (30 480)	100
I-4	10	11–500	"	"	75	75
M	50	51–500	"	"	75	75
R	10	11–500	"	"	75	75
S	30	31–500	"	"	75*	100
U	50	51–500	"	"	75*	75*

* Tenant spaces with an occupant load of less than 30 may have a common path-of-egress travel up to 100 feet (30 480).

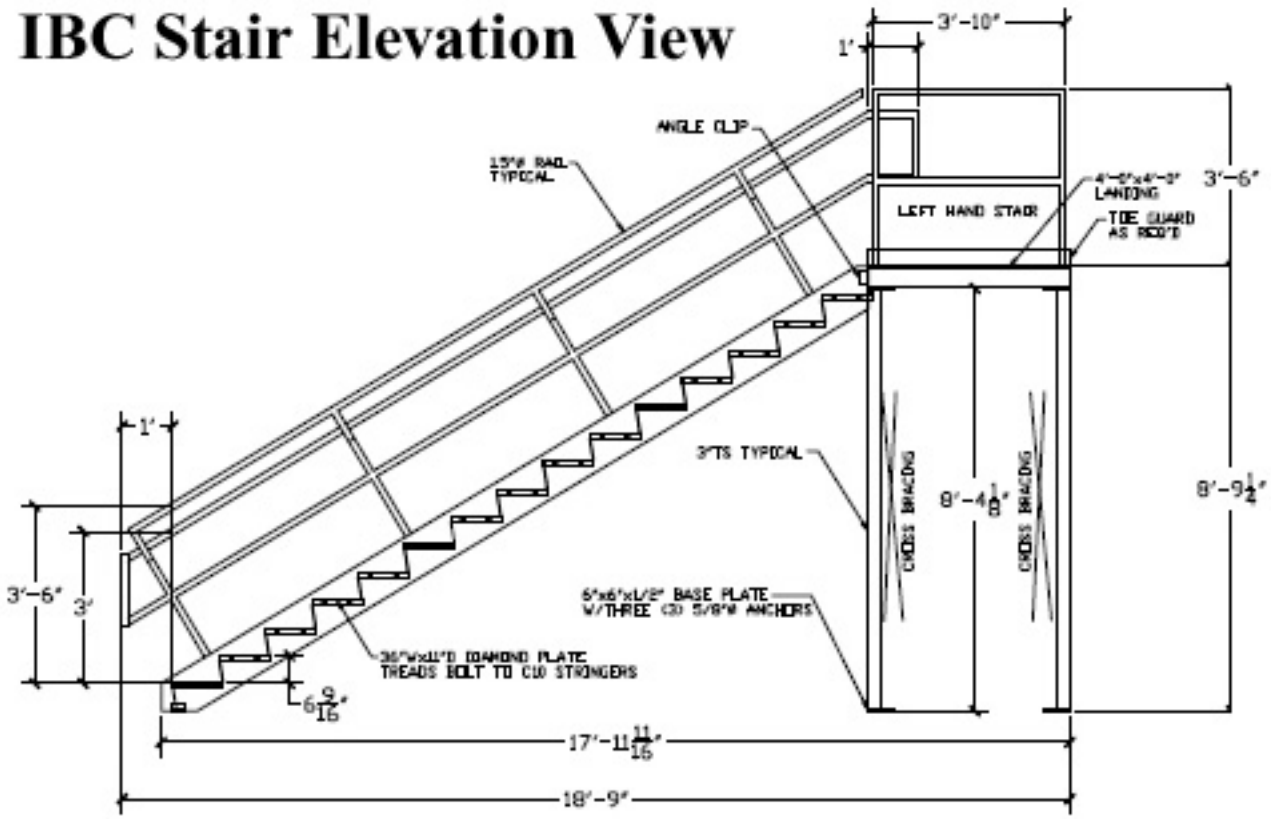
Egress

The maximum occupant load with 1 exit for B, F, and U are 50.
For most buildings, each floor with 500 or fewer occupants must have at least two independent exits. Floors with between 501 and 1000 occupants must have at least three such exits, and floors with more than 1000 occupants must have at least four.

The IBC requires egress doors to swing in the direction of egress travel.

§1004.2.1 Defines the requirements for the number of exits or exit access doorways
Combines the requirement of several code sections and compares requirements for occupant load, number of exits and length of paths of egress travel.

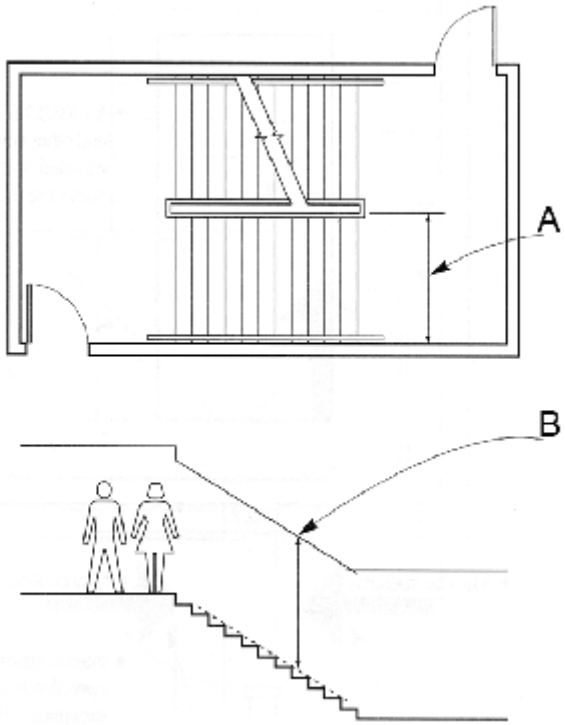
[charleston] VERTICAL FARM



Egress

1009.3 Stair treads and risers.
Stair riser heights shall be 7 inches maximum and 4 inches minimum. Stair tread depths shall be 11 inches minimum. The riser height shall be measured vertically between the leading edges of adjacent treads. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. Winder treads shall have a minimum tread depth of 11 inches measured at a right angle to the tread's leading edge at a point 12 inches from the side where the treads are narrower and a minimum tread depth of 10 inches.

[charleston] VERTICAL FARM



Egress

Defines the width of exit pathways, defined by the occupant load, the hazard of occupancy, and whether the building is sprinklered and whether the path is a stair.

Stairways must be at least 44" wide.

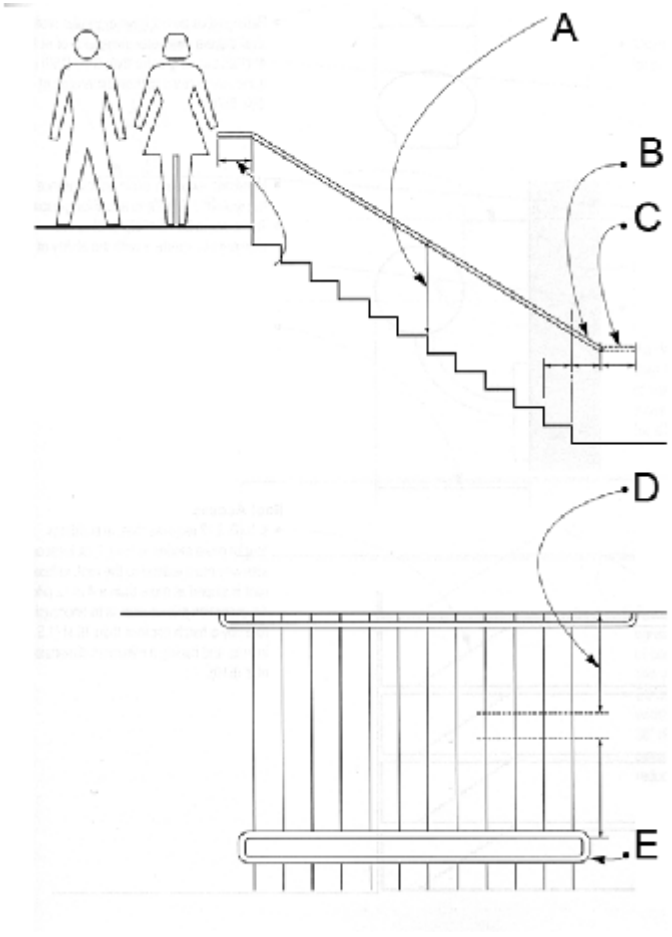
Any single flight of stairs may not exceed 12' in vertical rise between floors and landings.

Stairways shall have a minimum headroom clearance of 80 inches measured vertically from a line connecting the edge of the nosings. Such headroom shall be continuous above the stairway to the point where the line intersects the landing below, one tread depth beyond the bottom riser. The minimum clearance shall be maintained the full width of the stairway and landing.

[charleston] VERTICAL FARM

Handrails

Handrails have to be between 34" and 38" above the stair-tread nosing.
Handrails must continue their slope for the depth of one tread beyond the bottom riser.
ADAAG requires an additional horizontal extension.
Intermediate handrails are required for stairs that are more than 60" each side.
Handrail extensions are not required where the handrails are continuous between the flights.



[charleston] VERTICAL FARM

South Carolina Department of Health and Environmental Control (SCDHEC):

is organized to provide the coordination of environmental permitting and regulatory communication with business, government, and the general public to help minimize the impact of growth on the state's natural resources and environment.

Deals with waste management, pollution, air quality, etc.

- permitting
- licensing
- certification
- registration
- monitoring
- reporting

D H E C
PROMOTE PROTECT PROSPER

[charleston] VERTICAL FARM

DHEC Office of Ocean and Coastal Resource Management (DHEC-OCRM):

protects and enhances the state's coastal resources by preserving sensitive and fragile areas while promoting responsible development in the eight coastal counties of South Carolina.

DHEC-OCRM Program Goals and Objectives:

- Implement the Coastal Zone Management Program to manage wetland alterations, storm water and land disturbance activities, certify all federal and state permits and direct federal actions and all alterations of tidally influenced critical area lands, waters and beaches.
- Preserve sensitive natural, historic and cultural resources through regulatory oversight and guidance.
- Provide technical expertise to resolve complex coastal management issues.
- Encourage low impact and alternative development to preserve water quality and environmental integrity.

http://www.scdhec.gov/environment/ocrm

[charleston] VERTICAL FARM

Sources for Codes and Zoning

BAR Charleston
http://www.charlestoncity.info/dept/content.aspx?nid=491

Charleston County Zoning
http://www.charlestoncounty.org/departments/planning/ZLD-Reg-Ord.htm

DHEC
http://www.scdhec.gov

OCRM
http://www.scdhec.gov/environment/ocrm

IBC 2009

[charleston] VERTICAL FARM

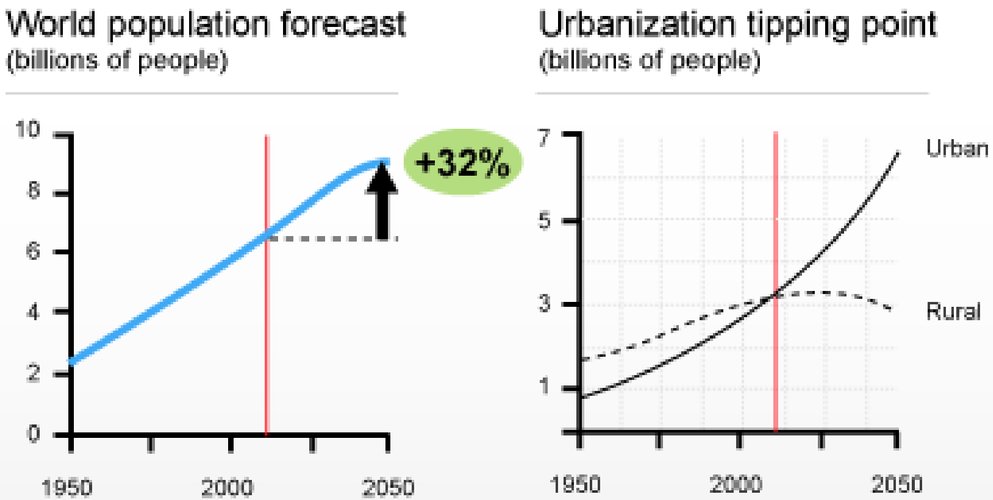
the THEORY behind the CONCEPT of VERTICAL FARMING

what's all the hype about?

by 2050 the human population will increase
by 3 billion and 80% of people will live in cities

[charleston] VERTICAL FARM

POPULATION: 2050 population to reach 9bn



Source: UN Department for Economic and Social Affairs, DESA, and UN Habitat, Living Planet Report, 2005

concept + theory
community
history + context

currently, traditional agriculture makes it difficult to acheive profitability, distances customers from their food and hurts the environment

[charleston] VERTICAL FARM

the fact is that bad weather makes farming difficult, risky and uncertain. Millions of tons of valuable crops are lost to hurricanes, floods, long-term droughts, and monsoons every year

[charleston] VERTICAL FARM




concept + theory
community
history + context

so what is the solution? how do we revolutionize the food system? a new kind of farming has to emerge

[charleston] VERTICAL FARM

urban farming

sky farming

vertical farming

THE URBAN FARM

Shenzhen & Hong Kong Biennale of Urbanism/Architecture

concept + theory
community
history + context

THE URBAN FARM

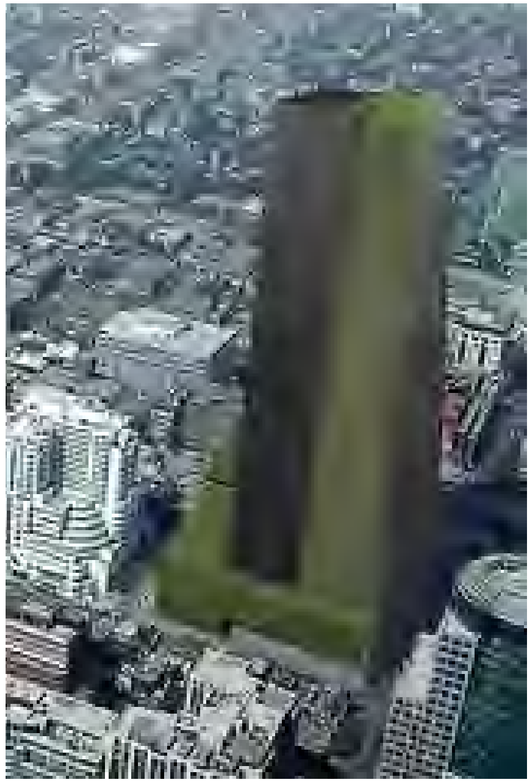
[charleston] VERTICAL FARM

Urban Farm Brooklyn, New York

THE SKY FARM

[charleston] VERTICAL FARM

The Living Skyscraper: Farming the Urban Skyline| Blake Kurasek



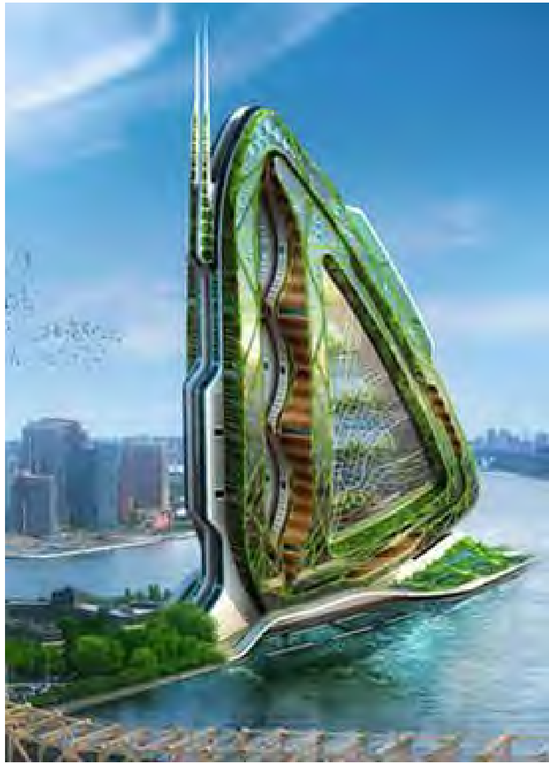
Pierre Sartoux's Living Tower | Gordon Graff

concept + theory
community
history + context

THE SKY FARM

[charleston] VERTICAL FARM

La Tour Vivante | SOA Architects



Dragonfly | Vincent Callebaut

THE VERTICAL FARM

Growing Power | Will Allen

concept + theory
community
history + context

THE VERTICAL FARM

[charleston] VERTICAL FARM

Eco Laboratory | Weber Thompson

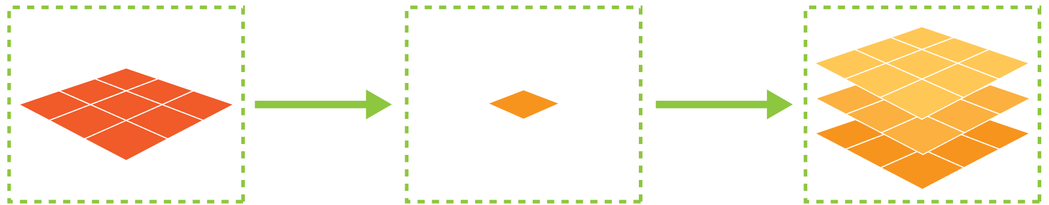
THE VERTICAL SOLUTION

The London City Farmhouse by Catrina Stewart

concept + theory
community
history + context

HORIZONTAL VS. VERTICAL

[charleston] VERTICAL FARM



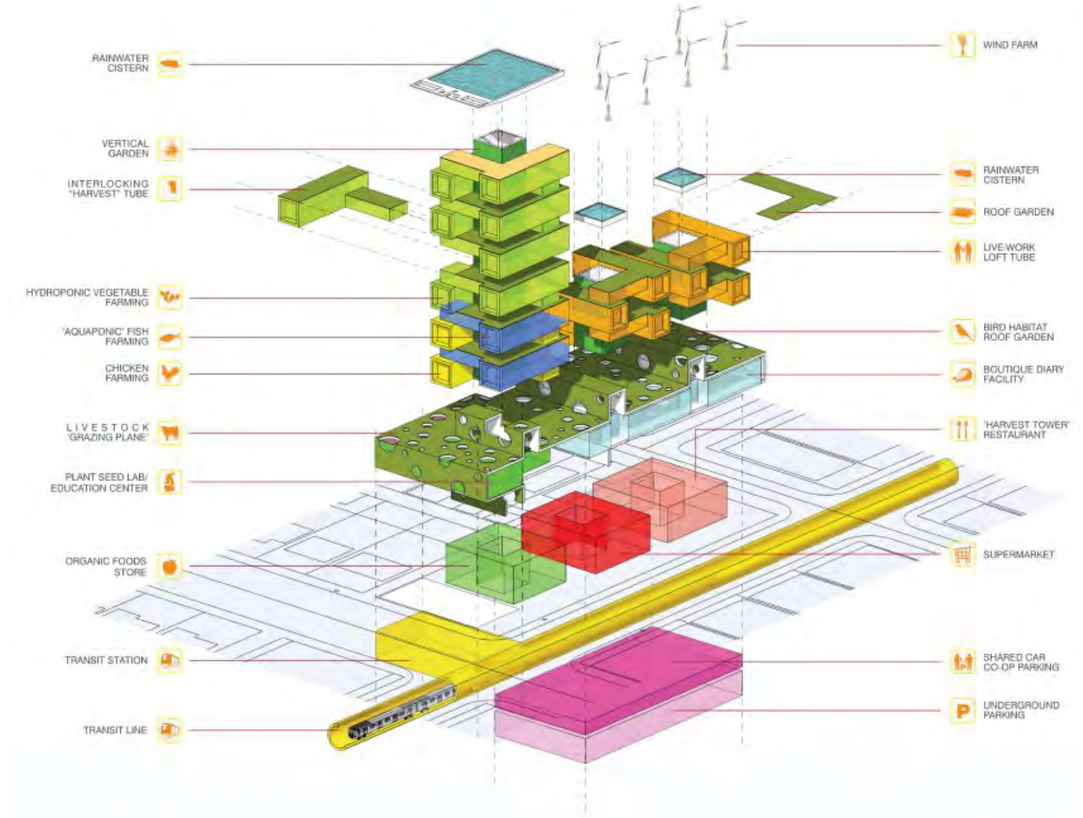
9 acres in a horizontal farm...

equals 1 acre in a vertical farm...

27 vertical farm acres is equal to 243 horizontal farm acres

[charleston] VERTICAL FARM

VERTICAL STACKING



Harvest Green | Romses Architects

concept + theory
community
history + context

[charleston] VERTICAL FARM

COMMUNITY INTEGRATION

what do we get out of it?

FARMING

COMMUNITY

How can the vertical farm design target each of these groups within the community?

CROPS

FARMERS MARKET

PEOPLE

EDUCATION

RETAILERS

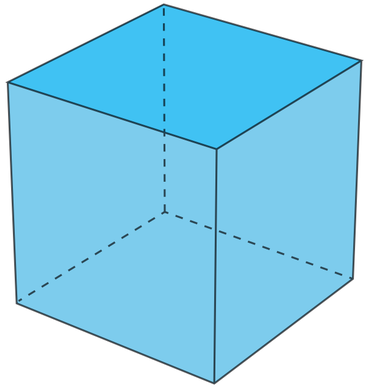
RESTAURANTS

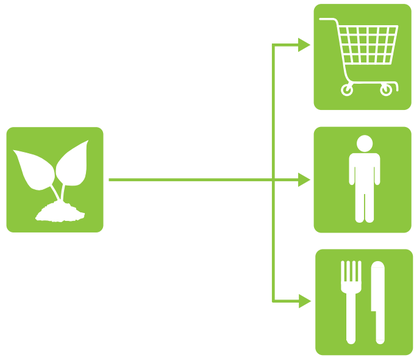
concept + theory
community
history + context

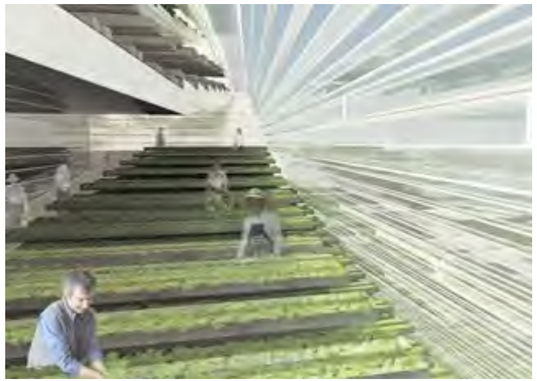
[charleston] VERTICAL FARM

THE "U-PICK" SYSTEM

level of integration: high







Urban Farm, Urban Epi-center | Jung Min Nam

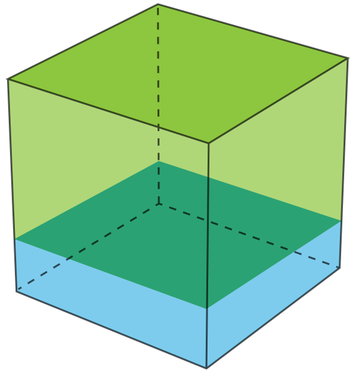
Vertical Farm | Victorian Eco Innovation Lab

concept + theory
community
history + context

[charleston] VERTICAL FARM

THE FARMERS MARKET

level of integration: medium

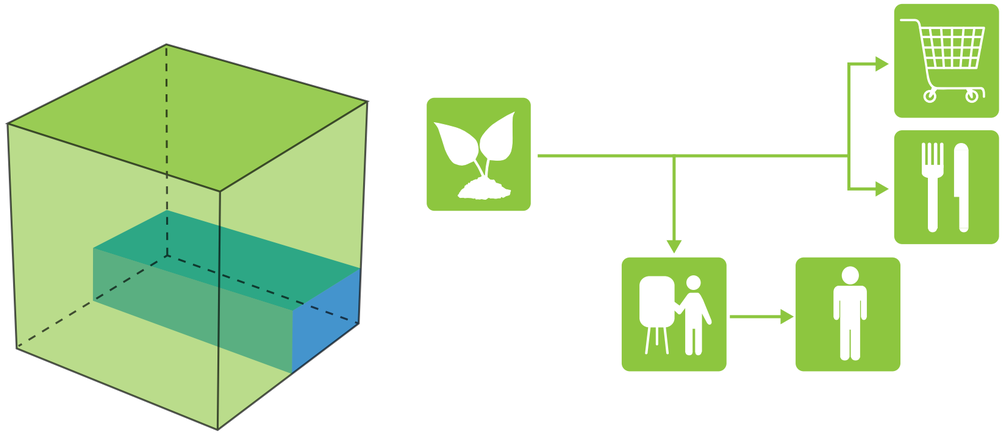


Vertically Integrated Greenhouse | Kiss + Cathcart Architects

Vertical Farm Outdoor Market | TKWA + Growing Power

concept + theory
community
history + context

THE EDUCATION LAB
level of integration: medium



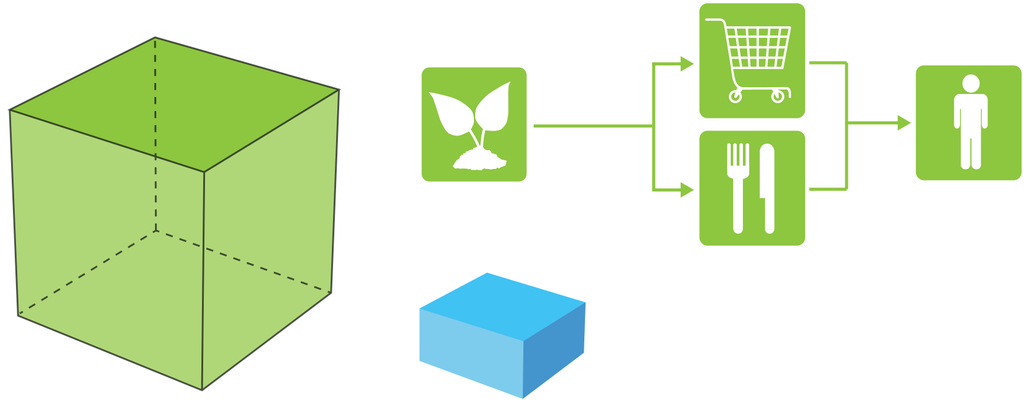
[charleston] VERTICAL FARM

Singularity University | Agropolis

Eco-Laboratory | Weber-Thompson

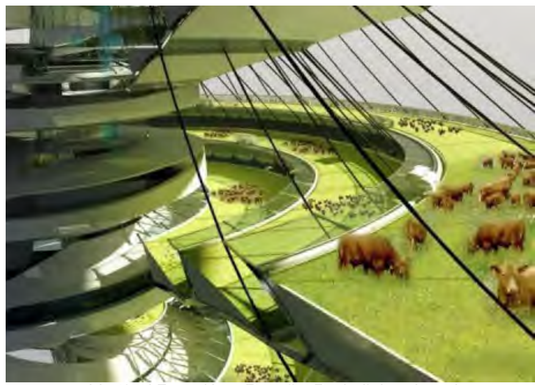
concept + theory
community
history + context

THE EXPORT SYSTEM
level of integration: low



[charleston] VERTICAL FARM

Vertical Farm | Chris Jacobs



Vertical Farm | Lee Dongjin, Park Jinkyu, Lee Jeongwoo

concept + theory

community

history + context

VERTICAL FARMING FOR THE COMMUNITY

[charleston] VERTICAL FARM

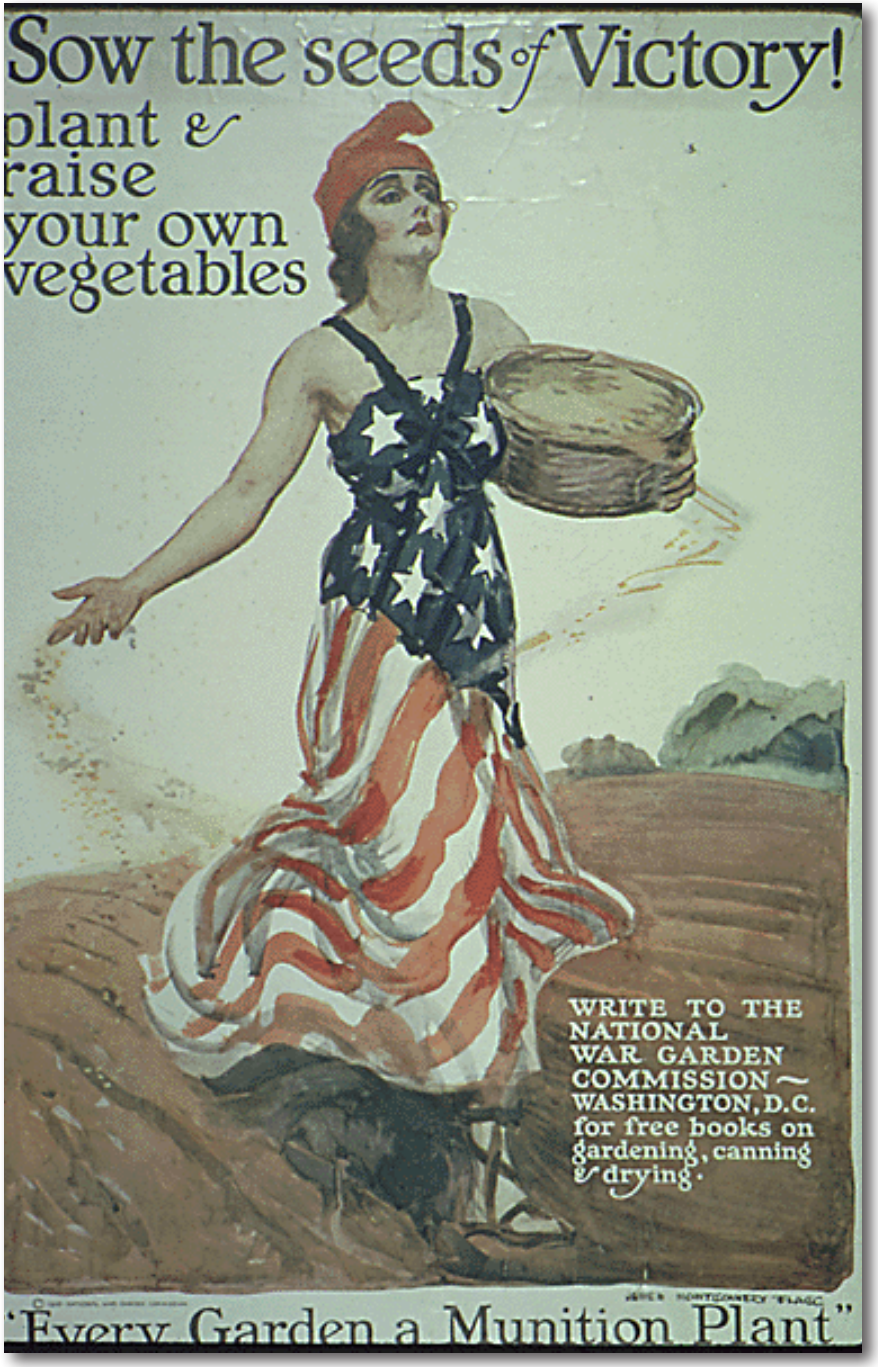
A Farm Grows in Queens | Work Architecture

"Whereas community gardens are more about feeding individuals or families, urban farms feed the larger community."

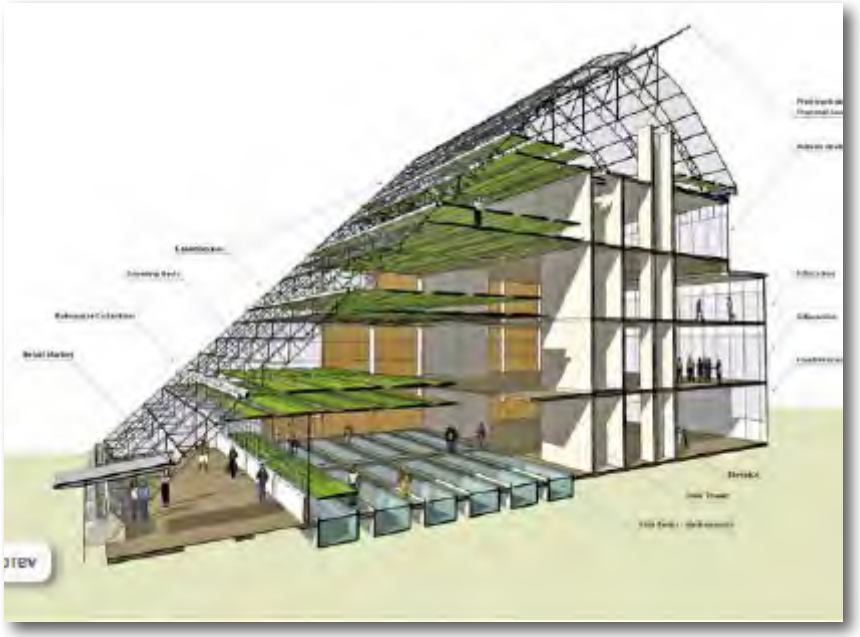
-Madalyn Painter

Broadacres / Usonia

Winning the War One Seed at a Time



Growing Power Inc
small scale efforts



Teachers Teaching small scale efforts

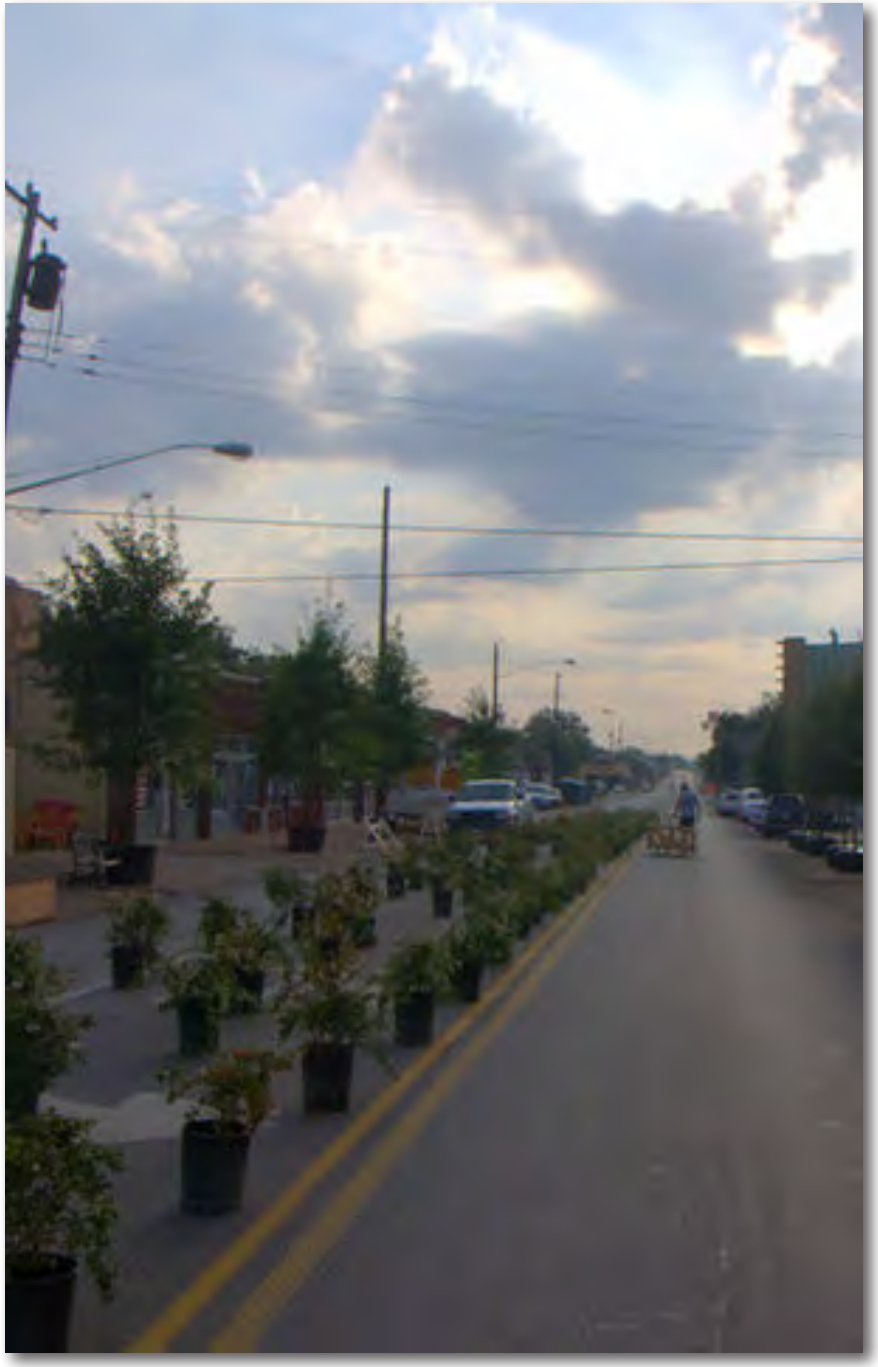
Indoor Farming

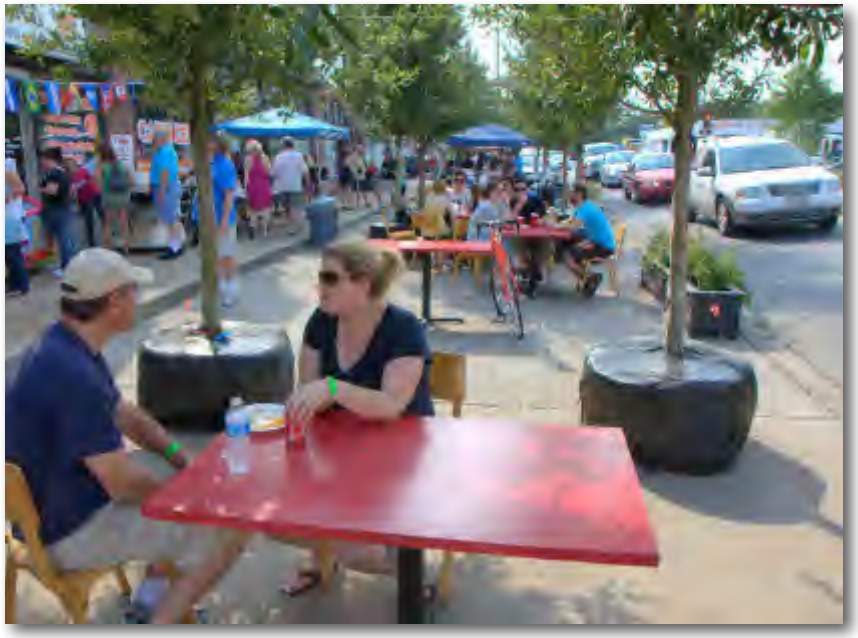
Urban Herding

Tactical Urbanism

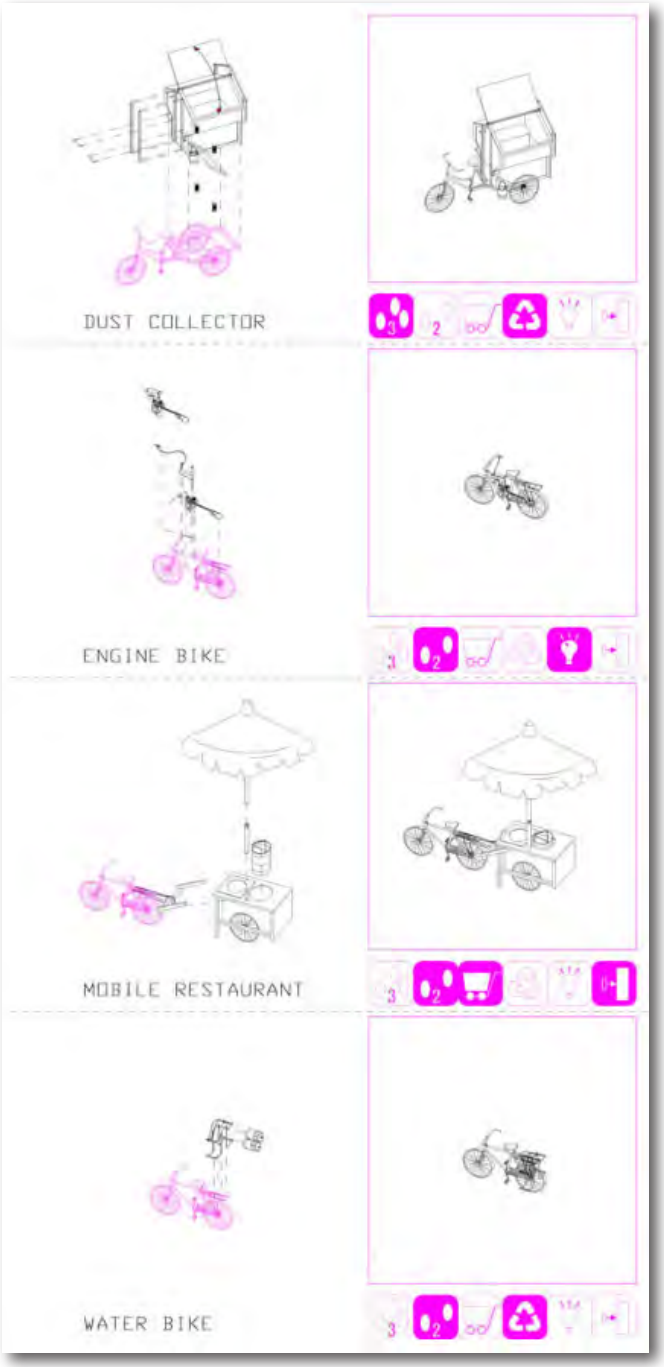
Guerilla Farming

Dallas Side Walk Transformation





Bike-Based Business



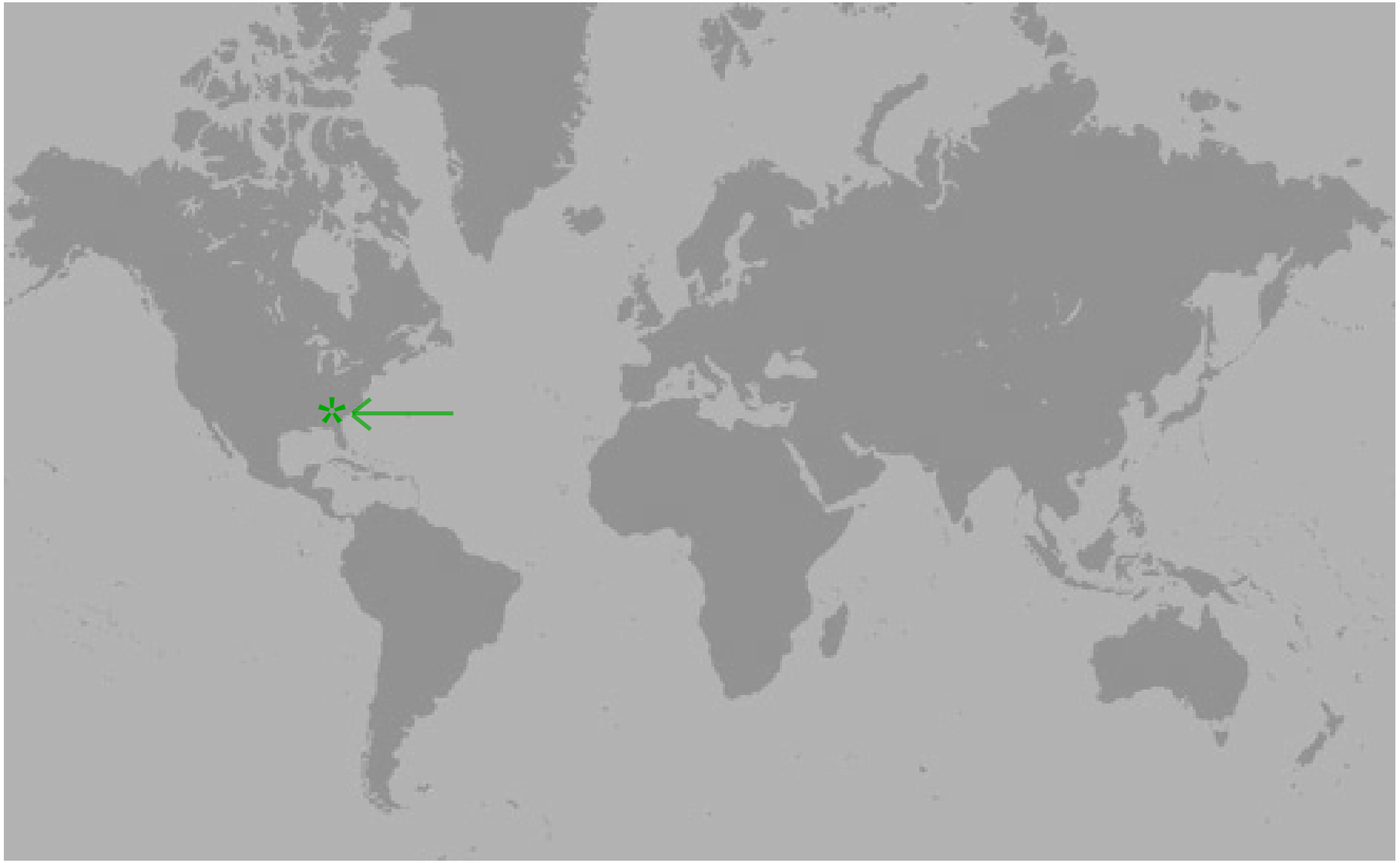
Large-scale Efforts
City Farms


CITY
FARM
02/22/2008

GrowHaus


ILLUSTRATION: BRYAI


Detroit is about to
return to its roots.



“Urban farming is not just about food security. That’s part of it. But it’s also about growing minds and growing communities. Our next generation of farmers is not going to come from rural areas - they are going to come from cities. And we need to nourish that.”

-Will Allen

[charleston] VERTICAL FARM

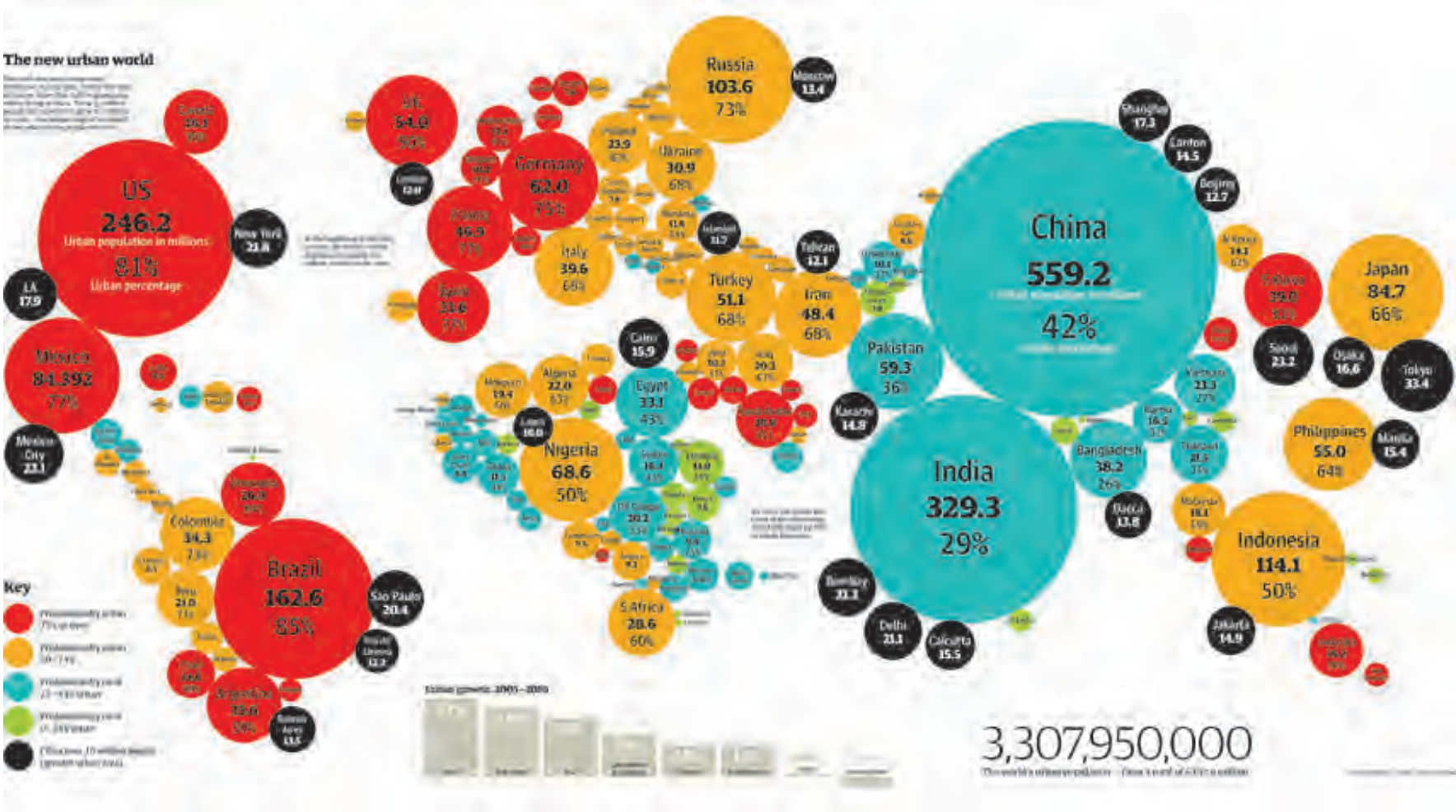
What does vertical farming mean for Charleston?

restored ecosystems

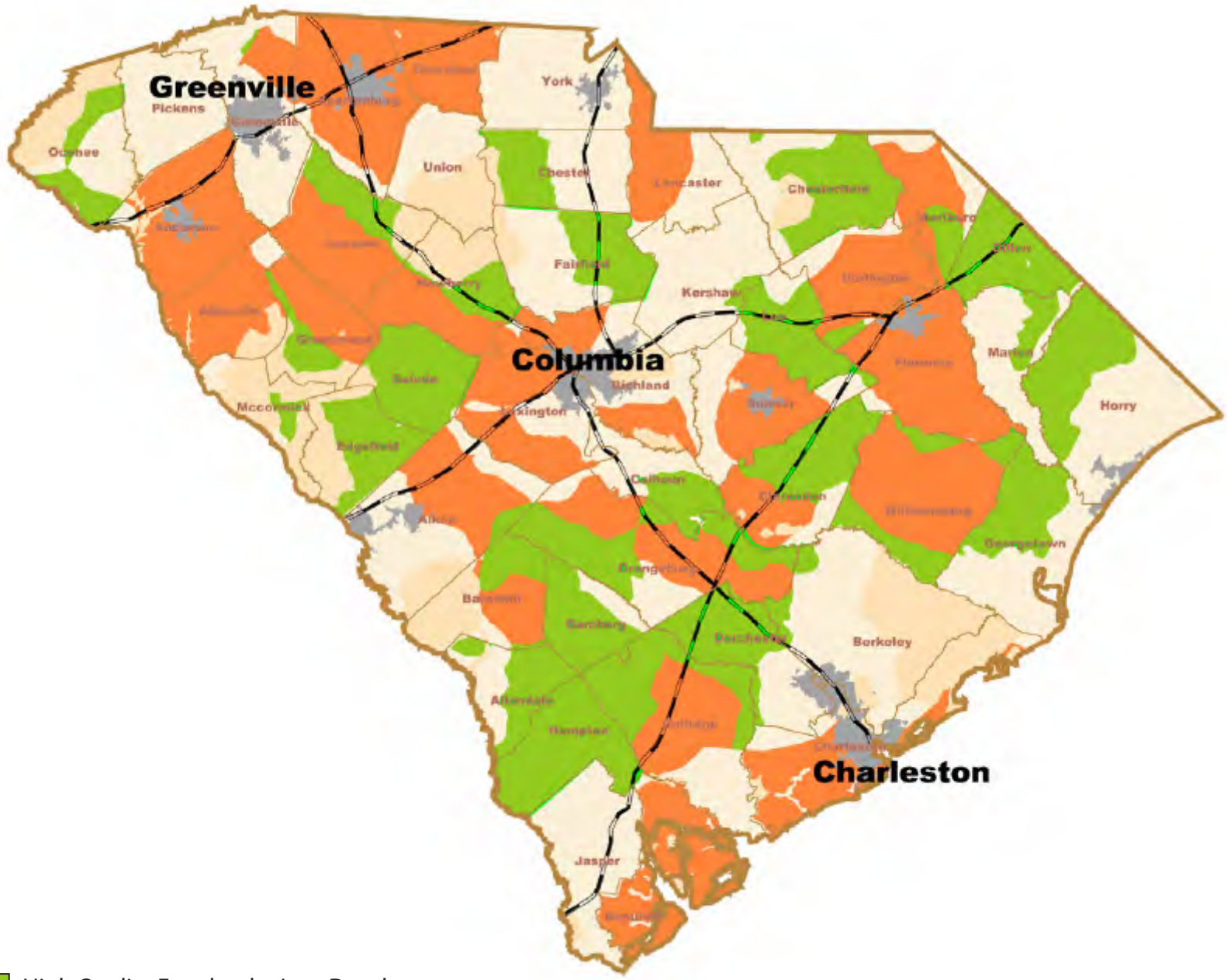
reduced trasnportation

less hunger

[charleston] VERTICAL FARM

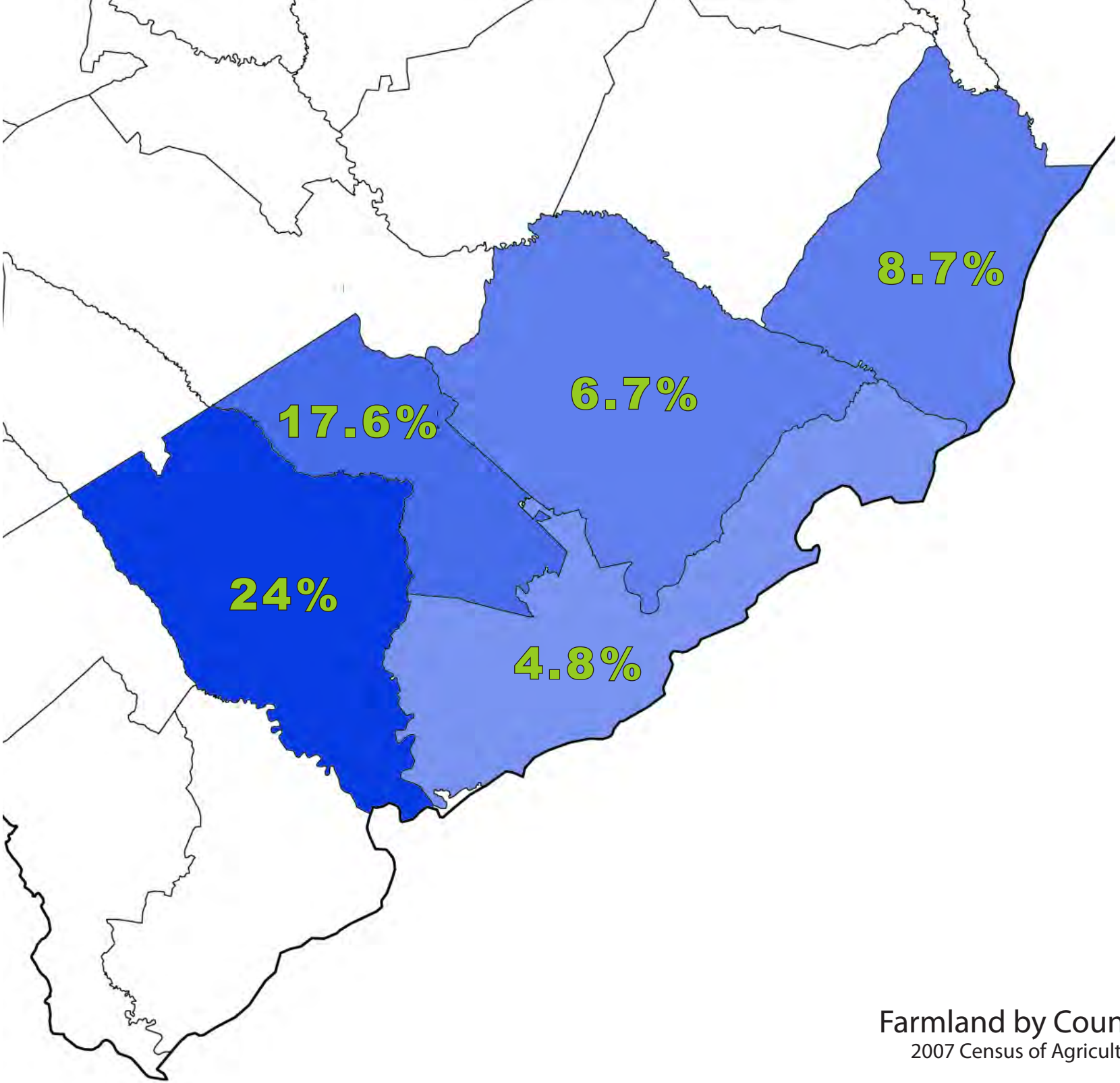


[charleston] VERTICAL FARM



American Farmland Trust

[charleston] VERTICAL FARM



Farmland by County
2007 Census of Agriculture

[charleston] VERTICAL FARM

2000 - 2010
population growth

Charleston
13%

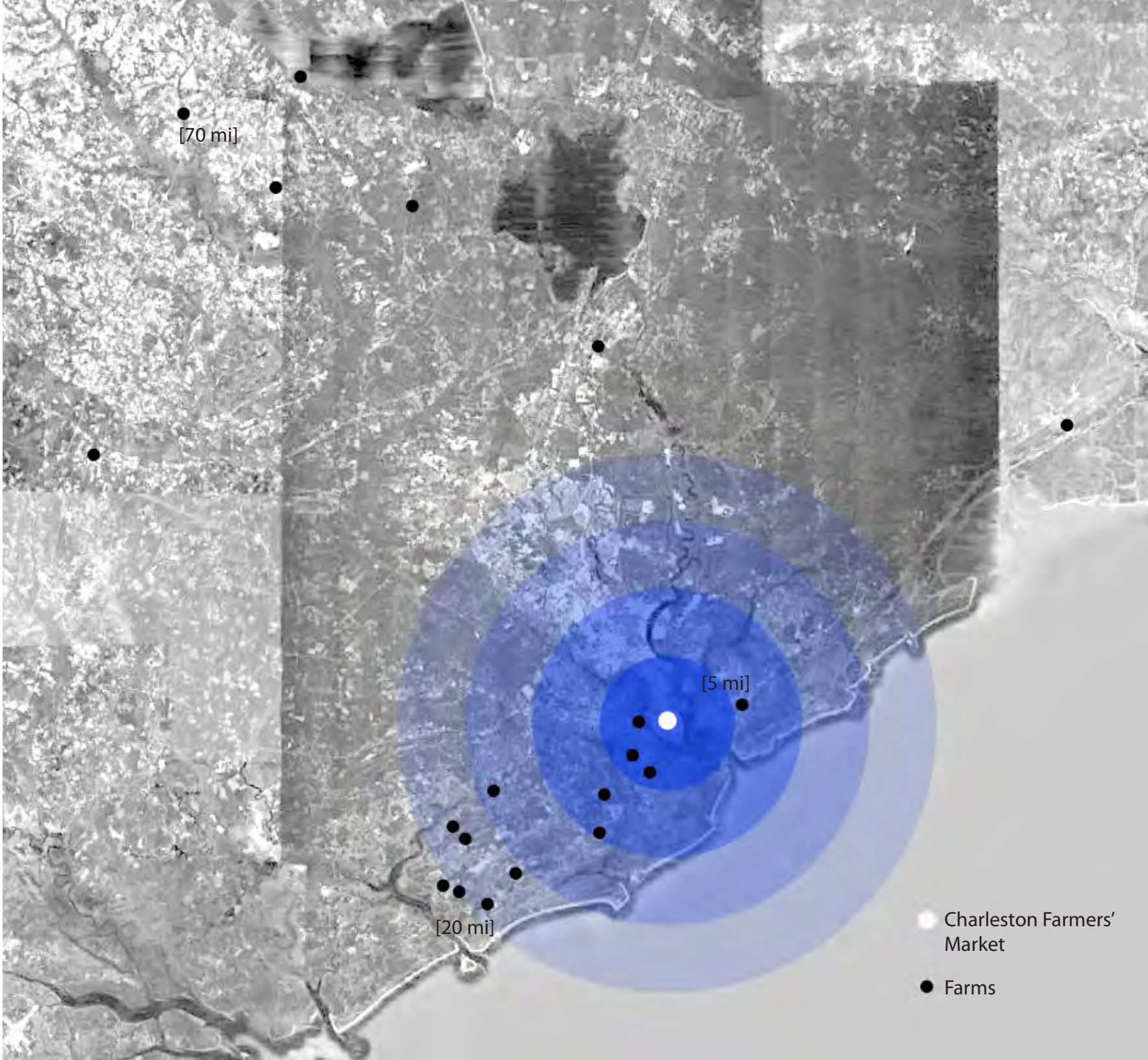
Colleton
1.6%

Dorchester
41.6%

Berkeley
24.7%

Georgetown
7.8%

[charleston]
VERTICAL FARM



[charleston] VERTICAL FARM

TechWorkingRealEstate

[charleston] VERTICAL FARM

FOOD DESERT

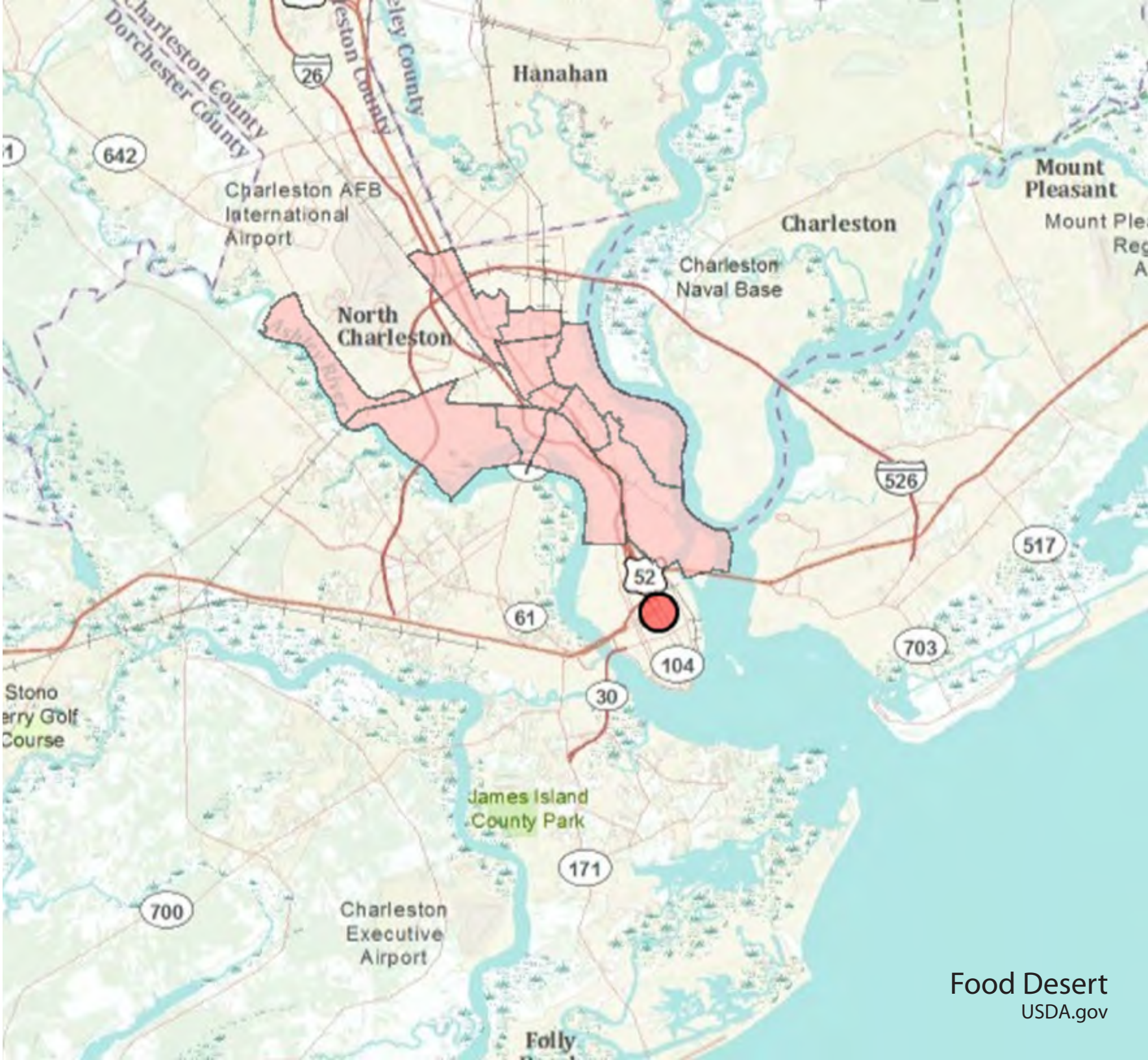
low income - low access

poverty rate over 20%

33% live over 1 mile away from supermarket

WillNesbittRealty

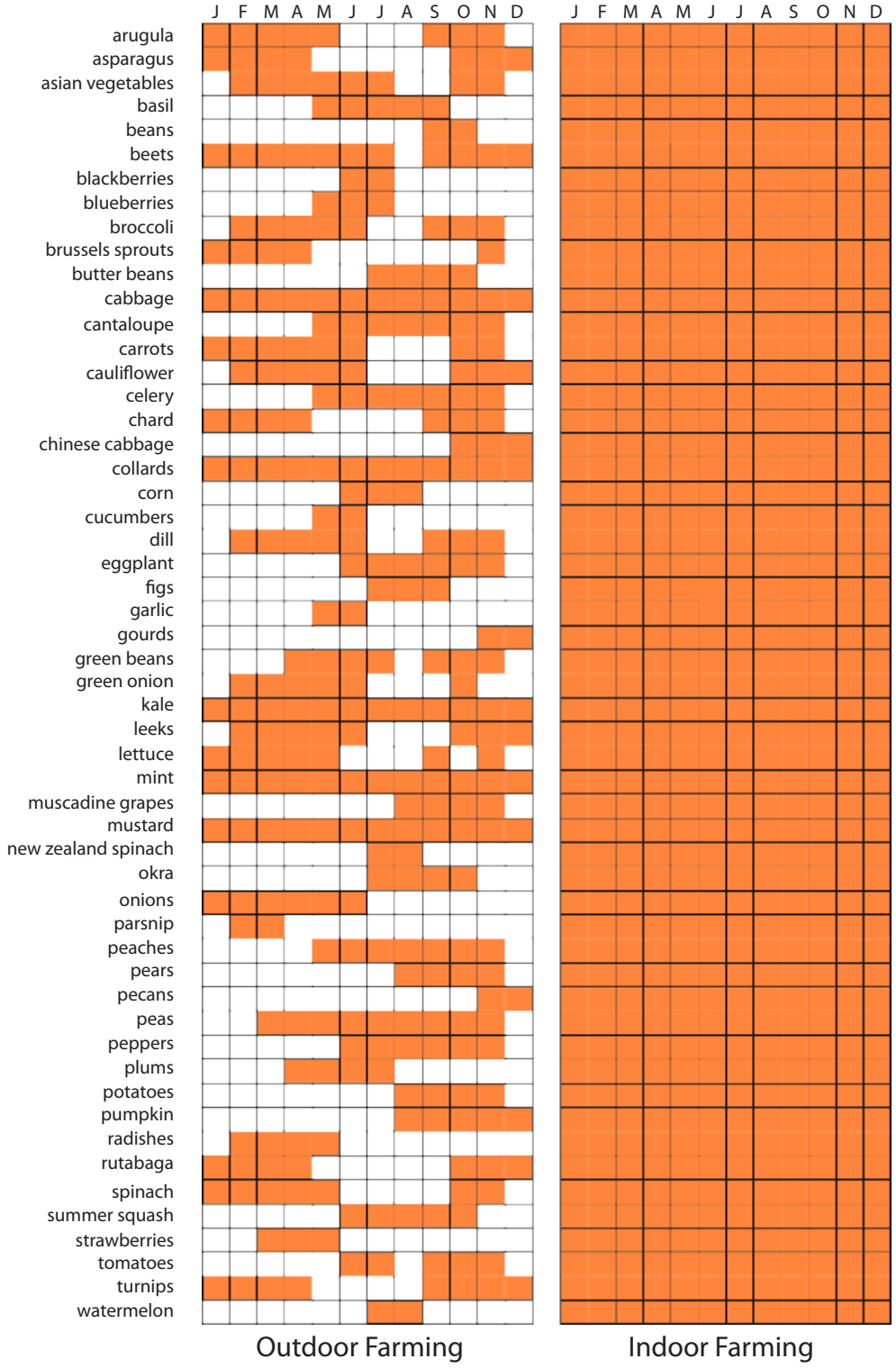
[charleston] VERTICAL FARM



Food Desert
USDA.gov

[charleston] VERTICAL FARM

LOWCOUNTRY PRODUCE AVAILABILITY



[charleston] VERTICAL FARM

SC Department of Agriculture

[charleston] VERTICAL FARM

Clean 15 Lowest in Pesticide

1		Onions
2		Sweet Corn
3		Pineapples
4		Avocado
5		Asparagus
6		Sweet peas
7		Mangoes
8		Eggplant
9		Cantaloupe - domestic
10		Kiwi
11		Cabbage
12		Watermelon
13		Sweet potatoes
14		Grapefruit
15		Mushrooms

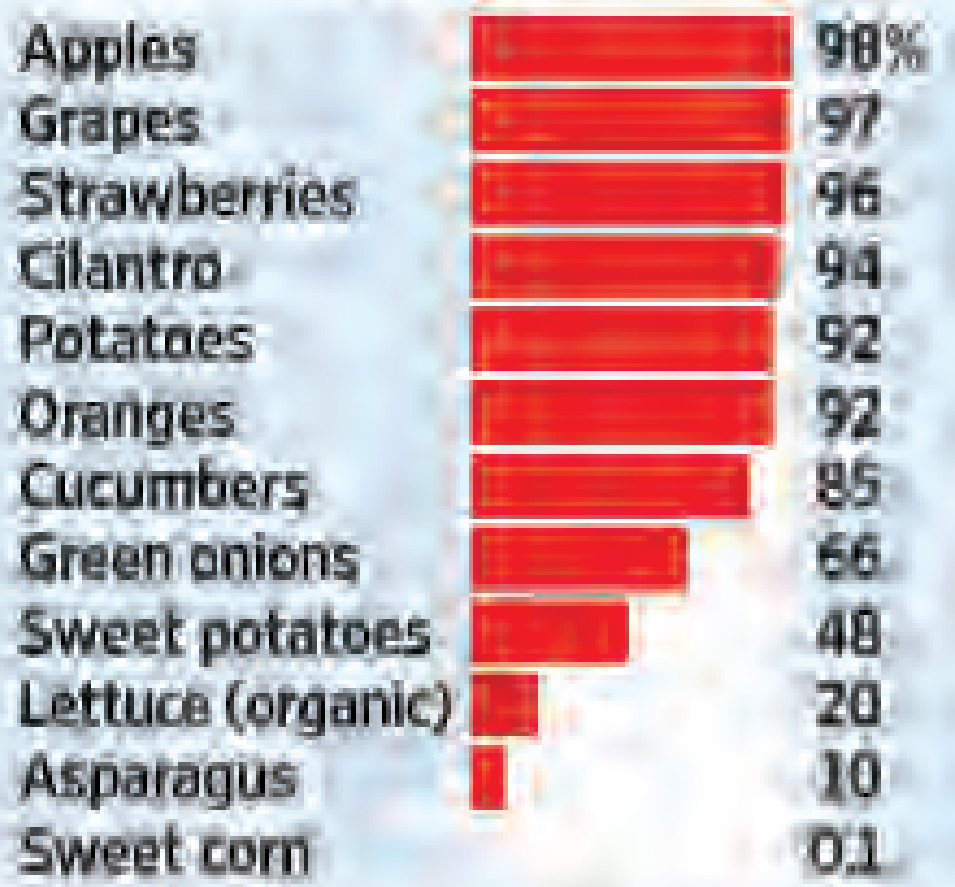
Dirty Dozen Buy these organic

1		Apples
2		Celery
3		Strawberries
4		Peaches
5		Spinach
6		Nectarines – imported
7		Grapes – imported
8		Sweet bell peppers
9		Potatoes
10		Blueberries – domestic
11		Lettuce
12		Kale/collard greens

[charleston] VERTICAL FARM

Pesky Pesticides

A USDA survey found samples of various fresh fruits and vegetables contained pesticide residues at the following rates:*



*After washed in water for 10 seconds
Source: Department of Agriculture, Annual Summary for 2009 (published May 2011)

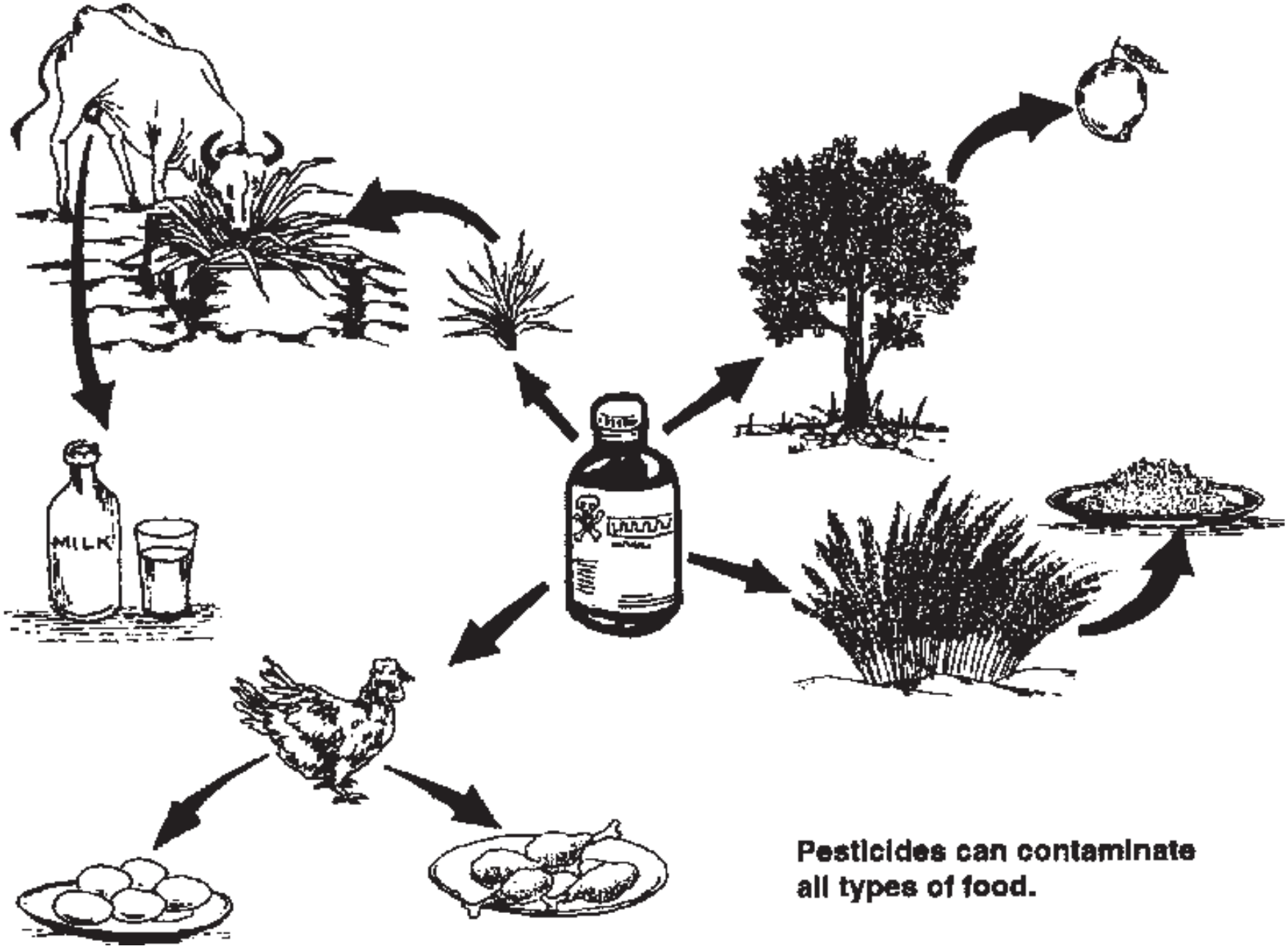
[charleston] VERTICAL FARM

***E. coli* O157:H7**	Hemorrhagic colitis or *E. coli* O157:H7 infection	1-8 days	Severe (often bloody) diarrhea, abdominal pain and vomiting. Usually, little or no fever is present. More common in children 4 years or younger. Can lead to kidney failure	5-10 days	Undercooked beef (especially hamburger), unpasteurized milk and juice, raw fruits and vegetables (e.g. sprouts), and contaminated water
Hepatitis A	Hepatitis	28 days average (15-50 days)	Diarrhea, dark urine, jaundice, and flu-like symptoms, i.e., fever, headache, nausea, and abdominal pain	Variable, 2 weeks-3 months	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler; shellfish from contaminated waters
Listeria monocytogenes	Listeriosis	9-48 hrs for gastro-intestinal symptoms, 2-6 weeks for invasive disease	Fever, muscle aches, and nausea or diarrhea. Pregnant women may have mild flu-like illness, and infection can lead to premature delivery or stillbirth. The elderly or immunocompromised patients may develop bacteremia or meningitis	Variable	Unpasteurized milk, soft cheeses made with unpasteurized milk, ready-to-eat deli meats
Noroviruses	Variously called viral gastroenteritis, winter diarrhea, acute non-bacterial gastroenteritis, food poisoning, and food infection	12-48 hrs	Nausea, vomiting, abdominal cramping, diarrhea, fever, headache. Diarrhea is more prevalent in adults, vomiting more common in children	12-60 hrs	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler; shellfish from contaminated waters
Salmonella	Salmonellosis	6-48 hours	Diarrhea, fever, abdominal cramps, vomiting	4-7 days	Eggs, poultry, meat, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables
Shigella	Shigellosis or Bacillary dysentery	4-7 days	Abdominal cramps, fever, and diarrhea. Stools may contain blood and mucus	24-48 hrs	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler
Staphylococcus aureus	Staphylococcal food poisoning	1-6 hours	Sudden onset of severe nausea and vomiting. Abdominal cramps. Diarrhea and fever may be present	24-48 hours	Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries
Vibrio parahaemolyticus	*V. parahaemolyticus* infection	4-96 hours	Watery (occasionally bloody) diarrhea, abdominal cramps, nausea, vomiting, fever	2-5 days	Undercooked or raw seafood, such as shellfish
Vibrio vulnificus	*V. vulnificus* infection	1-7 days	Vomiting, diarrhea, abdominal pain, bloodborne infection. Fever, bleeding within the skin, ulcers requiring surgical removal. Can be fatal to persons with liver disease or weakened immune systems	2-8 days	Undercooked or raw seafood, such as shellfish (especially oysters)

For more information, contact: The U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition
Food Information Line at 1-888-SAFEFOOD (toll free), 10 AM to 4 PM ET, Monday through Friday.
Or visit the FDA Web site at www.fda.gov.

FDA

[charleston] VERTICAL FARM



Pesticides can contaminate all types of food.

[charleston] VERTICAL FARM

[charleston] VERTICAL FARM

What's in Runoff Pollution?

- Bacteria
- Trash
- Heavy Metals
- Mercury
- Pesticides
- Fertilizers & *Nutrients*
- *Sediment*
- Motor Vehicle Fluids

Bacteria

Source: Raw sewage from failing septic systems, overflowing sewer lines, pet waste, farm animals and wildlife can all be sources of bacteria.

Effect: Stormwater contaminated from these sources can contain bacteria and viruses that may cause illnesses in people following swimming in contaminated lakes, rivers or the ocean. Illnesses may also occur after the consumption of raw or improperly cooked shellfish from these contaminated areas.

http://www.scdhec.gov

[charleston] VERTICAL FARM

Table 3.6. Average Pollutant Loading for Various Land Uses (mg/L)

Land Use	Pollutant Loading (mg/l)											
	BOD	COD	TSS	TDS	TP	DP	TKN	NO2 / NO3	Pb	Cu	Zn	Cd
Forest/ Rural Open	3	27	51	415	0.13	0.03	0.94	0.80	0.000	0.000	0.000	0.000
Urban	3	27	51	415	0.13	0.03	0.94	0.80	0.014	0.000	0.040	0.001
Agricultural/ Pasture	3	53	145	415	0.37	0.09	1.92	4.06	0.000	0.000	0.000	0.000
Low Density Residential	38	124	70	144	0.52	0.27	3.32	1.83	0.057	0.026	0.161	0.004
Medium Density Residential	38	124	70	144	0.52	0.27	3.32	1.83	0.180	0.047	0.176	0.004
High Density Residential	14	79	97	189	0.24	0.08	1.17	2.12	0.041	0.033	0.218	0.003
Commercial	21	80	77	294	0.33	0.17	1.34	1.23	0.049	0.037	0.156	0.003
Industrial	24	85	149	202	0.32	0.11	2.08	1.89	0.072	0.058	0.671	0.005
Highways	24	103	141	294	0.43	0.22	1.82	0.83	0.049	0.037	0.156	0.003
Water/ Wetlands	4	6	6	12	0.08	0.04	0.79	0.59	0.011	0.007	0.003	0.001

Adapted from NURP (1983), Horner et. al (1994), and Cave et. Al. (1994)

BOD = Biochemical Oxygen Demand
COD = Chemical Oxygen Demand
TSS = Total Suspended Solids
TDS = Total Dissolved Solids
TP = Total Phosphorus
DP = Dissolved Phosphorus
TKN = Total Kjeldahl Nitrogen
NO_2/NO_3 = Nitrates / Nitrites
Pb = Lead
Cu = Copper
Zn = Zinc
Cd = Cadmium

http://www.scdhec.gov

[charleston] VERTICAL FARM

GROWFOOD CAROLINA
FROM LAND TO HAND
GROWFOODCAROLINA.COM

CERTIFIED SOUTH CAROLINA SM

bakersarcesranch.com

Farm Fresh Food
LOWCOUNTRY LOCAL FIRST

lowcountrylocalfirst.org

LIMEHOUSE PRODUCE CO.

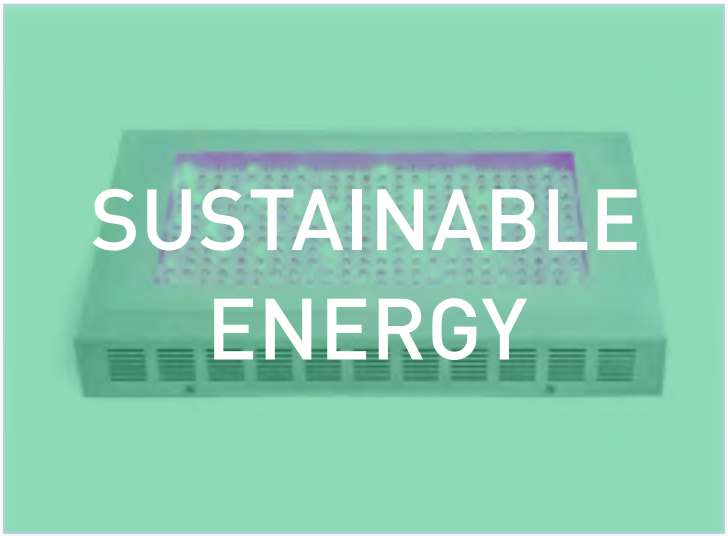
LimeHouseproduce.com

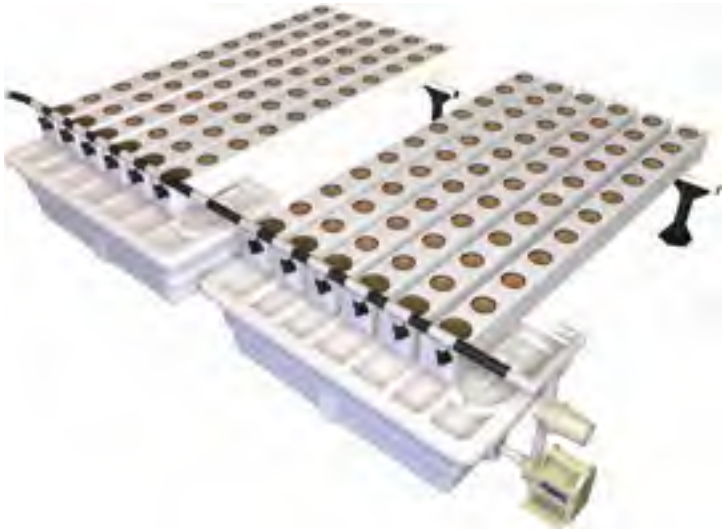

VERTICALFARMING
TECHNOLOGY
ARCHITECTURE
+ DESIGN
PRECEDENTS


GREEN WALLS


HYDROPONICS


ENVIRONMENTAL
CONTROLLERS


SUSTAINABLE
ENERGY



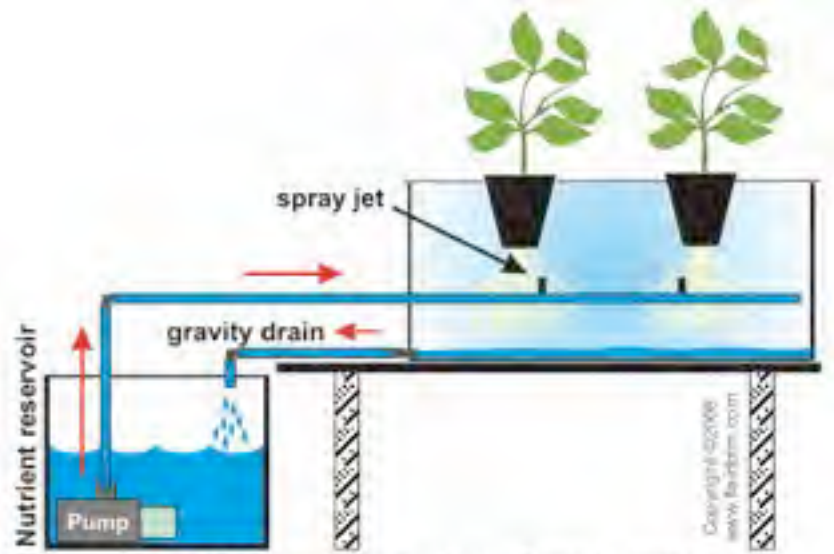
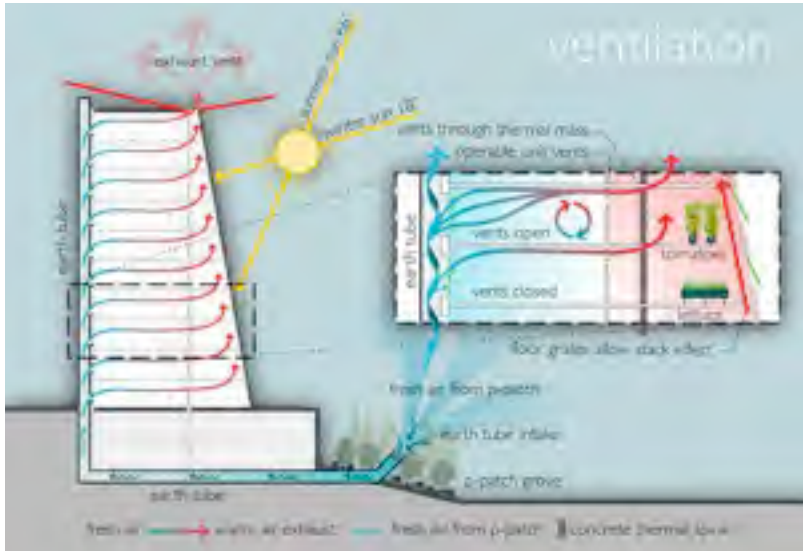
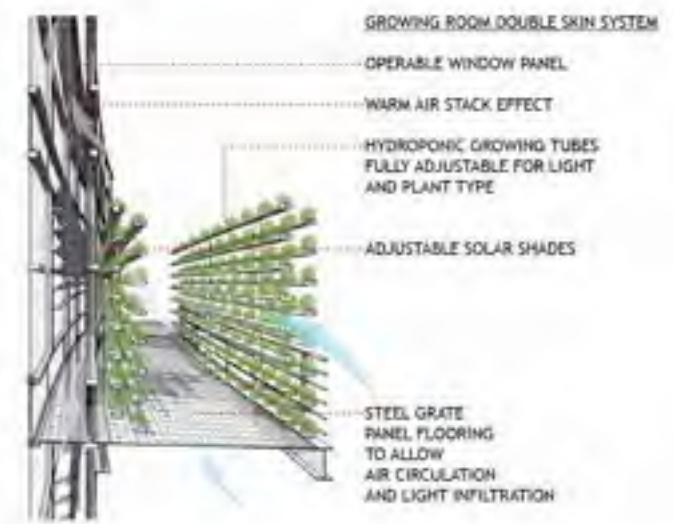
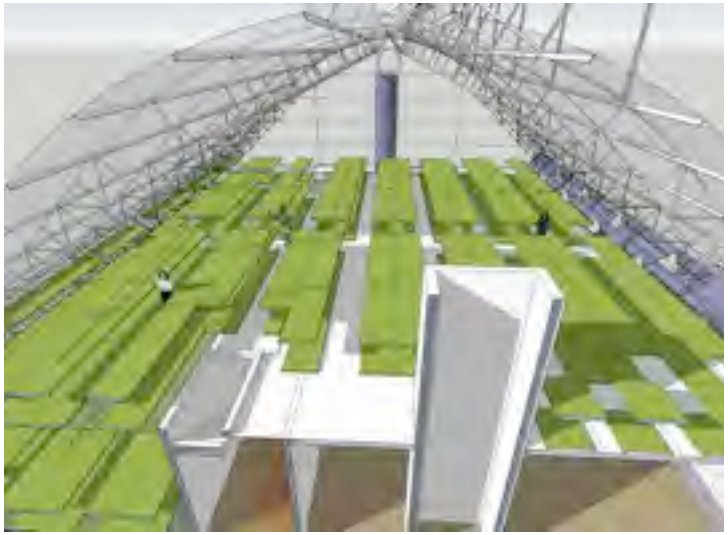


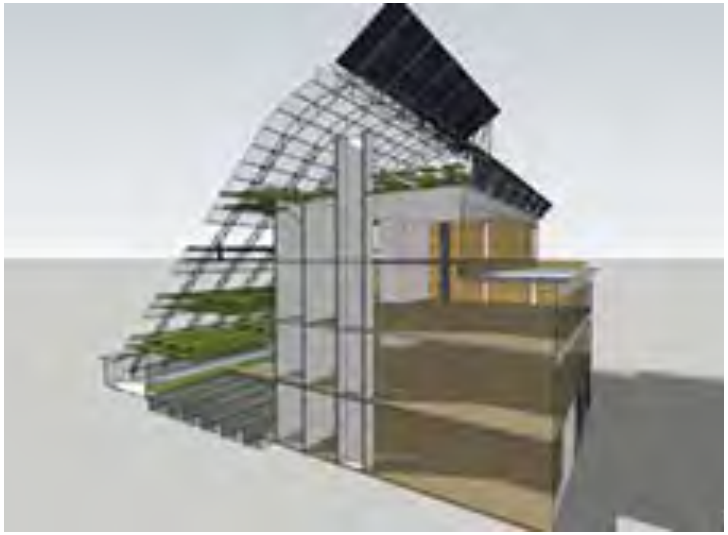
Fig 5.4 **Aeroponic system** (Basic layout)

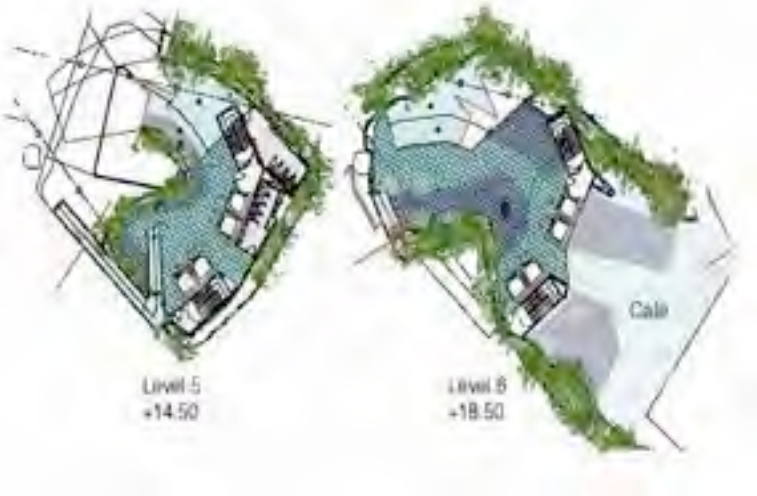

ventilation
earth tube
vents open
vents closed
earth tube

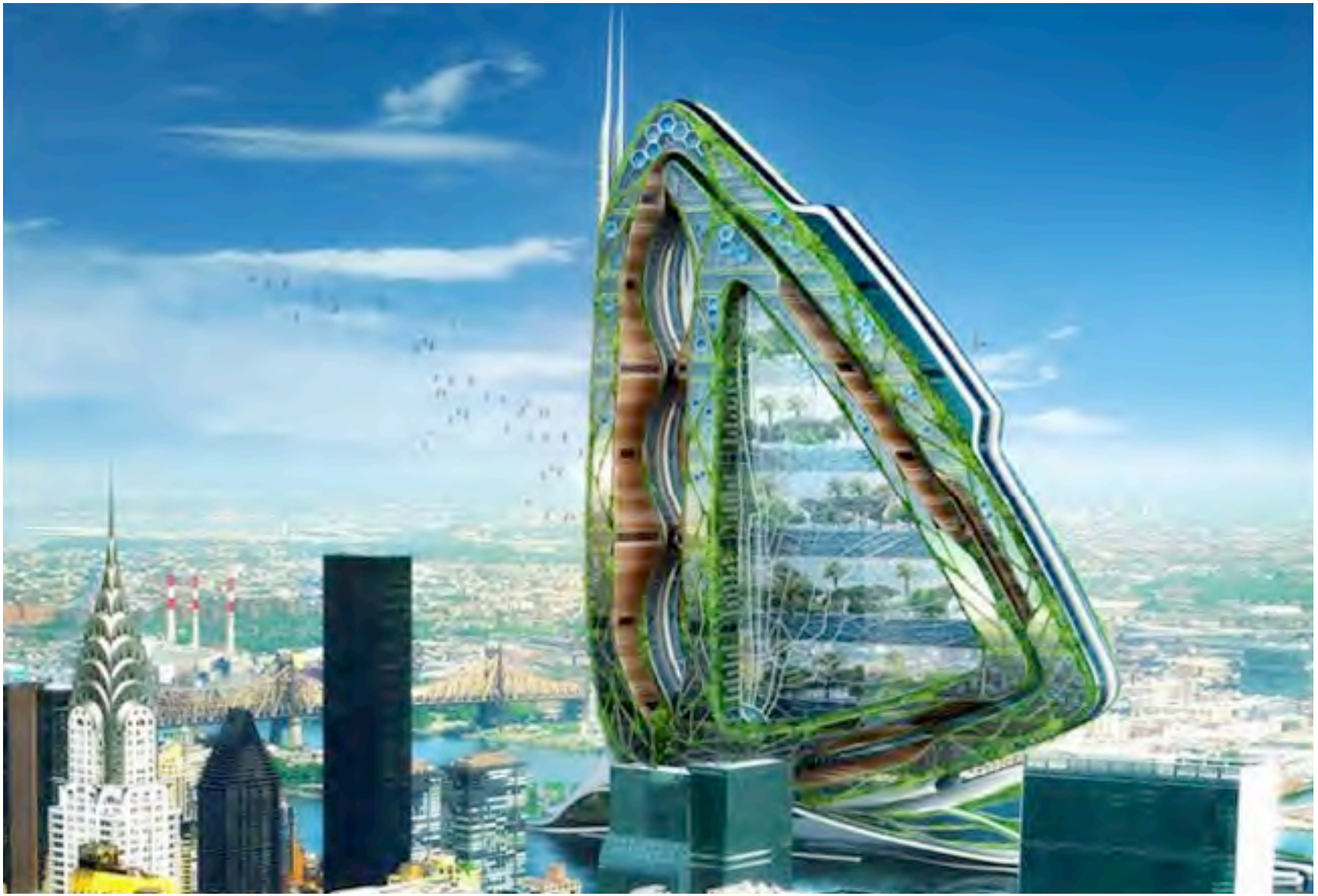

GROWING ROOM DOUBLE SKIN SYSTEM
OPERABLE WINDOW PANEL
WARM AIR STACK EFFECT
HYDROPONIC GROWING TUBES
FULLY ADJUSTABLE FOR LIGHT
AND PLANT TYPE
ADJUSTABLE SOLAR SHADES
STEEL GRATE
PANEL FLOORING
TO ALLOW
AIR CIRCULATION
AND LIGHT INFILTRATION

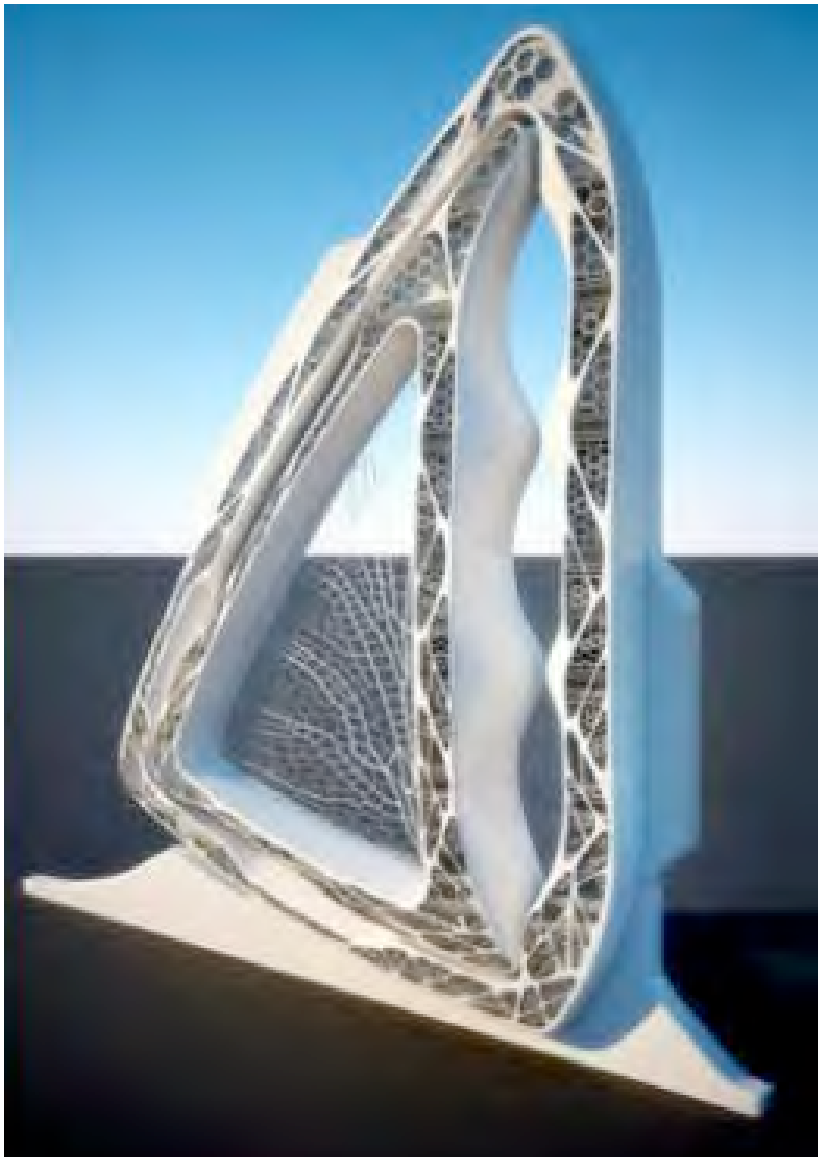

VAWA
Vertical Agriculture With Architecture
2arc-u-245

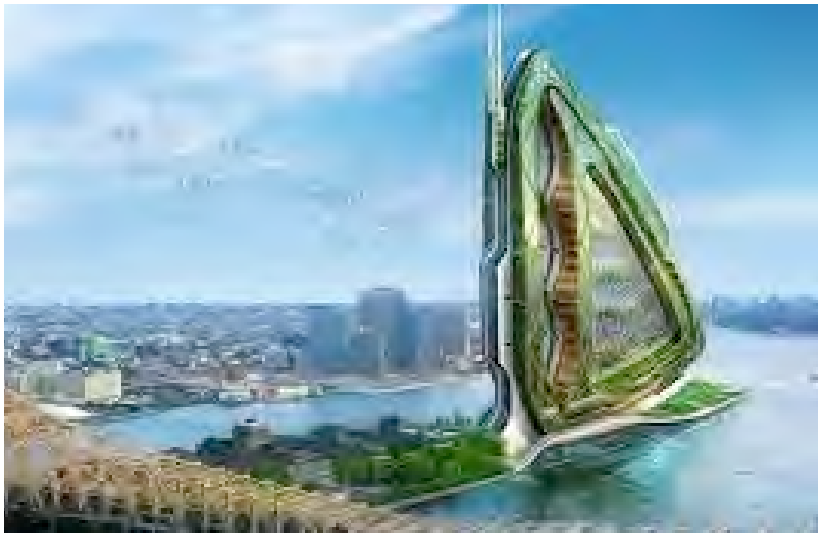


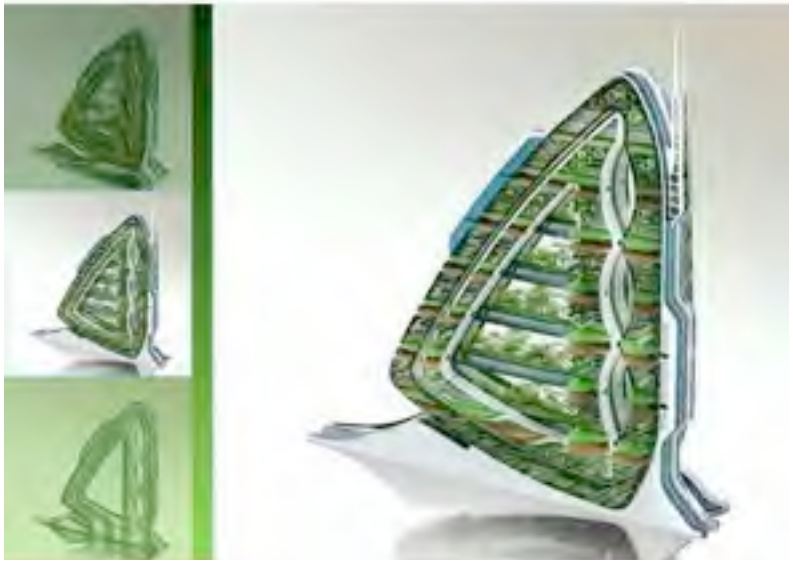


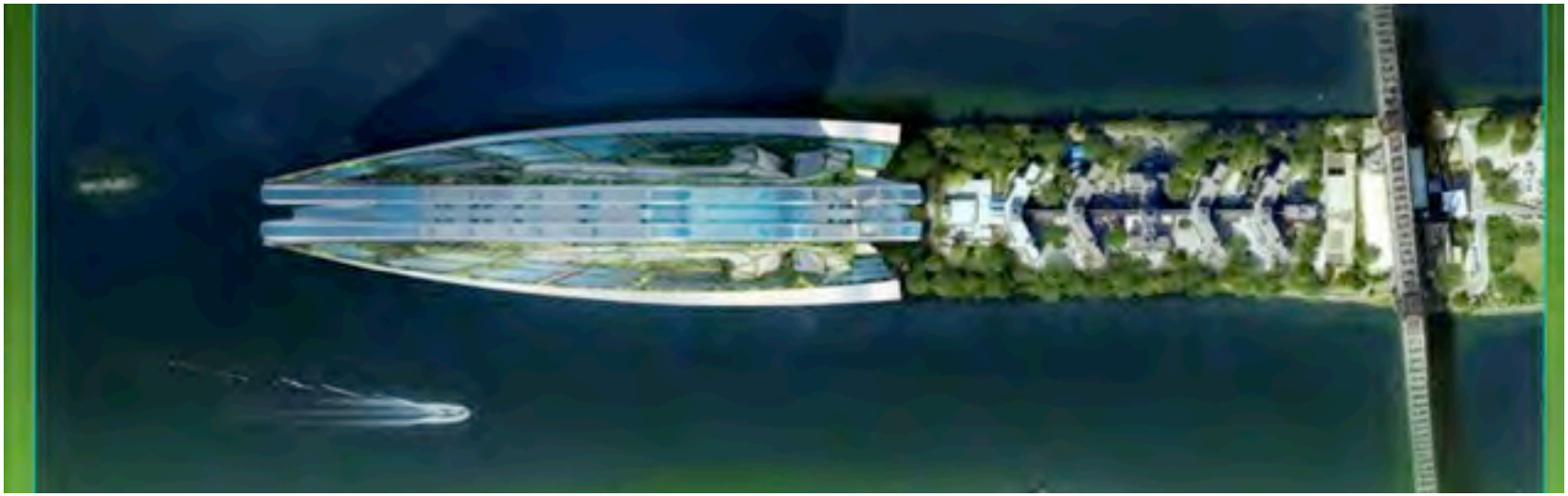

Cafe
Level 5
+14.50
Level 6
+18.50












DRAGONFLY
A NOURISHING TOWER LIKE A VERTICALY CULTIVATED CENTRAL PARK
Dragonfly suggests therefore building a prototype of urban farm offering around a mixed programme and farming spaces which are vertically laid out in several floors and partly cultivated by its own inhabitants.

1. Title Graphic: Green Wall at the Solar Planetarium in Nagoya, Japan.

2. Design Technologies: 2a. green wall panels, 2b. hydroponic pods, 2c. environmental controller, 2d. LED grow light. http://ledgrowlightsreviews.net/.

3. Green walls: 3a. Green Wall design | Greenworks. 3b. The Symbiotic Green Wall | Kooho Jung + Hayeon Kelly Choi. 3c. Green Wall design | Deesawat. 3d. Green Wall in Chicago

4. Hydroponics: 4a. Rendering of Hydroponic System | Becoville + meldynique Group. 4b. AeroFlo 60 Hydroponic System | AeroFlo. 4c. Diagram of Aeroponics System | AeroponicSystems

5. Environmental Controllers: 5a. Seawater vertical farm | Studiomobile. 5b. Diagram-ventilation | Chris Jacobs. 5c. Circular Symbiosis Tower | 2011 eVolo Skyscraper Competition Winner

6. Sustainable Energy: 6a. Methane digester for vertical farm design by Chris Jacobs. 6b. Underground organic farm training facility in Japan. 6c. Newark Urban Farm | Weber Thompson

7. Dickson Despommier + Chris Jacobs. 7a, c. http://www.farmvertical.com/. 7b. Dickson Despommier. http://www.examiner.com/green-living-in-national/vertical-farming-solution-to-climate-change-damage

8. La Tour Vivante | SOA. http://www.ateliersoa.fr/verticalfarm_en/urban_farm.htm

9. The Living Skyscraper: Farming the Urban Skyline | Blake Kurasek. http://blakekurasek.com/thelivingskyscraper.html

10. LOFT London 2011 Competition Winner | VAWA. http://www.awrcompetitions.com/competition/2/loft-london-farm-tower

11. Plantagon | Plantagon. http://plantagon.com/international/

12. Eco-Laboratory | Weber Thompson. http://www.weberthompson.com/eco-laboratory.html

13. The Inka Sun Curve | Inka Biospheric Systems. http://www.inkabio.com/ag_suncurve.html

14. Vertical Farm | The Kubala Washatko Architects + Growing Power. http://www.growingpower.org/verticalfarm.html

15. EDITT Tower | TR Hamzah + Yeang. http://inhabitat.com/editt-tower-by-trhamzah-and-yeang/

16- 17. The Dragonfly | Vincent Callebaut Architectures. (All) http://vincent.callebaut.org/planche-dragonfly_pl07.html and http://www.gapuak.net/dragonfly-building-concept-by-vincent-callebaut/

Progress times: Wordpress

http://buildingsustainablelifestyles.wordpress.com

What is Sustainability Community Infrastructure and asset based design as it pertains to vertical farming?

"Farming harnesses the efficiency of collectivity and community. Whether cultivating land, harvesting resources, extracting energy or delegating labor, farming reveals the interdependencies of a globalized world. Simultaneously, farming represents the local gesture, the productive landscape, and the alternative economy. The processes of farming are mutable, parametric, and efficient."

- Bracket [On Farming]

IMAGE: flickr.com – Iowa CCI

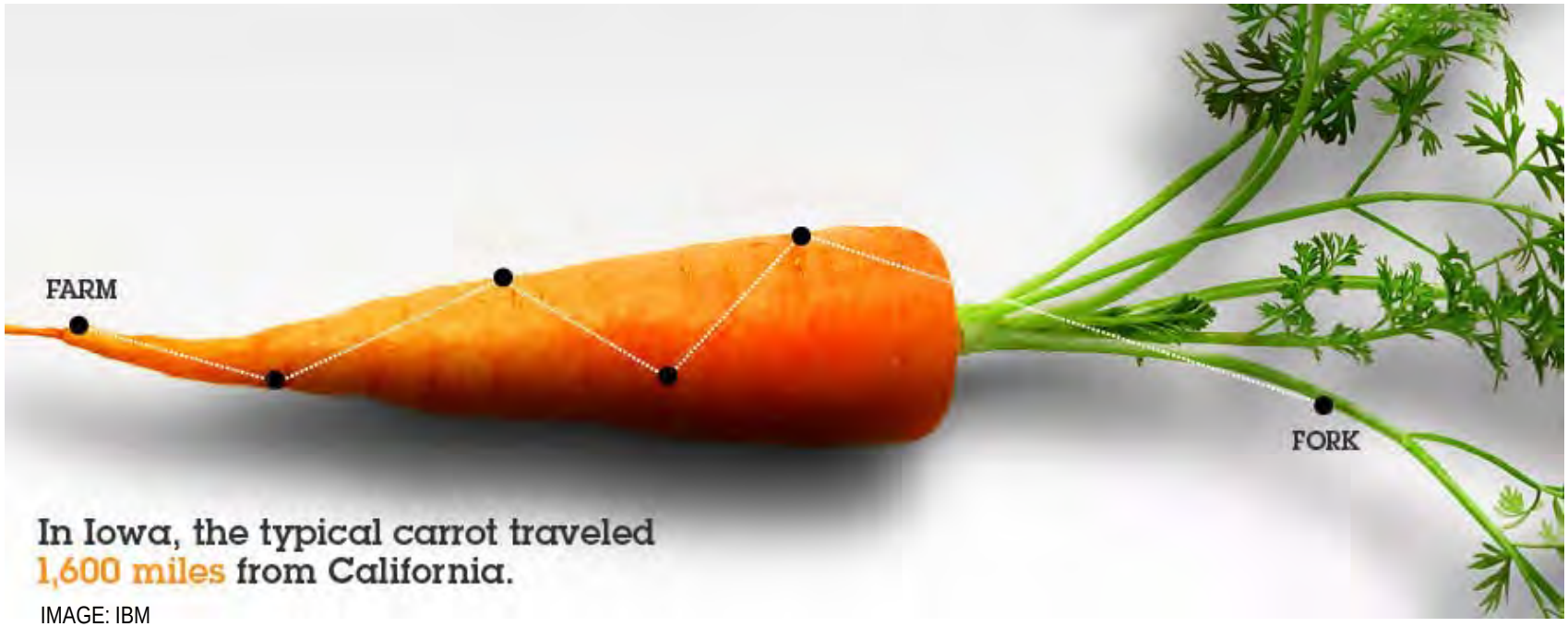
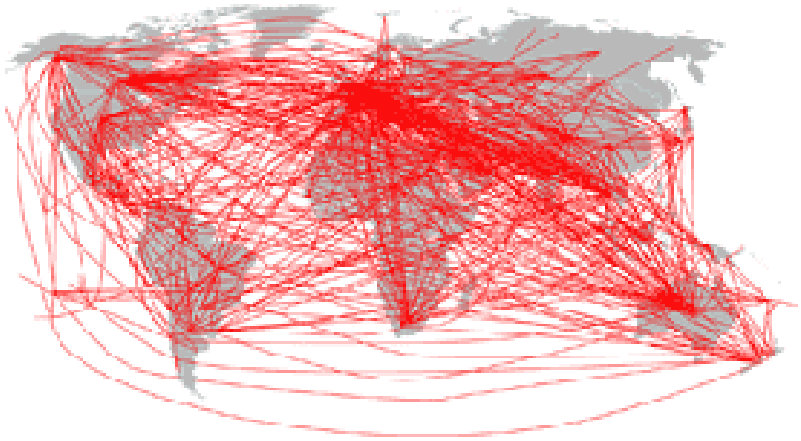


IMAGE: IBM



Global Food Transportation
IMAGE: ArkinetBlog

Consumers spend 6 -12% of food purchases to cover transportation costs.

Producers' Classified List

THE FARM TO TABLE PLAN

Postmaster General Burleson has designated this office as an intermediary between the producer and the consumer, by which means it is hoped to reduce the cost of living and, at the same time, provide the producer with a ready cash market. The entire plan is being worked out and conducted in the interest of the public welfare. In order that efforts in this direction may meet with the highest degree of success, the cordial co-operation of both producer and consumer will be necessary. In this connection, a careful reading should be given this pamphlet and instructions complied with in every particular.

This office cannot furnish names of those having for sale containers to be used in shipping eggs and produce, but if it is suggested that those having such containers for sale, communicate with the producers whose names appear on this list.

Inquiry Blank That May Be Used By Consumer

[SUGGESTION]

FROM FARM TO TABLE

VIA UNITED STATES PARCEL POST

TO.....

POST OFFICE.....

STATE.....

Please send me information and lowest cash prices of the following:

.....dozen eggs .....pounds lard

.....pounds butter .....honey

Farm products, poultry and other articles as follows:

.....

.....

Please let me know how much you can send me daily or weekly, properly packed in accordance with the Postal Laws and Regulations, via United States Parcel Post.

NAME.....

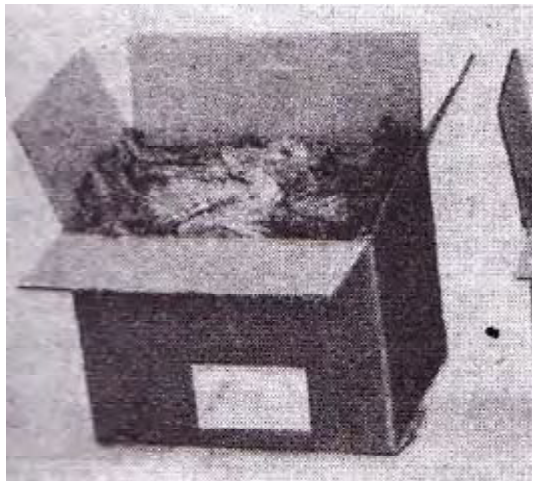
STREET and No.....

POST OFFICE.....

STATE.....

Press of United States Post Office, Saint Louis, Missouri

IMAGE: Bracket [On Farming]



Packing requirements
for lettuce
IMAGE: Bracket [On Farming]

IMAGE: transportation.org

IMAGE: Iowa DOT

IMAGE: Wikipedia, Farm-to-Market Road

Tracking your food…

www.openideo.com/open/localfood/concepting/socialvore

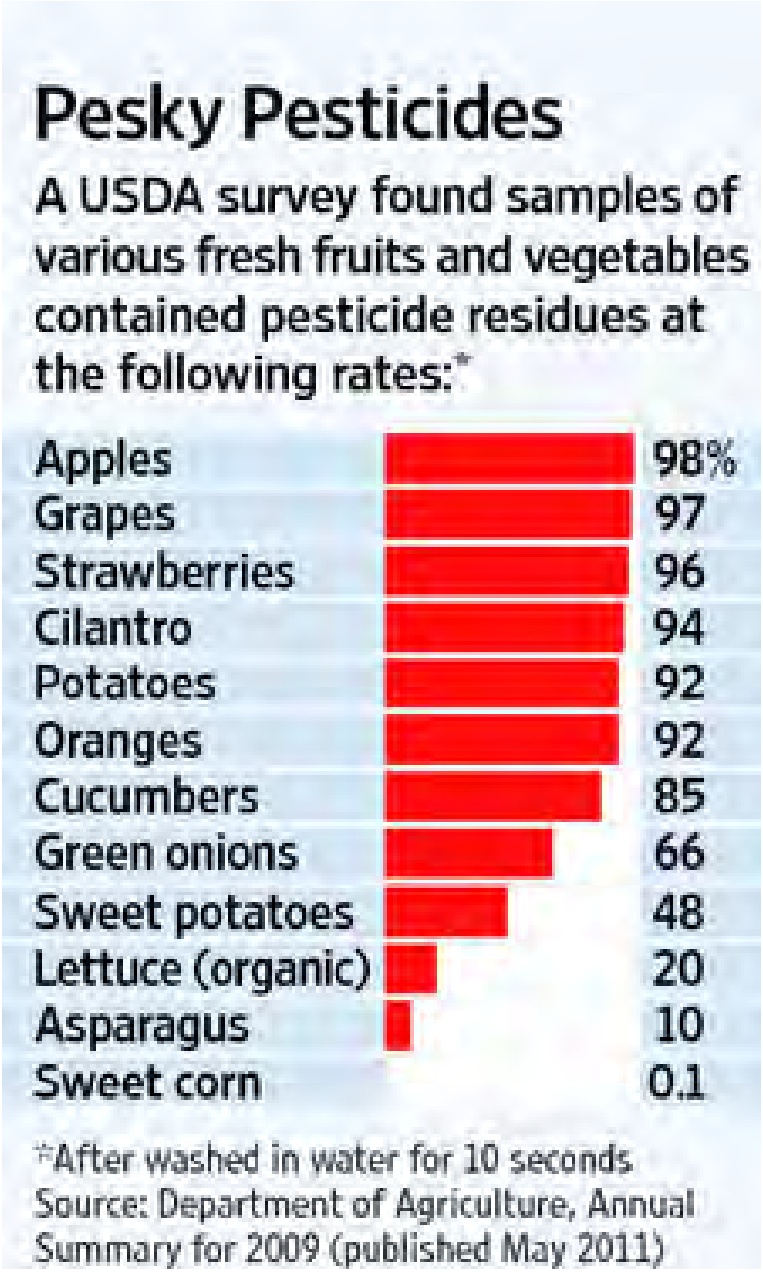
Where your food has been?

www.openideo.com/open/localfood/concepting/socialvore/

Organ-agriculture.org

Reason.com

Pesticide contamination in produce…



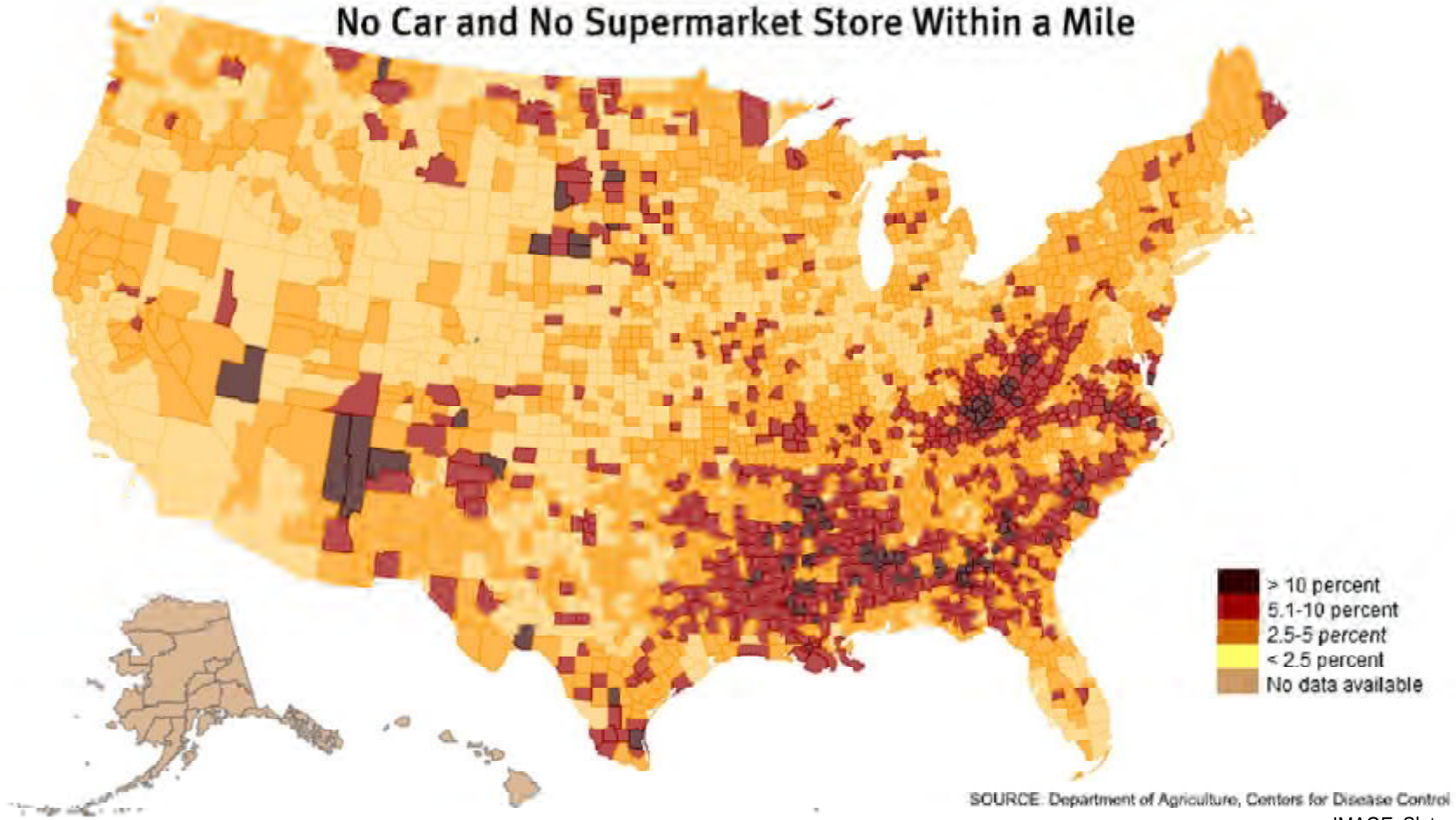
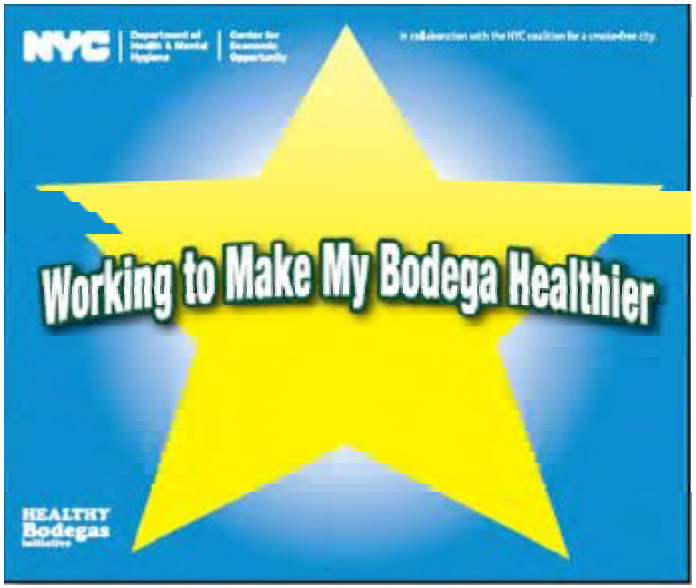

No Car and No Supermarket Store Within a Mile
> 10 percent
5.1-10 percent
2.5-5 percent
< 2.5 percent
No data available
SOURCE: Department of Agriculture, Centers for Disease Control

IMAGE: Slate

Green Carts
IMAGE: Queens Crap



Healthy Bodegas
IMAGE: nyc.gov

Health Bucks
IMAGE: nyc.gov

FRESH: Food Retail Expansion to Support Health
IMAGE: nycedc.com

IMAGE: lowfuel.org

IMAGE: Detroit Food Justice

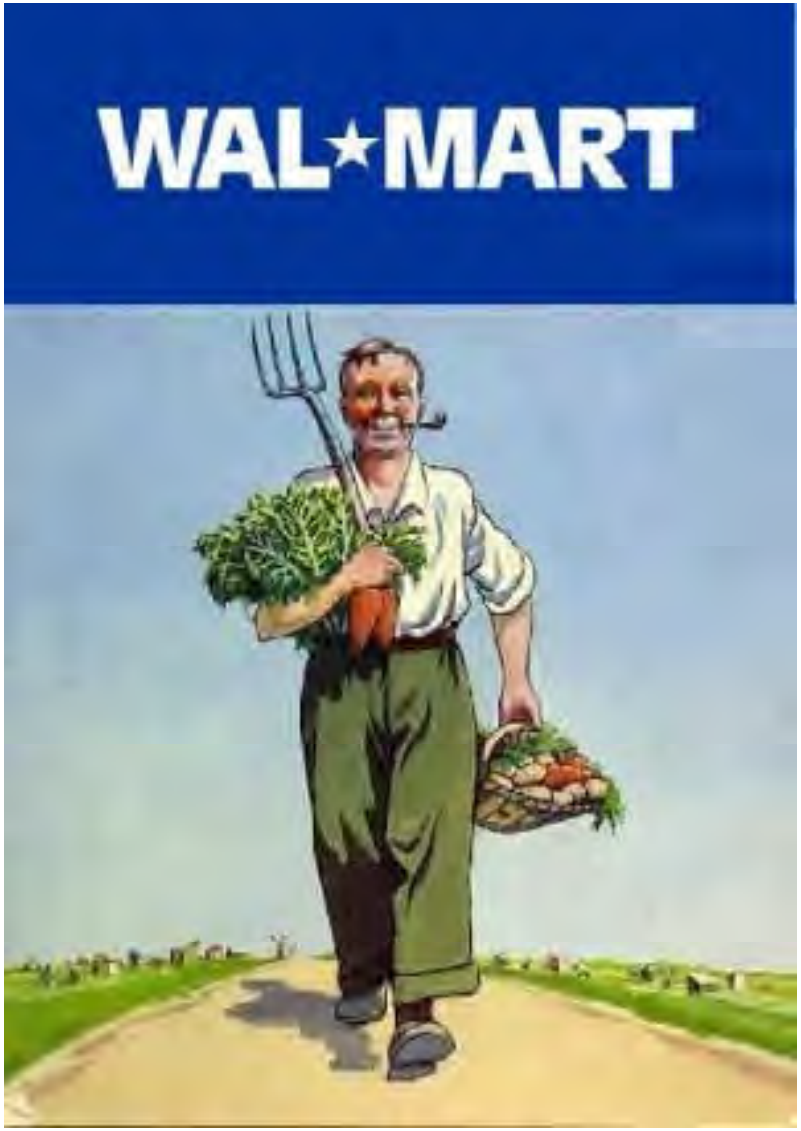
Nashville Farmers' Market

Greenville, SC - Farmers' Market

IMAGE: flickr.com, kelihoskins

IMAGE: scnow.com

Initiatives:



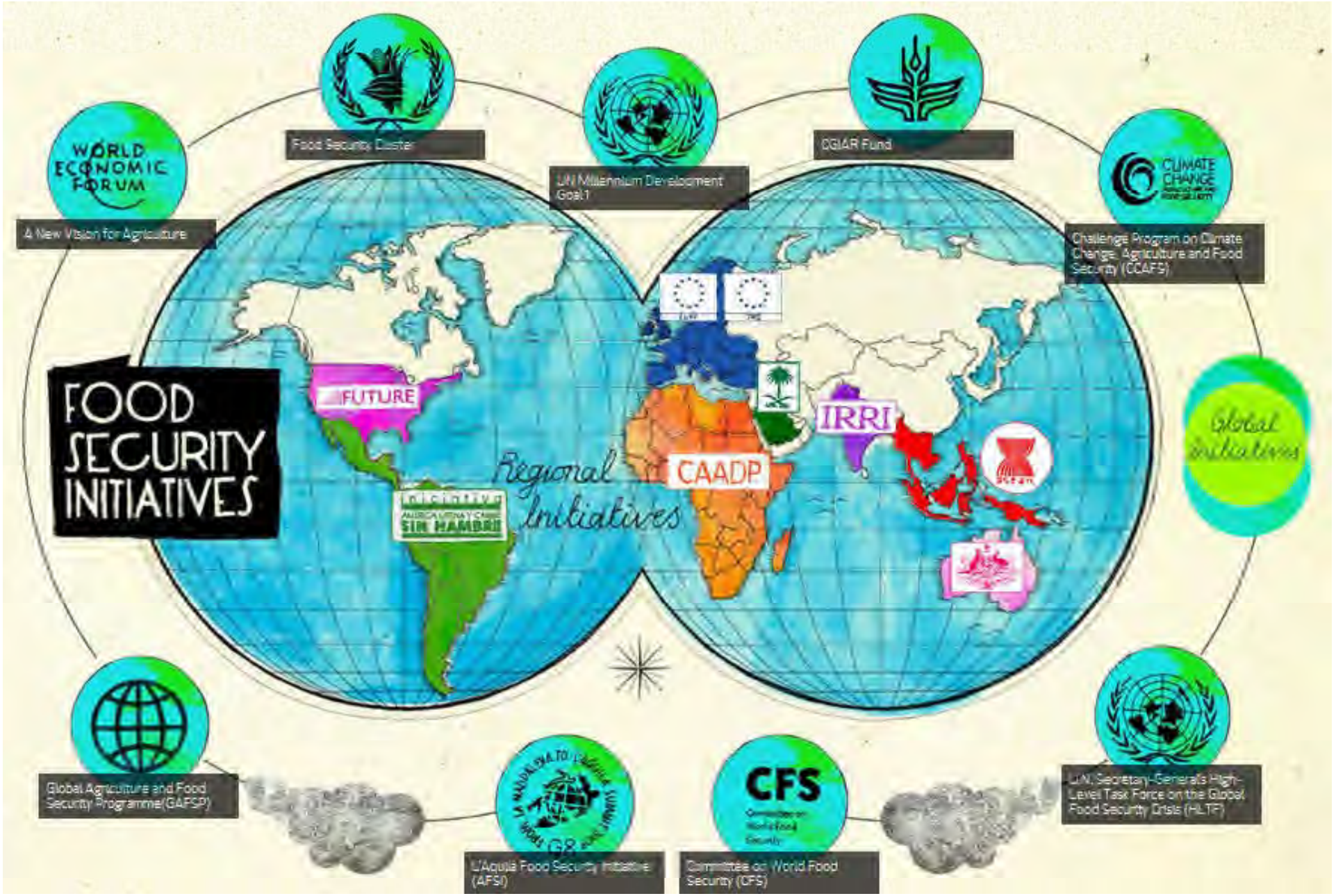
http://notionscapital.wordpress.com/category/agriculture/

www.openideo.com/open/localfood/applause/?page=29

Schematt.com

TABLE 2. EVALUATIVE CRITERIA OF THE QUALITY-OF-LIFE MEASURES.

VALUE	CRITERIA
Independent Family Farms…..	Productive
	Locally-owned
	Staying on the land
Vitality of Rural Communities...	Stable employment opportunities
	Thriving main-street businesses
	Sustained/expanding social capital
	Diverse land-use
	Retention of young people in the community
Entrepreneurship……..	Locally-owned enterprises
	Value-added enterprises
Leadership……..	Farmers to train other farmers
	Adults to train youth
Collaboration……....	Between farmers and technical advisors
	Between farmers and consumers
	Among rural residents
	Between/among rural residents and community leaders
Trust……	Between farmers and technical advisors
	Between farmers and consumers
	Among rural residents
	Between/among rural residents and community leaders



Farmingfirst.org

atlantalocalfood.com

Inhabitat.com

http://blog.lovewithfood.com/2010/12/10-facts-about-hunger-in-america-give-food-give-love/

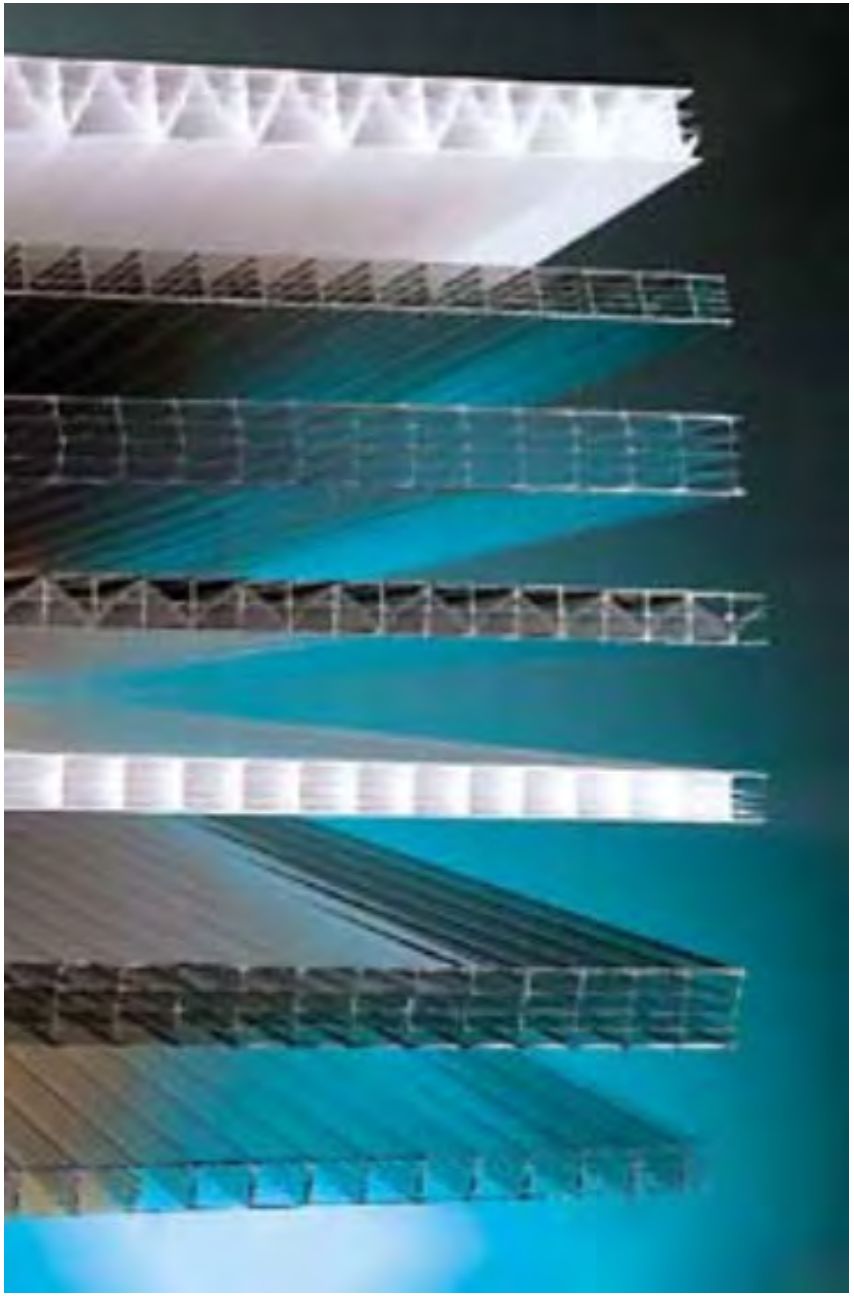
[charleston] VERTICAL FARM

greenhouse skin types
glass

[charleston]
VERTICAL FARM

polyetheline film

[charleston] VERTICAL FARM



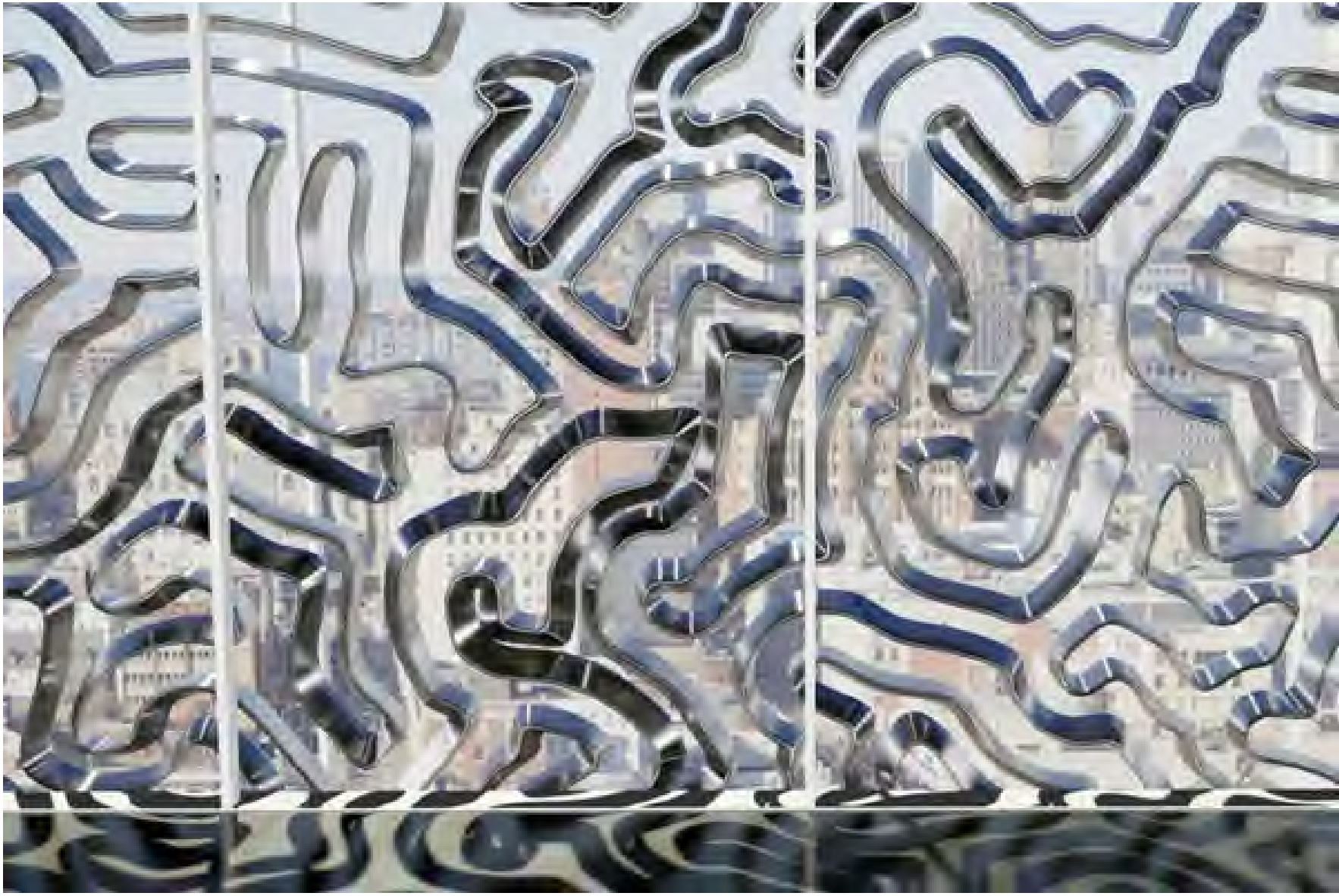
multi-wall polycarbonate + corrugated polycabonate

[charleston] VERTICAL FARM

Covering	Advantages	Disadvantages	Light Transmission	"U" Factor	Insulating Value "R"	Estimated Lifetime	Cost per Sq./Ft.**
Single Polyethylene Film	• Inexpensive • Easy to install	Short life	85 %	1.2	.83	1 to 4 years	$.085
Double Polyethylene Film	• Inexpensive • Saves on heating costs • Easy to install	Short life	77%	70	1.43	1 to 4 years	$.17
Corrugated Polycarbonate	• High transmittance • High impact resistance	Scratches easily	91%	1.2	.83	• 15 plus years • 10 year warranty	$1.30
Glass Double Strength	• High transmittance • High UV resistance • Resists scratching	• High cost • Difficult installation • Low impact resistance • High maintenance	88%	1.1	.91	25 plus years	$3.00
Glass Insulated	• High transmittance • High UV resistance • Resists scratching	• Very high cost • Difficult installation • Low impact resistance	78%	.70	1.43	25 plus years	$6.00
8mm Twin Wall Polycarbonate	• High impact resistance • Saves on heating costs	• Requires glazing system to install • Scratches easily	80%	.61	1.64	• 15 plus years • 10 year warranty	$1.66
10mm Twin Wall Polycarbonate	• High impact resistance • Saves on heating costs	• Requires glazing system to install • Scratches easily	80%	.56	1.79	• 15 plus years • 10 year warranty	$2.50
16mm Triple Wall Polycarbonate	• High impact resistance • Saves on heating costs	• Requires glazing system to install • Scratches easily	78%	.42	2.38	• 15 plus years • 10 year warranty	$4.00

skin type comparison chart

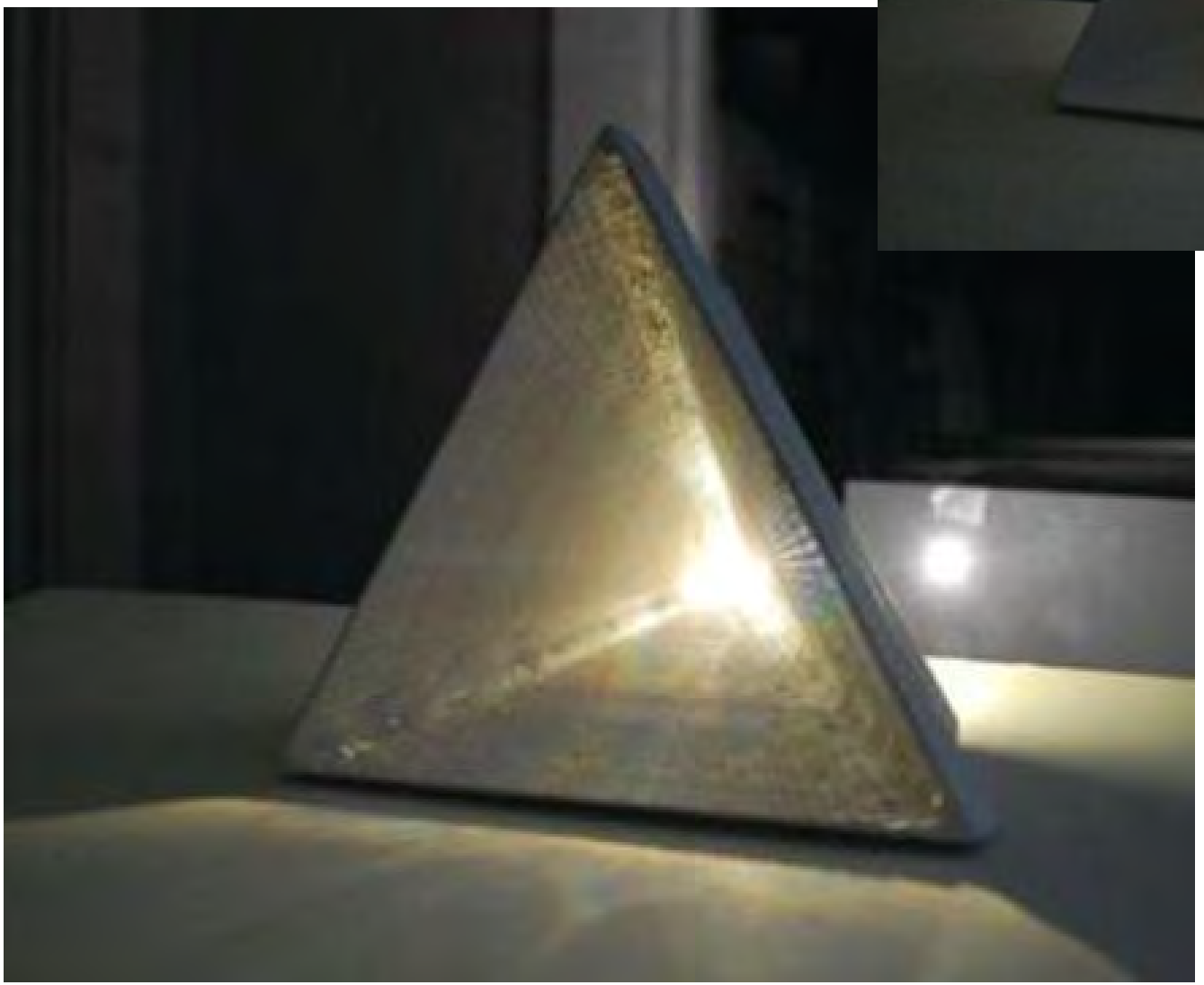
[charleston]
VERTICAL FARM



adaptive skin

[charleston] VERTICAL FARM

[charleston]
VERTICAL FARM



sensitive apertures

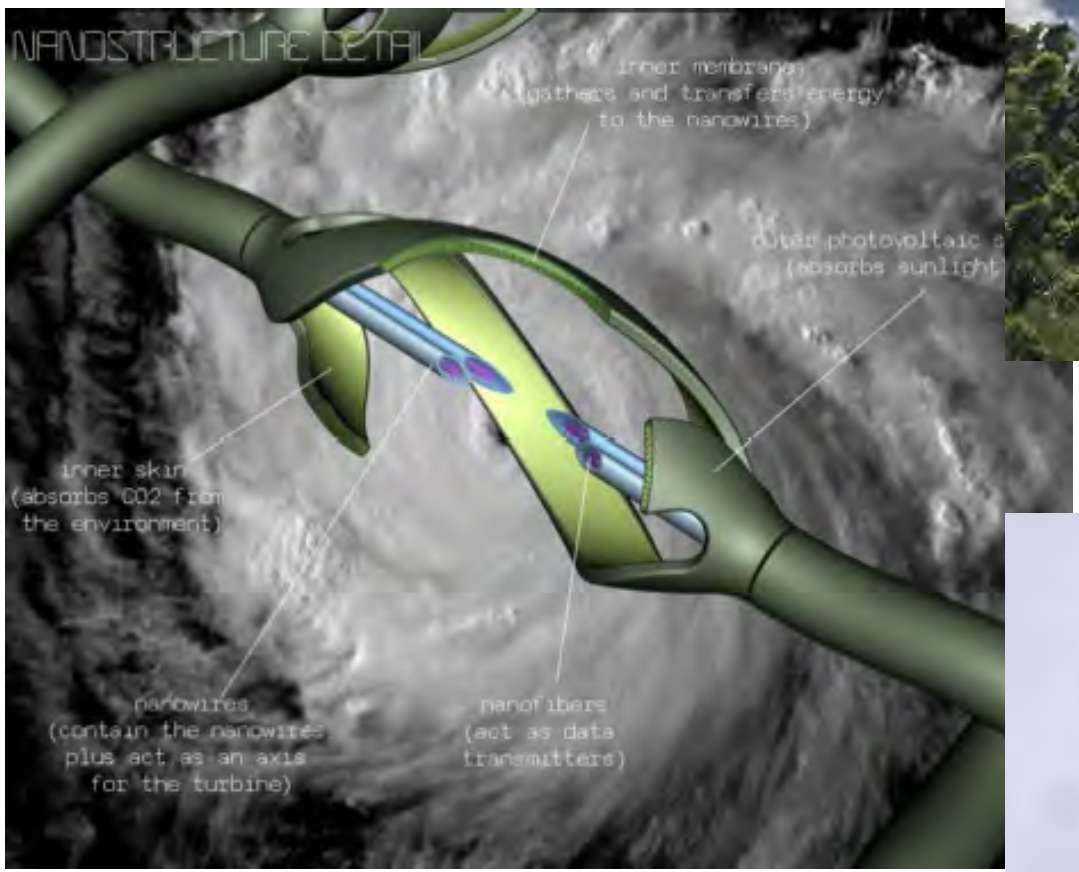
[charleston] VERTICAL FARM

greenpix

[charleston]
VERTICAL FARM

algae facade

[charleston] VERTICAL FARM



nano-vent skin

[charleston]
VERTICAL FARM

[charleston] VERTICAL FARM

vault-structured metal

[charleston] VERTICAL FARM

[charleston] VERTICAL FARM

volatile organic compunds

*harmful organic chemicals

*found in:

- paints
- solvents
- newspaper
- cleaning chemicals
- vinyl flooring
- carpets
- adhesives + caulks
- air fresheners
- fuel
- pressed wood furniture

SOLUTIONS!

- Increase Ventilation.
- Don't use things with VOC's.

OR....

according to a study done in 1973 by NASA, the low levels of VOC's given off by synthetic materials [better known as "off-gassing"] when placed in a sealed environment were combatted by the existence of....

PLANTS!

"If man is to move into closed environments, on Earth or in space, he must take along nature's life support system." Plants.

[charleston] VERTICAL FARM

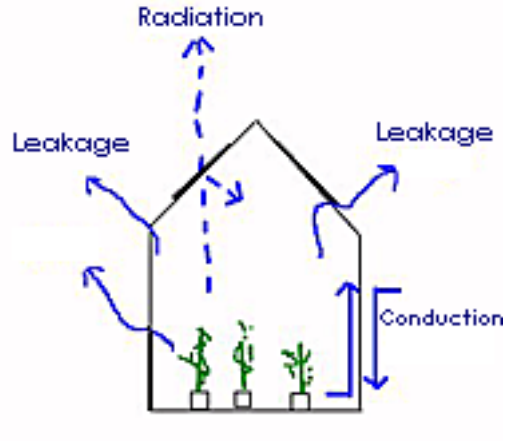
research labs represent a similar type of construction, in terms of materials, personnel, and equipment they contain. **costs are high** compared with buildings designed simply for user comfort. because of these higher costs, in **energy consumption** as well as in construction, labs represent a **special challenge** and opportunity in **sustainable design**.

- labs use 5 to 10X as much energy as typical office buildings. [HVAC loads due to vetilation requirements]
- can cost twice as much to build, or more....

[charleston] VERTICAL FARM

ventilation

- recirculated air vs. outside air

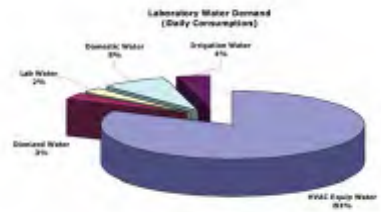


water

- gray water collection + HVAC water

pipe materials

- metal vs. plastic [recyclable?]



electrical/lighting

- daylighting vs. diffuse lighting

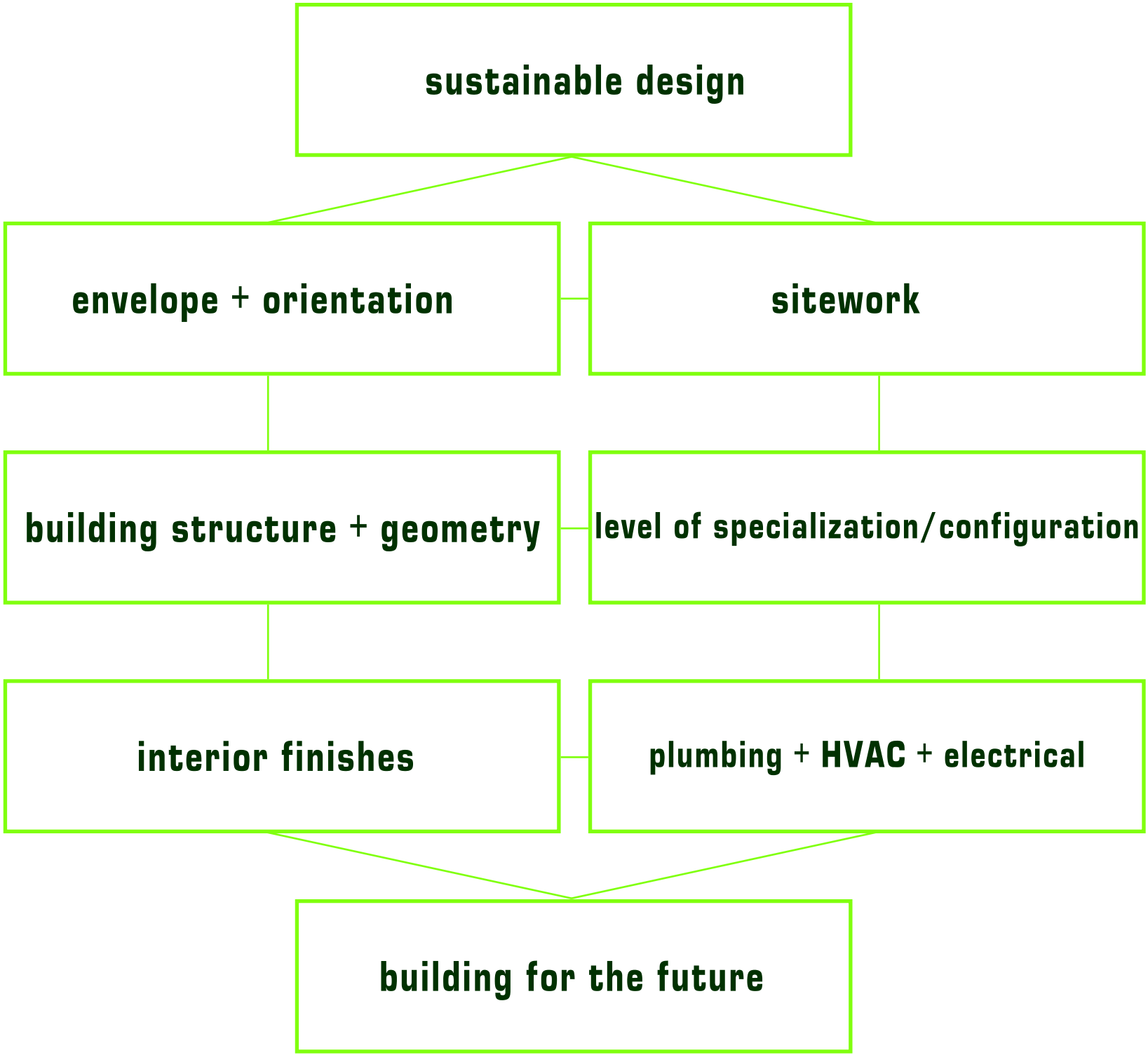
digital data

- computers + robotics?

the future?

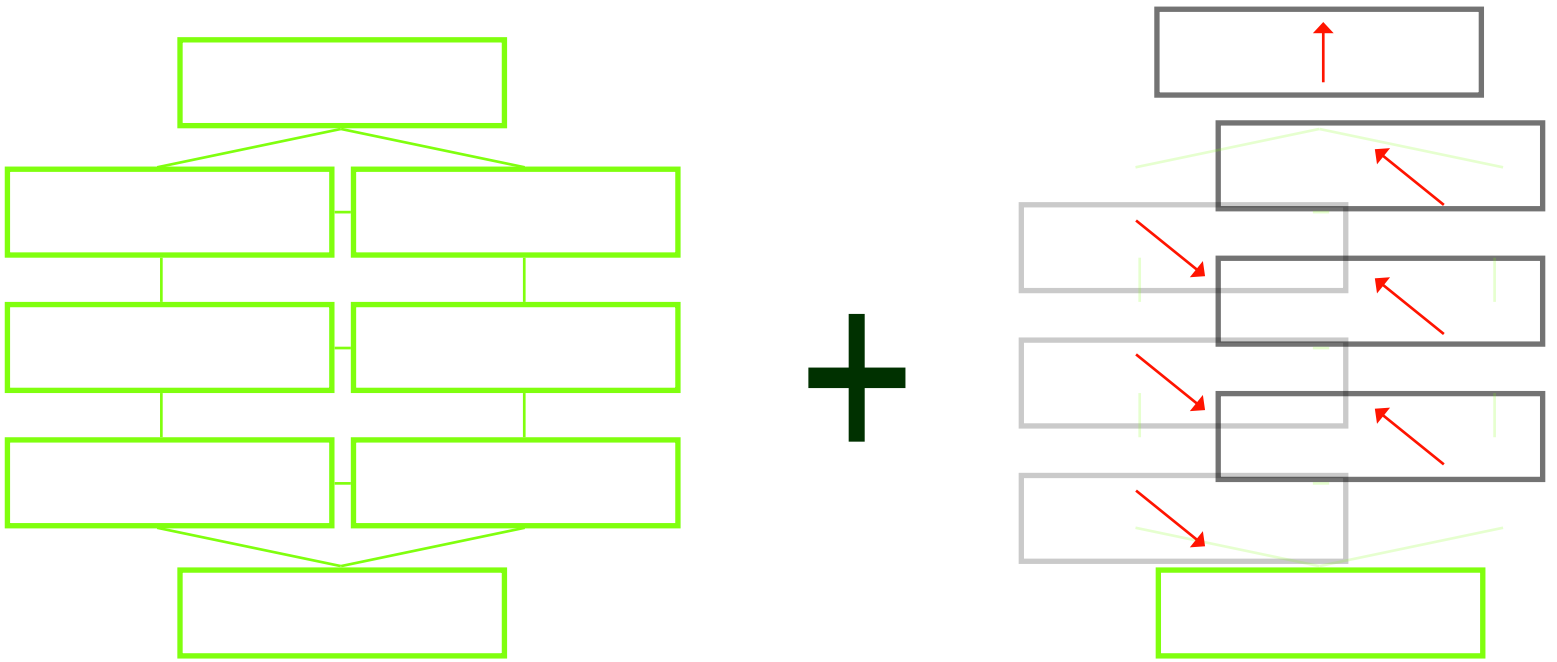
- adaptability of structure vs. cost effectiveness and functionality.

[charleston] VERTICAL FARM

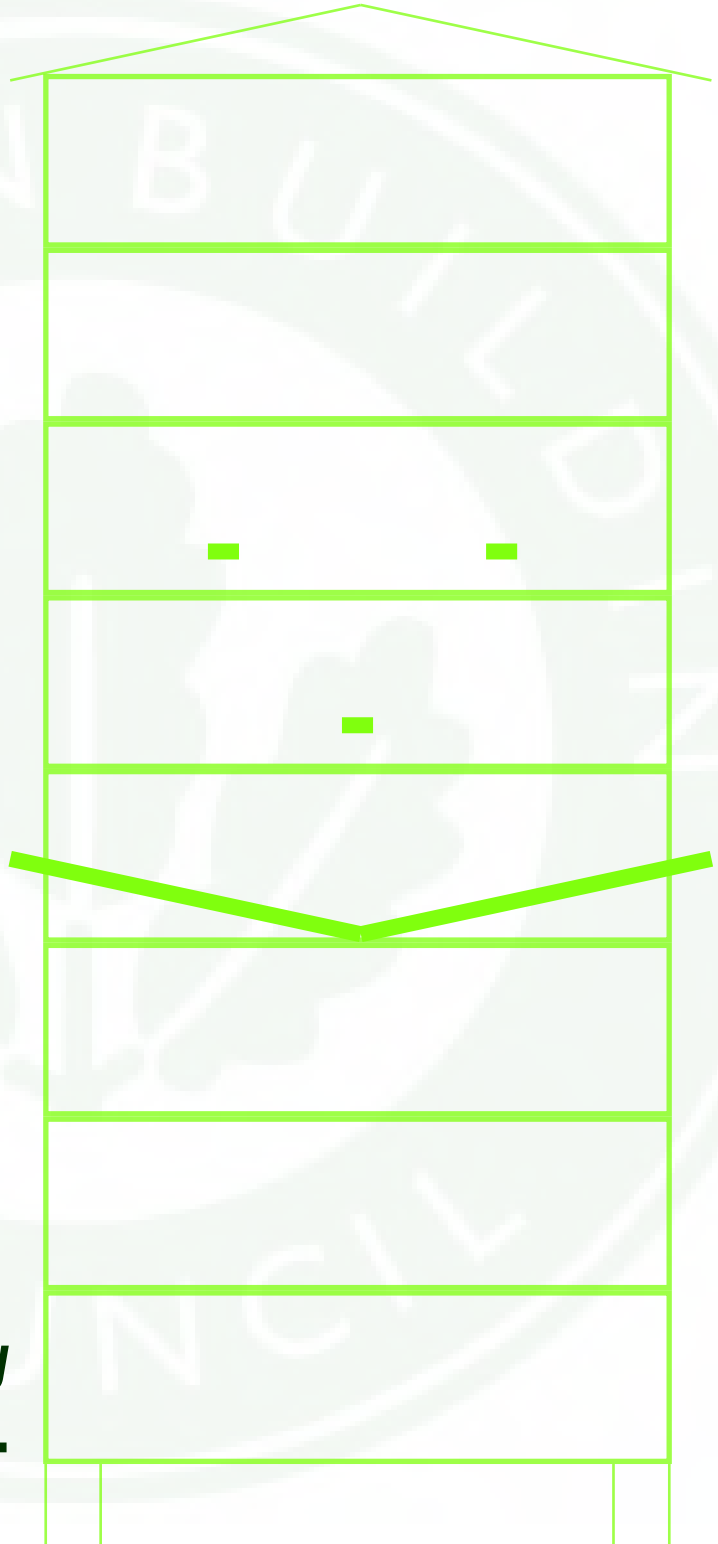


[charleston] VERTICAL FARM

designing a VERTICAL FARM?

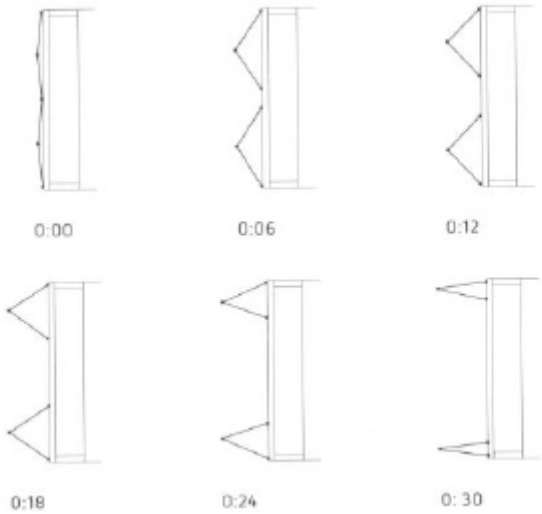


[charleston] VERTICAL FARM

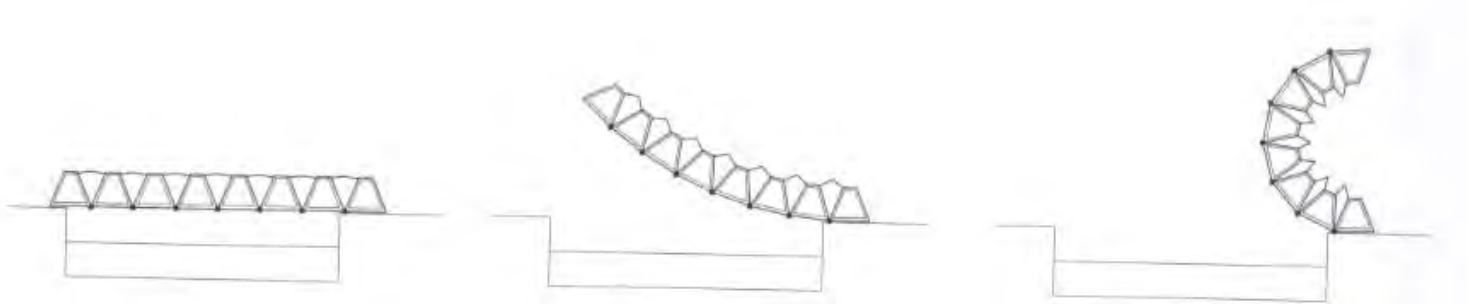


a green and happy vertical farm.


1
2
3


0:00
0:06
0:12
0:18
0:24
0:30

Footbridge




ENCLOSED DINING
HOME SPA
MAXIMUM KITCHEN
BEDTIME


01


02


03


04


05


06

01

02

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05

06


01

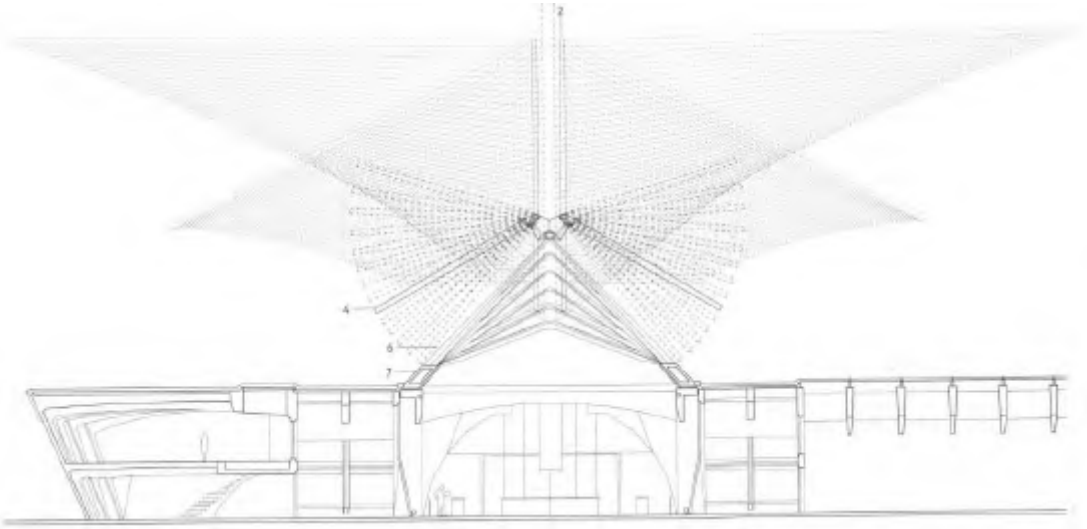

02

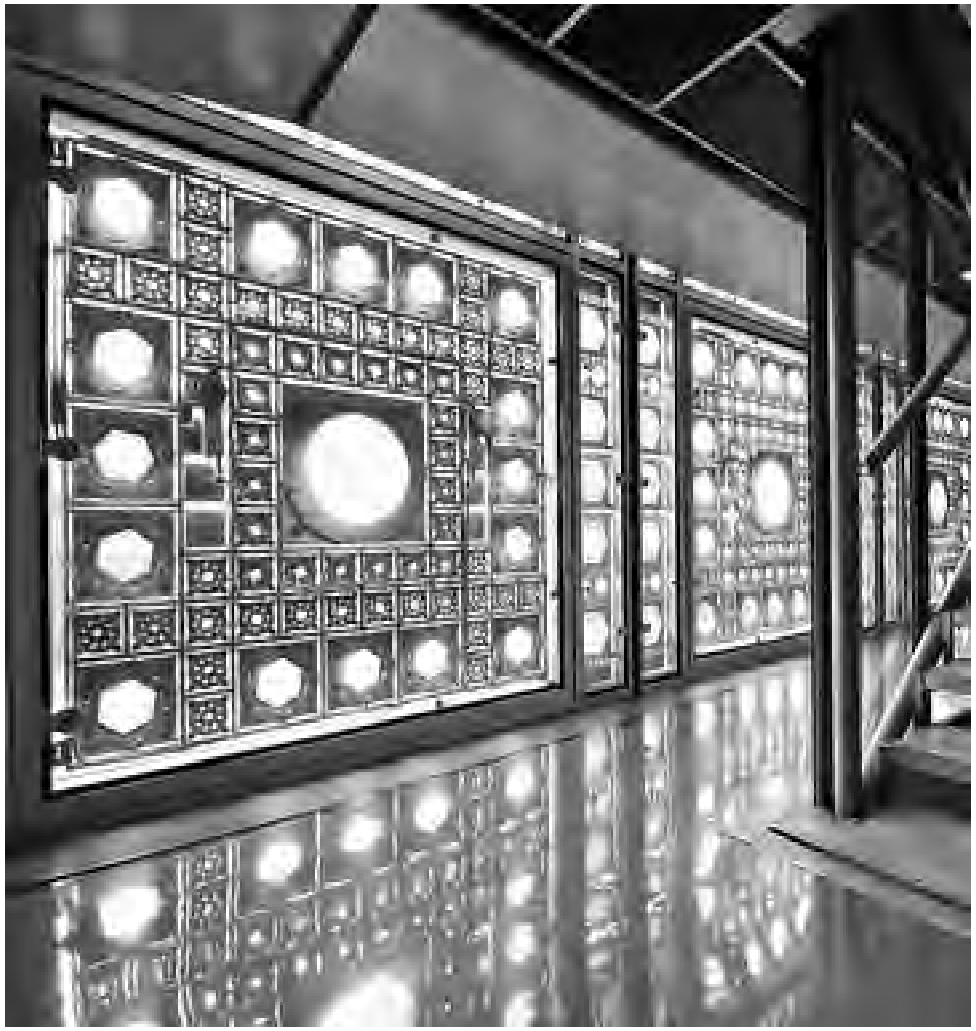

03


04


05


06





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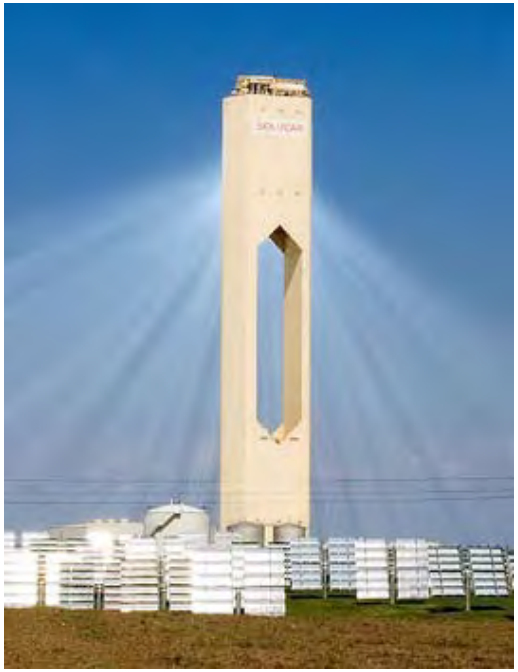


JOHN DEERE 6420
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What is NET-ZERO?

A building that creates as much energy as it uses

Net-Zero **Site Energy**

Site produces at least as much energy as it uses in a year

Net-Zero **Source Energy**

Accounts for “upstream” in efficiencies

Net-Zero **Carbon**

Factors in “grid” supply carbon intensity

Net-Zero **Energy Cost**

Annual revenues exported by the building are equal or greater than utility bills paid

NET-ZERO design process

Understand the Site Context

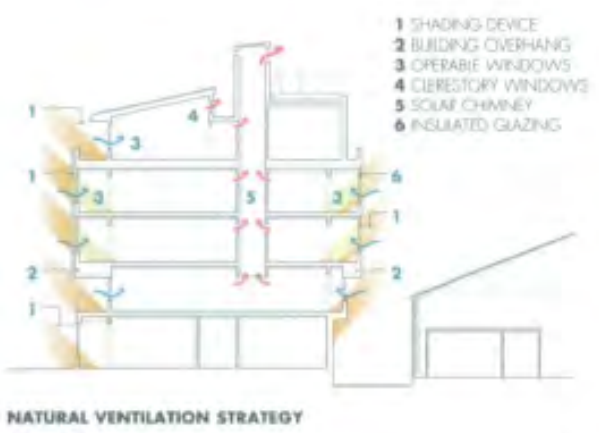
Reduce Energy Loads

Meet Energy Loads Efficiently

Generate and Supply Energy From Renewable Resources

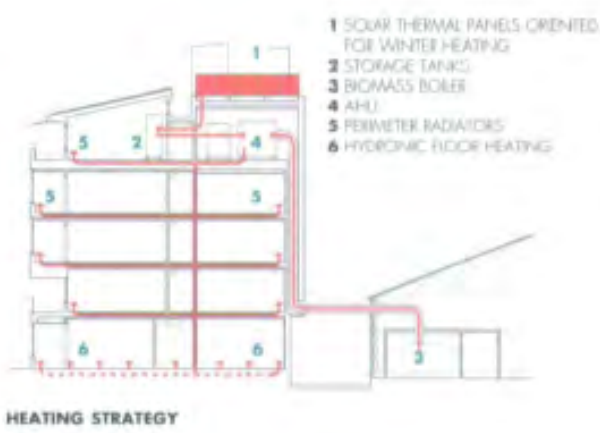
Energy Conservation Efforts must address all energy use aggressively

Conditioning of outdoor air (ventilation)



NATURAL VENTILATION STRATEGY

COOLING STRATEGY



HEATING STRATEGY

What is a ZERO ENERGY BUILDING (ZEB)?

Independent from the energy grid

Energy harvested on-site

Predicted by Building Information Modeling (BIM)

Combine Passive Solar & Natural Air Conditioning

BedZED
Environmentally Friendly Housing
Hackbridge, Wallington, Surrey, England

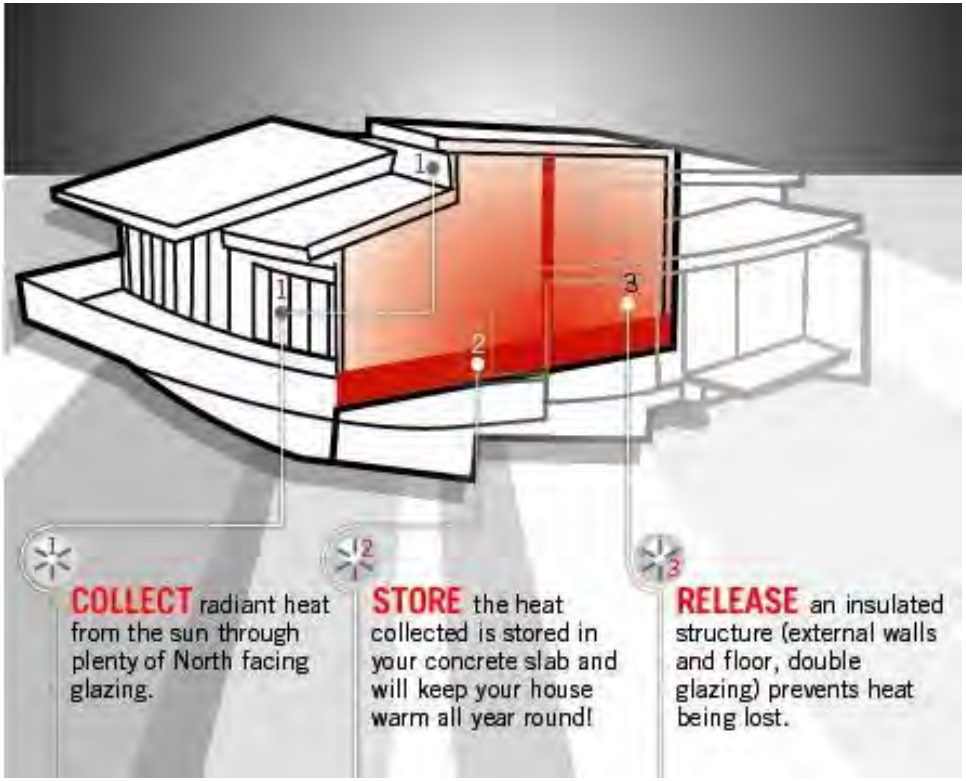
PASSIVE SOLAR DESIGN

Uses solar strategies to heat air and water

No mechanical systems

Stores heat during colder months

Releases heat when necessary



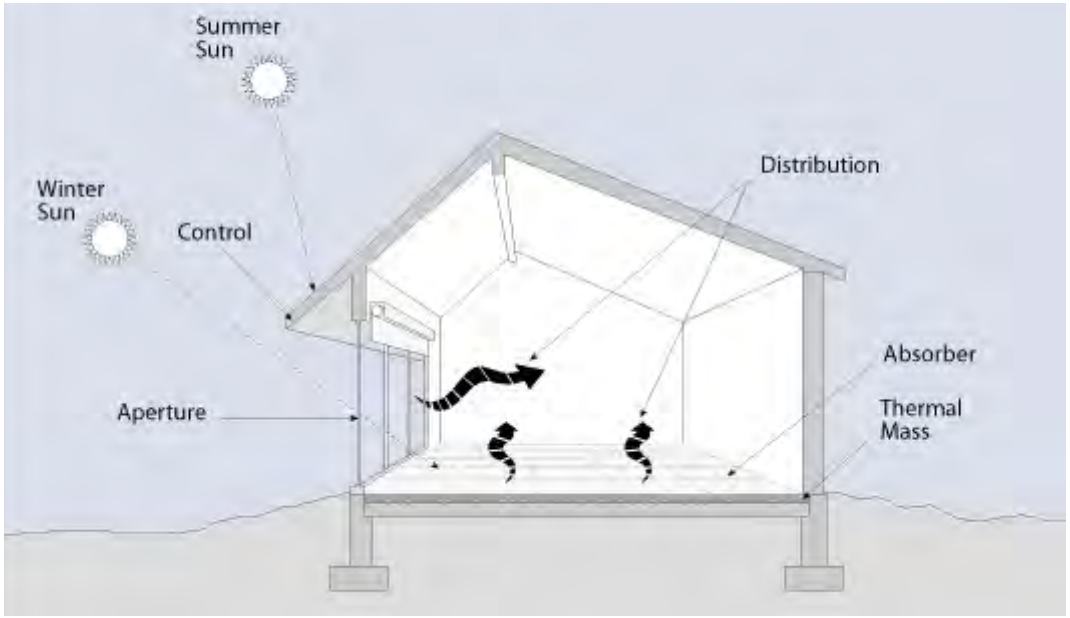
What is a PASSIVE HOUSE?

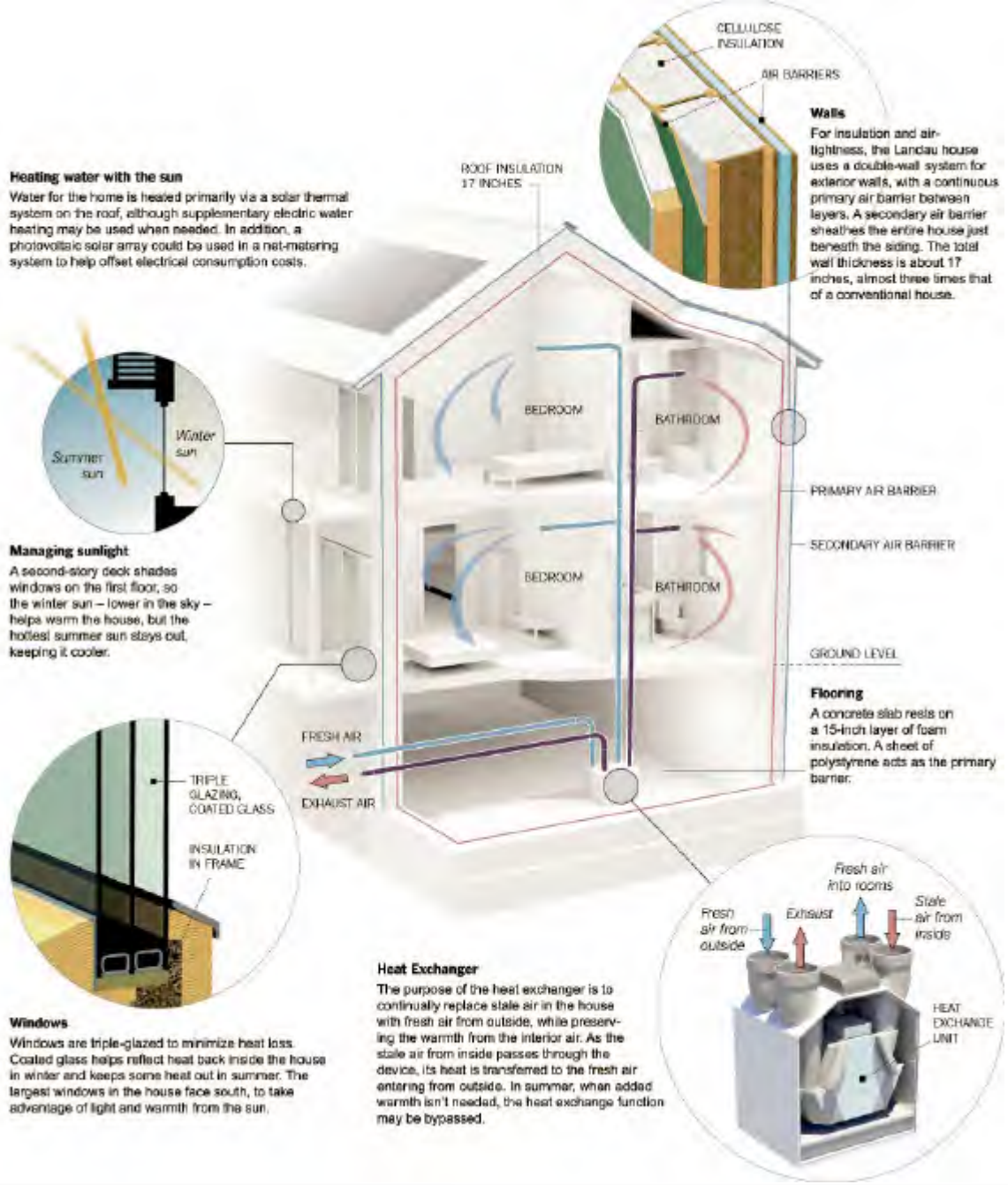
Reduces heating energy consumption by 90%

Well-Insulated, virtually air-tight building

Requires little energy for heating and cooling

A “design process” integrated with architectural design




CELLULOSE INSULATION
AIR BARRIERS
Walls
For insulation and air-tightness, the Landau house uses a double-wall system for exterior walls, with a continuous primary air barrier between layers. A secondary air barrier sheathes the entire house just beneath the siding. The total wall thickness is about 17 inches, almost three times that of a conventional house.
Heating water with the sun
Water for the home is heated primarily via a solar thermal system on the roof, although supplementary electric water heating may be used when needed. In addition, a photovoltaic solar array could be used in a net-metering system to help offset electrical consumption costs.
ROOF INSULATION 17 INCHES
Summer sun
Winter sun
Managing sunlight
A second-story deck shades windows on the first floor, so the winter sun – lower in the sky – helps warm the house, but the hottest summer sun stays out, keeping it cooler.
BEDROOM
BATHROOM
BEDROOM
BATHROOM
PRIMARY AIR BARRIER
SECONDARY AIR BARRIER
GROUND LEVEL
Flooring
A concrete slab rests on a 15-inch layer of foam insulation. A sheet of polystyrene acts as the primary barrier.
FRESH AIR
EXHAUST AIR
TRIPLE GLAZING, COATED GLASS
INSULATION IN FRAME
Windows
Windows are triple-glazed to minimize heat loss. Coated glass helps reflect heat back inside the house in winter and keeps some heat out in summer. The largest windows in the house face south, to take advantage of light and warmth from the sun.
Heat Exchanger
The purpose of the heat exchanger is to continually replace stale air in the house with fresh air from outside, while preserving the warmth from the interior air. As the stale air from inside passes through the device, its heat is transferred to the fresh air entering from outside. In summer, when added warmth isn't needed, the heat exchange function may be bypassed.
Fresh air into rooms
Fresh air from outside
Exhaust
Stale air from inside
HEAT EXCHANGE UNIT

PASSIVE HOUSE in the US

Passive House design is expensive

Current design strategies account for 40% excess energy use

Passive Buildings use up to 90% less energy

Passive House Institute

What is ENERGYplus/PLUSenergy?

Produces more energy than it consumes

Originated by Rolf Disch, Freiburg, Germany

Designed as a community of homes with negative energy consumption

Solar Settlement

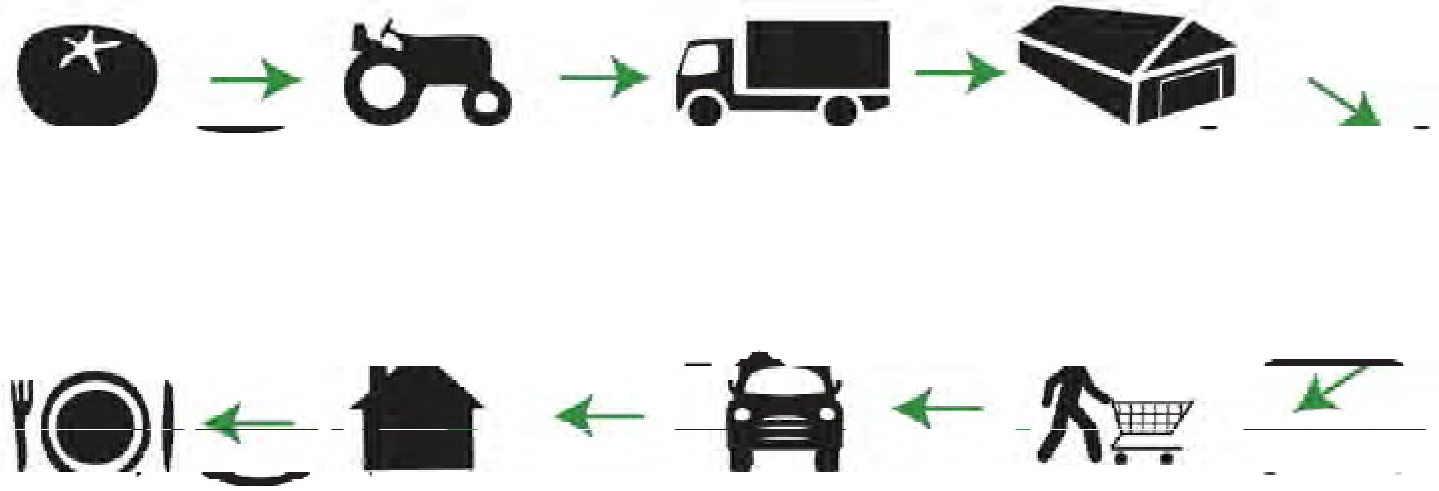
Designed by Rolf Disch – Freiburg, Germany

Built 2000-2005

Emissions-Free

CO_2 neutral

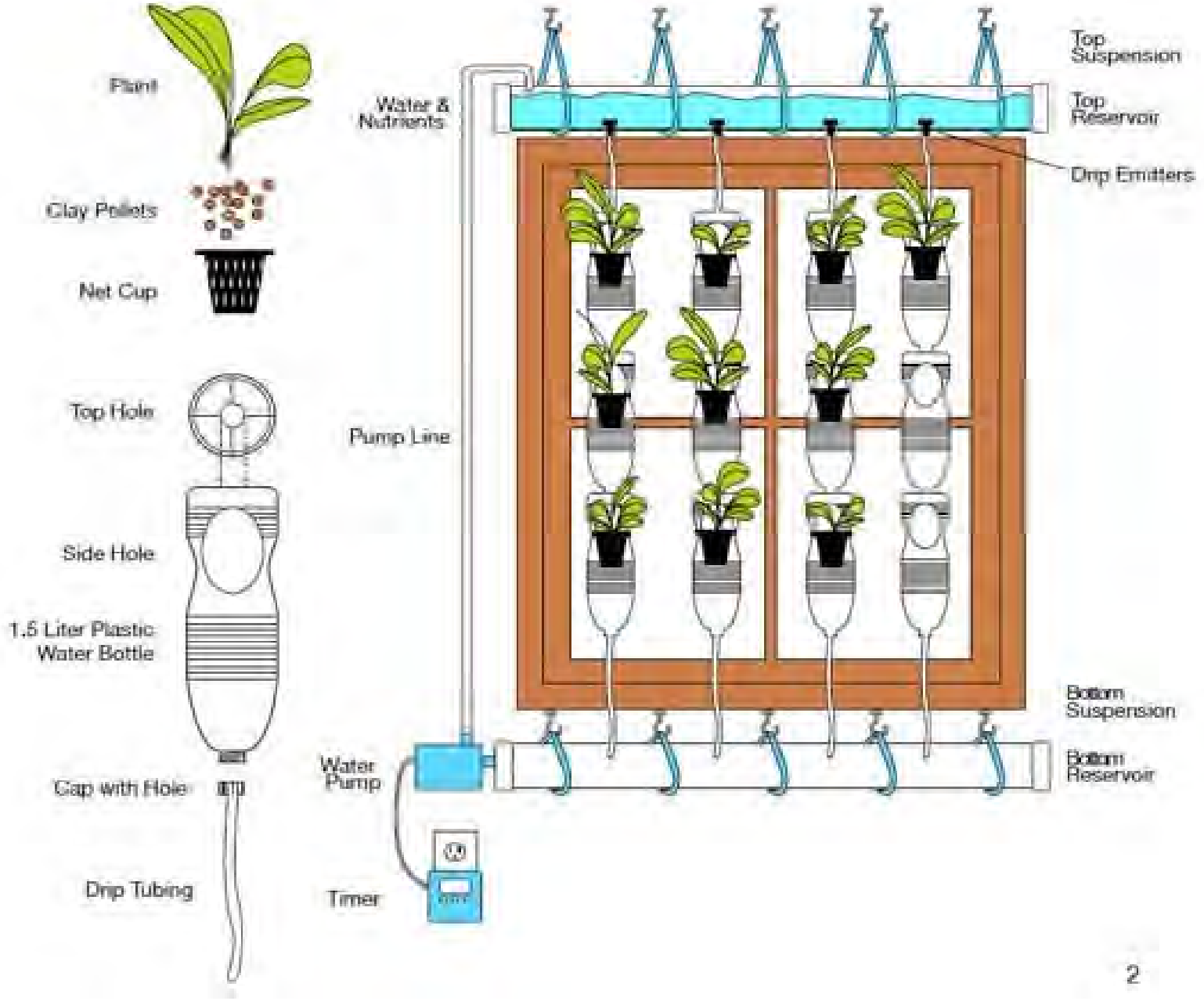
59 PlusEnergy Homes



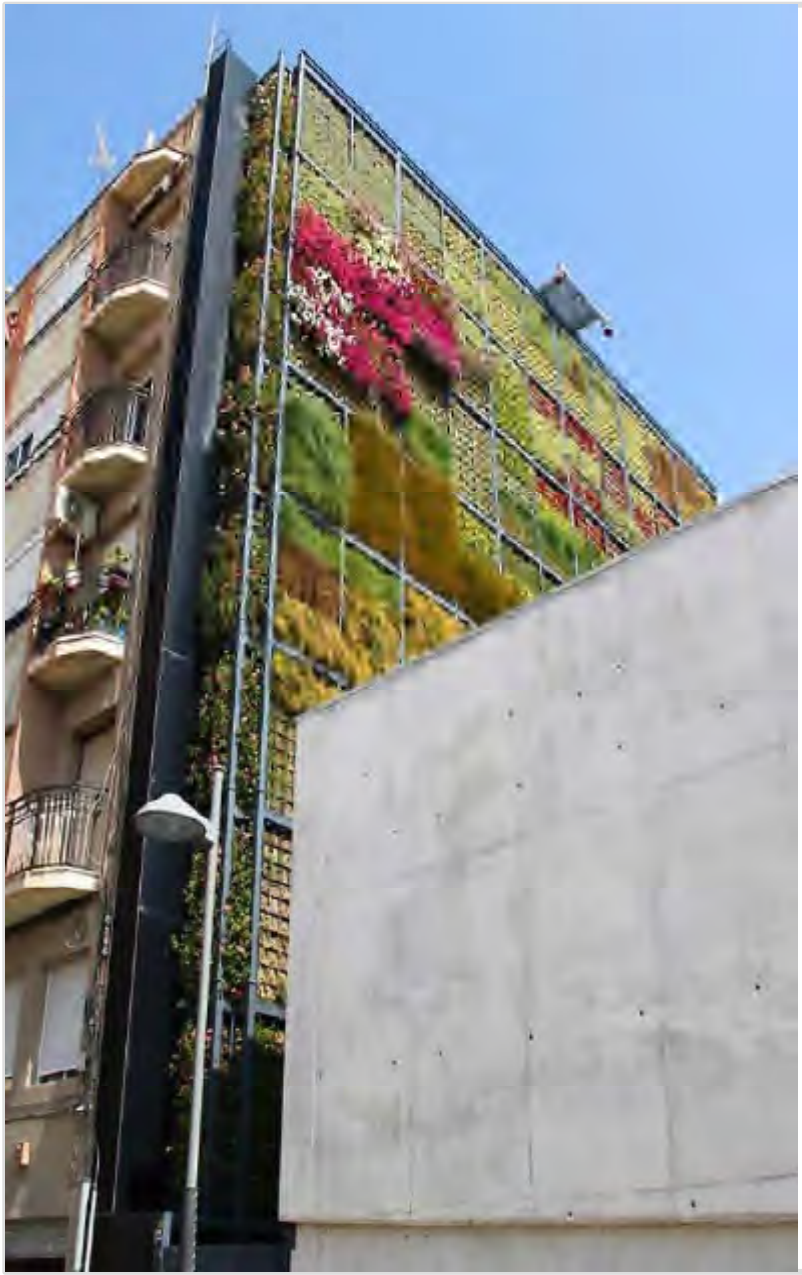
TRADITIONAL FARMING METHOD

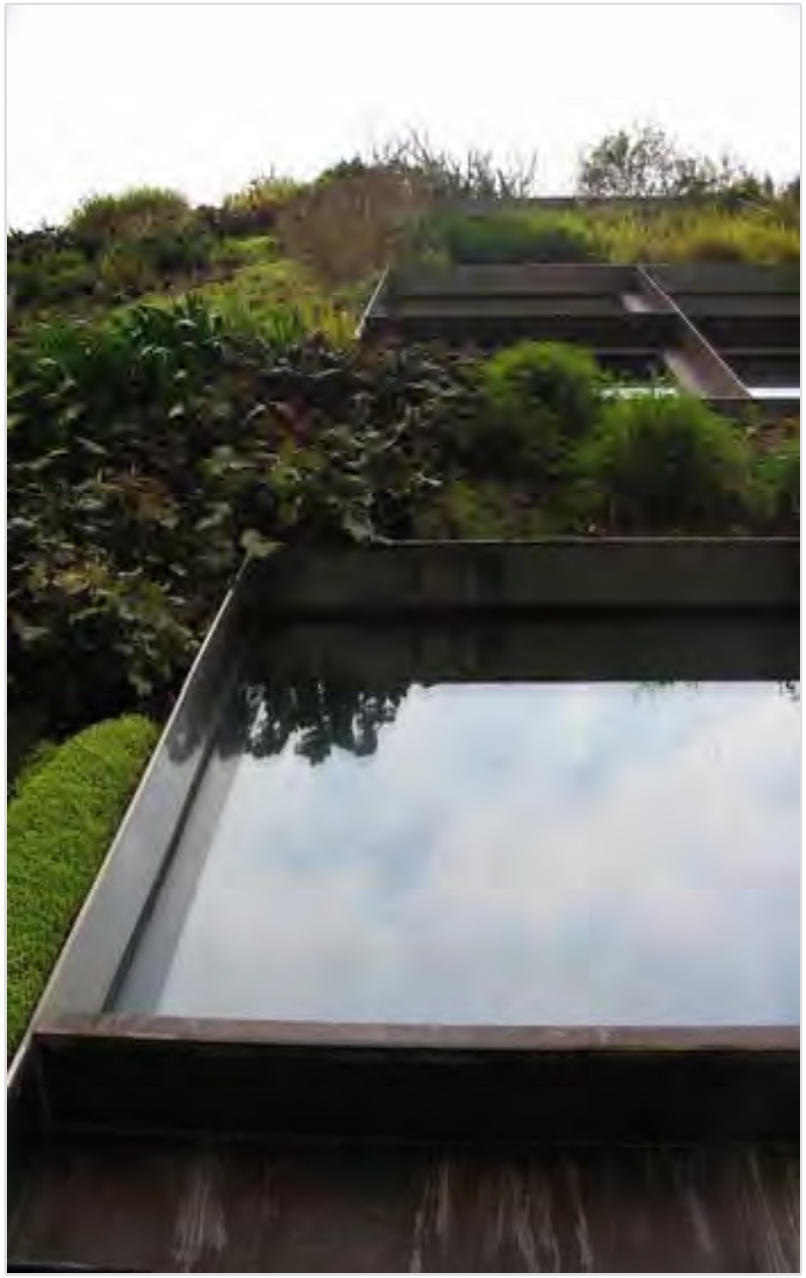
Figure 1. Freestanding hobby greenhouse styles

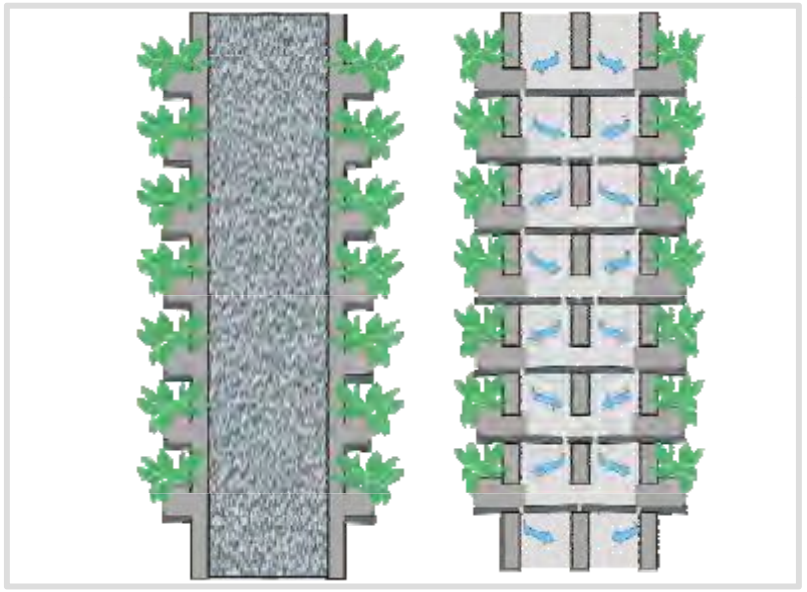

ABC

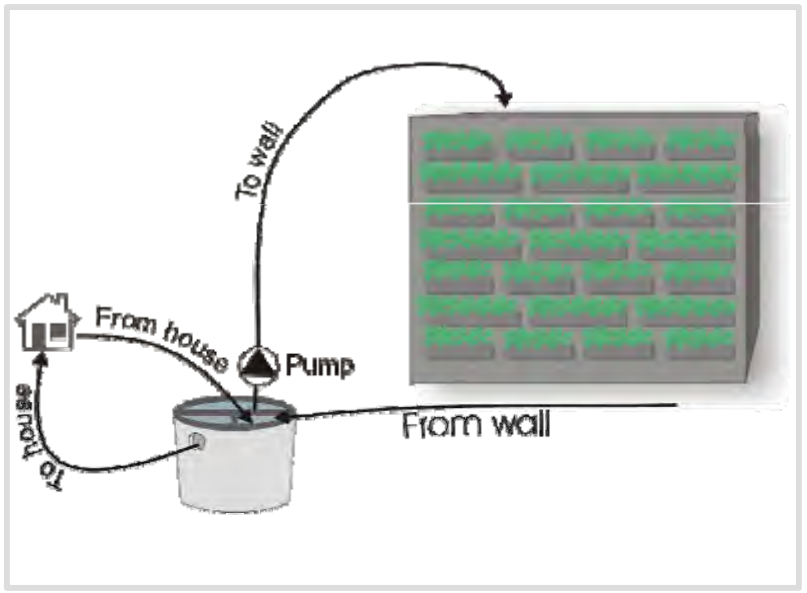

Plant
Clay Pellets
Net Cup
Top Hole
Side Hole
1.5 Liter Plastic Water Bottle
Cap with Hole
Drip Tubing
Water & Nutrients
Pump Line
Water Pump
Timer
Top Suspension
Top Reservoir
Drip Emitters
Bottom Suspension
Bottom Reservoir

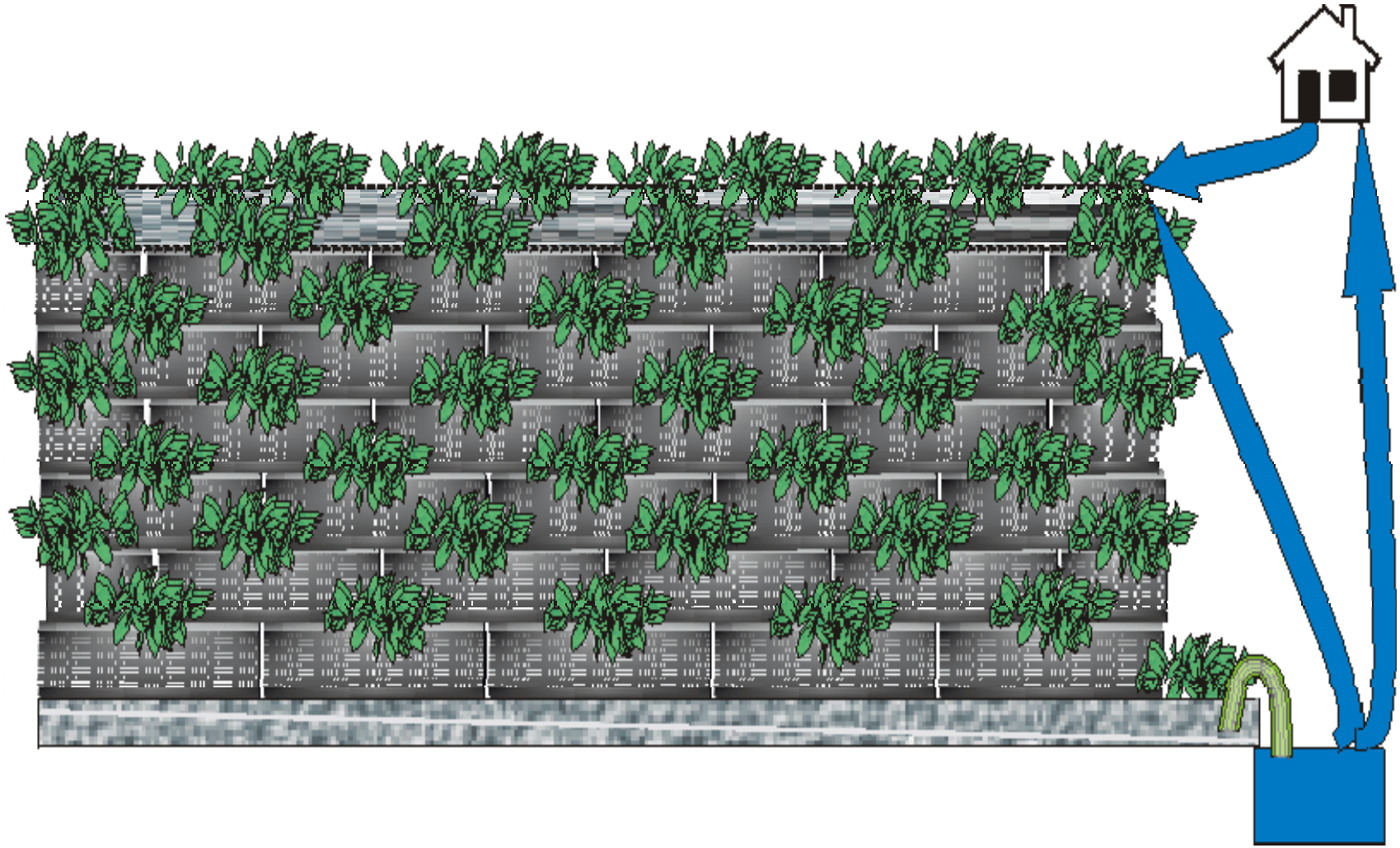
2



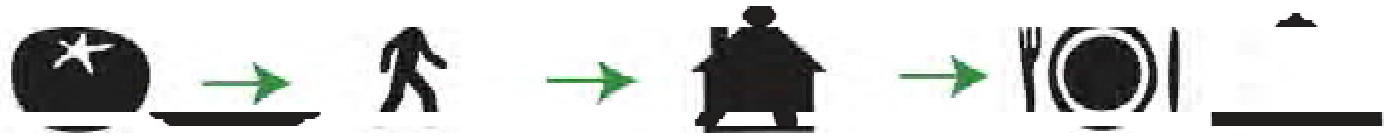





To wall
From house
Pump
From wall
To house



TRADITIONAL FARMING METHOD



VERTICAL FARMING METHOD