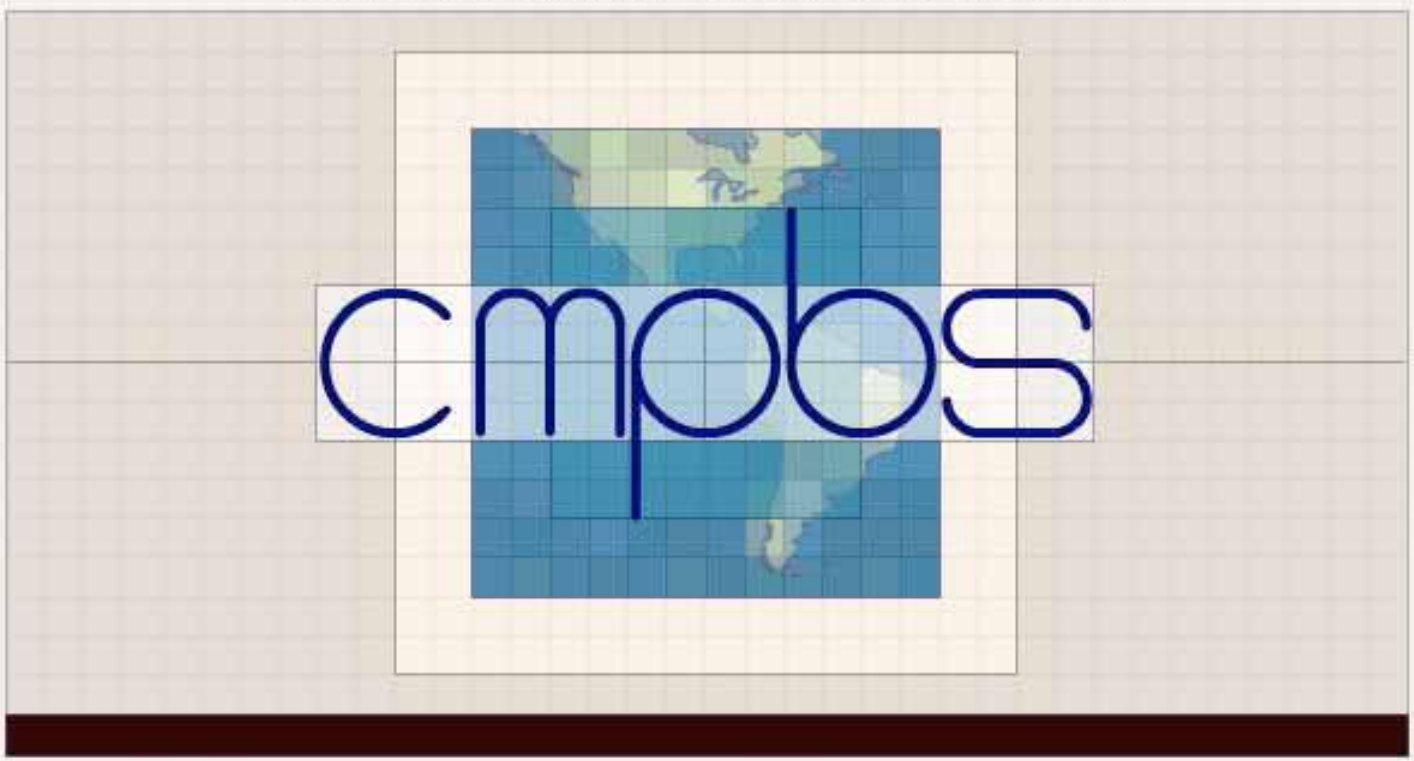
Eco-Balance

A Resource Balancing Approach To Community Planning

Pliny Fisk III
Fellow Sustainable Urbanism
Fellow Center for Housing and Urban Development
Fellow Health Systems Design
Texas A & M University

Co-Director
Center for Maximum Potential Building System
Austin, Texas

THE CENTER FOR MAXIMUM POTENTIAL BUILDING SYSTEMS



www cmpbs org

DESIGN

Flexible Open Building Systems Incorporating Life Cycle Design

- Internationally recognized green architecture
- Greenhouse gas-balanced design
- Prototype building systems
- Healthy building design and specifications

Blueprint
Demonstration Farm
Laredo, TX

Advanced Green
Builder Demonstration
Austin, TX

2007 Solar Decathlon
Texas A&M University

GroJoint™
CMPBS Farmstand
Austin, TX

MASTER PLANNING

Ecologically-Balanced Land Use Master Planning

- Nature centers & camps
- Community-supported architecture
- Educational facilities
- Integrated landscape/infrastructure systems

School for Field Studies
Baja Del Sur, Mexico

CMPBS 30th Year
Master Plan
Austin, TX

Verano Development
San Antonio, TX

Community Supported
Architecture
Mississippi

POLICY & EDUCATION

Sustainable Guidelines, Training & Policy Initiatives

- Intern program
- Green building programs and guidelines
- Life cycle planning procedures
- Professional development training seminars
- Environmentally preferred materials and methods
- Green health care initiatives

Green Guide for
Health Care

Green Building Guidelines;
Mueller Green Resources Guide
Austin, TX

Professional Training,
Conference Seminars,
and Workshops

Guidebooks, Manuals,
Publications

TOOLS

Environmental/Economic Impact Baselining and Benchmarking Life Cycle Evaluation

- BaselineGreen™
- GreenBalance™
- Materials library and assessment
- LEED® and sustainability consulting

Block 21
Austin, TX

LEED® Consulting

Materials and Building
Systems Library

EcoBalance™ Game

Building Scale

Life Cycle Design

GroJoint

GroColumn

GroWall

GroHome

GroVille

1 Solar Carport
2 Building Integrated Wind
3 Reflecting Pond
4 Solar Thermal Fence
5 Studio
6 High Efficiency BIPV
7 Light Reflecting BIPV
8 Light-Thru BIPV
9 Grassland Biome Simulation
10 Bat Tower
11 Food Garden

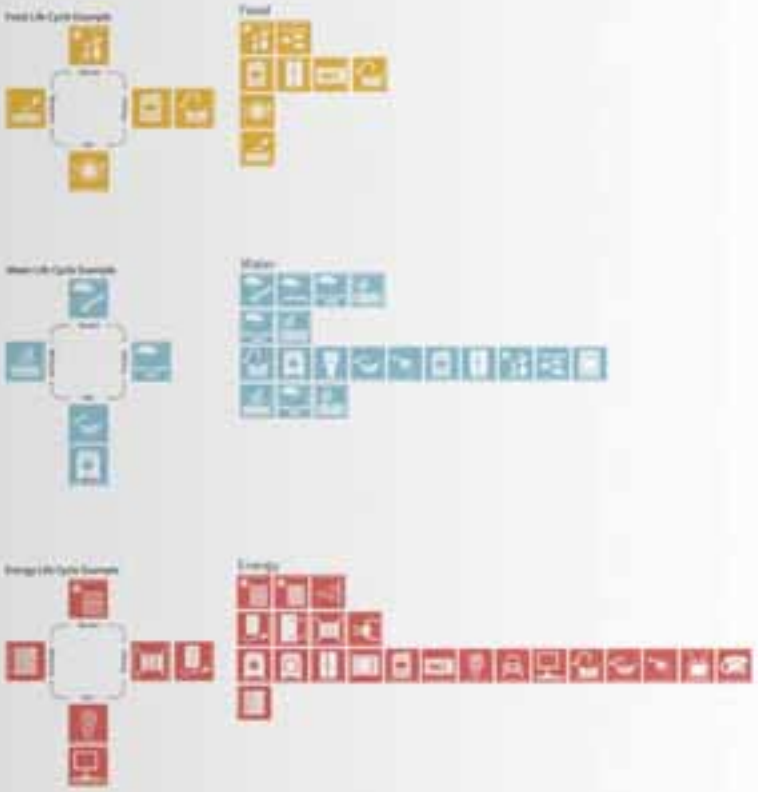
Growth Plans

Human Scale

Greening of the Brain

Life Cycle Events Icons

LIFE CYCLES ICONS

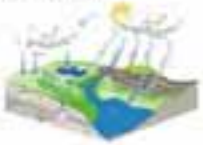


Biophilic Neoocortex

REPTILIAN LAYER

GLOBAL SUPPORT CYCLES

Hydrological Cycle

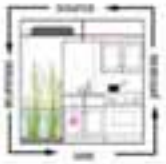


Food Cycle

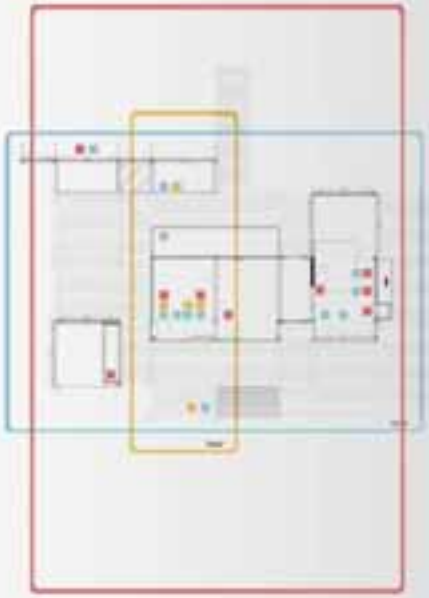
Material Cycle

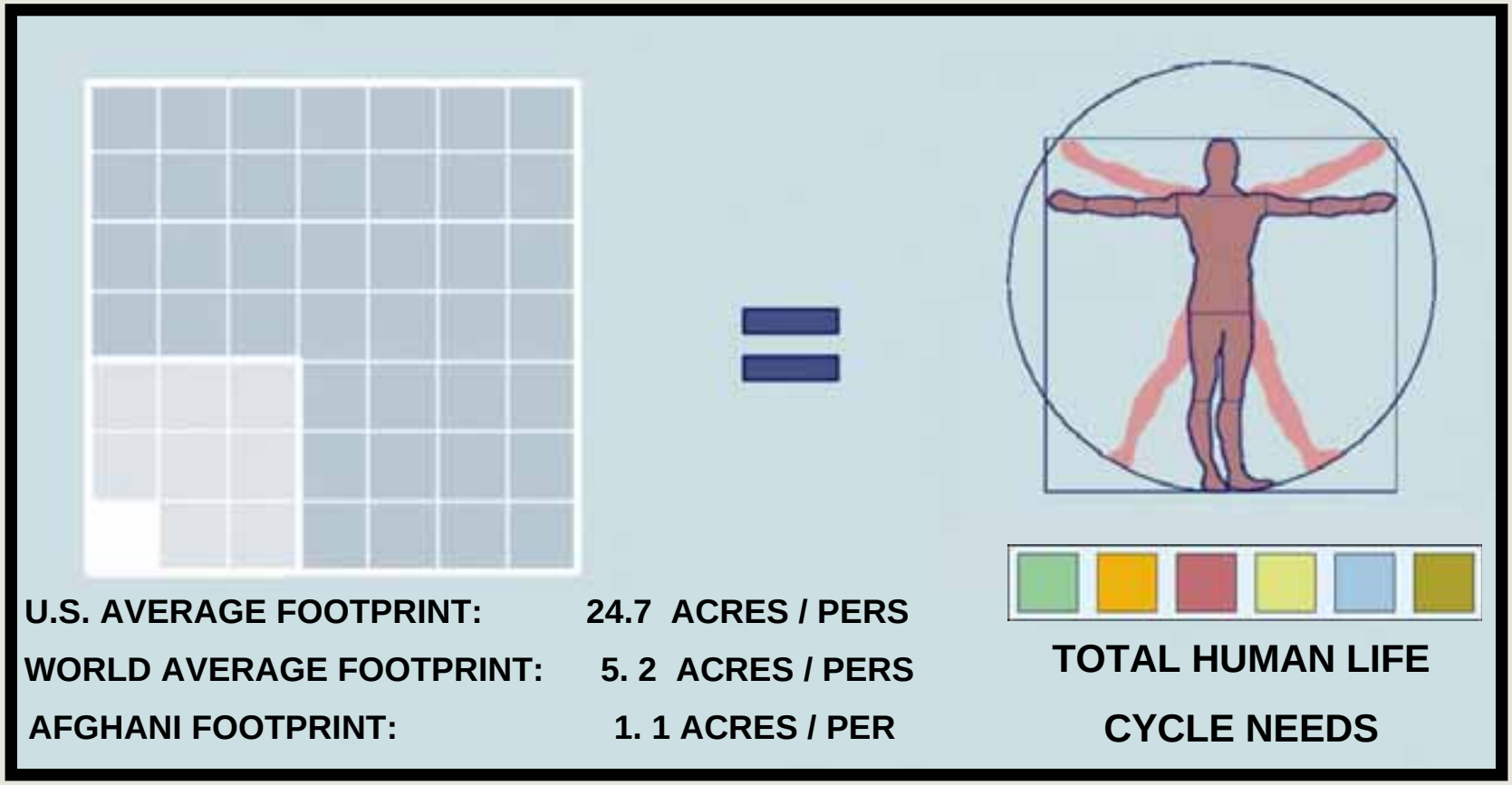
NEOCORTEX LAYER

BUILDING LEVEL EVENT CYCLES



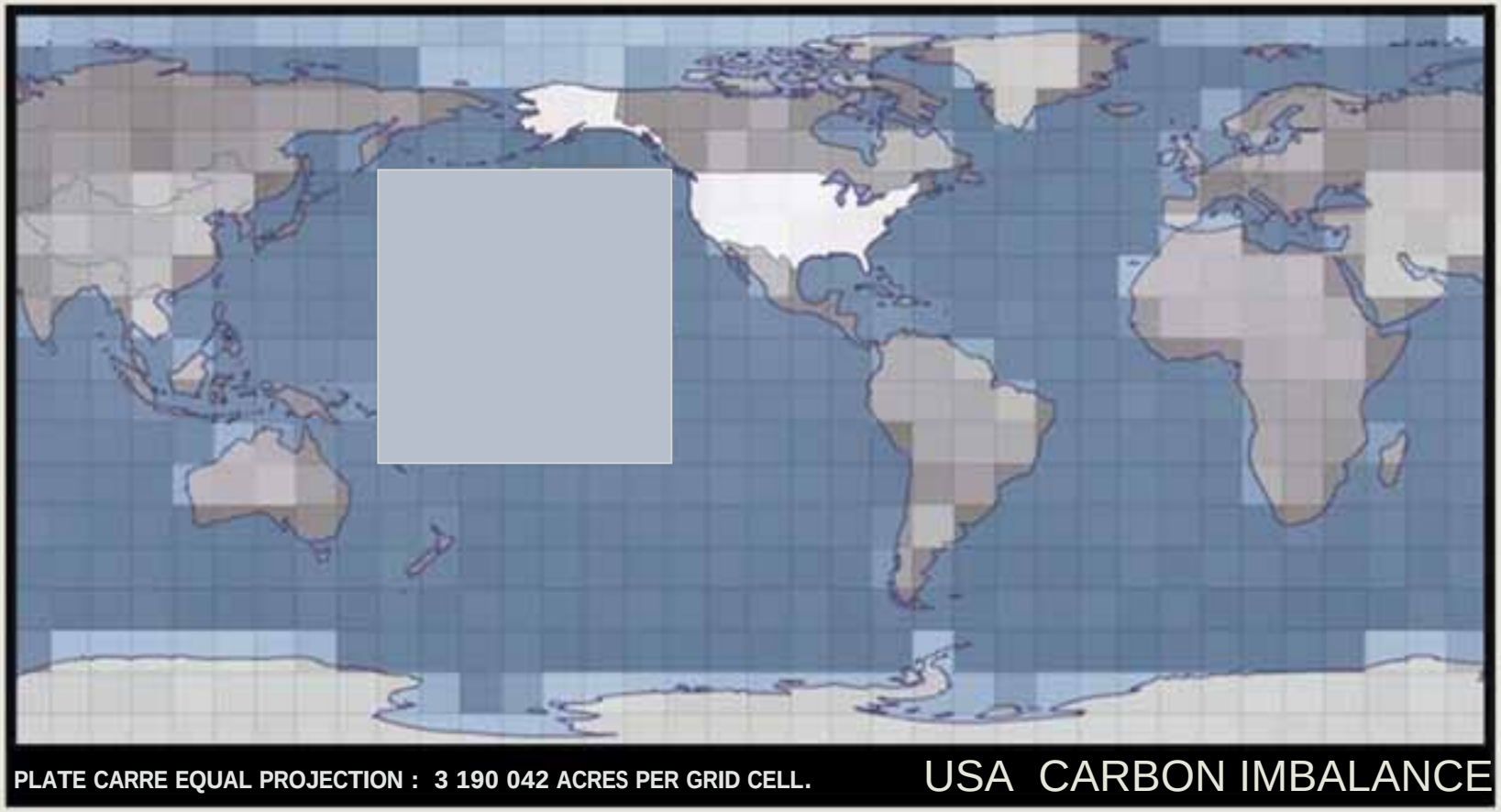
Life Cycle Event Space





Life cycle footprint : energy (includes fossil fuels expressed in land area necessary to sequester the corresponding co_2), built area (includes degraded land), vegetable/fruit production land area, grain area, pasture (dairy, meat, wool production), prime forest.

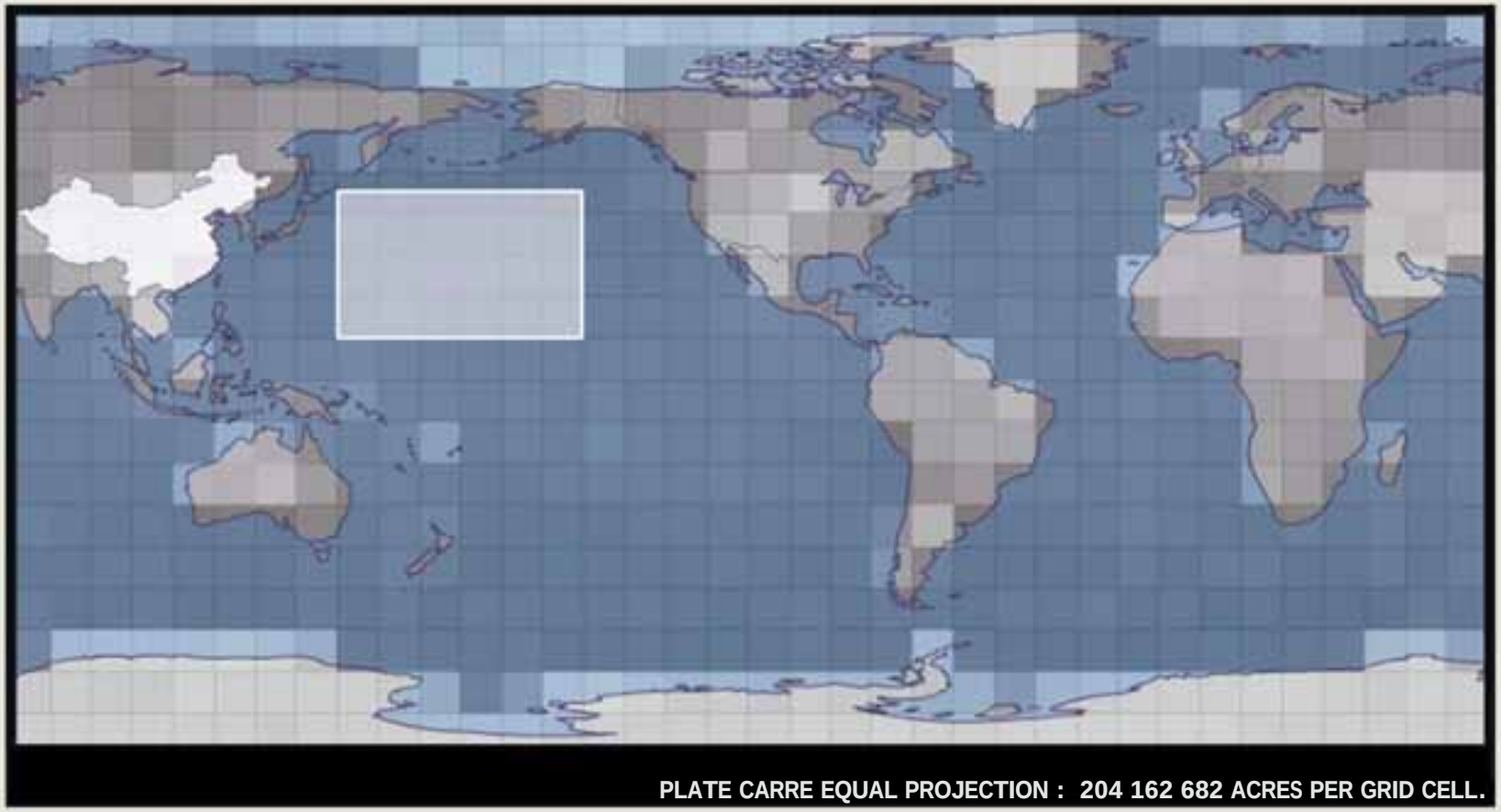
LIFE CYCLE FOOTPRINT



U.S. FOOTPRINT NEEDS

INTERNAL CAPACITY	**17.8 cells**
DEFICIT	**48 cells**

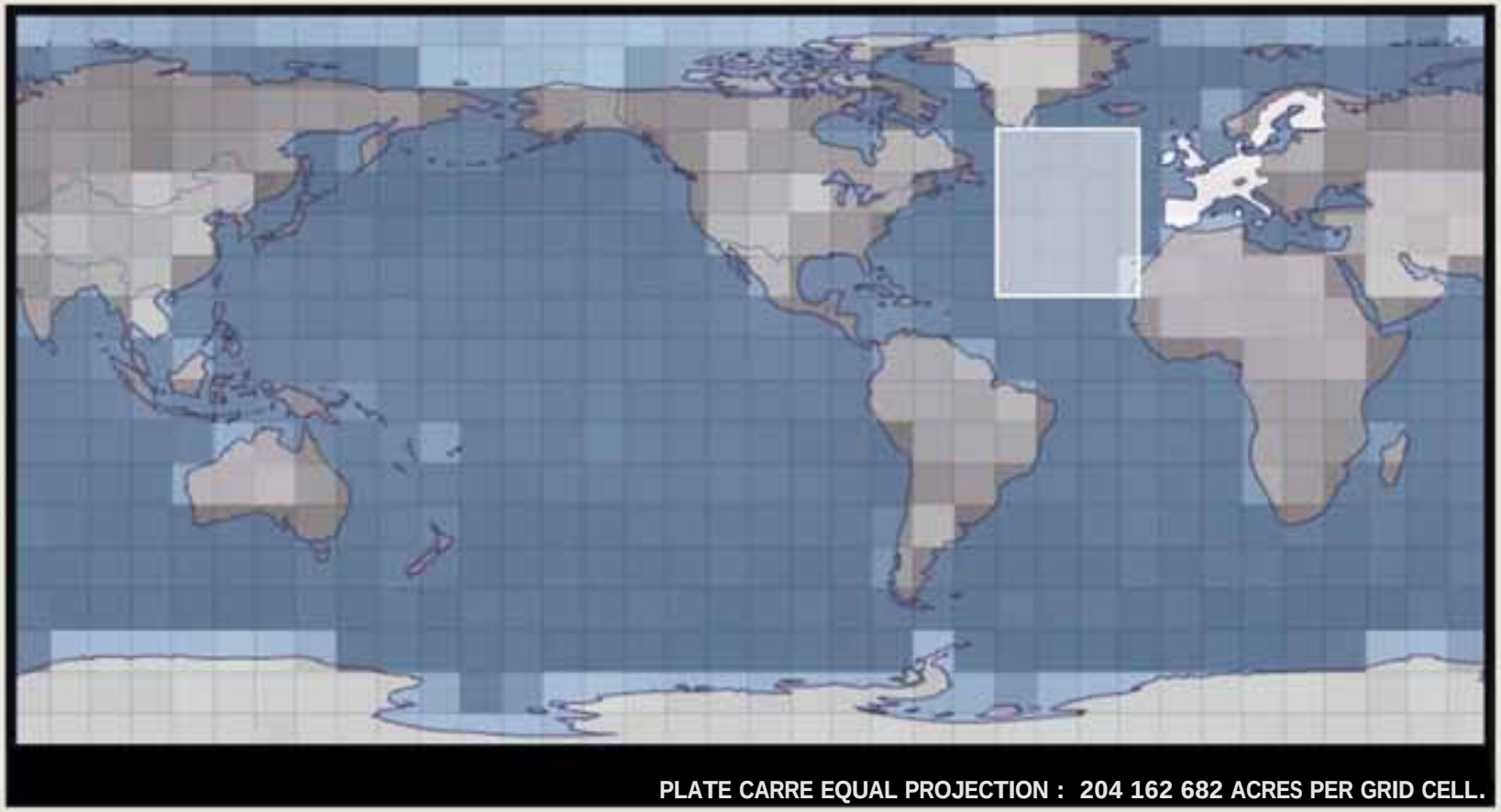
SOURCE: LIVING PLANET REPORT



CHINA'S FOOTPRINT NEEDS

BIO- CAPACITY	8.9 cells
DEFICIT	12 cells

SOURCE: LIVING PLANET REPORT



EUROPE'S FOOTPRINT NEEDS

BIO- CAPACITY	10.5 cells
DEFICIT	10.5 cells

SOURCE: LIVING PLANET REPORT

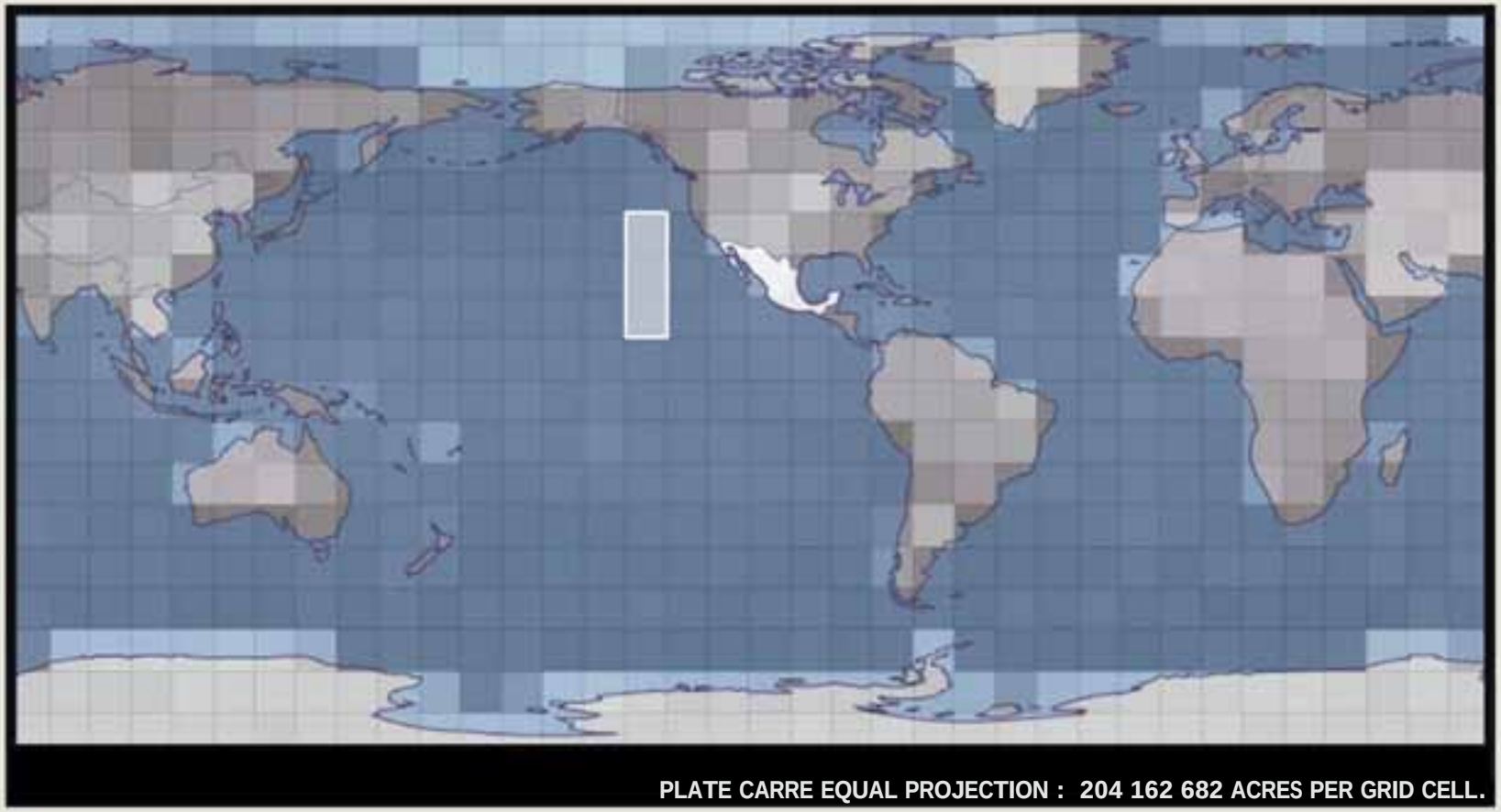
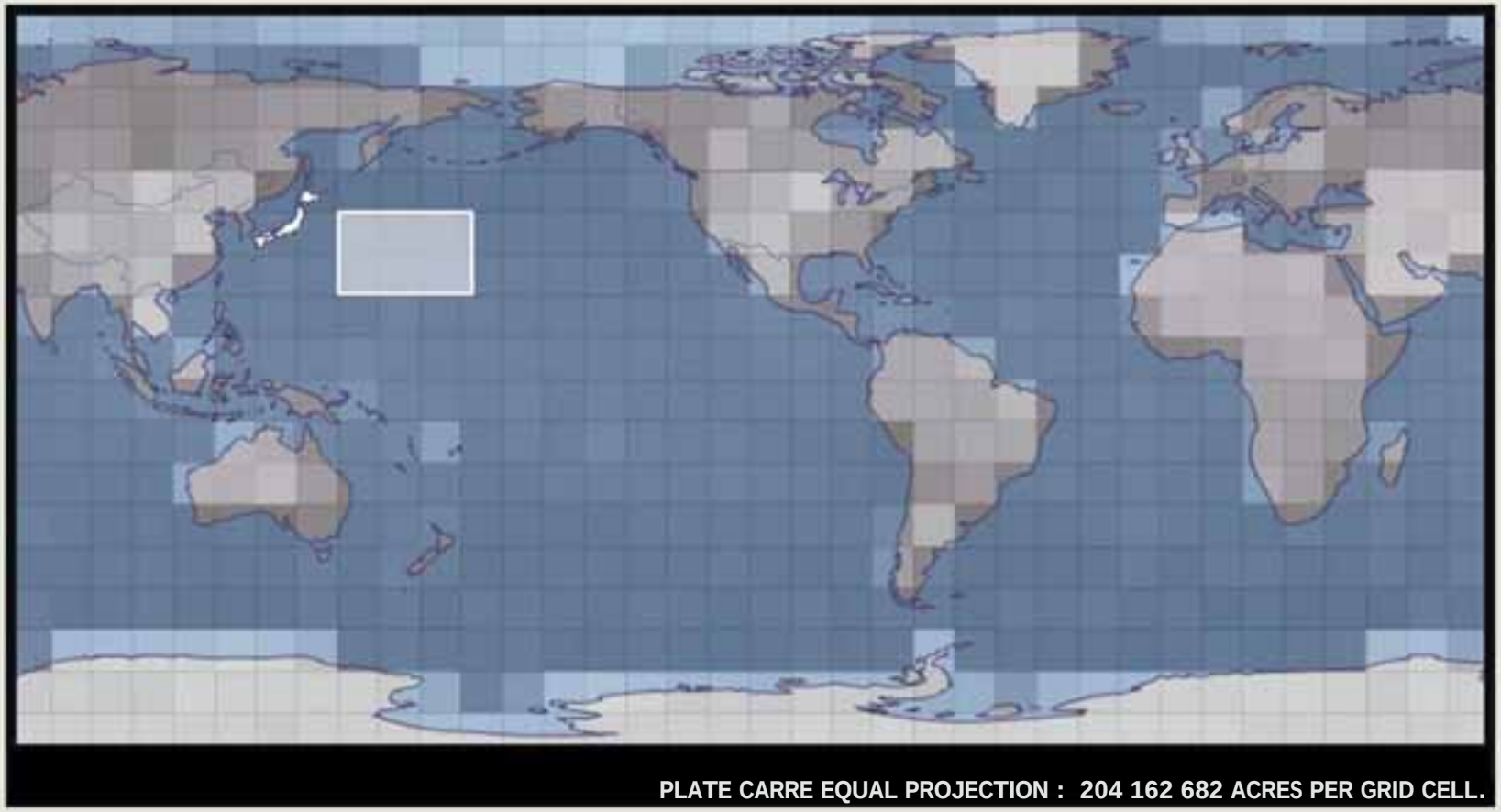


PLATE CARRE EQUAL PROJECTION : 204 162 682 ACRES PER GRID CELL.

MEXICO'S FOOTPRINT NEEDS

BIO - CAPACITY	1.3 cells
DEFICIT	1.4 cells

SOURCE: LIVING PLANET REPORT



JAPAN'S FOOTPRINT NEEDS

BIO - CAPACITY	1 cells
DEFICIT	5.3 cells

SOURCE: LIVING PLANET REPORT

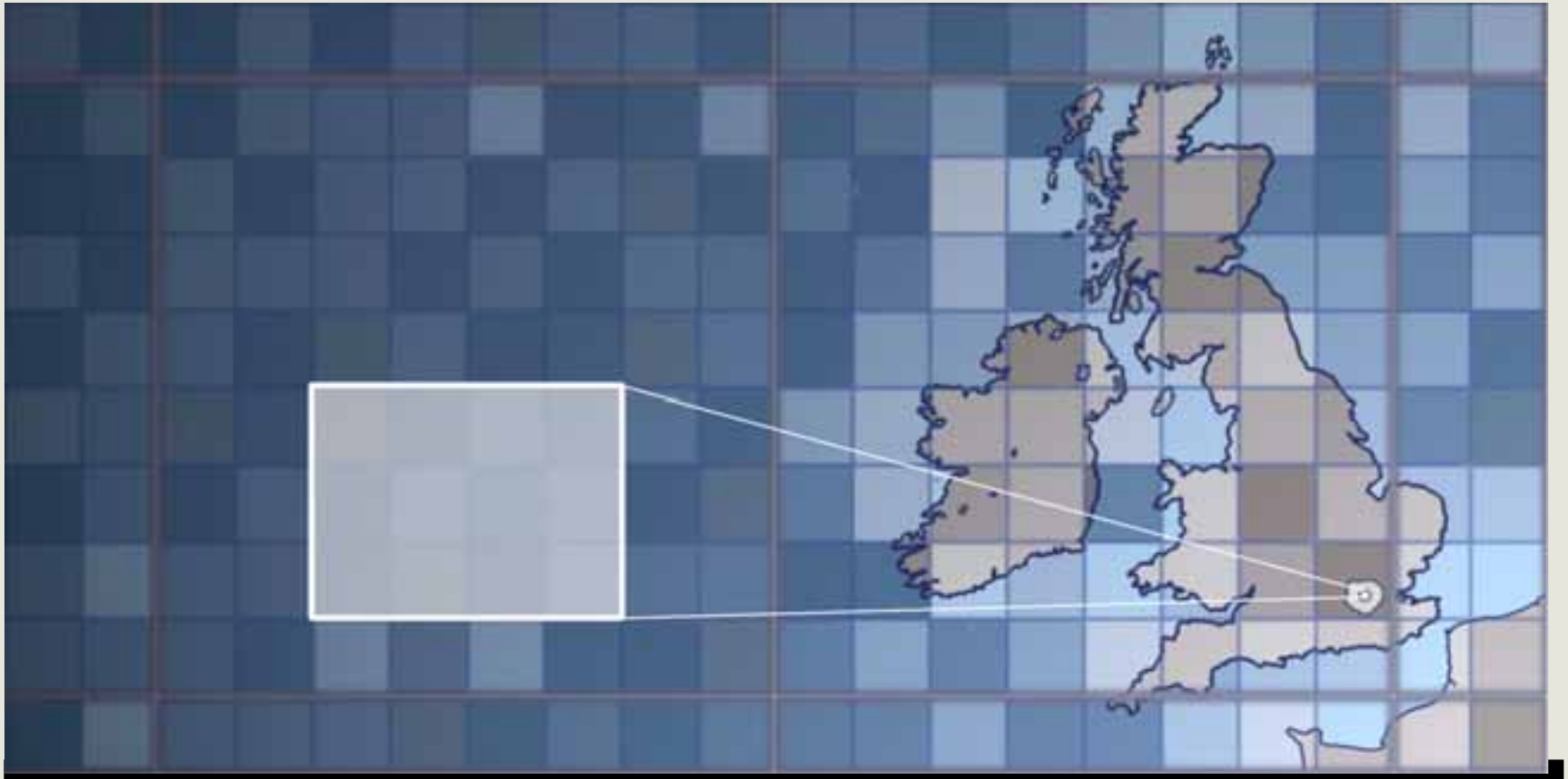


Plate carre equal projection : 3 190 130 acres per grid cell.

LONDON ENGLAND'S FOOTPRINT NEEDS

Biocapacity	0.1 cells
Deficit	11.6 cells

LONDON'S ECOLOGICAL DEFICIT FOOTPRINT

Source: Sharing

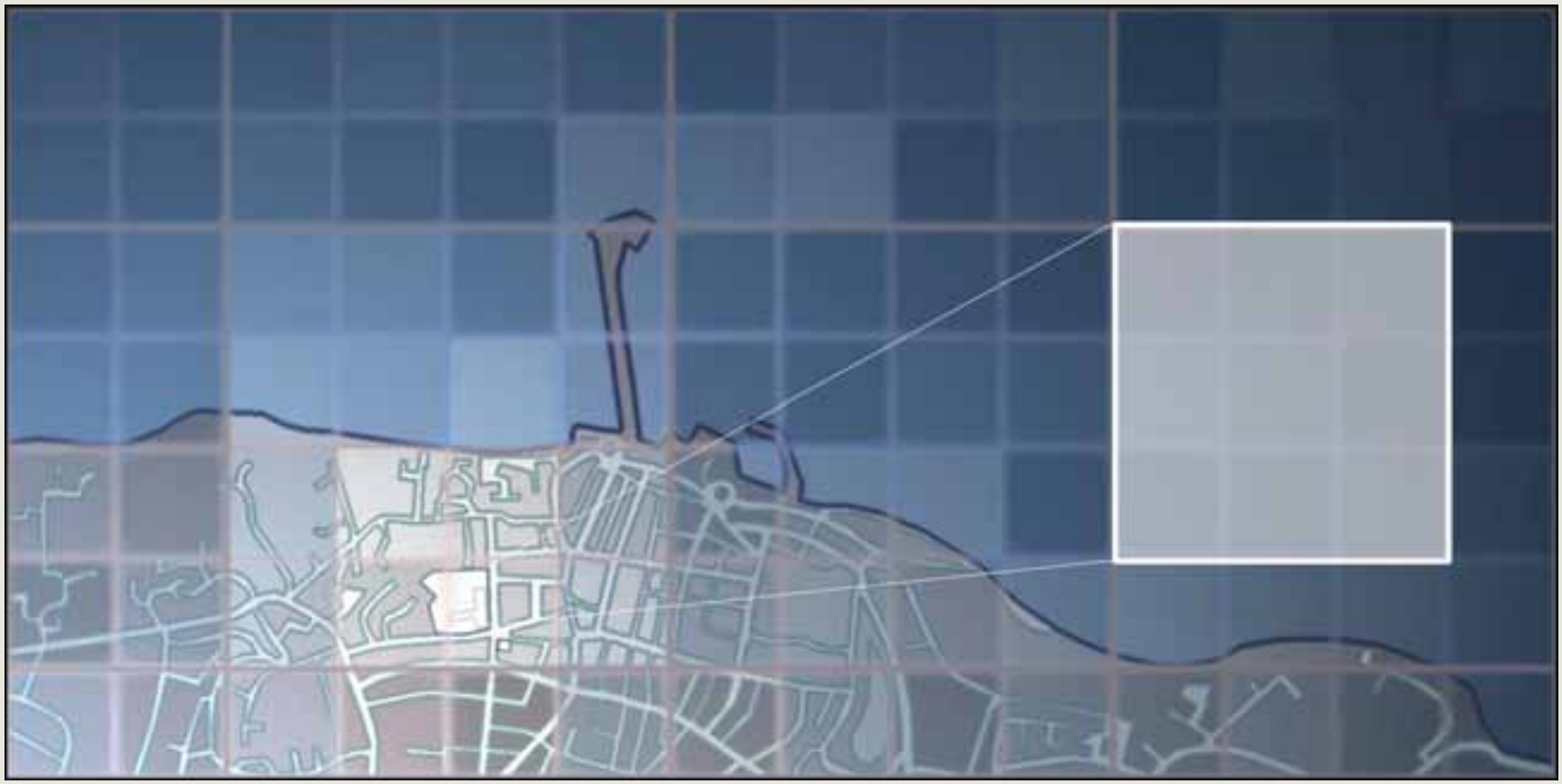
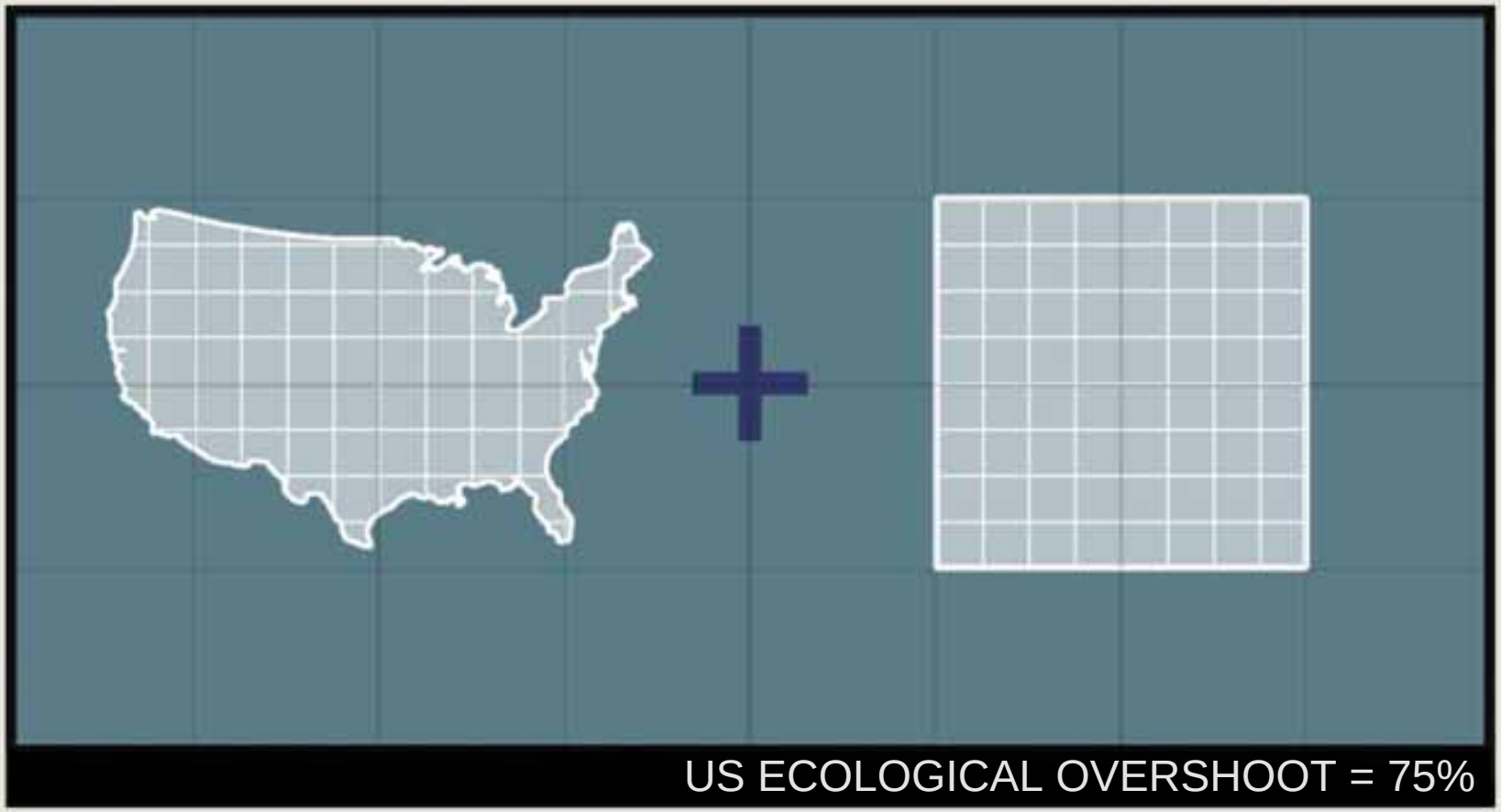


Plate carre equal projection : 40 acres per grid cell.

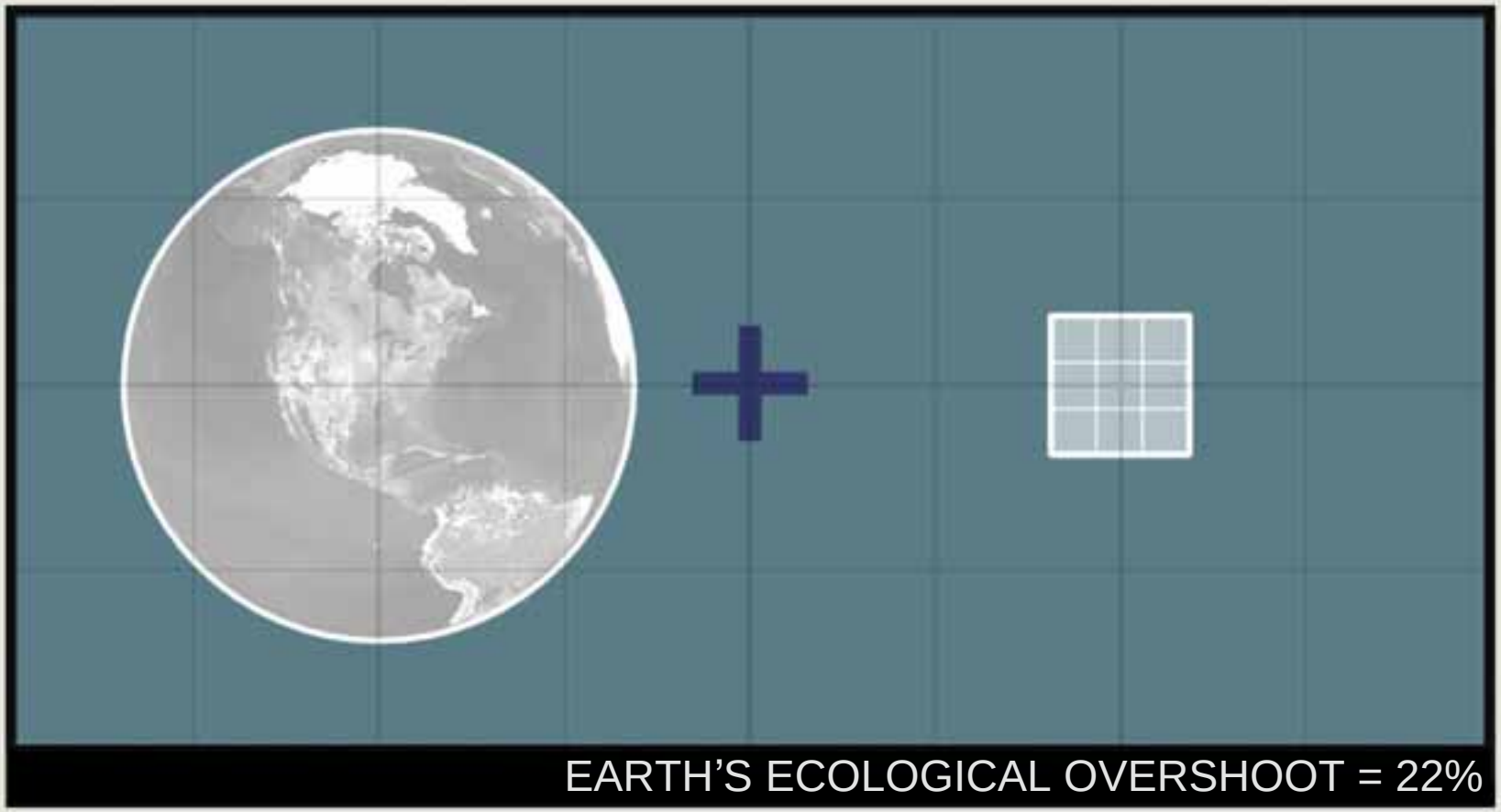
UNIVERSITY CAMPUS FOOTPRINT NEEDS

Biocapacity	**0.25 cells**
Deficit	**9 cells**

CAMPUS' ECOLOGICAL DEFICIT FOOTPRINT



SOURCE: LIVING PLANET REPORT



SOURCE: LIVING PLANET REPORT

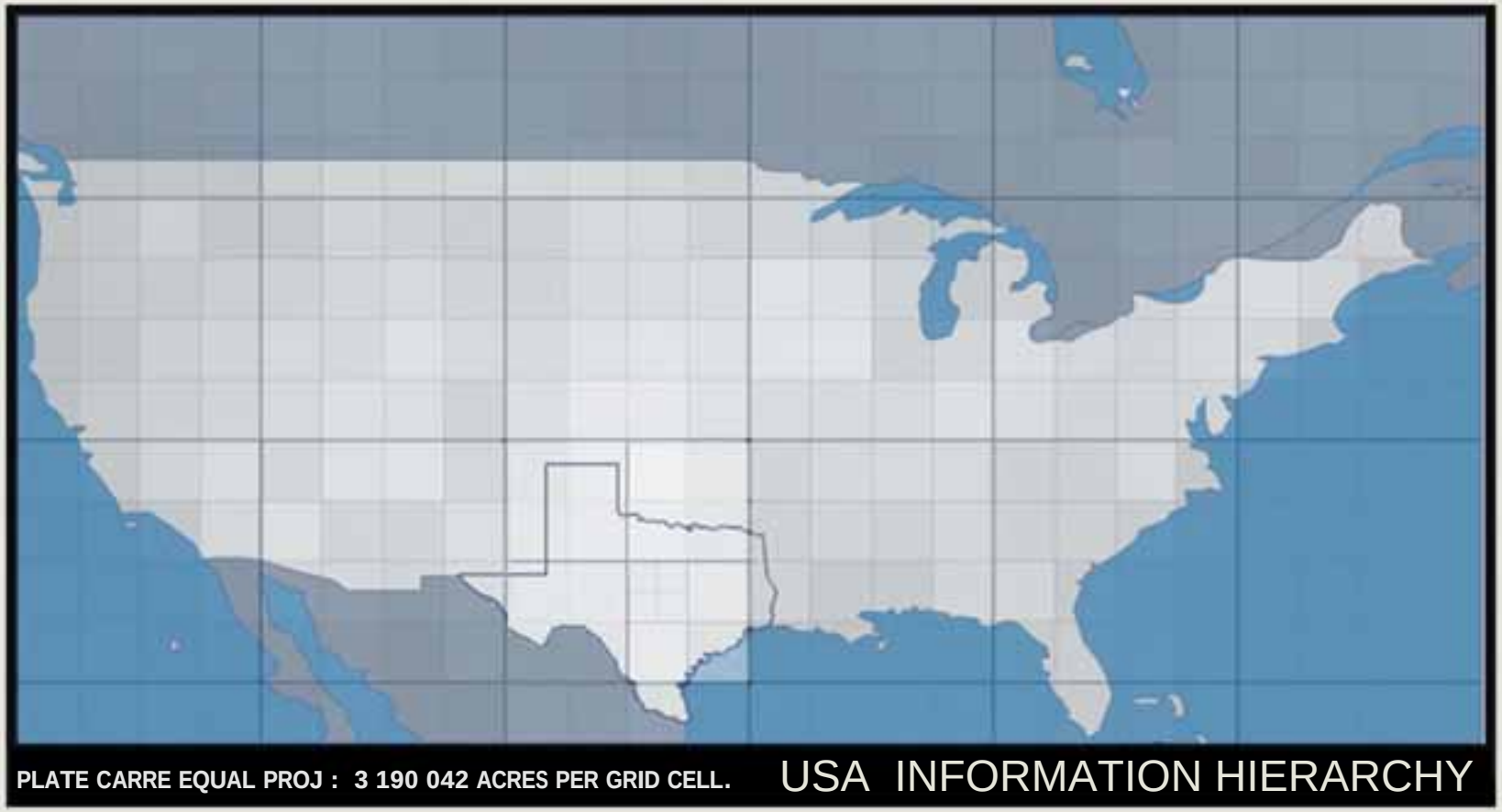


PLATE CARRE EQUAL PROJ : 3 190 042 ACRES PER GRID CELL.

USA INFORMATION HIERARCHY

AIR (CO^2) -imbalanced (21 times area of U.S. s. WWF, CENSUS, NASA)

WATER - Ground recharge, 0.17
- Surface, 0.18
(588% over balanced)

ENERGY -Non- renewable makes up 95% of the total energy supply

MATERIALS -Recycled materials only make up 6% of total

Spatial **Numeric**

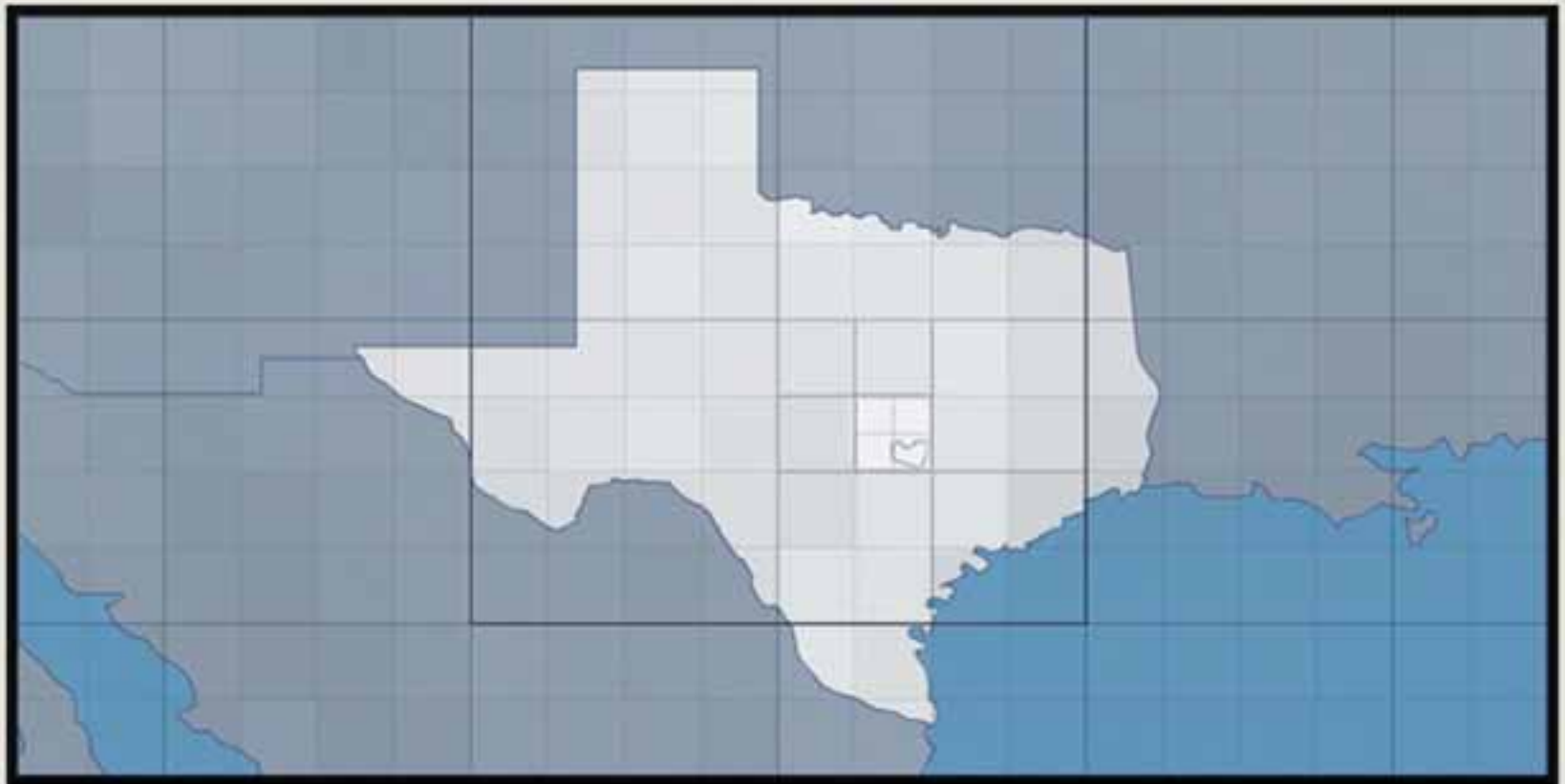


PLATE CARRE EQUAL PROJ : 3 190 042 ACRES PER GRID CELL.

TEXAS INFORMATION HIERARCHY

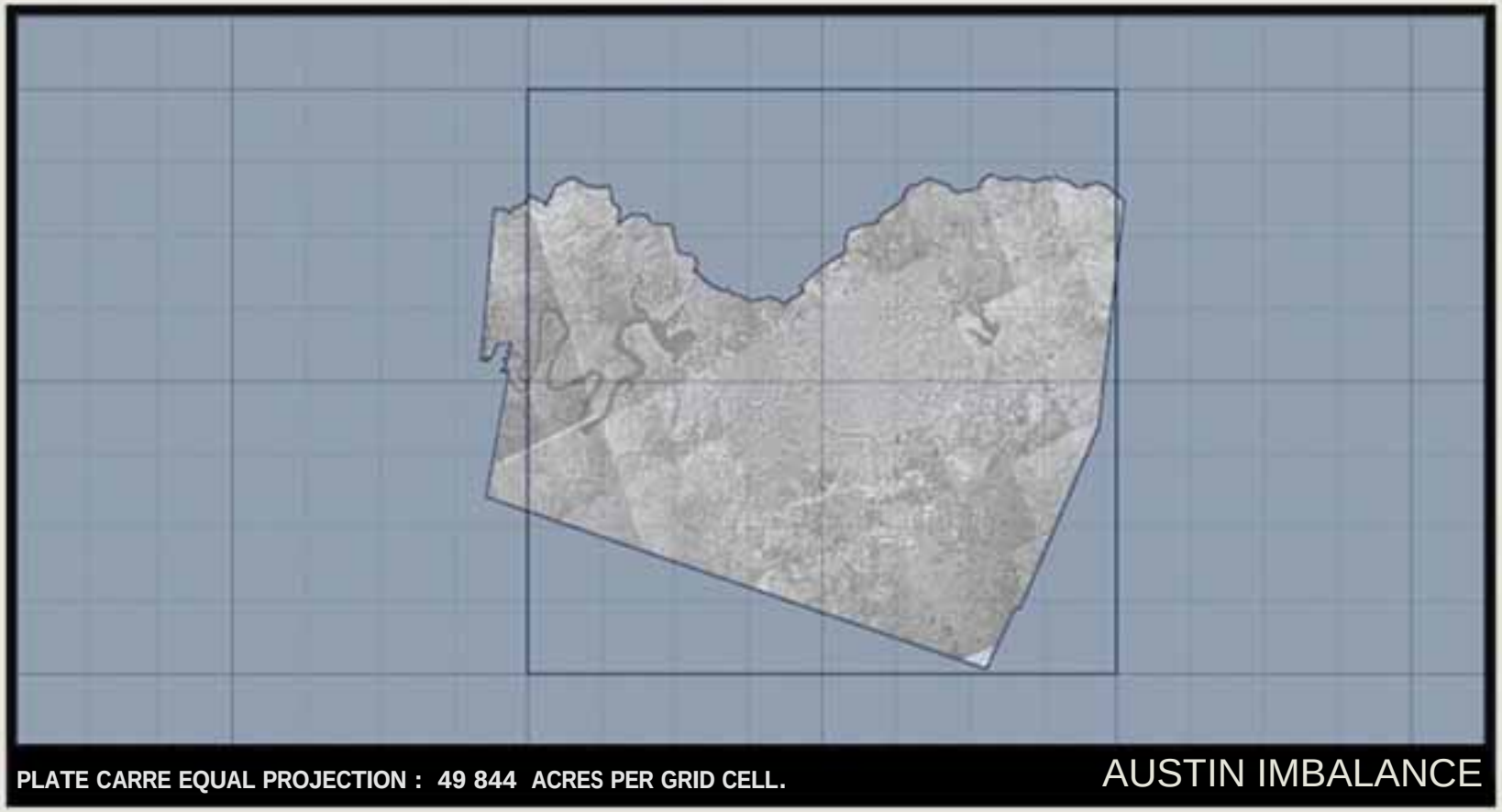
AIR (CO^2) - 8.8 times area of Texas needed

WATER - Ground recharge, 1.67
- Surface, 0.62
(160% imbalanced)

ENERGY -only .7% renewable (potential within state according to governors energy office could supply 25 times the present population of Texas

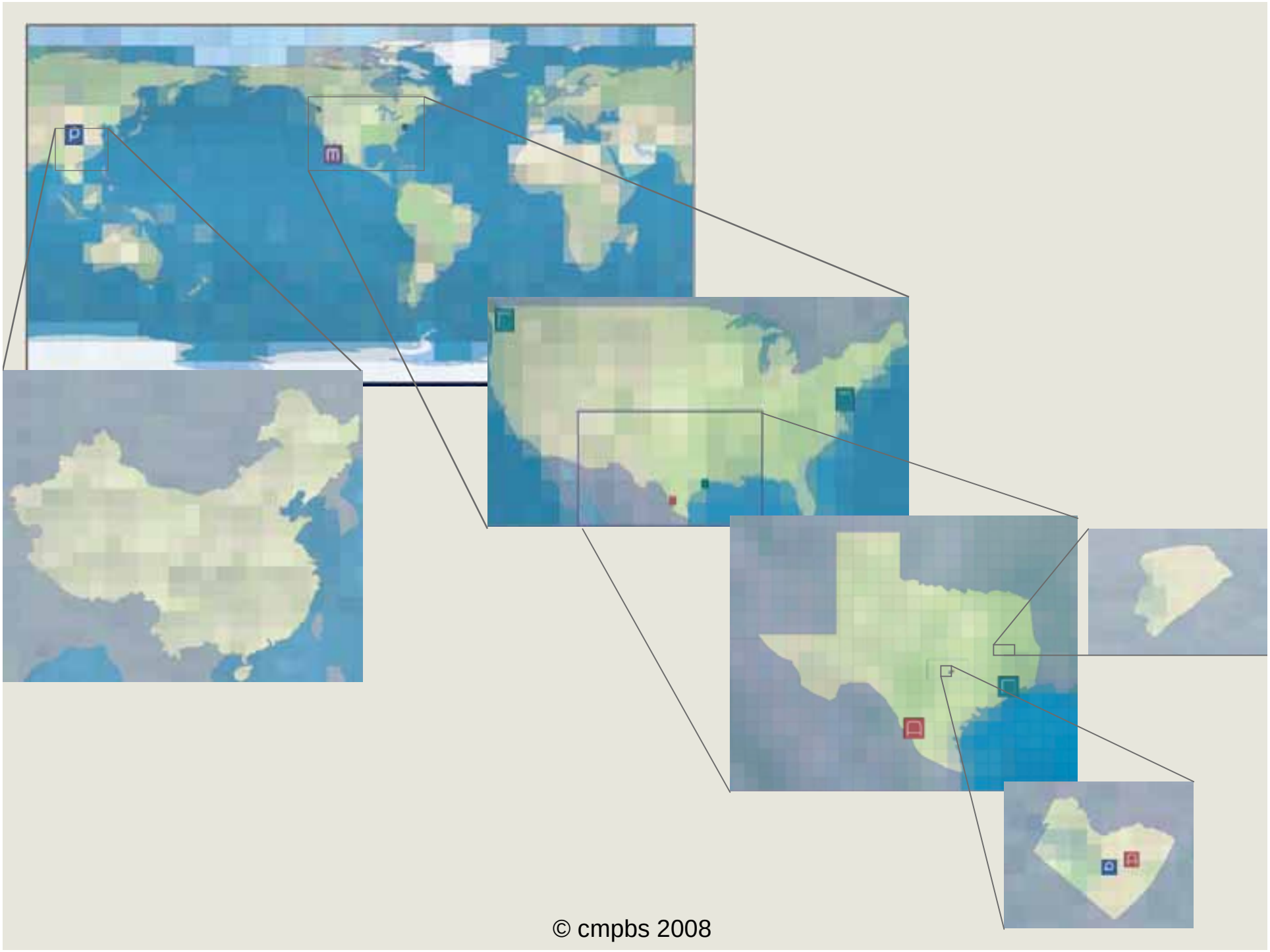
MATERIALS - N/A

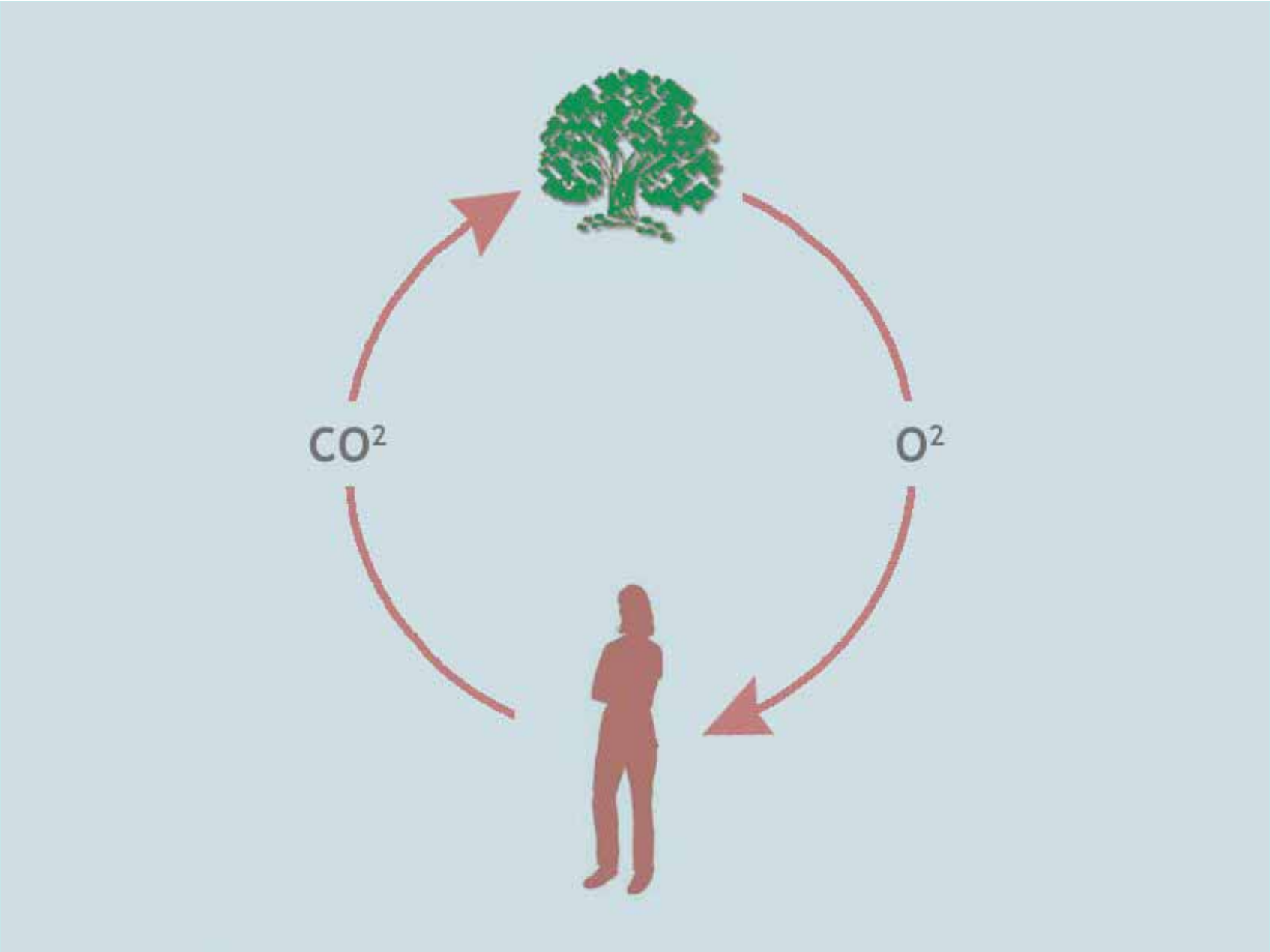
Spatial **Numeric**



AIR (CO^2)	- 62% tree cover loss*
ENERGY	- Renewable 4% of total
WATER	- 56% worse in water use
MATERIALS	- Solid waste recycled, 14% reduction*
FOOD	- 57% of local farming reduced*

All Numeric * **All over over ten years**



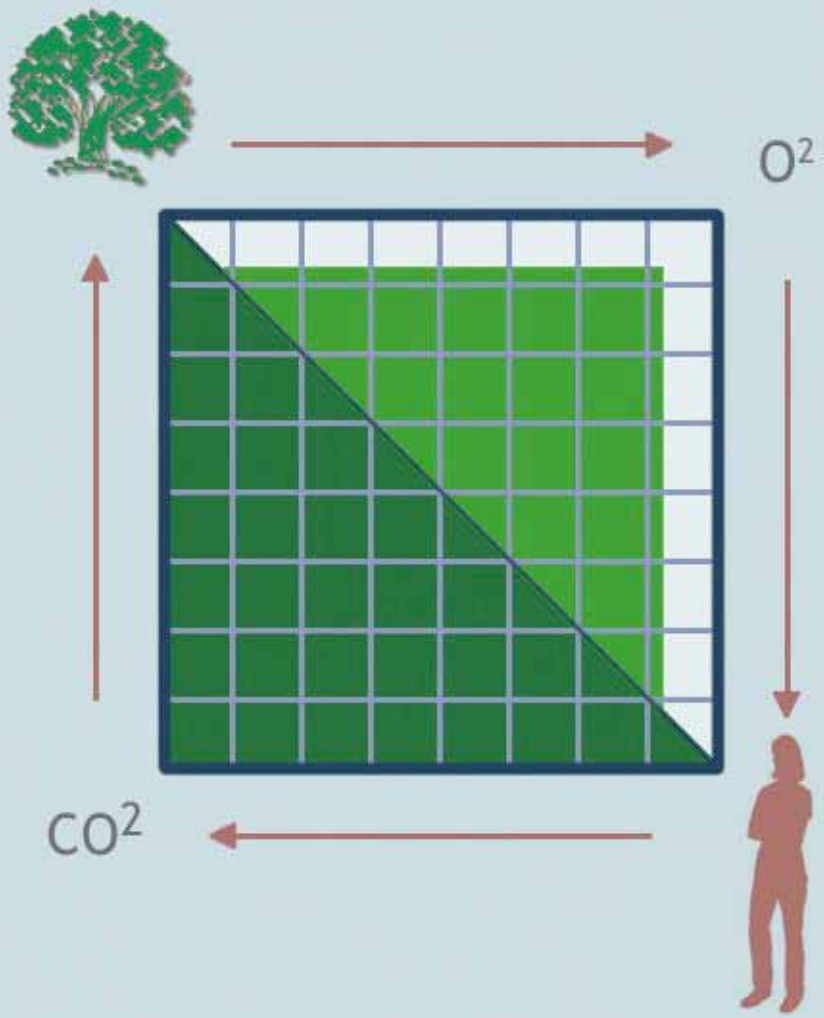


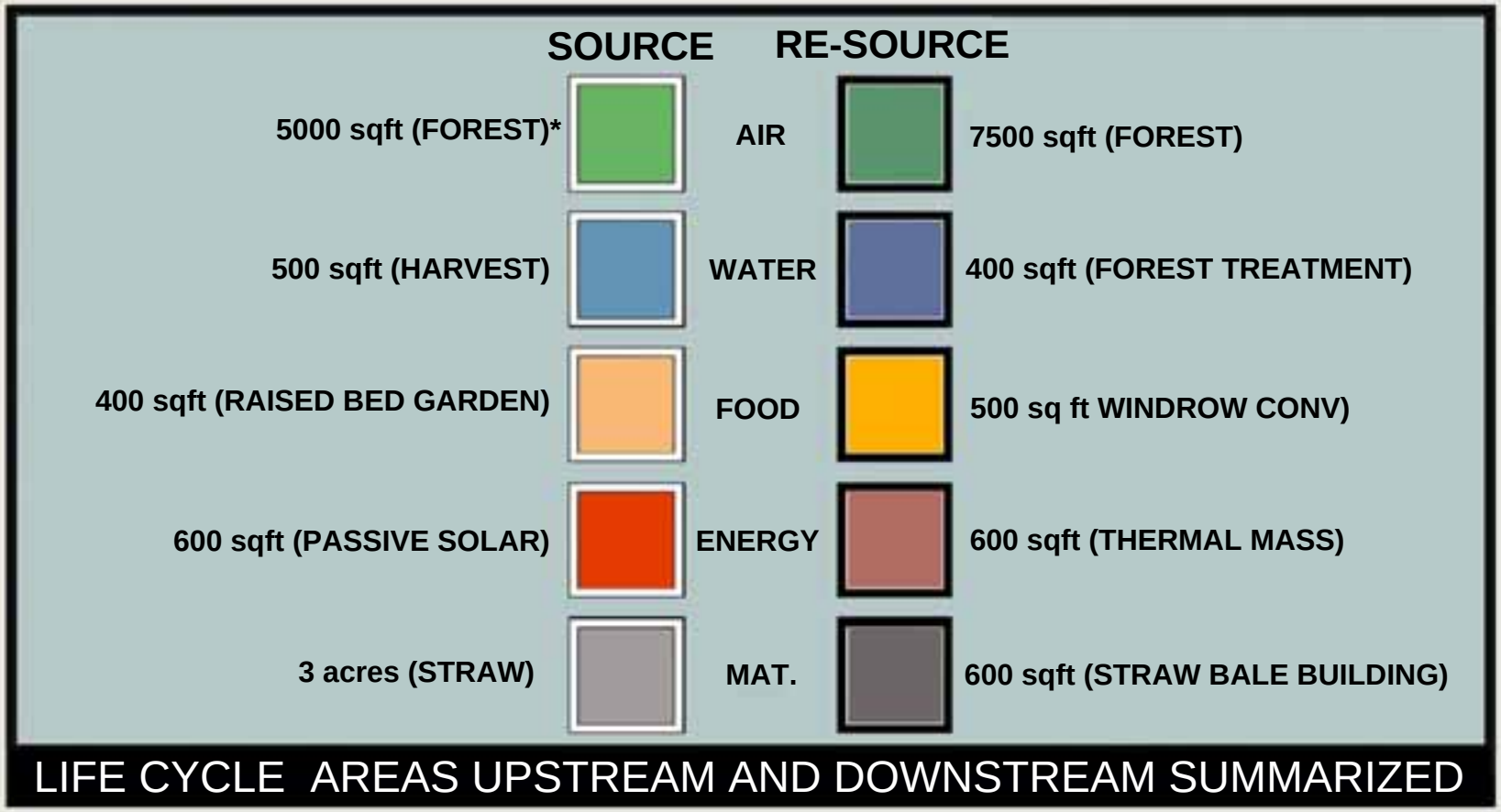
A SIMPLE AIR LIFE CYCLE FOR BREATHING BETWEEN HUMANS AND PLANTS

= 240 SQ.FT.

O_2 PRODUCTION : REQUIRES 5000 SQ.FT OF FOREST PER PERSON

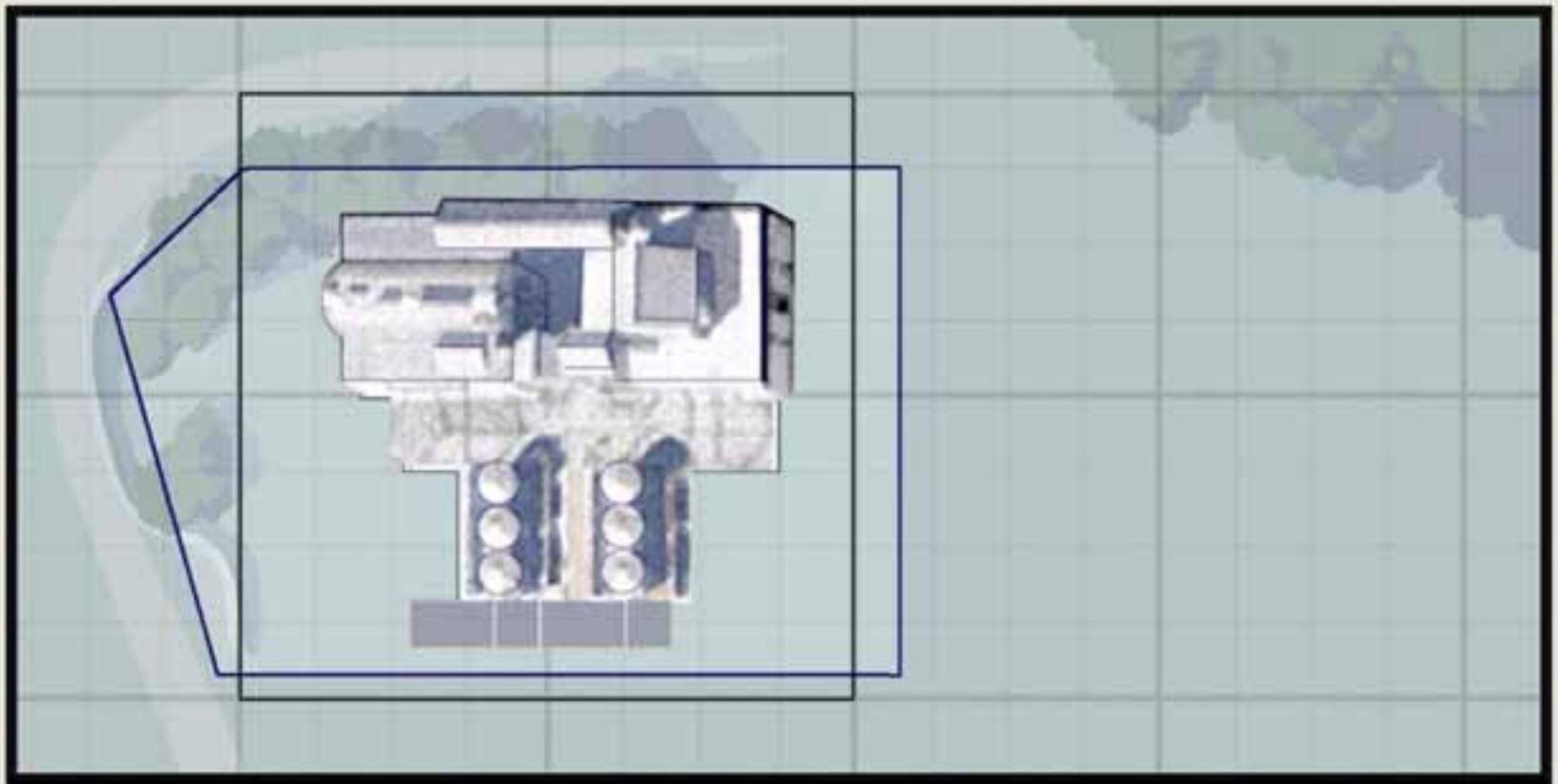
CO_2 ABSORPTION : REQUIRES 7660 SQ.FT OF FOREST PER PERSON



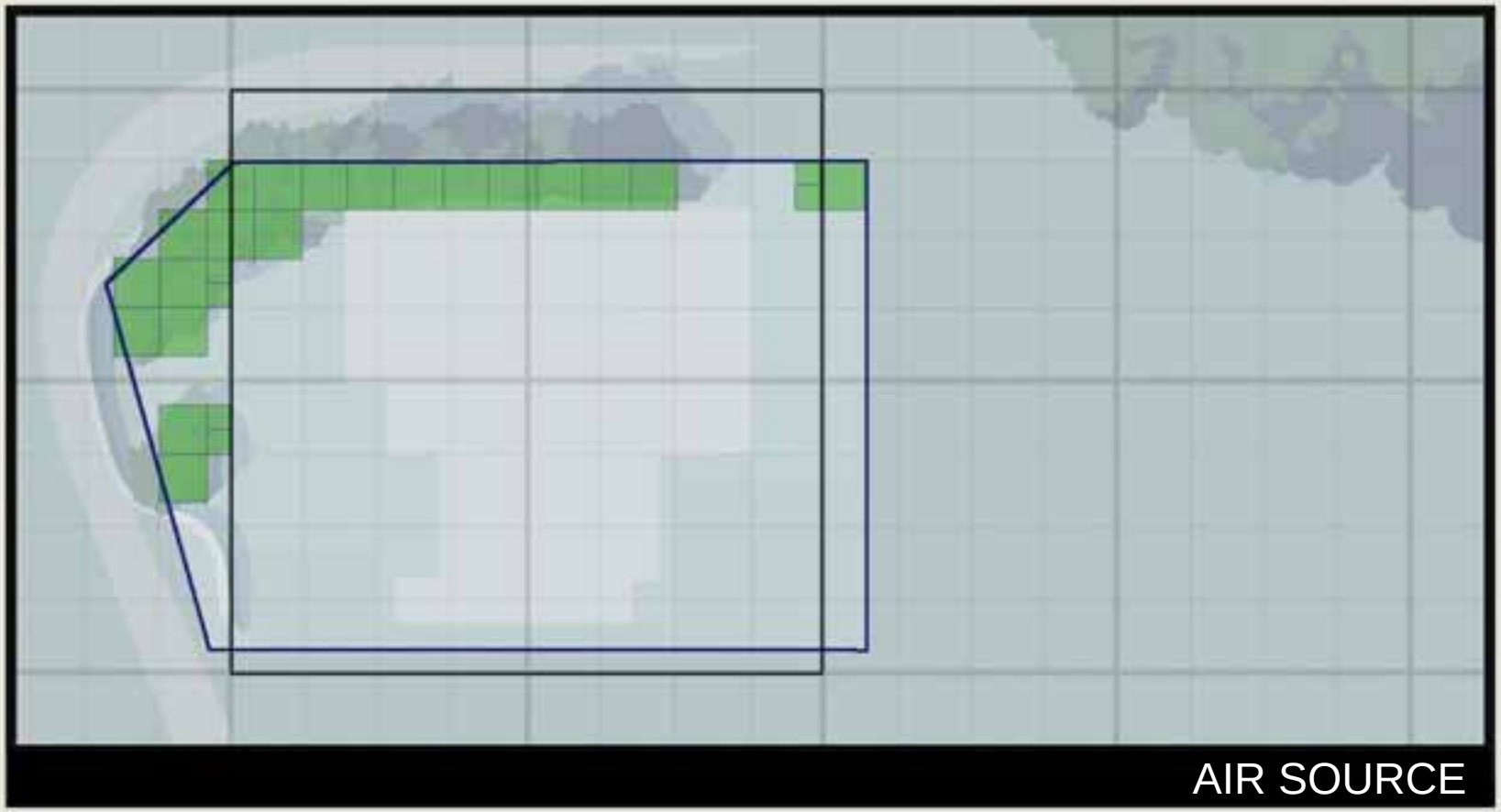


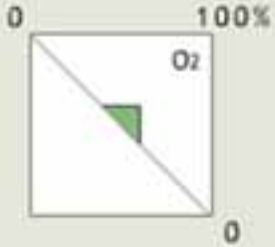
• AREA NEEDED PER PERSO

SOURCES UPON REQUEST

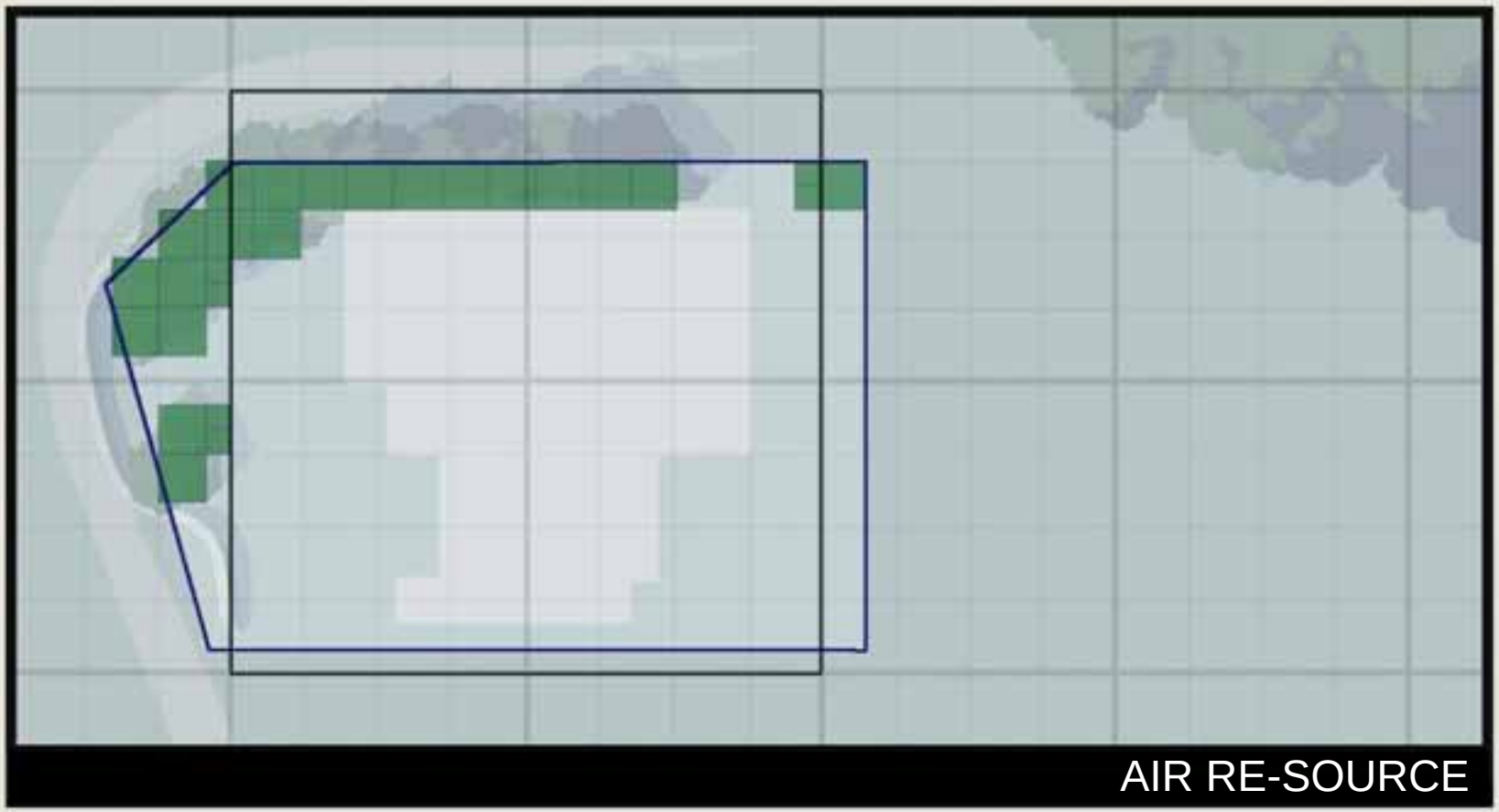


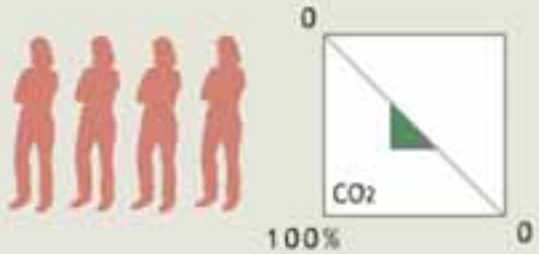
HOME SCALE SITE - QUAD GRID PLANNING UNITS





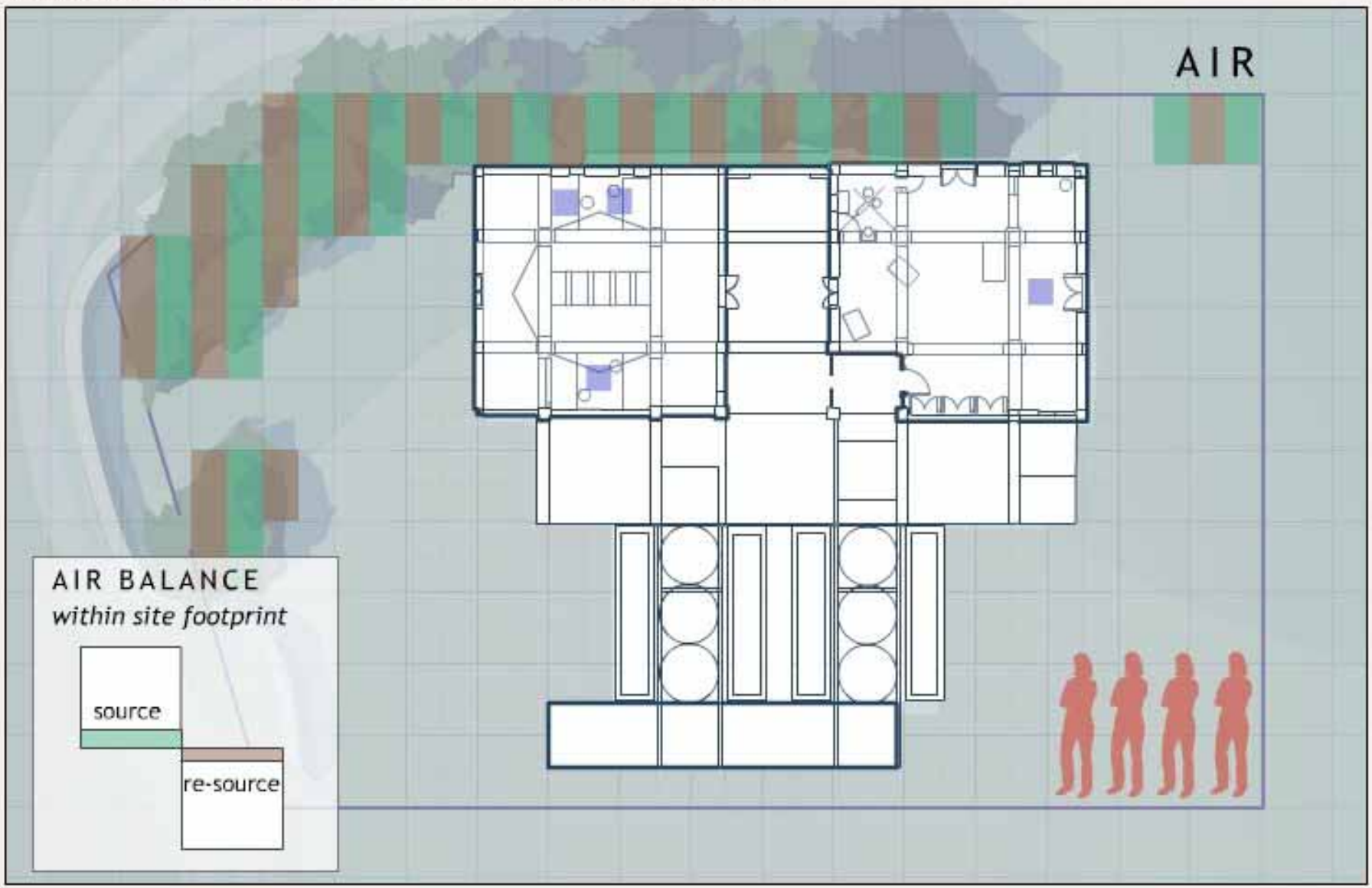
AIR (source) - 0.5% balanced



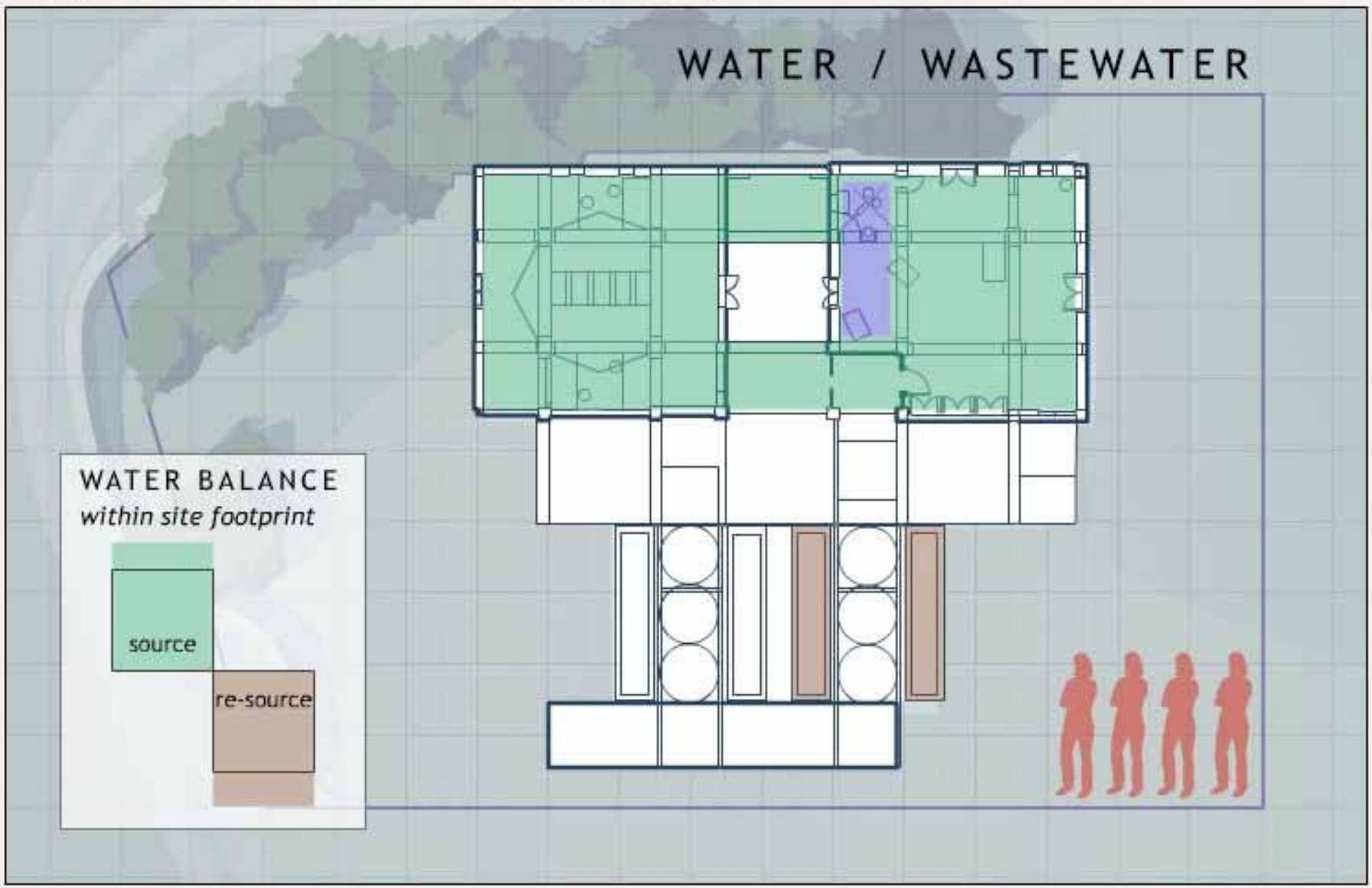


AIR (Re-source) -0.5 % balanced

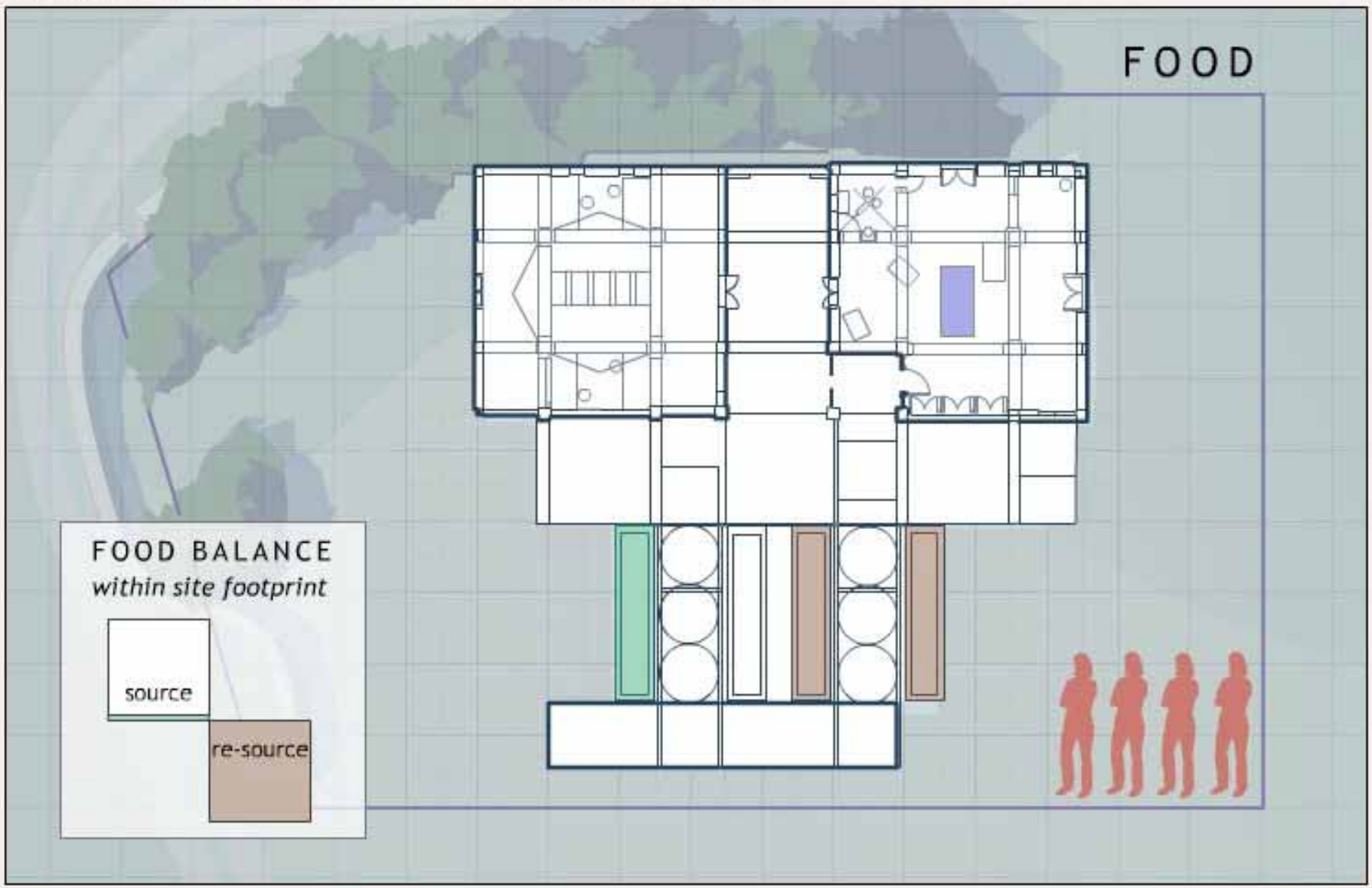
ADVANCED GREEN BUILDER DEMONSTRATION



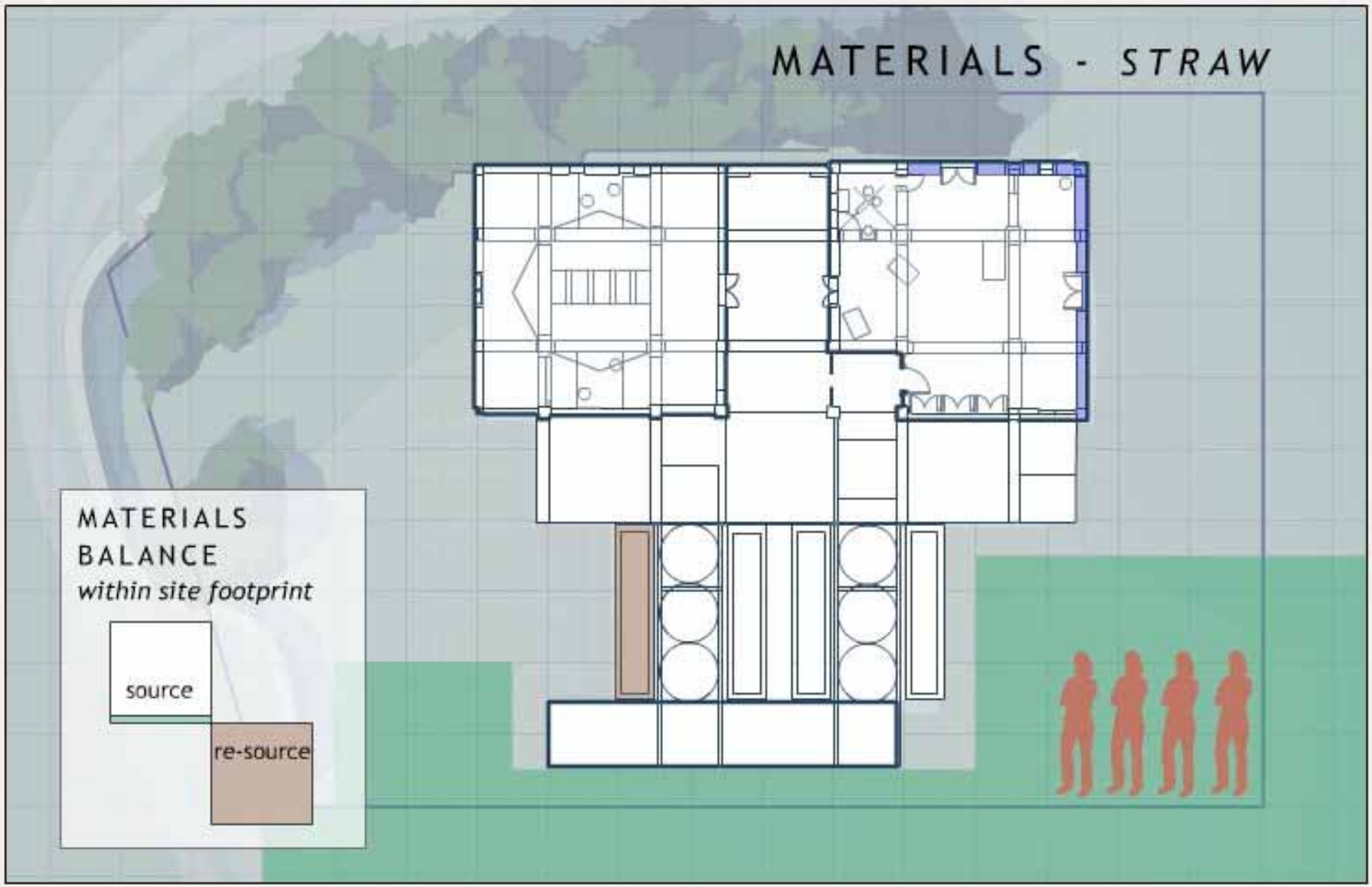
ADVANCED GREEN BUILDER DEMONSTRATION



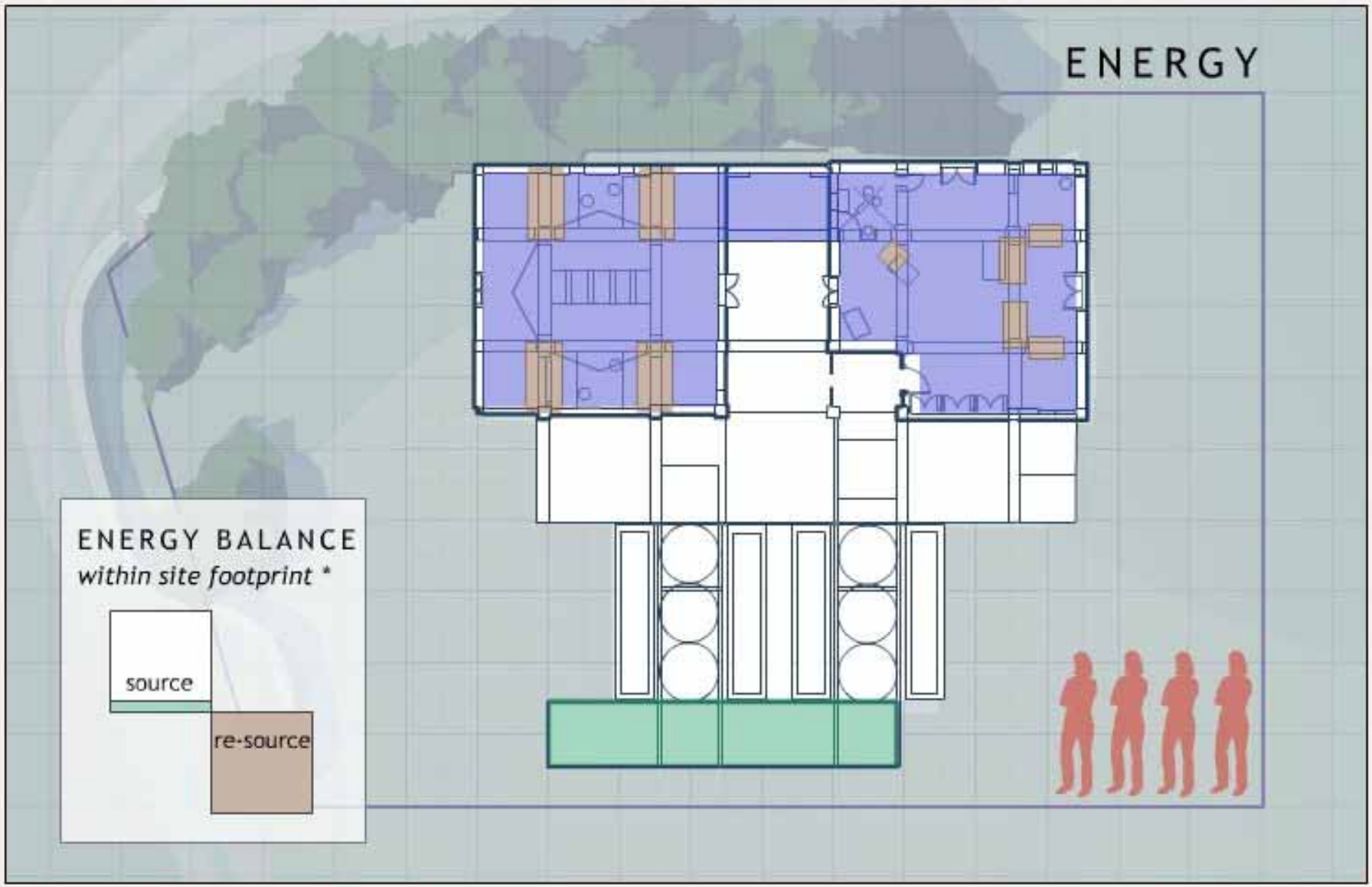
ADVANCED GREEN BUILDER DEMONSTRATION

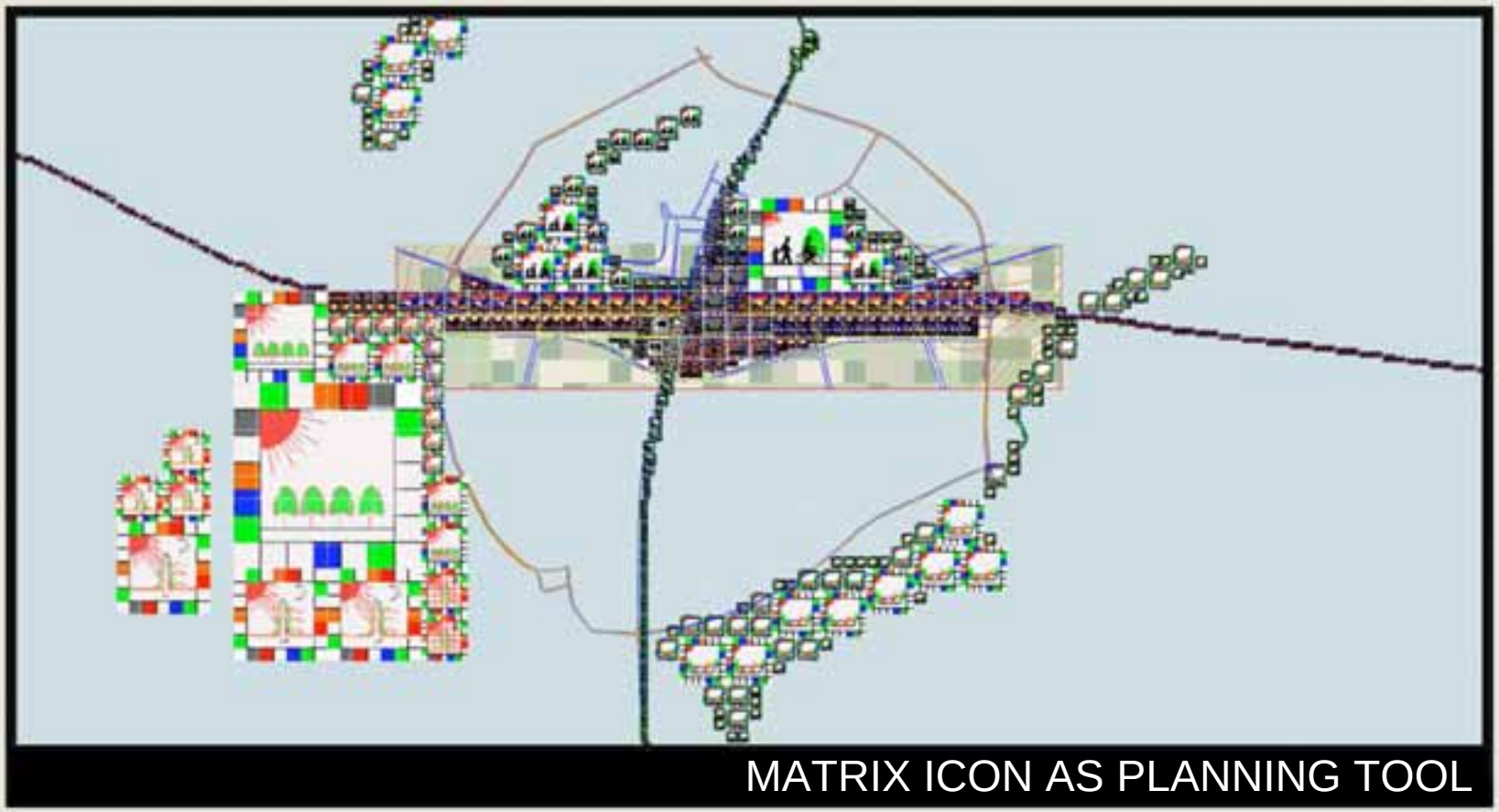


ADVANCED GREEN BUILDER DEMONSTRATION



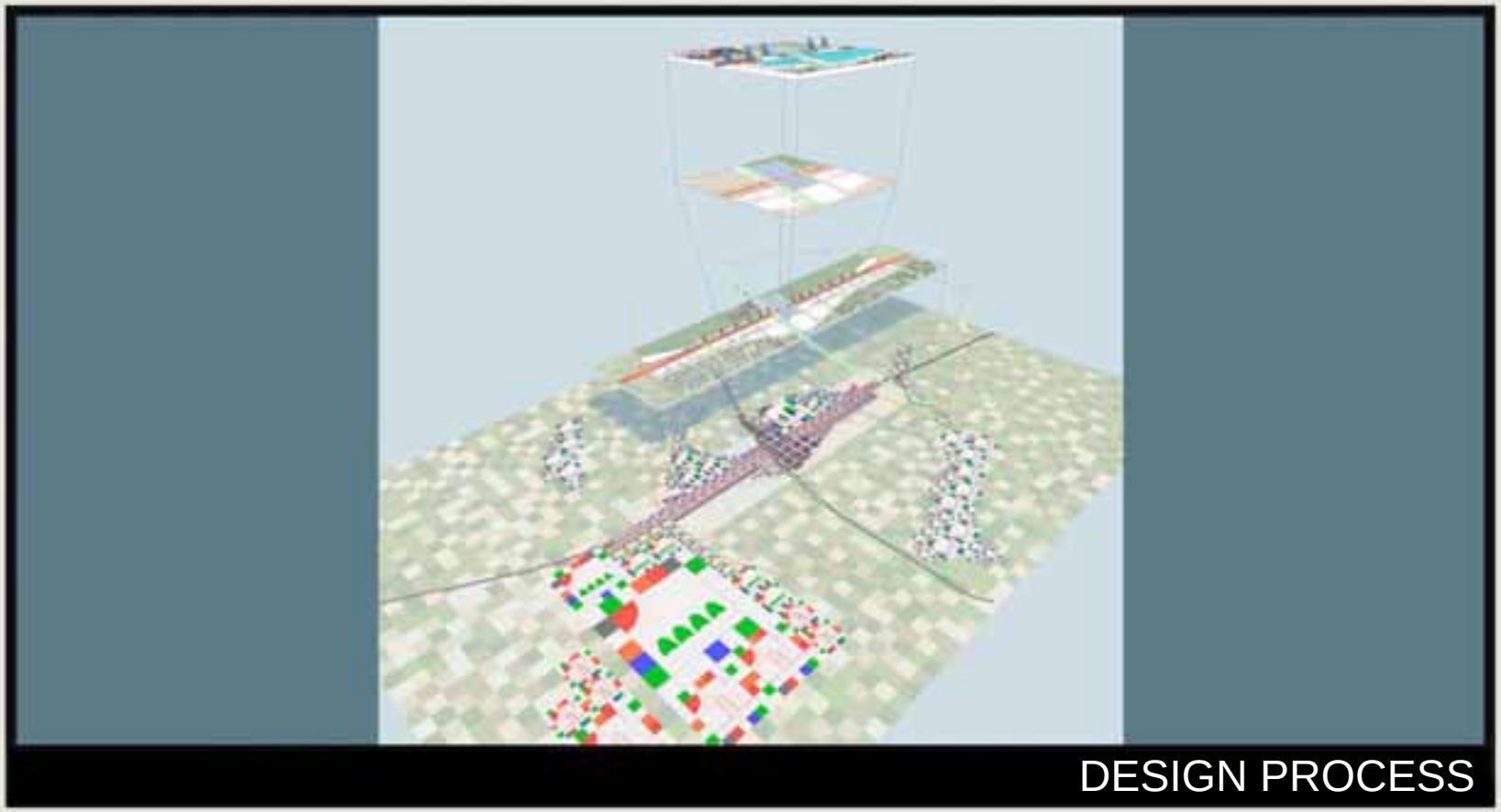
ADVANCED GREEN BUILDER DEMONSTRATION





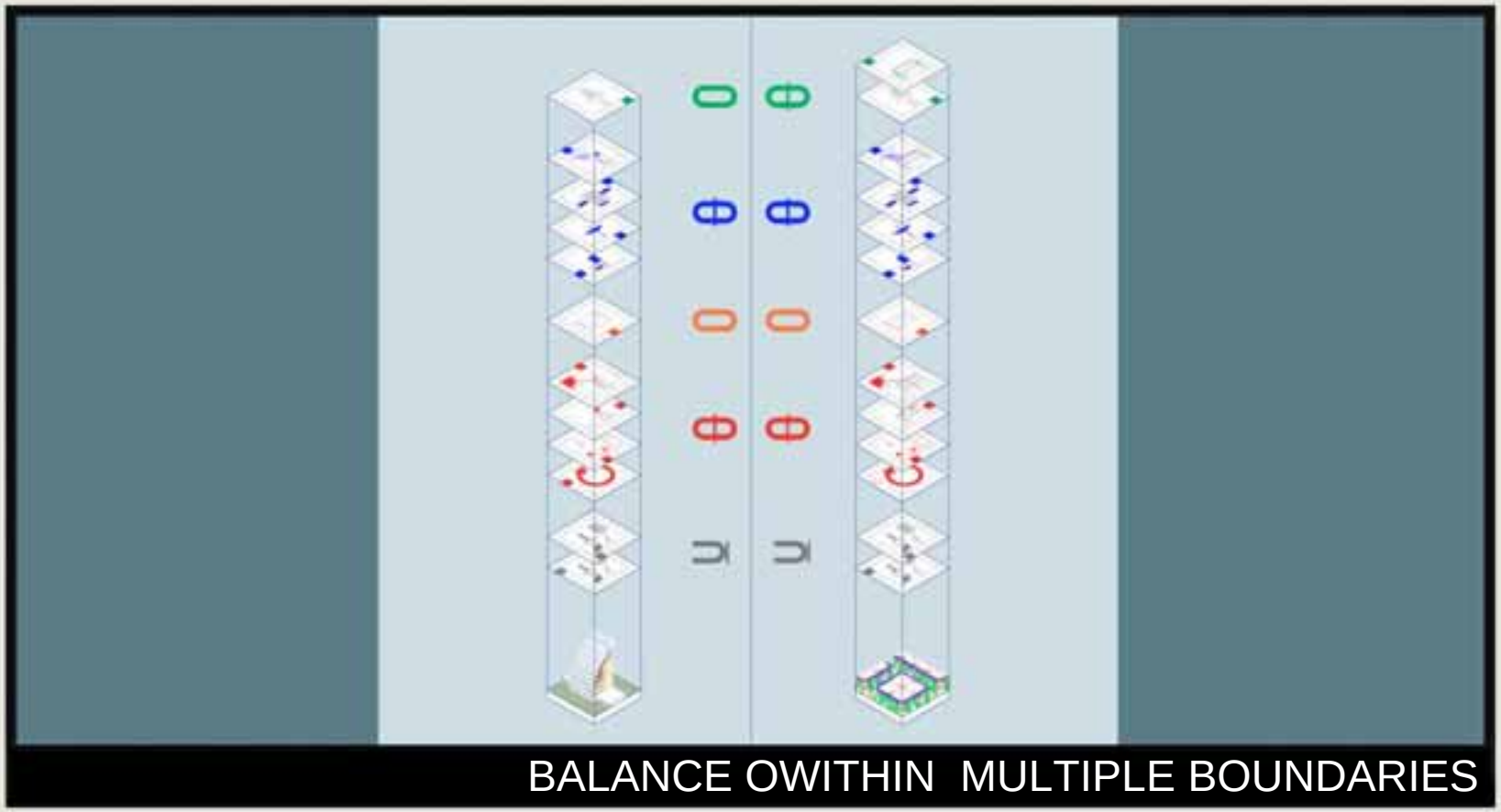
MATRIX ICON AS PLANNING TOOL

OLIVIER MISISCHI & FABIEN PROUVOST



DESIGN PROCESS

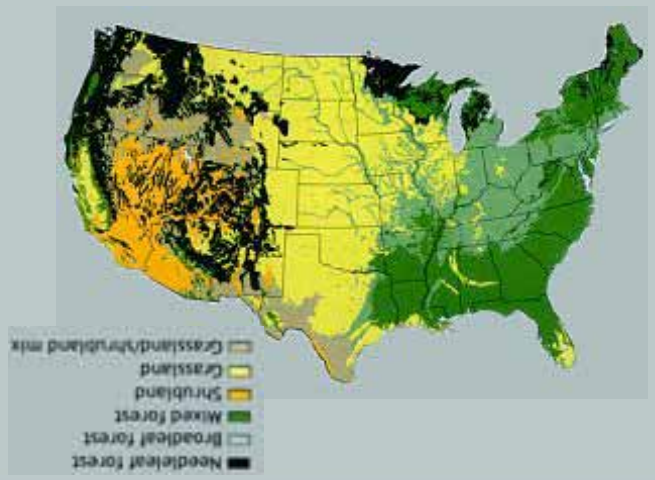
OLIVIER MISISCHI & FABIEN PROUVOST



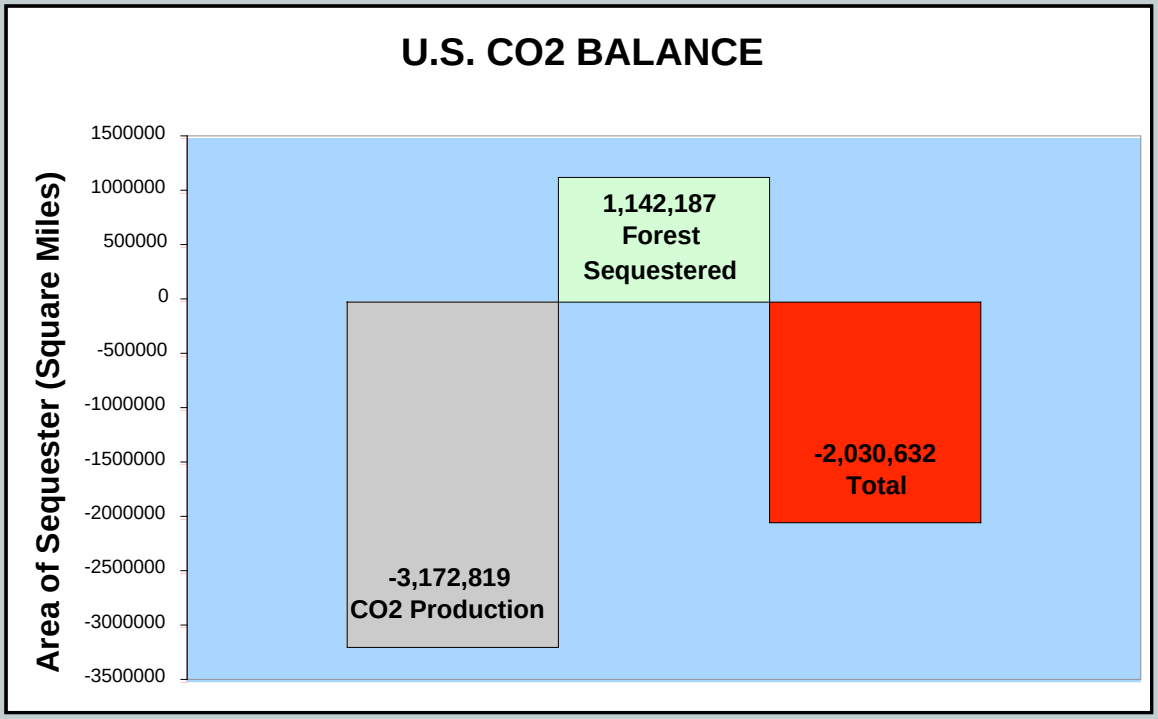
$$\Sigma_{Total} = \Sigma_{Build} + \Sigma_{Local} + \Sigma_{Urban} + \Sigma_{Regional} + \Sigma_{Country} = [\bigcirc + \oplus + \bigcirc + \oplus + \supset\!\mid] + \Sigma_{Local} + \Sigma_{Urban} + \Sigma_{Regional} + \Sigma_{Country} = 0$$

$$\Sigma_{Total} = [\Sigma_{Urban} + \bigcirc + \oplus + \supset\!\mid] + [\Sigma_{Local} + \oplus] + [\Sigma_{regional} + \bigcirc] = 0$$

Vegetation



Human Activity

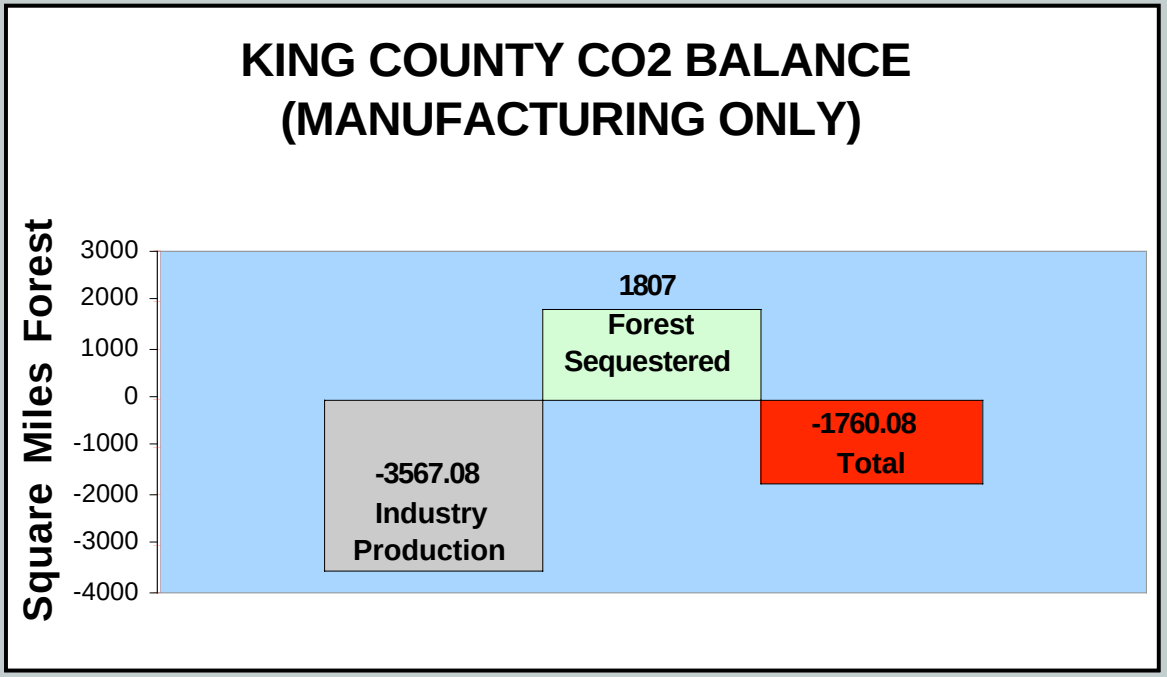


LAND COVER :NATURE TO HUMAN = 2.7 FOLD CO2 IMBALANCE

Source: Sharing Nature's Interest, U.S. Census Bureau, USDA

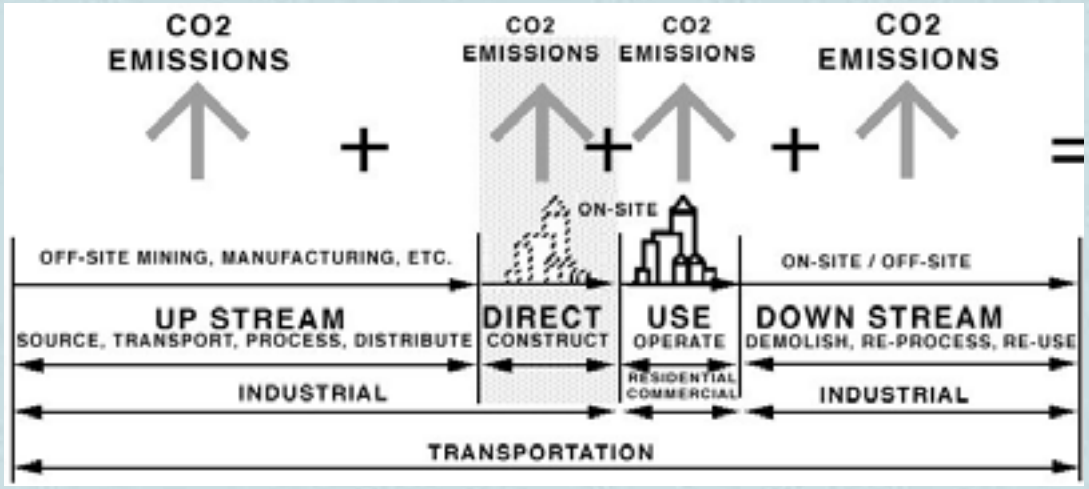
Forest Sequestered

Industry Production



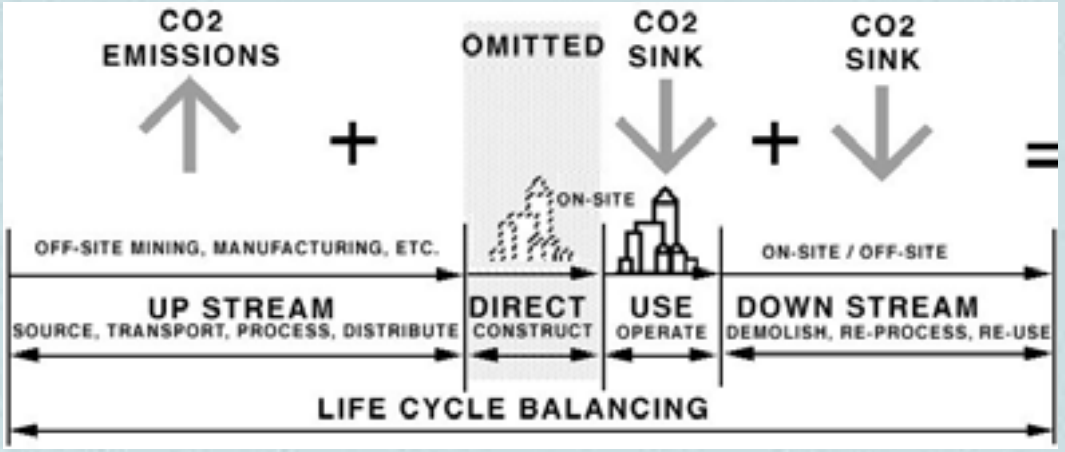
KING COUNTY CO2 BALANCE **(MANUFACTURING ONLY)**

LIFE CYCLE BALANCING - AIR EXAMPLE



+

CO_2 EMISSIONS



0

CO_2 EMISSIONS USING LIFE CYCLE BALANCING

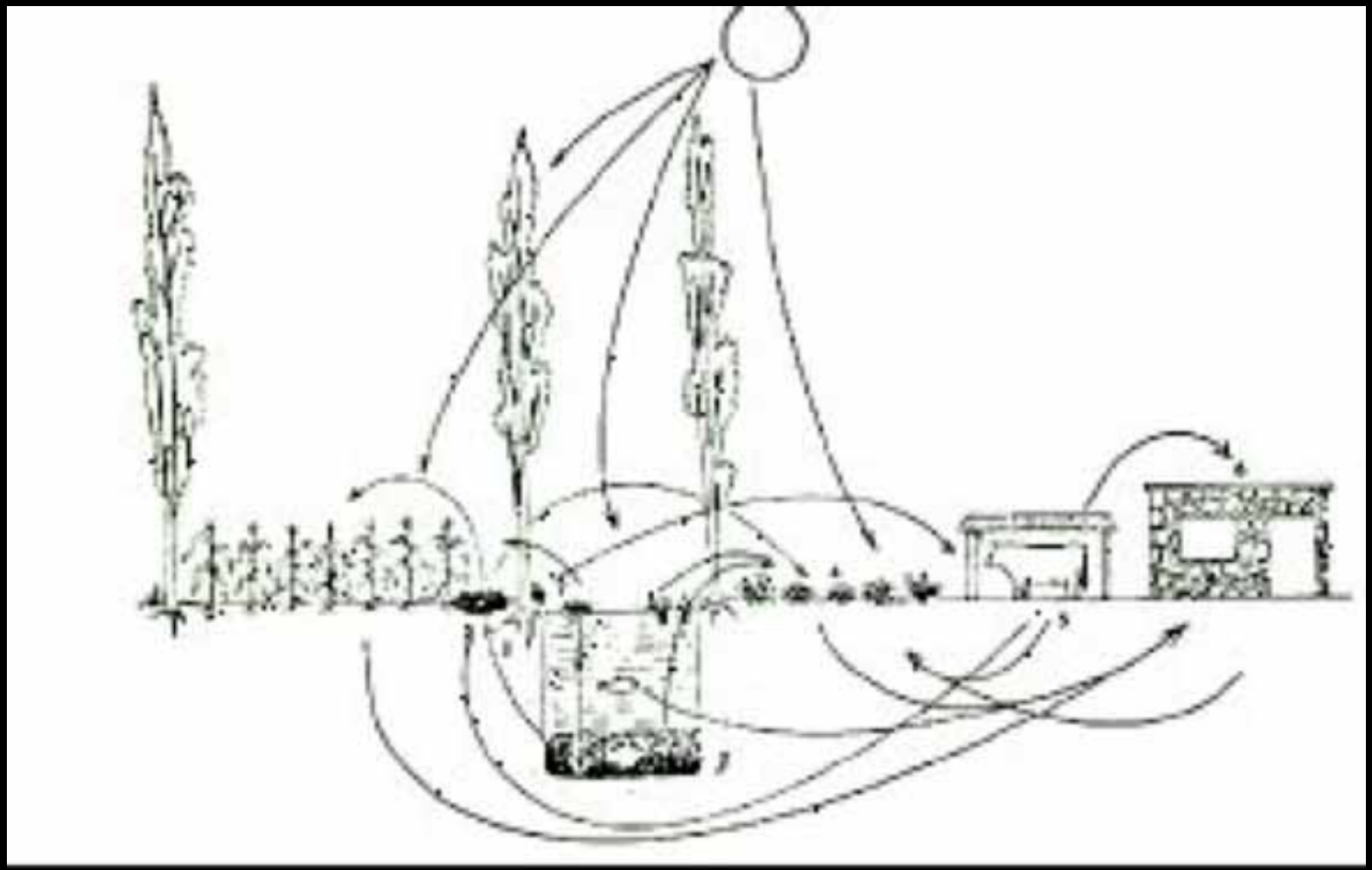
CO_2 emissions occur at every stage of a building's life cycle.
CO_2 balancing may be attained by using long-lasting CO2 sink materials and products.

Despite its complexity, this map of Indian effects on the environment is incomplete. The most important omission is fire. I have highlighted some areas where indigenous fire effectively controlled the landscape, but Indian burning played an important ecological role throughout the hemisphere. Similarly, scattered clearing, burning and earth movement for drainage occurred in all agricultural areas—this map indicates only those areas in which these factors were especially concentrated.

"Before Columbus…the Western Hemisphere held ninety to 112 million people. Another way of saying this is that in 1491 more people lived in the Americas than in Europe." Charles Mann, The Atlantic Monthly

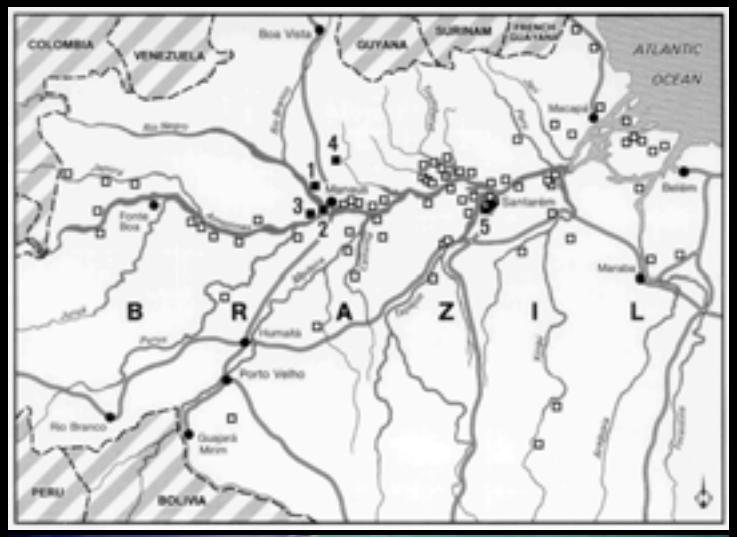
www..charlesmann.org/Images/Humanized%20landscapes-big.jpg

By 1519, the Mexica capital, Tenochtitlan, was the largest city in the world with a population of around 350,000 (although some estimates range as high as 500,000). By comparison, the population of London in 1519 was 80,000 people



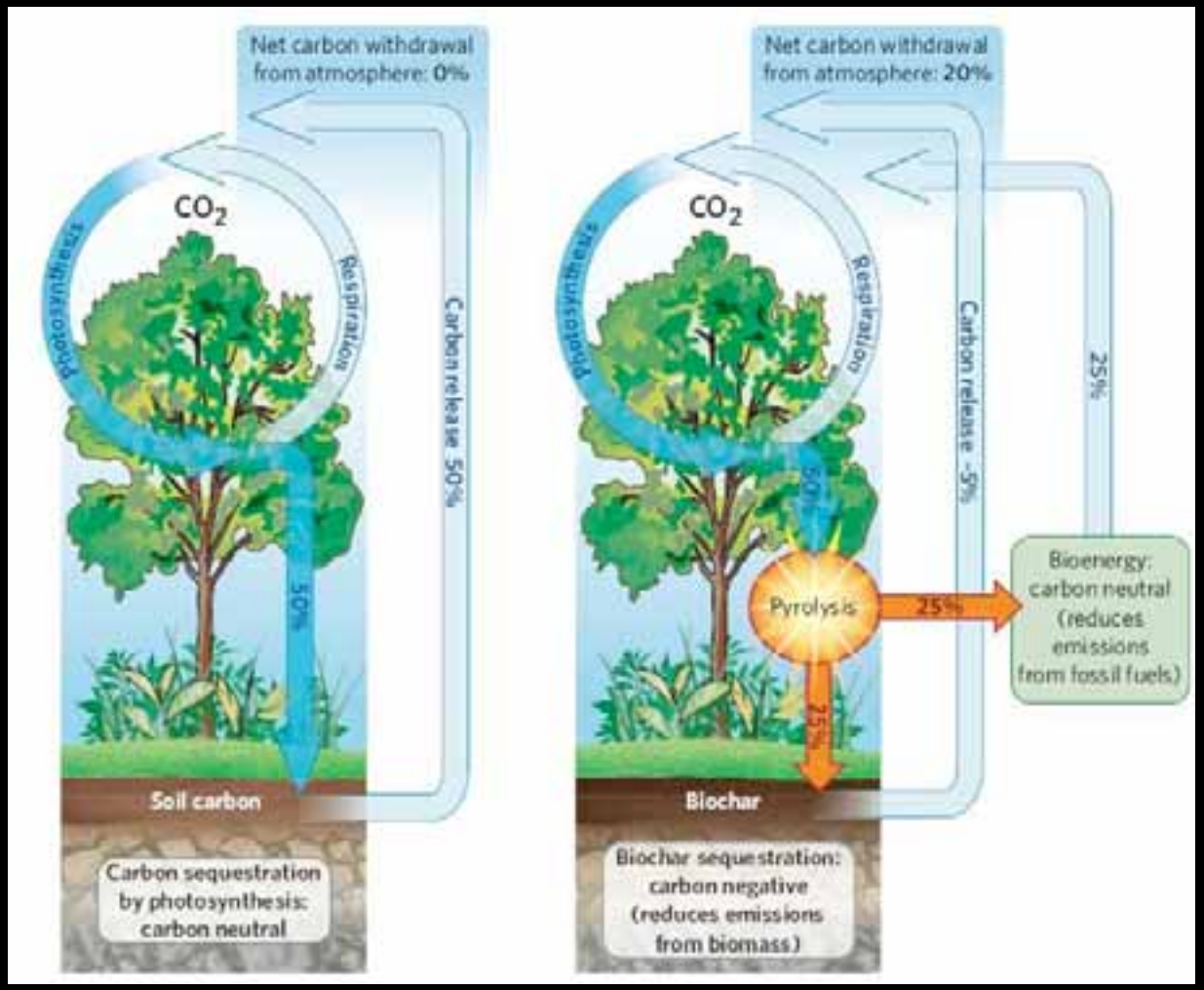
Continuous cycling of energy and materials in the Chinampa systems of Tenochtitlan

Terra preta, covers at least 10 percent of Amazonia, an area the size of France.



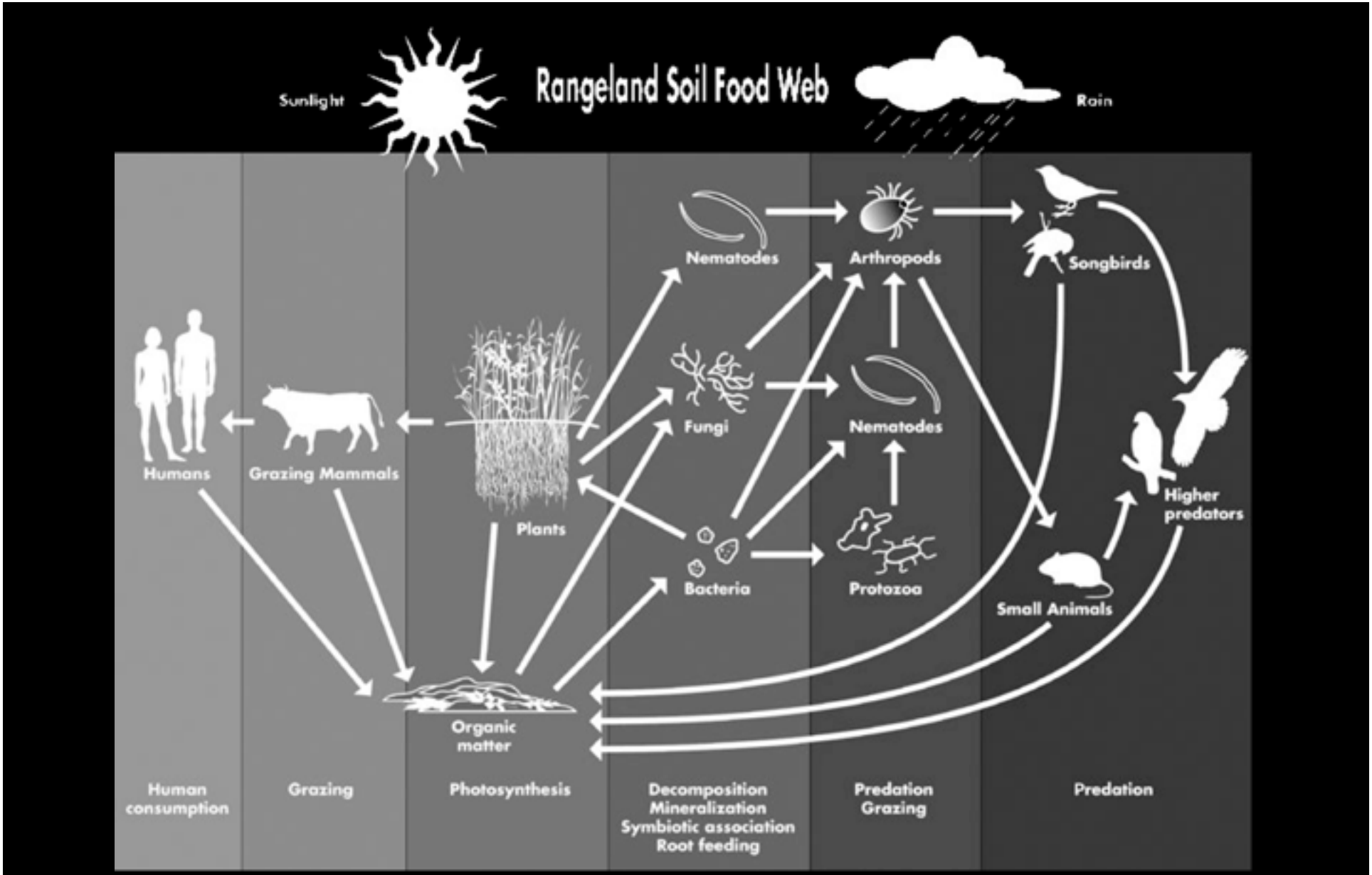
El Dorado - a large society as advanced as the Egyptians or the Incas created a soil that was several fold more nutrient rich than the the rainforest and could hold carbon 2- 3 times better than 10 times the carbon sequestering power of nutrient rich soil

Carbon Sequestration



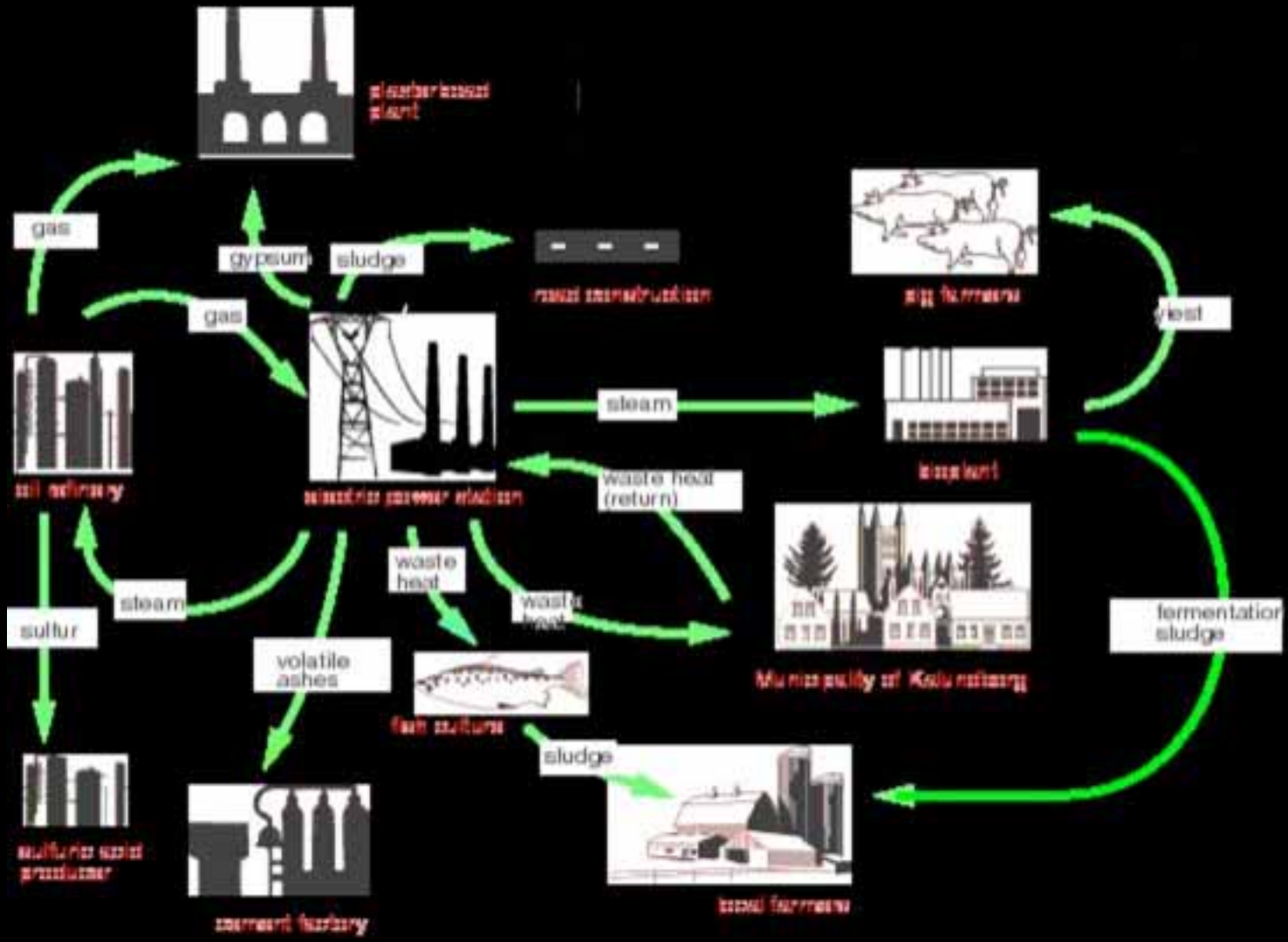
Compared to afforestation (left), when biochar (right) is used as a soil amendment, it has a net 20% gain in carbon sequestration

http://cabiblog.typepad.com/hand_picked/the_environment/index.html



Eco-Balance Analysis for City South
San Antonio, TX

Industrial ecosystem at Kalundborg, Denmark



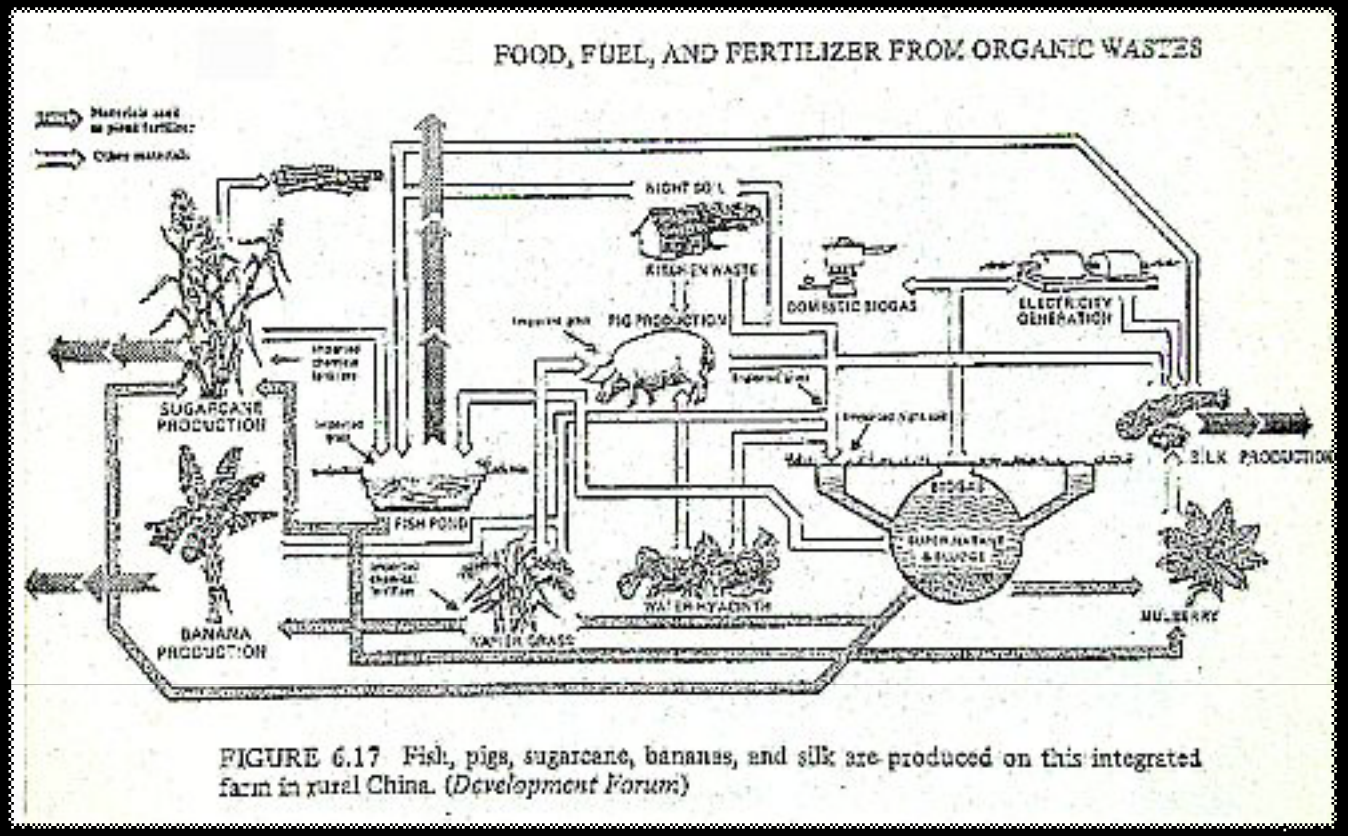
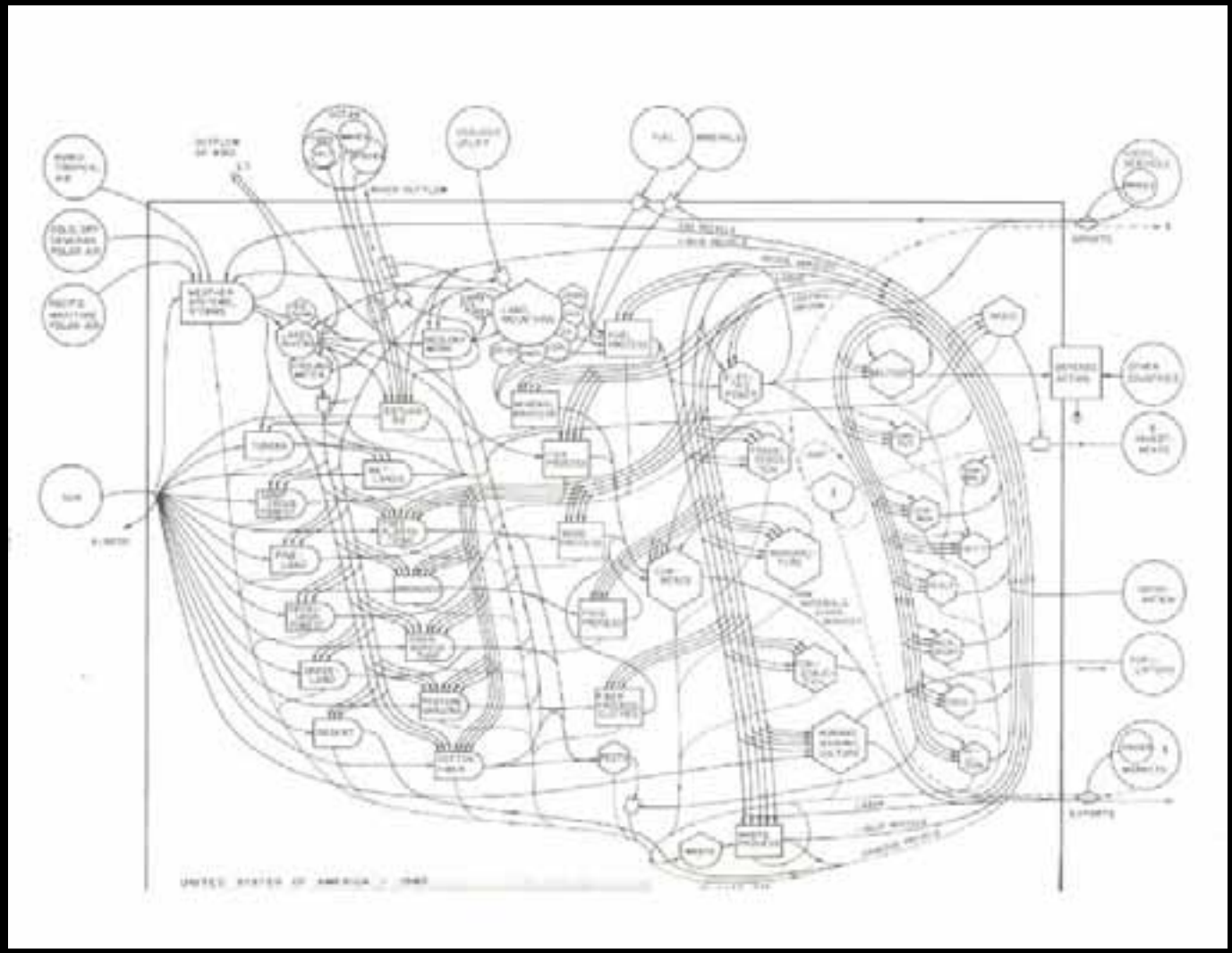
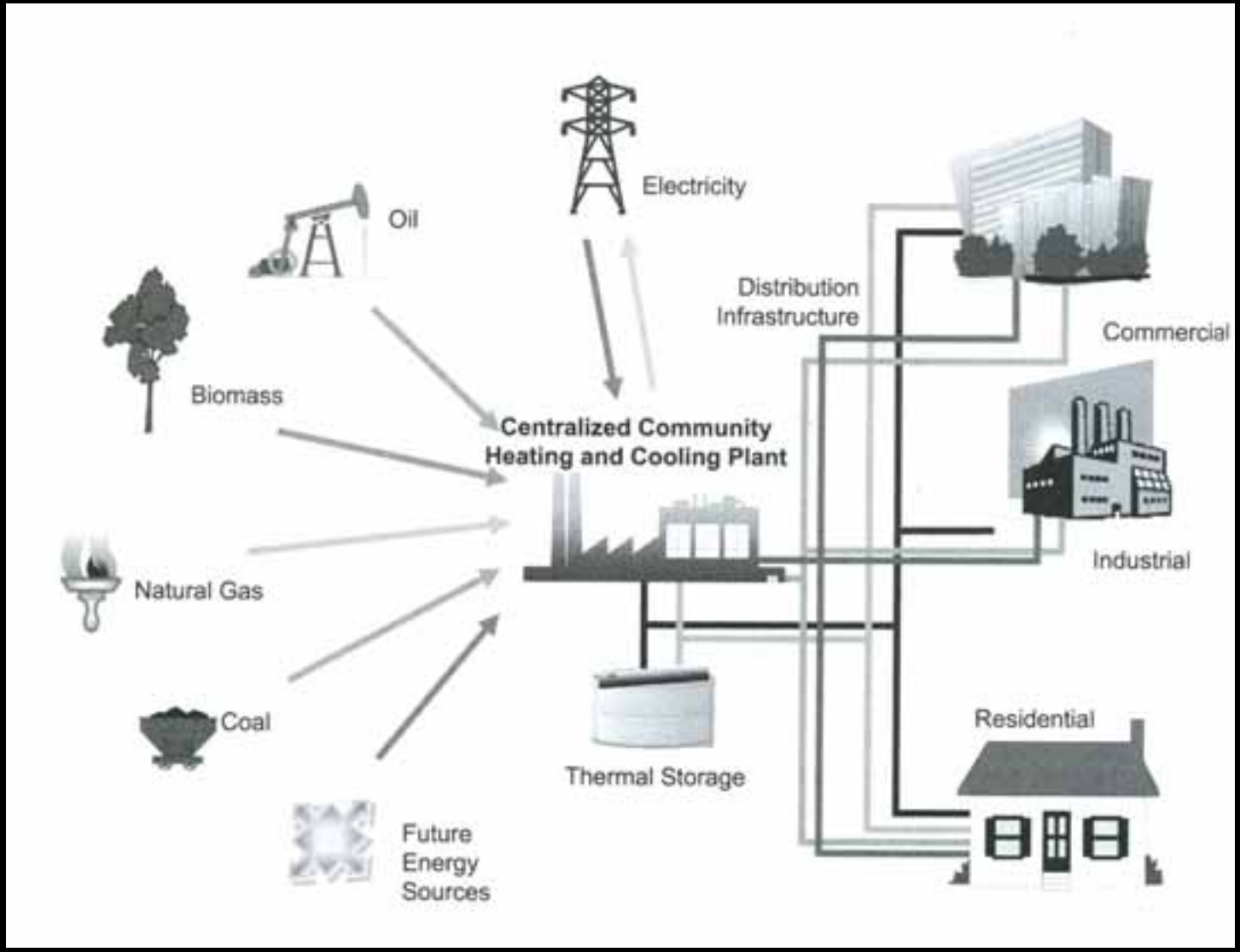


FIGURE 6.17 Fish, pigs, sugarcane, bananas, and silk are produced on this integrated farm in rural China. (*Development Forum*)

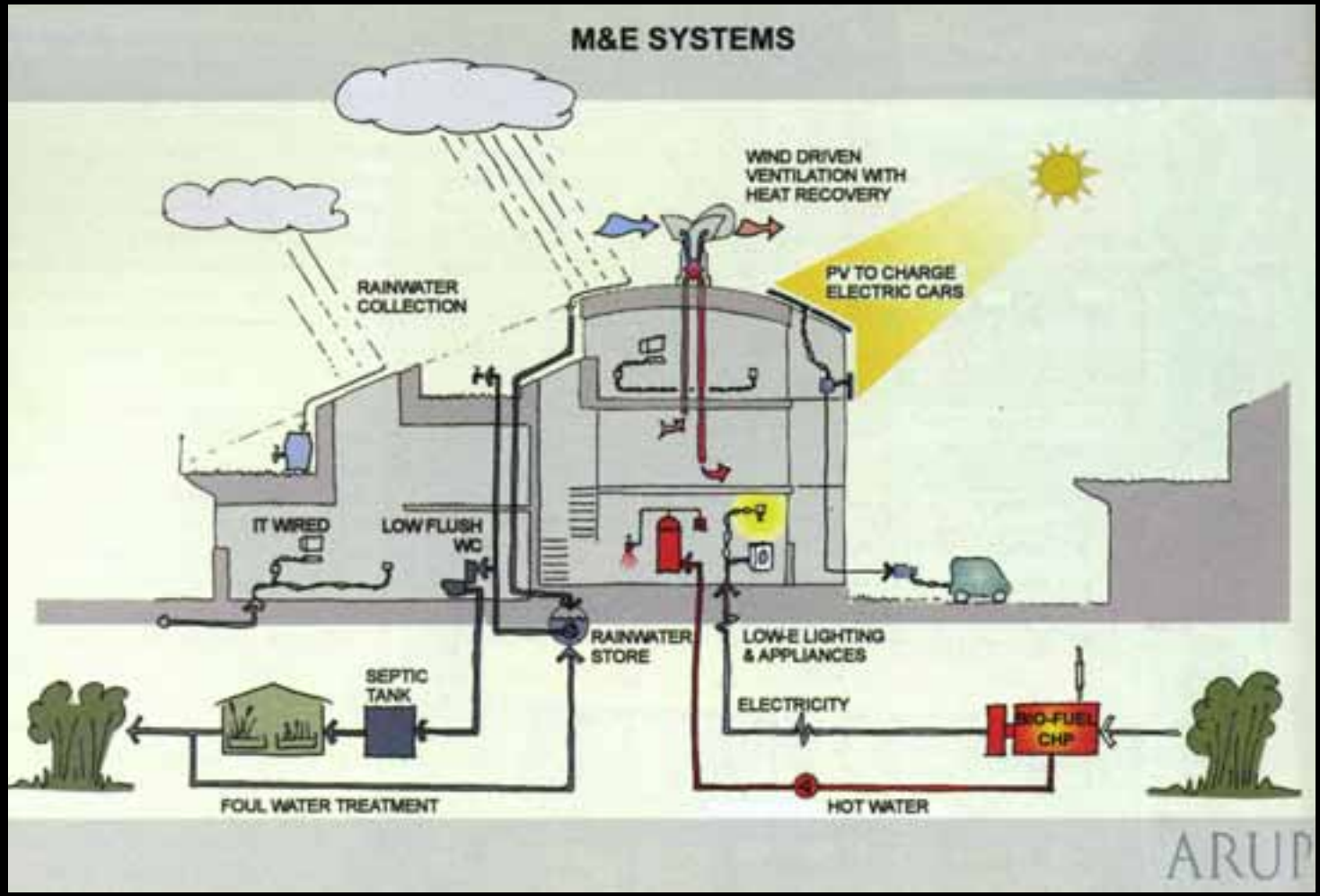
INTEGRATED BIOSYSTEM - BEIJING, CHINA



Source : systems Ecology Howard Odum



Douglas Farr, Sustainable Urbanism p 200 Image from District Energy St. Paul



Douglas Farr, Sustainable Urbanism p 216 Image c.Arup

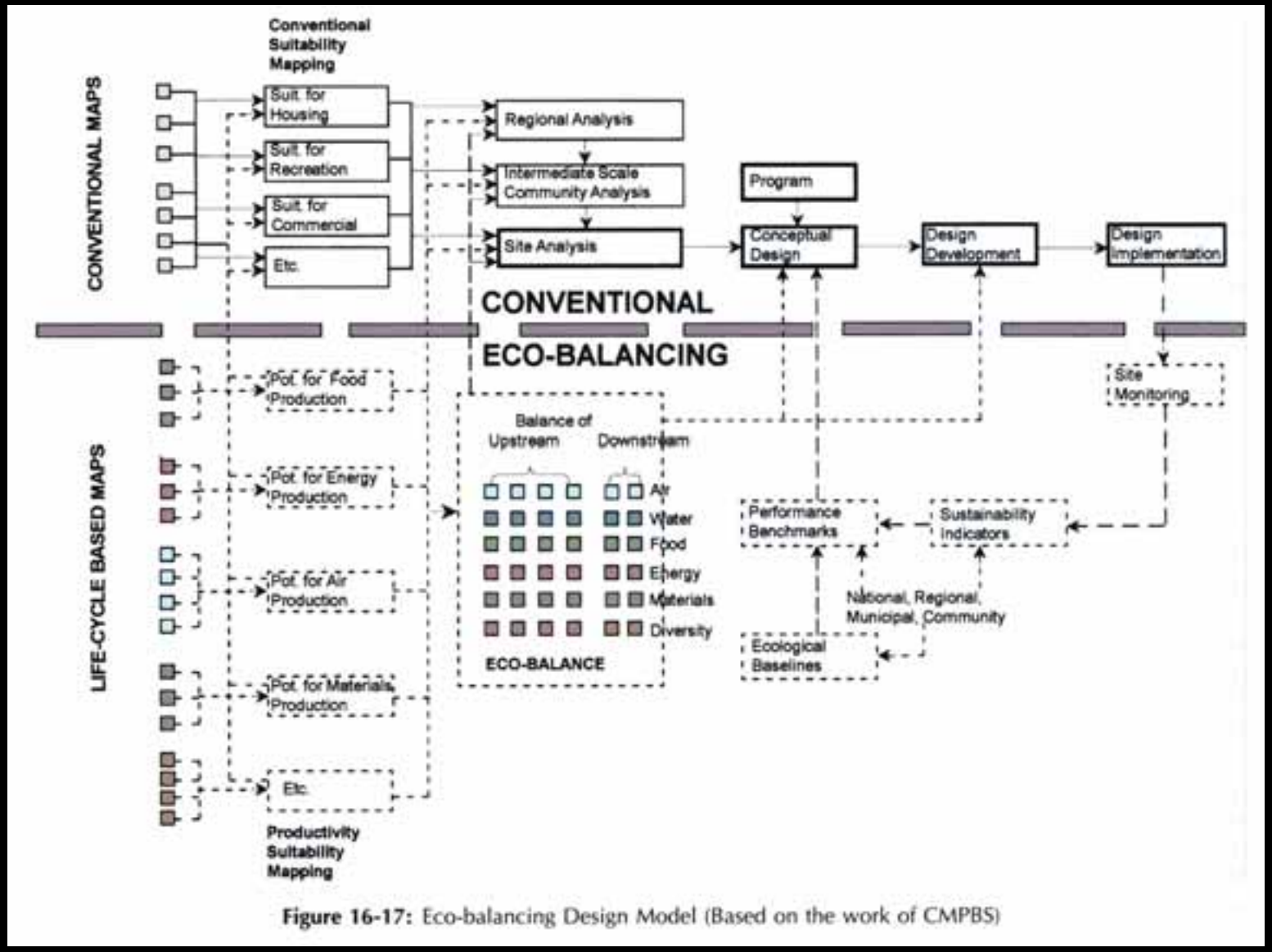


Figure 16-17: Eco-balancing Design Model (Based on the work of CMPBS)

John Motlock, Introduction to Landscape Design p 328

The ecology of regenerative systems or those living systems that sustain over time are based on cyclical patterns of resource use. When these cycles (air, water, food, energy, materials) symbiotically function with each other into a complex web of life, productivity is heightened to the extent that both nature and humans benefit beyond the capacity of either functioning unto itself

Eco-Balance Planning

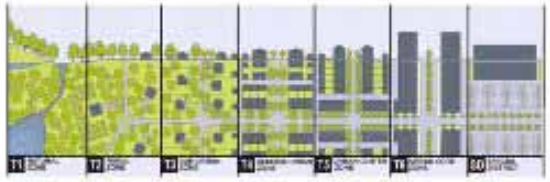
Eco-balance is a design methodology based on balancing resource use at various scales from home to community. It incorporates the life cycle structure by balancing between the sourcing and the re-sourcing of given life support needs In an ecological context. We are finding the result of multiple life cycle Integration provides a potential level of productivity beyond simple balance itself.

ECO BALANCE AS INTER-OPERABLE FRAMEWORK		
LIFE CYCLES	SOURCE	RE-SOURCE
Biologist	Flora	Fauna
Economist	Credit	Debit
Engineer	Heat Gain	Heat Loss
Hydrologist	Collect	Absorption
	Harvest	Treat
LCAnalyst	Upstream	Downstream
Ecologist	Producer	Consumer
Human	Opportunities	Constraints

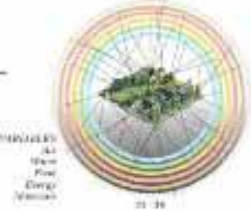
Balance occurs in many allied disciplines whether we apply it to economics or physics or how we simplify the complex webs in ecosystems. The initial step in creation of life as we know it is the conversion of sunlight Into flora that in turn supports the fauna that converts and re-sources the nutrients back to the plants. This Process of balance is shared by many of professionals that support the planning and design of the built environement

Why don't we?

New Urbanism Transect Zones



Life Cycle Balance
Integrated Approach



Smart Code
Best Management Practices

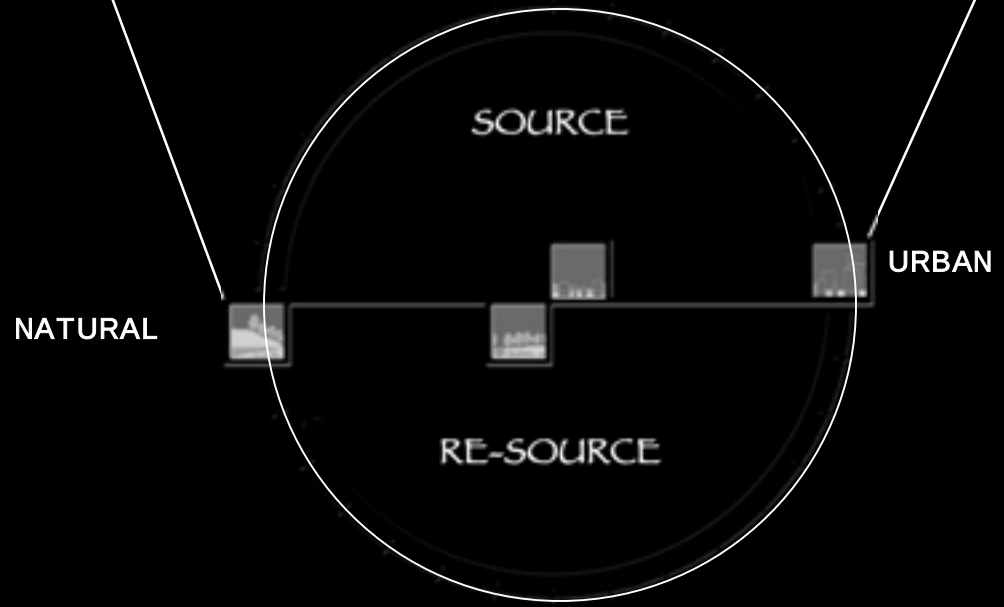
Life Cycle Balance
Single Variable Approach

Verano Master Plan
Transect Map

EARTH BALANCE

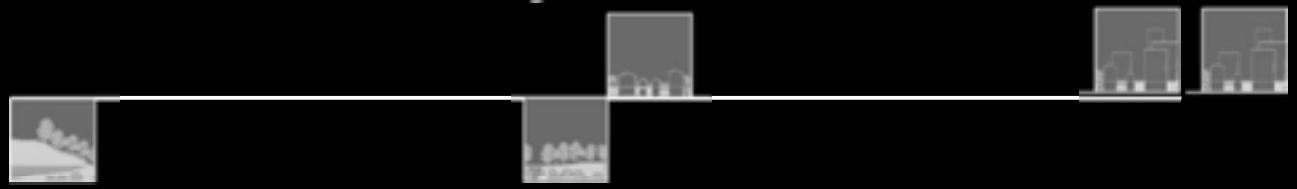
Eco-Balance Analysis for City South
San Antonio, TX

ECO - BALANCE



ECO-BALANCE USING PERFORMANCE MANAGEMENT PROCEDURES

Management Areas



Nature Balance

Flora

Fauna

Superstructure & Infrastructure Balance

Land

Building

Urban balance

Building

Building

Mapping Process

Nature Preserved

Water

Air

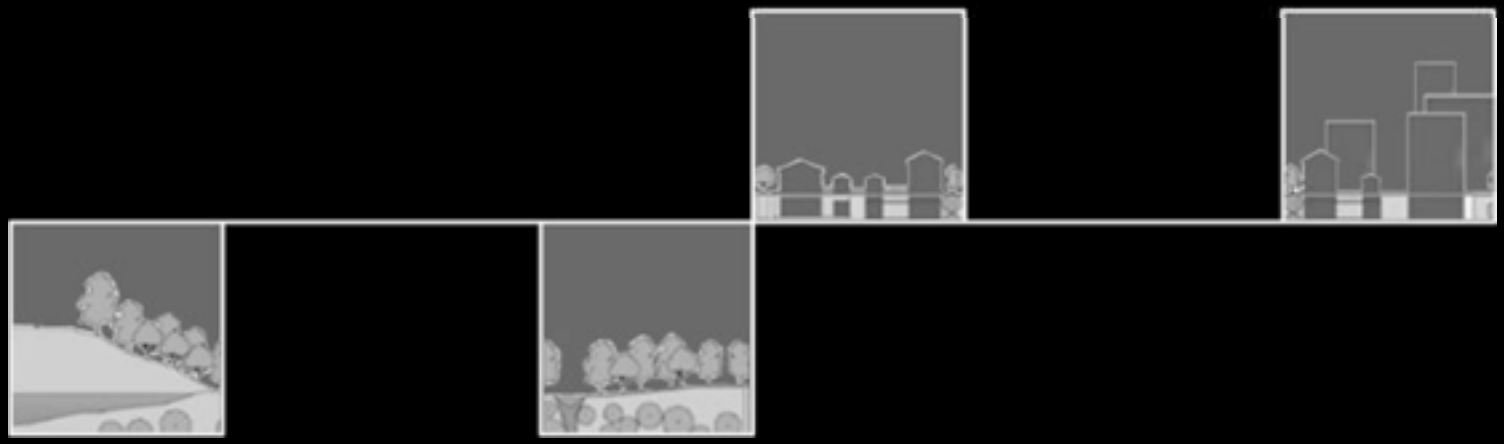
Energy

Food

Materials

Hazards

Base Maps



Land To Land Resources

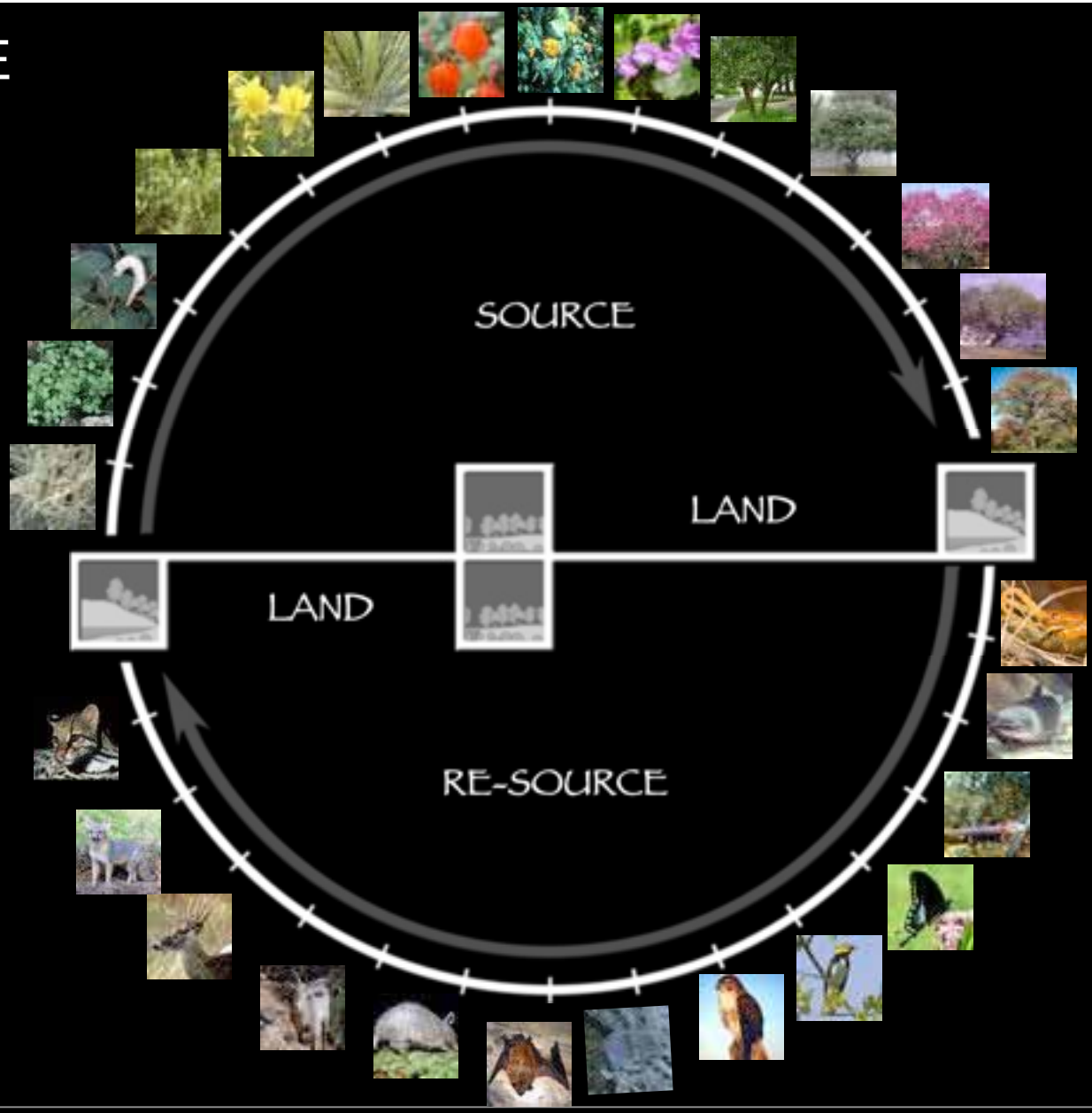
Land To Building Resources

Building To Building Resources

VERANO at City South

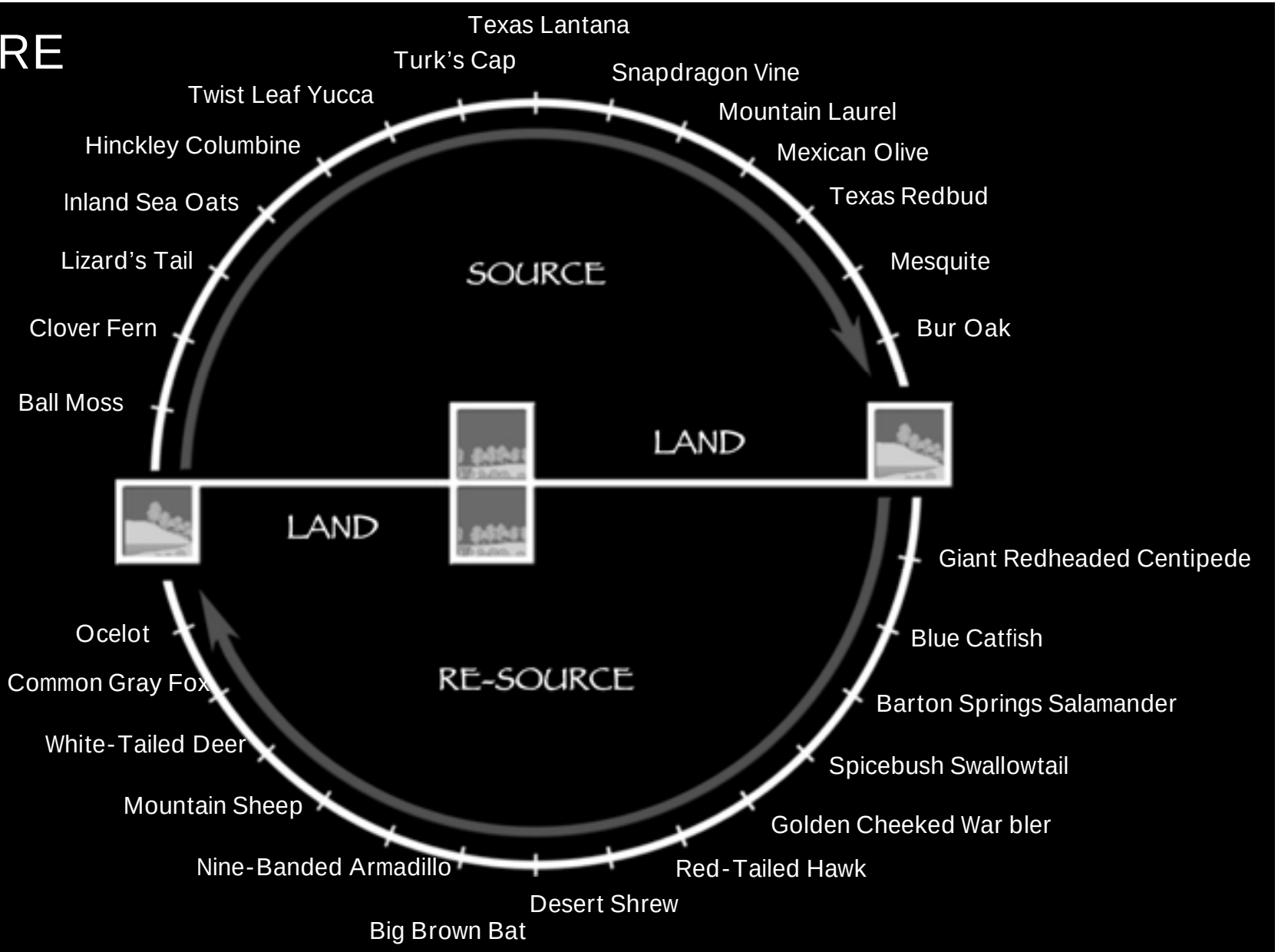
Eco-Balance Analysis for City South
San Antonio, TX

NATURE
T-1



Eco-Balance Analysis for City South
San Antonio, TX

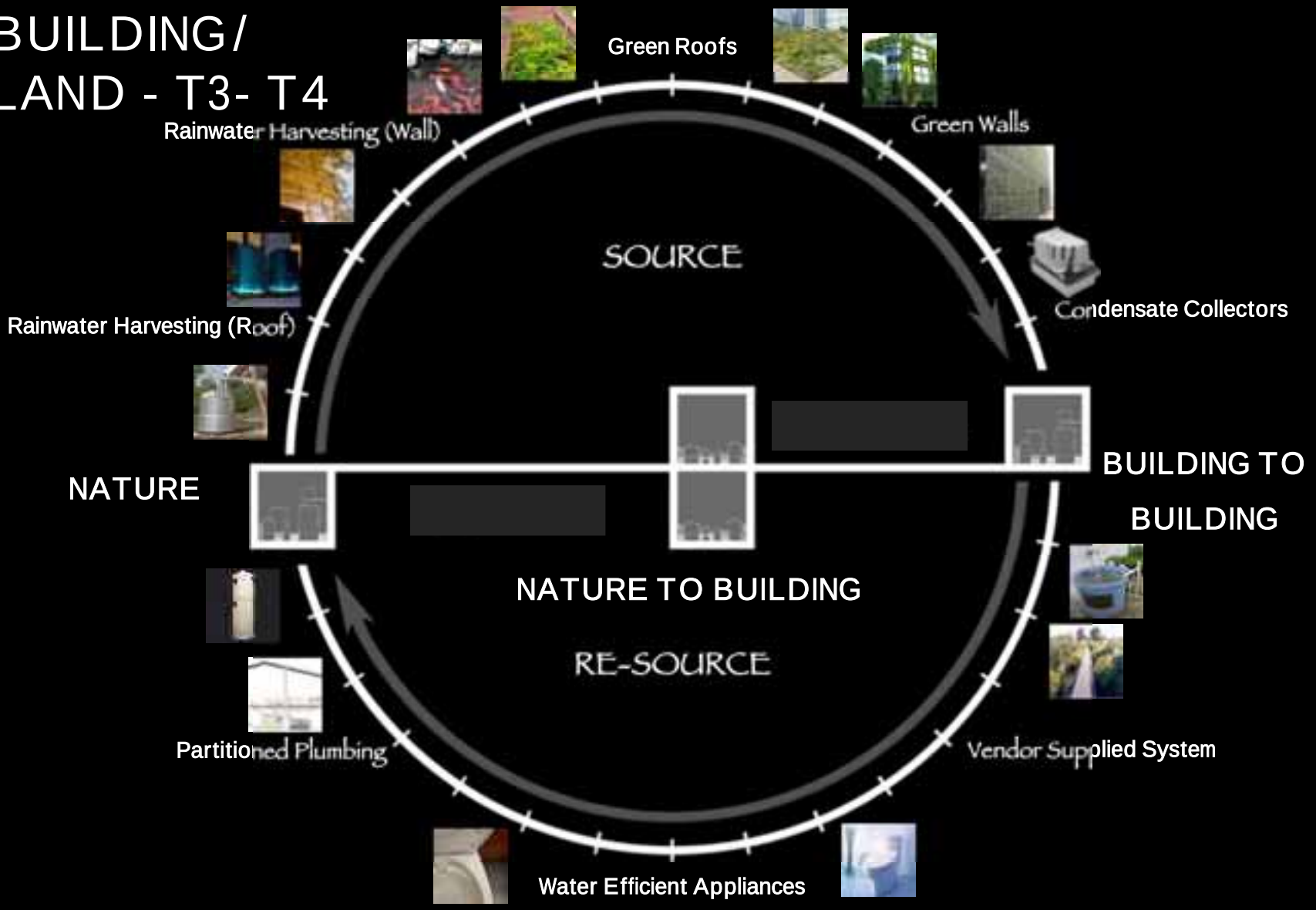
NATURE
T-1



VERANO at City South

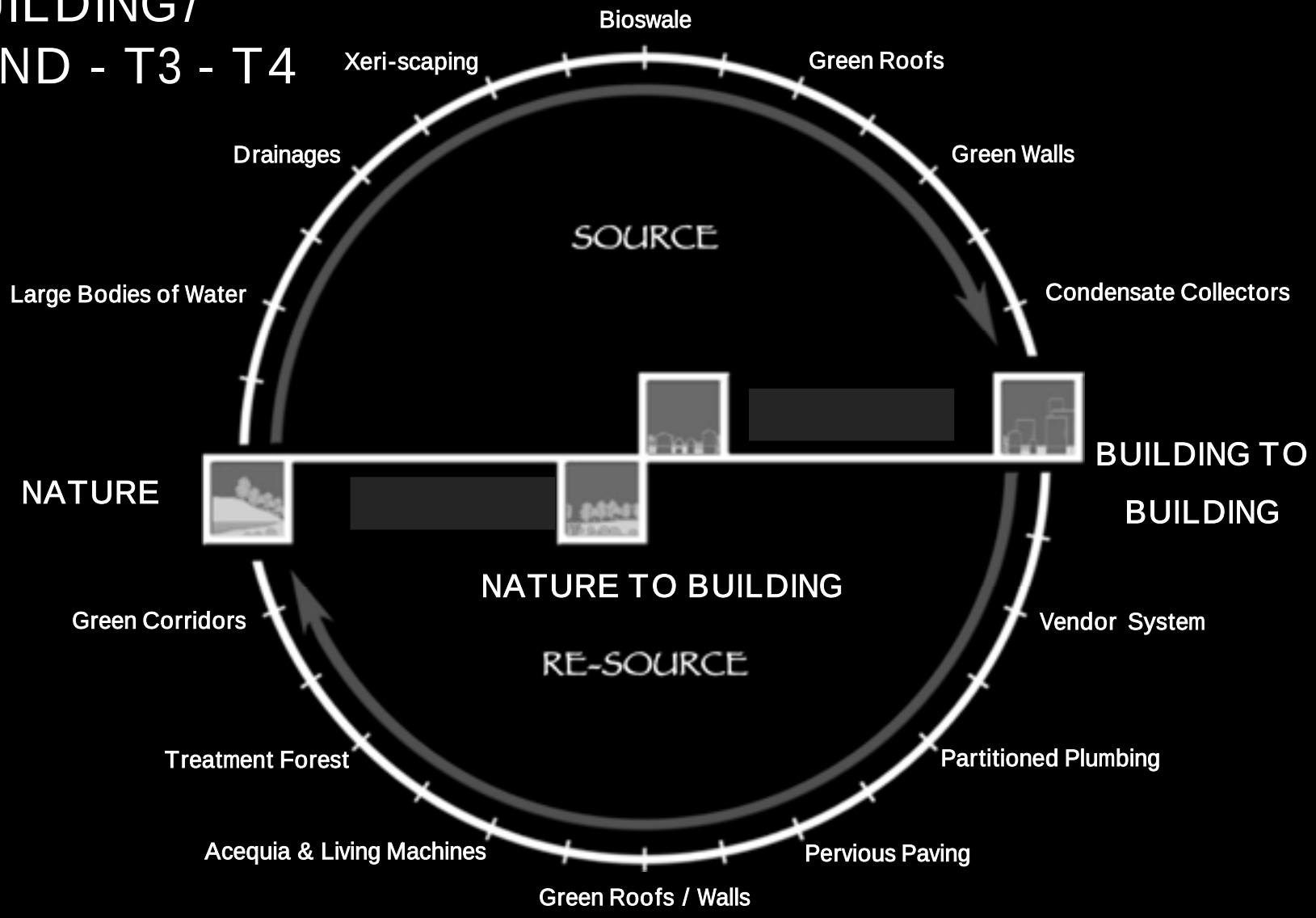
Eco-Balance Analysis for City South
San Antonio, TX

BUILDING/ LAND - T3- T4



Eco-Balance Analysis for City South
San Antonio, TX

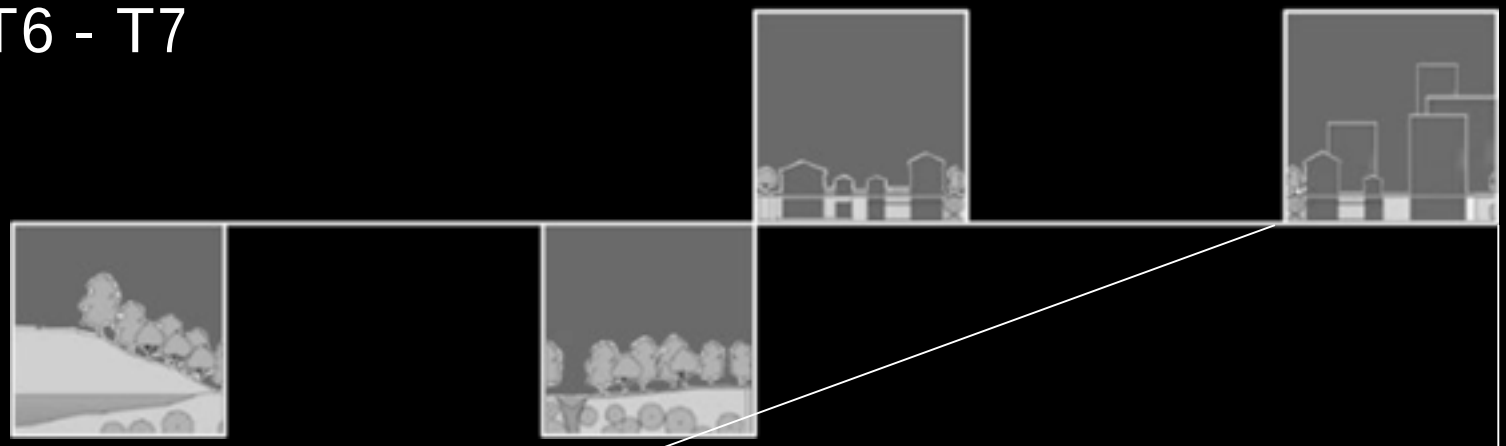
BUILDING/ LAND - T3 - T4



Eco-Balance Analysis for City South
San Antonio, TX

BUILDINGS
T5- T6 - T7

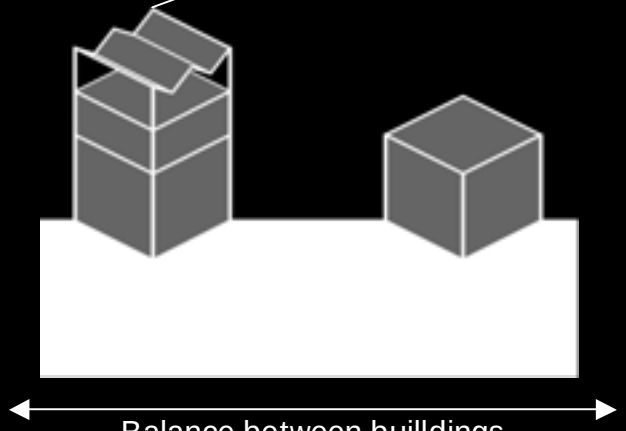
Balance Type Summary



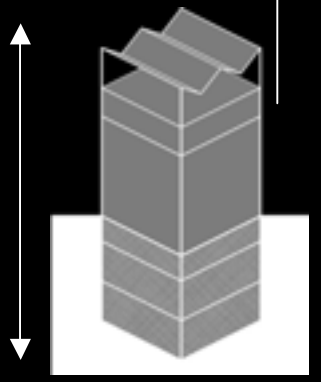
Land To Land Resource

Land To Building Resources

Building To Building Resources



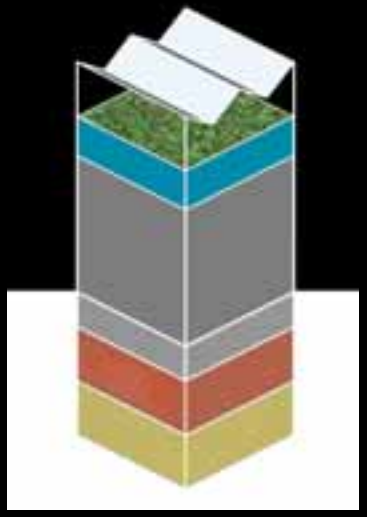
Balance between builldings



Balance within building

Eco-Balance Analysis
San Antonio, TX

Vertical Balance



BIPV -

- Shade
- Energy

Green Roofs-

- Food Landscape
- WW Treatment
- Water Treatment

Water Catchments

Space Use

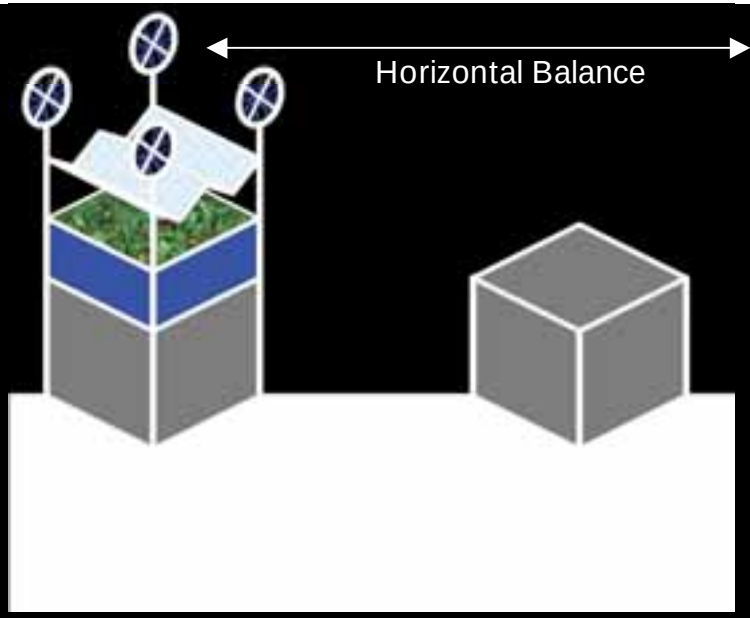
Foundation-

- Structure
- Balance

Energy Heat pump

Energy Geothermal

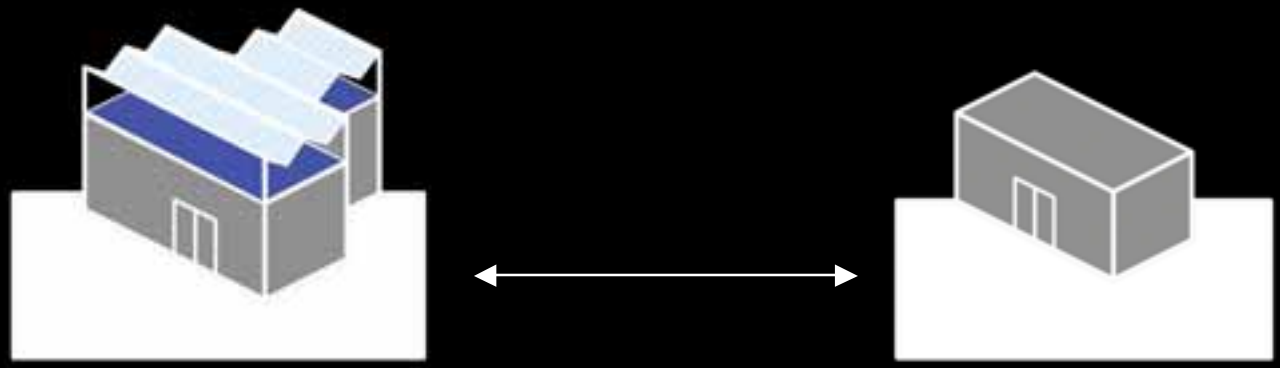
Horizontal Balance



Food	(+)	Garden Roof	Food	(-)
Energy	(+)	BIPV & Wind Sys	Energy	(-)
Water	(+)	Rainwater Collection	Water	(-)

Building	To		Building
Building	To		Land
Land	To		Land

Eco-Balance Analysis
San Antonio, TX

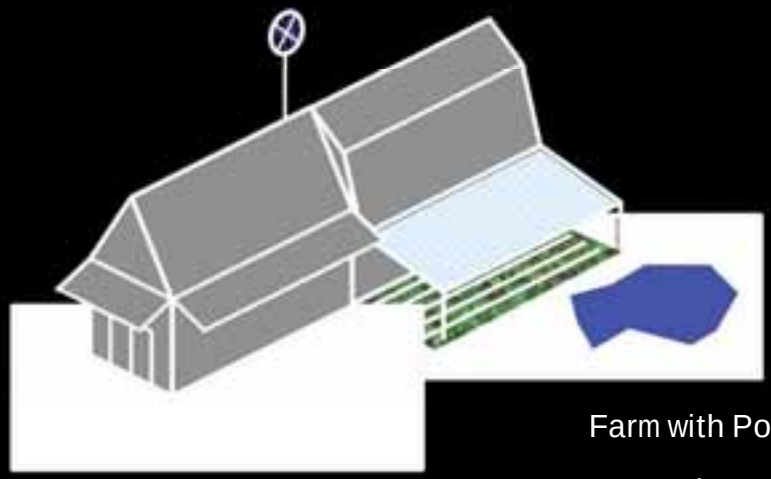


Drive-Through Bank

Energy (++)
Water (++)

Laundromat

Energy (--)
Water (--)



Restaurant

Food (--)
Energy (--)
Water (--)

Farm with Pond and Water Harvesting

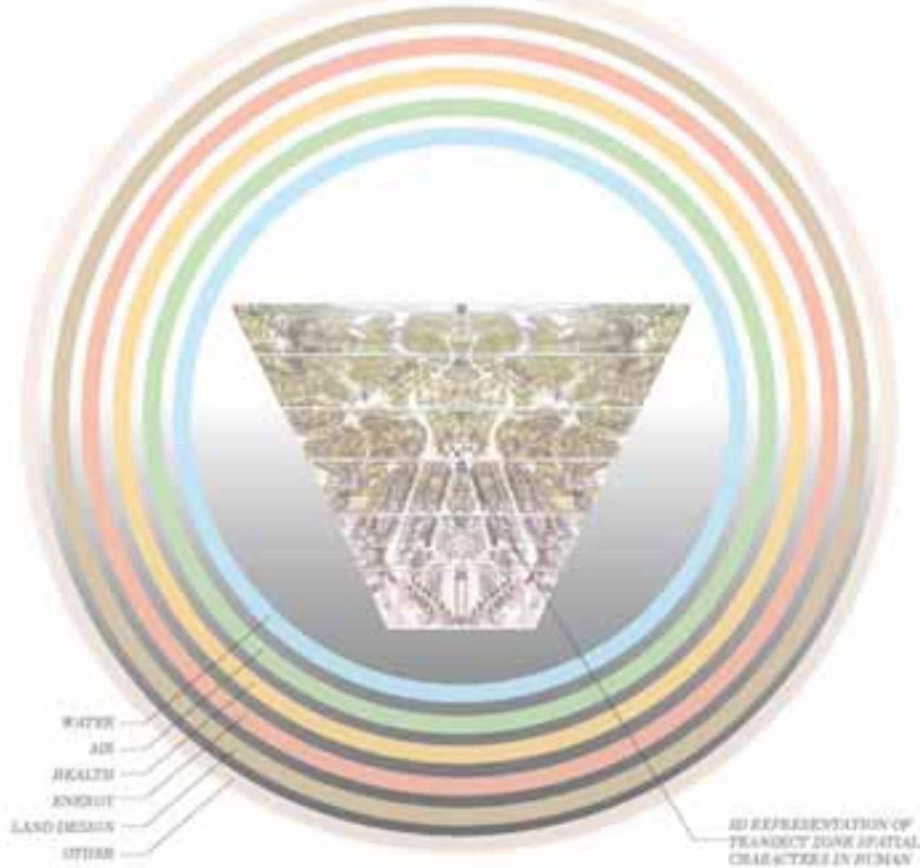
Food (++)
Energy (++)
Water (++)

VERANO at City South

Eco-Balance Horizontal Integration
Building to Building

Table 209-3.4

SUSTAINABLE DESIGN OPTION POINT SYSTEM				
Category	**Credit Identifier**	**Description**	**Credit**	**Score**
WATER	[illegible]	[illegible]	[illegible]	[illegible]
AIR	[illegible]	[illegible]	[illegible]	[illegible]
HEALTH	[illegible]	[illegible]	[illegible]	[illegible]
HEALTH	[illegible]	[illegible]	[illegible]	[illegible]
LAND DESIGN	[illegible]	[illegible]	[illegible]	[illegible]
OTHER	[illegible]	[illegible]	[illegible]	[illegible]
		Total Points Available 43.0	TOTAL	



INTEGRATION OF LIFE CYCLE CONCERNS AND TRANSECT PLANNING

The word sustain in the most basic sense means continued availability. Nature makes things continuously available through air, water, food, energy, and material cycles. The source end of these cycles balance with the re-sourcing end, and the more productive these cycles the more humans can siphon off to fulfill certain needs. To accomplish this means going beyond checklists and designing so that best management practices (BMPs) contribute with other BMPs to create these cycles within nature by using human management expertise.

PER CAPITA LAND USE FOOTPRINT

NEED	DESCRIPTION	AREA	
		ON-SITE	OFF-SITE
AIR QUALITY	OXYGEN PRODUCTION	300-500	
	CARBON EMISSION SEQUESTERING		88,000
WATER SUPPLY	DOMESTIC USES	400-500	
	CISTERN	30- 40	
	FOOD PRODUCTION (Vegetarian Diet)		33,000
FOOD SUPPLY	HOME GARDEN (Max. Maintainable By 1 Person In Spare Time)	300-400	
	ADDITIONAL AREA FOR COMPLETE DIET (Vegetarian)		4,000
ENERGY SUPPLY	PHOTOVOLTAICS-DOMESTIC ELECTRIC	250-300	
	PHOTOVOLTAICS-ELECTRIC VEHICLE	100-150	
	BIOMASS FUEL-PASSENGER VEHICLE		44,000
	BIOMASS FUEL-SPACE HEATING		44,000
LIVING SPACE	BATHING, COOKING, EATING, SLEEPING	200-250	
	OUTDOOR RECREATION	300-400	400
	PARKING SPACE-ELECTRIC VEHICLE	100-150	200
SIMPLE SUM		1,980-2,690 0.05 AC	213,600 4.85 AC
SUM WITH INTEGRATED FUNCTIONS		**1,030-1,380 0.03 AC**	**136,000 3.1 AC**

CONCLUSION : Rounded to the nearest unit of the infinite grid, the per capita footprint for a dwelling unit and lot in Austin, Texas is :

1,375 sqf ON-SITE (44,000 sqf/32)
132,000 sqf OFF-SITE (44,000 x 3)

PER CAPITA LAND USE FOOTPRINT

Energy Balance - Best Management Practices In Transect Zone T3

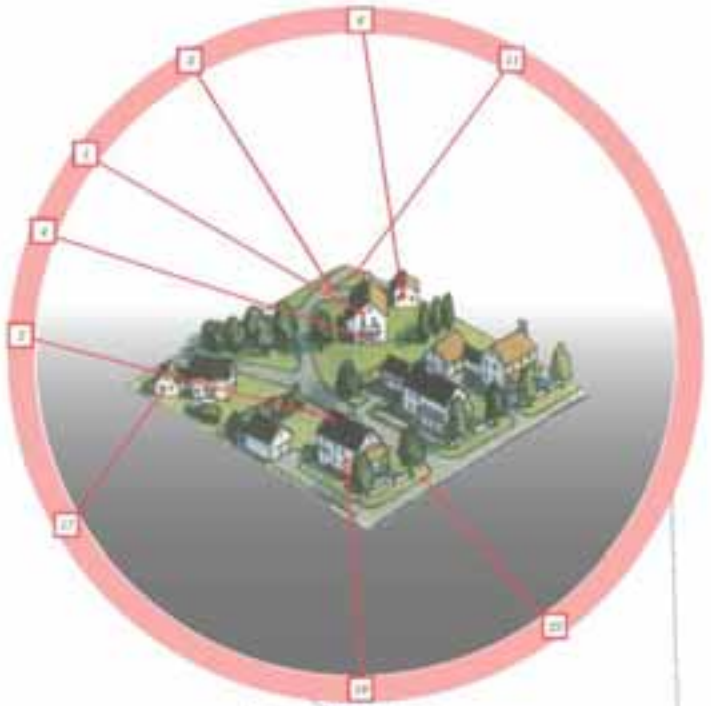
8. Low energy landscape

11. Solar street/path lights

20. Smart cars

22. Bike lanes

ECO-BALANCE ENERGY CHART FOR T3			
Code	**S/R**	**SB**	**Best Management Practices**
1	◒	S, M	light colored exterior pavements
2	◓	S, M	ventilated roof/ventilated attic
3	◒	S	deep set/overhang awning windows
4	◓	P, S, M	shaded porches/balconies
5	◓	M	shaded streets and alleys
6	◒	--	low embodied energy building
7	◒	M	low energy water system
8	◒	M	low energy landscape
9	◒	M	low maintenance materials
10	◒	S, M	reusable materials/structures
11	◓	S, M	solar streetpath lights
12	◓	P	solar electric PV provision
13	◓	P	solar hot water provision
14	◓	P	daylighting provision
15	◒	S	energy conserving lights
16	◒	S	energy conserving appliances
17	◒	S	energy conserving fenestration
18	◓	--	solar oriented fenestration
19	◒	S	high R value insulation
20	◒	S,M	smart cars
21	●	--	inter model cycle bus train centre
22	◒	M	bike lanes
23	●	M	walkable community



T2 Illustration by James Russell

Table Legend

◓ *Source*

◒ *Re-Source*

Sustainable Businesses
at level & transect zones

P - *Produce*

S - *Sell*

M - *Maintain*

ENERGY

Energy Balance at Verano: From the standpoint of the consumption end of the energy cycle the community fits the necessary LEED or other San Antonio code requirements. From the standpoint of actual Life Cycle balancing, energy follows a similar format at other life support cycles: 1) balance according to direct need (solar photovoltaics sized for basic electrical use); and 2) balancing at the full energy balance cycle. At the building scale the second can be satisfied by the PV's plus passive solar architecture including shade, solar and breeze orientation, daylighting combined with all necessary re-sourcing functions (window/wall insulation/ energy efficient appliances, etc). At a community scale, an example of the second involves the former plus production of enough biomass of biofuel from the waste generated on site through sewage treatment (woody plants, reeds, etc) in a managed harvesting/combustion process sized to satisfy remaining energy needs.

Energy Balance - Best Management Practices In Transect Zone T6

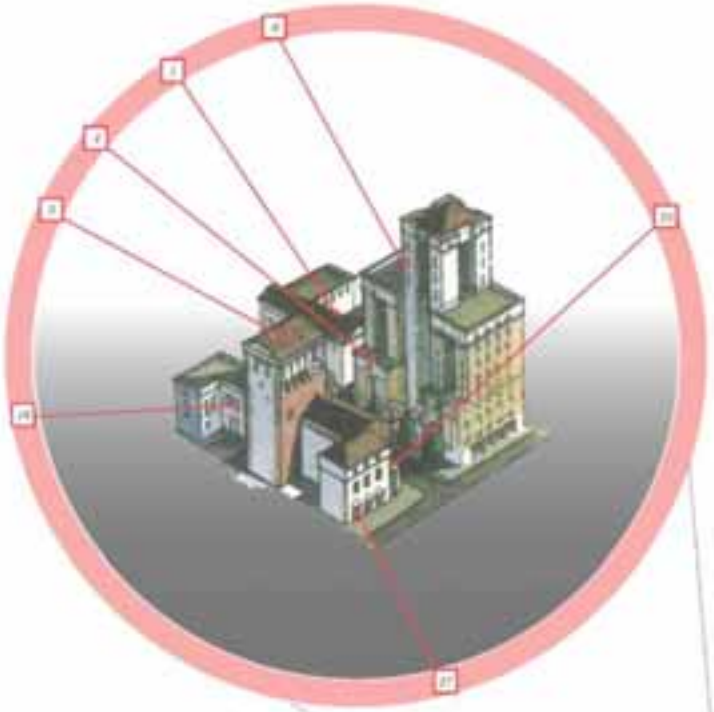
19. Low rpm roof top wind systems

23. Vertical and horizontal green space

23. v2g and g2v plug in parking

29. Large vertical plant-based atrium humidifiers

ECO-BALANCE ENERGY CHART FOR T6			
Code	**S/R**	**SB**	**Best Management Practices**
1	S	–	light colored exterior pavements
2	R	M	aspirating facades
3	S	M	PV shading facades
4	S	–	shaded balconies
5	S	–	shaded streets and alleys
6	R	–	low embodied energy building
7	R	–	low energy maintainence landscape
8	R	–	low maintenance materials
9	S	P, S, M	PV shades interior
10	S	S, M	PV panels
11	R	S, M	ice battery district cooling
12	S	S, M	open/flexible/reusable large building systems
13	R	P, S, M	pump storage water towers/roof tanks
14	R	–	energy conserving lights
15	R	–	energy conserving appliances - elevators
16	R	–	energy conserving fenestration
17	R	M	building to building utility sharing
18	S	S, M	fiber optic day lighting
19	S	S, M	Low rpm roof top wind systems
20	S	–	inter modal cycle bus train center
21	R	–	bike lanes
22	S	S, M	wind system elevator integration
23	S	P, S, M	vertical and horizontal green space
24	S	M	heat pump geothermal foundations
25	S	M	v2g and g2v plug in parking garages
26	S	P, S, M	hi rise pedestrian bridges
27	R	–	building to building waste heat reuse
28	S	M	fish plant waste integrated restaurants
29	R	S, M	large vertical plant based atrium humidifiers



TX Illustration by Jason Russell

ENERGY

Table Legend

S - *Source*
R - *Re-Source*

Sustainable Businesses
at level & transect zones
P - *Produce*
S - *Sell*
M - *Maintain*

Energy Balance at Verano: From the standpoint of the conservation end of the energy cycle the community fits the necessary LEED or other San Antonio code requirements. From the standpoint of actual Life Cycle balancing, energy follows a similar format at other life support cycles: 1) balance according to direct need (solar photovoltaics sized for basic electrical use), and 2) balancing at the full energy balance cycle. At the building scale the second can be satisfied by the PV's plus passive solar architecture including shade, solar and breeze orientation, daylighting combined with all necessary re-sourcing functions (window/wall insulation/ energy efficient appliances, etc). At a community scale, an example of the second involves the former plus production of enough biomass of biofuel from the waste generated on site through sewage treatment (woody plants, reeds, etc) in a managed harvesting/combustion process sized to satisfy remaining energy needs.

ECO-BALANCE

Water Balance - Best Management Practices In Transect Zone T3

4. Bioswales

5. Impervious surface parking driveways

7. Tree treatment of runoff

9. Reed Treatment pond

ECO-BALANCE WATER CHART FOR T3			
Code	**S/R**	**SB**	**Best Management Practices**
1	S	P, S, M	roof top rain/AC condensate capture and storage
2	R	P, M	creek infiltration trenches
3	S	P, M	water absorption ponds
4	R	P, M	end of pipe bioswales
5	S	P, M	impervious surface parking driveway
6	S	P, S, M	green machine fertilizer impact control
7	R	P, S, M	tree irrigation/treatment of runoff
8	R	P, S, M	shallow well reuse
9	R	P, M	reed treatment pond for landscape reuse
10	R	P, S	water conservation fixtures
11	R	P, S, M	decorative flower microbial treatment bed
12	R	P, S, M	fish pond collector/vector treatment system
13	S	S, M	NOx treating pavement
14	S	P, S	aviary vector control

T3 Illustration by James Wassell

WATER

Table Legend

S - *Source*

R - *Re-Source*

Sustainable Businesses
at level & transect zones

P - *Produce*

S - *Sell*

M - *Maintain*

Water balance at Verano through most transects fits into two primary types: 1) meeting precipitation condition of a 1" rainfall, and 2) meeting extreme 100 year flash flood conditions. The first condition operates under the assumption that full balance can occur on site and the second that some can occur on site but measures will be needed to absorb significant flood waters using surface lakes and ponds on and off site to absorb these extremes. Condition one, as with other life cycle balancing, occurs according to partial balance – matching need with collection or matching need with collection and treating that water quantity on site to a level equivalent or superior to the incoming water quality.

Water Balance - Best Management Practices In Transect Zone T6

2. Landscaped roofs

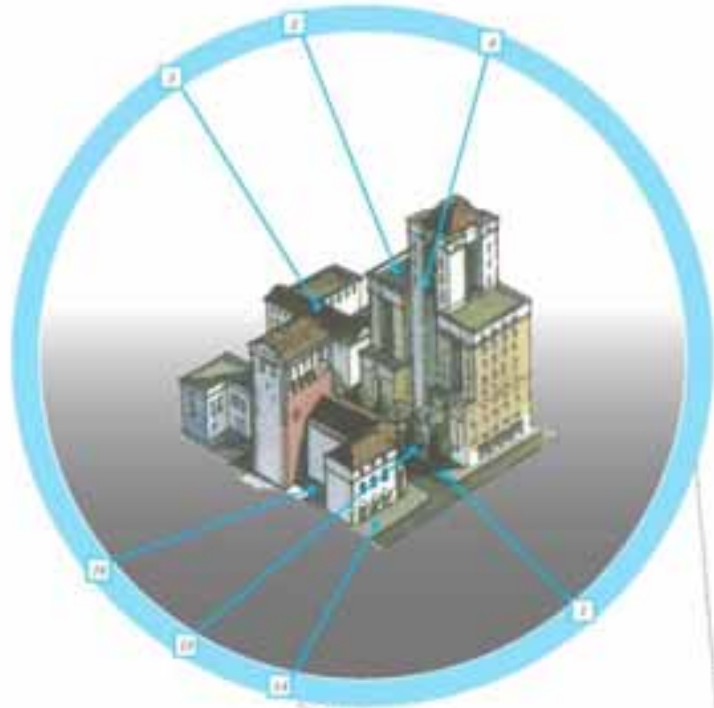
4. Disconnected downspouts

7. Micro-detention in parking lots

16. Reed treatment pond

ECO-BALANCE WATER CHART FOR T6

Code	S/R	SB	Best Management Practices
1	Re-Source	P, S, M	site grading, high performing landscape, greater infiltration
2	Source	P, S, M	create landscaped roofs
3	Source	P, S, M	roof top rain/AC condensate capture and storage
4	Source	M	redirect downspouts from sewer systems to treatment
5	Source	P, S, M	provide pollution control prior to existing storm inlet
6	Source	P, M	repair and expansion to existing pipes
7	Re-Source	P, M	micro detention and bioremediation in parking lots
8	Source	M	regional stormwater management fund stream restoration/buffers
9	Source	P, M	impervious surface limits with curbing
10	Source	P, M	[illegible]
11	Source	P, M	onsite detention
12	Source	—	[illegible]
13	Re-Source	M	[illegible]
14	Re-Source	P, M	[illegible]
15	Re-Source	P, M	[illegible]
16	Re-Source	P, M	reed treatment pond for landscape reuse
17	Re-Source	M	water conservation fixtures
18	Re-Source	P, M	subsurface tank containment
19	Re-Source	M	forest soil media treatment (landscape)
20	Re-Source	M	[illegible]
21	Re-Source	M	[illegible]
22	Source	P, M	[illegible]
23	Source	M	[illegible]



T6 Illustration by James Wassell

WATER

Table Legend

Source

Re-Source

Sustainable Businesses
at level & transect zones
P - *Produce*
S - *Sell*
M - *Maintain*

Water balance at Verano through most transects fits into two primary types: 1) meeting precipitation condition of a 1" rainfall, and 2) meeting extreme 100 year flash flood conditions. The first condition operates under the assumption that full balance can occur on site and the second that some can occur on site but measures will be needed to absorb significant flood waters using surface lakes and ponds on and off site to absorb these extremes. Condition one, as with other life cycle balancing, occurs according to partial balance – matching need with collection or matching need with collection and treating that water quantity on site to a level equivalent or superior to the incoming water quality.

ECO-BALANCE

Health Balance - Best Management Practices In Transect Zone T3

6. Microbial based waste water treatment

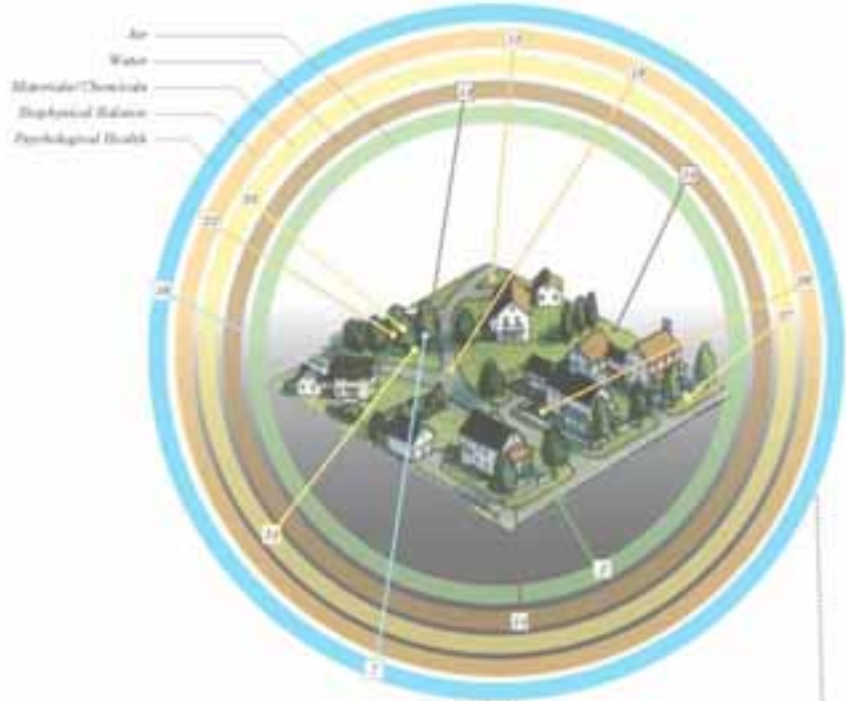
10. Rainwater Harvesting

23. Community garden

32. Household vermiculture

ECO-BALANCE HEALTH CHART FOR T3

Code	S/R	SB	Best Management Practices
1	◒	–	[illegible]
2	◒	–	[illegible]
3	◒	M	[illegible]
4	●	–	[illegible]
5	●	M	[illegible]
6	◒	M	[illegible]
7	◒	M	[illegible]
8	◓	S, M	UV vs chlorine purification
9	◓	S, M	O3 aeration vs chlorine purification
10	◓	P, S, M	rain water harvesting
11	●	–	avoid all PBT's
12	●	–	[illegible]
13	●	–	avoid pesticides / fertilizers
14	●	P, M	incorporate living machines (birds, amphibians, microbes, mammals)
15	◓	–	pedestrian walkability
16	◓	–	pattern designated walkability
17	◓	–	wayfinding walkability signage
18	◓	M	bike paths trails [illegible]
19	◓	–	accessible exercise
20	◓	–	vegetable herb gardens
21	●	P, M	[illegible] restaurant
22	◓	M	edible landscape
23	◓	–	community garden
24	●	–	[illegible] accessibility
25	◓	–	[illegible] views
26	◓	–	daylighting
27	◓	M	seasonal landscapes
28	●	–	[illegible]
29	◓	–	outdoor meeting public areas
30	●	–	[illegible] regional [illegible]
31	●	–	historic / cultural regional patterns
32	◒	S	household compost vermiculture
33	●	P, S, M	bird house
34	●	P, M	[illegible] house
35	●	M	butterfly garden



T3 Illustration by James Wassell

HEALTH

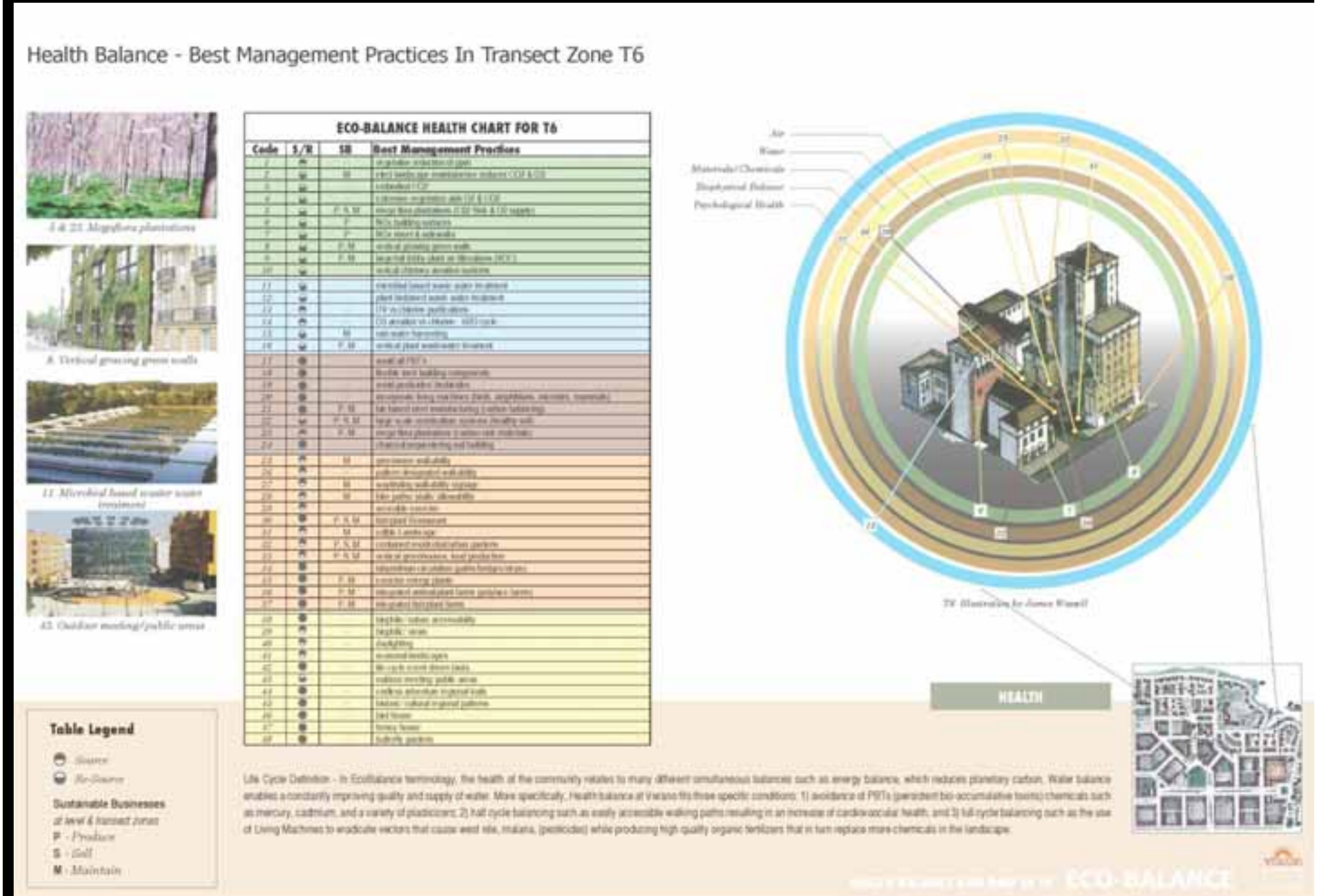
Table Legend

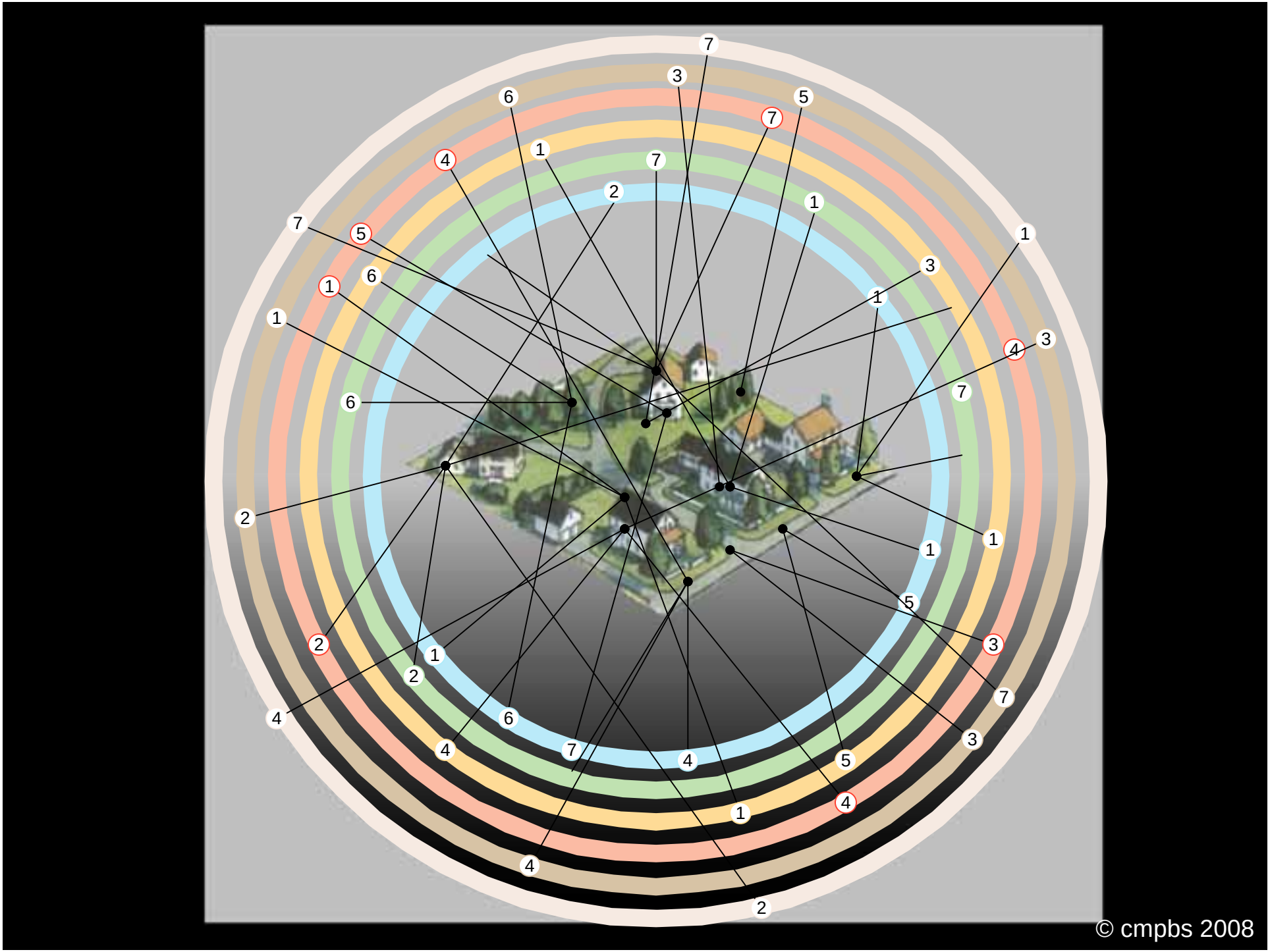
◓ Source
◒ Re-Source

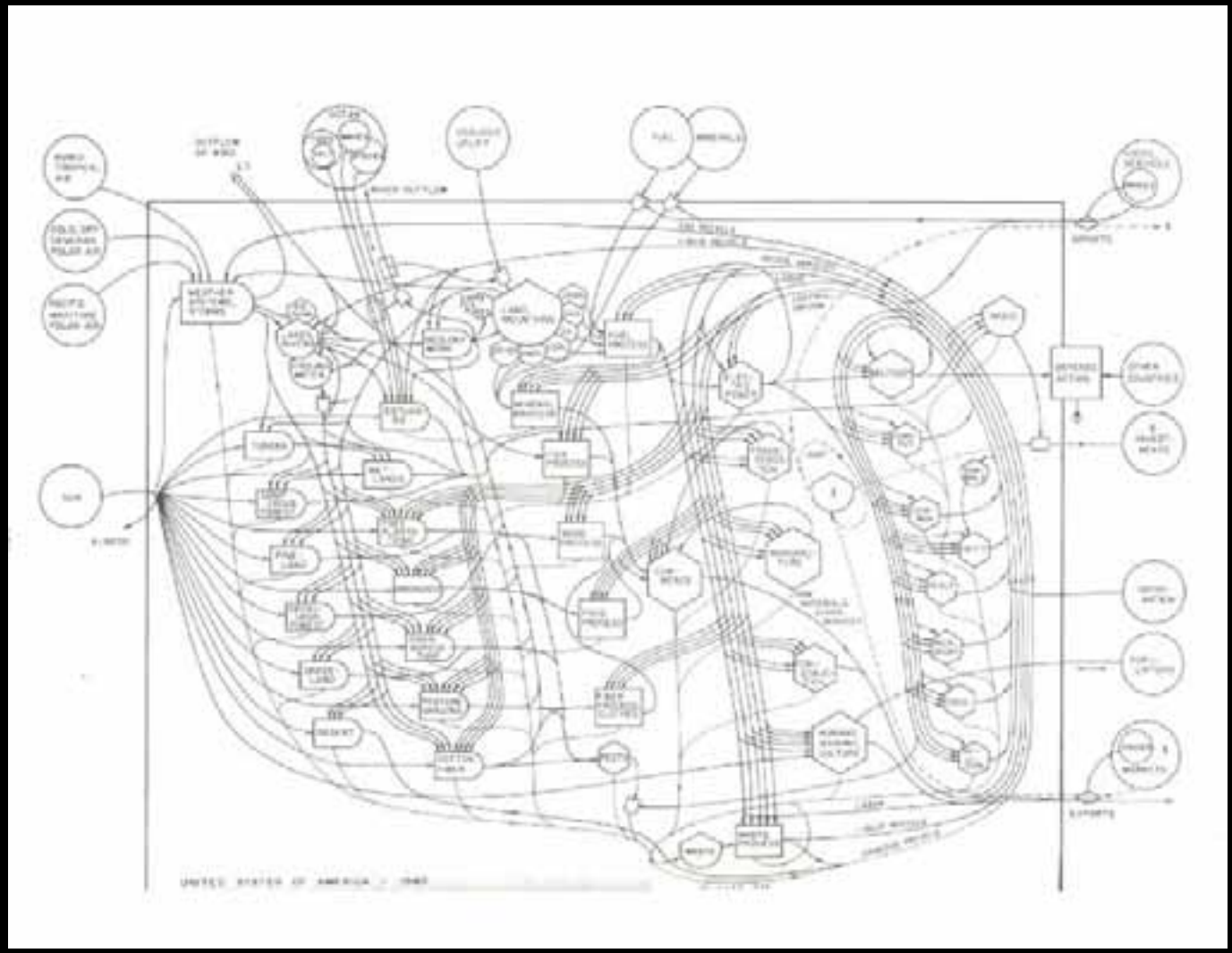
Sustainable Businesses
at level & transect zones
P - *Produce*
S - *Sell*
M - *Maintain*

Life Cycle Definition - In EcoBalance terminology, the health of the community relates to many different simultaneous balances such as energy balance, which reduces planetary carbon. Water balance enables a constantly improving quality and supply of water. More specifically, Health balance at Verano fits three specific conditions. 1) avoidance of PBTs (persistent bio-accumulative toxins) chemicals such as mercury, cadmium, and a variety of plasticizers; 2) half cycle balancing such as easily accessible walking paths resulting in an increase of cardiovascular health, and 3) full cycle balancing such as the use of Living Machines to eradicate vectors that cause west nile, malaria, (pesticides) while producing high quality organic fertilizers that in turn replace more chemicals in the landscape.

ECO-BALANCE

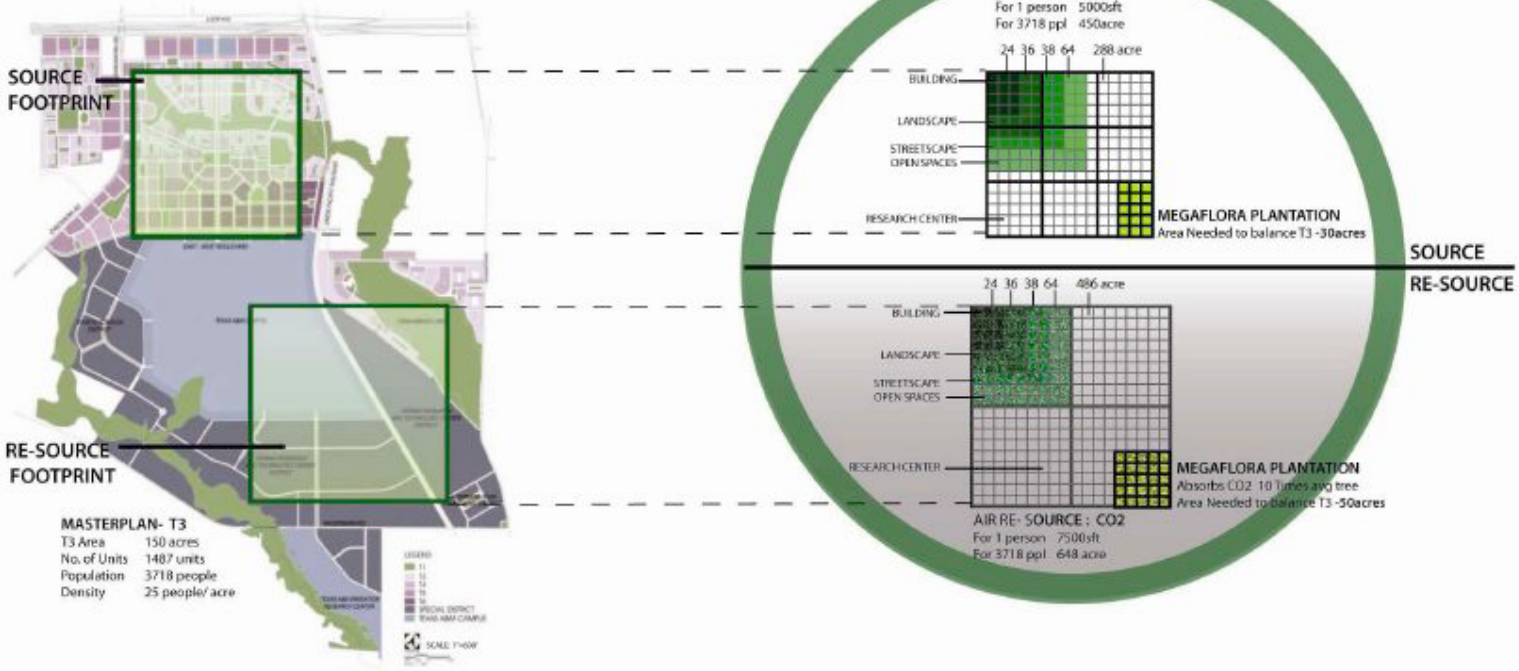

Health Balance - Best Management Practices In Transect Zone T6
5 & 23. Megaflora plantations
8. Vertical growing green walls
11. Microbial based waste water treatment
ECO-BALANCE HEALTH CHART FOR T6
Code
S/R
SB
Best Management Practices
Air
Water
Materials/Chemicals
Biophysical Balance
Psychological Health
HEALTH
Table Legend
Source
Re-Source
Sustainable Businesses
at level & transect zones
P - Produce
S - Sell
M - Maintain
Life Cycle Definition - In EcoBalance terminology, the health of the community relates to many different simultaneous balances such as energy balance, which reduces planetary carbon. Water balance enables a constantly improving quality and supply of water. More specifically, Health balance at Verano fits three specific conditions: 1) avoidance of PBTs (persistent bio-accumulative toxins) chemicals such as mercury, cadmium, and a variety of plasticizers; 2) half cycle balancing such as easily accessible walking paths resulting in an increase of cardiovascular health, and 3) full cycle balancing such as the use of Living Machines to eradicate vectors that cause west nile, malaria, (pesticides) while producing high quality organic fertilizers that in turn replace more chemicals in the landscape.
ECO-BALANCE

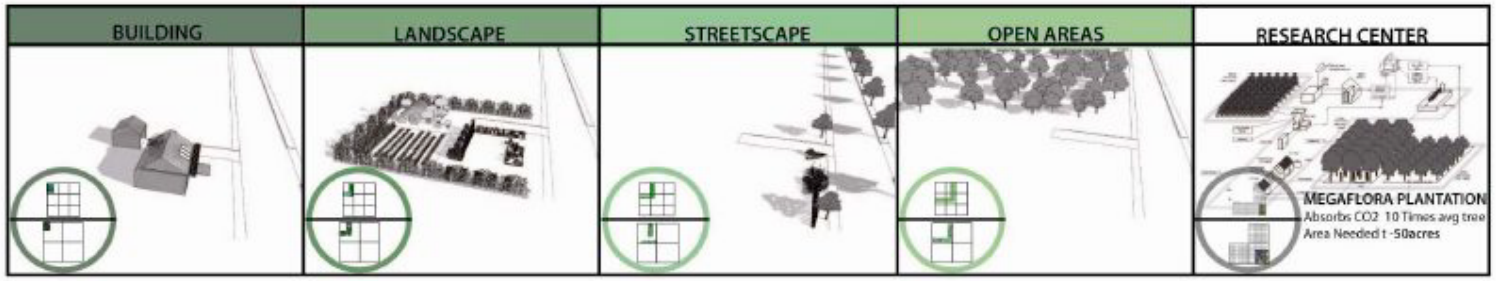

© cmpbs 2008

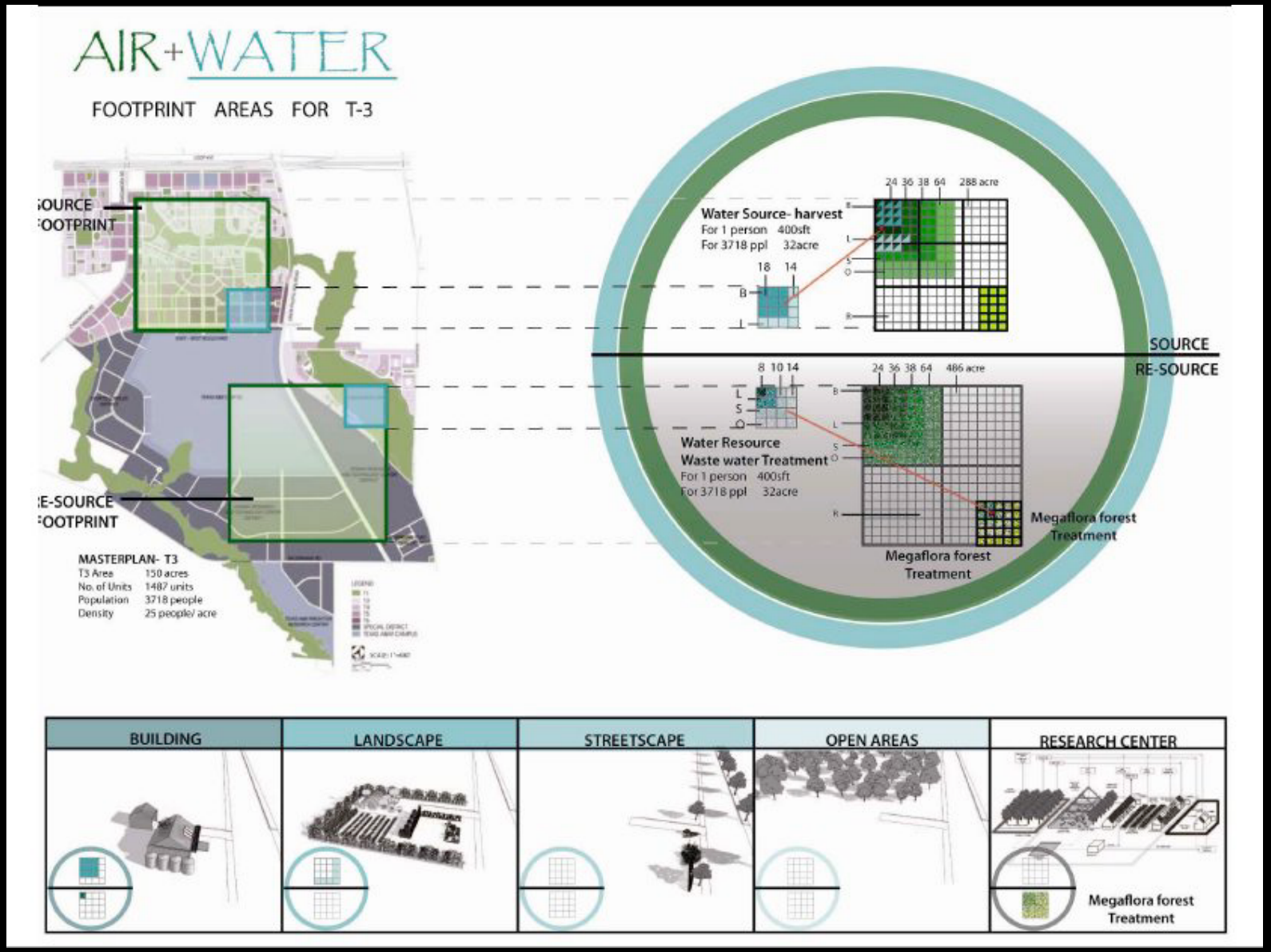


AIR

FOOTPRINT AREAS FOR T-3

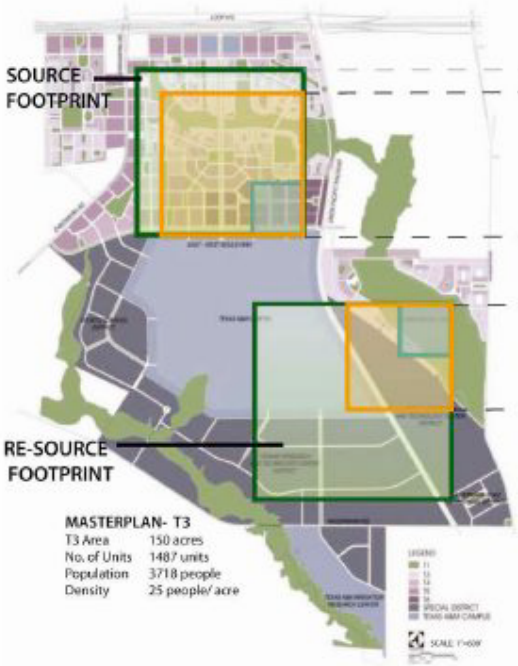


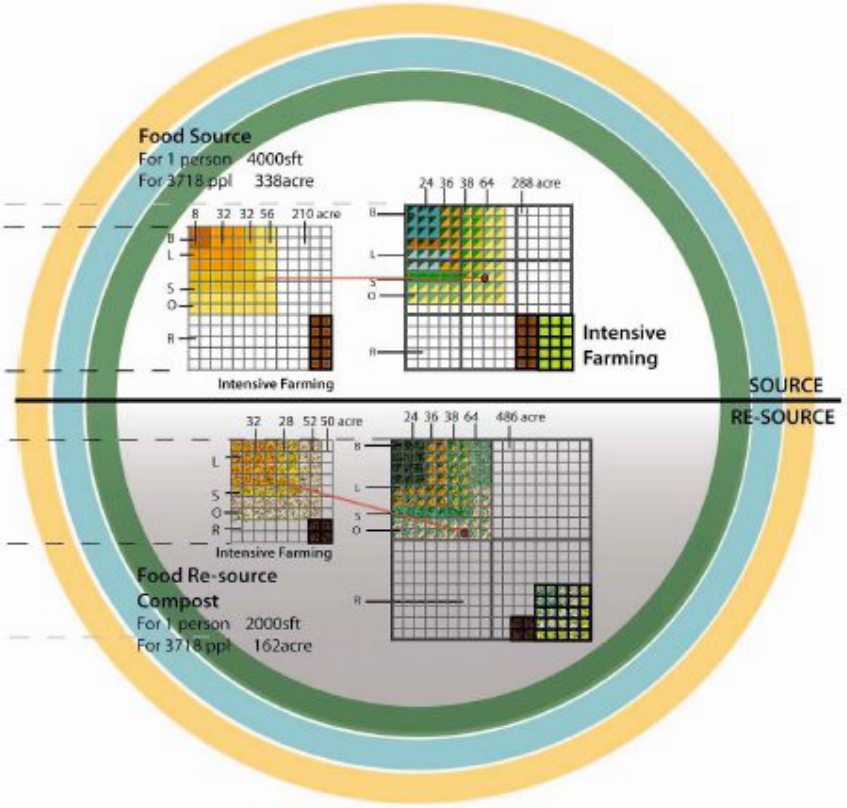


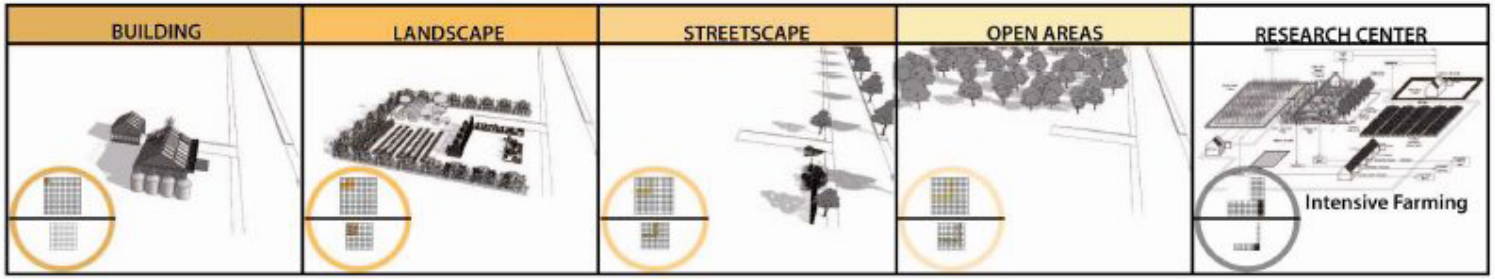

AIR+WATER
FOOTPRINT AREAS FOR T-3
OURCE
OOTPRINT
E-SOURCE
OOTPRINT
MASTERPLAN- T3
T3 Area 150 acres
No. of Units 1487 units
Population 3718 people
Density 25 people/ acre
Water Source- harvest
For 1 person 400sft
For 3718 ppl 32acre
24 36 38 64 288 acre
18 14
SOURCE
RE-SOURCE
8 10 14
24 36 38 64 486 acre
Water Resource
Waste water Treatment
For 1 person 400sft
For 3718 ppl 32acre
Megaflora forest
Treatment
Megaflora forest
Treatment
BUILDING
LANDSCAPE
STREETSCAPE
OPEN AREAS
RESEARCH CENTER
Megaflora forest
Treatment

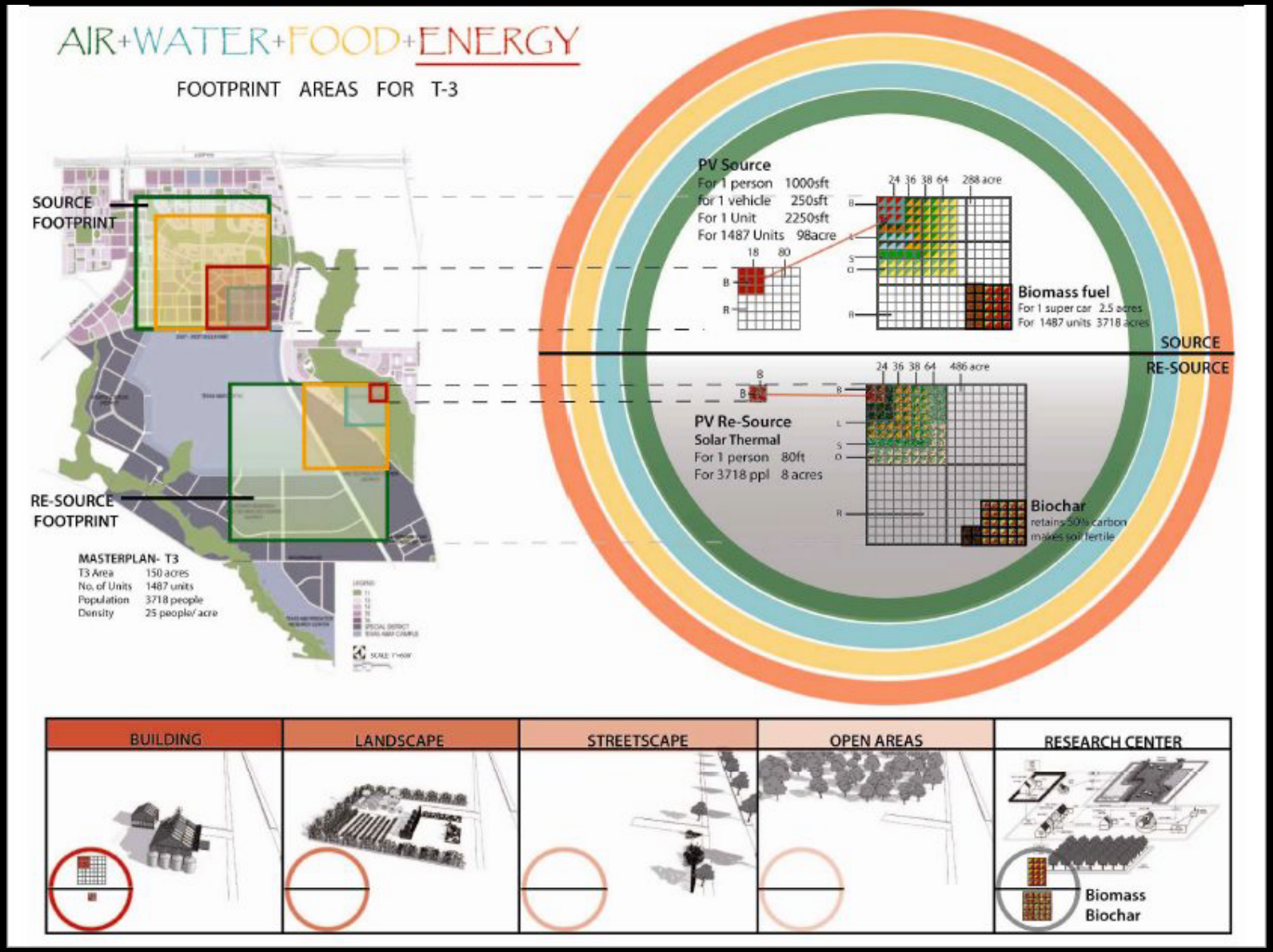
AIR+WATER+FOOD

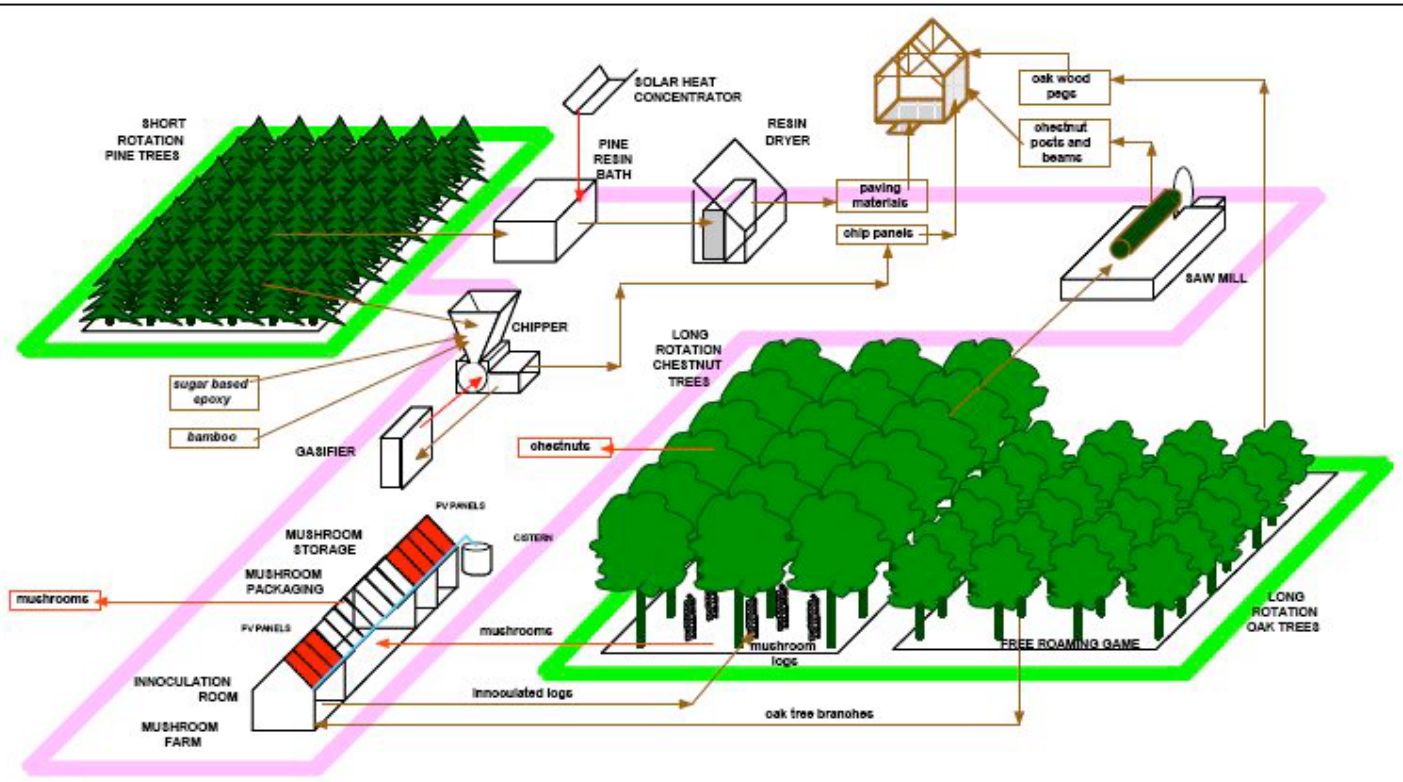
FOOTPRINT AREAS FOR T-3







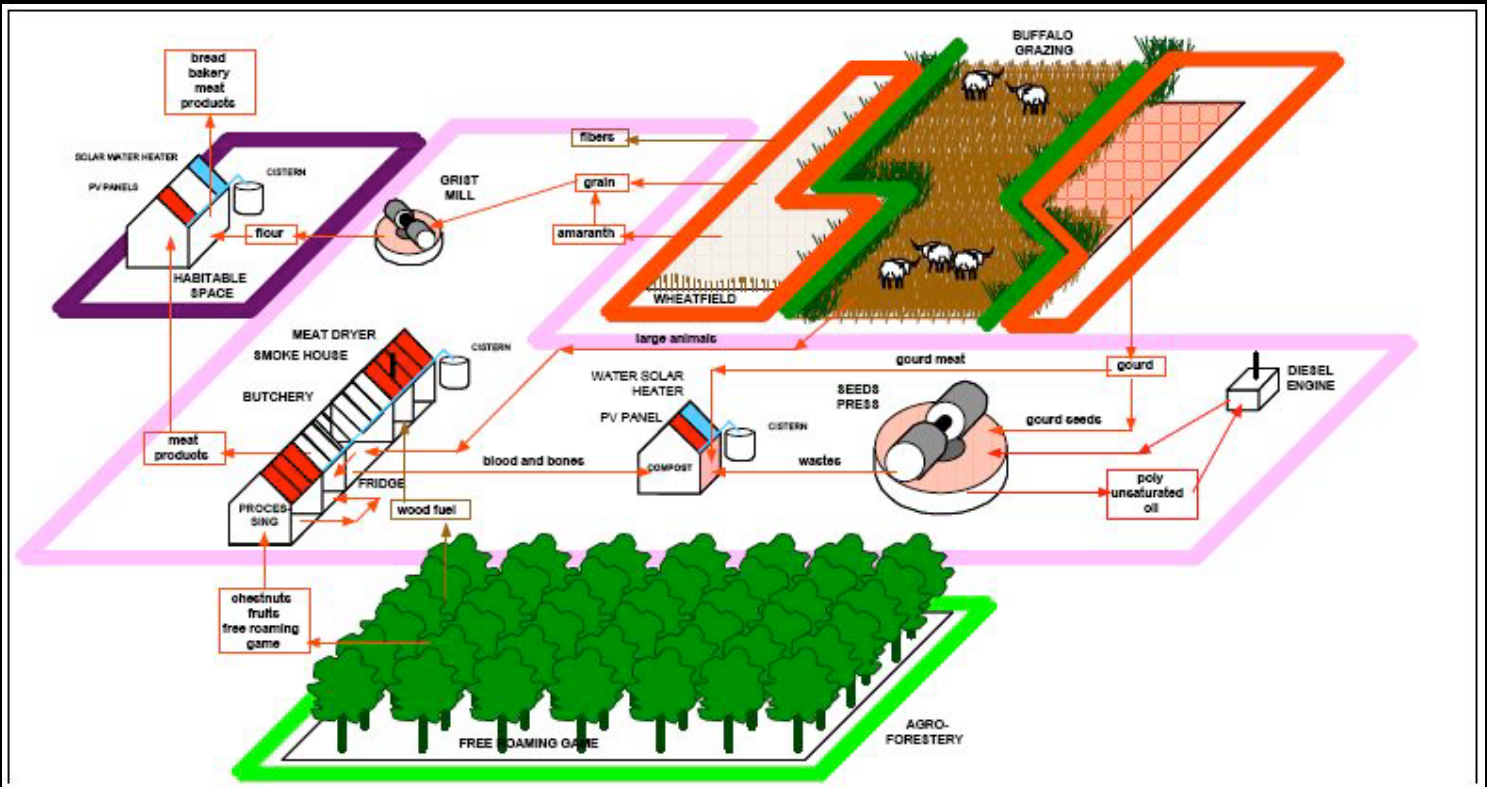

AIR+WATER+FOOD+ENERGY
FOOTPRINT AREAS FOR T-3
SOURCE FOOTPRINT
RE-SOURCE FOOTPRINT
MASTERPLAN- T3
T3 Area 150 acres
No. of Units 1487 units
Population 3718 people
Density 25 people/acre
PV Source
For 1 person 1000sft
for 1 vehicle 250sft
For 1 Unit 2250sft
For 1487 Units 98acre
24 36 38 64 288 acre
18 80
Biomass fuel
For 1 super car 2.5 acres
For 1487 units 3718 acres
SOURCE
RE-SOURCE
8
24 36 38 64 486 acre
PV Re-Source
Solar Thermal
For 1 person 80ft
For 3718 ppl 8 acres
Biochar
retains 50% carbon
makes soil fertile
BUILDING
LANDSCAPE
STREETSCAPE
OPEN AREAS
RESEARCH CENTER
Biomass
Biochar



IMPORT FROM OTHER CLUSTERS	sugar based epoxy bamboo fiber	EXPORT TO OTHER CLUSTERS	chestnuts mushrooms small game building materials
IMPORT FROM OUTSIDE		EXPORT OUTSIDE	chestnuts mushrooms small game building materials

AIR/MATERIAL INTEGRATED FARM

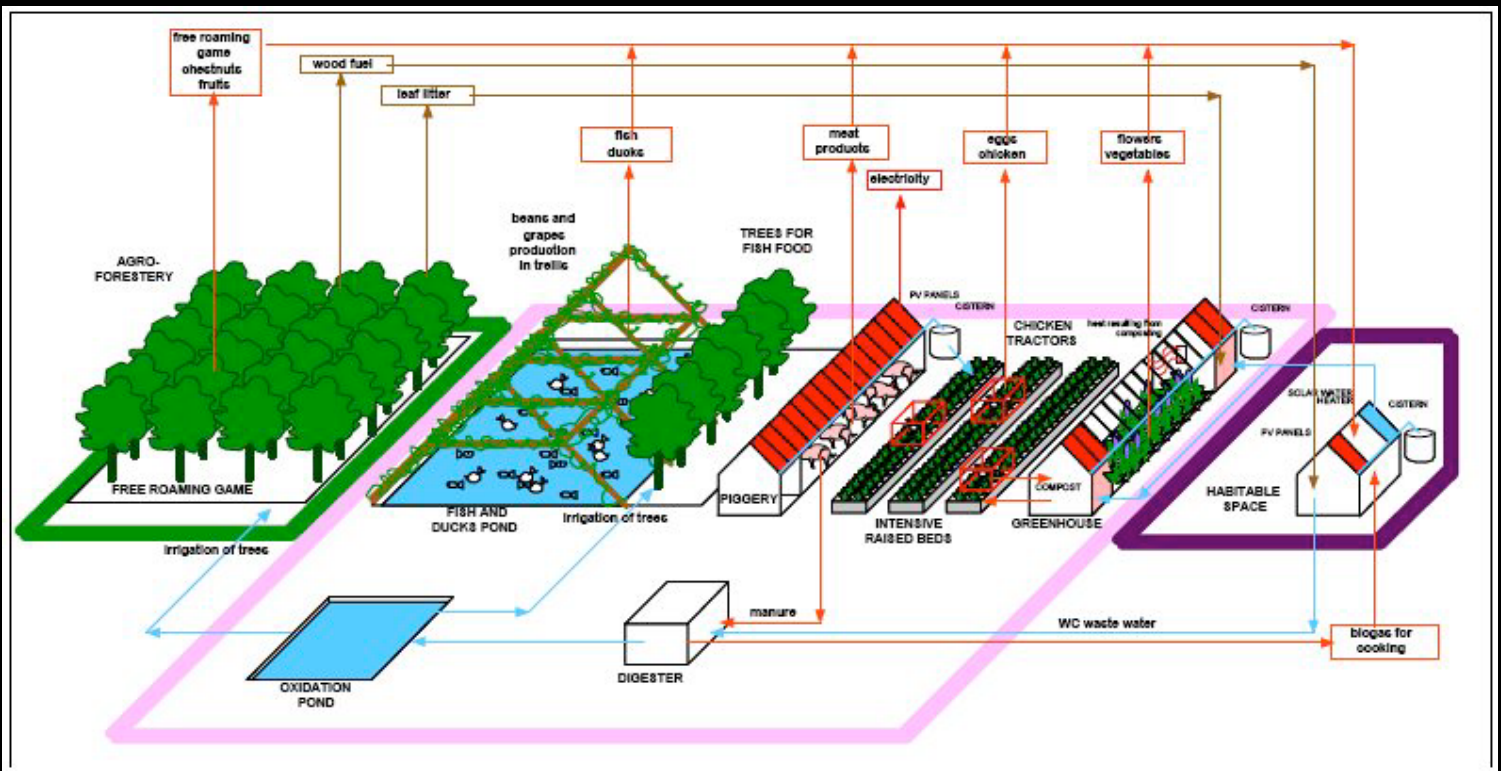
RESEARCH AREA



IMPORT FROM OTHER CLUSTERS	building materials eggs, poultry, ducks, small game	EXPORT TO OTHER CLUSTERS	meat products biofuel chestnuts fiber, grain, bakery
IMPORT FROM OUTSIDE		EXPORT OUTSIDE	meat products biofuel chestnuts fiber, grain, bakery

ENERGY/FOOD INTEGRATED FARM

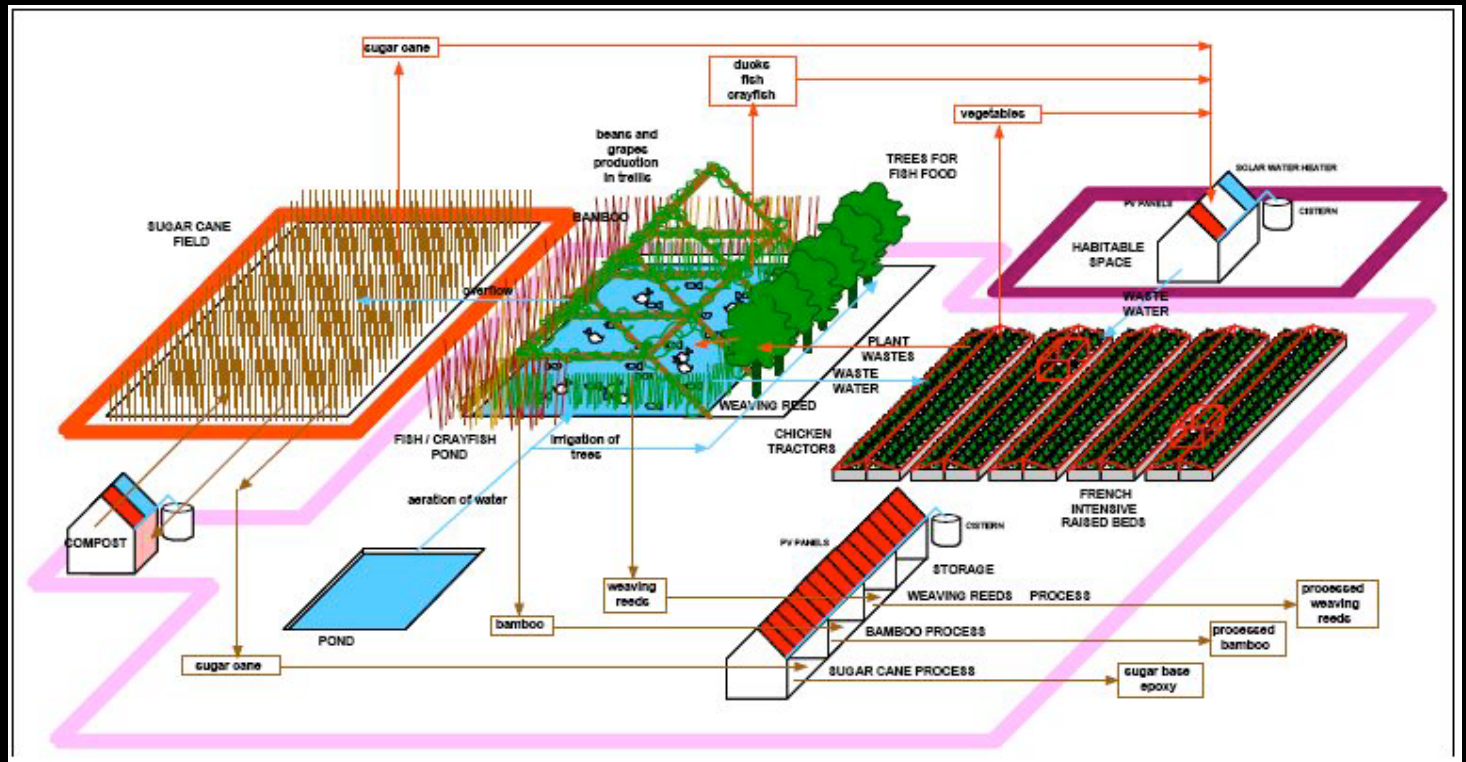
RESEARCH AREA



IMPORT FROM OTHER CLUSTERS	building materials	EXPORT TO OTHER CLUSTERS	eggs, poultry, ducks pork biofuel, electricity fish, crayfish flowers and vegetables, chestnuts
IMPORT FROM OUTSIDE		EXPORT OUTSIDE	eggs, poultry, ducks pork biofuel, electricity fish, crayfish flowers and vegetables, chestnuts

FOOD/WATER INTEGRATED FARM

RESEARCH AREA



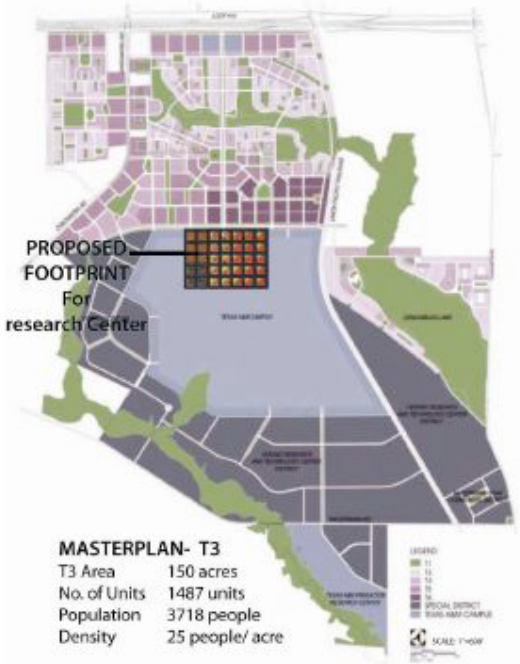
IMPORT FROM OTHER CLUSTERS	biofuel building materials	EXPORT TO OTHER CLUSTERS	eggs, poultry, ducks sugar cane, sugar based epoxy bamboo, weaving reeds fish, crayfish flowers and vegetables
IMPORT FROM OUTSIDE		EXPORT OUTSIDE	eggs, poultry, ducks sugar cane, sugar based epoxy bamboo, weaving reeds fish, crayfish flowers and vegetables

MATERIAL/FOOD INTEGRATED FARM

RESEARCH AREA

AIR+WATER+FOOD+ENERGY

COMBINED FOOTPRINT AREA FOR T-3



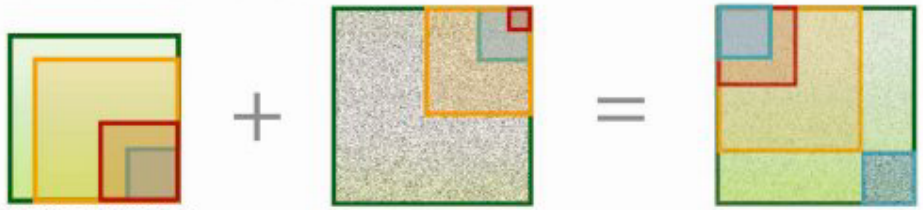
MASTERPLAN- T3

T3 Area	150 acres
No. of Units	1487 units
Population	3718 people
Density	25 people/ acre

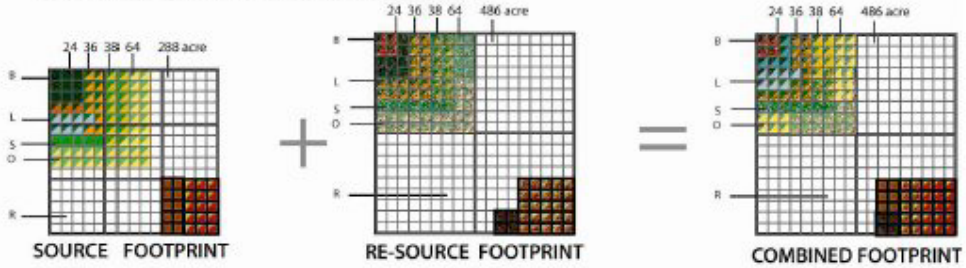
RESEARCH CENTER USAGE

Megaflora plantation	50acres
-O2 supply/Carbon sink	
-Waste water treatment	
-BiomassFuel / Biochar	
Intensive Farming	20acres

UNITEGRATED FOOTPRINT AREA :



INTEGRATED FOOTPRINT AREA :



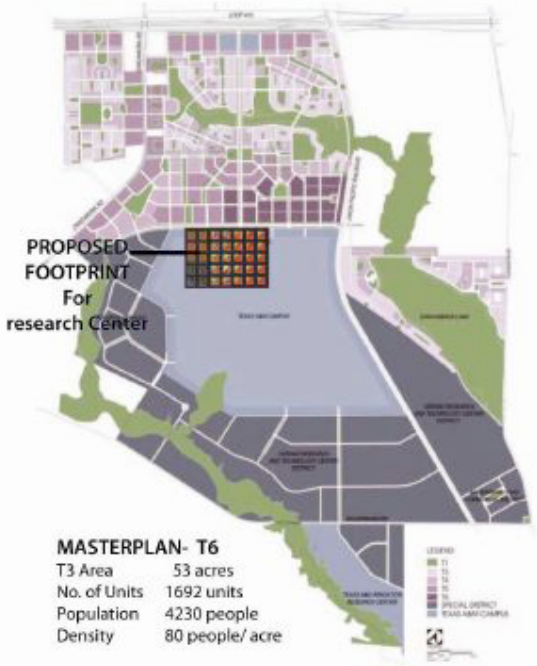
ACTUAL FOOTPRINT REQUIRED TO BALANCE T3:

INTEGRATED T3 FOOTPRINT 162 acre

PROPOSED FOOTPRINT For research Center 70 acres

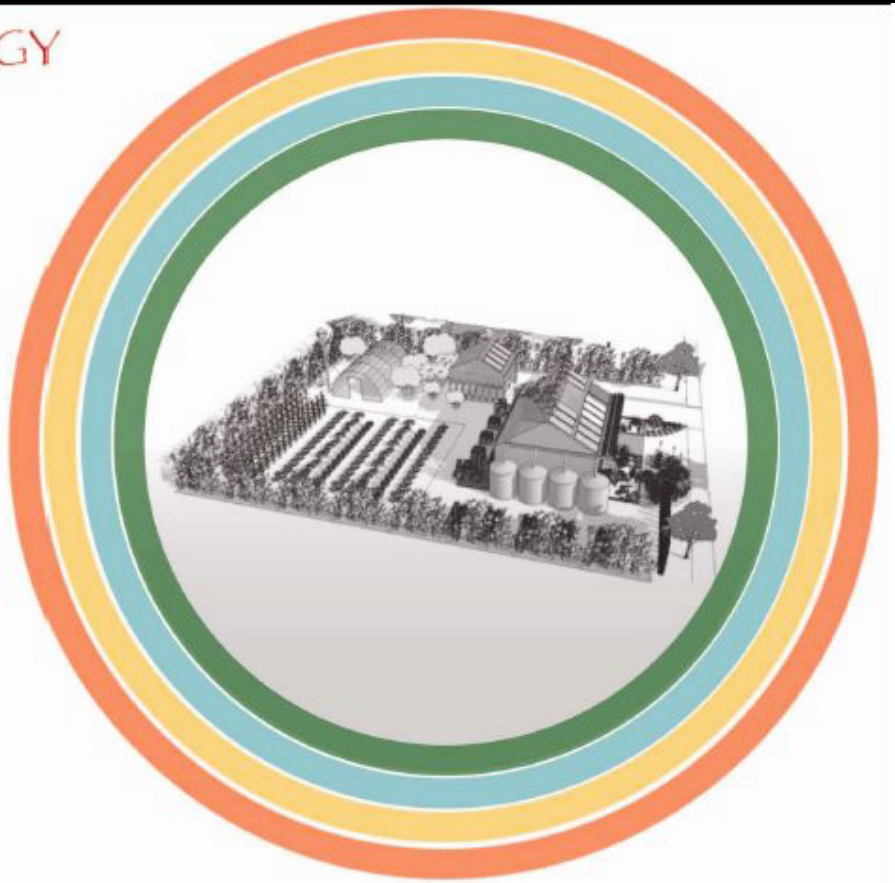
AIR+WATER+FOOD+ENERGY

COMBINED FOOTPRINT AREA FOR T-3

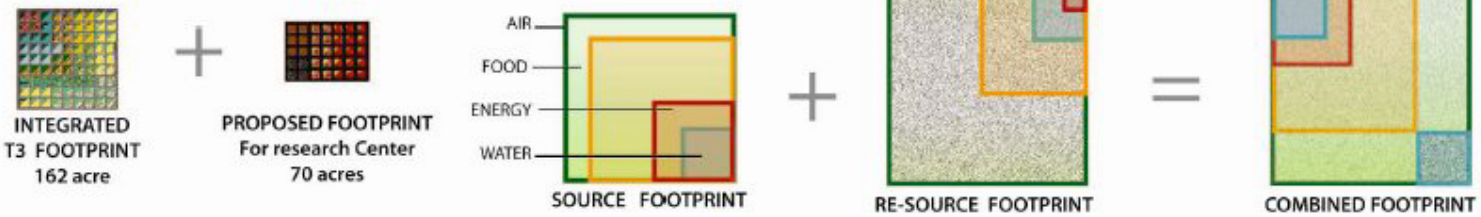


MASTERPLAN- T6

T3 Area	53 acres
No. of Units	1692 units
Population	4230 people
Density	80 people/ acre

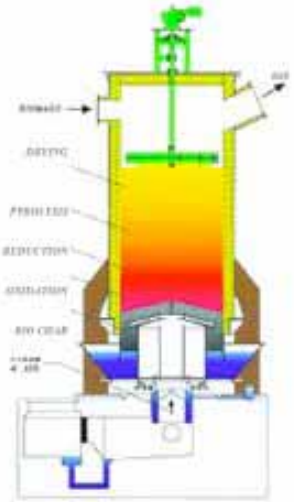


ACTUAL FOOTPRINT REQUIRED TO BALANCE T3:

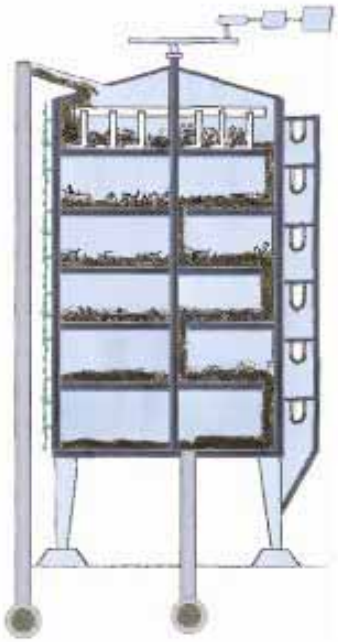


Energy bio waste material Food Conversion processes level T6

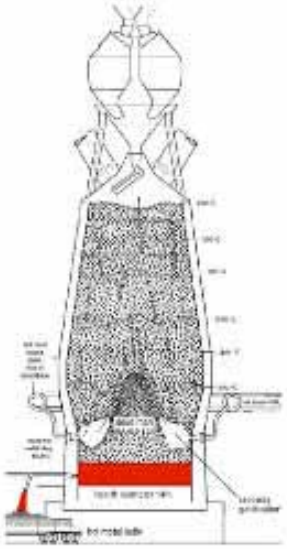
VERTICAL BIO-SYSTEMS



BIOCHAR KLIN

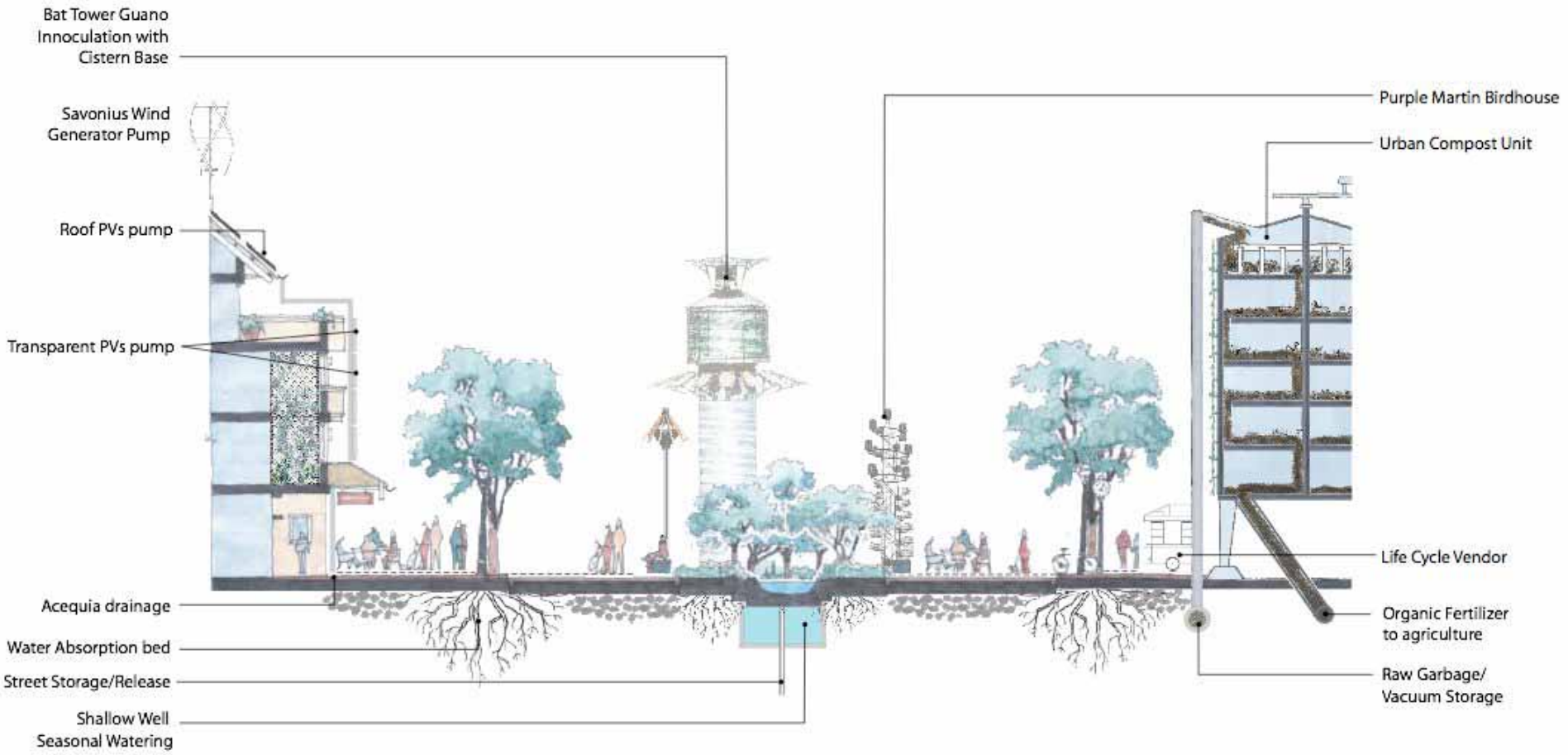


ERP THOMAS
BIODIGESTER



BIOSTEEL PLANT

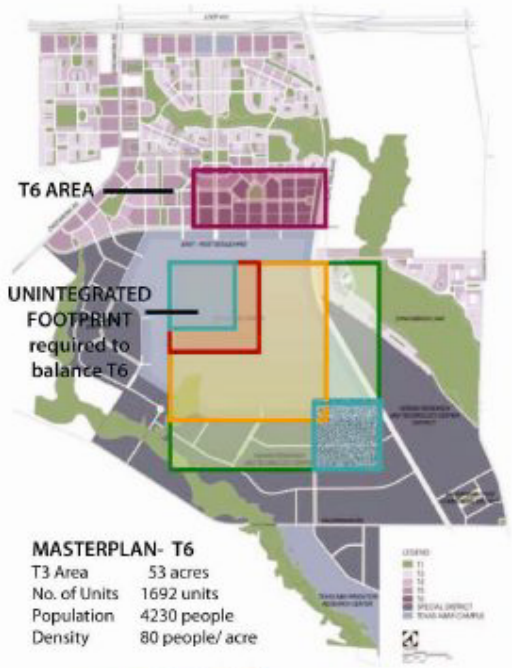
CHRIS JACOB
VERTICAL FARMS



Water/Waste Water Cycle

AIR+WATER+FOOD+ENERGY

COMBINED FOOTPRINT AREA FOR T-6



MASTERPLAN- T6

T3 Area	53 acres
No. of Units	1692 units
Population	4230 people
Density	80 people/ acre

PROPOSAL FOR INTEGRATED T6

MAIN PLAZA AND CENTRAL PARK AT TOWN CENTER

RAIL TRANSIT STATION

SULPHUR SPRINGS NEIGHBORHOOD CENTER

PEDESTRIAN PROMENADE