# Sustainability

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ARC 503

# Sustainability

For the purposes of this research, sustainability is the practice of implementing strategies to **minimize building energy** and **environmental impact**, **preserve resources**, and **promote health**.

Definition

# ENERGY

## ACTIVE

- ENERGY STORAGE
- SOLAR THERMAL
- WIND TURBINES
- GEOTHERMAL
- BIO ENERGY
- PV PANELS

## PASSIVE

- NATURAL VENTILATION
- REFLECTIVE ROOF
- SOLAR SHADING
- THERMAL MASS
- DAYLIGHTING

# RESOURCES

## WATER

- WATER TREATMENT
- PERVIOUS SURFACES
- COMPOST TOILETS
- RAIN BARRELS
- BIOSWALES

## MATERIALS

- LOW EMBODIED ENERGY
- RENEWABLE RESOURCES
- PREFABRICATION
- DISASSEMBLY

# IMPACT

## SMART GROWTH

- TRANSPORTATION & INFRASTRUCTURE DEVELOPMENT
- “RIGHT SIZE” HOUSING
- BROWNFIELD SITES
- REDEVELOPMENT
- DENSITY

## MINIMAL DISTURBANCE

- FLOATING FOUNDATIONS
- CONSTRUCTION WASTE
- BALANCE CUT & FILL

# HEALTH

## PROMOTING HEALTH

- LOW VOC & AIR QUALITY
- WATER QUALITY
- AGRICULTURE

# ENERGY

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## Active Energy Strategies

Using technology and additive building elements to achieve reductions in energy use.


## Passive Energy Strategies

Using the building envelope and orientation to achieve reductions in energy use.

# RESOURCES

## WATER

- WATER TREATMENT
- PERVIOUS SURFACES
- COMPOST TOILETS
- RAIN BARRELS
- BIOSWALES

## MATERIALS

- LOW EMBODIED ENERGY
- RENEWABLE RESOURCES
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- DISASSEMBLY

## Water Resources

Reducing daily water demand by collecting, treating and reusing water that falls on the site.

Bioswales

Pervious Surfaces

Compost Toilets

Water Treatment

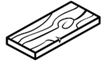
Rain Barrels

## Material Resources

Selecting materials for building based on their contribution to landfills and global carbon dioxide levels.

Low Embodied Energy

Prefabrication



Renewable Resources

Disassembly

# IMPACT

## SMART GROWTH

TRANSPORTATION & INFRASTRUCTURE DEVELOPMENT

“RIGHT SIZE” HOUSING

BROWNFIELD SITES

REDEVELOPMENT

DENSITY

## MINIMAL DISTURBANCE

FLOATING FOUNDATIONS

CONSTRUCTION WASTE

BALANCE CUT & FILL

## Smart Growth

Planning for the increased density of the urban environment to minimize destruction of green fields

Brownfield Sites | “Right Size” Housing | Zoning for Density | Infrastructure | Designing for Redevelopment

## Minimizing Disturbance

Mitigating the byproducts of building on the site by preserving existing wind and water patterns.

Construction Waste | Balancing Cut and Fill | Floating Foundations

# HEALTH

## PROMOTING HEALTH

LOW VOC & AIR QUALITY

WATER QUALITY

AGRICULTURE

# Promoting Health

Introducing initiatives to promote healthy lifestyles and healthy buildings through lifestyle changes, as well as air and water quality measures.

Agriculture/planting

Water Quality


Low VOCs and Air Quality

# Precedents

# Hammerby Sjostad

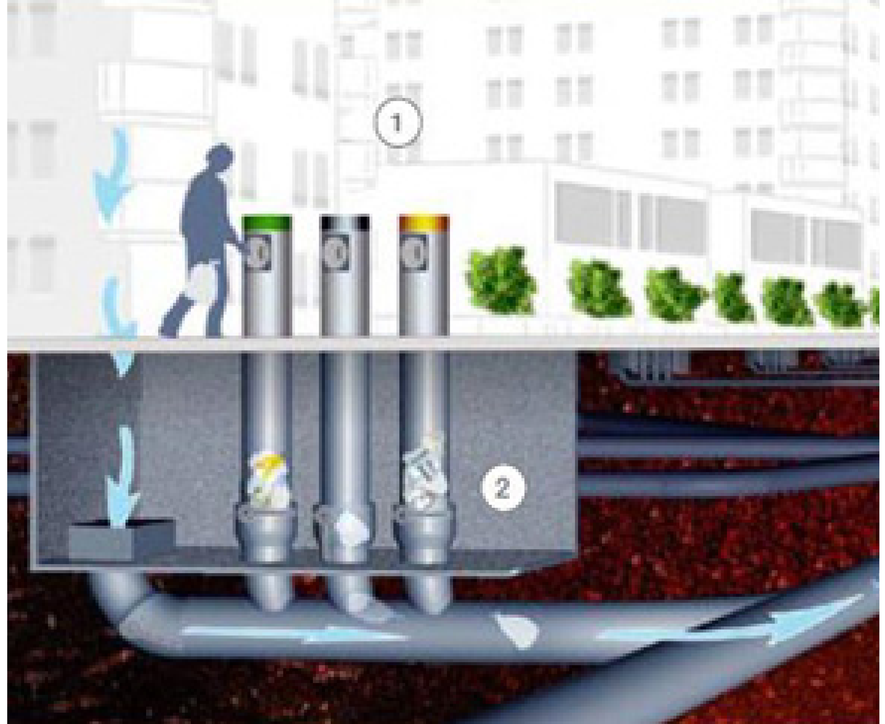
White Arkiteckter
Stockholm, Sweden

*Community was constructed on a previous hazardous waste site.*

*Public transit used for commuting.*

*Waste is burned to create energy.*

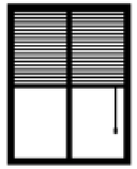
*Water is treated and recycled within the community*



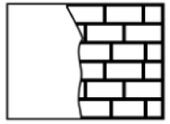

# The Great Wall of Western Australia

LUIGI ROSSELLI

North Western Australia



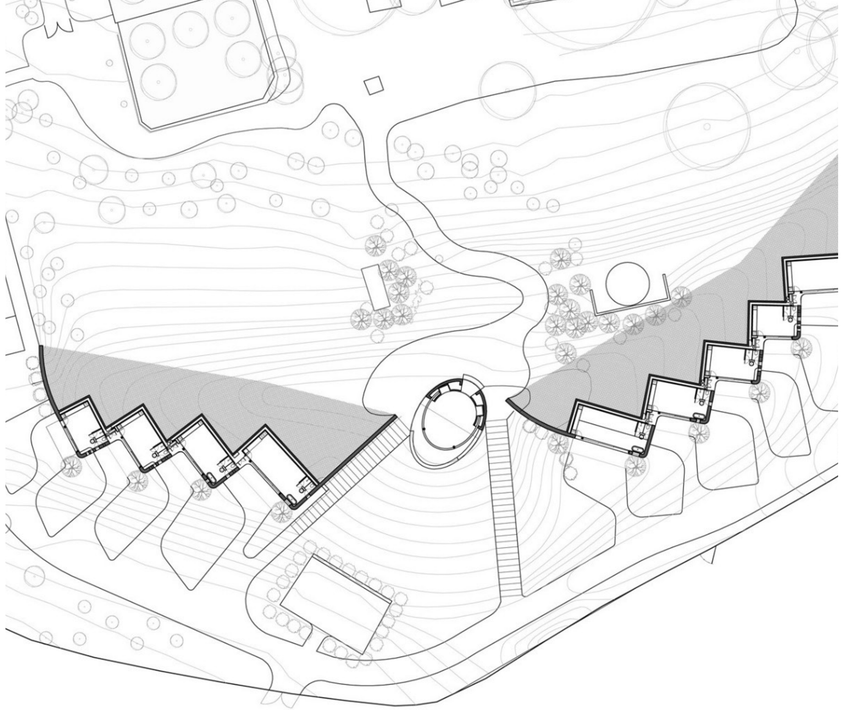
*Large southern overhangs prevent direct solar gain.*



*High Thermal Mass takes advantage of cool desert nights.*

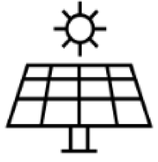
*Abundant Local Materials were used .*

*Public and private greenspaces encourage interaction.*



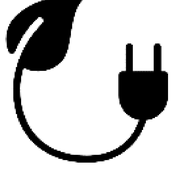
# Beddington Zero Energy Development

BILL DUNSTER
London, England



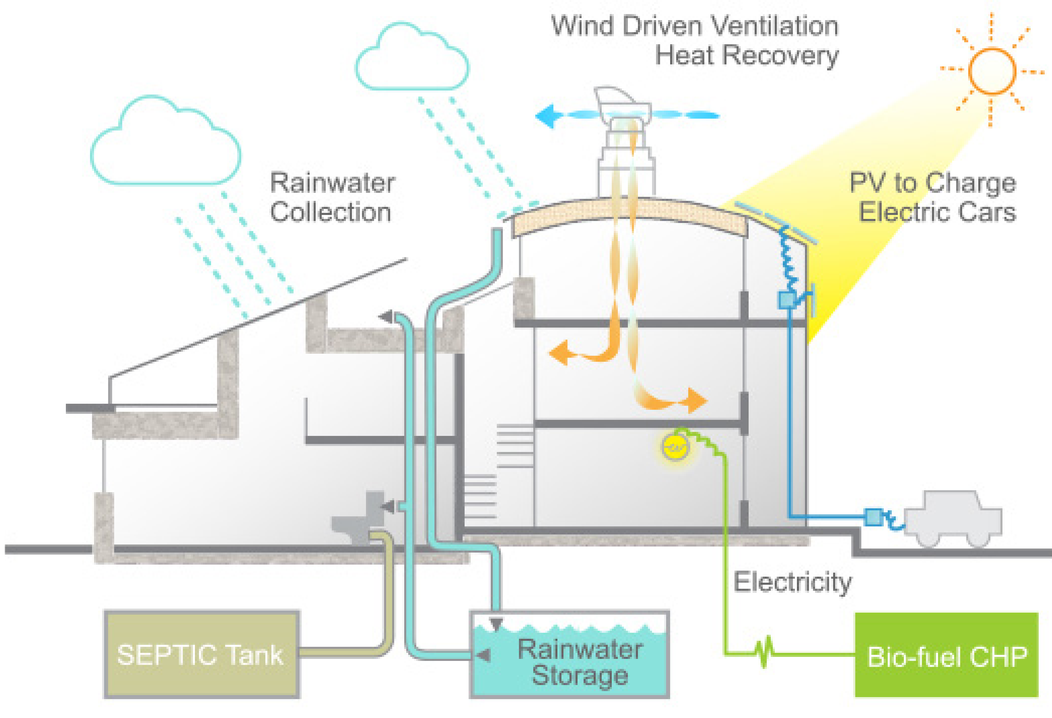
*Solar panels on the units feed the onsite electrical grid.*

*Public transit and pedestrian travel are encouraged.*



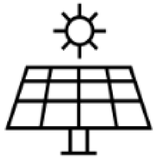
*Tree Waste is brought in from a local lumber company to heat units.*

*Greywater is treated and reused for irrigation*



# Regen Villages

EFFEKT
Almere, Netherlands

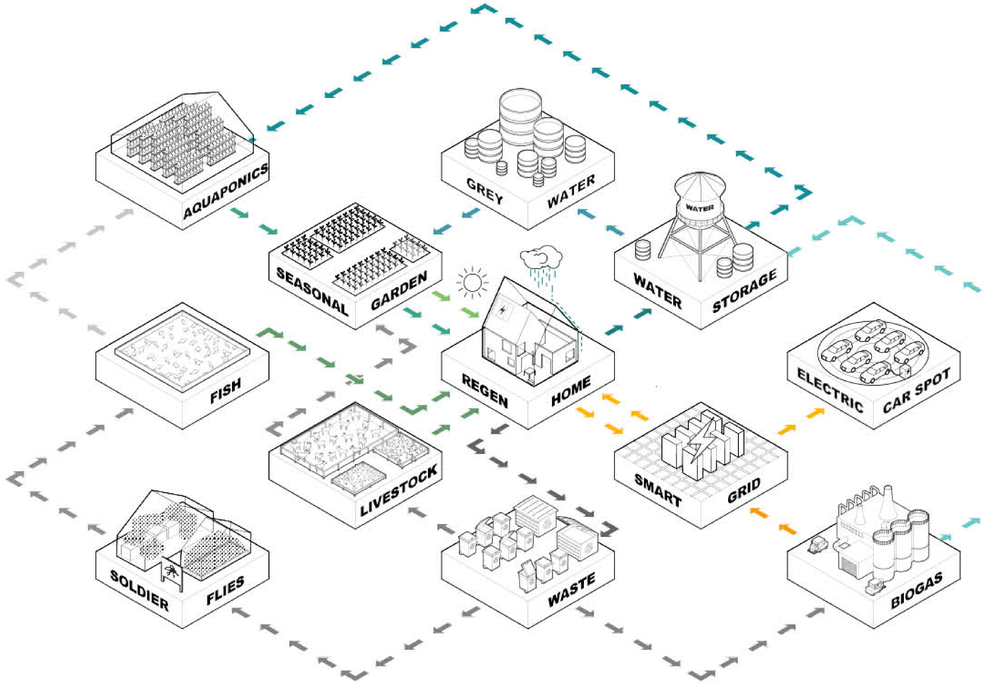


*Solar panels on the units feed the onsite electrical grid.*

*Agriculture and Aquaponics*

*Waste is converted to energy in biogas plant.*

*Greywater is treated and reused for irrigation*

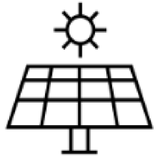



# Grow Community

DAVIS STUDIO A&D
Bainbridge, Washington

*Local waste is converted to bioenergy*

*Greywater is treated and reused for irrigation*



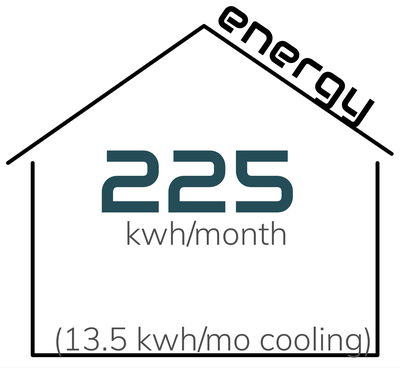
*Solar Panels are installed on each unit.*

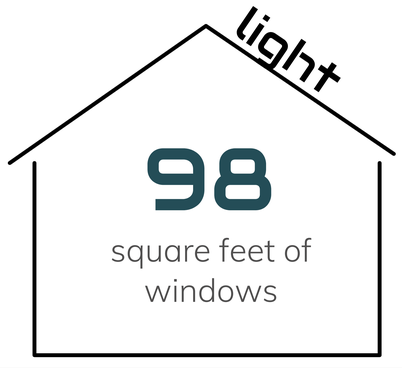
*Site was chosen for its proximity to transit*


grow community

possibility. connection. happiness.

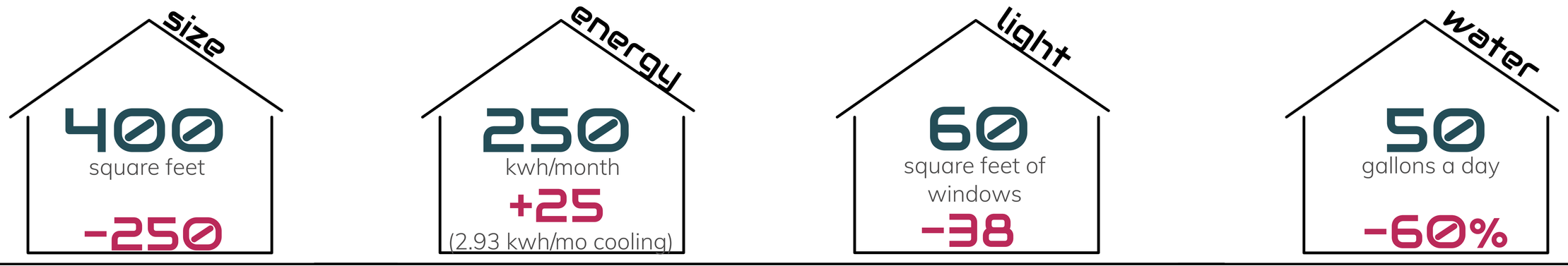
# Applications

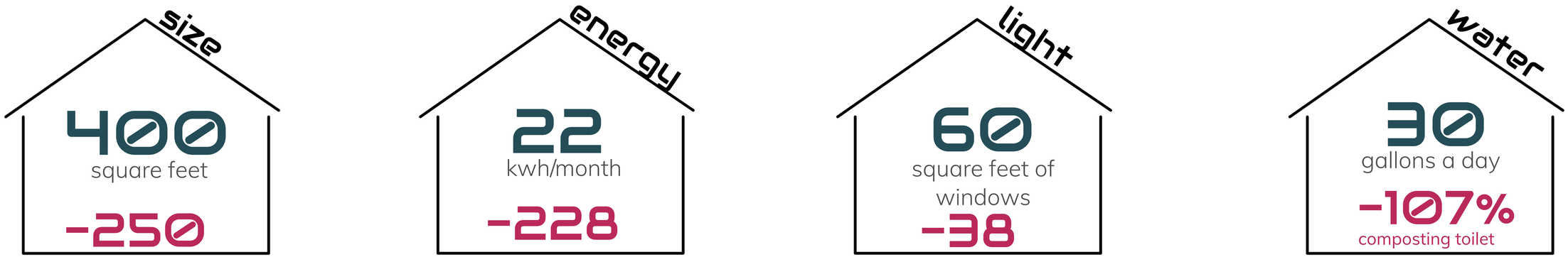





# Typical House
## (per person)



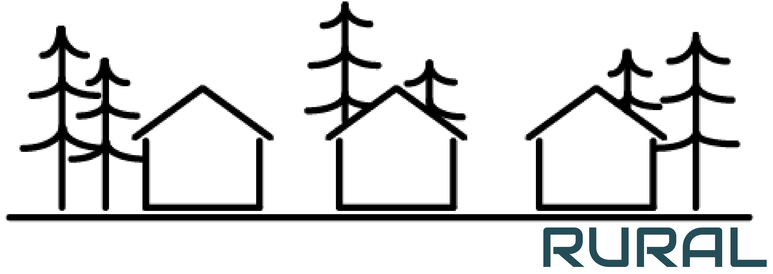

# Typical Tiny House



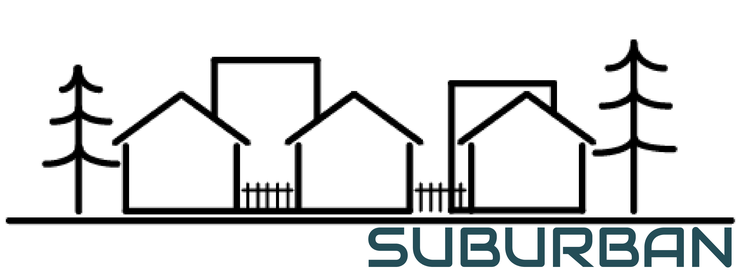

# Energy Efficient Tiny House

# Location Based Strategies

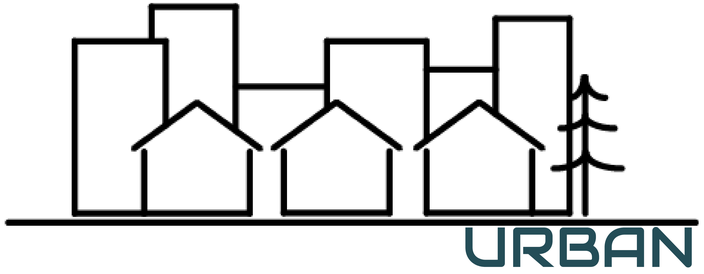
*Off grid energy and water*
*minimal disturbance*
*local material resources*




*active and passive energy*
*smart growth*
*local materials*
*healthy environments*




*water quality*
*air quality*
*public transportation*
*active and passive energy*



# Designers' Toolbox

## Active Strategies

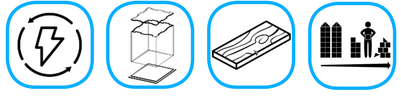
## Water Preservation

## Smart Growth

## Promoting Health


## Passive Strategies

## Resource Preservation



## Minimizing Disturbance

# Thermal Mass

High thermal mass walls absorb and hold heat during hot days, reducing indoor temperature fluxuations. Green Globes requires walls with a heat capacity of 5 BTU/ft² °F and gives maximum points for walls with **7 BTU/ft² °F or higher.**

## THERMAL CAPACITY:

specific heat X density X thickness

| Material | Specific Heat (BTU/lb°F) | Density (lb/ft³) | Thickness (FT) |
|---|---|---|---|
| Concrete | .239 | 124.85 | |
| Brick | .191 | 106.13 | |
| Wool Batt Insulation | .239 | 1.56 | |
| Rigid Insulation (XPS) | .310 | 1.56 | |
| Concrete Block | .239 | 143.5 | |
| Air | .239 | .076 | |
| Sheathing | .322 | 31.8 | |

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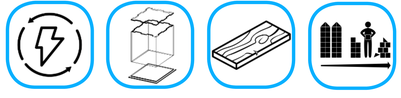

## Minimizing Disturbance

# Bioswales

For an unconnected bioswale, the flow rate should be below 1 ft/s and the swale must be large enough to accommodate the 100 year storm.  Bioswales are usually trapezoidal, with a minimum width of 4ft and a maximum width of 8ft.

## Calculate Length:

Flow rate*540 seconds (9 minutes)

## Calculate Flow Rate: (C*I*A)

I = inches per hour = 4 (North Carolina av)
C = (.95*%impervious surface) +
(.30*%pervious surface)
A = area in acres (multiply SF by .000023)

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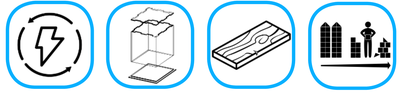

## Minimizing Disturbance

# Brownfield Sites

Brownfield sites are contaminated sites from industrial or hazardous waste.  Repairing them prevents voids in the urban fabric. 1 acre of rehabilitated brownfield sites can save up to 4.5 acres of greenfields.

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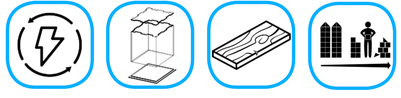

## Minimizing Disturbance

# Volatile Organic Compounds

The Living Building Challenge requires operable windows, and compliance with ASHRAE 62. LEED requirements for credit are listed.

| Product Type | Referenced Standard | VOC Limit (g/L minus water) |
|---|---|---|
| Interior Flat Coating | Green Seal GS-11, 1993 | 50 |
| Interior Non-Flat Coating | Green Seal GS-11, 1993 | 150 |
| Anti-Corrosive/ Anti-Rust Paint | Green Seal GC-03, 2nd Edition, 1997 | 250 |
| Clear Wood Finish: Lacquer | SCAQMD Rule 1113, 2004 | 550 |
| Clear Wood Finish: Sanding Sealer | SCAQMD Rule 1113, 2004 | 350 |
| Clear Wood Finish: Varnish | SCAQMD Rule 1113, 2004 | 350 |
| Clear Brushing Lacquer | SCAQMD Rule 1113, 2004 | 680 |
| Floor Coatings | SCAQMD Rule 1113, 2004 | 100 |
| Primers, Sealers and Undercoaters | SCAQMD Rule 1113, 2004 | 200 |
| Shellac: Clear | SCAQMD Rule 1113, 2004 | 730 |
| Shellac: Pigmented | SCAQMD Rule 1113, 2004 | 550 |
| Stain | SCAQMD Rule 1113, 2004 | 250 |
| Pigmented Lacquer | SCAQMD Rule 1113, 2004 | 550 |
| Waterproofing Sealers | SCAQMD Rule 1113, 2004 | 250 |
| Waterproofing Concrete/ Masonry Sealers | SCAQMD Rule 1113, 2004 | 400 |
| Wood Preservatives | SCAQMD Rule 1113, 2004 | 350 |
| Low-Solids Coatings | SCAQMD Rule 1113, 2004 | 120* |

*Note: VOC levels for Low-Solids Coatings are measured in grams of VOC per liter of material, including water.

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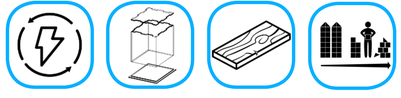

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