ENVIRONMENTALLY REGENERATIVE/RESTORATIVE ARCHITECTURE

THE FUTURE OF SUSTAINABLE DESIGN

Soo J. Ryu - MArch

www.theverymany.net

WHAT IS IT? WHY IS IT THE FUTURE?

"Buildings that go beyond the point of minimal or no environmental impact to become a vehicle for restoration and vital component in the integration with, and generation of, living ecosystems."

'Restorative' architecture is the next stage of 'green' architecture, where more is given to the environment over a building's lifetime than is taken during its construction and operation.

Alec Couchman – Warren and Mahoney, Excerpt from 'A Deeper Shade of Green'


THE NEXT SHIFT/MOVEMENT
GIVE BACK TO NATURE WHAT WE HAVE TAKEN
Environmentally Sustainable Design (ESD)
Restorative Environmental Design (RED)

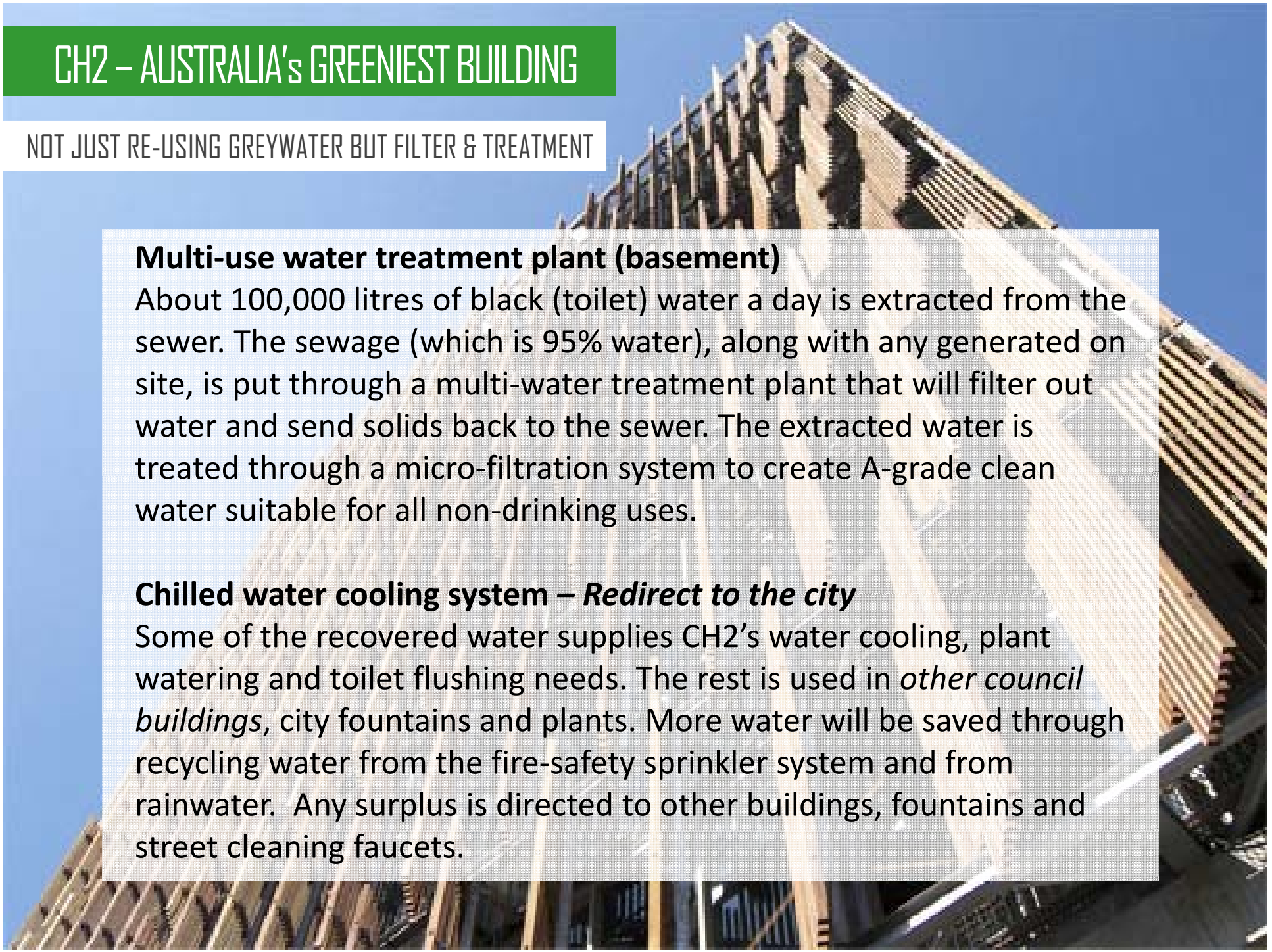
NATURE'S EXAMPLE: TREE

A tree does...

- ✓ Creates Oxygen (Manhatten Tower)
- ✓ Captures Carbon dioxide (Eco-concrete)
- ✓ Distils water (CH2 – Melbourne)
- ✓ Use solar energy as fuel (Integrated PV panels)
- ✓ Make food (Green roofs, vertical farms)
- ✓ Creates a microclimate
- ✓ Enhances diversity: Provides amenities for other organisms
- ✓ Creates beauty
- ✓ Responsive to changes in season, weather, stimulus (Living skin)
- ✓ Self replicates
- ✓ Zero Waste (R128 house)

CH2 – AUSTRALIA's GREENIEST BUILDING

NOT JUST RE-USING GREYWATER BUT FILTER & TREATMENT

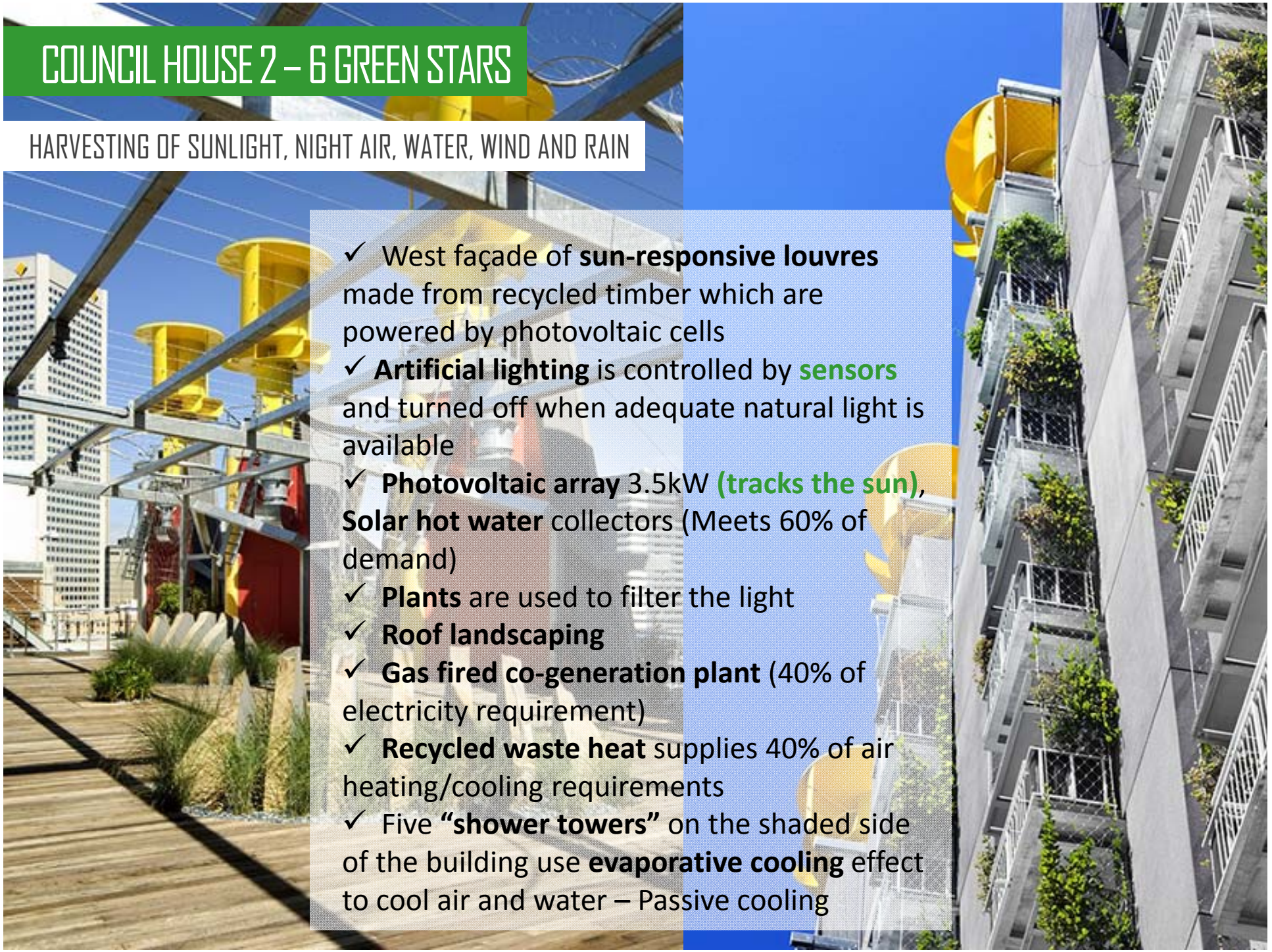


Multi-use water treatment plant (basement)
About 100,000 litres of black (toilet) water a day is extracted from the sewer. The sewage (which is 95% water), along with any generated on site, is put through a multi-water treatment plant that will filter out water and send solids back to the sewer. The extracted water is treated through a micro-filtration system to create A-grade clean water suitable for all non-drinking uses.

Chilled water cooling system – *Redirect to the city*
Some of the recovered water supplies CH2's water cooling, plant watering and toilet flushing needs. The rest is used in *other council buildings*, city fountains and plants. More water will be saved through recycling water from the fire-safety sprinkler system and from rainwater. Any surplus is directed to other buildings, fountains and street cleaning faucets.

COUNCIL HOUSE 2 – 6 GREEN STARS

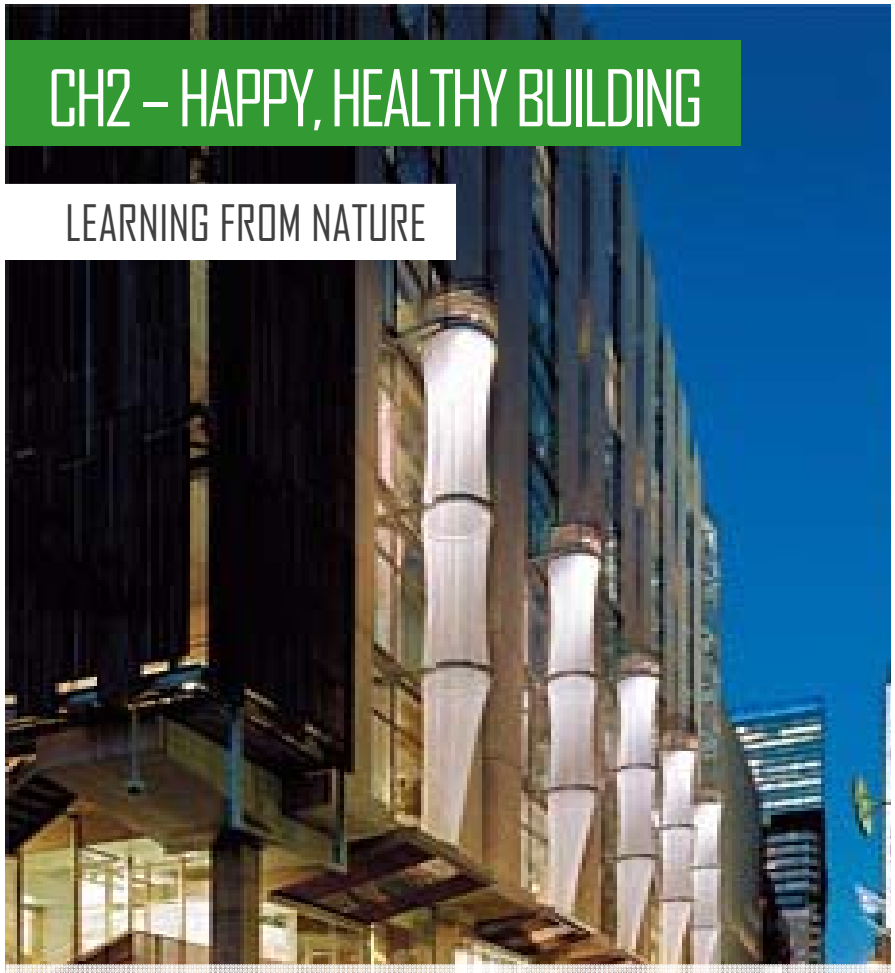
HARVESTING OF SUNLIGHT, NIGHT AIR, WATER, WIND AND RAIN



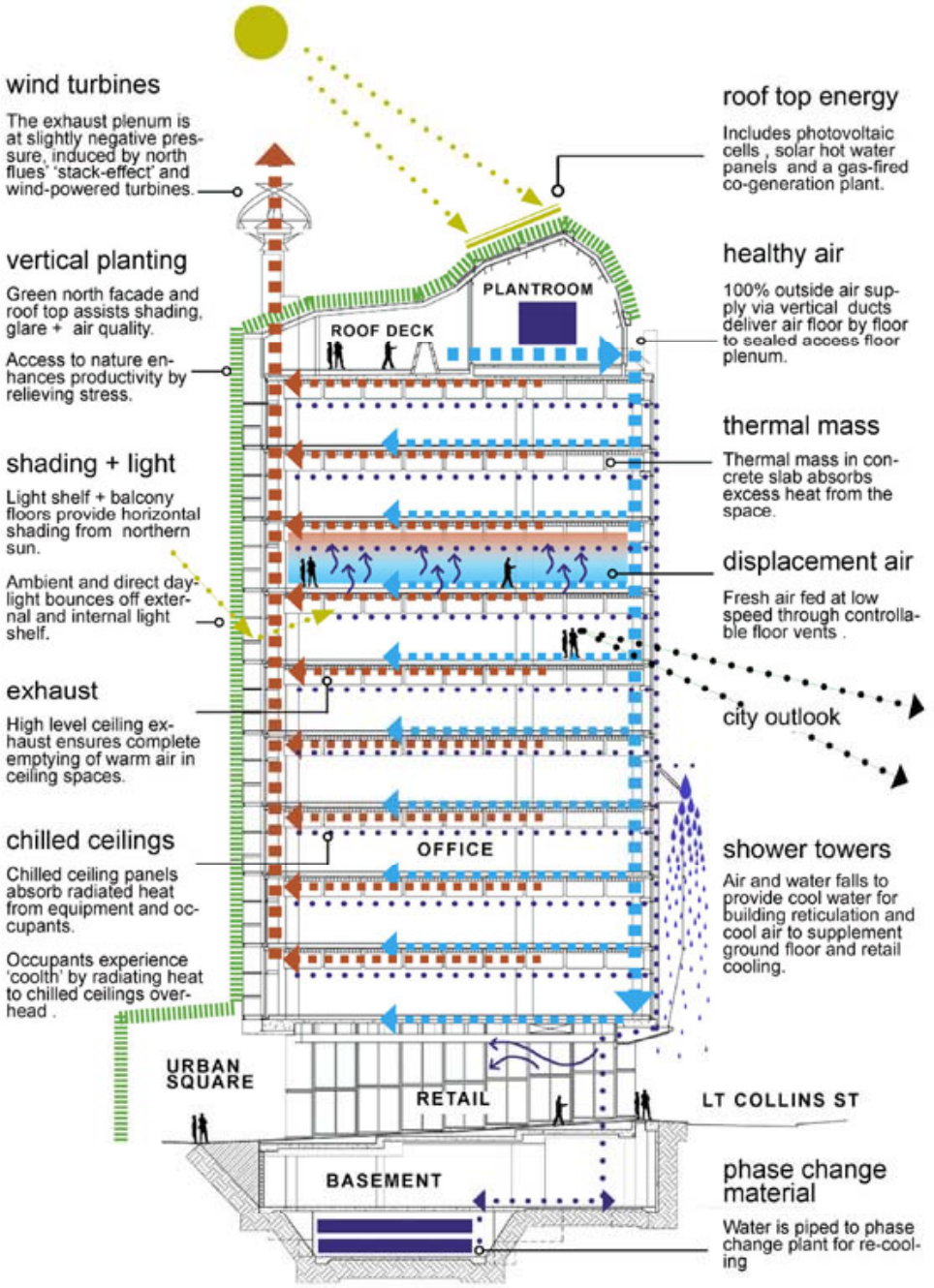
- ✓ West façade of **sun-responsive louvres** made from recycled timber which are powered by photovoltaic cells
- ✓ **Artificial lighting** is controlled by **sensors** and turned off when adequate natural light is available
- ✓ **Photovoltaic array** 3.5kW **(tracks the sun)**, **Solar hot water** collectors (Meets 60% of demand)
- ✓ **Plants** are used to filter the light
- ✓ **Roof landscaping**
- ✓ **Gas fired co-generation plant** (40% of electricity requirement)
- ✓ **Recycled waste heat** supplies 40% of air heating/cooling requirements
- ✓ Five **"shower towers"** on the shaded side of the building use **evaporative cooling** effect to cool air and water – Passive cooling

CH2 – HAPPY, HEALTHY BUILDING

LEARNING FROM NATURE



CH2 has a cooling system inspired by the mounds of certain termites. Some termite mounds are able to remain at a stable temperature in harsh desert climates and some use the evaporative cooling effect of aquifer water to further cool their mounds. (biomimicry)



BIO CLIMATIC SECTION

"THE LIVING TOWER"

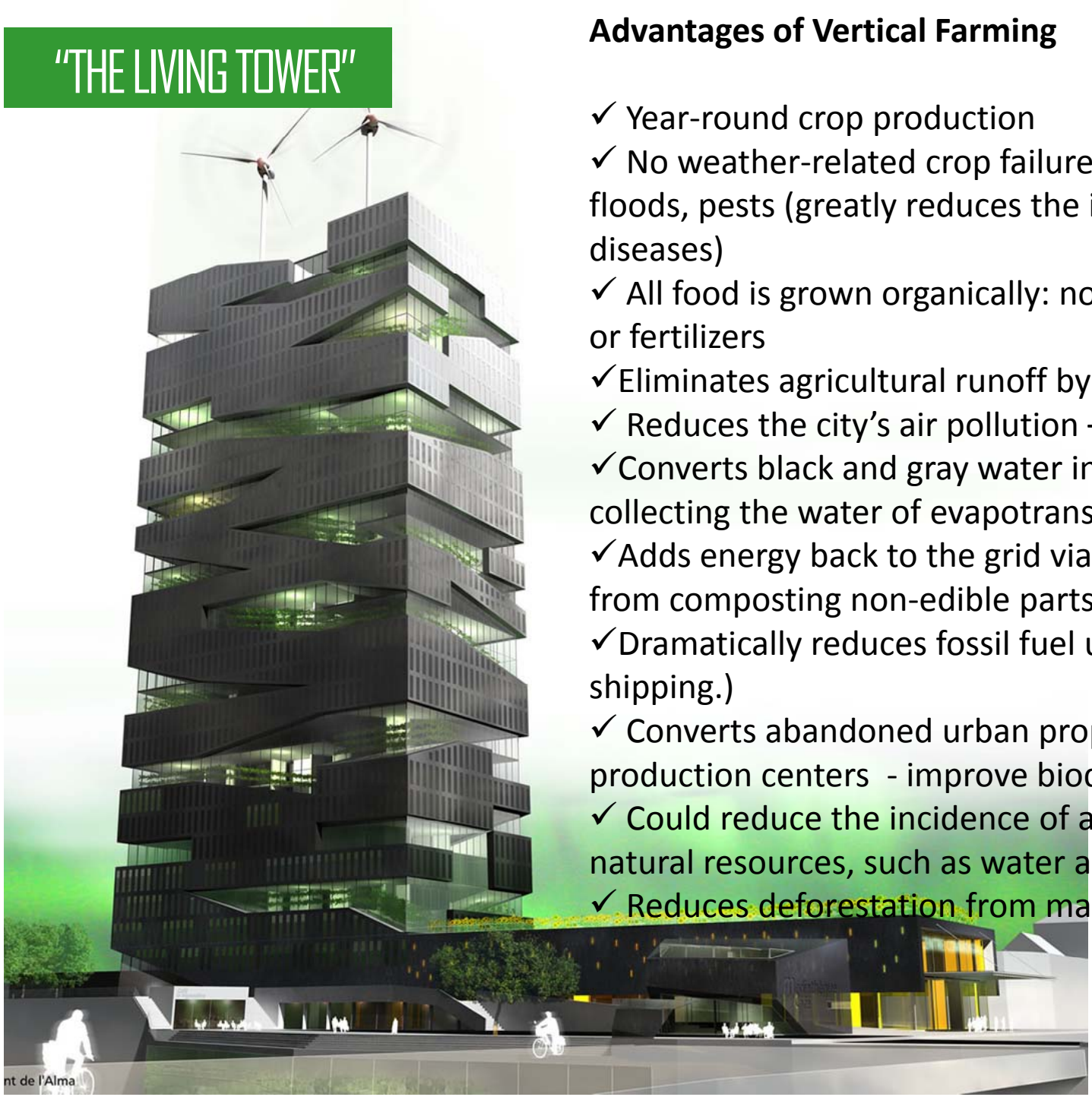
FARMSCRAPERS /VERTICAL FARMS – TOWERS OF FOOD

Vertical Farming would involve building high rise multi level "Farmscrapers" where farmers would employ sustainable farming practices in a controlled environment run by renewable energy (such as wind or solar).

Dickson Despommier, (professor of Environmental Health Sciences at Columbia) thinks this could ultimately ease the world's food, water, and energy crises. Despommier argues that the technology to build vertical farms currently exists and that it could be an economical and sustainable solution to a number of problems.

It's not just a way of generating food. It's a way of dealing with municipal waste, recycling water, and using methane digestion to help a city be sustainable.

"THE LIVING TOWER"

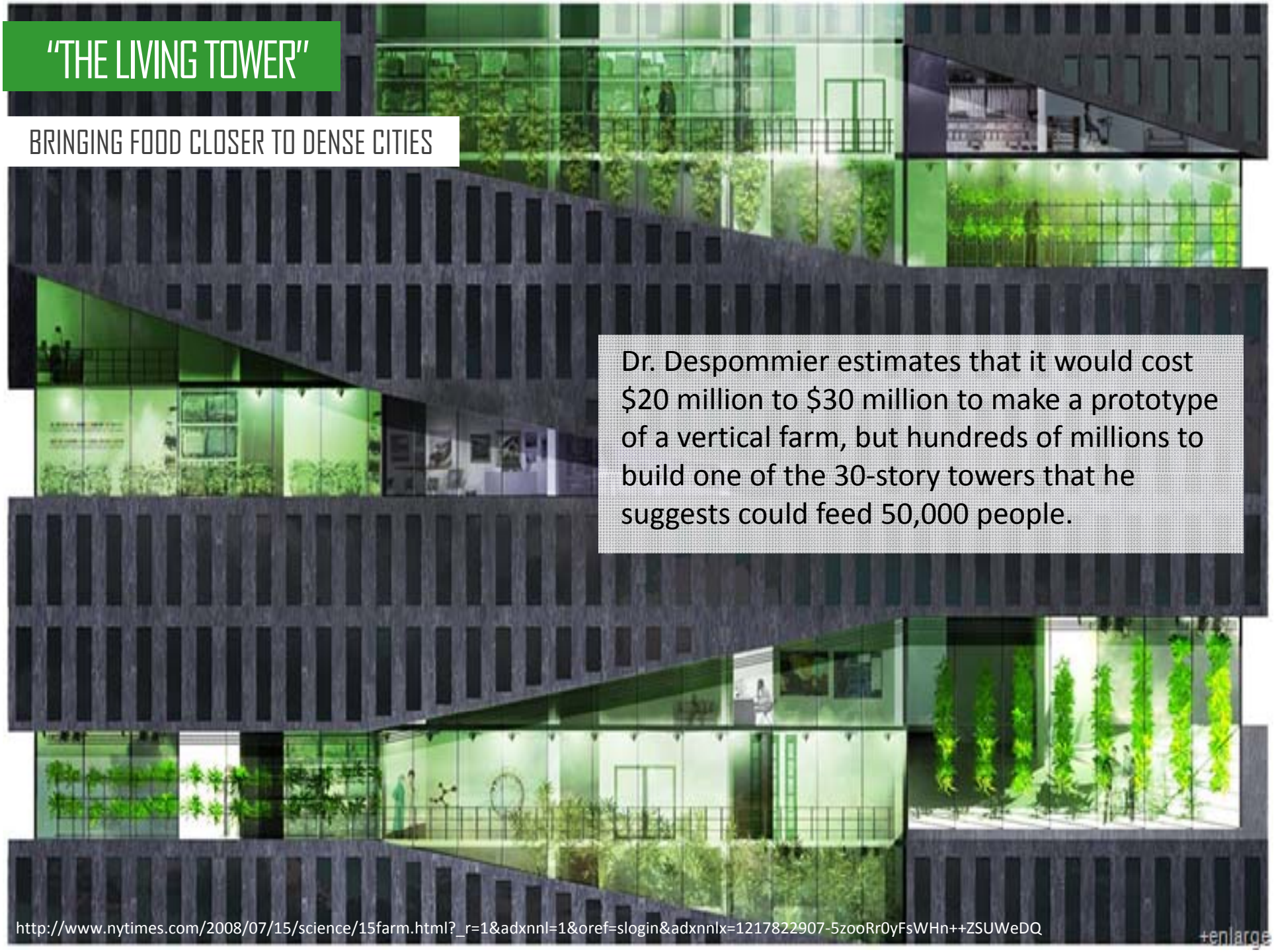


Advantages of Vertical Farming

✓ Year-round crop production
✓ No weather-related crop failures due to droughts, floods, pests (greatly reduces the incidence of many diseases)
✓ All food is grown organically: no herbicides, pesticides, or fertilizers
✓Eliminates agricultural runoff by recycling black water
✓ Reduces the city's air pollution – produces oxygen
✓Converts black and gray water into potable water by collecting the water of evapotranspiration
✓Adds energy back to the grid via methane generation from composting non-edible parts of plants and animals
✓Dramatically reduces fossil fuel use (no tractors, plows, shipping.)
✓ Converts abandoned urban properties into food production centers - improve biodiversity
✓ Could reduce the incidence of armed conflict over natural resources, such as water and land for agriculture
✓ Reduces deforestation from making land for farms

"THE LIVING TOWER"

BRINGING FOOD CLOSER TO DENSE CITIES



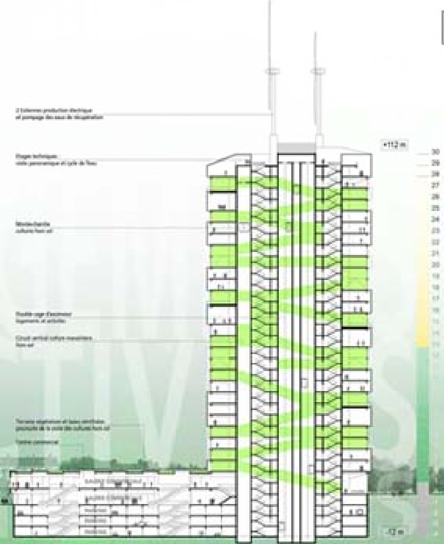
Dr. Despommier estimates that it would cost $20 million to $30 million to make a prototype of a vertical farm, but hundreds of millions to build one of the 30-story towers that he suggests could feed 50,000 people.

http://www.nytimes.com/2008/07/15/science/15farm.html?_r=1&adxnnl=1&oref=slogin&adxnnlx=1217822907-5zooRr0yFsWHn++ZSUWeDQ

+enlarge

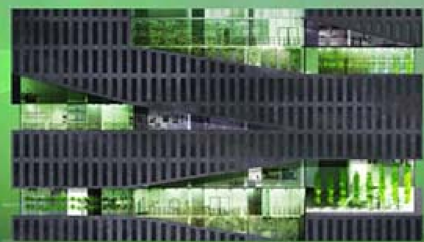
101 OIB

PLAN rez-de-chaussée



COUPE longitudinale

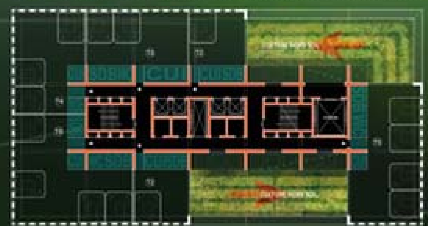
PLAN niv. -1



DETAIL façade sud niv. 11 > 28

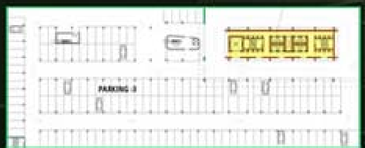
Logements + Culture hors sol

PLAN niv. -2

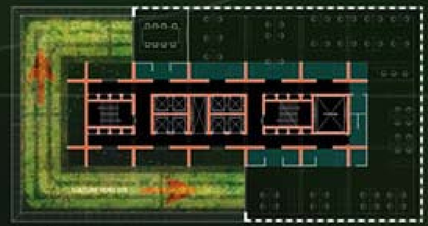


PLAN étage 21

Logements + Culture hors sol



PLAN niv. -3



PLAN étage 08

Bureaux et Activités + Culture hors sol

+en

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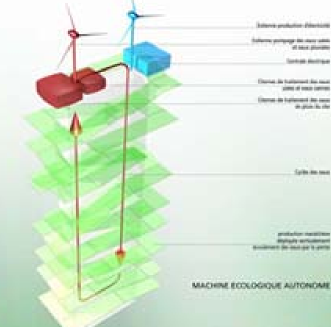
ligne

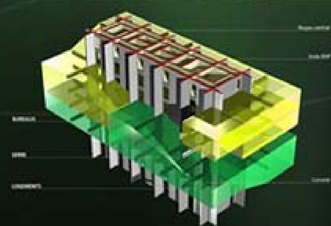


MACHINE ECOLOGIQUE AUTONOME

écologie

DETAIL CONSTRUCTIF + FACADE

structure



PRODUCTION MARAICHERE 24H/24H

+en

"THE LIVING TOWER"

A vertical farm design modeled after the Capitol Records building in Los Angeles features a prominent renewable energy source: a rotating solar panel that, like a sunflower, gyrates to face the sun.

"THE LIVING TOWERS"

EXAMPLES OF OTHER VERTICAL FARMS – SOA ARCHITECTS

Dickson Despommier says that the farmscrapers that are adapted for a specific place could protect a city's food supply from floods and droughts, and from pathogens that attack crops.

http://www.nytimes.com/slideshow/2008/07/15/science/0715-FARMING_7.html

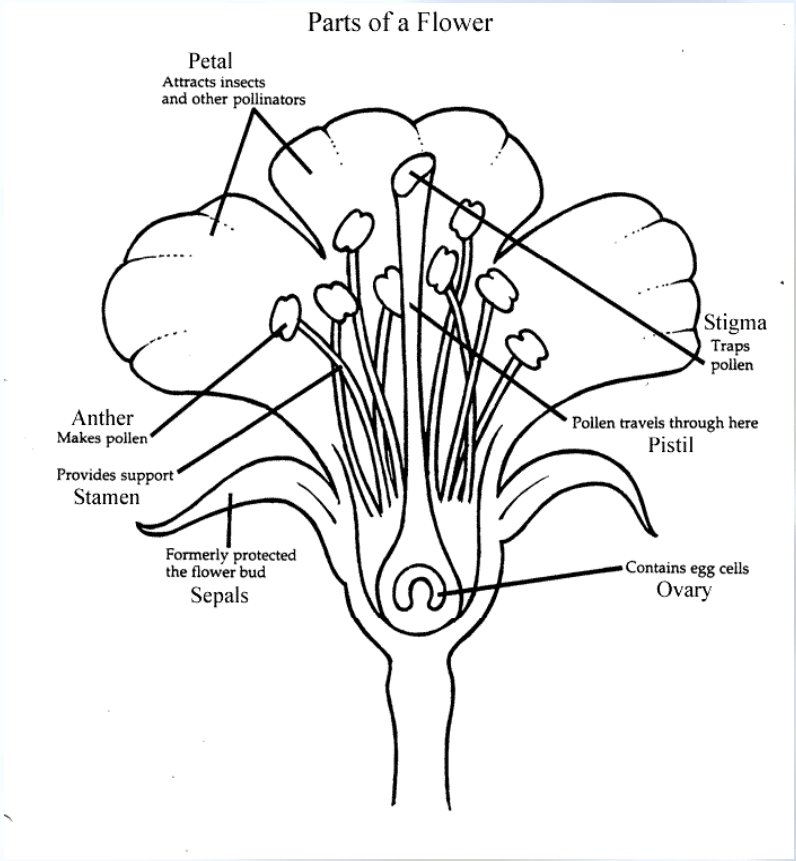
"THE LIVING TOWERS"

EXAMPLES OF OTHER VERTICAL FARMS

"There's embodied energy in the concrete and steel and in construction," he said, adding that the price of land in the city would still outweigh any savings from not having to transport food from afar. "I believe that this general relationship is going to hold, even as transportation costs go up and carbon costs get incorporated into the economic system."

TRUE MEANING OF 'GREEN' AESTHETIC

BEAUTIFUL AND EFFICIENT



Aesthetics is a key social aspect of sustainability. Beauty is an innate human need Appeals to an emotional, technological, social level

Mimicking of entire ecosystems could form the basis for regenerative architecture, able to participate in the major planetary cycles in reinforcing, rather than damaging ways.

Restorative Architecture very much in link with natural principles - biomimicry

BIOMIMICRY , BIO-INSPIRED DESIGN

INNOVATION INSPIRED BY NATURE

The web of a spider is stronger, gram for gram, than steel. It's also wholly natural and renewable, a simple by-product of the spider's bodily processes. It is biodegradable, its chemicals reabsorbed and reused in nature. In comparison, steel is enormously costly and polluting to smelt. Its useful life over, steel does not decompose but clutters our landfills.

Scientists and engineers are starting to design new materials and technologies that mimic biological processes—so they function in the same way as natural products, which use nothing, or are waste products, and can self-repair. Developments in nanotechnology and biotechnology copying nature assist this approach.

In the discipline of architecture, we're starting to think not only about using (and demanding) these materials, but also about designing buildings more like natural organisms—like bodies—functioning optimally as more than the sum of their (technological) parts

http://idealog.co.nz/magazine/november-december-2006/workshop/a-call-to-arms

BIOMIMICRY , BIO-INSPIRED DESIGN

MAIBRITT PEDERSEN ZARI

A proposal from Grimshaw architects to mimick the Nambian desert beetle, the camel, and the hydrological cycle itself for the inspiration of this desalination plant in the Canary Islands.

The stenocara beetle lives in a desert with little rainfall but is able to capture moisture from the swift moving fog that passes over it by tilting its body into the wind. Water condenses on the surface of the beetle's back because its shell is cooler than the surrounding air. The droplets then roll down into its mouth. Camel's nostril use a similar trick to keep cool and prevent water loss in the desert. The hydrological cycle is based on evaporation and precipitation.

http://idealog.co.nz/magazine/november-december-2006/workshop/a-call-to-arms

National

Engineers race to steal nature's secrets

Giant wind turbines based on a seed, and desalination plant that mimics a beetle

John Vidal
Environment editor

A new generation of small green companies is emerging with radical but proven ideas to revolutionise engineering and create anything from intelligent fridges to colossal wind turbines moored at sea.

The designers hope their projects will transform energy supplies and cut carbon emissions in the next 20 years. They include huge wind turbines, more powerful than any seen before, anchored to the seabed 20 miles off the coast; fridges that monitor the national grid to use less power; a desalination plant that is also a theatre; and a tidal lagoon that protects the coast while generating electricity.

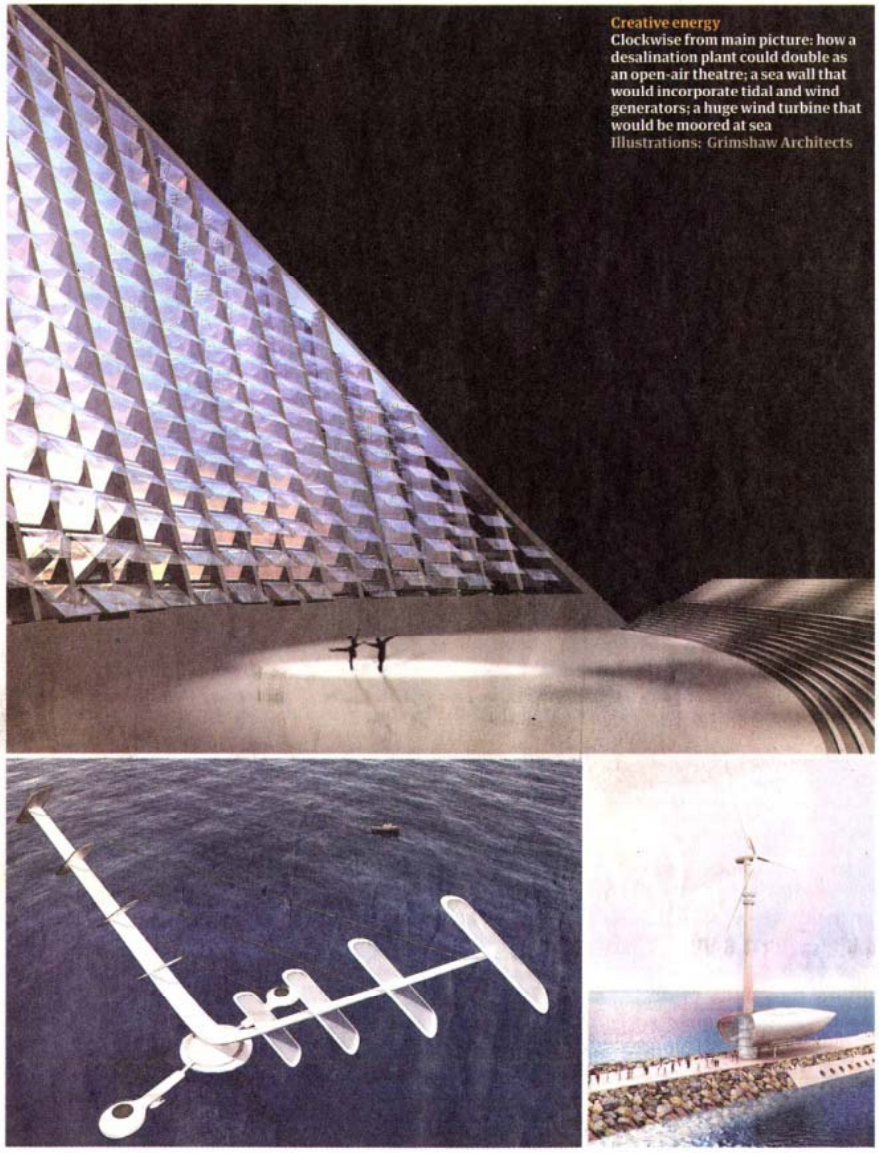
The new companies are rethinking major infrastructure projects using natural objects as their basis. The aero-generator turbine, now being laboratory tested before sea trials next year, mimics sycamore seeds that spin like propellers in the slightest breeze. Its twin arms could each be as tall as the Eiffel tower, and the structure could be moored like an oil platform in 450 feet of water.

Each turbine, said Martin Pawlyn, an architect with Grimshaw – which developed the transparent "biomes" at the Eden Project in Cornwall – could produce 20 megawatts of electricity, nearly five times as much as any existing wind turbine. "A cluster of 100 of them spread over just a few square miles of ocean, each turning at just a few revolutions a minute, could outperform almost all Britain's existing wind farms put together," he said.

"We are now learning from natural ecosystems, and are scaling up projects. We are going back to first principles, taking our inspiration from nature."

The desalination plant, essential in countries that suffer water shortages, is also being rethought. Mostly banished to the edges of cities, they are disliked for needing large amounts of energy and looking like ill-designed boxes. Architects working with designer Charlie Paton have developed one that needs next to no energy and can double up as an open-air theatre. It has been proposed by Grimshaw for the city of Las Palmas in the Canary Islands, historically short of fresh water.

The structure, looking like a wall of glass and steel, uses simple evaporators and condensers to produce large quantities of fresh water. "The inspiration came from the Namibian fog-basking beetle, which uses its shell as a condensing surface for moisture, which allows it to survive in the desert," said Mr Pawlyn. "There are countless other examples like this that we can turn to when tackling some of the environmental issues that we now face."



Creative energy
Clockwise from main picture: how a desalination plant could double as an open-air theatre; a sea wall that would incorporate tidal and wind generators; a huge wind turbine that would be moored at sea
Illustrations: Grimshaw Architects

The idea has been used in three commercial greenhouses in the Middle East to grow food using salt water. Seawater cools and humidifies the air in the greenhouse and sunlight distils fresh water.

A radical but simple design proposed for north Wales is a 15km-long tidal energy scheme that could generate up to 450 megawatts of power and protect the coastline from erosion and severe storms. It could be constructed from dredged sand and seabed material, or waste slate from disused Welsh quarries. Long rows of hydroelectric generators would turn and generate electricity as the tide rushes in and out. North Wales has some of the highest tidal ranges in the world.

"It would protect Rhyl and neighbouring towns with 30 linear miles of breakwater, reducing the risk of flooding disasters like the one in 1990. But it would not be visually intrusive. It works well with wind power, and it would even be possible to move it," said Mr Pawlyn.

The scheme could also offer a natural but nearly invisible shelter, allowing a marina to be built and a depressed area of north Wales to be regenerated. "We are trying to raise the utilitarian [infrastructure project] to another level. It's the idea of celebrating nature, and learning from it to rethink environmental problems," said Mr Pawlyn.

> 'One hundred of these wind turbines could outperform all Britain's existing wind farms'
> **Martin Pawlyn**

Other ideas being developed include sewage treatment processes that generate 20% more electricity than usual, and giant solar heaters that would concentrate sunlight on to solar cells, producing 30 times as much electricity as today's cells.

Mark Shorrock, a director of venture capital firm Low Carbon Accelerator, which is aiming to raise £50m to back dozens of small green technology companies, said the market for imaginative, new renewable energy technologies was taking off, and was expected to more than double in the next few years. Solar energy is expected to be a £50bn market by 2015.

guardian.co.uk/environment »

HARARE, ZIMBABWE – OFFICE AND SHOPPING COMPLEX

ARUP ASSOCIATES AND MICK PEARCE

The Eastgate Centre in Harare, Zimbabwe, typifies the best of green architecture and ecologically sensitive adaptation. It is an architectural marvel in its use of biomimicry principles.

The mid-rise building, has no conventional air-conditioning or heating, yet stays regulated year round with dramatically less energy consumption using design methods inspired by indigenous Zimbabwean masonry and the self-cooling mounds of African termites!

Termites in Zimbabwe build gigantic mounds inside of which they farm a fungus that is their primary food source. The fungus must be kept at exactly 87 degrees F, while the temperatures outside range from 35 degrees F at night to 104 degrees F during the day. The termites achieve this remarkable feat by **constantly opening and closing a series of heating and cooling vents throughout the mound over the course of the day.**

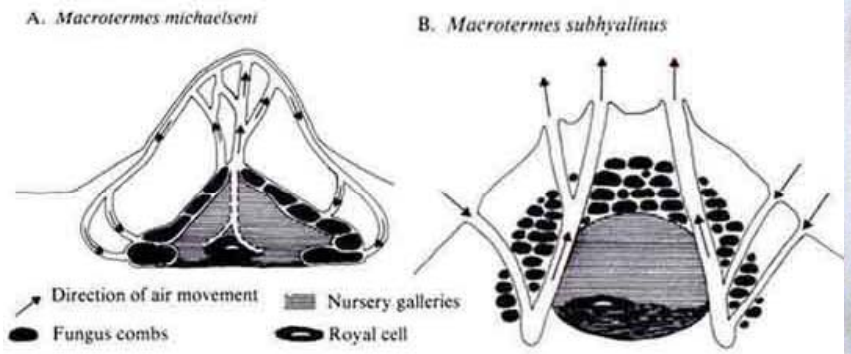
With a system of **carefully adjusted convection currents**, air is sucked in at the lower part of the mound, down into enclosures with muddy walls, and up through a channel to the peak of the termite mound. The industrious termites constantly dig new vents and plug up old ones in order to regulate the temperature.

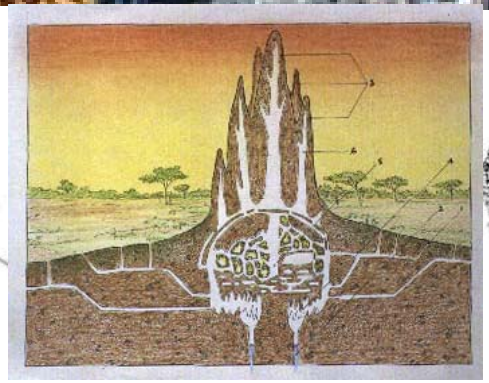
BIOMIMICRY 'S COOL ALTERNATIVE: EASTGATE CENTRE IN ZIMBABWE

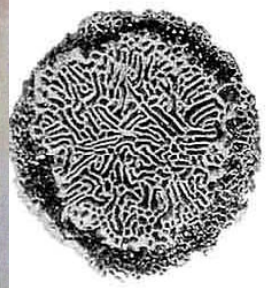
MAIBRITT PEDERSEN ZARI

The Eastgate Centre, largely made of concrete, has a ventilation system which operates in a similar way. Outside air that is drawn in is either warmed or cooled by the building mass depending on which is hotter, the building concrete or the air. It is then vented into the building's floors and offices before exiting via chimneys at the top. The complex also consists of two buildings side by side that are separated by an open space that is covered by glass and open to the local breezes.

Air is continuously drawn from this open space by fans on the first floor. It is then pushed up vertical supply sections of ducts that are located in the central spine of each of the two buildings. The fresh air replaces stale air that rises and exits through exhaust ports in the ceilings of each floor. Ultimately it enters the exhaust section of the vertical ducts before it is flushed out of the building through chimneys.

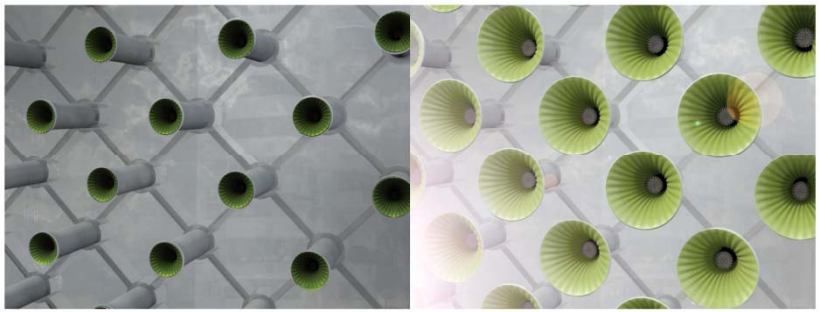


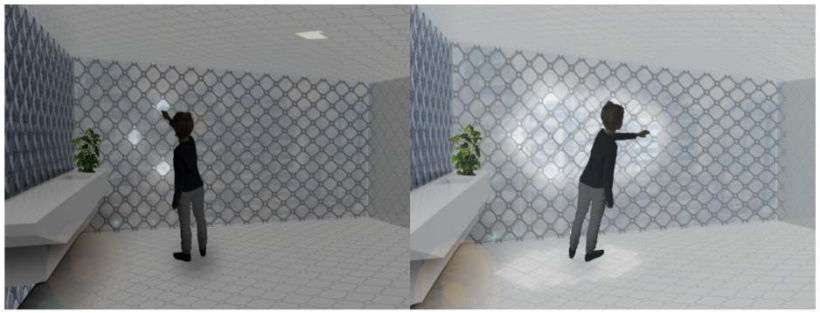


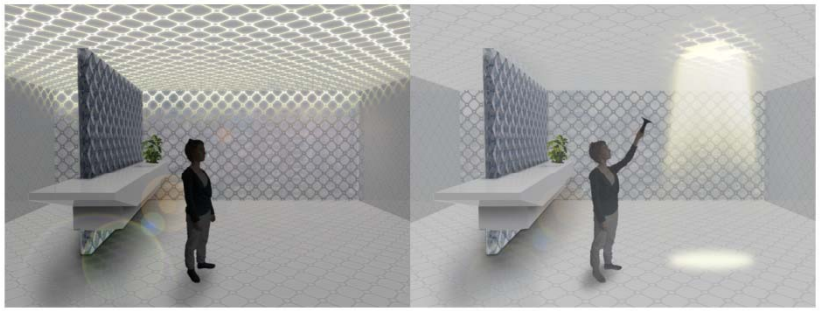


"THE LIVING SKIN"

HABITAT 2020 BUILDING IN CHINA







Within this cityscape, buildings open, close, breathe and adapt according to their environment. The Habitat 2020 building is envisioned for China, and radically alters our perception of a structure's surface. The exterior has been designed as a living skin, rather than a system of inert materials used only for construction and protection. The skin behaves like a membrane which serves as a connection between the exterior and interior of the habitat. Alternatively, the skin may be considered as the leaf surface having several stomata, cellular openings involved in gaseous exchange and transpiration in plants.

http://www.youtube.com/watch?v=-wmiNhkptQw

http://www.design.philips.com/probes/projects/sustainable_habitat_2020/index.page

"THE LIVING SKIN" – VIDEO PRESENTATION

GO TO THE FOLLOWING WEBSITE TO WATCH THE VIDEO:

http://www.design.philips.com/probes/projects/sustainable_habitat_2020/index.page
http://www.design.philips.com/shared/assets/design/movie/habitat_128.wmv

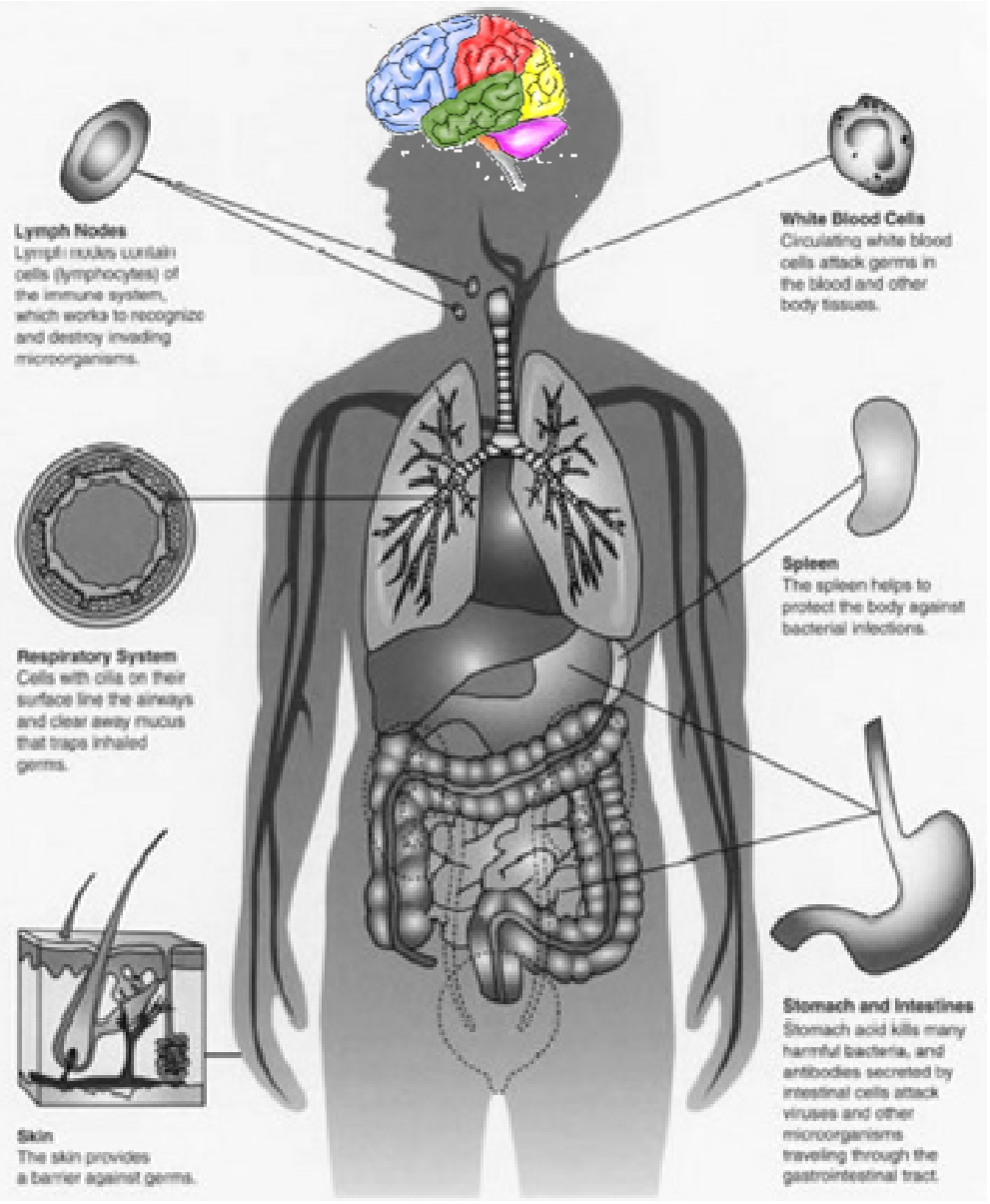
BUILDING AUTOMATION SYSTEM

INTELLIGENT BUILDINGS, COMPUTERIZED SYSTEM THAT IMITATES THE WAY HUMAN BODY WORKS

Interior climate technology

- BAS is a form of centralized control.
- This allows the ability to control a number of other systems from one point where all the system intelligence is concentrated.

- The control system is a computerized, intelligent network of electronic devices, designed to monitor and control lights, ventilation, space temperature and humidity, plumbing systems, electrical systems, life safety systems and other building systems. (Track sunlight from PVs)



BUILDING AUTOMATION SYSTEM (BAS)

INTELLIGENT SOLUTION FOR ENERGY EFFICIENT BUILDINGS

- Automatic monitoring and control of services within a building.
- They consist of sensors, controls and activators that have an electric digital processor as their base.
- The function of control systems is to ensure the optimal performance of a building (light, comfort ventilation) ensure s the productivity of the inhabitants.

Aid conservation of resources by **scheduling, engaging** and **regulating** equipment to meet the needs and comfort of the inhabitants without the unnecessary waste of resources that often arise from negligence and/or overuse of facilities.

R128 HOUSE – WERNER SOBEK - GERMANY

LESS IS BETTER – NO WALLS

- PV panels on the roof produces more energy than it needs
- No GIB walls – No waste – Free Interior
- Whole building was erected on site within 2 days in a single truck
- 100% recyclable as everything can be dismantled and re used (easy assembly/disassembly: mortice-and-tenon joints and bolted joints)
- Produces no emissions and is self-sufficient in terms of heating energy requirement.
- The completely glazed building has high quality triple glazing panels featuring a
  k-value of 0.4.
- Its design is modular, made of pre-fab components

R128 HOUSE – AN ENGINEER'S DREAM

ZERO ENERGY, ZERO WASTE- MODULAR PRE-FAB UNIT

Home Automation System

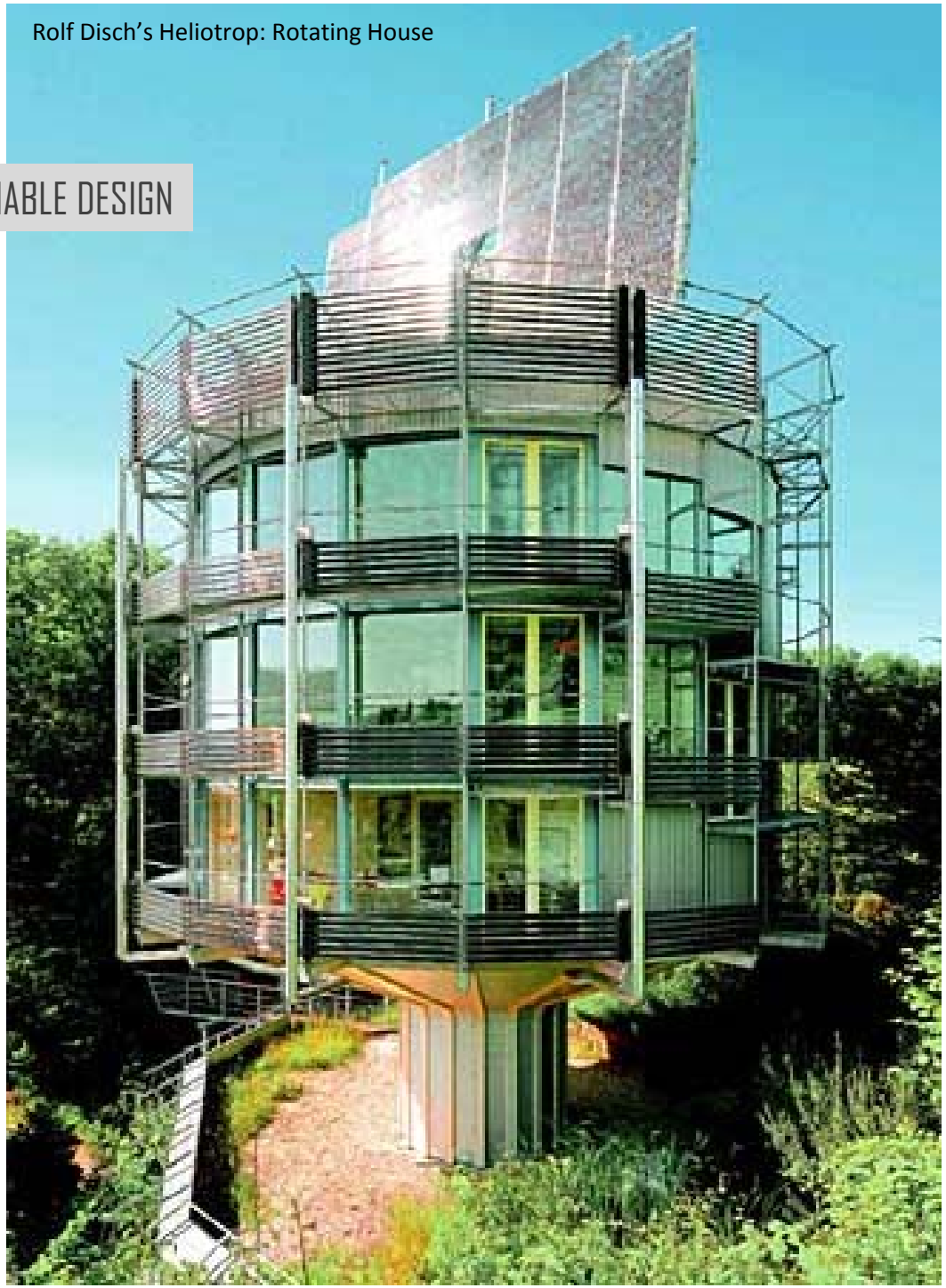
- Various functions in the house are controlled via non-touch sensors, voice control or touch screens. Functions such as opening and closing doors and controlling water flows in the sanitary module are activated by sensors or voice control.
- The operation or interrogation of functions such as controlling lights, opening and closing windows, watering the garden and setting room temperatures, is effected via a system, using specifically developed house control software.

- *"The architecture of our own time and the future must exhibit a radically different, viz. positive, attitude to the natural environment and its users and to its inherent technology."*
  – Werner Sobek

AESTHETICS IN GREEN ARCHITECTURE

THE FUTURE ROLE OF ARCHITECTS – FUTURE OF SUSTAINABLE DESIGN

And for those worried about aesthetics? Will the buildings of the future be ugly, blighted by solar panels and water collection tanks, the paraphernalia of environmental efficiency? Will art just ‘catch up’? No. In great, successful buildings art and technology are inseparable. Technological design solutions are art: art is technology. That’s another lesson from our past, before the separation of the disciplines of engineering and architecture.



Rolf Disch’s Heliotrop: Rotating House

http://idealog.co.nz/magazine/november-december-2006/workshop/a-call-to-arms

THE NEXT DESIGN REVOLUTION

Sustainability is NOT a constraint or restraint, it is a new way of re thinking architecture.

Bio-inspired aesthetic : Zaha Hadid, Abu Dhabi

"In most cases it should be stressed that there are no such thing as one perfect green technology or solutions."

"We cannot depend on technology as a quick fix to our problems."

"Don't believe blindly that next technology is going to solve the prior problem."

"Man made technology carries risks and limitations."

From The Philosophy of Sustainable Design
By Jason F. Mc Lennan

Air conditioning system at its zenith – 1980's

RECOMMENDED READING

- Dwellings by Paul Oliver
- A Deeper Shade of Green (NZ)
  edited by Johann Bernhardt
- Carbon Neutral by 2020 (NZ)
  edited by Niki Harré & Quentin D. Atkinson
- The Green House,
  New direction in sustainable architecture
  edited by Alanna Stang & Christopher Hawthorne
- Natural Capitalism
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