Lumière technologies

Sustainable development through LED Technology

Project Name
House Gaia, Cape Town South Africa

Principal Architect
Mr. John Barrett
Director Earth Temple Architecture
www.earthtemple.co.za

Words by the Architect: "…….. from the inception of House Gaia, our intention was to create a sustainable building, promoting Green Building Practice. In doing so we were not to compromise the quality and standard of systems and craft. To the contrary, we were to take these into a new realm.

We chose an highly specialised team, all passionate about their work. Labourers, Craftsman, Technicians and consultants all share things in common and all have voiced….. In all my years in my field I have never done this before. What an opportunity for learning and growth!"
"I thank you all and embrace the warmth of your smiles."

Project: House Gaia

23 Slides

April, 2010
Ulrich Lorenzen
ulrich.lorenzen@lumiere.co.za

Lumière technologies

Sustainable development through LED Technology

Sustainable Technology

A combination of Zigbee LED control, LED Lighting & Photovoltaic Solar

The 1st of its kind in South Africa and possibly the world!

Our client, and principal architect,
inspire others to dream more, learn more, do more and
become more, thus cultivating clear leadership.

“This project is an inspiration to the world and a vision that became reality.”

All this was made possible by the support and dedication of our suppliers: FutureElectronics, Freescale Semi (R & D Division), SMA Solar Technology, Sunpower Corporation, Hoppecke, Schletter to name a few.

Lumière technologies

Sustainable development through LED Technology

We custom designed: Energy efficient LED luminaires powered by a Hybrid PV solar system, controlled and monitored by a Zigbee LED lighting mesh network, also incorporating Zigbee Skylight actuators and wall controllers.

Sustainable Technology

Lumière technologies

Sustainable development through LED Technology

Sustainable Technology

The formula involved

Lighting without compromising light quality for the sake of energy reduction:

- ✓ Reduce lighting load by 60% by using energy efficient LED lighting.
- ✓ LED luminaires built with high quality, state of the art LEDs.
- ✓ Time controlling & automation, reduce lighting load by an additional 80%. (Energy Bill = Load x ON time)
- ✓ Locally manufactured, sustainable practice.
- ✓ LED luminaires that are actually comparable in brightness and beam spread to conventional 50W Quartz halogen downlighters. Therefore a smooth & even illumination.

Hybrid photovoltaic solar system for clean energy production. System cost reduction through:

- ✓ Supply energy to lighting circuit, and few other processes, instead of the entire building.
- ✓ System cost is reduced by >60% as lighting load is reduced by >60%.
- ✓ Battery backup reduced by >60%, hence reduction in system cost.
- ✓ Hybrid system design. Convert sunlight energy for daytime use, reducing battery backup and cost.
- ✓ Hybrid system design for semi grid-tie to public grid.
- ✓ Hybrid system design for future expansion of clean energy system.
- ✓ PV panels produce 50% more energy than general offerings within the same roof space.

Zigbee wireless lighting control and energy monitoring:

- ✓ Decentralized, robust control, self healing wireless system using far less hardware.
- ✓ Reduce installation cost - no communication wiring or extra conduits.
- ✓ Create Zigbee wireless network for future energy monitoring devices to communicate with.
- ✓ Flexible, adjustable system as lighting groups are software assigned instead of wired circuits.

Lumière technologies

Sustainable development through LED Technology

Sustainable Technology

List of Green Aspects

In addition, the following short form summary of other green systems in this project (heating, filtering, passive cooling, ventilation, solar heating systems and solar power.)

- bio-gas plant: waste water management converts brown/grey water to methane gas for cooking purposes and gas for fire place. (extension to reed bed to activate soil for vegetable garden)
- central heating tank for under-floor heating by solar heating panels. (plugs to heat exchanger for heated pool)
- central domestic hot-water system by solar and electricity. Included is basement hot water radiator for basement heating. Towel rails heated by solar. Heat exchanger on fire place feeds central boiler.
- mechanical louvre system for ventilation throughout the house. Double glazing for heat control.
- solar PV panels and wind turbine for electricity (LED and basic appliances + pick up from grid.)
- trusses are made from alien trees that are brought to sight in their raw form and cut/blocked for onsite hand crafting of the trusses.
- a percentage of bricks are re-used from demolished buildings. Natural Stone from site excavations.
- re-cycled slate for roof. Re -cycled timbers for floor as well as certified dead or dying Yellowood for floors.
- poplar ceiling boards (alien)
- bio pool chemical free fresh water eco swimming pool filtered by a bed of pebbles, plants and slugs.
- permaculture gardens for fruit veg and herbs
- passive cooled underground wine cellar with handmade brick, clompie vaults.
- re-claimed fittings in certain bathrooms

Lumière technologies

Sustainable development through LED Technology

Lighting without compromising light quality for the sake of energy reduction:

The project is a case-study, or platform for research, as to what can be achieved making use of LED lighting technology, as we need more exposure and real life installations. In addition energy efficiency and monitoring of energy is vital to this project, as now we have measureable feedback via the Zigbee LED drivers to see how this Green Building uses energy:

- ✓ This project is the first in South Africa & probably the world, where 92% of the building is lit with Zigbee LED lighting, except for the basement and garage which make use of linear fluorescent.
- ✓ A high quality CRI of 85 and an excellent colour temperature LED was selected as most of the materials are natural wood, exposed bricks, natural rock cladding, with many neutral light colours. We have a combination of many Reds, Browns, Greens, Light Orange to Yellows and versions of white that will show differently if the LED is not of high quality.
- ✓ We have a minimum of 450pcs of 9 LED modules besides all the other LED fittings incorporated in this project.
- ✓ Custom designed and locally manufactured to reduce CO_2 emissions from air freight carriers.
- ✓ LED Luminaires are dimmable, fully adjustable, with tilting of the beam for accurate lighting & scene control.
- ✓ We have many years of experience designing with high power LEDs and the product is fully recyclable.

LED Lighting Luminaires

Lumière technologies

Sustainable development through LED Technology

We custom designed and manufactured all the LED luminaires in Cape Town, South Africa, in line with international standards.

Emerald

Topaz 80

Jade

Lighting without compromising light quality for the sake of energy reduction

Lumière technologies

Sustainable development through LED Technology

AquaMarine 140

AquaMarine 86

AquaMarine WF

Lighting without compromising light quality for the sake of energy reduction

Lumière technologies

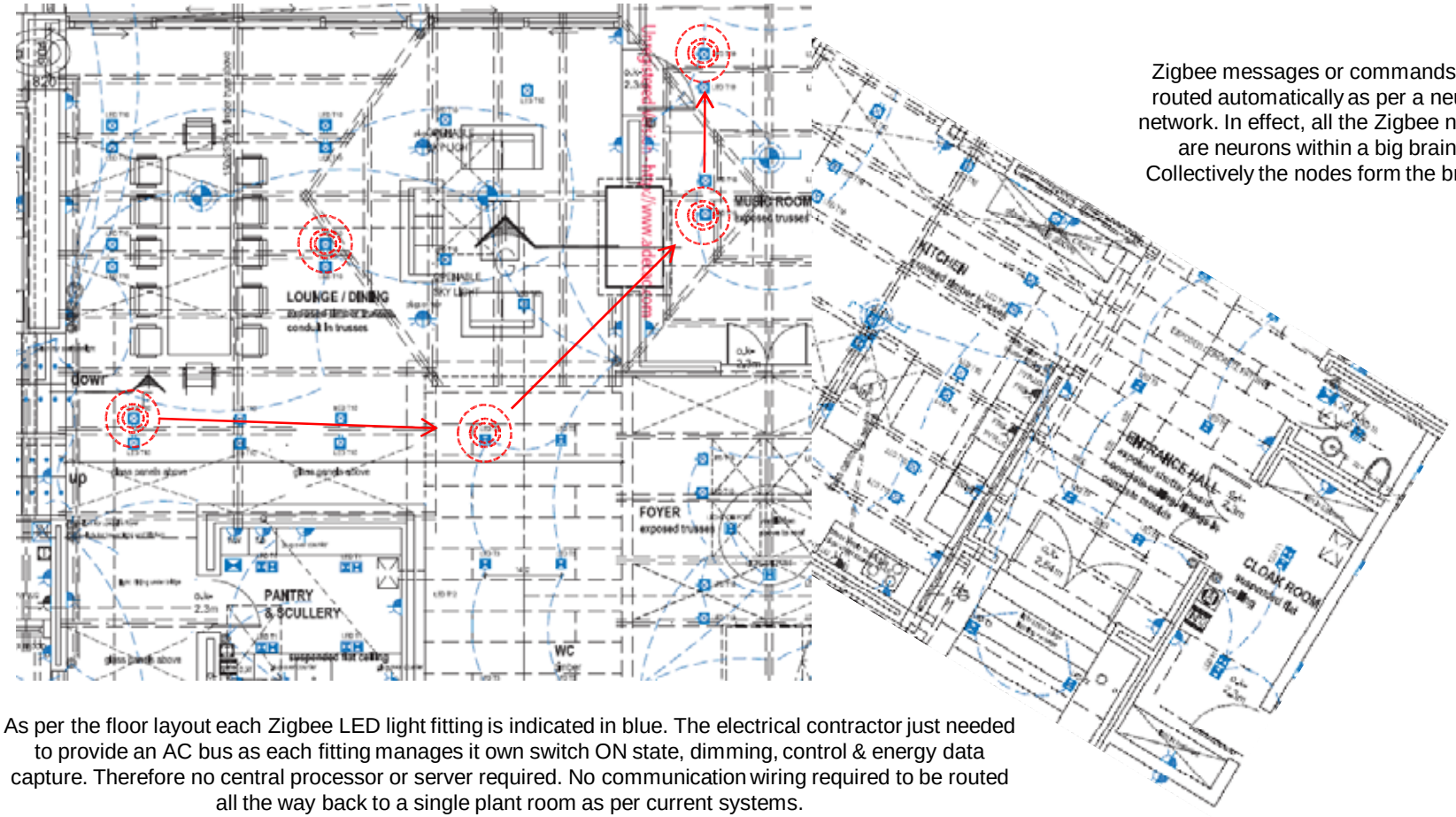
Sustainable development through LED Technology

Zigbee wireless lighting control and energy monitoring:

Zigbee: The leading wireless self-organising mesh networked, sensing and control standard for use in consumer electronics, energy, healthcare, home, commercial and industrial areas. A low energy device that remains in sleep mode until a switch or command activates the device, after which it goes back into standby mode.

- ✓ Besides controlling our lighting fixtures it provides low level energy monitoring data. This enables users to see how we they our energy resources by actively monitoring a green building's performance.
- ✓ Each lighting fixture has a Zigbee device, hence an enhanced mesh network for Zigbee compliant devices to relay information. Installation, upgrade and networking of Zigbee compliant devices are simplified, without the need for additional wiring and electrical conduits as per traditional systems, hence further reducing the building's carbon footprint and reducing installation and equipment cost.
- ✓ Scene settings and lighting fixture assignments to switches/dimmers do not need any physical wiring connection on installation or during a process of moving a fitting to a different location as this is assigned wirelessly. No need to hide any communication wiring amongst the many exposed trusses as communication is wireless.
- ✓ Installation consists of more than 318 Zigbee nodes, integrated within LED lighting luminaires, wall controllers and Skylight actuators. The biggest of its kind in the world within a 1433m^2 area.
- ✓ Decentralised control. Basically we created one universal big brain with a neural network. We do not have a control room as per traditional systems that talk to a central processor or server.

Zigbee Control



Zigbee messages or commands get routed automatically as per a neural network. In effect, all the Zigbee nodes are neurons within a big brain. Collectively the nodes form the brain.

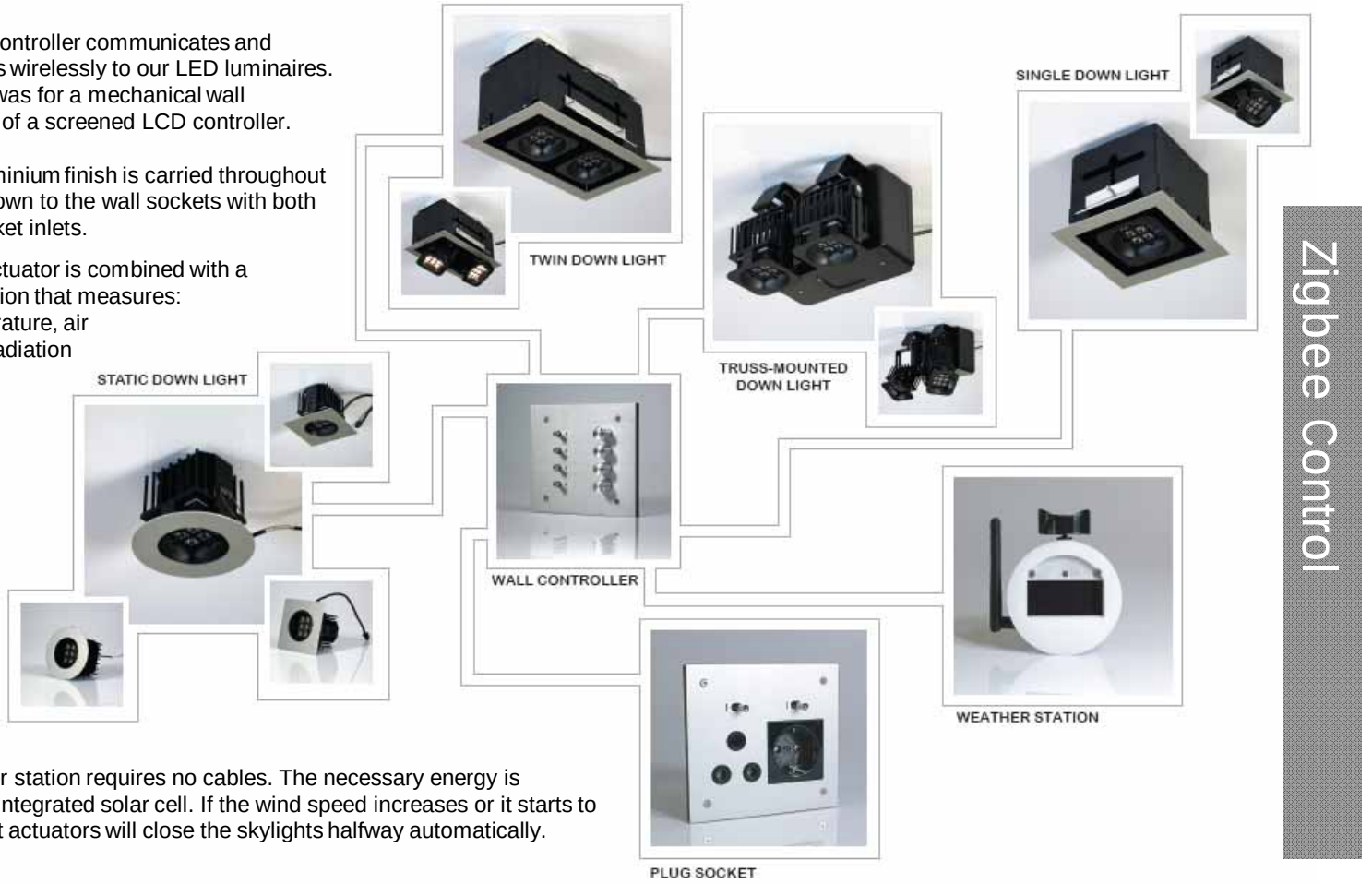
As per the floor layout each Zigbee LED light fitting is indicated in blue. The electrical contractor just needed to provide an AC bus as each fitting manages it own switch ON state, dimming, control & energy data capture. Therefore no central processor or server required. No communication wiring required to be routed all the way back to a single plant room as per current systems.

Zigbee Control

Our Zigbee wall controller communicates and issues commands wirelessly to our LED luminaires. The design brief was for a mechanical wall controller instead of a screened LCD controller.

The brushed aluminium finish is carried throughout the range even down to the wall sockets with both RSA and EU socket inlets.

Zigbee skylight actuator is combined with a mini weather station that measures: outside air temperature, air humidity, solar irradiation and wind speed.



The mini weather station requires no cables. The necessary energy is provided by the integrated solar cell. If the wind speed increases or it starts to rain, the Skylight actuators will close the skylights halfway automatically.

Lumière technologies

Sustainable development through LED Technology

Hybrid photovoltaic solar system for clean energy production.

Along with energy reduction, the ability to make use of clean energy is becoming increasingly important to counteract the alarming rise in carbon levels. In a country that has an abundance of sunlight, Photovoltaic (Solar Electrical) systems offer added insurance of a stable, reliable, electrical supply at a fixed cost over a 20 year period.

The Energy cost trend has always shown an increase and the price increase is compounded year on year. Therefore a 25% increase compounded over 5 years constitutes a 205% increase. Projections suggest: By 2025 world energy use will probably have increased by 54% from 2001 levels. Placing a bigger burden on CO_2 emissions and energy pricing, as cheap fossil fuels would have dwindled due to the increase in demand.

More information on energy production, its effect on climate change and consequences thereof, is available as a separate presentation from Lumière Technologies

PV Solar / Clean Energy

Lumière technologies

Sustainable development through LED Technology

Hybrid PV solar system – House Gaia:

What makes this system different from all other systems?

- ✓ Core system equipment is supplied from a single manufacturer, who also offers system monitoring equipment. Therefore robust, reliable system, with superior customer support. Most systems offered consist of various manufacturers - who is to blame if the system does not function as intended? Most systems do not offer actual energy produced by means of monitoring. (Your investment is substantial, therefore invest wisely.)

- ✓ Core system equipment is supplied by a manufacturer with a proven track record in design and manufacturing. They are more expensive, however lower risk for a substantial investment in equipment. You want your PV plant to produce energy everyday ……not limping along or shut down completely.

- ✓ Hybrid system design, simplifying adding to the system, various forms of clean energy technology in the future. Most systems you cannot upgrade easily.

- ✓ Hybrid system design, a portion of the system inverts sunlight directly to feed this energy into the house for daytime use. Whatever is not consumed during the day is redirected to charge the battery bank for nighttime use.

- ✓ Various contactors: to switch public grid into the PV Solar system should we need to charge the batteries, to bypass the PV system, to protect the batteries from a low discharge cycle. Most systems do not offer this advanced functionality.

PV Solar / Clean Energy

Lumière technologies

Sustainable development through LED Technology

Hybrid PV solar system – House Gaia:

PV Solar / Clean Energy

Equipment list:

- ✓ Hybrid PV Solar 3 phase System for a total load of 30kW: 15kW Sunny Mini Central inverters + 15kW SI Chargers/inverters, Wind and Temp sensor (Monitoring site for adding wind turbine in the future). Webbox communication/software for energy produced and system diagnostics.
- ✓ 15 kW of Sunpower Corporation PV panels. Panel conversion efficiency of 18.7%, producing 50% more energy than general offerings within the same roof space. Black, back contact monocrystalline cells - aesthetically more pleasing for architectural installations. Installation costs are far less as we use a lower count of panels and less mounting/cabling hardware.
- ✓ Gel Battery Technology (maintenance free, safe, long life technology). Manufactured as a single batch to match internal battery resistance for a higher quality installation.
- ✓ Roof mounting system, elevated tracking for water run-off, with special seals. Black anodised aluminium parts for durability as the installation must last 20 years plus.

Lumière technologies

Sustainable development through LED Technology

From May/June 2010, this roof could produce 25 MegaWatt of clean electricity per annum. Roof space occupied 78.27m^2.

The roof will prevent 25 tons of CO_2 emissions per annum , which equates to planting 50-65 trees to avert this emission.

25 tons of CO_2 emissions equates to annual greenhouse gas emissions from 15.9 passenger vehicles.

Black, back contact monocrystalline cells - aesthetically more pleasing for architectural installations. High efficiency for maximum energy yield per square metre.

PV Solar / Clean Energy

Lumière technologies

Sustainable development through LED Technology

Carbon emissions averted:

LED Lighting System

By installing LED lighting instead of 50W quartz Halogen lighting we save 46.9 MegaWatt of electricity per year. Realistically only 60% of the lights will be switched on, therefore savings of 28 MegaWatt of electricity per year.

This equates to prevention of:
- 28 tons of CO_2 emissions per annum
- equates to planting 56-73 trees to avert this emission

PV Solar System

By installing a PV Solar, clean energy system instead of using dirty coal fired electricity, we save 25 MegaWatt of electricity per year.

This equates to prevention of:
- 25 tons of CO_2 emissions per annum
- equates to planting 50-65 trees to avert this emission

Total Carbon averted

Calculating equivalents for 28 + 25 = 53 Megawatt:

This equates to prevention of:

- 53 tons of CO_2 emissions per annum
- equates to planting 106-138 trees to avert this emission
- Annual greenhouse gas emissions from 33.7 passenger vehicles
- CO_2 emissions from 410 barrels of oil consumed
- Carbon sequestered annually by 37.6 acres of pine or fir forests .
- Greenhouse gas emissions avoided by recycling 59.4 tons of waste instead of sending it to the landfill .

* Carbon footprint analysis above excludes all the other sustainable processes which form part of this building. Hence carbon averted is much, much larger than calculated above.

Carbon Footprint

Lumière technologies

Sustainable development through LED Technology

Improve energy security & reduce emissions?

We have demonstrated the possibilities of combining LED Lighting, Zigbee Lighting control and powering the system with PV Solar system, provided you have the correct equipment , knowledge and experience to make this a reality.

This system can be duplicated in office buildings, manufacturing facilities, warehousing or distribution centres. It is far simpler to separate the lighting circuit from the rest of the building and to provide the power from renewable clean energy, providing that you reduce the lighting load by making use of energy efficient LED lighting. This will also reduce your lighting heat load which will subsequently reduce your air-conditioning load , which is also a big energy consumer. From a financial point of view it is a far better option as the PV solar system cost is much less.

In most offices lighting is required during day time. With the correct PV core system equipment you can convert sunlight for direct daytime use. In the evenings you can automatically switch over to the public grid again should you not have adequate battery backup.

Companies who want to improve energy security, who would want to reduce emissions and be environmentally responsive can now introduce clean energy in their daily consumption mix.

By using Zigbee lighting management systems, energy wastage can also be reduced. (Enquire as to what our ZPOD technology has to offer, which is available in a separate presentation.)

Sustainable Technology

Working together these hands created a masterpiece. Timelessly captured within this building.
“Collectively we have accomplished so much.”

(Actual hand prints of all involved, captured permanently on site)

A project that is environmentally responsible and resource-efficient, throughout this building's life-cycle, encompassing durability and comfort, in so reducing CO_2 emissions & climate change on our PLANET*.
A true living example and proof of concept to inspire all who are making a difference to this planet we have to care for.

* In simple terms: Do not bite the hand that feeds you.

Lumière technologies

Sustainable development through LED Technology

Alexian Sky

SMA

SUNPOWER

EARTH TEMPLE

FUTURE Lighting Solutions
Making LED Lighting Solutions Simple™

freescale semiconductor

In awe and with much appreciation we salute our suppliers/partners for being the leaders in their field and for putting up with many hours of free work. Thank you, for all the special favours you called upon to make this project possible.

To the Lumière Team: ***"your mental strength to venture, persevere, and to withstand, made this all possible."***

"It has shown me that it is not only the responsibility of governments and policymakers to change how we use our finite energy resources, but it is up to all of us to make the difference we can. This home will hopefully highlight the benefit in recognizing one's own impact on the environment, and actively taking responsibility for it."

Lumière technologies

Patent Pending 210100896

Sustainable development through LED Technology

This is the end of the House Gaia project information. For further information on energy, climate change and the ZPOD technology, please contact Lumière Technologies.

Thank you for the time taken to review this information. I hope we have inspired you to become even more active in the role you have to play to avert climate change. Your actions are URGENTLY required as most of us still function under the false pretence that it still is: "Business as usual, which is not the case anymore."

Your actions are not just good for the planet, they actually save you and your clients a huge amount of money or running costs over a long term period.

ZPOD Technology