



INNOVENTUM

The Dali PowerTower

Bringing Typhoon-Protected Hybrid
Wind-Solar Energy Solutions
to those Who Need

UN Procurement Seminar 2014

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Why the PowerTower is Unique?

- ❖ Modular design reducing the packaging volume of a 12 meter tower to 1.2m³
- ❖ Patent-protected mechanism to erect and collapse the tower without the use of a crane or other heavy equipment
- ❖ Smart design of the wooden structure absorbs noise and vibrations from the generator
- ❖ Wind-solar-hybrid for energy production day and night - reducing the need for deep-cycling of the batteries - thereby extending their lifetime
- ❖ Integrated rugged solution for renewable energy and mobile internet by using the tower height for
 - 3G range extension and enhanced local reach of WiFi, or
 - Satellite equipment is no 3G network can be reached

Bringing Renewable Energy to New Levels



Exclusive design to those who can afford:

ART – INNOVATION – SUSTAINABILITY



Affordable solutions to those who need – to the
1.4 billion people with no electricity



Barnmissionen

VI ÅTERUPPBYGGER
Scandinavian Village i Tacloban

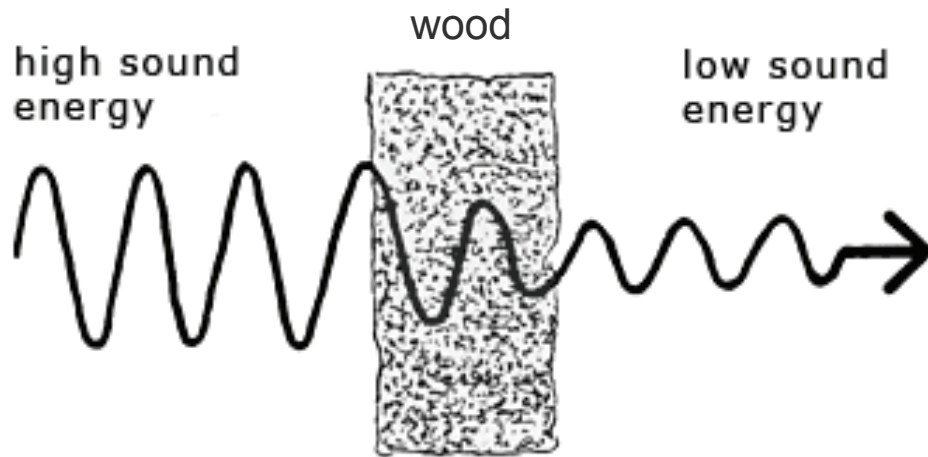
Stöd återuppbyggnaden

Seeing is Believing

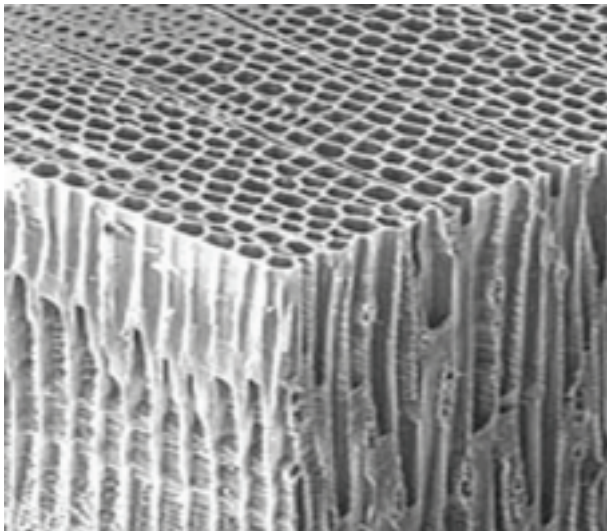


The pictures above are not our advertising photos but pictures taken by private individuals who posted them as part of our online photo competition
The World is our Marketing Channel

(NOT) Hearing is Understanding



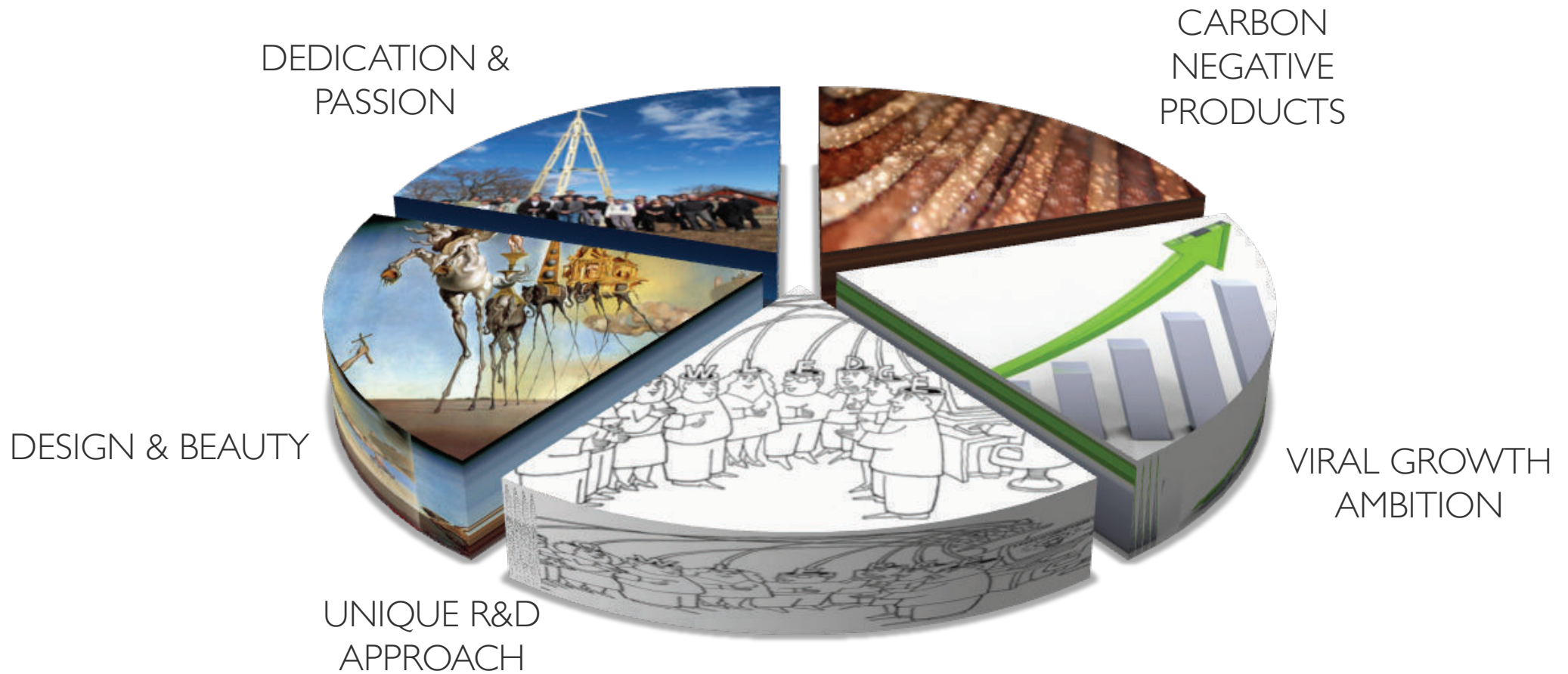
Wood under the microscope:



Our solutions are so silent, they have even been installed on the roof of a university library – at the Blekinge Institute of Technology in Karlskrona (Sweden)

Read more at: <http://www.innoventum.se/dali-performance/>

Why InnoVentum is Unique?



Our Origin is to Solve Extreme Innovation Challenges through www.iKnow-Who.com



- Setting a new standard for digital writing (2003)



- Cutting ammonia emissions by 95% (2008)



- Rare-earth material Replacement (2012)



- The World's first carbon negative wooden towers for small scale wind turbines (2006-09)
- The World's first hybrid wind and PV solution in renewable materials (2012-13)

- Solving the Locking-Pin Challenge (2006)
- Developing revolutionizing Downstream Equipment at half COGS (2007)



- BANG & OLUFSEN
- The new ICEpower conversion module for audio applications (1999) cutting energy consumption by 90%



- Breakthroughs in Functional Foods (2001)
- Porsche's Ceramic Brake System (2001)
- New manufacturing method for Porsche's lightweight carbon-reinforced body parts (2004)
- Project insights published in Harvard Business Review: <http://hbr.org/2005/12/bringing-the-college-inside/ar/pr>



PORSCHE



- Enhancing lifetime of the carbon strips (2010)
- Inductive Contactless Power Transmission (2011)
- Business model innovation to Commercialize the Inductive Primove Technology (2011)



- POLSKA MIEDŹ S.A.
- Cutting Energy Consumption and CO₂ Emissions by 50% (2013-ongoing)



- Breakthrough Polymer without any emissions (2012)



- New Crowdsourcing System (2004-2006)



- Developing a new napkin folding machine (2008-10)



- Doubling both flexural strength and fracture toughness while enhancing translucency (2011)

This Unique R&D Approach is applied to Develop Wooden Structures and Hybrid Solutions



More than 6000 engineering hours were put in the development of InnoVentum wooden towers, resulting in the Dali XII – used as a base for the Dali PowerTower

All designs have been tested in 1:10 scale prototypes for design validation



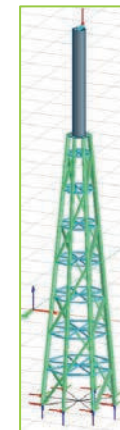
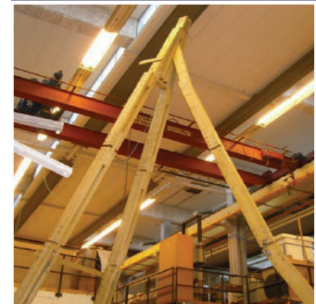
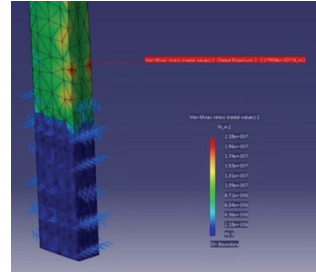
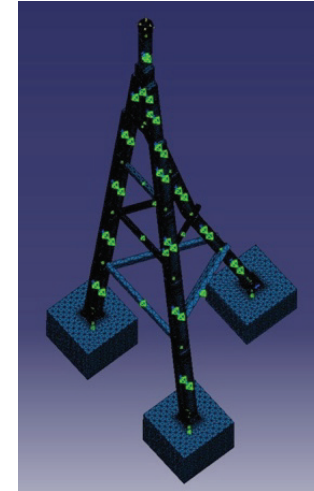
The Dali XII tower was tested in 2010 full scale in-house for the measurement of all critical parameters and the initial patent application was submitted

The Dali XII tower was further tested on site (on the windiest island in Sweden – Öland)



After 12 months of testing, a second generation of the Dali XII was developed resulting in an international patent application (PCT)

In 2013, the Dali Tower was extended into a the Giraffe – a hybrid combining wind and solar energies – just like the Dali PowerTower



The Giraffe has already reached Spectacular Venues

OFFGRID DECENTRALIZED POWER STATION AT THE EUROVISION VENUE

Powers lights, wi-fi, outlets for electronic devices. It can become a perfect spot for picnics, children's playgrounds and a gathering place for people who enjoy the benefits of decentralized renewable energy production.

Malmö Hyllie near Malmö Arena (Eurovision Song Contest 2013 venue):



The role of electricity in disaster recovery

Restoring electricity to a disaster area is vital for this area to undertake urgent disaster recovery activities.

After every disaster, it usually takes months to bring electric utilities in order so as to bring the grid back to life. During all those months, people of the Philippines are left without access to electricity.

To recover from such a disaster, access to electricity source is vital for at least four areas:

1. **Refrigeration**: preservation of medicines, vaccines, food;
2. **Water**: pumping and making the water drinkable is impossible without electricity;
3. **Telecom**, using phone or internet: communication with families, rescue teams, Red Cross;
4. **Light**: the day should not be over when the sun goes down.



Temporary energy sources based on fossil fuels do not provide sustainable solutions



- A few Portable Power stations have been dispatched by NGOs.
- Solar panel solutions will provide limited electricity and only during daytime.
- A more durable and reliable solution is needed
- Cost of operation must be reduced to make energy production sustainable.

Use of diesel generators is associated with many disadvantages. In particular, they:

- are entirely made of non-renewable materials
- require fuel that is expensive and difficult to deliver to disaster areas
- can be vandalized or stolen
- can lead to fires or explosions
- pollute the environment every hour and day
- make a lot of noise



What is a Sustainable Solution?

The **Dali PowerTower** is a 12m tall, 3-legged wooden tower with 6 PV panels (1.5kW) mounted on the side and a 3 kW wind turbine mounted on top of the tower. The combined wind and solar annual energy production at wind speed of 6m/s is approx. 6000 kWh.

Off-grid installation: For disaster relief areas or sites with no grid, the Dali PowerTower comes as an off-grid solution with a 10kWh battery back-up. Thanks to the continuous energy production of the solar-wind hybrid, deep cycling can be avoided for optimal battery lifetime.

Communication unit: The Dali PowerTower can be equipped with a HotSpot facility so as to provide mobile internet to those living in the vicinity of the Dali PowerTower (up to a 100 metre distance).

Modular: The Dali PowerTower is designed to provide energy access to areas that are hard to reach. It is modular with no module longer than 2,0 meters, which gives a packing volume of 1,2 m³ for the 12 meter tower itself.

Resistant against typhoons: A collapsible tripod structure with three independent foundations makes the Dali PowerTower well-protected against earthquakes and typhoons.



Why the Dali PowerTower is an Optimal Solution:



Continuous energy production

hybrid wind-solar systems provide energy day and night.



Easy logistics

the wood is lightweight (compared to steel) and the construction is modular to reduce transport volume



Typhoon- & earthquake-protected design

the construction is robust and allows for easy disassembly if required. In collapsed position, the Dali PowerTower will be better protected against typhoons.



No negative effect on the environment

renewable energy is clean and use of wood makes the system “carbon negative”— the wood used to make the structure had captured at least 2 tons of CO₂ before it took shape of the Dali PowerTower AND it produces energy without causing any emissions of CO₂ or pollutants.



Energy & communication in one unit

The Dali PowerTower provides an integrated rugged solution for renewable energy and mobile internet through WiFi



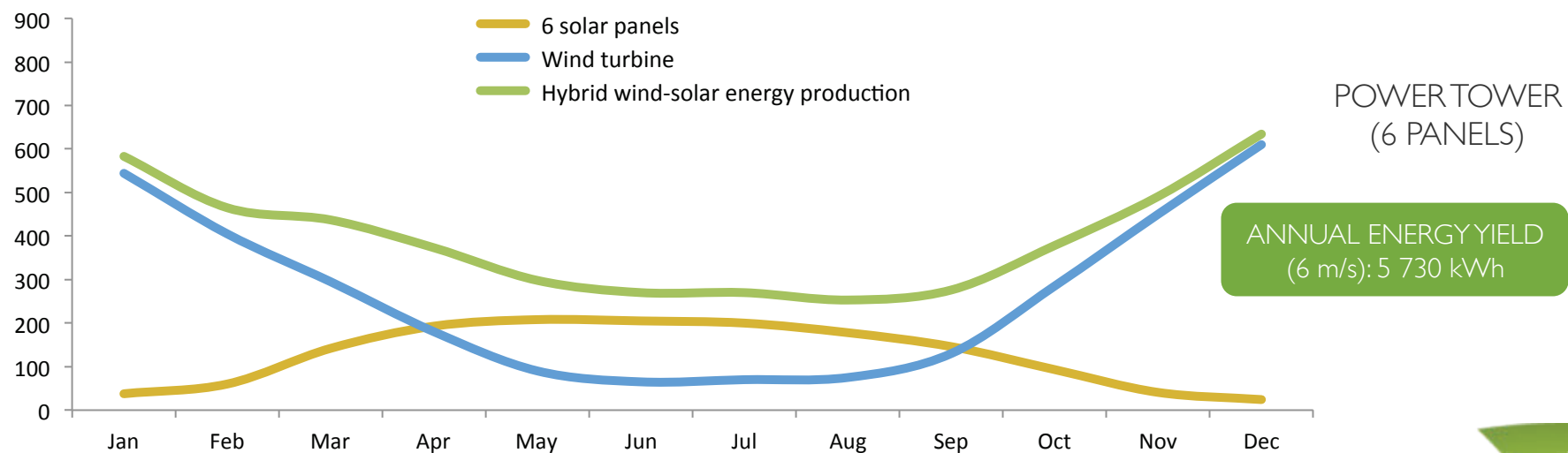
Silent operation

Modular wooden structure absorbs noise and vibrations from the generator

Energy Production: Hybrid Wind-Solar Systems for a Flatter and more Continuous Power Curve

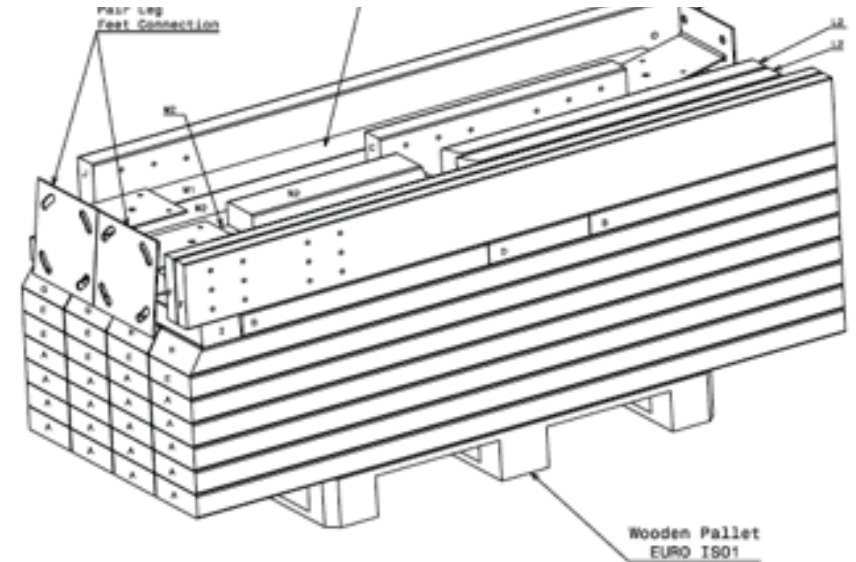
Wind and solar energy are highly complementary: wind energy is generated mostly during nights and colder months of the year, whereas solar energy is only generated during daytime, especially in summer

In this way, energy produced by a hybrid wind-solar power station has much more even flow of energy production compared to pure wind or pure solar installations, thus solving the inevitable sinusoidal curve problem that is regarded as the only drawback of renewable energy. Such complementarity is the main principle utilised in a hybrid construction like the Dali PowerTower



Transportable and Easy-to-Install Solution

- The tower design has been made to optimize space-efficient logistics with a total package volume of 1,2 m³
- No module is longer than 2 meters
- On-site-assembly based on clear manual



Tower on EU Pallet



All required bolts well-protected inside package



Assembling the Tower

Typhoon- & Earthquake-Protected Solution

The tower design has been validated by Lund University scientists and tested in full-scale for strength and ability to handle wind speeds up to 60 m/s

All installations made since launch in 2010 have endured all weather conditions – including the two recent 42 m/s hurricanes in Sweden

To protect the energy harvesting technologies – the Wind turbine and the PV Panels – the tower can be taken down very easily: By pulling away the third leg, the whole tower will go down in a “split” – recommended before a typhoon arrives.



Full-scale strength testing of the Dali PowerTower at Lund University



Typhoon Protection



Termite Protection

Water Barrier

Since many types of termites are unable to cross the water, simple water barriers can be used. One simple solution is making a neck in each concrete foundation so that a pocket of water is kept around the threaded steel rods.

Test

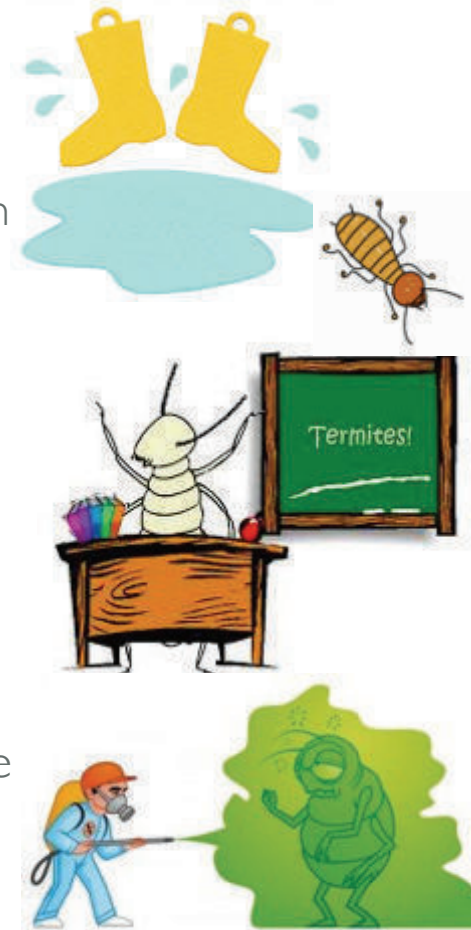
The currently used wood with deep pressure impregnation is tested at the intended installation site to see if it attracts termites or not.

Anti-Termite Pesticide

For further deliveries from Sweden, the wood can be pre-treated to further eliminate the risk of termites.

Ground Preparation

Most termites come from the ground. The first part they will encounter is an anti-termite product in the ground (selected in collaboration with Rentokil Philippines). The second part is the 1 m³ concrete cube. Finally, the water barrier needs to be crossed before climbing up the steel parts to reach the wooden parts – which are treated with anti-termite products.



Theft Protection

- In the PV industry there are many solutions to prevent theft as in some case required by insurance companies.
- Foundation: Concrete foundation with Unique toothed design
- Expensive components: batteries and electronics:
 - Looked into a steel container type with locker and a concrete foundation



Mobile Internet Solution

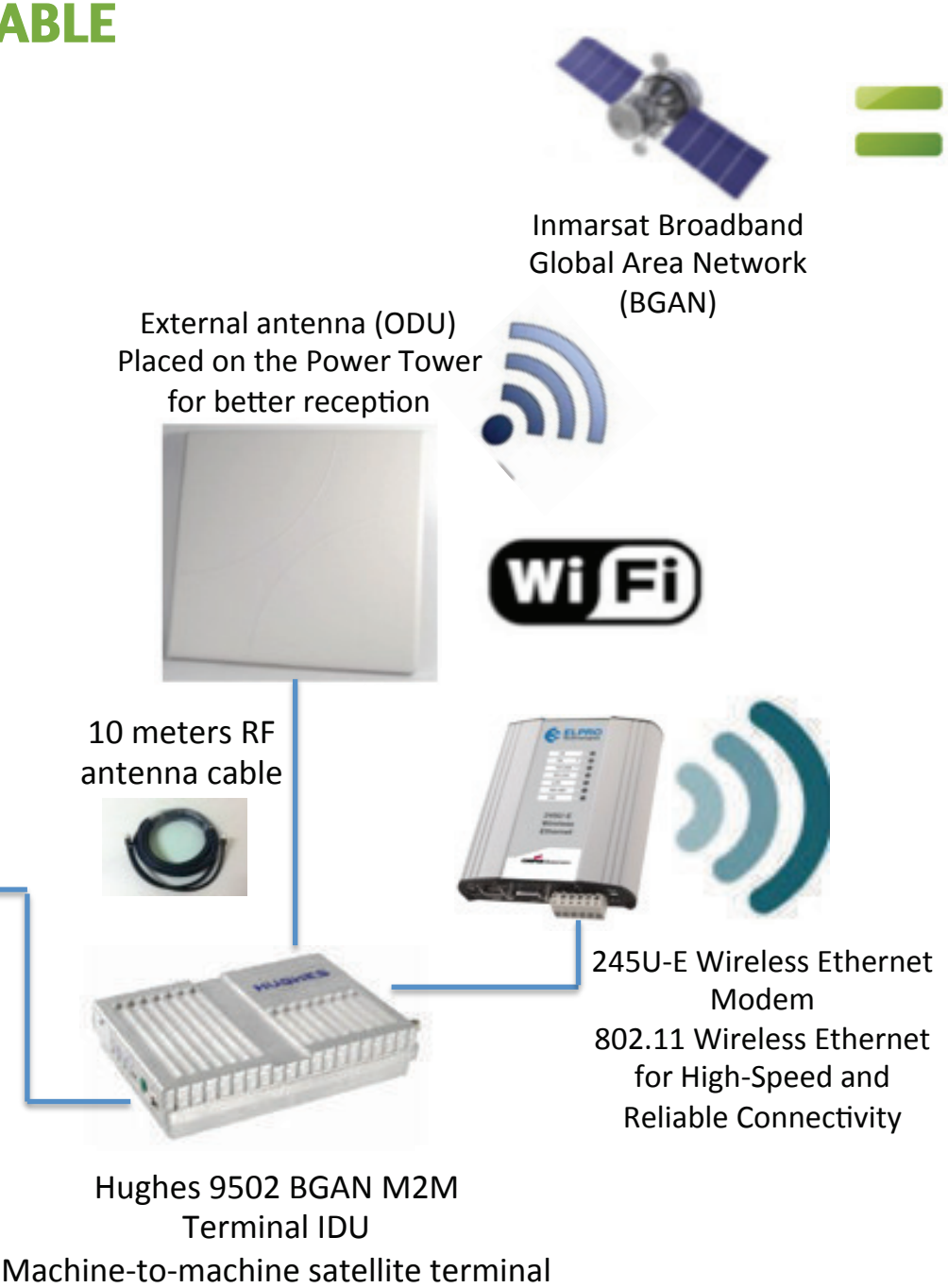


NO TELECOM NETWORK AVAILABLE

Off-Telecom Network



Off grid electrical cabinet
Control, manage, store energy



Hardware cost:

- \$ 6300

Post Paid
Operation Cost:

- Activation, one off: \$42
- \$35 per month
- \$6 per MB transferred

TELECOM NETWORK REMOTELY AVAILABLE

"Telecom Grid Extender – Philippines Example"



Off grid electrical cabinet
Control, manage, store energy

Remotely Available Network from
Smart or Glode company



Elins H720 Dual Module HSPA+ 3G Router
- Dual SIM / Dual Module M2M with WiFi
and Cold Or Hot Swap 3G Failover and
basic load balancing

SIM Only Plan 999

- Monthly fee: P999/month
- Inclusive hours: Unlimited
- Connection: Device dependent
- Speed: Up to 7.2 Mbps**
- Lock-in period: 6 months
- Application requirements: Subscriber Application Form , Proof of Identification, Proof of Address
- System requirements: SIM embedded device



Hardware cost:

- \$600 (if no range extender)
- \$6000 (if range-extender)

Operation cost:

- From \$25 per month



APPENDIX



WE ARE WITH YOU



AT THE VENUE OF
EUROVISION
SONG CONTEST
MALMÖ 2013

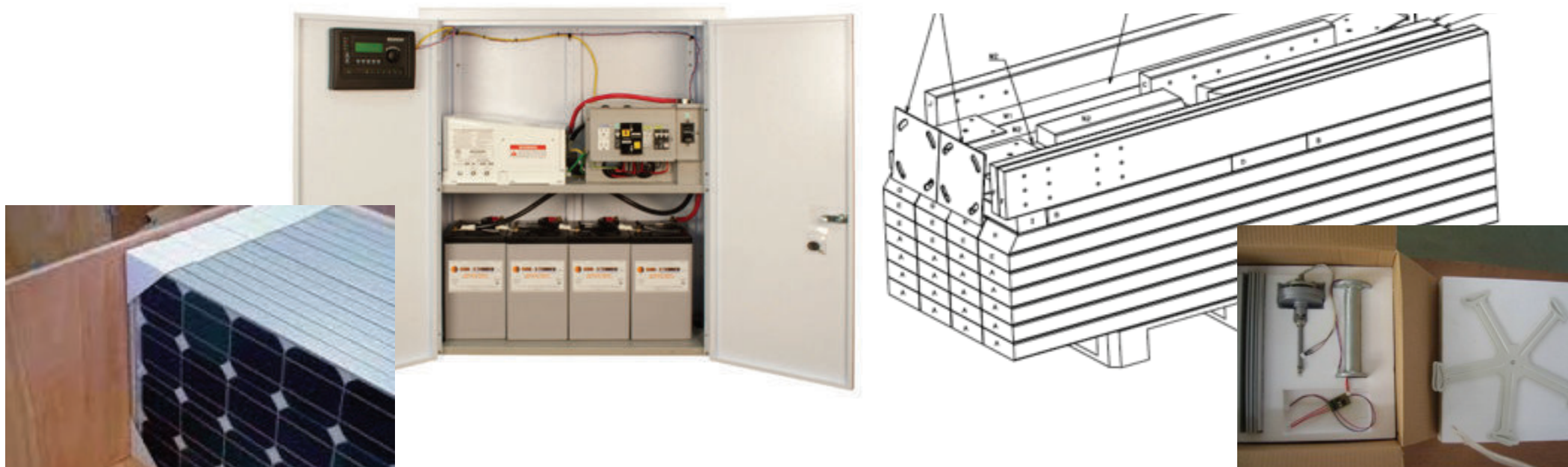
DAY &



NIGHT



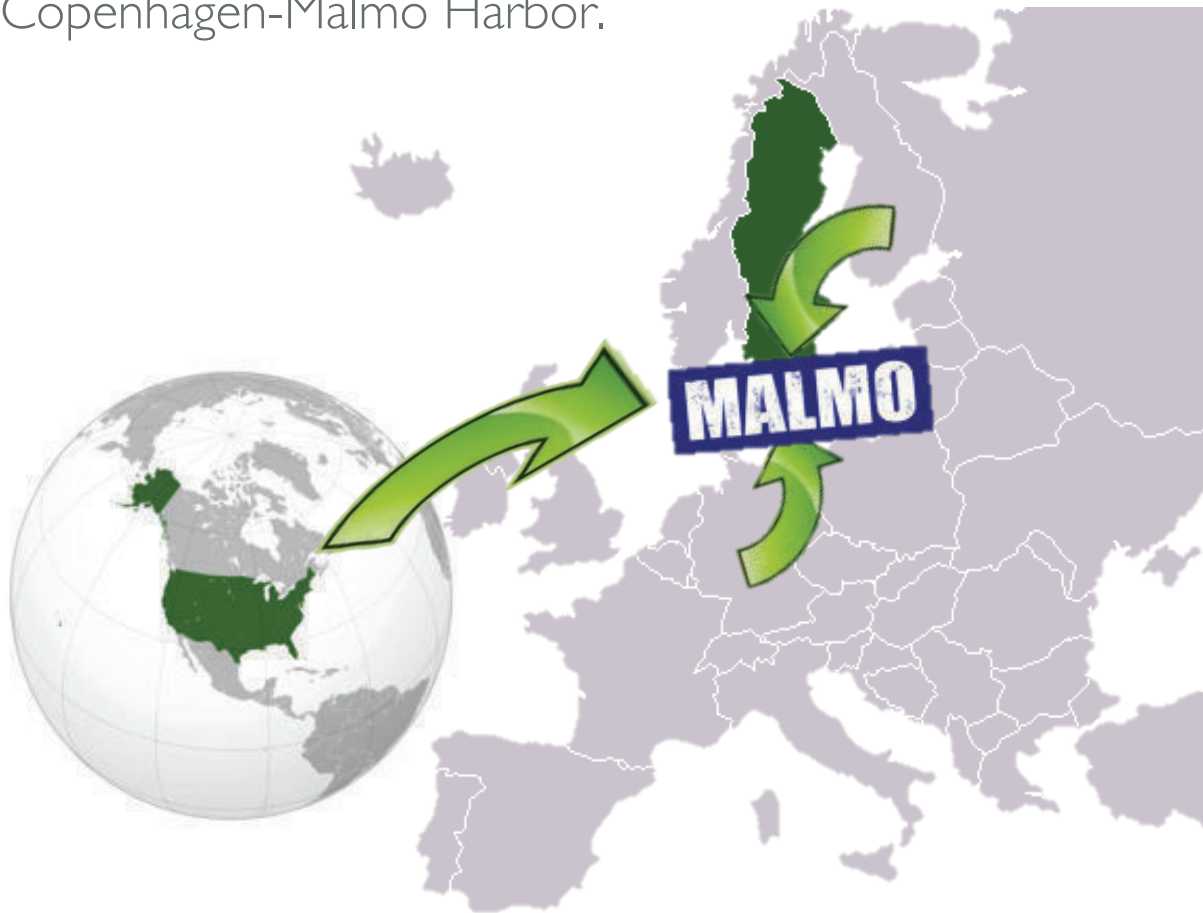
Full Specification of Packaging Volume: 4,55m³



	DIMENSION (m)	VOLUME (m ³)	WEIGHT (kg)
Dali PowerTower:Wood + Metal	0,8 × 2,0 × 1,5	2,40	1100
Wind Turbine	0,5 × 1,6 × 0,4	0,32	100
Solar Panel	1,0 × 1,7 × 0,4	0,69	150
Electrical Cabinet Batteries, off grid inverter, solar controller	1,5 × 1,5 × 0,5	1,13	200
TOTAL	2,8 × 6,8 × 2,8	4,55	1550

Collecting Goods & Loading

All components, except the turbine, will be gather at InnoVentum warehouse Sweden, Malmö. All Dali PowerTowers, including all parts and components, will be shipped directly in containers from our warehouse in the Copenhagen-Malmö Harbor.



One complete Dali PowerTower Hybrid Solution, including theft-proof cabinet = 4,55 m³

40 ft container = 67 m³

One container can take at least 10 Dali PowerTower solutions.

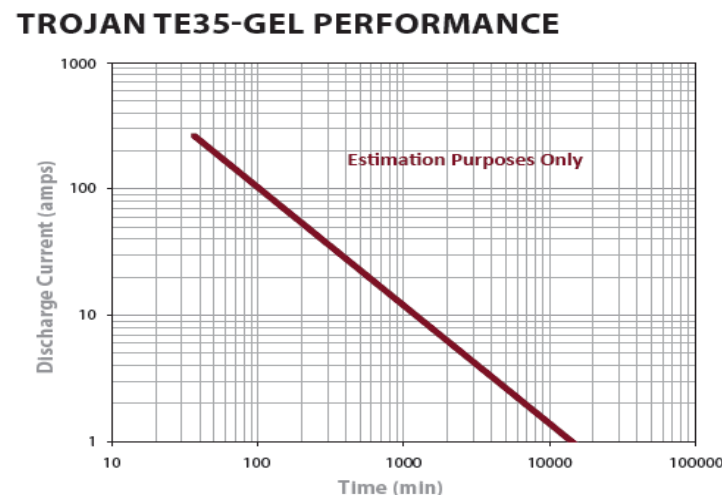
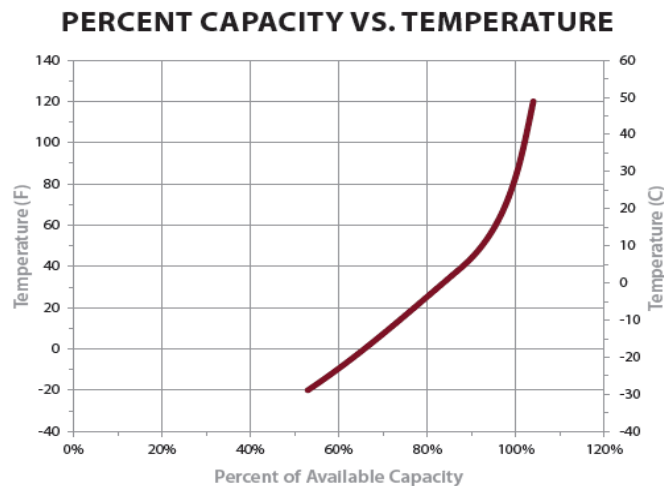
QC at reception will be proceed before container loading.

Distribution through the InnoVentum warehouse at the Copenhagen-Malmö Harbour

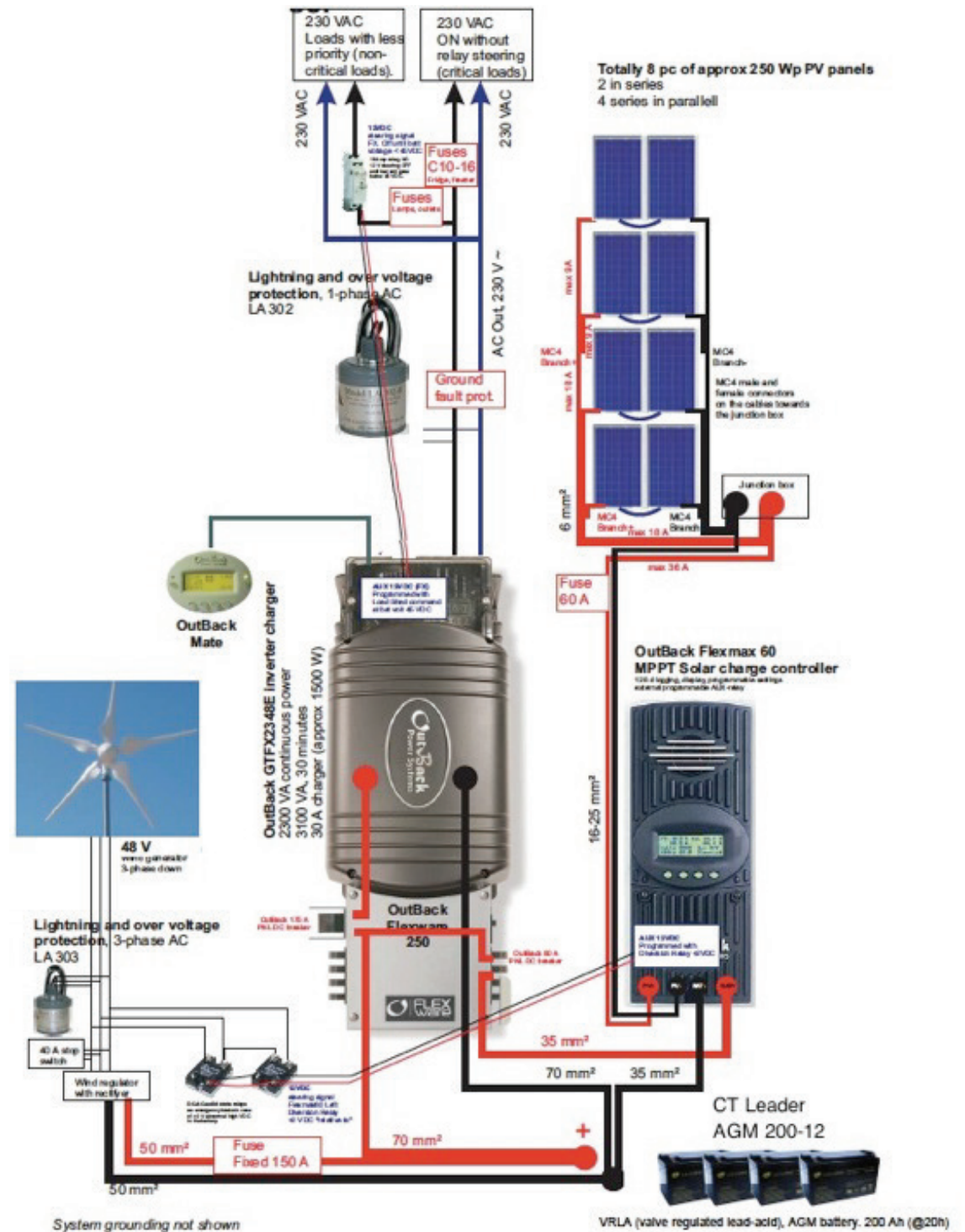


Gel Cell Batteries – For Safe Logistics and Optimal Performance at High Temperatures

- Chemical reactions internal to the battery are driven by voltage and temperature. The higher the battery temperature, the faster chemical reactions will occur. The Gel Cell Batteries excel at slow discharge rates and higher ambient operating temperatures.
- Operating Temperature: -20°C to $+45^{\circ}\text{C}$
- Battery VRLA GEL 2 Volt cells: design life 20 years – Daily usage of batteries at 30% DOD will give batteries lifetime about 5 years.
- Trojan gel batteries are **approved for air transport** by the F.A.A., I.A.T.A. and the D.O.T.
- 48 V DC battery bank with 210 Ah capacity has superior performance at high temperature:



A tall, slender wooden tower stands on a grassy hill. The tower is constructed from light-colored wood and has a small solar panel mounted on its side. At the top of the tower, there is a weather station or sensor. The background shows a clear blue sky and some distant trees.



Easy Local Ground Preparation

The very first shipment will have all modules, including foundation preparation, in the same container. For future shipments, ground preparation will be performed in advance of goods arrival – to shorten local installation time.

While the container is on his way to the target destination, local partners will prepare the ground foundation by digging holes and pouring concrete. As part of the container load, 10 sets of foundation bolts M18 will be shipped together with one positioning mock up – for accurate positioning of the foundation blocks and their connection bolts.



Tripod foundation for Dali PowerTower – Foolproof Approach for Perfect Accuracy Regardless of Local Conditions

Initial Performance Test of Equator Design in Sweden



Angling of the PV Panels is adopted to the Philippines – with one Layer of 6 Panels instead of two layers of 3

Selected Installation Site at the Hills of Grace Village operated by the Children's Mission near Manila

