InnoVentum with:

Barnmissionen

HUMANBRIDGE

Power to the Philippines

Bringing Typhoon-Protected Hybrid
Wind-Solar Energy Solutions
to the Philippines

Making Donations REAL

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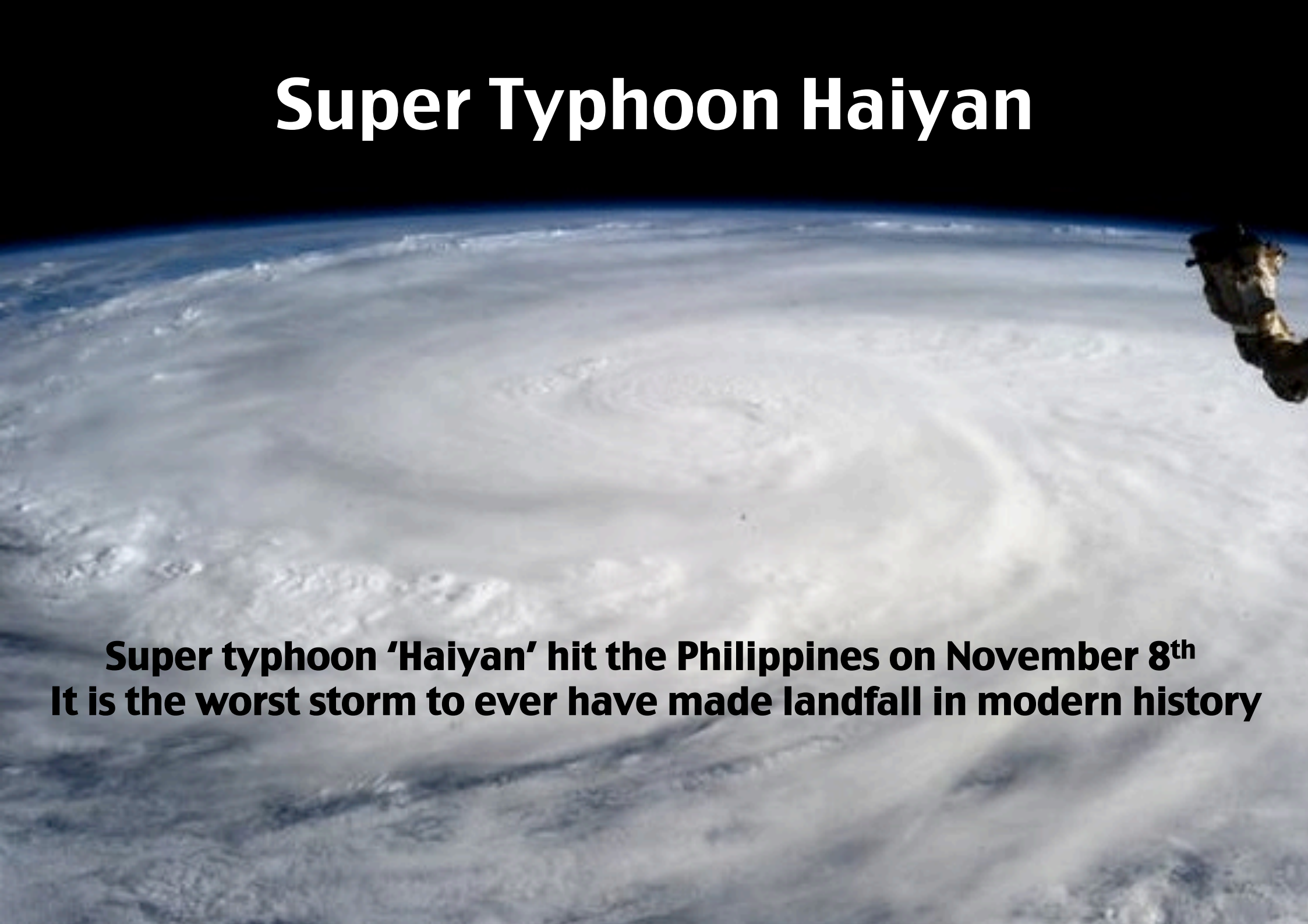
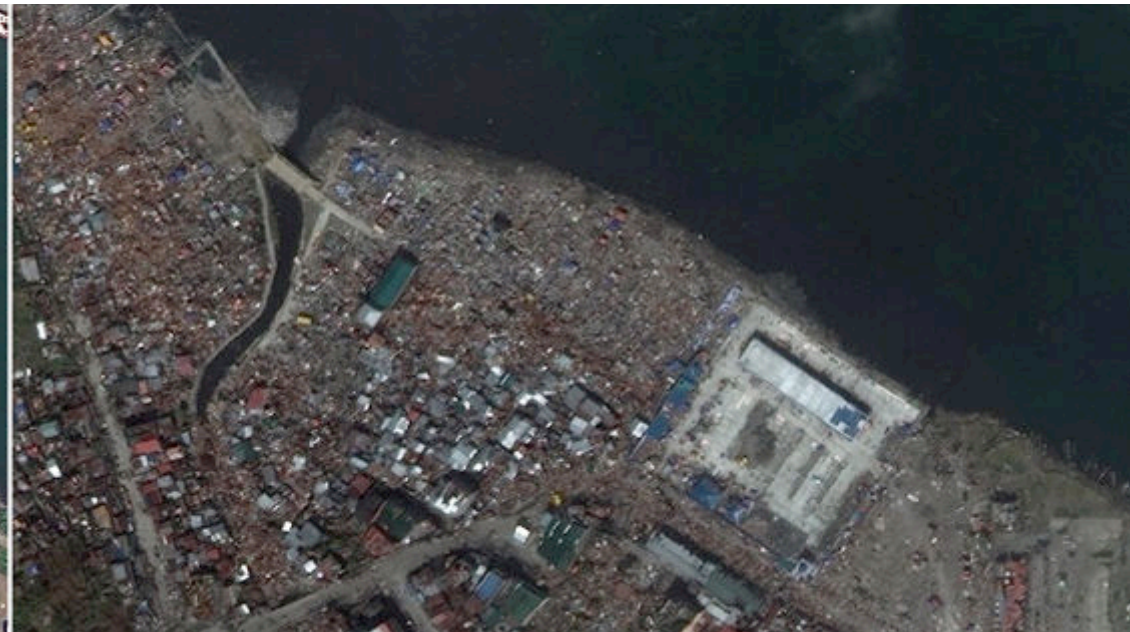
Super Typhoon Haiyan



Super typhoon 'Haiyan' hit the Philippines on November 8th
It is the worst storm to ever have made landfall in modern history

From Paradise to Disaster Area...



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

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

- 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.

What is a Sustainable Solution?

The **PowerTower** by InnoVentum is a hybrid wind-solar energy station that is robust, easy to install and made of renewable or recycled materials providing 4000-5000 kWh of renewable per year – day and night

Each day 10 PowerTowers will provide 130 kWh which is enough energy for:

- 50 LED lights
- 10 low consumption refrigerators
- 10 laptops or 50 mobiles phones
- 1 High Volume atmospheric water generator providing 1100 litres of fresh water per day

Why the PowerTower?

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 PowerTower will be better protected against typhoons. Protection against xylophagous insects, larvas and termites will be required.

No negative effect on the environment

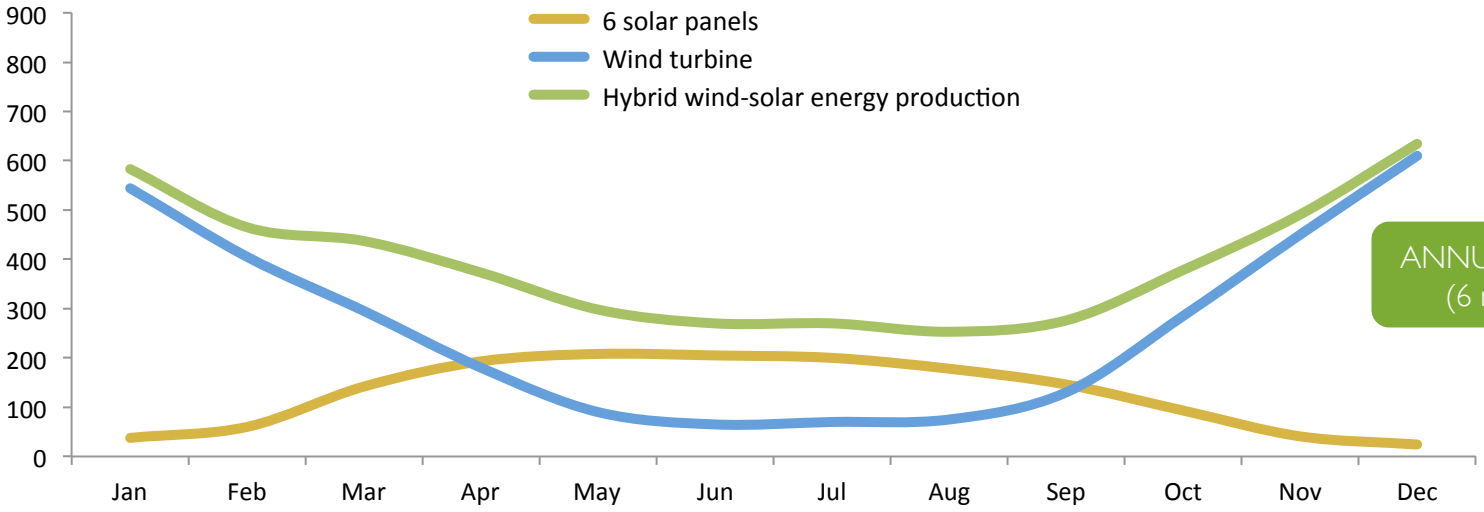
renewable energy is clean and use of wood makes the system "carbon negative"– the wood used to make the structure had captured at least 2 tons of CO_2 before it took shape of the PowerTower AND it produces energy without causing any emissions of CO_2 or pollutants.

Energy Production: Hybrid Wind-Solar Systems for a more Straight 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

There are more factors than simple availability of solar insolation that contribute to this complementarity: the air has higher density during winter months and at night, increasing the amount of wind energy generated. Plus, based on climate studies, stable strong winds that make wind energy generation possible, are prevalent during nights and cold months of the year.

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 our PowerTower



POWER TOWER
(6 PANELS)

ANNUAL ENERGY YIELD
(6 m/s): 4 730 kWh

All calculations made at Malmö latitude, average wind speed 6 m/s

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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 wind 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 PowerTower at Lund University

Typhoon Protection

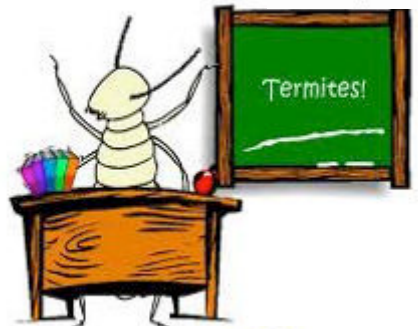
Termite Protection

Water Barrier

Since many types of termites are unable to cross the water, the viability of water barrier needs to be investigated. One possible 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 will be tested at the intended installation site to see if it attracts termites or not.



Anti-Termite Pesticide

For further deliveries from Sweden, the wood will be pre-treated to address the risk of termites. Over time, a business model for use of local wood will be developed. For example, coconut lumber is less sensitive to termite attacks

Ground Preparation

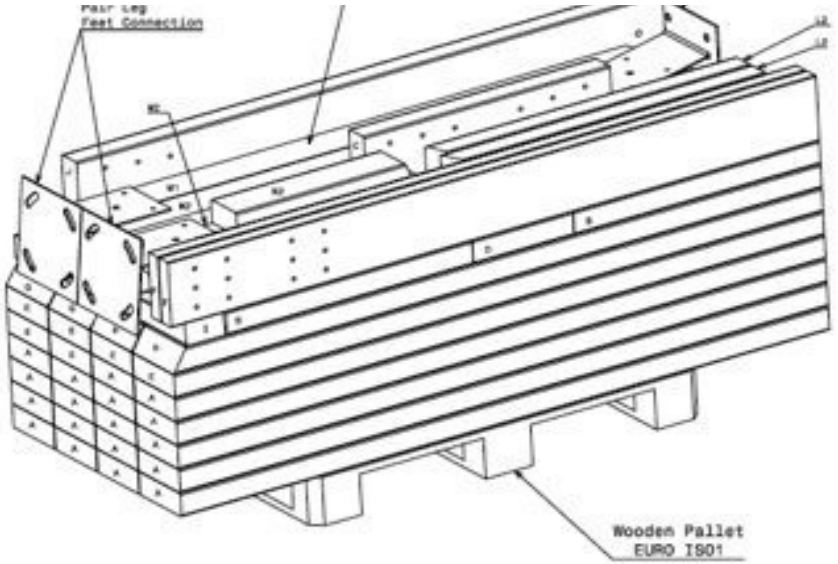
Most termites come from the ground. The first part they will encounter is an anti-termite product in the ground (to be selected in collaboration with Rentokil Philippines). The second part is the 1 m^3 concrete cube. Finally, the water barrier needs to be crossed before climbing up the steel parts to reach the wooden parts – which will be 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

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 m^3
- No module is longer than 2 meters
- On-site-assembly based on clear manual

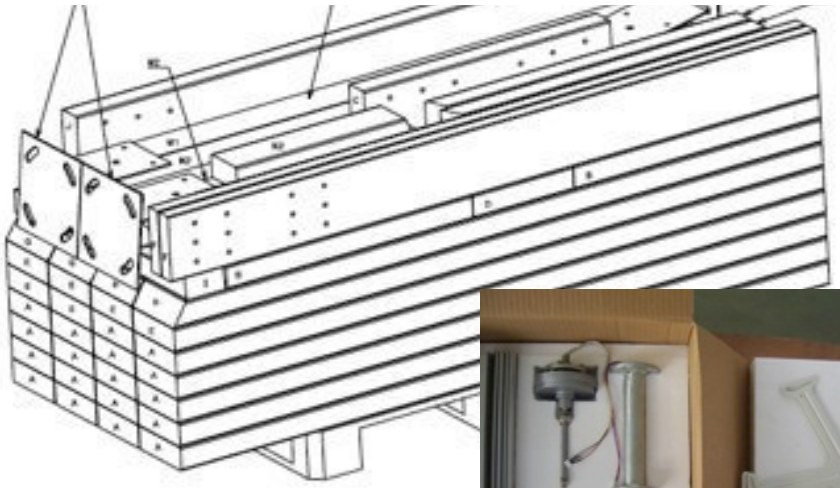


Tower on EU Pallet

All required bolts well-protected inside package

Assembling the Tower

Full Specification of Packaging Volume: 4,55m^3



	DIMENSION (m)	VOLUME (m3)	WEIGHT (kg)
Power Tower : Wood + Metal	0,8 x 2,0 x 1,5	2,40	1100
Wind Turbine	0,5 x 1,6 x 0,4	0,32	100
Solar Panel	1,0 x 1,7 x 0,4	0,69	150
Electrical Cabinet Batteries, off grid inverter, solar controller	1,5 x 1,5 x 0,5	1,13	200
TOTAL	2,8 x 6,8 x 2,8	4,55	1550

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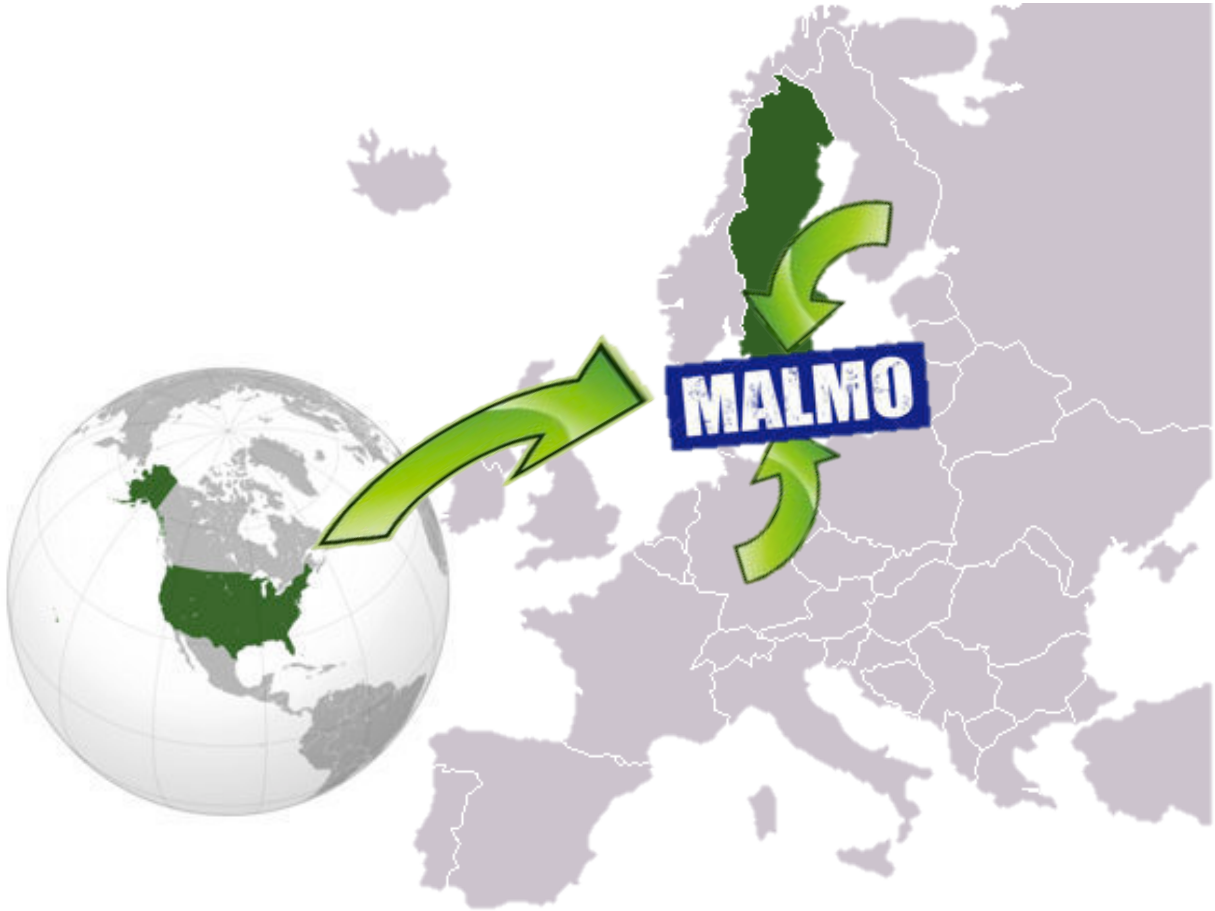
Collecting Goods & Loading

All components, except the turbine, will be gather at InnoVentum warehouse Sweden, Malmö. All PowerTowers, including all parts and components, will be shipped directly to the Philippines in one container.



One complete PowerTower Hybrid Solution, including theft-proof cabinet = 4,55 m^3

40 ft container = 67 m^3

One container can take at least 10 PowerTower solutions.

QC at reception will be proceed before container loading.

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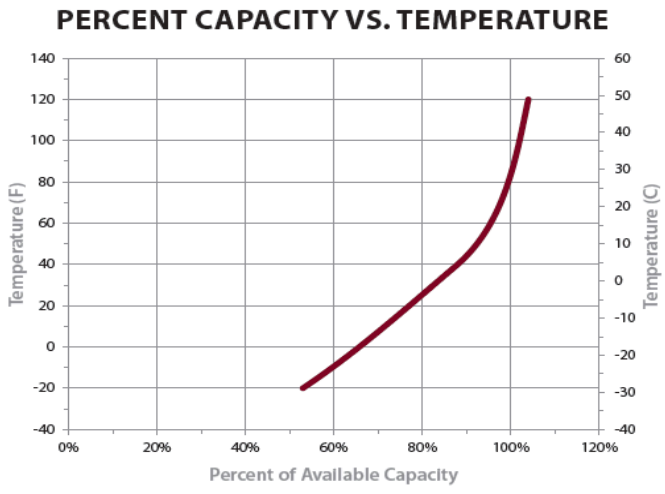
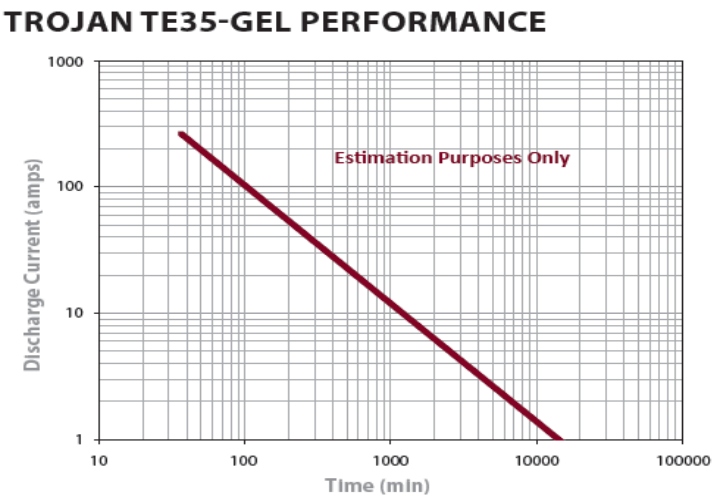
Gel Cell Batteries – For Safe Logistics and Optimal Performance at High Temperatures

- 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°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:





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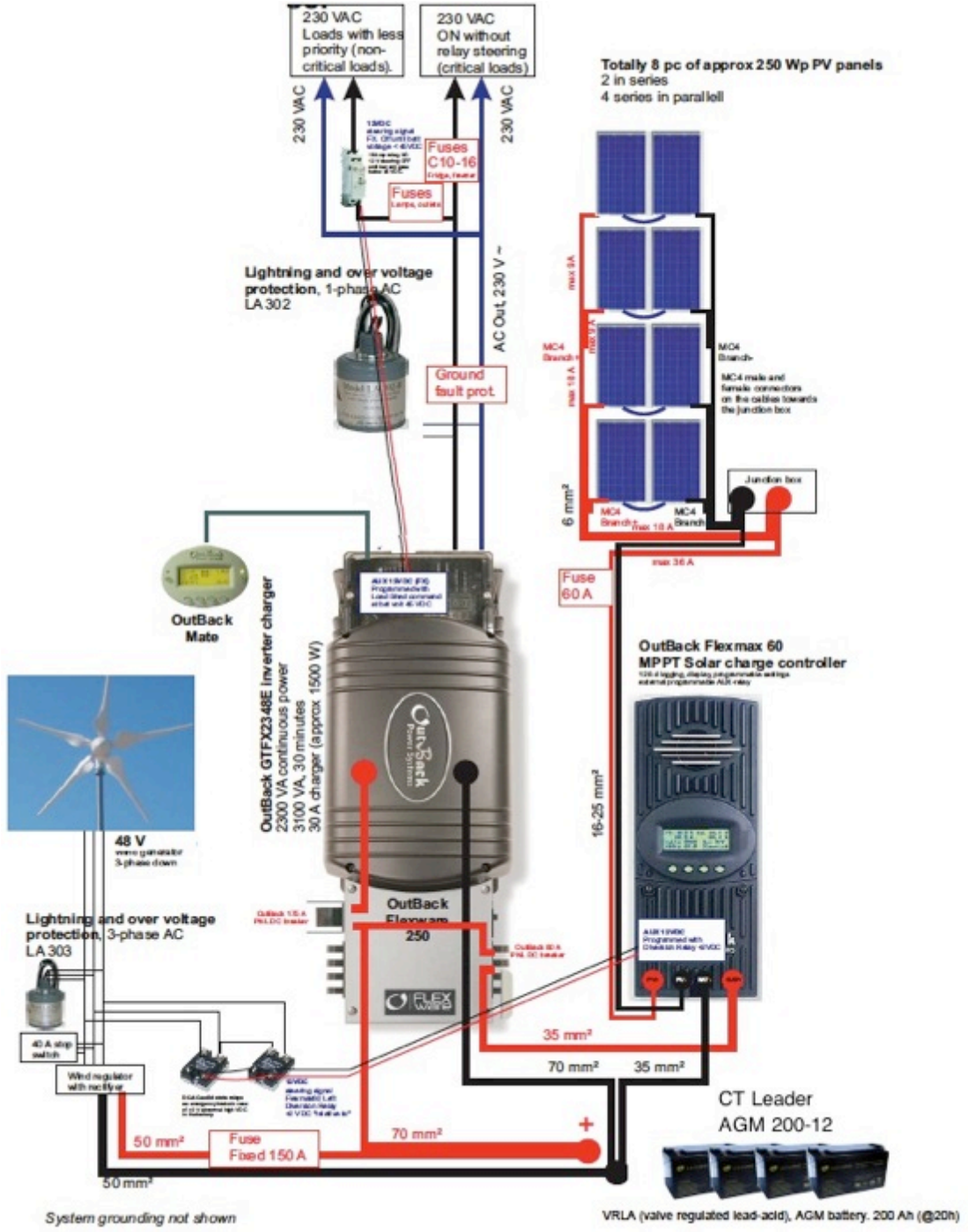
The PowerTower Off-grid System



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 Philippines, 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 Power Tower – Foolproof Approach for Perfect Accuracy Regardless of Local Conditions

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Lifetime – longer than for a Diesel Generator with less Regular Maintenance Required

PV

- Performance warranty: 25 years
- One of oldest PV installation "1982" is still producing in Switzerland and the efficiency only dropped by 9% over 30 yrs. The plant is expected to produce for at least 10 more years.
- Maintenance:
  - Visual checking (impact, crack, cables) every year
  - Dust cleaning when necessary

Turbine

- Lifetime expected with regular maintenance : 15 to 20 years
- Maintenance:
  - Replace blades every 5 years
  - Replace bearings and slip ring brush after 10 years

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Robust Sustainable Systems in and for Time

- Each Power Tower will HELP selected villages to recover faster from the disaster.
- With a lifetime of 20 years and the hurricane-proof design, each Power Tower will continue to provide GREEN energy to Philippine villages.
- Innovative way of mixing energy, wind and solar, will develop awareness about RENEWABLE Solutions and will contribute to achieving the Millenium Development Goal for the Philippines which is a United Nations Program for REDUCING CO_2
- Grid shortage will have less impact thanks to the Power Tower solution
- NGOs already try to help, but with limited access to reliable technology and hybrid solutions.

Help to Self-Help – for a more Sustainable and Reliable Future

- The easy-to-install Power Tower is designed for installation without heavy equipment, just by manpower.
- Apart from giving power to the people, installation work will unite the People of the Philippines to work together to build a better and more sustainable future.

- Knowledge & Technology Transfer is an important part of the project to enable Filipinos, together with InnoVentum R&D staff, to install more hybrid solutions.
- Once the PowerTower has been validated in the local conditions, a local supply chain can be established – for a sustainable business model to emerge around renewable energy.

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Targeted installation sites

Typhoon Path

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Leyte Region (Tacloban, Ormoc and Hilongos)

Leyte Region
(Tacloban, Ormoc and Hilongos)

Benefits:

- Great need of electricity supply especially for fridges to store the vaccines for anti-tetanus (according to MSF)
- Barnmissionen's (the Children's Mission) Scandinavian Village is based in Tacloban with 400 houses and a school – in urgent need of electricity for light, water pumping and charging of mobile phones and pocket lights.
- Presence of SOS Children's Villages, Medécins Sans Frontières camps and a Red Cross camp
- WHO and the Philippine Department of Health – a vaccination campaign to prevent outbreaks of measles and polio in Tacloban
- Good wind potential of the region

Challenges:

- The whole region is among worst struck in the Philippines
- High accessibility uncertainty
- Installation work likely to be challenging

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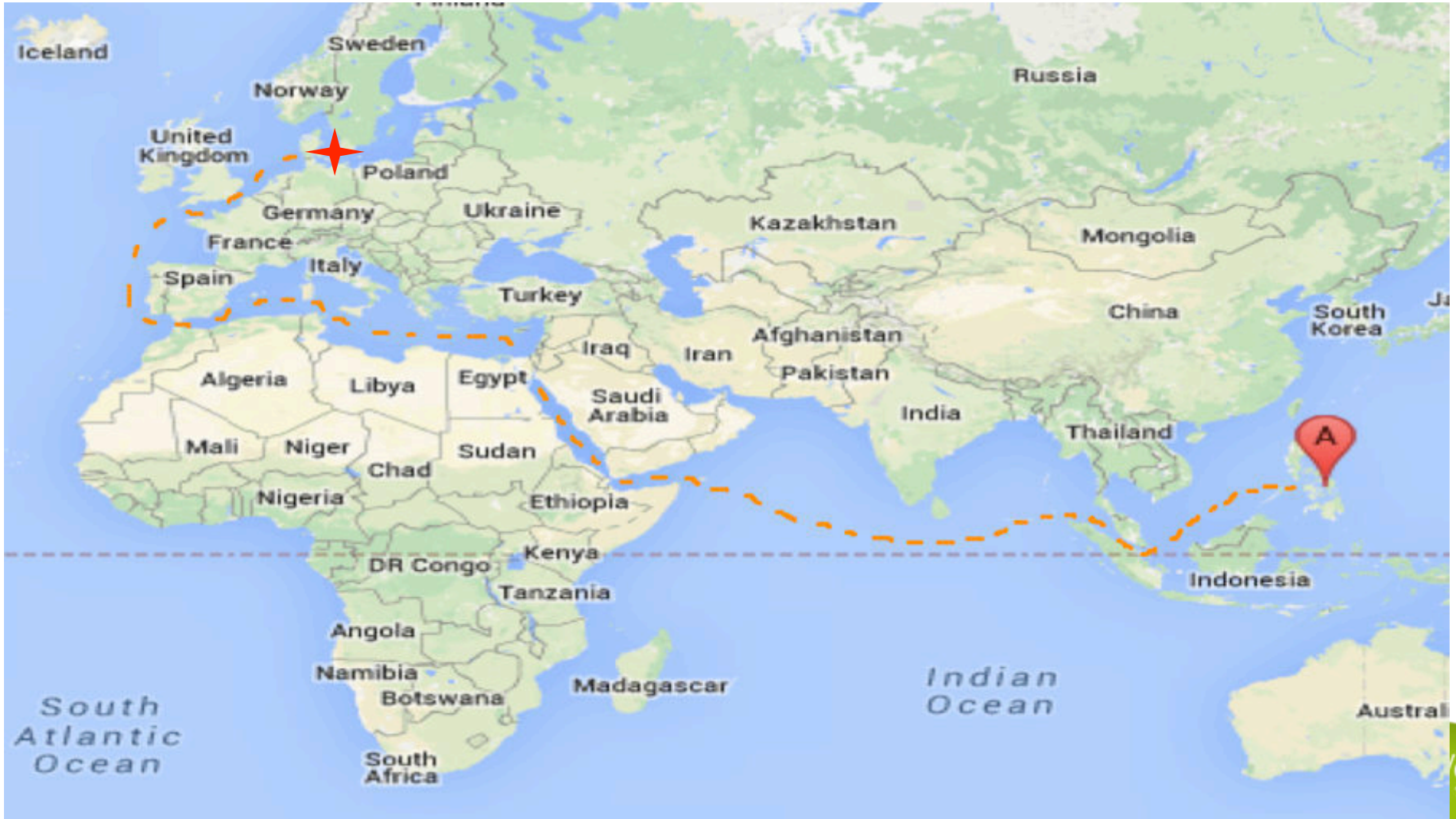
Selected Logistics Solutions for Bringing Power to the Philippines

Itinerary Human Bridge

- Malmö Harbor ⟶ Copenhagen Harbor ⟶ Ormoc Harbor



Making Donations REAL and DIRECT

- On average, for every donation, only 25% reaches the targeted people in need of help. The rest of the money is "lost in translation". The most common losses are caused by:
  - Rental costs of very exclusive office space
  - High salaries – often twice as high as equivalent positions in other organizations: http://www.ngopulse.org/article/nonprofit-salary-bill-comes-under-scrutiny and http://www.huffingtonpost.com/2013/04/08/10-insanely-overpaid-nonp_n_3038162.html
  - Travel expenses - often in first class or business class and expensive dinners
  - Some countries also apply taxation on donations of goods
- Our approach is to make donations REAL and DIRECT: For every 300.000 SEK (€33.000) donated, one new PowerTower will be installed – without any losses in bribes, taxes or salaries. The 300.000 SEK covers purchase of goods and services exclusively related to preparing, transporting and installing the hybrid solutions
- Donating the PowerTower directly and managing transport through a reliable and experienced partner makes it difficult for anyone to remove a percentage.

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Scandinavian Village near Tacloban by Barnmissionen first pilot in the Philippines

In the 1990s Barnmissionen built the Scandinavian Village North of Tacloban. This village consists of 300 houses and several schools. In total, 2500 people live in the village, which was devastated by the typhoon. The houses have been repaired, but the village is still without any supply of electricity.

Barnmissionen has bought a 5,5 kW diesel generator, but they only run it 4 hours per day due to noise and pollution. The generator provides power to LED lights around one school yard, outlets for charging phones and pocket lights. There is no refrigeration, but some electric pumps for water that also would need electricity.

Brief Project Summary

- Production by InnoVentum and shipment of the first PowerTowers by the Human Bridge to Ormoc Harbor – for installation at the Scandinavian Village site in Tacloban
- Qualified engineers from InnoVentum will guide and teach local volunteers to install the PowerTowers at the Scandinavian Village
- In collaboration with the Children's Mission, funding activities will secure further supply and installation of hybrid energy solutions for those who need them most
- Logistics by the Human Bridge = All Funding Gives Power
- In collaboration with the Children's Mission we consider a second pilot – to demonstrate the solution in a different environment.
- In collaboration both with the Children's Mission and the Copenhagen Business School, a business model will be developed for continued sustainable deployment and use of hybrid renewable energy solutions.

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