



WAVE

Urban Wind Turbine Wind Energy for Smart Cities

-BIZTEC Entrepreneur Challenge - First prize winner in Cleantech category
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-Pending Patent
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While a city consumes 80% of the total national electrical energy
Why the roofs of Tel-Aviv, for example, are all covered with sun collectors,
but not with even a single wind turbine?

WAVE Wind Turbines are rectangular

On the roofs of Tel-Aviv

Major Problems

- Cities consume about 80% of the world's energy but produces just little from PV.
- Conventional wind turbine are a threat to the urbane area, due to their properties.
- Minimum wind speed, and its quantity, are additional obstacles of the existing turbine designs.

The Solution •

- WAVE offers a disruptive approach to wind exploitation, in a way that makes it:
- Safe operation when installed on buildings
- Starts operate in low wind speed
- Complementary to PV (rooftop and Floating)
- Economical.
- Rectangular and In harmony with the architecture.

Swinging Wind Turbines

Tailor-made Wind Turbines

Facade Wind Turbines

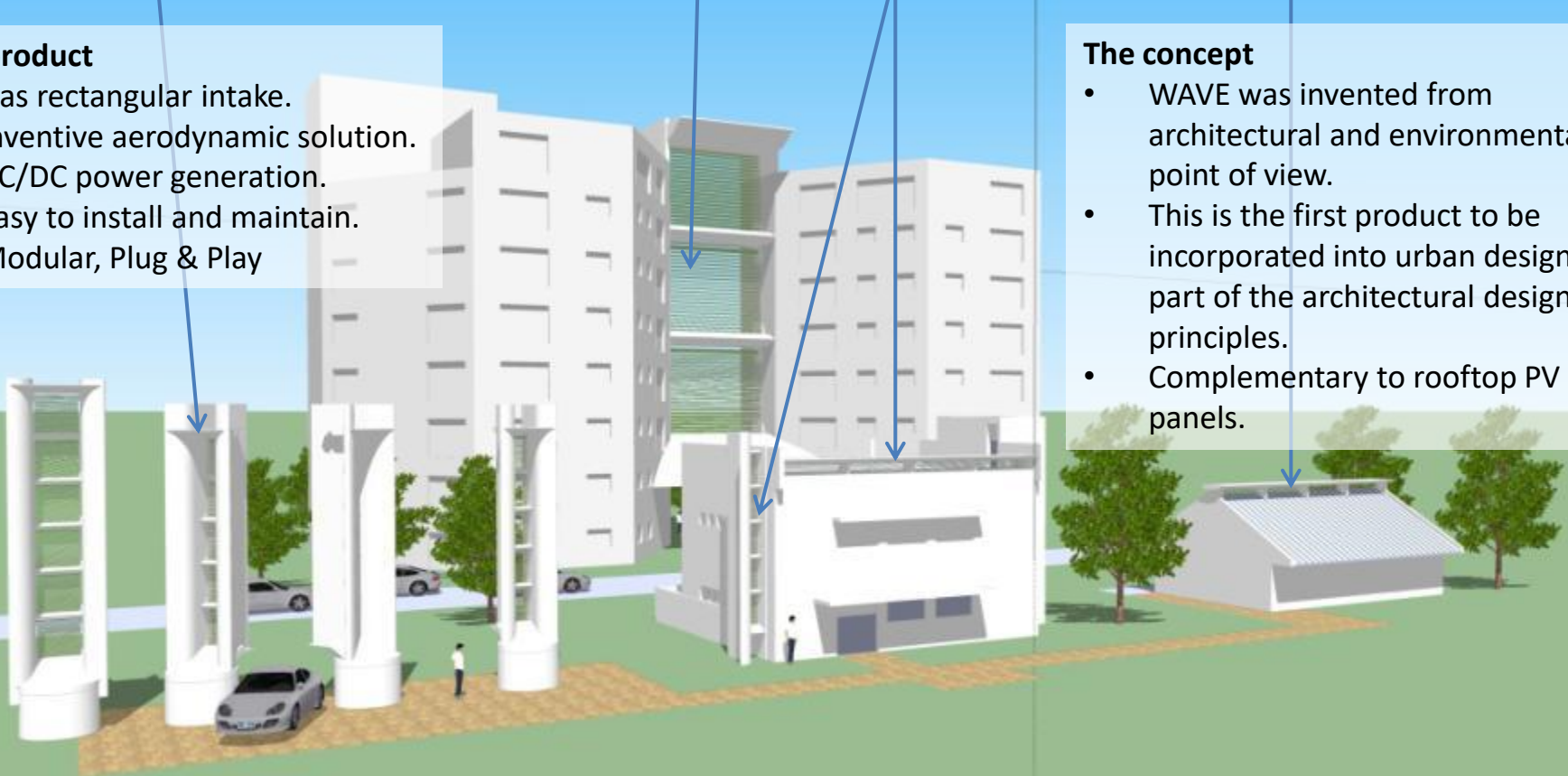
Ridge Wind Turbines

The product

- Has rectangular intake.
- Inventive aerodynamic solution.
- AC/DC power generation.
- Easy to install and maintain.
- Modular, Plug & Play

The concept

- WAVE was invented from architectural and environmental point of view.
- This is the first product to be incorporated into urban design as part of the architectural design principles.
- Complementary to rooftop PV panels.



In the built area – in harmony with architecture. Assimilated into the architecture where wind speed is accelerated

WAVE CONCEPT

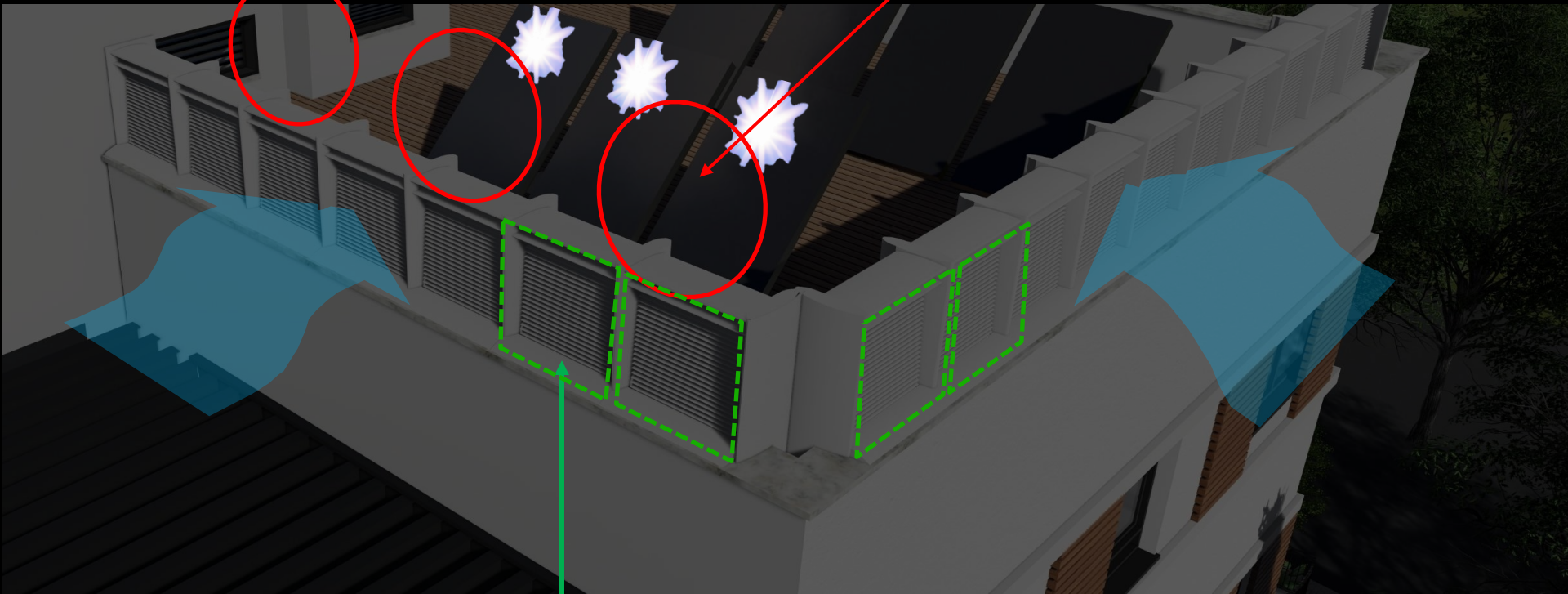


The city roofs are elegant hybrid energy source

WAVE

CONCEPT

To compare with ATLANTIS
VAWT Wind turbine 400 w



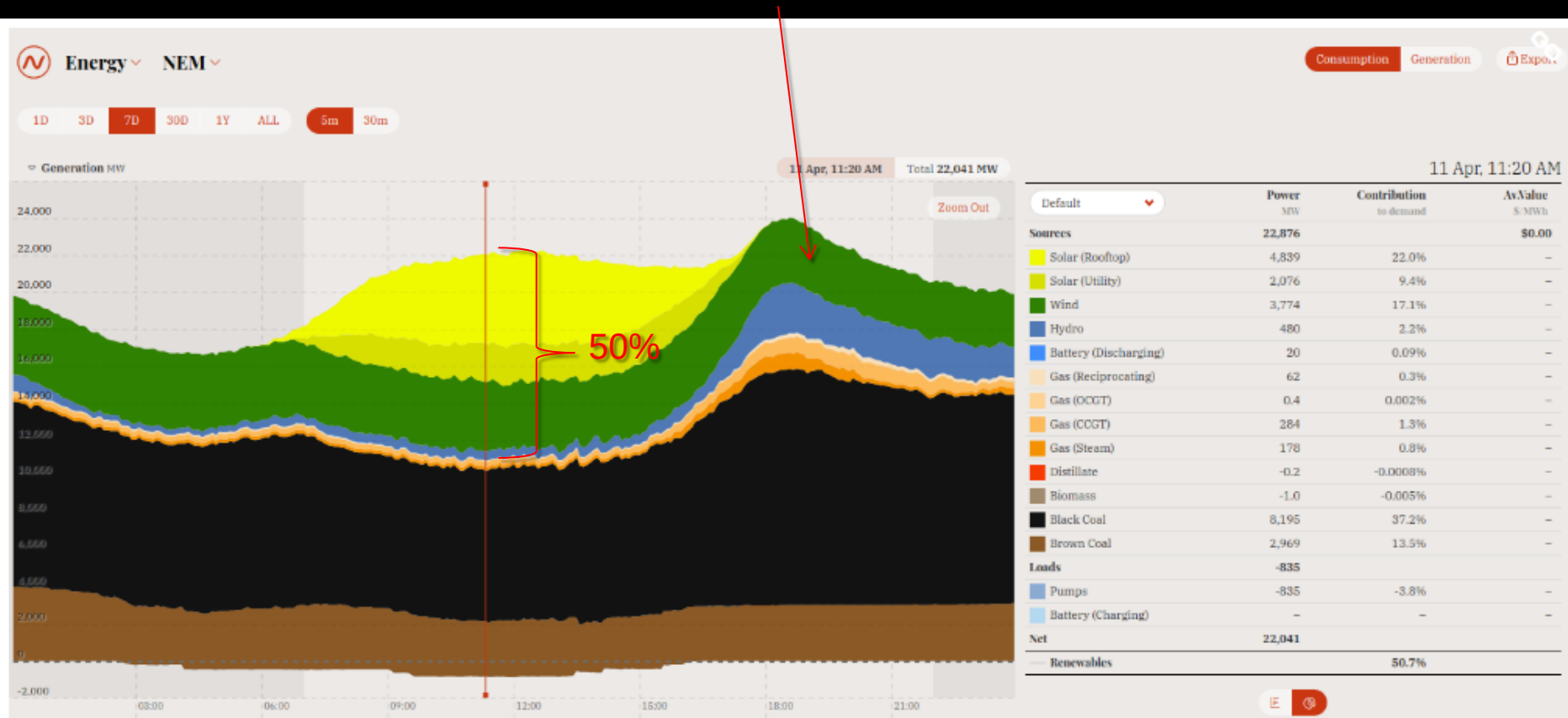
Wind turbine panel
Conceptual aerodynamic, examined and
designed by Dr Rimon from The Technion
Faculty of Aerodynamic Eng'

At night or when cloudy,
when PV panels are
useless, a new wind
energy source comes to
life...to recharge the
batteries.

The city roofs are elegant hybrid energy source
Sun during shiny day hours and multi directions wind 24/7

WAVE WIND & SUN Complementary sources

Specific day 24 h in Australia. When 50% of the energy came from clean sources.



The OpenNEM tool shows what sources of energy are meeting consumer demand at 11:20am on Saturday.

Image: Supplied

Conclusions:

1. Sun energy is available for just a few hours a day.
2. Wind energy is a stable clean energy source 24/7

C.F.D shows:
Even if wind velocity, in built areas is low in general, In specific locations, it is at least doubled. There (red) WAVE will be located

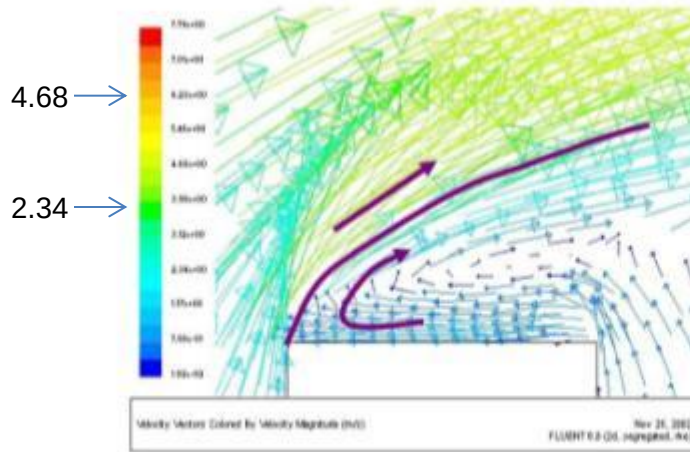


Figure 14: Wind flow around a building

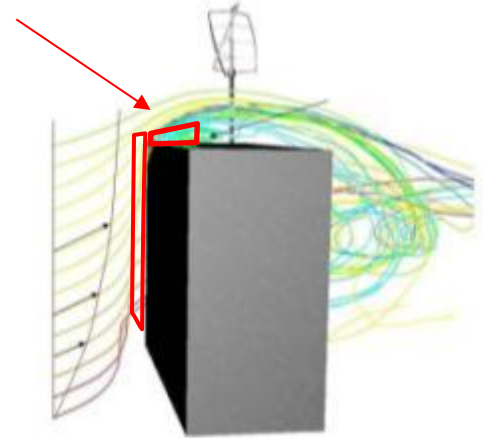


Figure 15: Placing of a turbine on the roof

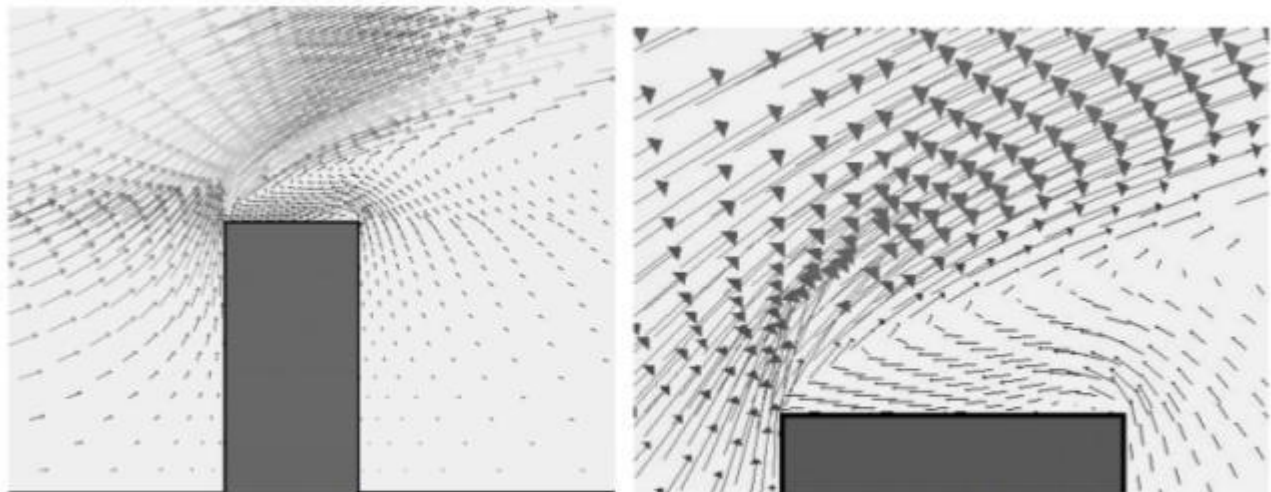
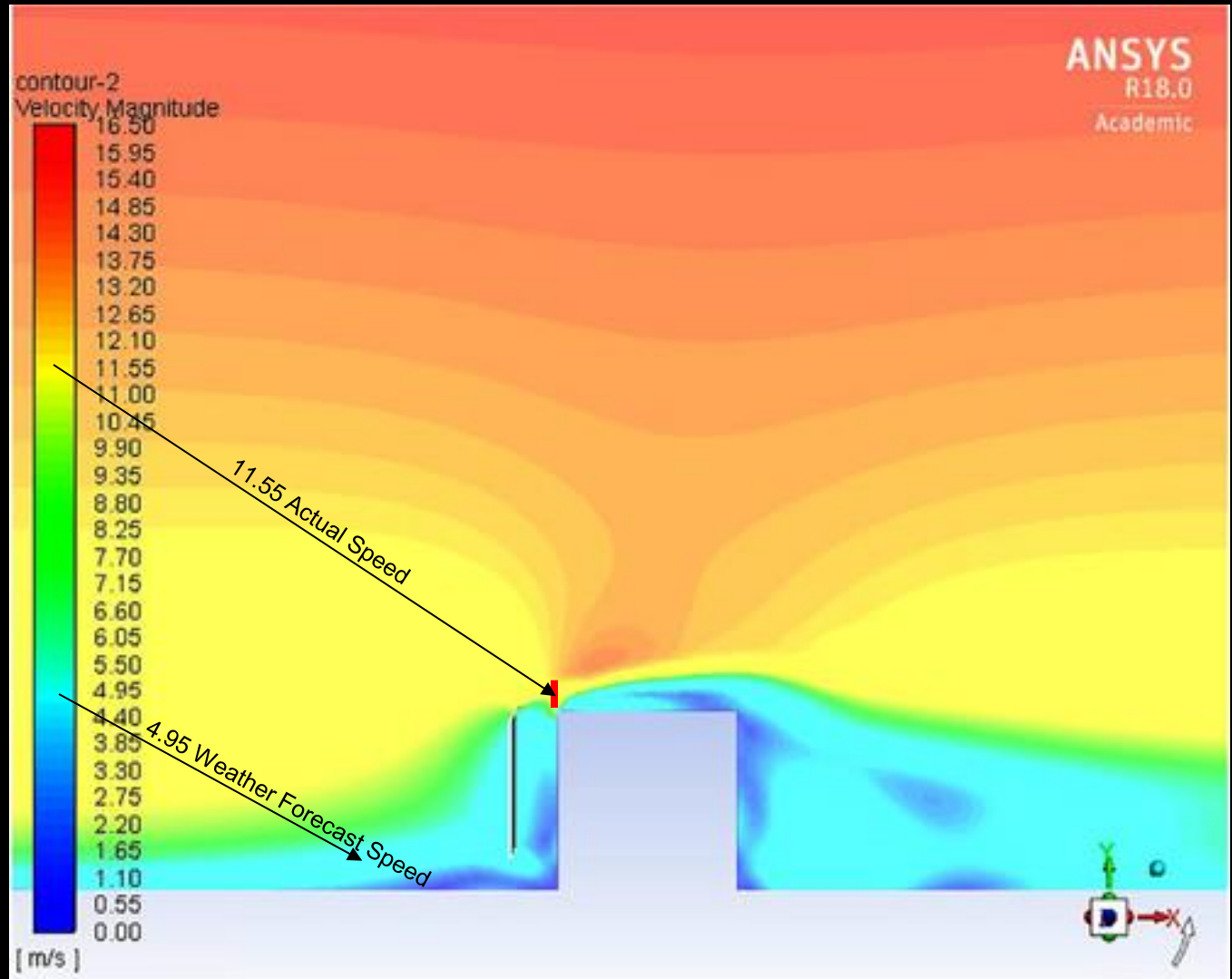


Figure 22 CFD calculation of the velocity vectors around a 2D building (left) and zoomed in at the roof (right). The flow comes from the left.

Wind speed has a great impact

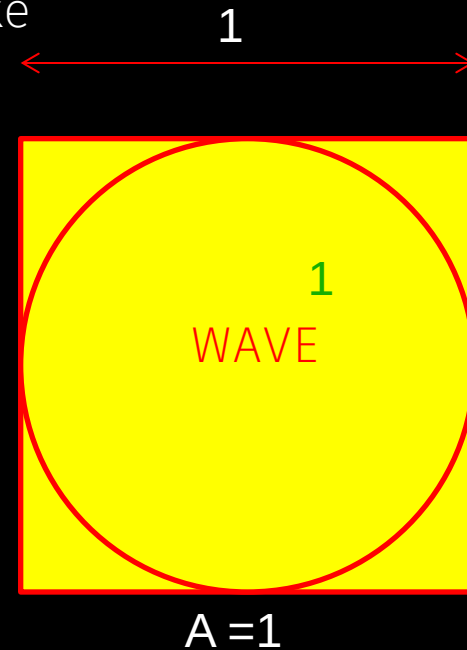
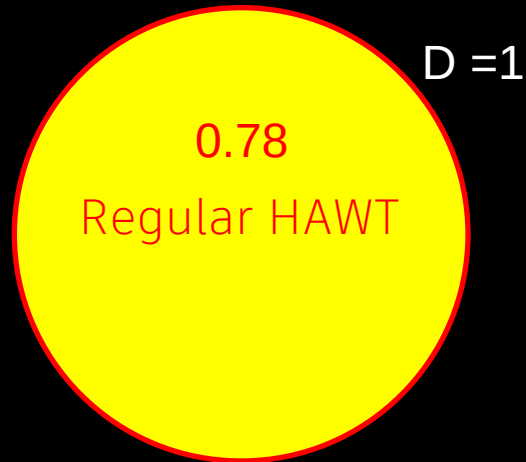
$$P = 0.5 \times \rho \times A \times C_p \times V^3 \times N_g \times N_b$$

Typical CFD example In specific location, Wind speed is at least doubled on rooftop specific location. There (red) WAVE will be located



WAVE turbine has a rectangular vertical air intake

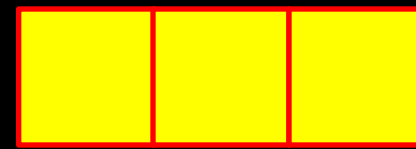
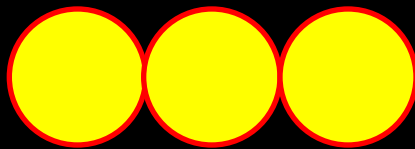
The area relation of square versus circle

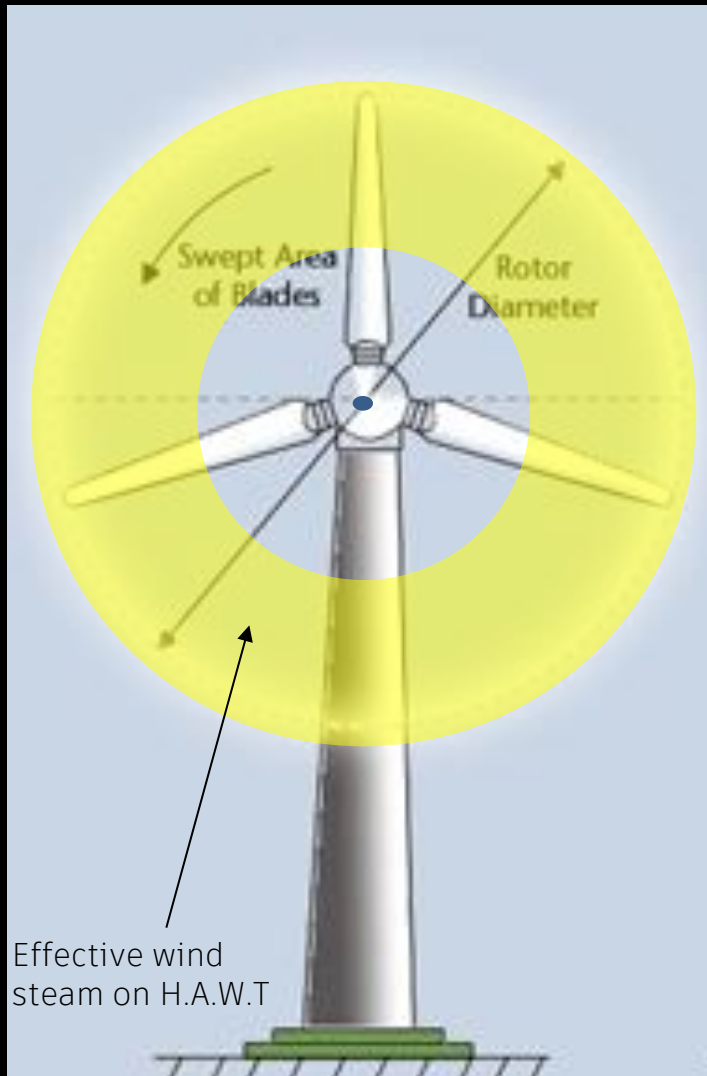


$$A = 0.5 \times 0.5 \times 3.14 = 0.785$$

The rectangular area is 27.3% larger than the circular and so is the electricity power.

And in case of array ?





"Wave" will harness energy from all the wind blowing through its location.



Potential wind stream on the same location for "WAVE"

Wave will harness wind energy from the whole wind pass its location
Place is expensive !!!

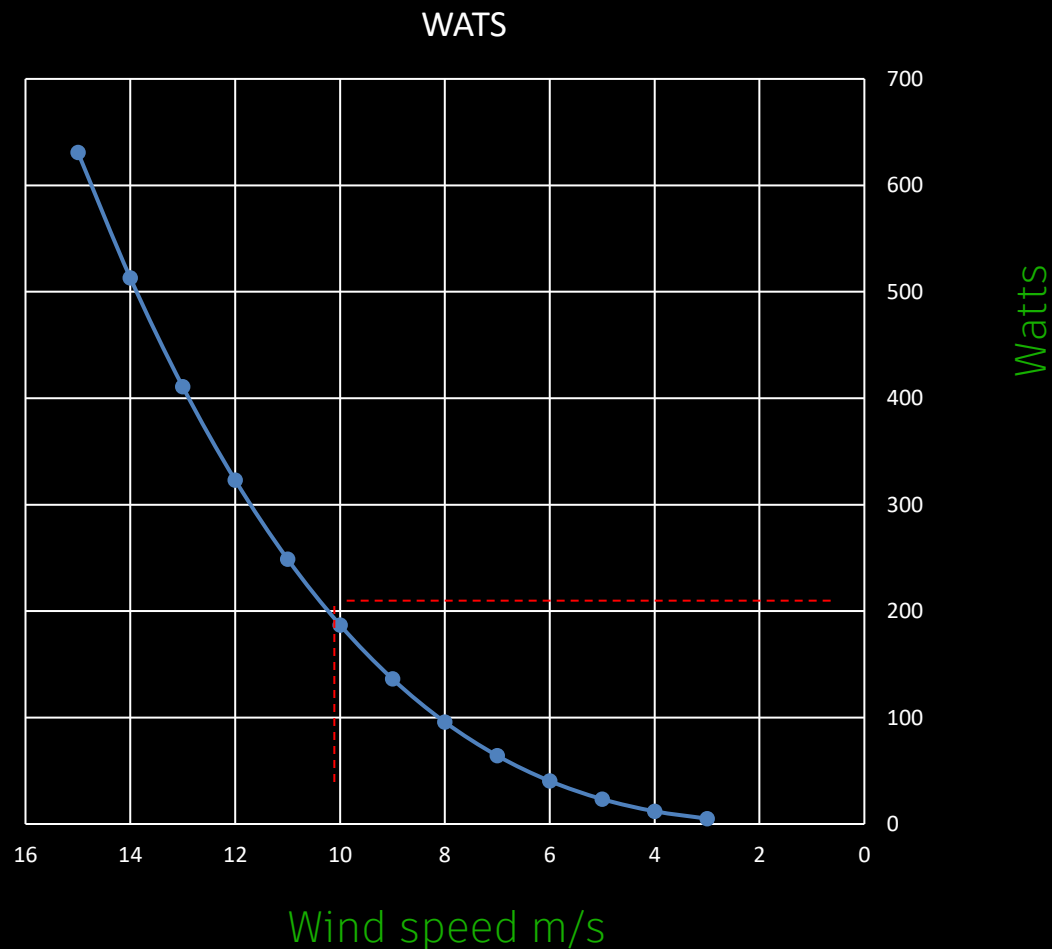


WATTS per WIND

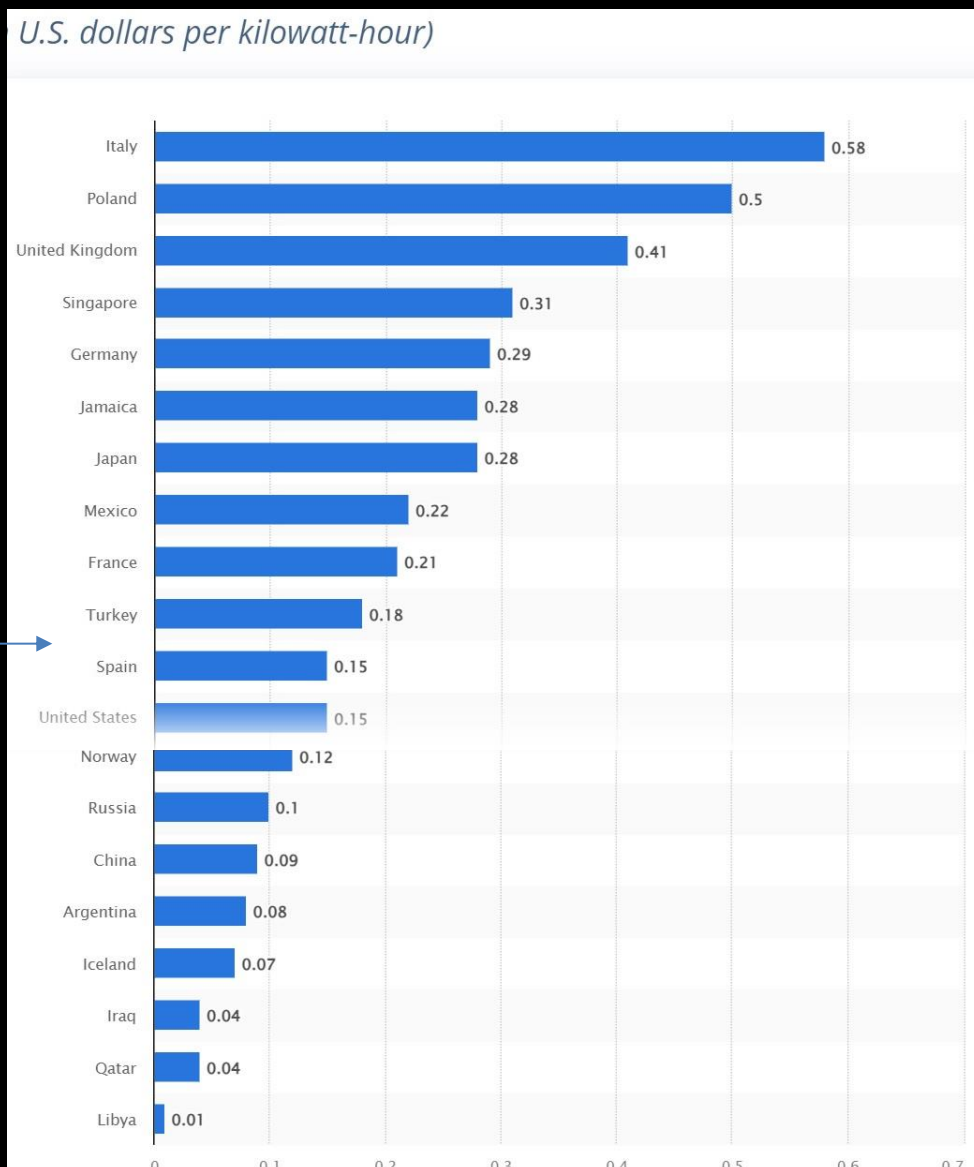
WAVE expected efficiency is above 40%

WAVE will supply 200 Watts per vertical sqm at wind of 10 m/s

WAVE will supply 660 Watts per horizontal sqm at wind of 10 m/s – to be compared with PV panels?



ISAERL →





World domestic electricity costs

IRELAND tariff is between Israel and Denmark

Global household electricity prices 2022, by select country	Rate		
	\$	₪	
Household electricity prices worldwide in June 2022, by select country (in U.S. dollars per kilowatt-hour)			
Denmark	0.53	1.86 ₪	
Germany	0.52	1.82 ₪	
United Kingdom	0.47	1.65 ₪	
Italy	0.46	1.61 ₪	
Spain	0.37	1.30 ₪	
Ireland	0.33	1.16 ₪	for calculations
Japan	0.25	0.88 ₪	
Rwanda	0.24	0.84 ₪	
Australia	0.22	0.77 ₪	
Singapore	0.22	0.77 ₪	
France	0.21	0.74 ₪	
Brazil	0.20	0.70 ₪	
Poland	0.18	0.63 ₪	
United States	0.18	0.63 ₪	
Kenya	0.17	0.60 ₪	
Venezuela	0.17	0.60 ₪	
Chile	0.17	0.60 ₪	
Israel	0.16	0.56 ₪	ISRAEL
South Africa	0.15	0.53 ₪	
Mexico	0.10	0.35 ₪	
South Korea	0.09	0.32 ₪	
United Arab Emirates	0.08	0.28 ₪	
Turkey	0.08	0.28 ₪	
China	0.08	0.28 ₪	
India	0.07	0.25 ₪	
Russia	0.06	0.21 ₪	
Nigeria	0.05	0.18 ₪	
Saudi Arabia	0.05	0.18 ₪	
Qatar	0.03	0.11 ₪	
Iran	0.01	0.04 ₪	



IN THE BUILT LANDSCAPE TILTABLE

ASUME:

Wind speed 7 m/s (the average in large area in Israel) but doubled due to unique wind tunneling location.

Turbine front face 4 sqm

WAVE will supply to its owner as follows:

0.2 \$ per hour
 4.8 \$ per day
 1,750 \$ every year
 8,750 \$ per 5 years

										(a)	Wind speed m/s		V	As on table
											Air density		p	1.293
											Wind façade area sqm		A	1
										(d)	Turbine coefficient 59% is max		Cp	30%
											Dinamo efficiency factor		Ng	80%
											Mechanical transmission efficiency factor		Nb	95%
											Watts		P	
Electrical power formula														
$P = 0.5 \times \rho \times A \times Cp \times V^3 \times Ng \times Nb$														
RUWT WIND ENERGY AND ECONOMICAL BENEFIT														
Electricity value per 1sqm		turbine	facade				Turbine coefficient	Air density	Turbine façade	Wind speed				
Supplied per				(e) Tarrif in Israel for							Wind speed factor per turbine	Factor for Wind during a day (b)	Prevailing wind speed	
years 10	years 5	year 1	hour 1	Kilowatt	Kilowatts	Watts	(d) Cp	Kg/sqm	Sq/m	Effective wind speed	©location		(a)M/s	Km/h
≈ 10,888.68	≈ 5,444.34	≈ 1,088.87	≈ 0.12	≈ 0.54	0.230	230.185	30%	1.23	1	12	2	95%	6	21.6
≈ 17,290.82	≈ 8,645.41	≈ 1,729.08	≈ 0.20	≈ 0.54	0.366	365.525	30%	1.23	1	14	2	95%	7	25.2
≈ 25,810.20	≈ 12,905.10	≈ 2,581.02	≈ 0.29	≈ 0.54	0.546	545.624	30%	1.23	1	16	2	95%	8	28.8

PROSUMER



The turbine transforms energy into communal batteries. Allows to integrate and reward flexibility from generation, consumption and storage devices in smart grids. This leads to integration with more renewables and increases efficiency.

GLOBAL MARKET BUISNESS MODELS



LICENSE



transform IP value to profit for little operation cost. Will allow the company to focus on farther R&D and developing business scopes.

CROSS SELLING



The wind turbines can be additional products to add to roof top PV market . Thus, additional revenue can be generated with relatively few changes to the existing infrastructure and distribution, since more potential customer needs are met.



WINDPODE is an Australian invention for urban environment. Designed like vertical PV panels. Very heavy and inefficient due to un aerodynamic design, the drag will block the wind causing most of the wind's kinetic energy to bypass the turbine.



Additional unsuccessful rooftop wind turbine creative episodes

WAVE

PIONEER ANCESTORS

Some pioneering experiments, of rooftop hybrid (wind+PV) solutions. Clames to solve only parts of the task.



WAVE is the only total one, contains all the critical properties.



The building accelerate the wind



Rectangular wind harvester



Aeromine – clames it operates without blades

Position on rooftop



Ibis Power - Dutch firm

The entire roof is energy source



Combine wind and PV on one rooftop



+



WAVE



- Commercial add-on using idle infrastructure
 - Floating system
 - Land system
- Productive sun is available only a few hours per day. Wind energy can use this infrastructure of Invertors and Grid connection at no extra costs

MARKET RESPONSE

Dear Shalom, dear Danny,

Thank you for the proposal. Yes, it is a dream to combine windpower and solar energy!

We talked about this potential innovation with Bernard

From our point of view, it is difficult to have good efficiency of a wind turbine with a very limited altitude.

We think the energy produces would be very limited compare to the additional material that should be installed.

Of course, it should be interesting to have first calculation to understand the capacity of production of this system and the cost of it.

On a 1MWp project, we should have a maximum of 50 floats in periphery of the solar islands available to support a wind turbine.

If the capacity of each windpower is 500Wp, it will be 250kWp of windpower (2,5% of the solar power capacity).

How much should be the wind production for one year at 1 meter of altitude?

I suppose 700 kWh/kWp/year (may be, it is wrong) → 17.5 MWh/year.

In Israel, the solar plant produces around 1500kWh/kWp/year, for 1MWp, it is 1500 MWh/year. So the windpower would increase the production around 1.2%.

In term of additive anchoring to the system, we suppose an increase of the cost by 25% : 20 000 euros for 1MWp. The price of a windturbine of 500W is around 150€/units → 7500 euros.

Cost of installation should be at minimum 20000 euros.

So the costs of the windpower system would be 45 000 euros for the 25 kWp.

We consider the gain of 1,2% too small compare to the investment of R&D, and investment for the system.

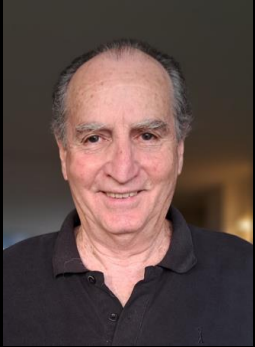
It should be interested if it produces more than 5%.

Best regards.

Alexis Gaveau - Ciel & Terre International

CEO - +336.95.66.31.54

THE TEAM



Danny Raz, B.SC. – Founder and CEO

Mr. Raz is an Architect - Graduated the Technion 1981 in Architecture and Town Planning. Registered architect in the Israel Architects Association. In 1982 established and owner of Raz Architects office. In 1998-2000 served as associated lecturer in the Faculty of Architecture and Town Planning in the Technion of Haifa.



Shalom Green, B.SC. – Business Development

Mr. Green is an Industrial Engineer by profession (Technion , 1973) and a certified 'Johna' at the Goldrat Institute (USA), with vast international business development experience. V.P. at Monster Cable Inc. (1987 – 1997)



Or Shaul, B.SC. – CTO

Mr. Shaul is a Mechanical Engineer by profession (Technion , 2014) with extensive experience in engineering design and consulting of product and systems. Currently serves as a system engineer at the Science Museum of Haifa, Israel



SUMMARY- “Exciting Investment Opportunity”



We seek finance of 500,000 \$ for P.O.C and R&D

THANKS

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