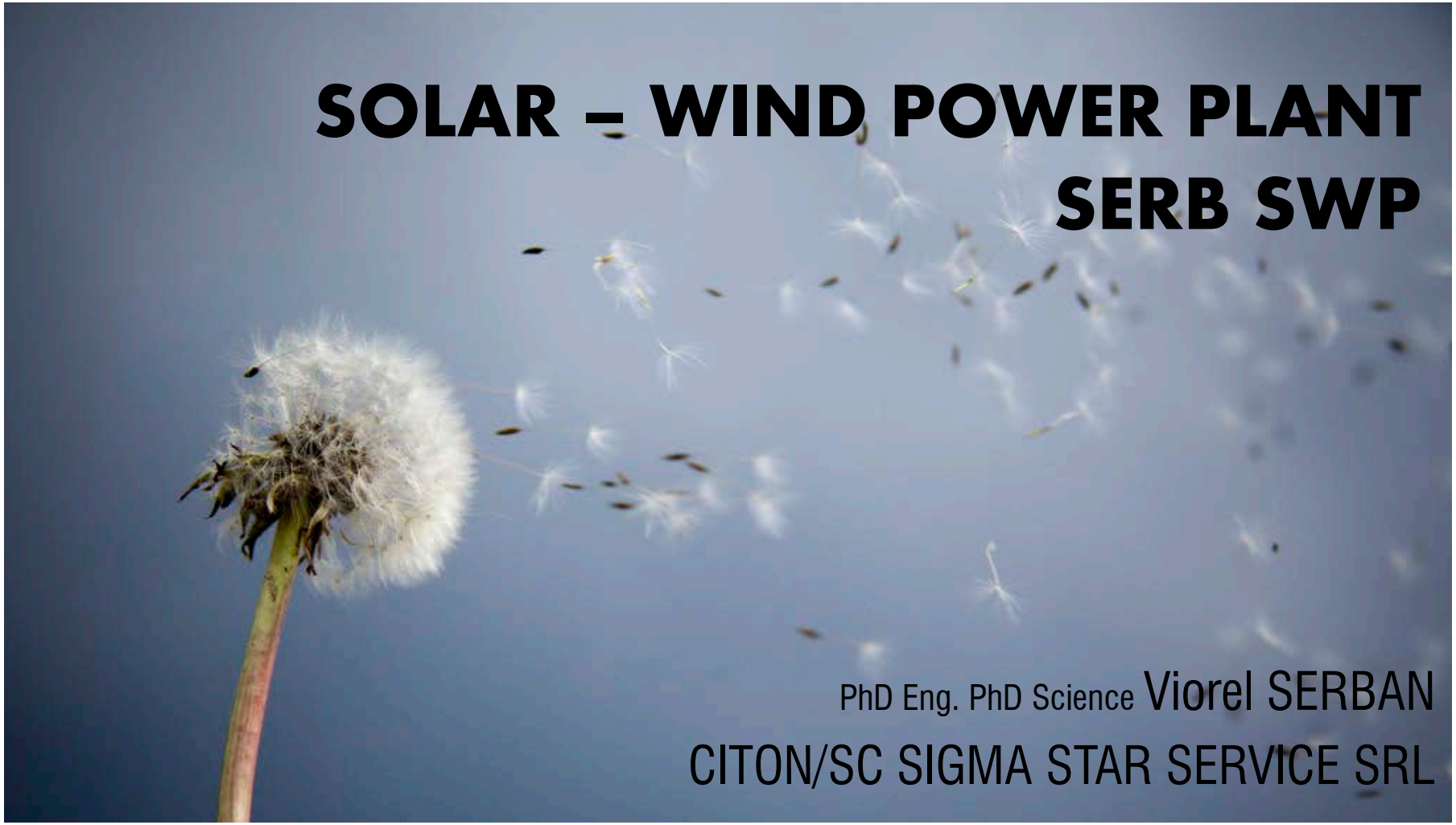

SOLAR – WIND POWER PLANT SERB SWP

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CITON/SC SIGMA STAR SERVICE SRL

INTRODUCTION

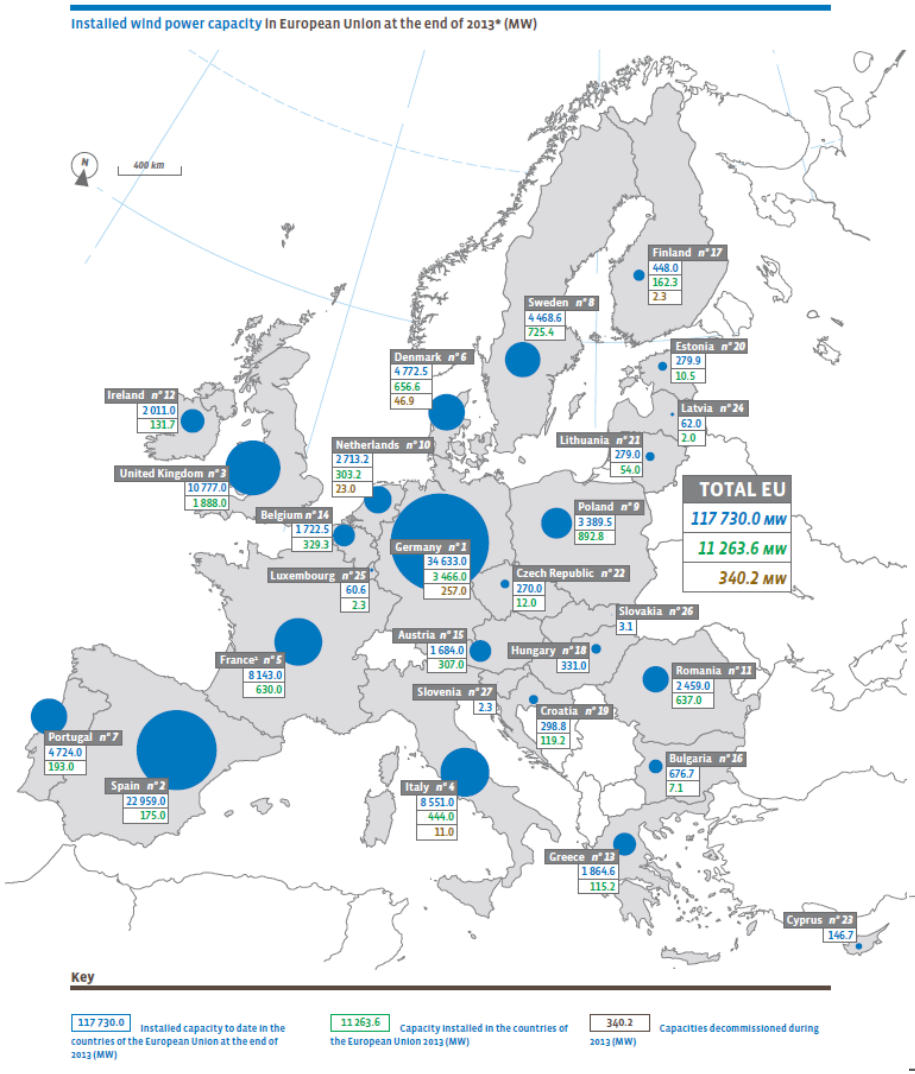
The current exploitation of solar and wind energy has the following disadvantages:

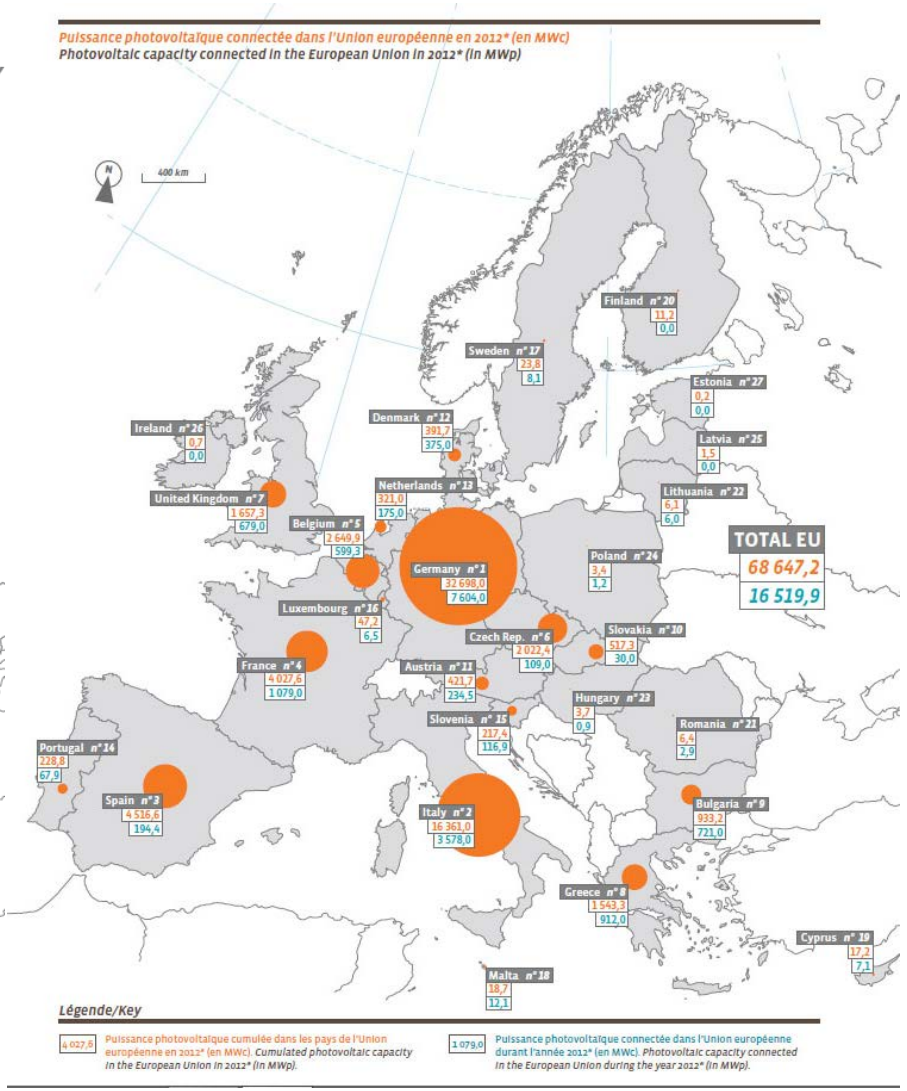
- low efficiency
- difficult to manufacture, transport, install and maintain
- requires areas with high wind and solar energy potential and incurs power losses at transportation
- electricity production is erratic and consequent transitory interruptions to integrated power systems costly
- unable store energy to be used when needed
- needs emergency carbon fuel power plants that produce greenhouse gases and other pollutants
- detrimental impact on the environment and the life of birds, animals and humans.

SERB solar – wind power plant solves all these critical issues:

- high efficiency
- modular design and size scalable, which makes it easy to manufacture, transport, install and maintain
- *can be placed in any location, including urban areas, and can serve isolated communities with electricity, as well as for heating and cooling*
- *can collect different types of energy and hence more reliable and consistent*
- can store energy
- *can be used to adjust the load curve as well as an emergency power plant.*
- *no pollution*

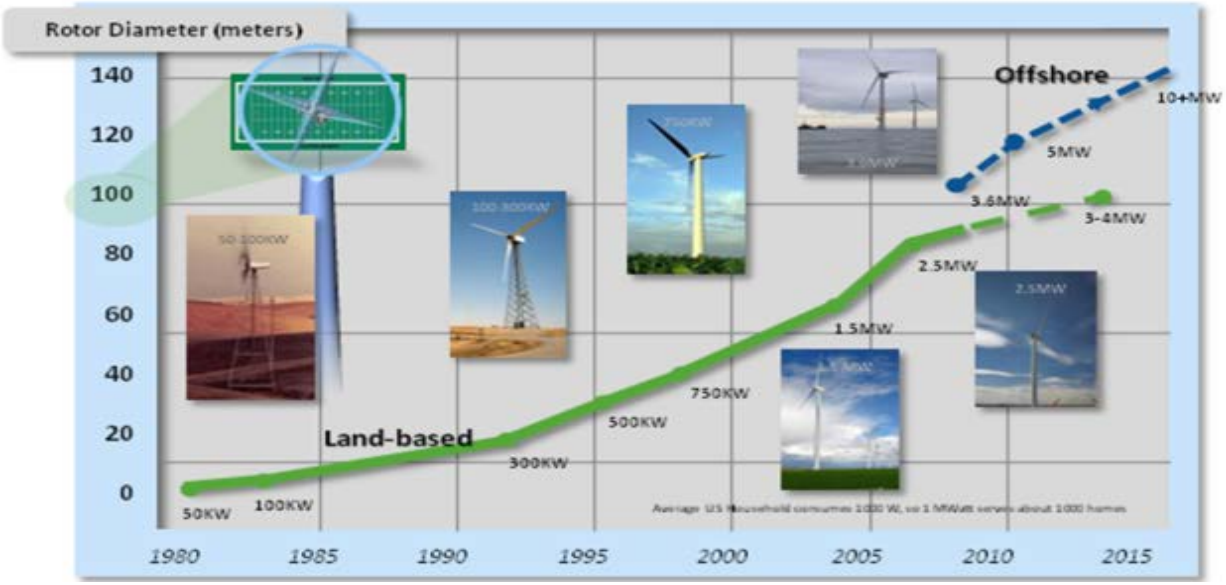
CURRENT SITUATION





CURRENT SITUATION

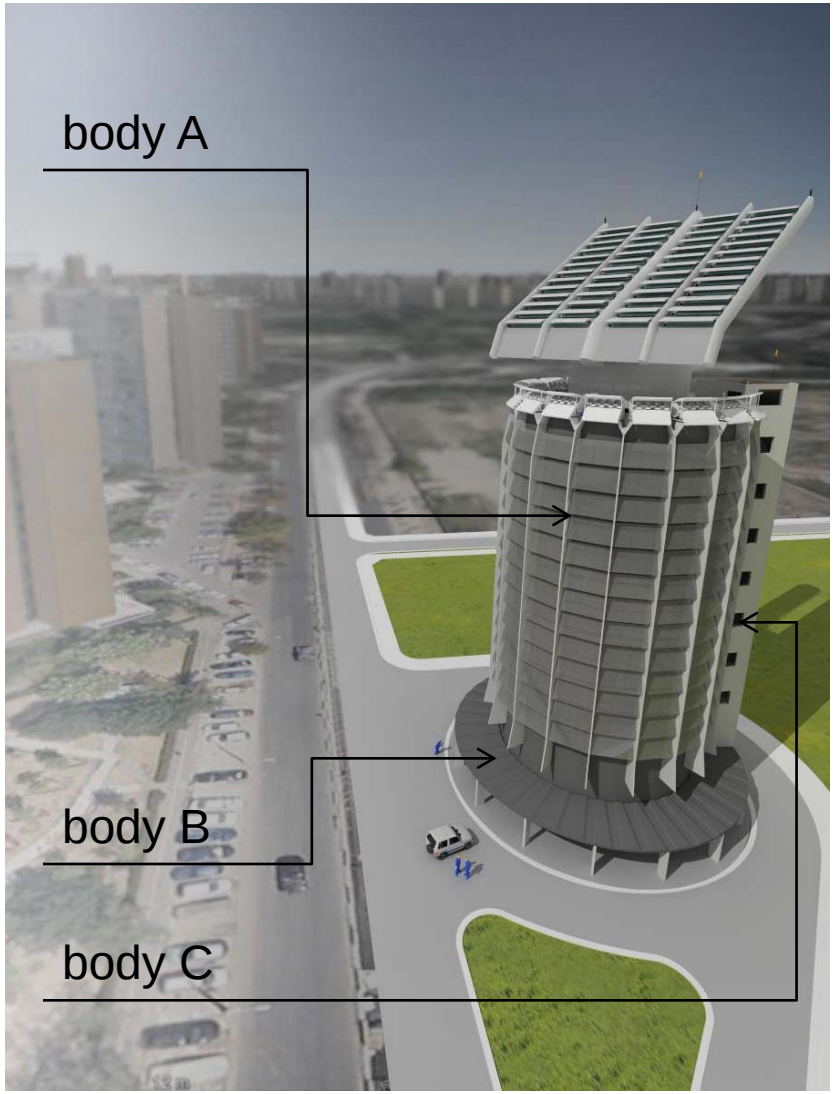
- Despite considerable financial investments in the E.U. (approx. 93 billion EUROs in wind energy and 70 billion EUROs in solar energy up to 2012) the available technology in the market doesn't allow for efficient exploitation.
- Electricity from wind and solar energy is generated with low efficiency and randomly, thus causing instability problems for the power system.
- Current technologies disrupt the operation of classical power plants increasing pollution and costs.
- The arbitrarily production of energy from these green sources (depending on their availability) requires back-up and emergency power plants that run on classic fuel in order to ensure consistent service.
- Wind energy cannot be exploited in urban environments
- Current wind turbines have increasingly large and untenable dimensions



Evolution of wind turbines: unit power and rotor diameter

SOLAR-WIND POWER PLANT – SERB SWP

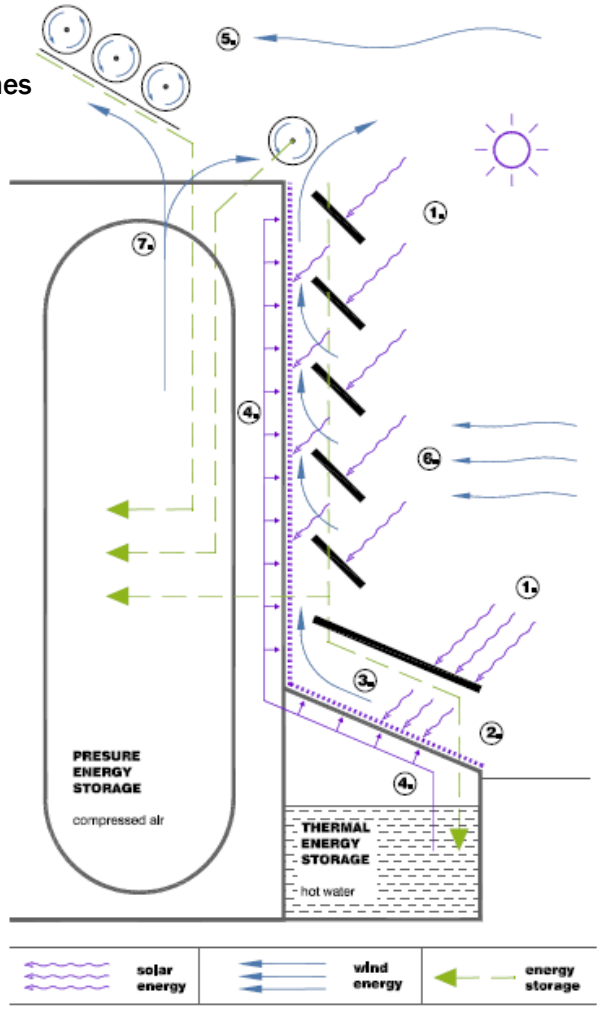
- SERB SWP consists of **three bodies**: main cylindrical body A, secondary circular body B and auxiliary tower C positioned on the north side. These have a common foundation that forms a rigid box for high stability.
- SERB SWP is a reinforced concrete **watertight structure** which contains a compressed air tank and a hot water tank for energy storage.
- This structure supports several devices: **wind turbines and photovoltaic and thermal panels**, air compressor, air turbine, heating and cooling equipment, buffer storage batteries and power plant operation control and command equipment.
- The SERB SWP plant may be built on a small scale **on new and existing buildings** to provide energy requirements.



SERB SWP – PRINCIPLES OF OPERATION

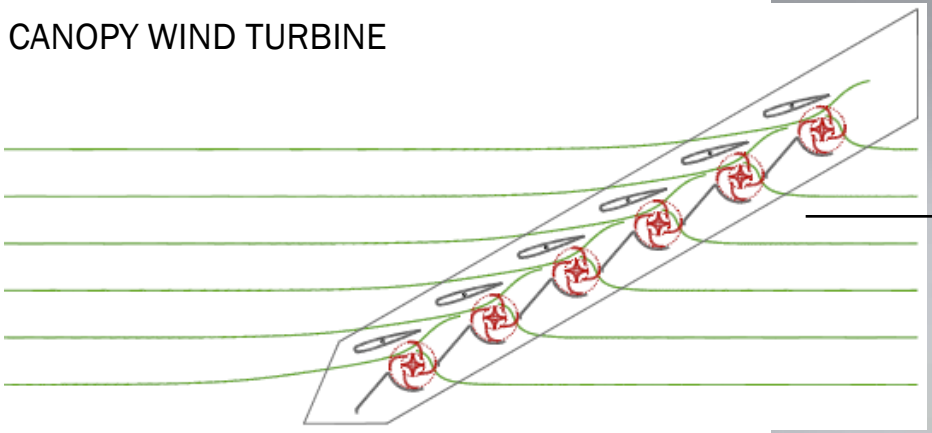
1. photovoltaic panels produce electricity
2. thermal panels at the base of semi-opened channels collect solar heat
3. sun creates chimney effect inside channels which generate electricity through wind turbines
4. hot water heats channels producing chimney effect
5. wind flow acts the canopy and cornice wind turbine to produce electricity
6. wind flow on the facade is redirected to the cornice wind turbine to produce electricity
7. compressed air is discharged on the wind turbines to produce electricity

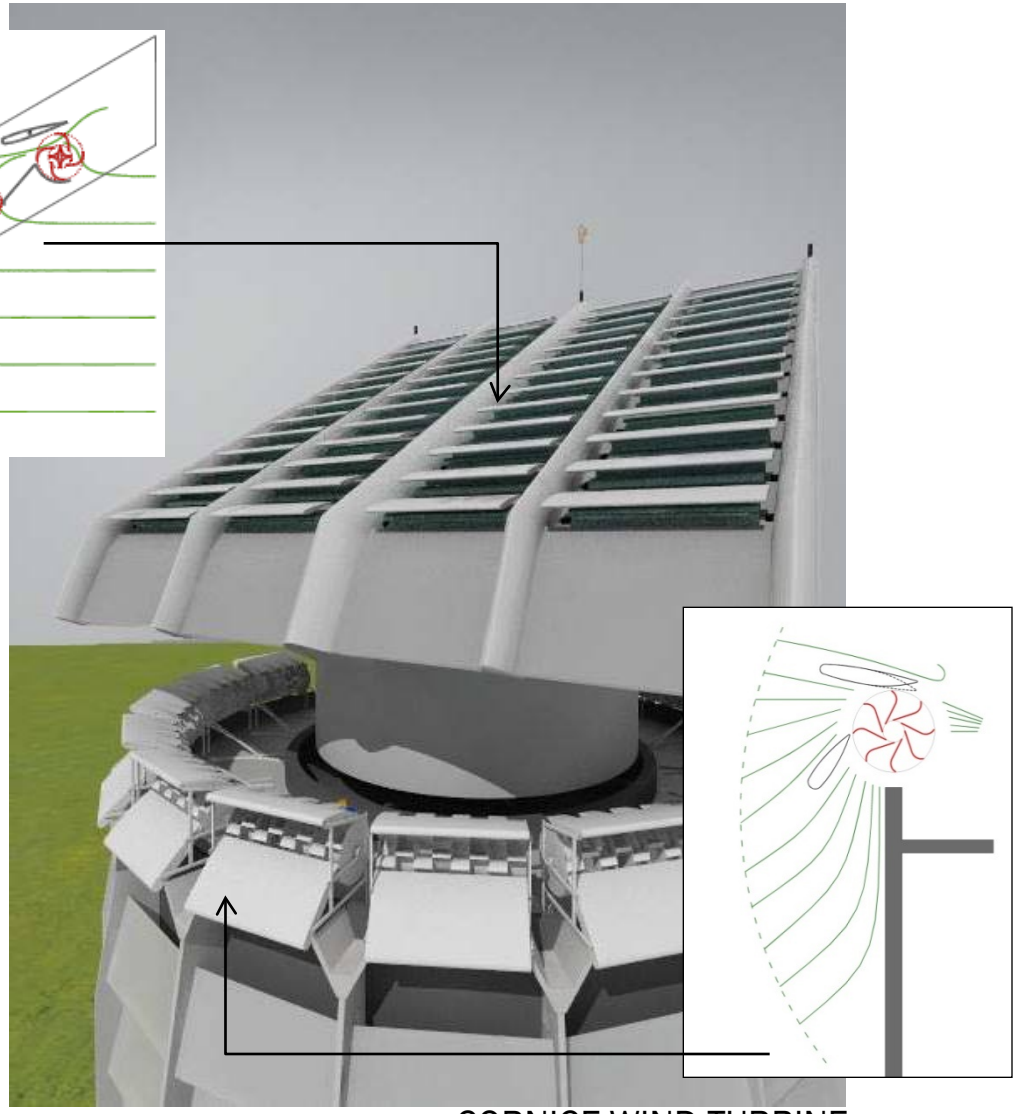
- Inside body A a **compressed air tank** (4 -10 bar) stores pressure energy.
- Inside body B a **heat water tank** stores thermal energy obtained from solar radiation. Water temperature uniformly rises from the bottom to the top (from 10°C to 120°C).
- Vertical channels are placed outside on the main body A and tilted ones on body B. They are partially closed by photovoltaic panels transparent to solar thermal radiation. At the bottom and inside of the channels thermal panels are installed.
- In these channels the greenhouse effect and the chimney effect generate strong vertical winds which move the turbines on top.
- Photovoltaic panels on the channels are tilted thus allowing horizontal wind to be redirected to the top.
- For electric power of up to 2kW, the energy is stored within a buffer tank of batteries up to a capacity of 200kWh; beyond this amount the energy is transferred the main tank in the form of pressure or thermal energy.
- Some of the upper body B compartments can be used to produce biogas.



WIND ENERGY COLLECTION

CANOPY WIND TURBINE





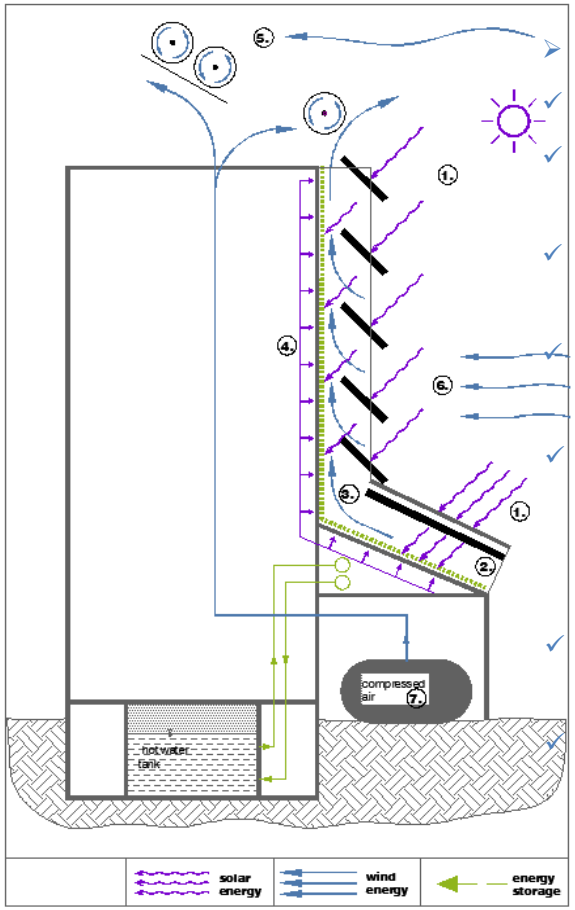
Wind energy is collected by SERB New Wind Turbines (NWT)

- **cornice wind turbines** - on the circular parapet
- **canopy wind turbine** - in the central area

- NWT practically eliminate all the disadvantages of current wind turbines: large dimension parts, birds butchery, noise and vibration generation, projectile generation, etc.

CORNICE WIND TURBINE

SWP ON EXISTING BUILDINGS



SWP can be installed on an existing building with the following advantages:

Small investment

Depending on solar and wind potential and buildings architecture the installation can be realized in many positions on the same building.

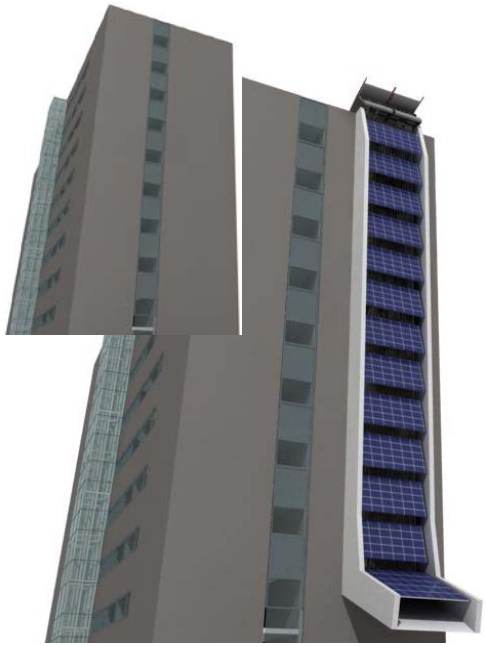
Ensures up to 80% of electricity, heat and cooling necessity, depending on the solar and wind potential in the area.

Stores energy in one or two tanks (compressed air and hot water) and buffer batteries.

Natural horizontal wind current are redirected to the cornice wind turbine by photovoltaic panels. On the upper part of the building can be installed canopy wind turbines.

Small intensity wind is amplified by chimney effect.

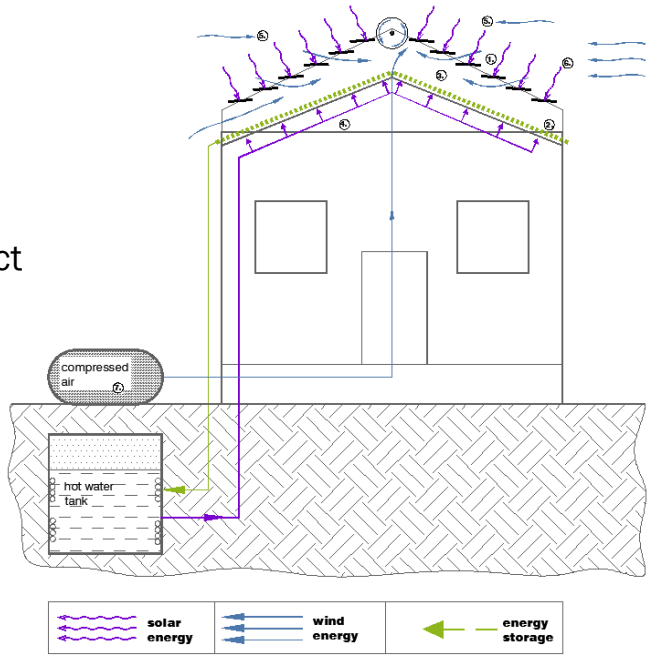
Solar thermal energy is collected by thermal panel installed in the bottom channels. With these panels is created the artificial chimney effect.



- ✓ The installation can be realized for the families living in a building, but is recommended to be realized for more buildings in order to increase efficiency using the same storage tanks.

SWP ON EXISTING HOUSE

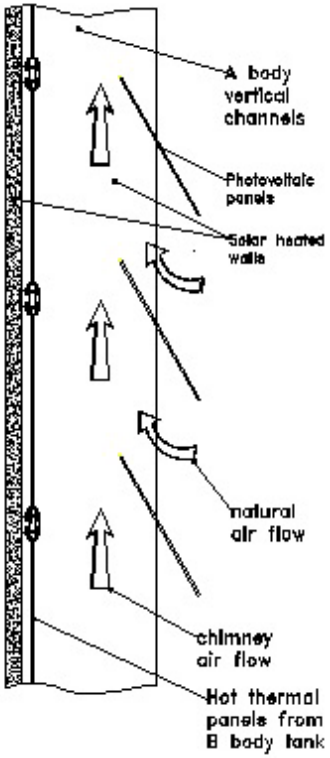
- SWP can be installed on an existing house with the following advantages:
- ✓ Small investment
- ✓ Ensures up to 80% of electricity, heat and cooling necessity, depending on the solar and wind potential in the area.
- ✓ Stores energy in one or two tanks (compressed air and hot water) and buffer batteries.
- ✓ The ridgee wind turbine can collect wind energy with good efficiency from every direction, without ± 5° along the ridge.
- ✓ Natural horizontal wind current are redirected to the ridge wind turbine by photovoltaic panels.
- ✓ Small intensity wind is amplified by chimney effect



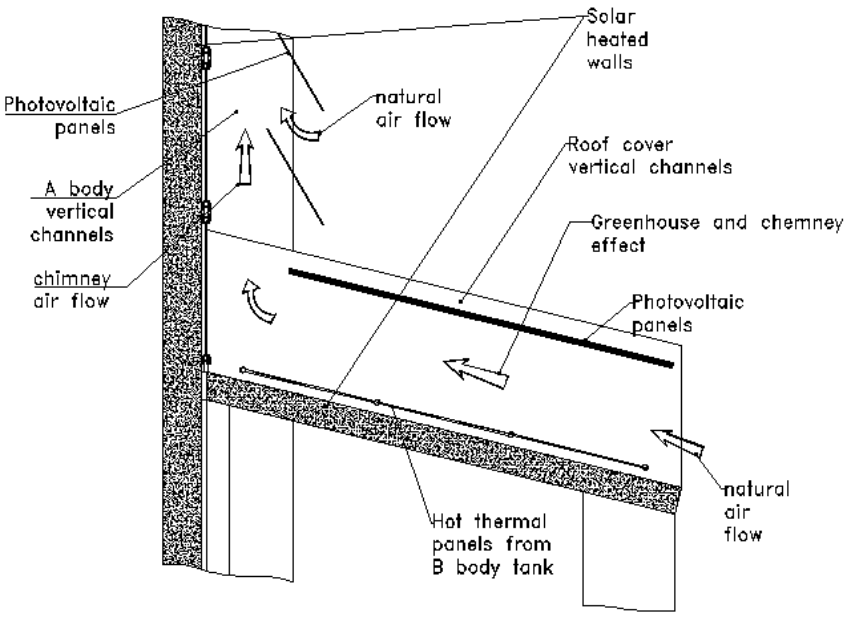
- ✓ Solar thermal energy is collected by thermal panel installed in the bottom channels. With these panels is created the artificial chimney effect.
- ✓ The installation can be realized for a family, but is recommended to be realized for more families in order to increase efficiency.

SOLAR ENERGY COLLECTION

- **Solar energy** is collected directly by:
  - photovoltaic panels
  - thermal panels
  - black walls channels (with an efficiency of 85 – 95%)



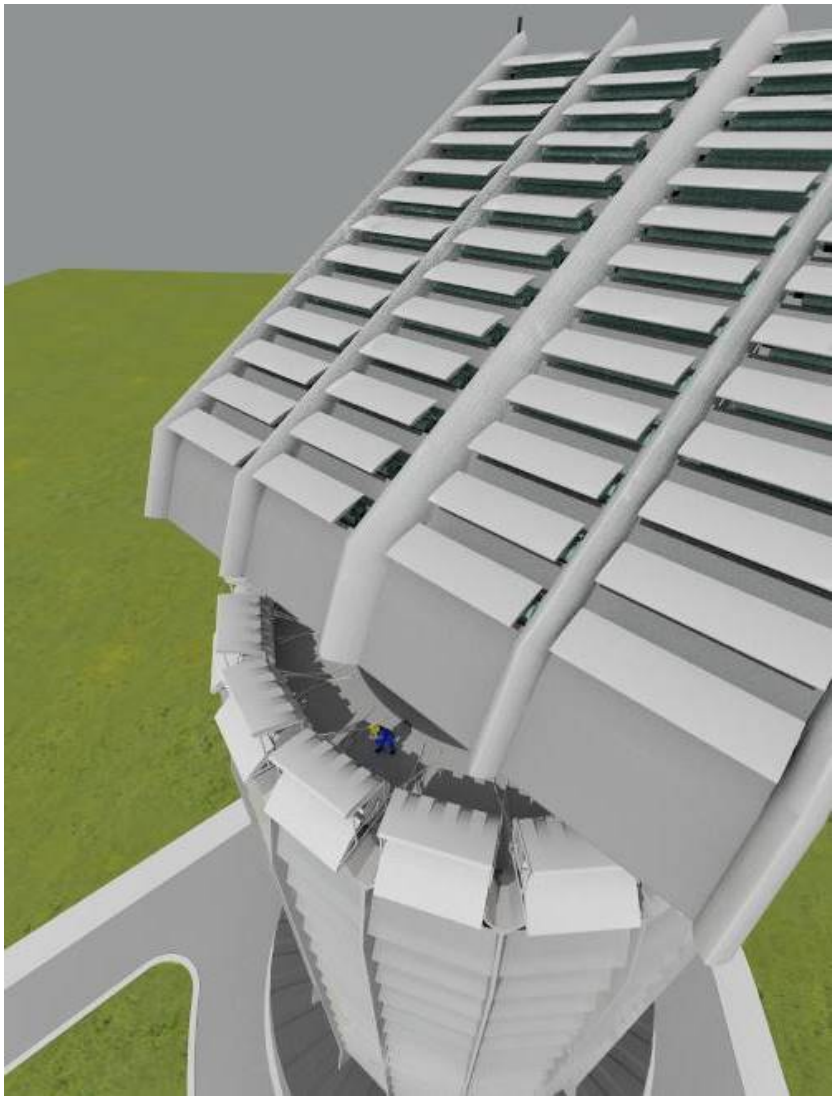
The collected thermal energy is stored in concrete walls channels and thermal storage tanks



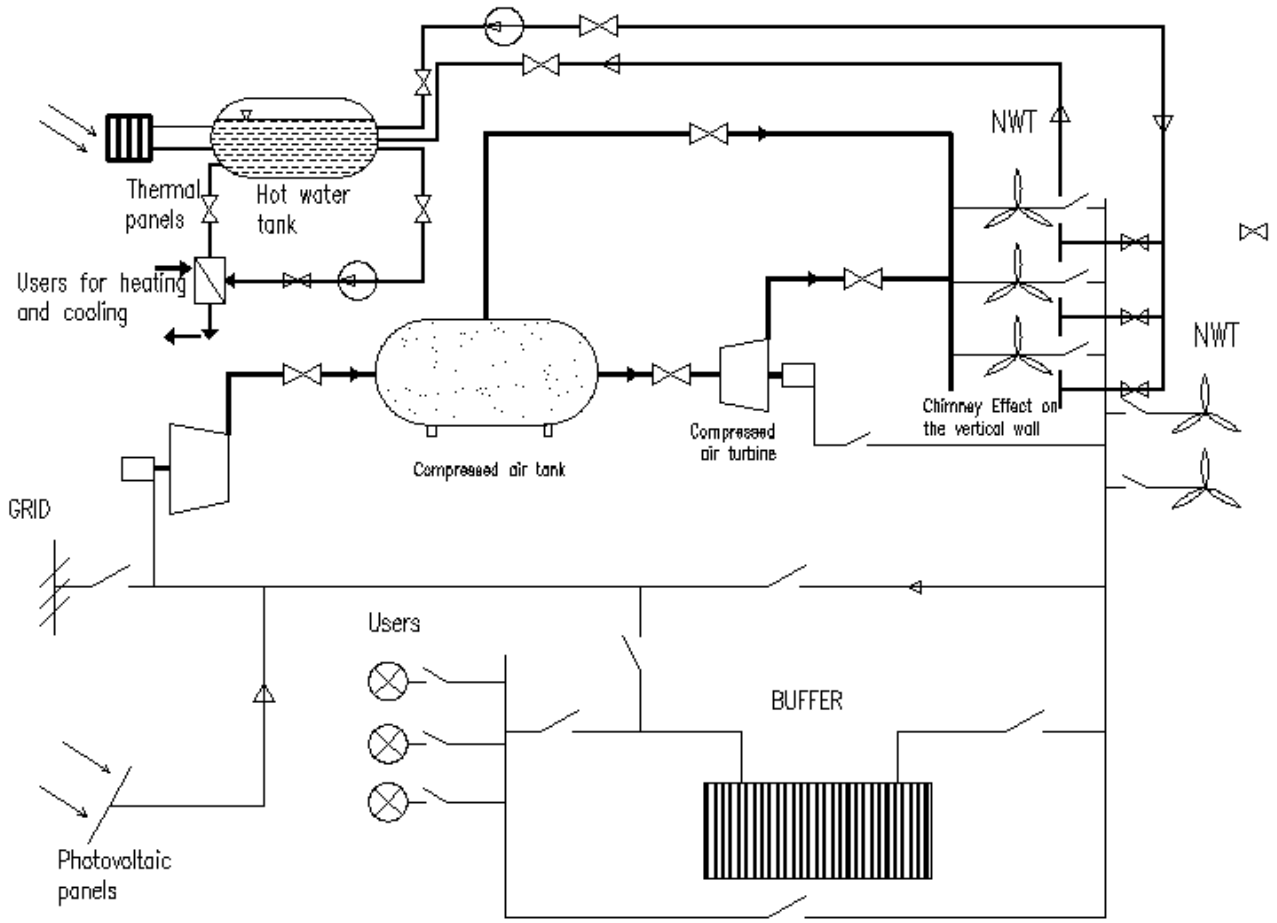
- Thermal energy can be used directly for heat or can be transformed into electricity by air currents generated by the **chimney effect.** The artificial air currents move the cornice wind turbines.
- Global efficiency of this technology is about 2 to 3 times higher than that of solar energy conversion into electricity by means of the standard existing photovoltaic panels.

ELECTRICITY PRODUCED FROM STORED ENERGY

- **From pressure energy electricity is produced by** discharging the compressed air into the air turbines (up to 0.2 – 0.5 bar) and then into the cornice and/or canopy wind turbines. This release can be done in the presence of natural or forced air currents for increased efficiency.
- **From thermal energy electricity is produced by** chimney currents.
- Chimney currents can be generated naturally or forced:
  - natural currents are generated due to heating of semi-open canals by solar radiation.
  - forced currents are generated by heating thermal panels from inside the channels with hot water.
- Thermal energy can be sent directly to consumers.



SERB SWP - FLOW DIAGRAM



Technical Diagram of SERB SWP

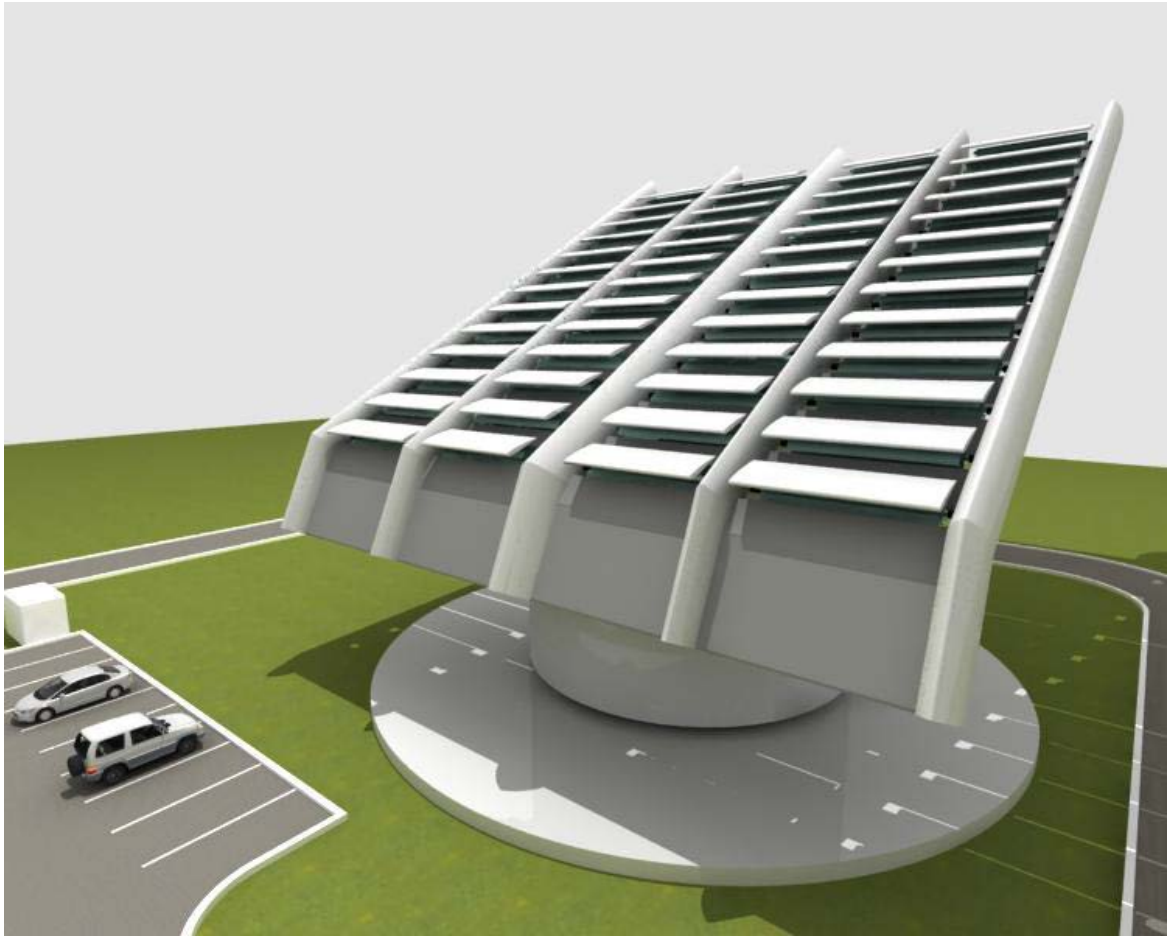
CANOPY WIND TURBINES

Canopy wind turbines consist of several horizontal rotors assembled on a tilted support structure with upper and lower deflectors for air currents guidance.

The inferior deflectors are fixed; the superior ones are mobile and can be rotated to increase or decrease the airflow action on the rotor.

Canopy wind turbines are mounted on a light structure that self-orients depending on the wind direction.

Canopy wind turbines can store energy in tanks of compressed air placed at its base.



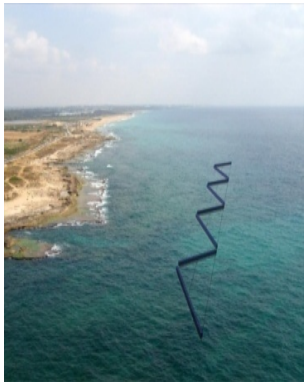
ADDITIONAL POWER PLANTS

HYDRO-SOLAR-WIND POWER PLANT

- Depending on the renewable energy potential in an area SERB SWP can be connected with hydro-solar-wind power plant or wave-solar-wind power plant

These can also operate independently because they have inner tanks for storage energy and can collect 3-4 type of renewable energy.

- Photovoltaic panels and special SERB NWT are installed on the plant to collect the solar and wind energy.

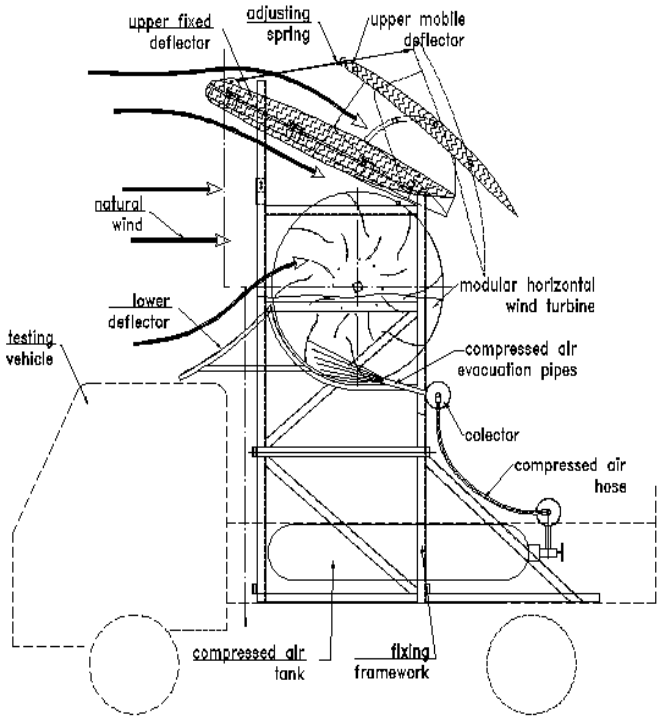


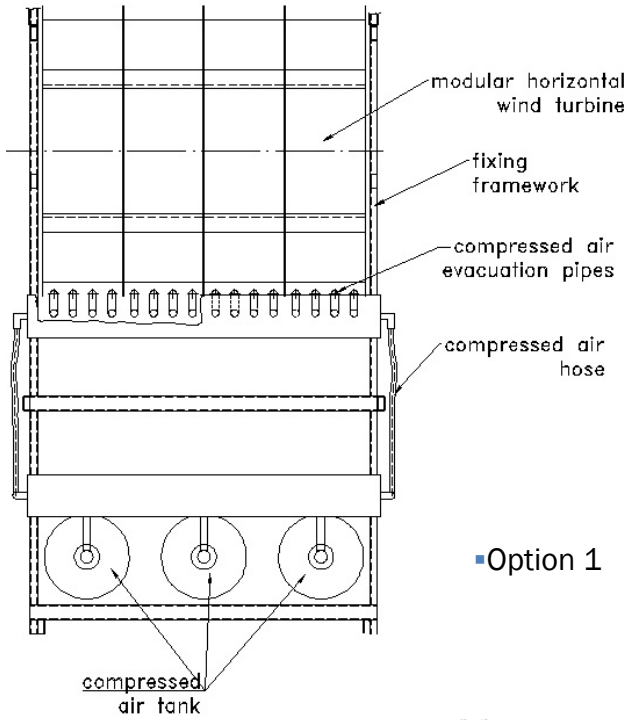
WAVE-SOLAR-WIND POWER PLANT

- In areas where marine currents exist, special turbines with horizontal axis can be installed in the inferior part to collect this energy

- In addition, these floating plants protect banks against erosion.

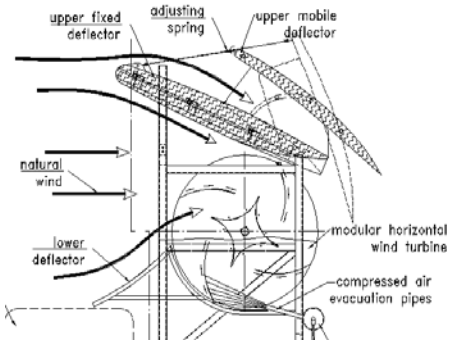
TESTING THE WIND TURBINE MODULE





▪Option 1

- An important element for the SERB SWP is the new wind turbine module.
- Currently manufactured and tested for experimental determination of performance.
- First simple test will be executed by installing the wind turbine prototype on a vehicle that moves at different speeds.



▪Option 2

SERB SWP ESIMATED CAPACITY

- Power capacity from stored energy

H	Ø	Thermal	Electric	Source	Operating Time for power 0,5 MW to 2 MW
[m]	[m]	[MWh]	[MWh]		[h]
40	22	0	4 – 10	Pressure	2 - 20
40	22	350 – 450	120 – 160	Thermal	60 - 320
60	40	0	24 – 58	Pressure	12 - 116
60	40	1000 -1400	340 – 510	Thermal	170 - 1020

- Depending on the solar and wind energy potential available in the area, the SERB SWP plant can run at increased operating times
- SERB SWP can be efficiently used to **adjust the load curve** by consuming electricity in the night and day gaps and delivering it in the evening and morning peaks of the load curve. This can be achieved because starting and stopping the production of electricity is practically instantaneous.
- SERB SWP can meet all the requirements of electricity and heat of a community (up to 2000 families) with or without connection to the National Power System (NPS). Due to its capacity to store and produce on demand electricity the power plant does not disrupt the NPS and helps its functioning.

SPECIFIC INVESTMENT

- Currently the typical investment for wind renewable energy ranges from 1000 to 2000 EUROs/kW.
- **The specific investment for the SERB SWP is 20% - 30% smaller than the required investment in current wind turbines .**

- Existing technologies for long term energy storage are inconvenient and expensive:
  - pumped storage power plants: installation minimum cost of 450EUROs/kW and maintenance cost of 3.2EUROs/kW/year
  - compressed air storage plants: installation minimum cost of 310EUROs/kW and maintenance cost of 1 EURO/kW/year

- **The compressed air storage plant technology SERB SWP is considerably more convenient financially as a single structure is used for collecting as well as storing the energy bringing the storage cost to less than 150EUROs/kW.**

WHAT ARE WE LOOKING FOR

- ✓ Partners (investors or companies) that will be co-owners with us in the new technology.
- ✓ Partners for the electrical part (for prototype the electrical power should be P=3kw for 160 RPM).
- ✓ Partners for air compressor and air turbine.
- ✓ Partners for the composite materials part.
- ✓ Partners for mathematical modeling.
- ✓ Partners for marketing, installing and running of the new units.

CONCLUSIONS

- *The paper presents a new technology for efficient exploitation of renewable energy using the SERB SWP power plant.*
- *SERB SWP has the following advantages:*

✓ efficiently **collects the wind energy**, including in urban areas

✓ efficiently **collects the solar energy**

✓ **stores renewable energy** as pressure and thermal energy

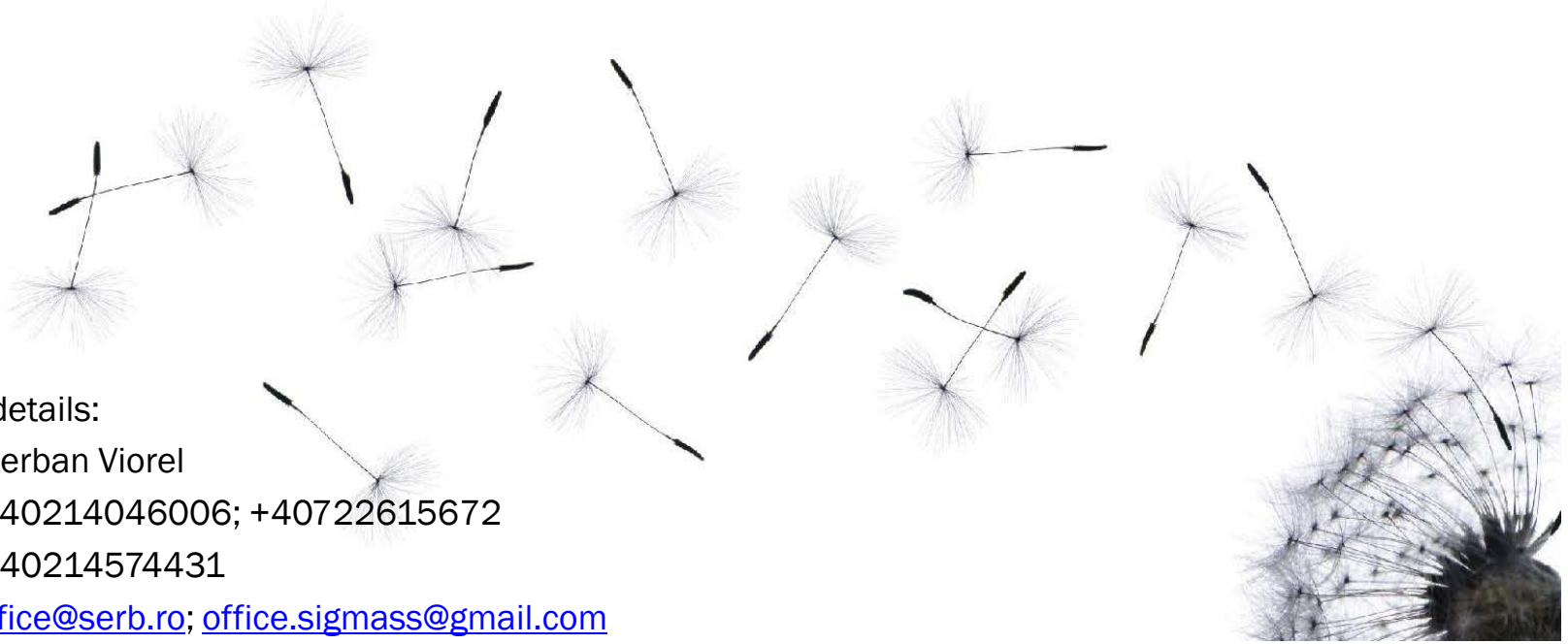
✓ can **provide electricity** and heat when needed and at emergency request

✓ can adjust the load curve and can operate as **back-up power plant**

✓ installed capacity of one SERB SWP is between **1MW** up to **3MW** on average

- *SERB SWP power plant provides an optimal and immediate technical solution to the critical problems related to the exploitation of renewable energy*

THANK YOU FOR YOUR INTEREST!



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