

FLOATING SOLAR AND LOW-COST ENERGY STORAGE FOR DEVELOPING COUNTRIES

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„WHITE KNIGHT?





ASEF2015 ASIAN DEVELOPMENT BANK

SOLAR – ENEMY OF FARMERS? FOOD VS. ENERGY – PART 2

BloombergBusiness



News

Markets

Insights

Video

Solar Parks on Fertile Land Are New Adversary of India's Farmers

- ▶ March – Sri Lanka announces plans for a 100 MW plant on a dam to be followed by multiple similar projects
- ▶ May – China start-up of the (then) largest floating solar plant with 40 MW
- ▶ November – Masdar announces development of a 200 MW plant in Indonesia with a potential pipeline of installations on 60 dams

- ▶ December – China starts first segment of a 150 MW plant
- ▶ December – The Indian government invites through SECI Expressions of Interest for 10 GW projects of floating solar
- ▶ April 2018 – The Maharashtra State Electricity Distribution Company invites EoI for 1000 MW floating solar on the Ujjani Dam.
- ▶ Etc.

FIRST SOLUTIONS

Land-based solar

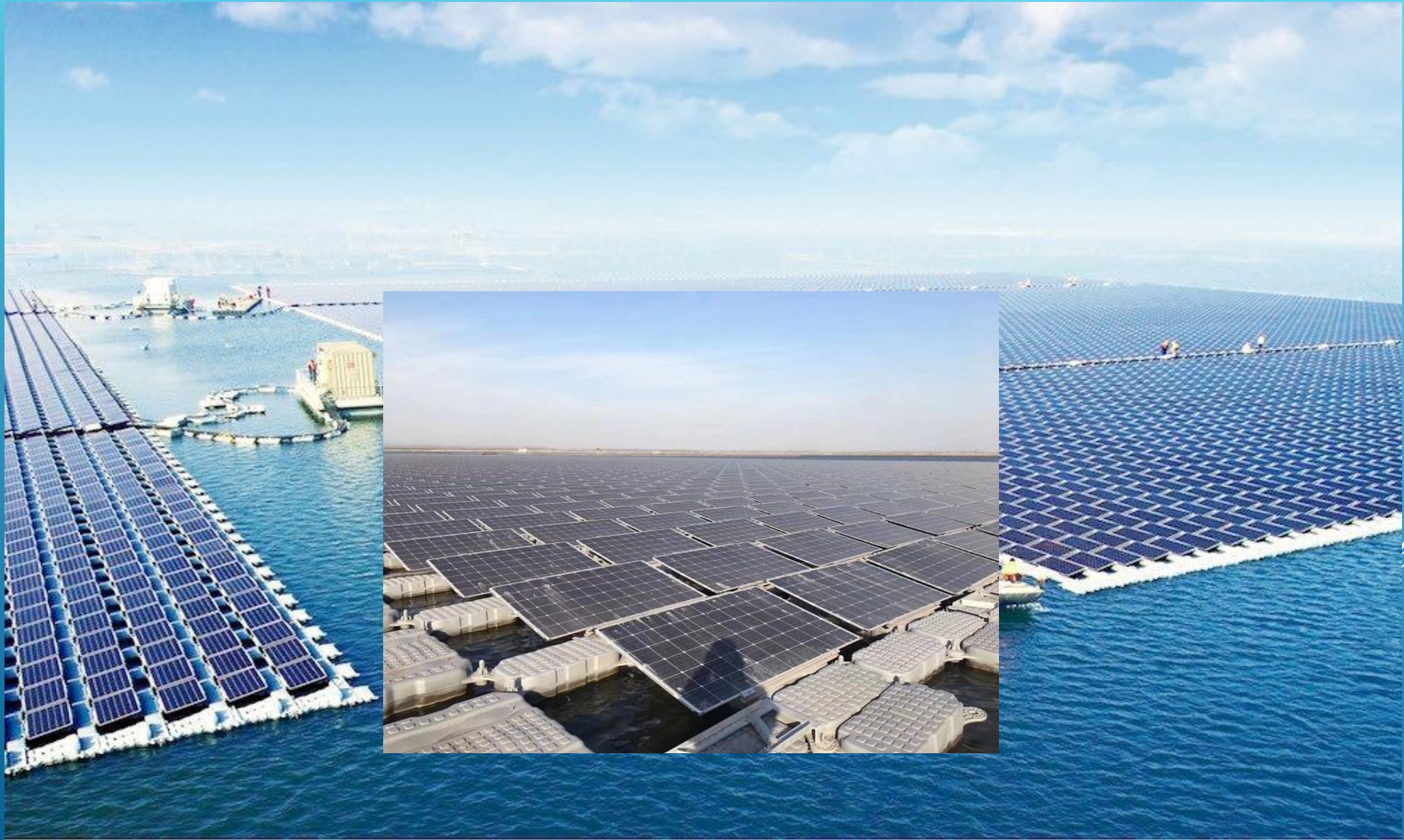


...combined with a float



CREATED THE FIRST GENERATION





YES, YOU CAN PULL A SUPER TANKER WITH 25,000
RUBBER BOATS AND 5HP OUTBOARD MOTORS –
BUT IS IT EFFICIENT??





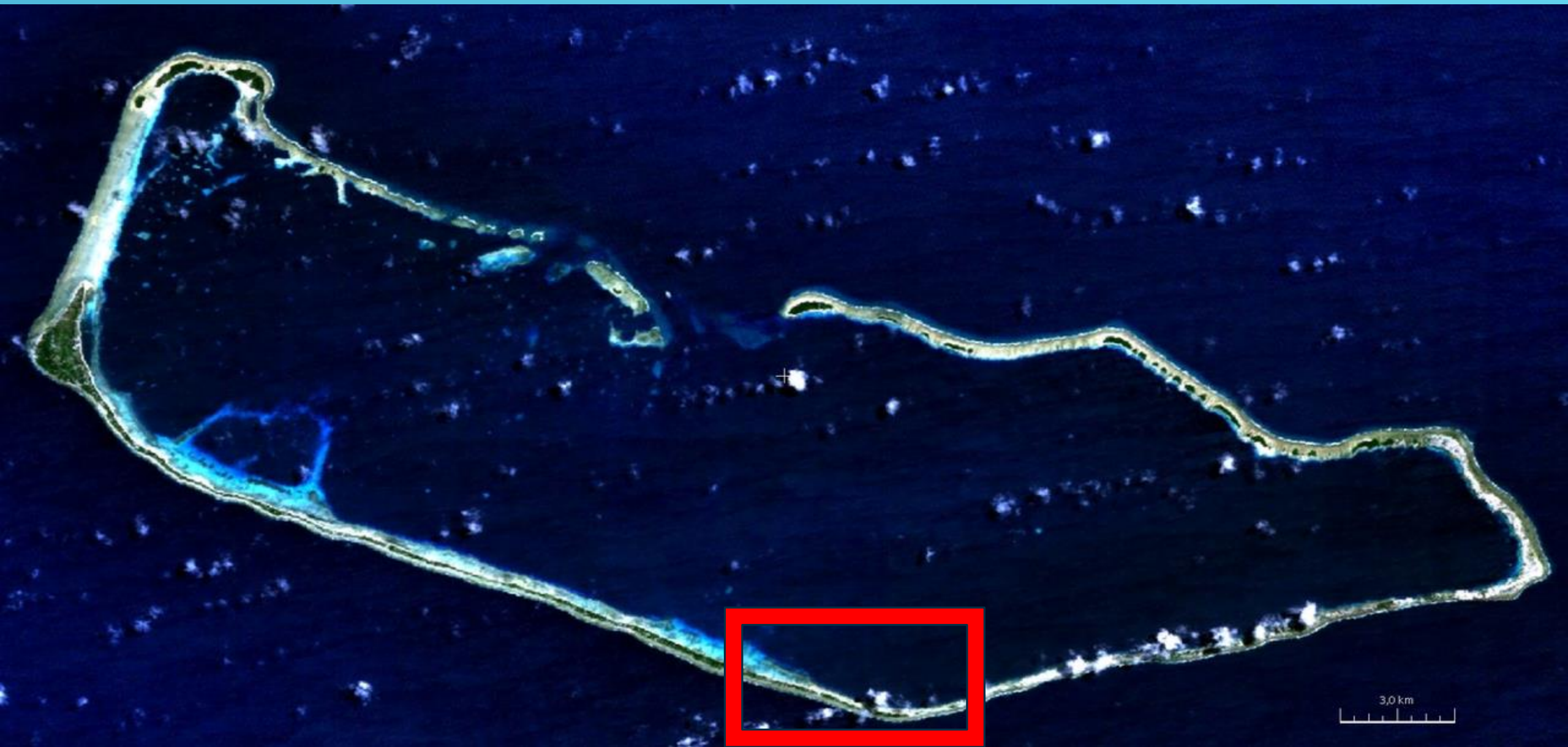


NEXT GENERATION®

NEXT GENERATION® – PARAMETERS TO FULFILL

- ▶ Costs reduction by utilizing off-the-shelf products
- ▶ Potential for on-site production of floaters to save transportation costs
- ▶ Facilitation and acceleration of module installation process
- ▶ Large-scale modules that can be installed without cranes
- ▶ Robotic cleaning, especially of bird droppings

MARINE ENVIRONMENT (MAJURO, MARSHALL ISL.)





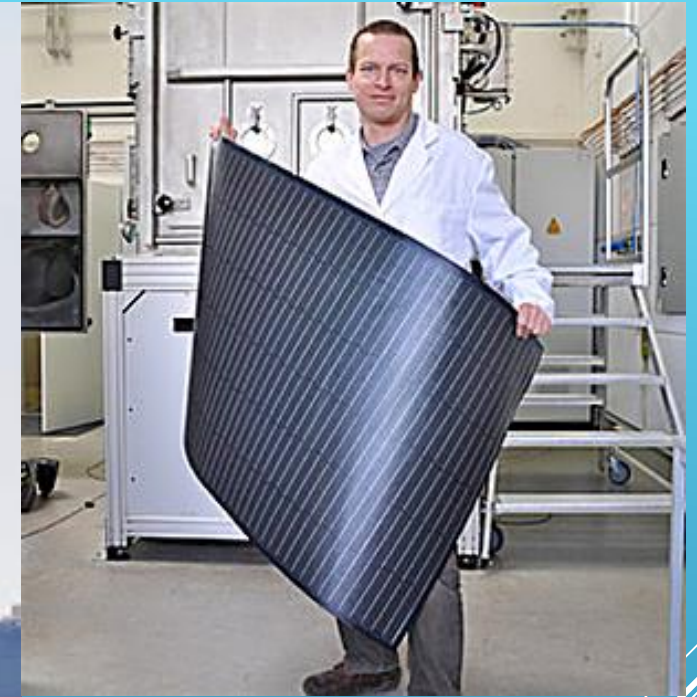
1000 フィート
500 m

MAIN PROBLEM: CORROSION

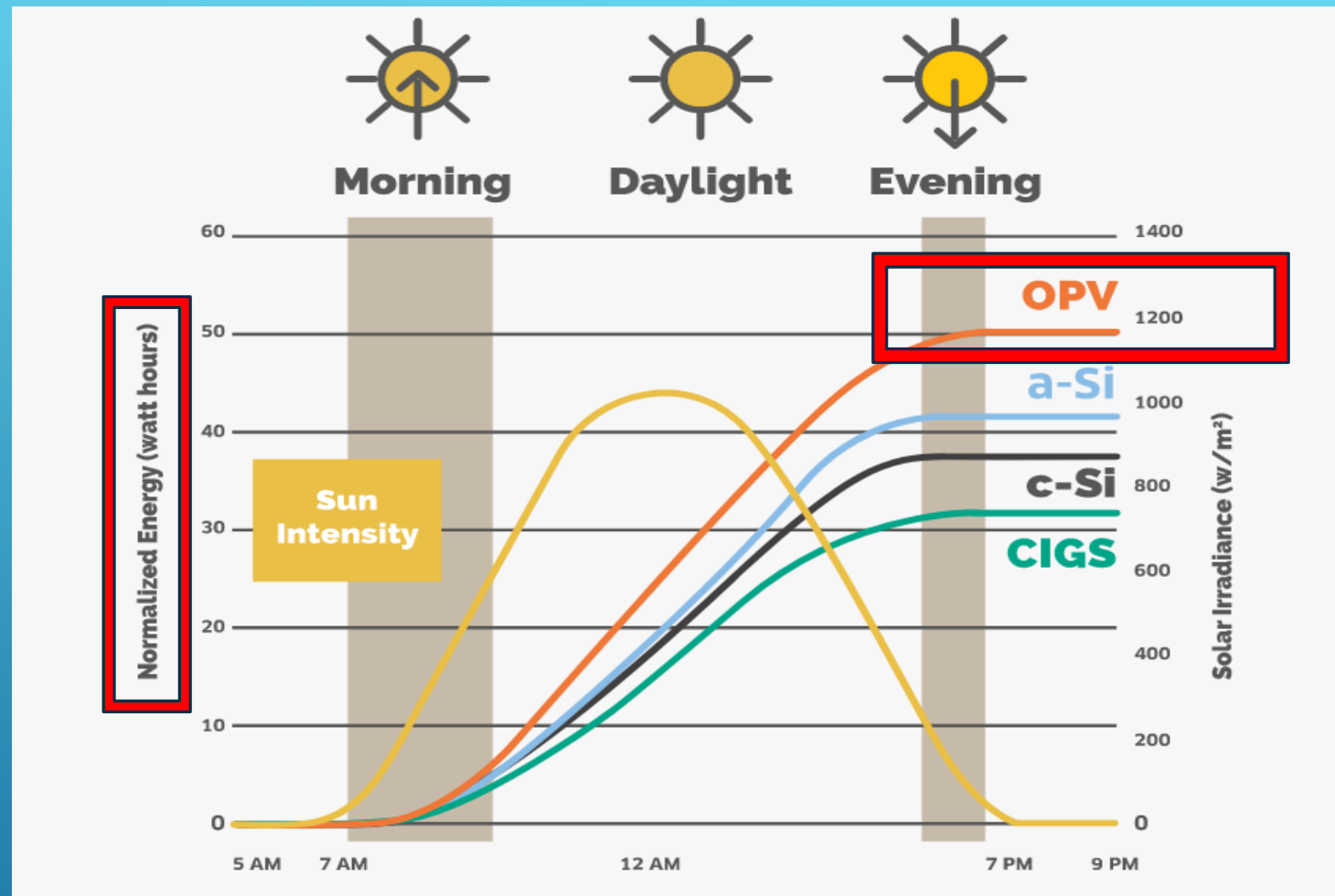








FLEXIBLE SOLAR RECEIVERS ON CLOTH




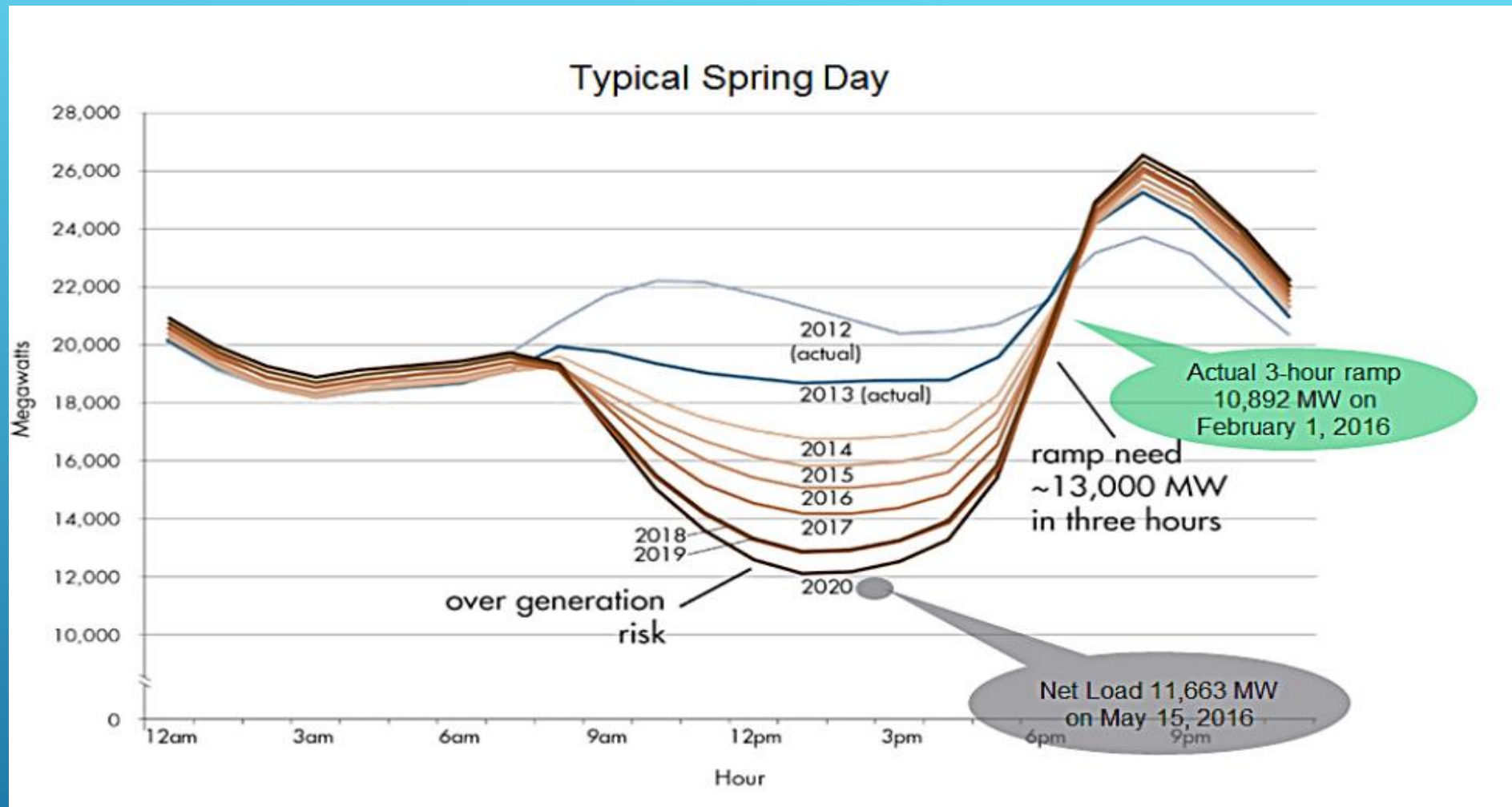
SURPRISING OPV

NEXT GENERATION – SOLAR RECEIVERS ADAPTED TO ON-WATER INSTALLATION (IMAGE)



THE FUTURE REQUIRES STORAGE!

- ▶ Worldwide over 5% of the solar and wind energy is curtailed
 - ▶ Solar cannot offer 24/7 energy supply
 - ▶ Fluctuations can lead to grid instability
 - ▶ Solar could become `second grade` power
- 
- A series of white diagonal lines of varying lengths and thicknesses, located in the bottom right corner of the slide, creating a modern, abstract graphic element.




THE `DUCK CURVE`

The 'duck curve' is solar energy's greatest challenge



LOW-COST ENERGY STORAGE

- ▶ We are offering non-battery storage as an option
 - ▶ 30+ years life time without deterioration
 - ▶ Costs substantially lower than Li-Ion-batteries
- 
- A series of white lines of varying lengths and orientations are positioned on the right side of the slide, extending from the middle to the bottom right corner.

WE ARE MISSING THE REAL POWER TOOLS

California Energy Storage Showcase
CAPTURING THE WIND

10,400 control computers preventing overheating

8 MW x 4 hours storage time = 32 MWh

**More than 600,000 battery cells used to store energy and
integrate renewable into the power grid.**

HOW DOES IT WORK?

Energy storage with induction heating in a proprietary alloy at 1750°C – 30MWh in a 20ft container format.



Comparison with other Technologies

Smallest volume per MW of stored thermal energy

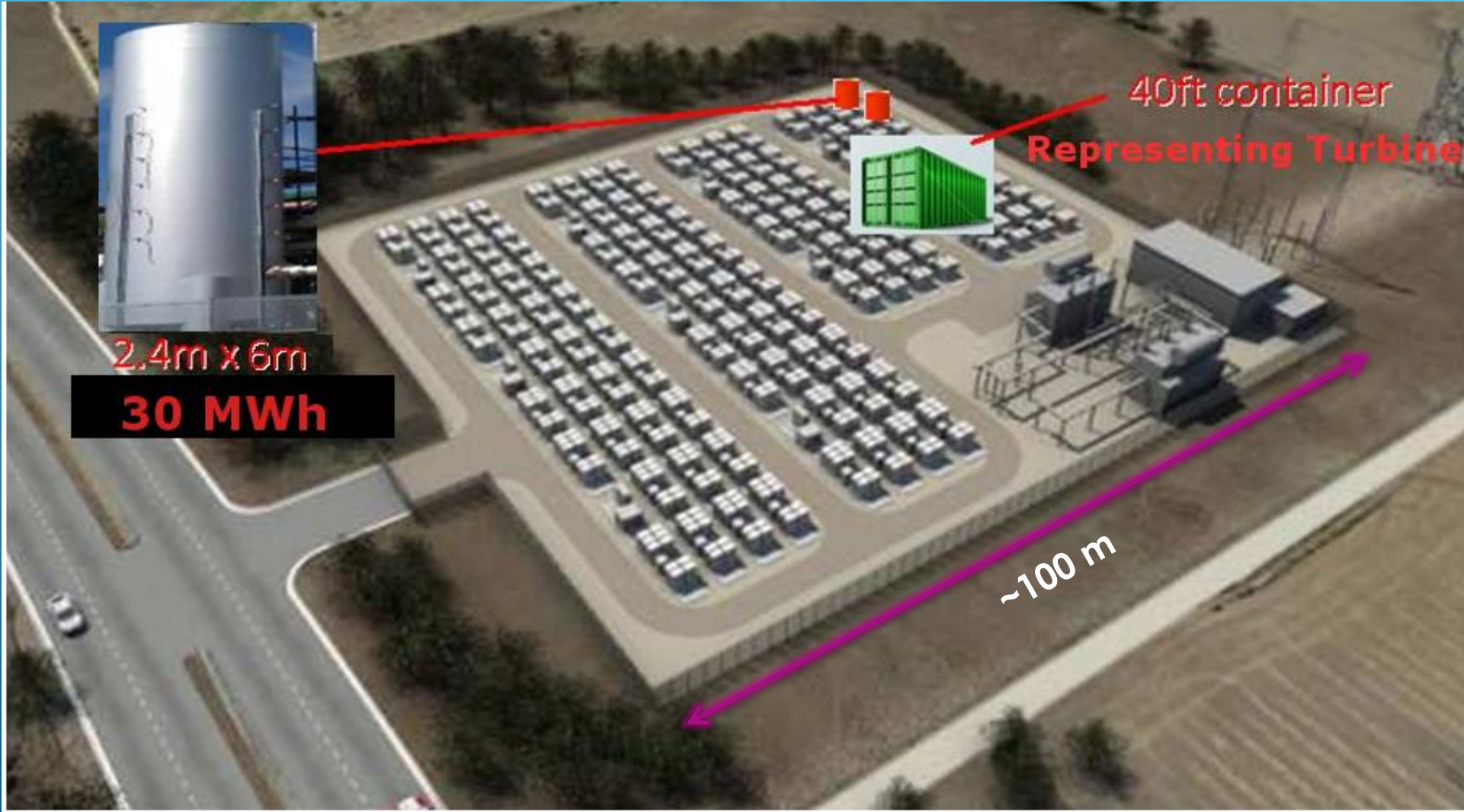


Eight 6m x 2.4m
molten salt storage
units equal 30 MWh
thermal



Single 6m x
2.4m storage
unit normal
charge stores
29.92MWh
thermal

60 MWh Thermal Battery vs. 54 MWh Lithium-Ion Battery



Thermal Battery

Totally Transportable



Un-charged or fully charged with 29.9 MWh of thermal energy the Thermal Battery can be transported by road, rail or sea safely.



.... BY TRUCK (FOR MINI GRIDS)

Round-trip Efficiency of Lithium-Ion Batteries?

98% - only 2% loss??

80%?

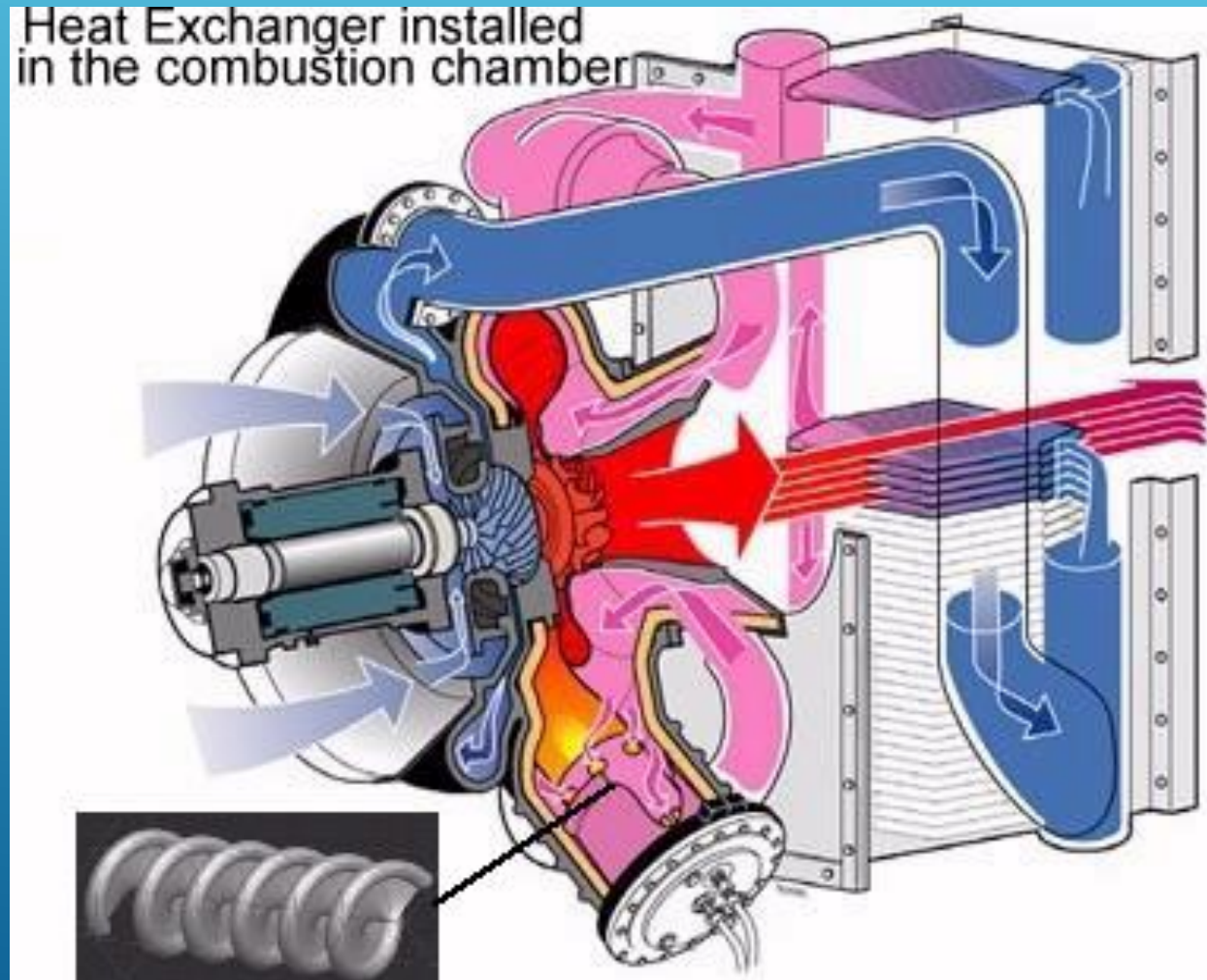
70%?



System Parameter	EES 1 (Rise Carr)	EES 2 (High Northgate)	EES 3 (Harrowgate Hill)
Capacity	5292 kWh (measured)	200.3 kWh (measured)	105.9 kWh (measured)
Round Trip Efficiency (excluding parasitic losses)	83.2% 16.8%	86.4 % 13.6%	83.6 % 16.4%
Average Parasitic Load	29.5 kW	2.50 kW	1.77 kW
Round Trip Efficiency including parasitic losses, assuming one charge/discharge cycle per day	69.0%	56.3%	41.2%
Response Time	< 1 minute	< 1 minute	< 1 minute

Energy Retrieval

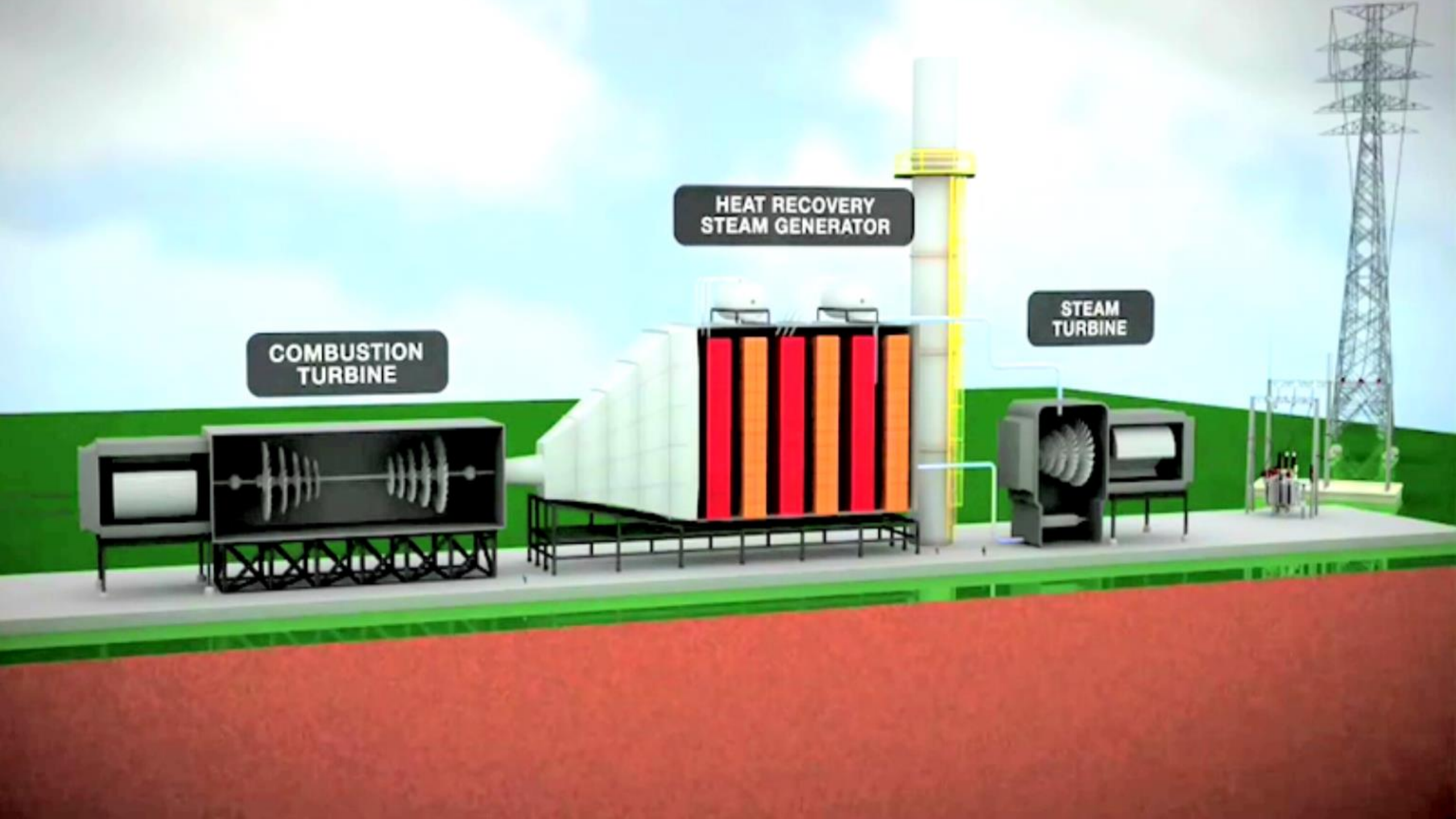
Via a Brayton cycle (Gas) Turbine without fuel – just by inducing 950°C heat into the compressed air of the turbine (Patented)



**COMBUSTION
TURBINE**

**HEAT RECOVERY
STEAM GENERATOR**

**STEAM
TURBINE**



Combined Cycle (gas and steam turbine in tandem)

- Electrical efficiency 60%. 40% thermal energy can be efficiently used for heating and cooling purposes with absorption chillers, e.g. HVAC or cold storage.

Our secret `Weapon` - The Aurelia Turbine

Currently available with 400 kW with 41% efficiency
From the middle of 2019 with 1 MW and 45% efficiency



Retrieval Efficiency

- ▶ With AURELIA turbine 41% el. & 59% thermal
- ▶ CCPP with AURELIA turbine and a super-critical steam turbine **up to 80% el.** & 20% thermal

That is beating Li-Ion electric efficiency, while the efficiently usable thermal energy is a bonus.

THANK YOU!

