



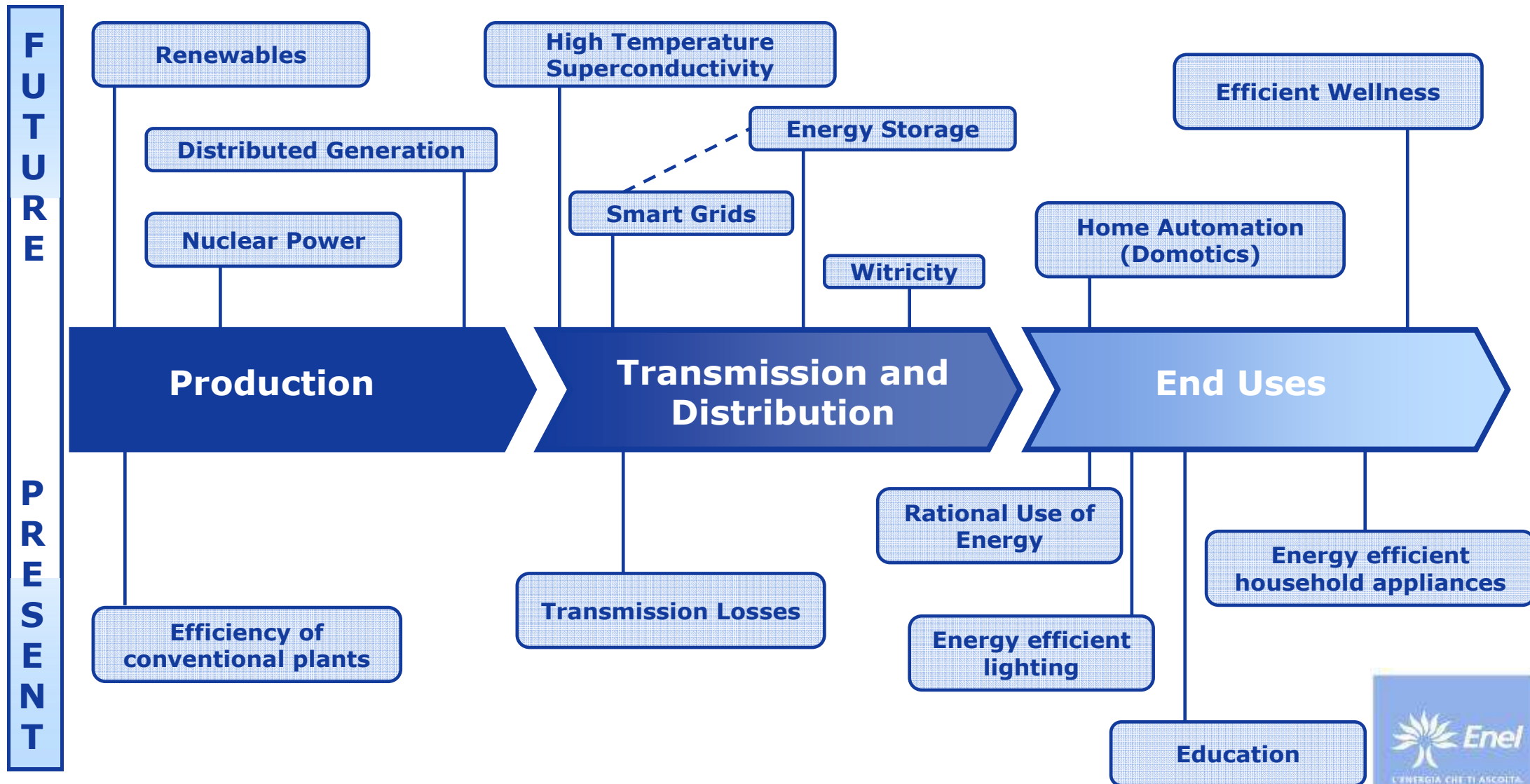
Energy Efficiency: from production to end uses

Smart and Efficient Energy Council 2009

Trento, October 9th 2009

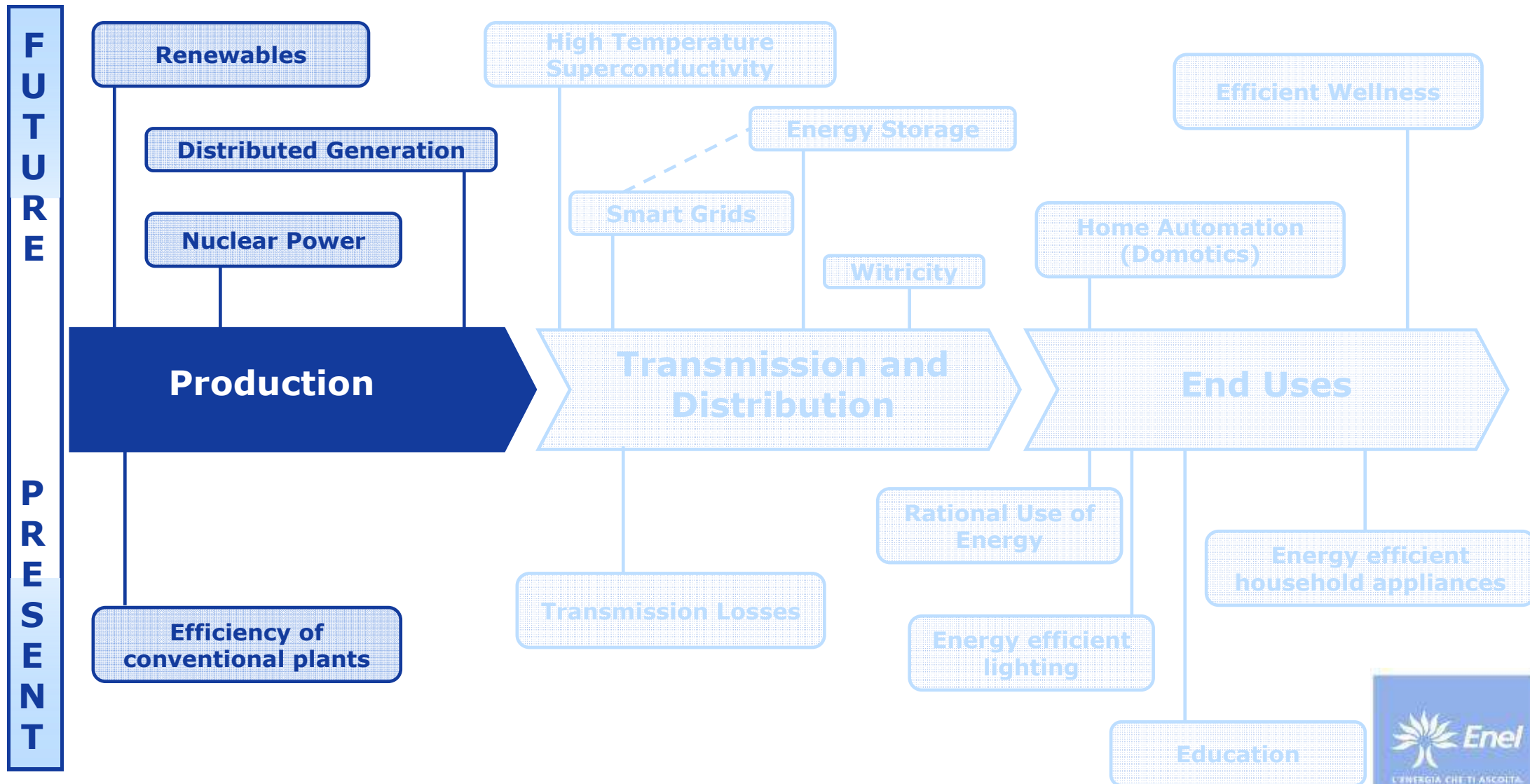
Enel's Vision Regarding Efficiency

Present and future areas of improvement

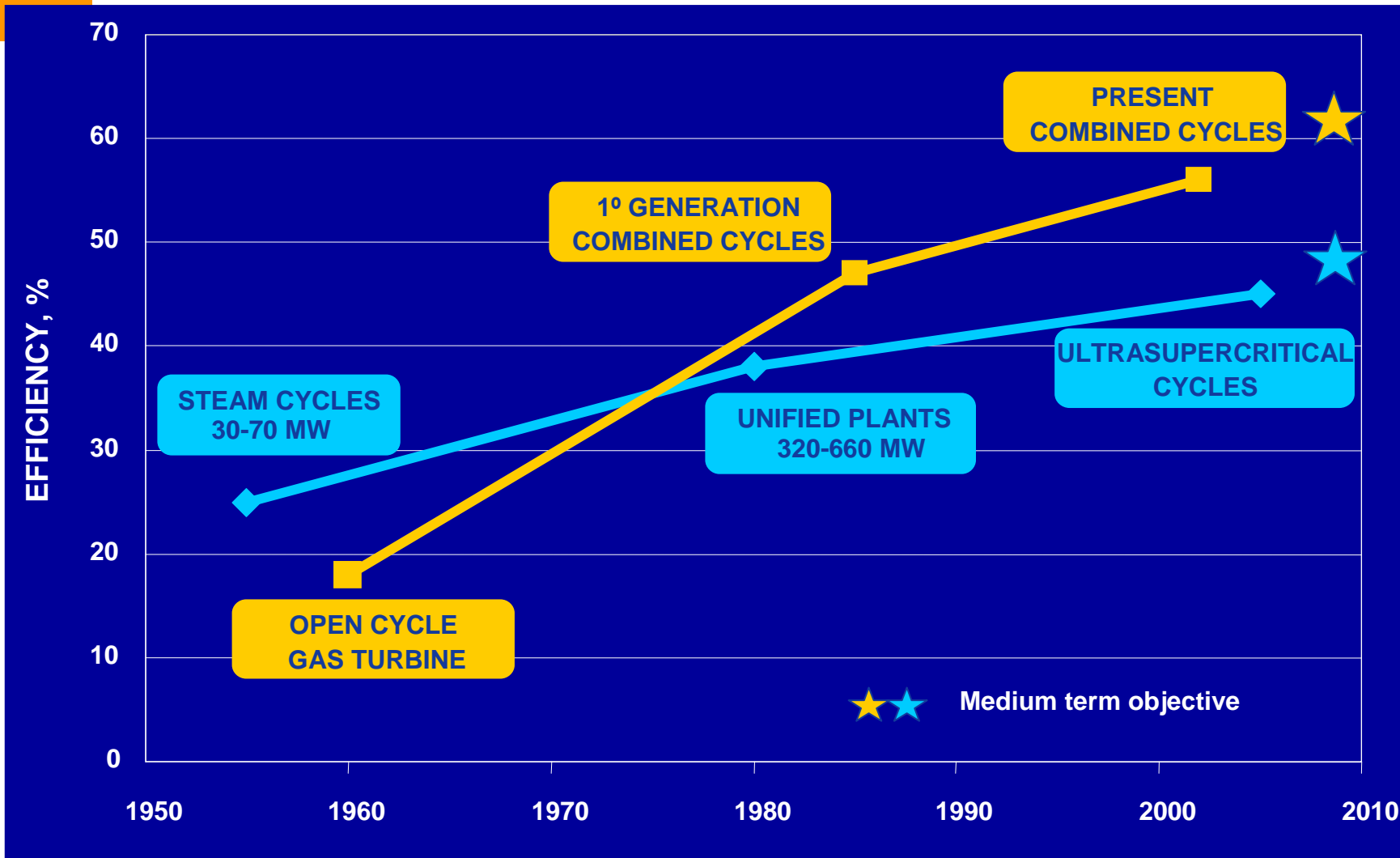


Enel's Vision Regarding Efficiency

Present and future areas of improvement



The key-word is efficiency



New coal fired power plants

Power plant	Company	Capacity (MWe)	Steam pressure (MPa)	Steam temperature (°C)	Start-up
Tsuruga 2	Hokoriku EPCo (J)	700	24.1	593/593	2000
Tachibana -wan 1&2	J-Power (J)	1050 x 2	24.6	600/610	2000/2001
Avedore 2	Energy E2 (DK)	410	30	580/600	2001
Hekinan 4&5	Chubu EPCo (J)	1000 x 2	24	568/593	2001 /2002
Tomatoh Atsuma 4	Hokkaido EPCo (J)	700	25	600/600	2002
Niederhaussem	RWE (D)	965	27.5	580/600	2002
Isogo 1	J-Power (J)	600	24	600/610	2002
Reihoku 2	Kyushu EPCo (J)	700	24.1	600/600	2002
Hitachinaka	Tokyo EPCo (J)	1000	24.5	600/600	2003
Maizuru 1	Kansai EPCo (J)	900	25.4	595/595	2004
Hirono 5	Tokyo EPCo (J)	600	25.4	600/600	2004
Genesee 3	EPCOR (CAN)	495	25	570/568	2005
Council Bluffs 4	Mid American Eco (USA)	790	25.3	566/593	2007
Yuhuan	Huanen Pow. Int. (China)	1000 x 4	25	600/600	2007
Weston 4	Wisconsin PServ. (USA)	530	25	585/585	2008
Torvaldaliga 2,3&4	Enel (I)	660 x 3	25	600/610	2008/2008/2009
Elm Road	Wisconsin E Power (USA)	677 x 2	25.5	566/566	2008 /2009
Isogo 2	J-Power (J)	600	25	600/620	2009
Boa 2&3 Neurath	RWE	2x1050	27.2	600/605	2009/2010
Walsum 10	Steag (D)	750	-	600/620	2010
Datteln 4	E.ON (D)	1100	25.5	600/620	2010
Boxberg R	RWE	1x670	-	-	2011
Hamm	RWE	2x750	27.2	600/605	2011/2012
Moorburg	Vattenfall	2x820	-	-	2011/2012
Maasvlakte	E.ON (D)	1100	25.5	600/620	2012

Boilers and Turbines

Innovative Boilers

Steam conditions:

$$T_{SH}=604^{\circ}\text{C}, T_{RH}=612^{\circ}\text{C}, T_{ECO}=310^{\circ}\text{C}$$

Innovative Turbines

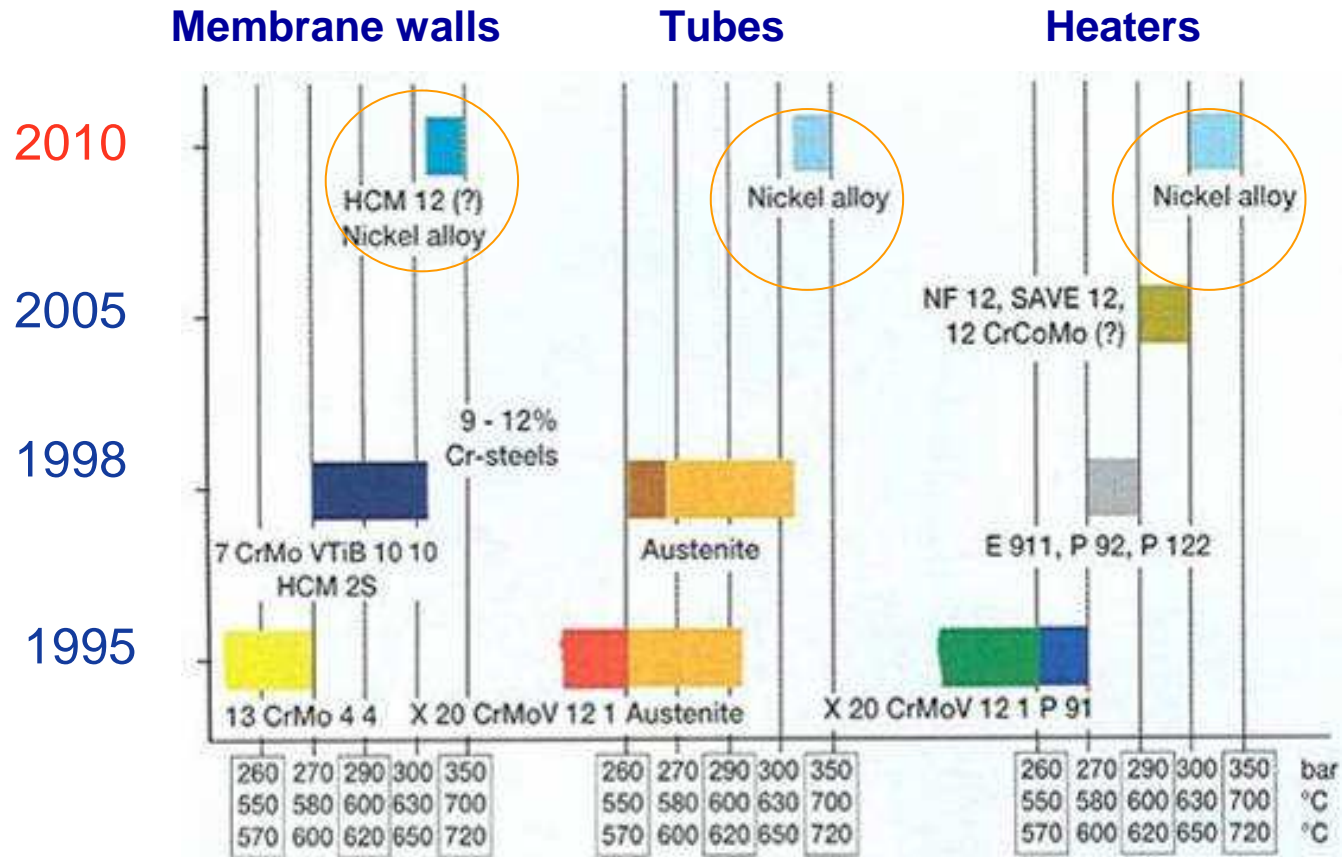
Turbine inlet temperature:

$$T_{SH}=600^{\circ}\text{C}, T_{RH}=610^{\circ}\text{C}$$



Efficiency: 45%

The importance of new materials in power plants



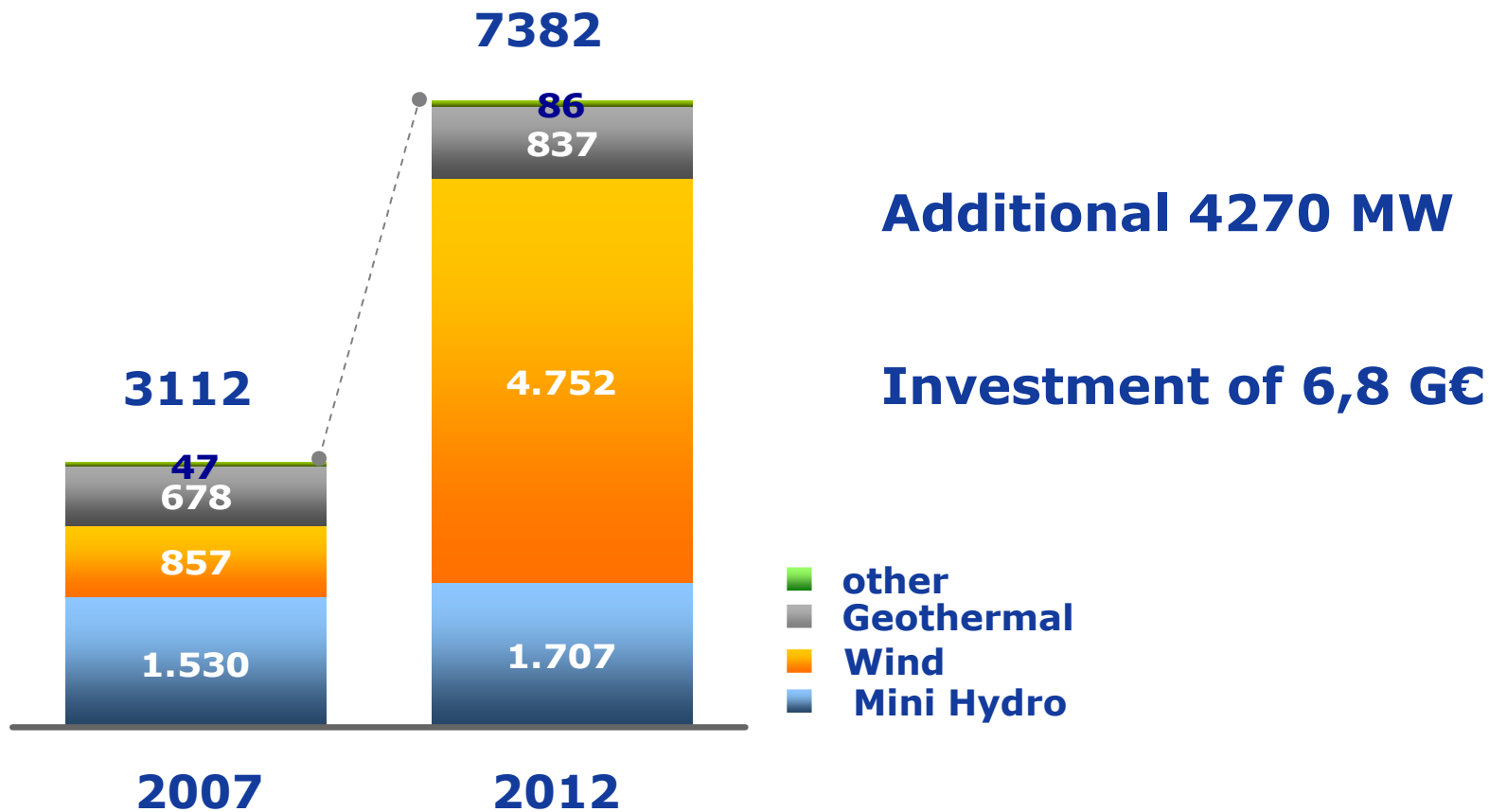
Present possible values: 300 bar, 600/610°C



Growth of renewables in Enel

2008-2012

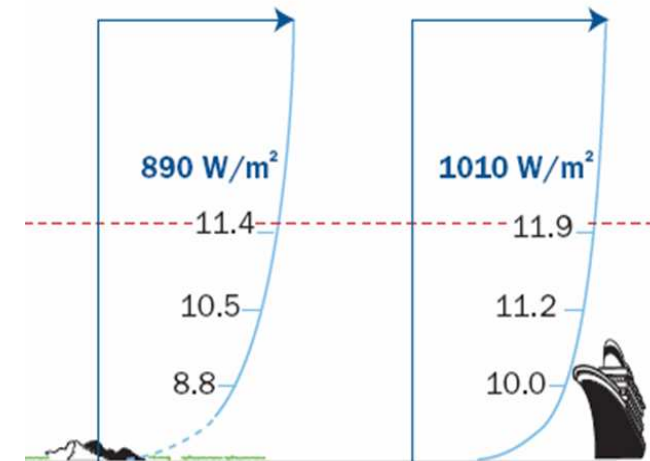
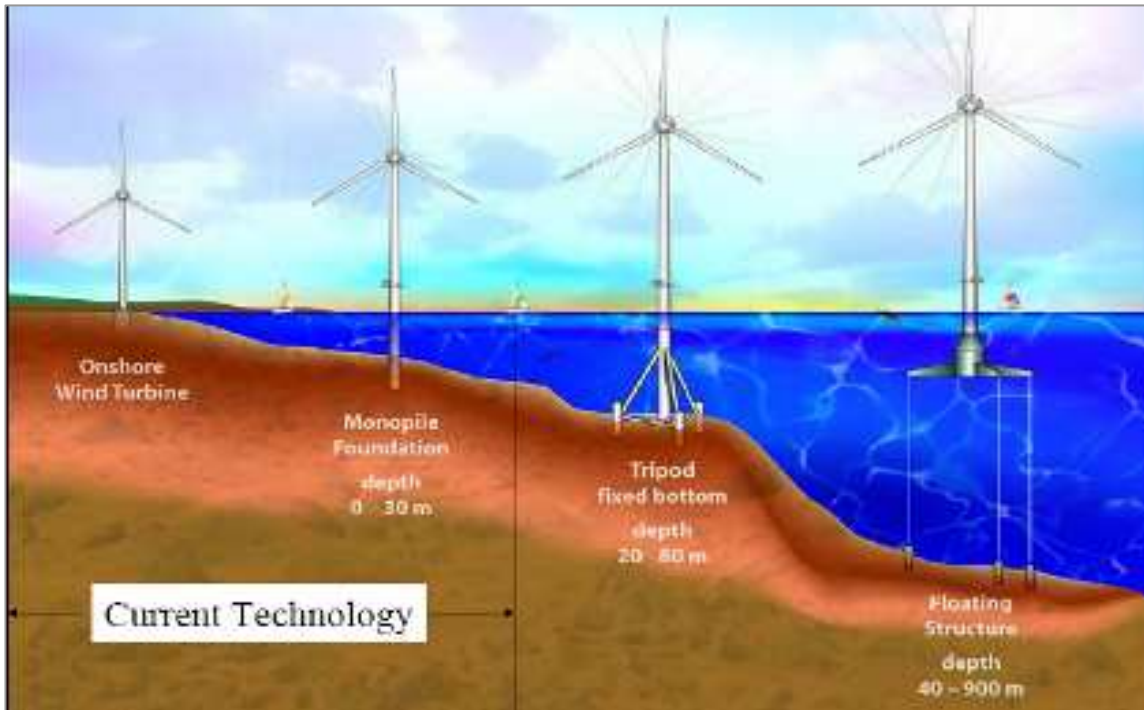
Installed Capacity (MW)*



* Without big hydro Italia, Viesgo and Slovenske Elektrarne

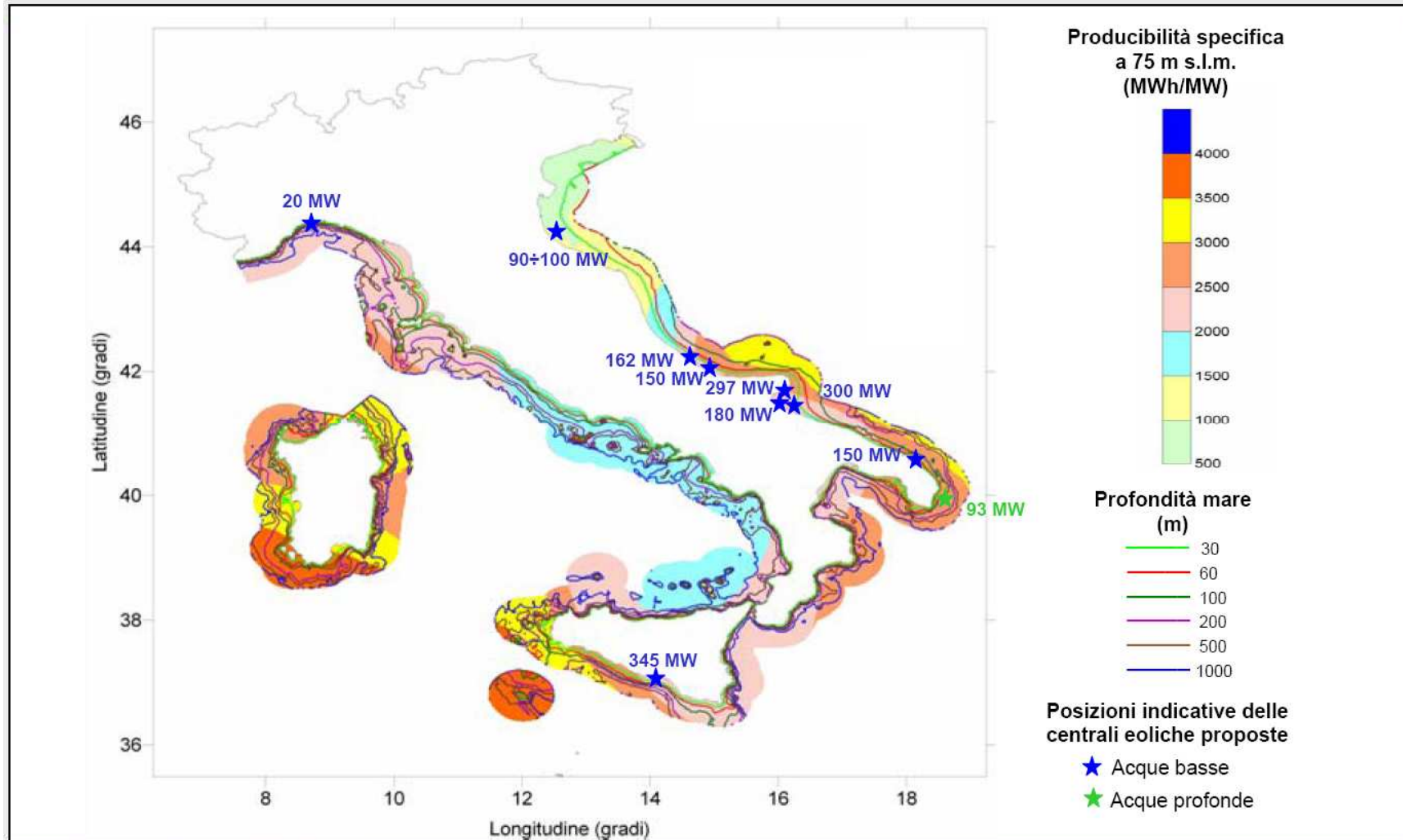


Offshore: a more efficient way to exploit wind



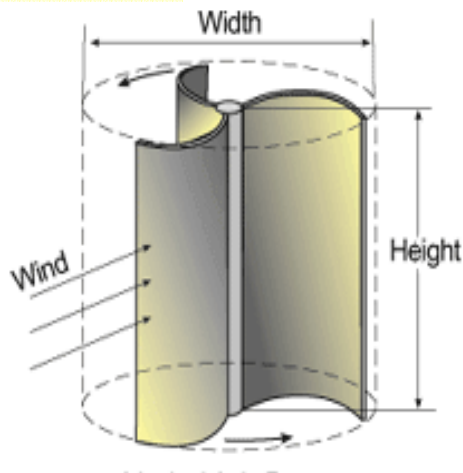
- Winds are typically stronger and more stable at sea, resulting in significantly higher production per unit installed.
- Wind turbines can also be bigger than on land because it is easier to transport very large turbine components by sea.

The offshore in Italy

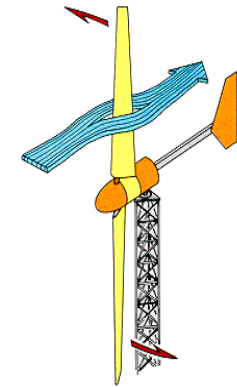
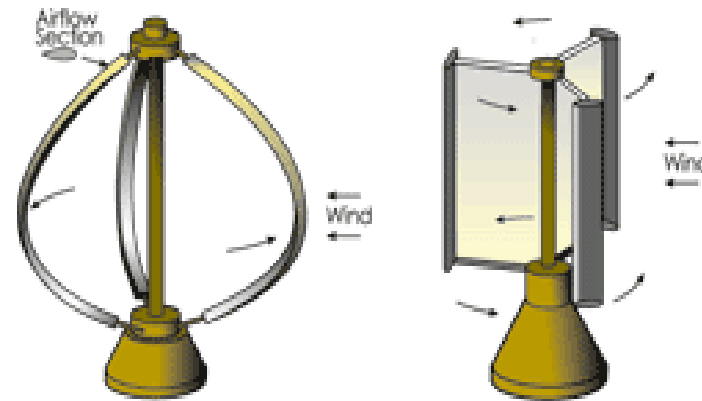


Mini and Micro Wind Turbines

Savonius



Darrieus



- **Effective and reliable systems for the supply of electricity to remote areas**
- **Ability to exploit low-intensity winds (2 m/s)**
- **Small size with very low environmental impact**
- **Simple and robust systems with low maintenance**

Technologies to increase the efficiency of renewables

Smart blades

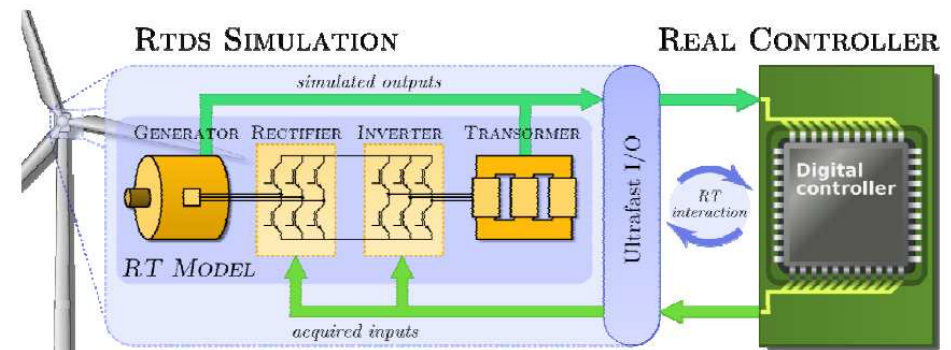


- sensors, incorporated into the blades, to measure in real time the load that the wind exerts on the blades and the corresponding deflection.
- it's possible to optimize the aerodynamic shape and adapt immediately to changes in the wind



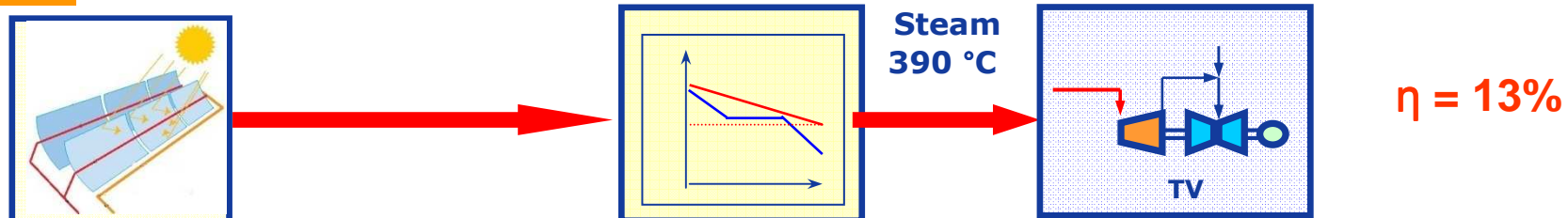
Less fatigue and enhanced efficiency

Real-time digital simulation tools

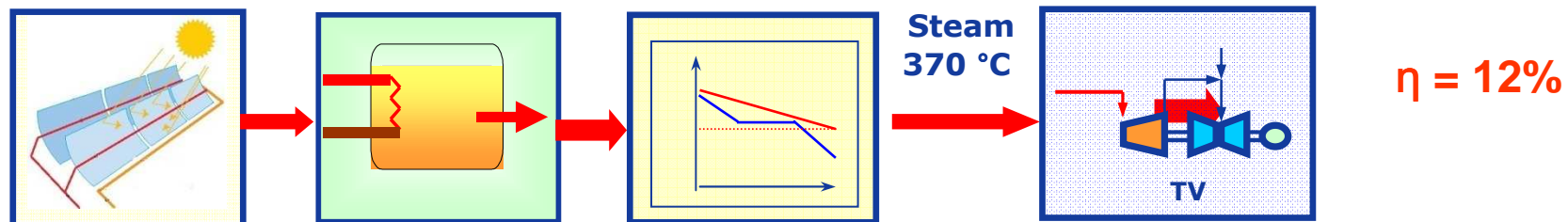


These technologies, by increasing power electronics reliability, reducing costs and increasing efficiency, can have a strong effect on aspects of energy efficiency

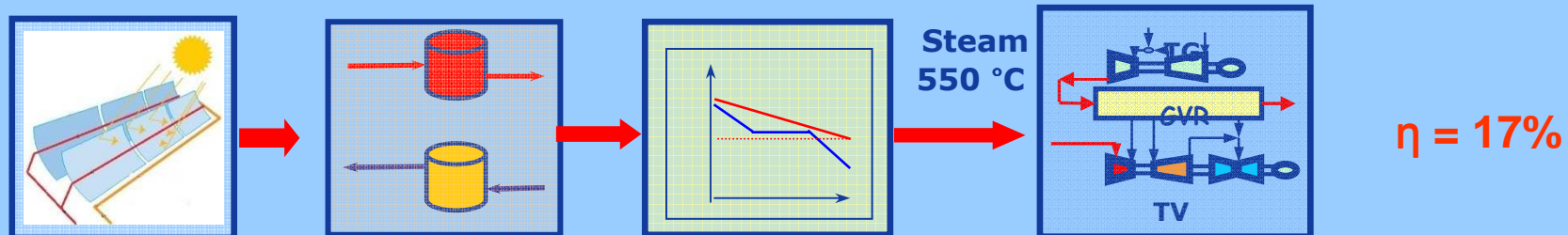
Thermal-solar generation: the technology evolution



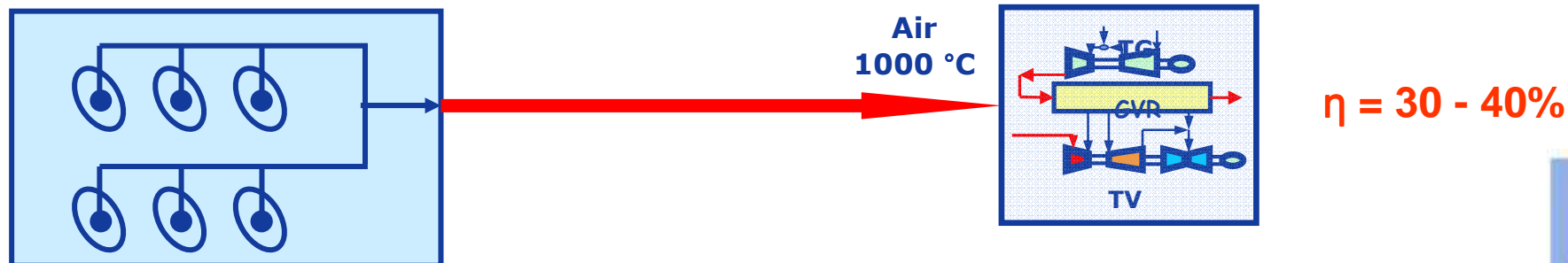
$\eta = 13\%$



$\eta = 12\%$

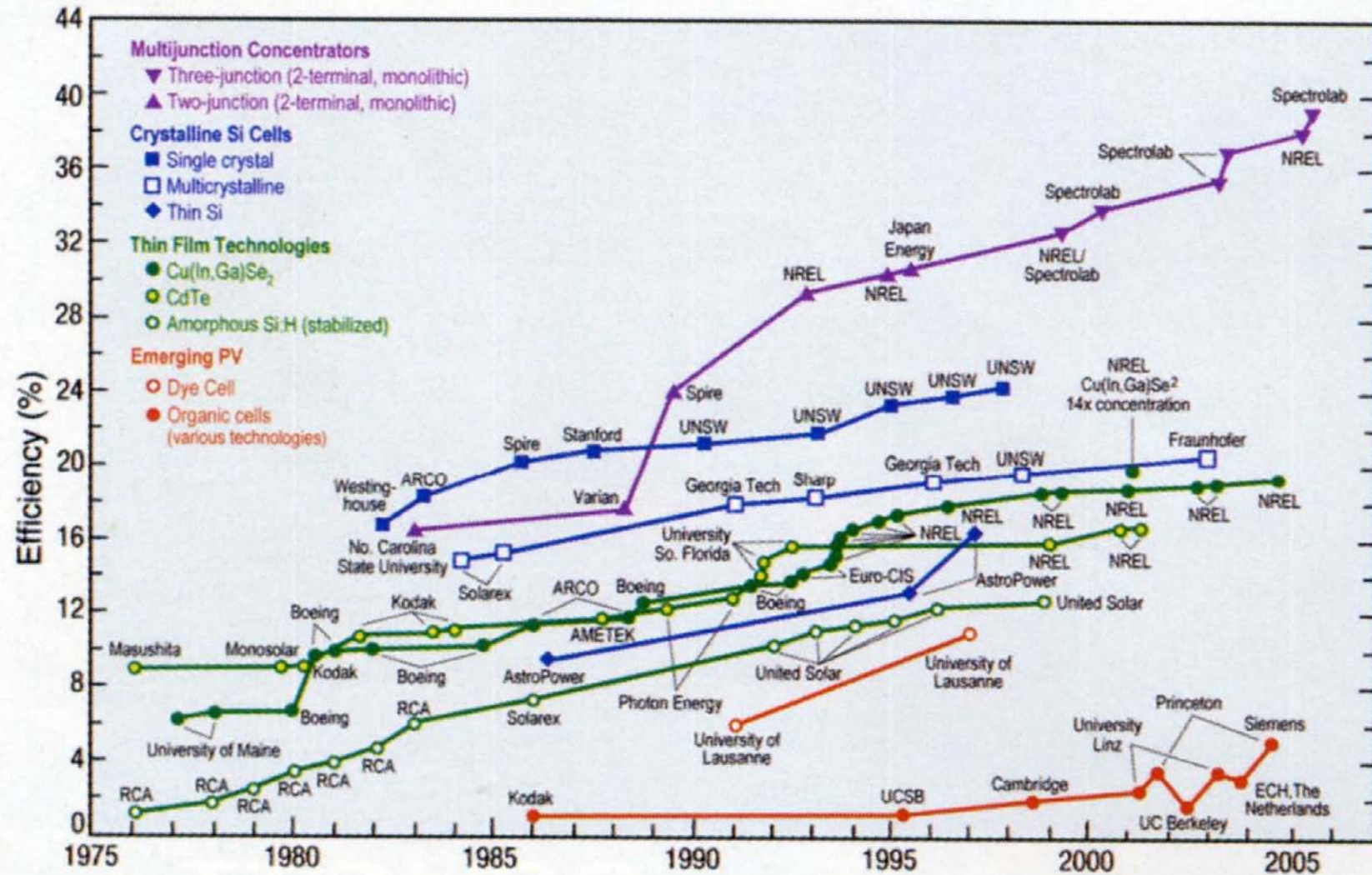


$\eta = 17\%$

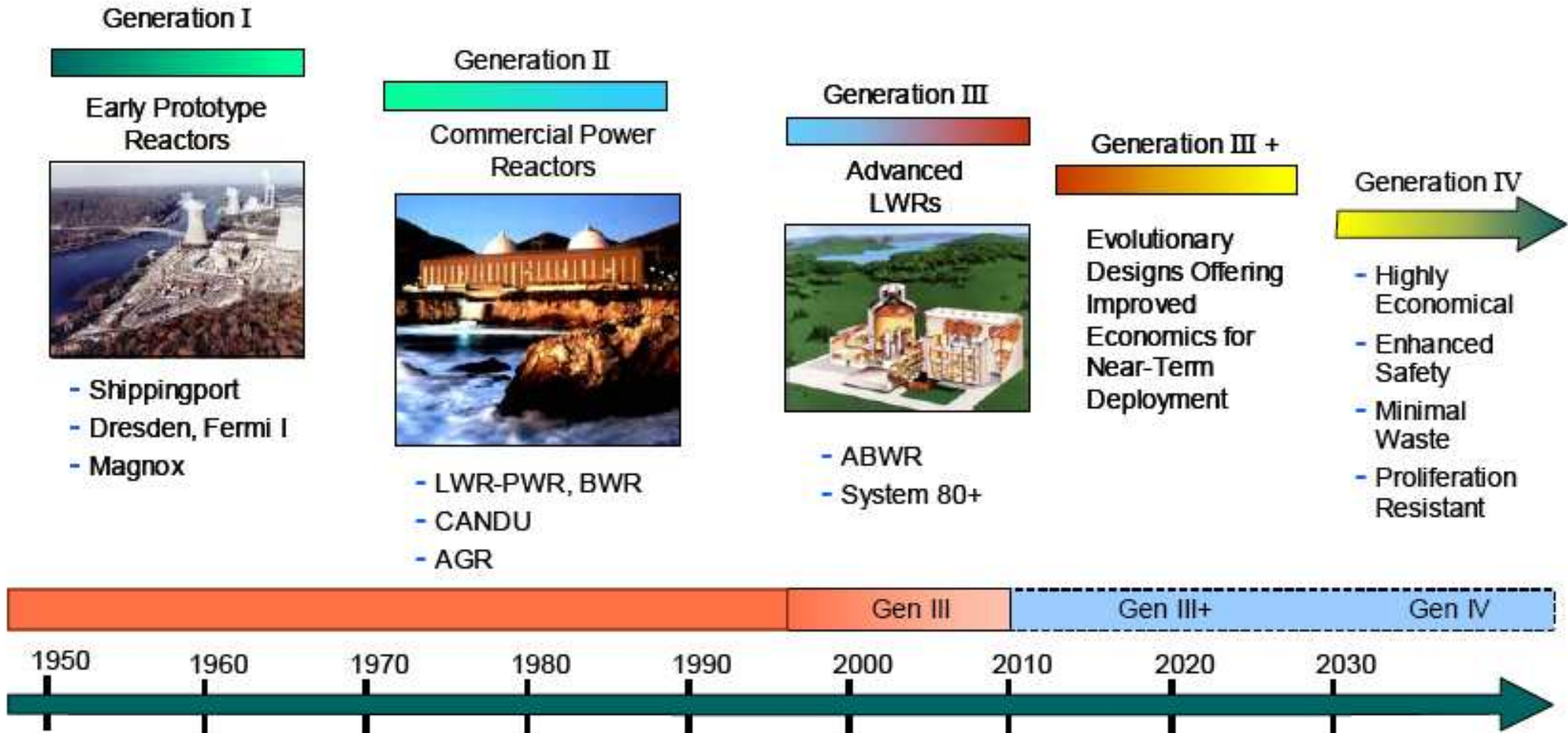


$\eta = 30 - 40\%$

PV: the challenge of new materials



Possible evolution of Nuclear Power



The European Pressurized Reactor (III+ generation)

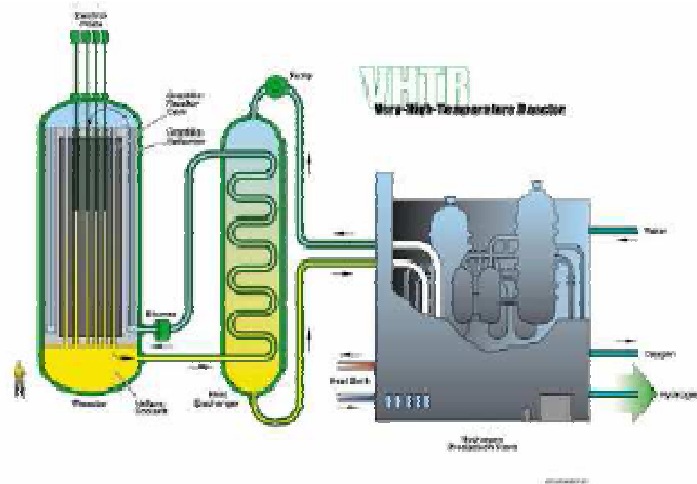


- The EPR is a third generation pressurized water reactor (PWR) design
- **increased safety** while providing **enhanced economic competitiveness** through evolutionary improvements to previous PWR designs
- Four independent emergency cooling systems, each capable of cooling down the reactor after shutdown

Olkiluoto Plant

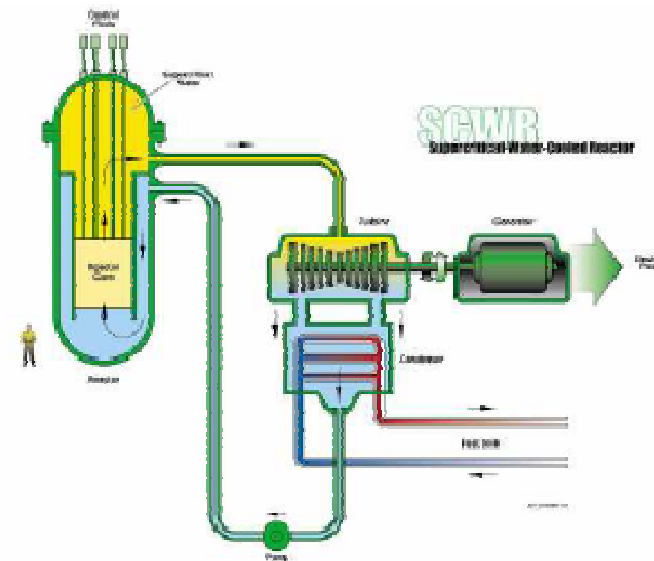
IV Generation Systems (1)

Very-High-Temperature Reactor System

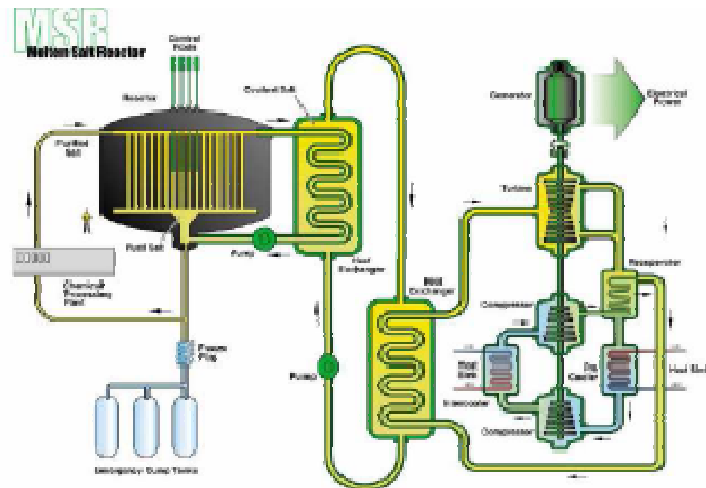


High temperature reactors

Supercritical-Water-Cooled Reactor System

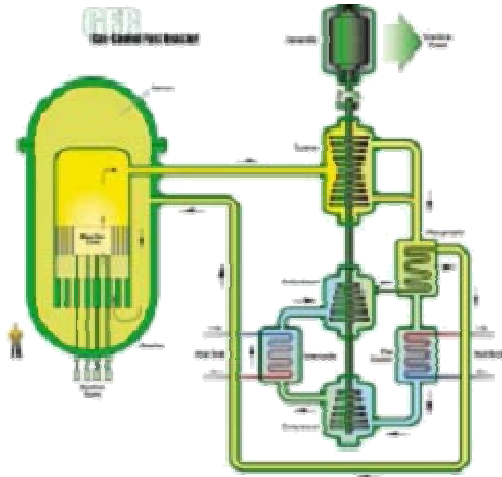


Molten Salt Reactor System



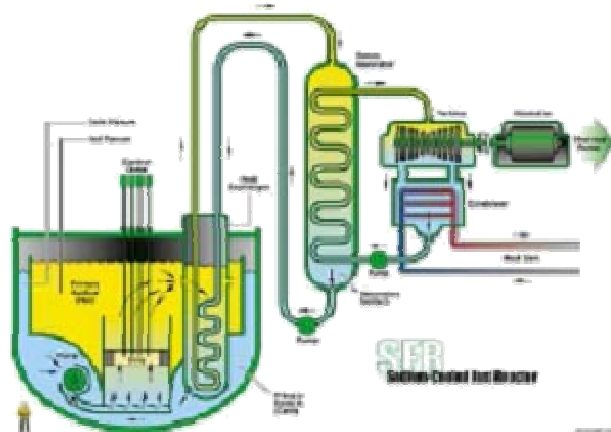
IV Generation Systems (2)

Gas-cooled fast reactors

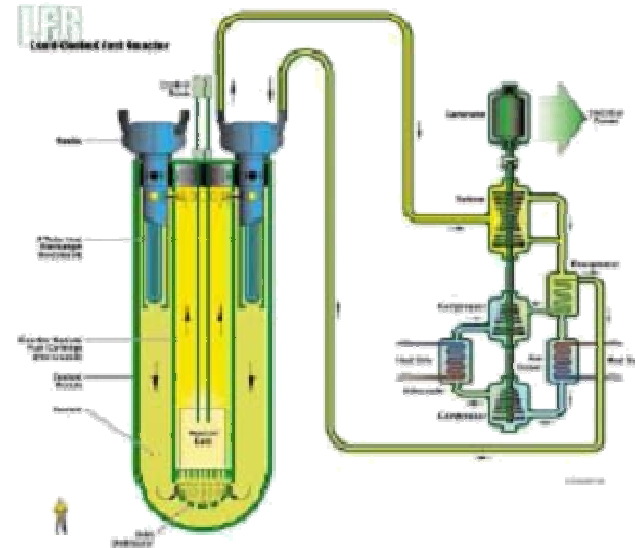


Fast reactors

Sodium-cooled fast reactors



Lead-cooled fast reactors



A new line: the small reactors

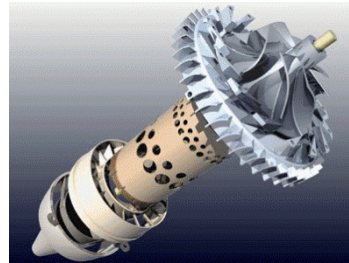
PROJECT	POWER	TECHNOLOGY	COMPANY
VK-300	300 MWe	PWR	Atomenergoproekt, Russia
CAREM	27 MWe	PWR	CNEA & INVAP, Argentina
KLT-40	35 MWe	PWR	OKBM, Russia
MRX 30-	100 MWe	PWR	JAERI, Japan
IRIS-100	100 MWe	PWR	Westinghouse-led, international
SMART	100 MWe	PWR	KAERI, S. Korea
NP-300	100-300 MWe	PWR	Technatome (Areva), France
PBMR	165 MWe	HTGR	Eskom, South Africa, et al
GT-MHR	285 MWe	HTGR	General Atomics (USA) Minatom (Russia) et al
BREST	300 MWe	LMR	RDIPE (Russia)
FUJI	100 MWe	MSR	ITHMSO, Japan-Russia-USA

Distributed Generation and Co/trigeneration

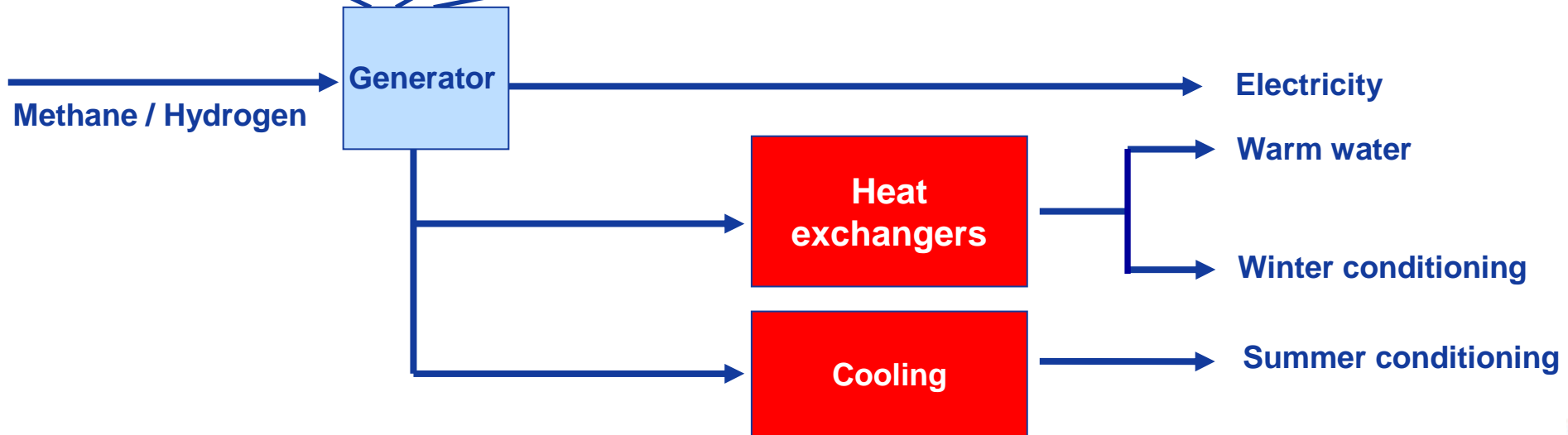
Alternative Engines



Microturbines



Fuel Cells



Capacity ranges from 20 to 1000 kW

Combined Heat and Power Plants

The St. Felicien cogeneration Project



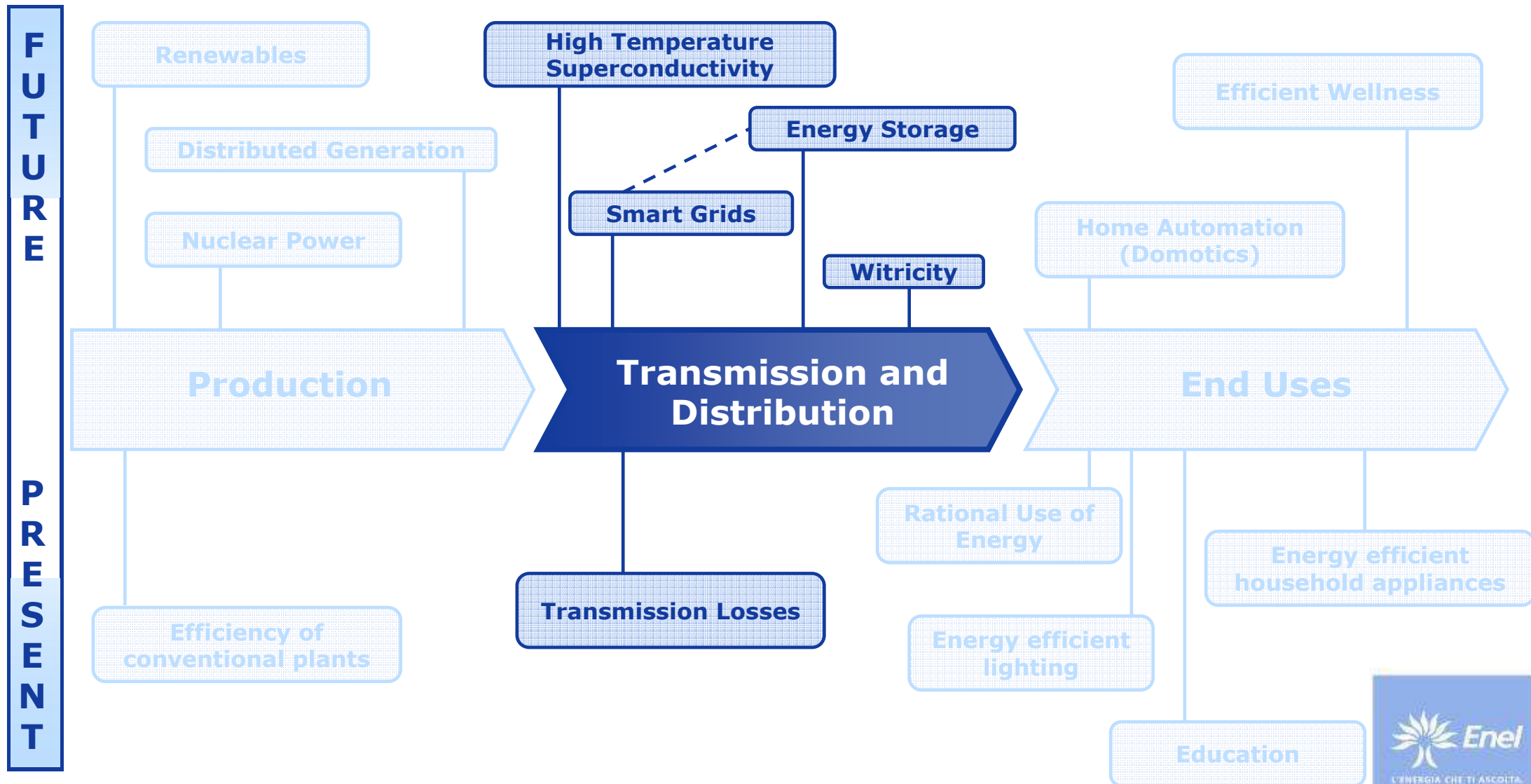
- A 23 MW **woodwaste fired cogeneration facility** that provides a clean and useful solution to the disposal of **sawmill waste**.
- By disposing of the woodwaste, the St. Felicien Cogeneration project produces **electricity** to be sold to Hydro-Quebec under the terms of a 25-year power purchase agreement, **steam** to Alliance Forest Products' sawmill for its wood dryers under a long-term agreement, **waste ash** for agricultural soil improvements and **residual hot water** for agro-industrial energy requirements.

The project has therefore been designed to optimize the use of the thermal capacity of the woodwaste while promoting local industrial developments.

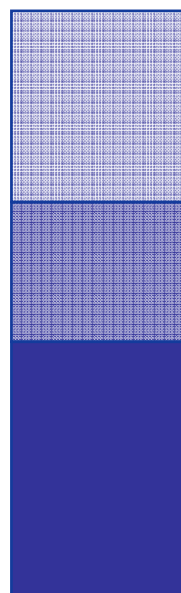


Enel's Vision Regarding Efficiency

Present and future areas of improvement



Transmission & Distribution Losses



To decrease resistive losses



Raising the voltage

To decrease losses due to reactive power



add capacitor banks and other components throughout the system to control reactive power

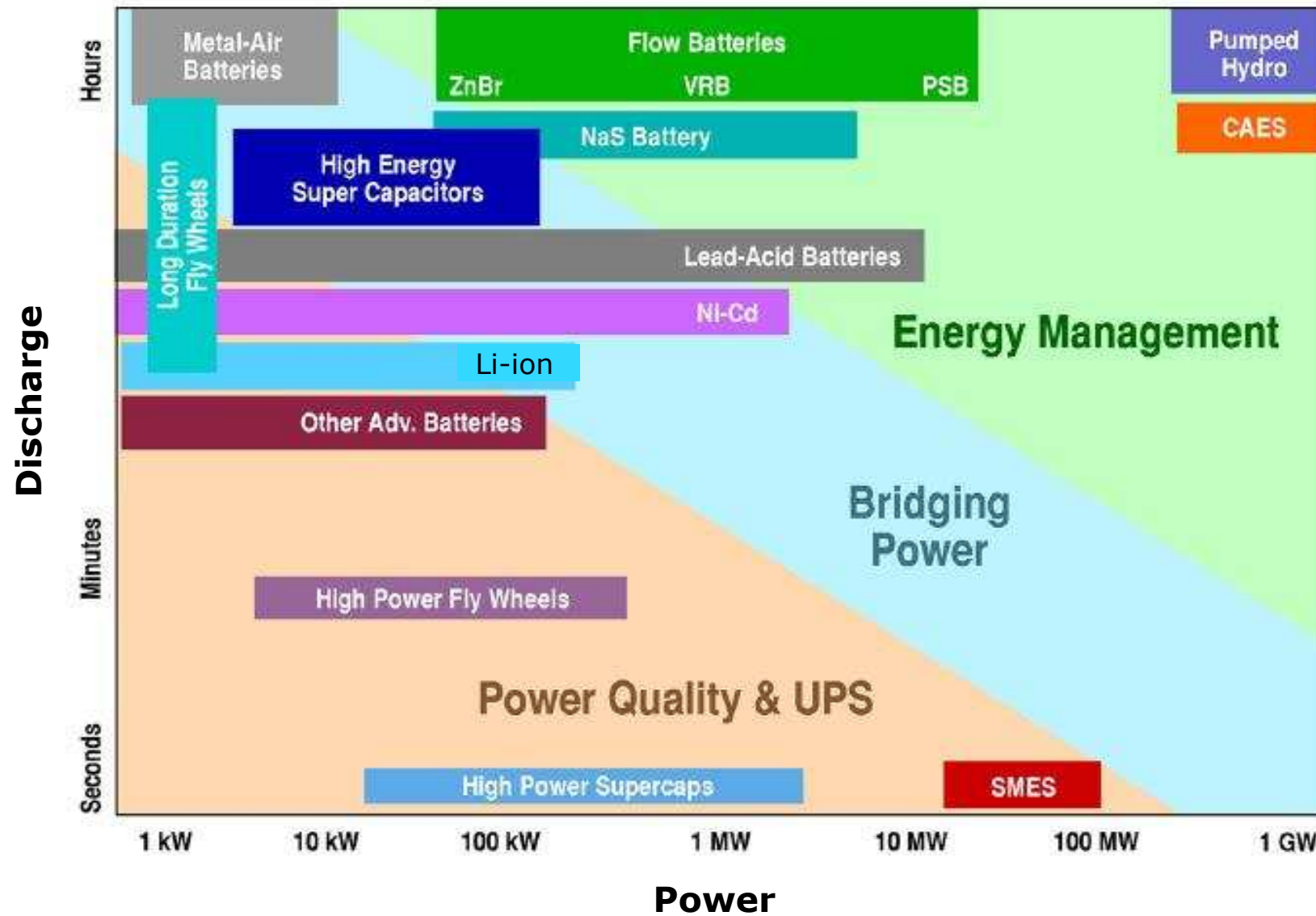
High Temperature Superconductivity



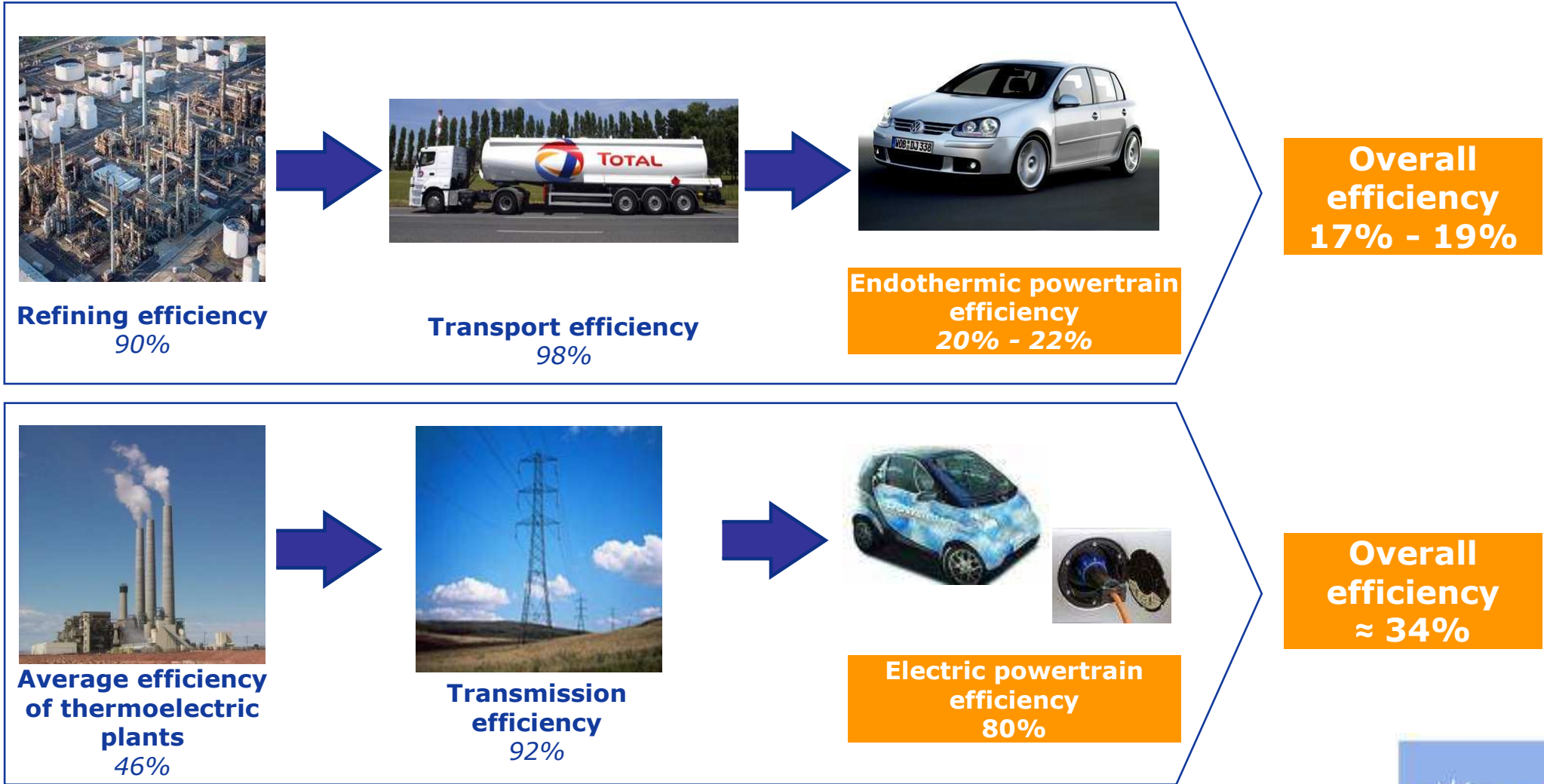
- DC power transmission systems are considered to be developed using high-temperature superconductors (HTS) with advantages of higher current carrying capability, energy loss reduction, lower system voltages, high stability with self-protection, and more compact systems.

- The structure of a superconductive power cable is such that multiple superconductive tapes are spirally wound on the center core called a former, over which an electric insulation layer, superconductive shielding layer and protection layer are provided to constitute a cable core, and **the cores as a whole are accommodated in a thermal insulation pipe in which liquid nitrogen flows.**

Energy Storage

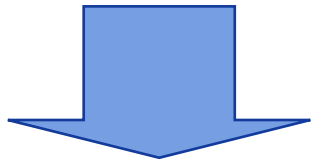


Electric Cars as distributed storage devices



Enel-Mercedes electric car project

Enel and Mercedes signed an agreement with the aim to analyze in deep the management of the electric mobility



Enel

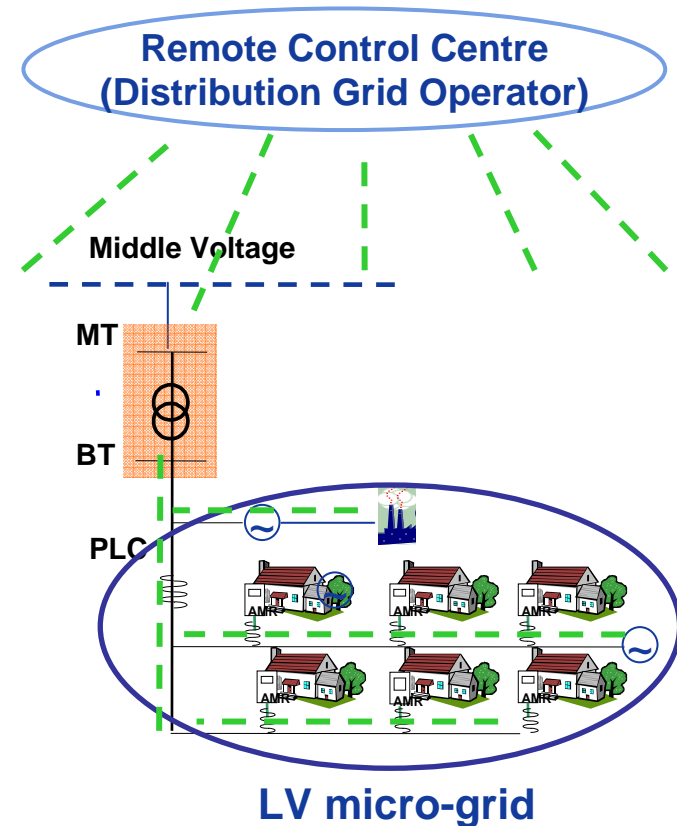
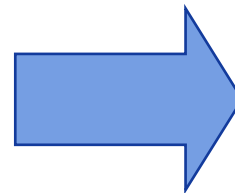
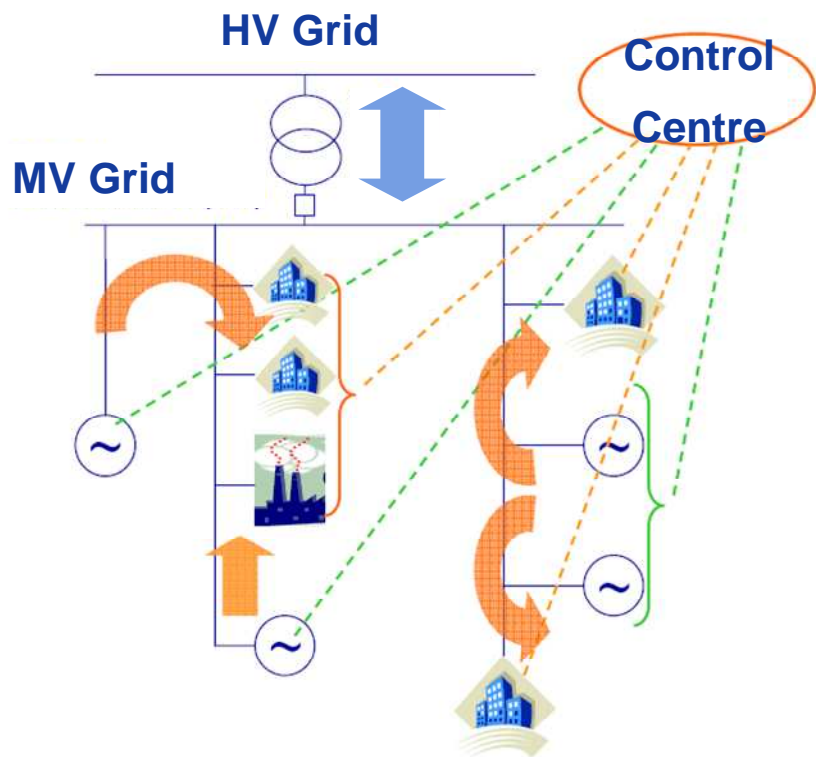
400 recharging smart points providing certified renewable energy

Mercedes

100 electric Smart For Two



The grid: from the present configuration to the smart grid



Generators



Customers / loads



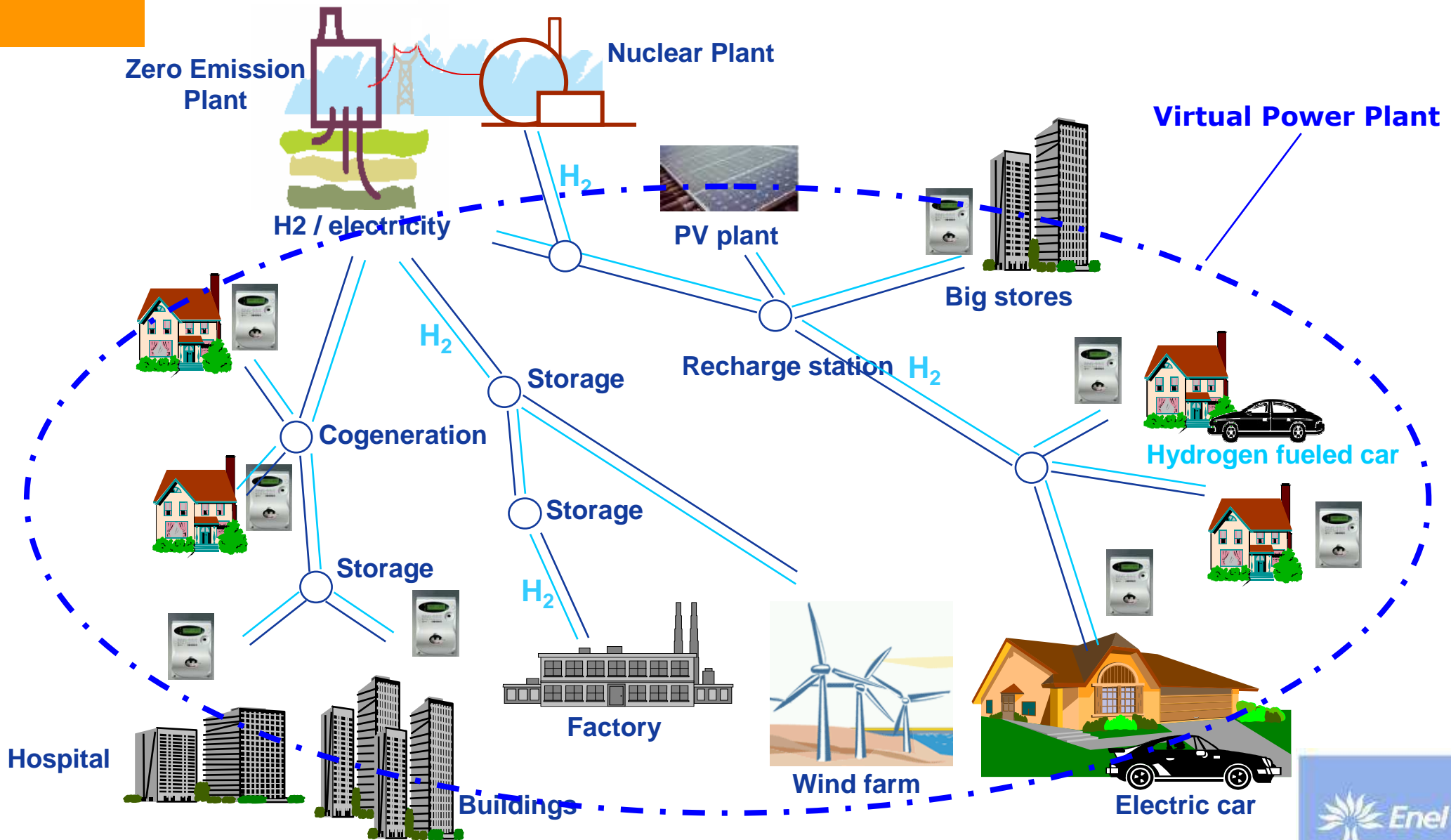
Efficient and reliable communications



Electronic meter – remote management

- Local balance between the energy produced by distributed generators and the energy required by the loads
- Real time estimation of the load
- Remote control of generator

The new generation system



Witricity

WiTricity (Wireless Electricity) is a **novel approach for safe & efficient transfer of electric power** over distances ranging from centimeters to several meters.

Provides power levels from milliwatts to kilowatts and it's **based on "near field strong resonant magnetic coupling"** of power source and powered devices.

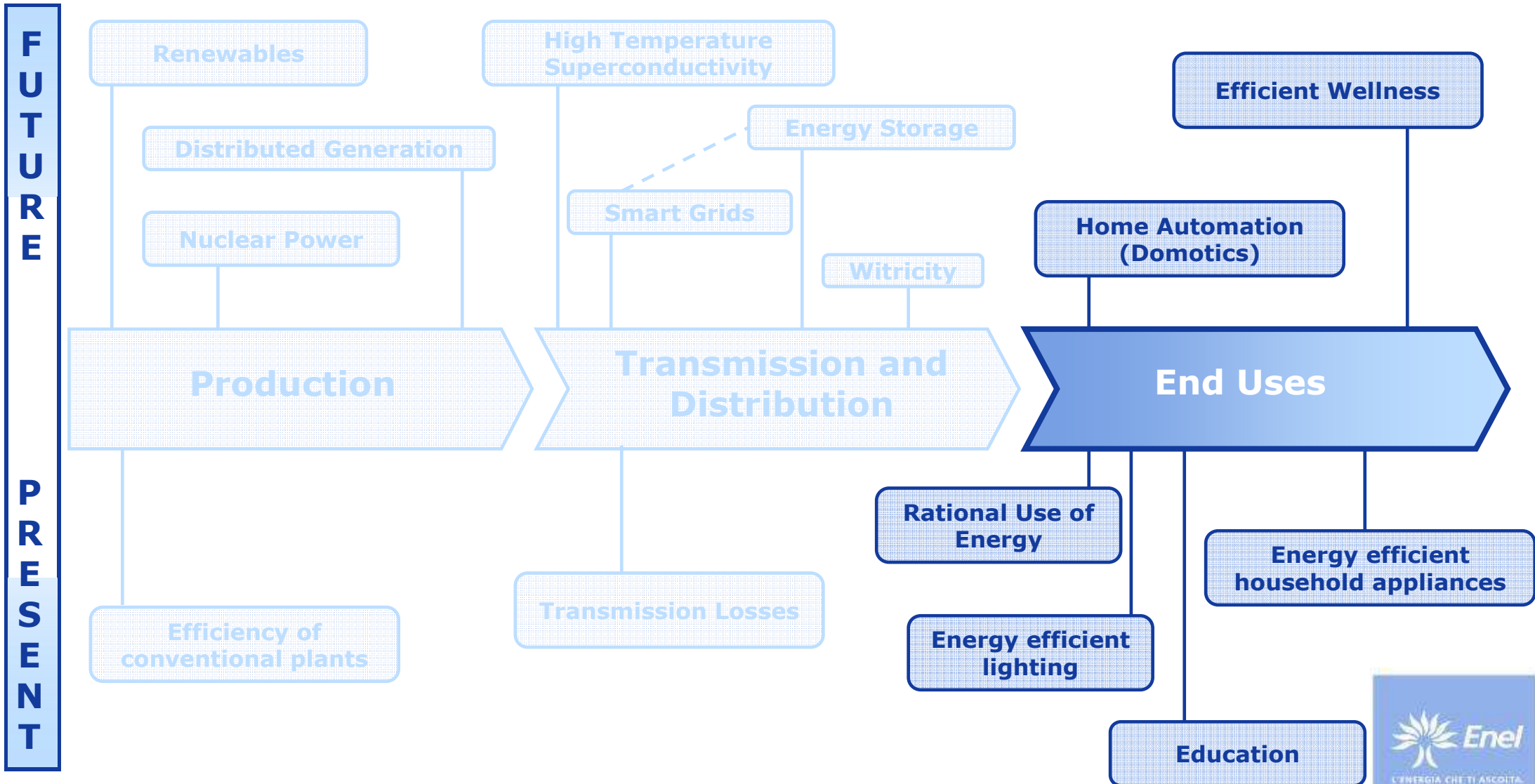
The theory was developed at MIT in 2006 by WiTricity Corp. and the experimental validation of theory was published in 2007 in "Science".



- **Huge and diverse market opportunity**
- Eliminate costly, unsightly, unwieldy wiring
- No more manual recharging or changing of batteries

Enel's Vision Regarding Efficiency

Present and future areas of improvement

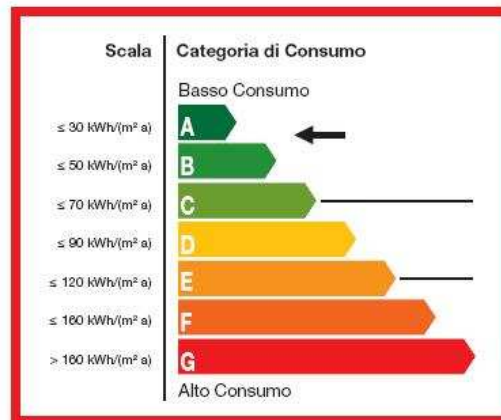


Energy Efficient Household Appliances and Lighting

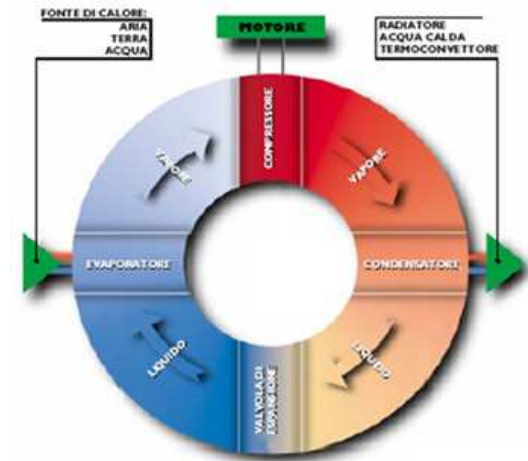
- **Enel.si** (a company belonging to Enel Group) offers services, products and integrated solutions for energy saving and efficiency, with particular focus on renewable energy sources.
- Enel, through its Enel.si stores, **markets energy-efficient appliances.**



Phase-out of incandescent light bulbs



Increased Efficiency Class of household appliances

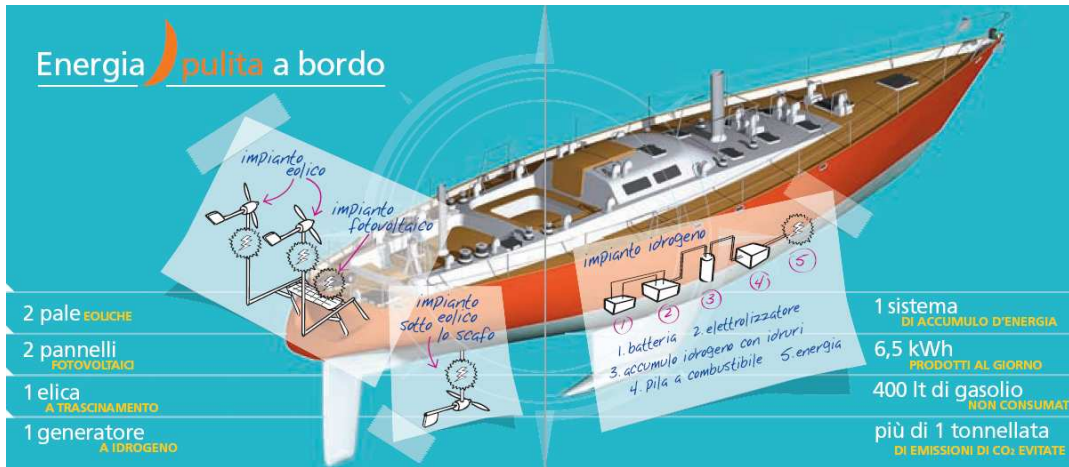


Heat pumps

Education

For years, Enel has encouraged thousands of students to discover the world of energy.

Adriatica Project



Objective: sensitize children on energy saving.

Adriatica is the first **sailboat powered with renewable energy.**

Micro wind turbines (2): 360 W each

PV panel: 215 W, 0.8 x 1.4 m

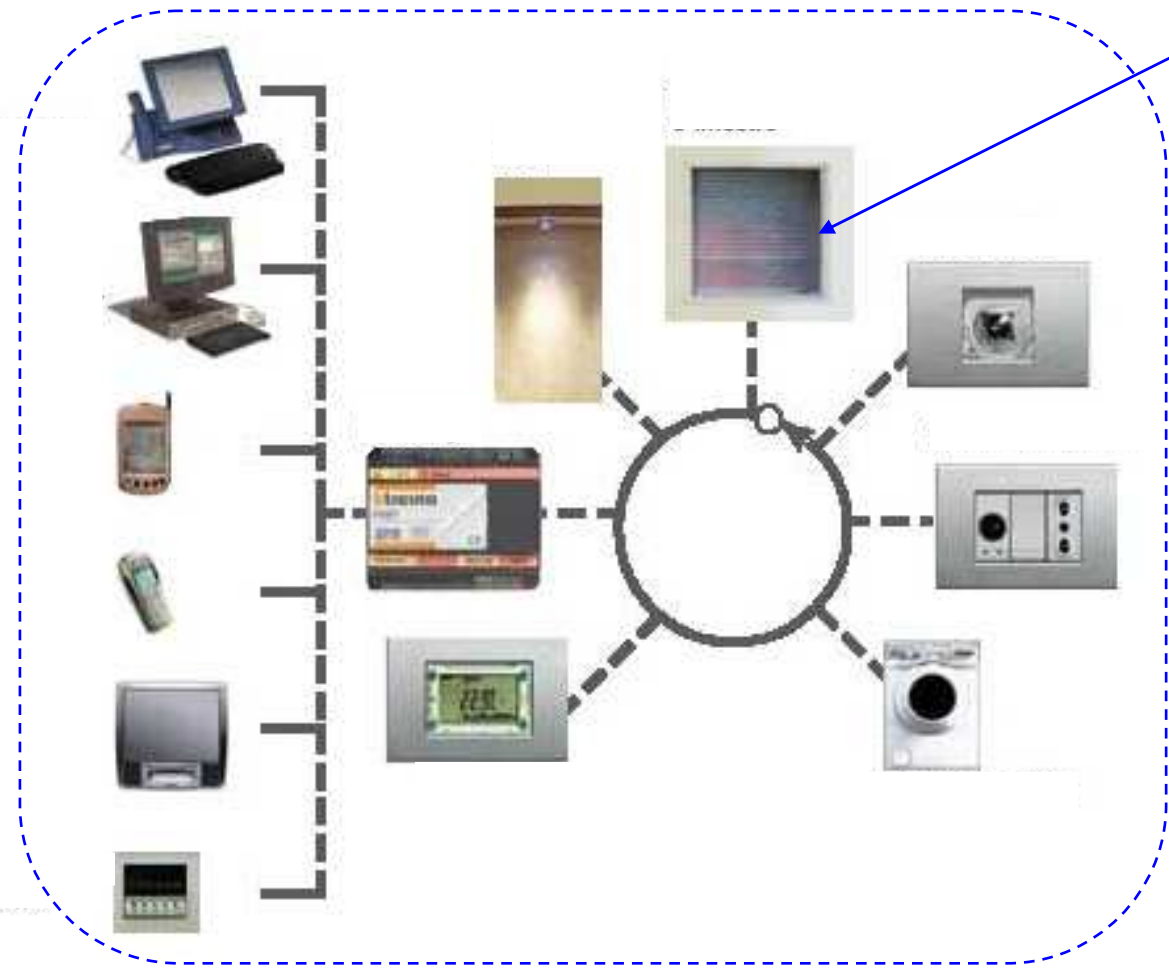
Hydro Turbine: 120 W

Play Energy



Enel has renewed its commitment to **spreading the culture of energy** and responsible consumption, with the creation of Play Energy, **the game and science program for schools** in Bulgaria, Chile, Costa Rica, Greece, Guatemala, Italy, Panama, Romania, Russia, Slovakia, and the United States.

Home Automation and the Electronic Meter

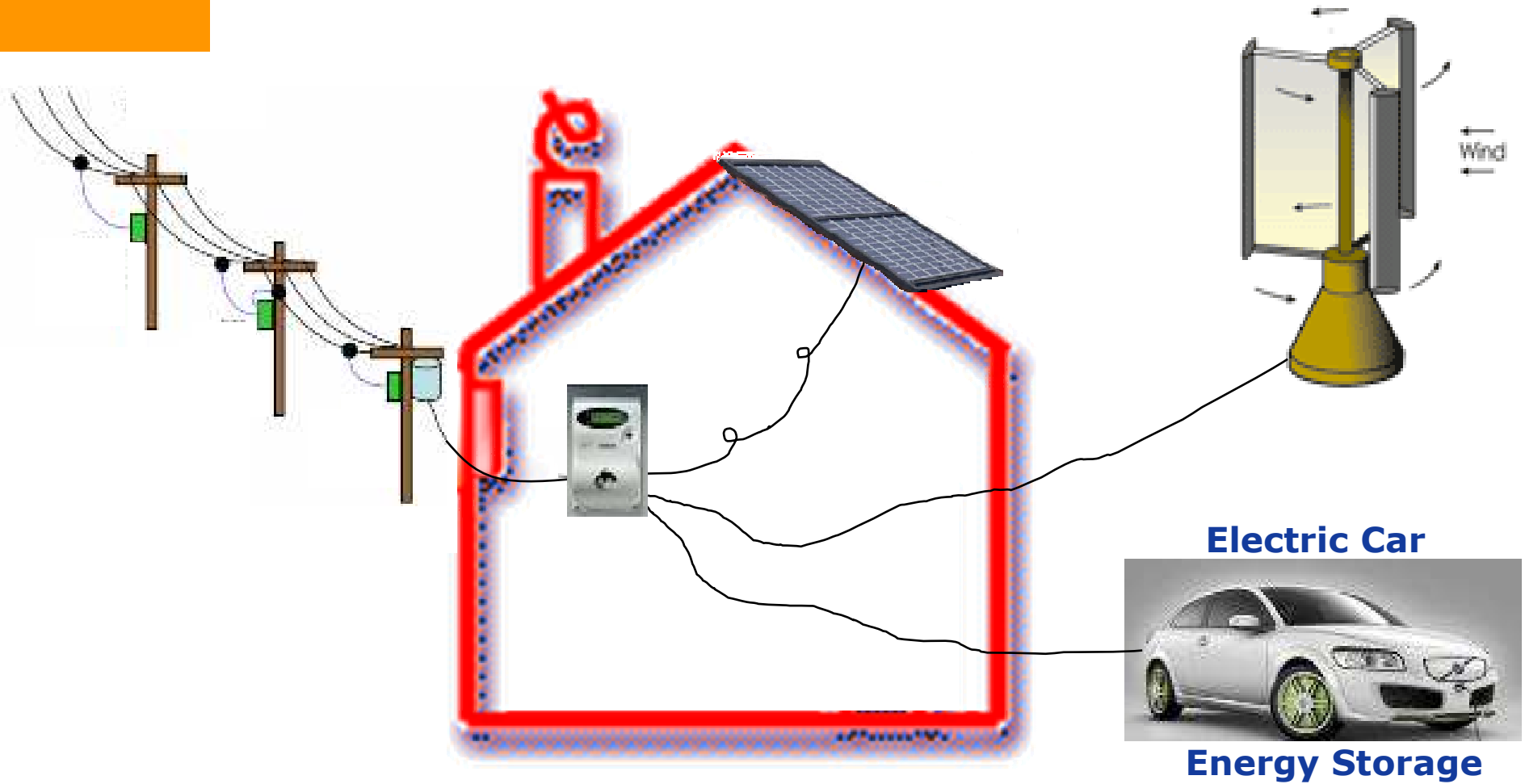


The project provides **free replacement of all old electromechanical meters** (about 32 millions) with the most innovative electronic meters.

The new meters, in addition to measuring the energy, allow the **remote reading** of consumption and the **remote management of contracts**.

The customer can verify the updates directly on the display

The effects on our lives

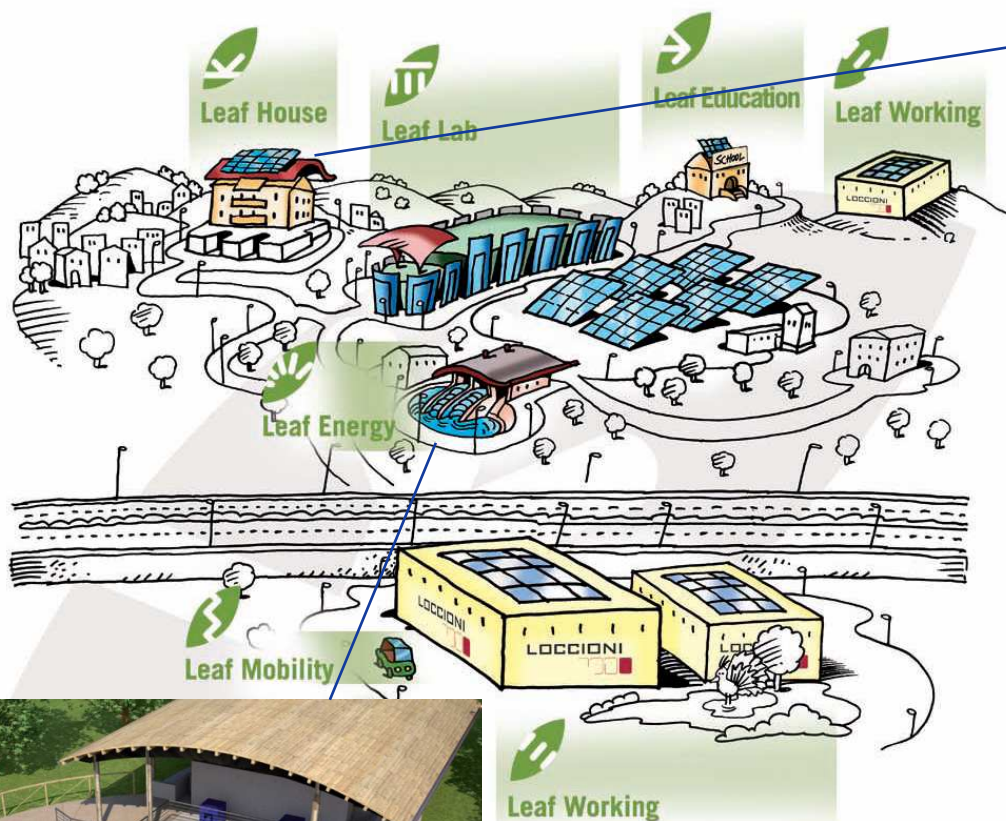


A new configuration: CONSUMER = PRODUCER = END USER



Efficient Wellness: the Leaf Community

The first eco-sustainable community in Italy (Marche Region)



In the carbon neutral house **energy is entirely produced by renewable sources** without CO2 emissions.

Leaf House is composed of six apartments, **a real house where real people live.**

Its southward exposition allows the maximum exploitation of solar systems and the best use of solar thermal and photovoltaic panels. **The exceeding energy is stored thanks to Enel storage system based on hydrogen and fuel cells.**



The **micro hydroelectric power** plant, taken from a water head of one meter, produces 160 MWh/year of energy



Thank you for your attention!