



**CENER**

CENTRO NACIONAL DE  
ENERGÍAS RENOVABLES

NATIONAL RENEWABLE ENERGY CENTER

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**ROBUST & EXTENSIVE  
RENEWABLE ENERGIES WITH MICROGRIDS**



GOBIERNO  
DE ESPAÑA

MINISTERIO DE  
INDUSTRIA, ENERGÍA  
Y TURISMO

MINISTERIO DE  
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Electrical Storage Experimental Platform

Seamless Energy Technology Integration

Versatile Design for Practical Applications

The background features a series of overlapping, semi-transparent geometric shapes in various colors including teal, blue, purple, magenta, red, orange, and yellow, set against a light gray background with faint vertical lines.

## 1. Global Trends

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### Global RE Market Trends

**Global Clean-Energy Market Size 2000-2011**

Year	Solar PV Global Market Size (in \$Billions)	Wind Power Global Market Size (in \$Billions)
2000	\$2.5	\$4.0
2001	\$3.0	\$4.6
2002	\$3.5	\$5.5
2003	\$4.7	\$7.5
2004	\$7.2	\$8.0
2005	\$11.2	\$11.8
2006	\$15.6	\$17.9
2007	\$20.3	\$30.1
2008	\$29.6	\$51.4
2009	\$36.1	\$63.5
2010	\$71.2	\$60.5
2011	\$91.6	\$71.5

Source: Clean Edge, Inc., 2012

Over 1/3 increase by 2020 !!

### Distributed RE Potential

- Military Clean-Energy Deployment
- Japan Moving to a Clean-Energy, Post-Nuclear Future
- Building Retrofits that will Provide Companies with substantial Efficiency Savings
- Breakthroughs in New Energy Storage Solutions
- Reliable, efficient and cost competitive Wind and Solar Technologies.



## 2. Economy Shaping Energy

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### Georgescu Roegens

Energy is the lifeblood of society and the necessary precursor of all its economic wealth.

Renewable Energy – Wealth Multiplier

*“Inexhaustibly Bequeathed to us from outside the Earth”*

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### EVOLUTIONARY MIX

Fossil Fuels are localised and inevitably lead to geostrategic tensions.  
Renewables are naturally distributed, i.e, their coexistence may contribute to relaxation of power related struggles.

*True costs should drive a dynamic Energy Mix.*

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### ONE TIME CHANCE

High renewable penetration needs changes at all levels in the Energy Infrastructure.

*This effort could bring as reward sustainable growth*

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### 3. Renewable Energy Distributed Infrastructure

### 3. Renewable Energy Distributed Infraestructure

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#### Key Strong Transmission Networks vs Storage

Match base loads

Average out the various sources of stochastic generation

Management of Dispatchable Loads

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#### Local Oportunities for Distributed Generation

Peak Demand Shaving

Security for Critical Loads

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#### Golden Rules from a System Perspective

Storage should be optimised observing the global goals

Cogeneration should be fully integrated.

*Local fossil fuel based balancing generation should be limited  
due to its relatively low efficiency and complex pollution regulation.*



## 4. LCOE Optimised Energy Mix



## 4. LCOE OPTIMISED ENERGY MIX

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### Progressively True Costs of Energy are globally acknowledged

- Competitive renewables should have their proportional share.
- Down Dispatchability vs Capacity Payments
- Good Complementarity is possible.
- 1m\$/MW of installed power.  
Short Term Horizon for SPV & Wind
- Gas & Hydro are good compensators.

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### Electric Systems must cater for Peak Demand.


Dispatchable Standby Plants → Balancing Plants (NO EXTRA !)

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### Virtual Power Plants – Centralised Control Centers for DG

Opportunity for energy management and balancing with advanced technologies:

- Accurate forecast of Stochastic Renewables
- Flexible Loads Management – Smart Grid
- Green Electric Car Storage Capacity



## 5. Robust and efficient generation with Microgrids

## 5. ROBUST AND EFFICIENT GENERATION WITH MICROGRIDS

### A Microgrid is an Integral Smart Grid

Manages Demand, Generation and Storage

### KEY Centralised Control:

- Internally Balanced
- Lower Congestion and Losses in Main Grid

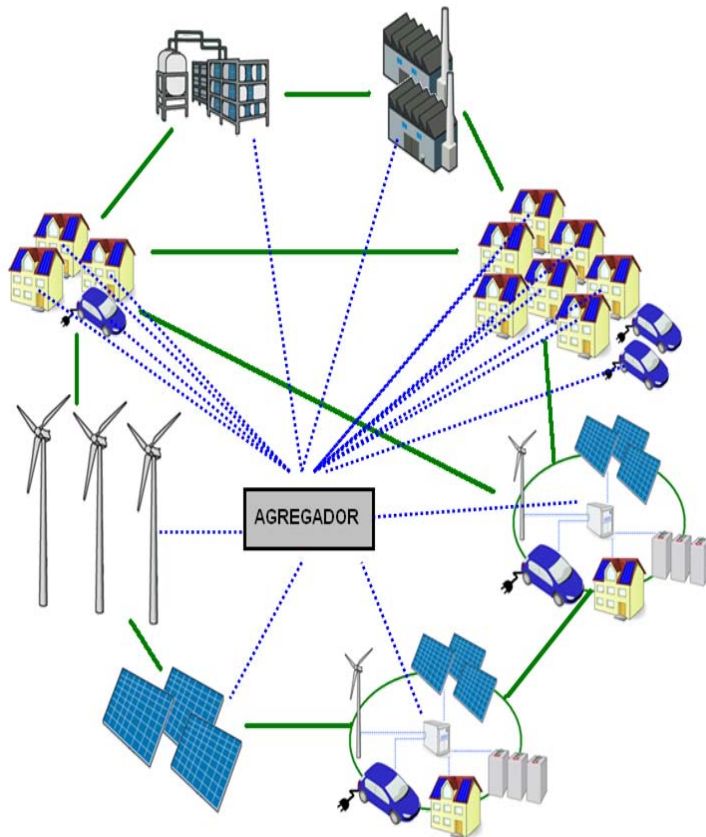
### TSO sees one single node

- Facilitates maximum Penetration of Renewable Energy & Cogeneration

### Organic Growth is Possible

### Grid Paradigm Change is needed

### Lack of Regulation and Operating Procedures





## 6. CENER MICROGRID



## 6. CENER MICROGRID

### 1- ELECTRICAL STORAGE EXPERIMENTAL PLATFORM



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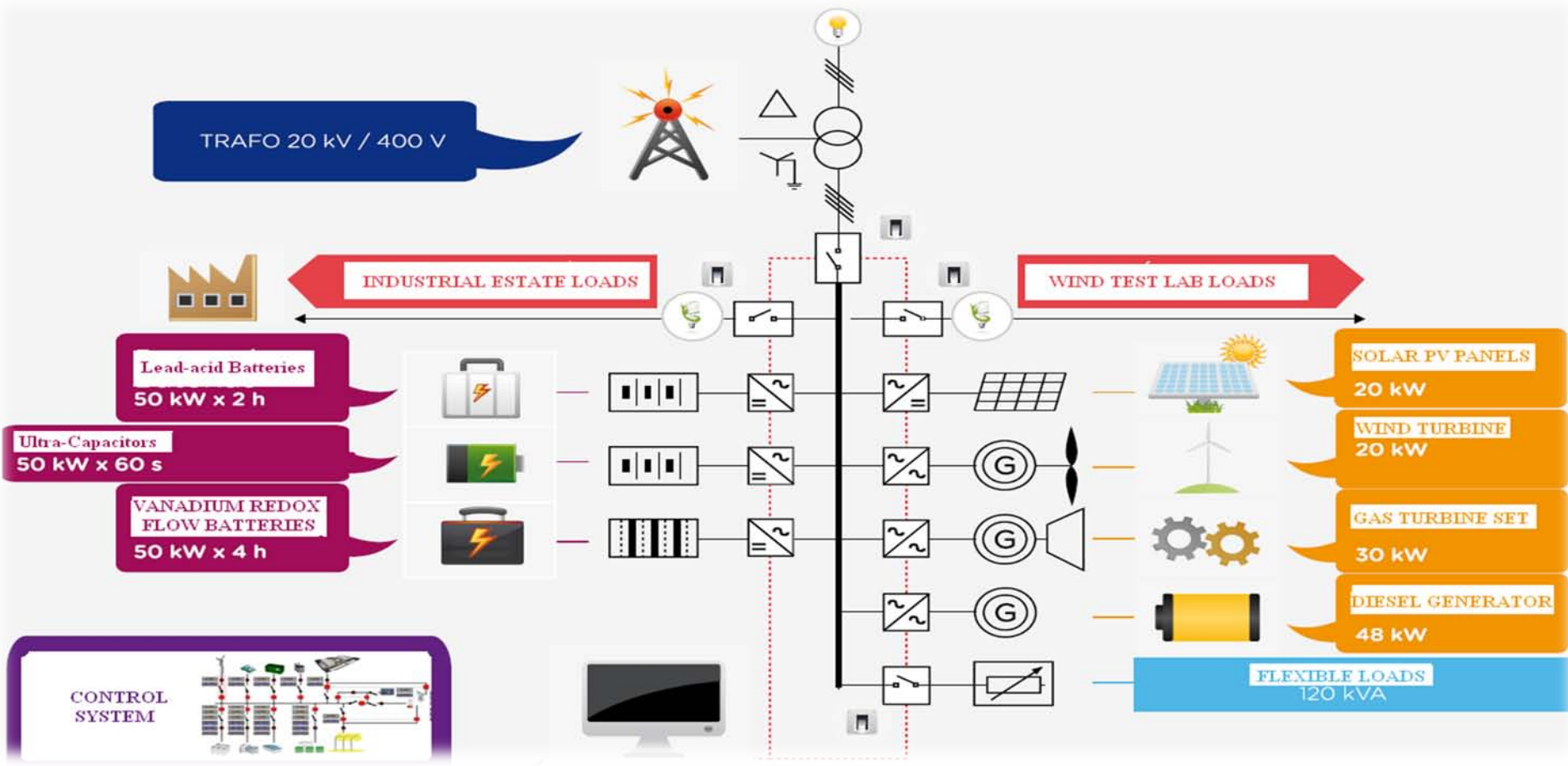
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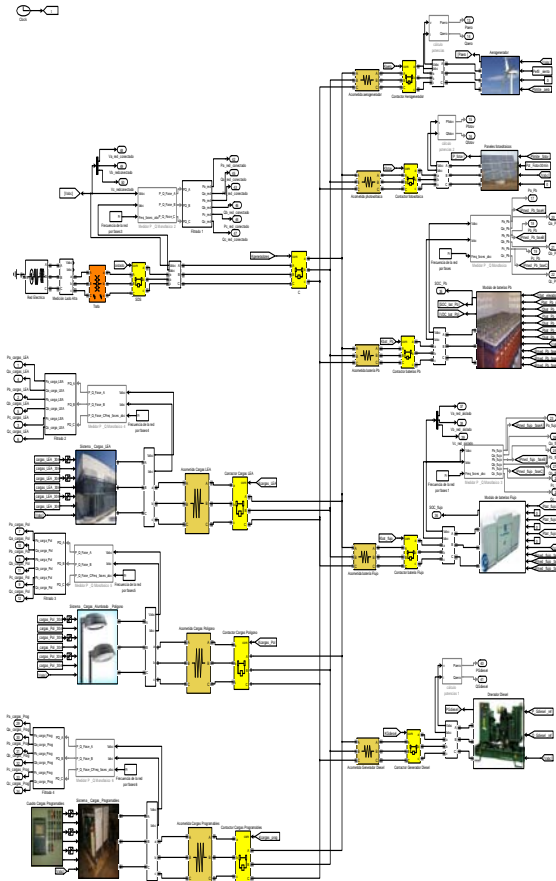
## 6. CENER MICROGRID

### 2- SEAMLESS ENERGY TECHNOLOGY INTEGRATION



## 6. CENER MICROGRID

### 3 - VERSATILE DESIGN FOR PRACTICAL APPLICATIONS



- ✓ Feeds Industrial Estate Lighting Loads
- ✓ Secures Wind Turbine Test Laboratory Loads
- ✓ TEST BENCH for Hybrid DG and Storage Systems
- ✓ Platform for Energy Management Strategies
  
- ✓ Flexible Configuration and Parametrisation  
to design and optimise purpose oriented microgrids:
  - Residential
  - Industrial
  - Electric Vehicle Charging Stations
  - Critical Applications (Hospitals, Jails, Defence, ...)



There is one road to the future....



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..., but we should not forget

In 1964, James Lovelock was among a group of scientists at the JPL who were requested by NASA to think of a life detection system for life on Mars that could be used by the Viking space mission. Wondering “*What is life intrinsically?*” Lovelock suggested how it could be recognised:

***“I ~~do~~ Look for a local entropy reduction, since this must be a necessary characteristic of Life”***

Possibly he had some reminiscences of a book published in 1944 *What is life?* written by the Nobel Prize Physicist E.Schrödinger, where an illuminating concept was clearly explained :

***“ Life strives againsts the increase of its entropy by feeding on Low entropy sources from its surroundings”*** ( primarily the SUN)

**“ONLY RENEWABLES ALIGN TRUE WITH LIFE COMPASS”**



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