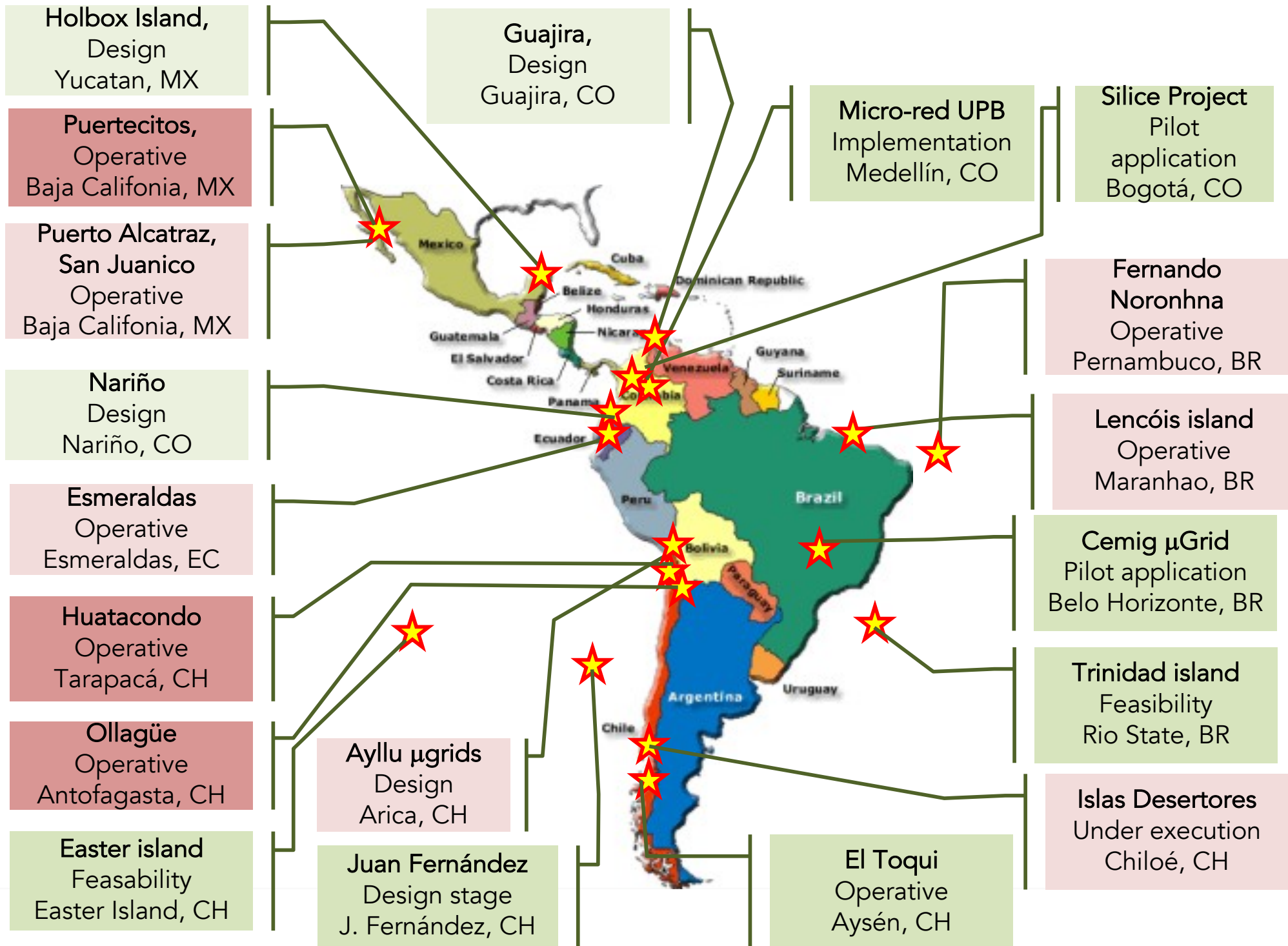


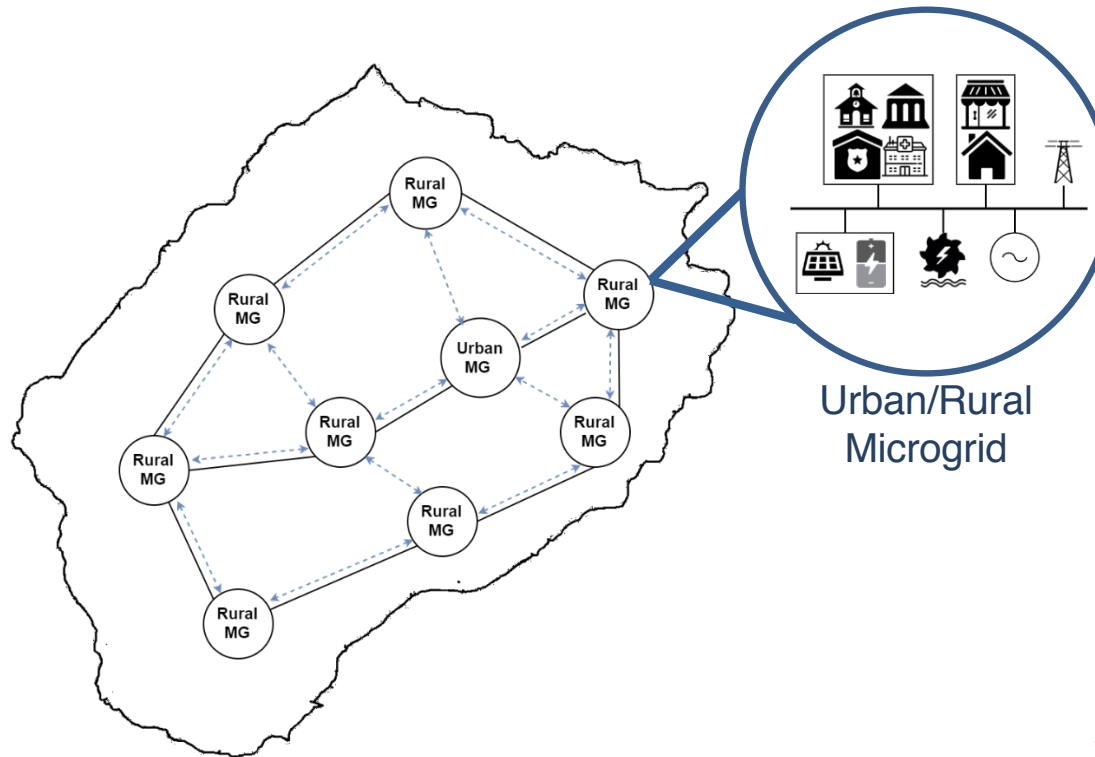
# Newcastle 2017 Symposium on Microgrids

## OVERVIEW OF MICROGRIDS IN LATIN AMERICA

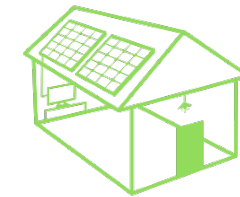
Guillermo Jiménez-Estévez  
Guillermo O. Garcia  
Rodrigo Palma-Behnke  
Felipe Valencia  
Nicanor Quijano  
Angélica Pedraza



# Microgrids for Non Interconnected Zones in Cundinamarca



**Design of Networked Microgrids**



**5 Nanogrids**



**Social SCADA**

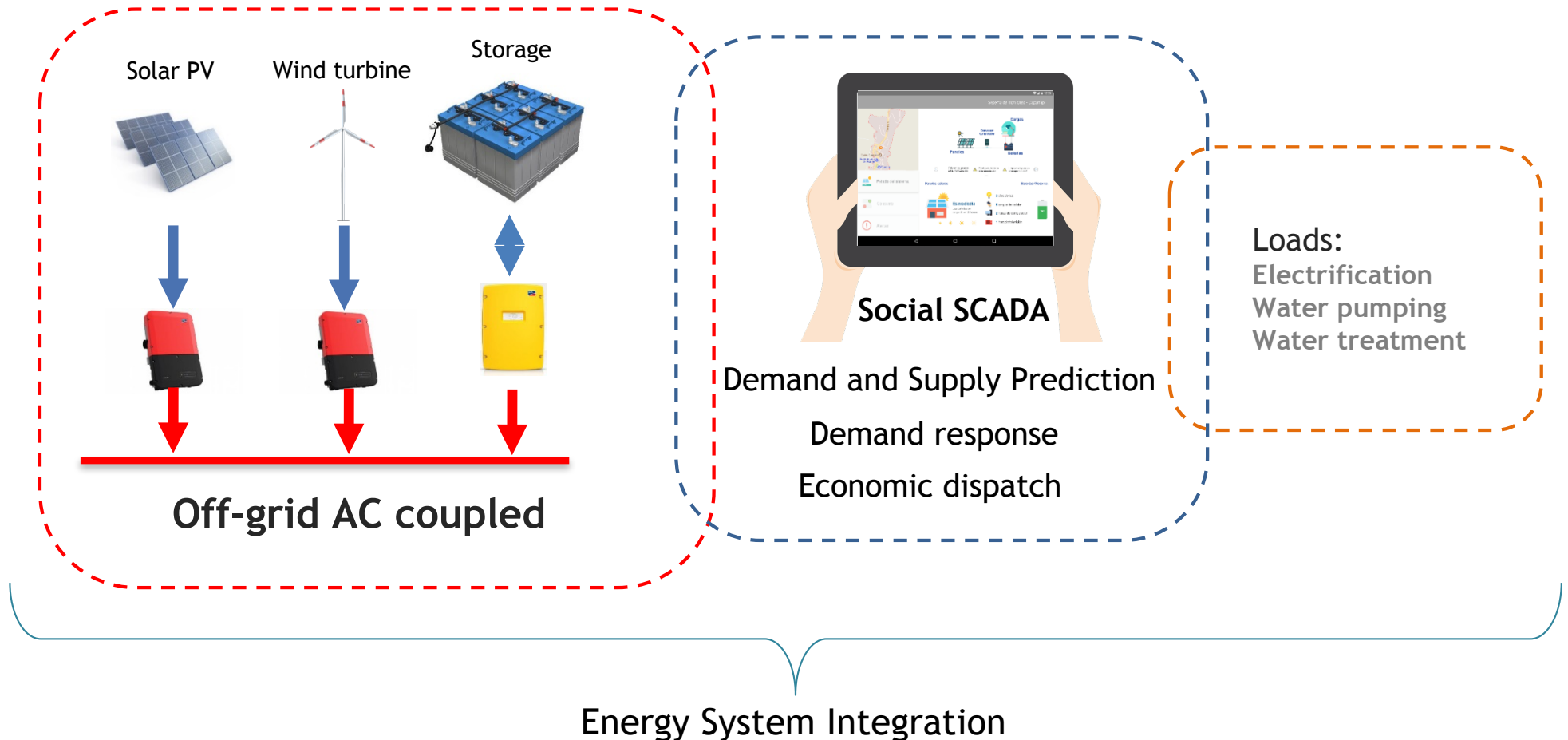
**Demand and Supply Prediction**



- Li, Z., Shahidehpour, M., Aminifar, F., Alabdulwahab, A., & Al-Turki, Y. (2017). Networked Microgrids for Enhancing the Power System Resilience. Proceedings of the IEEE.
- Palma-Behnke, R., Ortiz, D., Reyes, L., Jimenez-Estevez, G., & Garrido, N. (2011). A social SCADA approach for a renewable based microgrid—The Huatacondo project. In Power and Energy Society General Meeting, 2011 IEEE (pp. 1-7). IEEE.

# Microgrids for Non Interconnected Zones in La Guajira

## RE Hybrid Microgrid System (Solar - Wind - Storage)



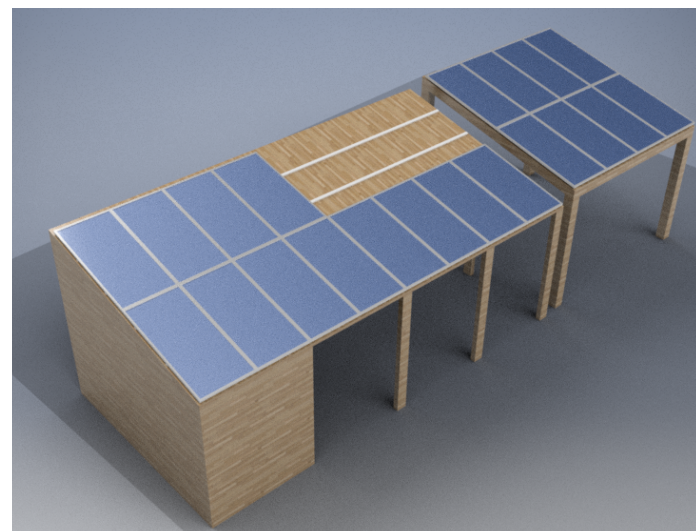
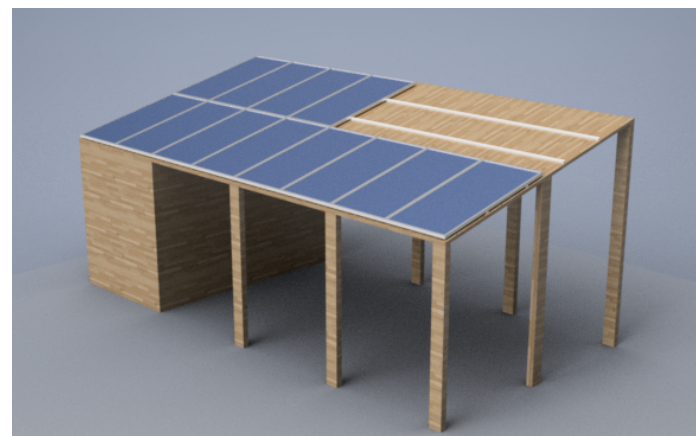


# Microgrids for Non Interconnected Zones in La Guajira

## RE Hybrid Microgrid System (Solar - Wind - Storage)



- Modular design
- AC coupled system
- The storage unit regulates the system frequency.
- The system has electric and meteorological variables as input, while power set points are considered outputs.
- Ethernet / WLAN as communication protocols.



# Microgrids for Non Interconnected Zones in Nariño

## Resource assessment



Statistical and satellite based and physical data estimation



15 meteorological stations - data validation

## Microgrid design



Community approach and load survey

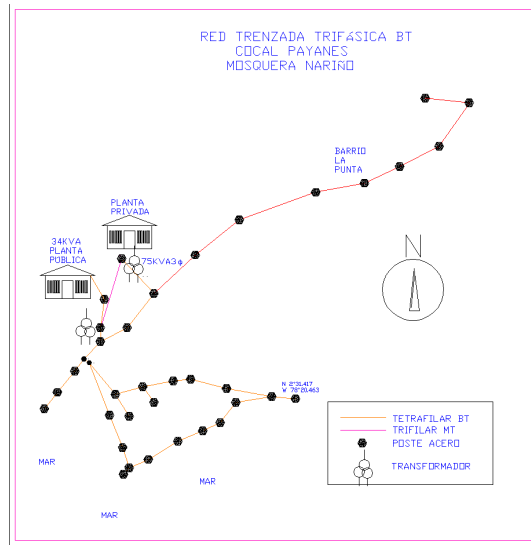


Assessment of initial infrastructure



# Microgrids for Non Interconnected Zones in Nariño

## Microgrid design



## Basic design and Technical engineering

		PV (kW)	Enair15	LISTER25KW (kW)	gas(20) (kW)	VRL 3500	Converter (kW)
		58,6	3	25,0	20,0	24	80,0
		39,1	5		20,0	24	80,0
			5	25,0	20,0	24	80,0
		58,6	3	25,0	20,0		80,0
		58,6	5	25,0		24	80,0

Back to communities:  
Socialize the project and  
community train



# Urban Microgrids - UDENAR case

## Microgrid concept


- Electric network characterization
- Data acquisition of load information and forecast
- Electric network simulation
- Distributed Generation analysis
- Communication network design
- Smart Metering
- Remote sensing of production and consumption





# EMS approaches

## Continuous optimal control approaches to microgrid energy management

Benjamin Heymann<sup>1</sup>  · J. Frédéric Bonnans<sup>1</sup> ·  
Pierre Martinon<sup>1</sup> · Francisco J. Silva<sup>2</sup> ·  
Fernando Lanas<sup>3</sup> · Guillermo Jiménez-Estévez<sup>3</sup>

$$(OCP) \begin{cases} \min_u \int_0^T \ell(u(t))dt + g(x(T)) \\ \dot{x}(t) = F(u(t), t) \\ x(0) = x_0 \\ u(t) \in U_{x(t)} \\ x(t) \in \mathcal{C}. \end{cases}$$

$$S\dot{O}C(t) = \frac{1}{Q_B}(P_I(t)\rho_I - P_O(t)/\rho_O),$$

$$P_D + P_O + P_S + P_{slack} - P_L - P_I = 0.$$

$$\int_0^T K P_D(t)^{0.9} dt,$$

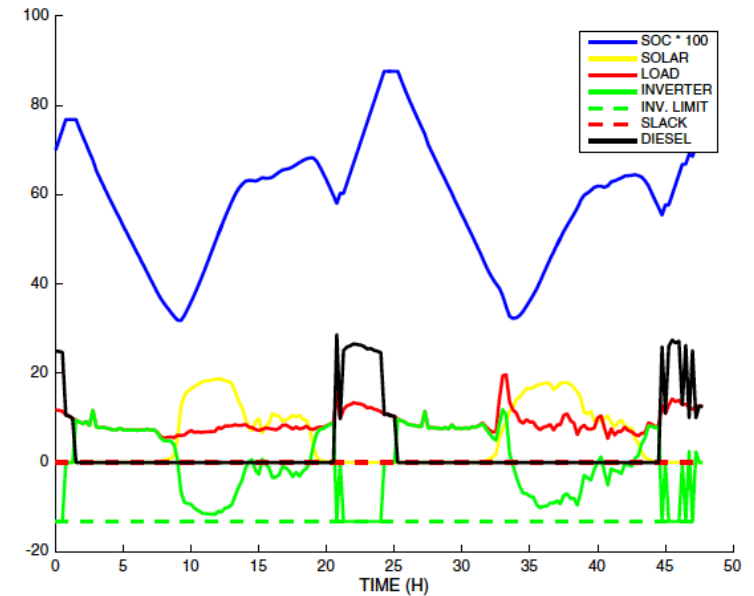


Fig. 5 Summer DPP simulation

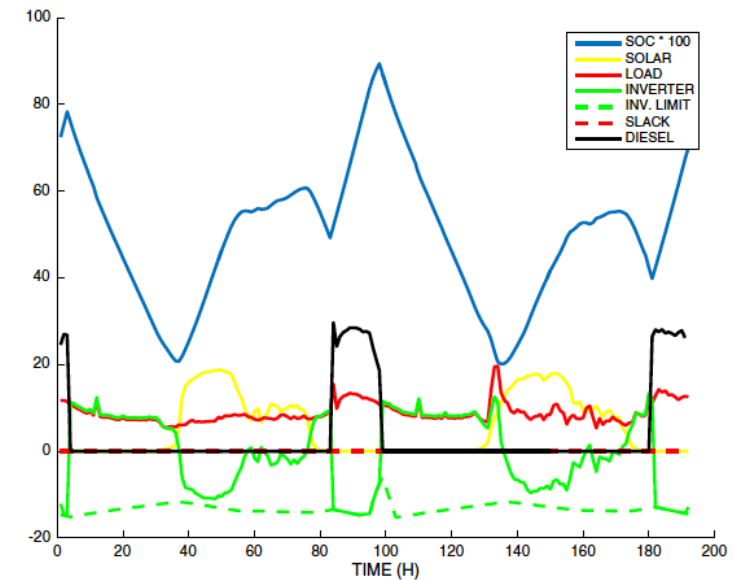


Fig. 9 Summer MILP simulation



## **Program CYTED**

CYTED is the acronym in Spanish of "Science and Technology for Development"

## **MEIHAPER**

(Spanish acronym for "Intelligent Hybrid Electric Microgrids with High Penetration of Renewable Energies")

Guillermo Oscar García  
General Coordinator

# OBJECTIVES

## **GENERAL:**

to found an Ibero-American Consortium, formed by research groups and companies, with the objective of developing Hybrid Intelligent Electric Microgrids with High Penetration of Renewable Energies at a demonstration scale, which can be replicated in different places.

## **PARTICULARS:**

- ✓ train human resources (HR) with R+D+i capabilities
- ✓ Promote the acceptance of these technologies to solve real problems
- ✓ Transfer knowledge to companies that are participating in the Consortium
- ✓ Generate new products specially adapted to the needs detected in Latin America.





# OBJECTIVES

The financing provided by CYTED is used to coordinate the actions scheduled for the 2017-2020 period.

The actions, as far as possible, are financed with resources contributed by the groups that are participating in the network.

Efforts are being made to obtain financing from national and multinationals institutions and companies, with the aim of strengthening and maintaining the activities of the Network over time, even after the 4 years of financing granted by CYTED.



# PARTICIPANTS

MEIHAPER is formed by:

- ✓ 13 Research groups as full members,
- ✓ 11 Institutions and companies as collaborators

from 9 different countries:

- ✓ Argentina,
- ✓ Brazil,
- ✓ Chile,
- ✓ Colombia,
- ✓ Ecuador,
- ✓ Spain,
- ✓ Mexico,
- ✓ Portugal and
- ✓ Venezuela

## **Coordination:**

National Council of Scientific and Technical Research (CONICET) and National University of Río Cuarto (UNRC), Argentina.



MEIHAPER CYTED



**What has MEIHAPER-CYTED done?**



MEIHAPER CYTED





**MEIHAPER-CYTED**

(Intelligent Hybrid Electric Microgrids with High Penetration of Renewable Energies)



# **1st Ibero-American Symposium on Intelligent Microgrids with Integration of Renewable Energies**

**August 14 to 18, 2017**

**Autonomous University of the West, Cali, Colombia  
Universidad Autónoma de Occidente, Cali, Colombia**





# INVITATION

## 2nd Ibero-American Symposium on Intelligent Microgrids with Integration of Renewable Energies

**September 2018, Itaipu, Brazil**

### Visits:

- ✓ Iguazú Falls,
- ✓ Itaipú hydroelectric power station and
- ✓ HVDC transformation station of +/- 700 kV

