Evora Microgrids Symposium

America´s session

Juan Fernández Island Project
Latin American Developments

CENTRO DE ENERGÍA

Dr. Guillermo Jiménez Estévez

Evora, September 2012

fcfm

Agenda

- Introduction
- Juan Fernandez island project
- Isolated microgrids
- Micro hydro P&P
- Latin American Developments

Introduction

Chilean Energy Supply Challenge

Energy efficiency programs

- Industry
- Transportation

Integration of huge potential of renewable based **distributed energy resources**

Traditional Supply Solutions

- Fossil fuels
- Huge hydro power plants
- Transmission expansion
- Large-scale non-conventional ..

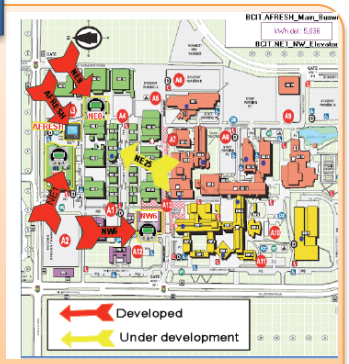
Cost-effective Smart Power Microgrid solutions

C-MG ***I-MG*** ***E-MG***

C-MG (Coordinated integration of distributed renewable resources to the interconnected power grid)

Incorporating distributed generation power injections to grid

- Coordination platform for a strong control and monitoring of SPMGs
- Virtual Power Plant



I-MG (Electrification of remote villages with abundant local renewable energy resource)

SPMG operating in islanding way

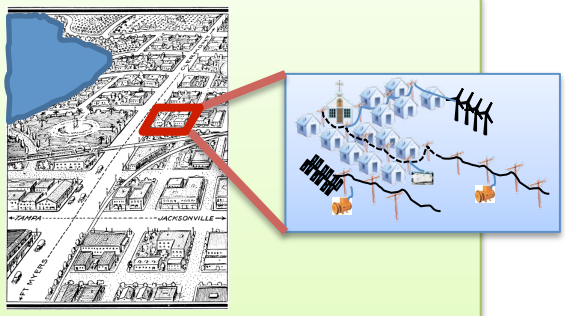
- Must be able to integrate and coordinate several energy sources with appropriate load-frequency strategies
- Active participation of the local community

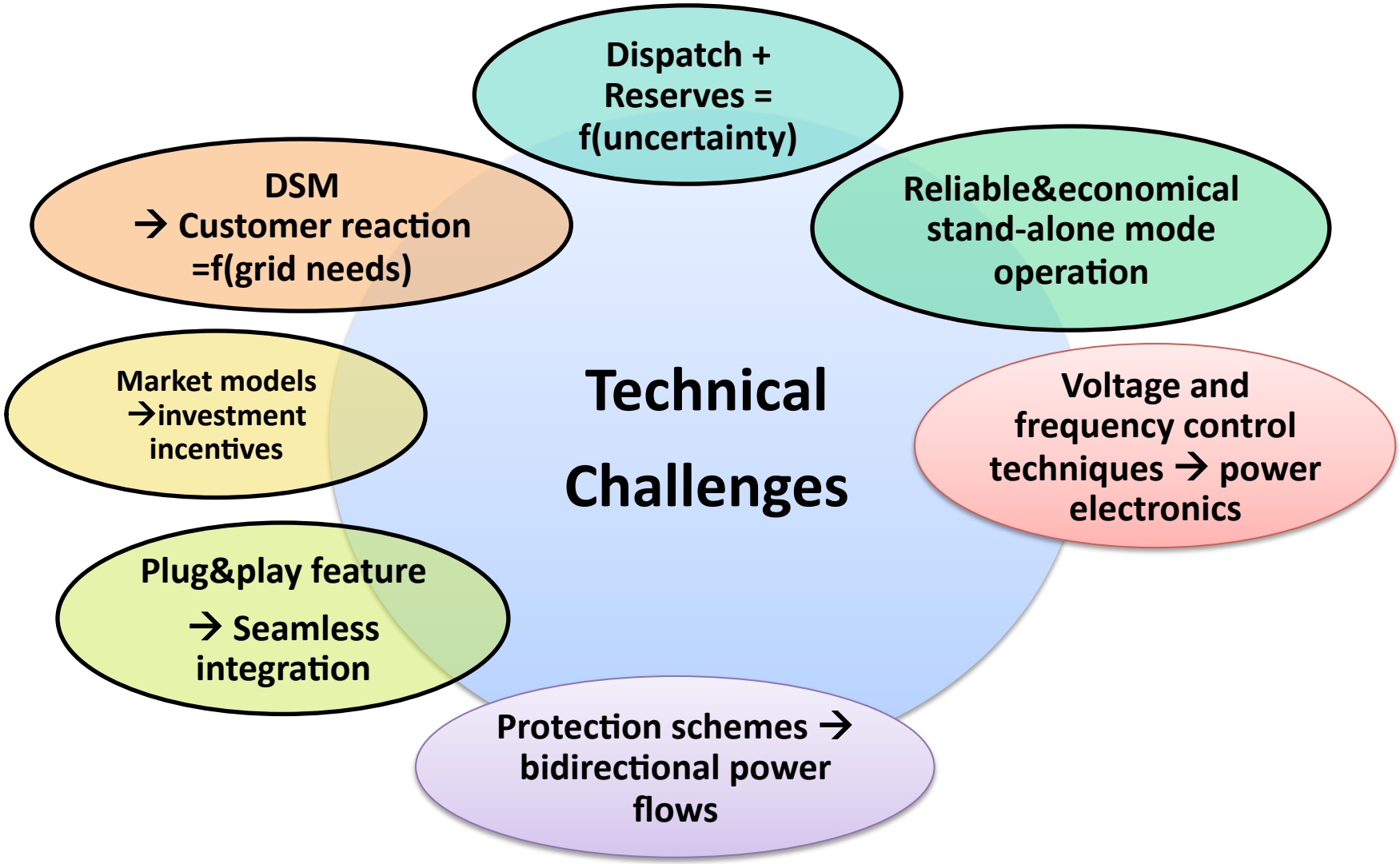
Source: Denda, Shimizu Corpotation

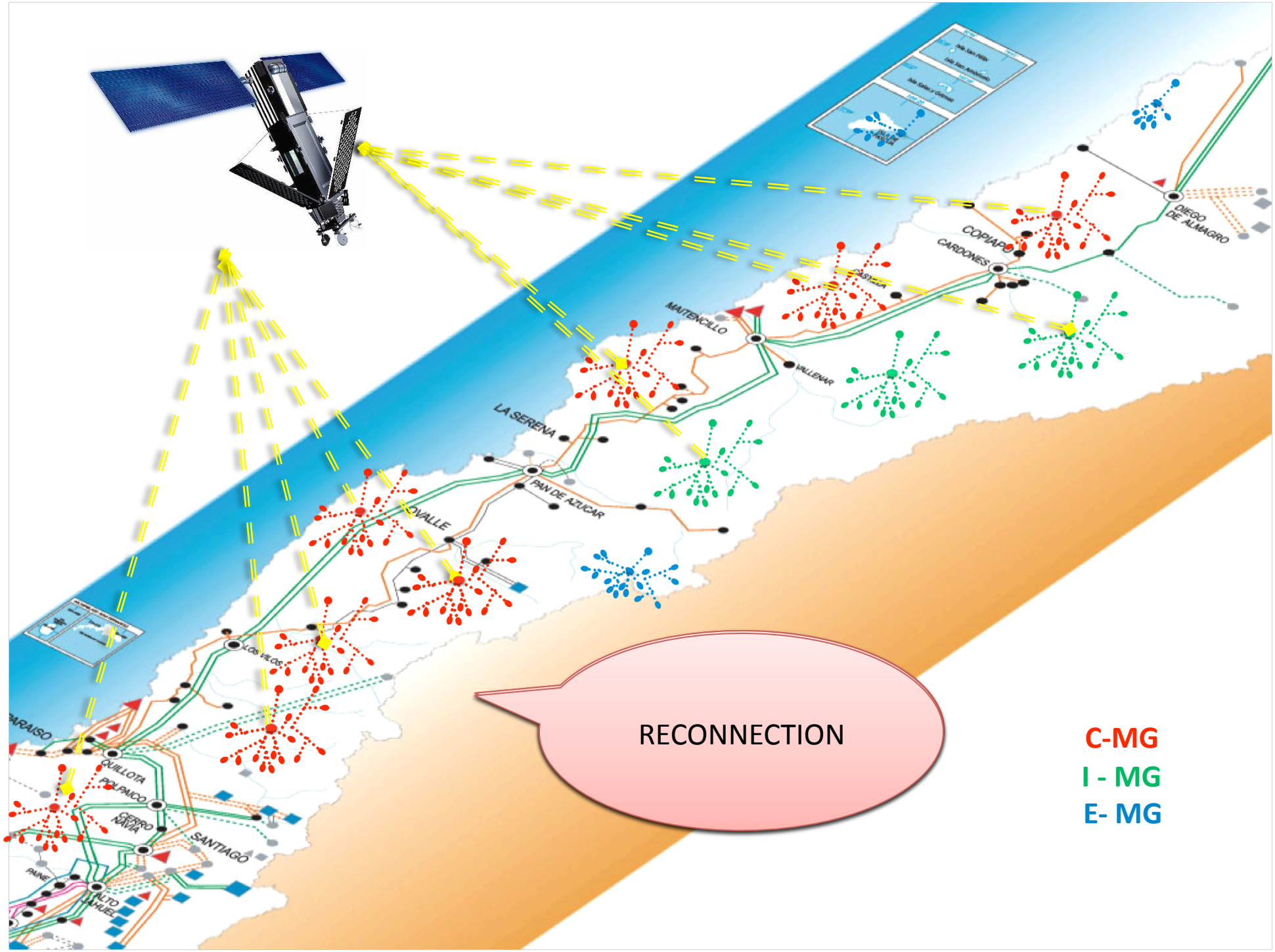
E-MG (Development of critical infrastructure power systems)

Emergency systems

- Locations prone to face natural disasters such as earthquakes, tsunamis, storms, floods.
- It is applicable both for islanding and interconnected application where the energy supply for a sector of the system must be continuous for a wide range of contingencies




Dispatch + Reserves = f(uncertainty)
DSM → Customer reaction =f(grid needs)
Reliable&economical stand-alone mode operation
Market models →investment incentives
Technical Challenges
Voltage and frequency control techniques → power electronics
Plug&play feature → Seamless integration
Protection schemes → bidirectional power flows


DIEGO DE ALMAGRO
COPIAPO
CARDONES
MAITENCILLO
VALLENAR
LA SERENA
PAN DE AZUCAR
OVALLE
LOS VILOS
QUILLOTA
POLPAICO
CERRO NAVIA
SANTIAGO
PAINE
ALTO MAHUEL
RECONNECTION
C-MG
I - MG
E- MG

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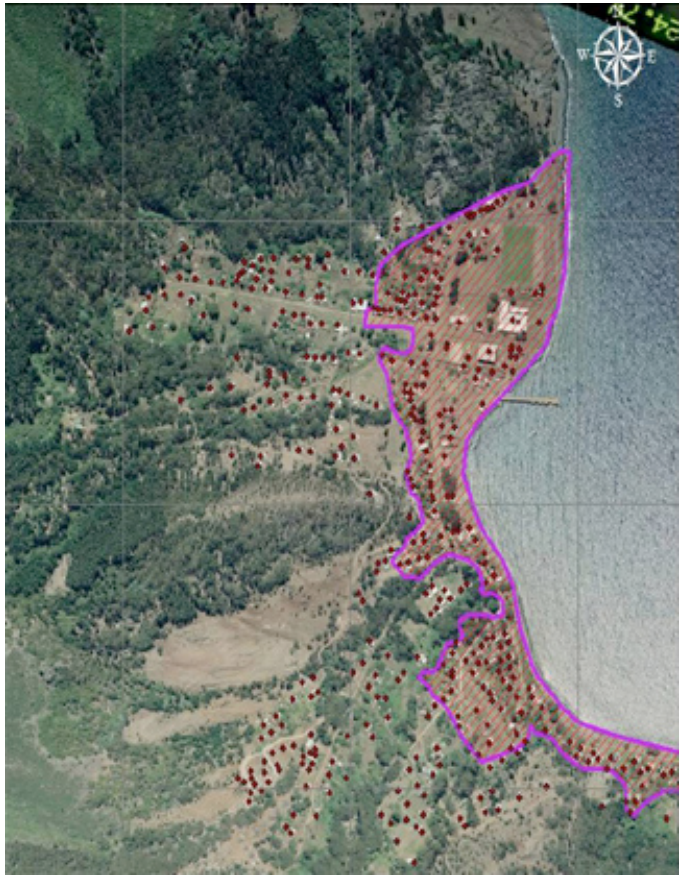
Juan Fernández Project

San Juan Bautista
900 inhabitants

Robinson Crusoe Island

Juan Fernández Project

27/02/10 Earthquake - Tsunami



Power supply interruption →
Health, communication, security

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Design criteria:

- Operation of the E-MG does not involve the integration of stand by diesel engines

- Autonomy time under emergency: according to inhabitants criterion and
- expected time for ship support → 2 days

- Energy consumption pattern under emergency: critical loads + behavior pattern

- Under normal operation condition storage system at floating state

- Worst case: MG dimensioning as a function of autonomy time, maximum demand
- and minimum availability of natural resources (winter)

- PV size: conditioned by operating constraints of the actual power system.

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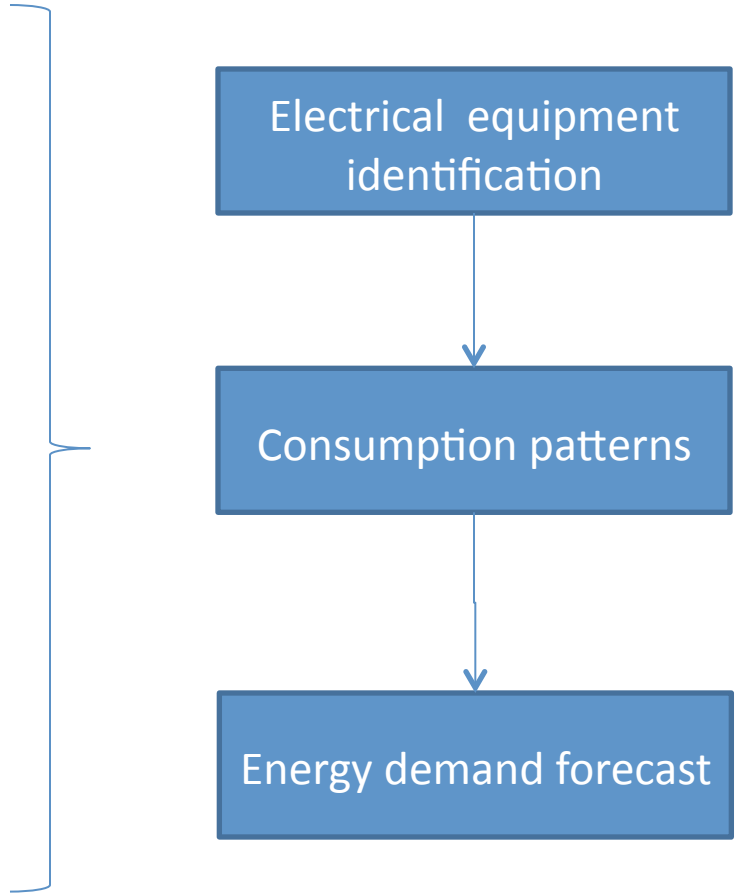
Critical loads:

- Municipal Offices
- DGAC offices at San Juan Bautista
- Port captaincy
- Family Health Center (CESFAM)
- CONAF administration
- Robinson Crusoe School
- Sandalito Kindergarten
- Police offices
- Power plant lighting
- Drinking water treatment plant
- Evacuation ways
- Mobile phone antennas
- Community radio antenna
- Bío Bio radio future antenna.
- Emergency siren



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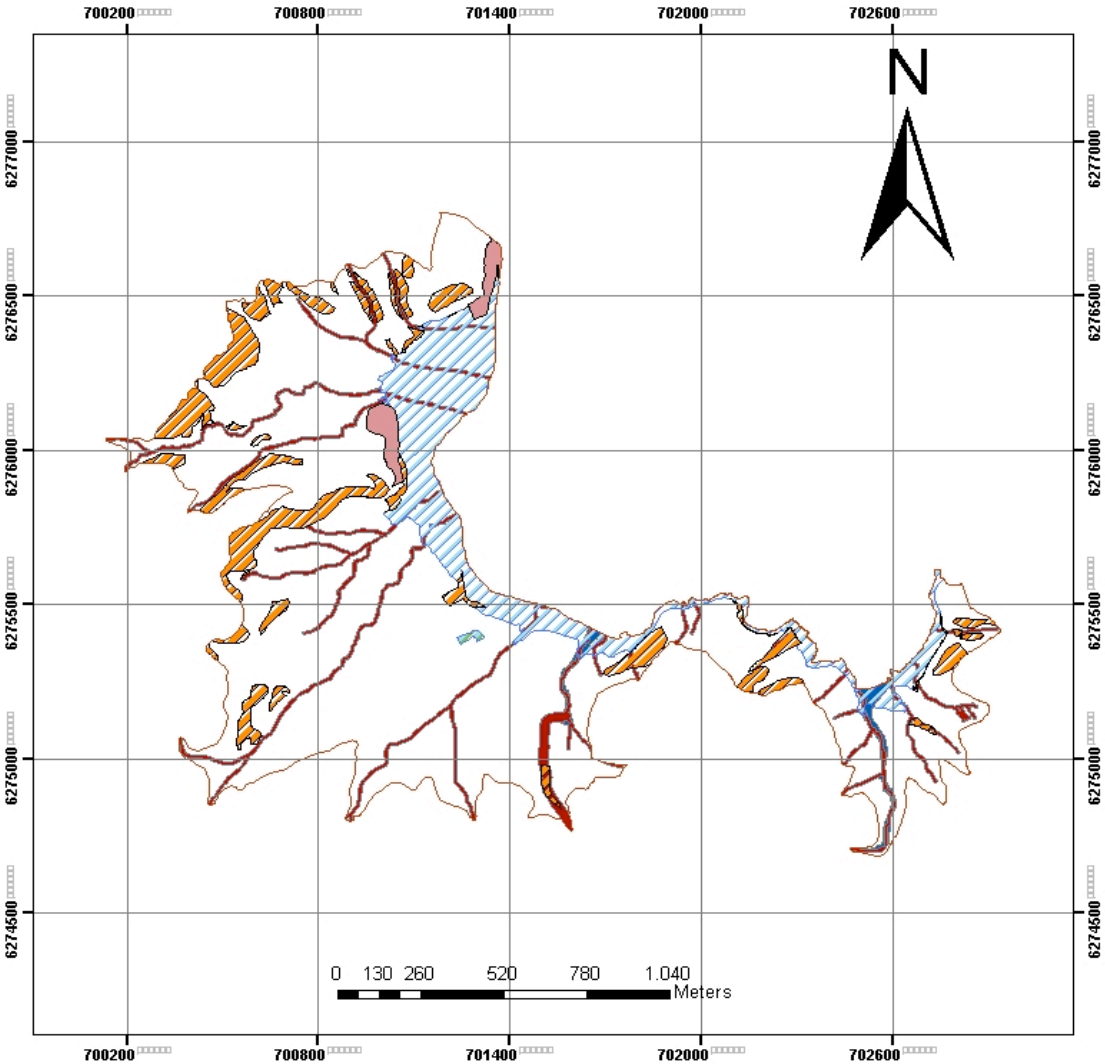

Symbology

- Urban limit
- Heritage areas
- Sea birds nests
- Removal risks
- Tsunami risks
- Small river risks
- Flooding risks

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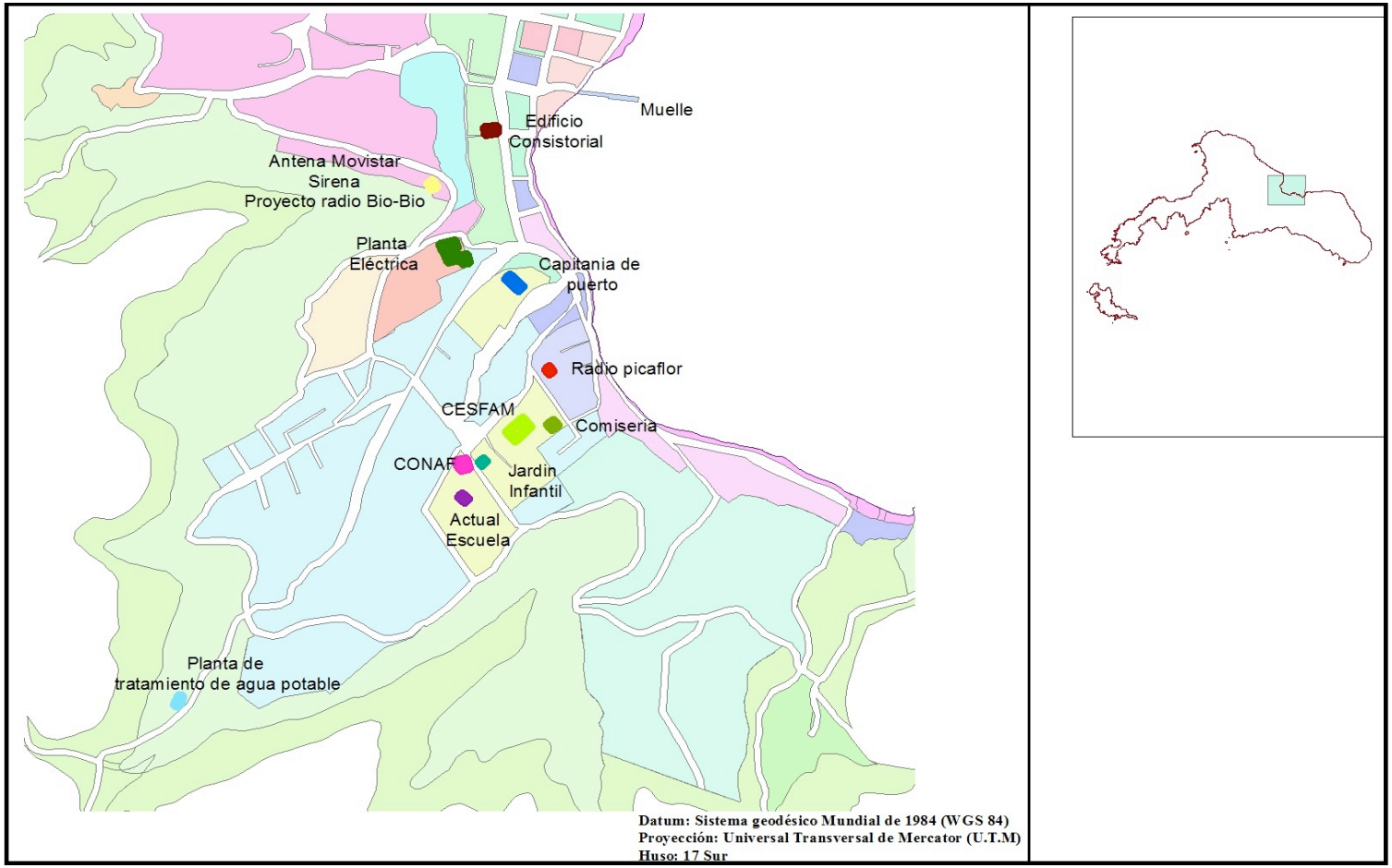
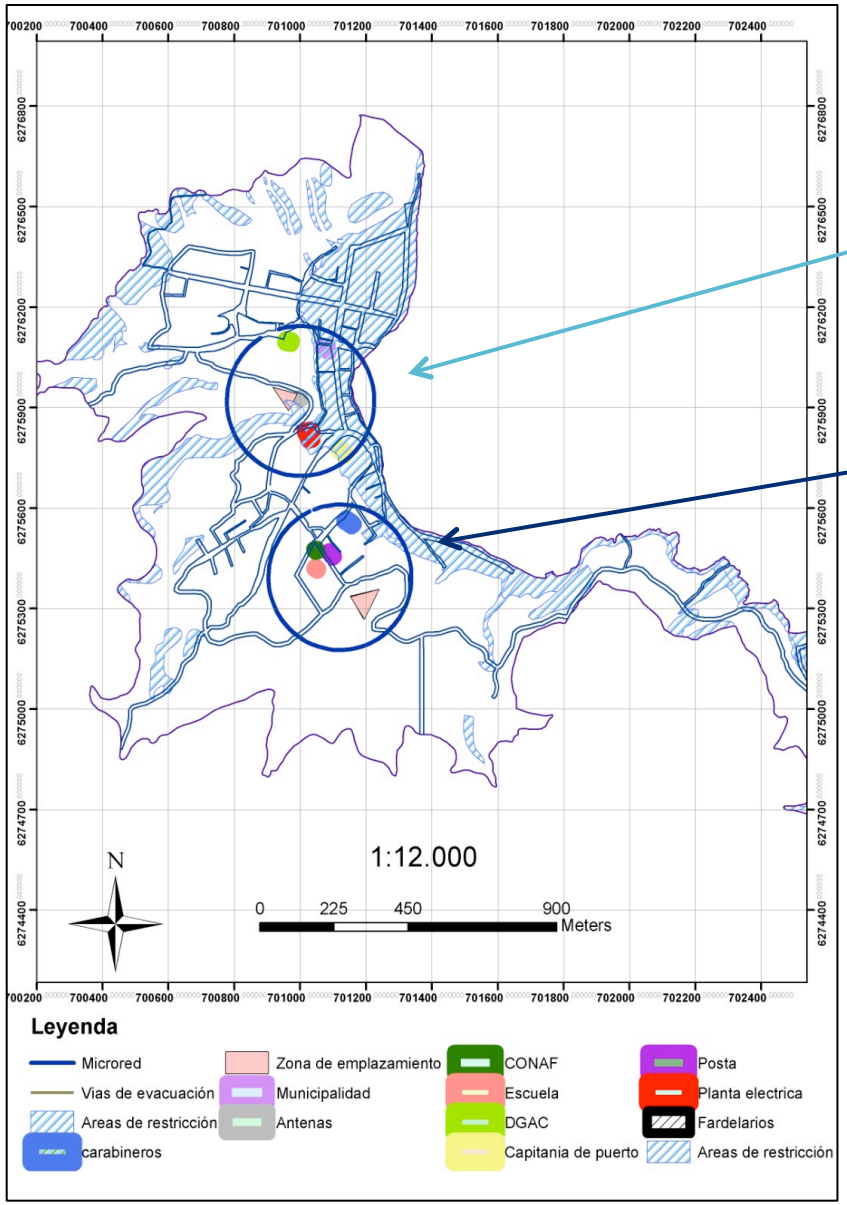
Critical consumptions



Evora Microgrids Symposium

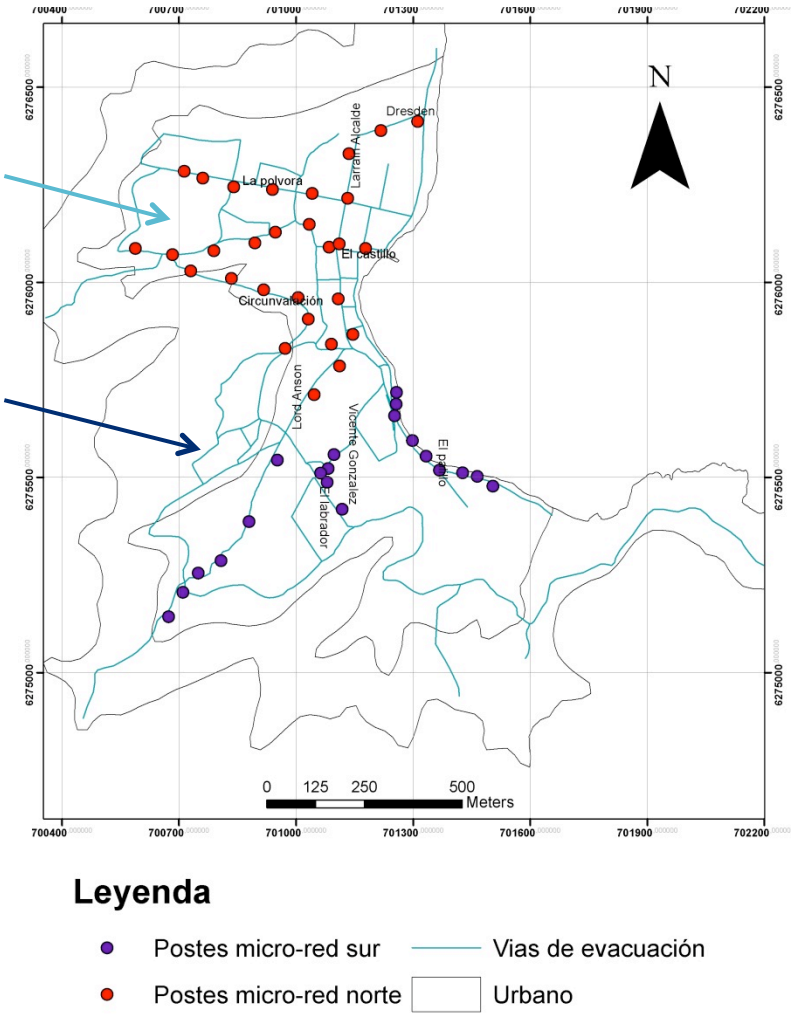
└ Juan Fernández Project / LA Developments

└ Emergency MG / Juan Fernández Project



North MG

South MG



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Expected energy consumption:

Microgrid	Consumption [kWh/day]
North	280.350
South	158.287
-	2.400
Total	**441.038**

Storage dimensioning:

Microgrid	Energy [kWh]	Area [m²]
North	700.876	105
South	395.718	59
Total	**1096.594**	**164**

Diesel engine specification :

Rating [kVA]	Prime power [kW]
200	**144**

PV specification :

Microgrid	Capacity [kW]	Area [m²]
North	36	1080
South	20	600
Total	**56**	**1680**

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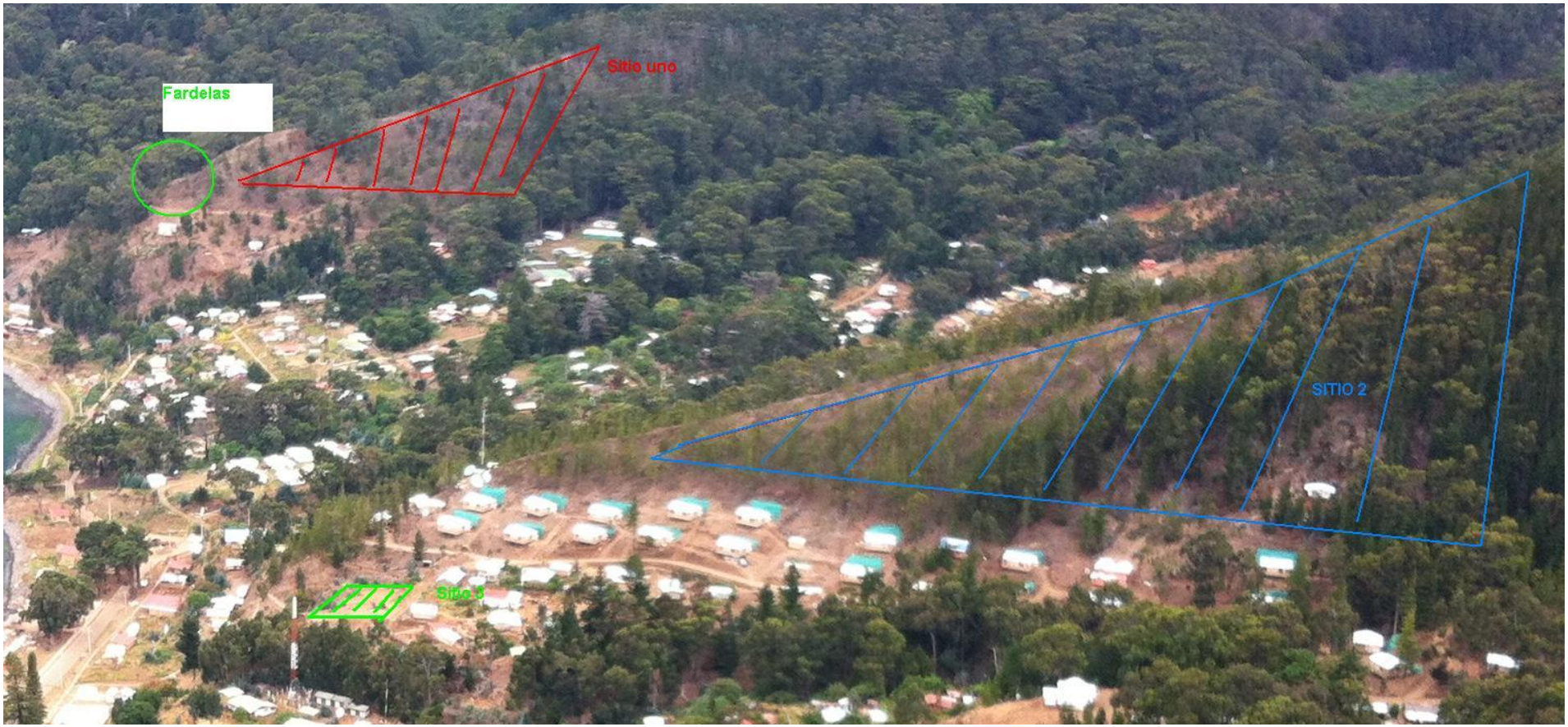
PV siting



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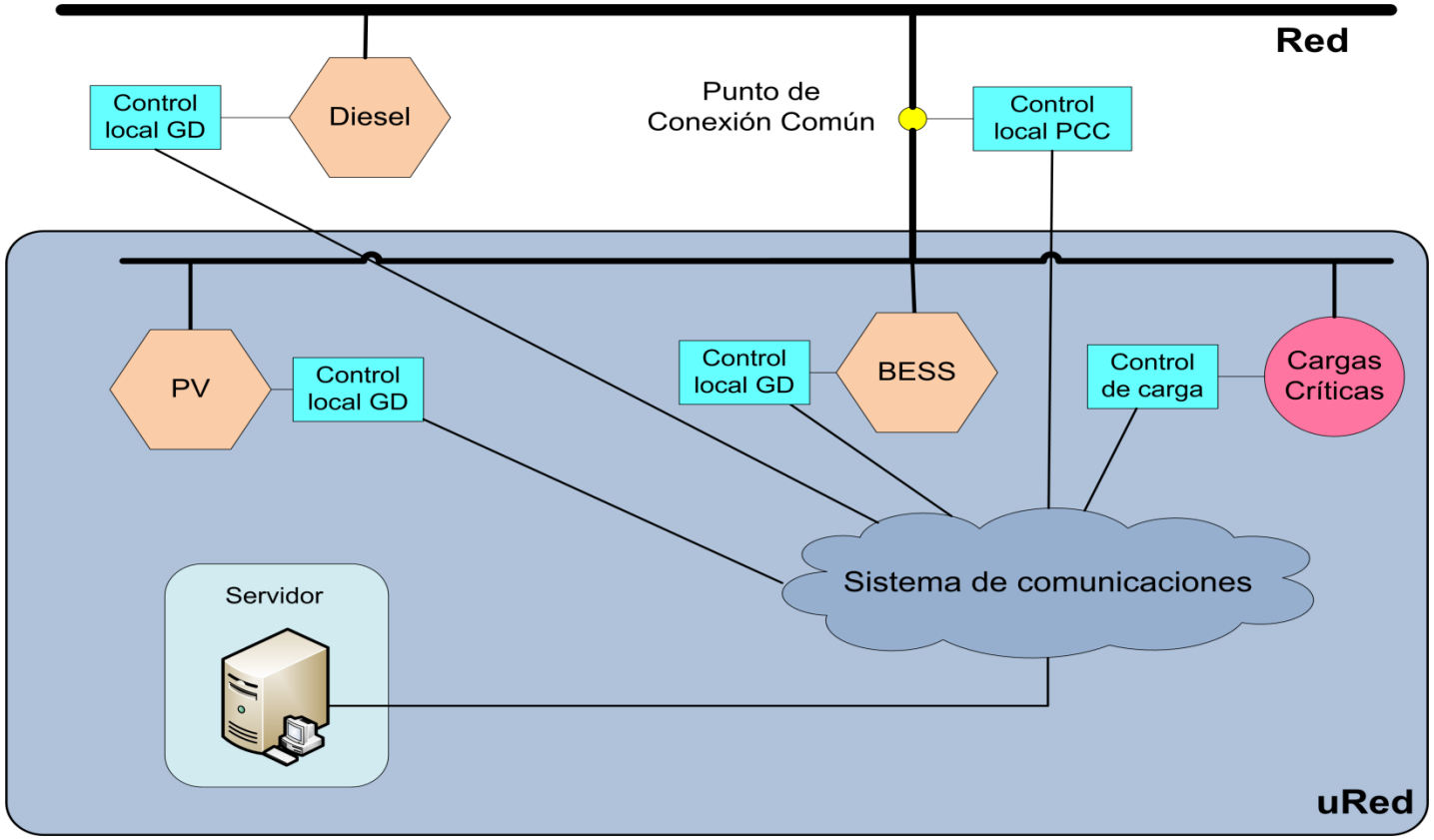
Communication system



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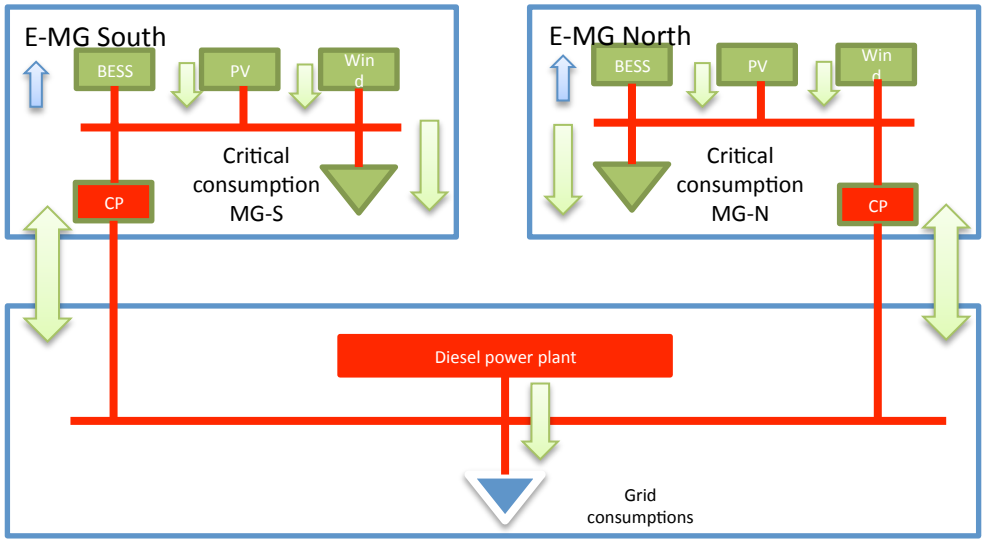
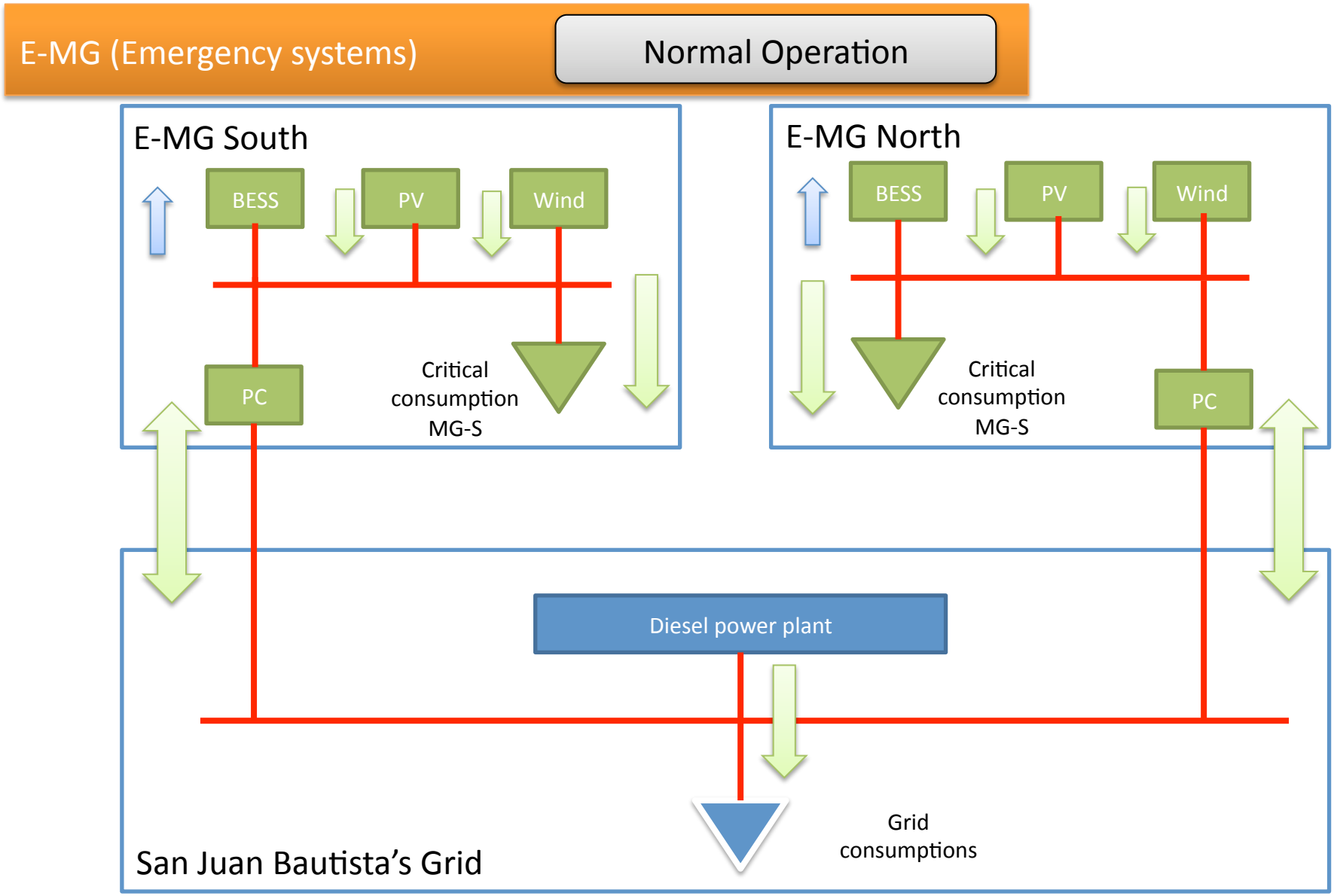
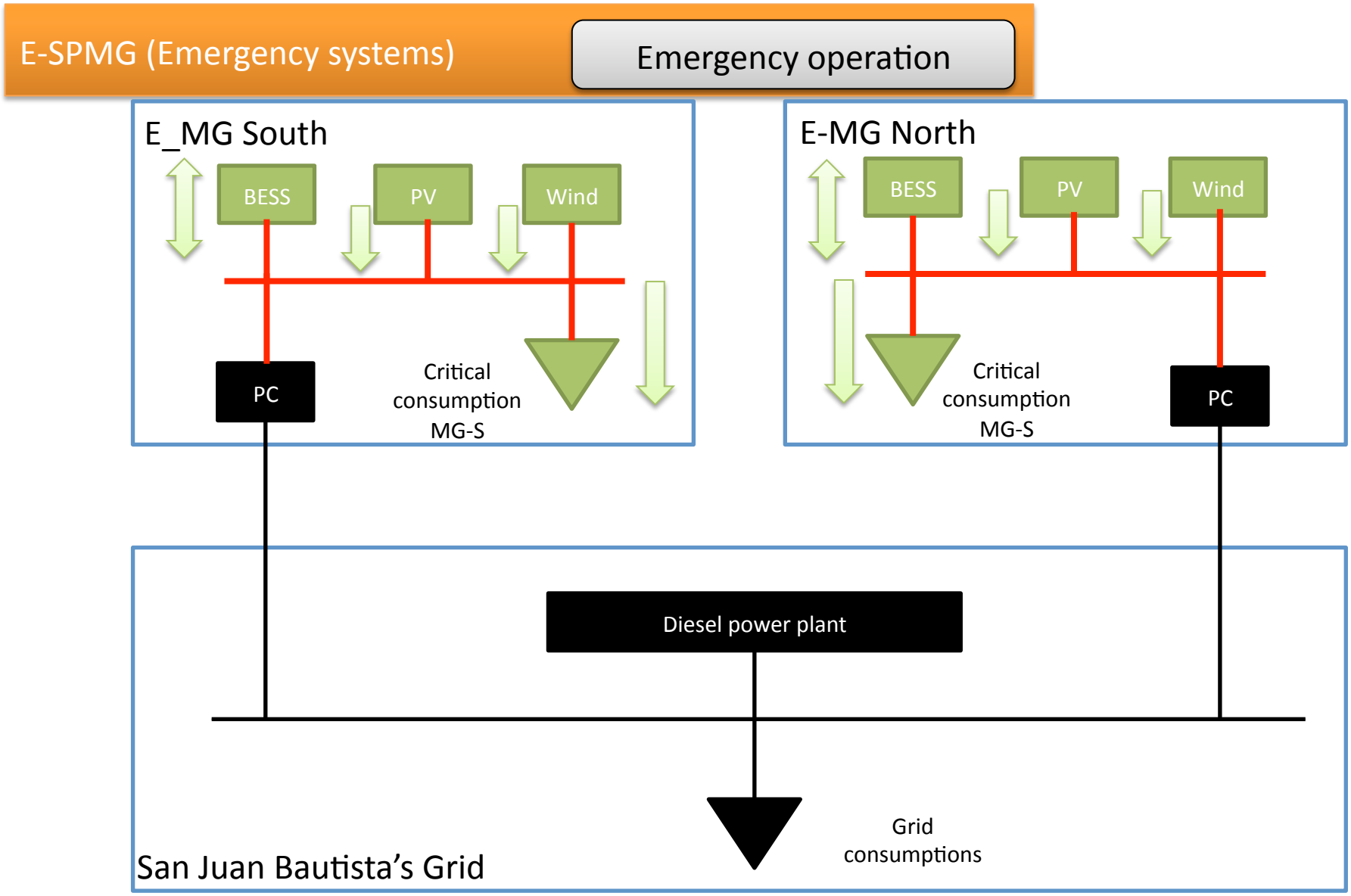
Operation states



ID	CPS	CPN	Diesel	Operation States
1	1	1	1	Normal / Synchronized
2	0	0	0	Emergency - Diesel
3	0	0	1	Re - synchronization
4	1	0	1	Emergency MGN
5	0	1	1	Emergency MGS
6	1	1	0	prohibited
7	1	0	0	prohibited
8	0	1	0	prohibited


E-MG (Emergency systems)
Normal Operation
E-MG South
BESS
PV
Wind
PC
Critical consumption MG-S
E-MG North
BESS
PV
Wind
Critical consumption MG-S
PC
Diesel power plant
Grid consumptions
San Juan Bautista's Grid


E-SPMG (Emergency systems)
Emergency operation
E_MG South
BESS
PV
Wind
PC
Critical consumption MG-S
E-MG North
BESS
PV
Wind
Critical consumption MG-S
PC
Diesel power plant
Grid consumptions
San Juan Bautista's Grid

Juan Fernández Project

Expected project timeline:

Microgrid design and technical specifications: January to July 2012

Energy ministry public tender: November to December 2012

Project execution: March 2013 – August 2013

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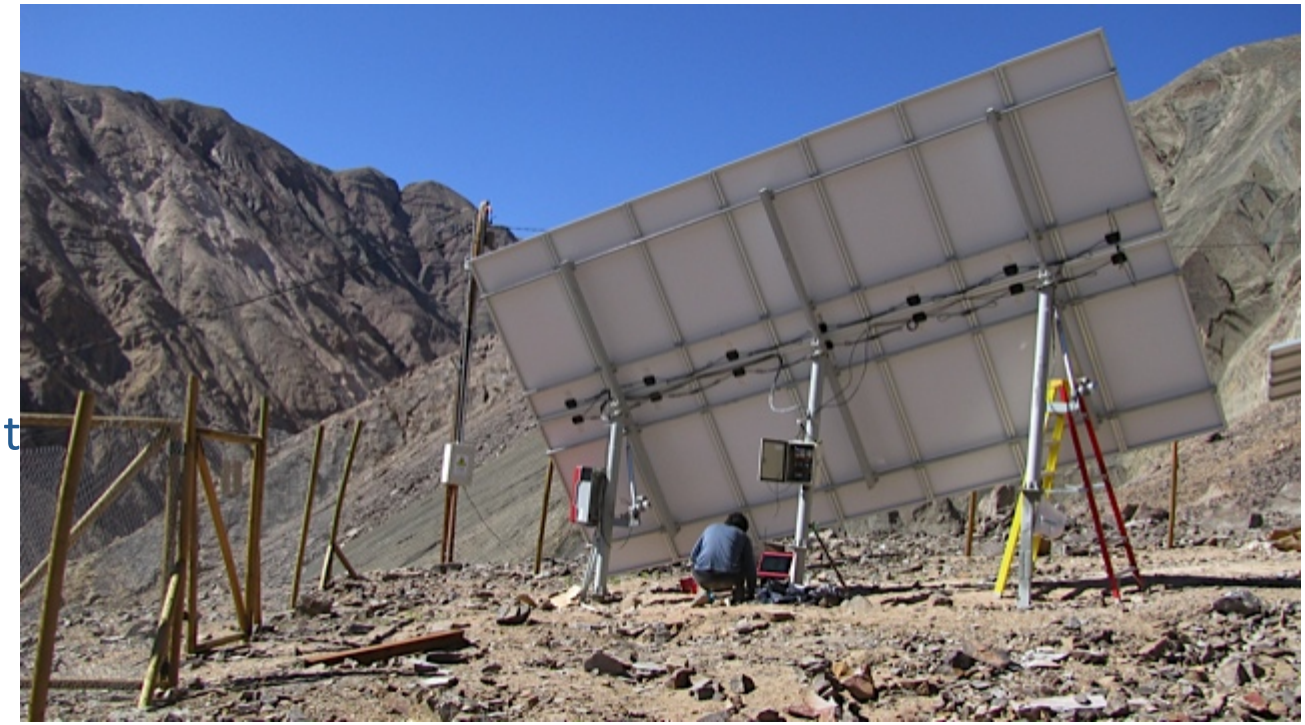
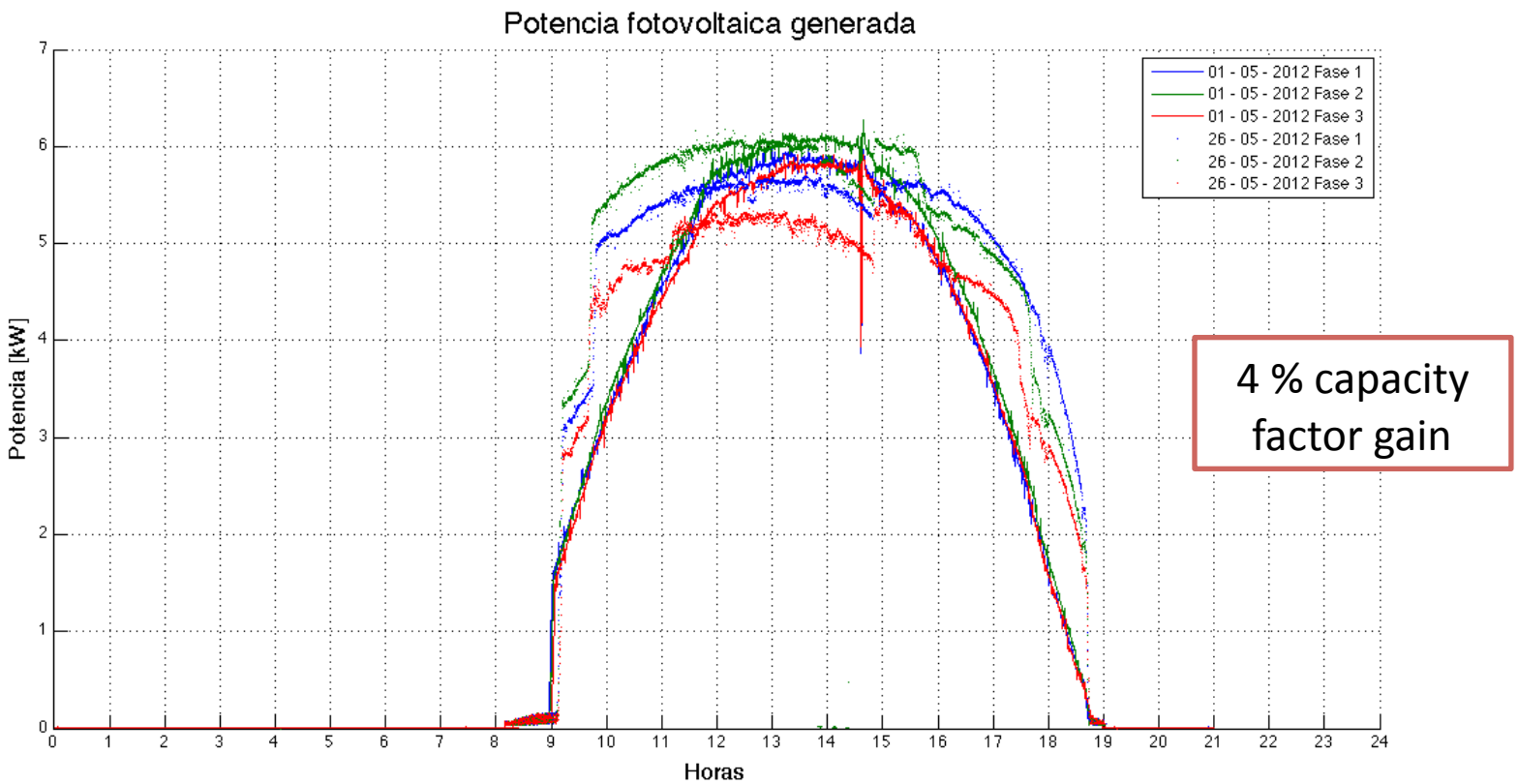
Chile developments – Huatacondo (PV tracking)

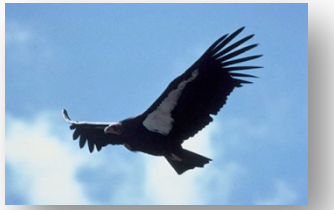
- 2 linear actuators
- No sensors
- Centralized control
- Position feedback
- Intelligent relay local cont
- Mechanical constraints considered on EMS



Chile developments – Huatacondo (PV tracking)



Chile developments – Huatacondo (Wind turbine)



- 3kW
- 12m high
- 8 m/s average
- Bird of prey protection
- 1ph – 3ph inverter

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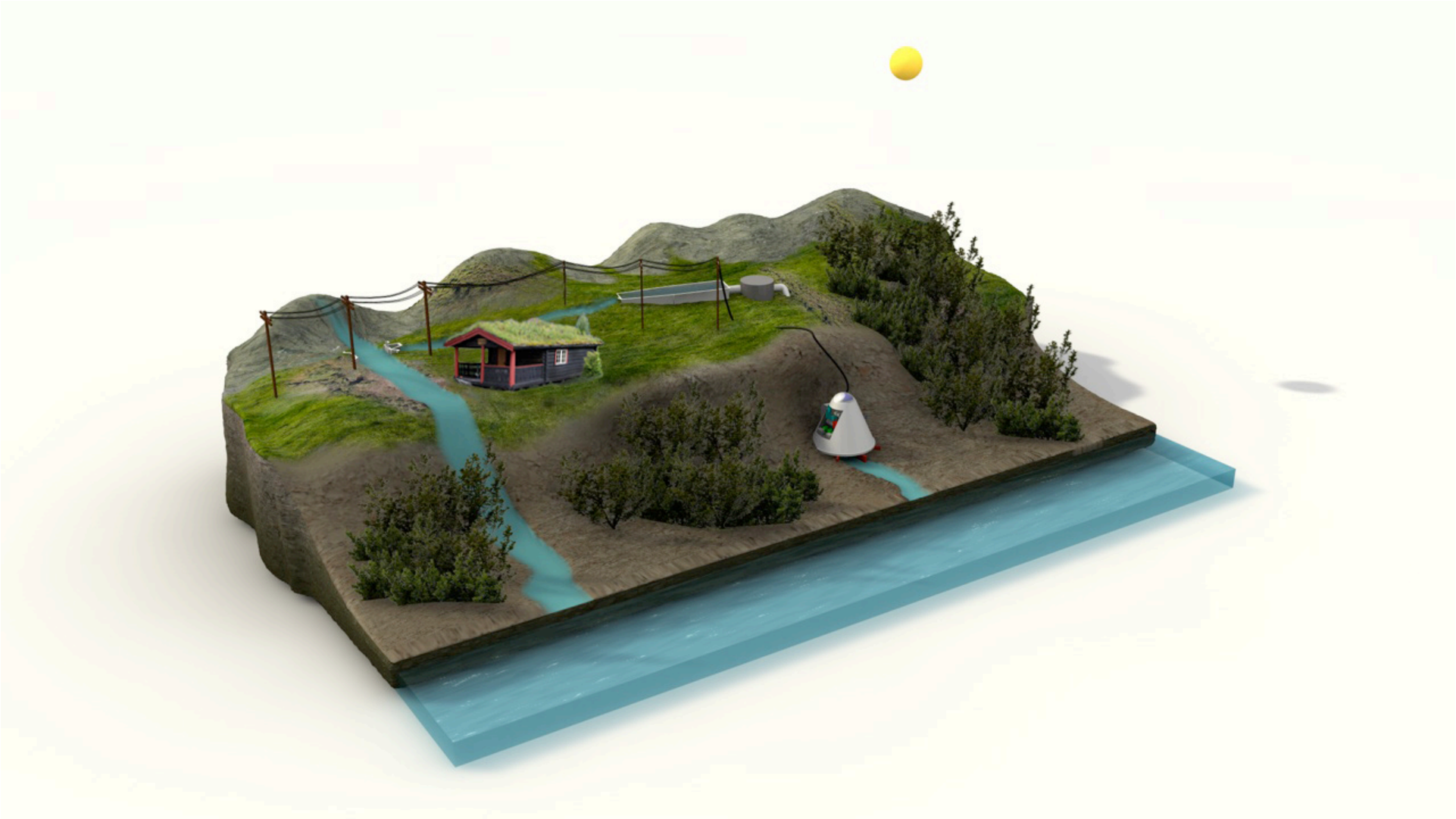
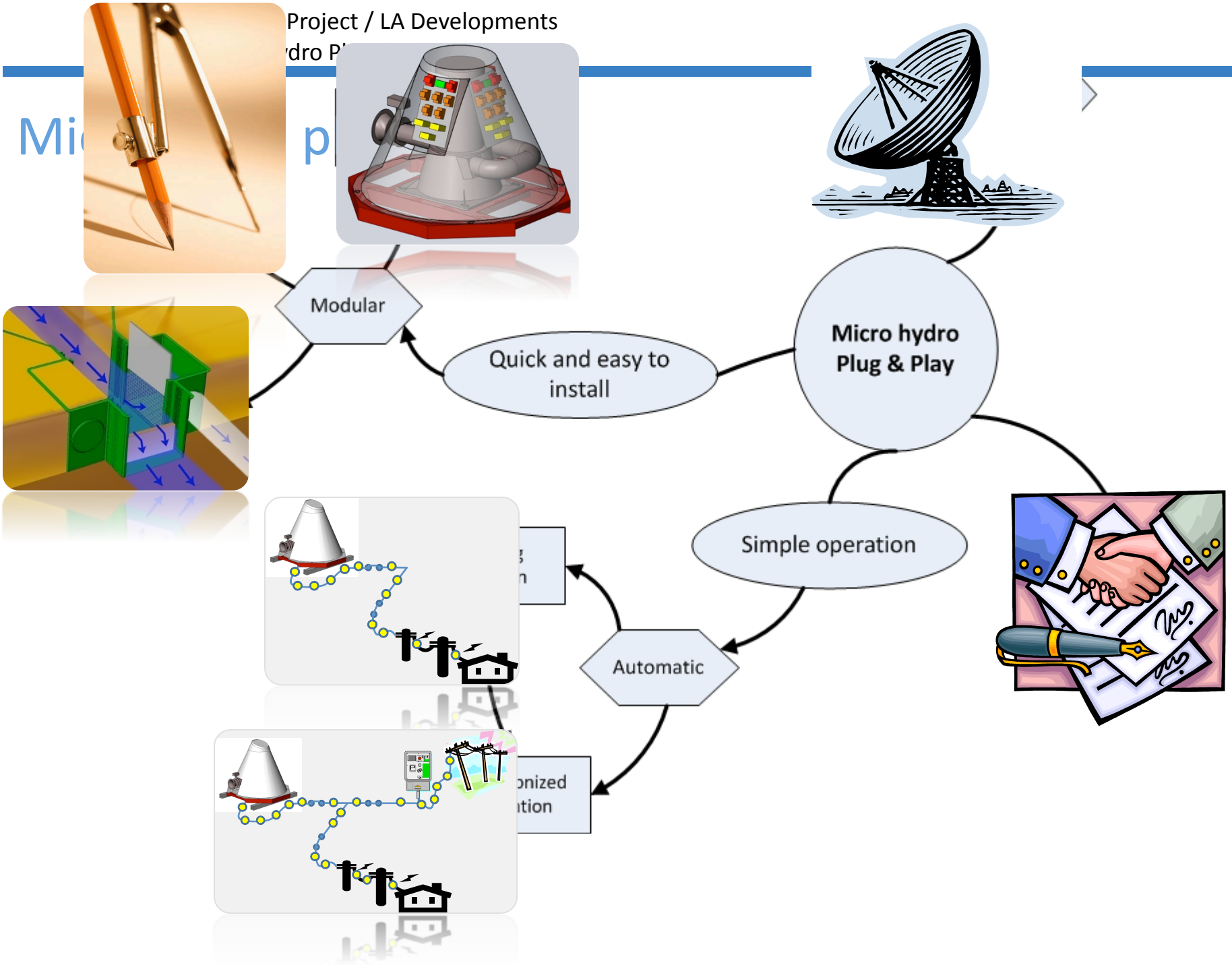
Micro hydro plug & play

Micro hidro plug & play




Micro hydro
Plug & Play
Quick and easy to install
Modular
Simple operation
Automatic

Micro hydro plug & play

Micro hydro plug & play

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Latin America Developments

Puertecitos
Under execution
Baja Califonia, MX

Silice Project
Pilot application
Bogotá, CO

Huatacondo
Operative
Tarapacá, CH

Isla Trinidad
Feasibility
Rio State, BR

Ollagüe
Design stage
Antofagasta, CH

Juan Fernández
Design stage
J. Fernández, CH

Villa Cameron
Feasibility
Patagonia, CH

"Silice" project

- Objective:

  "To propose a strategy for integration of Smart Grids and Microgrids in the distribution power systems in Colombia".

- Participants:
  - CODENSA, Distribution Network Operator of the capital city (Bogotá).
  - Four Universities:
    - Univesidad de los Andes (Phases I, II and III).
    - Universidad Nacional de Colombia (Phases I, II and III).
    - Universidad Industrial de Santander (Phases I and III).
    - Pontificia Universidad Javeriana (Phase III).
  - Administrative Department of Science, Technology and Innovation – COLCIENCIAS.

- Three phases:
  - **Phase I** (2007-2009):
    - Formal study and identification of technological challenges for implementation of microgrids and distributed generation in electrical distribution systems.
    - Perform the design and installation of the pilot microgrid at Universidad Nacional campus, and supervision and control from Universidad de los Andes.

4kW photovoltaics

15kW Biomass

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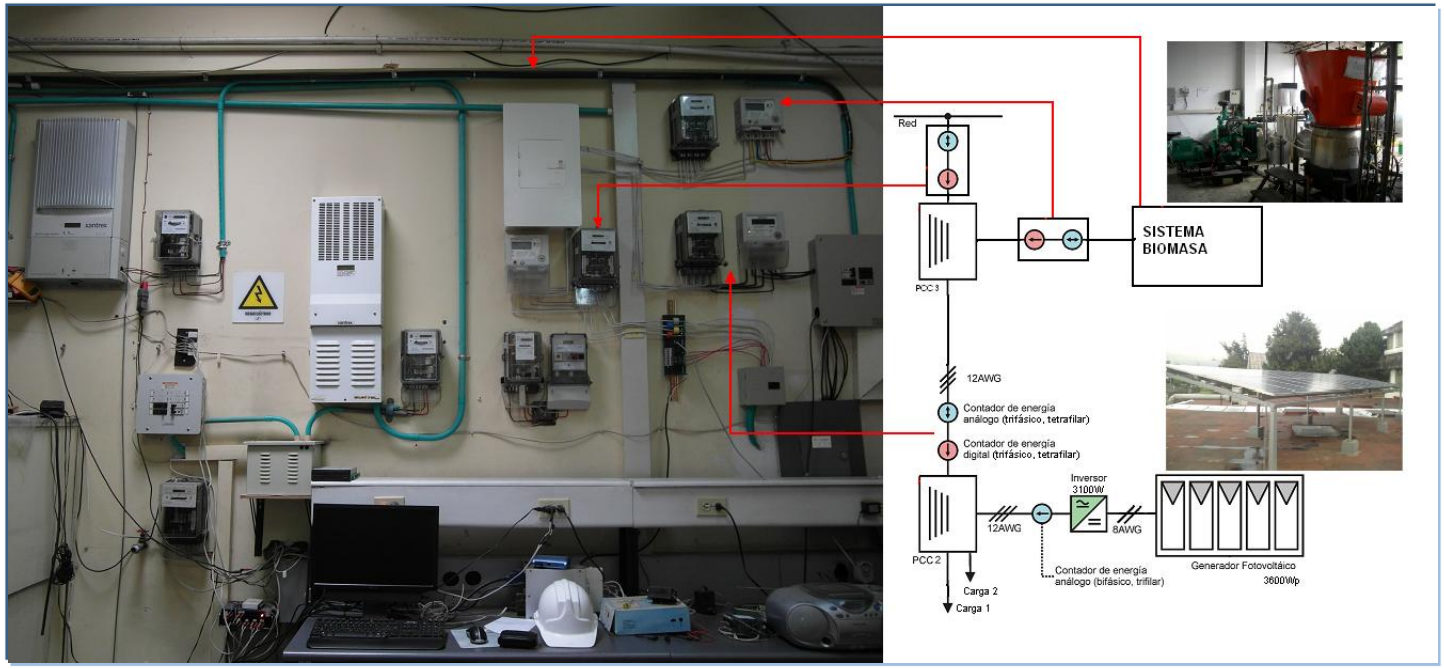
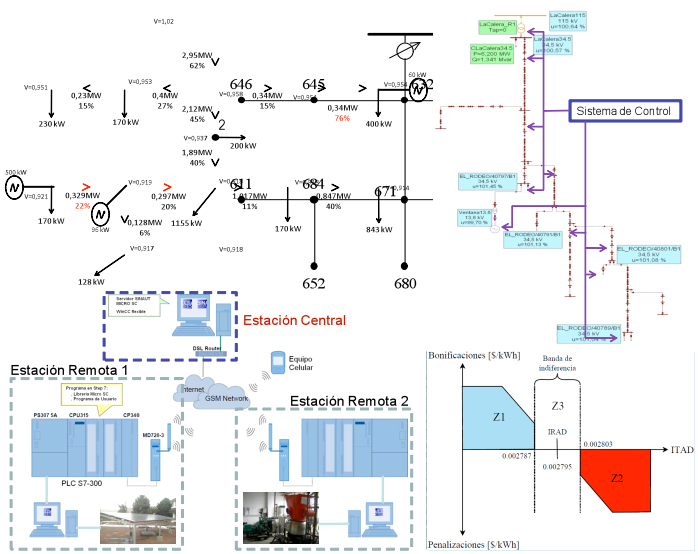
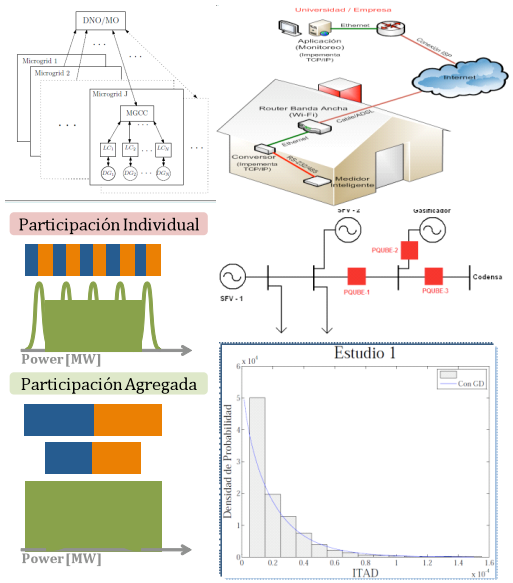


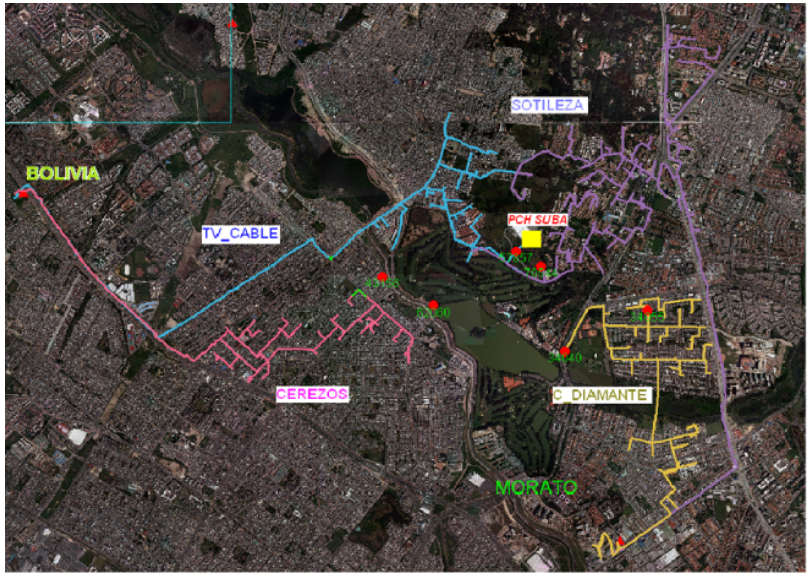
Measurement and monitoring systems

- Three phases:
  - **Phase II** (2009-2011):
    - Development of methodologies for the study of implications on the installation of smart grids in the distribution network , DG installation decisions, microgrids operation and control, users participation, and support of communications requirements.
    - There were developments in the analysis of the pilot microgrid installed at the Universidad Nacional campus, and for monitoring and control from Universidad de los Andes.





- Three phases:
  - **Phase III** (2011-2013):
    - To design a microgrid in a circuit of CODENSA's distribution system, including DG applications, storage systems, energy efficiency approaches and technologies, advanced metering infrastructure, demand response, and electric vehicles, with the support technological tools as control, communications , and information and data management.



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THANK YOU !
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