The GeVi Initiative

Patricio A. Mendoza-Araya

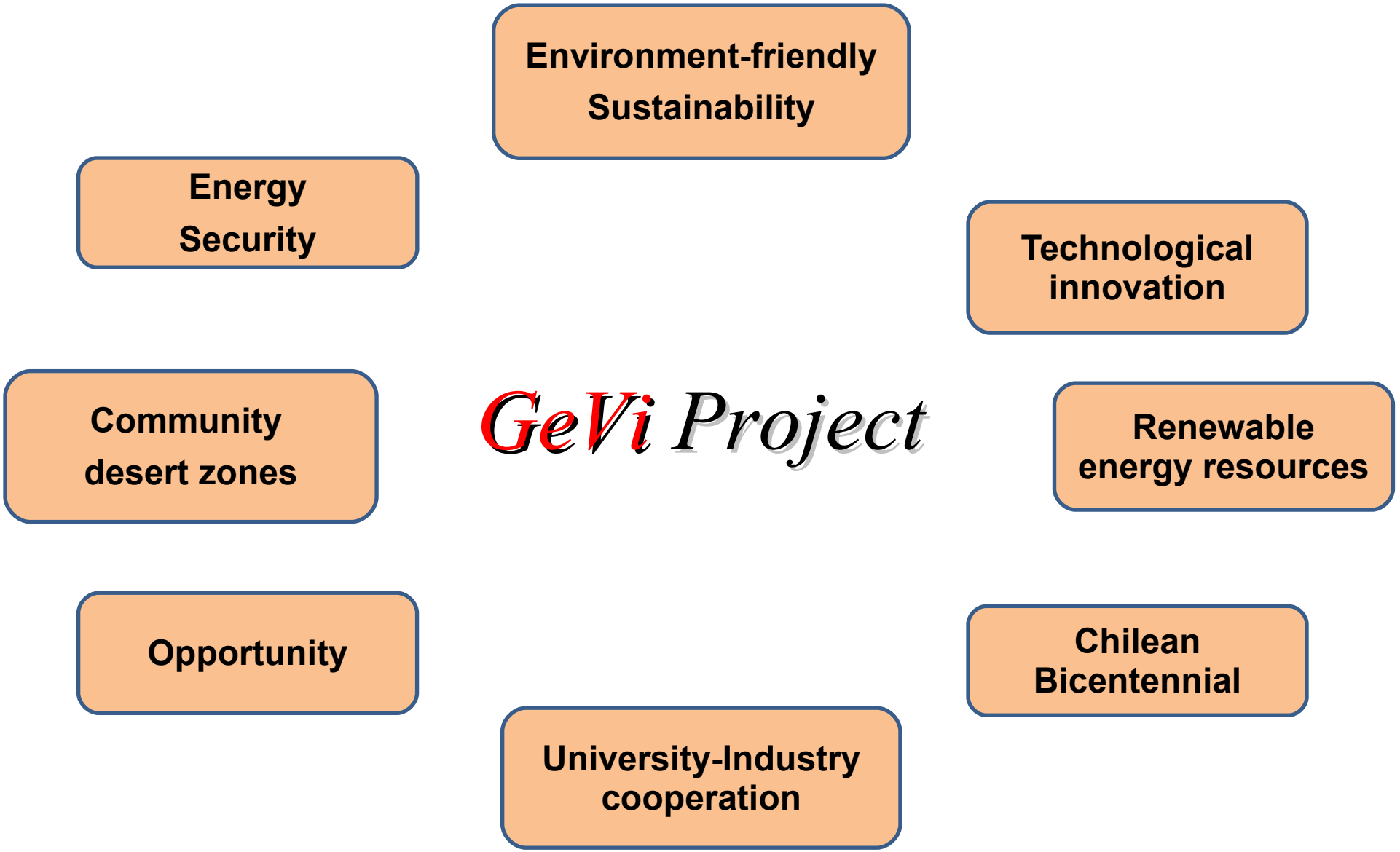
San Diego 2009 Symposium on Microgrids

September 18th, 2009

Outline

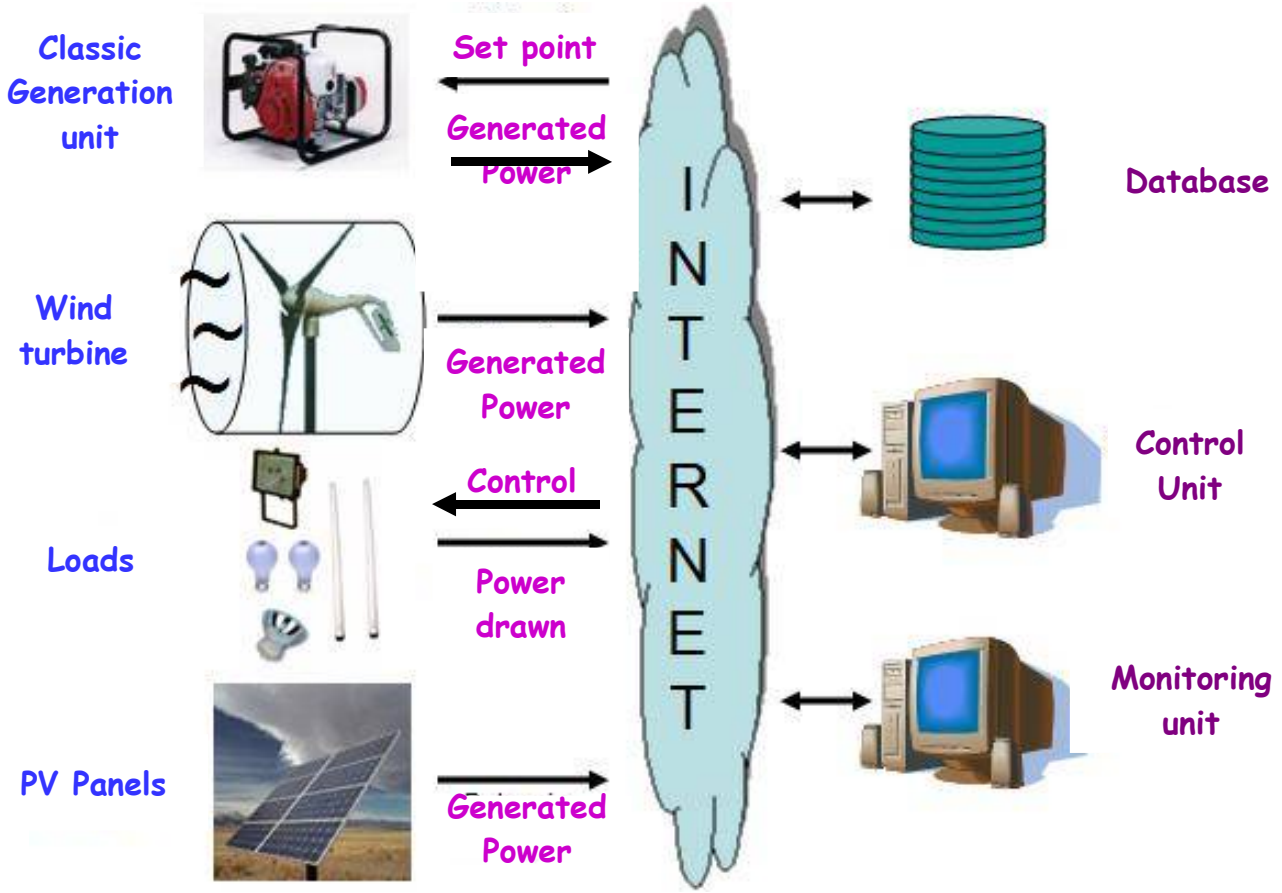
- **What** is the GeVi project?
- **Who** is working in this project?
- **How** is the project developed?
- **Where** and **When** is this going to be operative?
- Conclusions

What is the GeVi project?

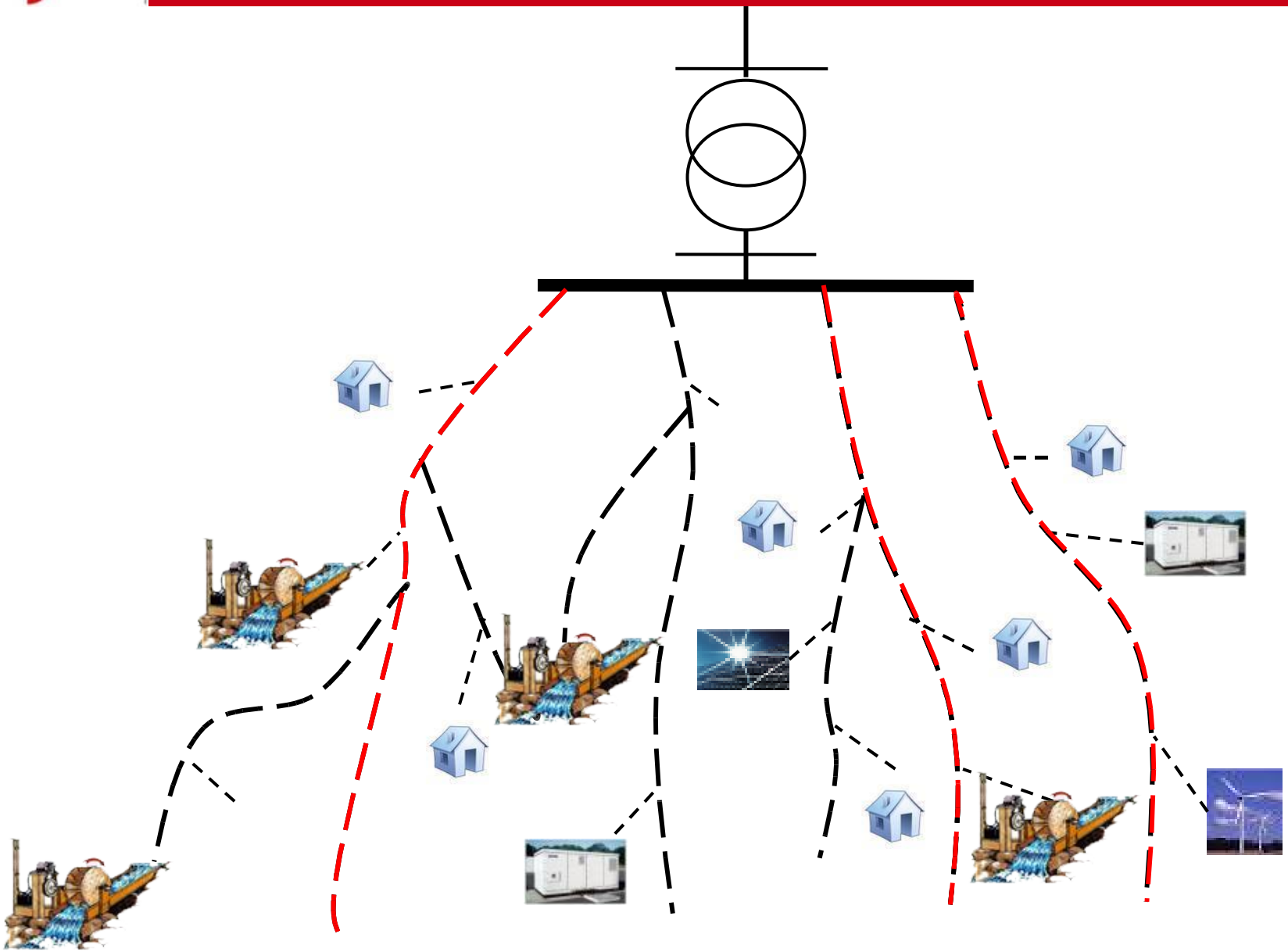


What is the GeVi project?

- Definition:
  - GeVi = "*Generador Virtual*" = Virtual Power Plant (VPP)
  - VPP: Group of distributed generators (DG) operating on a common coordinated scheme



What is the GeVi project?



What is the GeVi project?

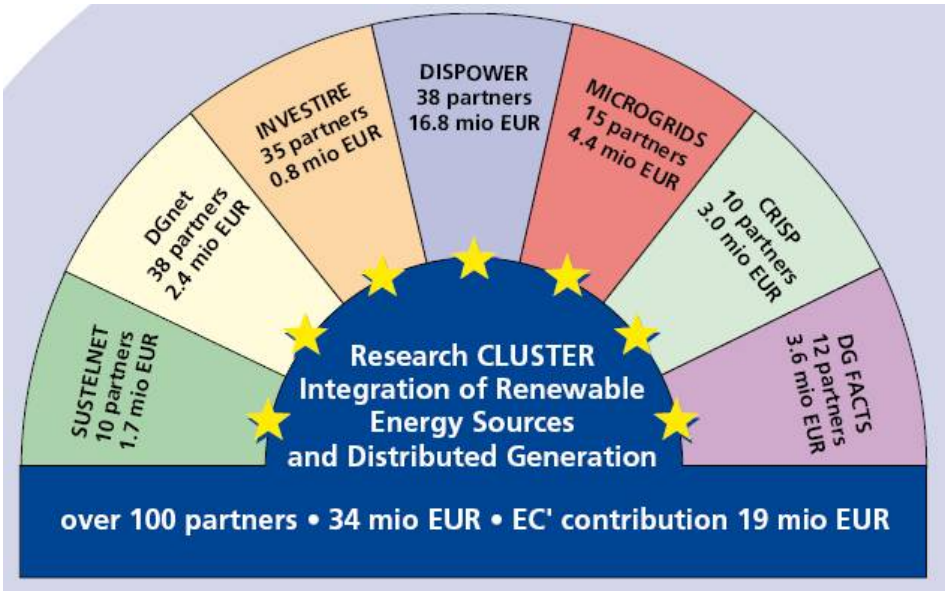
- Advantages
  - Coordinated operation
    - Additional services
    - Dispersed energy resources
- Questions
  - Economically feasible?
  - Technically feasible?
- Associated problems
  - Optimal allocation of generation units
  - Optimal operation
  - Ancillary services

What is the GeVi project?

- Differences with classic generation
  - Control and monitoring systems are costly in per power unit basis
  - Qualified personnel not available on all locations
  - Demand (local loads) is now close!
- Math tools
  - State estimator
  - OPF with security constrains
  - Real-Time coordination controllers

What is the GeVi project?

- International experience
  - ISET laboratories
  - STEAG Project
  - Encorp Virtual Power Plant
  - Virtual FC Power Plant
  - Fenix project (DER European Union)
  - SOLID-DER
  - Previous projects in Europe (CRISP, DISPOWER, MICROGRIDS, EUDEEP)
  - Virtual Power Plant NATCON7
  - Decentralized Energy Management System by SIEMENS
  - NTT research centre, Japan (control-communication)



Who is working in GeVi project?

Initiative founders

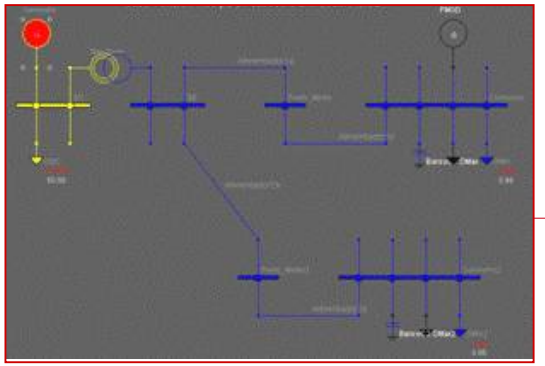
PhD. Rodrigo Palma B.	(*DIE, University of Chile*)
PhD. Francisco Gracia	(*DIQ, University of Chile*)
P.E. Patricio Mendoza A.	(*DIE, University of Chile*)
P.E. Claudio Vergara R.	(*University of Chile*)

Sponsors

Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile
Departamento de Ingeniería Eléctrica
Centro de Modelamiento Matemático
Instituto Milenio de Sistemas Complejos de Ingeniería

Who is working in GeVi project?

- Team background
  - Research and studies on renewable energy and energy efficiency topics (8 projects, 12 papers on journal/proceedings, 21 thesis)
  - Regulatory, statutory participation, rural electrification
  - 10 kVA micro-hydro power plant prototype
  - 1 kVAr static var compensator
  - Single-phase laboratory VPP experience
  - RF-based monitoring system
  - Simulation platform: DeepEdit
  - GeVi prototype (Jan. 2009)
  - PV MPPT (Eolian solar car)
  - “Lüfke” Electric car

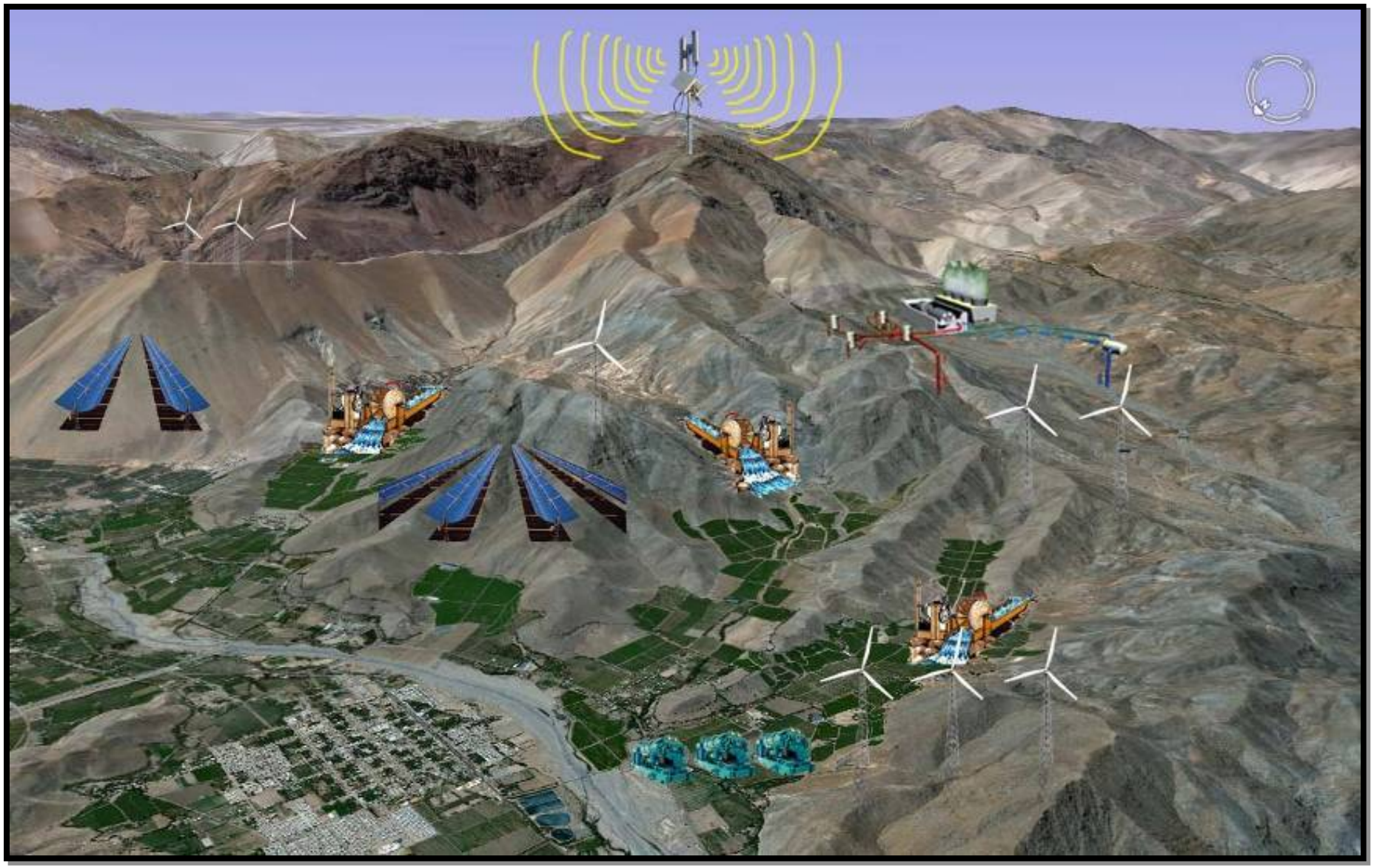


How is the project developed?

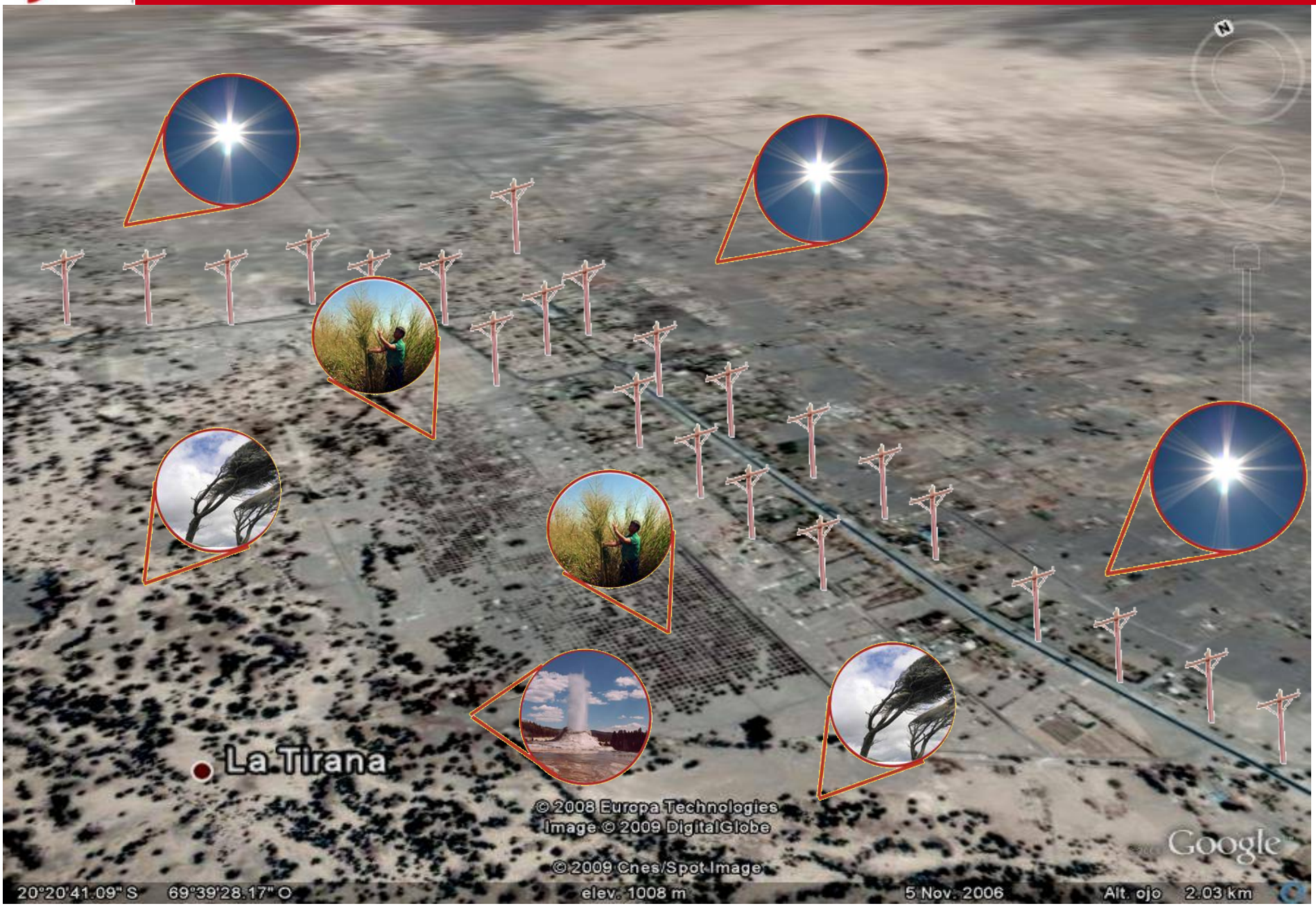
- Technical challenges
  - Coordination and telecommunications
  - Quality of service
  - Cost-effective solutions
- Methodology
  - Laboratory prototype, test plant
  - Field demo experience

How is the project developed?

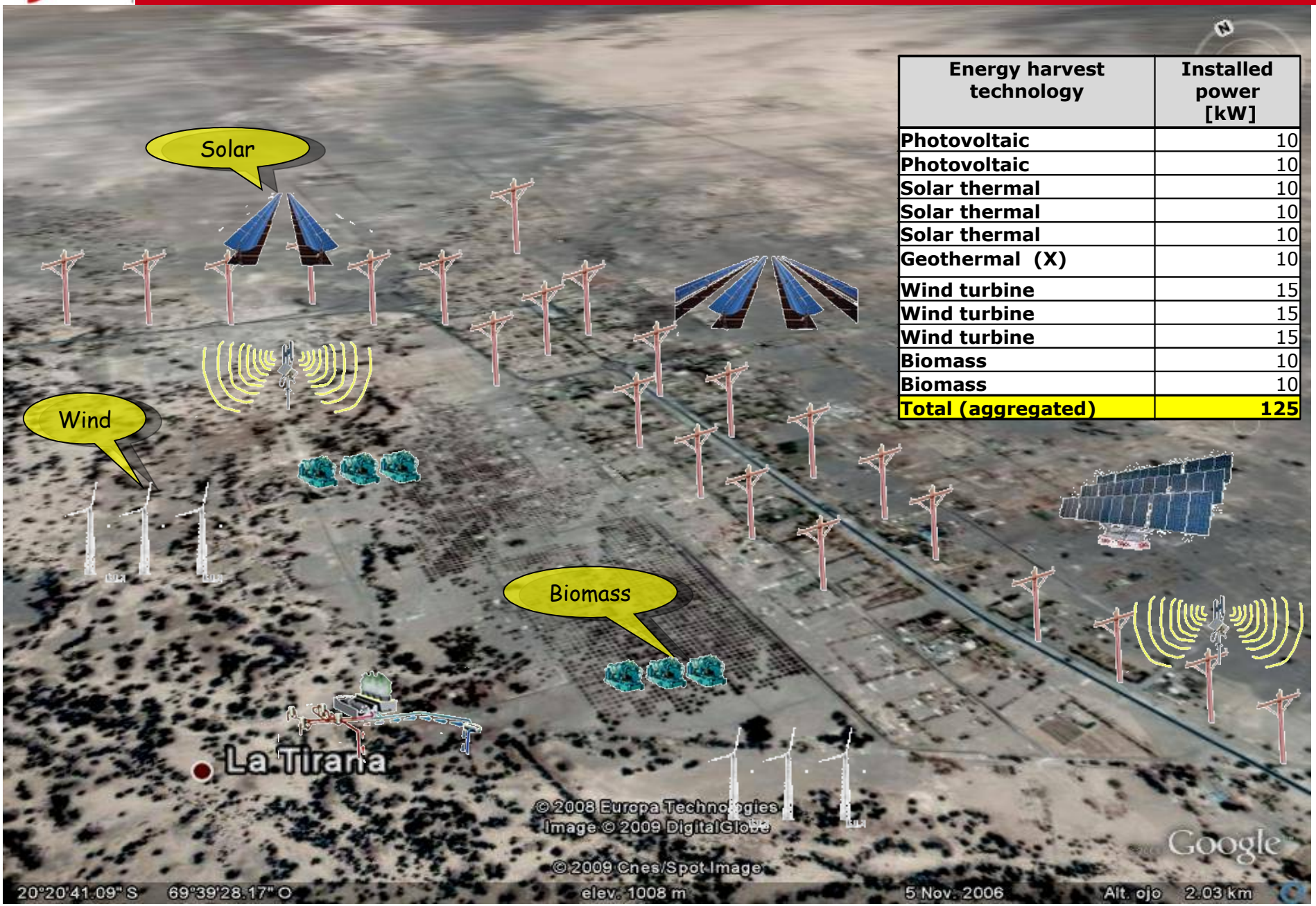
- Vision



How is the project developed?



How is the project developed?



Energy harvest technology	Installed power [kW]
Photovoltaic	10
Photovoltaic	10
Solar thermal	10
Solar thermal	10
Solar thermal	10
Geothermal (X)	10
Wind turbine	15
Wind turbine	15
Wind turbine	15
Biomass	10
Biomass	10
Total (aggregated)	**125**

How is the project developed?

- Prototype requirements
  - 4 different energy generation technologies
  - At least 20 DG units
  - Total installed power >= 100 kW
  - Islanding operation capability (faults)
  - Energy export capability
  - Ancillary services (congestion management, voltage and PF profile regulation, losses minimization, unbalance correction)
  - Modular scalable structure

How is the project developed?

- Components

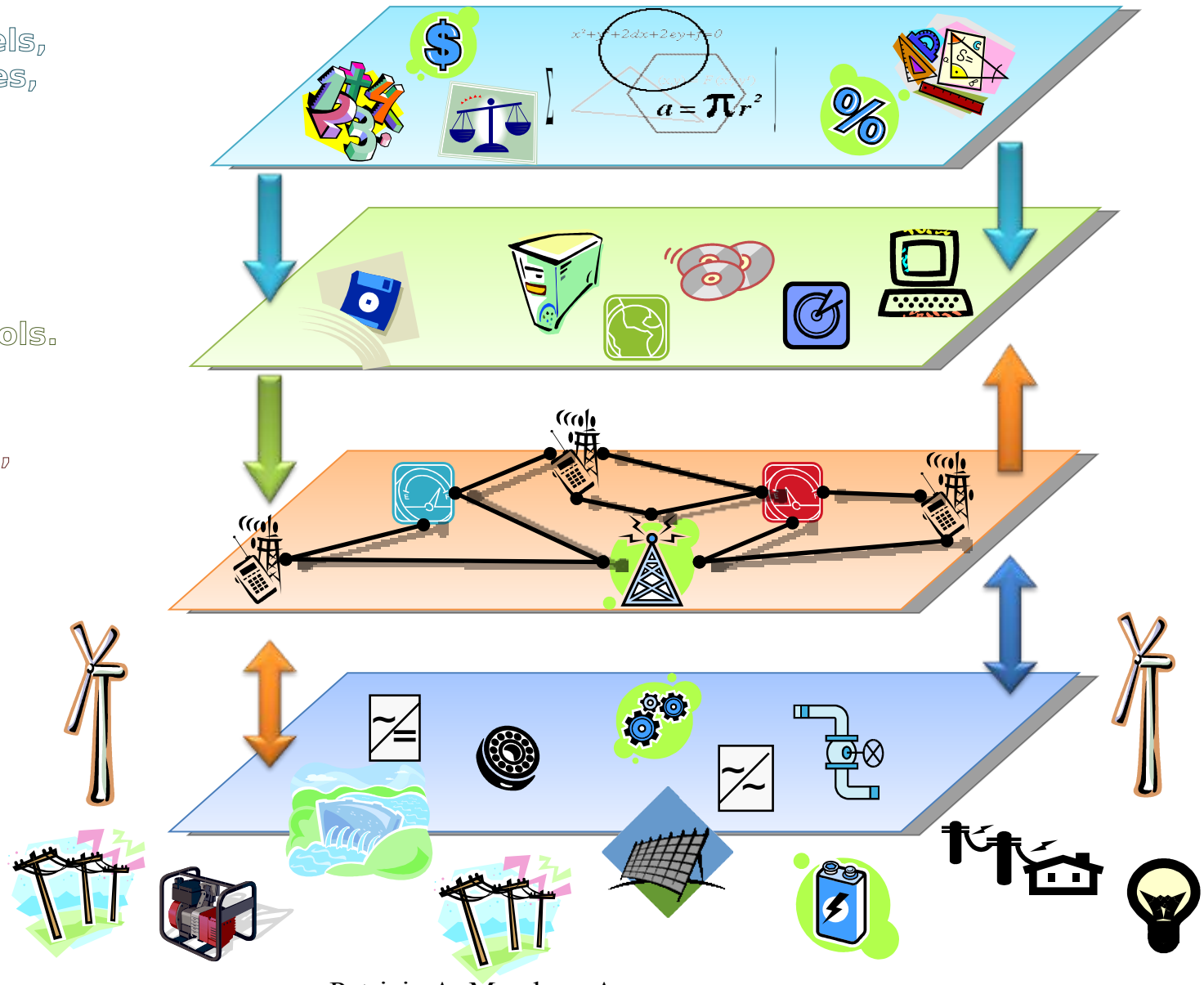
Progress

Concepts, Models, algorithms, rules, protocols, optimization. — 60%

Software, databases, visualization tools. — 50%

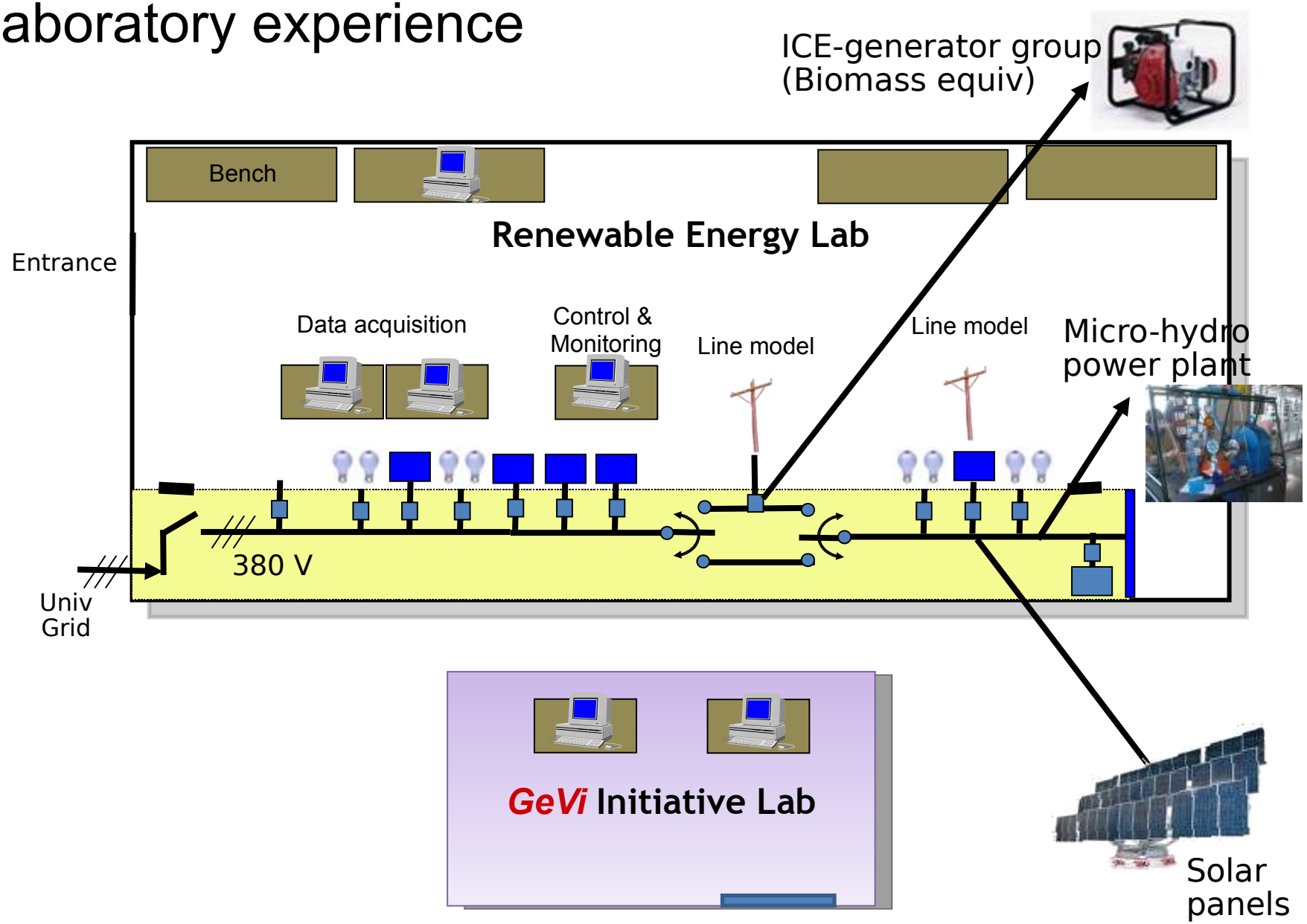
Communication, control and monitoring platform. — 20%

Controllers, actuators, converters, generators, storage technologies — 20%



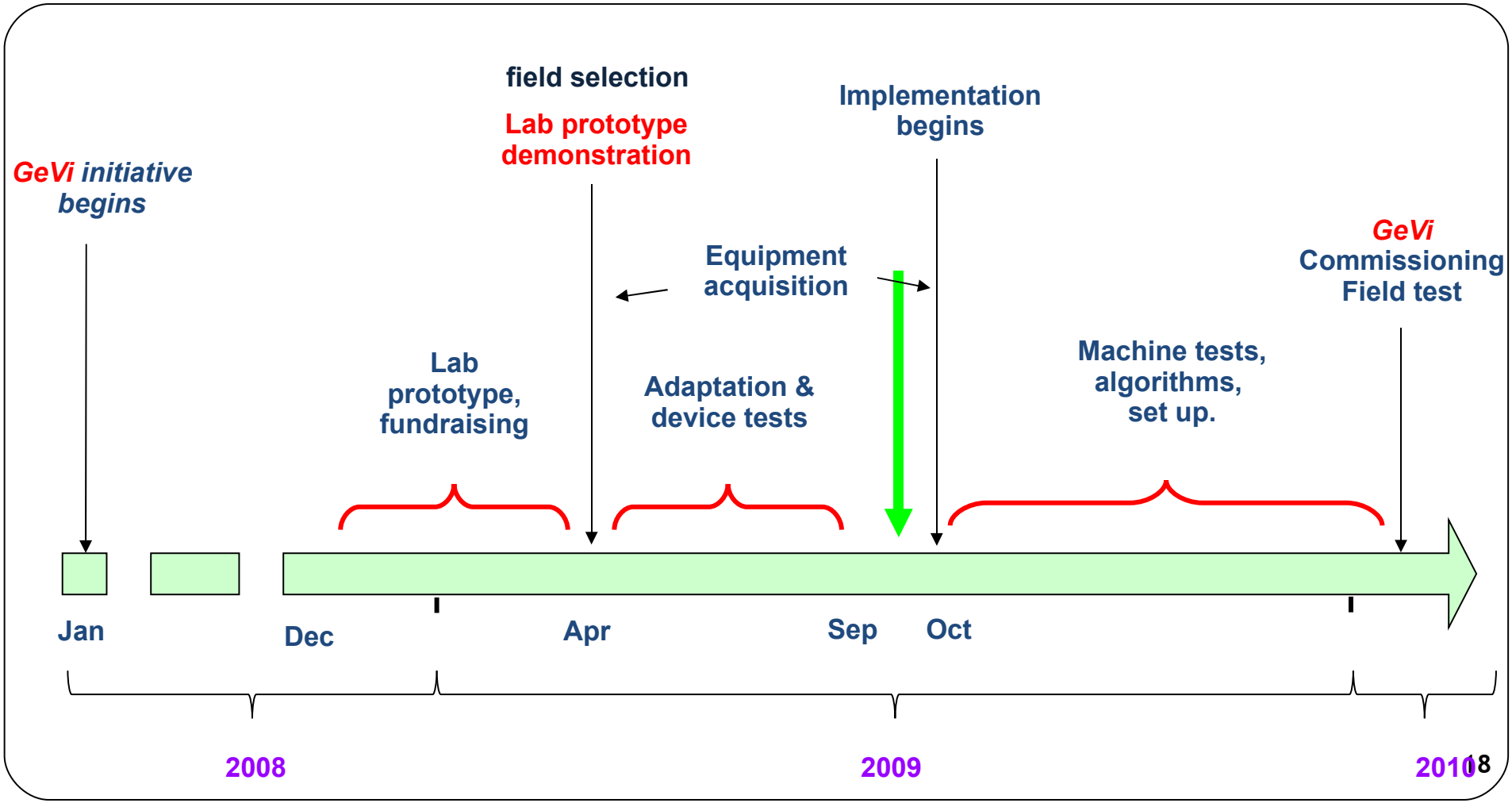
How is the project developed?

- Laboratory experience



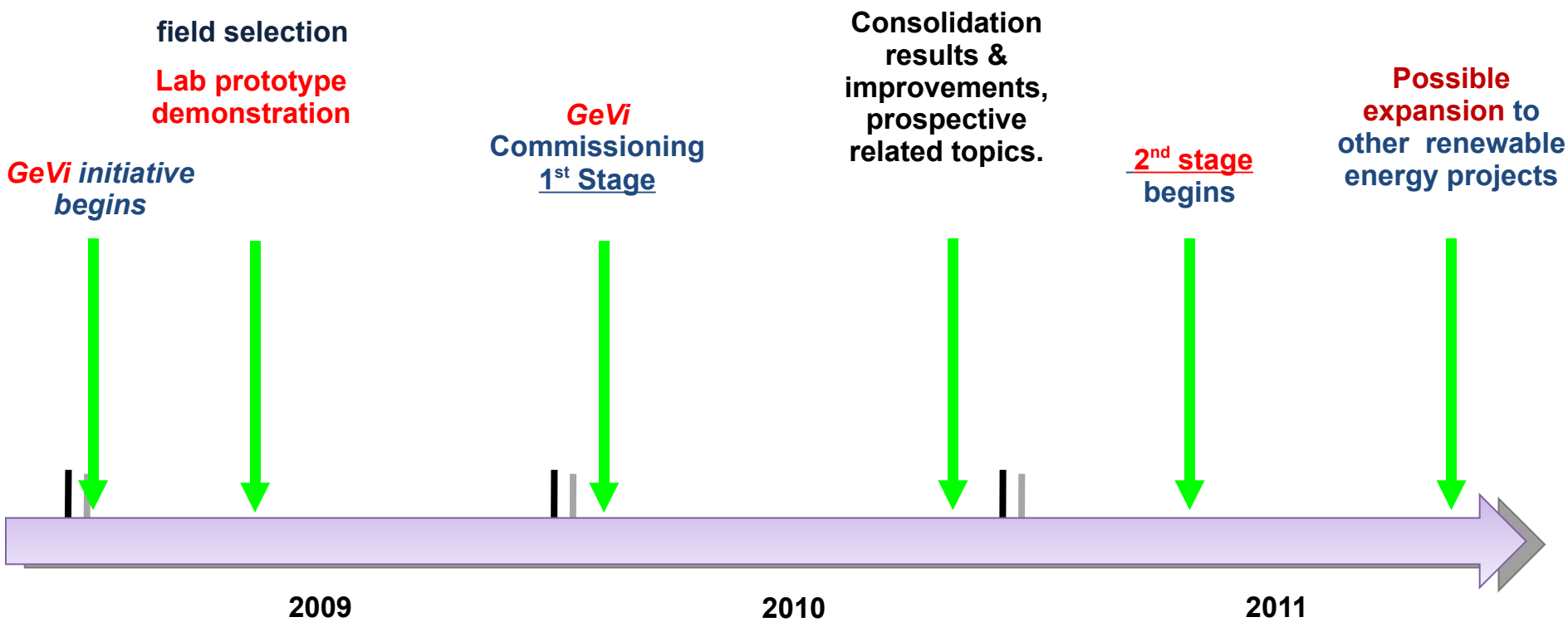
Where and when?

- Short term



Where and when?

- Long term



Conclusions

- Community impact
  - Social benefits
    - Energy-efficient and environment-friendly education
    - Promotion of the use of local energy resources
    - Motivation to the community to be part of the technological development
  - Economical benefits
    - Community professional training
    - New job positions
    - Electricity availability, better quality of service
    - Profit from energy & local ancillary services
    - New activities related to already-existent processes

Conclusions

- Environmental impact
  - Manage loads to improve system efficiency
  - Lower greenhouse gas emissions
  - Rational use of natural resources

Thanks!

Patricio A. Mendoza-Araya

pmendoza@ing.uchile.cl