ARE Business Delegation
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Project proposal: Analysis of the potential for renewable based energy systems on Philippine islands

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- **Renewable Energy Mobility**
  - Mobility concepts based on RE
- **Renewable Energy Technology**
  - Small wind power applications
  - Technical integration of RE
- **Renewable Energy Systems**
  - Optimization of energy systems
  - Energy transition processes
  - Off-grid energy systems

Reiner Lemoine
Initiatior of the Reiner Lemoine-Foundation and Institute

Scientific research and support for a transition towards 100 % renewable energies

Off-Grid Systems

- Simulation and optimization of renewable energy systems
- Analyses with geo-information systems (GIS)
- Resource assessment (solar, wind, hydro)
- Market potential analyses & feasibility studies

Decentralized energy systems with high shares of renewable energies

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Motivation: Energy system

Installed power capacity[1]	**15.6 GW**
Share of renewable energies[1]	**33.9 %** 21 % hydro 12.2 % geothermal 0.7 % other
Transmission grid[2]	**19,822 km**

- **„On-grid“**
  Energy supply on main islands

- **„Off-Grid“**
  Energy supply on smaller islands

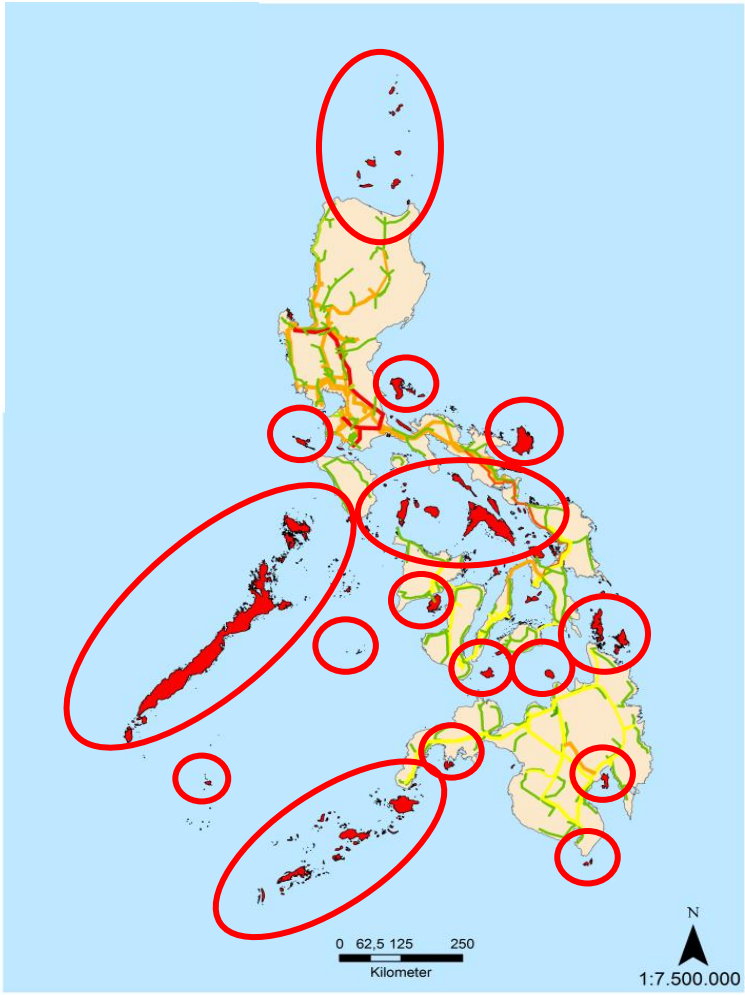

Fig: Spatial extension of the Philippine Transmission grid (GADM, 2012; NGCP, 2012).

Sources: [1] CIA World Fact Book 2012.
[2] NGCP, 2012.

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Motivation: Island Mini-Grids

Power supply through isolated diesel mini-grids

- high power generation costs
  - diesel fuel price, transport costs, low efficiency
- CO_2 emissions, air pollutants

► **Upgrade of diesel mini-grids with Renewable Energies**

- lower power generation costs
- lower fuel dependency
- fewer CO_2 emissions, fewer detrimental environmental effects
- existing diesel generators serve as back-up power sources

Fig: Destroyed diesel power barge, Lazi, Siquijor. May 2013.

Motivation: Fuel Price Trend/ Solar Price Trend

- Prices for crude oil have increased over the last years and are expected to do so in the future
- Costs for renewable technologies have been plummeting in the last years improving the economic feasibility additionally to its obvious ecological advantages

High economic pressure on existing energy supply schemes based on oil / diesel

Renewable energies become an interesting option for remote locations

➢ **Upgrade of diesel grids with RE technology to reduce the dependency on fossil fuels and provide environmentally sound power supply**

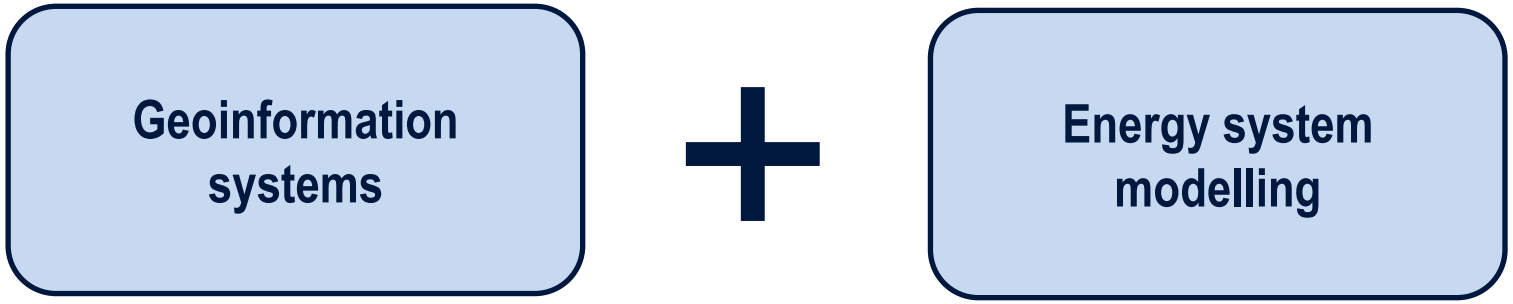
Project proposal: Aim of the Study

Aim of the study:

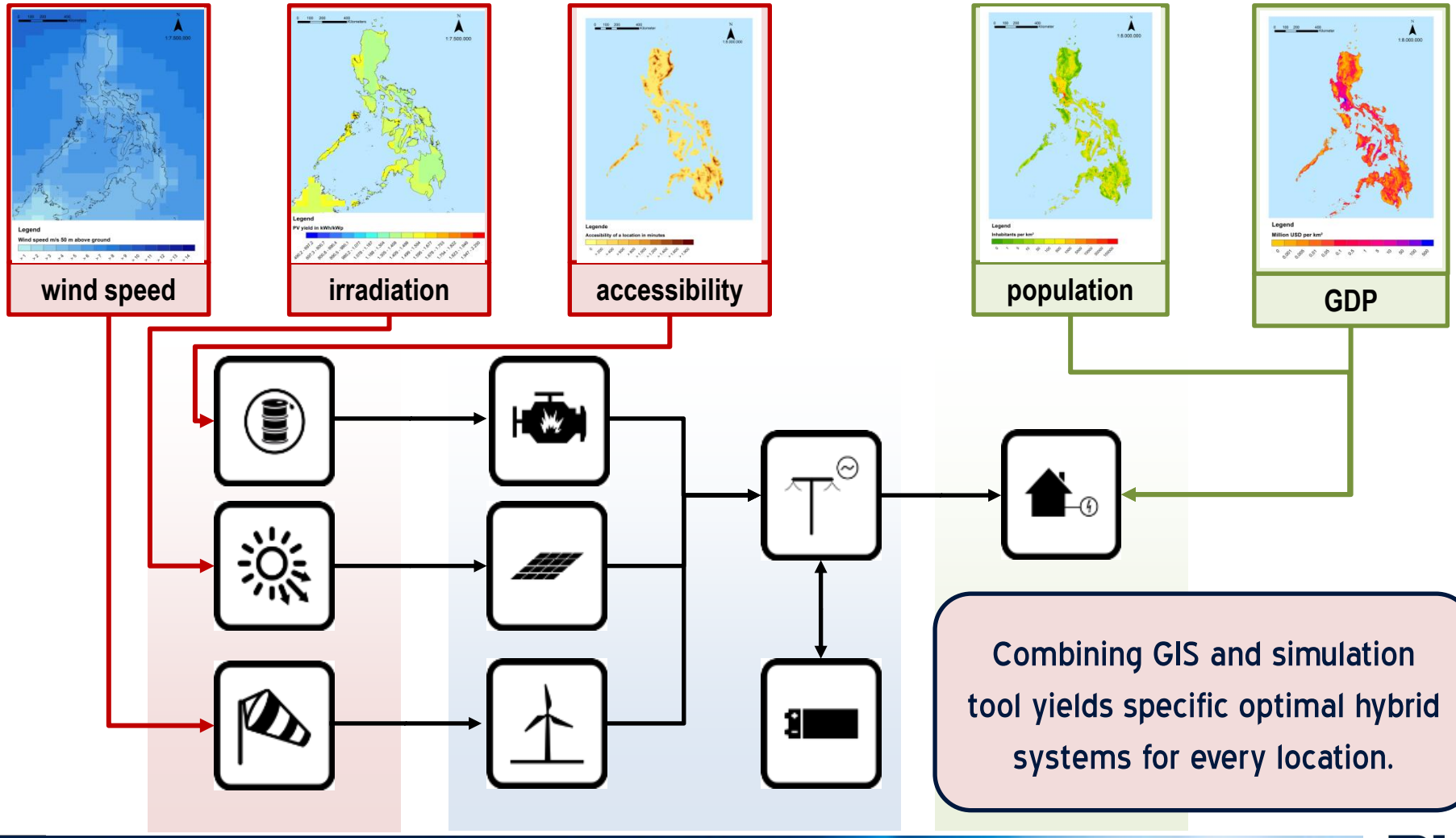
- Quantify the market potential for decentralized renewable power systems on Philippine islands
- Present business cases for renewable based island energy systems
- Providing a market entry decision tool for private investors

Research question:

On which islands are renewable based hybrid systems more cost effective than diesel only sytems?



RE Hybrid Electrification Options



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Case Study

Siquijor Island

Inhabitants[1]	108,698
Area[1]	320.94 km²
Energy consumption[2]	17.6 GWh/a
Operator[3]	7.4 MW SPUG, Siquijor Coop.

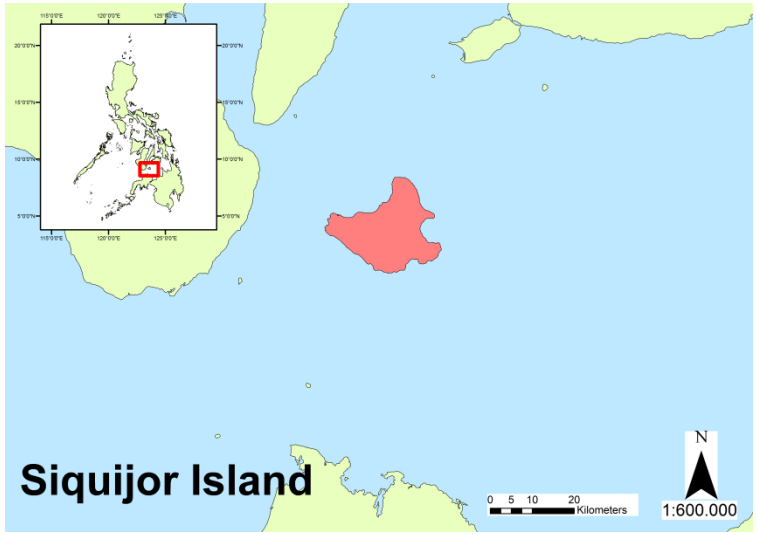

Fig: Siquijor island (GADM, 2012)

Diesel fuel

Initial diesel fuel price [4]	0.77 €/l
Annual diesel price growth rate (2015 – 2035)	2 % (0.96 €/l)

Renewable resources

Solar[5]	1409 kWh/kWp/a
Wind[5]	636 kWh/kW/a

Sources:
[1] own calculation based on Landscan, 2011;GADM, 2012.
[2] based on load data from SPUG, 2013
[3] Platts, 2012
[4] based on SPUG press information SPUG, 2012
[5] DLR, 2005

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Significant saving potential

Siquijor Island

Configuration optimized energy system:

- **6.7 MW** PV
- **1 MW** Energy storage (Lead acid)
- **2 MW** System stability

Advantages:

- Power generation costs decreased by **5.4** €ct/kWh
  (**32.1** €ct/kWh to **26.7** €ct/kWh)
- Saving of **2.8 mn** l diesel/year
- **7500 t CO_2** mitigated per year

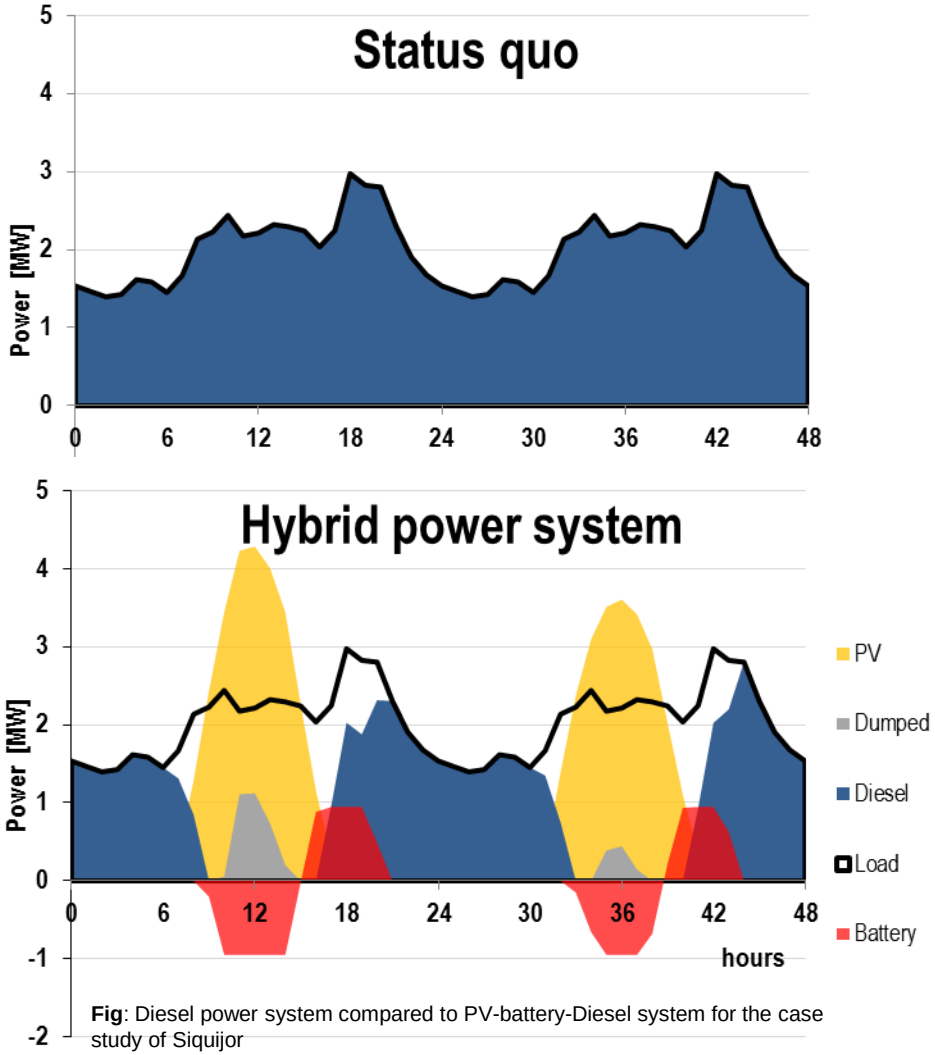
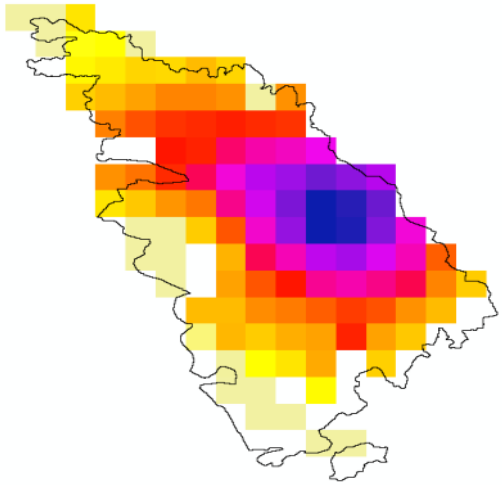


Fig: Diesel power system compared to PV-battery-Diesel system for the case study of Siquijor

Visualization of results



For each island detailed information is provided on:

- Infrastrcuture (Energy system, population, GDP)
- Renewable resources and fossil fuel resources
- Potential for off-grid renewable based energy supply (cost effectiveness, capacity, energy yield)
- Financial market potential (amortization period, business models)

Information per each island	
Resource Assessment	
Local diesel price	EUR/liter PHP/litre
Solar, wind, hydro, biomass	kWh, m/s, m³, kWh
Population	#
GDP	EUR/PHP
etc.	
RE Hybrid Electrification options	
Diesel only	EUR/kWh, PHP/kWh
Hybrid Mini-Grids (LCOE) (Solar, wind, hydro, biomass, battery, diesel)	EUR/kWh, PHP/kWh
Optimized solution: capacities, RE share, diesel consumption	kW, %, liter
Solar-Home-Systems (LCOE)	EUR/kWh, PHP/kWh
Electricity demand	kWh/year
Distance to grid	km
Nightlights (access to electricity)	yes/no
etc.	

Project Structure

Research steps

- WP I: Selection of islands
- WP II: RE Resource Assessment
- WP III:Development and application of simulation tool for hybrid island mini grids (Research collaboration)
- WP IV: Development of web-tool to visualize results
- WP 5: Final reports and case study analysis

Project partner

- DoE
- GIZ
- Bank of the Philippine Islands
- University of the Philippines – Diliman
- University of San Carlos

Personnel: 4 – 6 including researchers and students

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Thank you!

And special thanks to the RLI off-grid team

For further questions please contact us:

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