

Global PV market potential for small island energy systems

Philipp Blechinger
Intersolar – Munich
12th of June 2015

Overview

- Not-for-profit research institute
- 100% owned by Reiner Lemoine Stiftung (RLS)
- Based in Berlin, established in 2010
- Managing director: Dr. Claus Beneking
- 25 research assistants + students
- Member of e.g. ARE, eurosolar, BNE



Reiner Lemoine
Founder of the Reiner Lemoine
Foundation

Mission

Scientific research for an energy transition
towards **100 % renewable energies**

Optim. Energy Systems and Transition

- Simulation of integrated energy systems
- Modelling of energy supply including storage options (e.g. batteries, PtG)
- Feasibility studies for energy supply by GIS
- Energy transition and social acceptance

Off-Grid Systems

- Rural electrification planning
- Simulation of hybrid mini-grids
- Combination of GIS analyses and energy system simulations
- Market research and business strategies

Mobility with Renewable Energies

- Mobility concepts with renewable energies
- Research on electrolyses and PtG
- Implementation of hybrid mini-grids and small wind turbines
- Hardware in the loop testing and measurements

Booth B1.470

Agenda

-
- **Motivation**
 - **Island detection**
 - **Demand analysis**
 - **PV potential**
 - **Conclusion**
-

Unfavorable conditions in on-grid markets for PV increase the need for new emerging markets:

- Competitive PV projects without subsidies
- Complex systems allow technological advantages

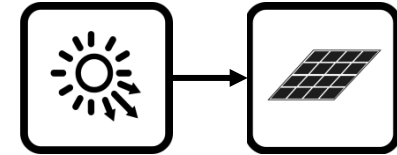
➤ **Diesel mini-grids** represent an interesting new market field based on **high fuel costs** and technologically challenging **integration of PV**

Small islands (> 100,000 inhabitants) are **geographically defined mini-grids**:

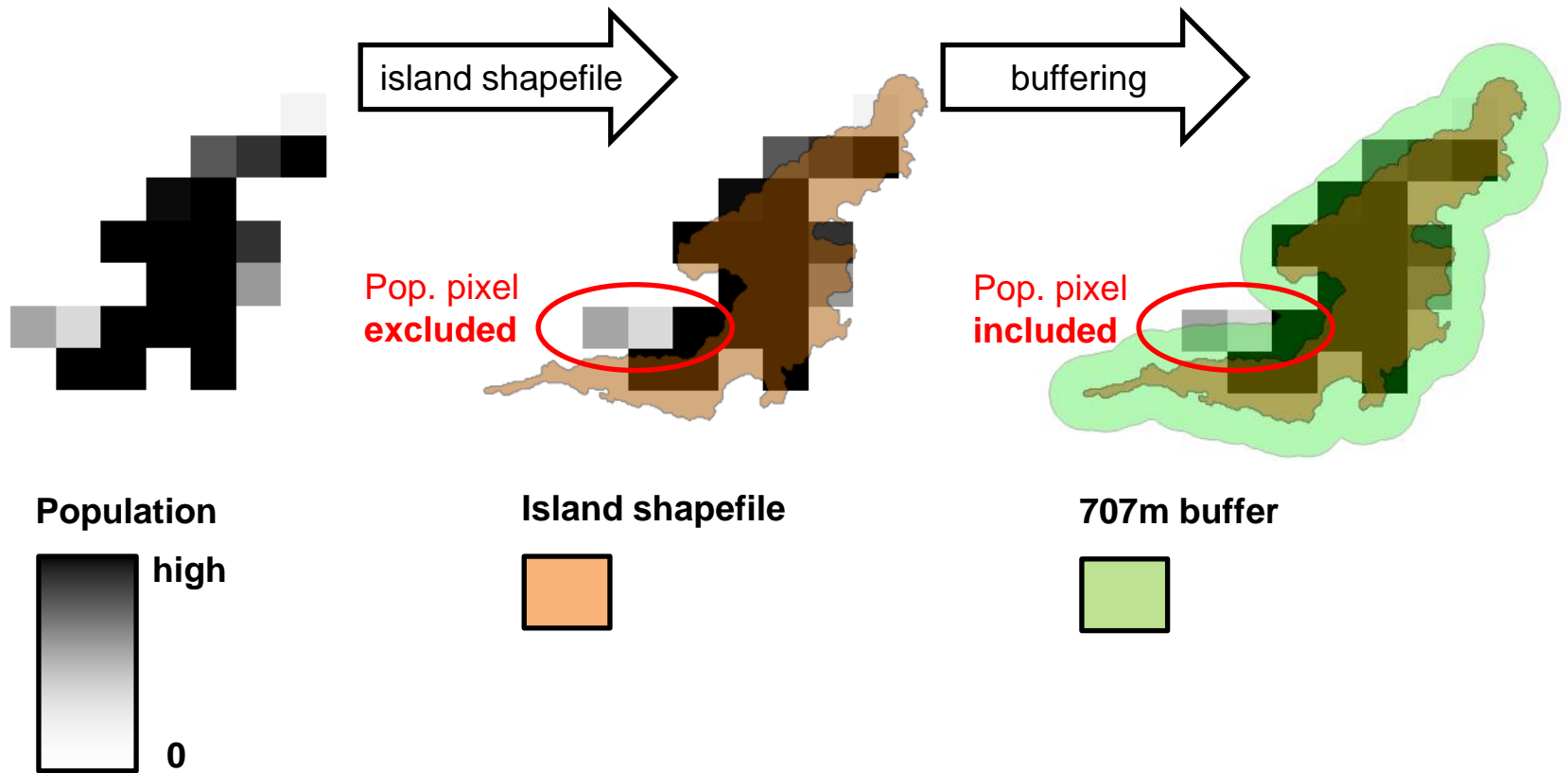
Where are these islands?

What is their electricity demand?

What is the related PV potential?



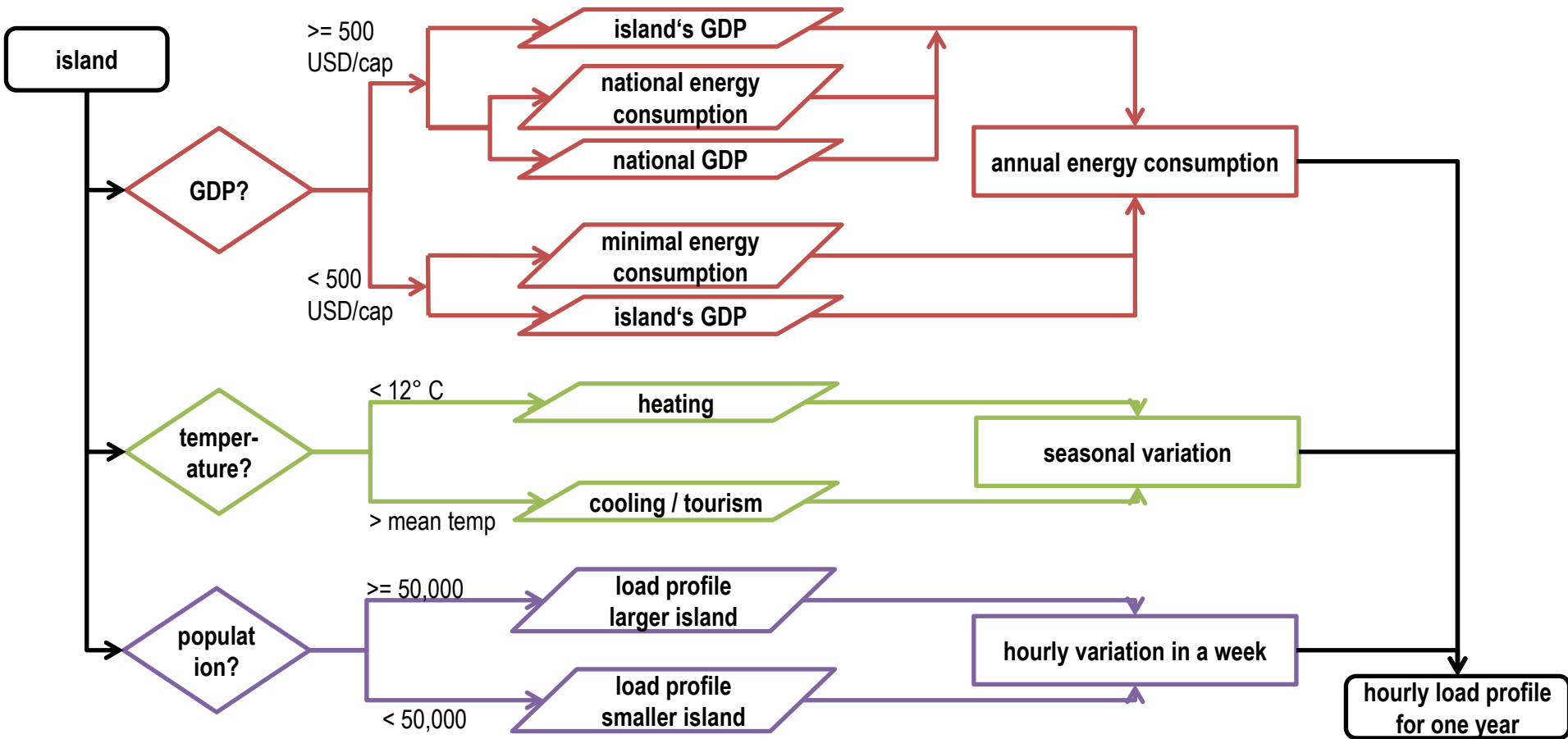
Where are small islands?



Global small island overview

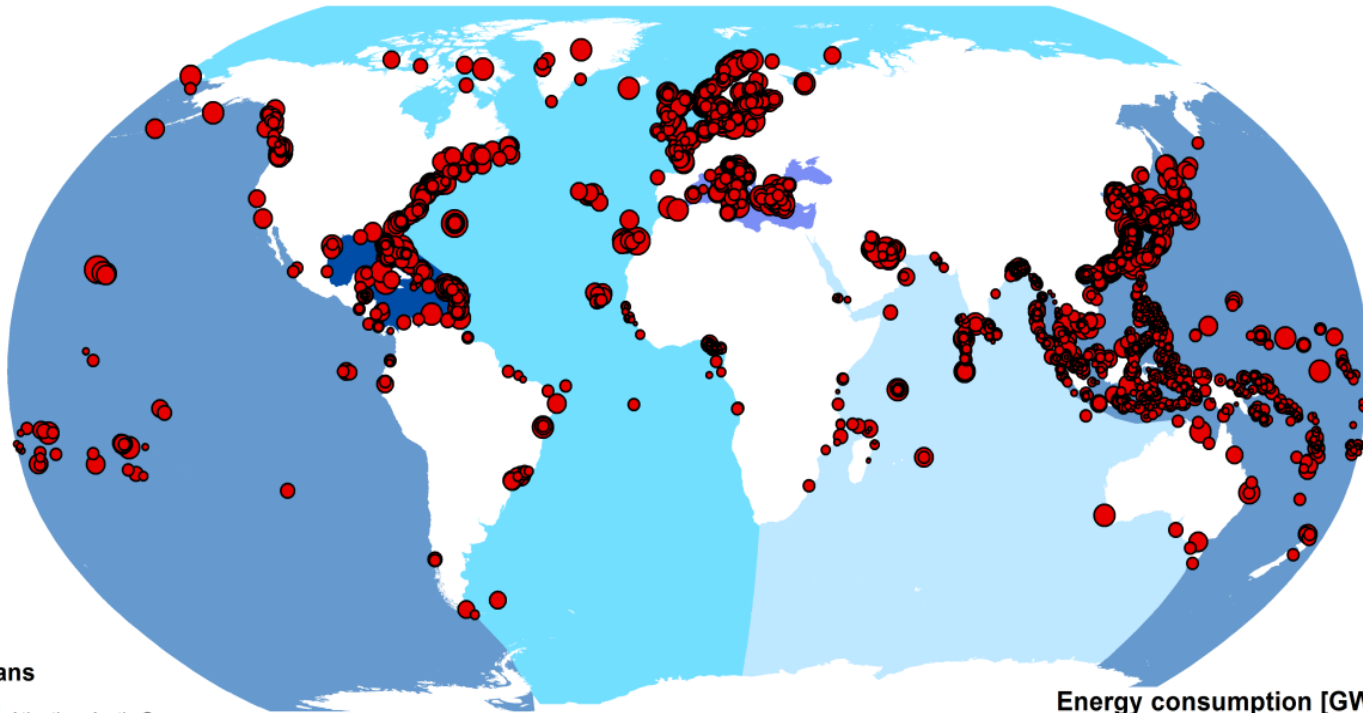
Region	Number of Islands	Population (av.)	Population (sum)	GDP (av.) [EUR/cap]
Atl. + Arct. Oc.	416	9,985	4,150,000	18,200
Caribbean +	105	16,160	1,700,000	14,600
Indian Ocean	232	12,210	2,830,000	2,960
Mediterr. Sea	104	10,540	1,100,000	23,500
Pacific Ocean	1,199	9,690	11,620,000	8,660
Total	2,056	10,410	21,400,000	14,300

What is the energy demand?



Island demand overview

Global Small Island Landscape
(1,000 - 100,000 inhabitants)



Oceans

- Atlantic + Arctic Ocean
- Caribbean Gulf of Mexico & Bahamas
- Indian Ocean
- Mediterranean Sea
- Pacific Ocean

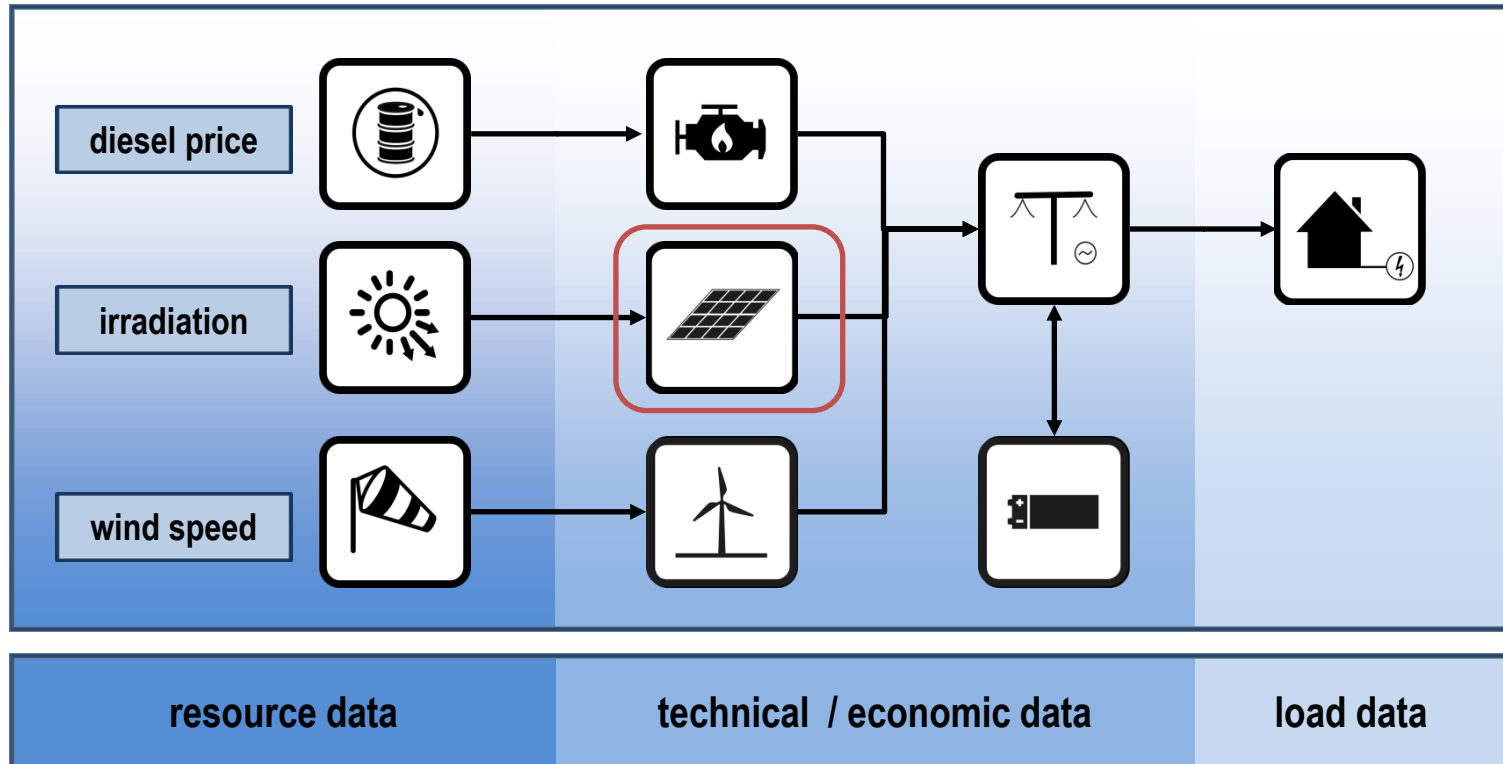
Energy consumption [GWh/y]

- 0.02 - 0.10
- 0.11 - 0.30
- 0.31 - 1.00
- 1.01 - 5.00
- 5.01 - 10.00
- 10.01 - 25.00
- 25.01 - 50.00
- 50.01 - 250.00
- 250.01 - 500.00
- 500.01 - 1150.00

Island demand overview and conventional power system

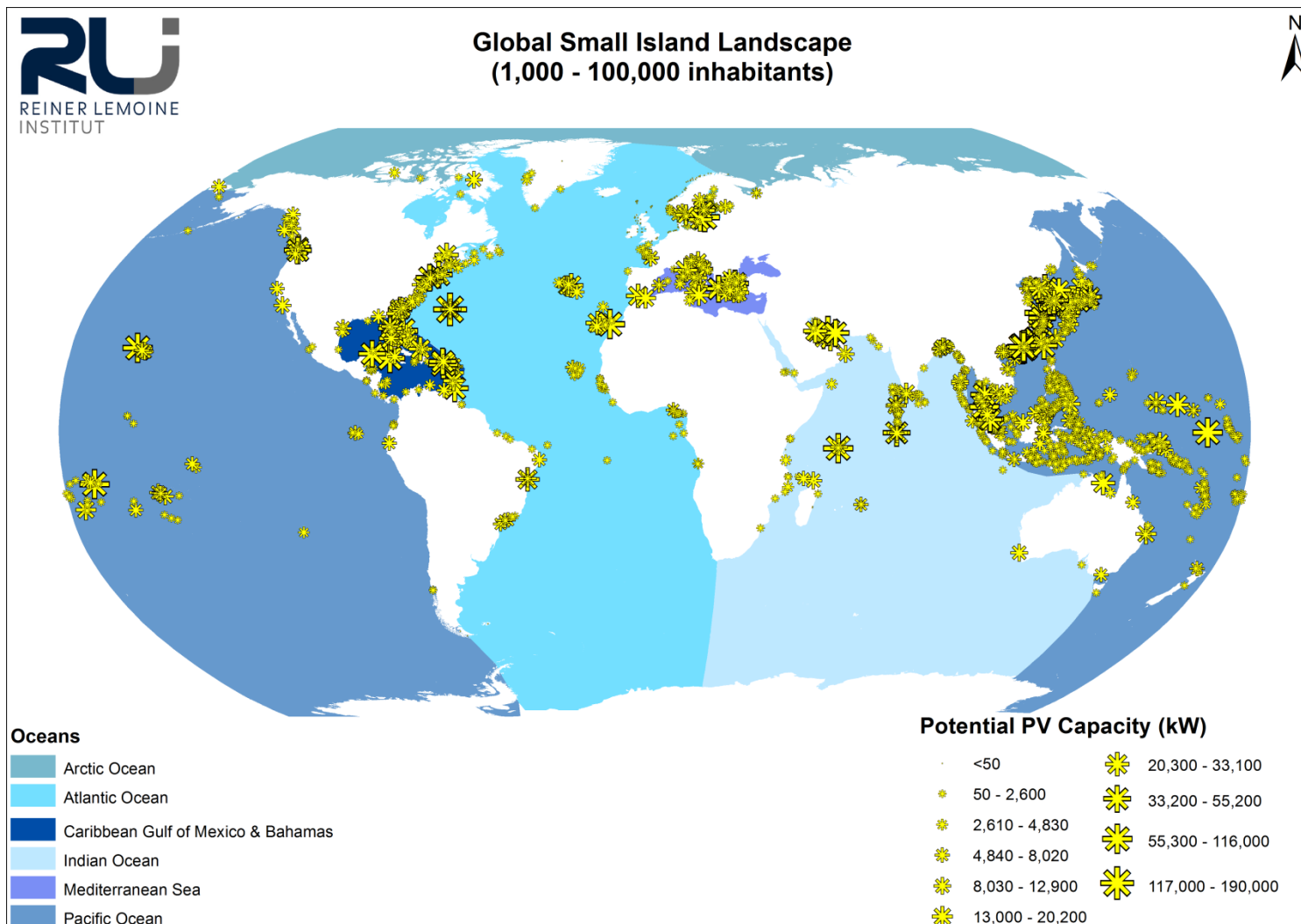
Region	El. cons. (sum) [GWh/year]	El. cons. (av.) [MWh/year]	El. cons. (av. per cap.) [kWh/year* cap]	LCOE Diesel only (av.) [EURct/kWh]
Atl. + Arct. Oc.	18,270	43,920	4,400	36.6
Caribbean +	5,710	54,380	3,370	34.2
Indian Ocean	2,240	9,660	790	38.0
Mediterr. Sea	3,680	35,390	3,345	33.2
Pacific Ocean	22,730	18,970	1,960	39.3
Total	52,630	25,600	2,462	38.0

Energy system simulation

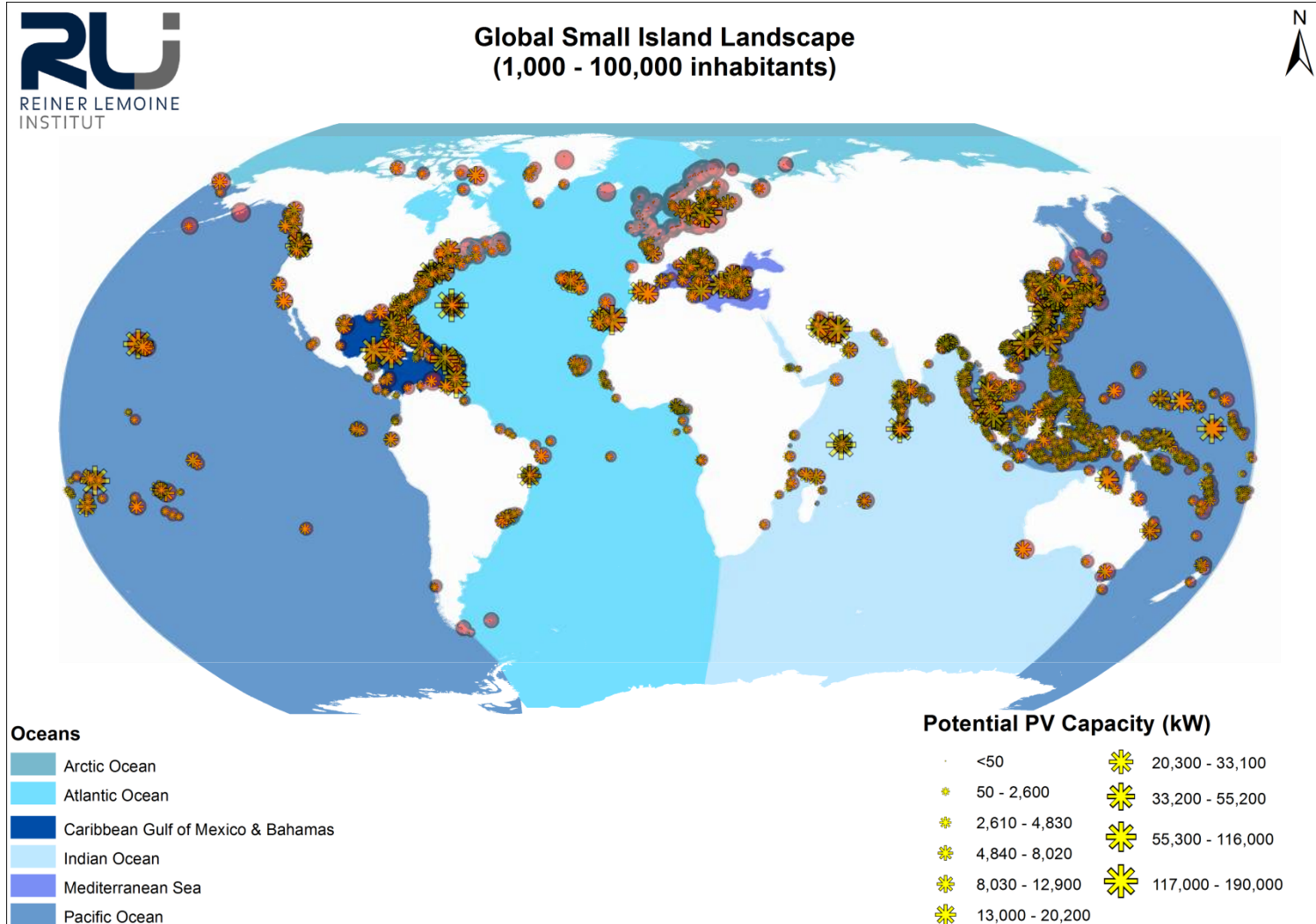


PV Capex of 2,000 €/kW

PV potential on islands - map



Island demand overview



PV potential on islands - numbers

Region	Scenario	PV (sum) [MWp]	Wind (sum) [MW]	Storage (sum) [MWh]	LCOE (av.) [EURct/kWh]	RE share (av.)
Atl. + Arct. Oc.	Scen I	930	5,320	n/a	26.3	48%
	Scen II	+21%	-1%	930	-1.9%	58%
Caribbean +	Scen I	910	1,210	n/a	24.3	57%
	Scen II	+9%	-2%	360	-1.6%	65%
Indian Ocean	Scen I	420	370	n/a	29.7	44%
	Scen II	+76%	-30%	1,240	-6.7%	65%
Mediterr. Sea	Scen I	550	770	n/a	25.8	47%
	Scen II	+10%	-1%	230	-1.2%	55%
Pacific Ocean	Scen I	3,390	5,090	n/a	30.2	44%
	Scen II	+19%	-5%	2,550	-7.0%	71%
Total	Scen I	6,200	12,760	n/a	30.2	46%
	Scen II	+21%	-4%	5,310	-5.6%	71%

Scenario I w/o battery storage

Scenario II with battery storage

A huge untapped techno-economic potential exists for PV implementation on small islands.

- PV with storage outperforms diesel only systems on many tropical and sub-tropical islands.
- Economic and ecological advantages should accelerate the implementation of PV systems on small islands.

Remaining challenges are

- High transaction costs for single projects
- Fossil fuel subsidies
- Lack of financing opportunities

GET IN TOUCH WITH US FOR

- Research cooperations
- Collaborative project applications
- Industry partnerships

- Business development in collaboration with



APRICUM
THE CLEANTECH ADVISORY.



Tel: +49 (0)30 5304 2012
E-Mail: [Off-Grid\(at\)rl-institut.de](mailto:Off-Grid(at)rl-institut.de)
Web: <http://www.rl-institut.de>