
Barriers and solutions to the development of renewable energy technologies for power generation on Caribbean island states

Katharina Richter
Philipp Blechinger

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-
- **Research Problem**
 - **Methodology**
 - **Results**
 - **Discussion**
-

Research Problem



Diesel power plant in Bequia

**BUT:
Barriers of
Implementation**

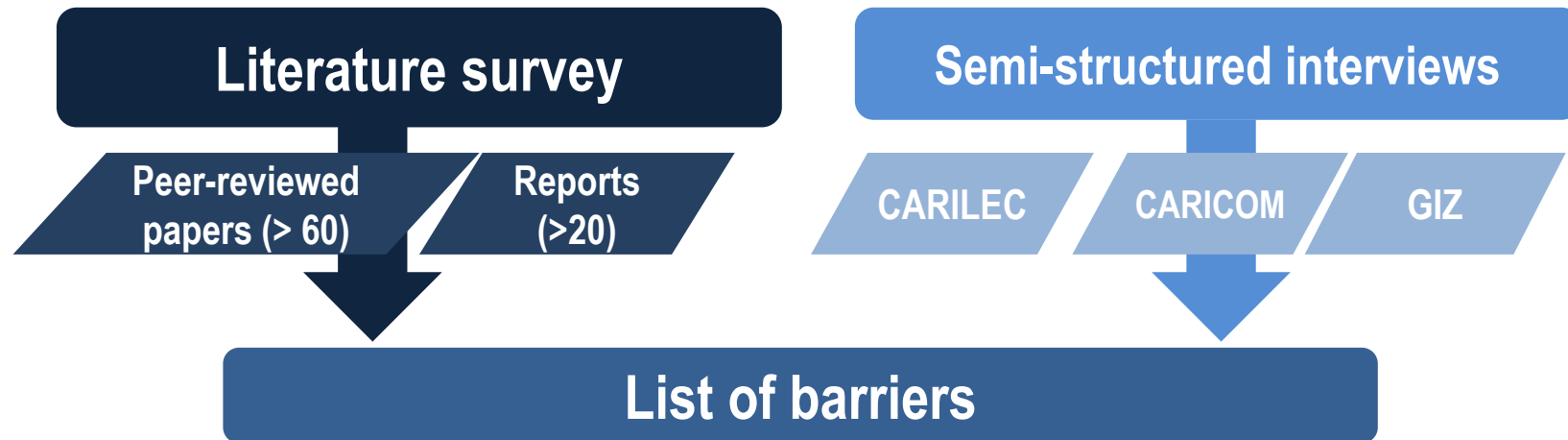
Transformation



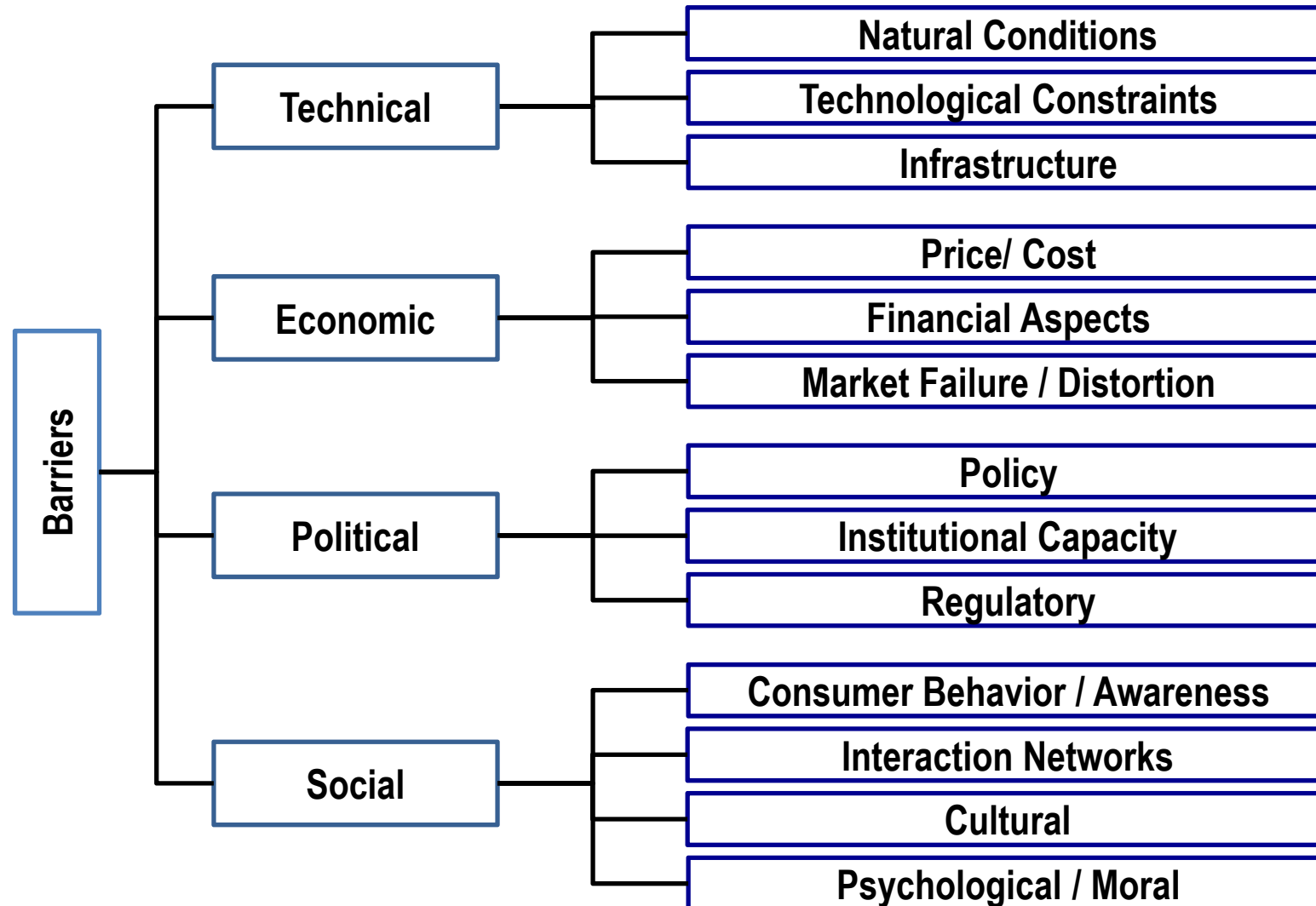
Source: Private

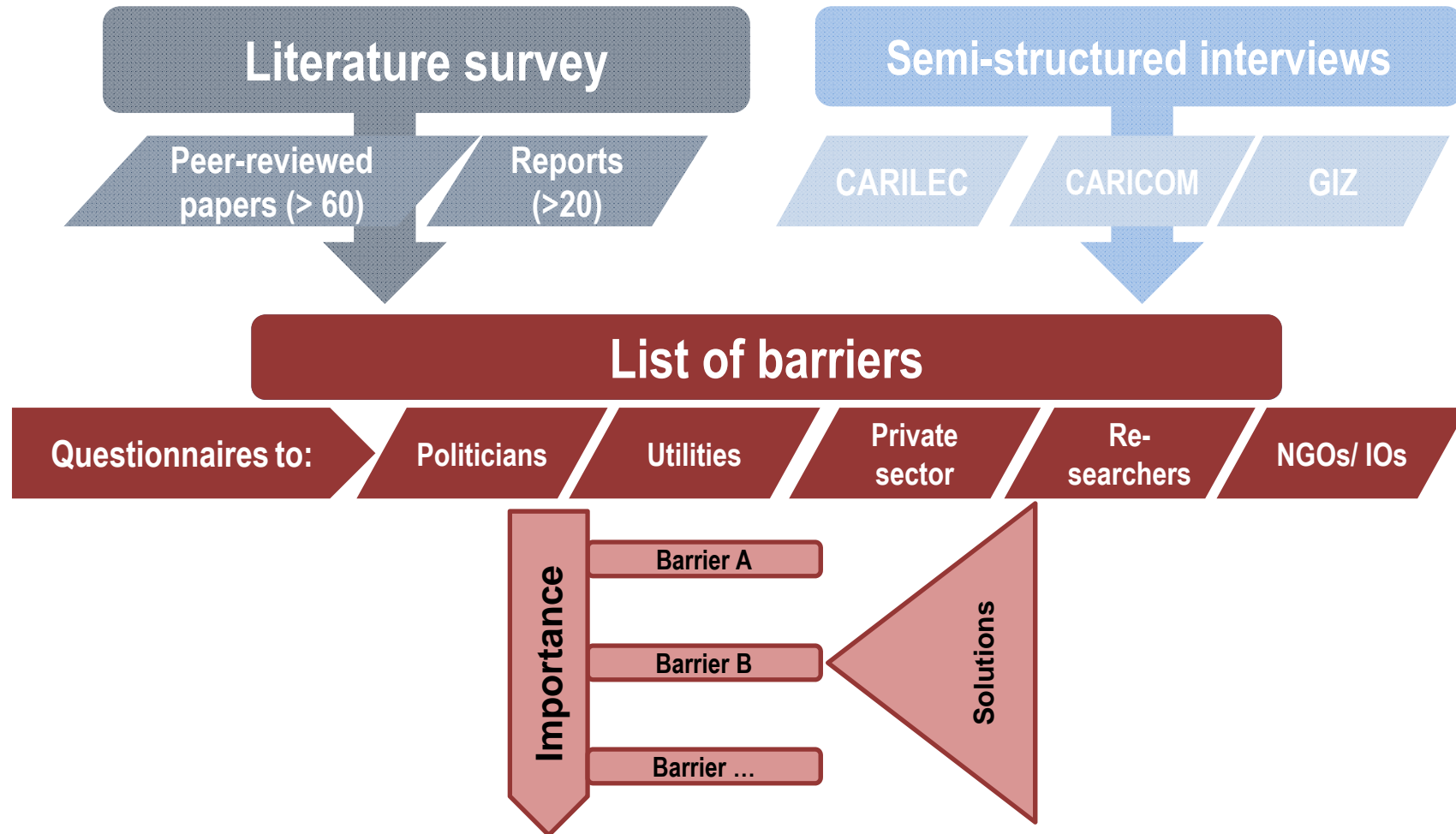
PV plant in Mustique and
wind turbines in Nevis





Results – List of Barriers



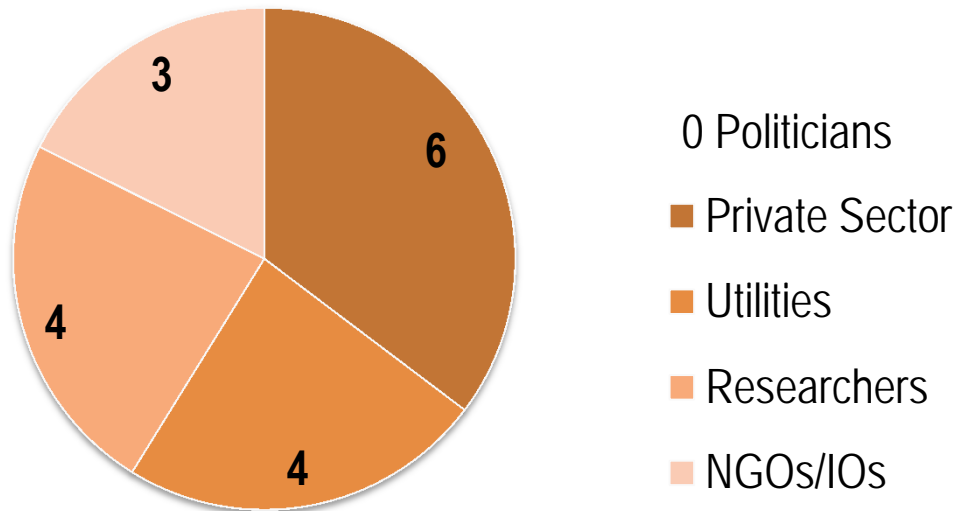


Questionnaire and Response Rate

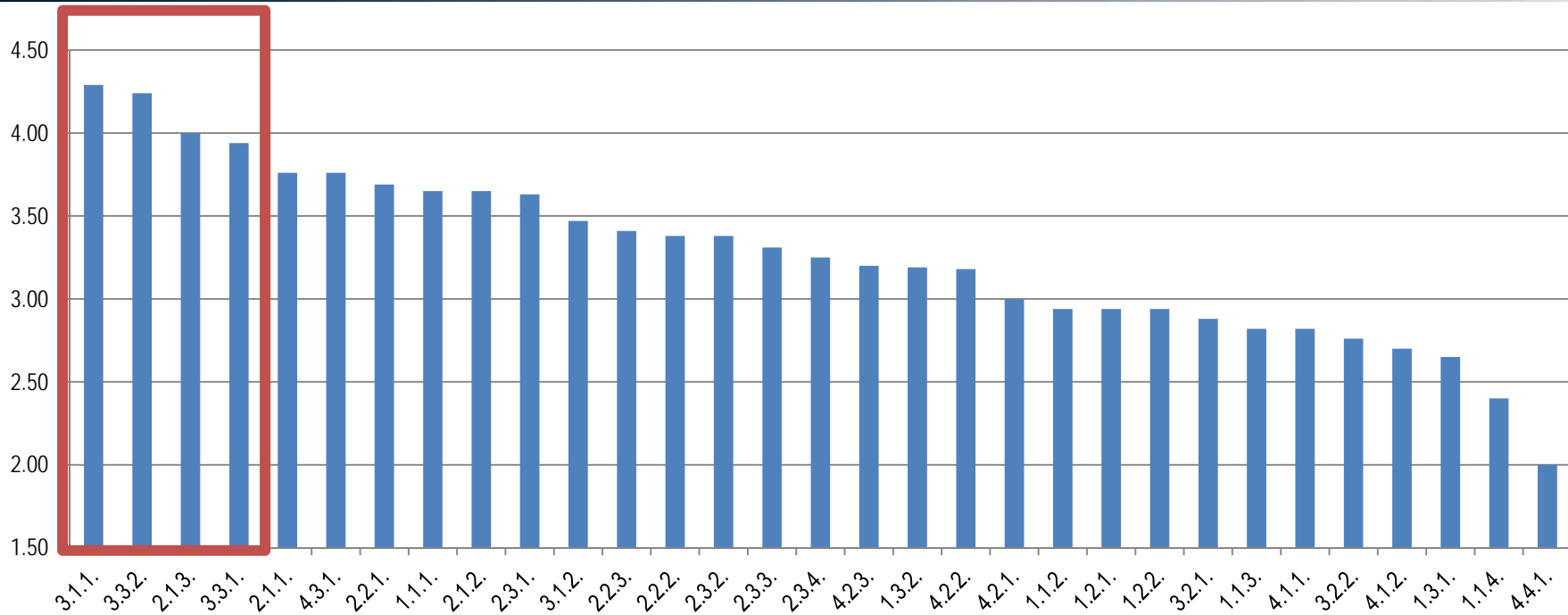
Likert scale to evaluate barriers:

5	4	3	2	1	0	Z
Highest importance	High importance	Moderate importance	Low importance	Very low importance	Absolutely no import.	Don't know

Response rate: 17/100



Results Ranking – All Stakeholders



1. Gaps between policy targets and implementation (4.29)
2. Lack of regulatory framework and legislation for private investors (4.24)

3. Diseconomy of Scale (4)
4. Lack of legal framework for IPPs and PPAs (3.94)

Results Ranking – Stakeholder Analysis

Barrier	All	Utility		Private Sector		NGOs/IOs		Researchers	
		Import.	Rank	Import.	Rank	Import.	Rank	Import.	Rank
Gaps policy targets/ implementation	1	4	5	4.67	1	4.67	5	3.75	16
Lack of regulation & legislation for private investors	2	4.25	2	4.33	2	3.67	23	4.5	2
Diseconomy of Scale	3	4	4	3.6	11	4	11	4.5	1
Lack of legal framework for IPPs and PPAs	4	3	11	4.17	3	4.5	7	4.25	4

Results Ranking – Top 5 for „Utilities“ and „Private“

TOP FIVE – Utilities Five Barriers ≥ 4		TOP FIVE – Private Five Barriers ≥ 4	
1.	Land use competition on islands	1.	Gaps between policy targets and implementation
2.	Lack of regulatory framework and legislation for private investors	2.	Lack of regulatory framework and legislation for private investors
3.	High transaction costs	3.	Lack of legal framework for IPPs and PPAs
4.	Diseconomy of scale	4.	Lack of access to low cost capital and credit
5.	Gaps between policy targets and implementation	5.	Utility monopoly of production, transmission and distribution of electricity

Results Ranking – Top 5 for NGOs/IOs and Researchers

TOP FIVE – NGOs/IOs Twenty Barriers ≥ 4		TOP FIVE – Researchers Eleven Barriers ≥ 4	
1.	Lack of access to low cost capital and credit	1.	Diseconomy of Scale
2.	High initial investments	2.	Lack of regulatory framework and legislation for private investors
3.	Lack of private capital	3.	Unsuitable transmission system and grid stability issues with decentralised RE
4.	Utility monopoly of production, transmission and distribution of electricity	4.	Lack of legal framework for IPPs and PPAs
5.	Gaps between policy targets and implementation	5.	Low availability of RE technologies

Discussion: Barriers and Solutions

- **Lack of legal framework for IPPs and PPAs**
- **Lack of regulatory framework and legislation for private investors**
- **Gaps between policy targets and implementation**



- **Creation of legal framework to allow IPPs and PPAs**
- **Implementation of regulatory frameworks to secure private investments (e.g. secure grid connection, feed-in tariff)**
- **Binding policy targets and implementation plans**

- **Diseconomy of scale**



- **Creation of single Caribbean-wide market**

Limitations and Future Research Needs

- **Negative feedback loops**
- **Discrepancy in perception of barriers**



- **Engagement**
- **Dialogue and interplay**
- **Communication**

THANK YOU!

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and my colleagues at the RLI for precious discussions.



I. Natural Conditions

- Land use competition on islands
- RE impact on landscapes and ecosystems
- Natural disasters
- Lack of evidence-based assessment of RE potentials

II. Technical Constraints

- Lack of technical expertise and experience
- Low availability of RE technologies

III. Infrastructure

- Inappropriate transport & installation facilities
- Unsuitable transmission system and grid stability issues with decentralised RE

I. Price/cost

- High initial investments
- High transaction costs
- Diseconomy of scale

II. Financial Aspects

- Lack of access to low cost capital or credit
- Lack of understanding of project cash flows from financial institutions
- Lack of private capital

III. Market Failure/distortion

- Utility monopoly of production, transmission and distribution of electricity
- Small market sizes
- Lock-in dilemma (conventional energy supply structures block REs)
- Fossil fuel subsidies and fuel surcharge

I. Policy

- Gap between policy targets and implementation
- Lack of incentives or subsidies for RE

II. Institutional Capacity

- Lack of formal institutions
- Lack of RE experts on governmental level

III. Regulatory

- Lack of legal framework for IPPs and PPAs
- Lack of regulatory framework and legislation for private investors

I. Consumer Behaviour/awareness

- Lack of social norms and awareness
- Lack of educational institutions

II. Interaction Networks

- Lack of RE initiatives
- Lack of local/national champions/ entrepreneurs
- Strong fossil fuel lobby

III. Cultural

- Dominance of cost over environmental issues

IV. Psychological/Moral

- Preference for status quo

Caribbean islands as research object

Islands are small- or mini-grids by geographic nature:

- special challenges to implement renewable energies
- lessons learned are applicable for larger grid systems

Key facts Caribbean:

- 13 island states
- 17 semi-autonomous states
- total population of 41.6 mill.
- mainly developing countries



Power generation mainly based on **diesel power plants** due to...

- fuel transport and availability
- easy scaling
- flexible operation

Two major challenges for Caribbean islands in power generation...

High levelized cost of electricity:

- Low efficiency (20 to 35 %, depending on operation and size)
- High fuel costs (diesel cost of 0.80 to 1.10 USD/liter)
- LCOE (fuel only): 0.19 to 0.46 USD/kWh (at 12 kW_{th} /liter diesel)

High GHG emissions:

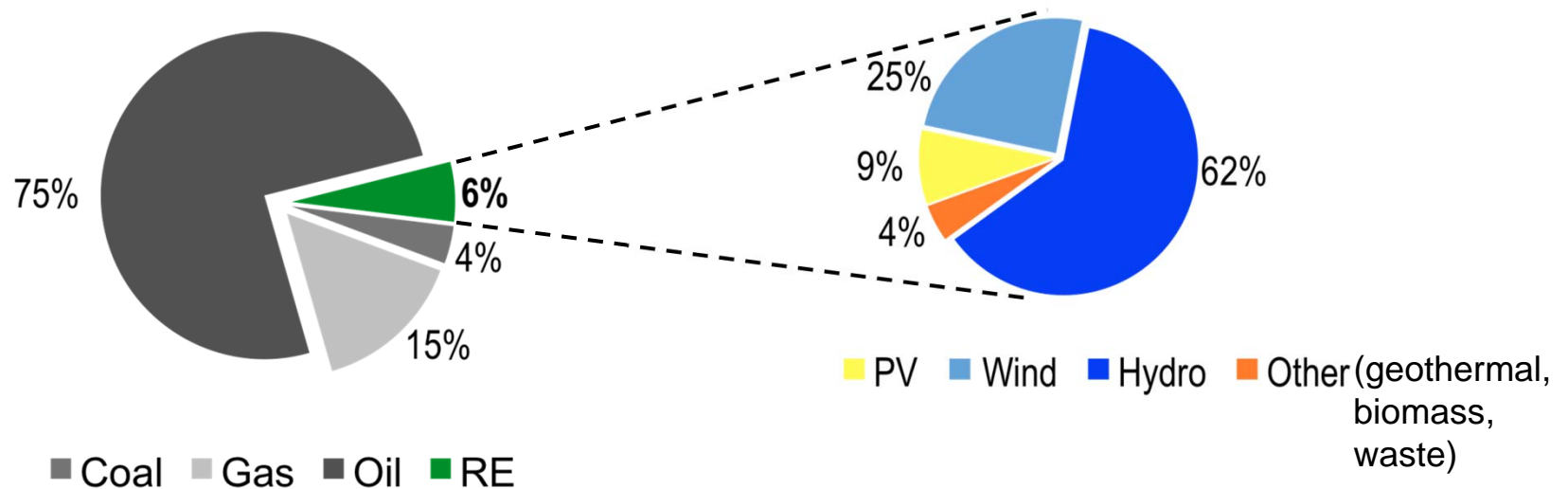
- 2.65 kg_{CO2} / burned liter diesel
- 0.540 to 0.950 kg_{CO2} / kWh



Very promising natural conditions for generating renewable electricity...

- high solar irradiation
- high wind speeds
- hydro and geothermal potential

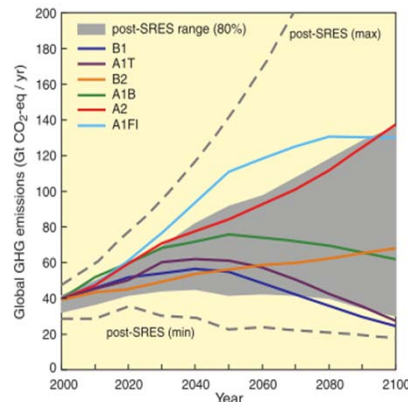
BUT problem of implementing RE



total conventional and renewable installed power plant capacity of appr. 21 GW

Global Problems: Affecting Especially Small Islands

Power generation on small islands is mainly based on fossil fuel based power plants (often diesel or heavy fuel oil). This power generation is highly expensive and polluting, leading to major global problems that affect islands disproportionately:

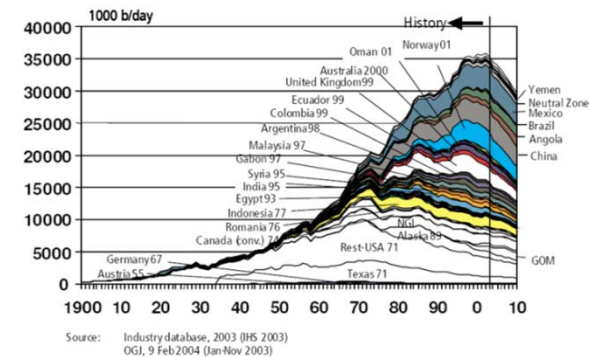


Climate Change

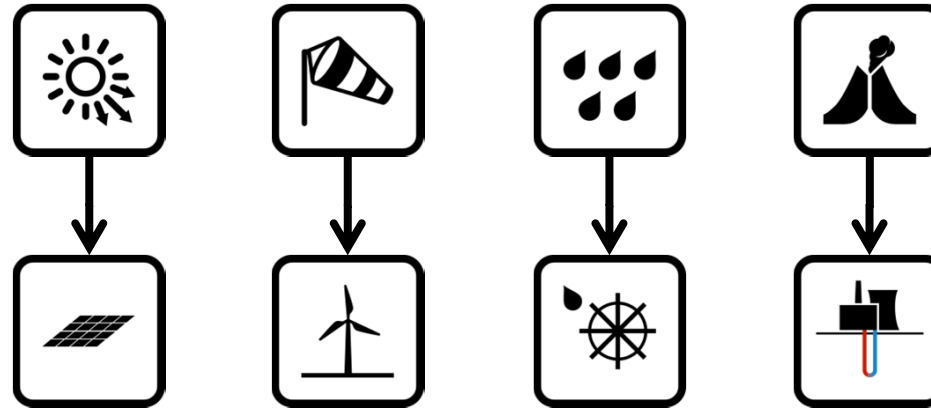
- Rising of the sea water level
- Extreme weather events

Peak Oil

- Increasing prices in the future
- Shortages of energy supply



Renewable Energies as One Solution



Renewable energies (e.g. PV, wind power, hydro power, geothermal energy) offer a broad range of **ecologically and economically sustainable ways of power generation**, while at the same time **reducing GHG emissions**.

BUT barriers in the form of **technical, economic, social and political conditions** hinder the implementation of renewable energies.