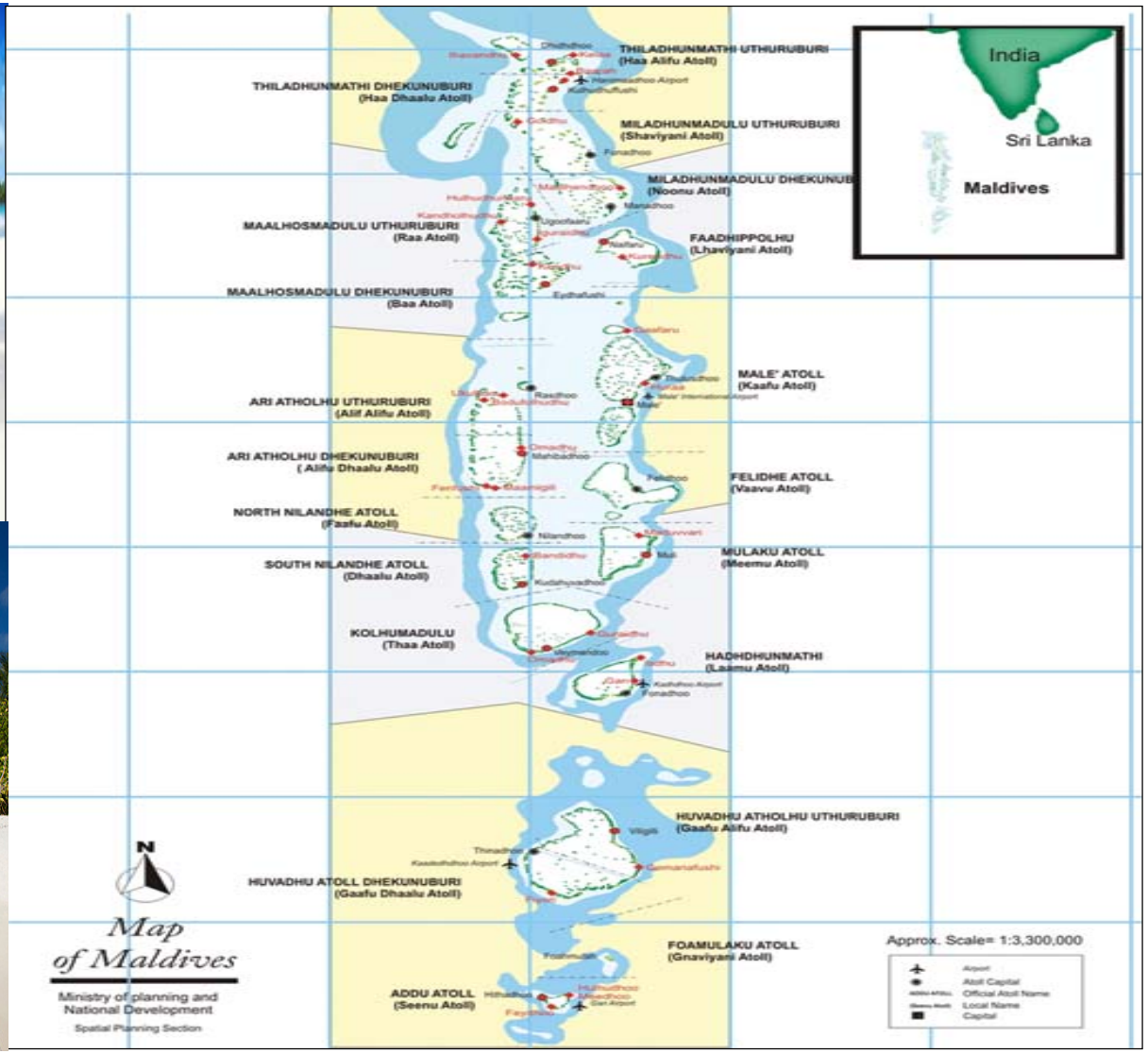
SREP Investment Plan

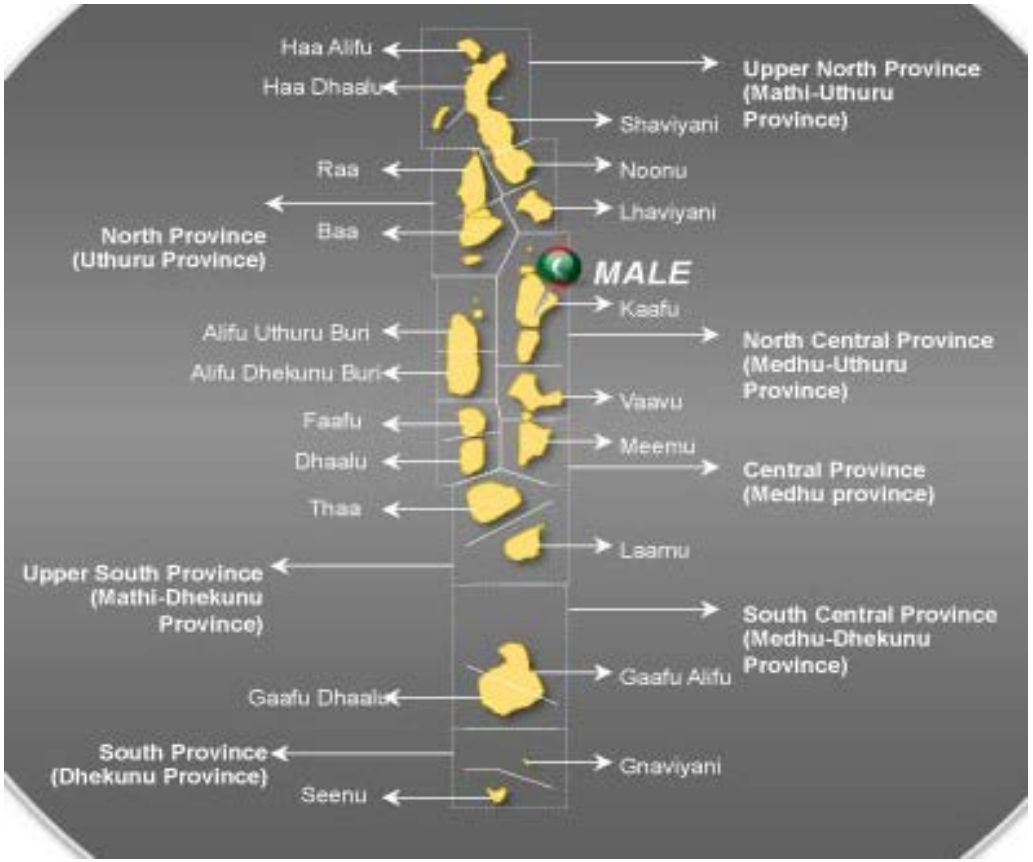
Republic of Maldives

Ministry of Environment & Energy

Maldives Energy System- Introduction

- An archipelago, located in south west of India and Sri Lanka
- 1,192 dispersed islands (grouped into 26 geographical atolls)
- Spreading over an area of 115,300 square kilometers occupying a total land area of 224 km^2
  - 190 inhabited islands and over 100 resorts
  - about 344,023 habitants and about two third of the habitants live on the outer islands
- Access to electricity 100%
- Installed generation capacity
  - Over 140 MW in inhabited islands, 105 MW in resorts
  - Practically 100% diesel
- Significant changes in utility structure
  - Pre – 2009 - STELCO covered major islands and island Development Committees (IDCs) for others, and private individuals and NGOs (almost 10% STELCO, NGOs and private 5%, and Communities /IDCs 85%)
  - Transition to 7 regional utilities (2009)
  - Consolidation of outer islands to FENAKA (in 2013)while STELCO covers Greater Male and the region, covering about 30 islands


India
Sri Lanka
Maldives
THILADHUNMATHI UTHURUBURI
(Haa Alifu Atoll)
THILADHUNMATHI DHEKUNUBURI
(Haa Dhaalu Atoll)
MILADHUNMADULU UTHURUBURI
(Shaviyani Atoll)
MILADHUNMADULU DHEKUNUBURI
(Noonu Atoll)
MAALHOSMADULU UTHURUBURI
(Raa Atoll)
FAADHIPPOLHU
(Lhaviyani Atoll)
MAALHOSMADULU DHEKUNUBURI
(Baa Atoll)
MALE' ATOLL
(Kaafu Atoll)
ARI ATHOLHU UTHURUBURI
(Alif Alifu Atoll)
ARI ATHOLHU DHEKUNUBURI
(Alifu Dhaalu Atoll)
FELIDHE ATOLL
(Vaavu Atoll)
NORTH NILANDHE ATOLL
(Faafu Atoll)
MULAKU ATOLL
(Meemu Atoll)
SOUTH NILANDHE ATOLL
(Dhaalu Atoll)
KOLHUMADULU
(Thaa Atoll)
HADHDHUNMATHI
(Laamu Atoll)
HUVADHU ATHOLHU UTHURUBURI
(Gaafu Alifu Atoll)
HUVADHU ATOLL DHEKUNUBURI
(Gaafu Dhaalu Atoll)
FOAMULAKU ATOLL
(Gnaviyani Atoll)
ADDU ATOLL
(Seenu Atoll)
N
Map
of Maldives
Ministry of planning and
National Development
Spatial Planning Section
Approx. Scale= 1:3,300,000


Haa Alifu
Haa Dhaalu
Shaviyani
Raa
Noonu
Lhaviyani
North Province
(Uthuru Province)
Baa
MALE
Kaafu
Alifu Uthuru Buri
Alifu Dhekunu Buri
Vaavu
Faafu
Meemu
Dhaalu
Thaa
Laamu
Upper South Province
(Mathi-Dhekunu
Province)
Gaafu Alifu
Gaafu Dhaalu
South Province
(Dhekunu Province)
Gnaviyani
Seenu
Upper North Province
(Mathi-Uthuru
Province)
North Central Province
(Medhu-Uthuru
Province)
Central Province
(Medhu province)
South Central Province
(Medhu-Dhekunu
Province)

Maldives SREP IP Objectives

- Transformation of electricity sector
- Large scale RE development
- Increase national energy security
- Creating a strong RE industry
- Attract foreign RE investors
- Emerge as model for other SIDS

SREP Component

ASPIRE
Renewable Energy for Greater Male' Region

1. Greater Male' Region Solar PV investments
2. Waste-To-Energy (Thilafushi)
3. Greater Male' Region Renewable Power System Integration

POISED
Renewable Energy for Outer Islands

1. Small power station RE
2. RE readiness - Power system rehabilitation
3. Outer Island Solar/wind investments
4. Outer Island Waste-To-Energy investments

Technical Assistance and Capacity Building

1. Creating an enabling environment
2. Human Capacity Building
3. Project Preparation and Feasibility studies
4. Improved access to quality data

ASPIRE - IMPLEMENTATION

ASPIRE

- Contract awarded to install 1.5MW solar PV in Hulhumale' island – in August 2015
  - All necessary agreements signed (Power Purchase Agreement, Roof Lease Agreement)

- Next phase contract preparation on going
  - 2.5MW roof top solar for Male

Design Objectives for POISED

- Optimum level of %RE penetration
- Minimize diesel fuel consumption
- Financial and economic viability
- Reduce impact on government budget for subsidies
- Minimize CO_2 emissions
- Minimize local environmental impact
- Optimize land-use
- Awareness of context, resources
- Flexibility

Transition Plan for Islands

- **Type A** – Initially large islands - Moderate RE
  - Up to 10% of energy or 30%-40% of peak-load
  - No Storage, new generators (where needed)
- **Type B** – Medium RE
  - 10%-80% energy based on modeling
  - Storage back-up (security, grid support)
- **Type C** – Initially very small islands - Full RE
  - RE penetration close to 100% (peak <20kW)
  - Storage back-up (security, grid support, load-following)

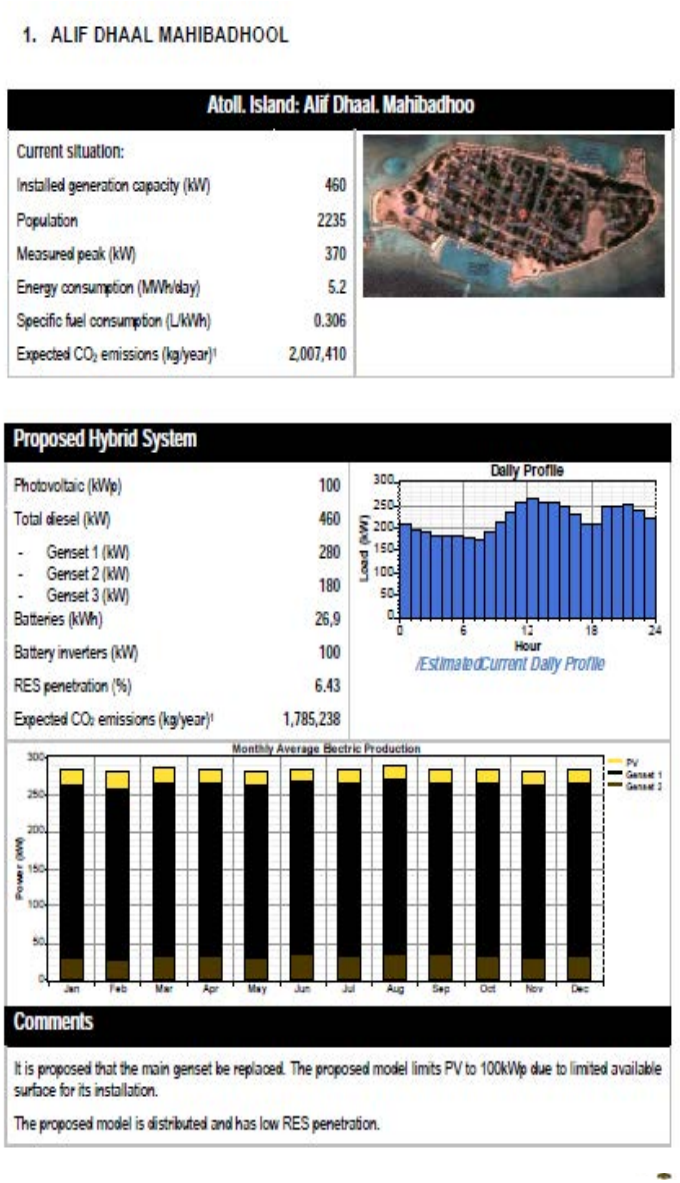
Financing for POISED

- ADB Financing (GRANT)
  - ADF – $38 million (Jan 2015)
  - SREP - $ 12 million (Jan 2015)
  - Additional financing (JFJCM) (August 2015)
- Co-financing (LOAN)
  - EIB - $50 million (Approved in March 2016 and signed)
  - IsDB – $10 million (FFM in August 2016, not signed yet)

POISED - IMPLEMENTATION

Roadmap

- **Phase 1** – Covering 5 islands
  - Efficient island grids with renewable energy providing part of the electricity requirement
  - Potential for scaling up solar initiatives
  - Data collection and monitoring for design for later phases
  - Replicability for subsequent phases
- **Subsequent Phases**
  - Sector project approach with agreed criteria for future projects
  - Atoll based approach to improve procurement, implementation and logistics



1. ALIF DHAAL MAHIBADHOOL

Atoll. Island: Alif Dhaal. Mahibadhoo

Current situation:	
Installed generation capacity (kW)	460
Population	2235
Measured peak (kW)	370
Energy consumption (MWh/day)	5.2
Specific fuel consumption (L/kWh)	0.306
Expected CO_2 emissions (kg/year)[1]	2,007,410

Proposed Hybrid System

Photovoltaic (kWp)	100
Total diesel (kW)	460
- Genset 1 (kW)	280
- Genset 2 (kW)	180
- Genset 3 (kW)	
Batteries (kWh)	26,9
Battery inverters (kW)	100
RES penetration (%)	6.43
Expected CO_2 emissions (kg/year)[1]	1,785,238

Daily Profile

Load (kW)

Hour

Estimated Current Daily Profile

Monthly Average Electric Production

Power (kW)

PV

Genset 1

Genset 2

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Comments

It is proposed that the main genset be replaced. The proposed model limits PV to 100kWp due to limited available surface for its installation.

The proposed model is distributed and has low RES penetration.

Phase 1 - Islands

Island	Population	Daily Peak (kW)	Annual Energy (MWh)
Addu City	25,571	3850	22,161
Ga.Villingili	3,460	481	2,684
Lh. Kurendhoo	1,945	165	881
B. Goidhoo	748	69	417
Th. Buruni	579	78	322

POISED Phase 1

Island	PV (kW)	Diesel Generation (kW)*	Storage (kWh)	Type
Addu City	1600	6850 (1x1500, 3x1000, 3x750)	None**	A
Villingili	300	800 (1x500, 1x300)	78	B
Khurendhoo	300	254 (1x104, 1x150)	74	B
Goidhoo	200	160	78	B
Buruni	100	100	40	B

* Existing Gensets retained on Addu and case to case replacements in other islands

** Storage to be taken up under JFJCM with additional solar PV of 1 MW to be developed on Addu

Phase 1 - Status

5 islands
Contract Awards – 22-29 October 2015

Other contracts

- Technical consultants recruited in December 2015
- Financial and IT consultants recruited in March 2016

- Complete and Commission by Feb and March 2017


SUNGROW

POISED Phase 2

Greater Male'

- Replace smaller inefficient sets with

  8 MW Genset – Awarded in April 2016

- Solar PV interventions are under the ASPIRE program (WB)

Outer Islands

- 2 atolls in the North
- HDh (13 islands) bid evaluation in process
- HA (14 islands) bid evaluation in process


WARTSILA.COM
8MW of Diesel Generator
Male Capital City of Maldives

POISED Phase 3

- Sh, N – Call for tender January 2017
- Lh,K, AA, Adh, V – Feasibility completed
- GA and GDh – Feasibility completed

JFJCM Project

- Advanced energy storage in Addu
- 1 MW additional solar PV
- Consulting support
  - Design ongoing
  - Procurement to start in 2016


Thank You