

The Republic of Maldives Renewable Energy Roadmap Final Workshop

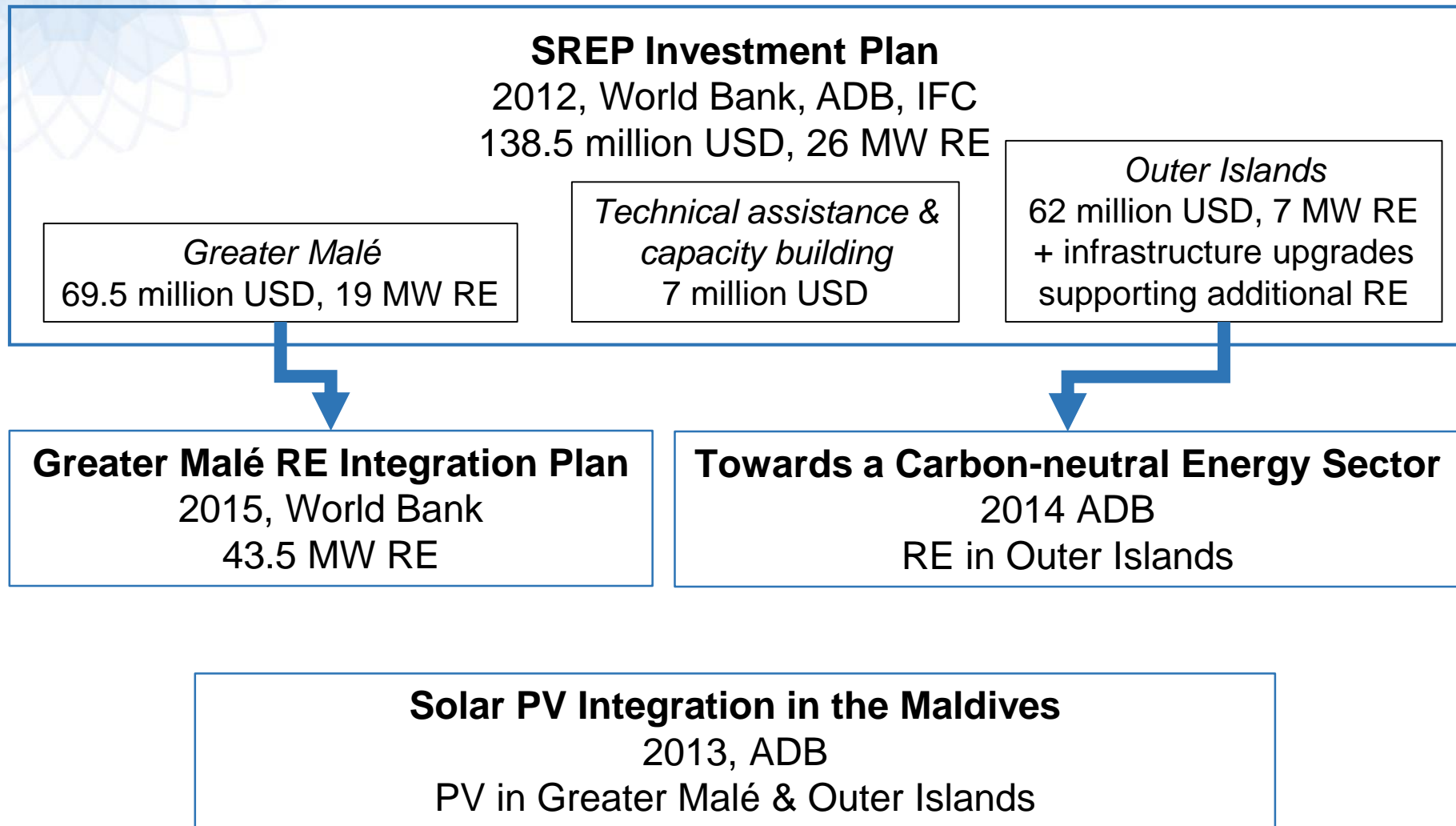
17 September 2015, Kurumba Resort, the Maldives

Organized by:

The Ministry of Environment and Energy, Republic of Maldives &
The International Renewable Energy Agency (IRENA)

- Review of key renewable energy plans & studies including:
 - *Maldives SREP Investment Plan*
 - *Greater Malé Region Renewable Energy Integration Plan*
 - *Towards a Carbon-neutral Energy Sector: Maldives Energy Roadmap 2014-2020*
 - *Solar PV Integration in the Maldives*
- Modelling of least cost options solar PV deployment
 - *Gdh. Thinadhoo & Villingili*
- Goal: supporting RE deployment by identifying:
 - Key barriers & areas for further analysis
 - Recommendations to build on existing efforts

Key RE Deployment Plans & Studies





Maldives

Scaling up Renewable Energy Program in Low Income Countries (SREP) Investment Plan

World Bank, ADB, IFC, 2012

SREP Investment Plan Overview

- Objective: RE deployment to transform electricity sector
- A key funding mechanisms for RE projects in the Maldives
- Designed to leverage private investment
- **138.5 million USD** divided into three components

SREP Investment Components	Funding (million USD)	
	Public	Private
1) Renewable energy for Greater Malé	34.5	35
2) Renewable energy for outer islands	46	16
3) Technical assistance & capacity building	7	0
Total investment	87.5	51

SREP: Four Funding Programs

1) **ASPIRE:** *Accelerating sustainable private investments in RE*

- Feed in Tariff with WB guarantees to leverage private investment
 - PV projects in Greater Malé
 - PV & wind projects in 30 islands with medium to large electricity demand
 - Waste-to-energy in outer islands

2) **POISED:** *Preparing outer islands for sustainable energy development*

- PV & wind projects aiming for 20-100% RE electricity
- ADB funded pilot projects are underway: *1.6 MW PV in Addu City*

3) **Technical assistance for renewable energy scale-up**

- Capacity building
- Data collection
- Identification of additional RE investment opportunities

4) **Thilafushi Waste-to-Energy Project:** IFC funded 4 MW system



Greater Malé Region Renewable Energy Integration Plan

World Bank, 2015

Greater Malé RE Plan Overview

- Renewable energy deployment plan for Greater Malé
 - Covers RE resources & technologies, policy & regulation
 - Recommends deployment of PV & onshore wind generation
 - Electrical interconnection between islands necessary

Island	Proposed RE (MW)		Peak Demand 2014 (MW)
	PV	Wind	
Malé	5.1	0	45.9
Hulhumalé	5.2	0	3.4
Hulhulé	6.6	0	4.7
Villingili	0.6	0	1.8
Thilafushi	4.1	20	0.7
Gulhifalhu	1.9	0	0.1
Total	43.5		56.6

Greater Malé Integration Plan: PV

- Plan only analyzed PV deployment on public roof space
 - Achieving full PV potential requires private investment
 - Policies in place / being developed to support private investment
 - Current Feed in Tariff supports PV systems over ca. 10 kW
 - Upcoming net metering supports ca. 5 -10 kW PV systems



Example: Private PV Potential in Malé

- Malé: PV only on public roof space = 5.1 MWp
 - Uses 36,520 m² public roof space = less 2% of land area in Malé
 - If 25% of land area could use for private roof top PV = 62 MWp
 - Current diesel capacity = 61.42 MW



Greater Malé RE Plan: Wind

- Onshore wind power key part of RE deployment
 - 20 MW proposed project in Thilafushi
 - 80 MW proposed project in nearby uninhabited islands
- Recommendations to support wind power
 - Data collection & management system: 80 meter mast in Thilafushi
 - Technical & logistical studies: turbine transportation & installation
 - Operation & maintenance: local staff training & dedicated budget



Greater Malé RE : Interconnection

- Interconnection key for RE deployment in Greater Malé
 - Allows large-scale RE deployment on islands with low demand & population to supply power to islands with high demand & population
 - Malé: growing demand & limited space for power generation
 - No assessment of interconnection contribution to a least-cost power system
 - No comparison of interconnection cost vs. energy storage or other measures
 - No analysis on optimal RE deployment supported by interconnection.





Towards a Carbon-neutral Energy Sector: Maldives Energy Roadmap 2014-2020

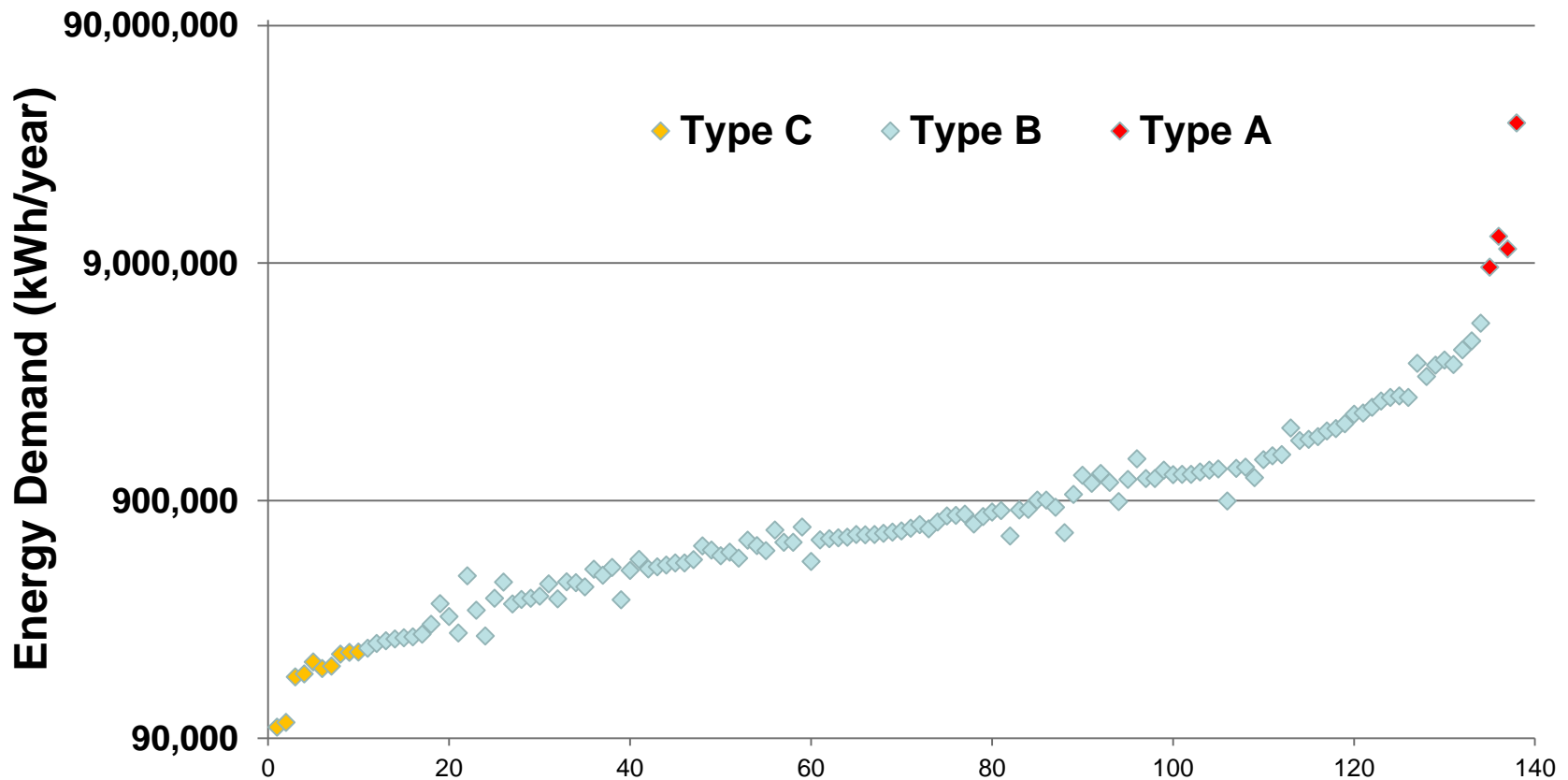
ADB, 2014

- RE deployment plan for 138 islands outside Greater Malé
 - Examined RE resources and existing diesel power systems
 - Recommends hybrid systems: PV + diesel / battery storage
 - Modeling used to determine least cost option for three system types

Recommended Outer Island Hybrid Systems				
System Type	Number of islands	Electricity demand	Annual RE share	Battery storage
A	4	High	<10%	None
B	124	Normal	10-80%	Litium-ion
C	10	Low	80-100%	Lead acid

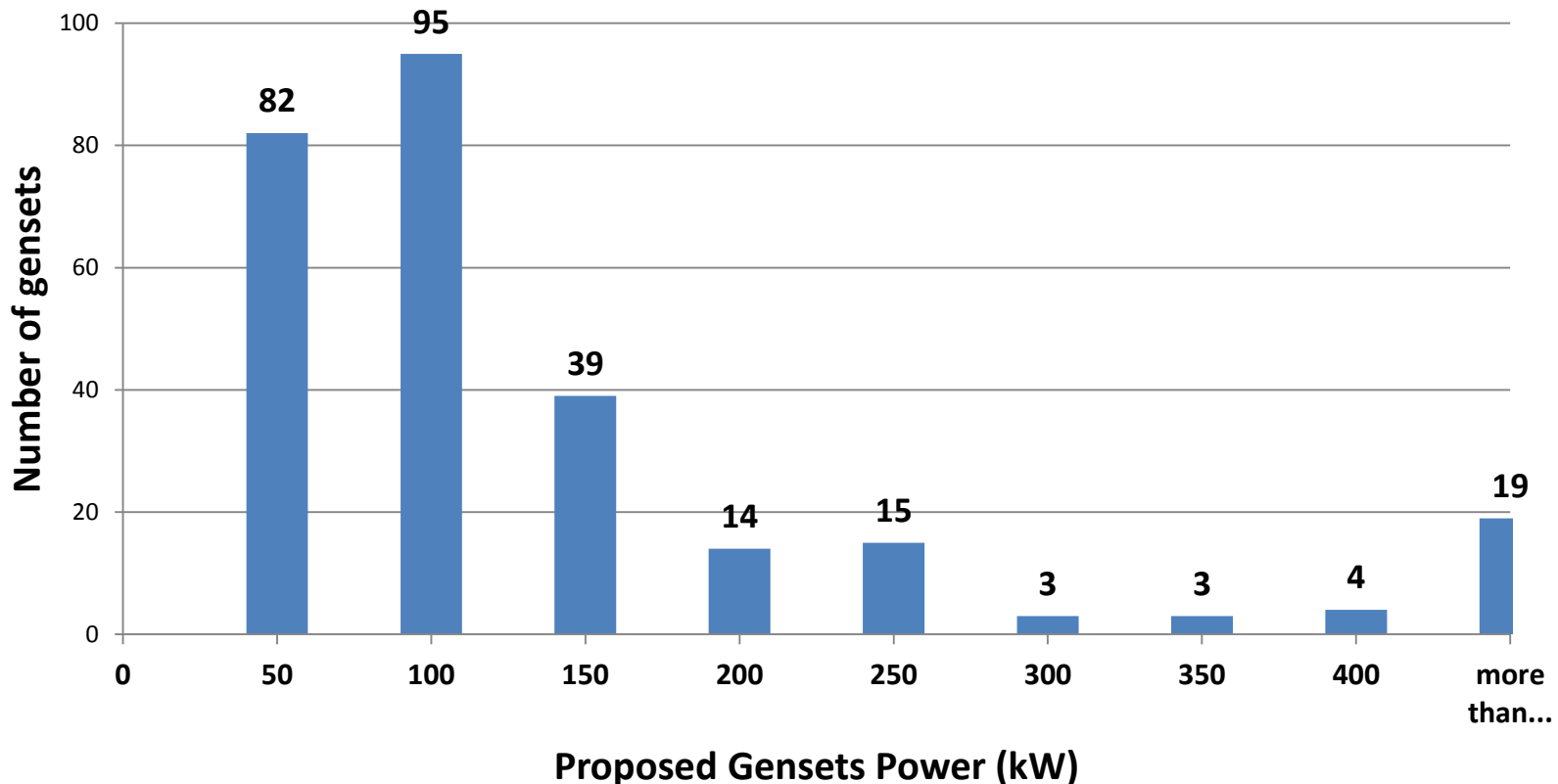
Outer Island RE System Distribution

- Type A: Addu City, Kulhudhuffushi, Fuvahmulah & Thinadhoo
- Type B: 124 islands (6 with land restricted RE deployment)
- Type C: 10 island with RE system less than 20 kWp



Outer Island Diesel Deployment

- Plan notes upgrading diesel generation may be needed
 - To ensure proper sizing vs. demand & optimal operation
 - Significant fuel savings & greater RE deployment potential



Outer Island RE Deployment Cost & Timeline

RE System Cost Estimate			
System Type	Total PV Capacity (MWp)	Total Cost (Million USD)	Million USD/MWp
A	2.8	13.9	5.0
B	16.8	89.8	5.3
C	1.3	7.2	5.8
Total	20.9	110.9	5.3

RE deployment timeline		
Project phase	Number of islands	Year of completion
1	5	2015
2	69	2016
3	60	2017

- Phase 1: 5 ADB funded demonstration pilot projects
- Phase 2 & 3 require significant private investment
- Plan identifies several private investments barriers
 - High risk investment perception
 - Nascent regulatory structure
 - Inadequate public sector infrastructure to integrate private RE
 - Lack of energy data



Solar PV Integration in the Maldives

ADB, 2013

PV Study Overview

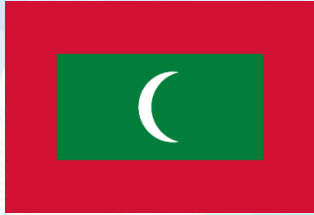
- Analysis supporting PV deployment across the Maldives
- Grid stability studies on representative islands
- Determines upper limit of PV deployment **without storage**
- Significant PV deployment w/out risk to grid stability

Island Category	Peak Electricity Demand	Annual PV Generation
Small	less than 100 kW	10%
Resort	typically 300-800 kW	30%
Medium & large	significantly above 100 kW	12-32%
Malé	ca. 40 MW	10%

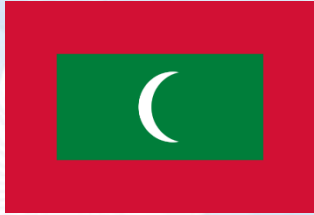
- Present FIT may not support large-scale PV deployment
 - Upcoming net metering policy should increase investment in PV
- Current tariff structure does not support PV deployment
- Recommendation options to explore
 - Time-of-use tariff
 - Interruptible load contracts for large deferrable loads
- Need for a clear aggressive RE policy driver
 - RE targets based on least cost deployment options

Insights from Key RE Plans & Studies

- RE deployment can have a major impact in the Maldives
- PV & onshore wind are the least cost options
- Significant private investment is required
- Greater Malé plan does not identify least cost option
- Lack of regularly update high quality data on energy sector
- All studies note policy & regulatory barriers
 - Lack of ambitious but achievable RE targets
 - Establishment of market structure supporting RE investment



Thank You



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