

Diesel to Solar Transformation

RCREEE Private Investments' Promotion Program

Presented by

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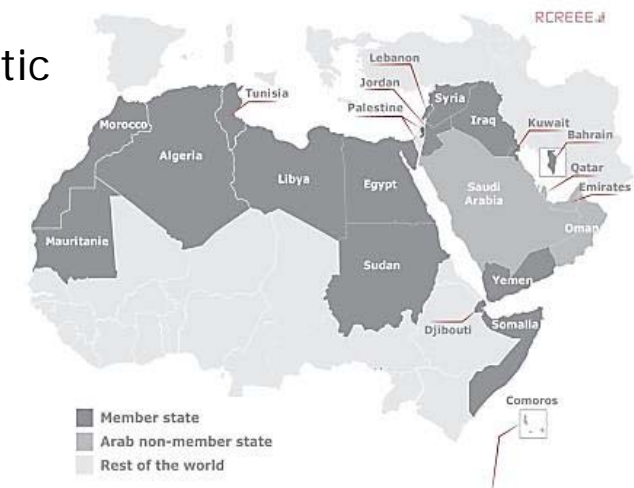
RCREEE 

Regional Center for Renewable Energy and Energy Efficiency
المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

Arab Forum for Renewable Energy and Energy Efficiency,
Cairo, 1–2 June, 2016

About RCREEE

- Independent regional inter-governmental diplomatic organization
- 17 member states
- National focal points in every country
- In operation since 2008
- Headquartered in Cairo, Egypt



Our Vision

"The energy systems in the Arab region are characterized by a significant share of renewable resources and a highly-efficient use of energy."

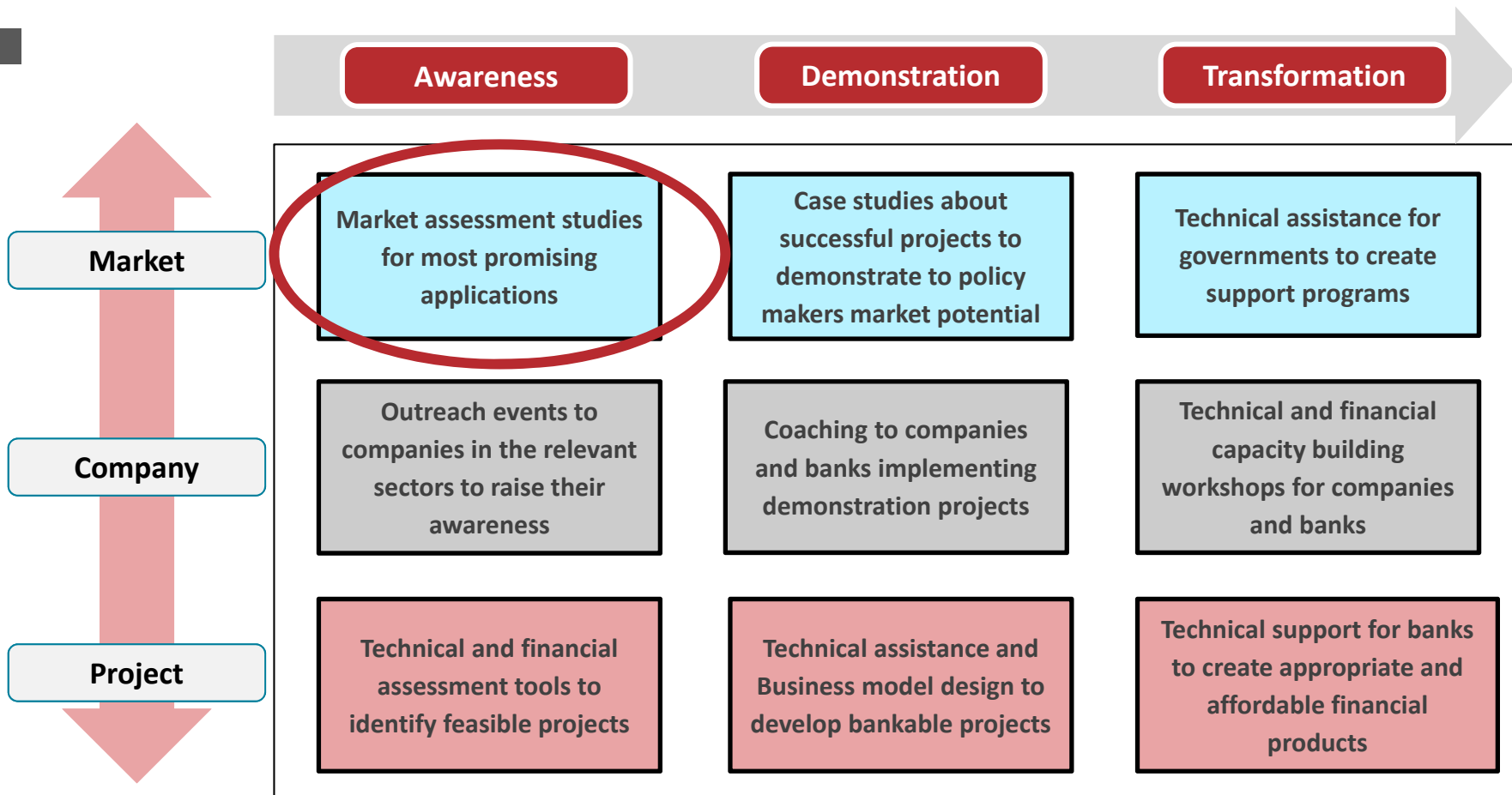
Our Mission

"To enable a sustainable growth in Arab states' adoption of renewable energy and energy efficiency applications and initiatives through leading regional policy dialogues, learning, and research."

■ A Key Objective

To translate **improving framework conditions** in Member States into concrete renewable energy and energy efficiency **actions by the private sector**





- **Market assessment supported by UNDP**
- **First of its kind for the Arab region**

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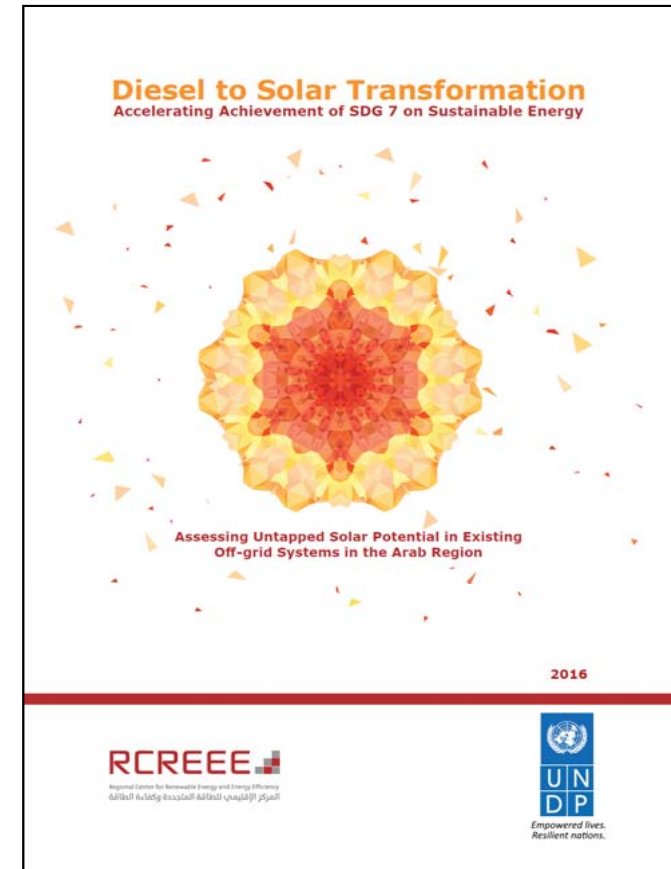
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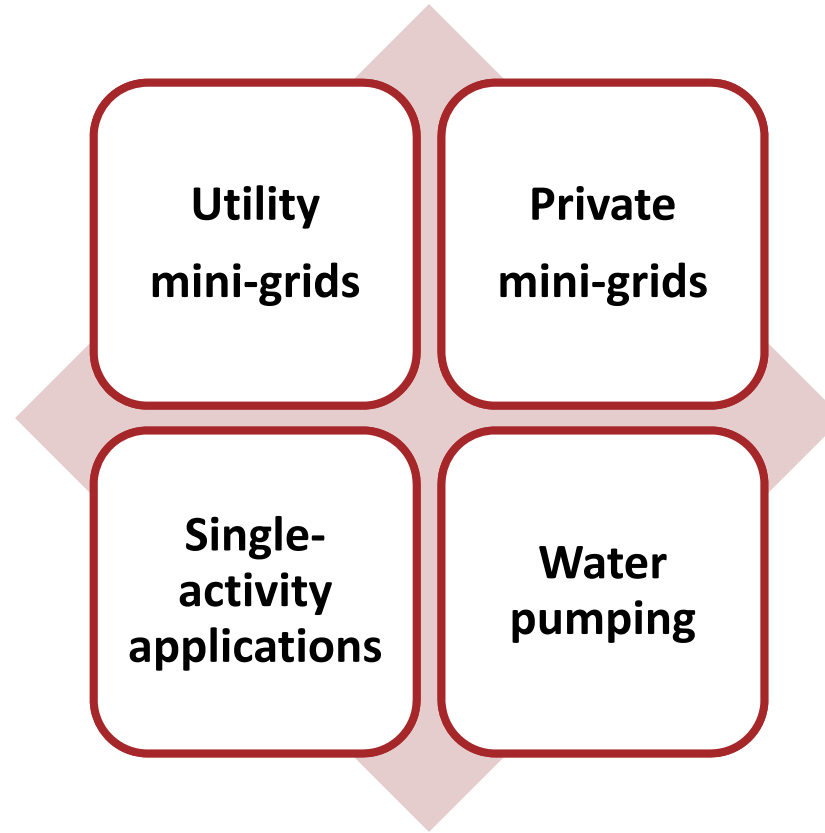
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- **Four countries: Egypt, Djibouti, Sudan and Yemen**
- **Mixed primary and secondary sources**
- **Identifies the most promising applications**

■ Target applications










Country Specific Analysis (Sudan)

Population	HDI ranking	GDP (USD)	Electrification rate	Diesel price (USD per Liter)
				
37,960,000 <small>(World Bank, 2013)</small>	166 out of 187 <small>(United Nations Development Programme, 2013)</small>	66.57 billion <small>(World Bank, 2013)</small>	34.5% <small>(Arab Union of Electricity, 2013)</small>	0.51 <small>(World Bank, 2014)</small>

~ 3200MW Installed Capacity

Key socioeconomic and energy facts for Sudan






Country specific analysis: Djibouti

Population	HDI ranking	GDP (USD)	Electrification rate	Diesel price (USD per Liter)
				
872,900 (World Bank, 2013)	164 out of 187 (United Nations Development Programme, 2013)	1.456 billion (World Bank, 2013)	50% (Africa-EU Energy Partnership, 2013)	1.18 (World Bank, 2014)

~ 130 MW Installed Capacity

Key socioeconomic and energy facts for Djibouti

Country Specific Analysis (Yemen)

Population	HDI ranking	GDP (USD)	Electrification rate	Diesel price (USD per Liter)
				
25,956,000 (Central Statistical Organization, 2014)	154 out of 187 (United Nations Development Programme, 2013)	35.95 billion (World Bank, 2013)	40% (United Nations Development Programme, 2014)	0.70¹² (Yemen Petroleum Company, 2015)

~ 1500MW Installed Capacity

Key socioeconomic and energy facts for Yemen

Country specific analysis: Egypt

Population	HDI ranking	GDP (USD)	Electrification rate	Diesel price (USD per Liter)
				
90,000,000 (Central Agency for Public Mobilization and Statistics, Nov 2015)	110 out of 187 (United Nations Development Programme, 2013)	272 billion (World Bank, 2013)	99% (Arab Union of Electricity, 2013)	0.23 (World Bank, 2014)

~ 38000MW Installed Capacity

Key socioeconomic and energy facts for Egypt

Country specific analysis: Egypt

Isolated diesel power plants in Egypt

Company	Number of plants	Installed capacity (MW)	Gross energy generation (GWh/year)
Canal DC	18	145	184.7
El-Behera DC	4	12.3	30.7
Middle Egypt DC	6	41.3	24.3
Upper Egypt DC	1	2.9	-
Total	29	201.5	239.7

Country specific analysis: Egypt

Nameplate capacity (HP)	Estimated operational capacity (kW)	Yearly energy consumption ⁴ (kWh)	Diesel consumption per kWh (gm)	Number of pumps	Total diesel consumption (000s tonnes)
Portable:					
< 5	2.625	15,750	400	45,599	294
6 – 9	5.625	33,750	350	89,951	1,086
10 – 12	8.25	49,500	300	36,178	549
> 12	10.5	63,000	250	15,467	249
Fixed:					
< 15	7.5	45,000	250	27,549	317
16 – 25	14.25	85,500	235	24,716	508
26 – 45	26.25	157,500	220	8,597	304
> 45	37.5	225,000	200	10,182	468
Total				258,239	3,775

■ D2S Market Assessment – Key Findings

~ **6 Million tonnes /year of diesel consumption** in the four target applications

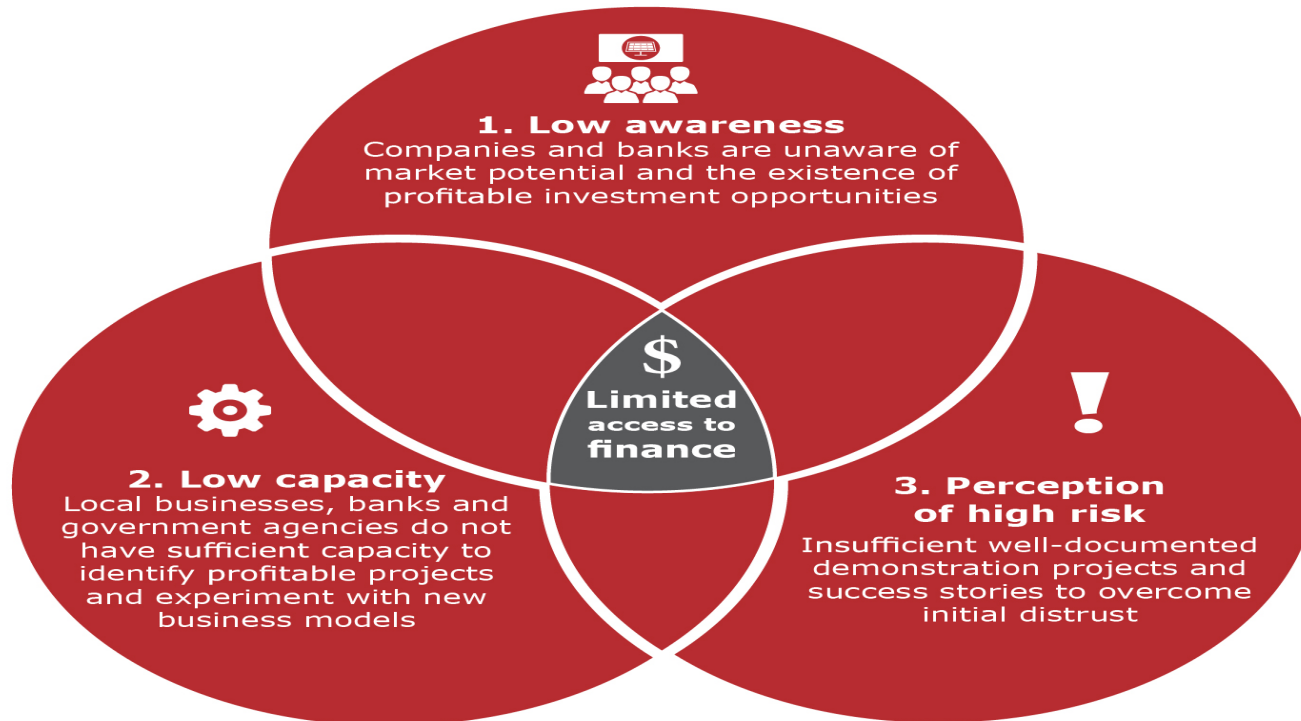
Category (000s tonnes)	Djibouti	Egypt	Sudan	Yemen	Total
Utility mini-grids	5	78	40	223	346
Private mini-grids	20	60	-	78	158
Single-activity applications	-	-	-	16	18
Water pumping in agriculture	0.7	3775	52	1,648	5,475.7
Total	25.7	3,915	92	1,965	5,997.7

D2S Market Assessment – Key Findings

- **3.5 GW_p** potential PV peak capacity

Category (MW _p)	Djibouti	Egypt	Sudan	Yemen	Total
Utility mini-grids	0.7	62	53	280	395.7
Private mini-grids	7	77	-	76	160
Single-activity applications	-	-	-	5	5
Water pumping in agriculture	0.5	1,938	101	894	2,933.5
Total	8.2	2,077	154	1255	3,494.2

■ The Way Forward: Situational analysis



Stakeholder Involvement

1. End Users

Farms, hospitals, army bases, hotel owners, etc.

2. Solution providers

Local diesel providers, local solar energy providers, etc.

3. Government and public agencies

Ministry of energy, ministry of development, sustainable energy agencies, etc.

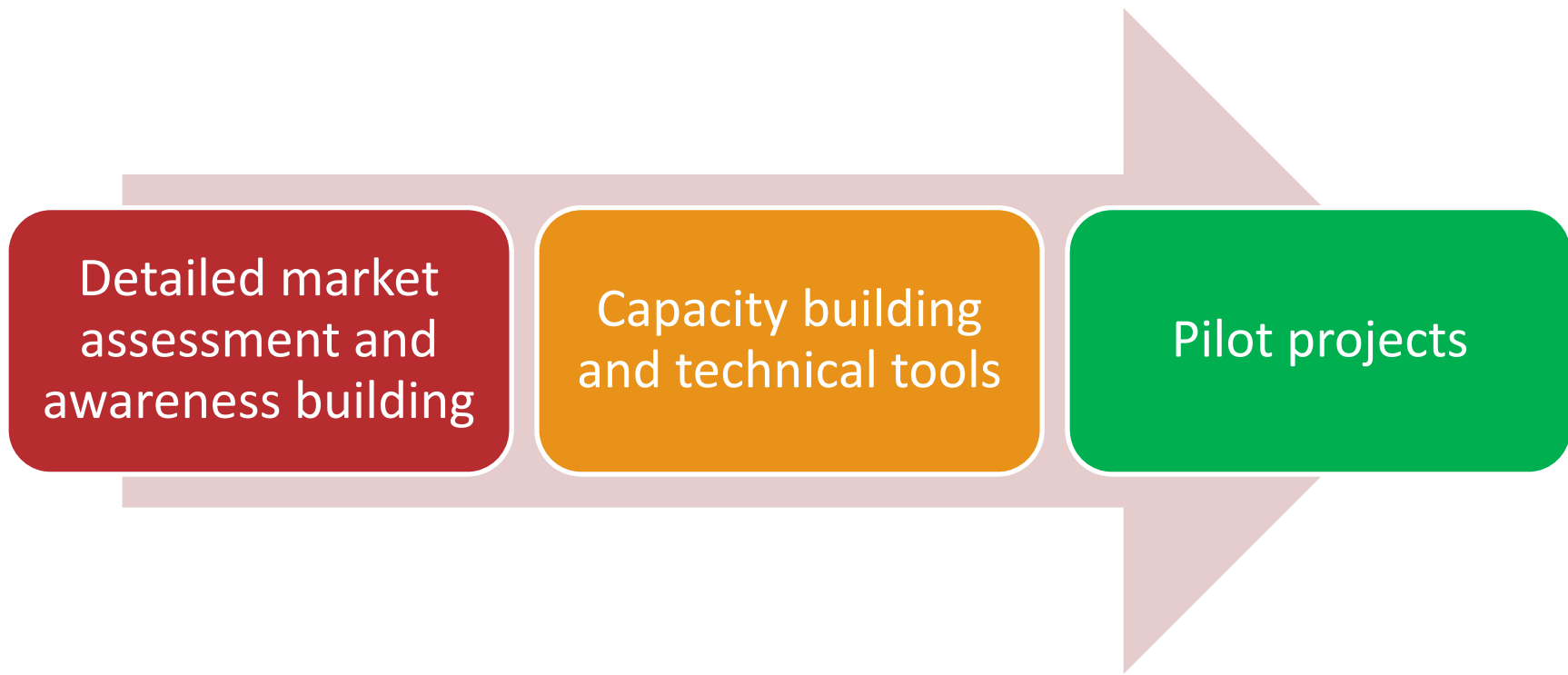
4. Development organizations

UN organization, international NGOs, foundations, etc.

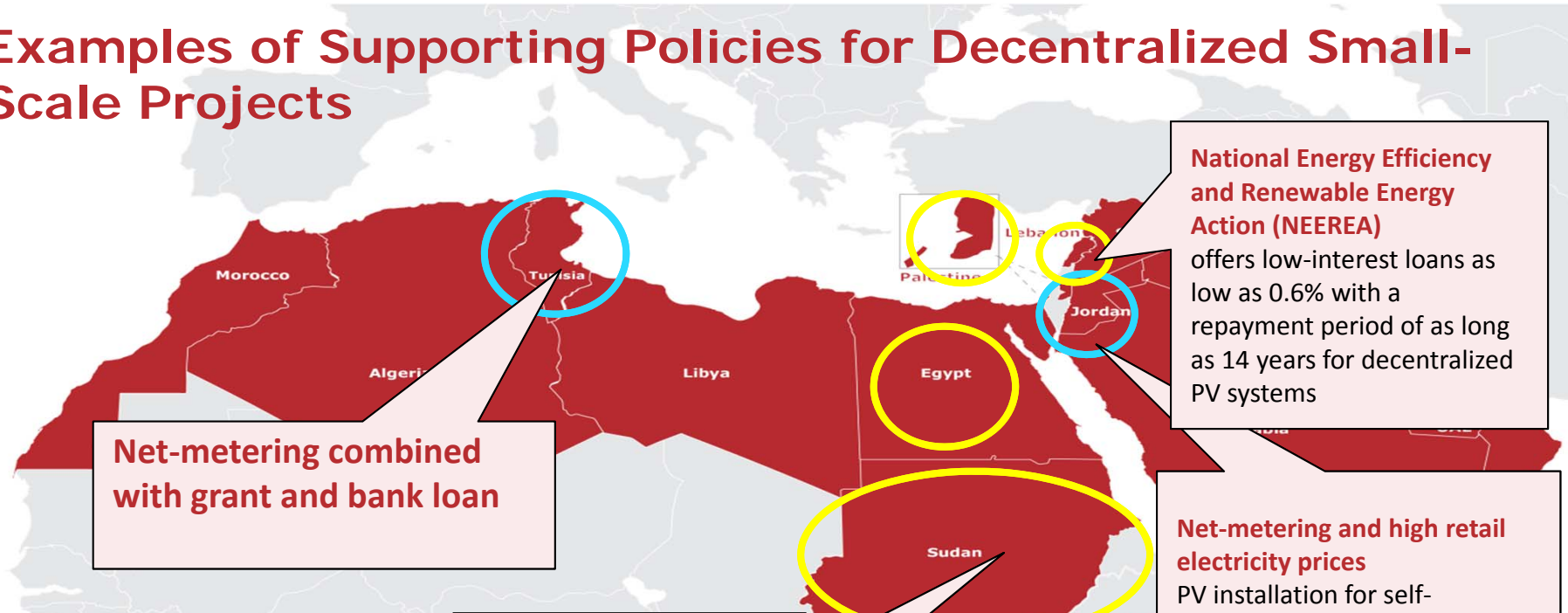
5. Financial institution and investors

National banks, commercial banks, national funds, etc.

■ Proposed Actions



Examples of Supporting Policies for Decentralized Small-Scale Projects



Net-metering combined with grant and bank loan

National Energy Efficiency and Renewable Energy Action (NEEREA) offers low-interest loans as low as 0.6% with a repayment period of as long as 14 years for decentralized PV systems

Net-metering and high retail electricity prices
PV installation for self-consumption

Rural Electrification Project
Install **1.1 million** individual solar rooftops in rural areas between 2012 -2031



Business Models for Private Mini-grids



		WORST	BASE	BEST
Technical Parameters	Unit			
Nominal Capacity	MW	0.3	0.3	0.3
Energy Yield	kWh/kW.p.a	1700	1900	2000
Degradation Factor	%	1.4%	1.2%	0.8%
Area of Plant	km2	0.008	0.005	0.004
Cost Parameters	Unit	WORST	BASE	BEST
CAPEX	€/kW	1,540	1,400	1,330
Fixed O&M	€/kW/year	77.00	28	26.00
Variable O&M	€/MWh	0	0	0
Plant Insurance	€/kW	30	20	15
Land Lease	% of output	2%	2%	2%
O&M Escalation	%	2.0%	2.0%	2.0%
Depreciation Period	year	15	10	5
Tax Rate	% of Revenue	1%	1%	1%
Revenue Parameters	Unit	WORST	BASE	BEST
PPA price	EGP/kWh	0.7	1.3	1.4
PPA Duration	years	10	15	20
Annual PPA price Escalator	%	0%	0%	0%

Amer: Mr. Namgalies will further examine this number based on meteorological data and input from

Amer: We used a high degradation factor information provided from Matthias based on workshop at Tuv




The BSW recommends using 0.8% factor for Jordan. Nothing for Egypt

Amer: Karm Solar and Axel said that O&M is approximately 1% of capex per year. However, Matthias and Amer did a back of the envelope calculation which can be found in Calculations worksheet and seems to suggest that O&M is at least double that figure

Amer: Cristof said 22 euros per kWp.year. CAR and business interruption

Tarek el Amad said \$9 for war, CAR, sabotage and business interruption

Tarek Akel said 20 euros is a good conservative assumption, could

Business Models for PV in Egypt

by
Matthias Namgalies

submitted to the
Faculty of Electrical Engineering and Computer Science
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In partial fulfillment of the requirements for M.Sc. degree in
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REMENA

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Examiner: Prof. Dr. sc. techn. Dirk Dahlhaus
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RCREEE – Lahami Bay PV Site Visit

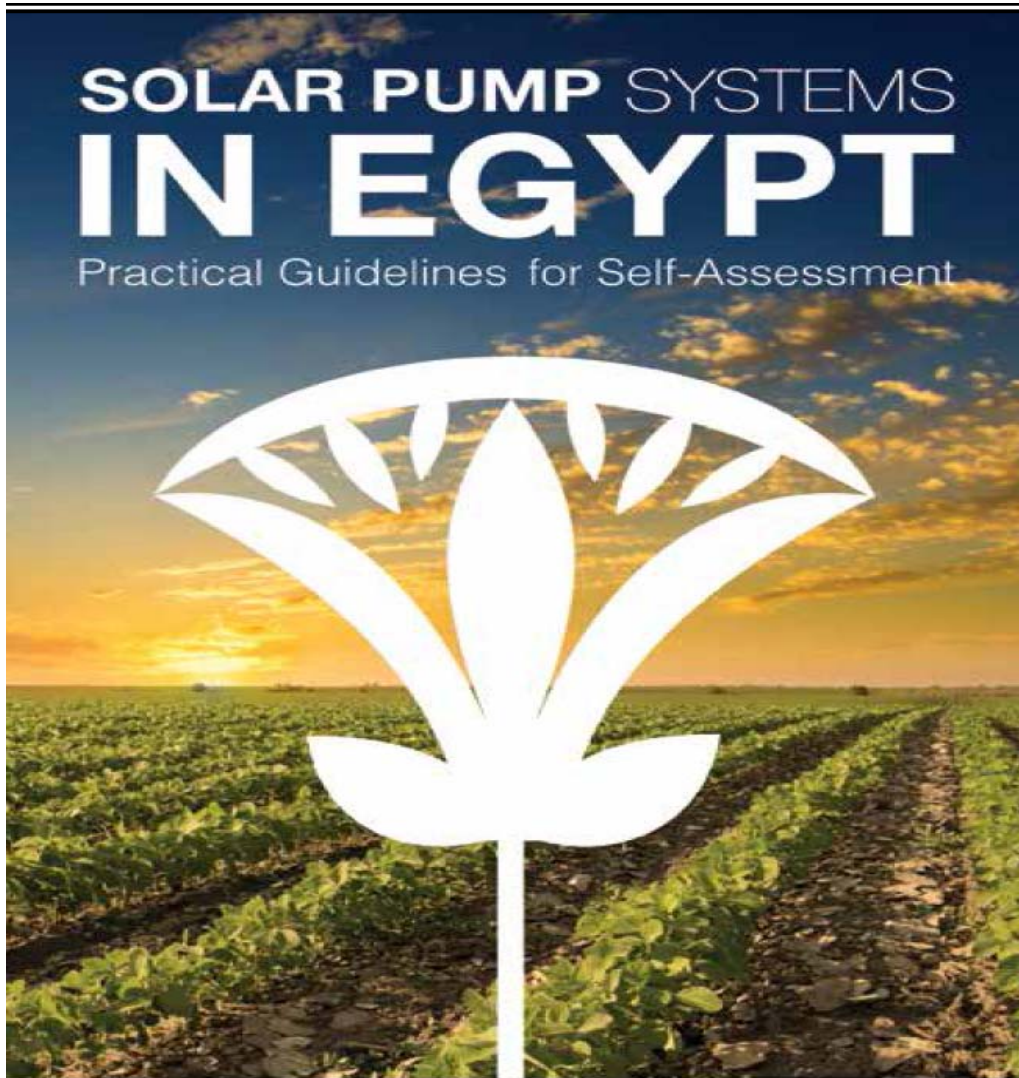
Report on PV Plant Installation Check of
Lahami Bay Pilot Power Plant
on March the 19th, 2015

Site Visit & Report by Matthias Namgalies, Visiting Researcher at
RCREEE

23rd of March 2015



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Exercise 3

Cost (E)	Operating Costs	Cost (\$ / year)
3000	Clearing & Maintaining Staff Salaries	25
300	Battery service	175
150		
850		
450		
2750	Total	200

are expected to rise by 10% every year.
to be replaced every 10 years.
to be replaced every 5 years.

RaSeed giz

Solar Pumping Training

RaSeed
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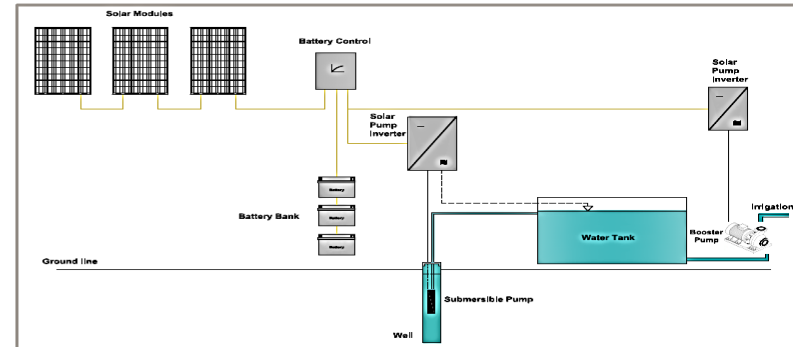
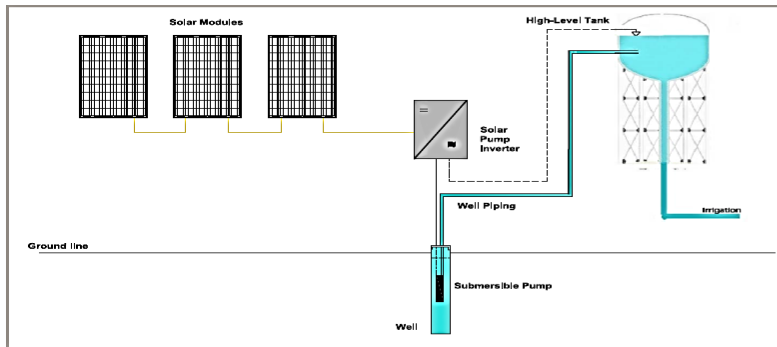
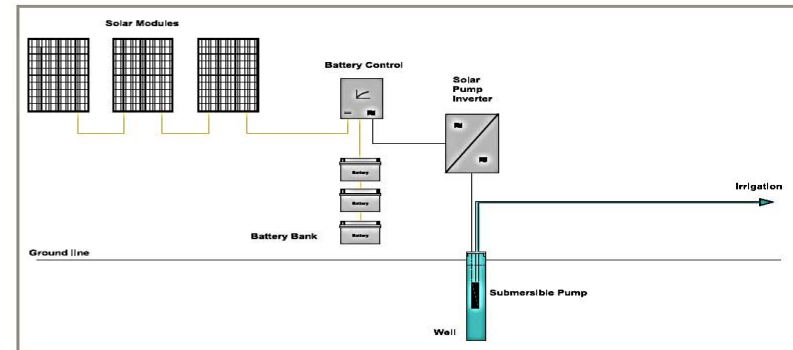
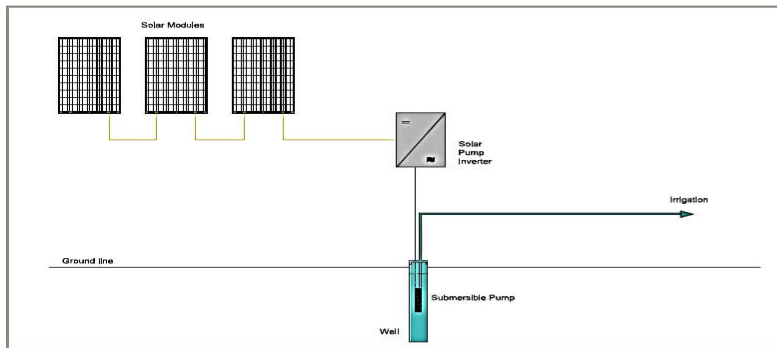
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German Cooperation
DEUTSCHE ZUSAMMENARBEITUNG

Certificate of Attendance

for
Eng. Mohamed Hamed
4-Day Intensive Solar Pump
24th to 27th

Example: Stand-alone Single Well Solution



Ref. "Practical Guidelines for Solar Pump Systems in Egypt", GIZ 2015 <http://raseed-rcreee.com/infomaterials/>



Implemented by:
giz
Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH



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<http://raseed-rcreee.com>

REGIONAL PROJECT RE-ACTIVATE:
PROMOTING EMPLOYMENT
THROUGH RENEWABLE ENERGY
AND ENERGY EFFICIENCY
IN THE MENA REGION

RE-ACTIVATE



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Pilot Projects

Four pilot projects supported by the RaSeed initiative to promote the feasibility and efficiency of solar energy in hot weather conditions, high soil salinity as well as sand storms. They are implemented at four different locations across Egypt. This allows for a realistic overview of opportunities and challenges for the future of solar energy in desert areas.

SEKEM	Wadi Food	PICO	Solar Water Heater
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- Desert Farm on Cairo's outskirts
- First step in Farm's Energy Transformation : 123.5kWp for one of the Irrigation pumps
- Solar Company Choice in negotiation phase

PICO

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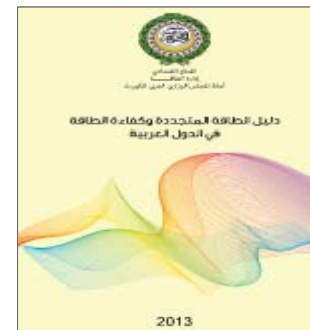
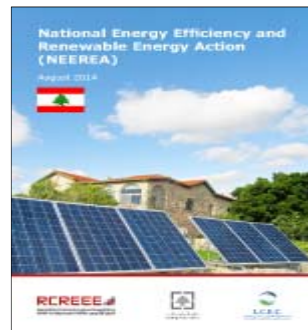
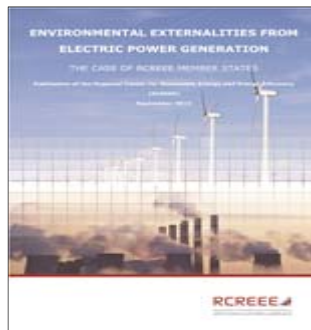
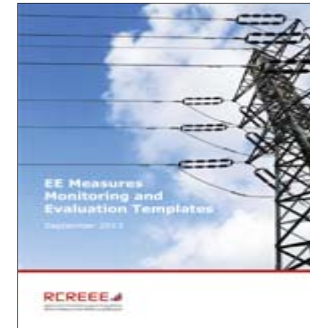
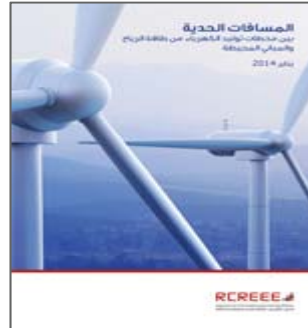


Infomaterials

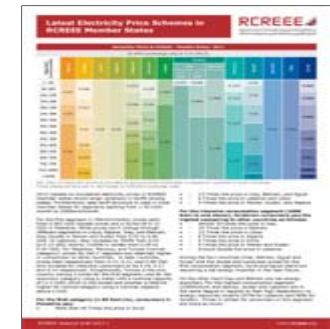
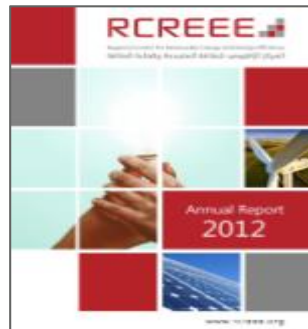
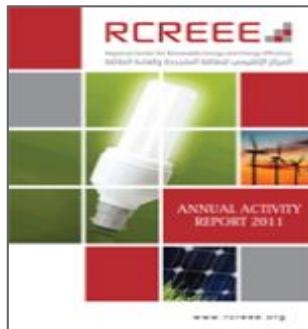
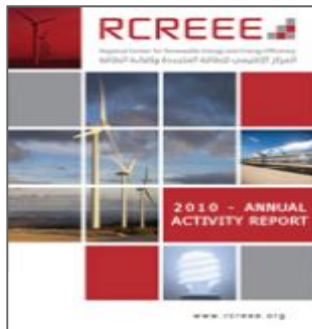
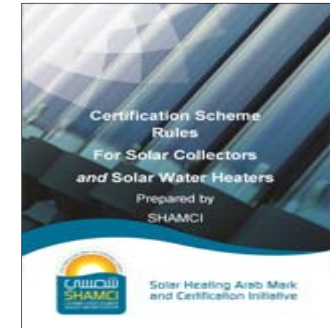
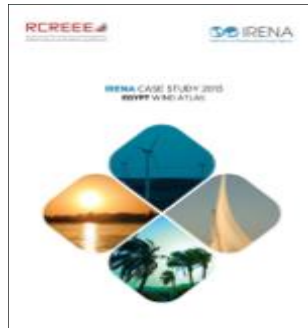
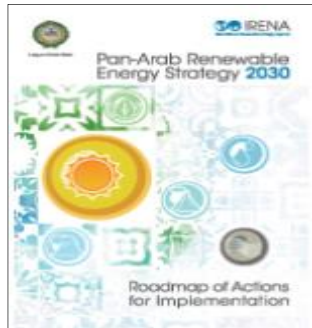
Title	Link
GIZ RaSeed Green Energy in Agriculture Brochure	View
Manual for Irrigation Practices in Egypt	View
Practical Guidelines for Solar Pump Systems in Egypt	View
Solar Pump Systems in Egypt	View
Presentation Desert Modules	View

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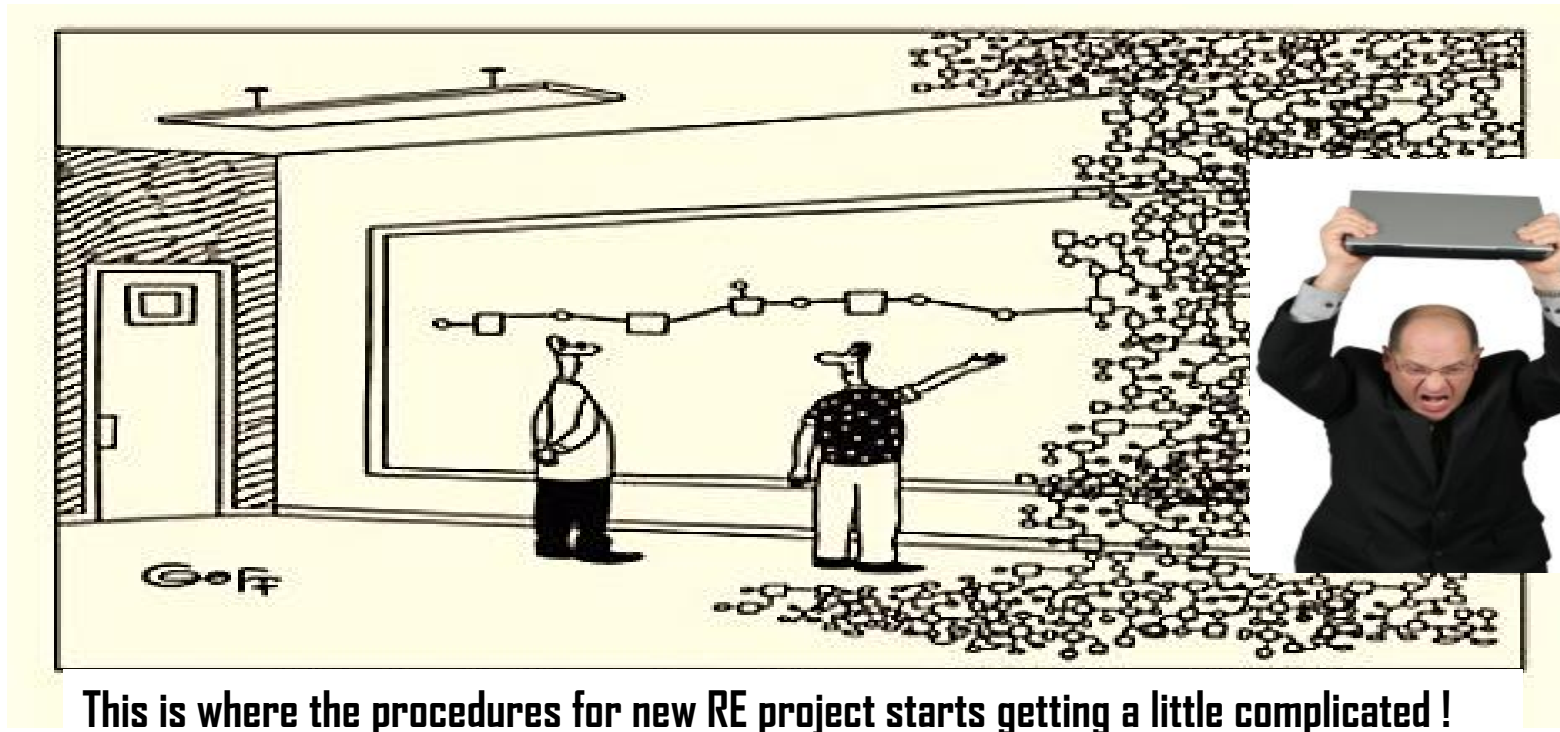
Selected Publications



Selected Publications



■ Final Remark: Attracting Investments



Source: <http://www.ehealthinformationsolutions.com>

■

“The best way to predict your future ...
is to create it.”

Peter Drucker



Thank You

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