



Business Implementation Model (BIM) Renewable Energy Technology

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Paris Implementation

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C O M M E N T S

Unlocking Willpower and Ambition to Meet the Goals of the Paris Climate Change Agreement (Part One): Shifting Needs of Law, Policy, and Economics

by Thomas D. Peterson, Steven Chester, and Robert B. McKinstry Jr.

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In December 2015, 195 nations attending the 21st Conference of the Parties (COP21) in Paris, France, adopted a historic agreement to combat climate change (the Paris Agreement). The Agreement charts a course for achieving two main goals of the United Nations Framework Convention on Climate Change (UNFCCC). First, to prevent dangerous anthropogenic climate change, the Agreement includes a global commitment to limit the increase in global average temperature to no more than 2°C (3.6°F) above pre-industrial levels, with an aspirational goal of no more than 1.5°C (2.7°F). Second, the Agreement provides a framework for reducing greenhouse gas emissions (GHGs) to achieve "carbon neutrality" during the second half of this century. It does so by calling on all nations to make commitments to limit carbon emissions (intended nationally determined contributions, or INDCs) and to update those commitments every five years. Like its predecessors, the Agreement provides enabling mechanisms such as financing, technology transfer, capacity-building, and measurement guidelines to facilitate policy implementation.

The Paris Agreement incorporates a long-standing recognition of the need for expanded "ambition," which in the context of the UNFCCC means attaining higher levels of GHG mitigation (environmental aspiration and strin-

gency) by participating nations.¹ This specific concept of ambition first appears at COP16 in Cancun in the context of nationally appropriate mitigation commitments or actions by developed country Parties²; then again at COP18 in Doha through more ambitious emission reduction commitments³; and later at COP20 in Lima through the formation of INDCs and the Lima call for climate action.⁴ The evolving focus on ambition in the UNFCCC during this period is an outgrowth in large part of shortfalls in global GHG reductions and other lessons learned from the Kyoto Protocol.

In order to achieve the 2°C climate stabilization goal established in Paris and to make progress toward a 1.5°C

1. Edward Cameron, *What Is Ambition in the Context of Climate Change?*, WORLD RESOURCES INST., Nov. 26, 2012, <http://www.wri.org/blog/2012/11/what-ambition-context-climate-change>.

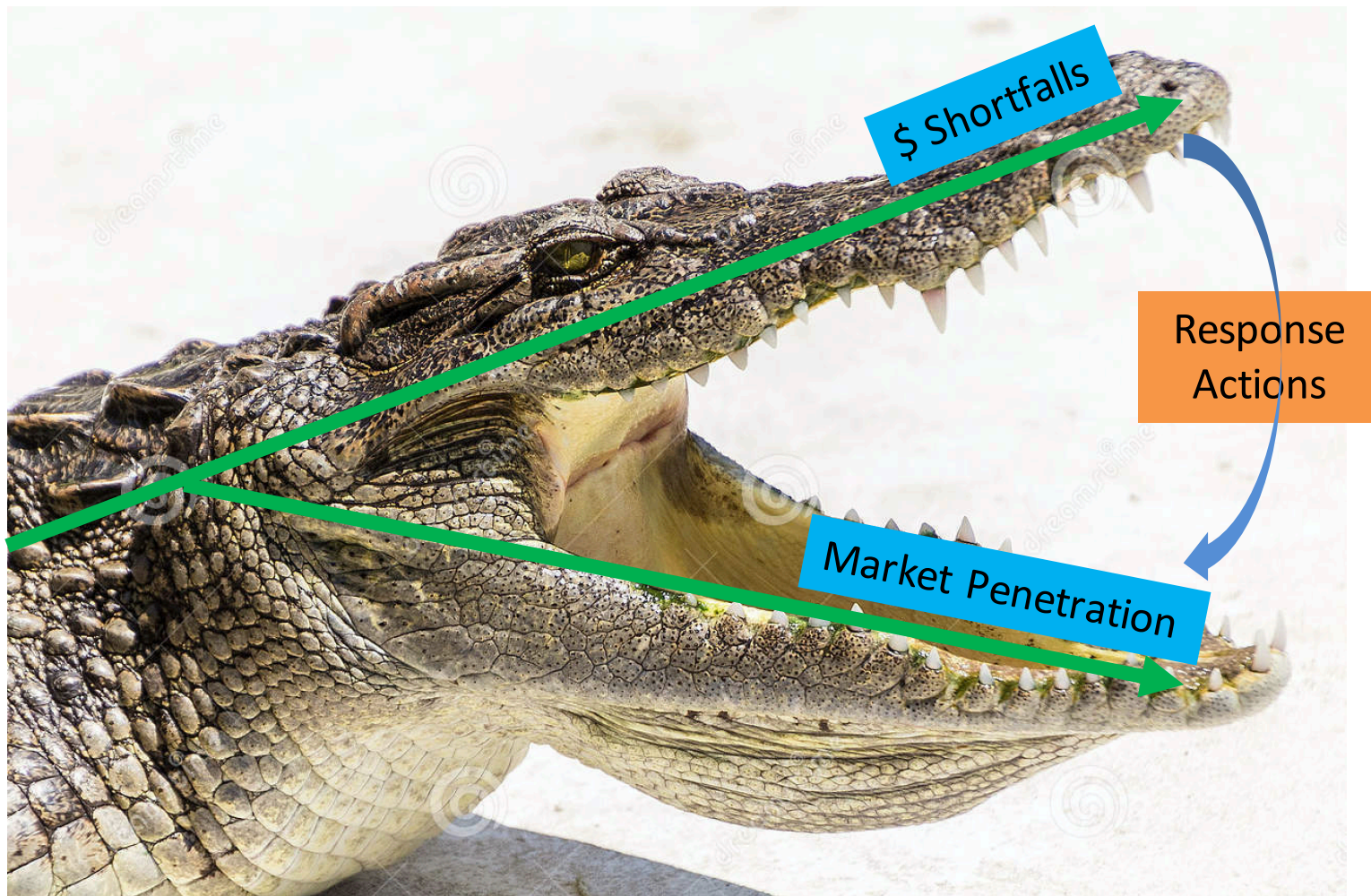
2. The official text of the Cancun Agreements is available online. *Report of the Conference of the Parties on Its Sixteenth Session, Held in Cancun From 29 November to 10 December 2010*, UNFCCC, U.N. Doc. FCCC/CP/2010/7/Add.1 (2011), <http://unfccc.int/resource/docs/2010/cop16/eng/07add1.pdf>. See Article 38, for the reference to the concept of "ambition."

3. *Doha Amendment to the Kyoto Protocol* at 4, Item E, art. 3, para. 1 quater (2012), http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf.

4. *Lima Call for Climate Action*, Decision-/CP.20, §18, http://unfccc.int/files/meetings/lima_dec_2014/application/pdf/awc_cop20_lima_call_for_climate_action.pdf.

- Alignment with national goals
- Assurance of manpower and money
- Public support from participation
- Freedom of choice on policy
- Access to effective tools

Goals



RE Implementation

Central → Mini Grid → Micro Grid → Off Grid

BAU Gap →

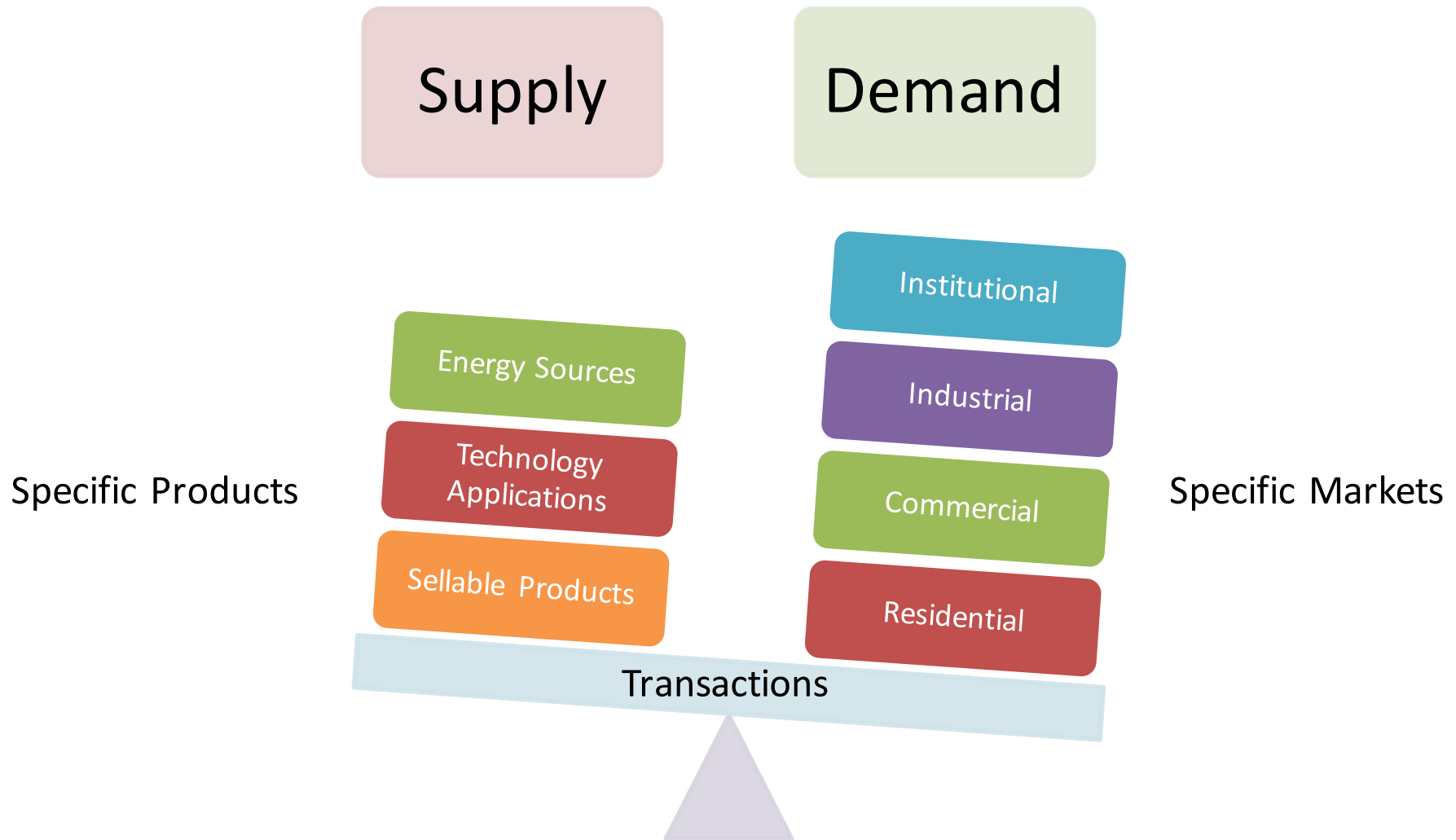
Aggregation →

Standardization →

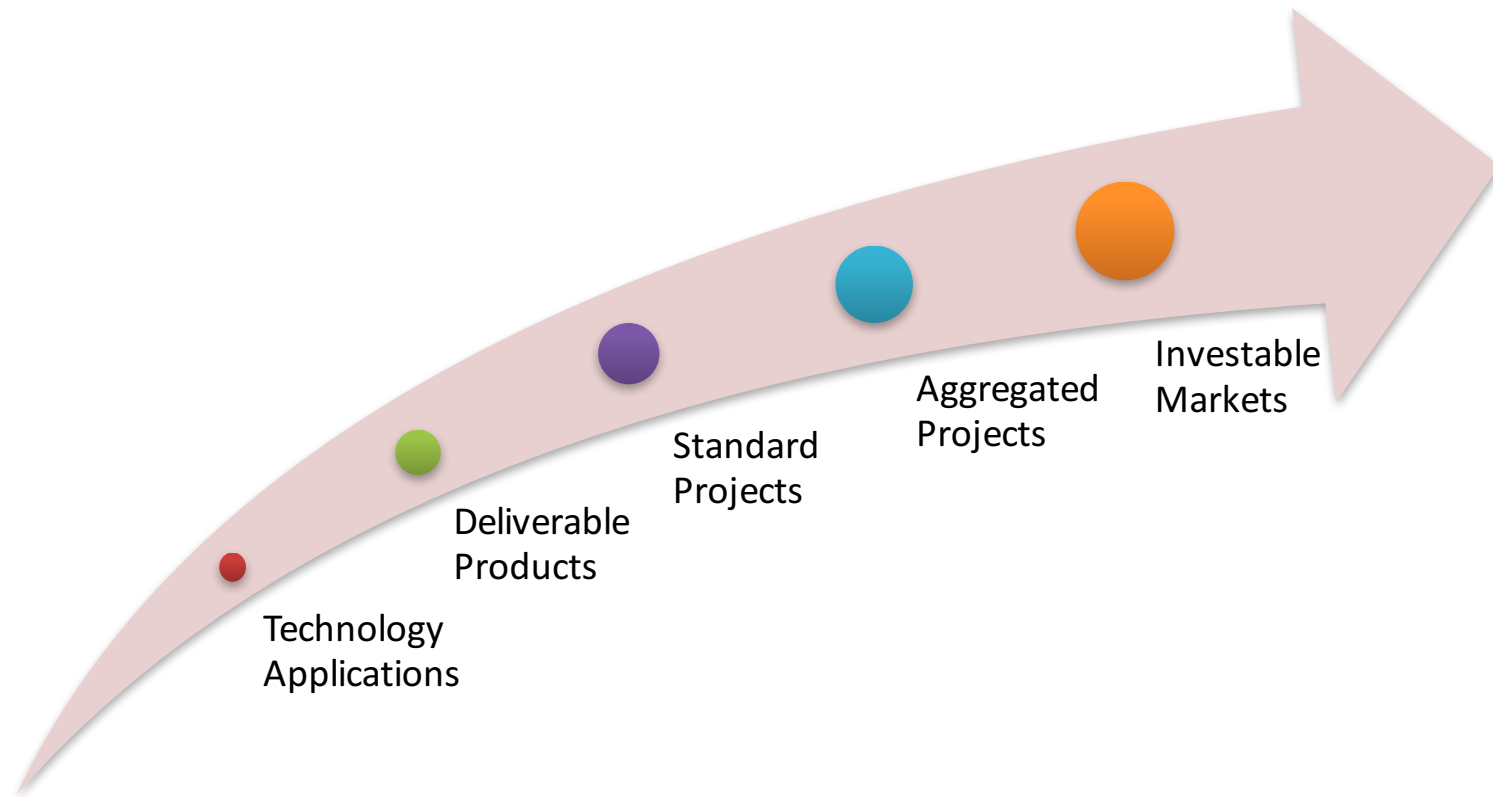
Better Use of Tools →

New Business Models →

Market Expansion

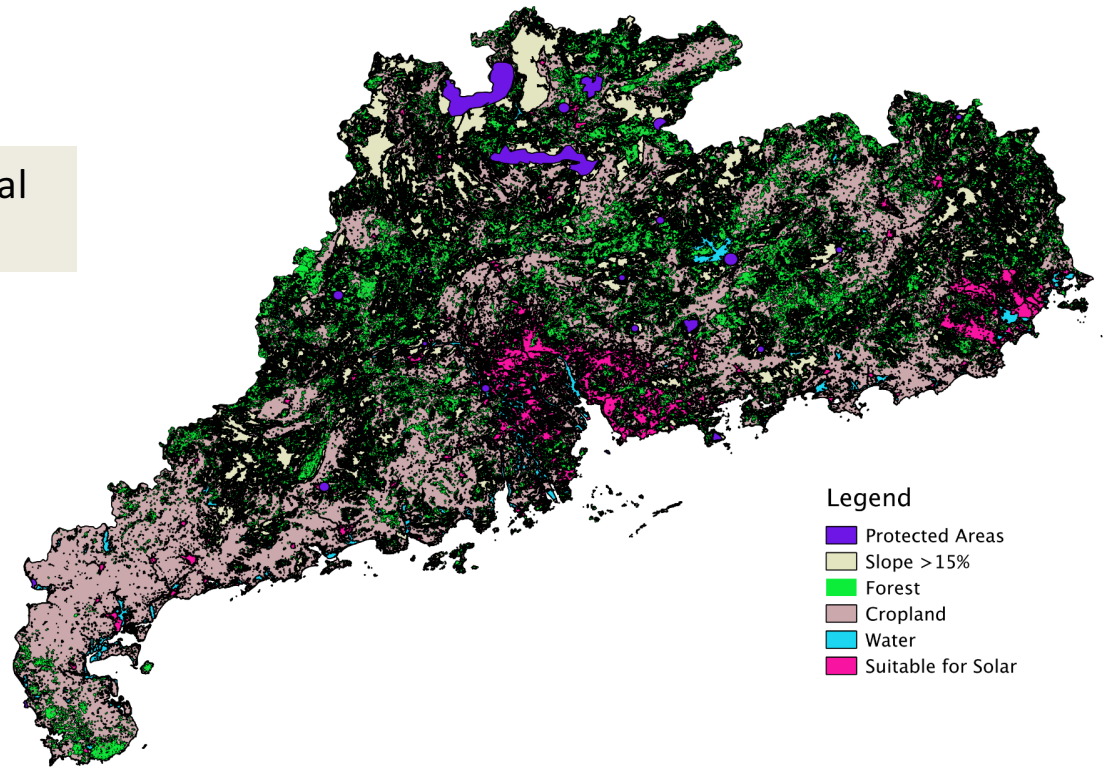


RE Product Development



Resource Scoping

Areas with Best Solar PV Potential
Guangdong Province, China



Technology Scoping

Central Installations

- Utility-scale solar PV facilities (>50 kW)
- Utility-scale onshore wind turbine facilities
- Utility-scale offshore wind turbine facilities
- Concentrated solar power (CSP) plants
- Geothermal plants
- Hydroelectric plants (>10 MW)

Mini Grid Components

- Solar PV
- Mini hydro (<10 MW)
- Electricity storage technologies (batteries, fuel cells, etc.)
- Small distributed wind turbines
- Small biomass combustors (with sustainability sourced biomass)
- Biodiesel generators (<100 kW)

Micro Grid Components

- Solar PV (< 1 kW)
- Micro hydro (0.1-1 MW)
- Small distributed wind turbines (1-250 kW)
- Deferrable thermal loads
- Small biomass combustors (with sustainability sourced biomass)
- Biodiesel generators
- Deferrable thermal loads (electricity water heaters)

Off Grid Installations

- Solar PV (< 1 kW)
- Micro hydro (0.1-1 MW)
- Small distributed wind turbines (1-250 kW)
- Electricity storage technologies (batteries, fuel cells, etc.)

Product Scoping

Revenue Streams

- Subscription fee + brokerage fee
- Asset sales + asset lending, leasing, renting
- Commodity sales (electricity)
- Asset sale + commodity sale
- Asset sale + asset lease + brokerage fees

Customer Segments Targeted

- Commercial, Industrial, Residential customers
- Regulated utilities
- Regional transmission organizations
- Load serving entities
- Regional transmission organizations + regulated utilities
- Independent system operators
- Commercial + Industrial customers
- Other combinations of above listed customers segments

Electricity Services

- Firm capacity
- Spinning and non-spinning operating reserves
- Voltage support
- Frequency regulation
- Frequency inertia
- Load following
- Mitigation of electricity network constraints and congestions
- Electricity (energy commodity)

Distributed Energy Resource Leveraged

- Solar PV
- Electricity storage
- Thermal storage
- Distributed micro wind turbines
- Demand response
- Energy management systems (virtual power plant, etc.)

Investment Scoping

Debt

- Consumer loans
- Commercial loans
- Leases
- Government bonds
- Municipal bonds
- Senior Debt
- Subordinate Debt
- Credit Enhancement
- Etc.

Equity

- Stocks
- Full project ownership
- Full RE equipment ownership
- Blended Debt/Equity
- Etc.

Securitized Structures

- Asset Based Securities (ABSs)
- Collateralized Debt Obligations (CDOs)
- Public Capital Take Out (PCTOs)
- Etc.

Special Purpose Instruments

- Municipal/Community Ownership of Clean Energy Assets
- Lease to Own Structure
- Partnership Flip Structure
- Virtual Power Plants (U.S. Model)
- Etc.

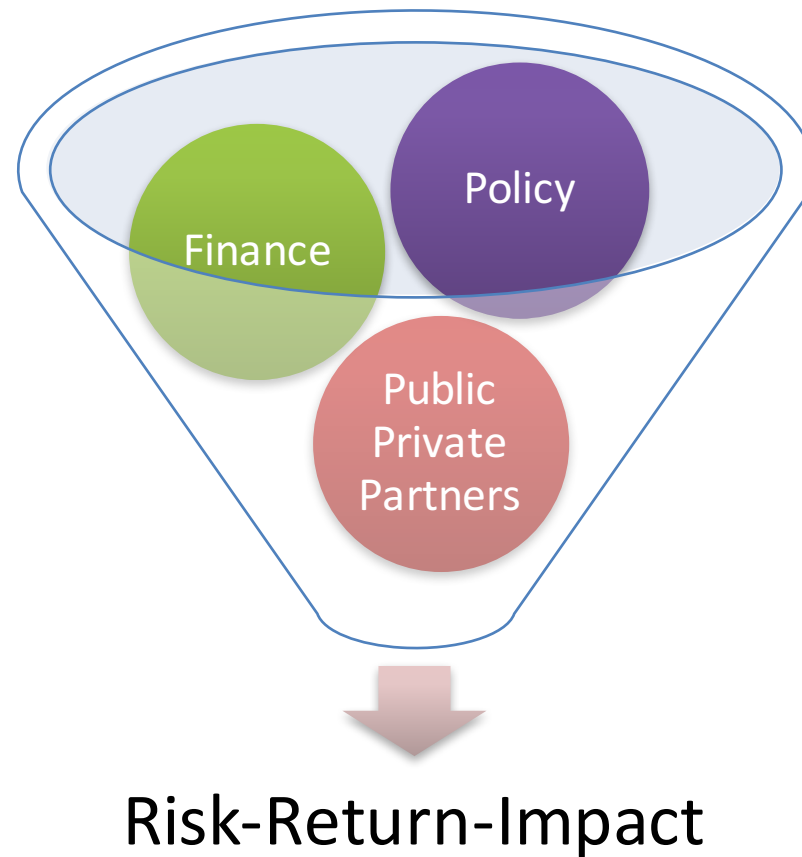
Screening

MCA Rating for Solar Technology Application

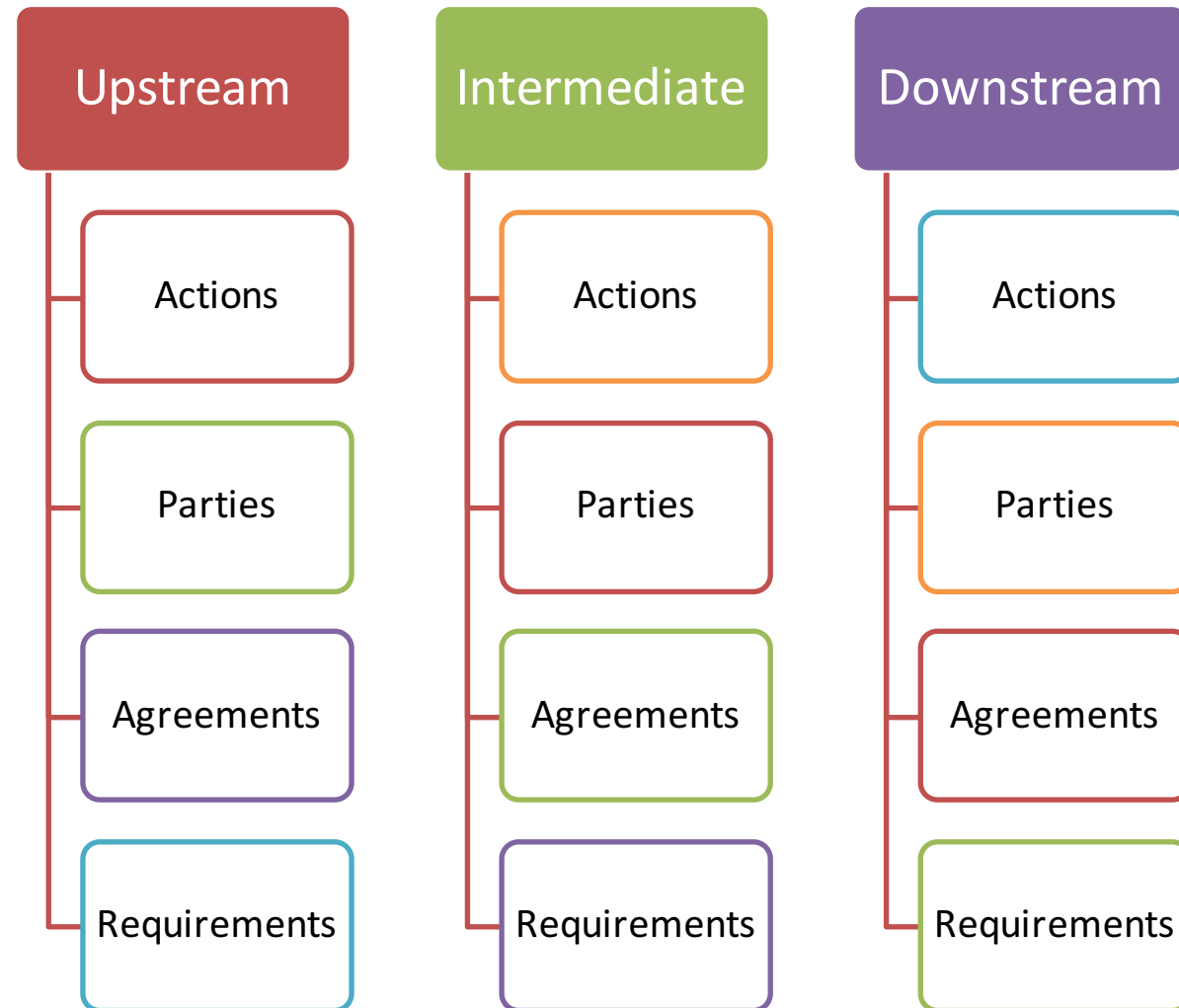
3. Please rate the status/impact/importance of each listed criteria for every solar technology application in the research region.

	Market Penetration Potential	Greenhouse Gas Reduction Potential	Economic Development (GDP impacts, jobs, or sector-specific goals)	Financing potential and feasibility	Costs and savings (cost-effectiveness)	Energy Diversity	Co-Benefits of interest
Residential -PV-Rooftop -Fixed	High ▾	Medium ▾	Low ▾	Uncertain ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Residential -PV-Open Space-Fixed	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Residential -PV-Open Space-One-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Residential -PV-Open Space-Dual-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Rooftop-Fixed	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Open Space-Fixed	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Rooftop-One-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Rooftop-Dual-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Open Space-One-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾
Commercial/Institutional-PV-Open Space-Dual-axis Tracking	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾	-- Please Select -- ▾

Structuring



Development




Policy

Technology Application	Concept	Launch	Conversion	Adoption	Expansion
Codes, Standards					
Pricing					
Procurement & Auctions					
Funding Assistance					
Technical Assistance					
Voluntary Agreements					
Disclosure & Reporting					
Information & Education					



Finance

Technology Application	Concept	Launch	Conversion	Adoption	Expansion
PUBLIC					
Appropriations					
Fees					
PRIVATE					
Debt					
Equity					
Grants					
Gifts					
Combos					



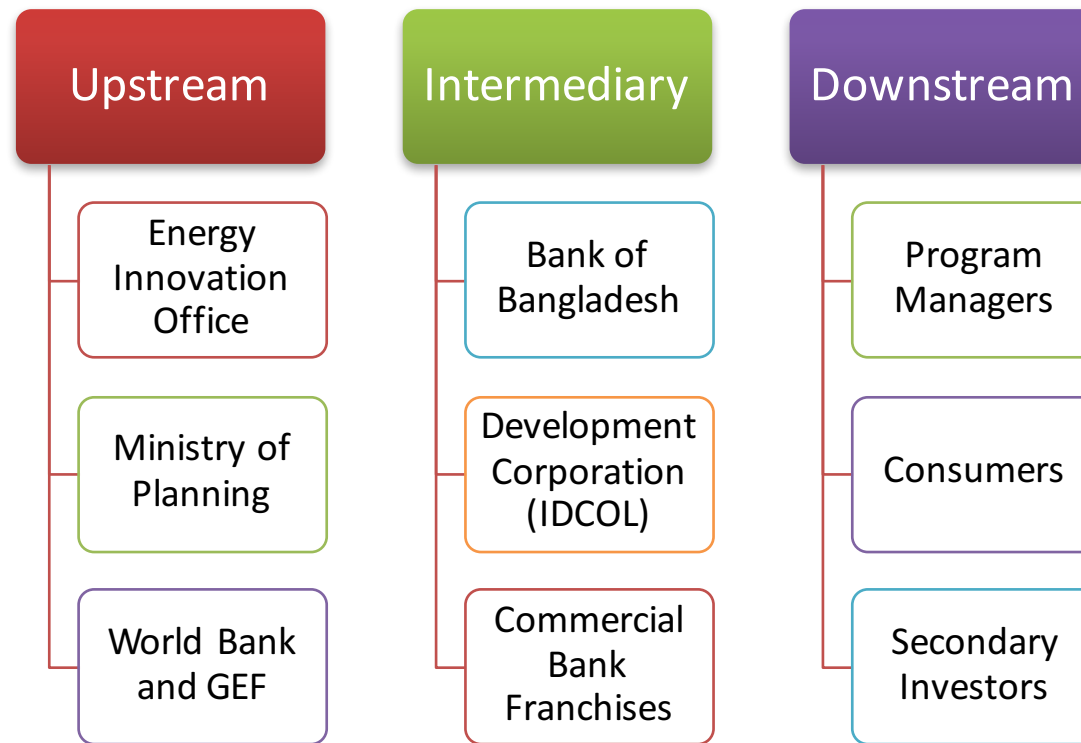
BIM

Phase/Activity	Upstream	Intermediary	Downstream
Action	<ul style="list-style-type: none"> Set policy and market goals Create policies and measures Map public, private finance Create business model Mobilize initial funds 	<ul style="list-style-type: none"> Receive funds Structure markets, products, instruments and tools, delivery programs, administration Build and install program capacity Coordinate full business model Set technical specs and standards 	<ul style="list-style-type: none"> Customer acquisition Product sales Acquire and install technology Manage products and services, including updating and enhancing Manage energy systems Sell secondary products
Parties	<ul style="list-style-type: none"> Funders (e.g. social impact, commercial investors) Government agencies (national, local, regional) Stakeholders (business and citizen) Intermediaries Multilateral institutions 	<ul style="list-style-type: none"> Central bank sustainable finance units Development corporations Development banks Commercial banks Investment banks Green banks NGOs 	<ul style="list-style-type: none"> Technology providers Installers Residential RE buyers Commercial RE buyers Industrial RE buyers Institutional RE buyers Secondary investors
Agreements	<ul style="list-style-type: none"> Goals Funding Actors Outcomes Instruments Business model 	<ul style="list-style-type: none"> Regulatory actions Financial bodies Financial aggregation Financial instruments Financial products Target return, risk, and impact 	<ul style="list-style-type: none"> Price of product (e.g. asset or service) Terms and conditions (e.g. payback period, performance guarantees) Ownership of RE assets Price, terms of secondary financial product
Requirements	<ul style="list-style-type: none"> Policy and Governance Risk, Return, Impact Business model 	<ul style="list-style-type: none"> Regulatory authority Financial solvency Management capacity 	<ul style="list-style-type: none"> RE product performance Financial product pricing Acquisition and use procedures

BIM

Public/Private Developers	Upstream Funders	Intermediaries	End-Product Buyers	Secondary Investors
<u>Government Agencies</u> (national, state/provincial/local) Energy <ul style="list-style-type: none"> • Environment • Economic • Interior • Finance • Industry 	<u>Commercial Investors</u> <ul style="list-style-type: none"> • Commercial Banks • Individuals • National Corporations • Transnational Corporations • Pension Funds • Mutual Funds 	<u>Banks</u> <ul style="list-style-type: none"> • Central banks • Development banks • Green banks • Commercial banks • Investment banks 	<u>Retail</u> <ul style="list-style-type: none"> • Residential households • Commercial sector/business consumers • Large industrial consumers • Military bases • Hospitals • Large government facilities • others 	<ul style="list-style-type: none"> • Pension funds • Investment funds • Corporate investors • Individual investors
<u>Private Entities</u> <ul style="list-style-type: none"> • Technology providers • Service organizations • Public interest groups • Philanthropies • Foreign Governments Multi-Lateral Institutions 	<u>Social Impact Investors</u> <ul style="list-style-type: none"> • Mutual Fund Managers • Development finance institutions • Diversified financial institutions/banks • Private foundations • Pension funds and insurance companies • Family Offices • Individual investors • NGOs • Religious institutions • Development Banks • Foreign Governments • Philanthropies 	<u>Others</u> <ul style="list-style-type: none"> • Public-private partnership entities • Special purpose institutions Development corporations • Consulting firms • NGOs 	<u>Wholesale</u> <ul style="list-style-type: none"> • Investor owned electricity utilities • Government owned utilities • Municipal power companies • Cooperative electric utilities 	

Bangladesh SHS



Nine implementation phases...

Bangladesh SHS

Rural Household Solar Project



Solar PV Array for a Bangladesh Mini-grid Project



Source: IDCOL -
http://idcol.org/home/solar_min.



Bangladesh SHS

- Fulfill basic electricity requirements for off-grid rural people (government goal of electricity access for all by 2021)
- Create an RE market in rural off-grid areas
- Include supplier and end-user credits, technical and promotional supports,
- Include a combination of household solar PV systems and mini-grid systems



Bangladesh SHS

Parties and responsibilities

- Government of Bangladesh (GoB): receives funding from international donors (the World Bank, ADB, USAID, Islamic Development Bank, and others) and provides them to IDCOL in the form of grants and soft loans.
- Program lead: Infrastructure Development Company Limited (IDCOL). A government-owned, independently operated, non-bank financial institution that funds infrastructure projects and off-grid renewable energy and oversees commercial bank loans for SHS.



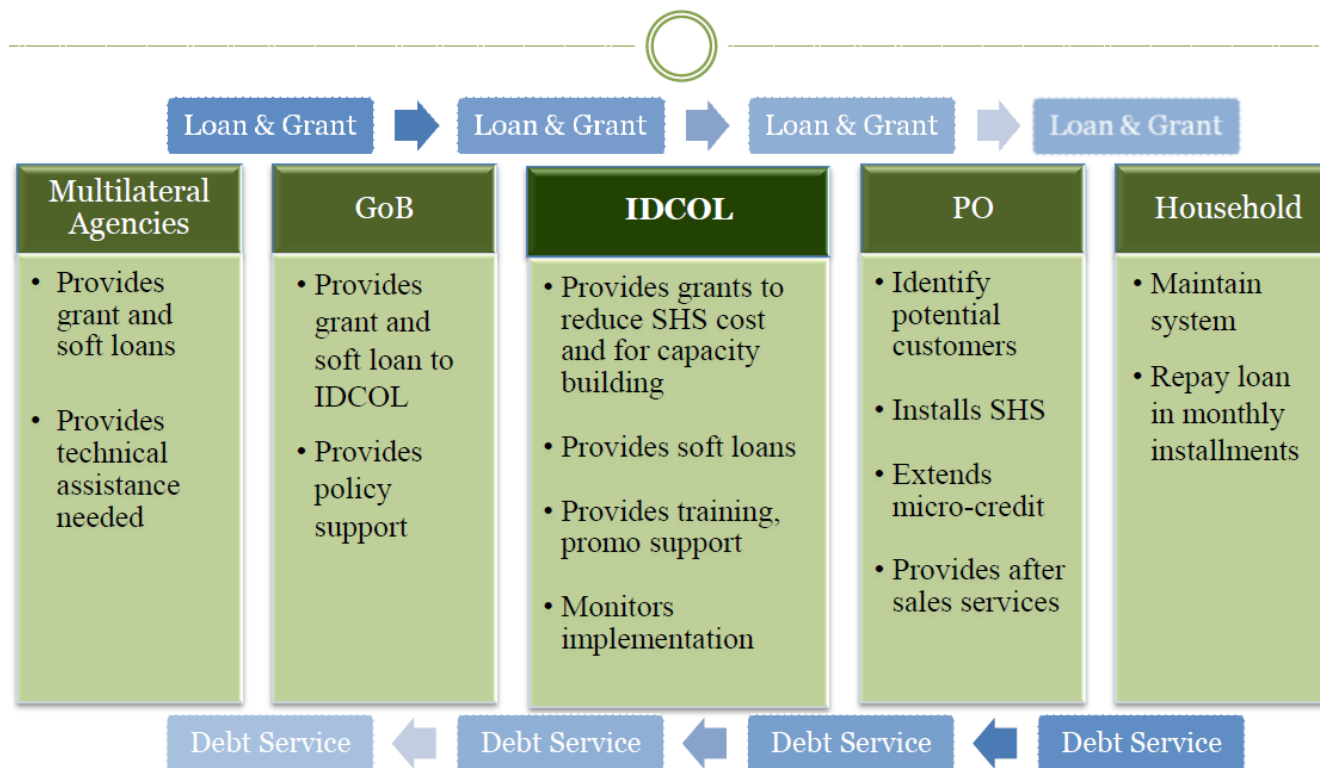
Bangladesh SHS

Parties and responsibilities

- Partner Organizations (POs): receive grants and soft loans from IDCOL. NGOs/Private Companies responsible for selecting the project area and potential customers, extending consumer loans, installing solar systems, training customers, and providing after-sales services.
- Rural households: receive installation of PV system, maintain the system, and repay a loan for it through monthly installments.
- Secondary investors in progress...

Bangladesh SHS

Fund Flow and Role of Partners



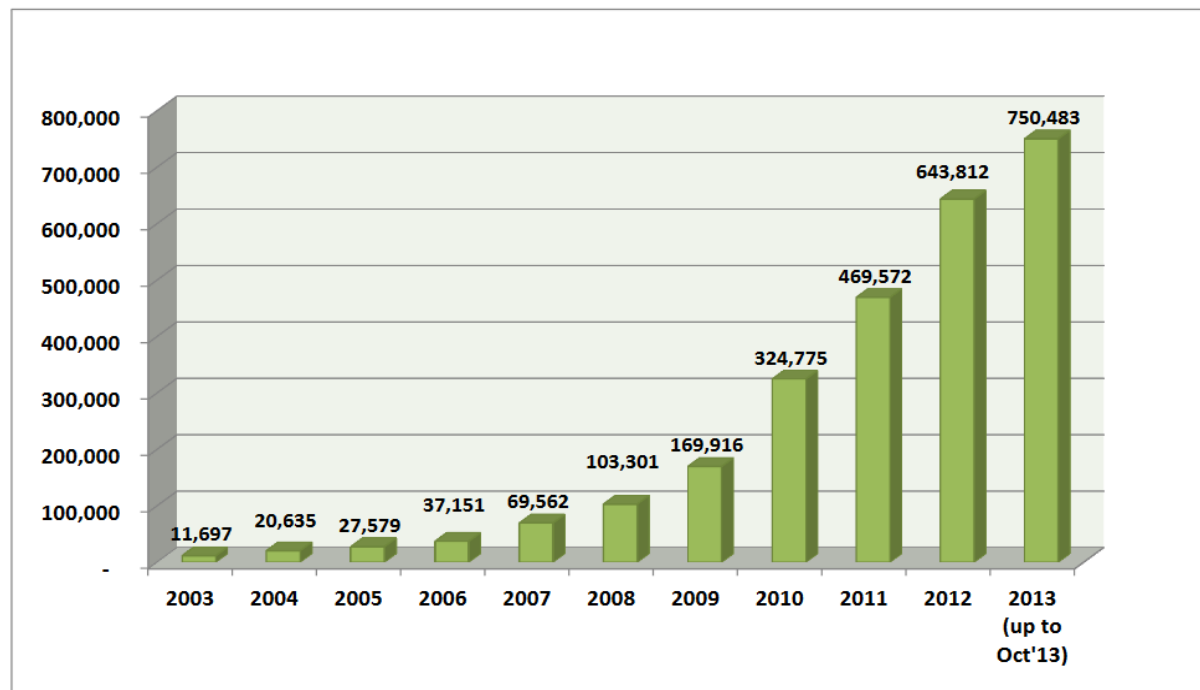
Currently 56 POs are involved in the Program.

IDCOL current investments:

- \$600 million USD in loans
- \$96 million USD in grants

Bangladesh SHS

Year wise SHSs installation



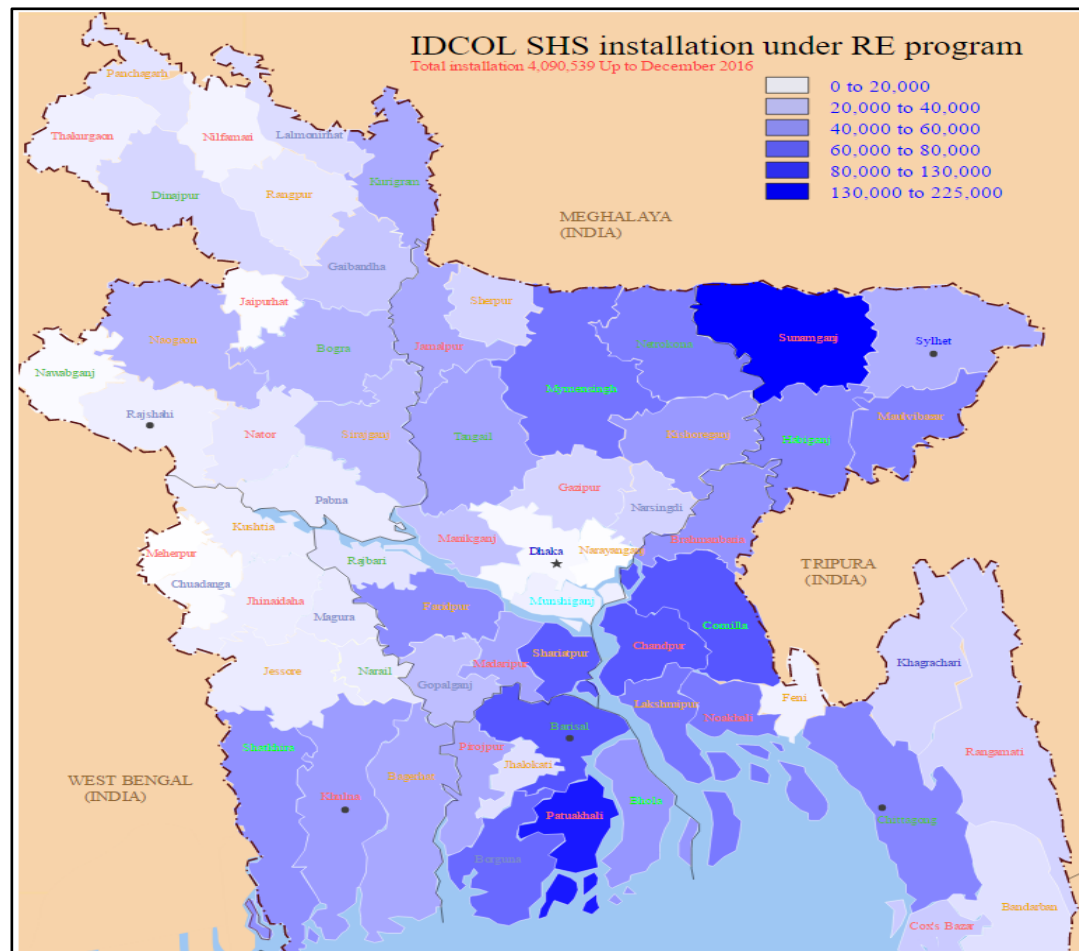
10/2013 cumulative:
>2.6 million SHS

Through 5/2017:
>4.1 million

2021 Target:
6 million
220 MW PV

From Nazmul Haque, "DCOL Solar Home System Program", dated December, 2013,
<https://sustainabledevelopment.un.org/content/documents/4923haque.pdf>.

Bangladesh SHS



Installations
through
December
2016.

Source: IDCOL

Thailand Rice Husk Biomass Power

Roi-et Green Power Plant, Thailand

Source: Thailand Ministry of Energy



Thailand Rice Husk Biomass Power

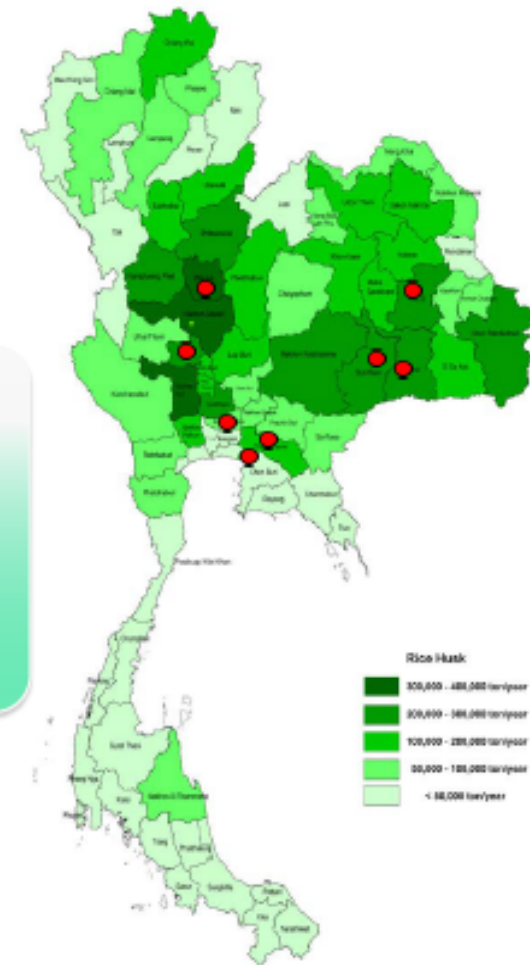


Biomass form Rice

Small Power Producer (SPP)
8 Project (122.6 MW)

1. THAI POWER SUPPLY (47.4 MW)
2. BPK POWER SUPPLY (10.4 MW)
3. BIOMASS POWER (6 MW)
4. ROI ET GREEN (9.9 MW)
5. AT BIOPOWER (22.5 MW)
6. SATUEK BIOMASS (7.5 MW)
7. MUNGCHARIAN GREEN POWER (9.9 MW)
8. PATUM RICE MILL (PRG) (9 MW)

Very Small Power Producer (VSPP)
17 Project (110.95 MW)



Planned Biomass Power From Rice Husk Projects

Source: Thailand Ministry of Energy



Thailand Rice Husk Biomass Power

25 Projects with a total of 234 MW capacity:

- Includes 8 small power producers (<25 MW) and 17 very small producers (<10 MW)
- Beginning with the Roi-et Green Power Plant (9.9 MW)
- Overall program begins with Government of Thailand geographic assessment of biomass supply potential and its availability relative to the existing and planned transmission grid.



Thailand Rice Husk Biomass Power

10 Conceptual Implementation Plan Phases:

1. Develop & Implement Supporting Mechanisms: including biomass supply, local energy demand, and transmission assets assessment.
2. Project Concept & Business Plan: agreements on tie-ins to transmission system, power purchase agreement (PPA) proposals.
3. Feasibility Study: accepted PPA; negotiation of fuel supply contracts.



Thailand Rice Husk Biomass Power

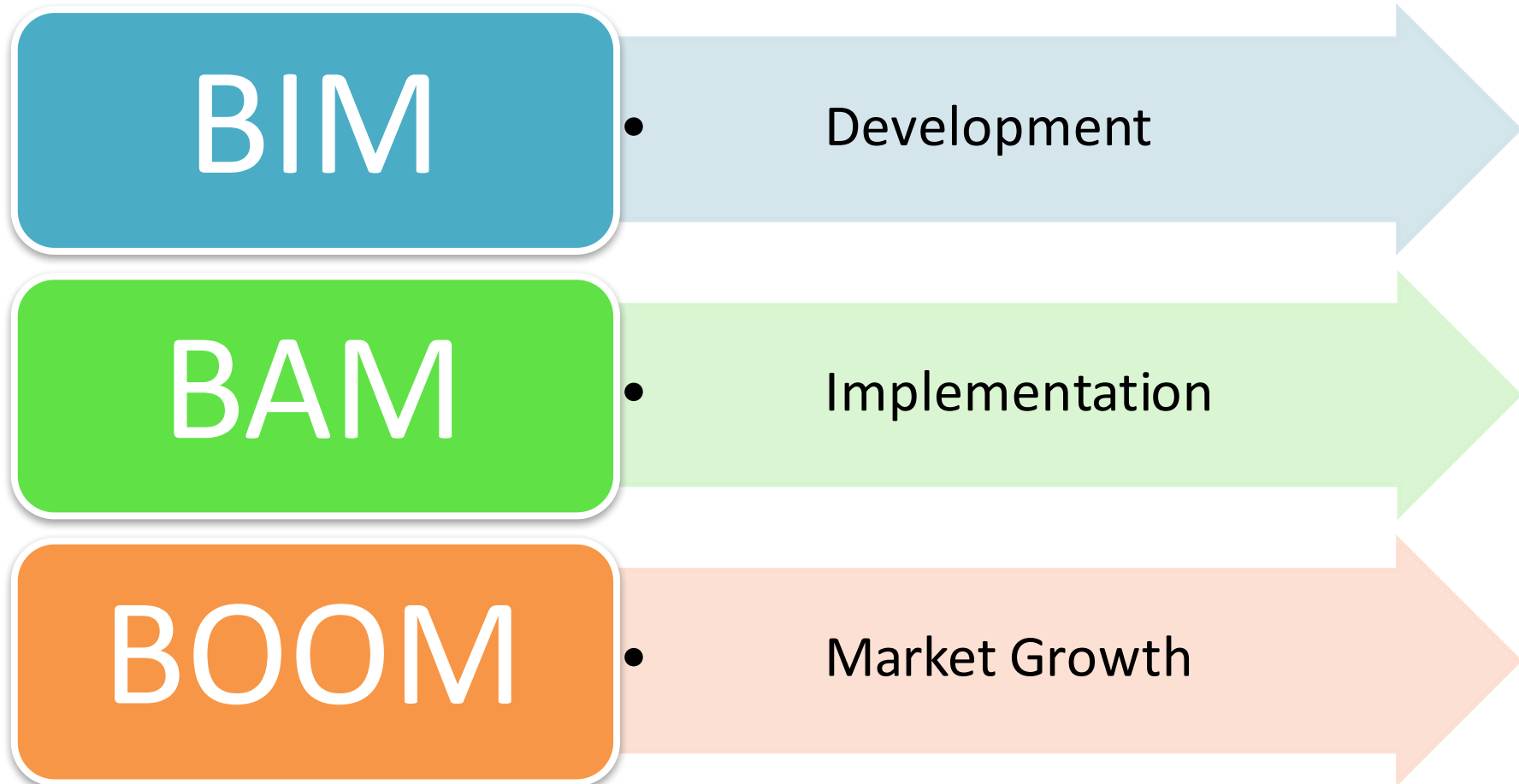
10 Conceptual Implementation Plan Phases:

4. Signed Fuel Contracts and PPAs
5. Permitting and Preliminary Engineering
6. Engineering, Procurement and Construction (EPC) Bid Package Development
7. EPC Firm Selection
8. Funding Negotiations: grant and loan applications and contracts
9. Plant Construction and Start-Up
10. Monitoring and Scale-Up of Subsequent Projects

DCF Analysis: Roi-et Power Plant

Year	Total Installation Costs (\$)	Equity Payment (\$)	Debt Service (\$)	Fuel Costs (\$)	Other Variable O&M (\$)	Fixed O&M (\$)	Taxes (\$)	Power Revenue (\$)	Feed-In Tariff (\$)	Other Revenue (\$)	Developer's Net Cash Flow (\$)	Developer's Discounted NCF (\$2017)	Project Discounted NCF (\$2017)
2018	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2019	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2020	\$11,940,000	\$2,388,000	\$1,004,515	\$668,388	\$925,056	\$945,250	\$925,056	\$6,167,040	\$598,203	\$0	\$2,296,978	\$1,725,754	\$8,764,531
2021	\$0	\$0	\$1,004,515	\$695,124	\$945,870	\$966,518	\$925,056	\$6,167,040	\$598,203	\$0	\$2,228,161	\$1,521,864	\$2,839,787
2022	\$0	\$0	\$1,004,515	\$722,928	\$967,152	\$988,265	\$925,056	\$6,167,040	\$598,203	\$0	\$2,157,327	\$1,339,530	\$2,537,642
2023	\$0	\$0	\$1,004,515	\$751,846	\$988,913	\$1,010,501	\$925,056	\$6,167,040	\$598,203	\$0	\$2,084,413	\$1,176,597	\$2,265,789
2024	\$0	\$0	\$1,004,515	\$781,919	\$1,011,163	\$1,033,237	\$925,056	\$6,167,040	\$598,203	\$0	\$2,009,352	\$1,031,116	\$2,021,290
2025	\$0	\$0	\$1,004,515	\$813,196	\$1,033,914	\$1,056,485	\$925,056	\$6,167,040	\$598,203	\$0	\$1,932,077	\$901,328	\$1,801,487
2026	\$0	\$0	\$1,004,515	\$845,724	\$1,057,178	\$1,080,256	\$925,056	\$6,167,040	\$598,203	\$0	\$1,852,515	\$785,647	\$1,603,973
2027	\$0	\$0	\$1,004,515	\$879,553	\$1,080,964	\$1,104,562	\$925,056	\$6,167,040	\$0	\$0	\$1,772,391	\$452,007	\$1,195,940
2028	\$0	\$0	\$1,004,515	\$914,735	\$1,105,286	\$1,129,414	\$925,056	\$6,167,040	\$0	\$0	\$1,088,034	\$381,349	\$1,057,652
2029	\$0	\$0	\$1,004,515	\$951,325	\$1,130,155	\$1,154,826	\$925,056	\$6,167,040	\$0	\$0	\$1,001,164	\$319,002	\$933,822
2030	\$0	\$0	\$1,004,515	\$989,378	\$1,155,583	\$1,180,810	\$925,056	\$6,167,040	\$0	\$0	\$911,699	\$264,087	\$823,015
2031	\$0	\$0	\$1,004,515	\$1,028,953	\$1,181,584	\$1,207,378	\$925,056	\$6,167,040	\$0	\$0	\$819,555	\$215,814	\$723,931
2032	\$0	\$0	\$1,004,515	\$1,070,111	\$1,208,169	\$1,234,544	\$925,056	\$6,167,040	\$0	\$0	\$724,645	\$173,474	\$635,398
2033	\$0	\$0	\$1,004,515	\$1,112,915	\$1,235,353	\$1,262,321	\$925,056	\$6,167,040	\$0	\$0	\$626,880	\$136,427	\$556,358
2034	\$0	\$0	\$1,004,515	\$1,157,432	\$1,263,149	\$1,290,723	\$925,056	\$6,167,040	\$0	\$0	\$526,166	\$104,099	\$485,854
2035	\$0	\$0	\$1,004,515	\$1,203,729	\$1,291,569	\$1,319,764	\$925,056	\$6,167,040	\$0	\$0	\$422,406	\$75,973	\$423,024
2036	\$0	\$0	\$1,004,515	\$1,251,878	\$1,320,630	\$1,349,459	\$925,056	\$6,167,040	\$0	\$0	\$315,502	\$51,587	\$367,087
2037	\$0	\$0	\$1,004,515	\$1,301,953	\$1,350,344	\$1,379,822	\$925,056	\$6,167,040	\$0	\$0	\$205,350	\$30,524	\$317,342
2038	\$0	\$0	\$1,004,515	\$1,354,031	\$1,380,727	\$1,410,868	\$925,056	\$6,167,040	\$0	\$0	\$91,843	\$12,411	\$273,155
2039	\$0	\$0	\$1,004,515	\$1,408,193	\$1,411,793	\$1,442,613	\$925,056	\$6,167,040	\$0	\$0	\$25,129	\$3,087	\$233,953
2040	\$0	\$0	\$1,004,515	\$1,464,520	\$1,443,558	\$1,475,071	\$925,056	\$6,167,040	\$0	\$0	\$145,681	\$16,269	\$199,222
2041	\$0	\$0	\$0	\$1,523,101	\$1,476,038	\$1,508,260	\$925,056	\$6,167,040	\$0	\$0	\$734,584	\$74,579	\$168,496
Totals											\$23,030,233	\$10,753,814	\$12,699,687

Formula



Thanks!

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