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CARIBBEAN CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY
AN INSTITUTION OF CARICOM

PROJECT PREPARATION FACILITY

Sustainable Energy Technology Considerations and Regional Outlook

Project Preparation Facility Project Concept Development Training

March 28th-30th 2022

Introduction and Disclaimers

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This presentation is:

- not investment advice
- not going to cover every technology
- intended to be broad, not deep

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Outline

1. A conceptual framework for project development
    - BETPC, SROPTTC-C
2. Technology considerations
    - Efficiency, solar, wind, hydro, storage, e-mobility
3. Activity in the region
    - Targets, deployment, policy and climate action
4. Sources of support
    - Project finance and technical assistance

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1: A conceptual framework for project development

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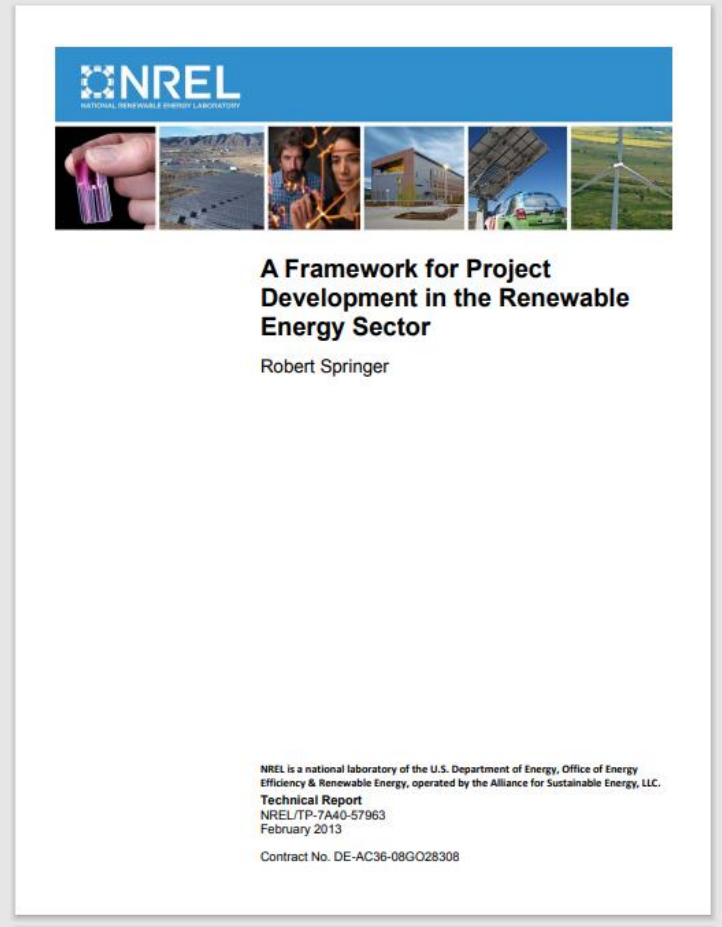
The Value of a Conceptual Framework

- NREL, 2013. "A Framework for Project Development in the Renewable Energy Sector." NREL/TP-7A40-57963
  - https://www.nrel.gov/docs/fy13osti/57963.pdf

"The two major concepts to establish a common understanding and language around the fundamental principles of project development are ***project motivation*** *and the* ***project development environment****.*

A motivated project is one that has a strong basis to come to fruition and is built on economics and risks that are acceptable to both parties, and includes supportive policies, an execution pathway, and project 'bankability.'

The second concept is a framework and mapping of an established, repeatable, disciplined process for project development that is consistent with professional commercial practices."



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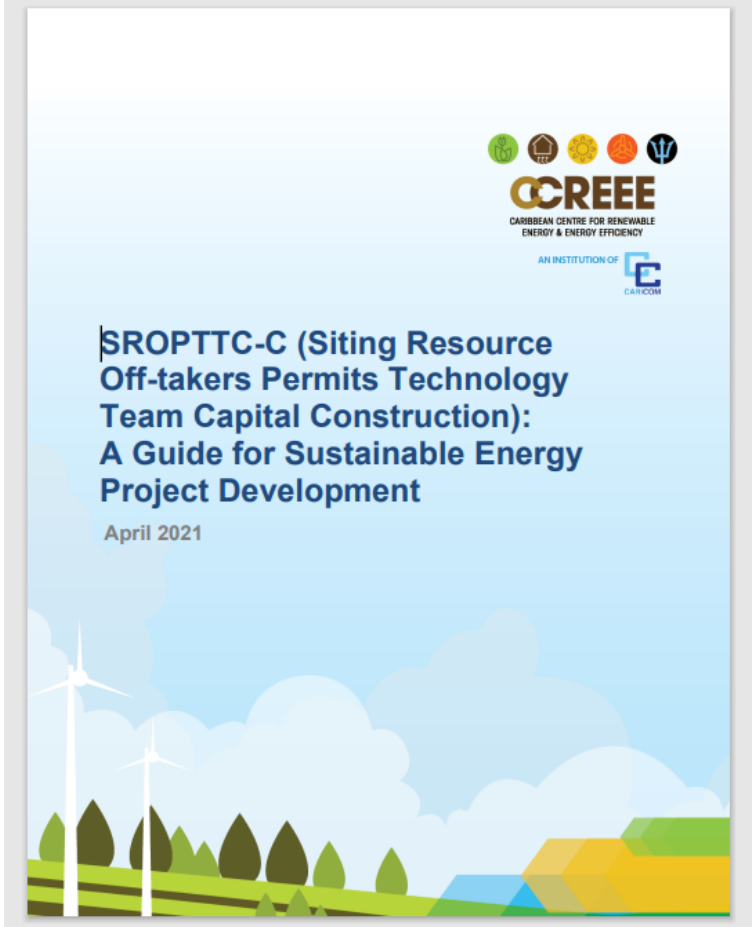

https://www.ccreee.org/wp-content/uploads/2021/04/SROPTTC-C-Guide.pdf

BEPTC and SROPTTC-C

- Baseline
- Economics
- Policy
- Technology
- Consensus

- Site
- Resource
- Off-take
- Permits
- Technology
- Team
- Capital
- Construction

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2. Technology considerations

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Efficiency

- An energy audit should always be your primary intervention
- Usually the lowest cost, highest return option for any facility-based energy intervention
- Human elements: behavioral, cultural, managerial
- Integrated Utility Services is a model to accelerate deployment

Solar Technologies: Solar Water Heating

For many facilities NPV for SWH >> NPV for Solar PV

Determine a suitable site

- Sturdy, south-facing roof
- Direct sunlight from 1000-1600 – beware shading!

Size correctly

Natural circulation vs pumped

Look for rebates, tax credits, financing options

Storm resilience

Maintenance

Solar Technologies: Photovoltaics

Determine a suitable site

- Sturdy, south-facing roof
- Direct sunlight from 1000-1600 – beware shading!
- Resource assessments – online resources available

Size correctly

- Efficiency first!
- What does your load look like?

What's your regulatory situation?

- Buy-all-sell-all vs. net billing vs net metering vs. stand alone
- Understand your interconnection tech requirements

Storm resilience

Maintenance

Envi considerations: glare

Wind Energy

Power output highly sensitive to changes in wind speed

- Power $\propto v^3$

The physics/economics favour larger, taller turbines (see next slide)

- Offshore, for some of the same reason

For utility scale, intensive modelling required

- Detailed site-specific resource studies (~18 months) typically required for financing utility scale projects
- Arrangement of turbines in a farm critical

For domestic / small commercial, additional components needed to condition output AC

Envi considerations: noise, birds, aesthetics

- Get the community on board

Wind Energy: Logistics

Image credit: NREL

Storage Technologies

Image credit: Xenogy RE

Use cases

- Smoothing out intermittent power
- Arbitrage opportunities
- Resilience / backup

Different forms for varied applications

- Electrochemical (Lithium ion, lead acid)
- Mechanical (flywheels, pumped hydro, compressed air)
- Thermal (ice)

Power vs. energy

Hydroelectricity

Image credit: JPS

- Extremely site specific
- Head will determine configuration and turbine technology
- High environmental impact
- Expensive to build, cheap to run

Electric Mobility

Image Credits: The Voice LU, Bike Europe

- More than just electric cars
- Expensive to acquire (for now), but cheap to run.
- Strongest business case may be fleet applications (high mileage / utilization)
- Crossover application: storage / grid services
- High demand growth potential for utilities, so they are champions
- Private charging networks may be a regulatory challenge

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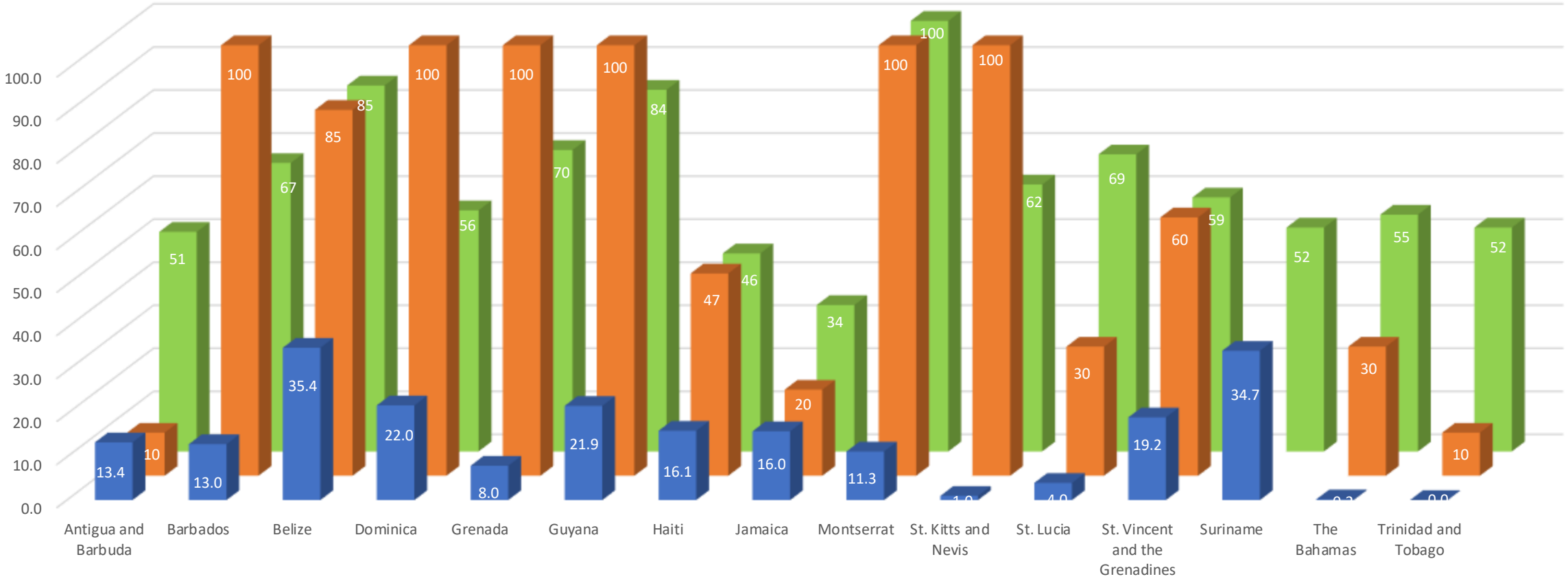
3. Activity in the region

Regional Benchmarks

Technology	Regional Leaders	Regional Pipeline	2020 Global Cost Benchmarks, USD	2020 Regional cost Benchmark, USD
Solar PV	JM (57MW), KY(11MW), BB(10MW)	HT (202MW), BH(119MW) TT (112MW)	Res.: 658-4,236 /kW Com.: 651-2974 /kW Utility: 883 /kW	JM: Utility: 1,730-3,150 / kW
Wind	JM: 102 MW KN: 2.2 MW	GY: 25MW LU: 12MW	Global: 1,355/ kW LAC: 2,062 / kW	JM: 1,875-2,489 / kW
Hydroelectricity	SR: 189 MW BZ: 54MW HT: 54 MW	GY: 168MW DM: 0.22 MW	21,807 / kW	?
Storage	BB: 5MW/20MWh (lithium) BH: 4MWh; 250kW/500kWh (lithium, Lead acid) JM: 24.5MW/6 MWH (lithium + flywheel)	GD: 0.3 MW KN: 15 MW	Lithium: 4-hour system: 350 / kWh	JM: 881 / KW 3,600 / kWh

Renewable Energy as a Percentage of Installed Capacity: 2019 vs. National Target vs. CARICOM proposed target



Country Trajectories

What would countries need to do to make their targets?

Per IEA, RE growth over 10y: solar +37% p.a.; wind +23% p.a.; all other forms grew by +12% p.a. or less.

- Bahamas, Barbados and St Lucia are especially ambitious
- A single investment in a small system can easily make or exceed the target.
- The "right" technology mix is an open question

Country	2019 RE %	Target RE %	Target year	Required CAGR for RE
Antigua and Barbuda	13%	20%	N/A	N/A
Barbados	4%	100%	2030	38%
Belize	55%	85%	2030	4%
Dominica	22%	100%	2030	16%
Grenada	6%	47%	2035	15%
Haiti	22%	47%	2030	8%
Jamaica	16%	50%	2037	7%
Montserrat	4%	17%	2020	N/A
Saint Lucia	4%	50%	2030	27%
Saint Vincent and the Grenadines	16%	60%	N/A	N/A
Suriname	35%	N/A	N/A	N/A
The Bahamas	0%	30%	2033	67%
Trinidad and Tobago	N/A	10%	2021	N/A

Energy efficiency programs and policies in the Caribbean countries

	Energy efficiency standards	Tax Credits	Tax Reduction / Exemption	Public Demonstration	Restrictions on Incandescent Bulbs	Appliance Labeling Standards	N.A.	Planning	In Place
Antigua and Barbuda	Planning	n.a.	n.a.	Planning	Planning	Planning	2	4	0
Aruba	n.a.	n.a.	In place	In place	n.a.	n.a.	4	0	2
Bahamas	n.a.	n.a.	n.a.	n.a.	In place	n.a.	5	0	1
Barbados	Planning	Planning	n.a.	Planning	n.a.	n.a.	3	3	0
Belize	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	0	0
Cayman Islands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	0	0
Dominica	Planning	n.a.	In place	In place	Planning	Planning	1	3	2
Grenada	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	0	0
Guyana	n.a.	n.a.	In place	In place	n.a.	n.a.	4	0	2
Jamaica	n.a.	In place	In place	n.a.	n.a.	In place	3	0	3
Dominican Republic	n.a.	n.a.	In place	In place	In place	n.a.	3	0	3
St. Kitts and Nevis	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	0	0
St. Vincent and the Grenadines	Planning	Planning	In place	In place	In place	Planning	0	3	3
St. Lucia	n.a.	n.a.	Planning	n.a.	n.a.	n.a.	5	1	0
Trinidad and Tobago	Planning	In place	In place	n.a.	Planning	Planning	1	3	2
Turks and Caicos Islands	n.a.	n.a.	n.a.	n.a.	In place	n.a.	5	0	1
Virgin Islands	n.a.	n.a.	n.a.	n.a.	In place	n.a.	5	0	1

							Average Caribbean Country		
N.A.	12	13	9	10	9	12	4	1	1
Planning	5	2	1	2	3	4			
In Place	0	2	7	5	5	1			

Source: CEPAL, 2016

NDCs and Global Climate Negotiation Processes

- Decarbonization of energy systems is driven by economics, but also by environmental imperatives
- Mitigation commitments by SIDS don't matter much in terms of overall GHG reductions, but:
  - They send signals to negotiating partners and funders
  - The commitments can drive national policy forward
  - They typically come with useful co-benefits
- CARICOM countries generally have ambitious NDCs
- If the clean energy transition and climate adaptation are not justly funded, some CARICOM countries will take a high carbon development pathway

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4. Sources of support

Support

- The CCREEE
  - The PPF (project development support)
  - EMREV (modelling services)
  - CEKH (data, analysis, GIS, training)
- National and regional development banks (incl. CDB, IDB)
- Private finance (incl. commercial banks, VC, etc.)
- Bilateral aid agencies
- And many more…

Institution	Support Offered
Abu Dhabi Fund for Development (ADFD)	Concessional loans
BlueOrchard Finance S.A.	Credit (incl. private debt and bonds), private equity, blended finance
Caribbean Community Climate Change Centre (5Cs)	Technical assistance, grants, project finance. GCF accredited.
Caribbean Development Bank	Technical assistance, grants, project finance. GCF accredited.
CARICOM Development Fund / Caribbean Risk Abatement Facility (CRAF)	Grant, partial credit guarantee.
Clean Technology Fund (CTF)	Grants, concessional loans, risk mitigation instruments (guarantees)
Climate Risk Early Warning System (CREWS) Initiative	Technical Assistance (in-kind)
Deetken Impact Sustainable Energy (DISE)	Subordinated debt, Preferred equity, Common shares, Leasing structures (incl. performance-based payments).
EKOenergy / EKOenergy Climate Fund	Grants
Michelin Corporation Foundation	Grants (EURO 5,000 to 100,000)
MPC Caribbean Clean Energy Fund	Private equity, project finance, blended finance
Nordic Development Fund / Nordic Climate Faciality (NCF) - challenge fund.	Grants, loans and equity, blended finance.
SDG Impact (UNDP)	Technical Assistance (in-kind)
Supporting Renewable Energy and Energy Efficiency in the Caribbean (EcoMicro)	Grants
Sustainable Energy and Climate Change Initiative (SECCI)	Grants.
UNDP United Nations Social Impact Fund	Blended finance

Conclusion

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