Perspectives for Distributed Generation with Renewable Energy in Latin America and the Caribbean:

Analysis of case studies for Barbados, Chile, Jamaica and Mexico

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Agenda

- Scope of the Analysis
- Definition: What Is Distributed Generation (DG)?
- Rationale: What are the Benefits of Renewable DG?
- Case Studies: What Is Actually Happening in LAC?
  - Jamaica
  - Barbados
  - Mexico
  - Chile
- Analysis: an Encouraging Picture, with Room for Improvement
- Recommendations: How to Promote Competitive DG

Scope of the Analysis

- DG done with **Renewable Energy (RE)** generation technologies
- DG in emerging markets of **Latin America and Caribbean (LAC)**
- DG that can **increase competitiveness and achieve sustainable economic growth**
- DG in its 'accommodation stage' (IEA): priority is to identify the **immediate opportunities for implementing viable distributed RE in LAC**, where most electricity generation is currently centralized
- **In the future**, with cost reductions and technological progress, DG can move towards:
  - Decentralization stage: decentralized providers increase, centralized generation remains (Denmark)
  - Dispersal stage: limited centralized generation, coordination of local networks

Definition: What is Distributed Generation?

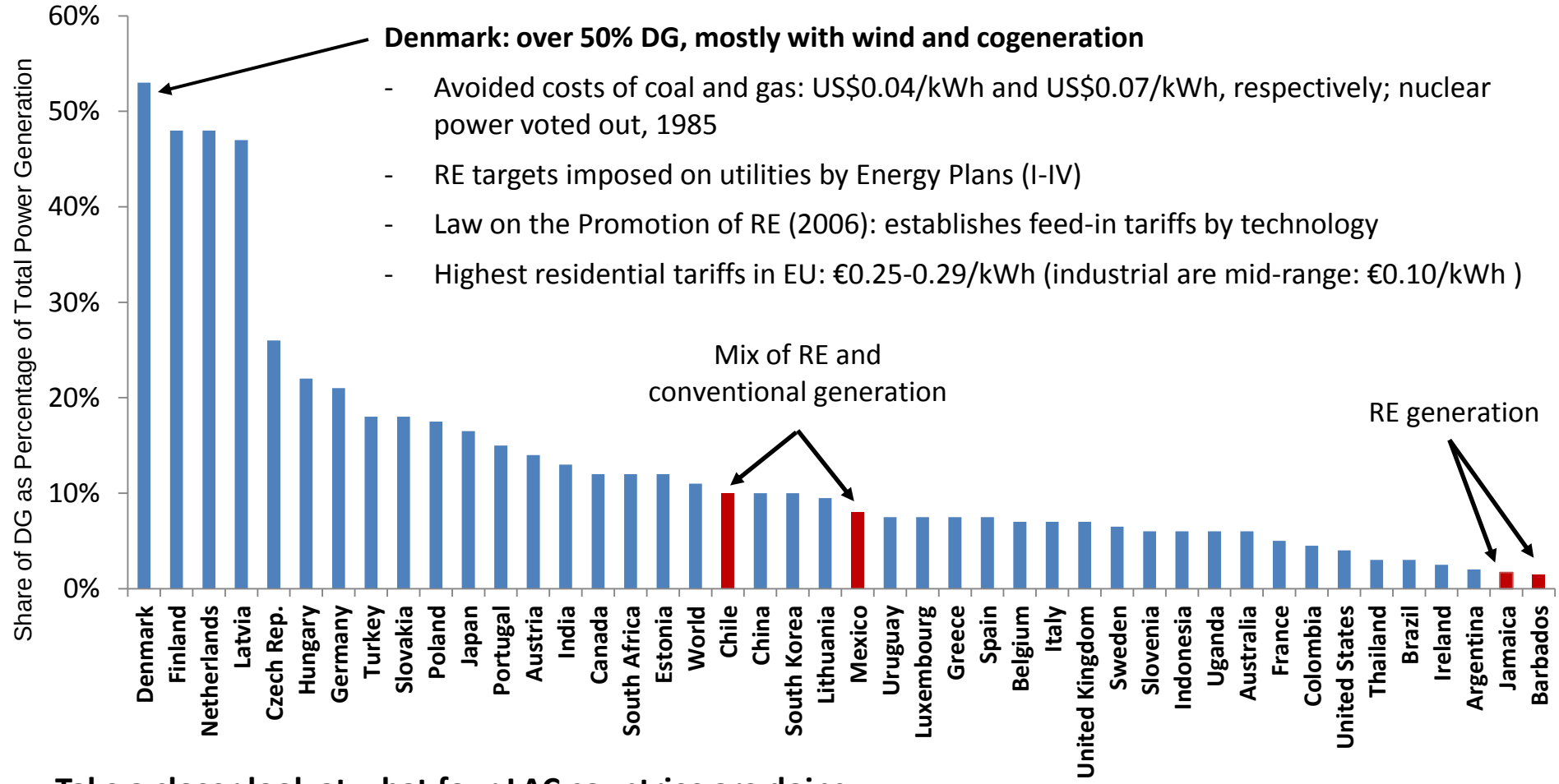
- No universally accepted definition of DG (plant size, technology type…)
- Defining feature of DG: **connection to distribution network** rather than to high voltage transmission network, meaning:
  - Located at customer premises, or in close proximity to load being served
  - Typically smaller generation, such as renewable generation, including small hydro, wind, solar, and combined heat and power (CHP)
  - In turn, requires defining what transmission and distribution networks are for each country
- Three main types of DG (one small scale, two commercial scale):

	Small Scale	Commercial Scale	
Connection	Customer load	Customer load	Distribution network
Sale of Electricity	Excess electricity	All electricity	All electricity
Sectors	Residential, non-residential	Non-residential	Non-residential
Main RE technologies	Solar PV, wind, hydro	Industry cogeneration	Solar PV, wind, hydro, biomass cogeneration
Approximate size	Up to 100kW	Up to 1MW	Above 1MW

Rationale: What are the Benefits of Renewable DG?

- **Key rationale: reduce the cost of electricity to customers**
  - DG must be competitive with utility scale conventional generation
  - Reduced costs for all, not just some customers: country as a whole must benefit
- **Other benefits of renewable DG**:
  - Reduce global environmental externalities (CO_2)
  - Reduce local environmental and social externalities
  - Help a new industry develop
  - Increase energy security
  - Reduce system losses and unnecessary capacity
  - Develop a 'green branding'

Case Studies: What is Actually Happening in LAC?



Denmark: over 50% DG, mostly with wind and cogeneration

- Avoided costs of coal and gas: US$0.04/kWh and US$0.07/kWh, respectively; nuclear power voted out, 1985
- RE targets imposed on utilities by Energy Plans (I-IV)
- Law on the Promotion of RE (2006): establishes feed-in tariffs by technology
- Highest residential tariffs in EU: €0.25-0.29/kWh (industrial are mid-range: €0.10/kWh)

Mix of RE and conventional generation

RE generation

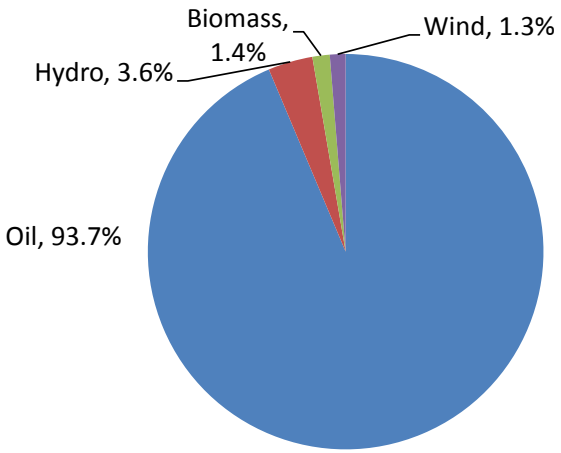
Take a closer look at what four LAC countries are doing:

- Jamaica, Barbados (Caribbean)
- Mexico, Chile (Latin America)

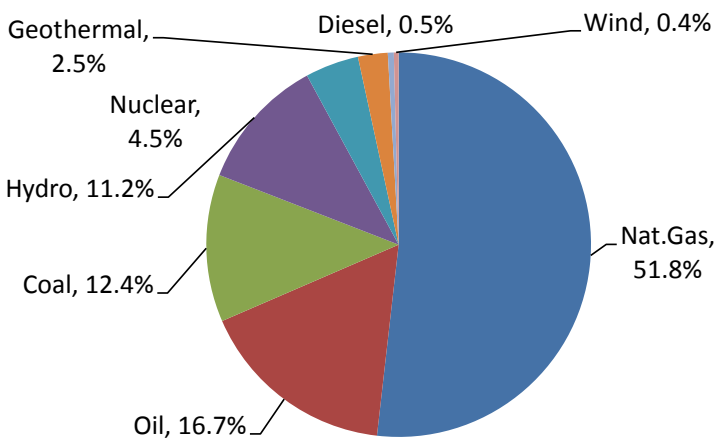
Case Studies of DG with RE: Jamaica, Barbados, Mexico and Chile

COMPETE CARIBBEAN

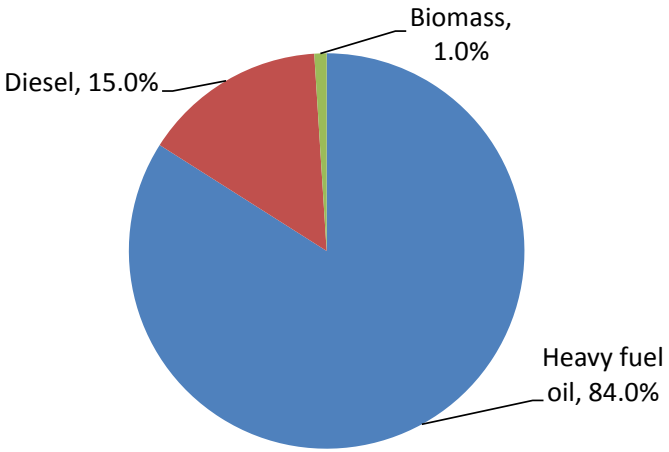
Electricity generation by source (%)



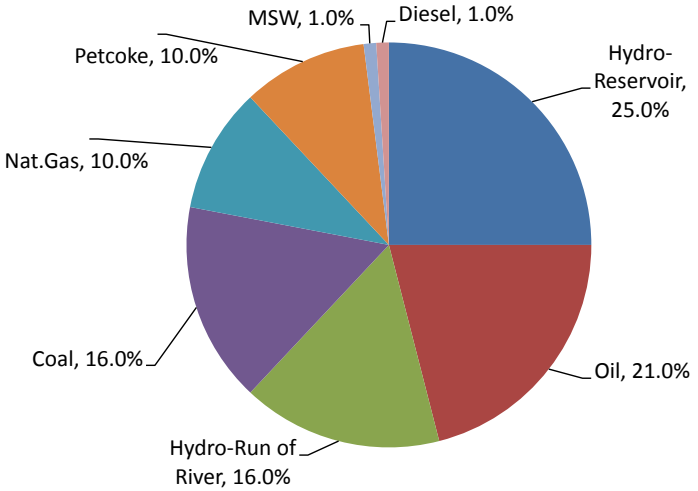
Jamaica: ~6.3% RE



Mexico: ~14% RE

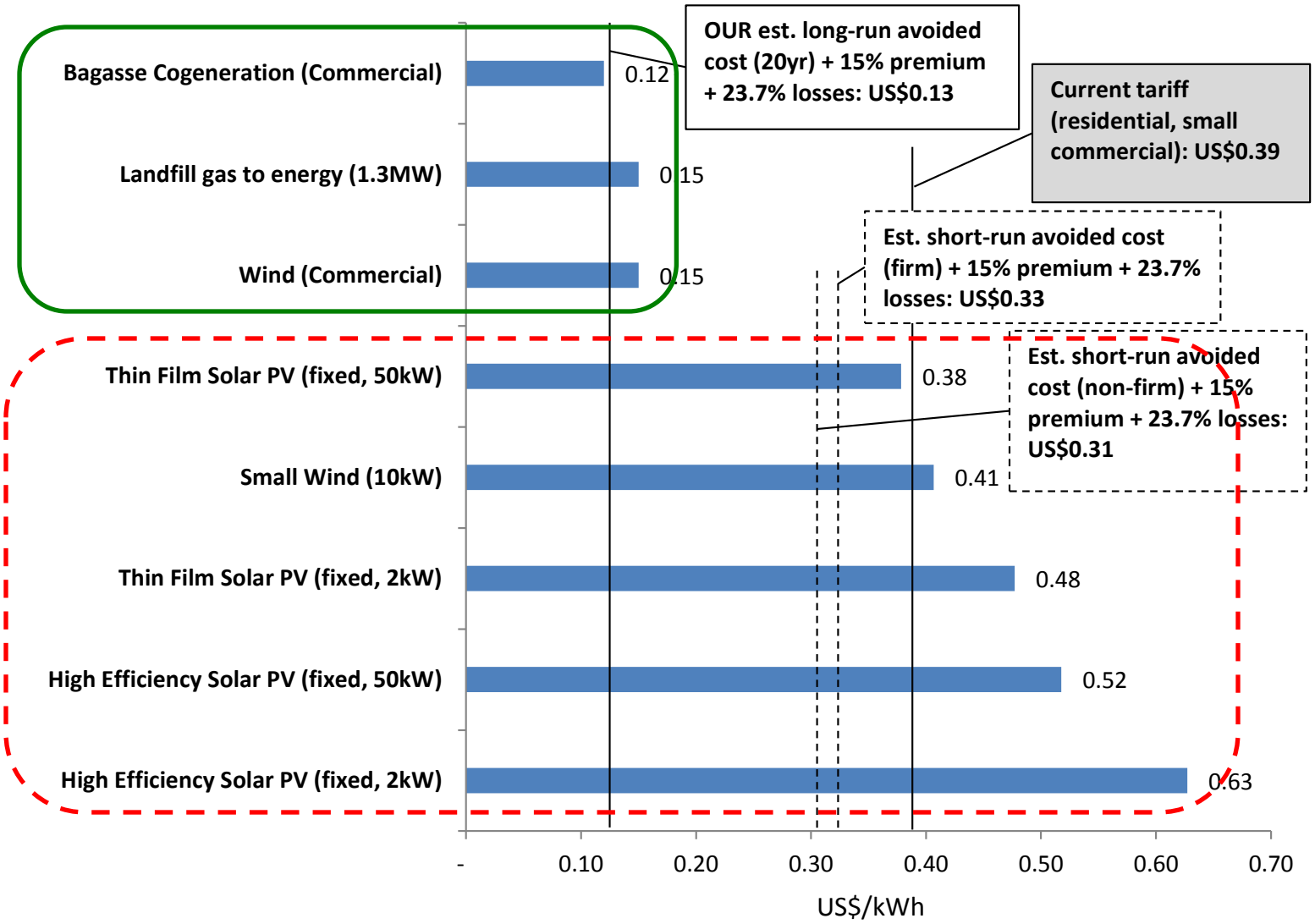


Barbados: ~1% RE



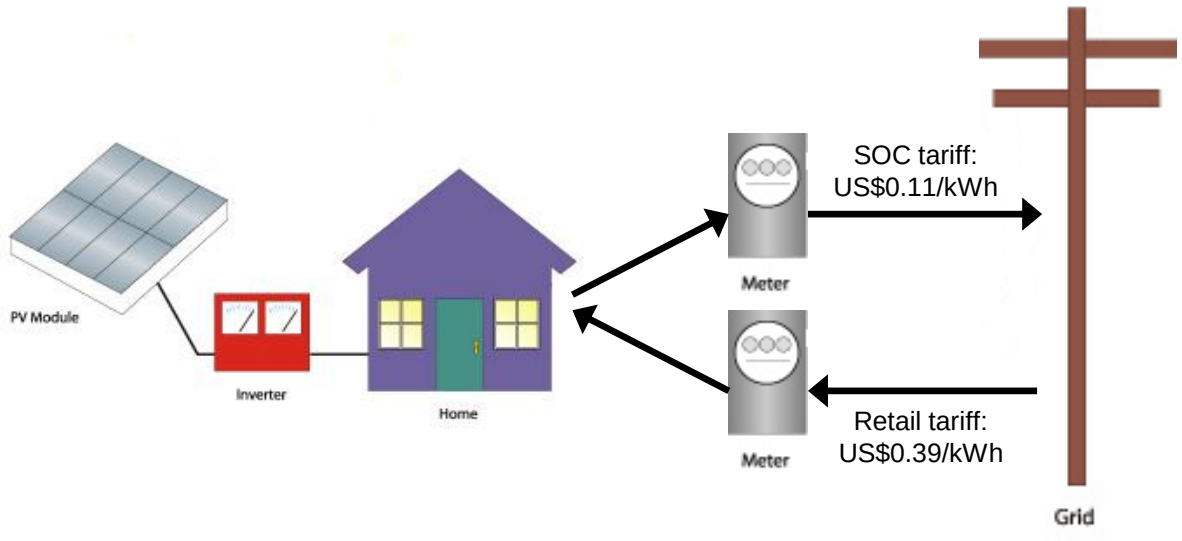
Chile: ~42% RE

Jamaica


OUR est. long-run avoided cost (20yr) + 15% premium + 23.7% losses: US$0.13
Current tariff (residential, small commercial): US$0.39
Est. short-run avoided cost (firm) + 15% premium + 23.7% losses: US$0.33
Est. short-run avoided cost (non-firm) + 15% premium + 23.7% losses: US$0.31
Bagasse Cogeneration (Commercial)
0.12
Landfill gas to energy (1.3MW)
0.15
Wind (Commercial)
0.15
Thin Film Solar PV (fixed, 50kW)
0.38
Small Wind (10kW)
0.41
Thin Film Solar PV (fixed, 2kW)
0.48
High Efficiency Solar PV (fixed, 50kW)
0.52
High Efficiency Solar PV (fixed, 2kW)
0.63
-
0.10
0.20
0.30
0.40
0.50
0.60
0.70
US$/kWh

Jamaica (cont.)

- **For commercial scale DG**: Office of Utilities Regulation enforces least cost planning; auctions
- **For small scale DG**: Standard Offer Contract at avoided cost, plus premium



Standard Offer Contract (SOC)

Term: 5 year contract

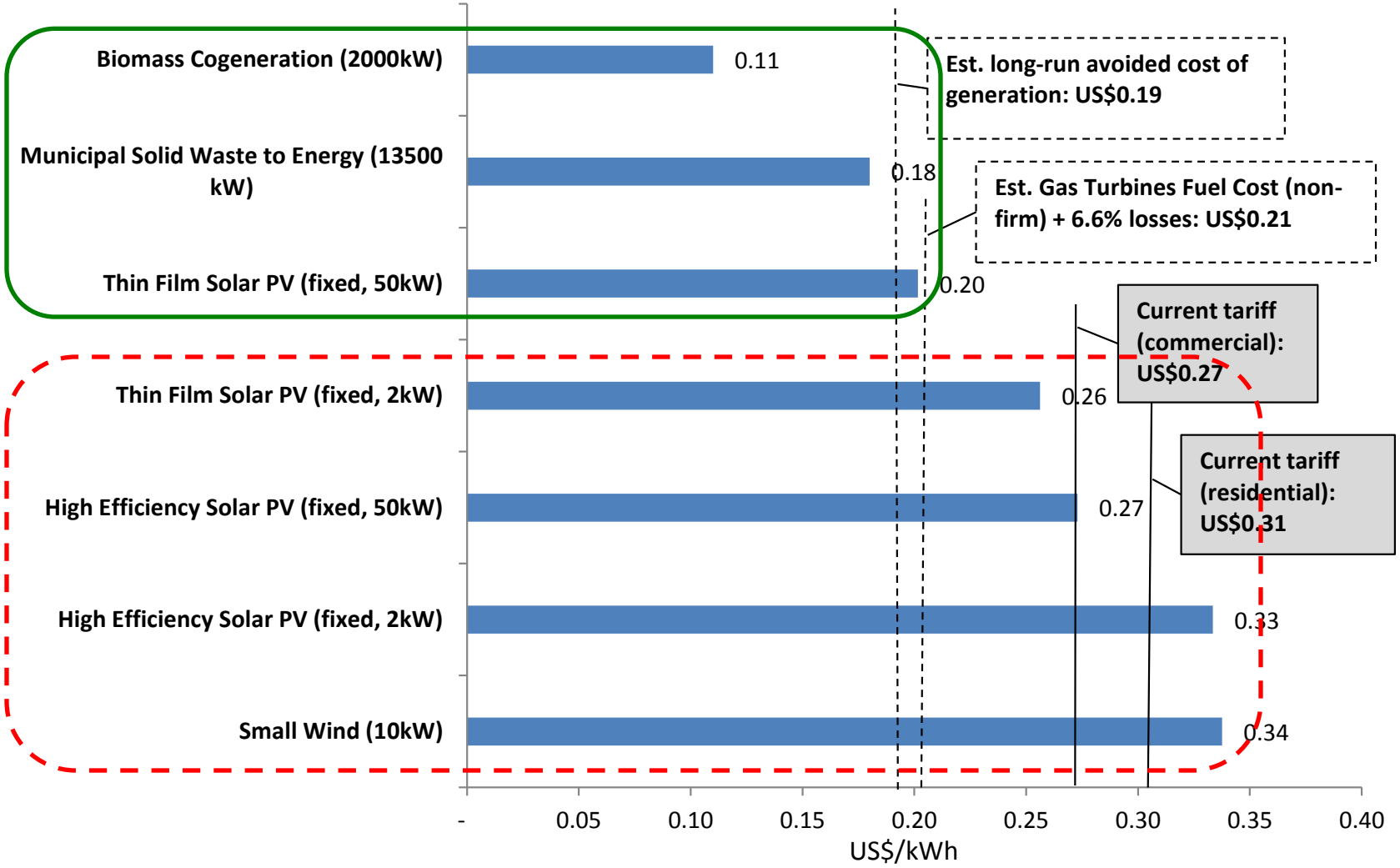
Eligibility: per individual system: ≤100kW; total cap: 3% of system peak

Tariff: long-run avoided cost + 15% premium (to recognize economic benefits)

Metering rule: net billing/ bidirectional metering

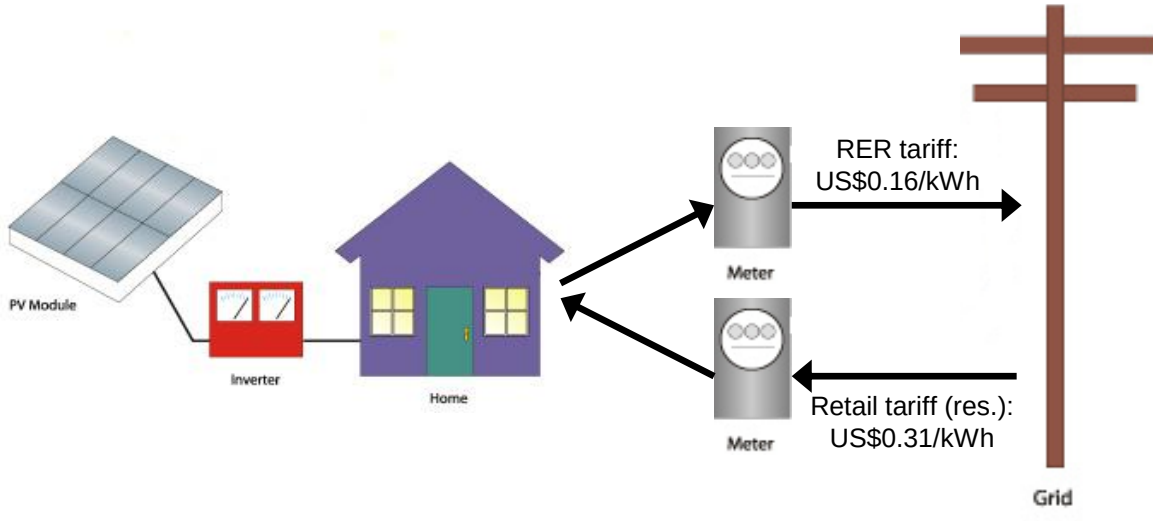
Shortcoming of SOC	Effect
OUR long run avoided cost calculation appears too low, includes uncertain plant	▪ Full contribution of RE not recognized ▪ In future, may screen out viable RE
Term of SOC too short (inconsistent with useful lifetime of systems)	▪ Customers face uncertainty, cannot recover costs ▪ Higher transaction costs

Barbados


Biomass Cogeneration (2000kW)
0.11
Municipal Solid Waste to Energy (13500 kW)
0.18
Thin Film Solar PV (fixed, 50kW)
0.20
Thin Film Solar PV (fixed, 2kW)
0.26
High Efficiency Solar PV (fixed, 50kW)
0.27
High Efficiency Solar PV (fixed, 2kW)
0.33
Small Wind (10kW)
0.34
Est. long-run avoided cost of generation: US$0.19
Est. Gas Turbines Fuel Cost (non-firm) + 6.6% losses: US$0.21
Current tariff (commercial): US$0.27
Current tariff (residential): US$0.31
-
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
US$/kWh

Barbados (cont.)

- **For commercial scale DG**: RE Policy approved to include least cost planning, third party generation regime, easier licenses to IPPs thanks to proposed change in legislation
- **For small scale DG**: Renewable Energy Rider (RER) by BL&P at avoided cost



Renewable Energy Rider (RER)

Term: 2 year agreement (pilot)

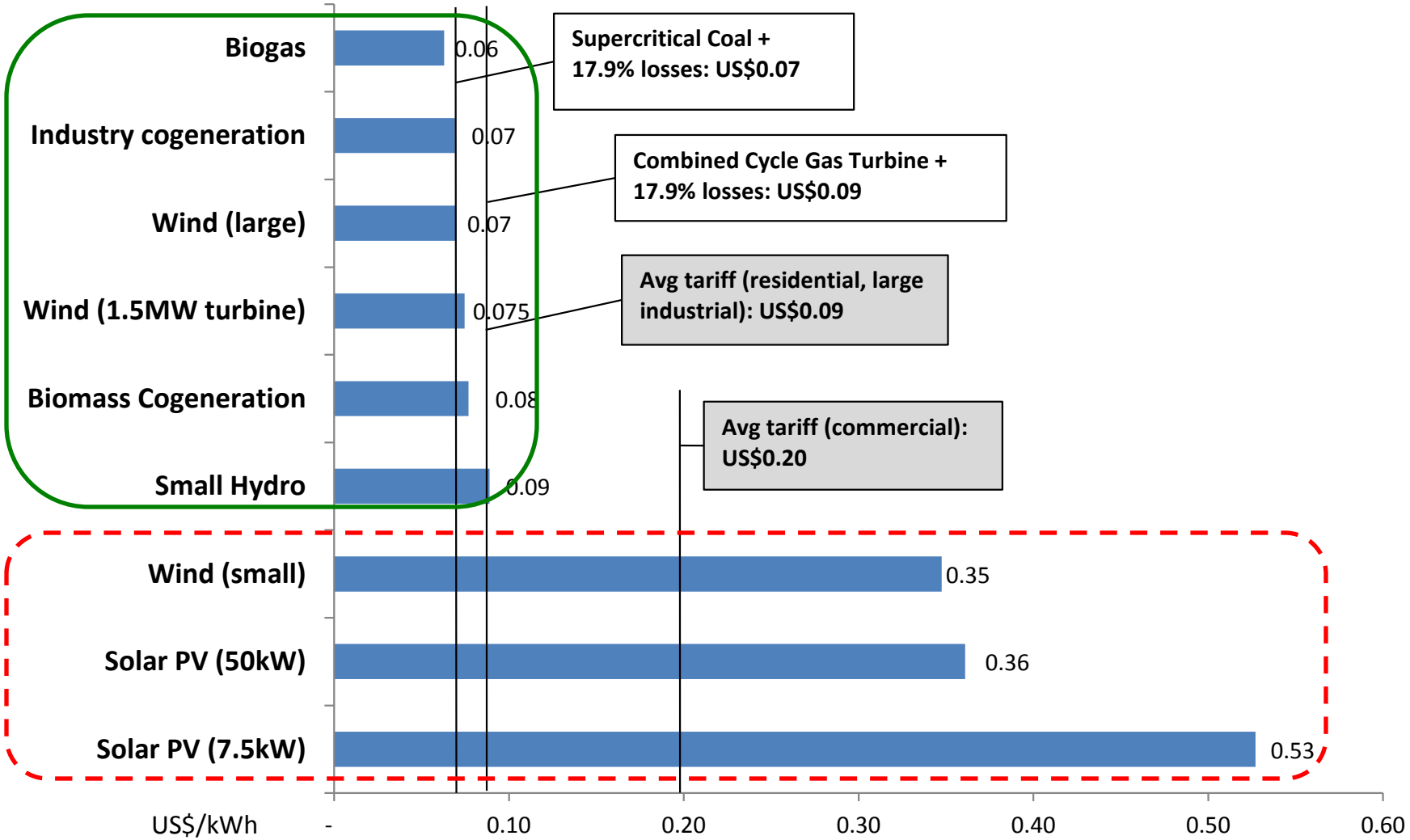
Eligibility: per individual system: ≤5kW (small customers), ≤50kW (large customers; total cap: 1.6MW (~1% of system peak) or 200 systems, whichever first

Tariff: short-run avoided cost

Metering rule: net billing/ bidirectional

Shortcoming of RER	Effect
Term of RER too short (inconsistent with useful lifetime of systems)	▪ Customers face uncertainty, cannot recover costs ▪ Higher transaction costs
Tariff structure has mostly 'bundled' energy rates, especially for residential customers	▪ Customers get services they do not pay for ▪ May encourage inefficient DG

Mexico


Biogas
0.06
Industry cogeneration
0.07
Wind (large)
0.07
Wind (1.5MW turbine)
0.075
Biomass Cogeneration
0.08
Small Hydro
0.09
Wind (small)
0.35
Solar PV (50kW)
0.36
Solar PV (7.5kW)
0.53
Supercritical Coal + 17.9% losses: US$0.07
Combined Cycle Gas Turbine + 17.9% losses: US$0.09
Avg tariff (residential, large industrial): US$0.09
Avg tariff (commercial): US$0.20
US$/kWh
-
0.10
0.20
0.30
0.40
0.50
0.60

Mexico (cont.)

- Least cost generation mandated by Electricity Sector Law
- National Energy Strategy (2010): 'clean energy' to represent 25% of capacity by 2025
- RE Development Law (2008) asks Program for RE, maximum/minimum prices to be paid, based on 'net economic benefits'
- SENER's Special RE Program (2009) sets targets for RE by 2012
- Methodology for 'net economic benefits' for quantities and prices under development

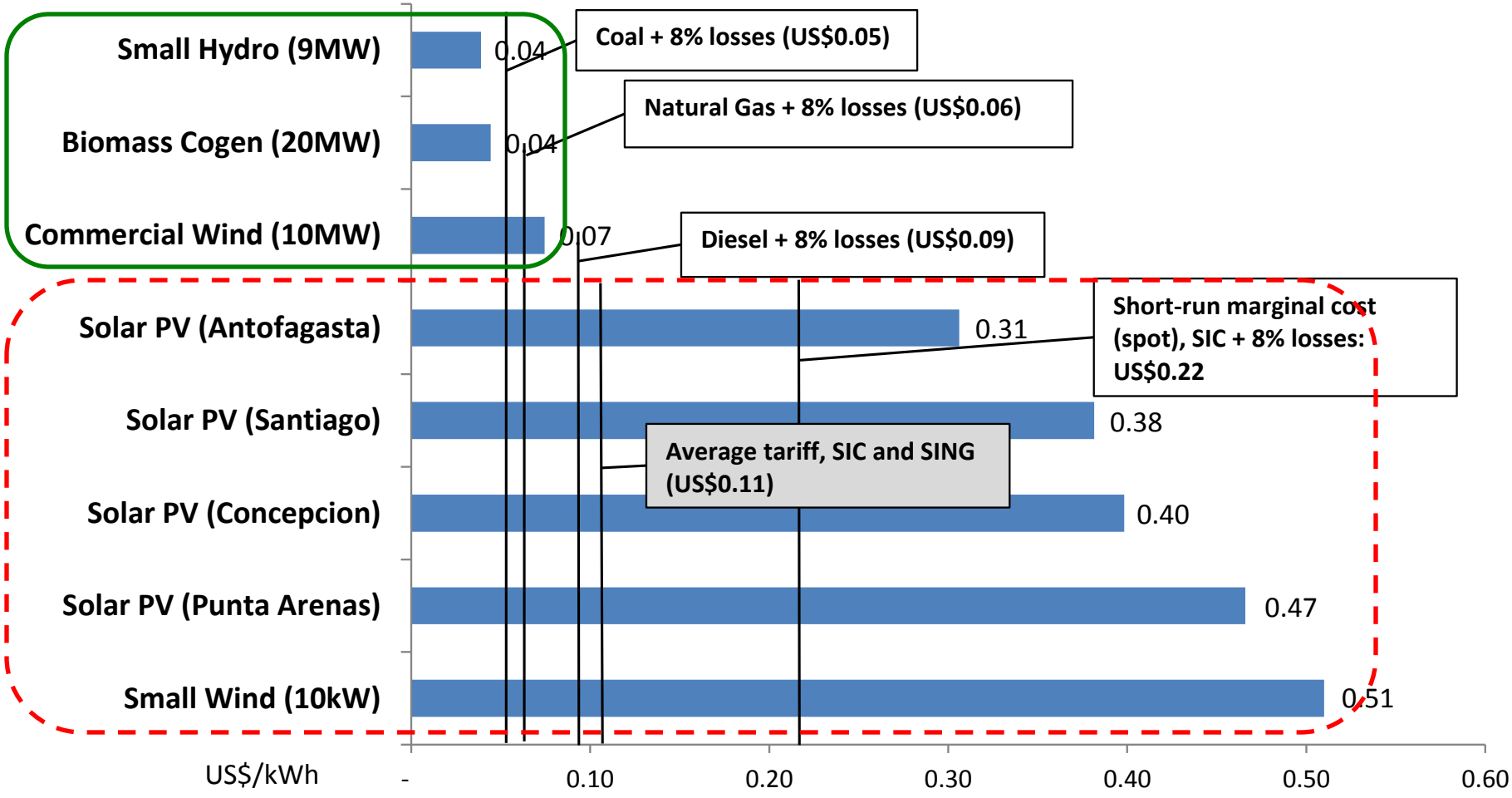
Commercial scale renewable DG: effective framework, but how will it change?

- **CFE does (and has done) auctions based on least cost planning (mandated by law)** just like for conventional power
- **Only targets for now** are for cost-effective RE that CFE expected
- **Wind energy under development, local manufacturing being supported**
- **How will next RE targets be established?**

Small Scale renewable DG: still in pilot phase, but how will it evolve?

- **CFE offers interconnection agreement** based on feed-in tariff/net metering
- **Caps**: only for individual systems, not for overall
- **First example: Mexicali (Baja California)**:
  - 220 homes with solar PV systems
  - Agreement CFE-Government of Baja California
  - Net metering (although using bidirectional meters)
  - Result: "customers save up to 50%"… who pays?

Chile


Small Hydro (9MW)
0.04
Biomass Cogen (20MW)
0.04
Commercial Wind (10MW)
0.07
Solar PV (Antofagasta)
0.31
Solar PV (Santiago)
0.38
Solar PV (Concepcion)
0.40
Solar PV (Punta Arenas)
0.47
Small Wind (10kW)
0.51
Coal + 8% losses (US$0.05)
Natural Gas + 8% losses (US$0.06)
Diesel + 8% losses (US$0.09)
Short-run marginal cost (spot), SIC + 8% losses: US$0.22
Average tariff, SIC and SING (US$0.11)
US$/kWh
-
0.10
0.20
0.30
0.40
0.50
0.60

Chile (cont.)

- Most DG traditionally done with conventional generation, but more recent regulation tries to rebalance this (easier interconnection, reduced fees)
- **RE Portfolio Standard**: 5% of electricity sold by 2014, to increase by 0.5% per year, and reach 10% by 2024
- **Studies** completed to assess wind, solar, biomass, geothermal (surface)
- **Four draft bills on 'net metering'** for small scale DG under consideration

Commercial scale DG: well-designed framework

- Mix of **limited incentives and competition** with conventional generation
- **Renewable portfolio standard** is technology neutral, limited, and only gradually increasing
- Commercial suppliers of electricity have a general obligation, but can choose which technologies to use for complying with it → **pick the cheapest**
- Commercial generators using RE can sell to DisCos, unregulated customers, or on the spot market

Small scale DG: unclear framework

- **Four draft bills presented**, none looks solid
- **Unclear objectives**
- **Metering arrangement** not clearly defined
- **Rate** unclear: retail rate? avoided cost?
- **Overall cap** not clearly defined, or excessive
- **Term**: none well specified

Analysis: an Encouraging Picture, with Room for Improvement

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Strengths

- Jamaica, Barbados, Chile, Mexico **already developing what is viable without imposing additional subsidies**
- **Least cost generation** ensured in Jamaica, Chile, Mexico, and effectively implemented in Barbados
- Jamaica, Barbados, Mexico **allow selling excess electricity from small scale RE**
- Jamaica and Barbados offer **net billing, feed-in tariffs at avoided cost, and total cap on eligibility**
- Jamaica offers **premium for recognizing economic benefits of RE**

Weaknesses

- Jamaica, Barbados offer **too short terms for SOC/RER**
- Jamaica's **avoided cost calculation too low**: does not recognize full contribution of RE
- Barbados's **tariff structure may offer inefficient incentives** for small scale RE
- **No total caps for small scale renewable DG** eligible for feed-in tariffs in Mexico, or in Chile's draft bills
- Mexico offering (and Chile considering) **net metering instead of net billing**
- **Not possible to sell excess RE** in Chile

Opportunities

- **Current options already exist to reduce costs** through commercial scale RE in all countries
- **Additional options to arise** as capital costs decrease for small scale RE (such as solar PV)
- Recently approved **RE Policy in Barbados**
- Mexico **completing RE framework**
- Chile **developing framework for small scale RE**

Threats

- **Inertia**: people only do what they already know, unless induced to change
- **Impossibility to connect to the grid to sell power**: grid rules not designed to accommodate DG
- **Burdensome planning/permitting, high transaction costs**: 'new' projects pose unknown problems for first time

Recommendations: How to Promote Competitive DG

1. Define DG clearly and appropriately in each country, based on system size
2. Ensure that power systems are developed based on least cost generation
3. Neutralize threats to efficient DG
4. Consider if paying more for power may increase competitiveness and growth
5. Avoid the trap of paying too much

1. Define DG Clearly and Appropriately in Each Country, Based on System Size

- **A clear definition matters for effective policy**
- **Location within a network is clearest criterion**
  - DG connected to the Distribution Network
  - Defining plant capacity, technology type, or other features are welcome additions
- **Must also define what 'Distribution Network' is**
  - Define for small and large countries, or better define for each country
  - Use voltage

Mexico's Example: CRE's Resolution 54/2010

- "Connected to national electric system": it's not off-grid
- "Not directly interconnected to transmission network": connected to Distribution
- "Distribution networks" in Mexico are those with a voltage between 2.4kV and 34.5kV
- Small DG is up to 30kW of capacity, and connected to the network at voltages up to 1kV

2. Ensure that Power Systems Are Developed Based on Least Cost Generation

For commercial scale DG: Effective regulation and market design

- Vertically integrated markets (Barbados, Jamaica)
  - Obligation of least cost expansion planning
  - Obligation to purchase from lower cost IPPs
  - Duty of the regulator to check plans
- Liberalized markets (Chile, Mexico)
  - Market model: non-discriminatory treatment of RE
  - Single buyer model: auctions

➢ Ensure that investors recover costs and make a reasonable return; and that investors (not customers) bear cost of non-performance

For small scale DG Well designed feed-in tariffs

➢ **Define feed-in tariffs as something that is not a subsidy**: they are a standing offer to purchase excess power from small scale systems at a predetermined price (which can be flexible) for a predetermined term, and for a limited amount

➢ **Set price at no more than actual avoided cost**

➢ **Set term at least to useful lifetime** of systems

➢ **Prefer net billing to net metering** (consistent with offering no more than avoided cost)

➢ **Cap eligibility**:
- cap size of individual systems
- cap total capacity/number of systems

3. Neutralize Threats to Efficient DG

- **Combat inertia with obligations and incentives**
- **Make it easy and safe to connect to the grid with a Grid Code**
- **Use streamlined, standardized permitting and planning approaches**

4. Consider if Paying More for Power May Increase Competitiveness and Growth

- Premium must be **economically and politically acceptable**
  - Involve key stakeholders to decide what deserves a premium, and what not
  - Develop methodology for determining premium to be paid
  - Assess actual economic costs and benefits
- Possible premiums:
  - Premium for **increasing system resilience and energy security**
  - Premium for developing a '**green economy**' and create '**green jobs**'
  - Premium for **reducing local and global environmental externalities**
    - Local externalities: pay full cost
    - Global externalities: focus on win-win options; get concessional finance and grants for what is good for the world
  - Premium to **promote branding**

5. Avoid the Trap of Paying Too Much

- **Create a disaggregated, cost-reflective tariff structure** that charges separately for services:

- **Always set total caps for feed-in tariff eligibility**

- **Always prefer net billing to net metering**

Thank you.

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