

# Smart Grids in Developing Countries: Some Activities at the WB

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# Smart networks can increase efficiency and reliability and at the same time reduce emission in developing countries

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## Reducing Losses

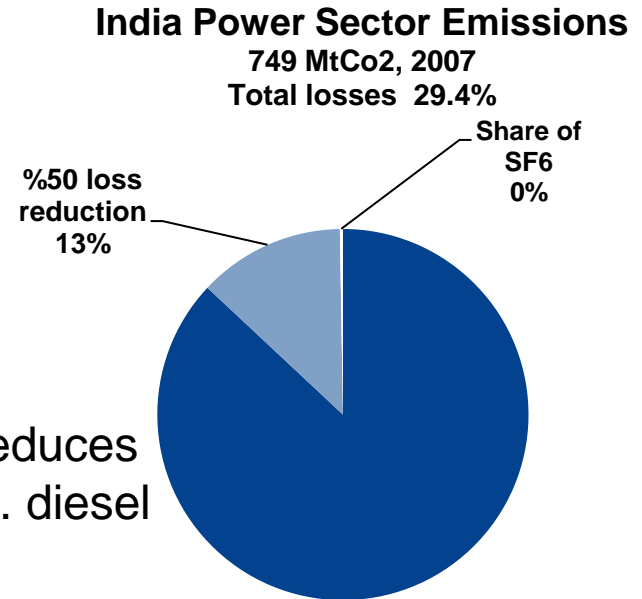
- Improves efficiency and reduces emissions
- Improves financial performance increasing chances to pay for renewable energy

## Improving reliability

- Often, reducing hour and duration of outages reduces the need for more GHG intensive solutions (e.g. diesel fired power) as compared to grid electricity

## Connecting renewable energy across territories

- Traditional renewable resources not yet exploited (such as hydro power in Africa) and newer technologies such as solar and wind power (Kenya, Morocco, and many others)



# Smart Grids ?

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**Smart grids could be described as the progressive integration of hardware, software, monitoring, control and communication networks into an electricity grid to help utilities deliver their services more efficiently, reliably, and in an environmentally sustainable way.**

- Smart Grids is not something you buy, but a **vision** each grid should create given its challenges and opportunities. Not a one time event !
- While there are some opportunities to lead-frog, the best technological applications to some grids may be old (“not-so-smart”) for other grids
- Since all grids are at different stages of technological development and face different challenges, utilities are increasingly relying on smart-grid **road maps** to define their smart grid vision

# Case study 3: Brazil, Electrobras distribution rehabilitation

Status Approved  
 Objective Service quality improvement and loss reduction

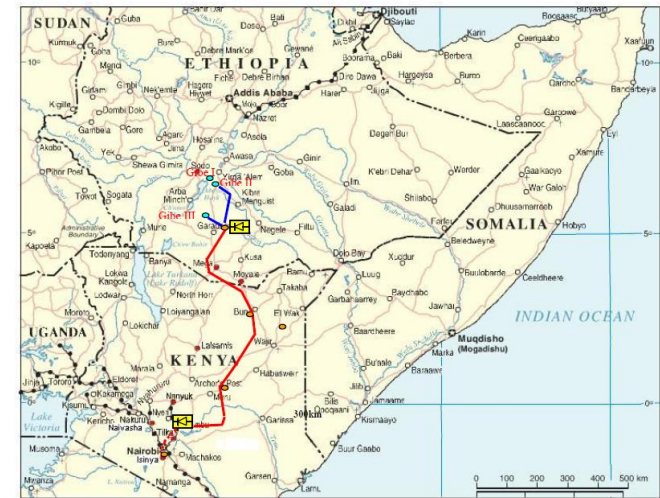
Description Replacement of transformers, resizing conductors, meters, improved CMS/RMS



<b>Direct no generation impacts</b>			
	<b>Baseline</b>	<b>Project</b>	<b>Net</b>
<b>Direct generation impacts</b>			
Technical Loss Reduction	<b>570,988</b>	<b>0</b>	<b>-570,988</b>
<b>Indirect generation impacts</b>			
Increased reliability	<b>208,736</b>	<b>63,411</b>	<b>-145,325</b>
Capacity Expansion			
Electrification			
Cross-border trade			

# Case study 1. Ethiopia-Kenya, transmission interconnection project

Status Under preparation  
 Objective Save generation cost and improve reliability  
 Description 1200Km, 500 KV, AC and DC  
 Two phases 1000 MW and 2000 MW



Direct No generation impacts			
	Baseline	Project	Net
Land clearing		554,400	
SF6		250,359	
<b>Direct Generation impacts</b>			
Technical Loss Reduction			
<b>Indirect Generation impacts</b>			
Increased reliability			
Capacity Expansion			
Electrification			
Cross-border trade	69,817,071	0	-69,817,071

# Advanced Meeting Infrastructure

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- Remote metering solutions are an integral part Improved Utility Technical and Commercial Management Solutions that are necessary to reduce losses and improve performance
- The meter is a tool, but will not by itself reduce losses. Metering is just the starting point of the commercial cycle
- When losses are high, returns on AMI solutions are much higher. Developing countries can sometimes benefit much more from new technologies
- Ex-ante payback expected pay back periods of 1-2 years are highly common

# Advanced Meeting Infrastructure

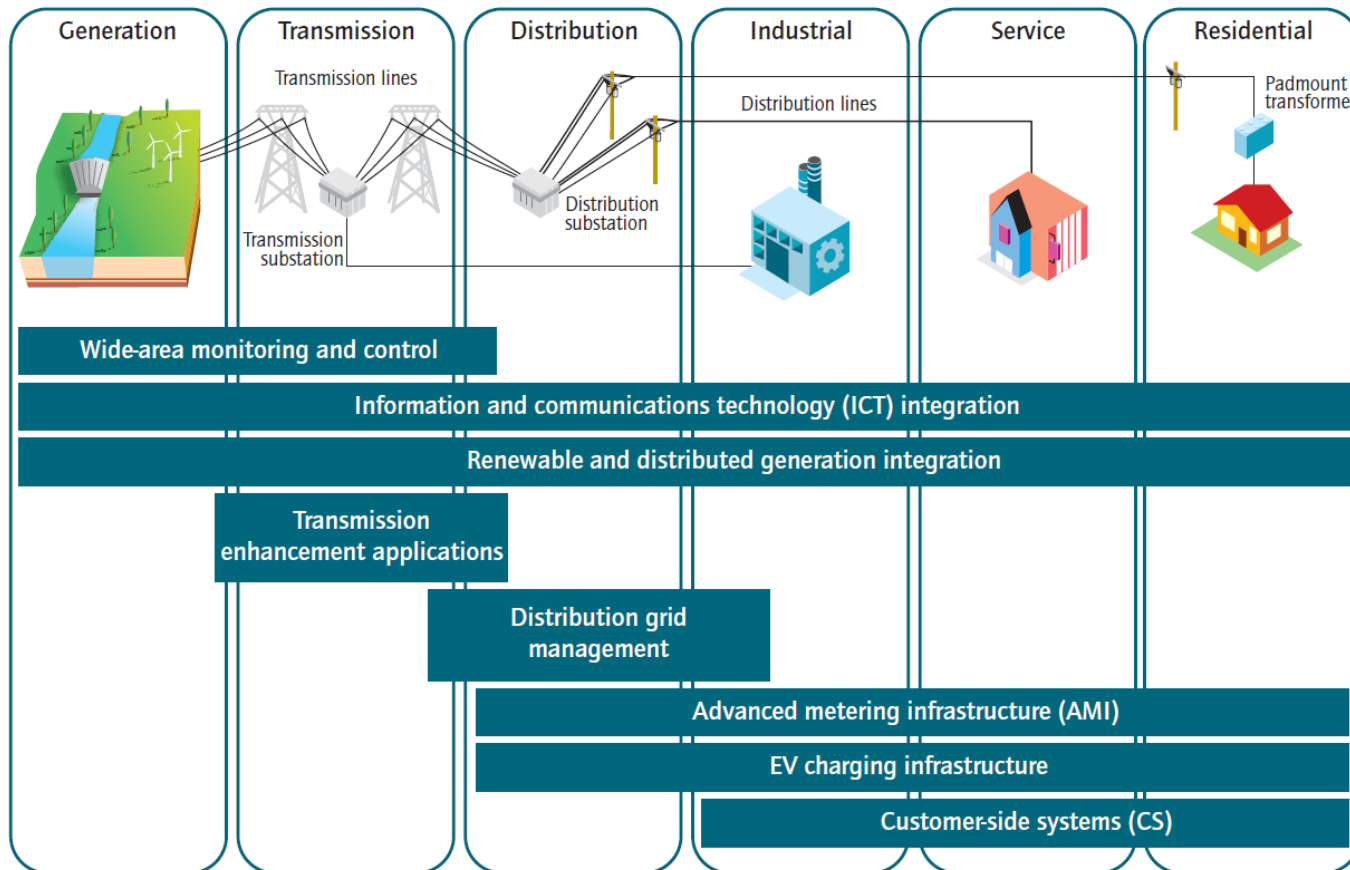
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- Pay-back periods have been confirmed by projects supported by the Bank

Example: An integral Technical and Utility Management Improvement Program in a Caribbean country.  
**AMI investment is US\$2.65 million**, which has already been **recouped in less than 7 months !**

Billed Energy (Recouped + Increase in Sales)								
	Janry.	Febry.	March	April	May	June	July	
<b>(GWh)</b>	0.24	0.44	1.69	2.35	3.81	5.94	6.31	SUB-TOTAL July 20.87 GWh
<b>(US\$)</b>	41,133	75,412	289,650	402,768	653,516	1,024,138	1,087,931	<b>SUB-TOTAL July US \$ 3,574,548</b>

# Smart Grids go far beyond the Smart Meters



Source: Technology categories and descriptions adapted from NETL, 2010 and NIST, 2010.

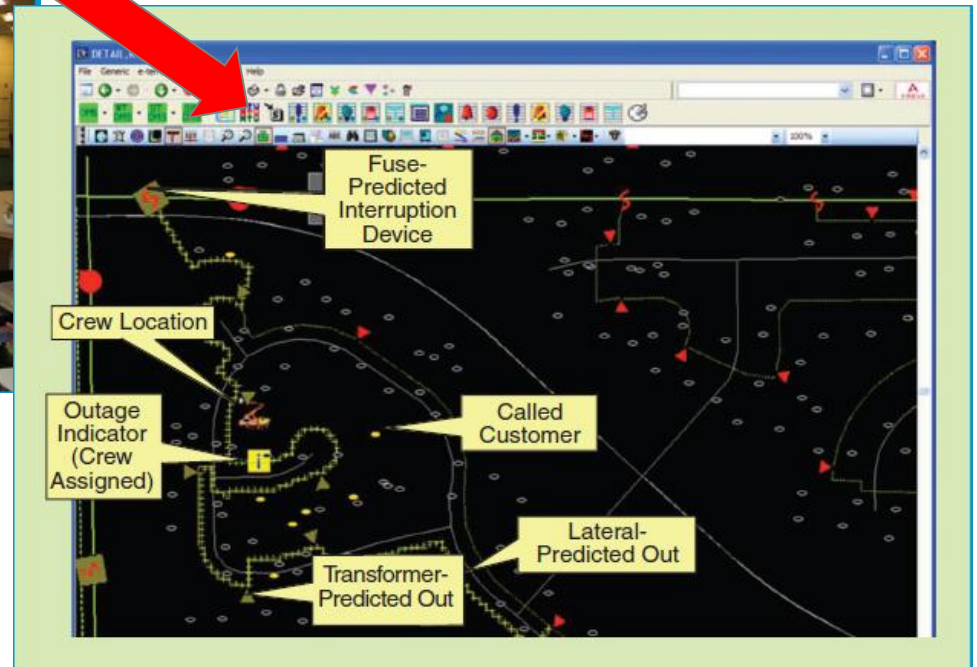
# Smart Grids in Distribution

- Distribution **information** and automation system to improve business processes, service quality



Typical distribution utility map board

Advanced map board



Source: IEEE Power and Energy Magazine

- Other **control** applications to improve service quality, reliability, efficiency: Volt/Var Control & Automatic Feeder Configuration

## Connecting renewable energy sources: challenges for grids

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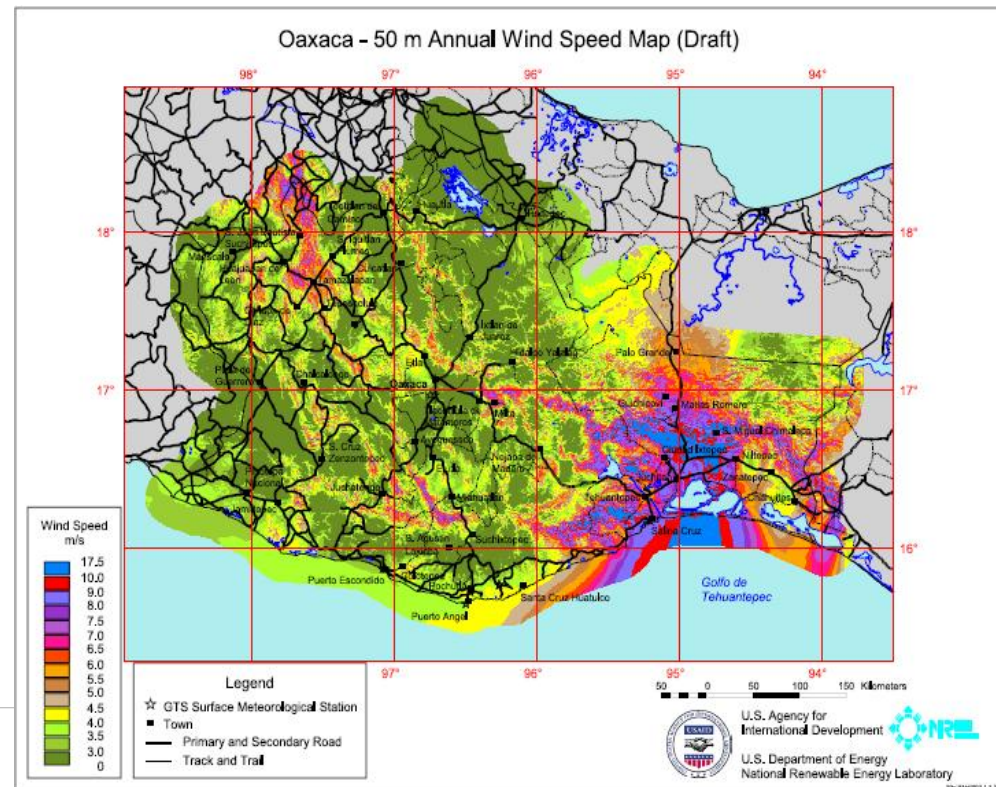
- Transmission needs to get the resource, not resource to the transmission. Site constrained resource
- Resource is usually “misplaced” located far away from consumption and existing network
- Scaling-up requires exploiting hundreds of sites whose average size is “small” (100-200 MW)
- Building transmission takes longer than building, say, the wind power plant
- Transmission also to balance the system: smooths out variability from different regions

# Mexico: Wind potential in Oaxaca 10 GW

First 1,895 MW of privately-developed wind power require a new framework to expand the publicly-owned transmission system with 271 km of double circuit 400 Kv lines plus 2,125 MVA substation are needed

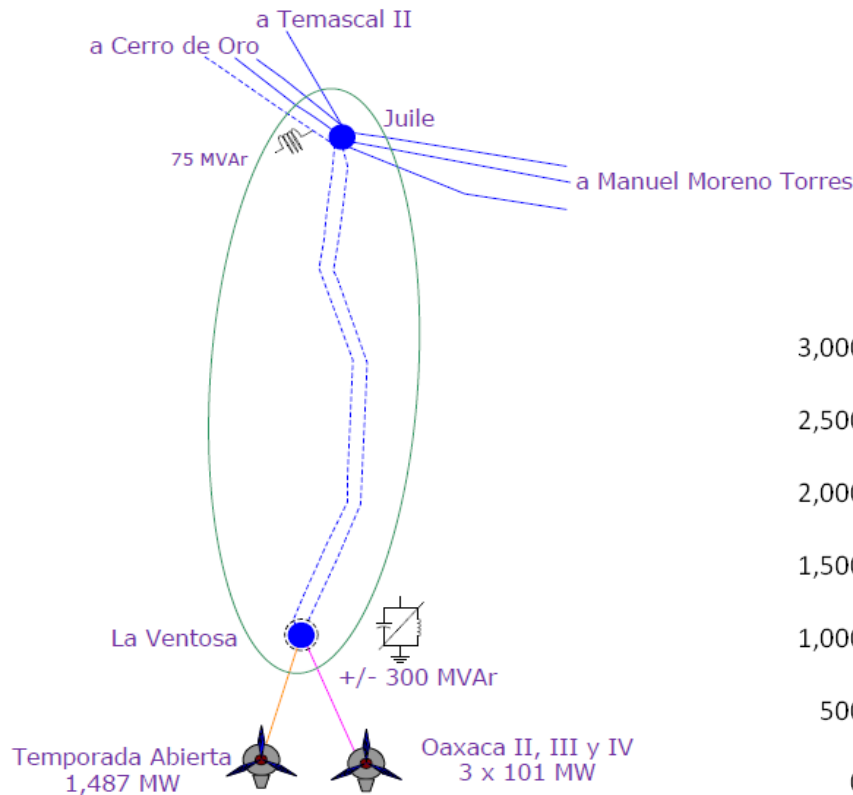
\*Source: CRE (2009) and CFE (2009)

- Average wind velocity above 15 m/s
- Average plant load factor > 50%
- Location: remote, far from consumption centers and the transmission system

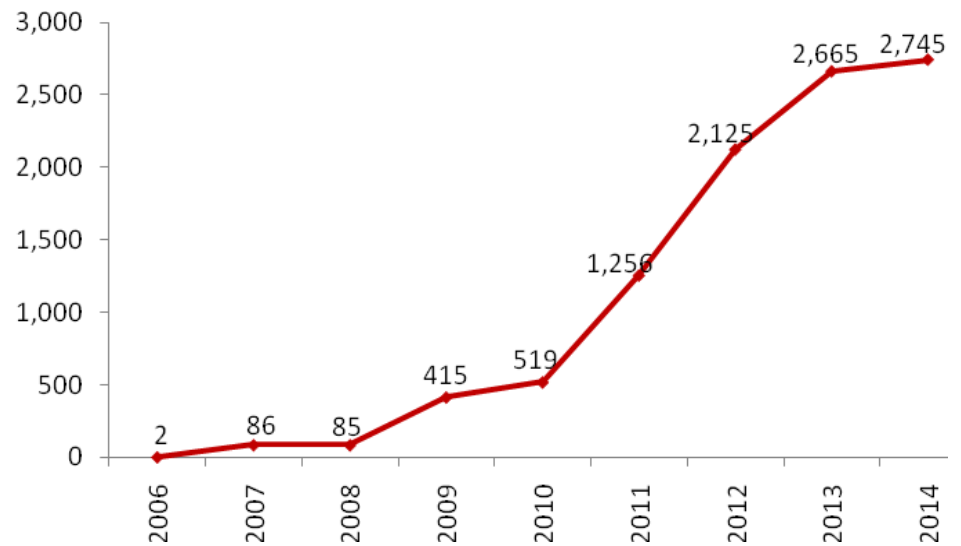


# Transmission: barrier to re generation in several countries

## Mexico: Open Season for Private Wind Power Producers: Reducing and Sharing Transmission Costs

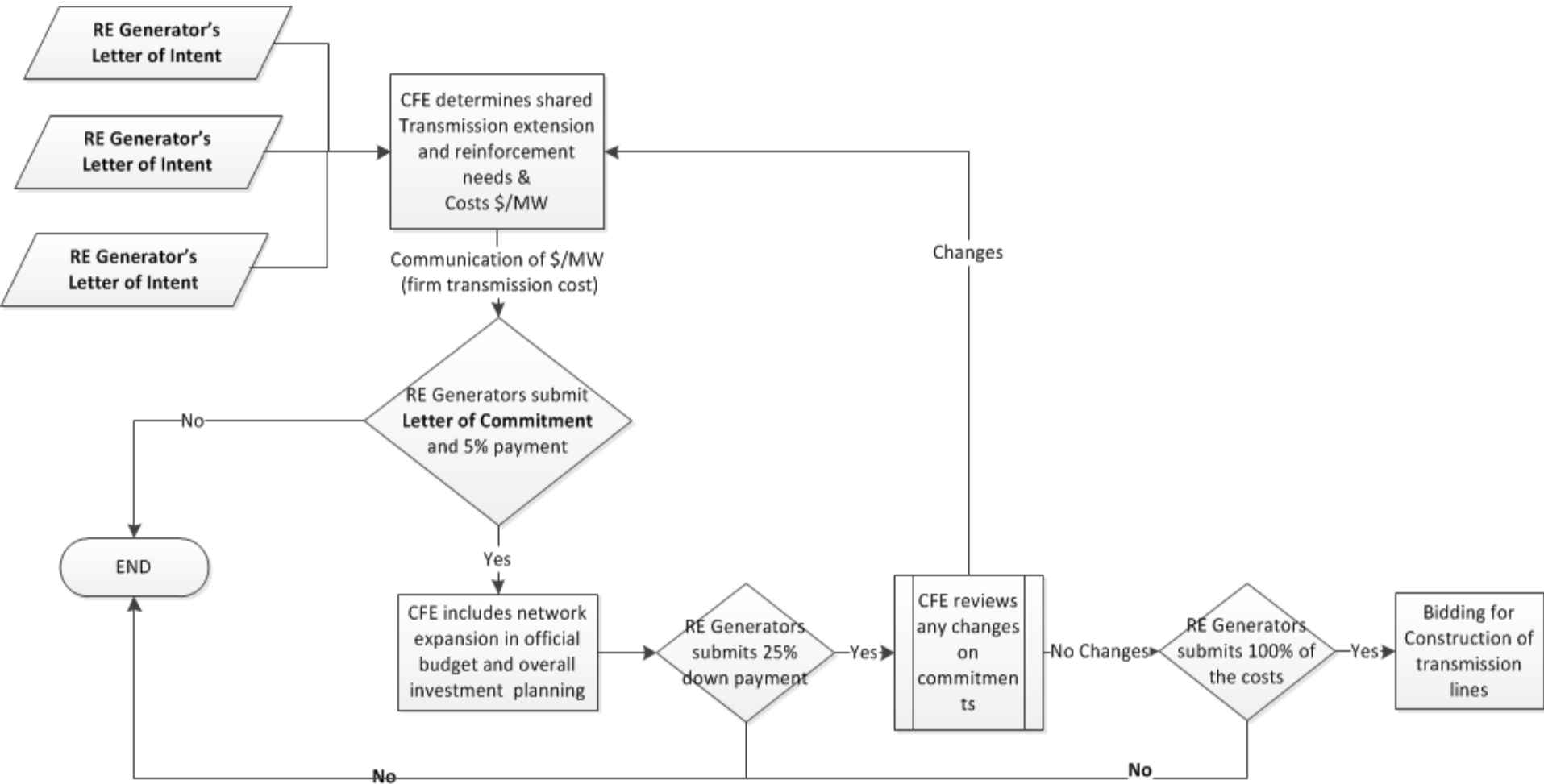


### Wind power operating and committed



# Transmission: barrier to re generation in several countries

## Mexico: Open Season process flow



# Smarter regulatory and planning principles to ensure grids are efficiently develop and contribute greening power sector

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**Principle 1: Extra transmission is often worth the cost.** The cost of expansion transmission is often worth the incremental benefits renewable generation. Benefit should be measured considering the value attributed exclusively to renewable (P3).

**Principle 2: Develop transmission proactively.** Sparsely and granular renewable resources require proactive and organized planning to reduce cost and connection times

**Principle 3: Maximize the net benefit of renewable transmission.** Transmission should be planned as to maximize the benefits of renewable minus the cost of generation. Along with proper pricing, this ensure that the most valuable sources are developed first

**Principle 4: Transmission should use efficient pricing.** Suppliers need to pay their share of transmission costs, to help ensure best combined transmission and renewable generation resources are developed first and reduce excess profits

**Principle 5: Broadly allocate uncovered transmission costs.** Given the benefits of renewable are externalities reduced, uncovered transmission charges should be applied as broadly as possible

## Some countries with Smart Grids activities supported by the Bank

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- Dominican Republic, Haiti, Africa: AMI for revenue protection
- Poland: AMI for demand management and consumer response
- Africa (several regions): HVDC for long-distance efficient transmission
- Vietnam: Smart grids application in distribution, information management systems (SCADA and others)
- Jordan: Road map for Smart Grids
- Ukraine: Updating transmission system protections with microprocessor based solutions