

## GE Power & Water

# Renewable Energy

**Vic Abate**

V.P. Renewable Energy



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## Global macro trends



**Electricity** demand ... 2X by 2030



**Population** .... 8 billion by 2030



**Environment** ... 73 countries have renewable portfolio targets



**Security** ... heightened energy concerns

**Changing energy needs driving new opportunities**



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# GE Power & Water portfolio

Diverse technologies totaling \$21 billion revenue in '09



Renewables – building on power generation technology & expertise

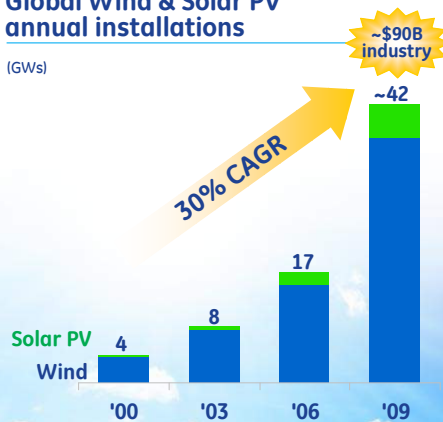
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## The renewables revolution

### Global Wind & Solar PV annual installations

(GWs)



Source: GE Marketing, REN21

### LAST decade ... key drivers

#### Technology

- Reliability & efficiency ↑

#### Cost

- ↓ 80% last 25 years

#### Policy

- EU: 20% renewables by 2020
- US: PTC thru '12 ... 33 state RPSs
- 50 countries installing wind power

### NEXT decade ... by the numbers

1% more renewables =

- ~40,000 more wind turbines
- ~500,000,000 more solar panels

~4% penetration today ... significant growth ahead

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# GE's "Play to-date"

## Delivering wind product leadership

### Technology



- Capacity factor: ↑13pts
- Availability: 98% ↑13pts
- Advanced grid expertise
- >2X US patents vs. comp.

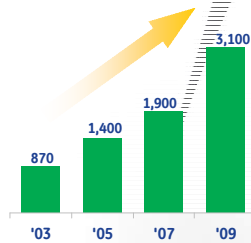
### Customer value

40% ↑  
Homes powered  
per 1.5MW turbine



### Scale

GE 1.5MW installed units



Source: GE Marketing

World's single largest fleet  
Quality ↑, cost ↓ = margin expansion

GEs 1.5MW wind turbine ... "The industry workhorse"



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## 2.5MW... Expanding product leadership

### Technology differentiation

Industry leading energy output

Built for reliability ... 98%+

↑ 55% output

Gen MW	1.5	2.5
Energy output	6.7 GWh	10.4 GWh
Rotor	82.5m	100m
Tower	80m	100m

### Big wins ... ~\$4B of commitments

#### Caithness ... World's largest project

- Shepherds Flat, Oregon
- 338 - 2.5MW units ... 845MW
- Installation begins '11

#### CEZ ... Europe's largest project

- Cogealac, Romania
- 240 - 2.5MW units ... 600MW
- Installation began '09

**\$100M technology investment ... positioned to win**



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## Fleet performance driving customer loyalty

### GE 1.5MW fleet availability



### Smarter ... Faster ... Better

#### Differentiated fleet data & insight

- Remote operations & analysis
- 13,500+ units operating globally
- 350+ reliability engineers

#### Rigor & speed

- Daily ops reviews for focus, priority
- 80% of issues resolved within 10 mins
- Automated early warning systems

**Newsweek**

When asked to pick his favorite turbine  
"GE units have amazing reliability"  
Zhang Jianjun, Huitengxile wind farm

**GE wind ... world's best running fleet**

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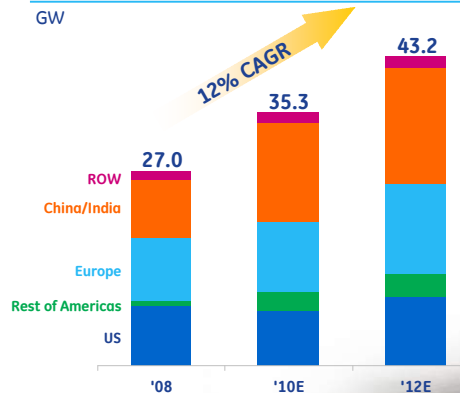
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# Next wave of growth

## Onshore growth

**~\$130B** Opportunity '10-'12

### Wind annual installs thru '12



Source: GWEC, EER

### Targeting new growth regions

#### Canada ... ~40% CAGR

- '10-'12 installs: 3.5GW
- 2.5MW 60Hz rollout

#### Latin America ... ~70% CAGR

- '10-'12 installs: 4GW
- 40% of first Brazil OEM auction

#### E. Europe ... ~28% CAGR

- 2.5MW launch ... product design for EU
- Largest onshore wind project

#### China/India ... ~20% CAGR

- Local assembly in place
- New products launched ... 1.5xle

**Well positioned with local presence & technology leadership**



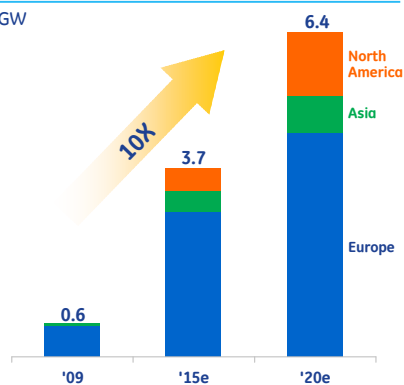
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## Expanding into offshore

### Offshore annual installs

GW



Source: EER

Today: <2% of global wind installed base

**~\$100B** Opportunity '10-'20

### Investing in technology leadership

- ScanWind acquisition 9/09 ... developer of direct-drive technology
- Built for offshore environment
- 4.0MW-110m rotor designed for energy output leadership
- High reliability with 40% lower planned maintenance
- Investing ~\$100MM over next 3 yrs.

**Offshore technology challenges match GE strengths ... reliability a must**

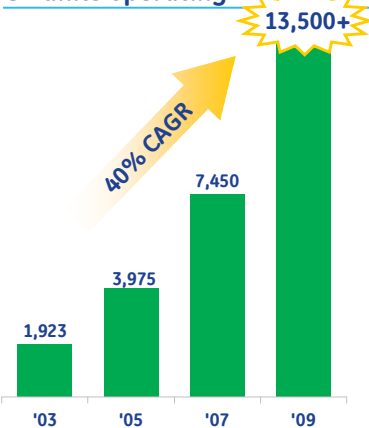


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## Enhancing the installed base

### GE units operating



Source: GE Marketing

**~\$3B** GE opportunity '10-'12

### Technology upgrades

- Increased output & efficiency ... WindBOOST™: 4% increased energy output
- Increased reliability ... remote monitoring & diagnostics
- 6X ↑ in services R&D in 3 years

### Enhanced services capabilities

- Doubled global field services organization
- Increasing portfolio of services offerings
- 10X growth in part sales

**Continuous, long-term opportunity for GE & customers**



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# GE Smart Grid for wind



## Advanced grid features

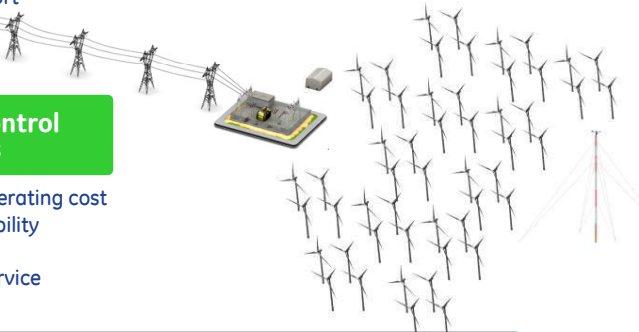
- Disturbance ride-through
- Voltage/frequency support
- Critical for higher renewable penetration



## Plant level control & diagnostics

- ↑ energy output ... ↓ operating cost
- Forecasting & dispatchability
- Turbine self-diagnostics
- 90%+ faster return to service

75+ wind patents  
grid integration  
leadership



**Proven GE power gen technology (100+ yrs) ...  
making wind plants behave like conventional plants**



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# Investing for bold moves



## \$1 billion renewable energy technology investment & growing

<b>Blade innovation</b>	<ul style="list-style-type: none"> <li>• Aero elastic sweep – bend twist</li> <li>• Advanced materials-carbon</li> </ul>
<b>Power conversion</b>	<ul style="list-style-type: none"> <li>• ↑ power density &amp; reliability w/higher voltage</li> <li>• Control for increasing weak grid penetration</li> </ul>
<b>Drive train</b>	<ul style="list-style-type: none"> <li>• Direct drive ... 50% ↑ output/same weight</li> <li>• Compact drive ... 25% ↓ weight</li> </ul>
<b>Solar</b>	<ul style="list-style-type: none"> <li>• Thin Film technology leadership through PrimeStar</li> <li>• Differentiated utility-scale Brilliance™ inverter</li> </ul>

**Bringing GE scale & expertise to differentiate long-term**



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# GE Renewables business journey

## GE revenue

(\$ in billions)



GE internal data

## Keys to success

- Focusing on customer value
- Product leadership
  - Technology differentiation
  - Efficiency/reliability
  - Low Cost of Energy
- Global supply chain
  - High quality
  - Rapid response
- Flawless execution ... project management & logistics

Wind ... GE's #1 ecomagination play

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