GE Energy

2020: Vietnam's achievement In Renewable Power development

Nguyen Thang
Country Executive

Hanoi

November 15, 2010

GE imagination at work

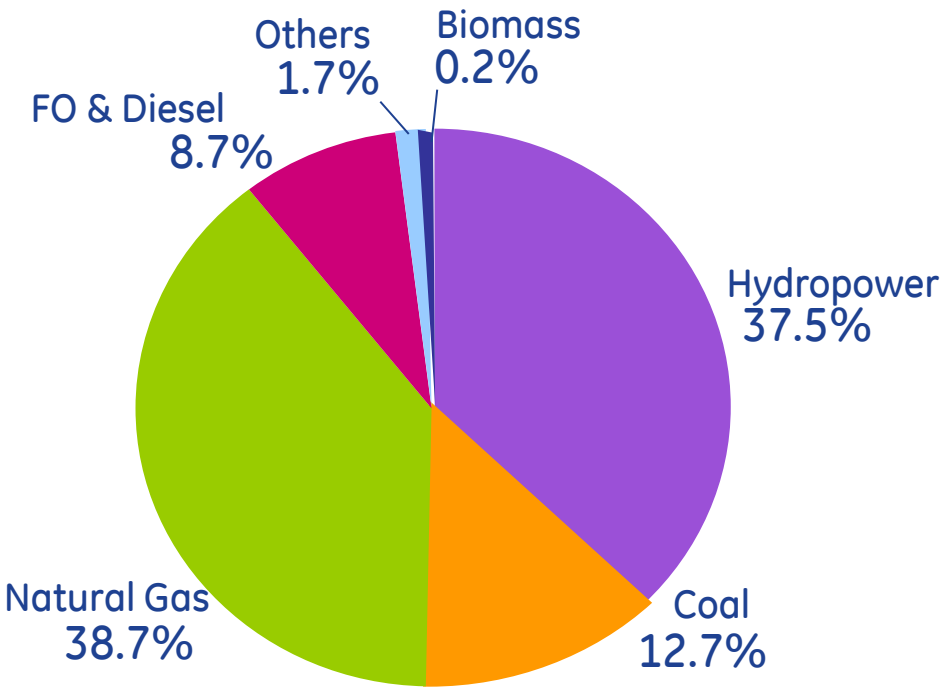
Renewable Energy … why changed?

Uncertainty driving diversification

2010: Fossil fuel reserves were running out…

Reserves-to-production ratio	
Oil	27.5 yrs
Natural gas	28.5 yrs
Coal	4 yrs

Power Generation Fuel Mix



Sources:
BP Statistical Review of World Energy, June 2008.
Asian Development Bank, Extended Annual Review Report Nov 2008.
Vietnamnet Bridge, April 15, 2009.

GE imagination at work

2010: Fuel diversity critical

Diverse




Gas
Coal
Nuclear
Oil
Geothermal
Biomass
Wind
Solar
Hydro

Efficient

Efficiency
Reliability
Emissions

Driving cost of electricity down

Affordable, reliable & environmentally responsible

The change started…

Power Master Plan 7

- Capacity additions from 2011-2030

- Projects list for hydro, gas and coal power generations.

- Set Renewable power target at **5%** of total generation capacity

GE imagination at work

Global Renewable Power

Wind
40%

Concentrated
Solar <1%

Solar PV
<1%

Biomass
19%

Small hydro
32%

Tidal
<1%

Geothermal
<1%

Potential Wind Power in Vietnam

Theoretically possible 500GW

Realistically possible 100GW

Economically possible 10GW

Wind Resource at 65 m

	Speed (m/s)	Power (W/m2)	Quality*
	< 5.5	< 200	Poor
	5.5 - 6.0	200 - 250	Poor
	6.0 - 6.5	250 - 320	Fair
	6.5 - 7.0	320 - 400	Fair
	7.0 - 7.5	400 - 500	Good
	7.5 - 8.0	500 - 600	Good
	8.0 - 8.5	600 - 720	Very Good
	8.5 - 9.0	720 - 850	Very Good
	9.0 - 9.5	850 - 1000	Excellent
	> 9.5	> 1000	Excellent

*For utility-scale wind turbines. Small wind turbines are sensitive to lower wind speeds.

Source: World Bank

GE imagination at work

2020 - Wind power achievement:

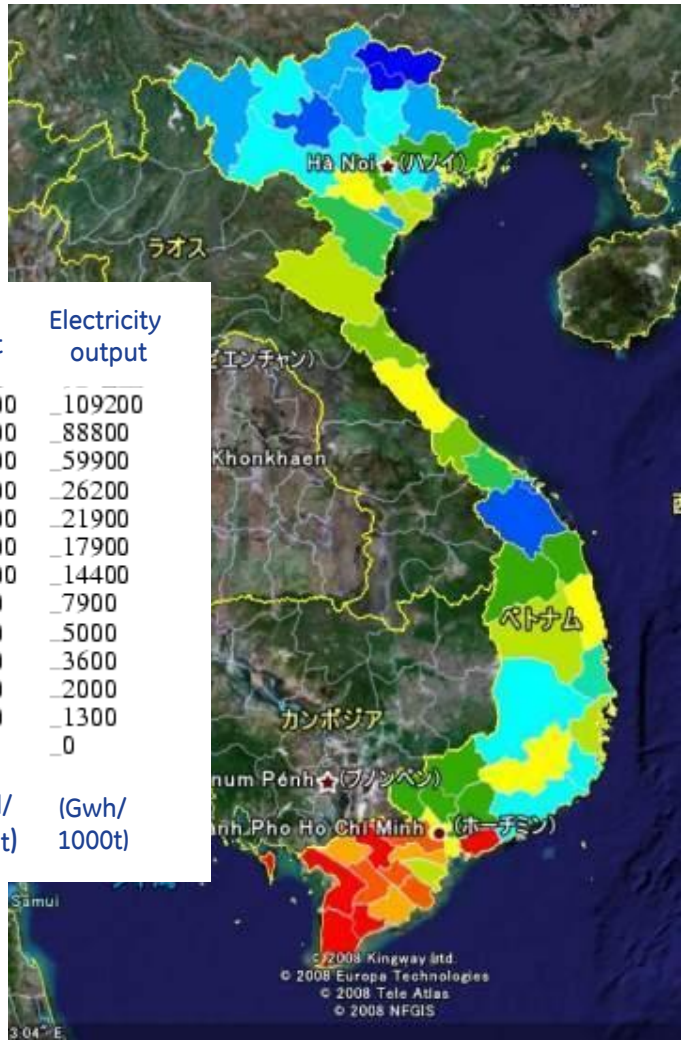
Vietnam have developed 1.2GW of Wind power - 3% of total country's generation capacity

Potential Biomass Power in Vietnam

1.6GW Potential

Major resources :

- Rice husk,
- Sugarcane,
- Cassava (tapioca),
- Wood,
- Animal waste, and
- Other agricultural waste



Production	Amount of biomass	Heat	Electricity output
113700	34100	94400	109200
92500	27800	76800	88800
62400	18700	51800	59900
27300	8200	22600	26200
22800	6900	19000	21900
18600	5600	15400	17900
15000	4500	12500	14400
8300	2500	6900	7900
5200	1600	4300	5000
3700	1100	3100	3600
2100	600	1700	2000
1300	400	1100	1300
0	0	0	0
(1000t, 1000m2)	(1000t, 1000m2)	(Tcal/ 1000t)	(Gwh/ 1000t)

Sources:
Vietnamese Academy of Science & Technology, 2005
GIS Database by Central Research Institute of Electric Power Industry

GE imagination at work

Rice Husk – An abundant energy source

Vietnam is the 2nd largest rice exporter in the world

Mekong River Delta

- Total paddy production ~ 18 mils tons/year
- Rice Husk: ~25% equivalent to 4.5 mils tons/year

Rice husk was thrown away from Rice mills into rivers in Mekong delta

Source: Tuoitre Online - VN

GE imagination at work

2020 - Biomass Power achievement:

Vietnam have developed 0.8 GW of biomass power - 2% of total country's generation capacity

Lower emissions facts

GE 1.5MW wind turbines

- 8,000 units
- Displace 21.3mm tons of CO2/year
- Equals 4.6mm cars off the road

Displace 58.5mm T Co2/year

GE's Jenbacher gas engines

- 800 units of 1MW capacity
- Displace 37.2mm tons of CO2/year
- Equals 8mm cars off the road

Ninh Thuan wind farm

-Technology: 62 x GE 1.6XLE wind turbines

-Application: grid connected

-Output: 100MW

-Commissioning: 2012

Rice Husk Power Plant – Tien Giang

- chnology: steam turbine, boiler nventional)
- blication: Off-grid cogeneration
- ctrical output: 5MW
- ermal output: 3MW
- mmissioning: 2013

GE imagination at work

Biogas plant - Ninh Binh

Technology:	2 x 1.5MW Jenbacher gas engine + waste water digester
Fuel:	Biogas from Chicken Dung of 2.3 mm chicken + slaughter waste
Application:	Off-grid cogeneration
Electrical output:	2126 kW
Thermal output:	1234 kW
Commissioning:	Sept 2014

GE imagination at work

AD of biomass – Soc Trang:

Biomass:

- Spent wash – 675 m3/d
  -> effluent removed after fermenting sugar cane molasses (alcohol/ethanol production)

Technology:

Waste water digester + 2 x Jenbacher 1.5 MW gas engines

Power output:
1034 kWel. / 1416 kWel.

Thermal output:
Water:586 kWth. / 748 kWth.
Steam: ~ 1350 kg/h; 10bar

Commissioning:
2015/2016

Thank you.

GE imagination at work