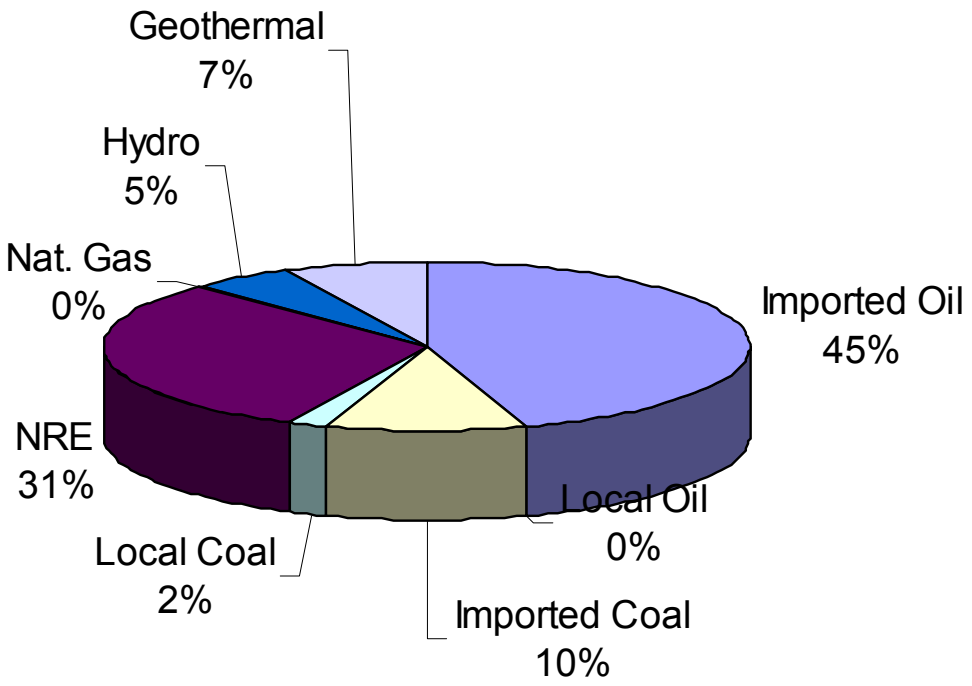
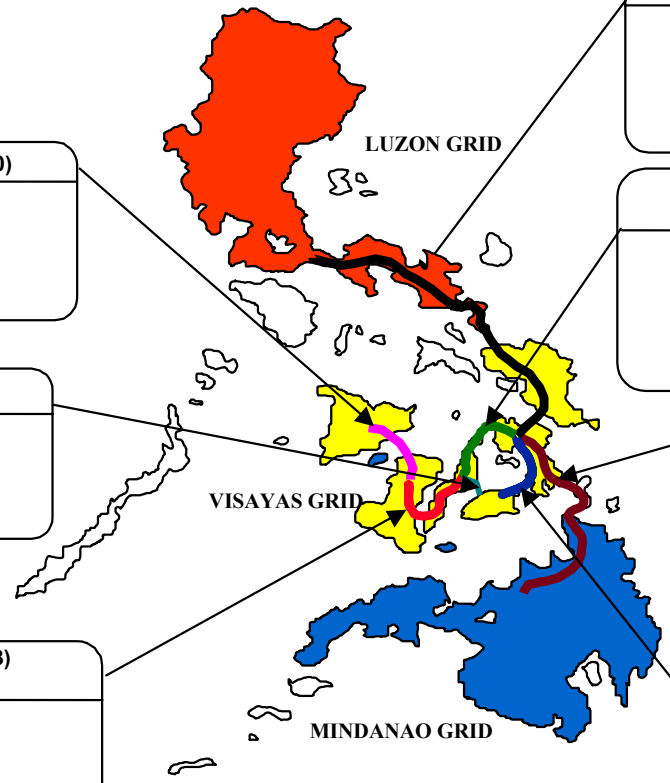
Emerging Markets for Wind-Diesel Hybrid Systems in the Philippines

Total Primary Energy Mix in 2001

(in million barrels of fuel oil equivalent, MMBFOE)



MAJOR ELECTRIC GRID



LEYTE-LUZON (1998)

CAPACITY : 440 MW
VOLTAGE : ± 350 HVDC
OHL : 420 KM
CABLE : 23 KM

NEGROS-PANAY (1990)

CAPACITY : 100 MW
VOLTAGE : 138 KV
OHL : 167 KM
CABLE : 18 KM

LEYTE-CEBU (1997)
UPGRADE (2004)

CAPACITY : 200+200 MW
VOLTAGE : 230 KV
OHL : 330 KM
CABLE : 32+32 KM
COST : P 4,071M

CEBU-MACTAN (2004)

CAPACITY : 100 MW
VOLTAGE : 138 KV
UGC : 8.5 KM

LEYTE-MIND. (2011)

CAPACITY : 500 MW
VOLTAGE : ± 250 HVDC
OHL : 455 KM
CABLE : 23 KM

NEGROS-CEBU (1993)

CAPACITY : 100
VOLTAGE : 138 KV
O H L : 109 KM
CABLE : 18 KM

LEYTE-BOHOL
Stage 1: 2000 Stage 2: 2003

CAPACITY : 100 MW
VOLTAGE : 138 KV
O H L : 152 KM
CABLE : 17 KM

MINDORO GRID

22. PULANG LUPA
23. MAMBURAO
24. LUBANG
25. CALAPAN
26. MINOLO COVE (PB 102)
27. TINGLOY

PALAWAN GRID

28. PTO. PRINCESA (PB 106)
29. PTO. PRINCESA
30. NARRA
31. BROOKES POINT
32. EL NIDO
33. ROXAS
34. TAYTAY
35. SAN VICENTE
36. BUSUANGA
37. CUYO
38. CULION
39. LINAPACAN
40. ARACELI
41. BALABAC
42. CAGAYANCILLO
43. AGUTAYA

MASBATE / ROMBLON AREA

44. MASBATE DPP I
45. MASBATE DPP II
46. MOBO (PB 105)
47. TICAO
48. TABLAS
49. TABLAS (PB 109)
50. ROMBLON
51. ROMBLON (PB 114)
52. SIBUYAN
53. BANTON
54. CORCUERA
55. CONCEPCION
56. SAN JOSE

VISAYAS

A. WESTERN VISAYAS

57. BANTAYAN
58. BANTAYAN (PB 116)
59. GUINTARCAN
60. DOONG
61. SIQUIJOR
62. SIQUIJOR (PB 113)
63. HIGANTES
64. CALUYA

B. EASTERN VISAYAS

65. LIMASAWA
66. DARAM
67. ZUMARRAGA
68. SAN ANTONIO
69. CAPUL
70. TAGAPUL-AN
71. ALMAGRO
72. SAN VICENTE
73. STO. NIÑO
74. BIRI
75. CAMOTES
76. PILAR
77. MARIPIPI

MINDANAO

A. WESTERN MINDANAO

82. BASILAN
83. BASILAN (PB 119)
84. JOLO (SULU)
85. SIASI
86. CAGAYAN DE TAWI²
87. TAWI-TAWI
88. TAWI-TAWI (PB 108)
89. BALIMBING
90. MANUK-MANGKAW
91. SIBUTU
92. SITANGKAY
93. WEST SIMUNUL

NORTHERN LUZON

1. BASCO
2. SABTANG
3. ITBAYAT
4. CALAYAN
5. LUBUAGAN
6. KABUGAO
7. PALANAN
8. CASIGURAN

CATANDUANES / ALBAY AREA

9. BALONGBONG
10. MARINAWA
11. PB 110
12. VIGA
13. RAPU-RAPU
14. BATAN
15. CAGRARAY

MARINDUQUE / QUEZON AREA

16. BOAC
17. TORRIJOS
18. MOGPOG (PB 120)
19. POLILIO
20. JOMALIG
21. PATNANUNGAN

MINDANAO

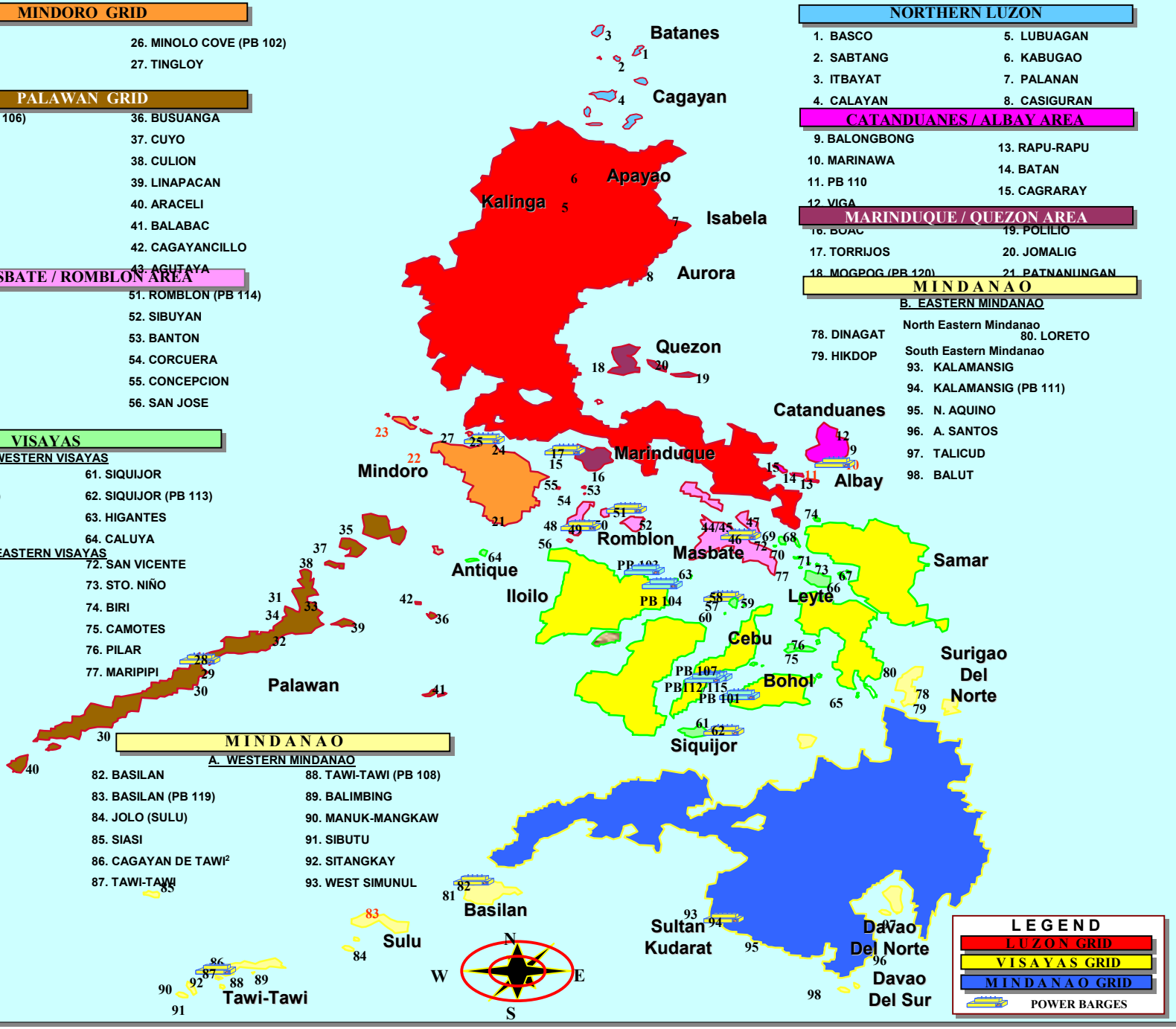
B. EASTERN MINDANAO

North Eastern Mindanao

78. DINAGAT
79. HIKDOP
80. LORETO

South Eastern Mindanao

93. KALAMANSIG
94. KALAMANSIG (PB 111)
95. N. AQUINO
96. A. SANTOS
97. TALICUD
98. BALUT



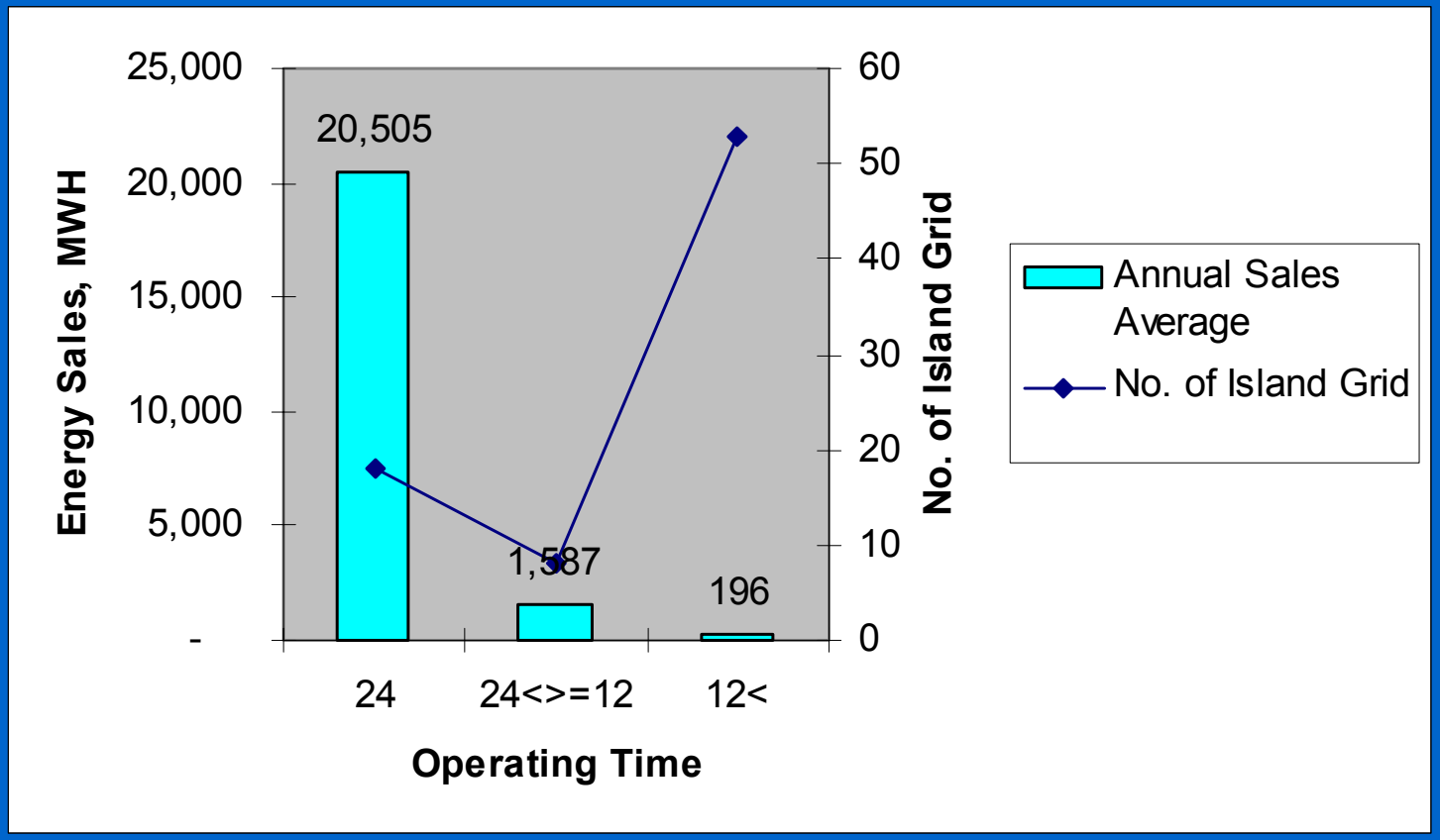
Existing Coverage Areas

- 69 islands & 7 isolated areas
  - 41 Rural Electric Cooperatives
  - Local Government Units
  - 197 Municipalities

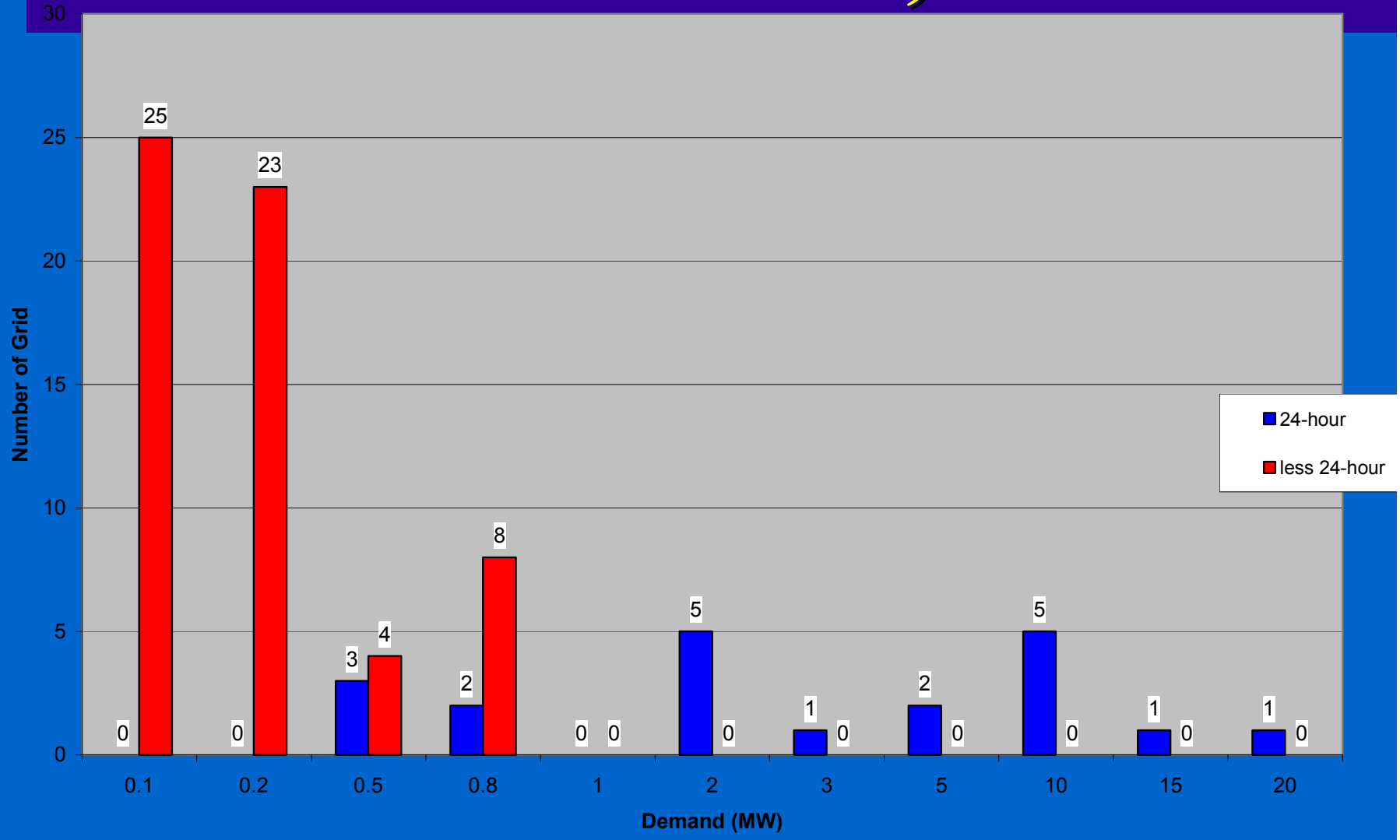
Facilities

- Power Plants
  - 86 land based diesel power plants
  - 1 hydro power plant
  - 16 power barges
- 69 kV Transmission Lines
  - 507 ckt. km.
  - 90 MVA Substation

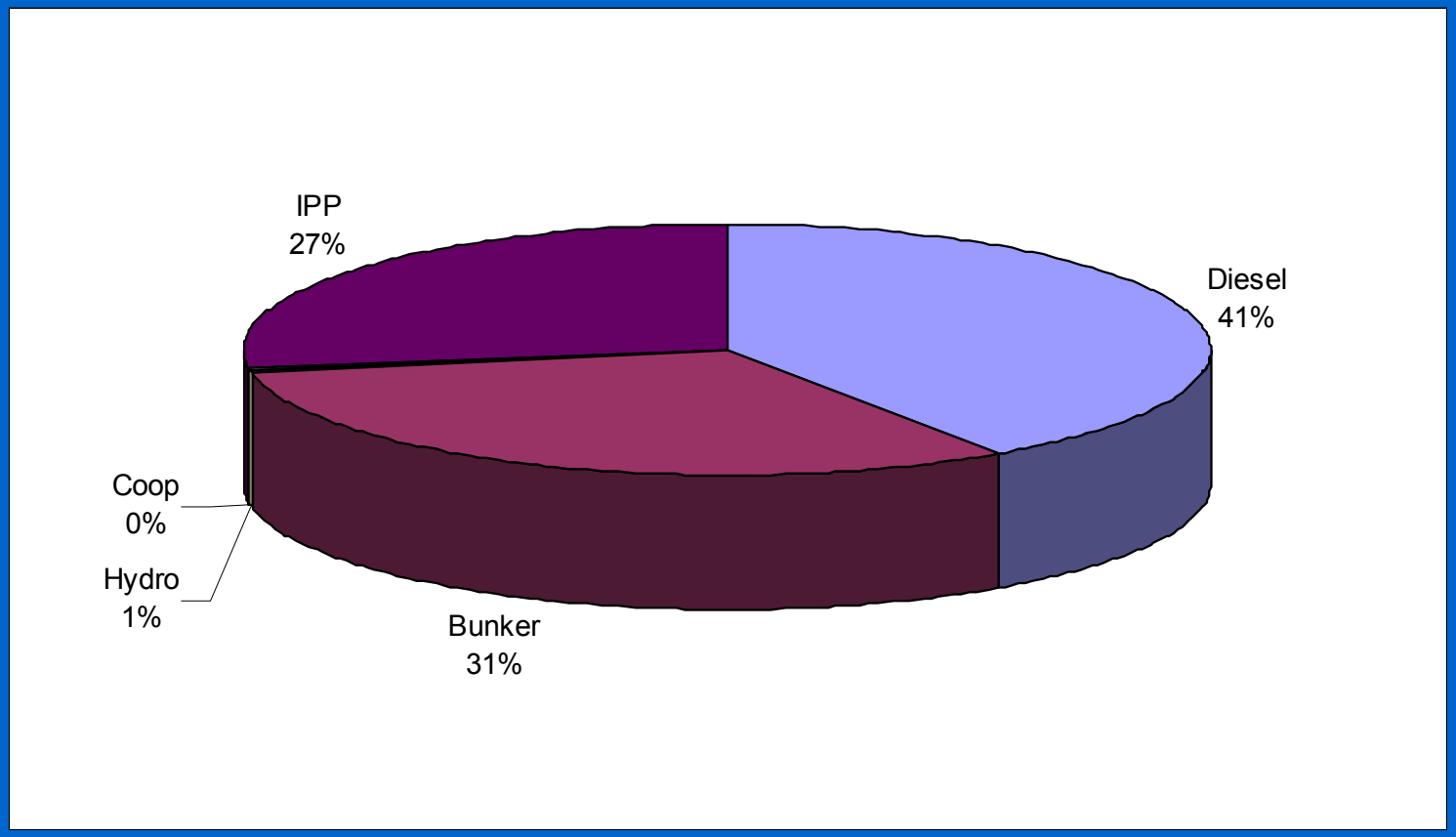
Annual Energy Demand



Peak Demand, MW



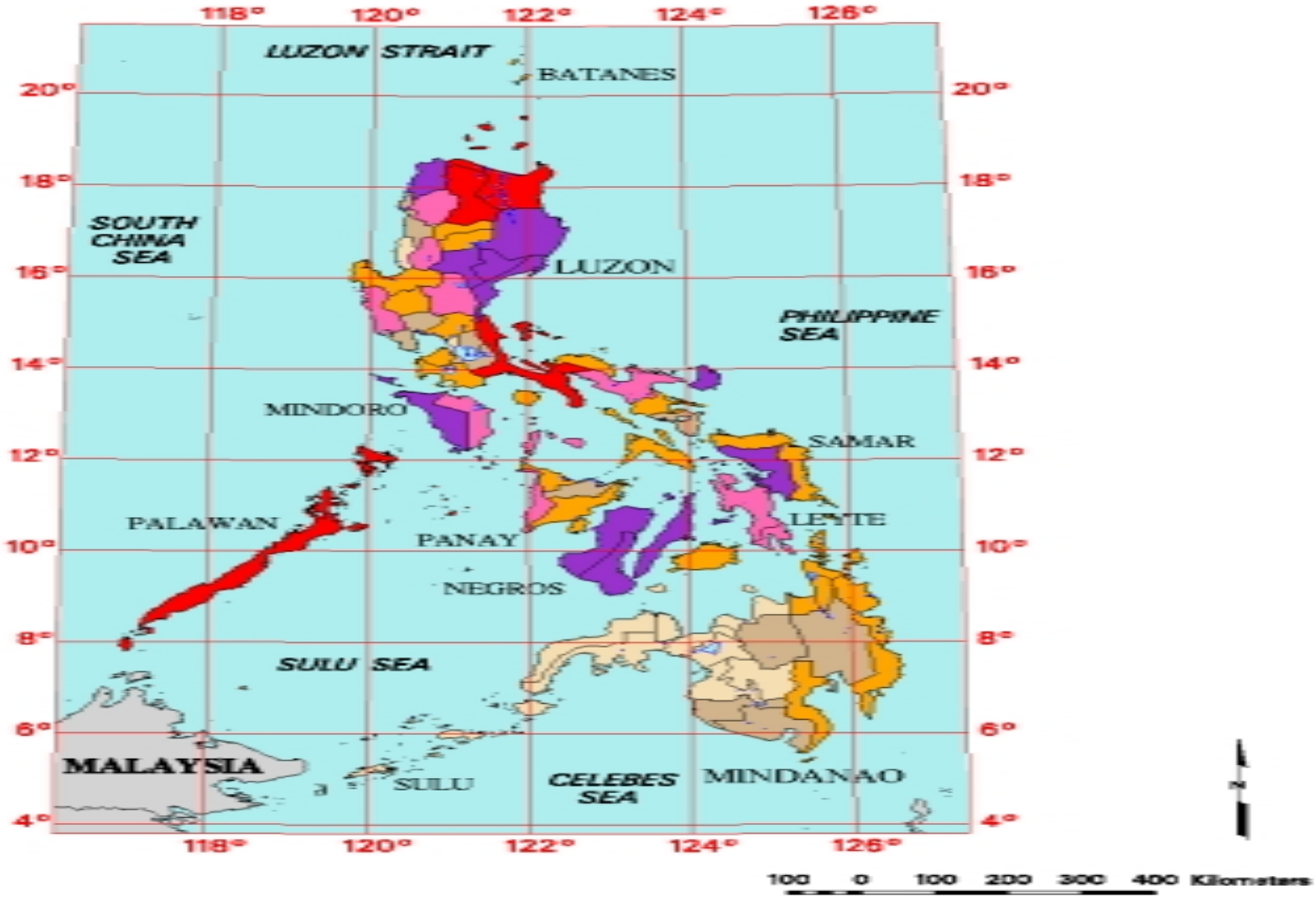
Generation Mix by Fuel Type in Island Grids



For June 2002

Philippines - Wind Electric Potential

Good-to-Excellent Wind Resource (Utility Scale Classification)



Philippines Total - 76,600 MW

Wind Electric Potential
Megawatts

- < 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,000
- 2,000 - 3,000
- 3,000 - 5,200

The following assumptions were used in calculating the total potential wind electric capacity installed:

Minimum wind power - 300 W/m2
Turbine size - 500 kW
Hub height - 40 m
Rotor diameter - 38 m
5D Side-to-side spacing - 190 m
10D Front-to-back spacing - 380 m
Swept area - 1134 m2
Turbines/km2 - 13.9
Capacity/km2 - 6.9 MW

US Dept. of Energy - National Renewable Energy Laboratory

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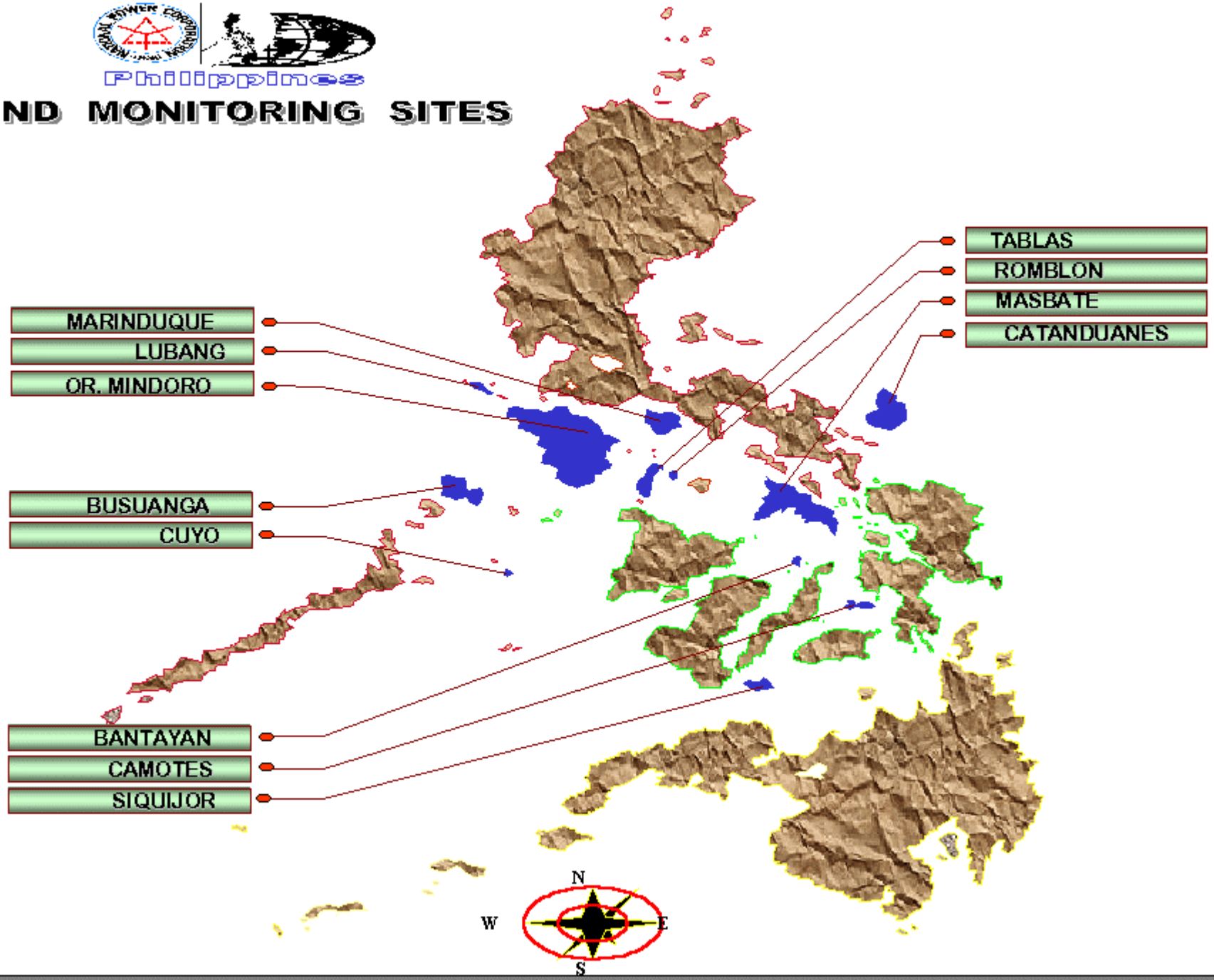
Figure 7-1

WIND MONITORING SITES



Preliminary Result

Annual Average Wind Speed (m/sec)

Location	2000	2001	2002	Start Date	Latest Data	% Recovery
Tablas	6.34	6.72	6.77	Jun-00	Aug-02	99%
Romblon	7.20	7.60	7.78	Oct-00	Aug-02	100%
Masbate	7.42	7.49	8.04	Jul-00	May-02	100%
Catanduanes	4.76	5.09	5.51	Jun-00	Aug-02	97%
Marinduque	6.74	7.37	6.80	Aug-00	Apr-02	84%
Oriental Mindoro	3.40	5.50	6.10	Aug-00	Aug-02	69%
Occ. Mindoro**	6.90	6.10		May-00	Apr-01	100%
Lubang	6.03	5.90	5.89	Jul-00	Jul-02	100%

Note: Tower height: 20 m

** - Tower height: 40 m

Market Potential

- Opening power generation market in island grids to private sector
- Retrofitting of existing island grids
- Supplementing new capacities (186 MW additional capacities in 10 years)
- Village electrification

Market Potential

- Private Sector Participation in power generation
  - Encouraging distribution utilities to tap other generation companies or IPPs
  - Rationalization of tariff

Market Potential

- Retrofitting of Existing Island Grids
  - Cost effective for 24-hour operation
  - Rising fuel cost
  - Reliability issues of existing generating sets
  - Interconnection issues
  - Consideration for island grids operating less than 24 hours daily but with great wind energy resource

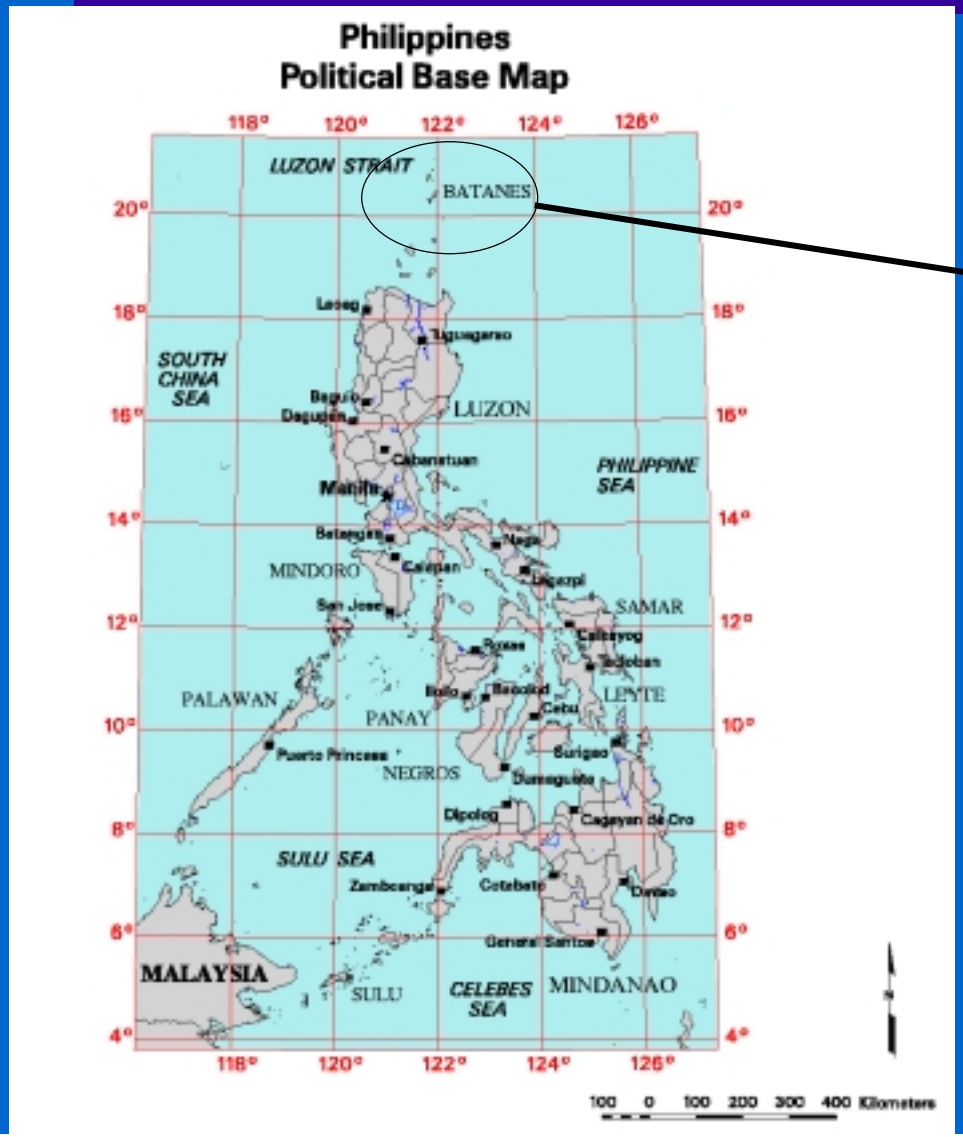
Market Potential

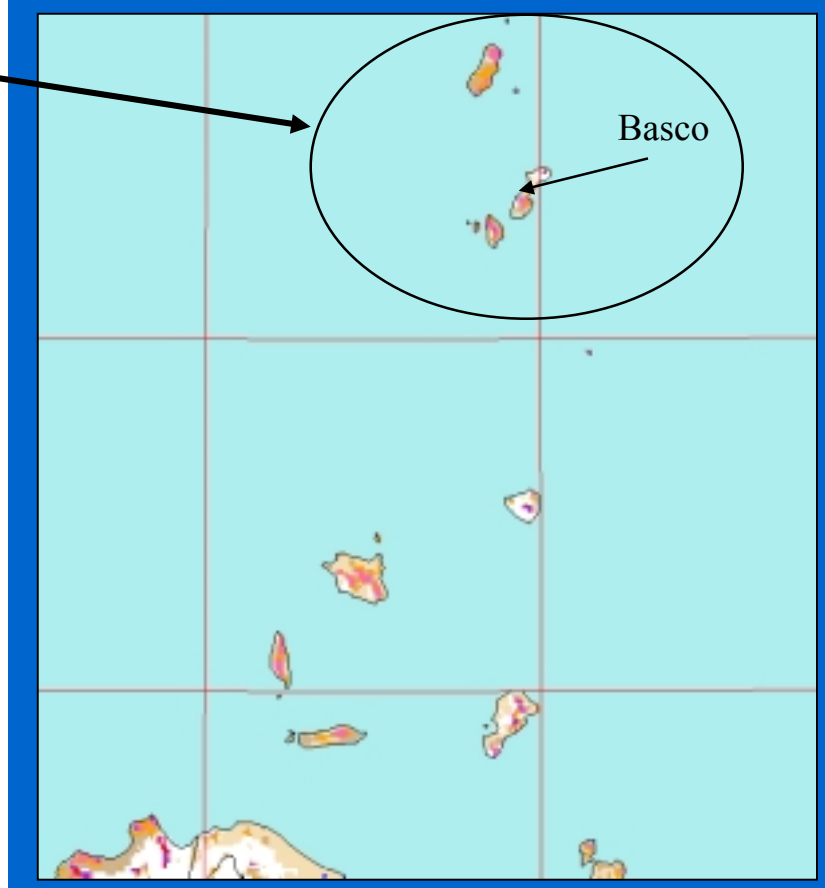
- Supplementing Additional Capacities
  - Wind turbines maybe included in the package if found viable by proponent
  - Cost effectiveness will depend on the cost of fossil fuel and level of penetration

Location	Dependable Capacity kW	Peak Demand kW	Capacity Addition, kW										
			2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tablas	3,270	2,750	4,400	5,000	-	-	-	-	-	-	5,000	-	-
Romblon	1,800	910	-	1,000	-	-	-	-	-	-	-	-	-
Masbate	9,400	7,400	-	5,000	-	-	-	-	-	10,000	-	-	-
Catanduanes	8,600	5,420	3,600	5,000	-	-	-	10,000	-	-	-	-	10,000
Marinduque	11,000	6,000	-	5,000	-	-	-	5,000	-	-	5,000	-	-
Mindoro	38,300	27,200	3,000	5,000	24,000	-	-	50,000	-	-	40,000	-	-
Lubang[1]	850	600	1,000	-	-	-	-	-	-	-	-	-	1,000

Note: [1] - operating in 12 hours

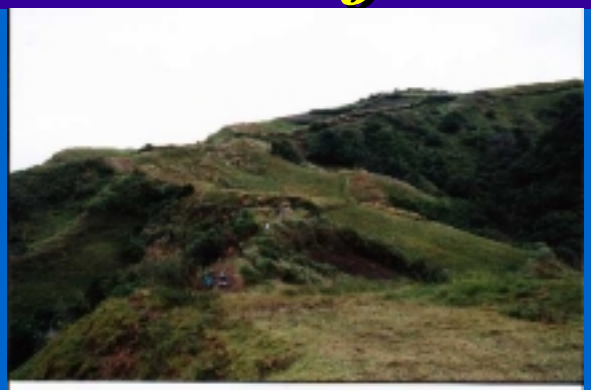
Batanes Wind-Diesel Project

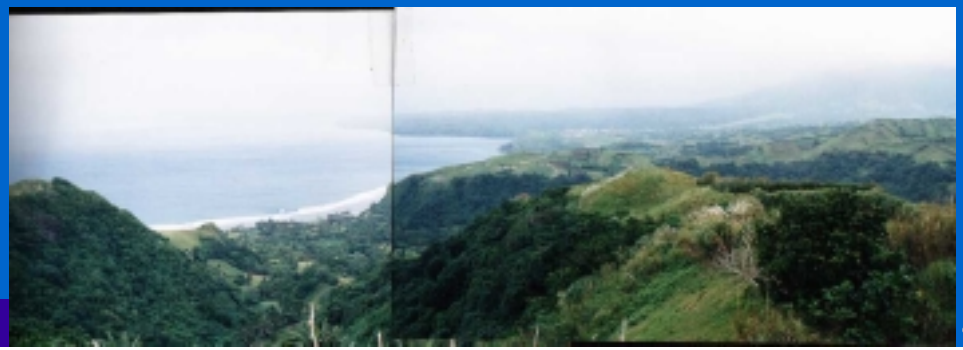




Batanes Wind-Diesel Project

- Stage 1a
  - 180 kW wind turbines
  - 2 x 625 kVA, diesel generator
  - Minimal controls
- Current Installed Capacity: ~ 1,254 kW
- Load Demand
  - 650 kW peak
  - 217 kW min
  - 180 kW average
- Expected Energy Penetration: ~ 23%





Market Potential

- Village Electrification
  - 6,123 villages non-electrified as of June 2002
  - Electrification of all villages by 2006
  - As low as US$125 million in capital equipment is needed
  - Possible electrification scheme:
    - Grid extension
    - Solar PV
    - Wind
    - Diesel generating set
    - Hybrid

Market Potential

- Major Players in Village Electrification
  - Distribution utilities } Full Cost Recovery
  - Qualified Third Party (QTP) } Full Cost Recovery
  - Small Power Utilities Group (SPUG) } Levy
    - US$80 million being requested to cover capital and operational expenditures
    - US$6.0+ + million for 140 villages or more

Wind/PV/Diesel Hybrid

SYNERGY HRAPS SPECIFICATIONS - ATULAYAN ISLAND

- Ave. Load: 36.5kWh/day
- Peak Load: 11.5kW
- 1 x Synergy S20000 wind turbine (48V) & 24 m tilt-up tower, w/ lightning protection
- 3 x 5.5 kVA sine wave interactive inverter, tropicalized
- 1 x 48 V battery bank 2000 Ah (C20) and battery racks c/w maintenance kit
- 1 x Synergy 40A control box
- 12 x 75Wp solar panels c/w pole mount array frames and wiring
- 1 x 75 kVA gen set (retrofit of existing Atulayan unit, thus oversized)
- 1 x genset controller

End!