



# GUIDE

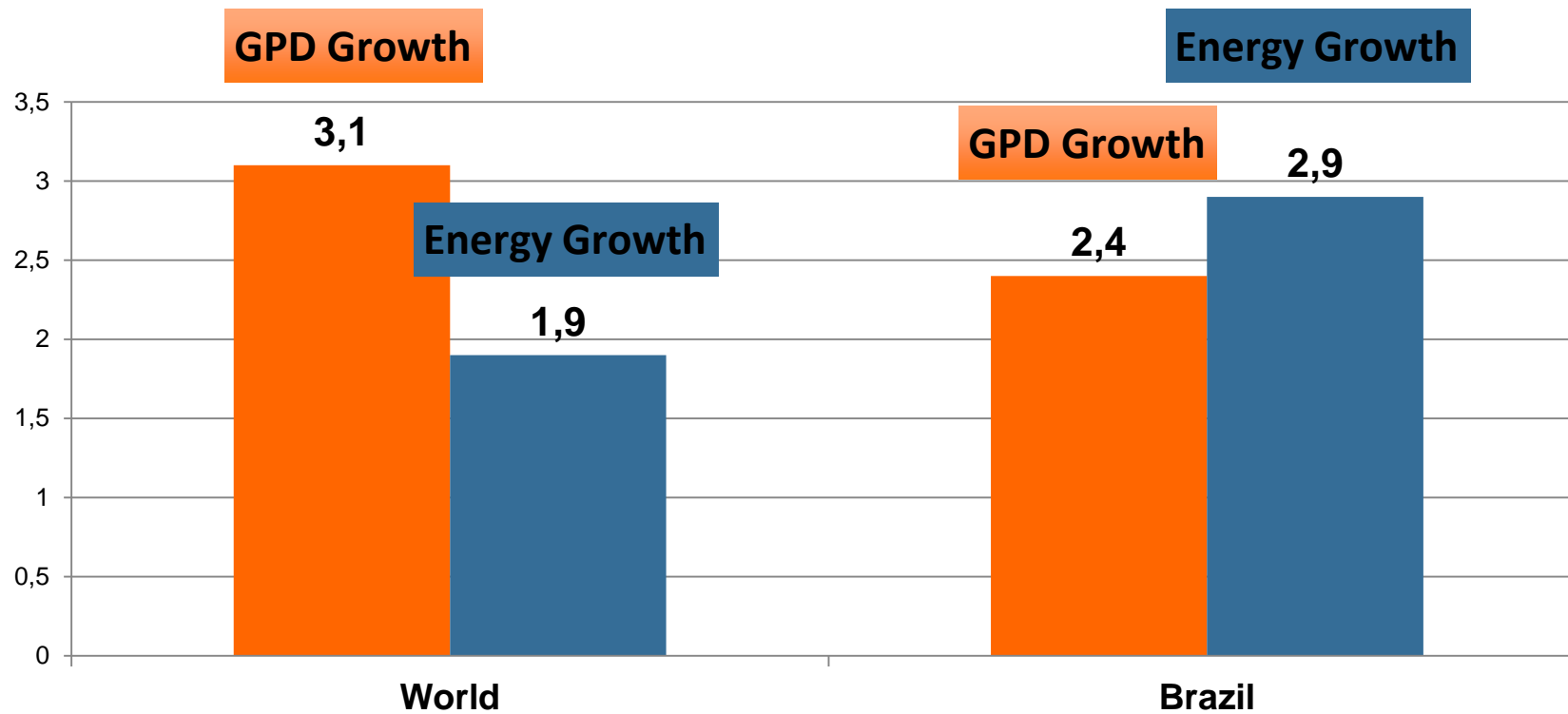
ORIENTAÇÕES INTELIGENTES

# ENERGY, ELETRICITY AND WIND ENERGY MARKET IN BRAZIL - TECHNICAL AND SOCIO-ECONOMIC PERSPECTIVE

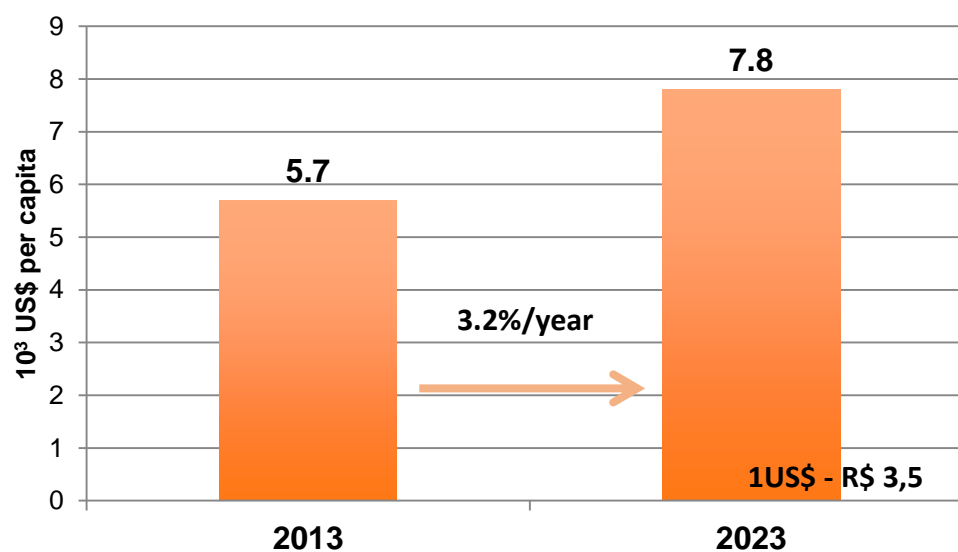
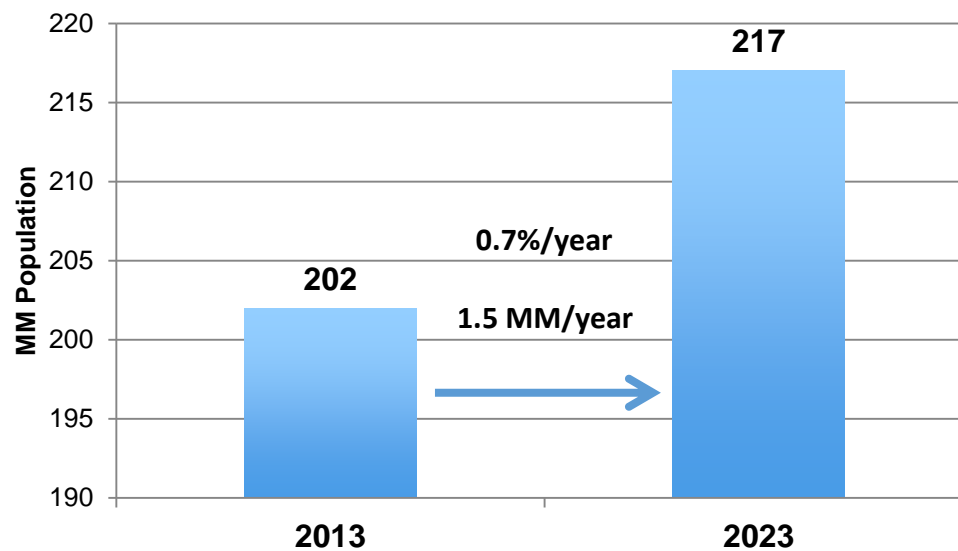
Bergamo, 22 Sept. 2015

WAGNER BARBOSA. M.Sc.

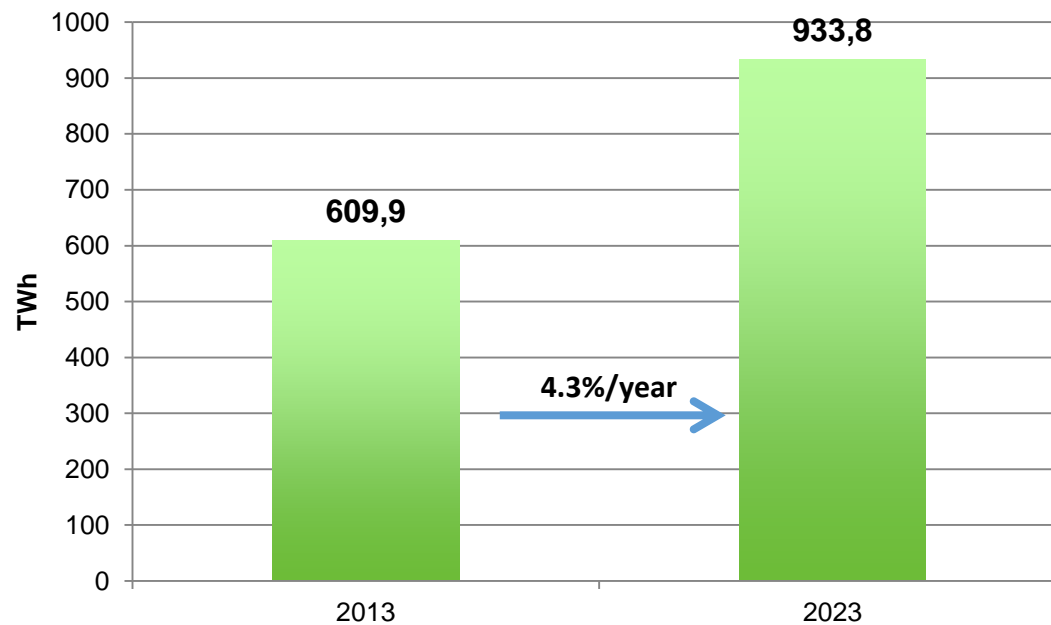
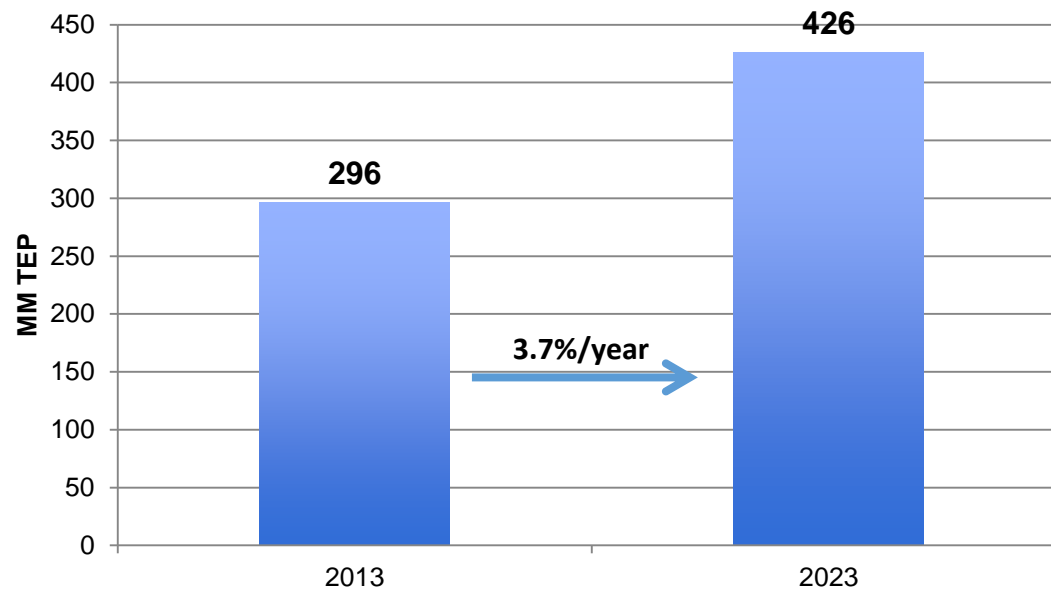
## GPD and Energy Supply Average Annual Growth Rates (1980 – 2010)



## Demography and Economy Brazil (2013 – 2023)



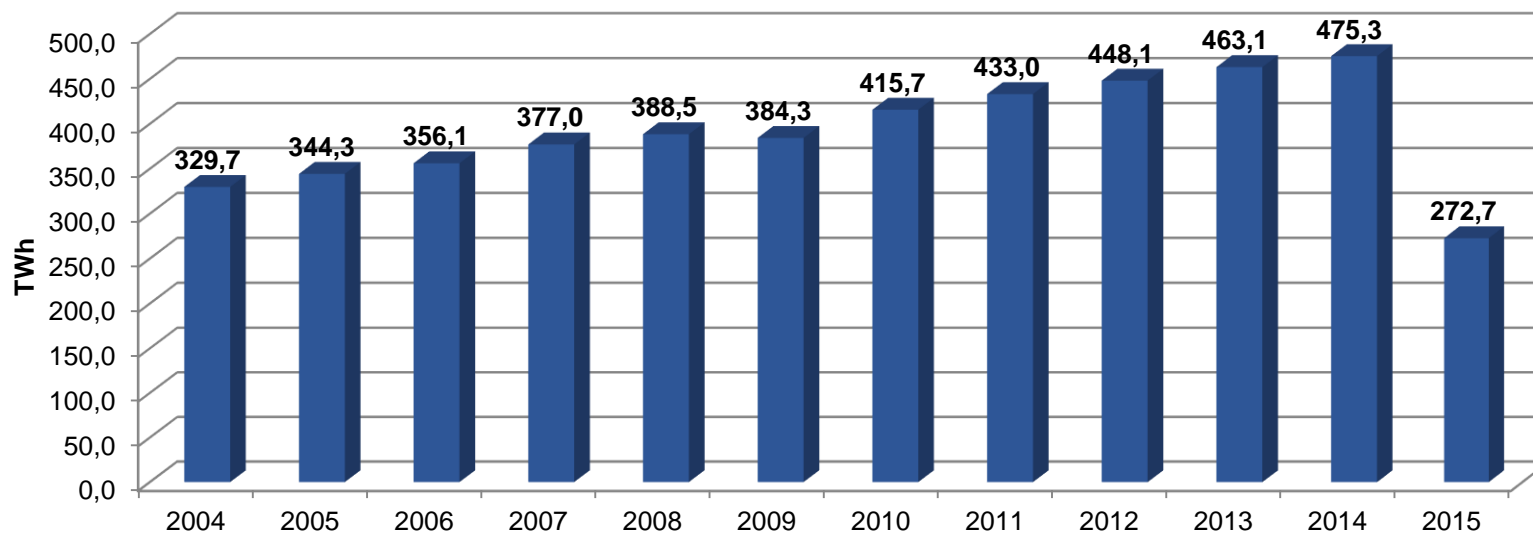
## Energy Response Brazil (2013 – 2023)



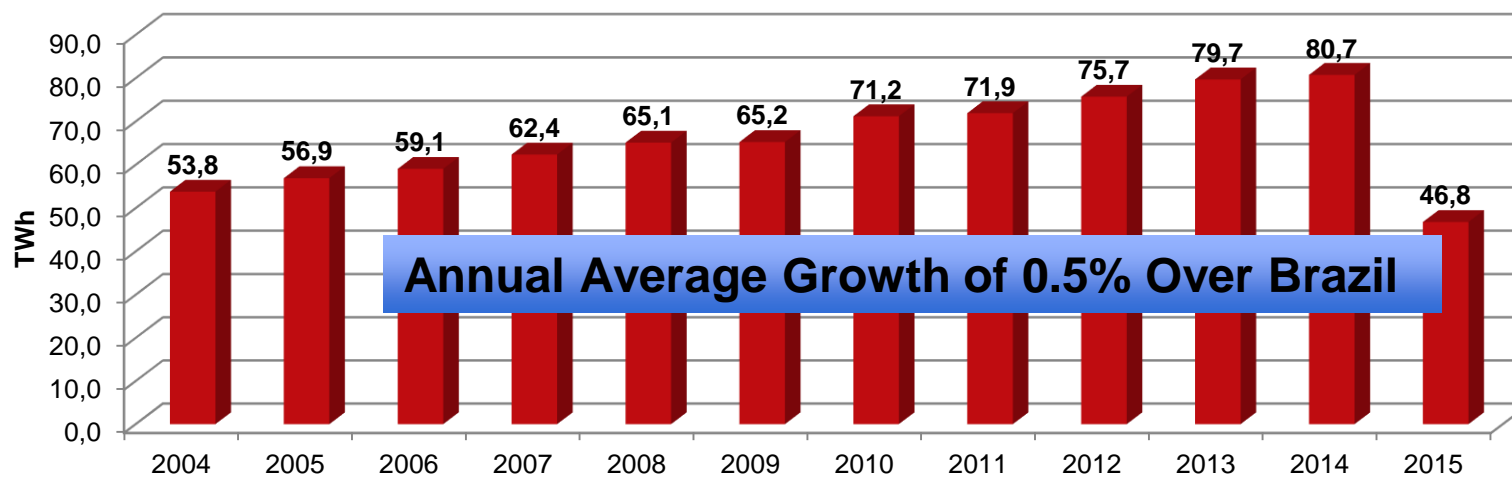
**Doubles every  
17 years**

## Electricity Consumption Growth Brazil and NE (2004 – 2015\*)

### Annual Growth: 4% **Brazil (TWh)**



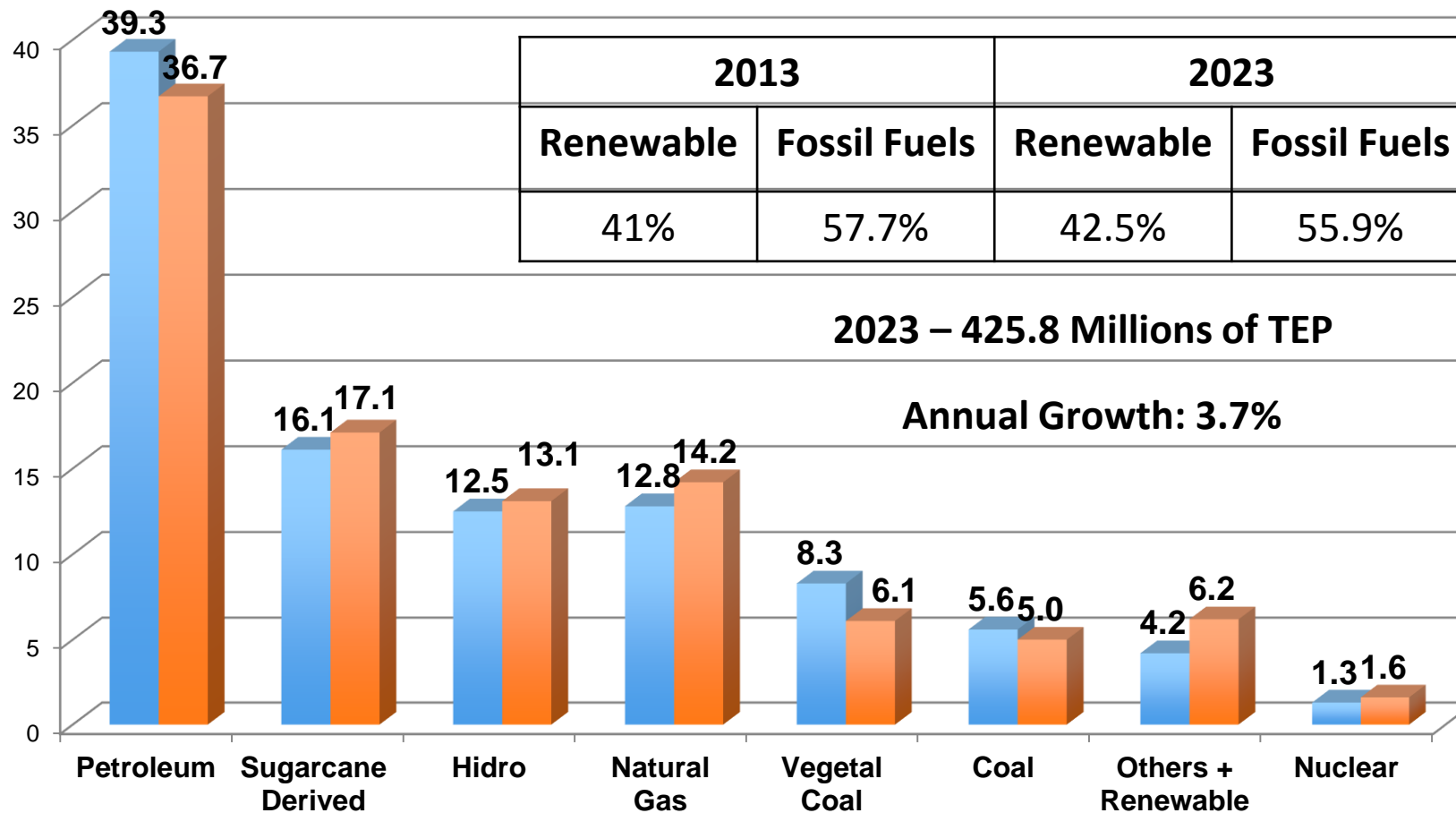
### Annual Growth: 4.5% **NE (TWh)**



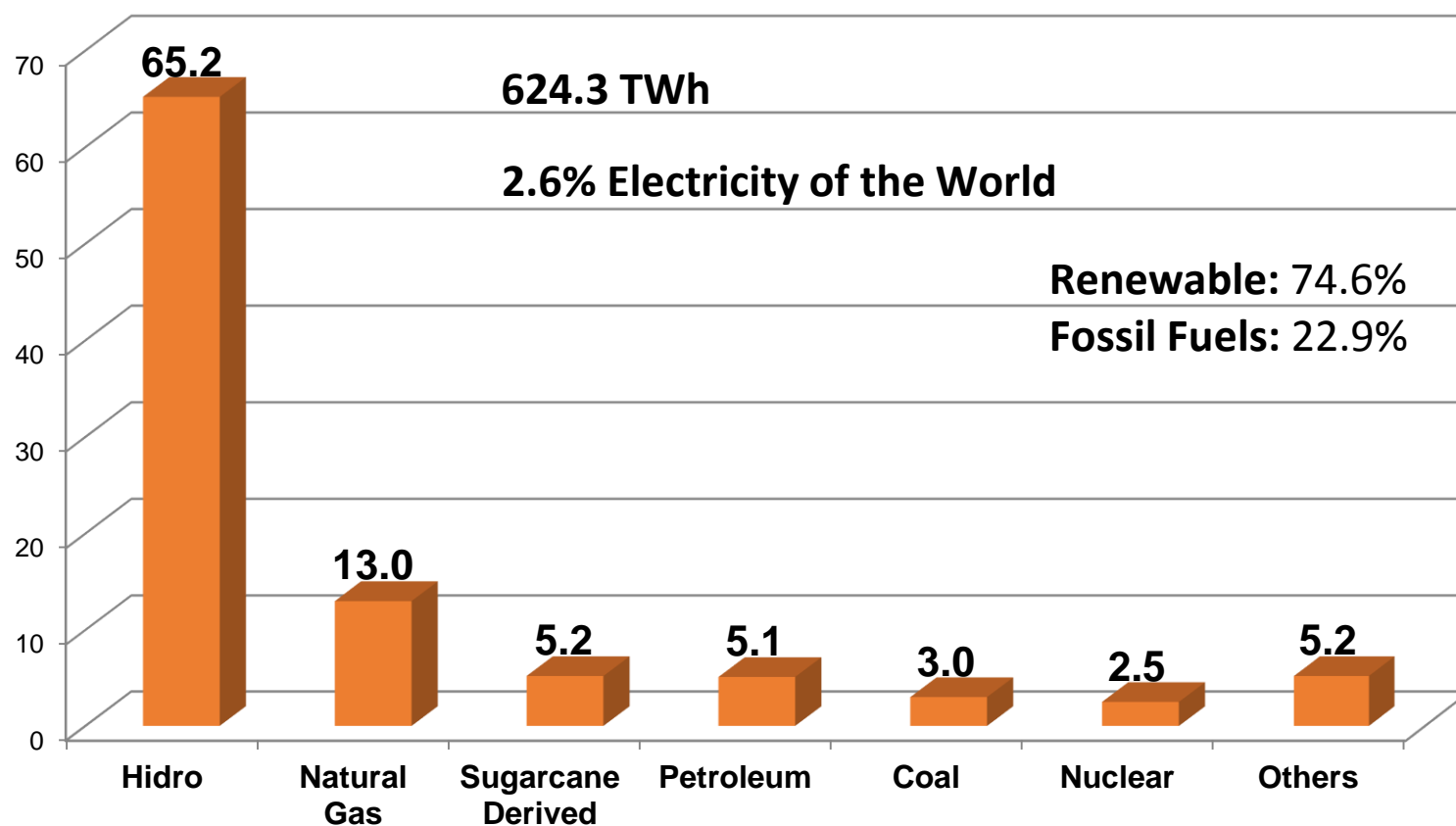
(\*) 2015 until 07/15/15

Source: EPE

# Matrix Energy Supply Sources of Participation (%) Brazil (2013-2023)



## Matrix ELECTRICITY Brazil 2014 (%)



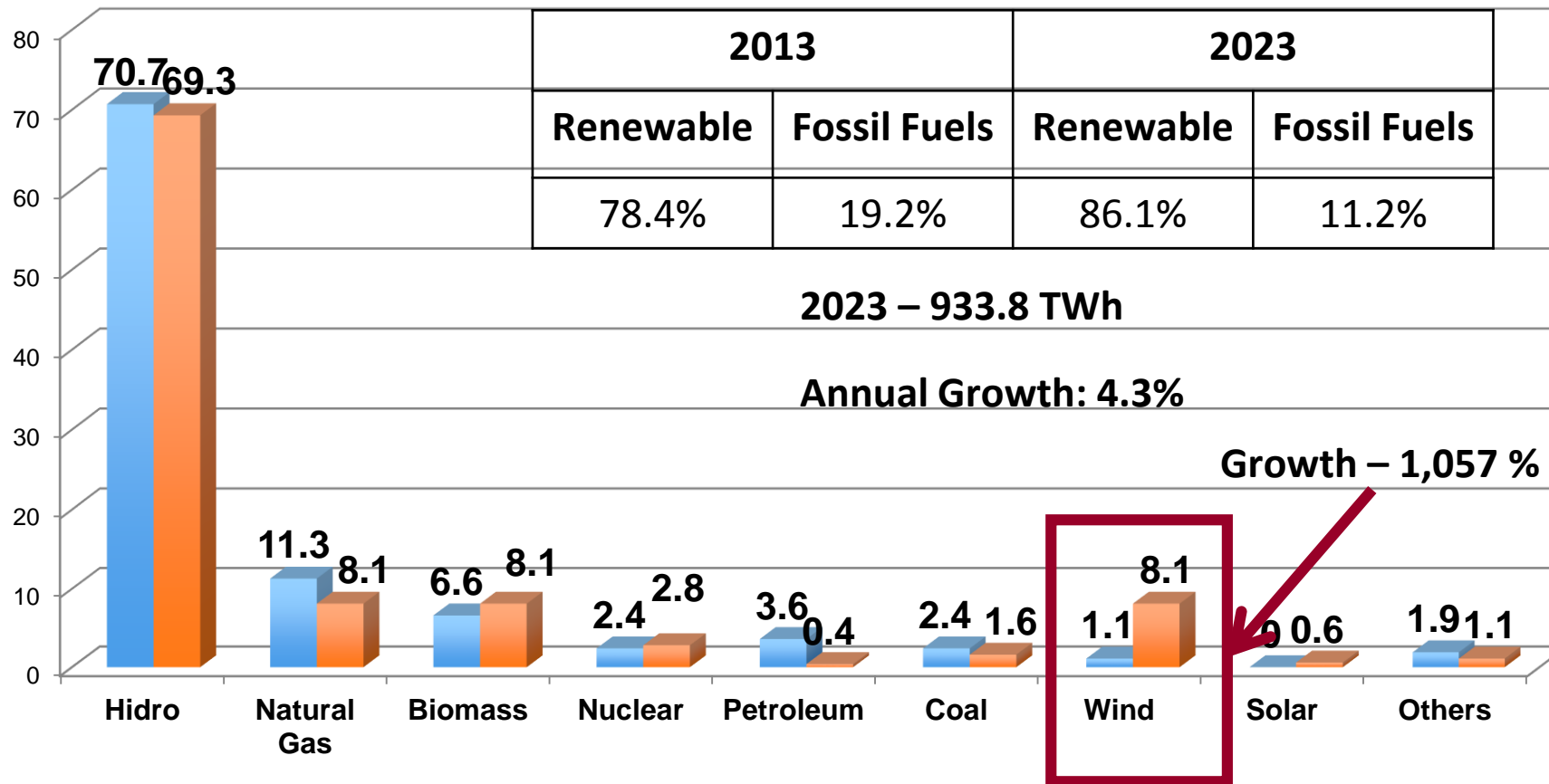
Source: IEA a MME/BEN



# Electricity Matrix

## Sources of participation (%)

### Brazil (2013-2023)



Source: MME/EPE



## Installed Capacity Brazil (2013 – 2013)

2013: 2.5 GW

2023: 23.5 GW

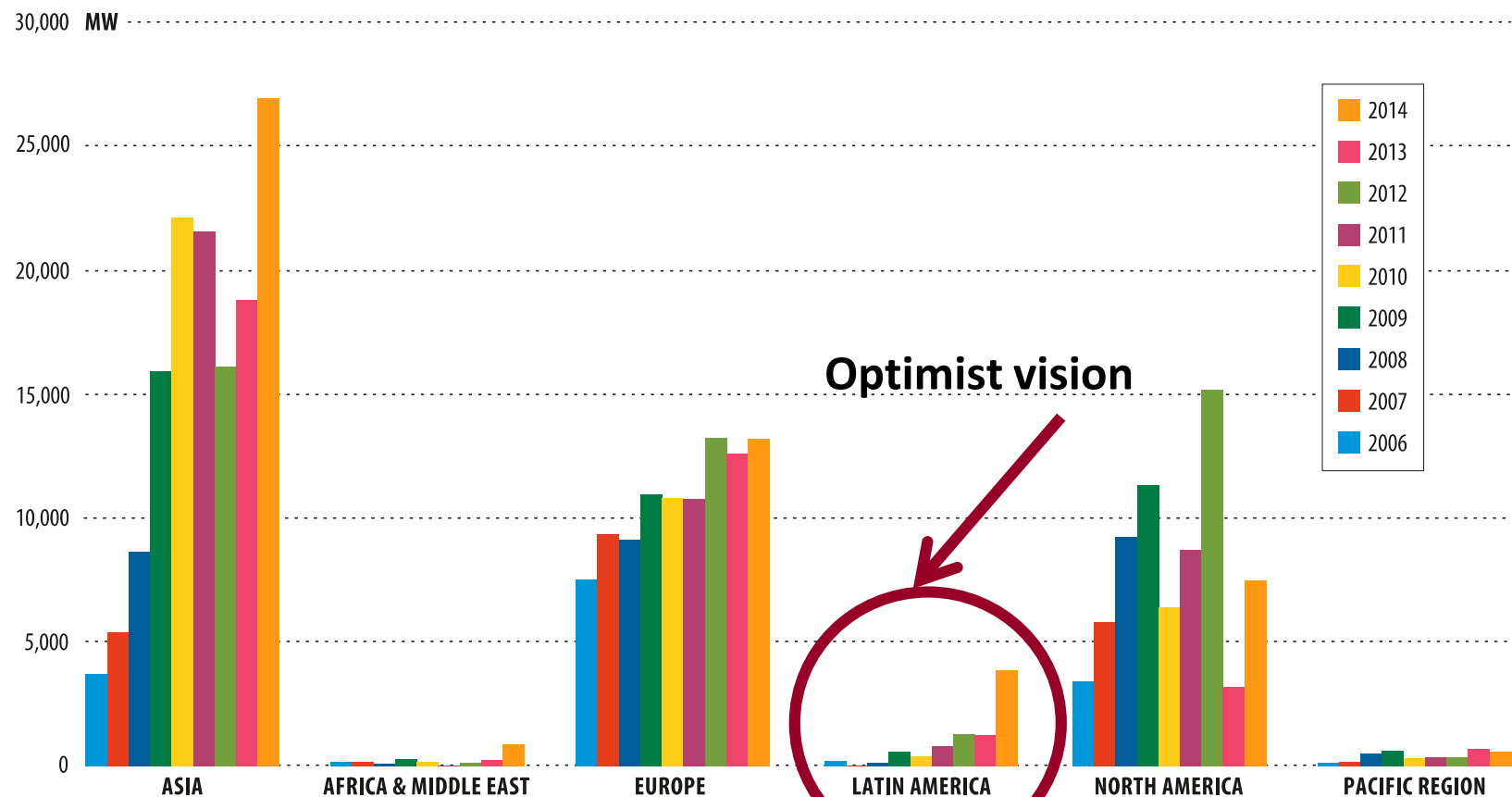
2,040 MW/year

| Source      | GW          | %           |
|-------------|-------------|-------------|
| Hydro       | 35          | 45%         |
| Wind        | 20,4        | 26%         |
| Biomass     | 6,9         | 9%          |
| Solar       | 4           | 5%          |
|             |             |             |
| Natural Gas | 10,3        | 13%         |
| Nuclear     | 1,4         | 2%          |
| Petroleum   | -1,3        | -2%         |
| Coal        | 0,5         | 1%          |
|             | <b>77,2</b> | <b>100%</b> |

Source: PDE 2023, MME/EPE

# **Why Wind Energy in Brazil?**

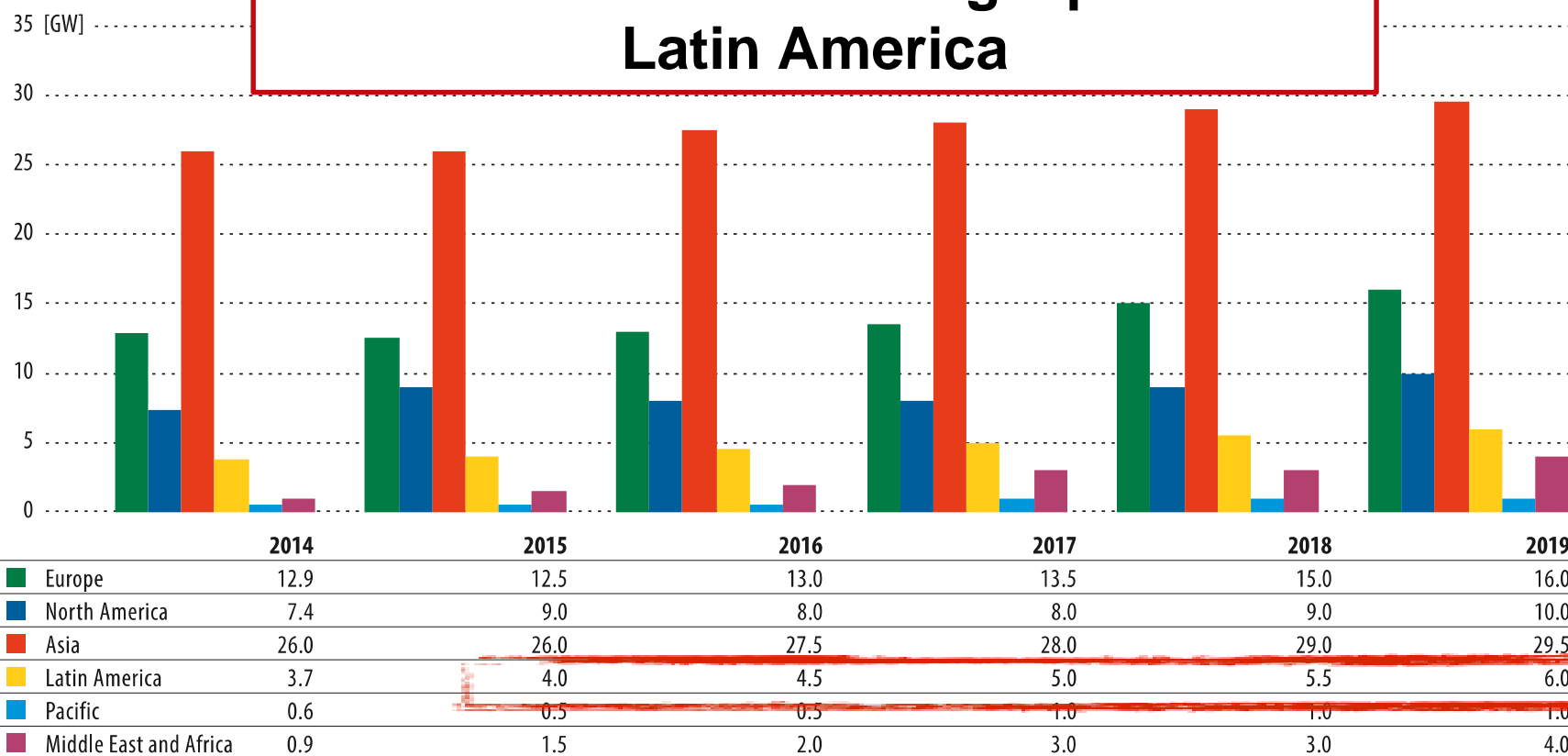
# Annual Installed Capacity by Regions (MW) (2006-2019)



Source: GWEC

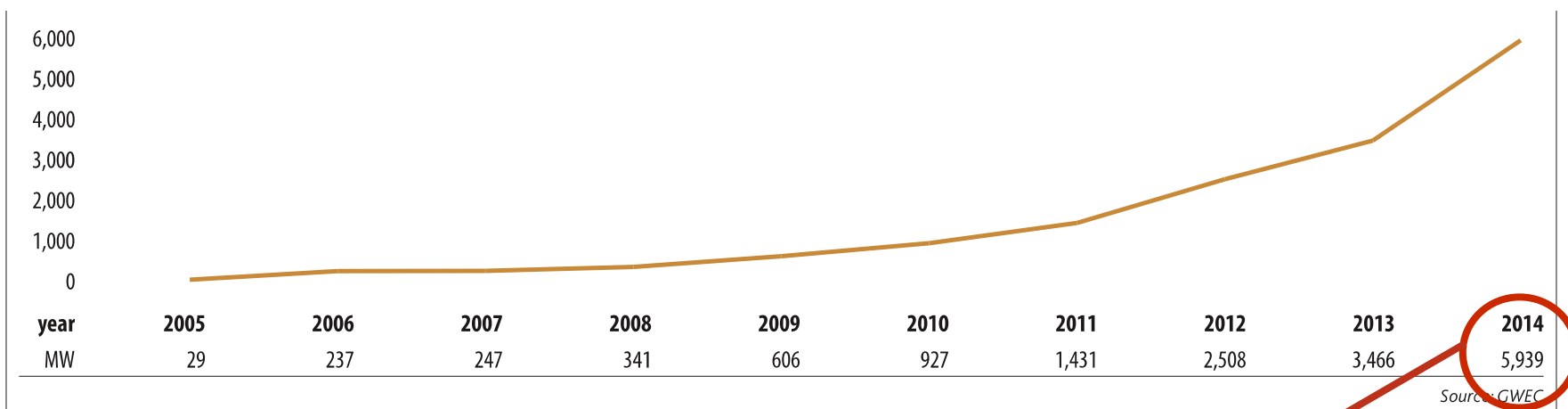
# Annual Market Forecast by Regions (GW/year) (2015-2019)

**Pernambuco has a strategic position in Latin America**



Source: GWEC

## Cumulative Capacity Brazil/NE (2005-2014)

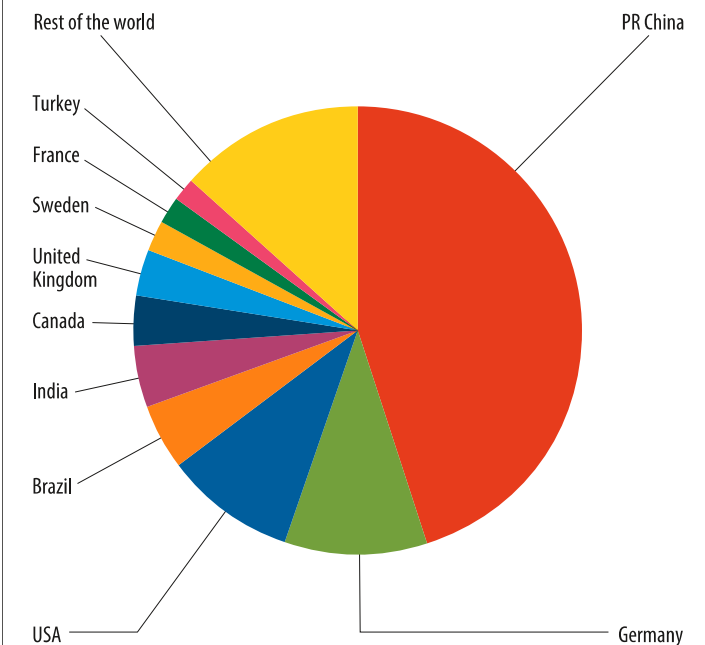


### Installed capacity by State in 2014 (MW)

| State               | Installed capacity in 2014 | Cumulative capacity at the end of 2014 |
|---------------------|----------------------------|--|
| Bahia               | 342.8                      | 931.4                                  |
| Ceará               | 572.2                      | 1,233.2                                |
| Paraíba             | —                          | 69.0                                   |
| Pernambuco          | 79.9                       | 104.7                                  |
| Piauí               | 70.0                       | 88.0                                   |
| Paraná              | —                          | 2.5                                    |
| Rio de Janeiro      | --                         | 28.1                                   |
| Rio Grande do Norte | 751.6                      | 2,092.0                                |
| Rio Grande do Sul   | 654.9                      | 1,118.8                                |
| Santa Catarina      | —                          | 236.4                                  |
| Sergipe             | —                          | 34.5                                   |
| <b>Total</b>        | <b>2,472.4</b>             | <b>5,938.5</b>                         |

6th

## Top 10 New Installed Jan-Dec 2014

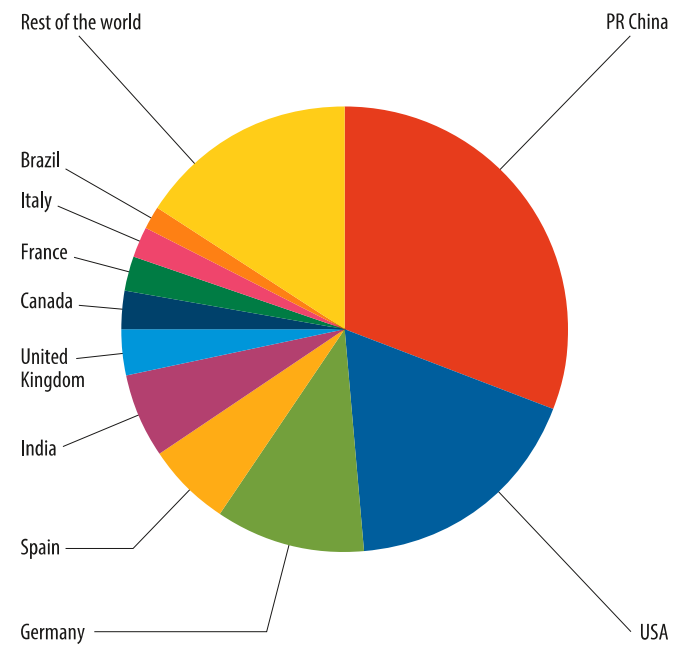


| Country             | MW            | % SHARE    |
|---------------------|---------------|------------|
| PR China            | 23,196        | 45.1       |
| Germany             | 5,279         | 10.2       |
| USA                 | 4,854         | 9.4        |
| <b>Brazil*</b>      | <b>2,472</b>  | <b>4.8</b> |
| India               | 2,315         | 4.5        |
| Canada              | 1,871         | 3.6        |
| United Kingdom      | 1,736         | 3.4        |
| Sweden              | 1,050         | 2.0        |
| France              | 1,042         | 2.0        |
| Turkey              | 804           | 1.6        |
| Rest of the world   | 6,852         | 13.3       |
| <b>Total TOP 10</b> | <b>44,620</b> | <b>87</b>  |
| <b>World Total</b>  | <b>51,473</b> | <b>100</b> |

\* Projects fully commissioned, grid connection pending in some cases

Source: GWEC

## Top 10 Cumulative Dec 2014



| Country             | MW             | % SHARE     |
|---------------------|----------------|-------------|
| PR China            | 114,609        | 31.0        |
| USA                 | 65,879         | 17.8        |
| Germany             | 39,165         | 10.6        |
| Spain               | 22,987         | 6.2         |
| India               | 22,465         | 6.1         |
| United Kingdom      | 12,440         | 3.4         |
| Canada              | 9,694          | 2.6         |
| France              | 9,285          | 2.5         |
| Italy               | 8,663          | 2.3         |
| <b>Brazil*</b>      | <b>5,939</b>   | <b>1.6</b>  |
| Rest of the world   | 58,473         | 15.8        |
| <b>Total TOP 10</b> | <b>311,124</b> | <b>84.2</b> |
| <b>World Total</b>  | <b>369,597</b> | <b>100</b>  |

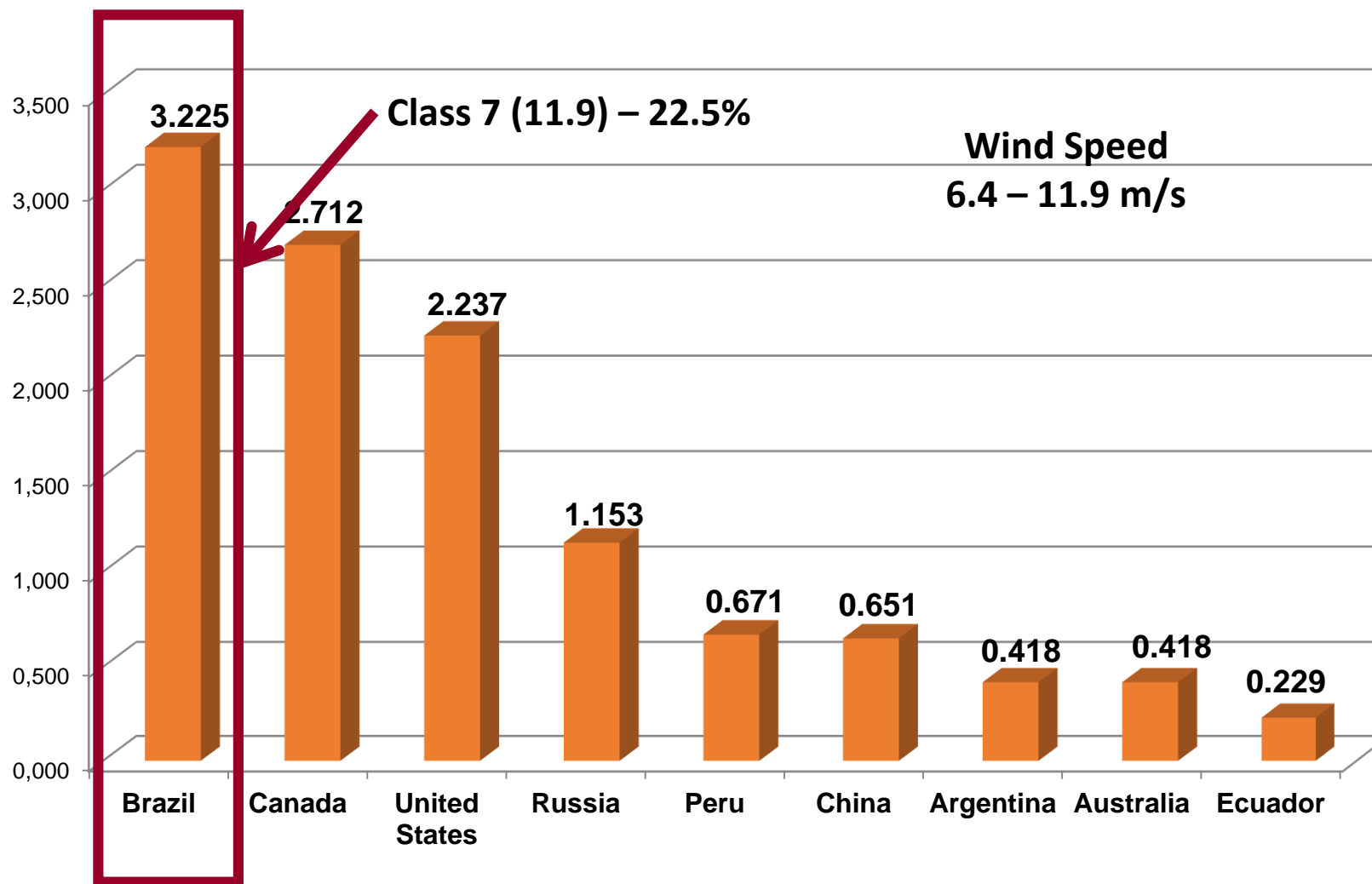
\* Projects fully commissioned, grid connection pending in some cases

Source: GWEC

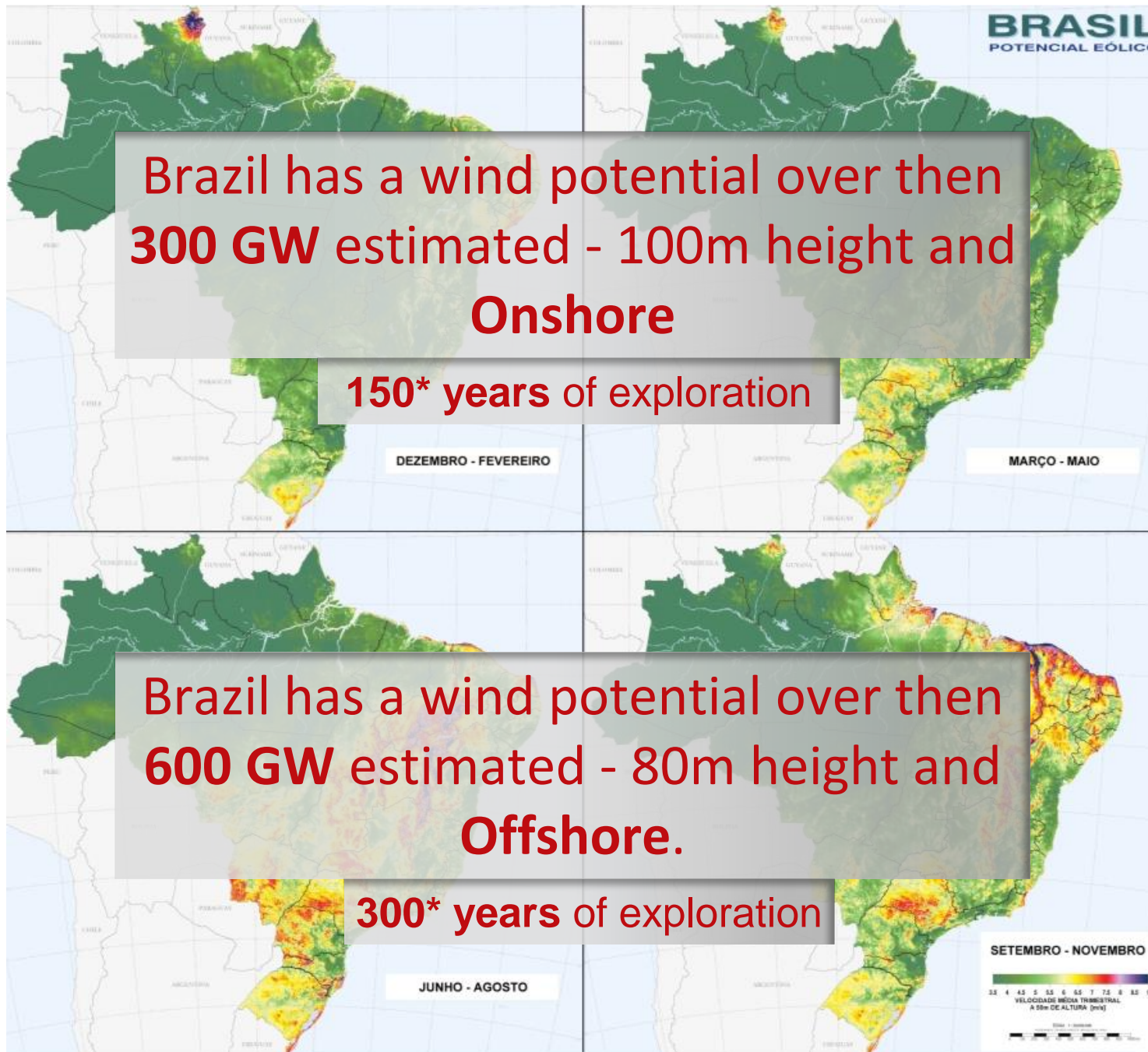
**Why wind energy in Brazil / NE  
is so good?**



## Top 10 - Total Resource Area (MM km<sup>2</sup>) 50m Classes 3-7



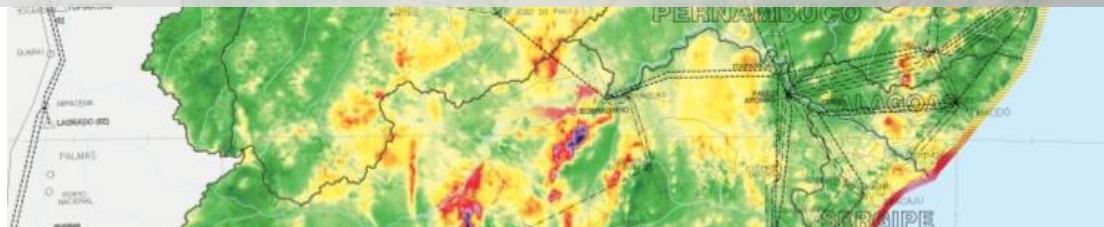
Source: MME/EPE



(\*) Based in 2.000 MW/year



**Northeast** has a wind potential over then  
**75 GW** estimated - 50m height and  
**Onshore**



**Pernambuco** has a strategic position in  
relation to wind speed in **NE**



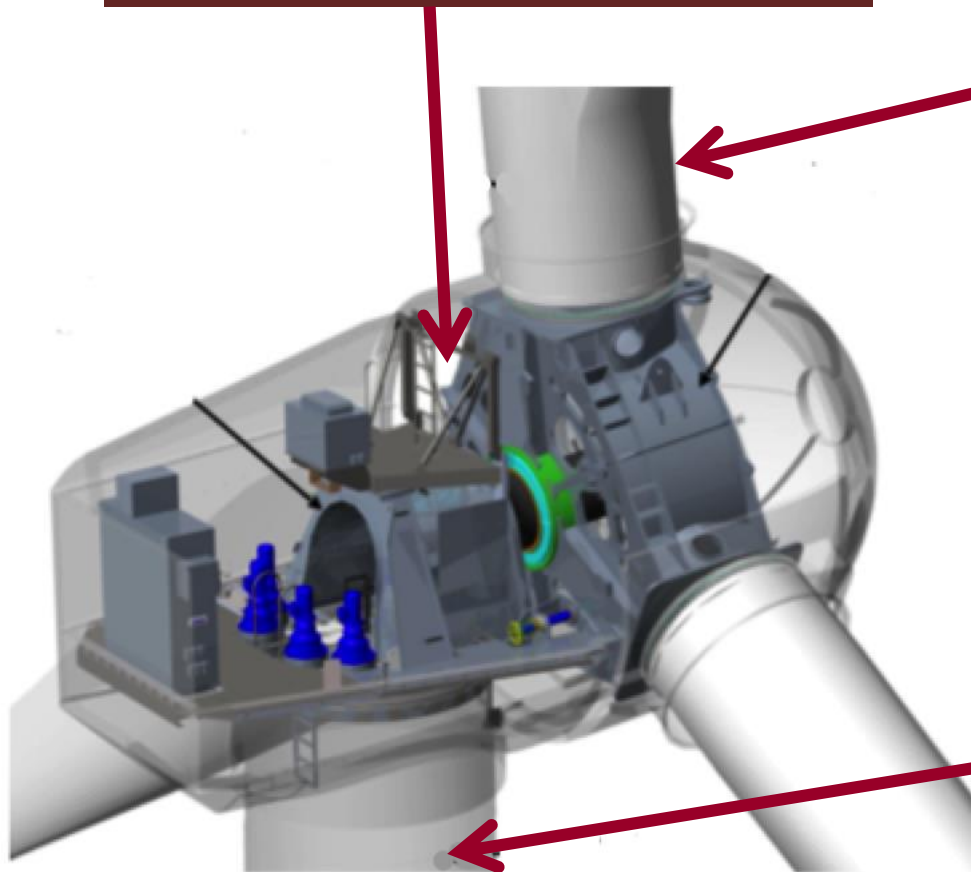


**How is the supply chain  
infrastructure?**

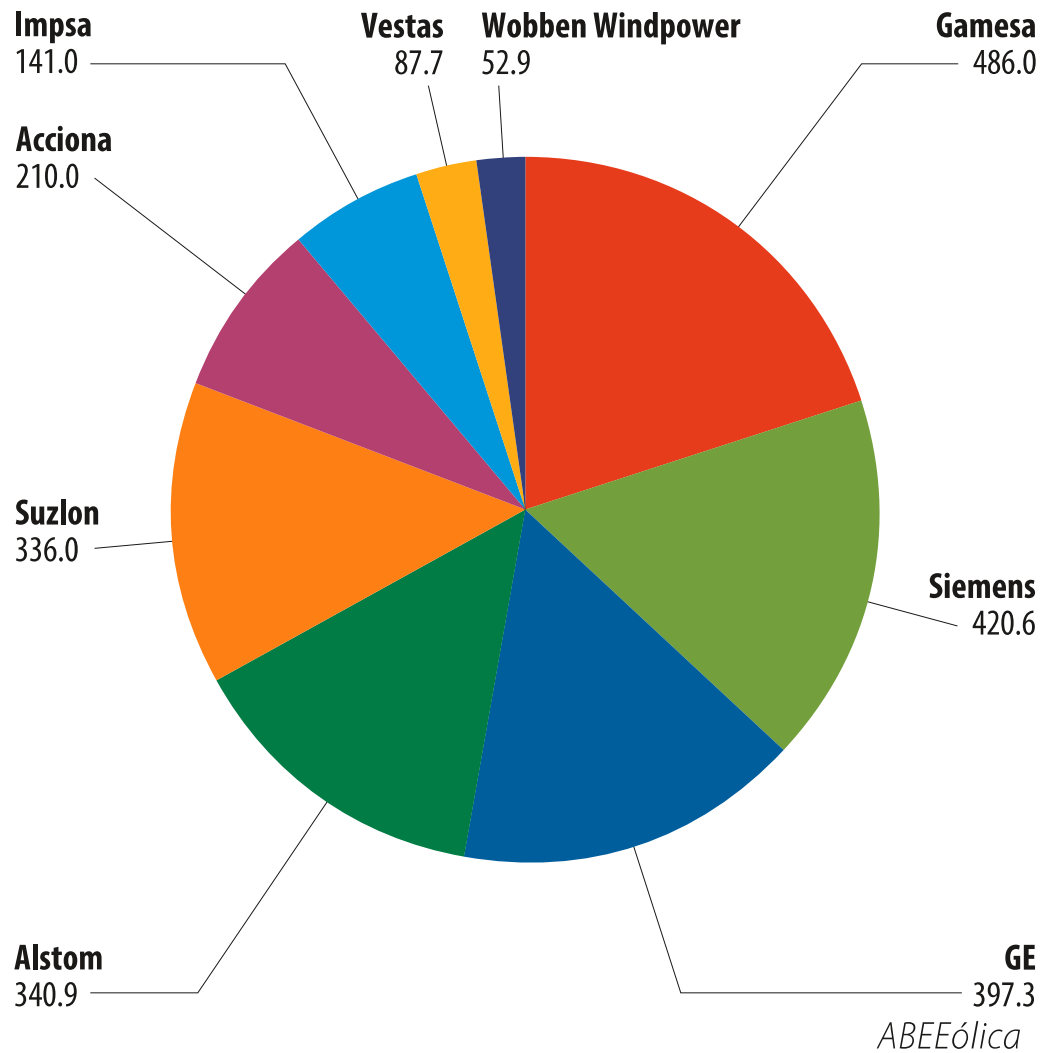
| Wind Turbine Companies |                       |            |
|------------------------|-----------------------|------------|
| Company                | Capacity<br>(MW/year) | Location   |
| Alston                 | 300                   | Bahia      |
| Acciona                | 300                   | Bahia      |
| Gamesa                 | 300                   | Bahia      |
| Impsa                  | -                     | Pernambuco |
| Wobben                 | 500                   | São Paulo  |
|                        | <b>1400</b>           |            |

| Turbine Blade Manufacturers |                           |            |
|-----------------------------|---------------------------|------------|
| Company                     | Capacity<br>(Blades/year) | Location   |
| Aeris                       | 240                       | Ceará      |
| Tecsis                      | 6492                      | São Paulo  |
| Wobben                      | 300                       | São Paulo  |
| LM Wind Power               | 900                       | Pernambuco |
|                             | <b>7932</b>               |            |
| <b>Sets/year</b>            | <b>2644</b>               |            |

| Wind Tower Manufacturers |                          |                   |
|--------------------------|--------------------------|-------------------|
| Company                  | Capacity<br>(Tower/year) | Location          |
| Alston                   | 120                      | Ceará             |
| Brasilsat                | 120                      | São Paulo         |
| ICEC                     | 100                      | São Paulo         |
| Intecnial                | 80                       | Pernambuco        |
| Engebasa                 | 173                      | São Paulo         |
| Engebasa                 | 300                      | Rio Grande do Sul |
| MPN                      | 150                      | Pernambuco        |
| Tecnomaq                 | 200                      | Ceará             |
| RM Eólica                | 200                      | Pernambuco        |
| Wobben                   | 200                      | Rio Grande do Sul |
| TorreBras                | 220                      | Bahia             |
|                          | <b>1863</b>              |                   |



# Market Share of Wind Turbine Companies in Brazil (2014 ) MW



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