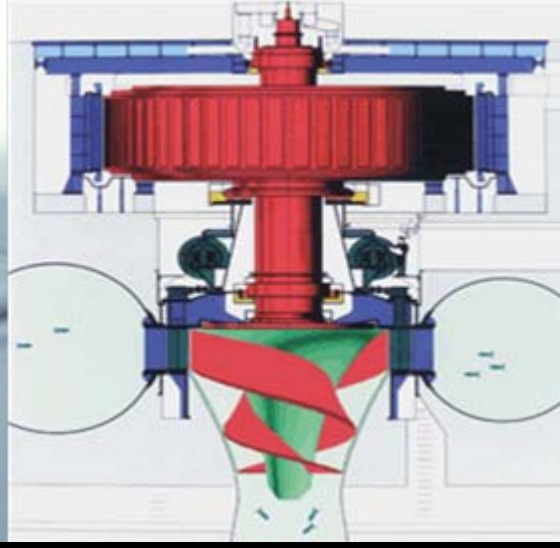


# Brazil's Energy Lifeblood: Hydro

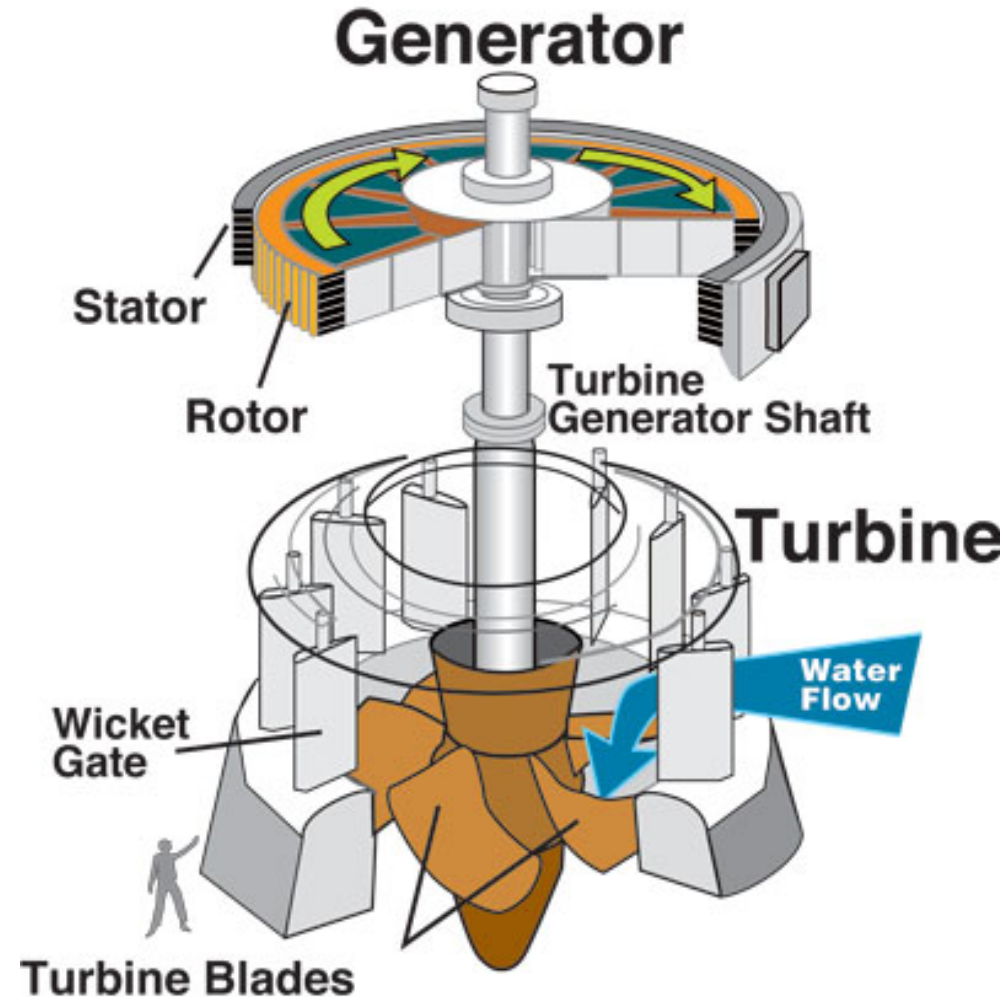


**Jonathan O'Day**  
**Wharton MBA, Lauder MA**

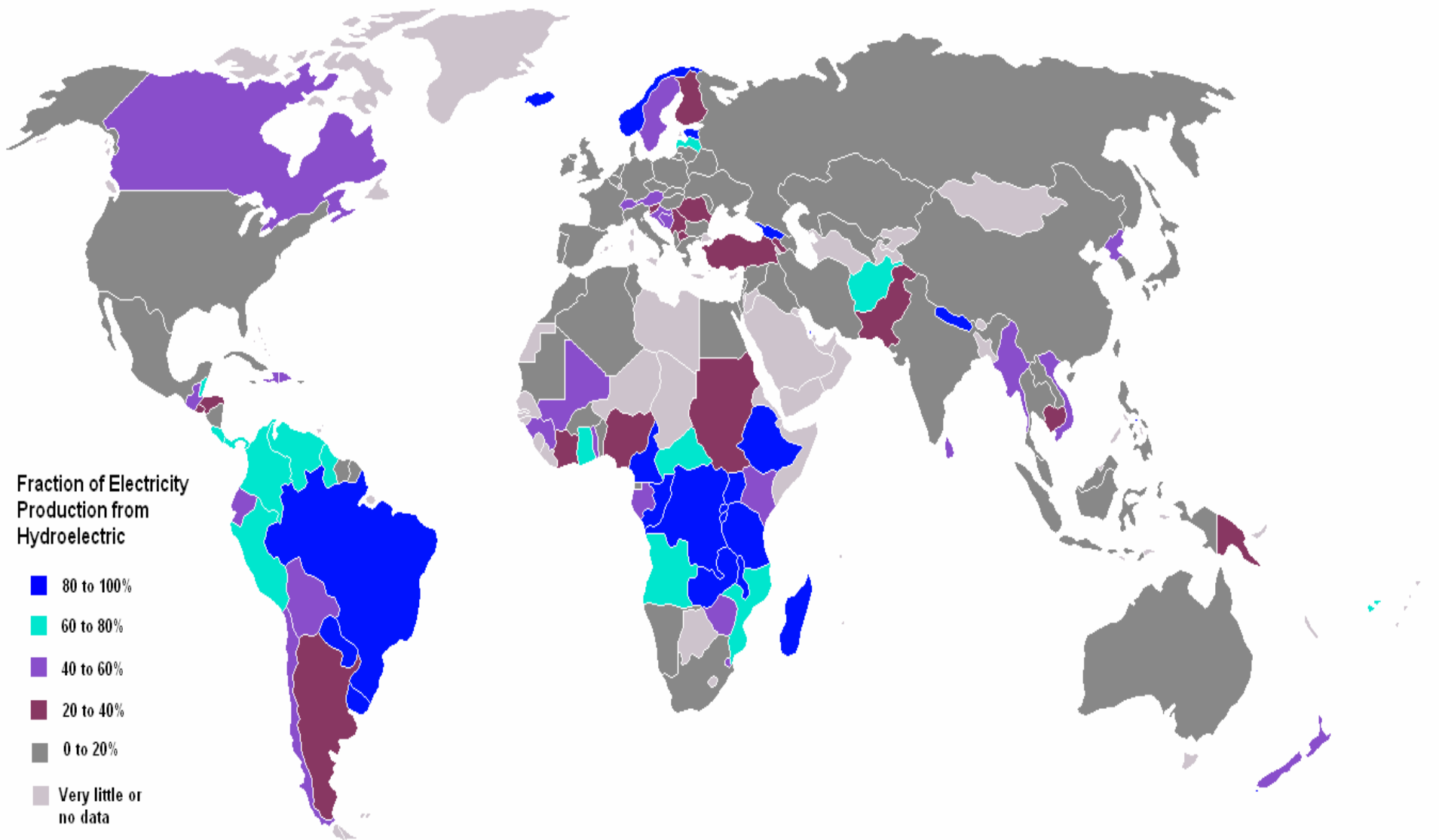
**November 20, 2007**

# Agenda

- A Renewable Source of Energy for the World
- Brazil's Quest For Energy Self-Sufficiency
- Hydropower in Brazil
- Brazil's Technological Hope: The Floating Turbine
- Hydropower: A Success?



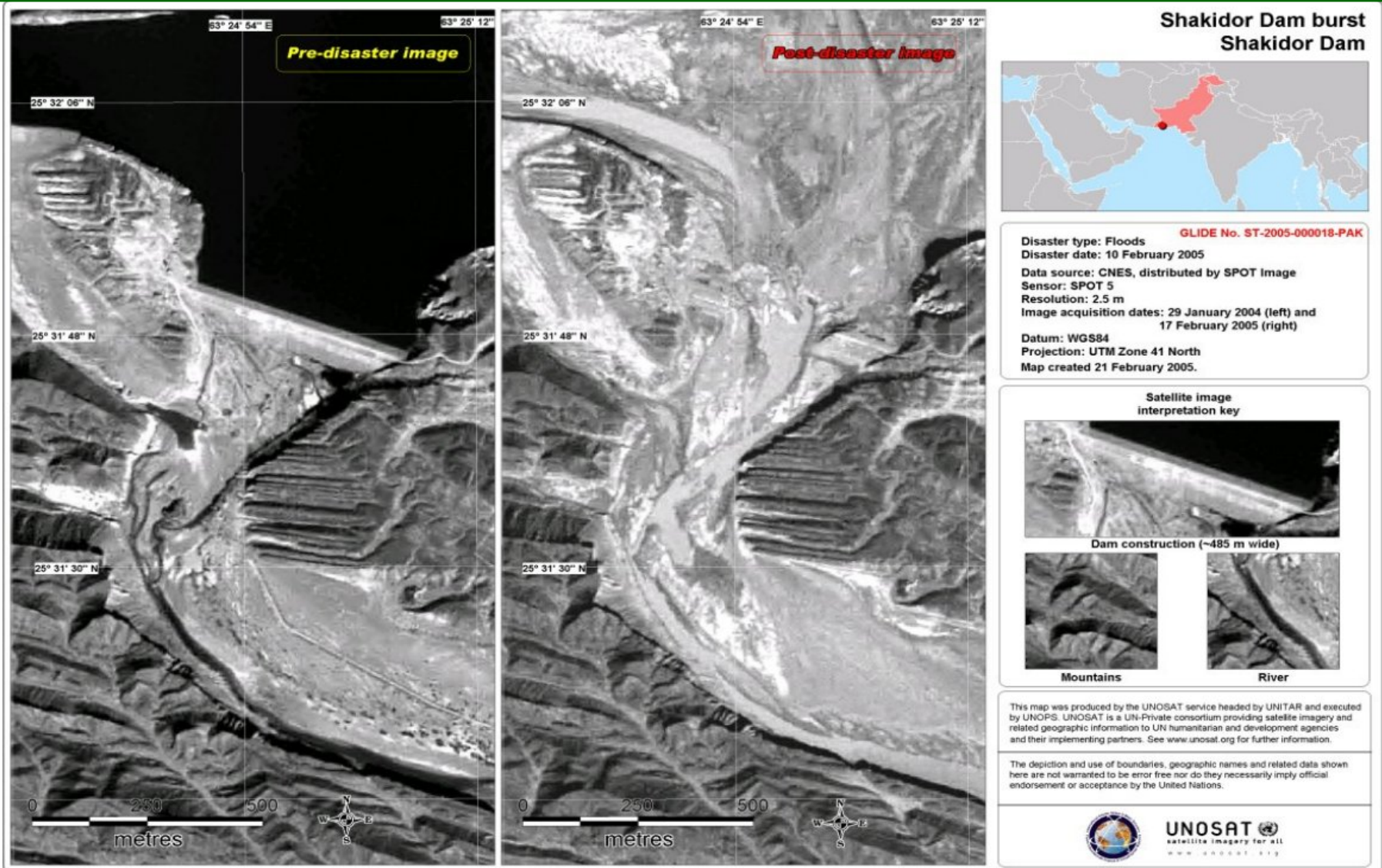
# Hydropower: A Renewable Energy Source for the Developing World



# One Dam Example



# Example of Catastrophic Failure (Pakistan)



# Brazil's Quest for Energy Self-Sufficiency

- Oil Crisis of 1973
  - ProAlcool Project: Ethanol for 'Flex' Cars
  - PROCAP 3000: Ultra-Deep Sea Oil Reserves (70% of reserves today)
- Hydropower Becomes the Focus
  - Brazil ranks 32<sup>nd</sup> and 41<sup>st</sup> in coal and natural gas production
  - 1975: Government Plan makes Hydro Nation's Priority for 25 years
- Future Investment in Wind Energy
  - One of several initiatives to diversify energy resources
  - "Millennium Wind Farm": 10.2MW (future capacity of 300MW)
- Uniquely, Brazil is essentially self-sufficient today

\*<http://www.csmonitor.com/2005/1007/p05s01-woam.html>

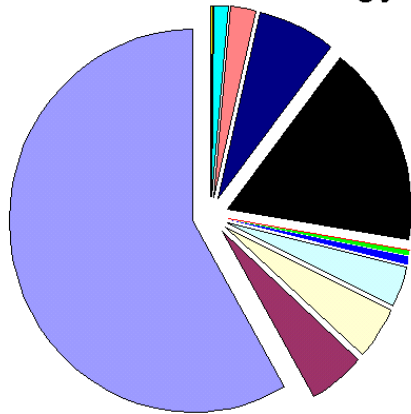
\*\*[http://www2.petrobras.com.br/tecnologia/ing/areadeatuacao\\_exploracaoaguas.asp](http://www2.petrobras.com.br/tecnologia/ing/areadeatuacao_exploracaoaguas.asp)

\*\*\*Brazil Information Center. *Brazil's Energy Crisis is Over. Now What?* Brazil News, Volume 3, Issue 2. June 2002. Page 1.

# Hydropower in Brazil

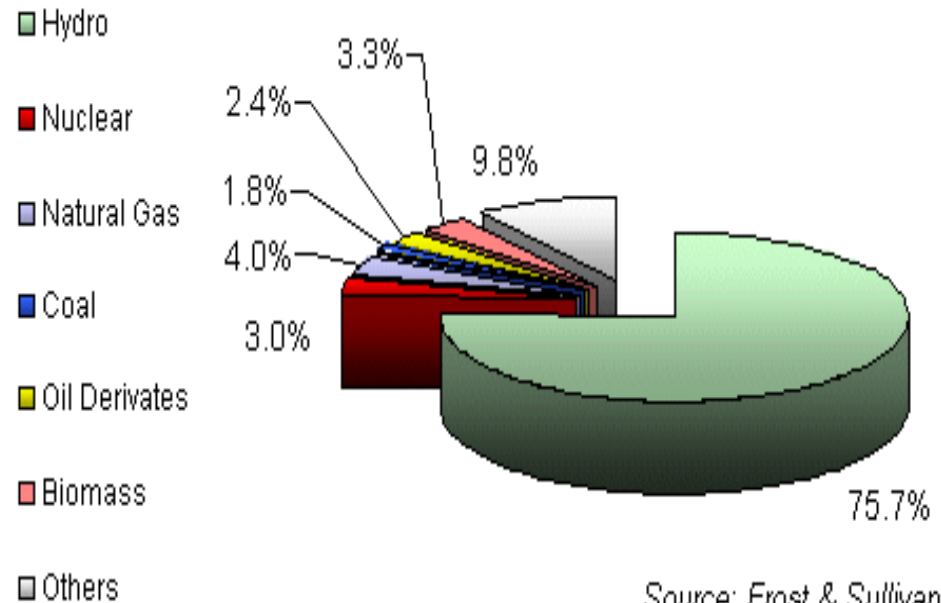
- Brazil outperforms World in terms of Renewable Energy
  - World: 19% Renewable in 2007
  - Brazil: Hydro accounts for 93% in 2002, 76% today

World Renewable Energy 2005



Large hydro 58.23%	Small hydro 5.12%	Wind power 4.58%	Biomass elec 3.42%
Geothermal elec 0.72%	Photovoltaic 0.42%	Other elec** 0.05%	Biomass heat* 17.08%
Solar heat 6.83%	Geothermal heat 2.17%	Biodiesel fuel 1.21%	Bioethanol fuel 0.16%

Electricity Supply in Brazil by Different Sources, 2006



Source: Frost & Sullivan

\*REN21. *Renewables: Global Status Report 2006*. Renewable Energy Policy Network for the 21st Century. Eric Martinot. Page 20.

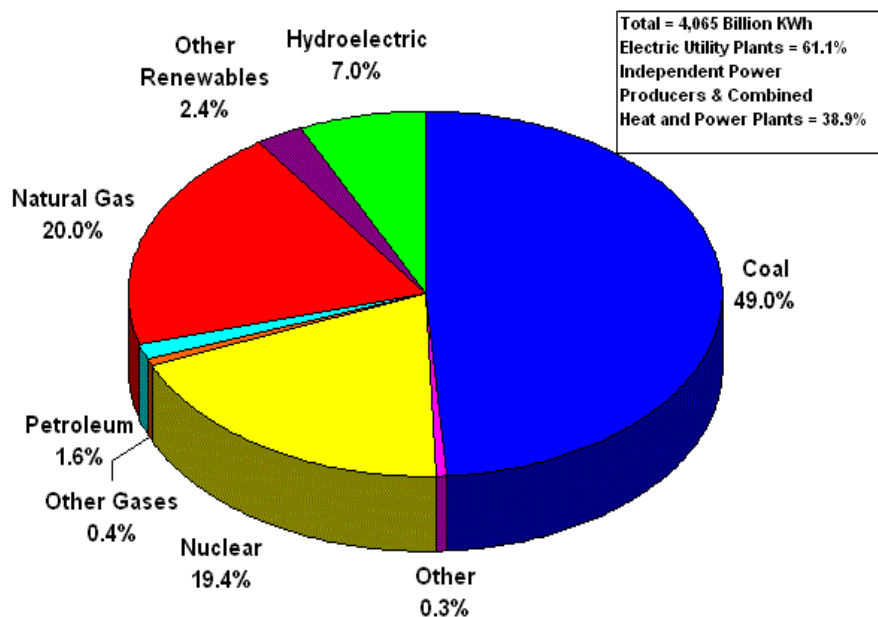
\*\*Jorge De Rosa. *Brazilian Energy Blackout 2010-2012*. Frost & Sullivan. 23 October 2007.

\*\*\*Brazil Information Center. *Brazil's Energy Crisis is Over. Now What?* Brazil News, Volume 3, Issue 2. June 2002. Page 1.

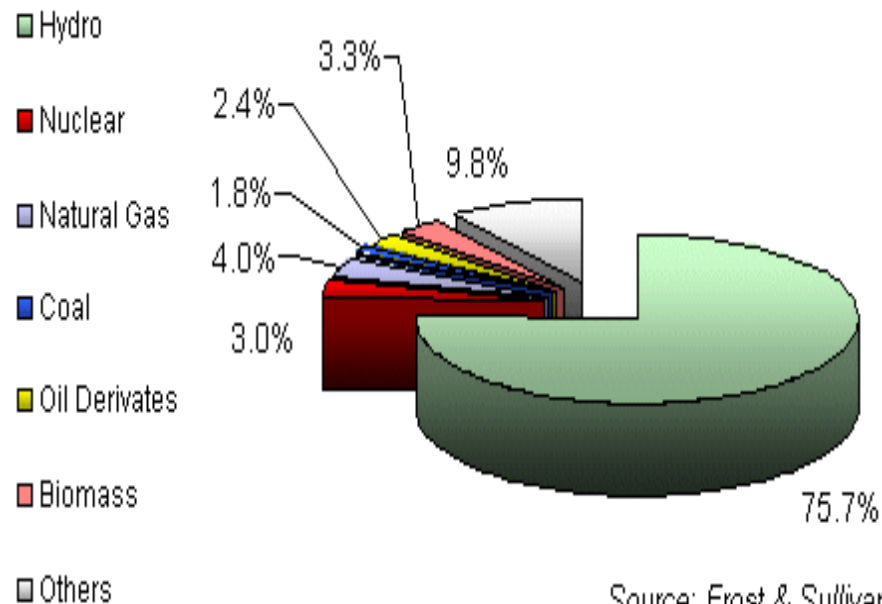
# Hydropower in Brazil

Brazil easily outperforms US in terms of Renewable Energy

US Electrical Power Net Generation, 2006



Electricity Supply in Brazil by Different Sources, 2006



\*<http://www.eia.doe.gov/cneaf/electricity/epa/figes1.html>

\*\* Jorge De Rosa. *Brazilian Energy Blackout 2010-2012*. Frost & Sullivan. 23 October 2007.

# Hydropower in Brazil

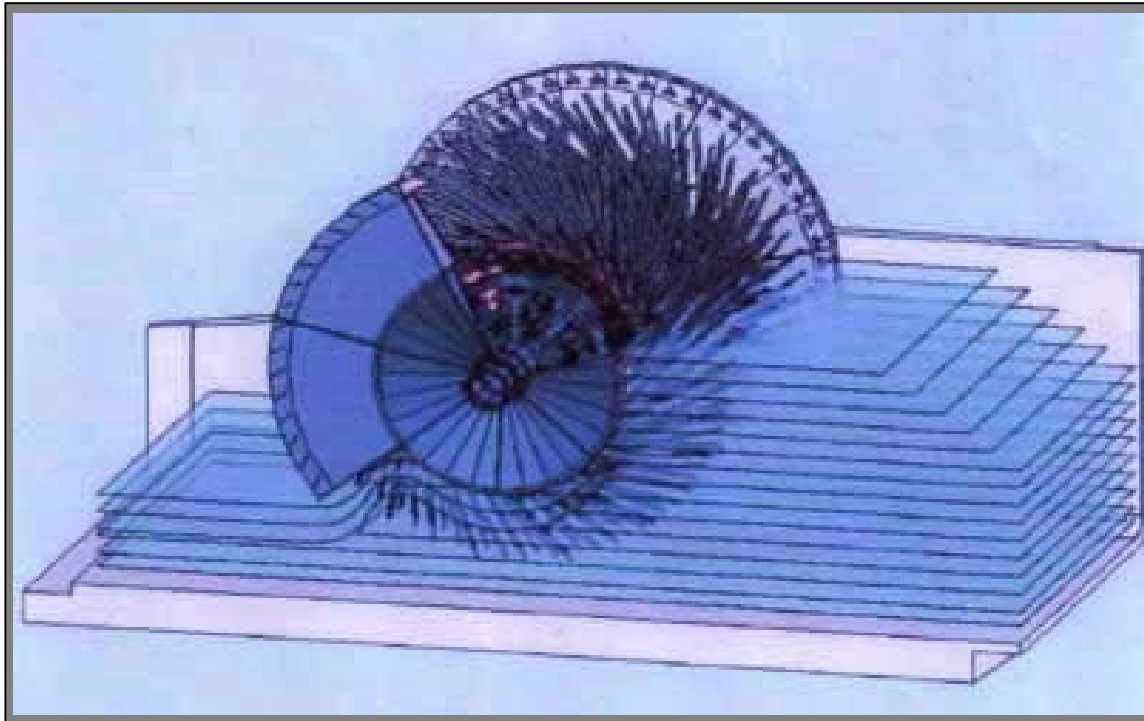
- The Cause of Significant Risk
  - Apagão of 2001 (June – December nationwide rationing)
  - Future Risk of Rationing Calculated:
    - 5% in 2009
    - 8%-23.5% in 2010
    - 14%-30% in 2011 (highs if GDP growth > 5% p.a.)
  - Risk of catastrophic failure
- Is it Renewable in the Biblical Sense? Maybe not.
  - Initial flooding of reservoir causes massive CO<sub>2</sub> release
    - Trees and vegetation rot
  - Continual cyclical methane release
    - Vegetation springs up in drawdown
    - Refill causes plants to decay due to lack of O<sub>2</sub>, creating methane
    - New research states this could have significant negative effect
  - Loss of long-term beneficial atmospheric effect of forests

\*Reuters. *Brazil at Risk of Energy Rationing from 2010 Study*. Reese Ewing. 13 April 2007.

\*\*Executive Intelligence Review. *There is Nothing 'Natural' About Brazil's Energy Crisis, Either*. 6 July 2001.

# Brazil's Hope: The Floating Turbine

- Produces 240MW/hr
  - Supply a city of 2 million people
  - 30m diameter, 160m length
- Functional in slow-moving, gradient free rivers of Amazon
- Cheap: Estimated cost of \$450,000/MW capacity
- Can provide power to those in remote areas



# A Success for Brazil?

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- ✓ > 600 Dams = 76% Renewable
  - ✓ Reduced energy costs and reliance on foreign sources
  - ✓ 'Floating Turbine' technology very similar to core competency
- 
- 12 million people still without power
  - Risk of rationing remains high
  - Vulnerable (little past investment in wind, steam and gas etc.)
  - 31.6% of federal expenditure on infrastructure in 2006 was for energy
- 
- ✓ Yes, overall. Hydropower has provided Brazil with a sustainable foundation from which to diversify.