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Matching Nuclear and Renewables to Decarbonize Energy

Panel #1
Power Policies and Nuclear Programs Structure – Latin America

ENERGY ECONOMICS GROUP-GEE
FEDERAL UNIVERSITY OF RIO DE JANEIRO – UFRJ

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Junho 2016

A geração nuclear no Brasil sob um foco estratégico

Nuclear generation in Brazil under a strategic focus

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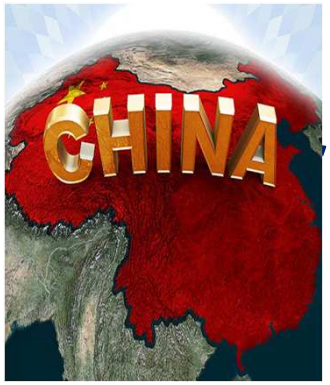
Outline of Presentation

- Introduction
  - Contextualizing the global energetic situation
  - Reality : Effects of climate change
- Energy security and climate change: the hard convergence
- The agenda of nuclear generation in this transition
- Brazil: The role of Nuclear Power Plants

Introduction
Contextualizing the global energetic situation

Contextualizing the global energetic situation

- The use of energy in the world should grow by a third by 2040 driven by countries non OCDE (India , China, Africa, Middle East and Southeast Asia.)



Demand ill nearly double the US Demand

IEA. **World Energy Outlook 2015**

- **India holds a sixth of the world population**
- **Power consumption contributes only 6 % of global consumption**
- **240 million Indians have no access to electricity**

Energy security is the main driver of energy policy of India. :

The priority of India is economic growth and reduce poverty.

The reduction of CO2 emissions is not a high priority ,

Contextualizing the global energetic situation

- World Population : 2013= 7.1 billion

  2040= 9.0 billion

- World energy demand grows-2040 (2,1 a.a)

- The electricity sector is leading the process of building a decarbonised energy system .

Source: IEA. World Energy Outlook 2015

Introduction
Reality : Effects of climate change

Warning

- IPCC-Intergovernmental Panel on Climate Change : Man is responsible for the current warming of the planet (Evaluation Report 2014).
- IPCC: In 2050 →2 ° C, 80 % of electricity in the world should be low carbon.
- COP21 Paris : 2 ° C.→ man lose control on environment
- COP 21 Paris: from 2020 it is the obligation of participation of all nations - not just rich countries - to combat climate change

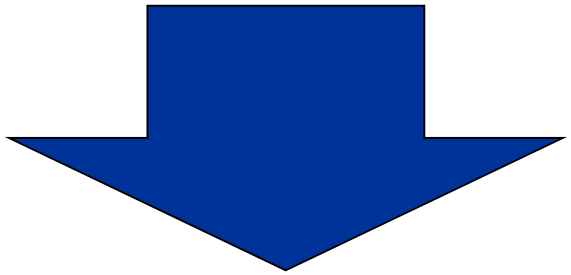
Effects of climate change

Scientists associate floods in France with climate change

Robert Vautard: cientist Laboratory for Climate and Environmental Sciences French.

Experts warn : " climate change could contribute the proliferation of zika and other viruses transmitted by mosquitoes” .

Air pollution as a driver of energy system transformation



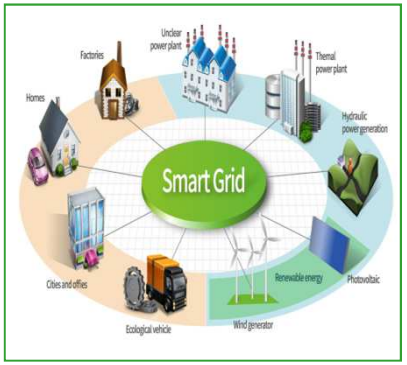
The world of energy is in a state of change

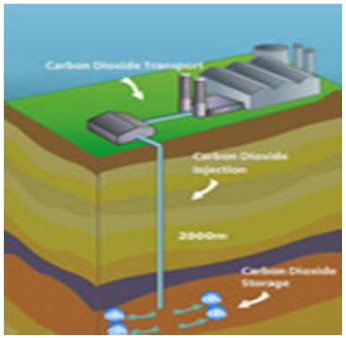
World and Brazil: menu of energy sources and options.



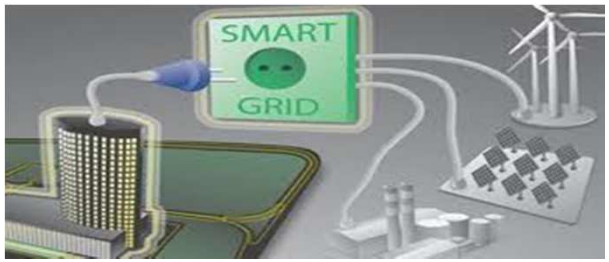






This system will change as a function of a new reality
Generation of electric power



- A new era for renewable energy sources

- Renewable energy sources have emerged with unexpected speed as large-scale, and increasingly economically viable, alternatives to fossil fuels.

- New energy flow path with complex network system (decentralized energy)

- Brazil: The tradition of projection studies the expansion of electric power supply .

- This system will have to be rethought.

Deforestation is responsible for about 5 to 8 billion tons of carbon dioxide (CO_2)

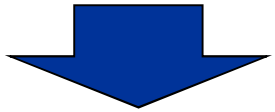
Nuclear and hydropower: Two proven low-carbon technologies

•Hydropower and nuclear power are still by far the biggest non-fossil sources of electricity, at 16% and 12% of global generation, respectively.

•Both offer nearly emissions-free energy, with very low marginal costs, and have a proven record at large scales.

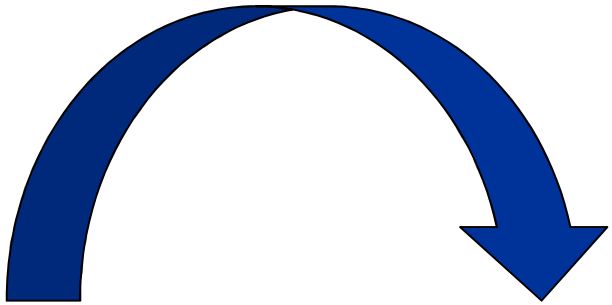
•However, they are also highly capital-intensive, can take a decade or more to plan and build.

Energy security and climate change: the hard convergence.



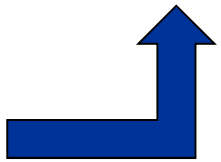
Energetic security x Climate change

The hard convergence



The attributes of fossil fuels

- Stocks
- Flexibility
- Availability and Control
- The amount , time and place desired by that consumer .



To Recognize

Transition process between the current economy based on the intensive use of fossil fuels and a future sustainable economy is in renewable energy

The agenda of nuclear generation in this transition

Nuclear transition - Global

- Much of the world's nuclear power stations in the next fifteen years will have over forty years.

- The legitimacy in society as a solution to security assurance of energy supply. A matter of public opinion.

- Cost Escalation - new nuclear power plants: - construction cost , number of years to built the plants (delays: safety authorities might impose rules, regulatory requirements).

Nuclear transition - Global

The energetic transition

- Policies that recognize that nuclear generation brings energy security.

- The role to be played by nuclear energy in the energy transition depends not only on its own technical attributes, economic and political, but :

The evolution of the process as a whole(intermittency storage (renewable), CO2 storage, social agreements for new hydroelectric plants.

The role of Nuclear : increasing

- The technology is also towards reducing energy dependency abroad
- Nuclear signals to be observed
  - 2030: Increase of 17% of the world nuclear power capacity
  - Japan
  - India -25% of electricity from nuclear power by 2050(BP 2015)
    -Energy security is the main driver
    -The Nuclear Non-Proliferation Treaty (NPT)
    - The energy consumption will grow 128 % -2035 (BP2015)
  - China-half of the expansion of nuclear power in coming decades.
- In the situation of the urgency of climate change mitigation or ambitions CO2 emissions-hard or hard decarbonization policy →The role of Nuclear : increasing

Brazil:
The role of Nuclear Power Plants

Brazil: The role of Nuclear Power Plants

Angra 1 = 657 MW: in operation since 1985.

Angra 2 = 1,350 MW : in operation since 2001

Angra 3 = 1435 MW: the works were stopped .

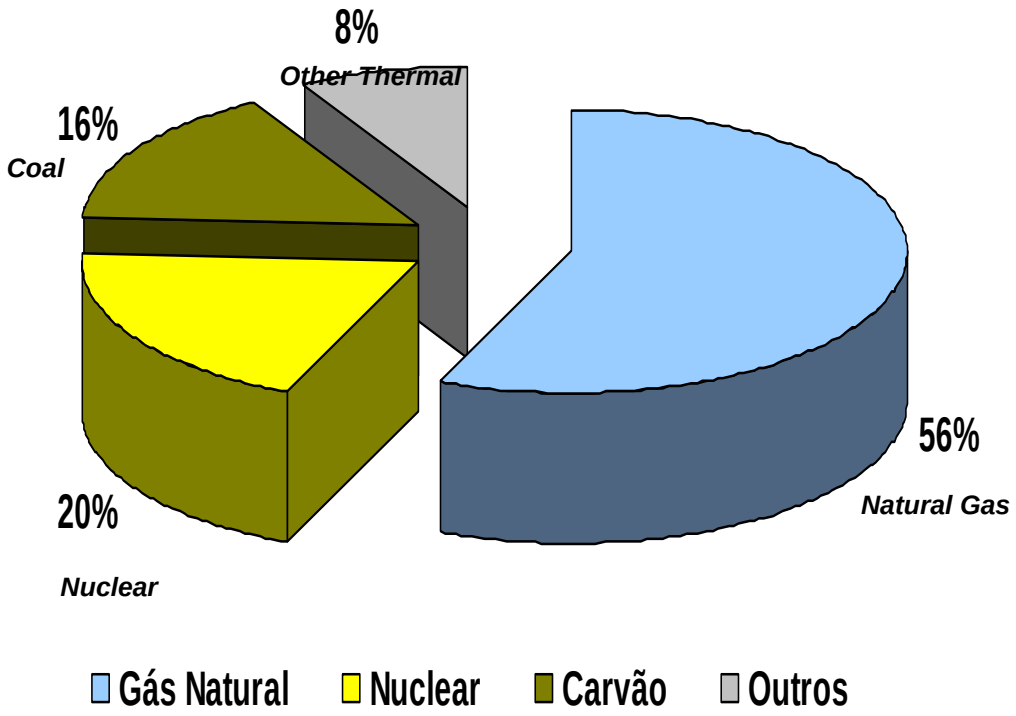
PNE 2030- Strategy to meet the demand of electric power

PNE 2030: Developed in 2006

- Demand Management
  - **Efficiency energetics**
  - **Distributed generation (solar photovoltaic panels)**
- Power supply expansion
  - Autogeneration
  - Electric power generation plants
    - **Hydropower**
    - **Thermoelectric: fossil fuels**
      - Natural Gas
      - Coal
    - **Nuclear power plants**
    - **Thermal power plants with renewable sources**
      - Biomass - cogeneration - sugar cane
      - Agricultural waste, industrial and urban
    - **Wind power plants**

Source: EPE/MME

PNE 2030 : Thermoelectric structure of the electric matrix

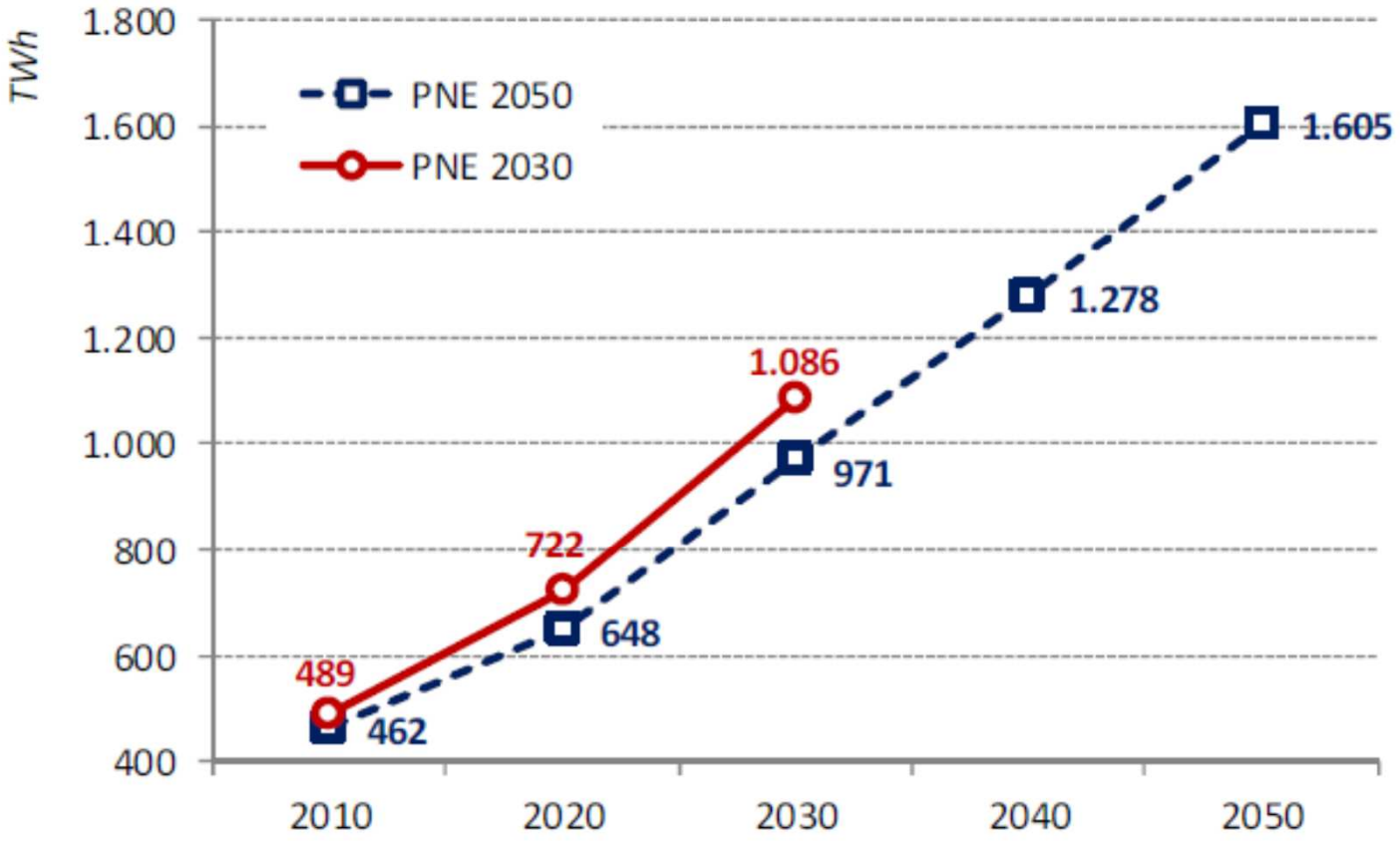


	GW Increase 2015-2030
Capacity installed	15,5
Natural Gas	*8,0*
Nuclear Plants	*4,0*
Coal Plants	*3,5*
Other Thermal plants	*0,00*
Increase in the period	
Average annual increase MW	**1.030**

Source: EPE/MME 2006

Brazil: Long -Term Energy Pl**ans**

Energy Demand : 2030 x 2050



Source: EPE/MME 2014, november

What sources of electricity generation will meet this demand ?

and

what should be the role of nuclear generation that electric?

Brazil: The role of Nuclear Power Plants

Ministério de Minas e Energia

The National Energy Plan 2050 , which is nearing completion , will include the construction of new nuclear power plants, according to the former executive secretary of the Ministry of Mines and Energy , Mr Eduardo Barata. " (April 2016)

Brazil: The role of thermal plants in the Brazilian electric sector

- Depletion of an electric model based on intensive exploitation of hydropower plants with large reservoirs.
- The thermoelectricity by natural gas has an important role in complementing the hydroelectricity.
- Brazil imports natural gas (LGN)
- The availability of natural gas dispute with demand from other sectors.

Brazil: period of energy transition to a highly renewable electric matrix (energetic security with a lower percentage of CO2 emissions)

- The implementation of new hydroelectric meeting the social and environmental demands.
- Strategic management of the hydroelectric reservoirs in operation.(back-up wind and solar)
- Keep the successful program of wind power development.(Brazil is already one of the ten largest generators in the world with 8,600 MW)
- To improve and speed up the implementation process of photovoltaic distributed generation in the country.

Brazil: period of energy transition to a highly renewable electric matrix (energetic security with a lower percentage of CO2 emissions)

- Encourage the generation of renewable energy from biomass and biogas (forestry residues, agricultural residues , urban waste etc): the Energy Plan (PDE 2024) the federal government plans to install 800MW in new projects)
- The prompt conclusion of ANGRA 3 .(Strategic)
- To consider the construction of news nuclear power plants (until 2050) within a strategic process of energy security.
- About Natural Gas: complementation as hydro with imported gas : The Energy Plan (PDE 2024) the federal government plans to install 10,500 MW of thermal power by 2024.

In conclusion an important issue:

The hydroelectric reservoir with another function which thermal power plant able to structure the new Brazilian electric sector . natural gas , coal or nuclear ?

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