



Eletrobras
Eletronuclear

Matriz Elétrica Brasileira

Desafios para o século 21

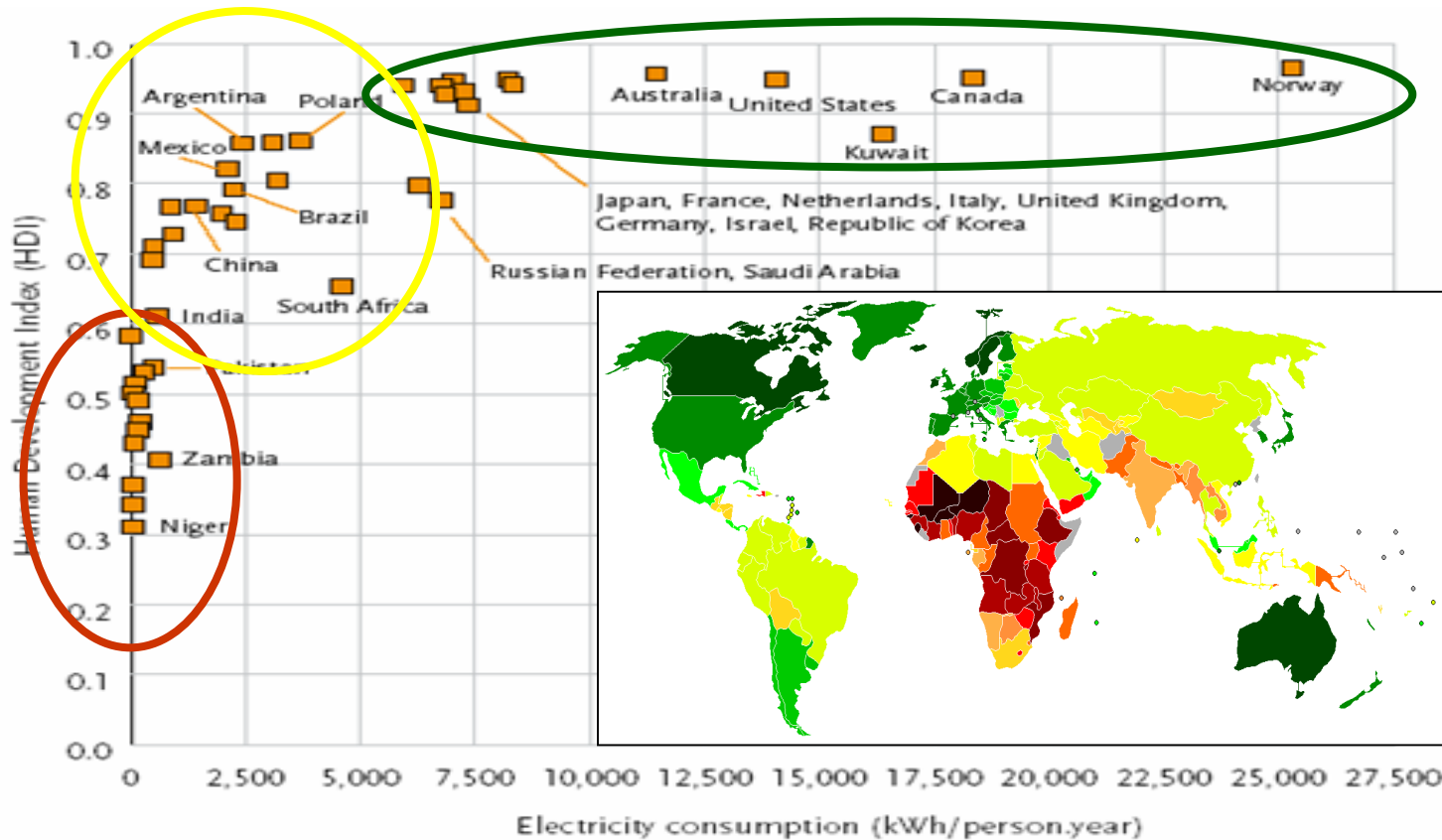
A importância da Energia Elétrica

A Energia Elétrica é fator fundamental para o desenvolvimento e melhoria da qualidade de vida



que somente ocorrerá no Brasil se houver um significativo crescimento no consumo por habitante.

IDH x Consumo per capita de eletricidade



Energia e desenvolvimento



O Planejamento Energético

- Plano Nacional de Energia – PNE 2030

Cenário de Referência: 4.000 MW instalados

Nova revisão – Horizonte 2050

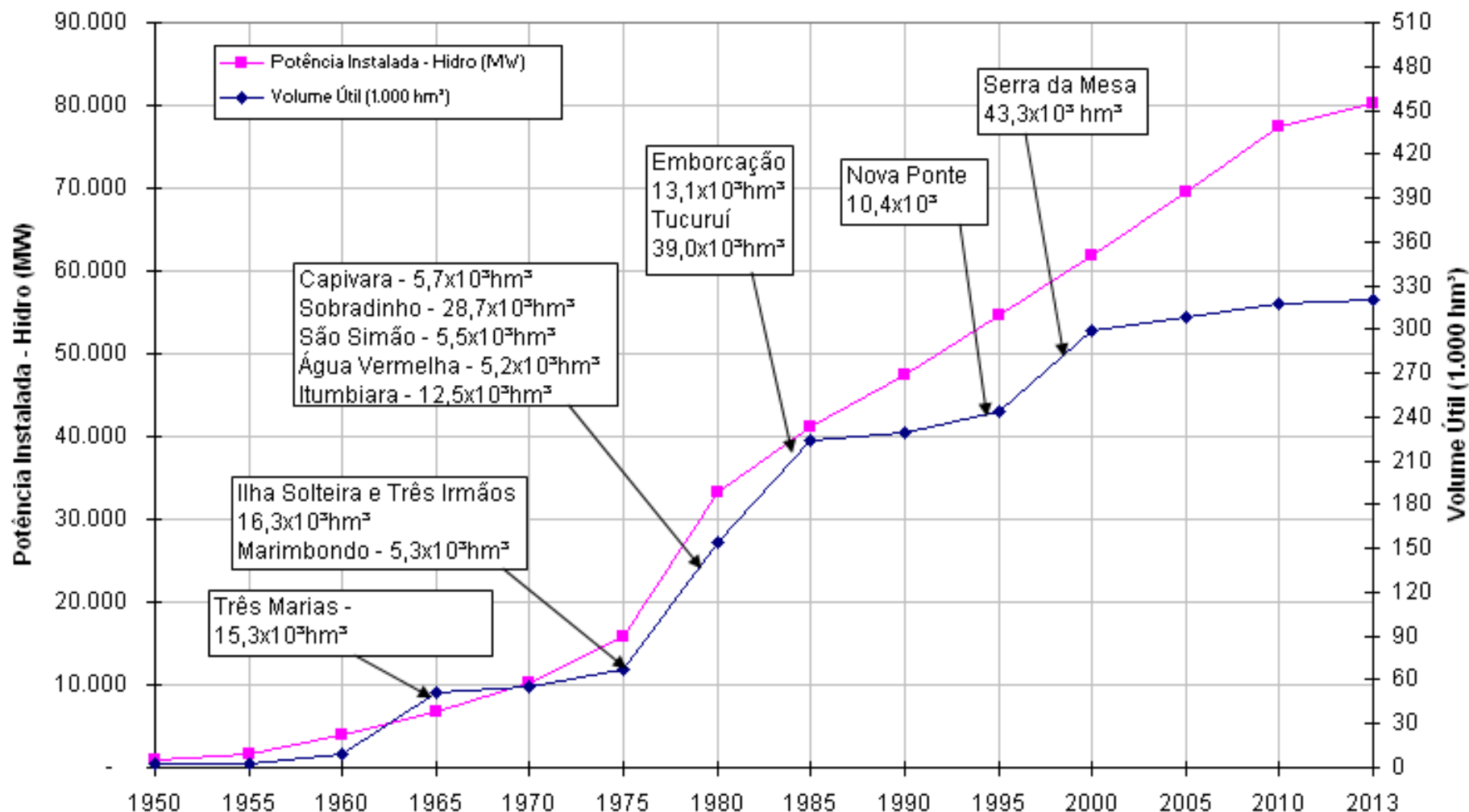
O Planejamento Energético

- Plano Decenal de Expansão de Energia

Atualmente – Angra 3

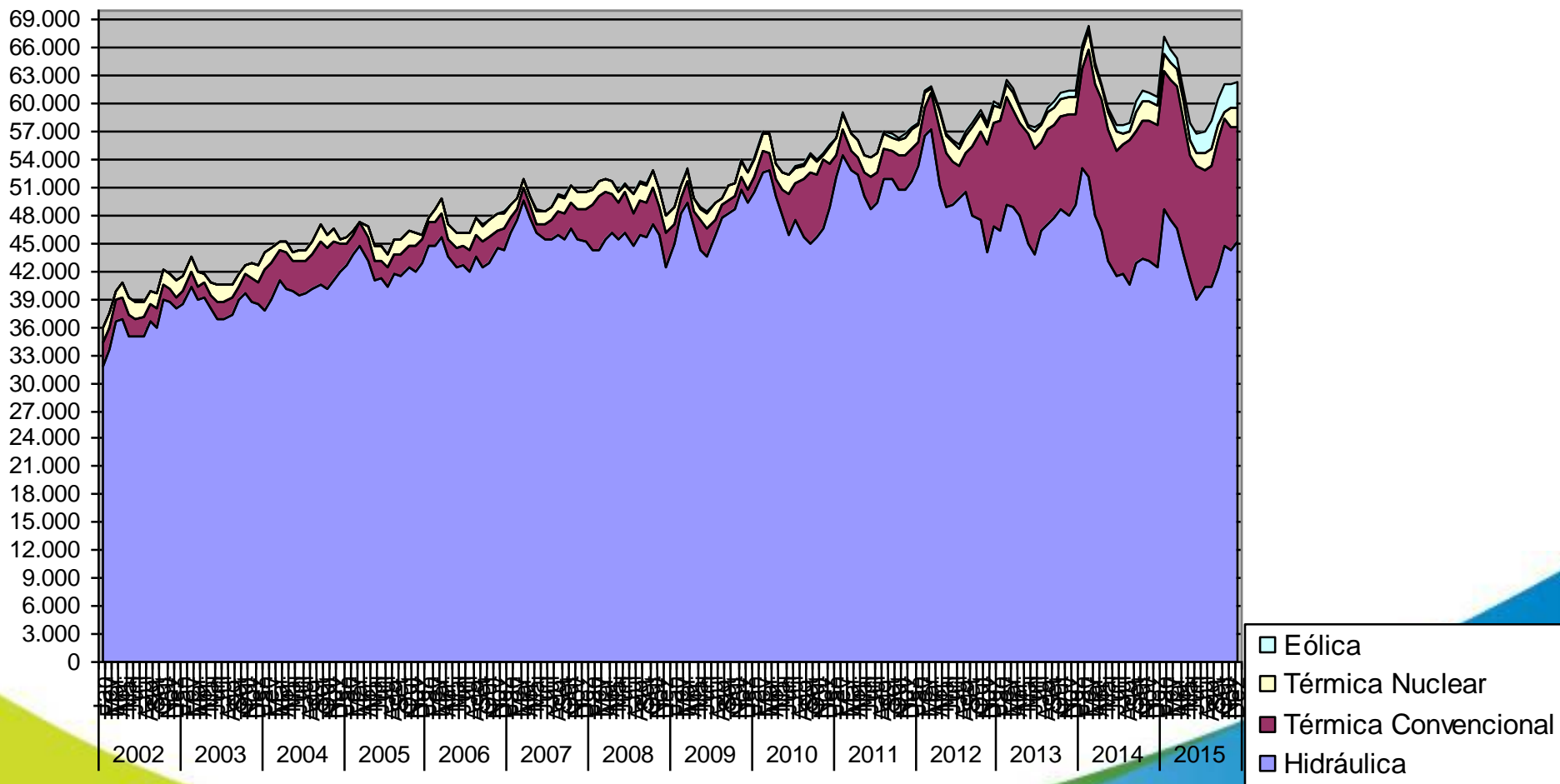
Nova revisão – Identificada a necessidade de expressiva geração térmica de base

Evolução do Volume Útil Acumulado e da Potência Instalada (Geração Hidráulica) no SIN



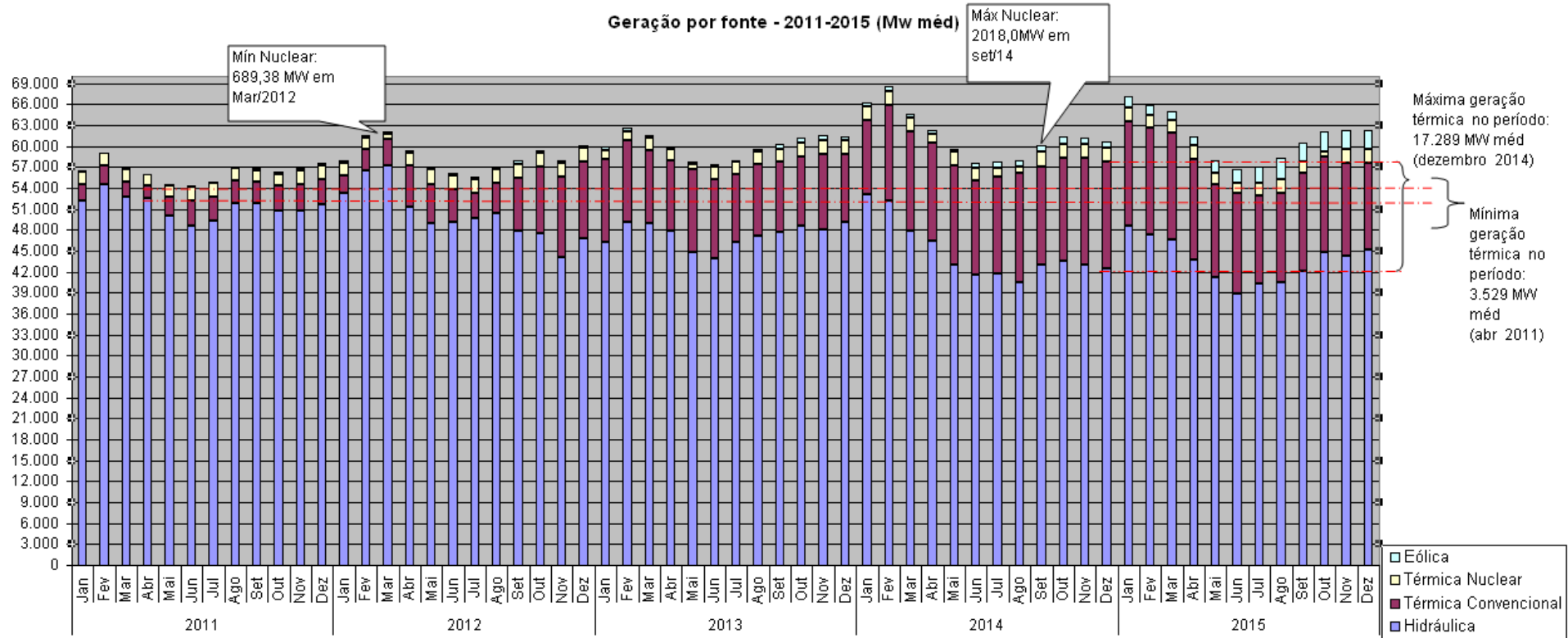
Os 13 maiores reservatórios identificados na figura possuem volume útil maior que $5 \times 10^3 \text{ hm}^3$ e, juntos, correspondem a 74% do volume útil total acumulado no período 1960 a 2000

Geração de Eletricidade no Brasil por Fonte



Geração por fonte 2011-2015

Geração por fonte - 2011-2015 (Mw méd)



Compromisso Brasileiro na COP 21

Meta brasileira

INDC (Intended Nationally Determined Contribution)

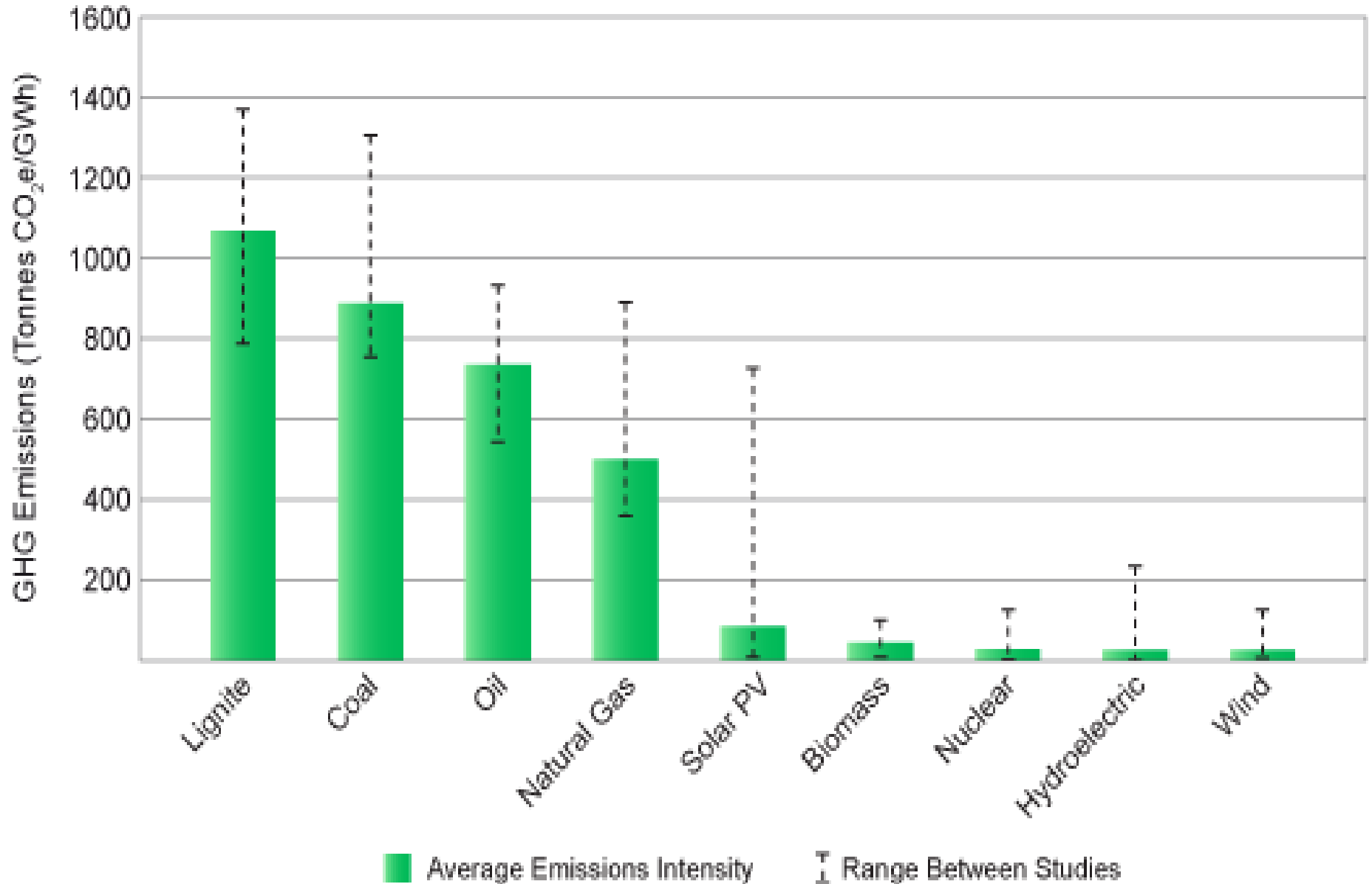
Meta de redução de emissões de gases de efeito estufa:

37%

até 2025 (na comparação com 2005)

43%

até 2030 (na comparação com 2005)



A eficiência energética tem crescido...



LIGHTING RETROFIT



LOW-FLOW SHOWERHEAD



WIRELESS THERMOSTAT CONTROL SYSTEM



GREEN WALL



SUBMETERING



ENERGY EFFICIENT FRIDGE



.. mas a demanda aumenta muito mais

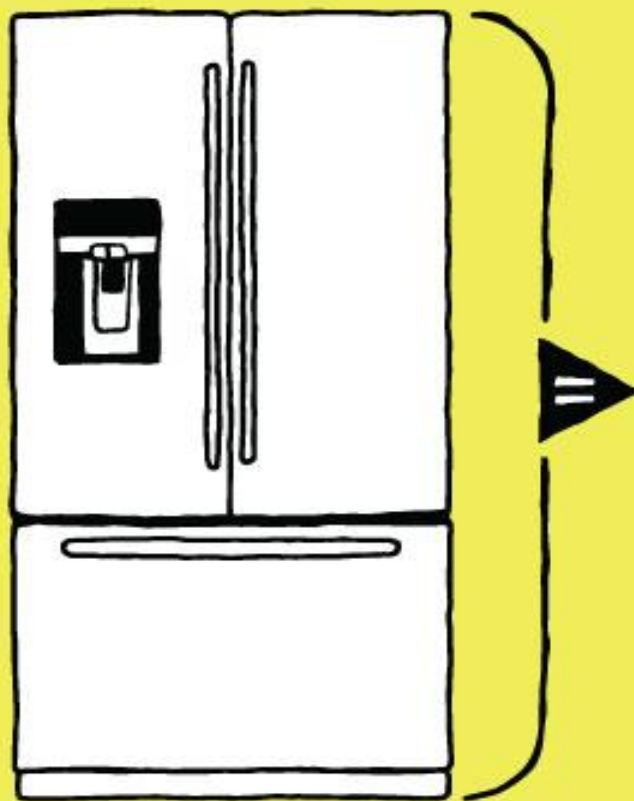


A TYPICAL U.S. REFRIGERATOR

USES AS MUCH ELECTRICITY IN A YEAR

AS 9 ETHIOPIANS.

1 TYPICAL U.S. FRIDGE



459 kWh/year

3 KENYANS



156 kWh/year
PER KENYAN

3 NIGERIANS



136 kWh/year
PER NIGERIAN

6 LIBERIANS



79 kWh/year
PER LIBERIAN

6 TANZANIANS



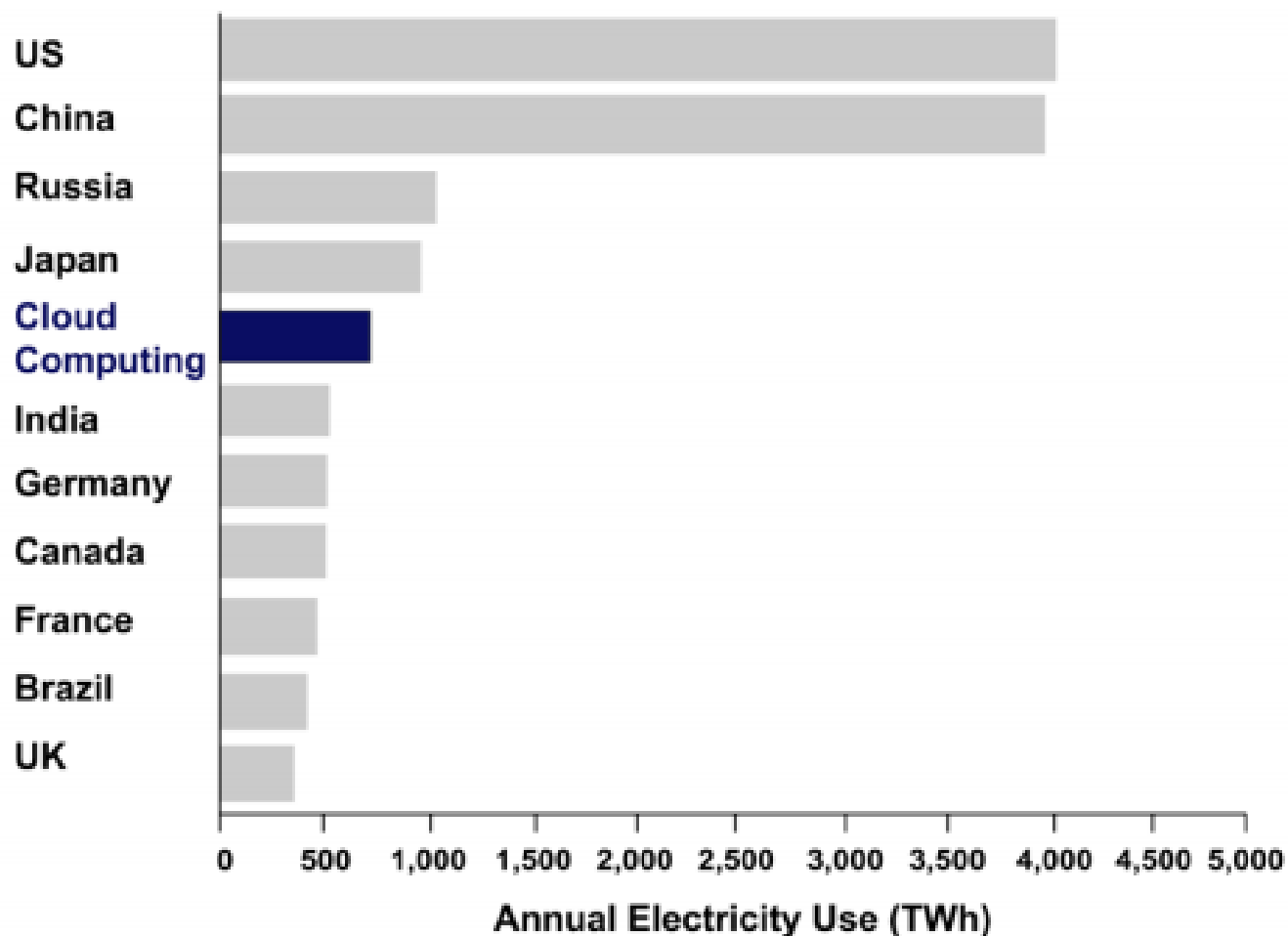
78 kWh/year
PER TANZANIAN

9 ETHIOPIANS



52 kWh/year
PER ETHIOPIAN

Global Cloud Electric Consumption

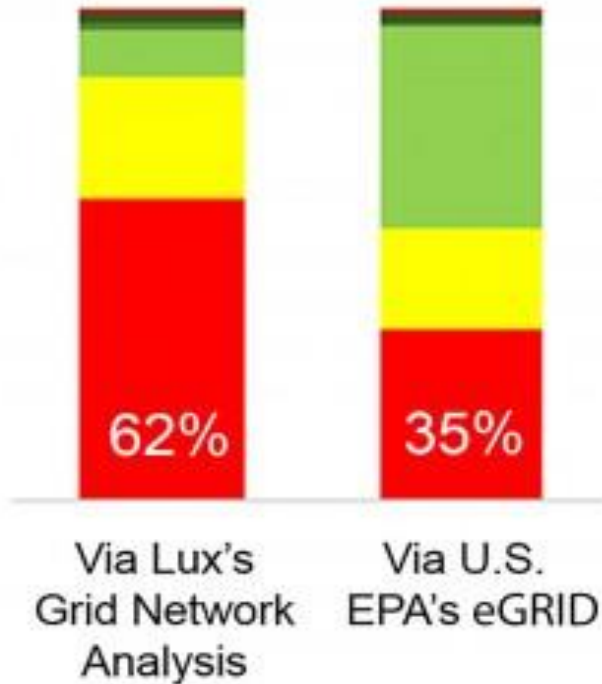


Source: Greenpeace International, How Clean is Your Cloud, April 2012

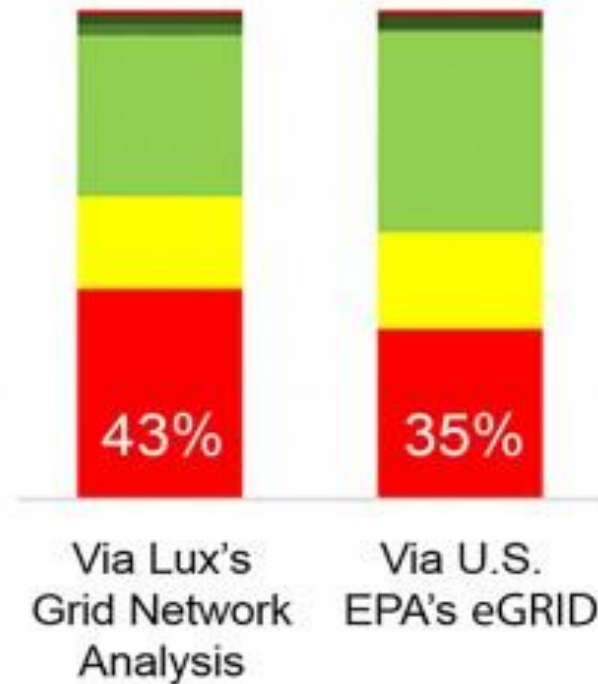
Note: Cloud consumption here includes telecommunications infrastructure, but not the entire ICT ecosystem.

Data centers energy mix

Electricity Sources for
Google's Datacenter in
Berkeley County, SC



Electricity Sources for
Amazon's 23 Datacenters
in VA



■ Coal ■ Oil ■ Gas ■ Nuclear ■ Hydro ■ Non-Hydro Ren.

A nuvem é cinza



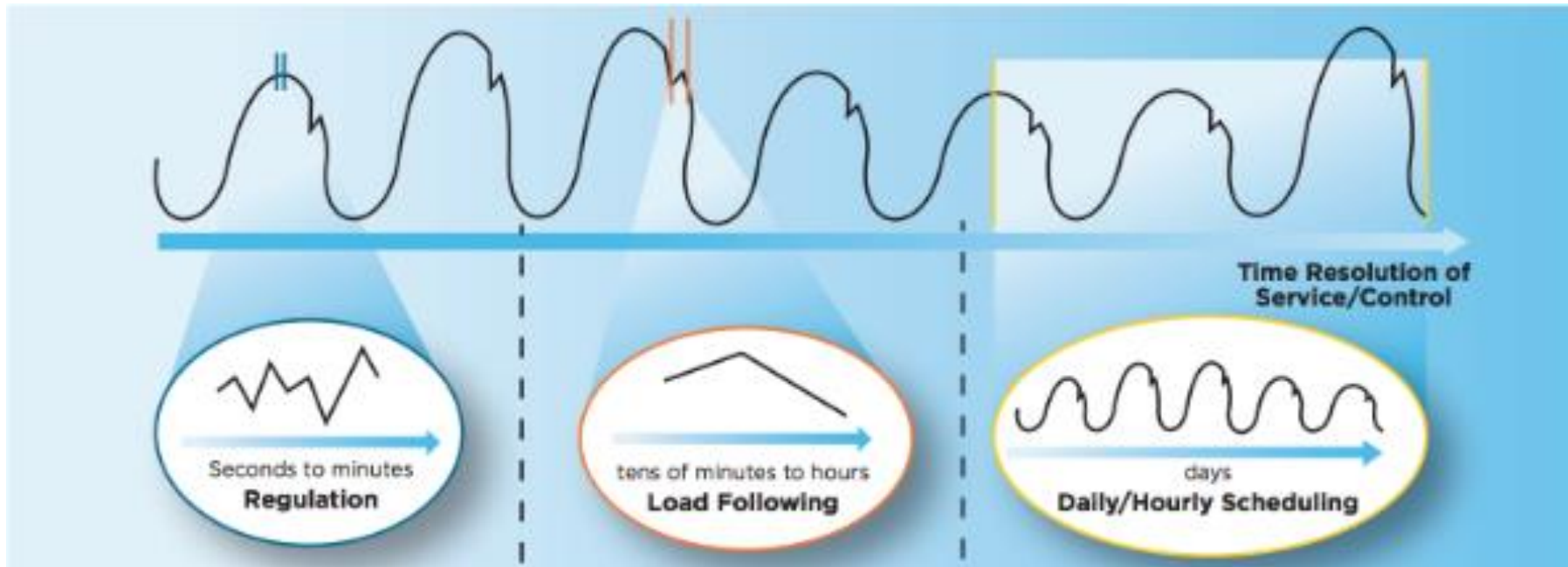
Tudo pode mudar...



Integração Nuclear - renováveis

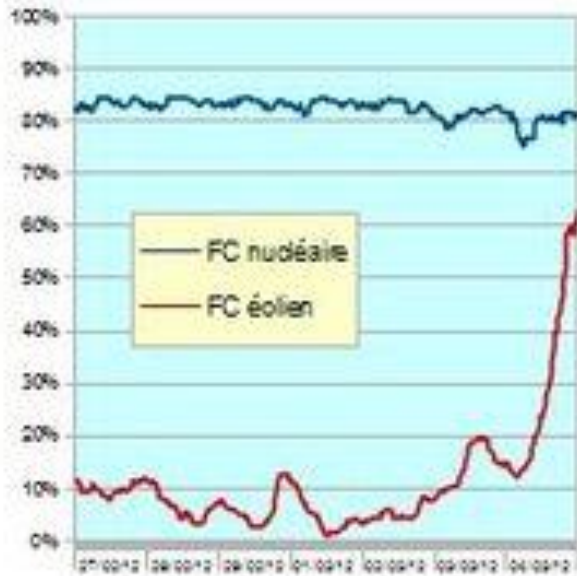


O desafio da variabilidade



Production éolienne et nucléaire (facteur de charge)

semaine la moins ventée de 2012



semaine la plus ventée de 2012



Texas (ERCOT) hourly wind generation (March 2014)
megawatts (MW)

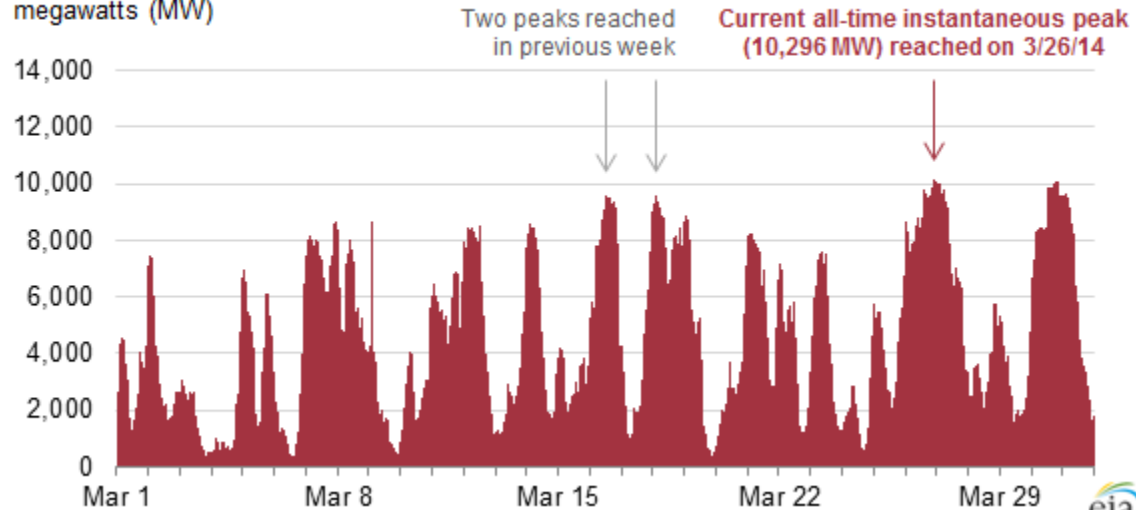


Figure 1.7: Example of a load patterns over a 24 h period of time

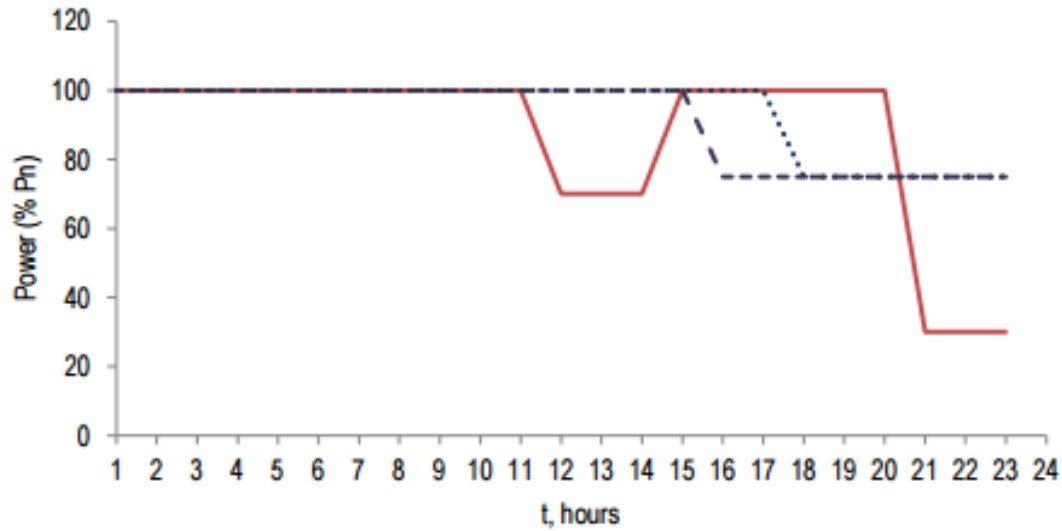
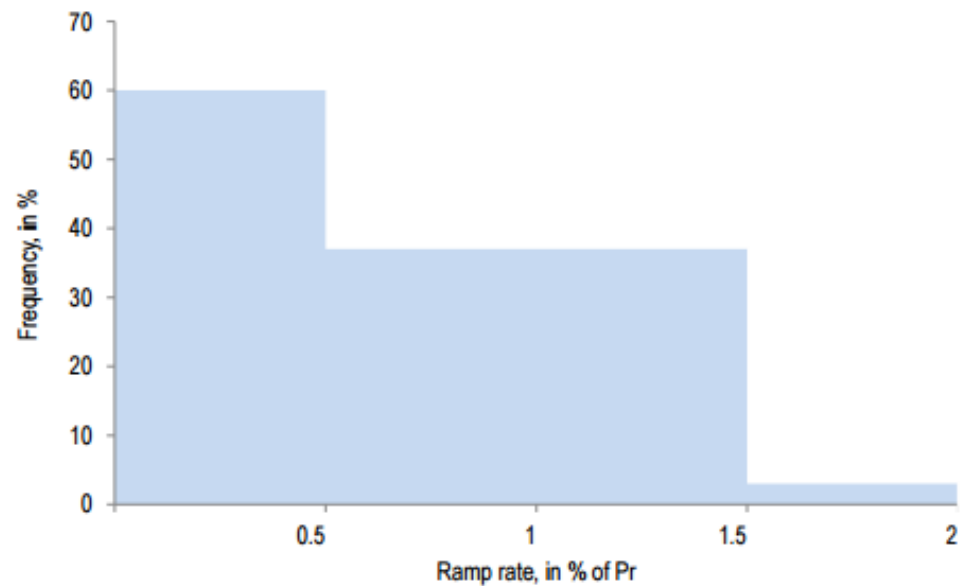
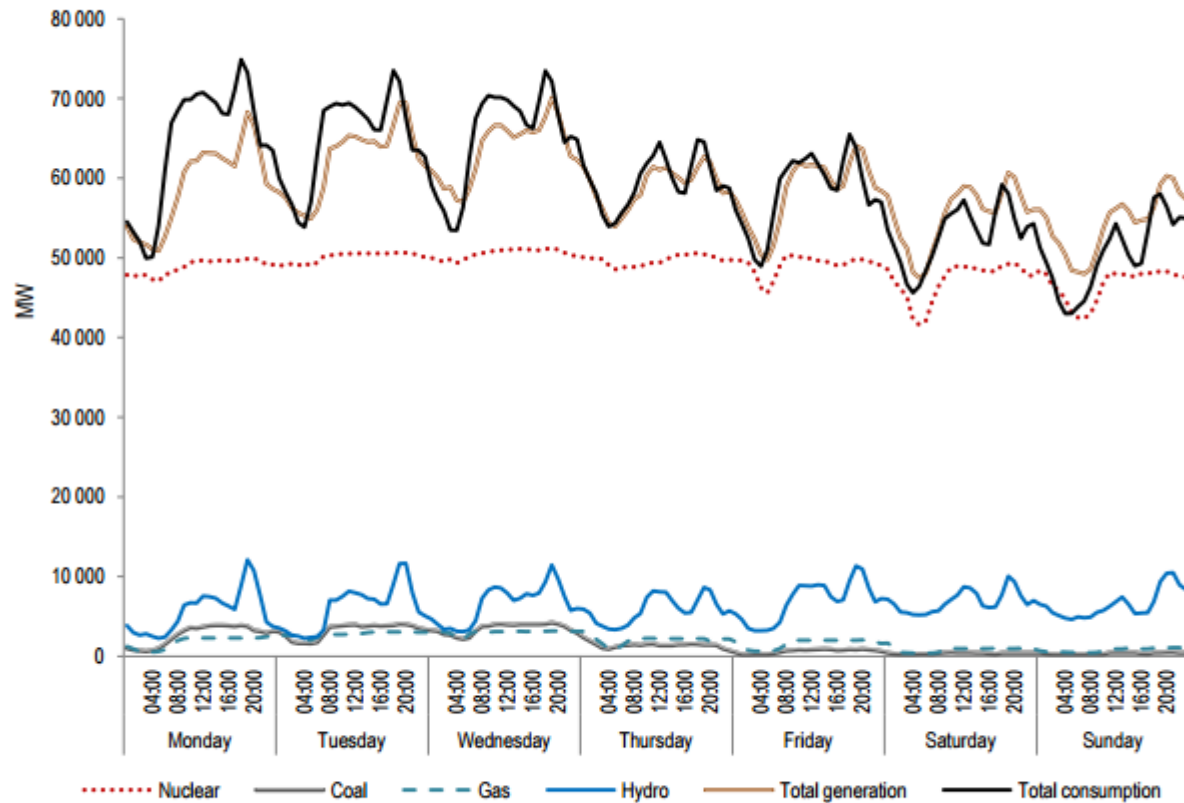


Figure 1.8: Approximate frequencies of different ramp rates in French NPP



Source: Cappolani, *et al.*, 2004.

Figure 1.3: Example of the electricity generation in France during 2 weeks in November, 2010



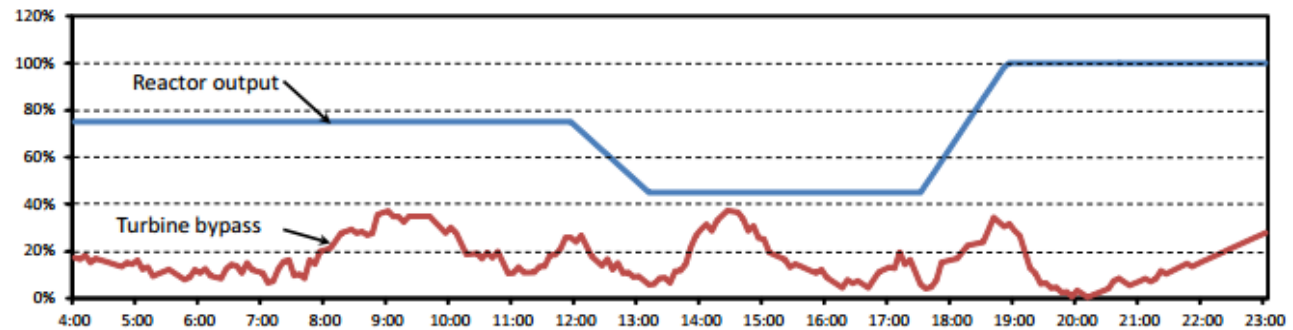
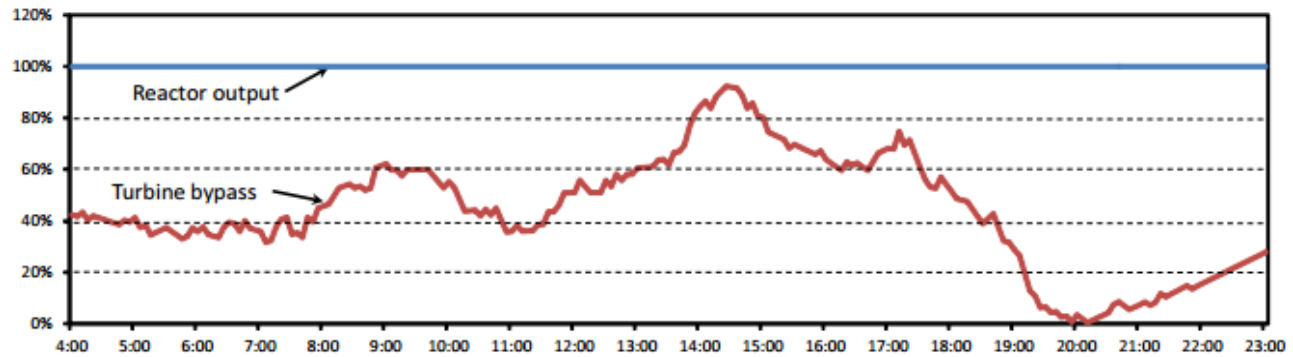
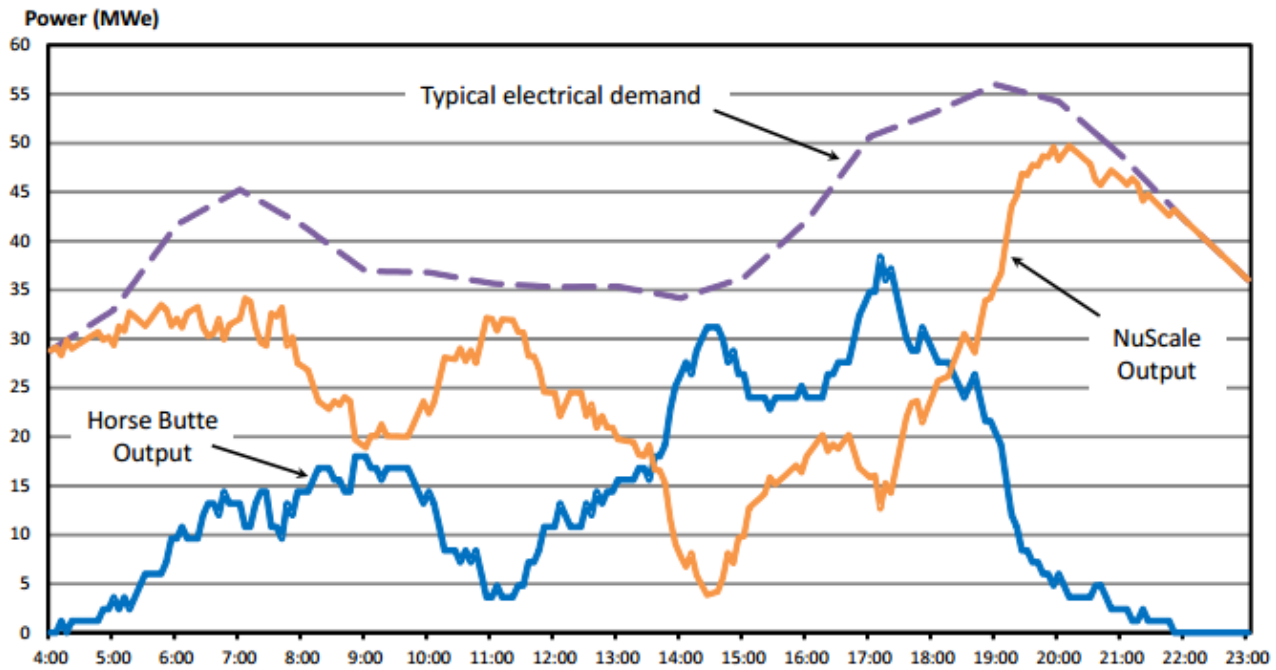
Source: Electrical Energy Statistics for France 2010, RTE (Réseau de transport d'électricité, France), <http://clients.rte-france.com/lang/fr/visiteurs/vie/telecharge.jsp>

Integração SMR-Eólica

Horse Butte - Idaho

- 32 turbinas Vestas V100
- 1.8 MWe cada turbina
- 57.6 MWe capacidade total





As Futuras Usinas Brasileiras

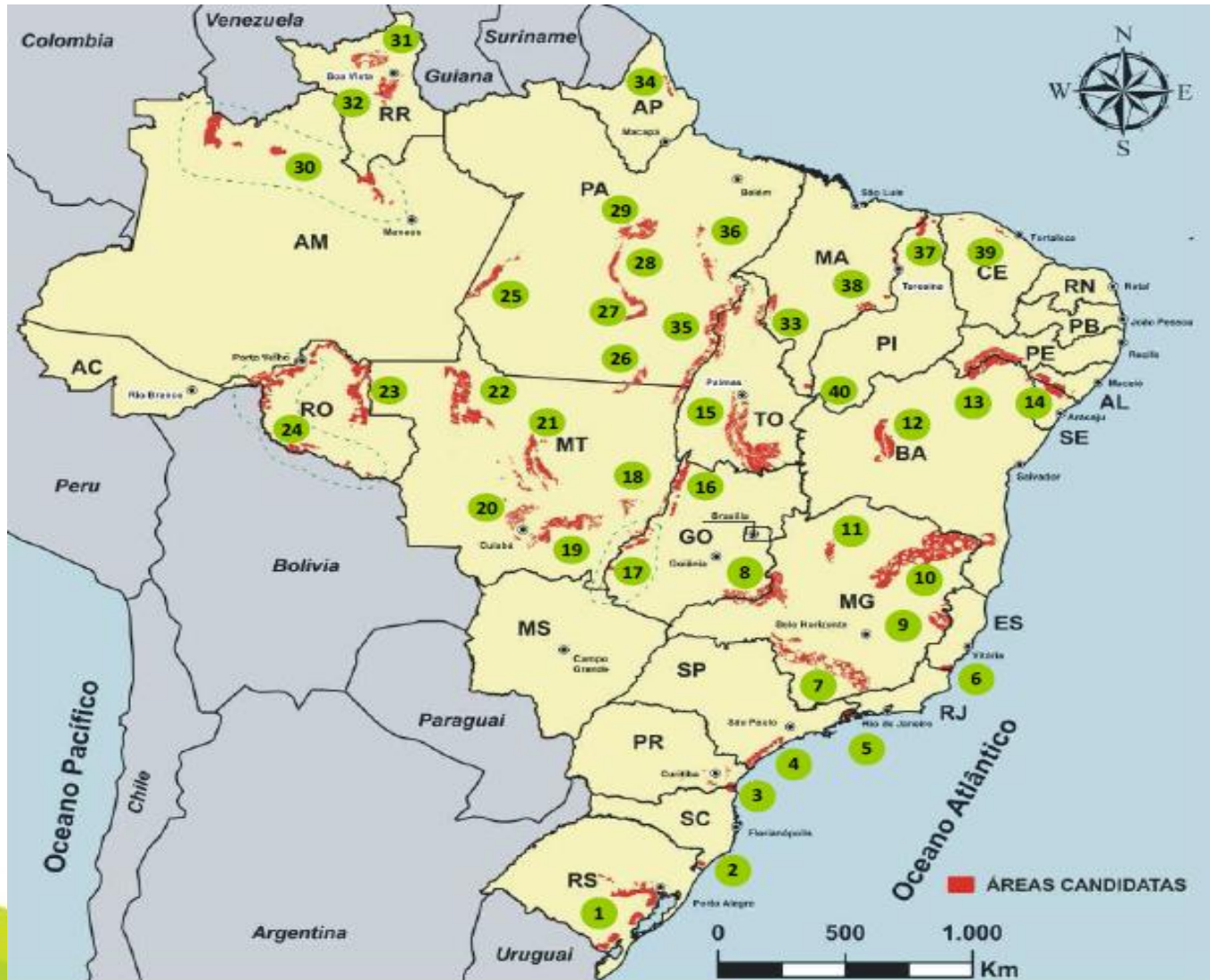
- Seleção de Sítios
- Tecnologias

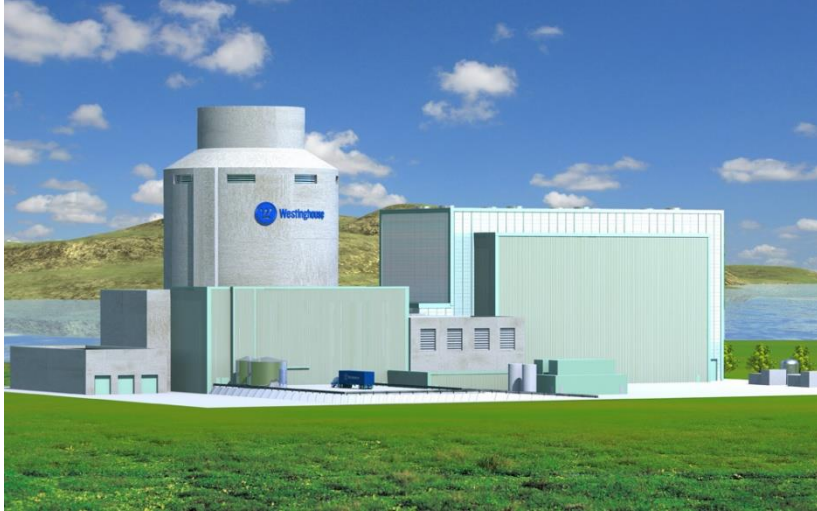
O Processo de Seleção de Sítios

EPRI Sitting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application (Sitting Guide), Março 2002



SÍTIOS POTENCIAIS BRASILEIROS





AP-1000 – WEC / USA



VVER 1200 – Rosatom - Russia

Tecnologias disponíveis 1000 – 1200MW

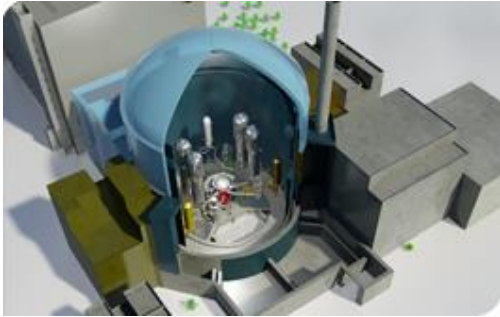


ACP1000 – CNNC - China



ATMEA1 – Atmea - França

Tecnologias disponíveis > 1200MW

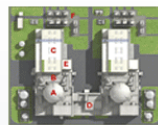


EPR 1650MW
AREVA - França



CAP-1400
SNPTC - China

Advanced Power Reactor
1400



A. Containment Building
B. Acutally Building
C. Turbins Building
D. Containment Building
E. Acutally Building
F. Turbins Building

APR1400
Kepco - Korea

Visão: Uma central com 6 reatores – Oportunidade de desenvolvimento regional sustentável



INVESTIMENTO TOTAL
US\$ 30 Bilhões

CAPACIDADE DA CENTRAL
6600 MWe

FATOR DE CAPACIDADE
85% A 90%

PRODUÇÃO ANUAL
50,58 Milhões MWh

RECEITA ANUAL
~US\$ 2,5 Bilhões

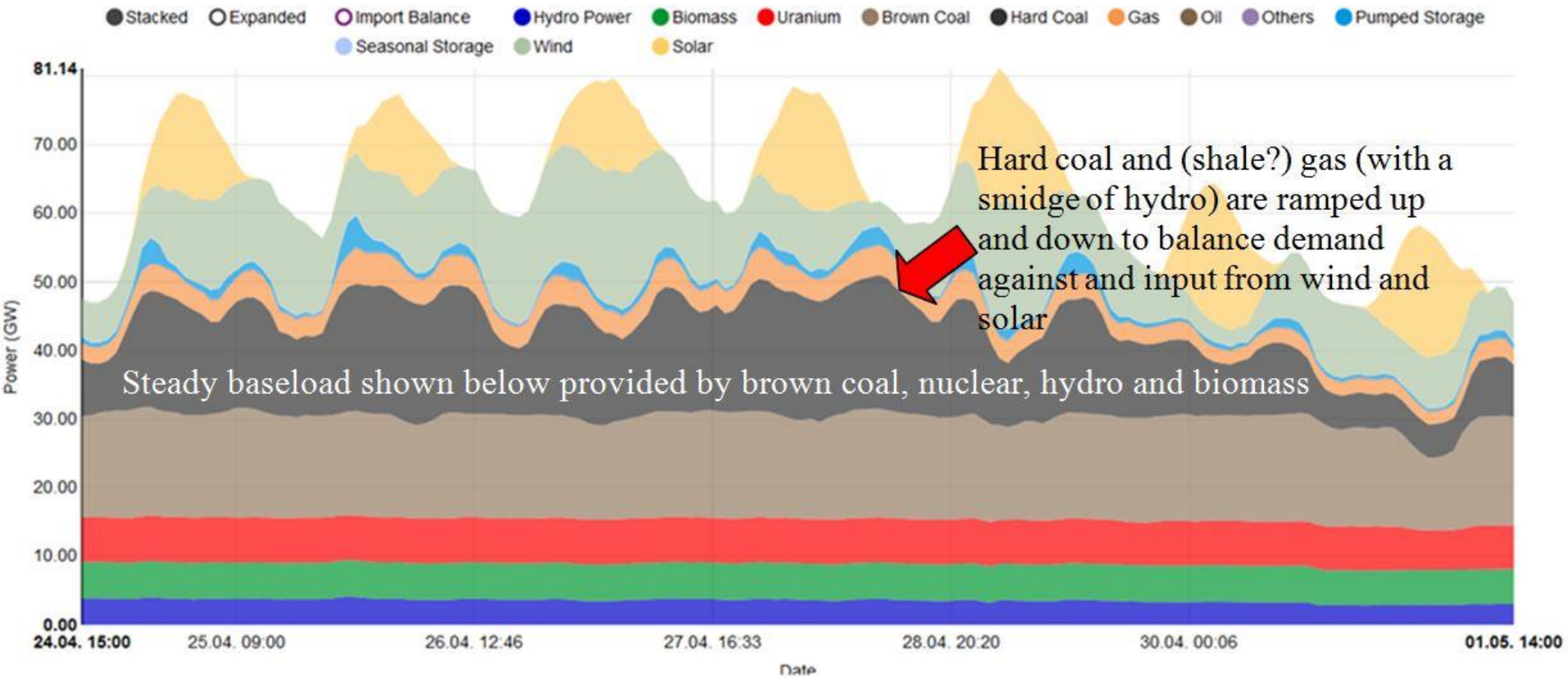
CUSTO ANUAL
US\$ 1 Bilhão

MARGEM
US\$ 1,5 Bilhão

RETORNO DO INVESTIMENTO
~17 Anos

Obrigado!

The background features abstract, wavy shapes in shades of blue and green, set against a white background. The blue shape is on the left, and the green shape is on the right, both curving upwards towards the center.



German Electricity Production Week 17, 2016