#AÁguaÉUmaSó

Water management in Brazilian hydropower

Antonio Augusto Borges de Lima

Coordenador de Acompanhamento de Reservatórios e Sistemas Hídricos

03/12/2019

ANA

AGÊNCIA NACIONAL DE ÁGUAS

COUNTRY OVERVIEW

ANA
AGÊNCIA NACIONAL DE ÁGUAS

BRAZIL IN NUMBERS

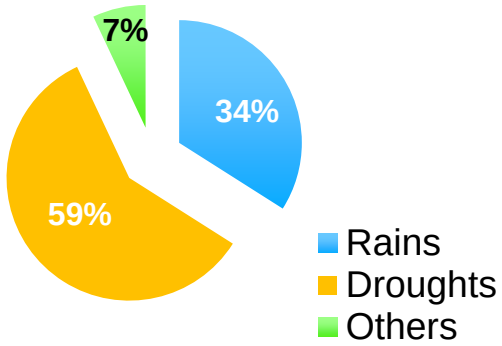
5th	largest country in the world (area of 8.514.876 km²)
210	million inhabitants (IBGE, 2019)
5	Geopolitical Regions
5.570	cities located in **26** States and **1** Federal District
12%	Planet´s fresh water is in Brazil
83	boundary and transboundary rivers

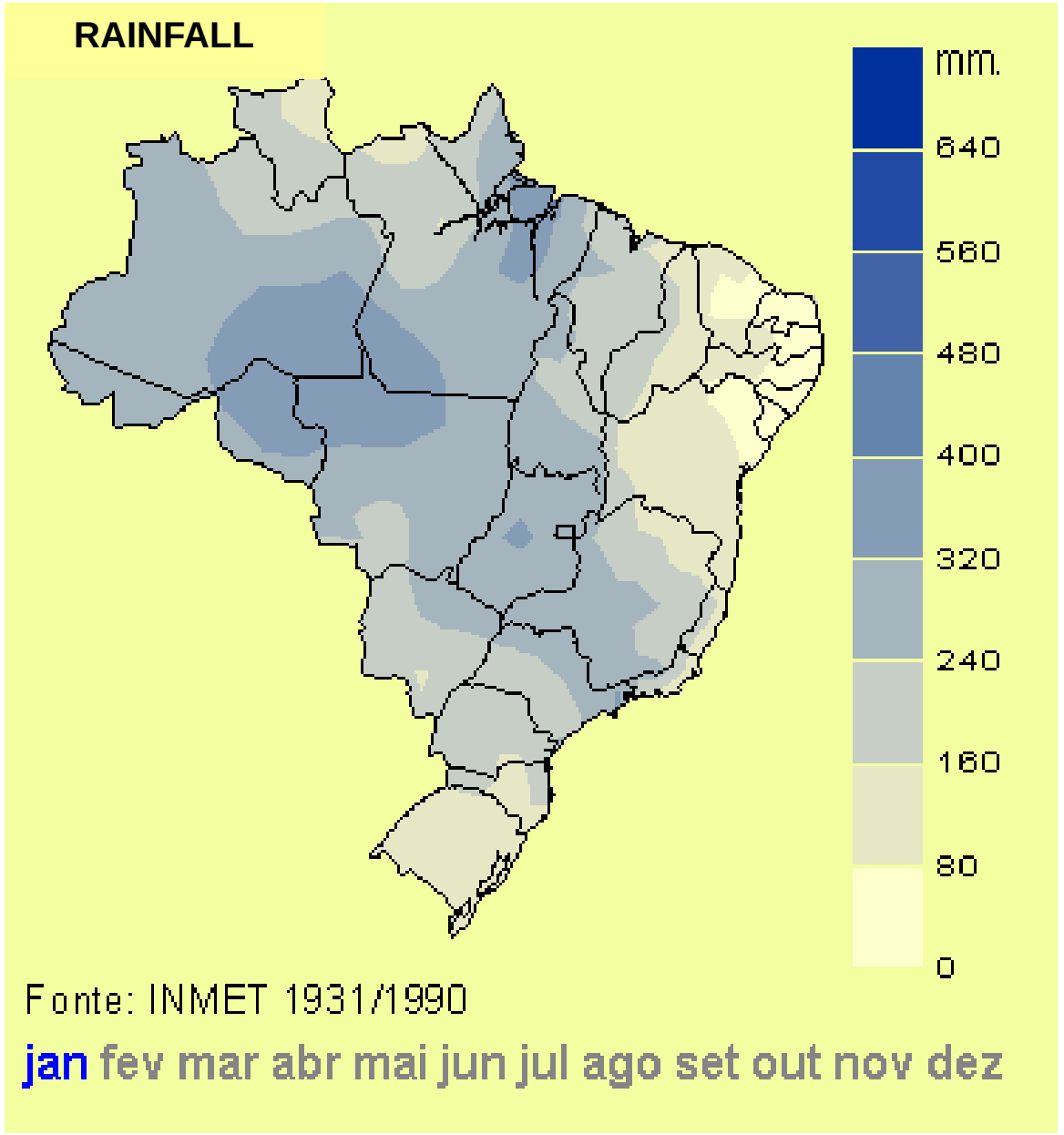
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Critical events in Brazil

Rainfall distribution

- Climate diversity
- It demands continuous monitoring
- Droughts and floods





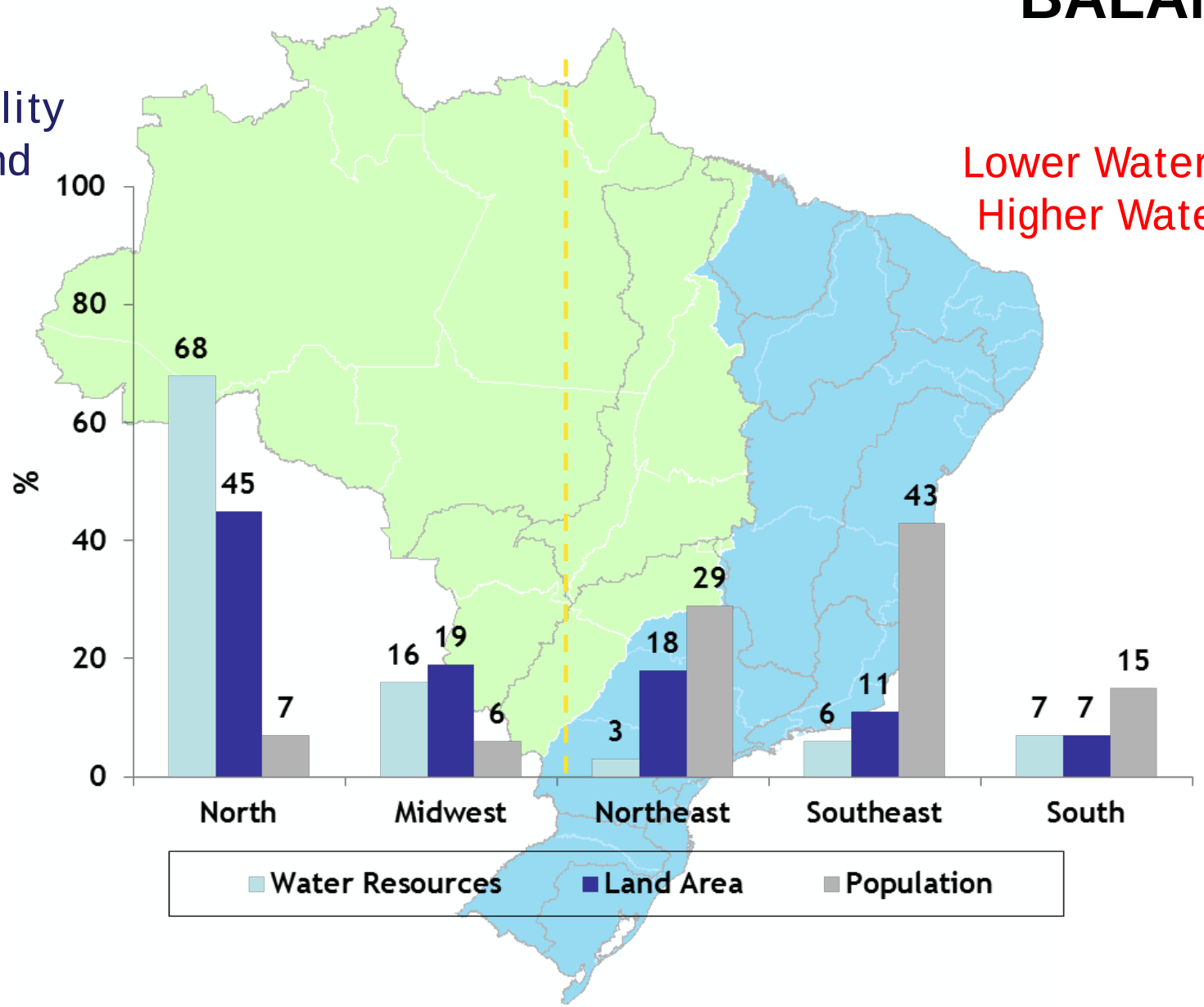
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Unequal Distribution of Water and Population

BRAZIL: WATER BALANCE

Higher Water Availability
Lower Water Demand

Lower Water Availability
Higher Water Demand



ANA
AGÊNCIA NACIONAL DE ÁGUAS

THE BRAZILIAN WATER RESOURCES POLICY

ANA
AGÊNCIA NACIONAL DE ÁGUAS

Water Resources Policy

*"Art. 21. The Federal Government is responsible for establishing a **national water resources management system** and defining criteria for water permits" - 1988*

1988

Establishes the National Water Resources Policy.

1997

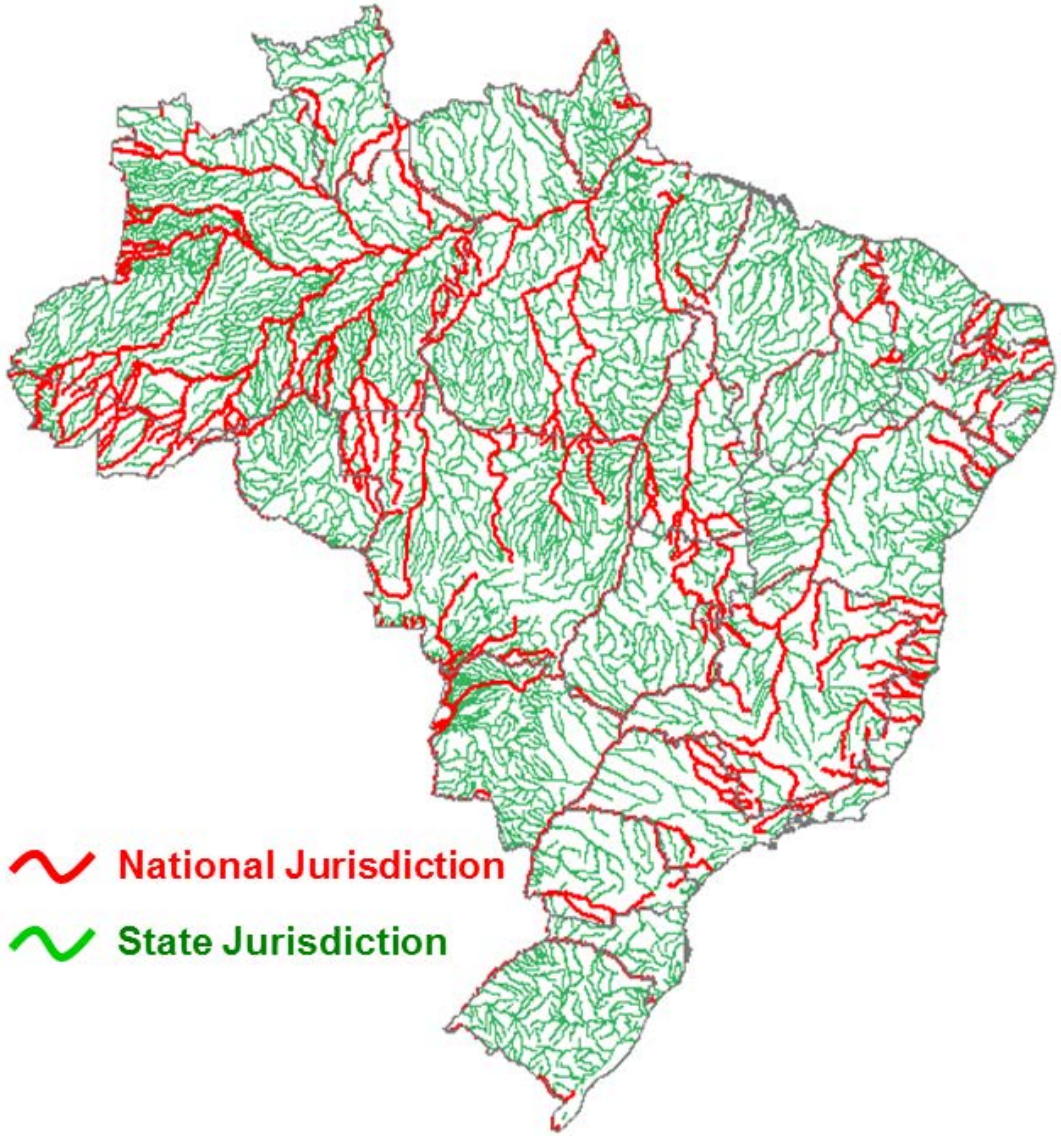
Responsible to implement the National Water resources Policy

ANA
AGÊNCIA NACIONAL DE ÁGUAS

2000

ANA
AGÊNCIA NACIONAL DE ÁGUAS

Federal Constitution of 1988
National and State Responsibilities



- *National Jurisdiction (national water resources) in the case of transboundary rivers and surface waters shared by two or more States;*

- *State Jurisdiction (state water resources) in the case of groundwater and surface water bodies not shared with other States.*

ANA
AGÊNCIA NACIONAL DE ÁGUAS

National Water Resources Policy (1997)
Basic Principles

- *Water is a public good;*
- *Water is a limited natural resource, which has economic value;*
- *During water shortages, priority in the use of water is for drinking water and for supplying livestock;*
- *The river basin is the basic territorial unit for water resources management;*
- *Water resources management shall guarantee the multiple uses of water;*
- *Water resources management shall be decentralized and open to the participation of the water users, local communities and the organized civil society.*

ANA
AGÊNCIA NACIONAL DE ÁGUAS

ANA's role (highlights)

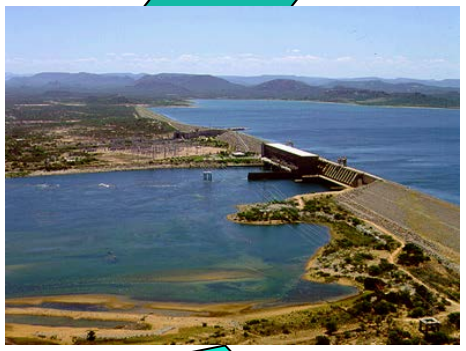
- Responsible to plan and promote actions to prevent and minimize the effects of droughts and floods;

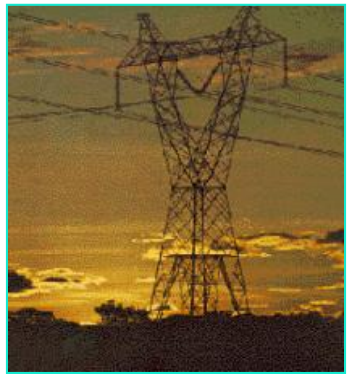
- Establish and supervise reservoir operation conditions aiming to meet all multiple uses of water

    - In articulation with the Eletric System National Operator (ONS)

ANA
AGÊNCIA NACIONAL DE ÁGUAS

HYDROPOWER

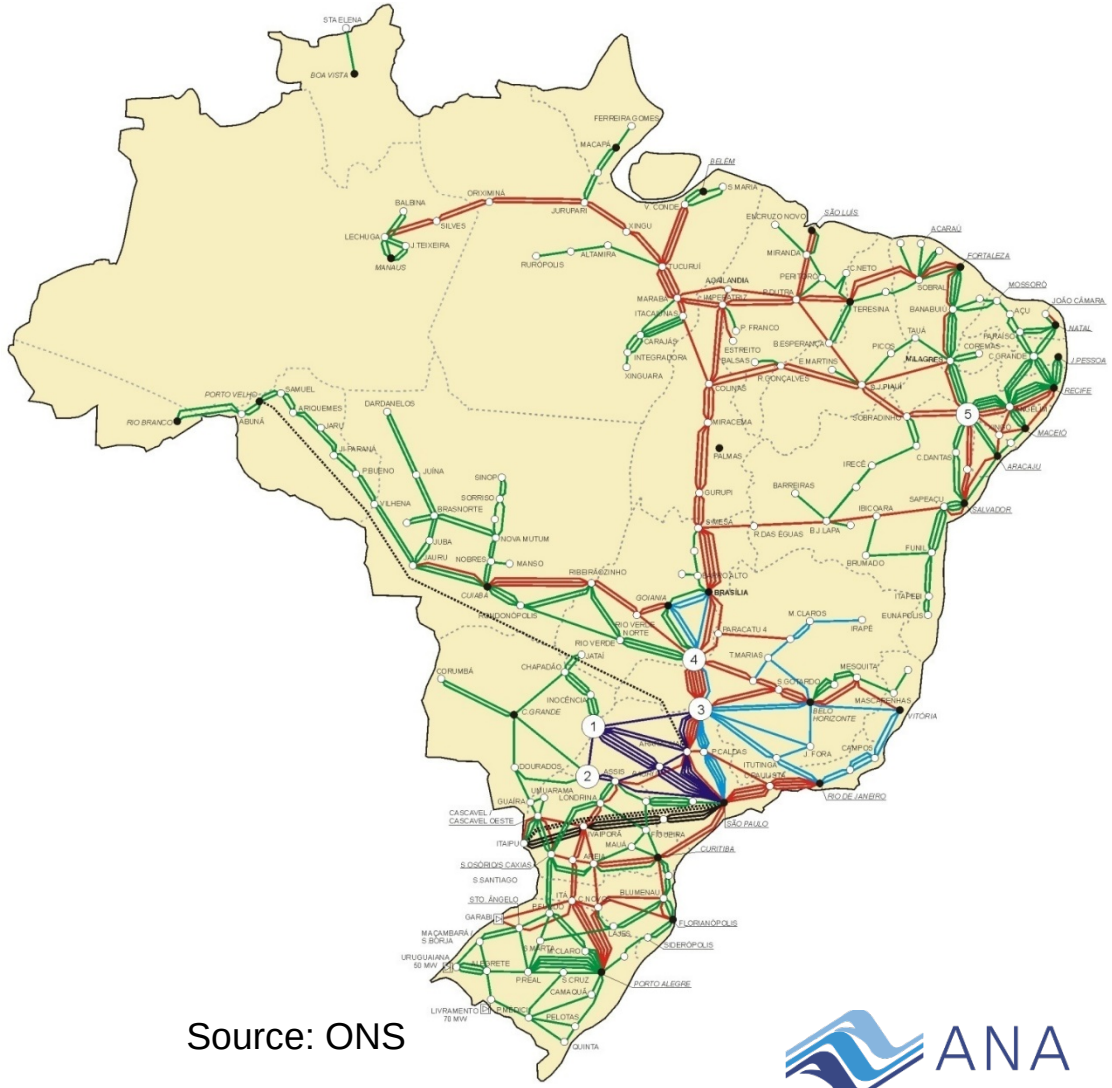




Hydroelectric power accounts for more than 66% of the total electric energy produced in Brazil

ANA
AGÊNCIA NACIONAL DE ÁGUAS

National Interconnected System (SIN)



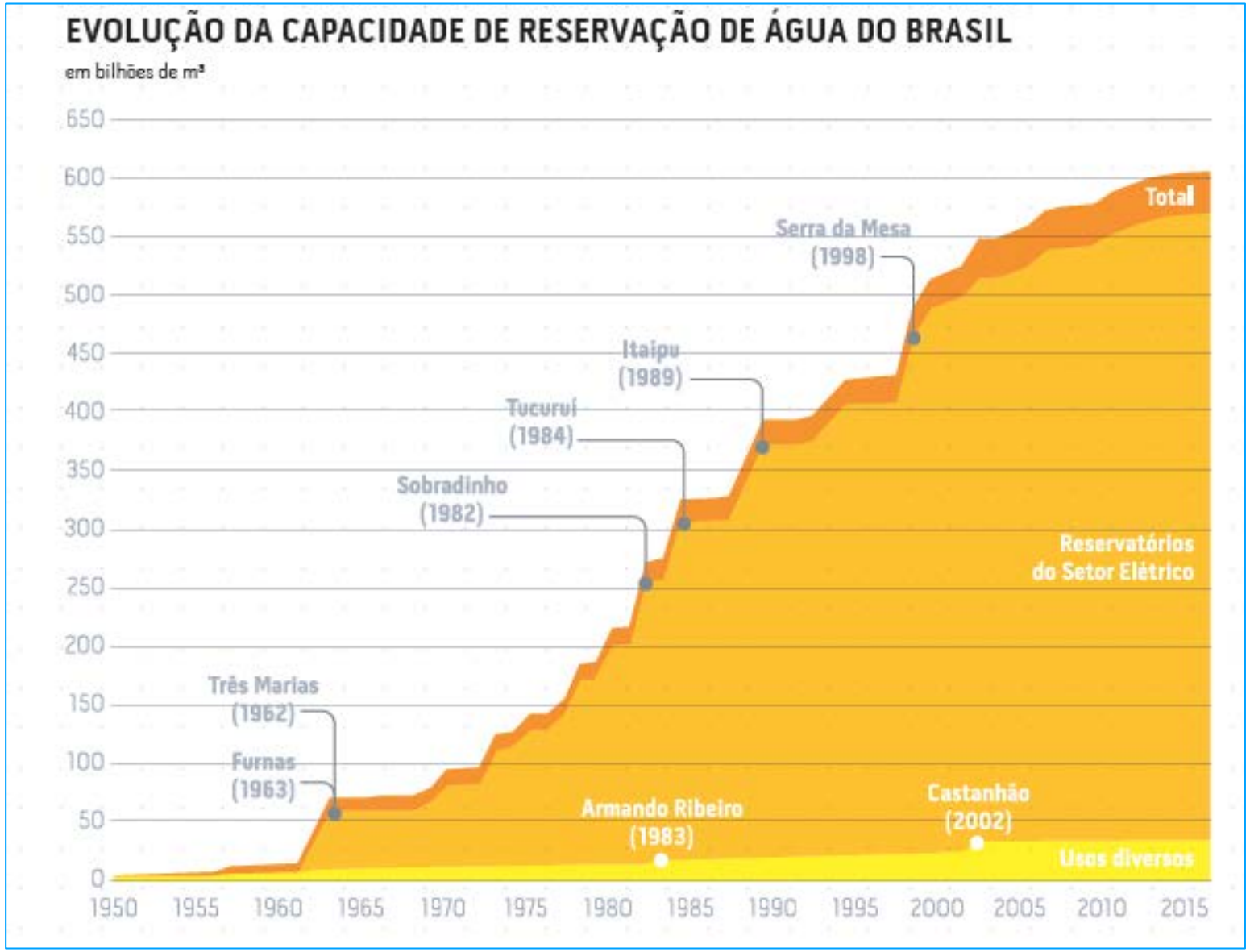
Source: ONS

ANA
AGÊNCIA NACIONAL DE ÁGUAS

Water Reservation in Brazil

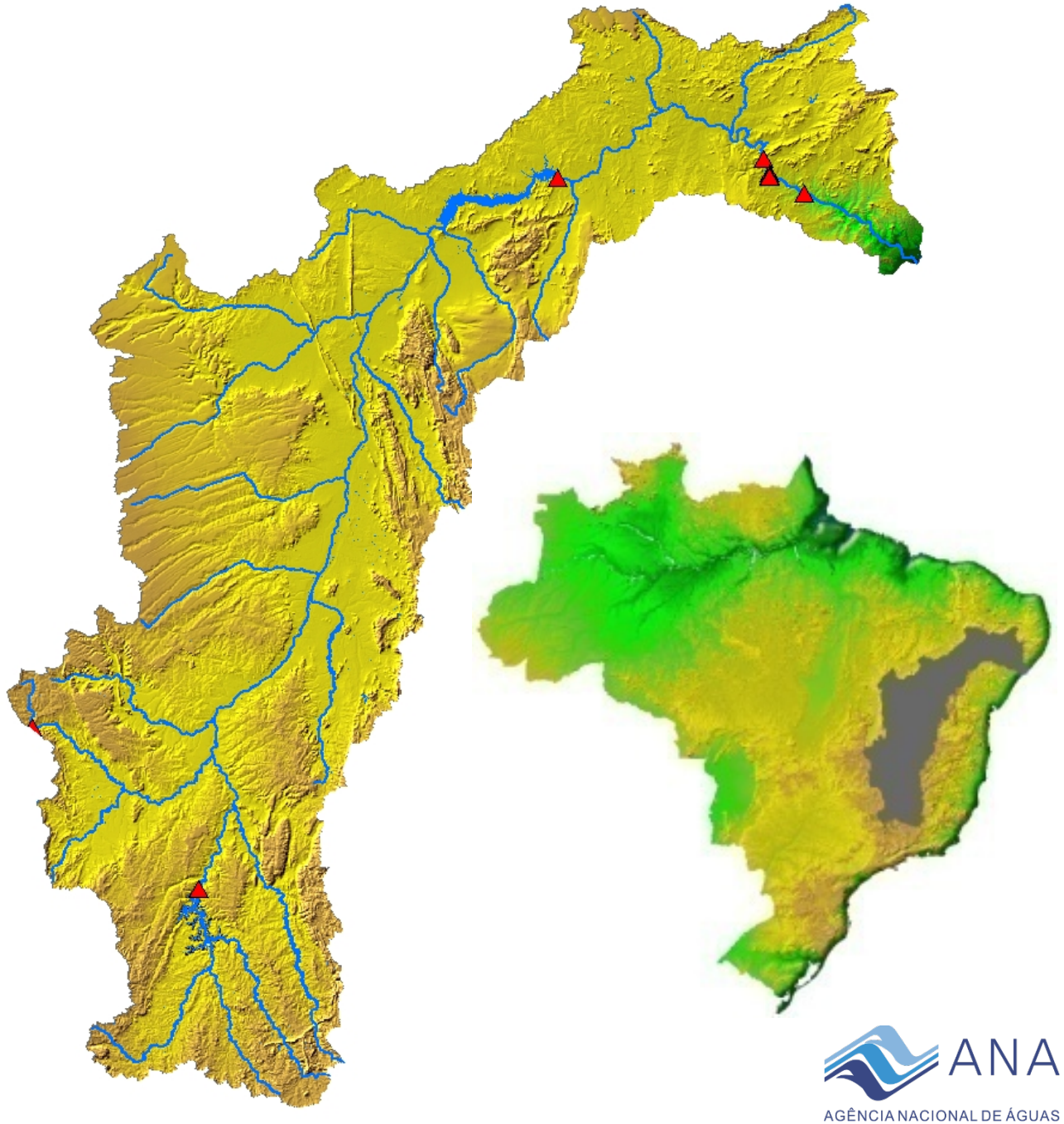
ANA
AGÊNCIA NACIONAL DE ÁGUAS

- In 2015, Brazil had a water reserve capacity of 600 billion cubic meters.
- About 95% of this total are stored in hydropower generation reservoirs.

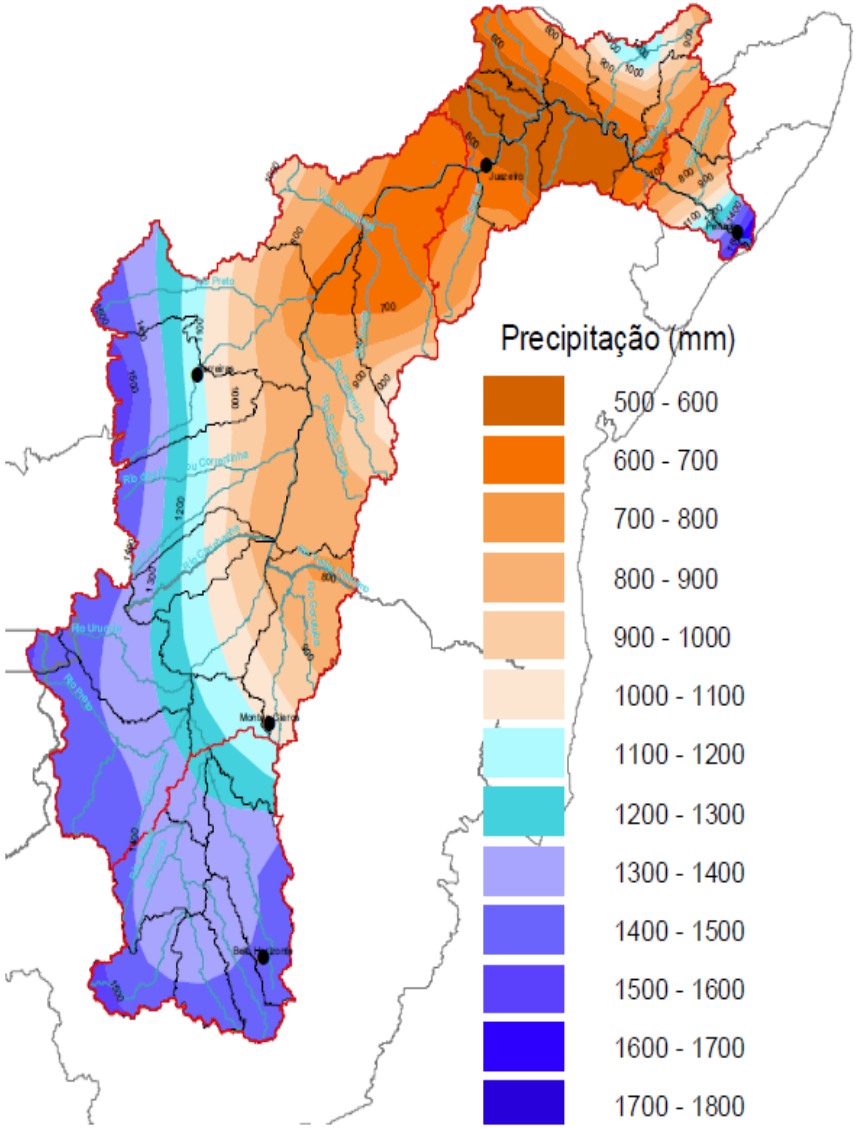


Source: Conjuntura dos Recursos Hídricos no Brasil, 2018

SCARCITY IN THE SÃO FRANCISCO RIVER WATERSHED (2012)



ANA
AGÊNCIA NACIONAL DE ÁGUAS

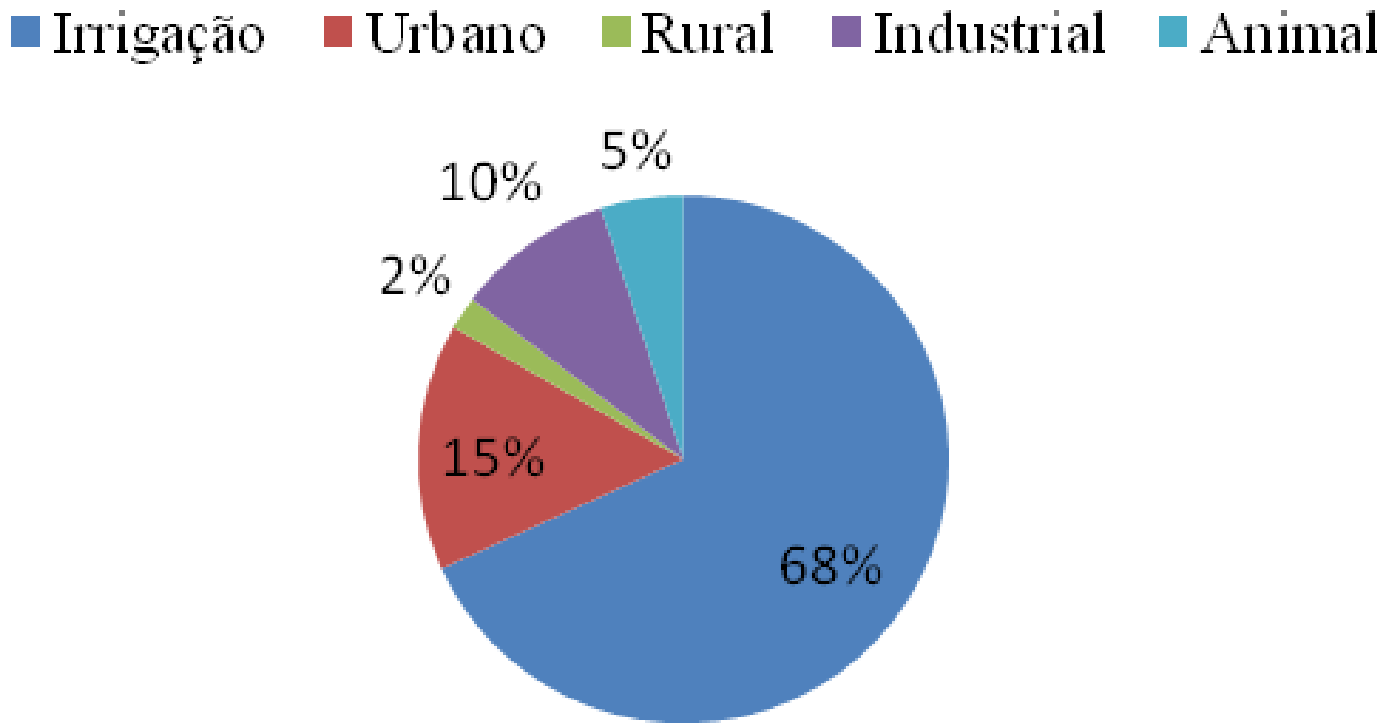


São Francisco river watershed

- Area – 634.781 km²
- River length – 2.700 km
- Population – 13 million inhabitants
- Average flow in the mouth – 2.850 m³/s

ANA
AGÊNCIA NACIONAL DE ÁGUAS

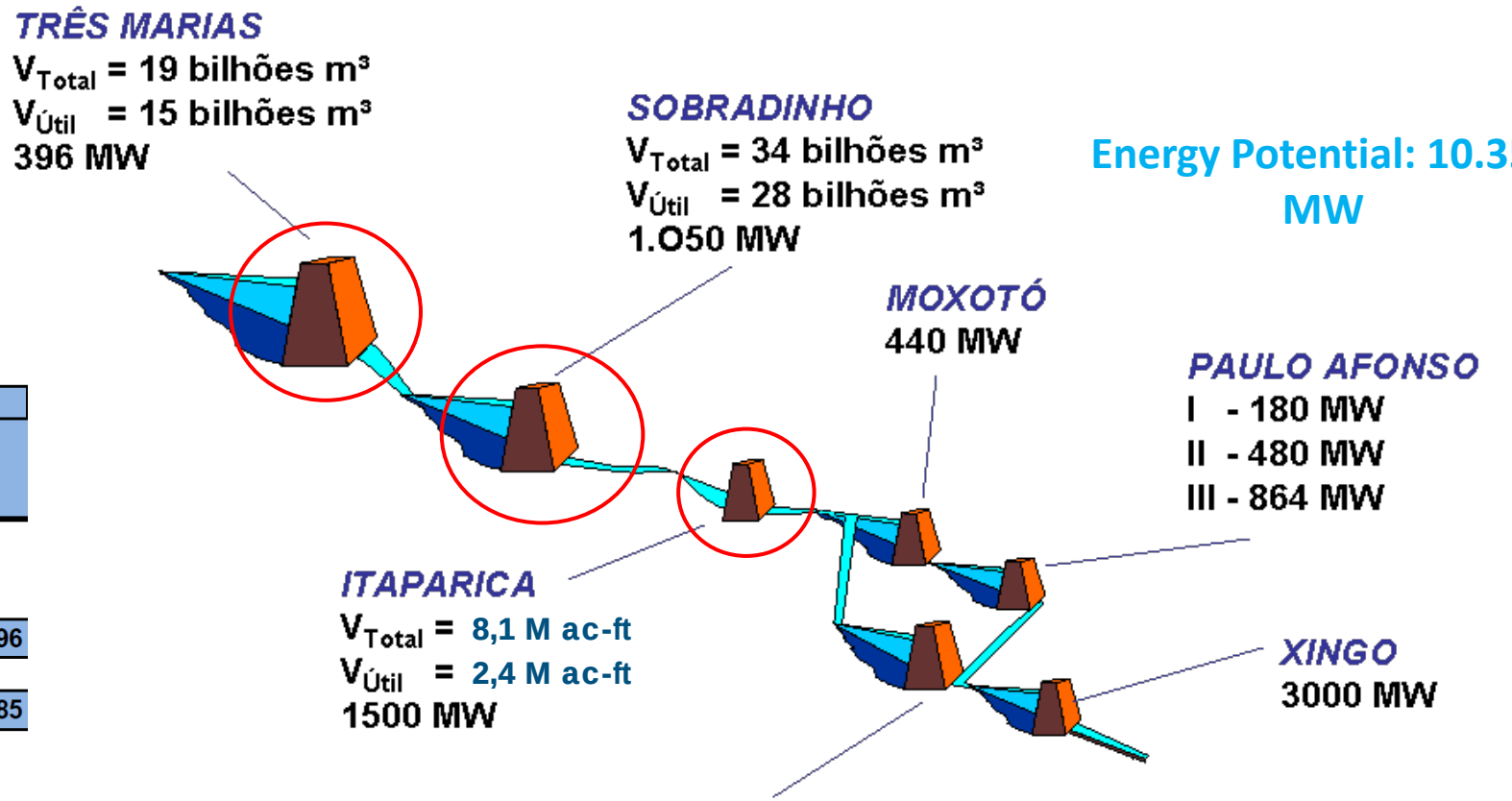
Distribution of demand for water resources in the São Francisco river watershed



ANA
AGÊNCIA NACIONAL DE ÁGUAS

São Francisco's chain of powerplants

Características			
RESERVATÓRIOS	Volume Máximo (hm³)	Volume Mínimo (hm³)	Volume Útil (hm³)
Três Marias	19.528,0	4.250	15.278
Sobradinho	34.117,0	5.448	28.669
Itaparica	10.782,0	7.233	3.549
Reservatório Equivalente	**64.427,0**	**16.931**	**47.496**
Queimado	477,97	88,51	389,46
Total	**64.905,0**	**17.020**	**47.885**



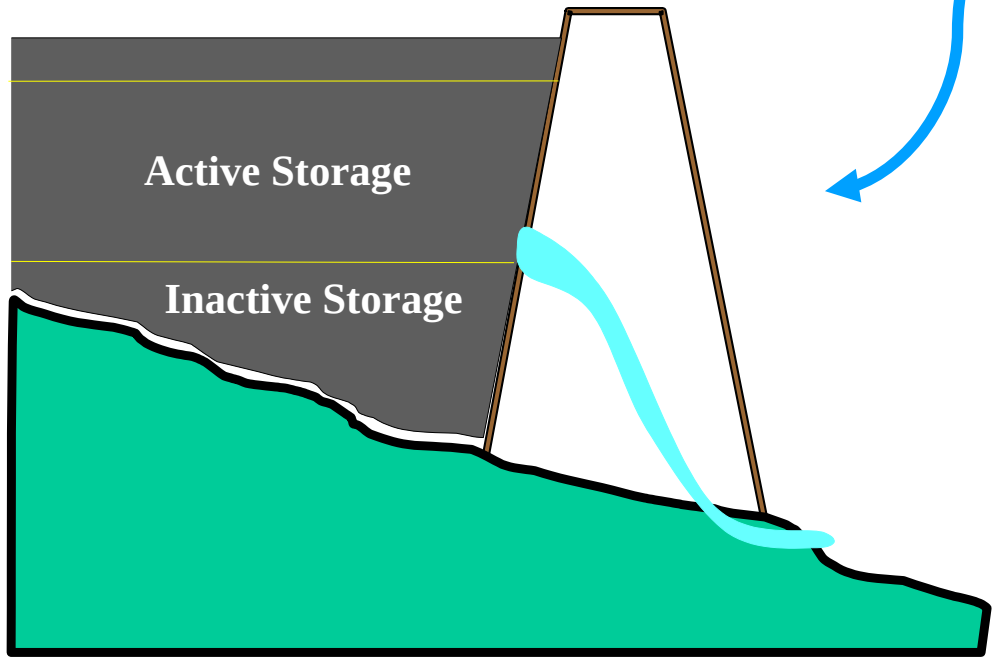
Energy Potential: 10.356 MW

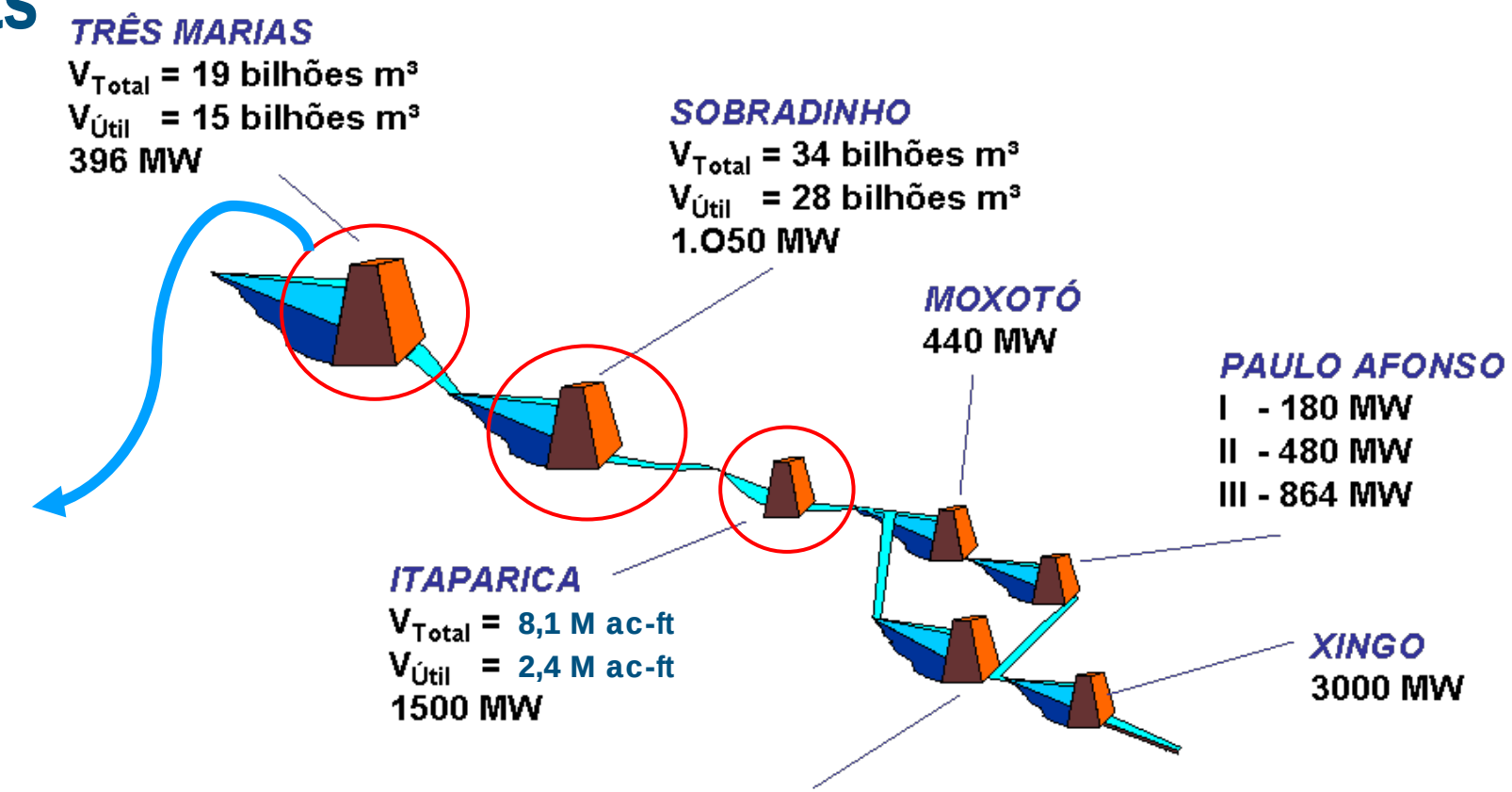
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Potencial energético: 10.356 MW = 17% energia do país

São Francisco's chain of powerplants

Major constraints:





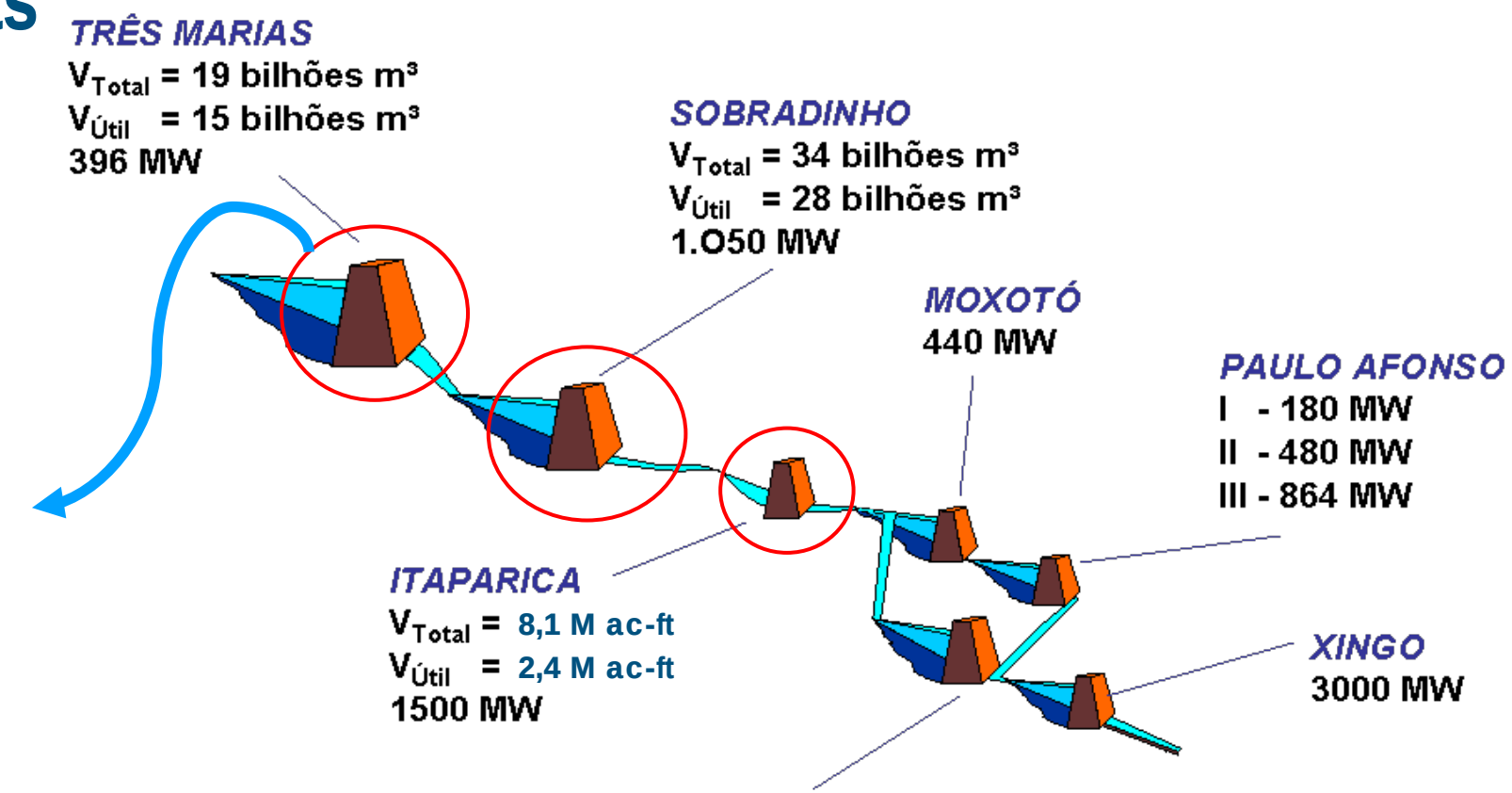
Potencial energético: 10.356 MW = 17% energia do país

ANA
AGÊNCIA NACIONAL DE ÁGUAS

São Francisco's chain of powerplants

Major constraints:

Minimum discharge 350 to 550 m³/s

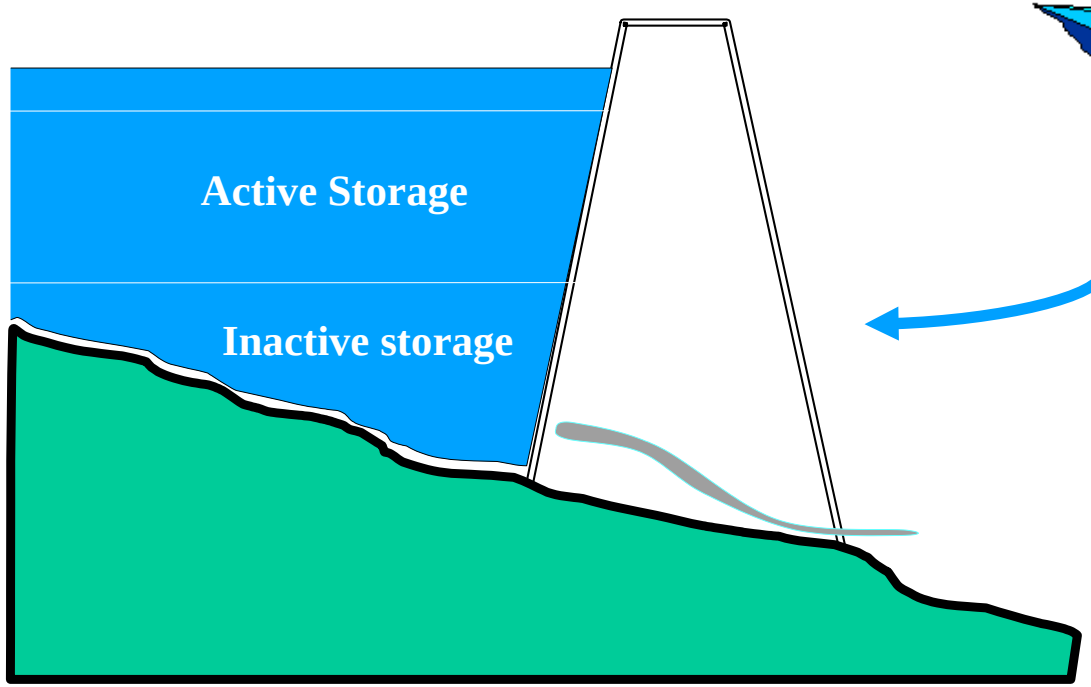


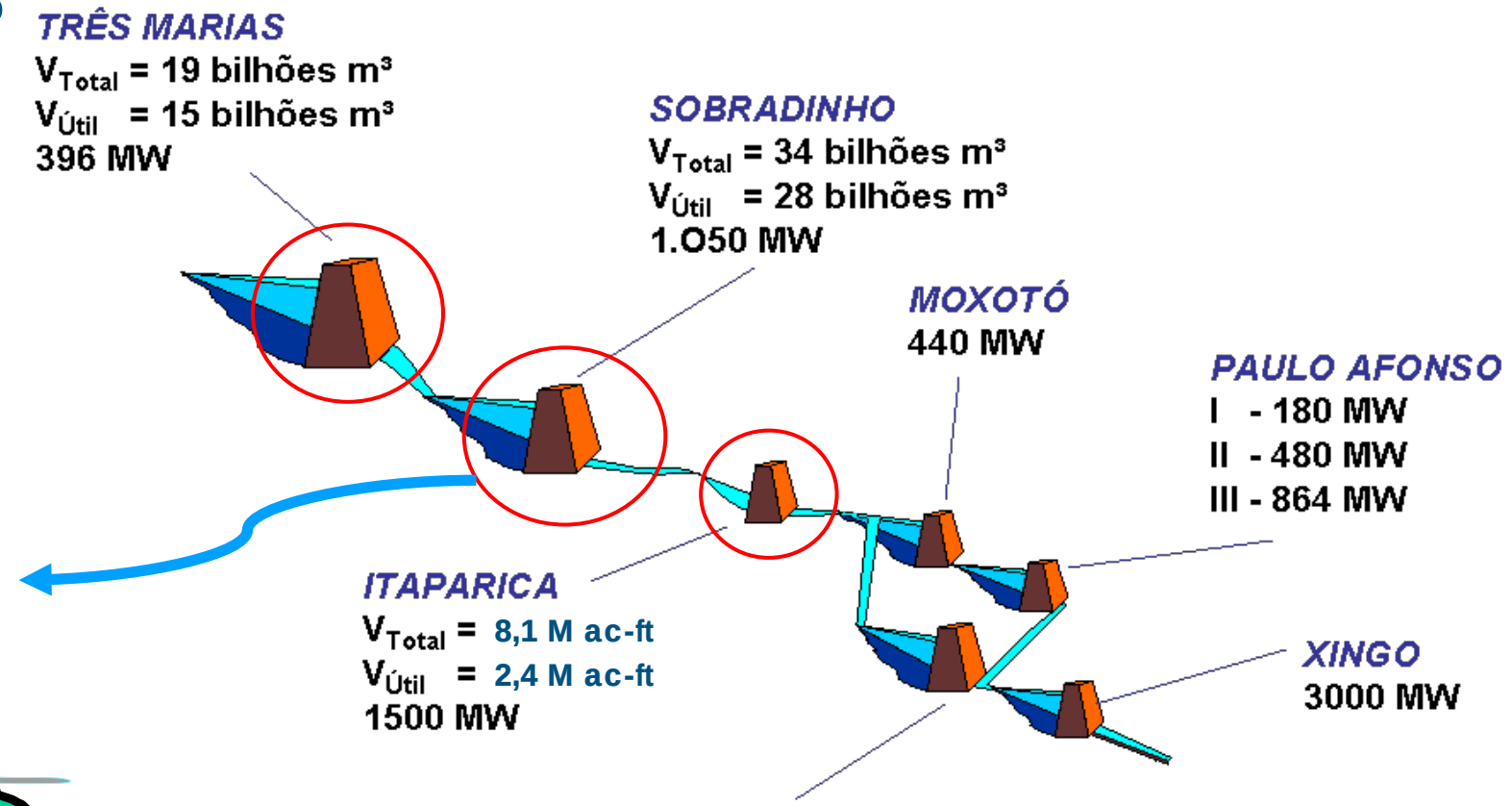
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Potencial energético: 10.356 MW = 17% energia do país

São Francisco's chain of powerplants

Major constraints:





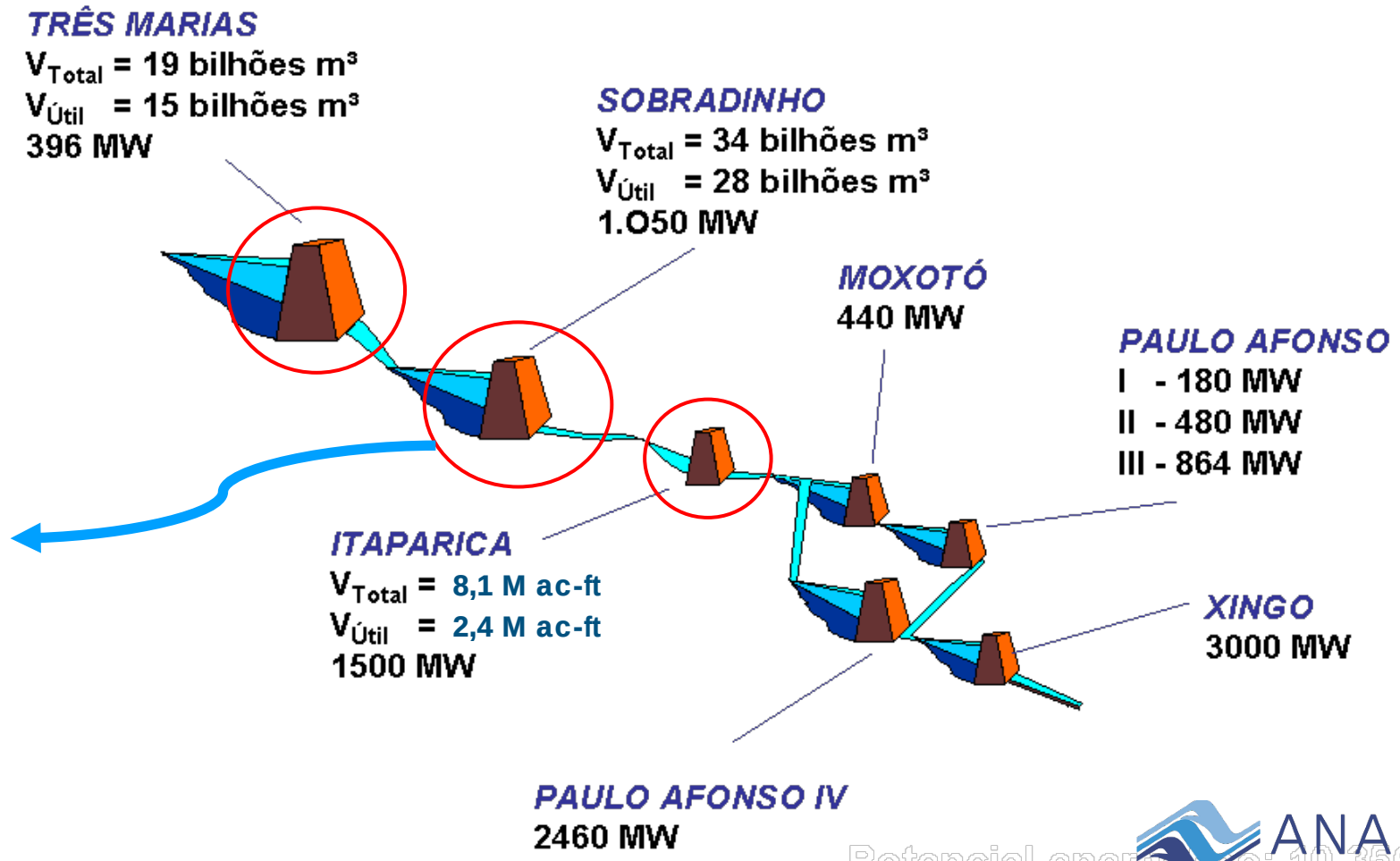
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Potencial energético: 10.356 MW = 17% energia do país

São Francisco's chain of powerplants

Major constraints:

Minimum discharge
1.300 m³/s



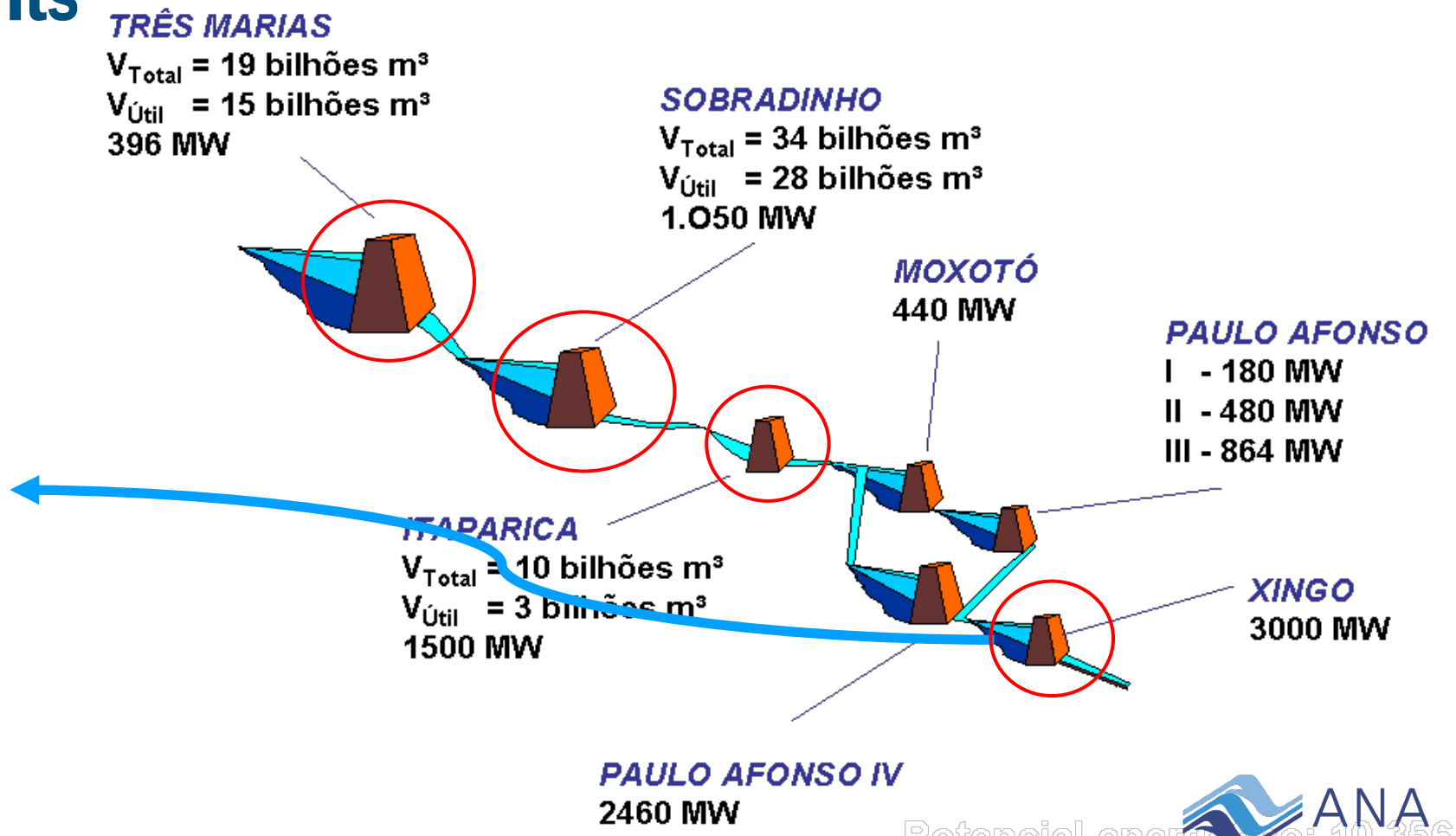
ANA
AGÊNCIA NACIONAL DE ÁGUAS

Potencial energético: 10.356 MW = 17% energia do país

São Francisco's chain of powerplants

Major constraints:

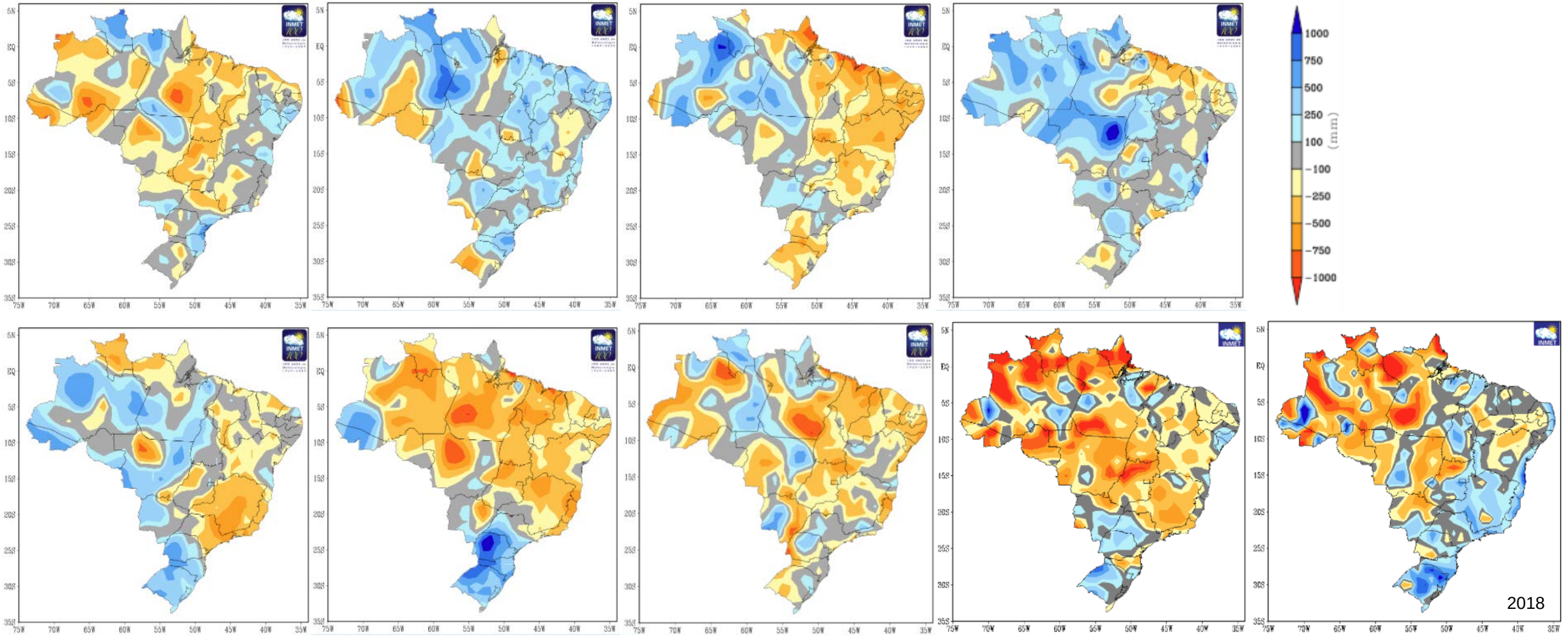
Minimum discharge
1.300 m³/s



ANA
AGÊNCIA NACIONAL DE ÁGUAS

Potencial energético: 10.356 MW = 17% energia do país

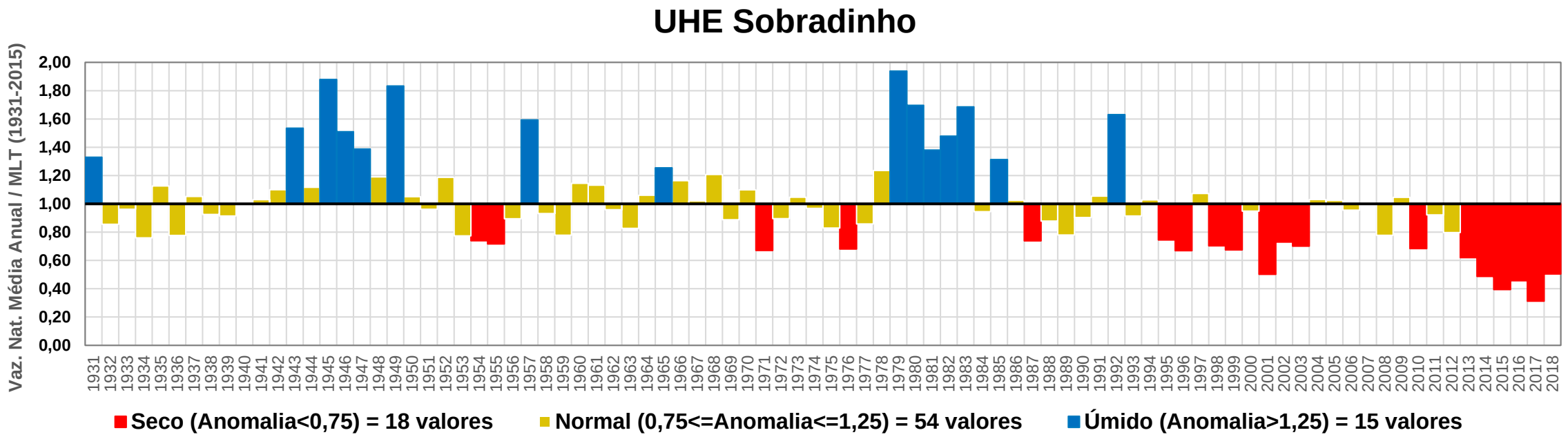
Precipitation anomaly

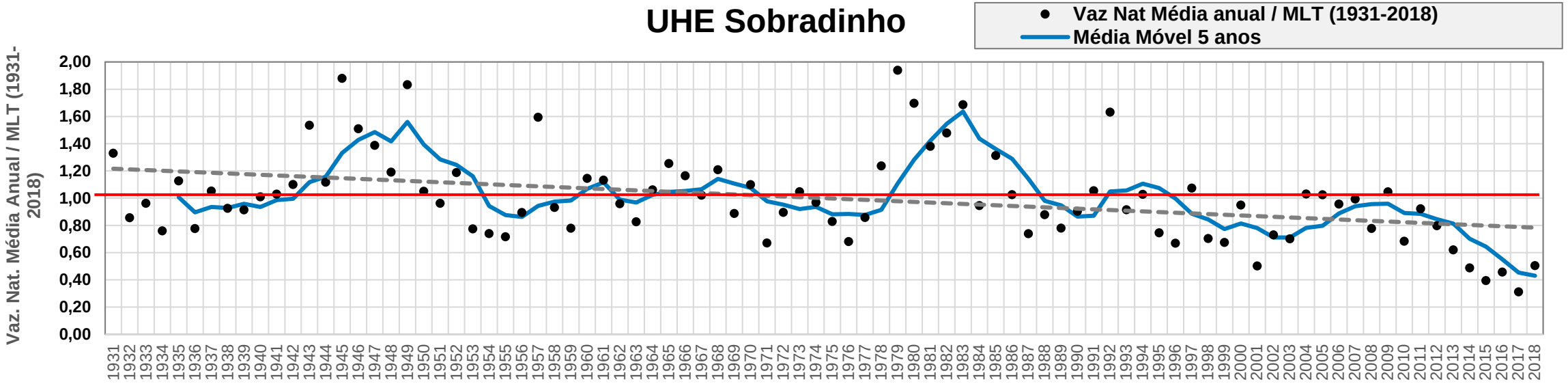


Source: Instituto Nacional de Meteorologia (INMET)

ANA
AGÊNCIA NACIONAL DE ÁGUAS

Sobradinho Reservoir – river flow and anomalies





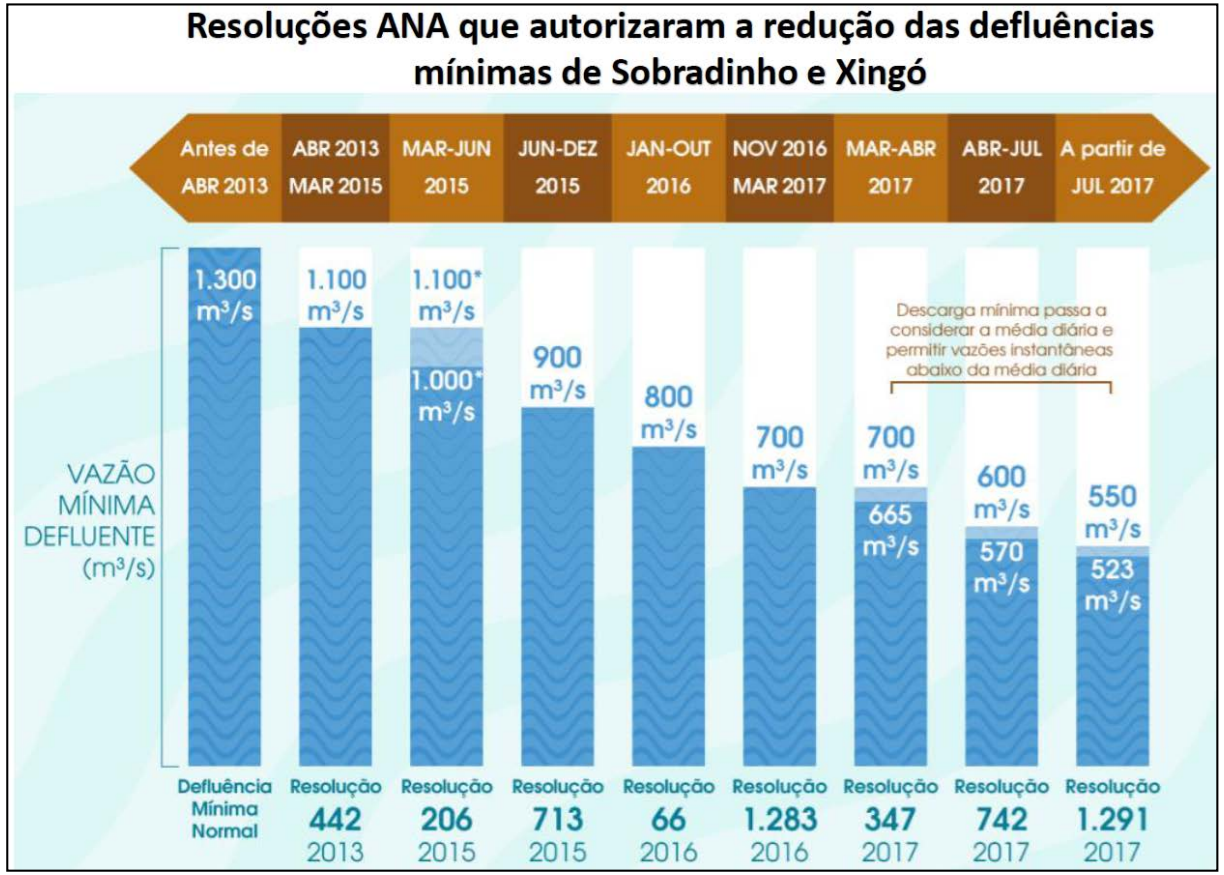
SÃO FRANCISCO WATERSHED (Crisis room– 2013 a 2019)

Promotes articulation with different agencies, users and sectors to monitor the situation, draw scenarios, search and implement actions to mitigate the impacts

ANA
AGÊNCIA NACIONAL DE ÁGUAS

SÃO FRANCISCO WATERSHED (Crisis Room– 2013 a 2019)

- **Measures:**
  - **Outflow adjustments (Resolutions)**
  - **Maintenance of strategic volumes**
  - **continuous monitoring**
  - **adaptation of some intakes**
  - **Demand management– Dia do Rio**

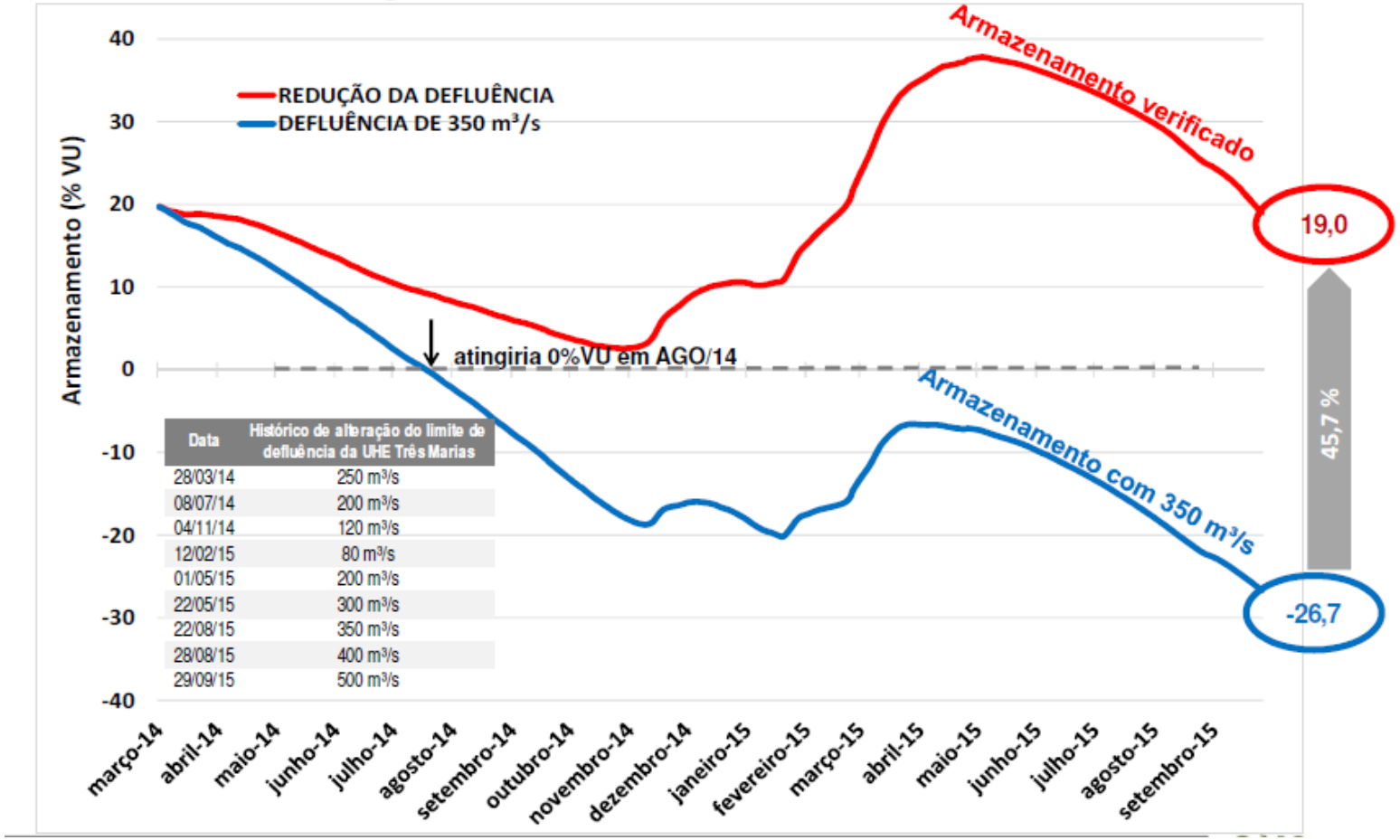


ANA
AGÊNCIA NACIONAL DE ÁGUAS

BACIA DO SÃO FRANCISCO
(Sala de Crise – 2013 a 2019)

Ganhos com a Operação Adotada em 2014/2015

Flexibilização da Defluência Mínima na UHE Três Marias



Data	Histórico de alteração do limite de defluência da UHE Três Marias
28/03/14	250 m³/s
08/07/14	200 m³/s
04/11/14	120 m³/s
12/02/15	80 m³/s
01/05/15	200 m³/s
22/05/15	300 m³/s
22/08/15	350 m³/s
28/08/15	400 m³/s
29/09/15	500 m³/s

Source: ONS

ANA
AGÊNCIA NACIONAL DE ÁGUAS

SÃO FRANCISCO WATERSHED (Crisis Room– 2013 a 2019)

The uses of water were impacted in different degrees

- Reduction in hydroelectric generation since 2013;
- Paralyzed commercial navigation since 2014;
- Intakes had to be adapted to lower levels and more distant point;
- High levels of salt intrusion on the lower part of the basin;
- Irrigation and industry (Dia do Rio, since 2017);
- Water quality (Algae bloom)
- Cultural uses – boat processions.

ANA
AGÊNCIA NACIONAL DE ÁGUAS

WHAT IS WATER SECURITY ?

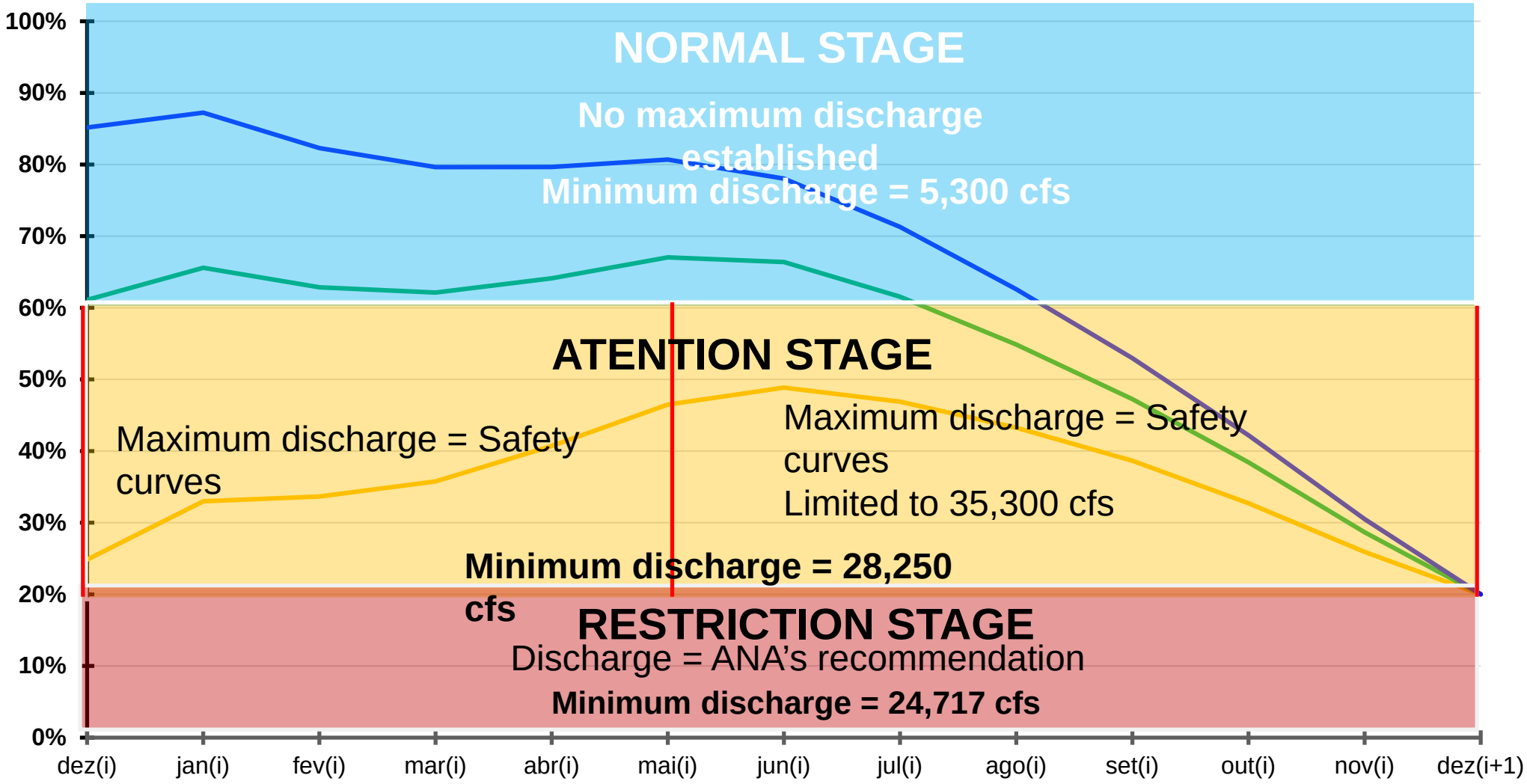
Acoording to the United Nations:

“The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.”.

NEW OPERATION RULES
Resolução ANA N° 2.081/2017

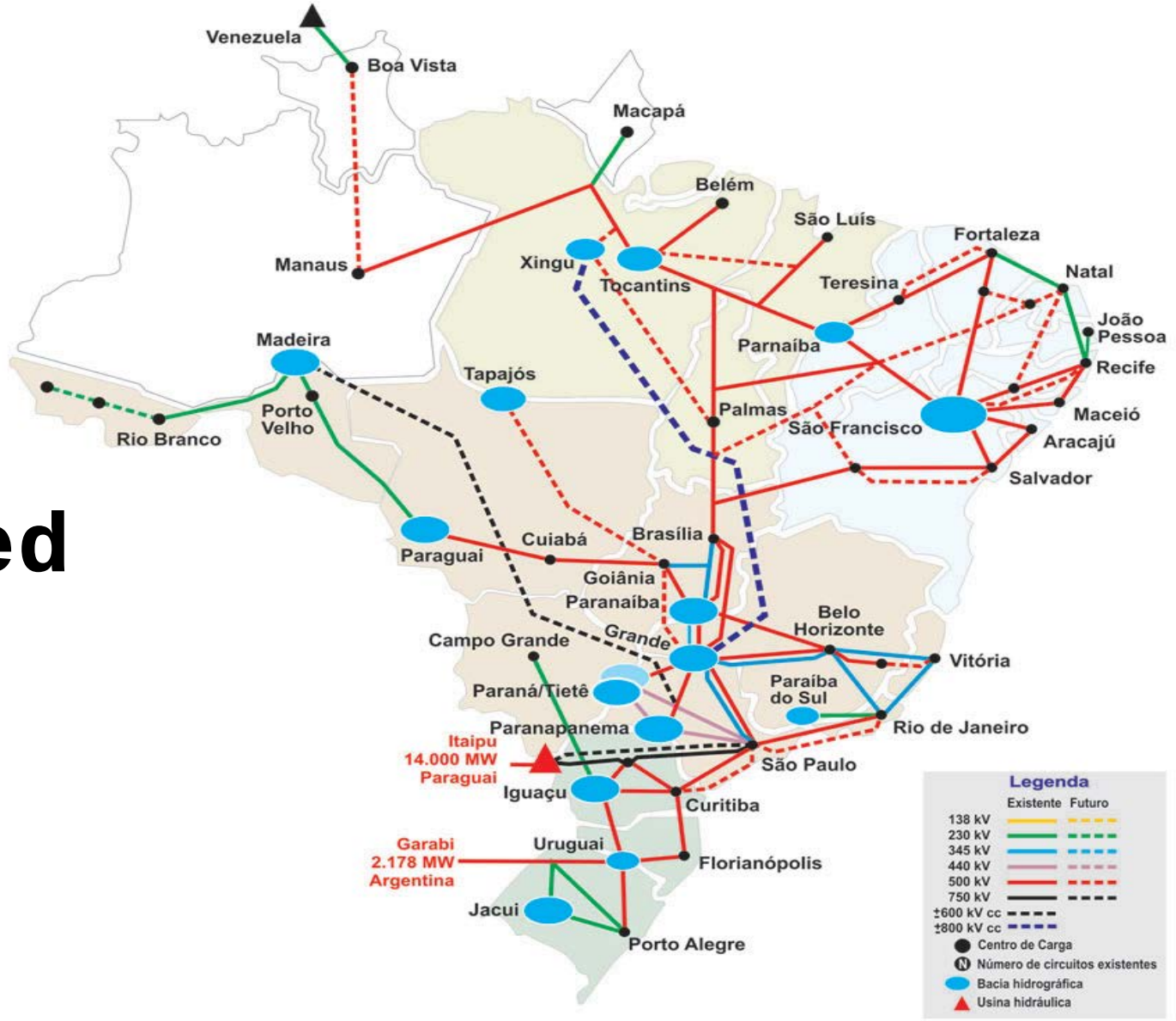
- Establishes operation stages (Normal, Atention and Restriction)
- Distinct operation conditions for the dry and wet season
- Establishes boundary conditions to allow the realization of pulses in Três Marias and Xingó to serve marginal lagoons and ichthyofauna
- Increased resilience to extreme drought events
- Gradual recovery of storage levels
- It took effect in may 1st 2019

SOBRADINHO'S OPERATION STAGES



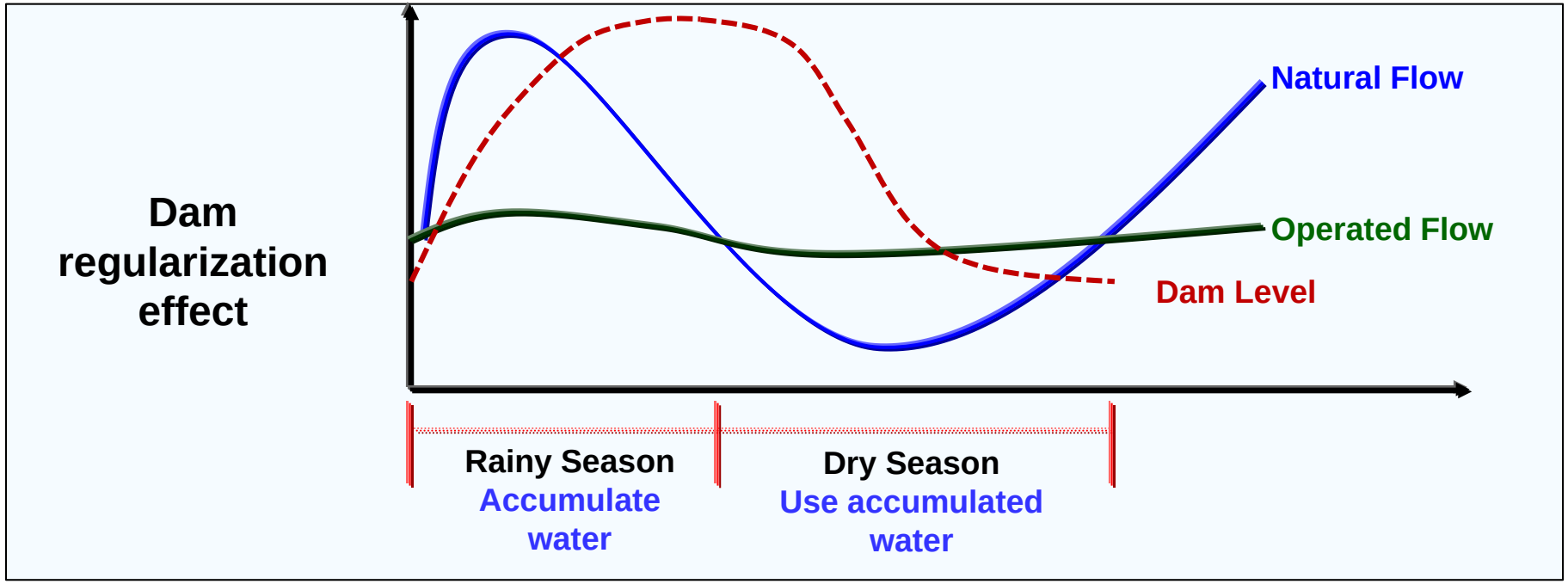
ANA
AGÊNCIA NACIONAL DE ÁGUAS

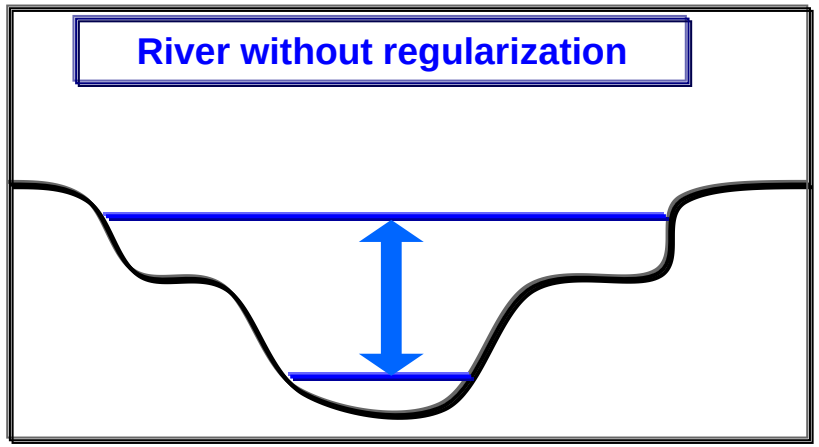
Flood Control in the Brazilian Interconnected Eletric System

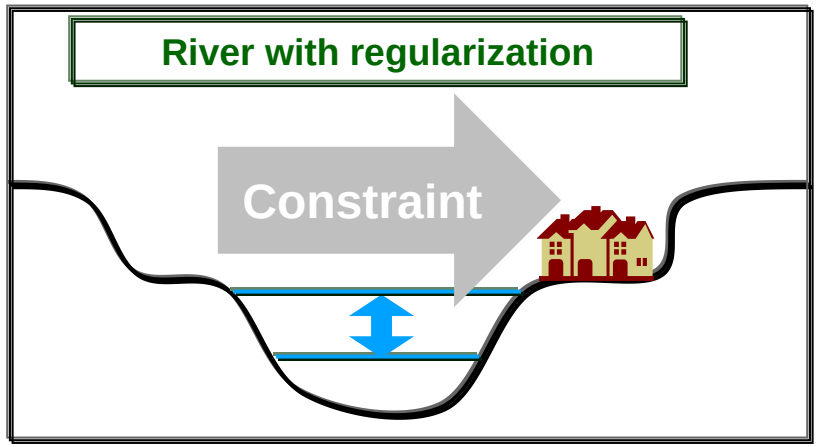


ANA
AGÊNCIA NACIONAL DE ÁGUAS

The outflow constraint genesis

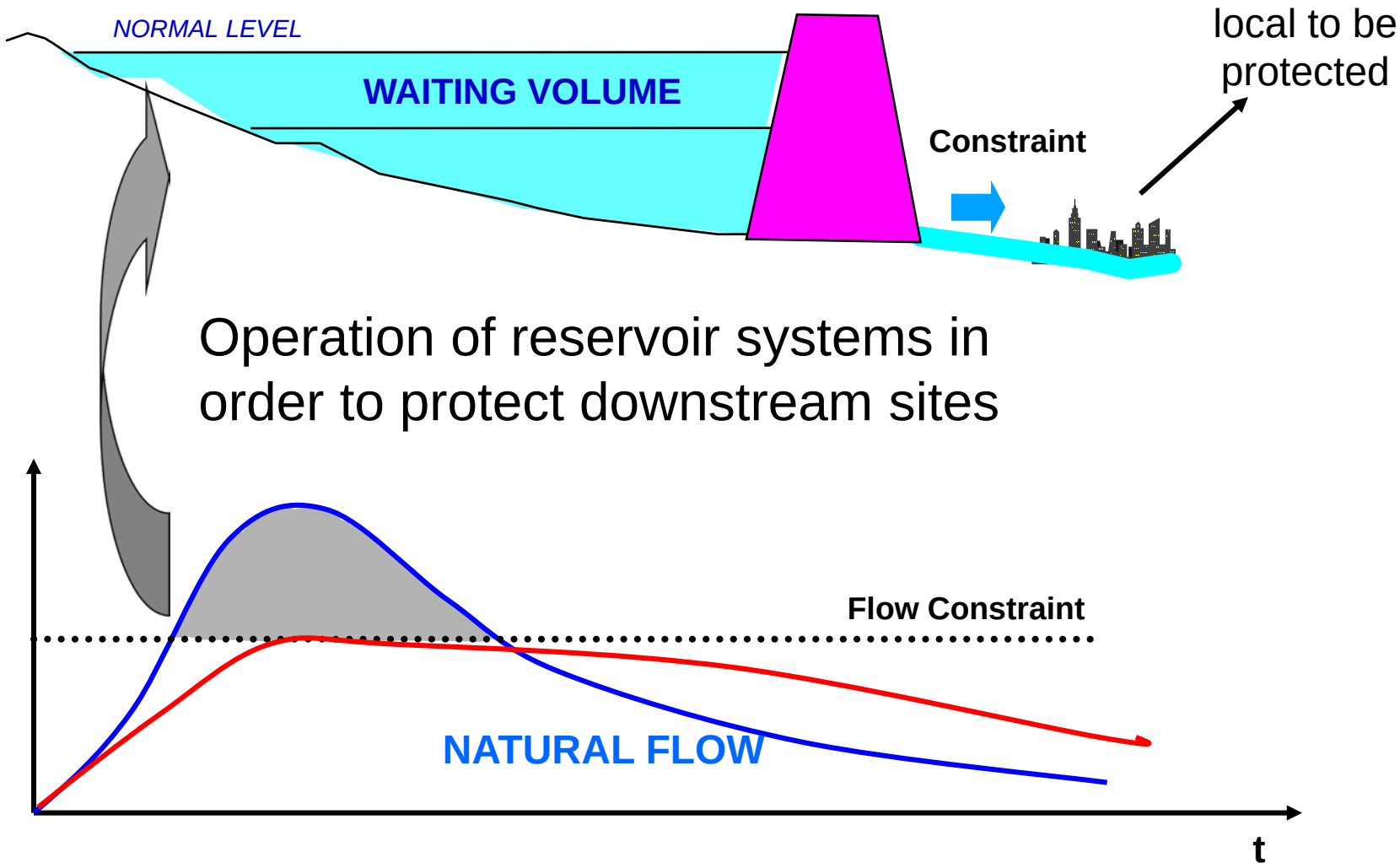




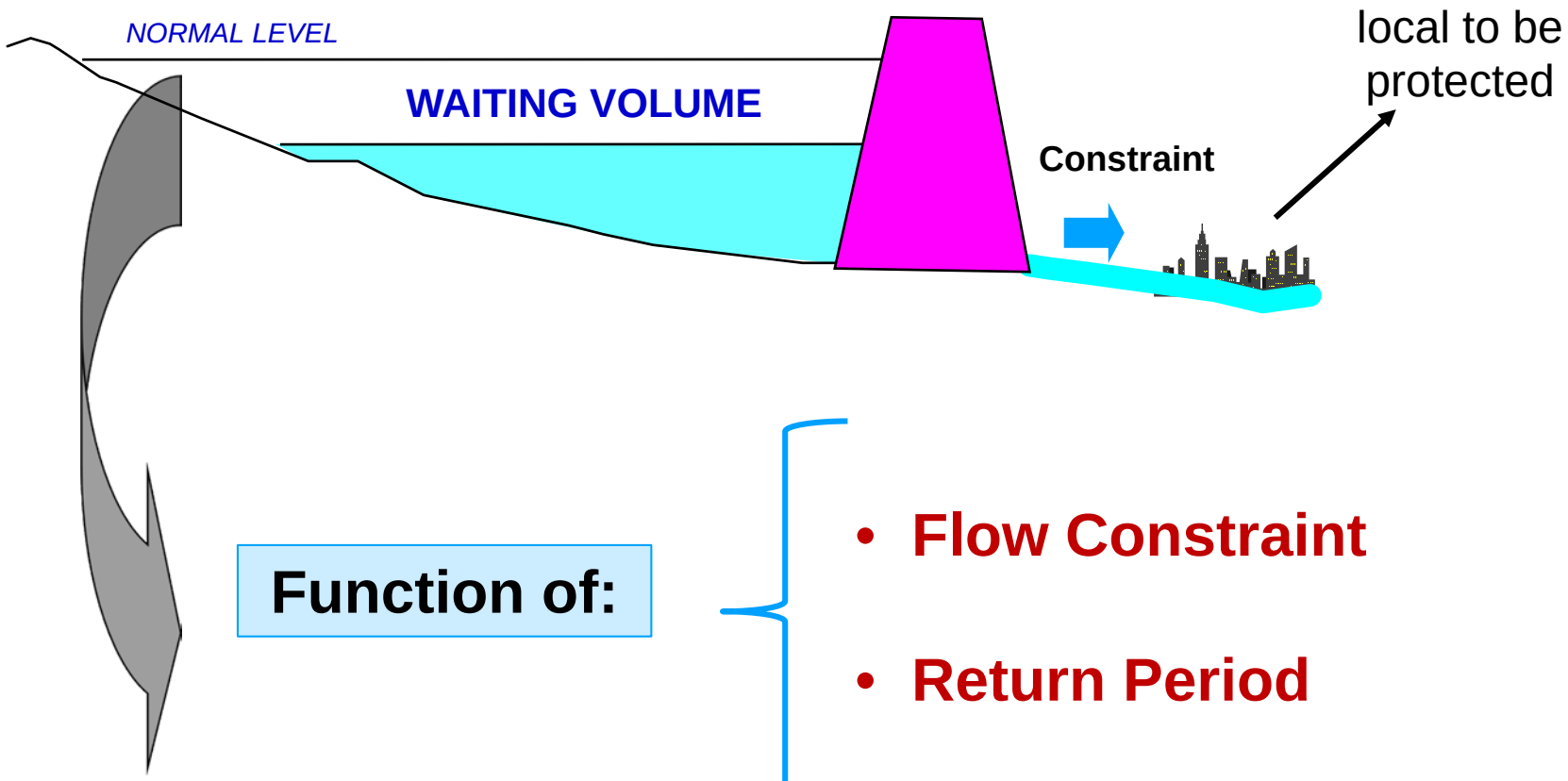


ANA
AGÊNCIA NACIONAL DE ÁGUAS

Flood control problem - concept



Flood control problem - concept

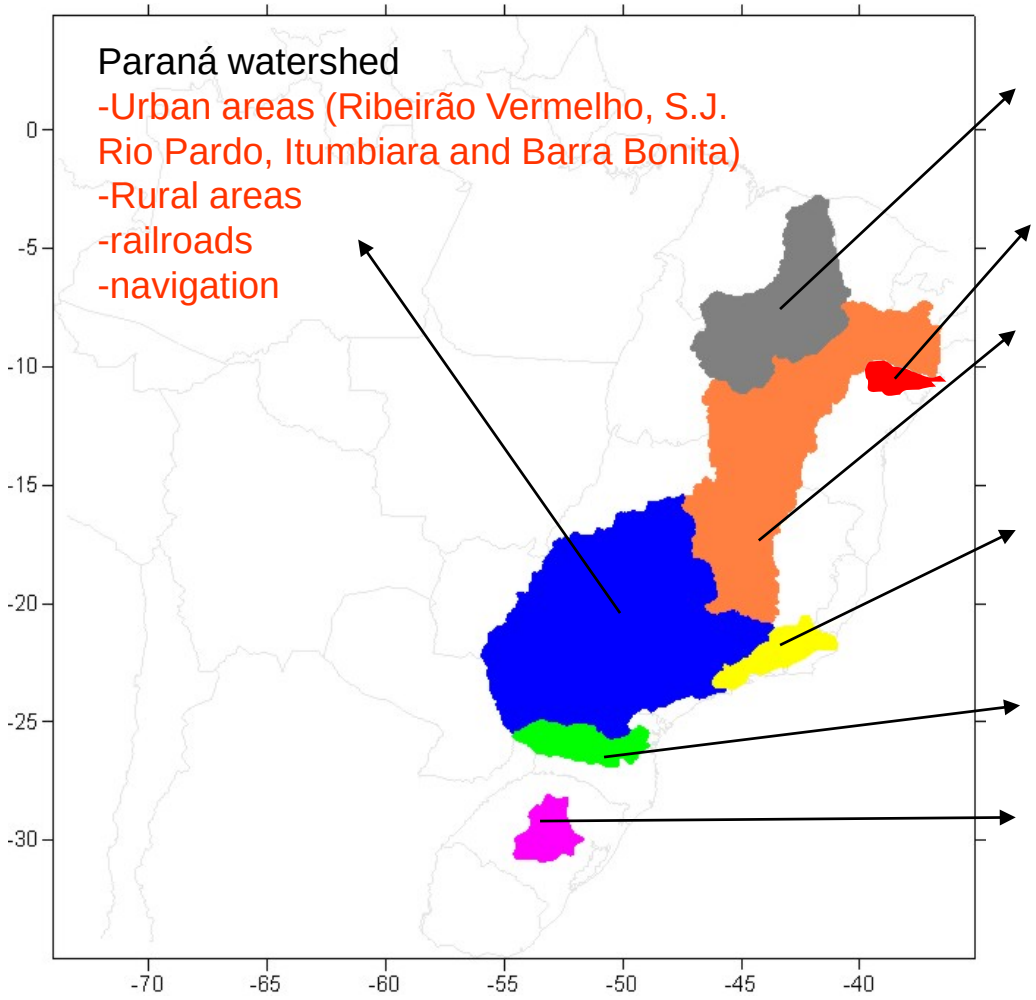


Function of:

- **Flow Constraint**
- **Return Period**

ANA
AGÊNCIA NACIONAL DE ÁGUAS

Where does it apply



Paraná watershed
-Urban areas (Ribeirão Vermelho, S.J. Rio Pardo, Itumbiara and Barra Bonita)
-Rural areas
-railroads
-navigation

Parnaíba watershed
-Urban areas (Teresina and Floriano)

Jequitinhonha watershed
-Urban areas (Coronel Murta)

São Francisco watershed
- urban areas (Pirapora, Juazeiro, Petrolina, Traipu and São Brás)

Paraíba do Sul watershed
-urban areas (Guararema, Jacareí, Resende, Barra Mansa and Volta Redonda)

Iguaçu watershed
- urban areas (União da Vitória and Porto União)

Jacuí watershed
-urban areas

ANA
AGÊNCIA NACIONAL DE ÁGUAS

CHALLENGES AND OPORTUNITIES

CHALLENGES

- **Stationarity loss of hydrological series**
- **Extreme events – droughts and floods – tend to occur more frequently and more intensily**

OPPORTUNITIES

- **We must be prepared for current crises to be able to meet the challenges ahead**
- **No-regret and low-regret adaptation strategies**
  - Emphasis on water/reservoir management measures
  - Increase flexibility and resilience

TALK TO ANA

#AÁguaÉUmaSó

TELEPHONE

(61) 2109-5400 / 5252

@anagovbr

ADDRESS

Setor Policial (SPO), Área 5, Quadra 3, Blocos B, L, M, N, O e T, Brasília (DF), 70610-200.

www.ana.gov.br

Antonio Augusto Borges de Lima

antonio.lima@ana.gov.br

Thank you!

Till next time.

ANA AGÊNCIA NACIONAL DE ÁGUAS

MINISTÉRIO DO DESENVOLVIMENTO REGIONAL

PÁTRIA AMADA BRASIL GOVERNO FEDERAL