AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

Energy made present.

The case study of Brazil Solar energy in the Brazilian electric matrix:

Overview and challenges

VI CEER-ARIAE MEETING

ANDRÉ PEPITONE DA NÓBREGA
ANEEL's DIRECTOR

2017, 20 April - Brasília - DF

BRAZIL SUMMARY

Territorial area 8.515 million km^2 (86% of USA)

Total population - 2014 202 million inhabitants (63,5% of USA)

Population annual growth 1.200.000/year

Monthly new residential consumers 125.000

Overall GDP - 2014 U$1.715 billion

Installed capacity 151.596 MW

Peak load 85.708 MW (Feb 2014)

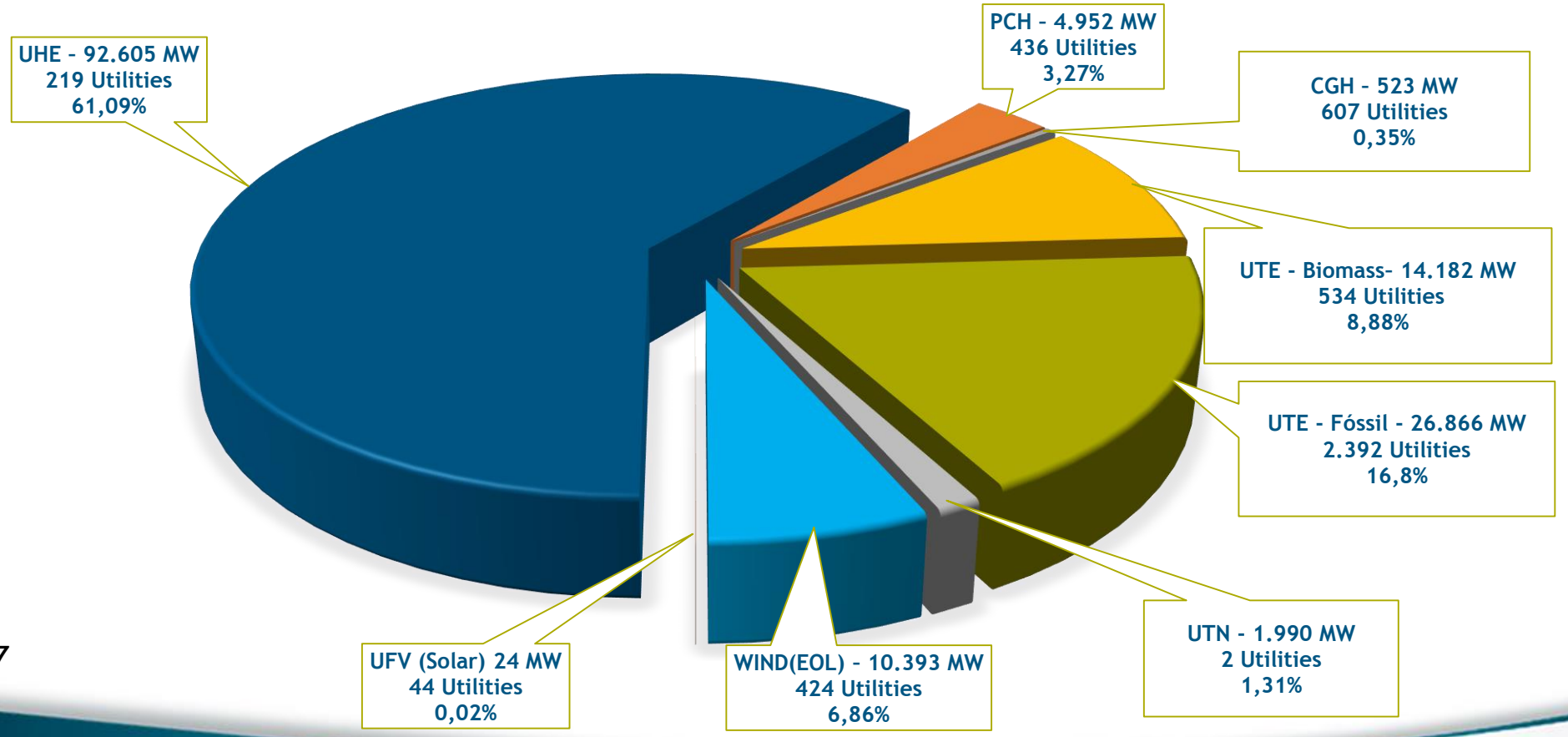
Electricity consumption per capita 2.664,15 kWh/year

Average energy consumption growth Annual Rate 4%

Energy generation sources

BRAZIL's INSTALLED CAPACITY (2017)

*Installed capacity of the country **151.596 MW***



Source: BIG/ANEEL
Updated on 2017-4-7

BRAZILIAN INTERCONNECTED SYSTEM-SIN (MWmed)

Energy Balance-April 3rd,2017

Verified Programmed

Brazilian Interconnected System - SIN - MWmed			
Production			
National Hydro	42,130	39.701	61,83%
Binational Itaipu	8.904	9.029	14,06%
Nuclear Thermal	1.990	2.005	3,12%
Conventional Thermal	10.181	9.943	15,49%
Wind	1.979	3.529	5,50%
Total SIN	65.184	64.207	100,00%
International Interchange	0	0	-
Load(*)	65.184	64.207	-

Sub-market	Occurred on	Historical Max
South	14.525 at 14h44min	17.971 on 06/02/2014
Southeast - CO	47.456 at 14h28min	51.894 on 21/01/2015
North	6.075 at 15h27min	6.492 on 21/10/2015
Northeast	11.655 at 14h28min	12.473 on 03/12/2015
SIN	79.605 at 14h28min	85.708 on 05/02/2014

Source: ONS
Updated on 2017-4-3

BRAZILIAN DISTRIBUTION SYSTEM

63 DISCOs
Different tariffs for each concession area

LATEST INTERNATIONAL RENEWABLE ENERGY NEWS

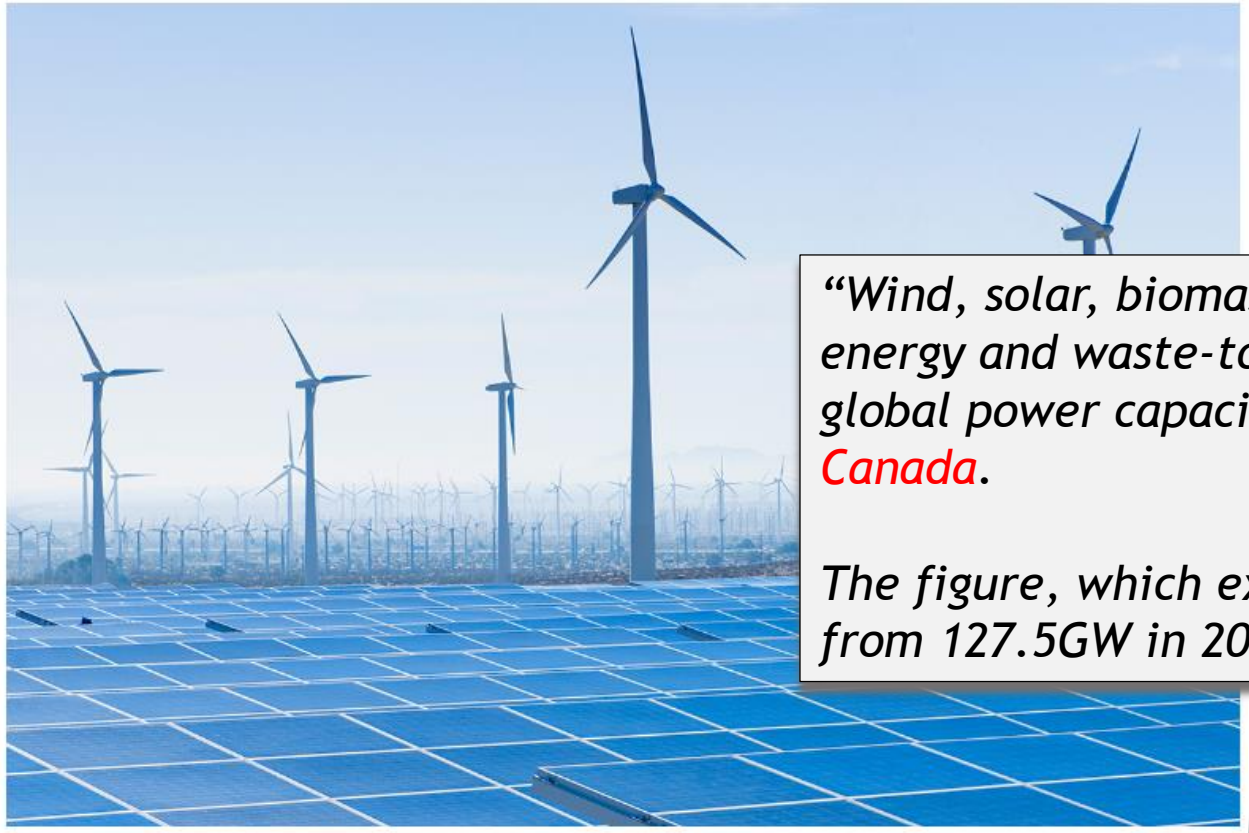
ANEEL
Agência Nacional de Energia Elétrica

WWW.NEWSCIENTIST.COM

RECORD ADDED ENERGY

SHORT SHARP SCIENCE 6 April 2017

Record amounts of renewable energy added to the mix in 2016



"Wind, solar, biomass, geothermal, small-scale hydropower, marine energy and waste-to-energy schemes added 138.5 gigawatts (GW) to global power capacity, equivalent to the total installed capacity of Canada.

The figure, which excludes large hydroelectric dams, is up 8 per cent from 127.5GW in 2015."

WWW.UTILITYDIVE.COM

RECORD DEMAND SERVED

Utility DIVE Home Events Library Jobs Viewpoints Topics

"The California ISO hit an all-time peak percentage, serving 56.7% of demand with renewable energy around 11:19 a.m. on March 23.

Solar and wind power, combined, also hit a peak on the same day at 49.2% of demand."

BRIEF

CAISO notches record, serving 56.7% of demand with renewable energy in one day

California ISO
@California_ISO

Follow

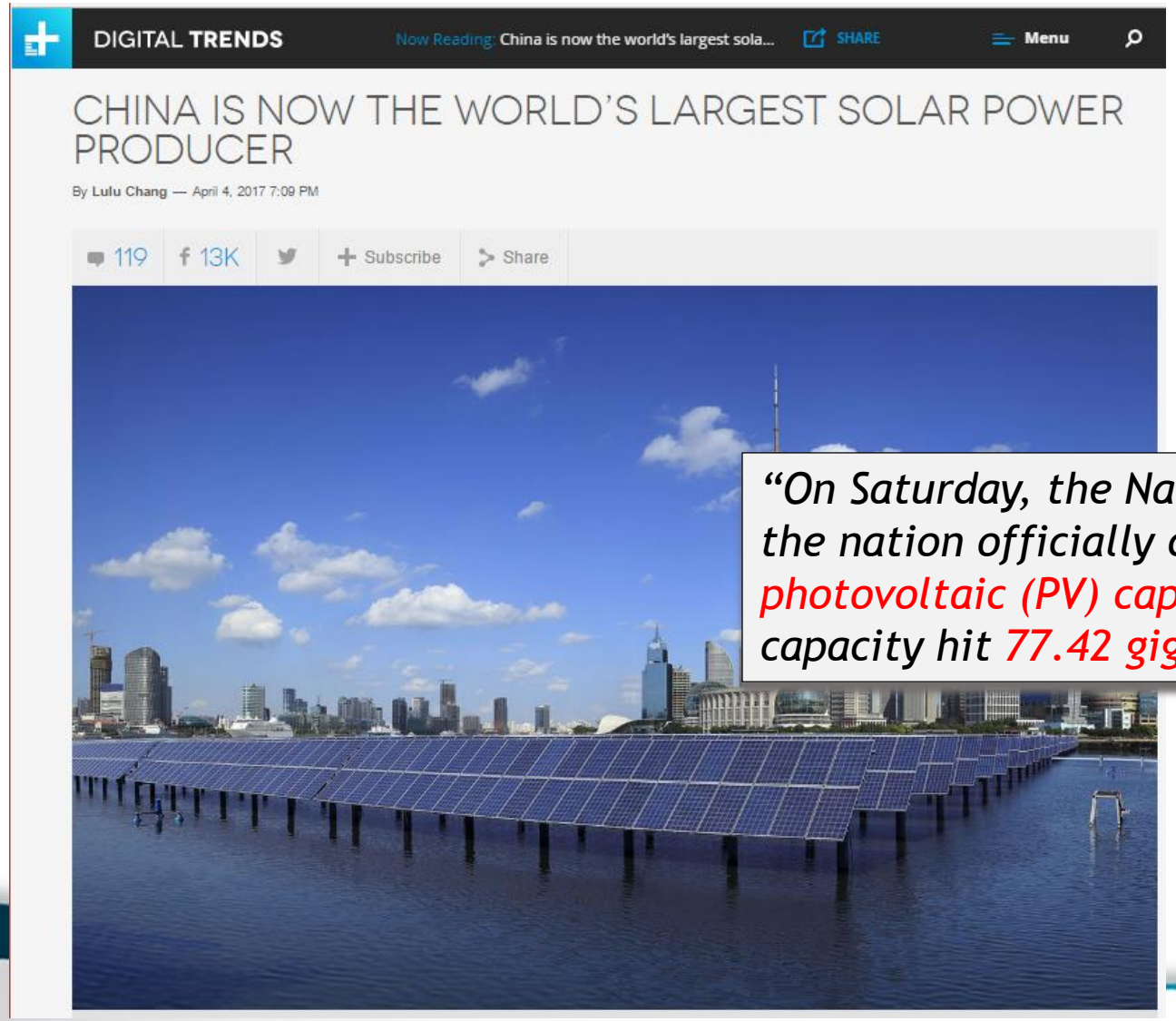
#ISO hit all-time peak percentage of demand served by #renewables, 56.7% at 11:25 a.m. today #cleanenergy

7:51 PM - 23 Mar 2017

218 234

WWW.DIGITALTRENDS.COM

CHINA IS THE LARGEST SOLAR PRODUCER



"On Saturday, the National Energy Administration (NEA) noted that the nation officially claimed the title after doubling its installed photovoltaic (PV) capacity last year. By the end of 2016, China's capacity hit 77.42 gigawatts […]".

The future is made up of renewable energy!

SOLAR POWER FACTS AND FIGURES

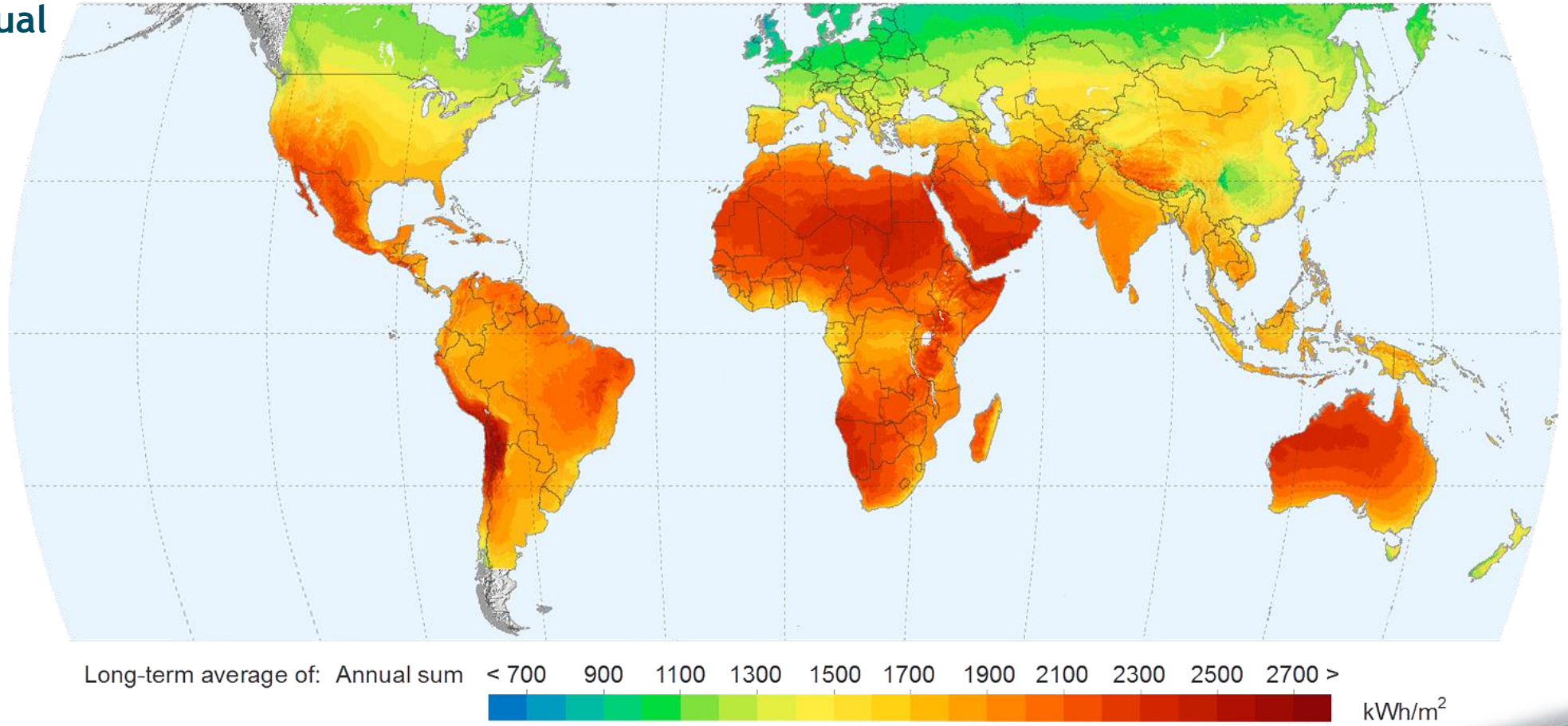
20 ANEEL
AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

International Map

SOLAR IRRADIATION

Daily Irradiation Annual Average:

- Germany: 900-1.250 kWh/m2/year
- France: 900-1.650 kWh/m2/year
- Spain: 1.200-1.850 kWh/m2/year



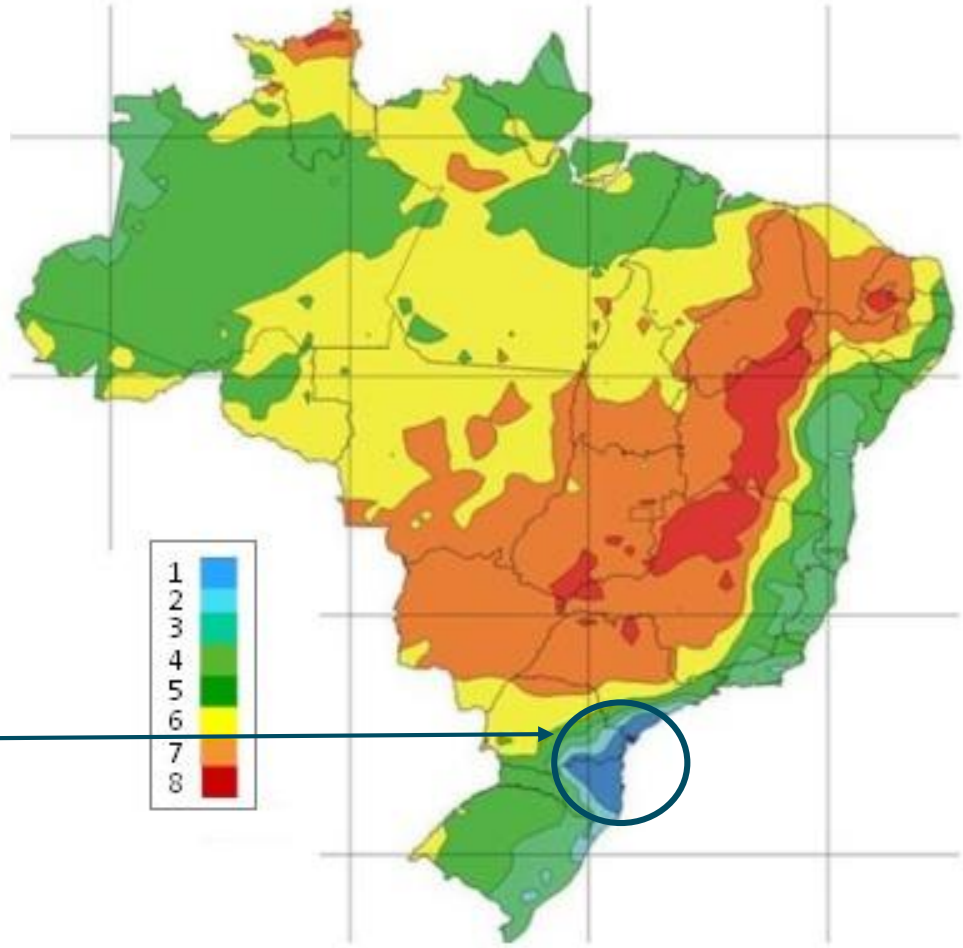
Brazilian Map

SOLAR IRRADIATION

Annual average daily irradiation superior to most European countries

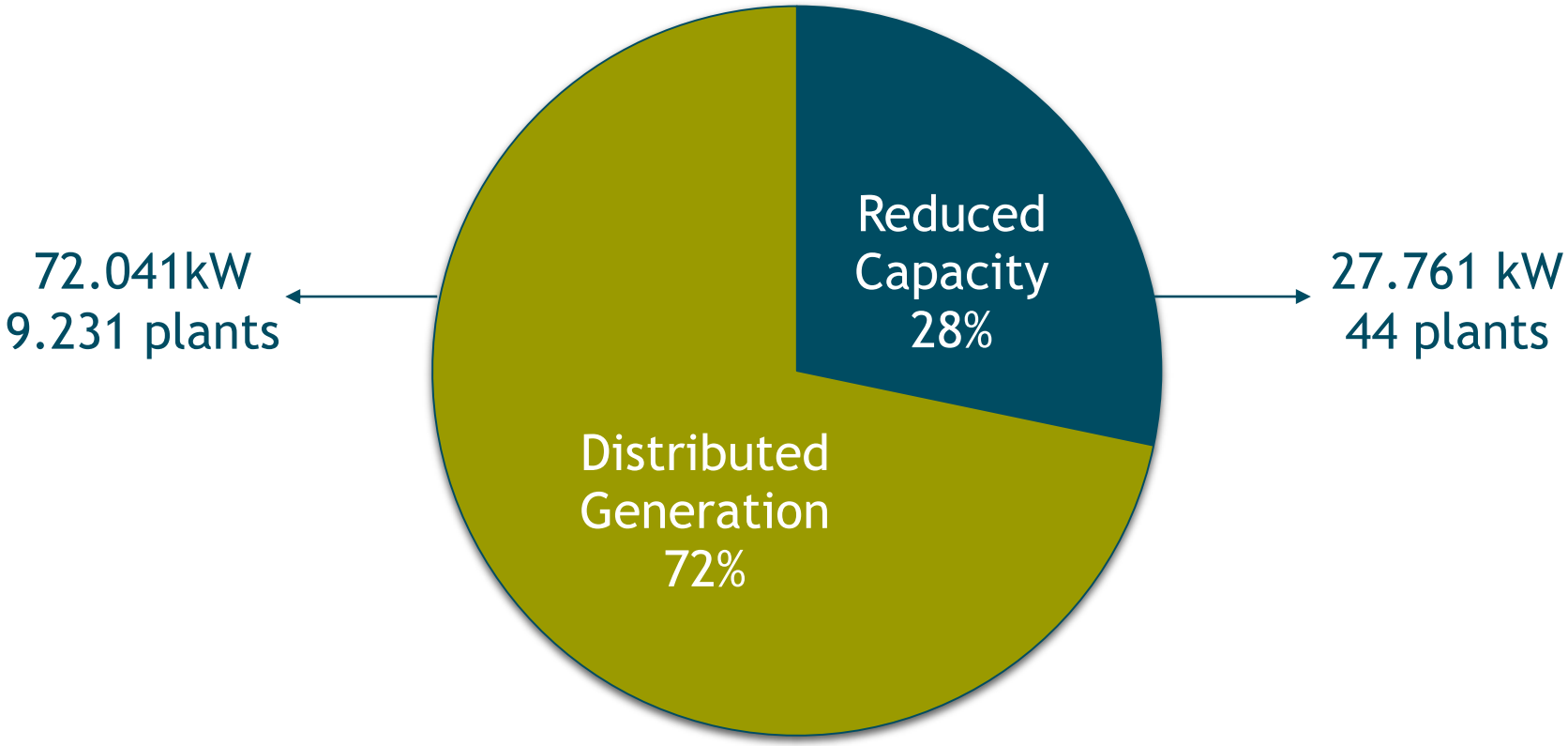
- 1.500 e 2.400 kWh/m2/year

- The lowest irradiation in Brazil is higher than the highest in Germany



PHOTOVOLTAICS PLANTS (UFV)

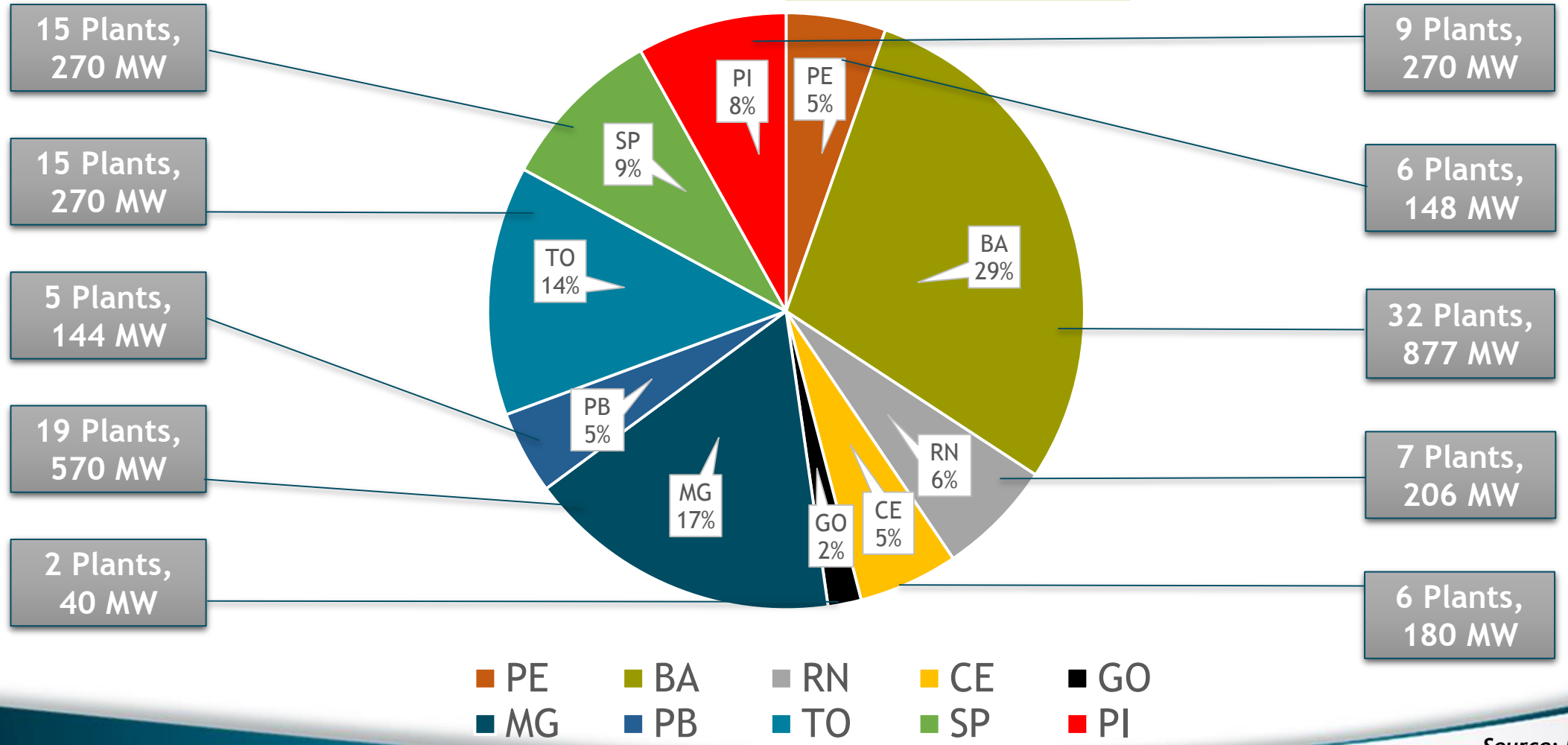
IN OPERATION



Source: BIG/ANEEL
Updated on 2017-4-7

UFV POWERPLANTS
IN CONSTRUCTION

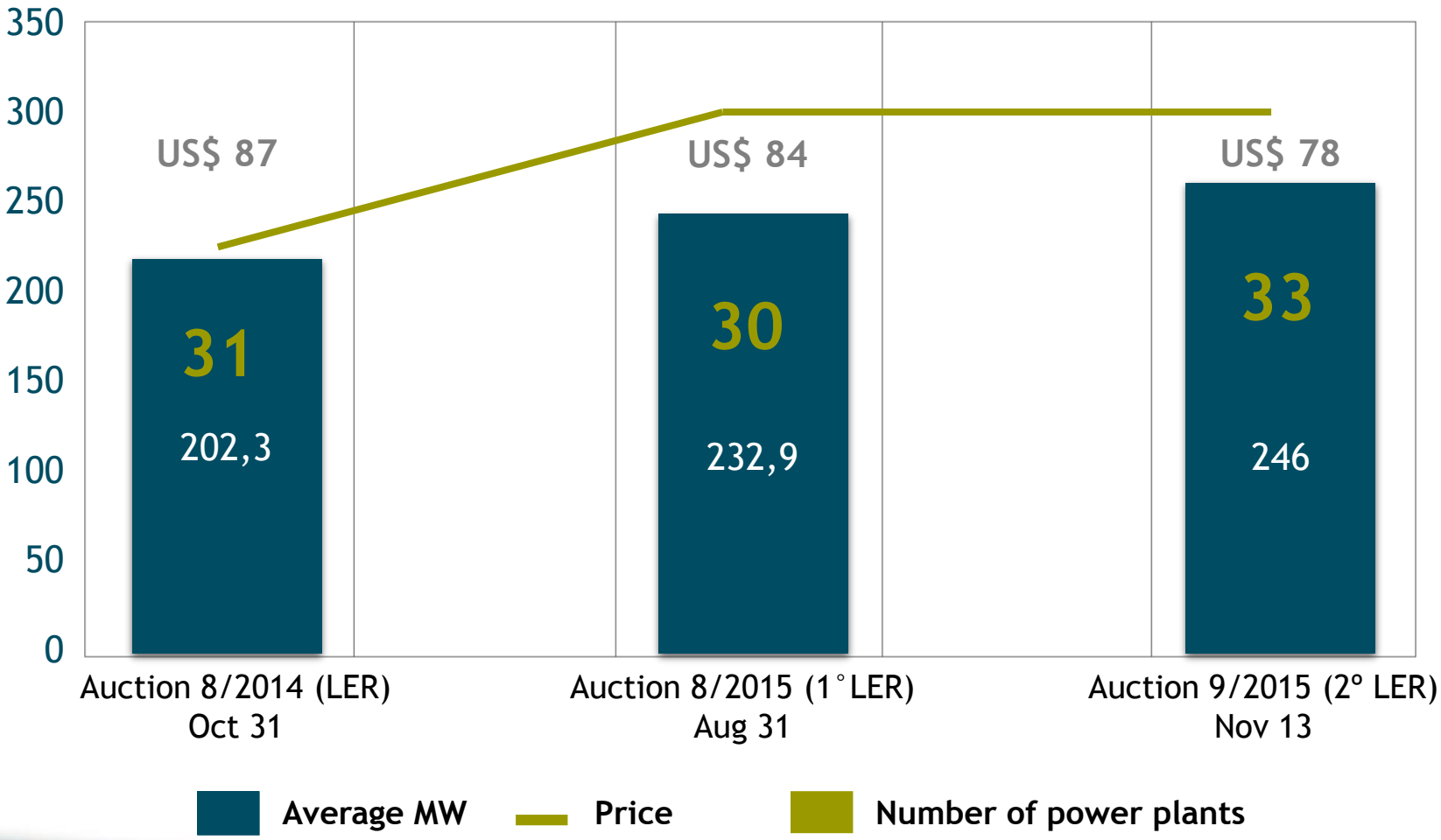
TOTAL
116 Plants
2.975 MW



Source: BIG/ANEEL
Updated on 2017-4-7

2014/2015 Auctions

CENTRALIZED PHOTOVOLTAICS LER



NORMATIVE RESOLUTION

Resolution # 687/2015

BRAZILIAN ELECTRICITY REGULATORY AGENCY – ANEEL NORMATIVE

RESOLUTION No. 687, OF NOVEMBER 24, 2015.

Changes Normative Resolution no. 482 of April 17, 2012, and Modules 1 and 3 of the Distribution Procedures – PRODIST.

The CEO of the National Agency for Electrical Energy - ANEEL, in the use of his due grants, in accordance with the Board decision, in view of the provisions of Law 9,427 of December 26, 1996, based on Art. 4, sections IV and XVI, Annex I of Decree No. 2,335, of October 6, 1997, as set out in the Process No. 48500.004924/2010-51 and considering the input received at the Public Hearing on 026/2015, held between May 7, 2015 and June 22, 2015, which were analyzed in this Agency and allowed the improvement of this regulatory act, decides:

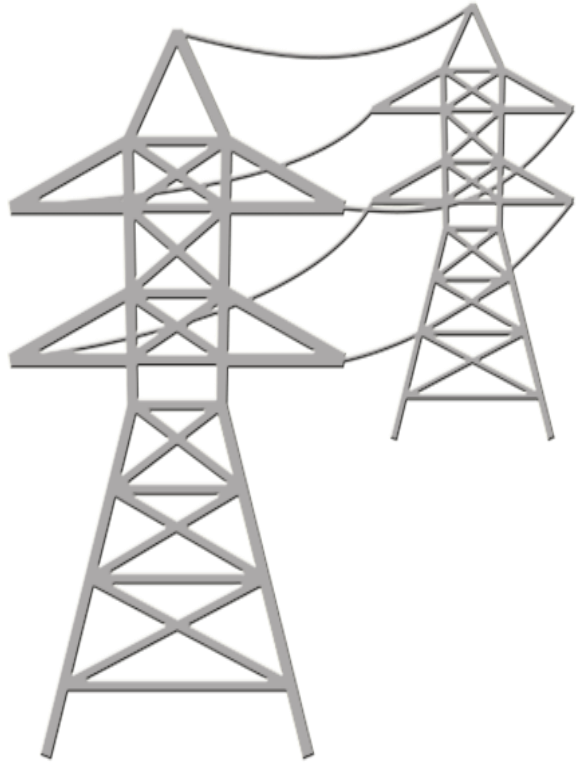
Art. 1 To amend Art. 2 of Normative Resolution 482 of April 17, 2012, which shall read as follows:

"Art. 2.....

NET METERING SYSTEM

Consumption

Injection



Bill = Net difference

DISTRIBUTED GENERATION (DG) MODALITIES

ANEEL
AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

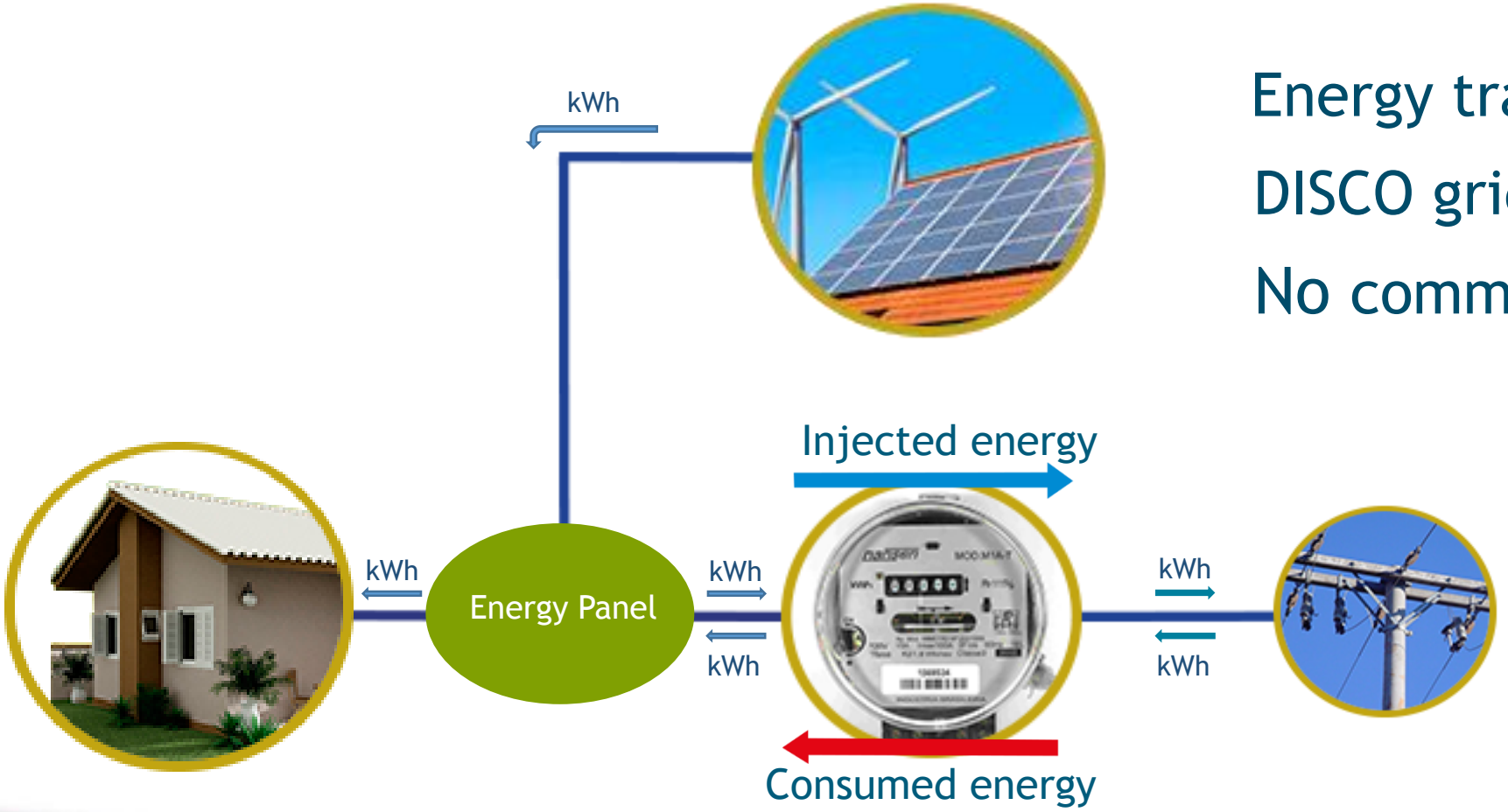
Distributed Generation

RESOLUTION ANEEL # 482/2012 (updated by Resolution ANEEL # 687/2015)

- Any renewable source or eligible cogeneration
- Microgeneration (75 kW max.) and Minigeneration (5,000 kW max.)
- Energy trade – no commercialization

REN # 687/2015

NET METERING SYSTEM

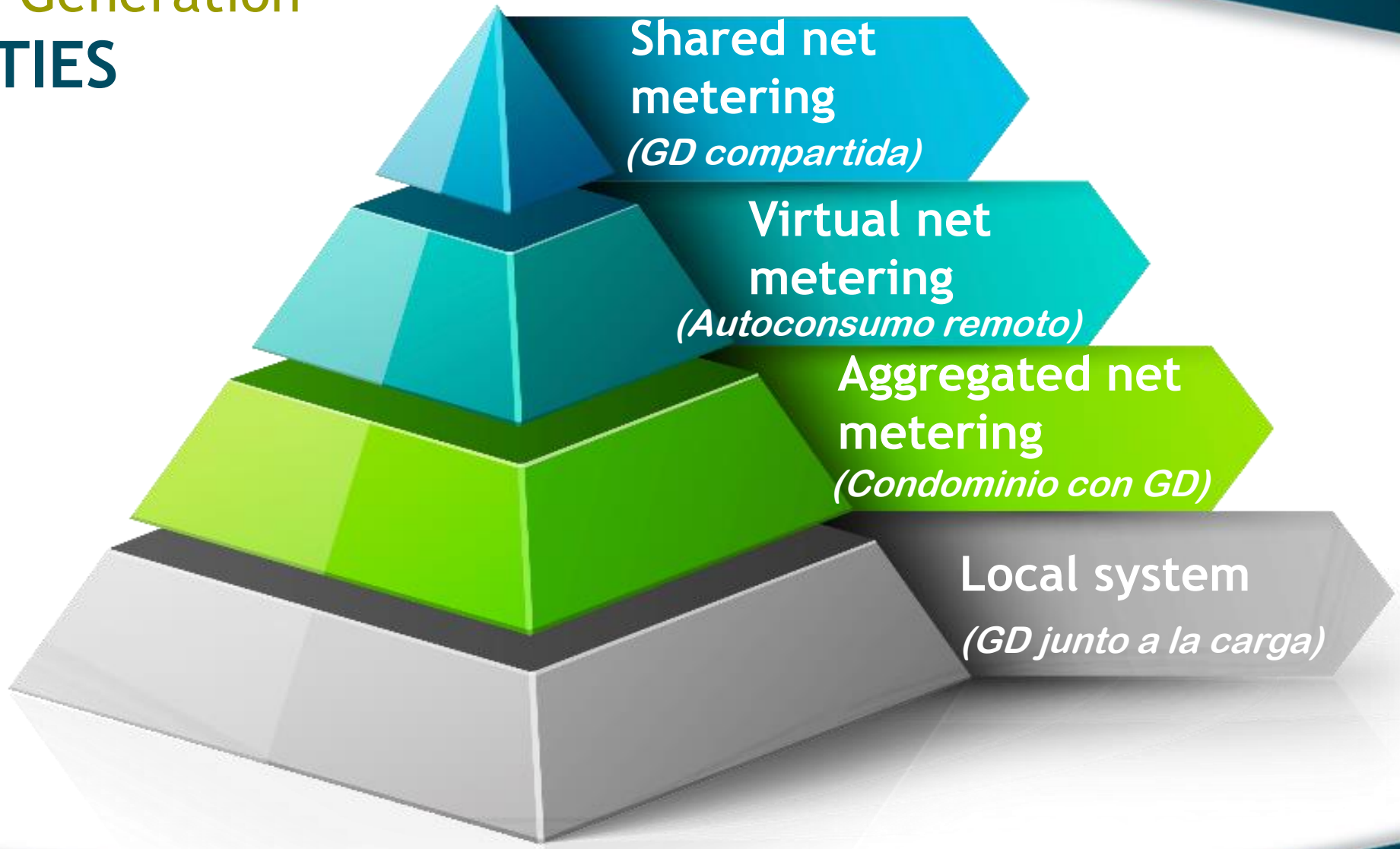


Energy trade

DISCO grid as virtual battery

No commercialization

Distributed Generation
MODALITIES



Distributed Generation
MODALITIES

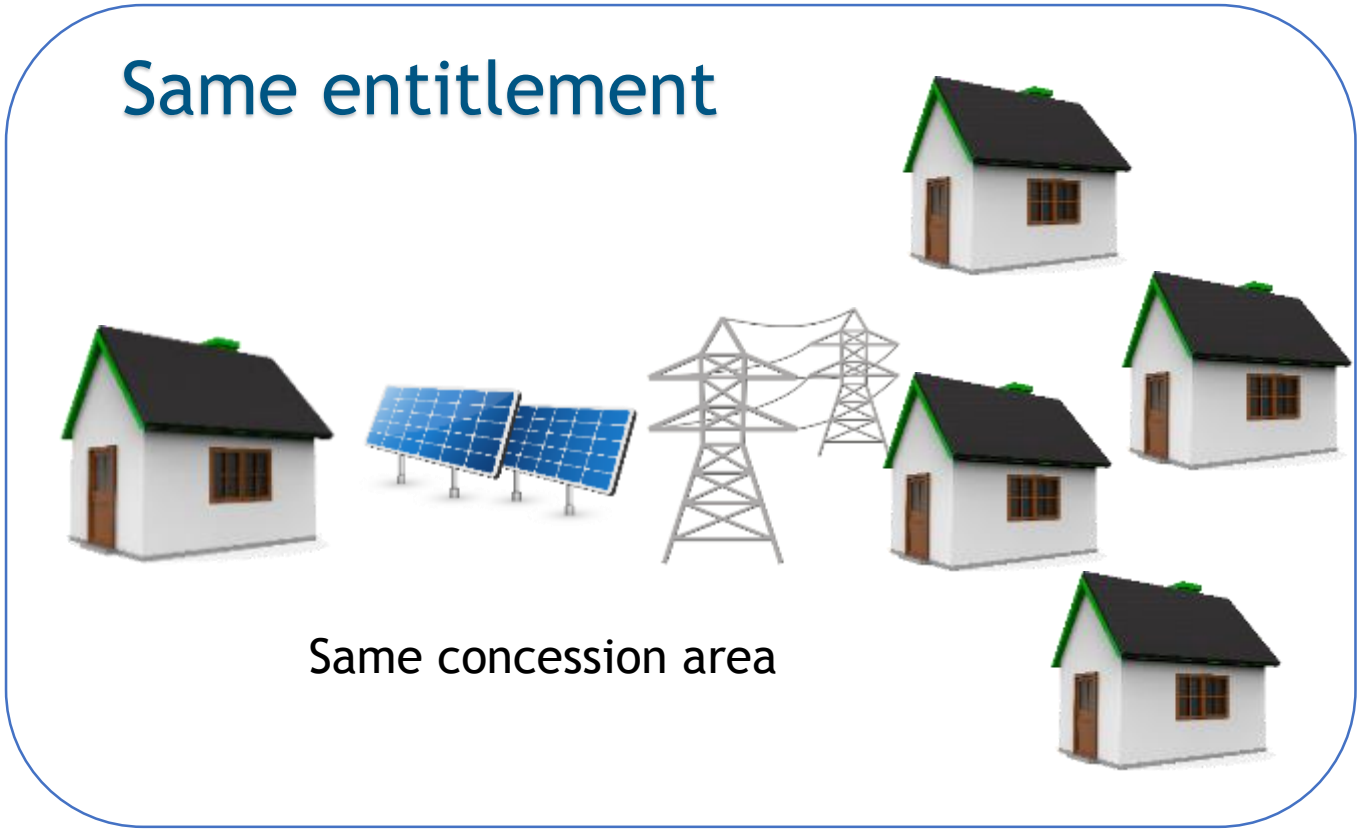
Local system
(GD junto a la carga)

Aggregated net metering
(Condominio con GD)

Distributed Generation
MODALITIES

- Same owner (entitlement)
- (natural person or legal entity)

Virtual net metering
(Autoconsumo remoto)



Distributed Generation
MODALITIES

- Consumers assembled through a consortium or cooperative

Shared net metering
(GD compartida)

New

Same concession area

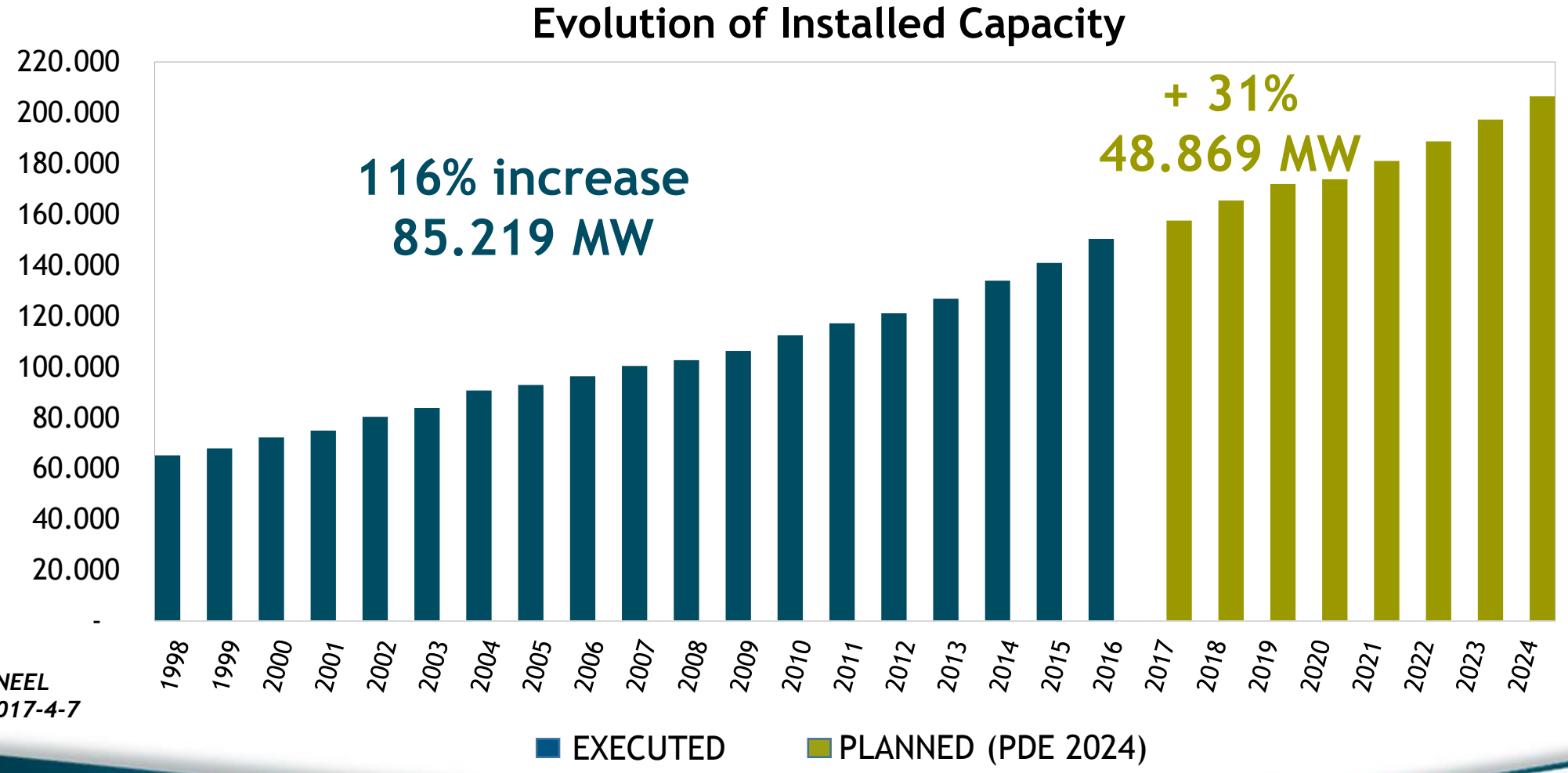
Consortium or cooperative

EVOLUTION, PROJECTIONS and IMPACTS

ANEEL
AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

Energy

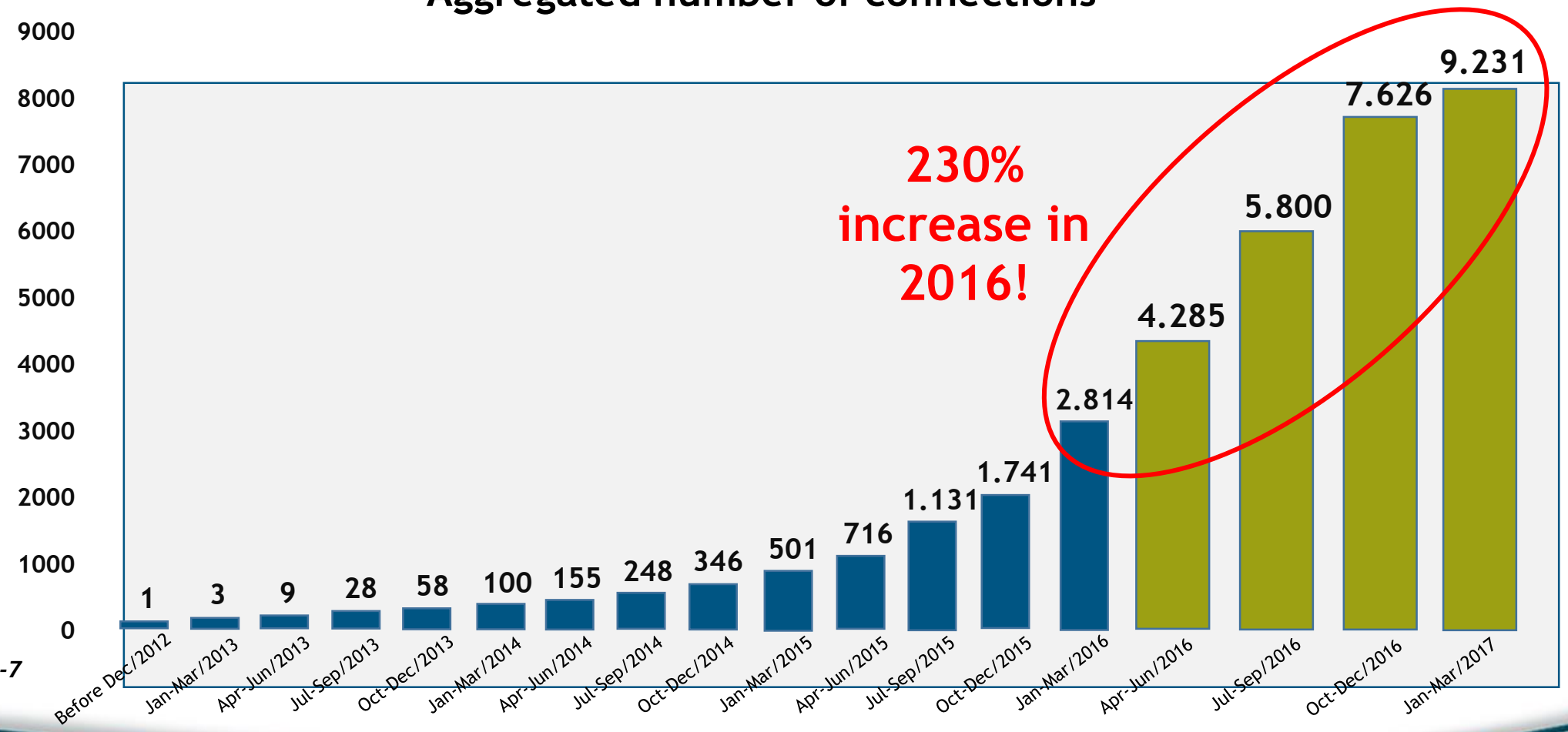
GENERATION



Source: BIG/ANEEL
Updated on 2017-4-7

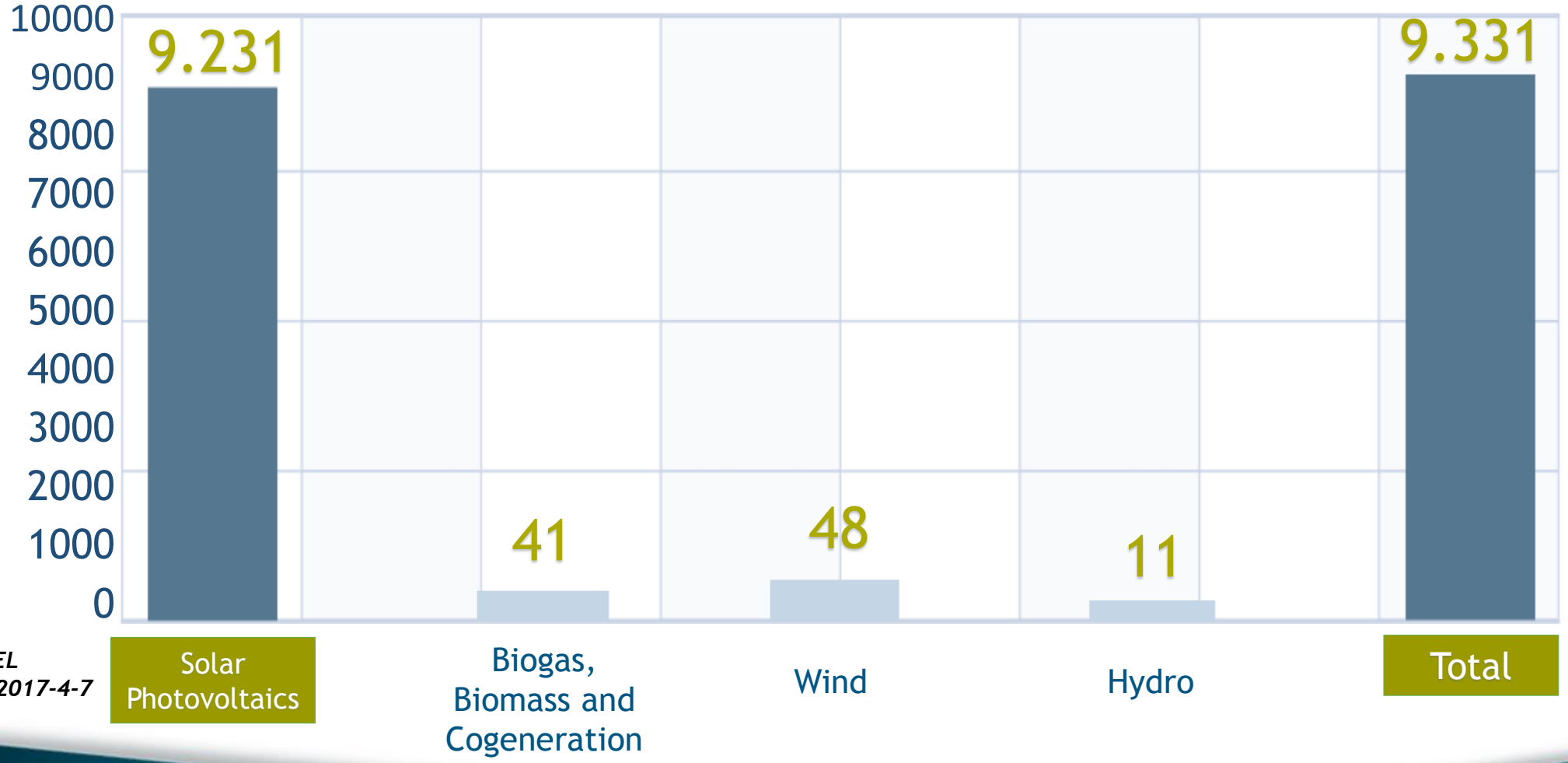
Evolution

DISTRIBUTED GENERATION (Photovoltaics Plants)



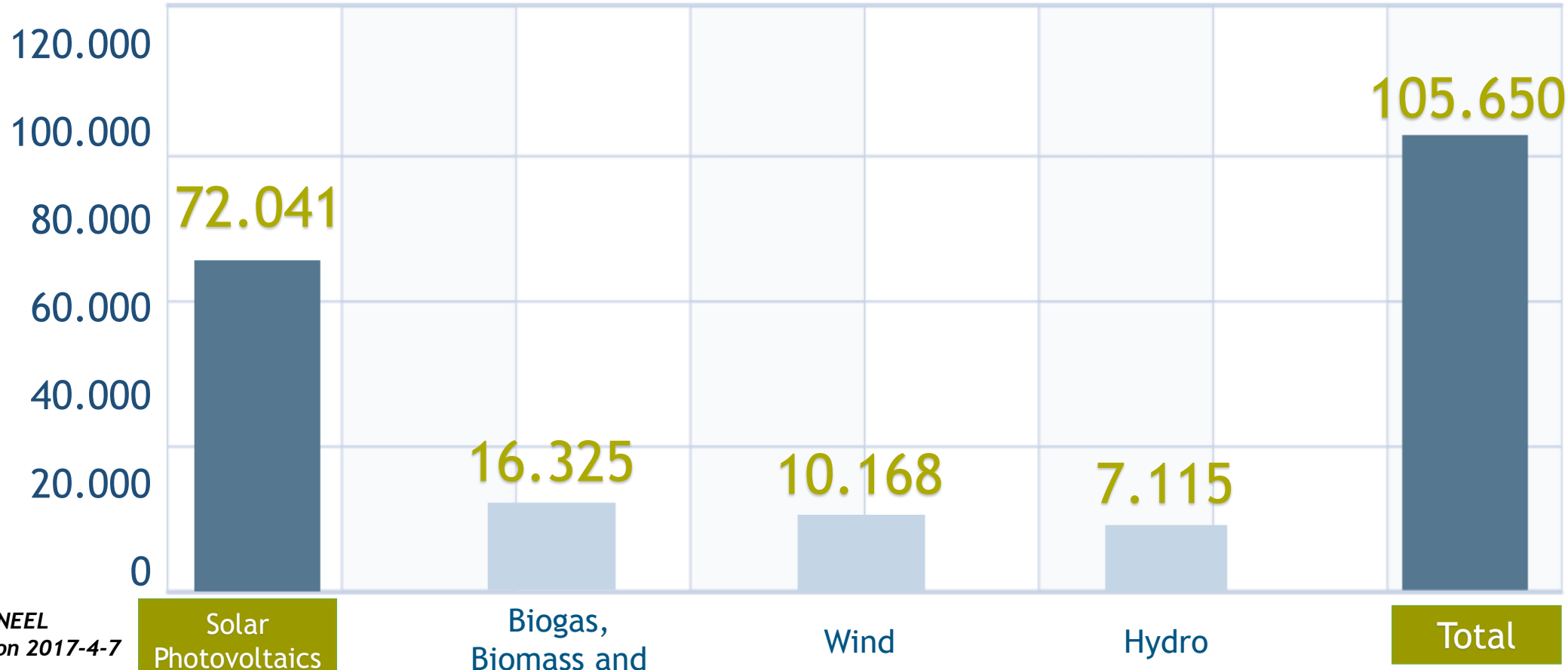
Source: BIG/ANEEL
Updated on 2017-4-7

NUMBER of CONNECTIONS PER SOURCE



Source: ANEEL
Updated on 2017-4-7

TOTAL INSTALLED POWER (kW)



Source: ANEEL
Updated on 2017-4-7

GD DATA (APRIL 2017)

105.650 kW

Power installed in distributed generation

68,2%

Distributed generation comes from solar source (Kw)

79,3%

Connections are residential

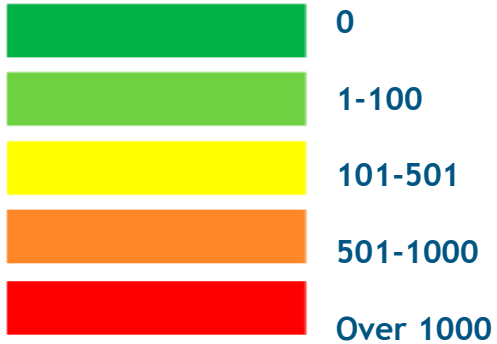
25 Years

Service life of the solar panels

Source: ANEEL
Updated on 2017-4-7

Distributed Generation

DG CONCENTRATION

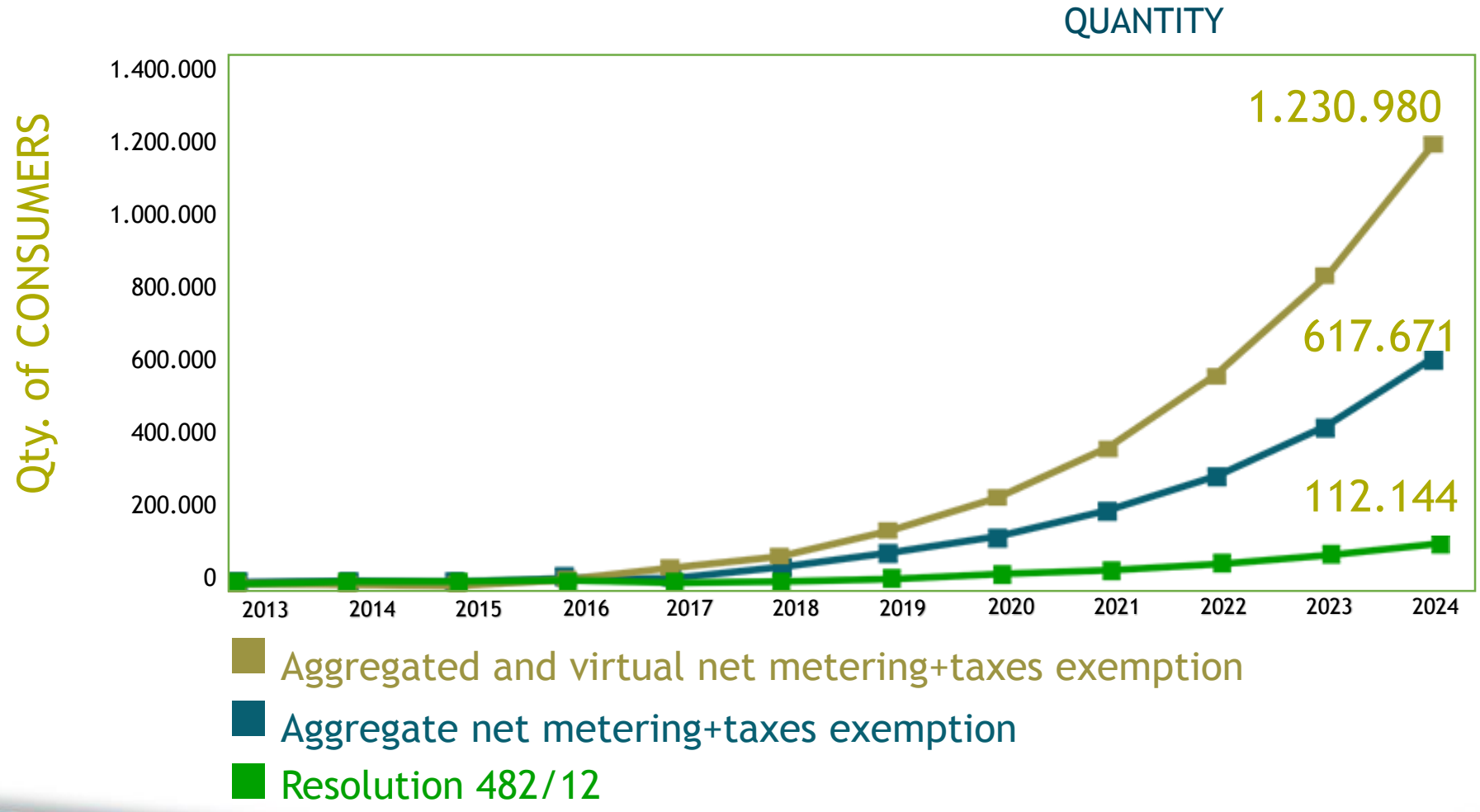


DISTRIBUTED GENERATION PROJECTIONS IN BRAZIL

ANEEL
AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

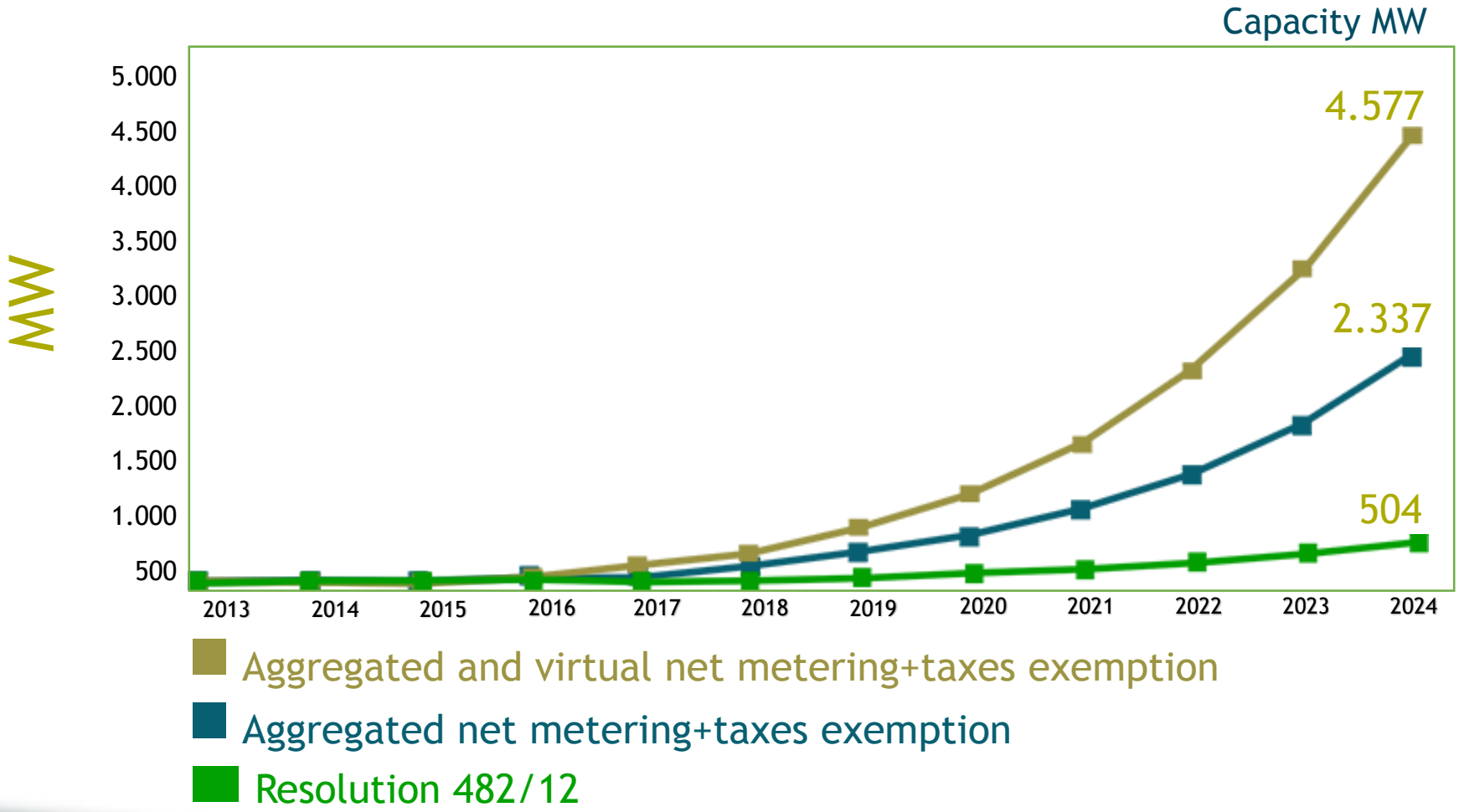
Distributed Generation

PROJECTIONS



Distributed Generation

PROJECTIONS



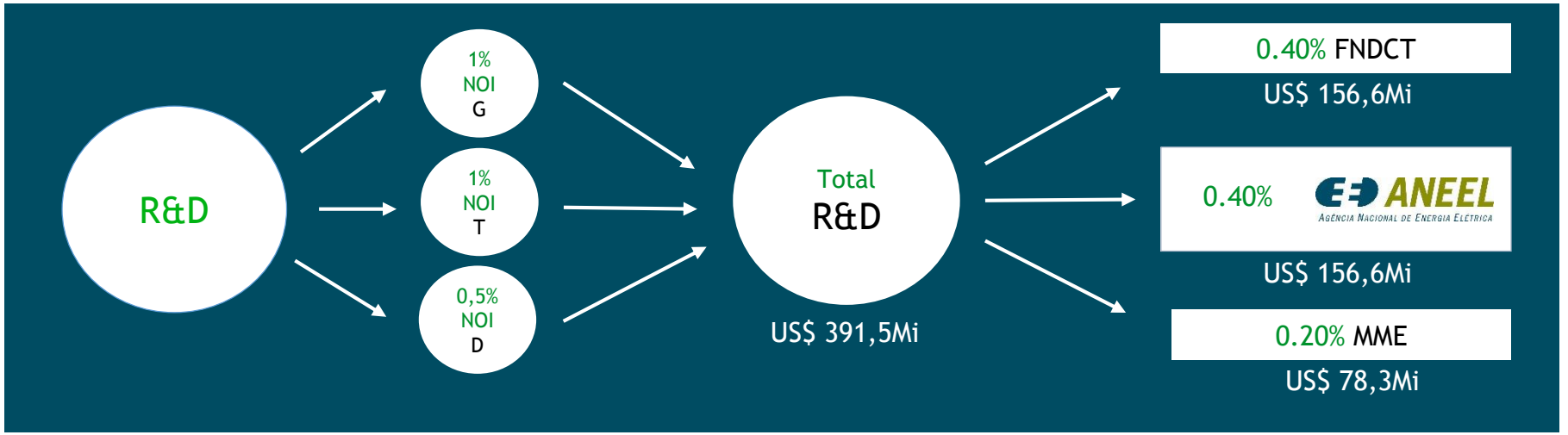
R&D AND EE PROGRAMMES

NOI= US$ 58,01b

1% NOI= US$ 580,1Mi

NOI(D) = US$ 37,71b => (65,6% NOI)

1% NOI
Net
Operational
Income



Procel: 0,1% NOI (D) = US$ 37,7Mi

BRAZILIAN SOLAR PHOTOVOLTAIC CHALLENGES

ANEEL
AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

SOLAR PHOTOVOLTAIC

❖ Distributed Generation

Publicity

Funding

Tax exemptions for the new modalities

Rules to be updated in 2019

❖ Centralized Generation

Auction Structure well defined

Funding

SOLAR PHOTOVOLTAIC

Appropriate remuneration of the grid costs

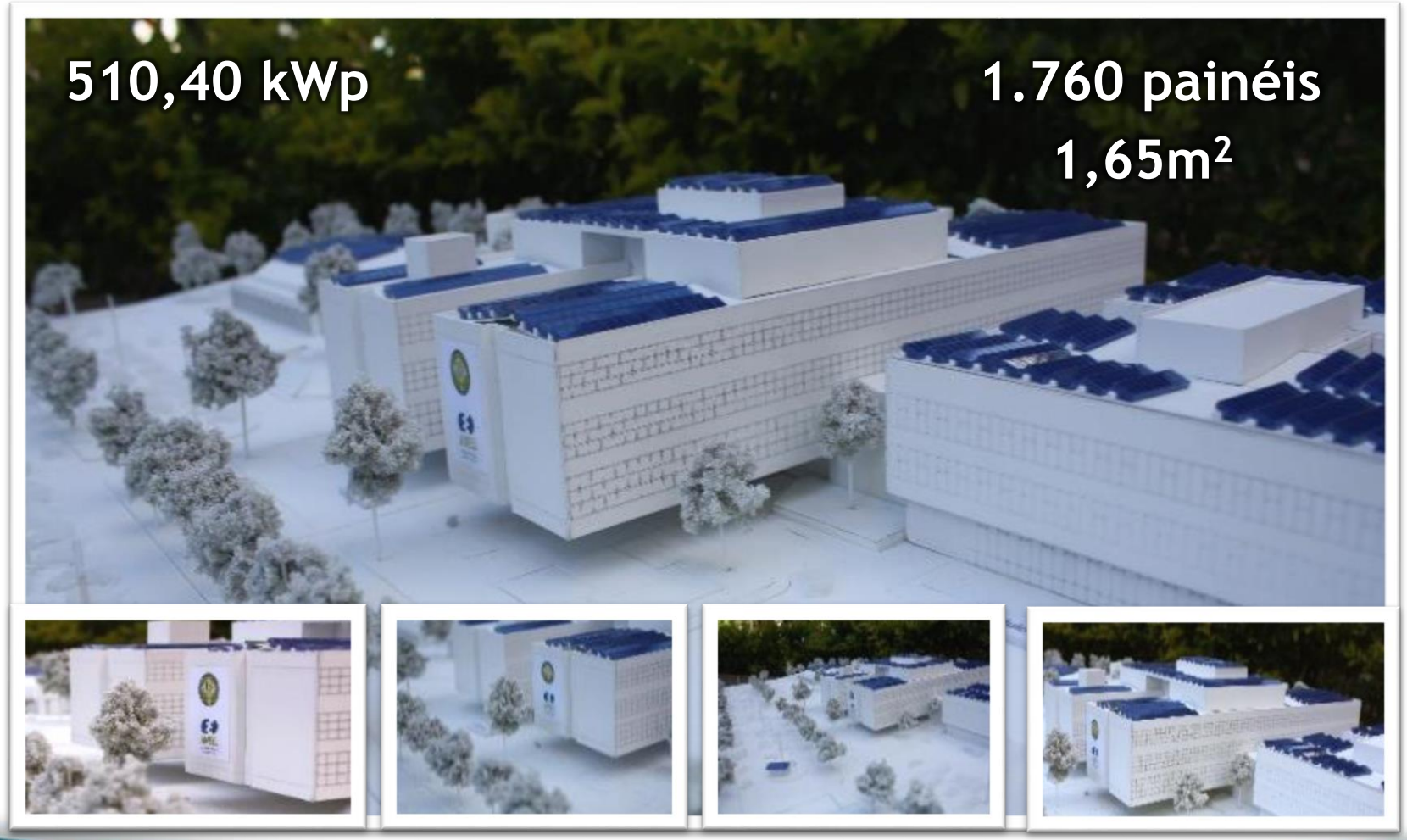
Low Voltage Consumers: when generation ▫ consumption – only pays the availability costs (30 kWh for single-phase, 50 kWh for two-phase, and 100 kWh for three-phase)

High Voltage Consumers: pays for hired demand

Possible solution: use of binomial tariff for low voltage consumers: energy + “wire” (grid transport), similar to the high voltage consumers

Projeto de eficiência energética

EDIFÍCIO SEDE DA ANEEL



Why we Exist

ANNEL's MISSION

To provide favorable conditions for the electric power market to develop with balance between the agents and for the benefit of society

20 ANEEL

AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

Energy made present.

ANDRE PEPITONE DA NÓBREGA
ANEEL's DIRECTOR

WWW.ANEEL.GOV.BR

www.facebook.com/aneelgovbr

www.twitter.com/aneel_noticias

www.youtube.com/user/anel

ADDRESS: SGAN 603 Módulos I and J - Brasília/DF, Brazil
Zip Code: 70830-110
GENERAL PHONE: +55 61 2192 8626
SECTOR OMBUDSMAN:167