



AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

Energy made present.

ANDRÉ PEPITONE DA NÓBREGA
ANEEL's DIRECTOR

**The case study of Brazil
Solar energy in the
Brazilian electric matrix:
*Overview and challenges***

VI CEER-ARIAE MEETING

2017, 20 April - Brasília - DF

BRAZIL SUMMARY

Territorial area 8.515 million km² (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

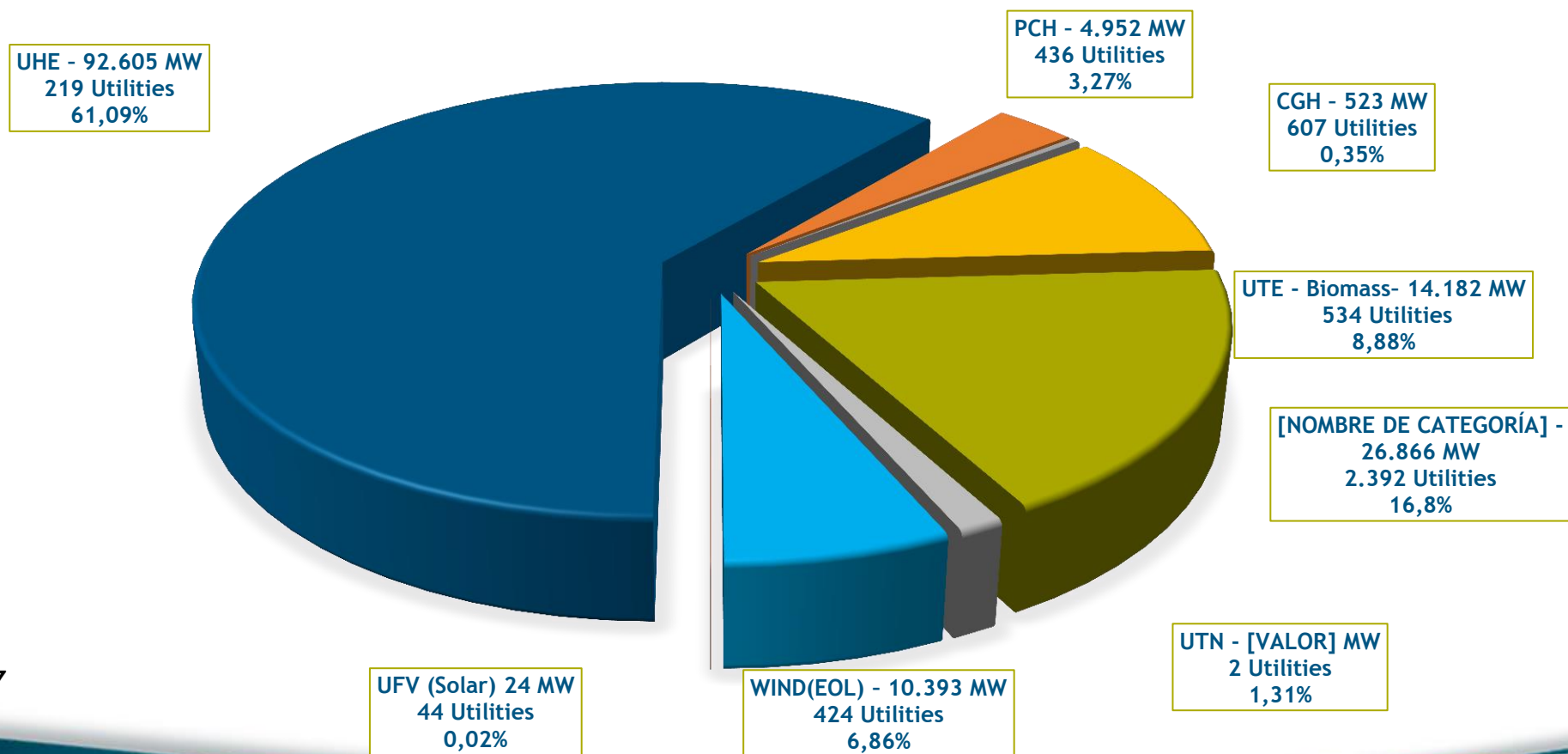
Average energy consumption growth Annual Rate 4%



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

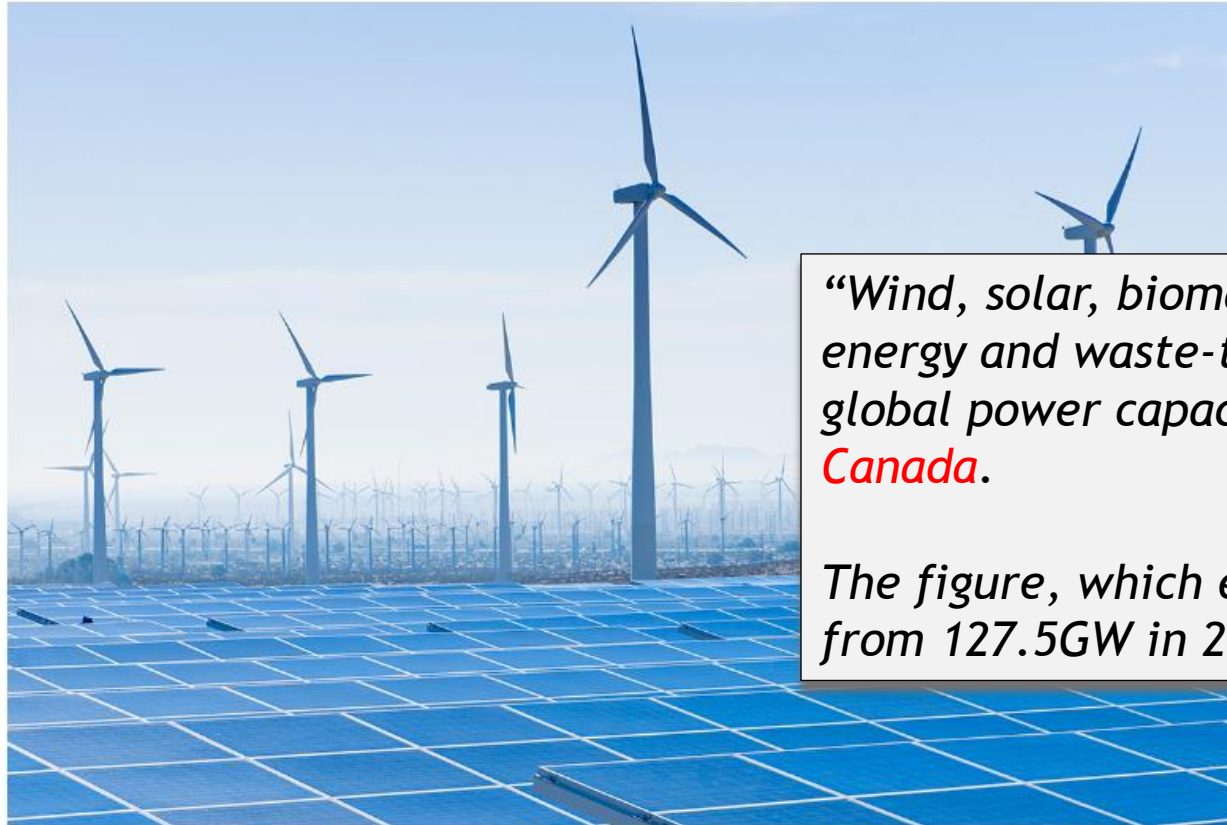
LATEST INTERNATIONAL RENEWABLE ENERGY NEWS

WWW.NEWSIDENTIST.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.”

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RECORD DEMAND SERVED

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*“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

CHINA IS THE LARGEST SOLAR PRODUCER

DIGITAL TRENDS

Now Reading: China is now the world's largest sola... SHARE Menu

CHINA IS NOW THE WORLD'S LARGEST SOLAR POWER PRODUCER

By Lulu Chang — April 4, 2017 7:09 PM

119 13K + Subscribe Share

*“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!**

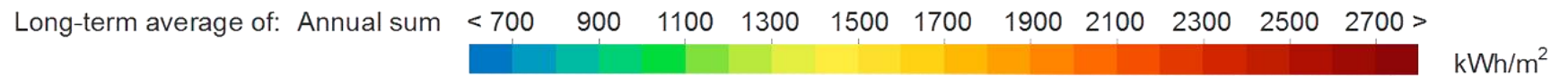
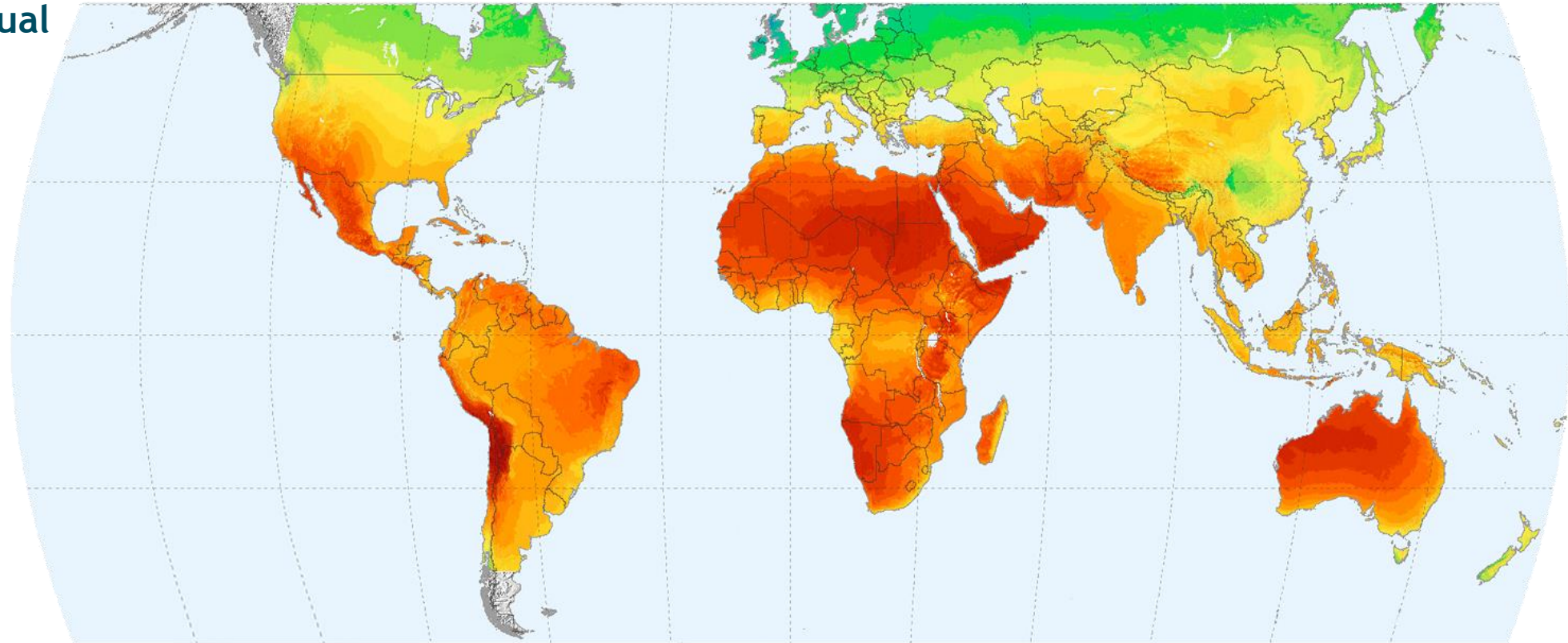
SOLAR POWER FACTS AND FIGURES

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



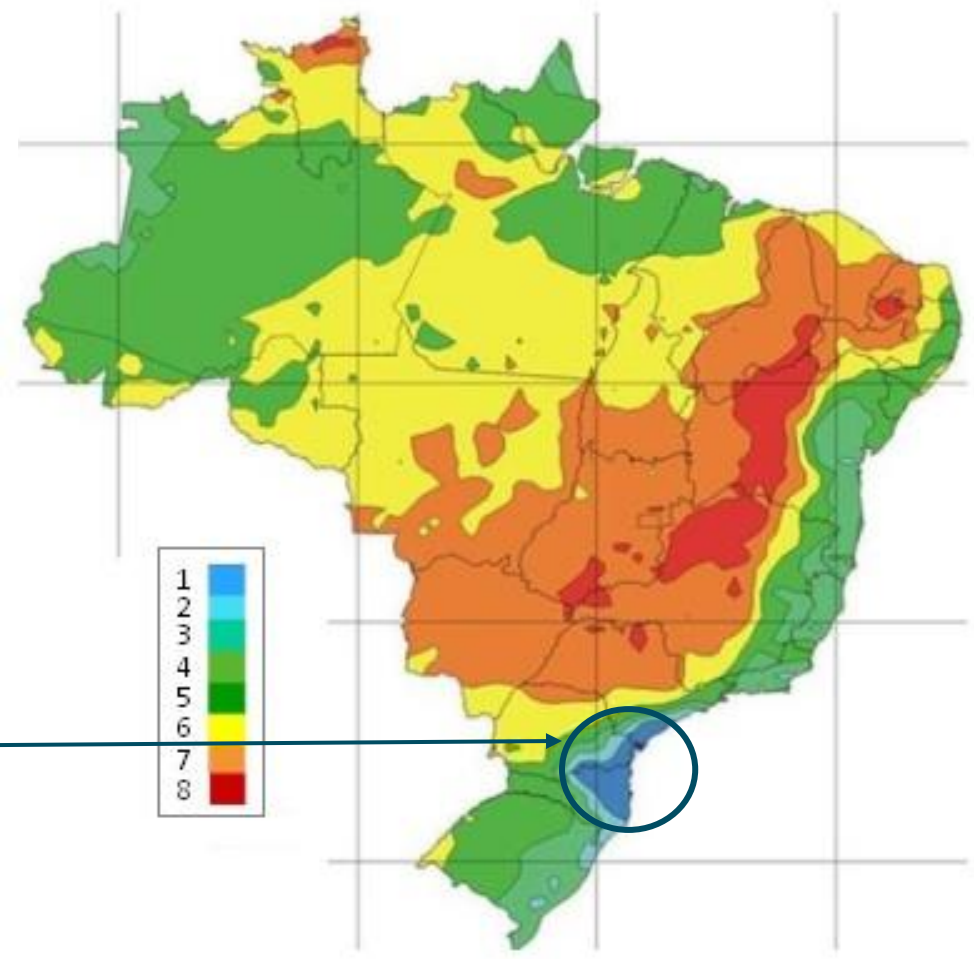
Brazilian Map

SOLAR IRRADIATION

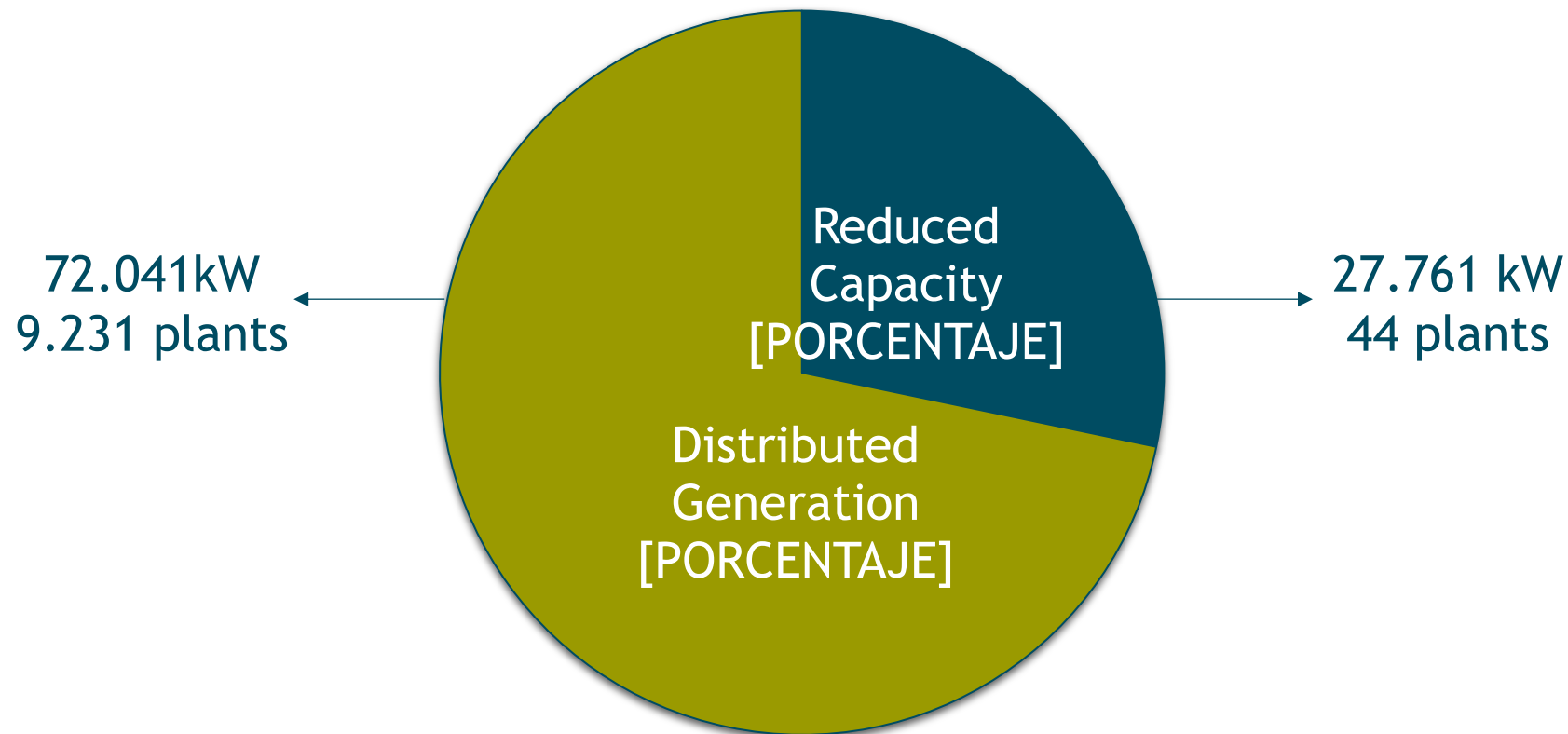
Annual average daily irradiation superior to most European countries

❖ 1.500 e 2.400 kWh/m²/year

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

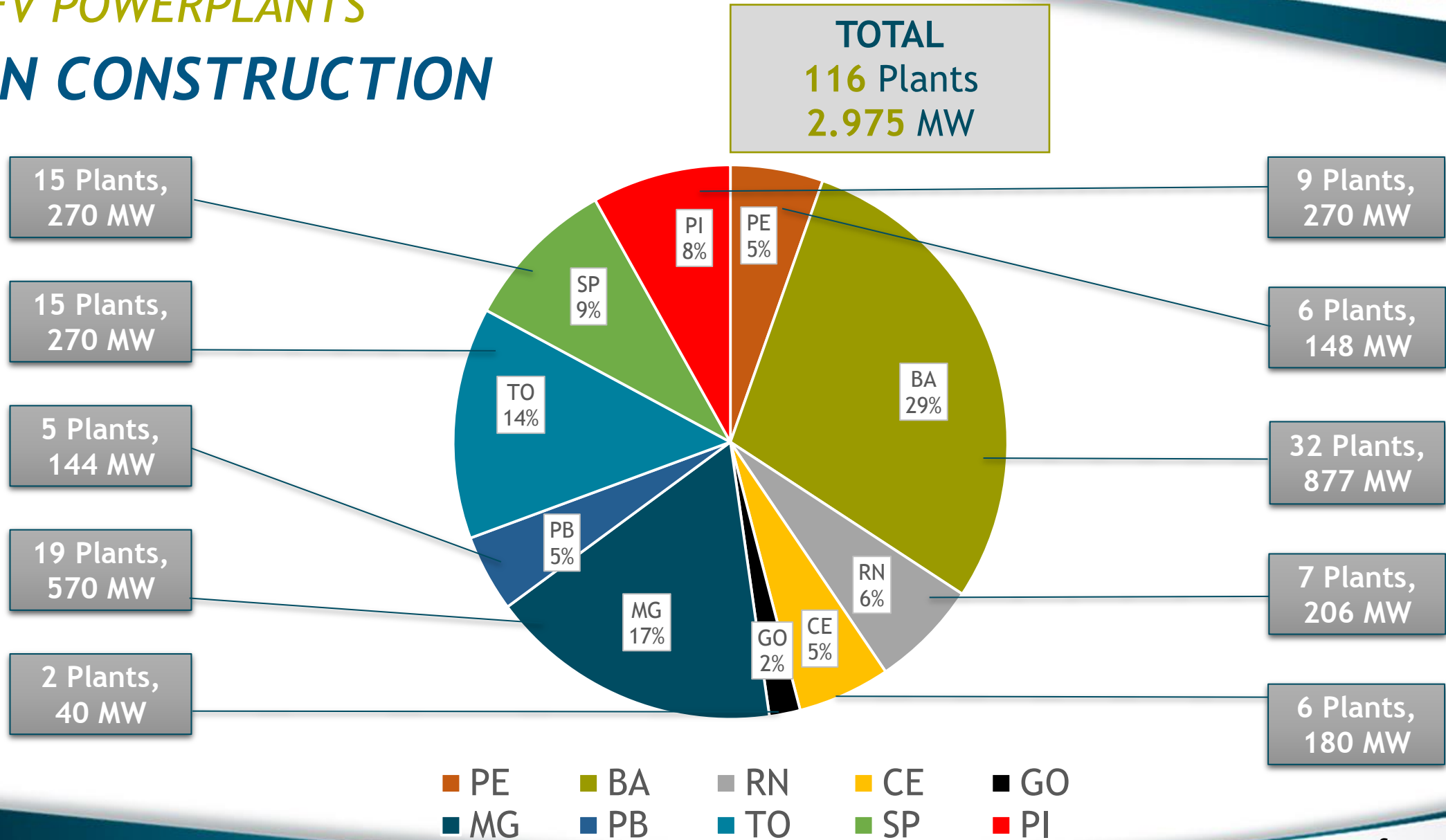


PHOTOVOLTAICS PLANTS (UFV) IN OPERATION



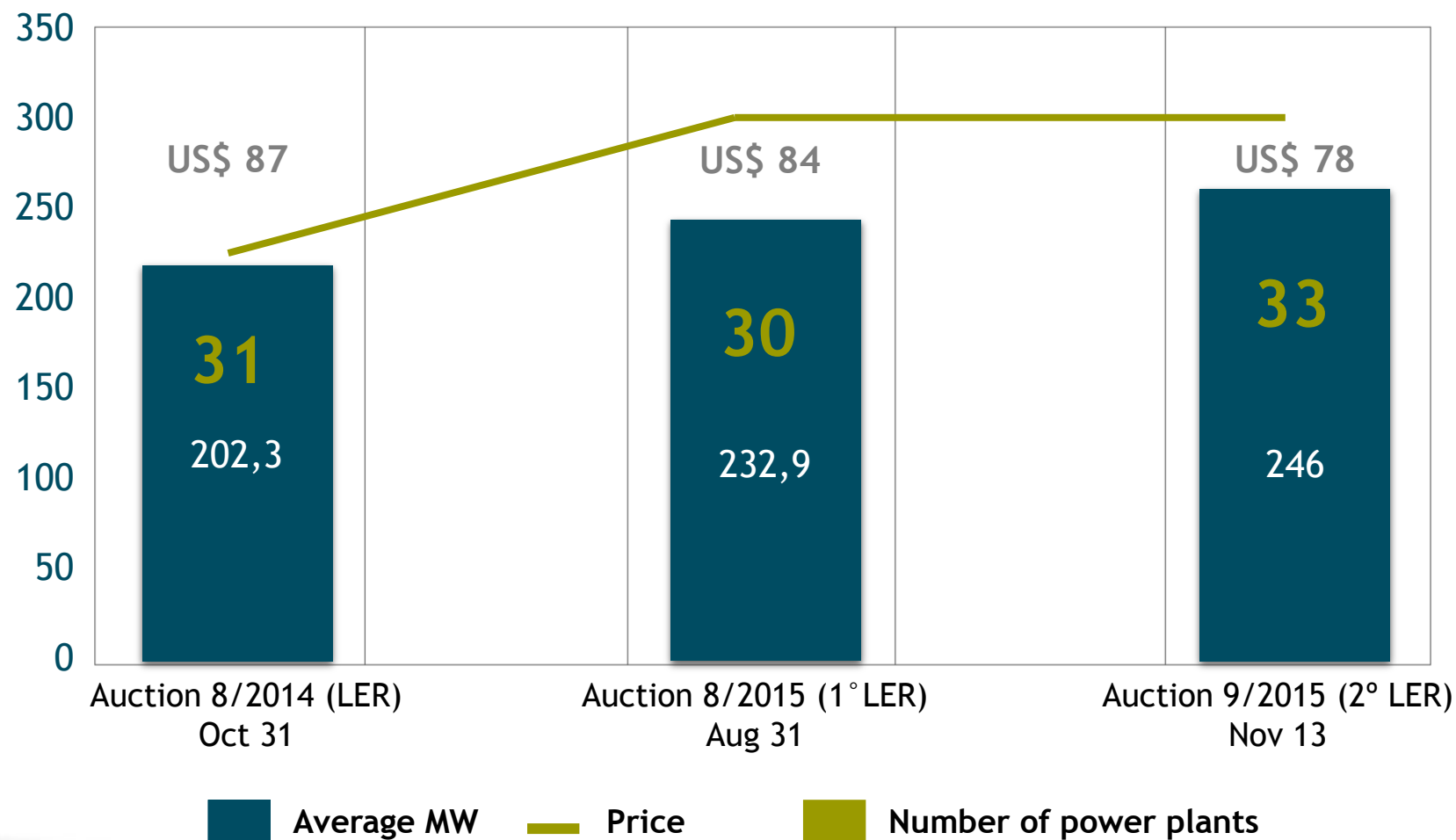
Source: BIG/ANEEL
Updated on 2017-4-7

UFV POWERPLANTS IN CONSTRUCTION



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.**

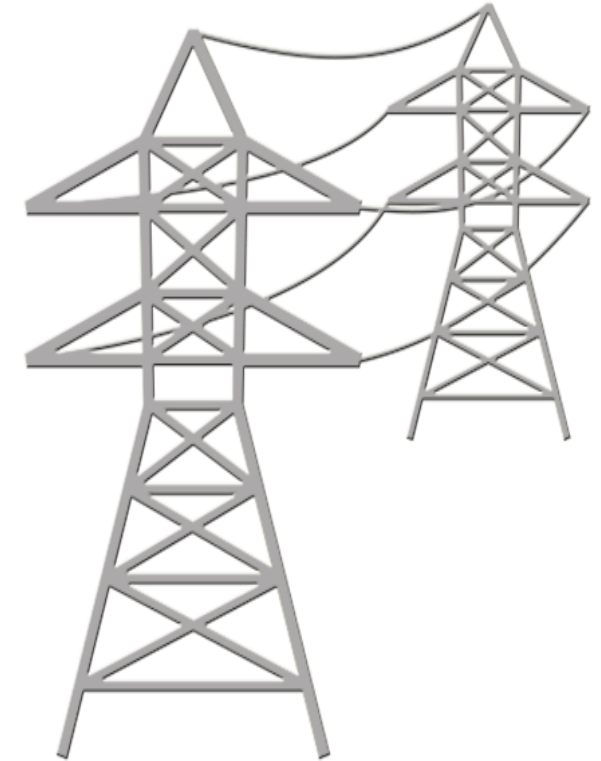
The CEO of the National Agency for Electrical Energy - ANEEL, in the use of his due grants, in accordance with the Board decision, in view of the provisions of Law 9,427 of December 26, 1996, based on Art. 4, sections IV and XVI, Annex I of Decree No. 2,335, of October 6, 1997, as set out in the Process 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



Bill = Net difference

DISTRIBUTED GENERATION (DG) MODALITIES

Distributed Generation

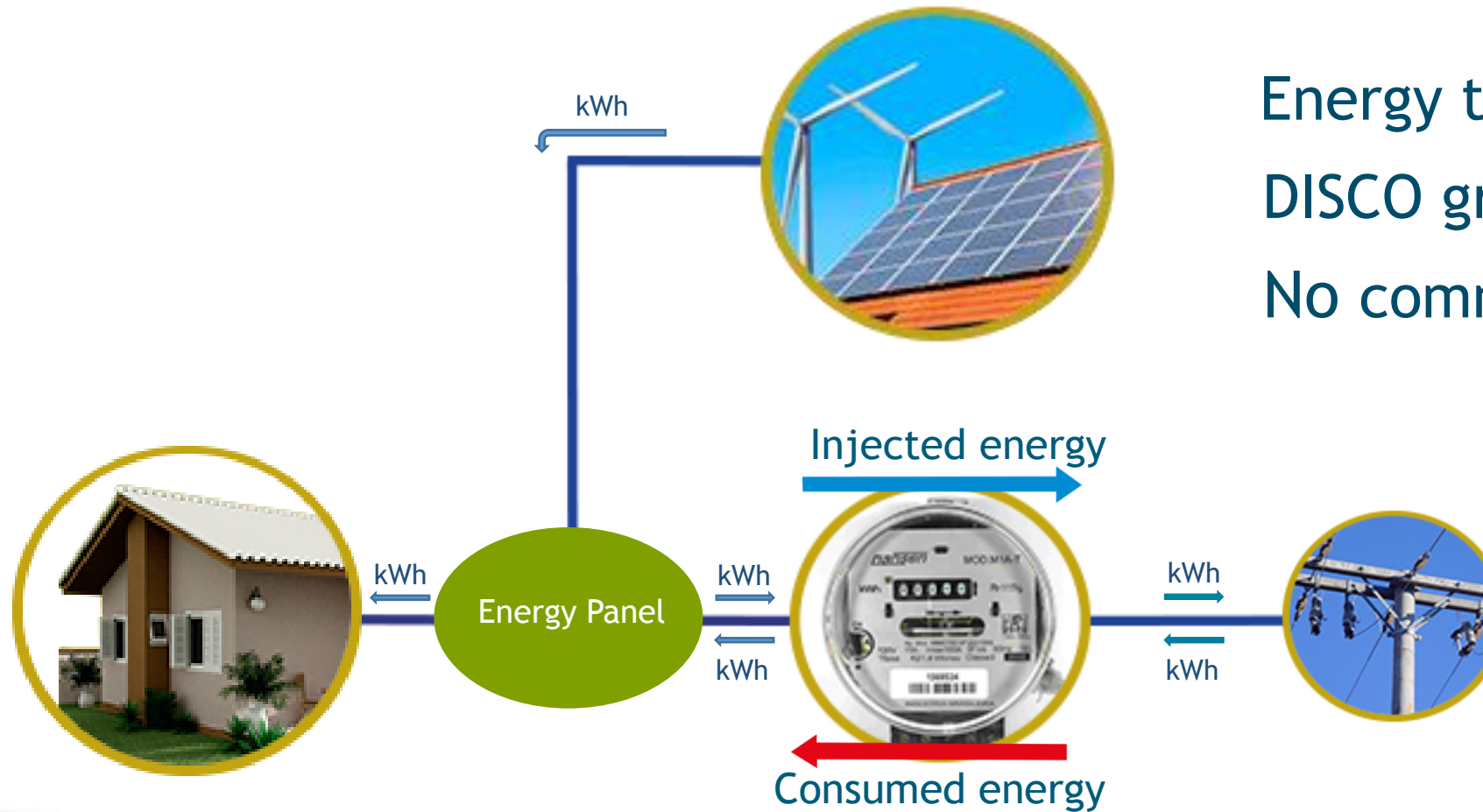
RESOLUTION ANEEL # 482/2012

(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

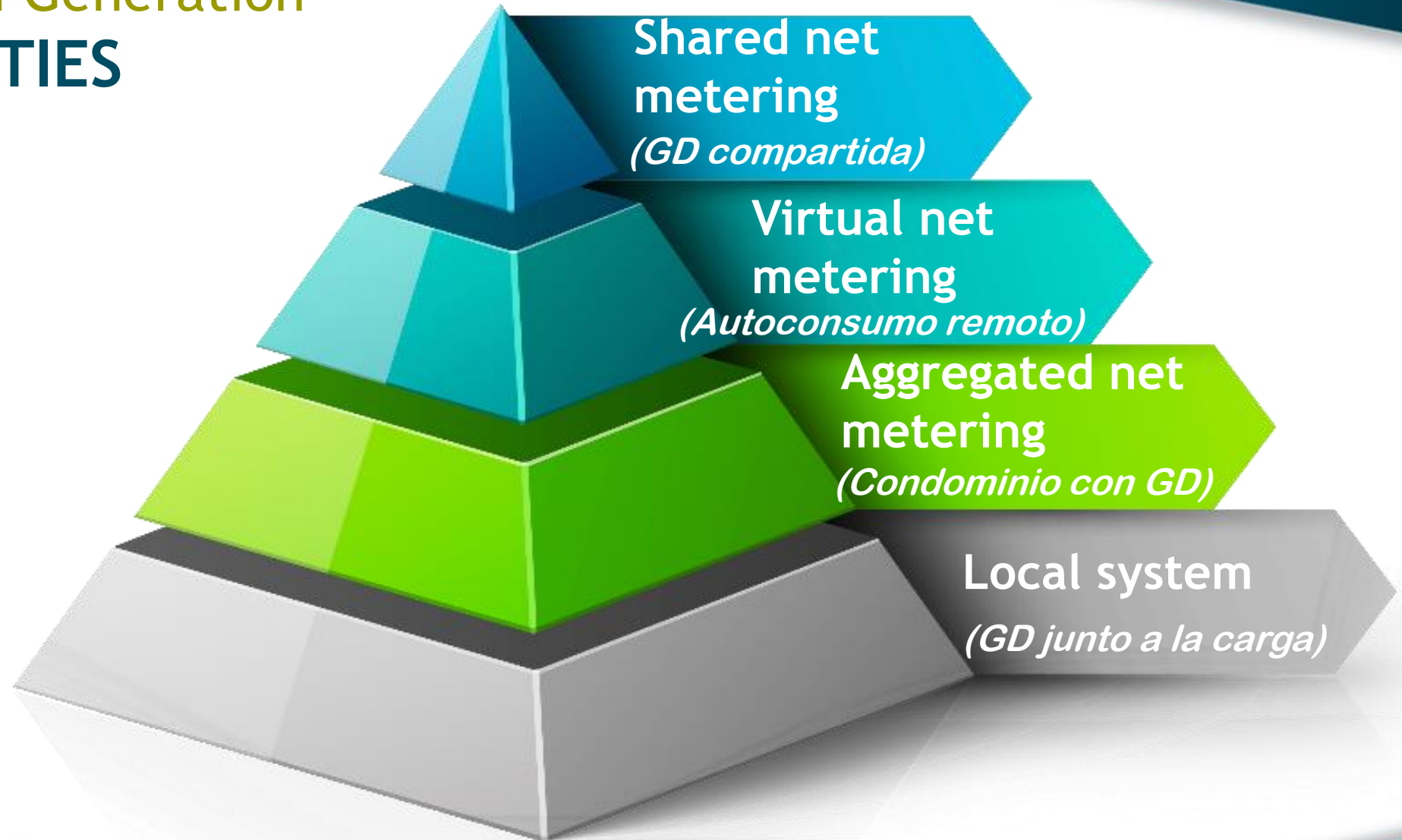


Energy trade

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)

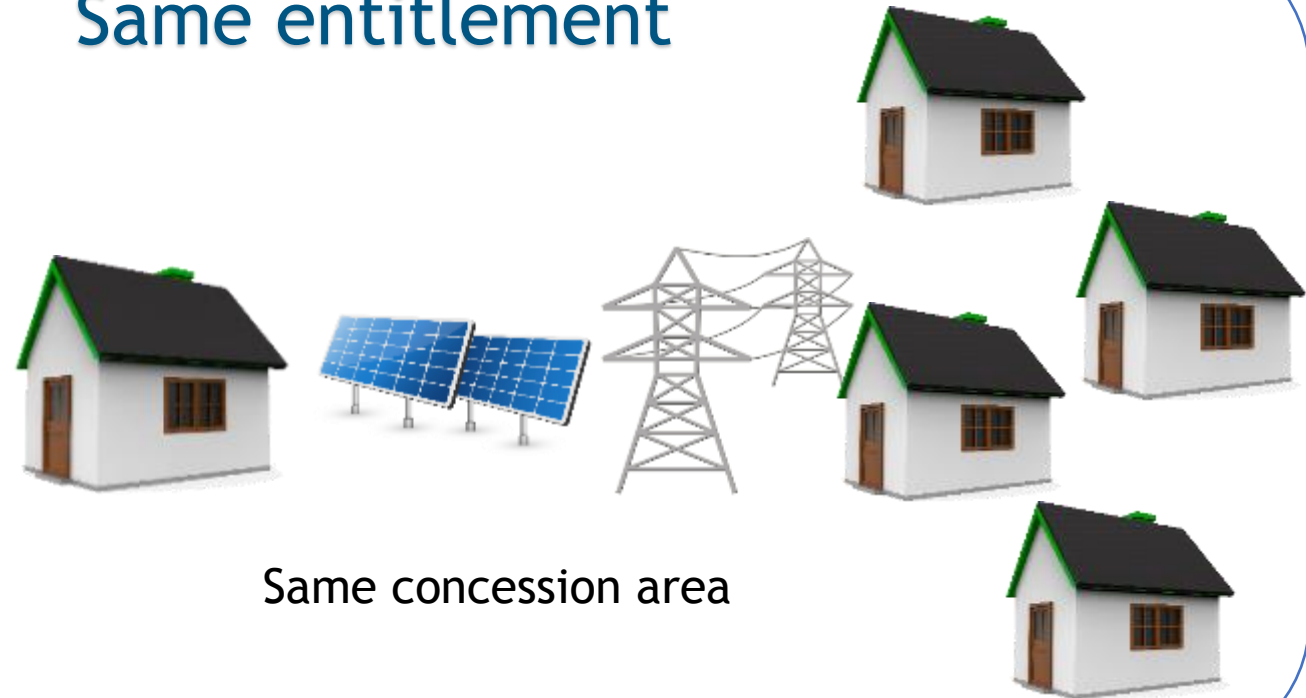


Distributed Generation MODALITIES

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

Virtual net
metering
(*Autoconsumo remoto*)

Same entitlement



Distributed Generation MODALITIES

- ❖ Consumers assembled through a consortium or cooperative

Shared net metering
(GD compartilhada)

New

Same concession area



Consortium or cooperative

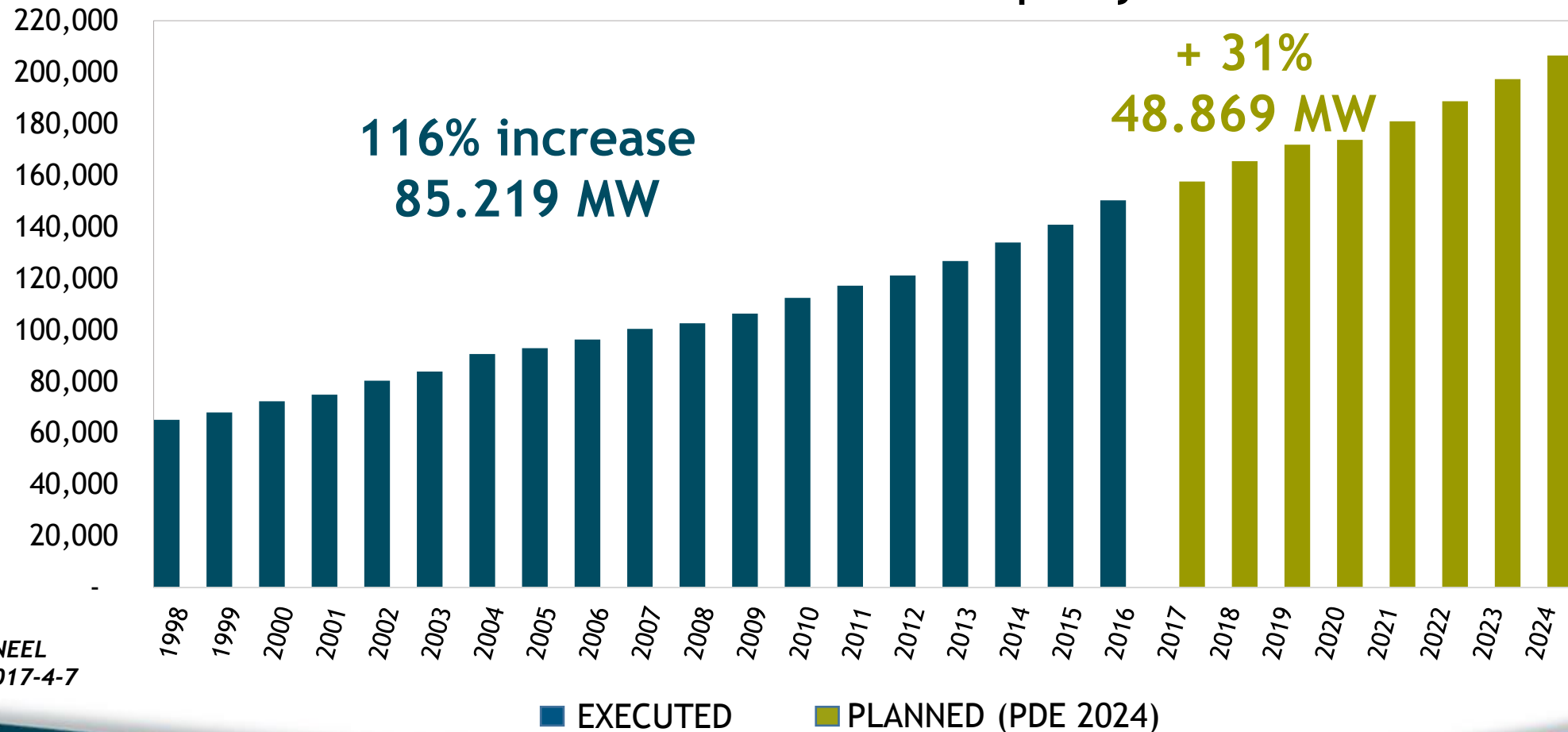
EVOLUTION, PROJECTIONS and IMPACTS



Energy

GENERATION

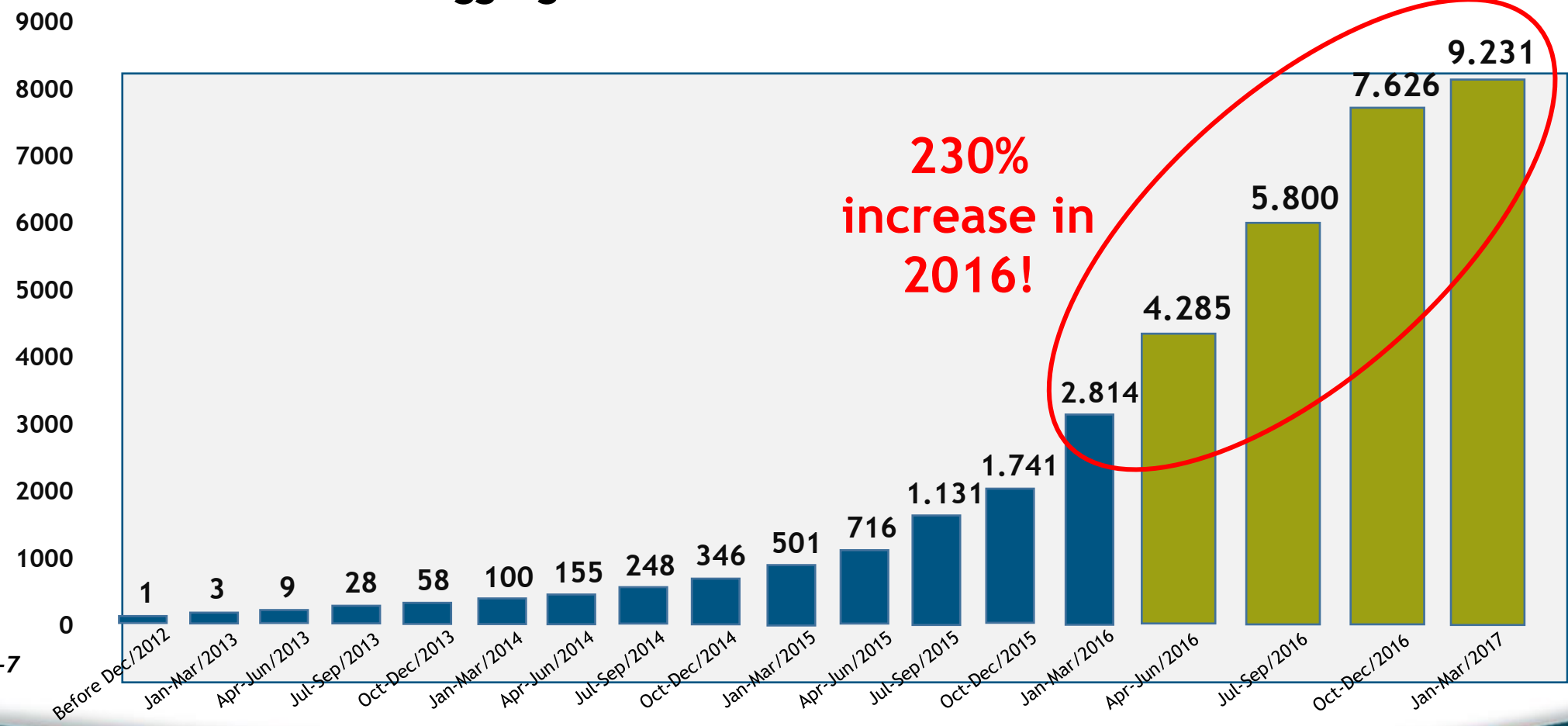
Evolution of Installed Capacity



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

Evolution DISTRIBUTED GENERATION (Photovoltaics Plants)

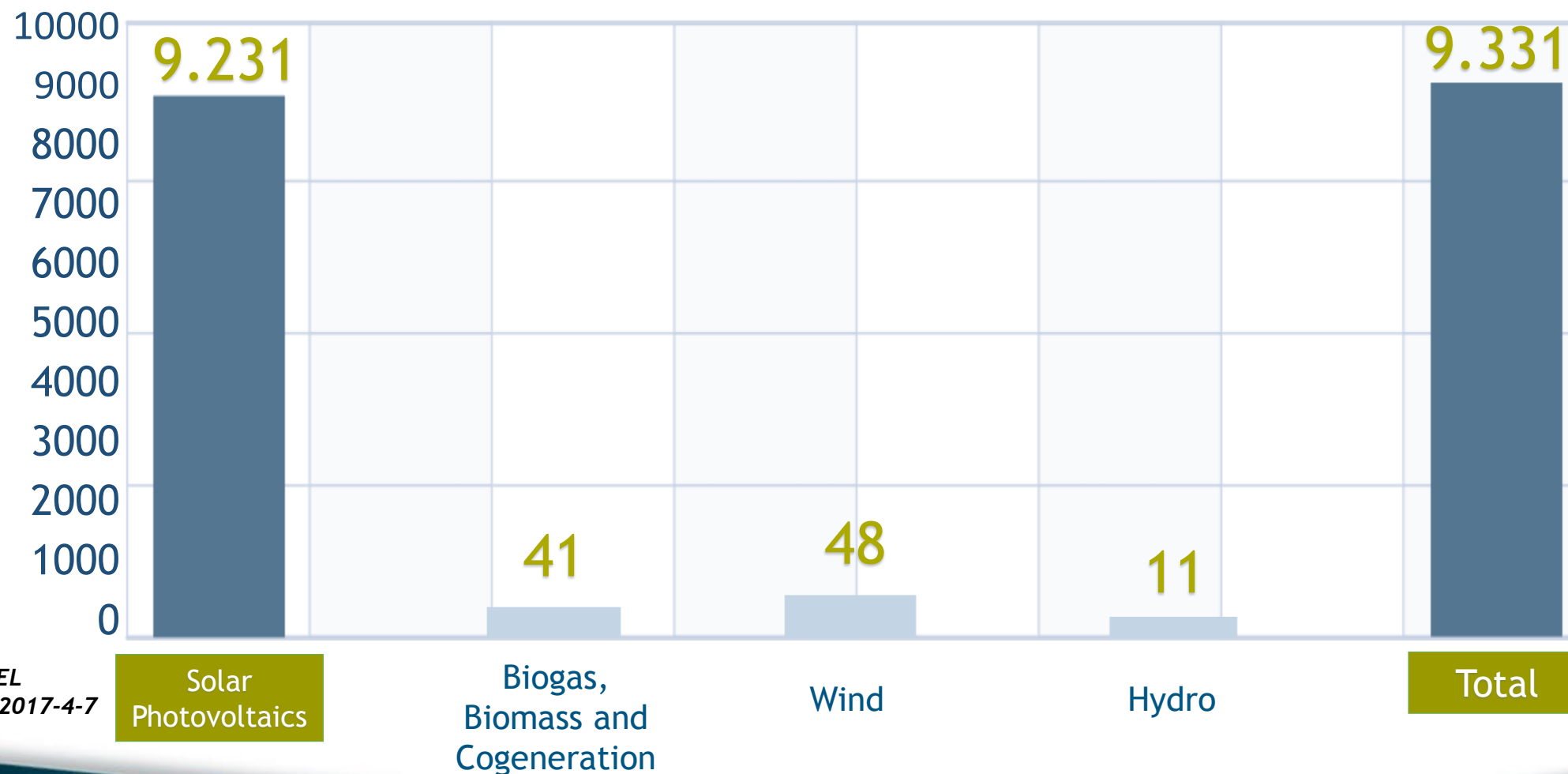
Aggregated number of connections



**230%
increase in
2016!**

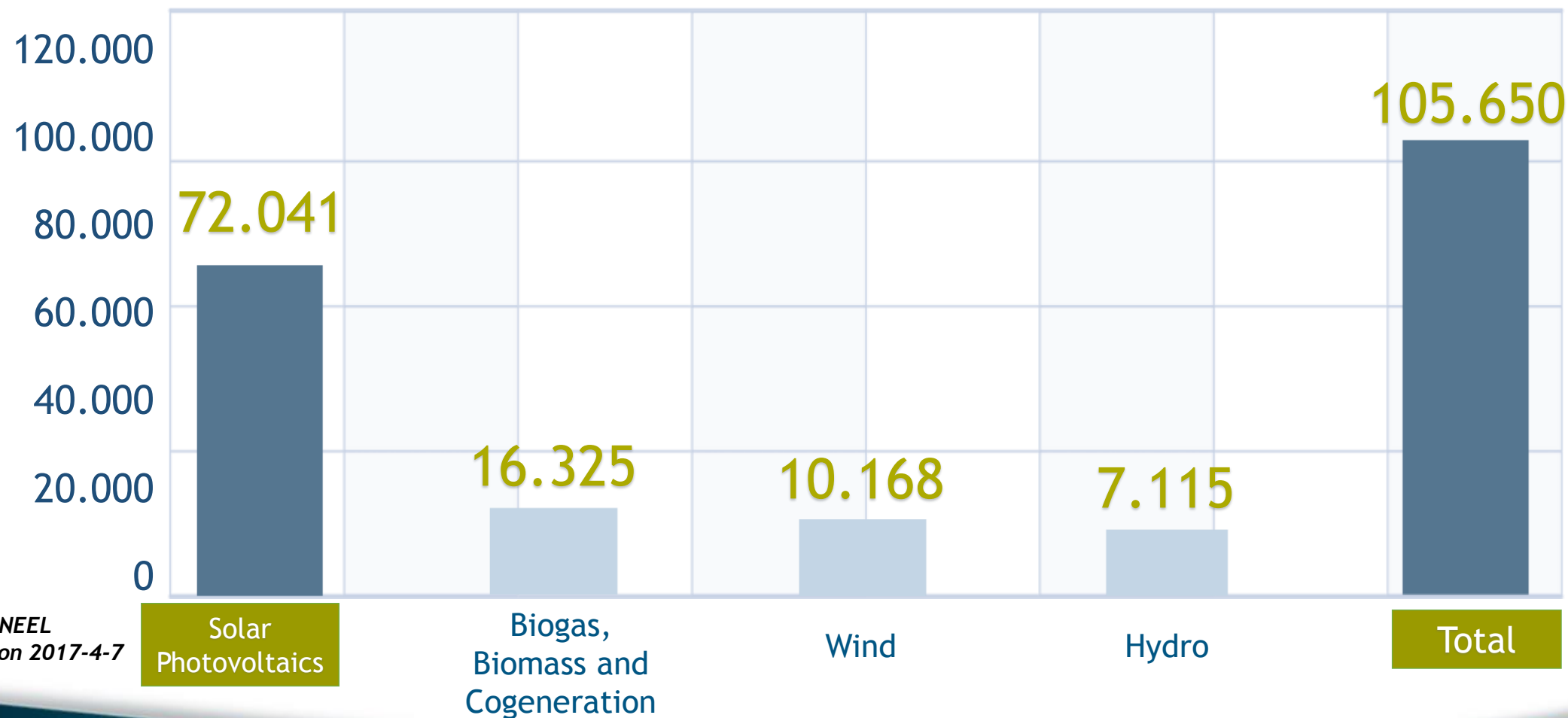
Source: BIG/ANEEL
Updated on 2017-4-7

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%

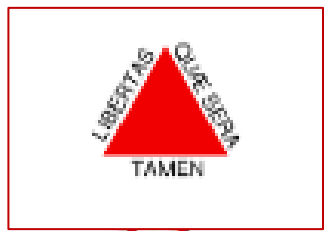
Connections are
residential

25 Years

Service life of
the solar panels

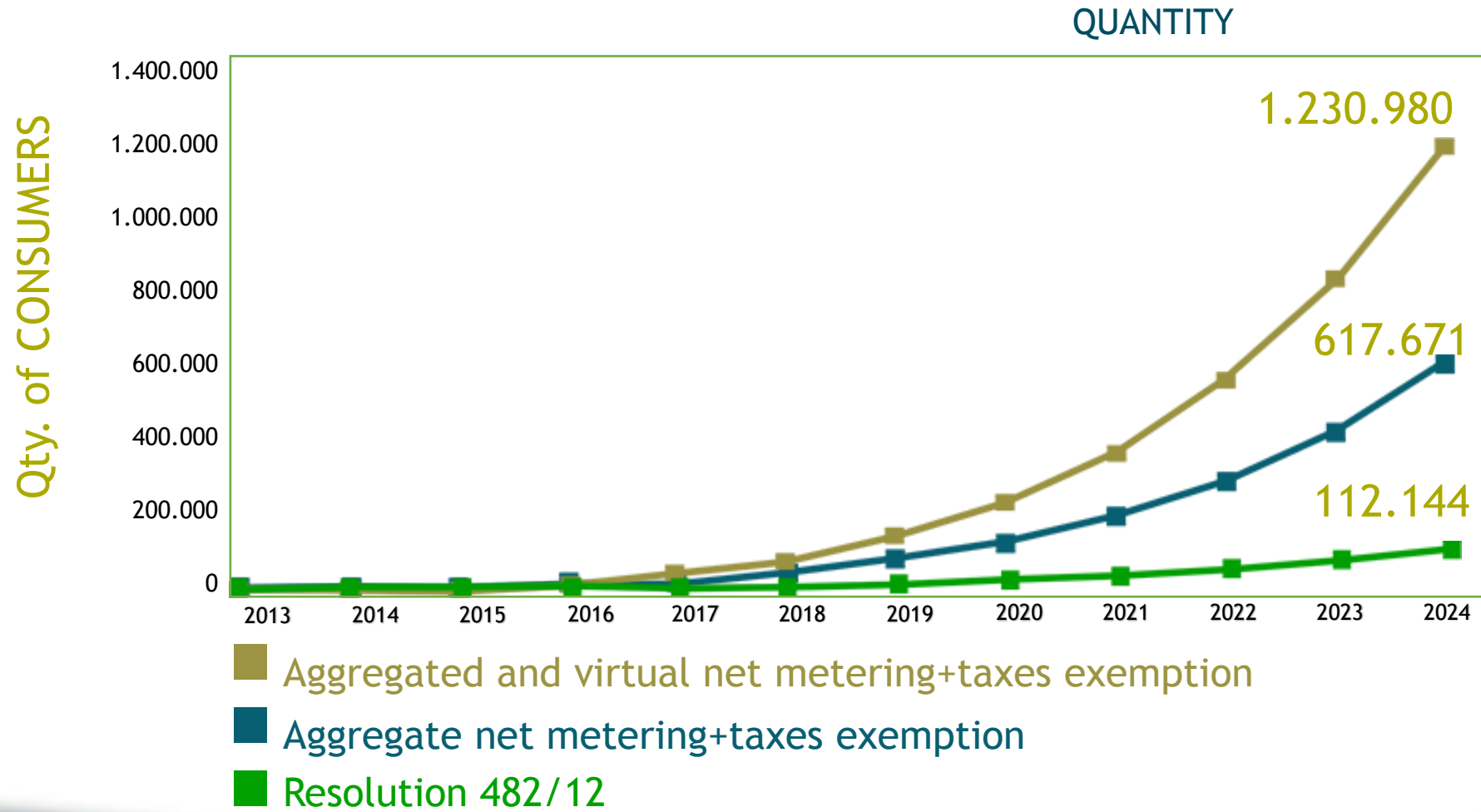


Distributed Generation DG CONCENTRATION

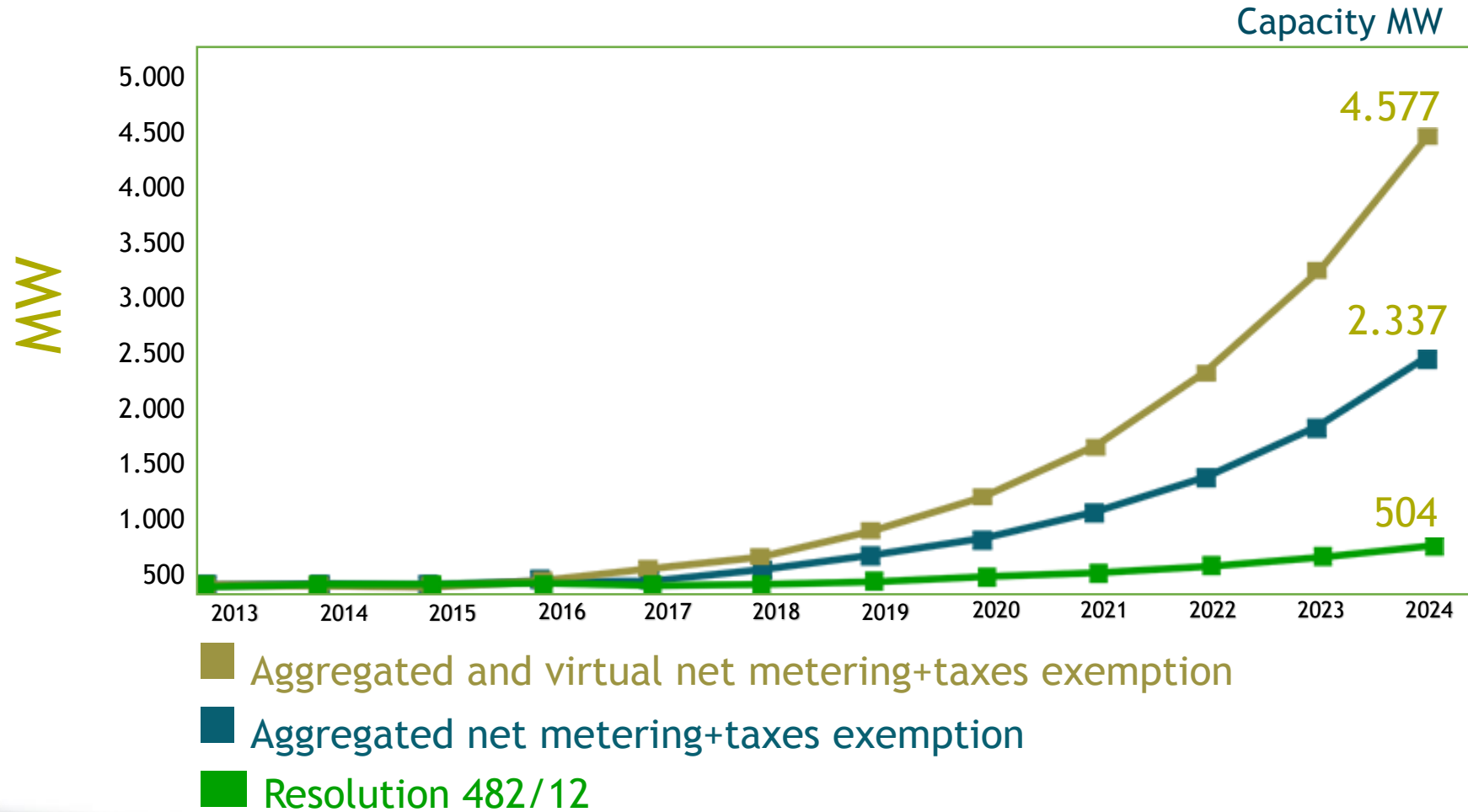


DISTRIBUTED GENERATION PROJECTIONS IN BRAZIL

Distributed Generation PROJECTIONS



Distributed Generation PROJECTIONS

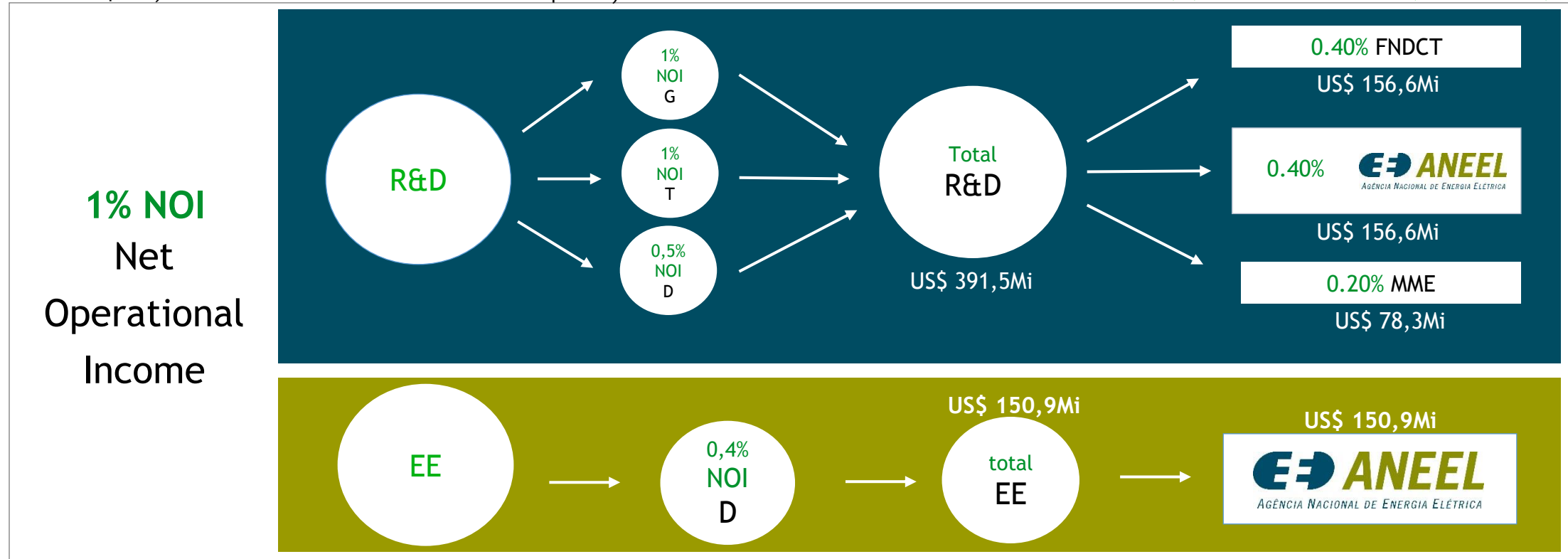


R&D AND EE PROGRAMMES

NOI= US\$ 58,01b

1% NOI= US\$ 580,1Mi

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



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

BRAZILIAN SOLAR PHOTOVOLTAIC CHALLENGES

SOLAR PHOTOVOLTAIC

❖ Distributed Generation



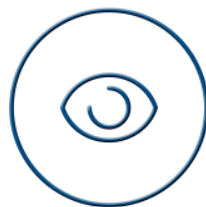
Publicity



Tax exemptions for
the new modalities



Funding



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 \square 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

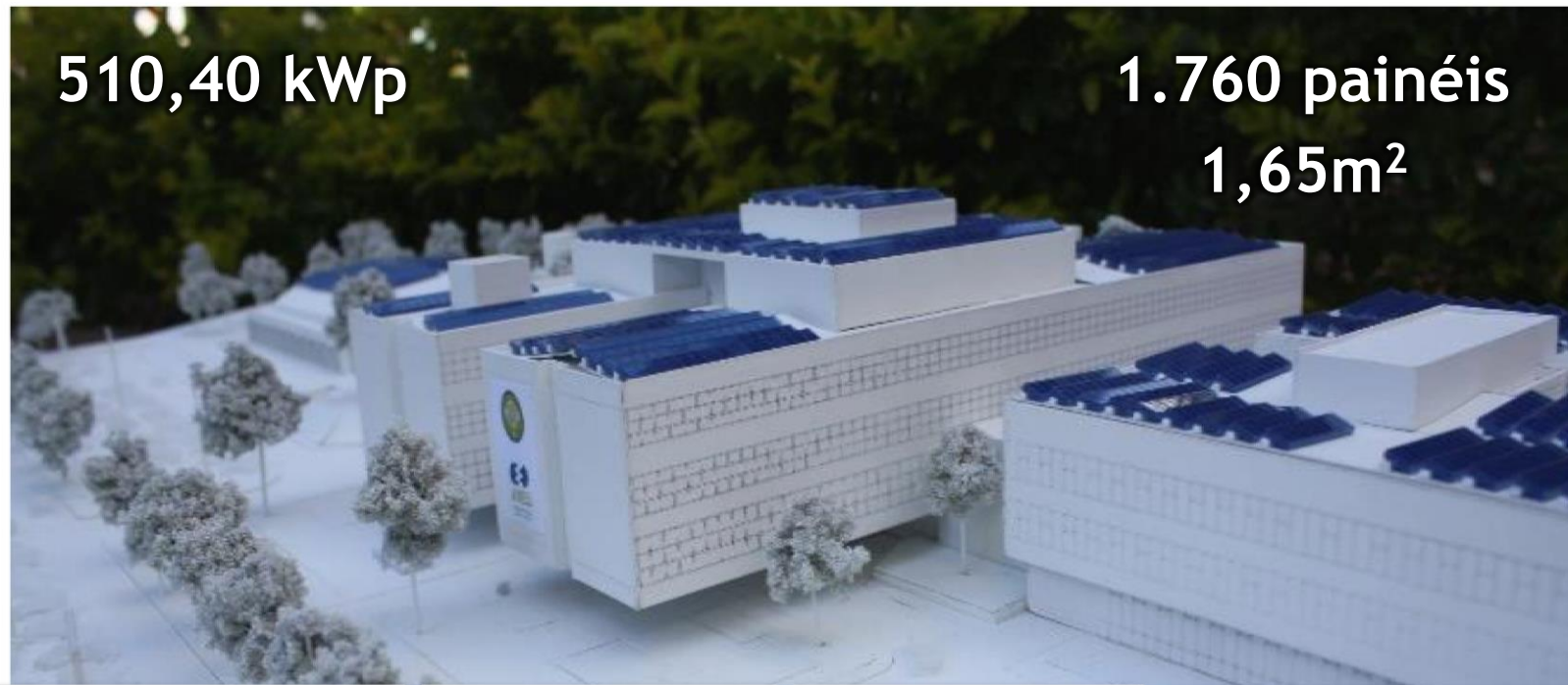


Possible solution: use of **binomial tariff** for low voltage consumers: energy + “wire” (grid transport), similar to the high voltage consumers

Projeto de eficiência energética EDIFÍCIO SEDE DA ANEEL

510,40 kWp

1.760 painéis
1,65m²



Why we Exist

ANEEL's MISSION

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



AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA

Energy made present.

ANDRE PEPITONE DA NÓBREGA
ANEEL's DIRECTOR

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