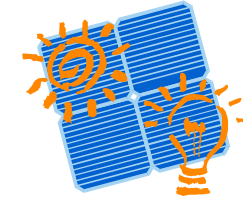




UNIVERSIDAD CARLOS III DE MADRID
ELECTRONIC TECHNOLOGY DEPARTMENT
POWER ELECTRONICS SYSTEM GROUP (GSEP)



IEA PVPS Workshop, Valencia, Spain
Thursday, 4th September, 8.30am to 12.00pm
Sala de Conferencias 3F + 3G, Centro de Eventos
“Grid parity and beyond...”

A changing Spanish perspective? – Grid issues and promotion of building- integrated PV

Dr. Vicente Salas

vsalas@ing.uc3m.es



23rd European Photovoltaic Solar Energy Conference and Exhibition
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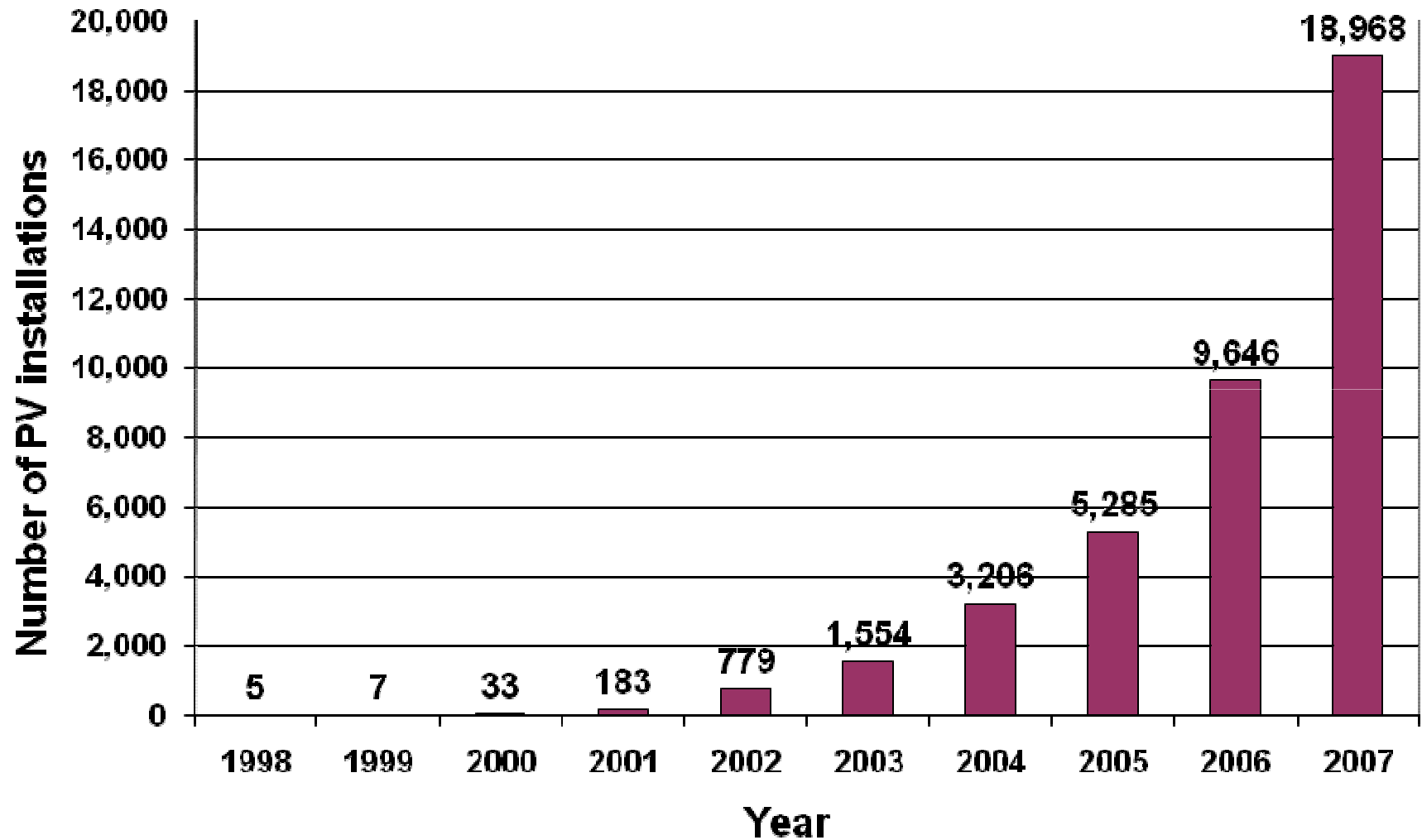
1 – 5 September 2008
VALENCIA, SPAIN

OUTLINE

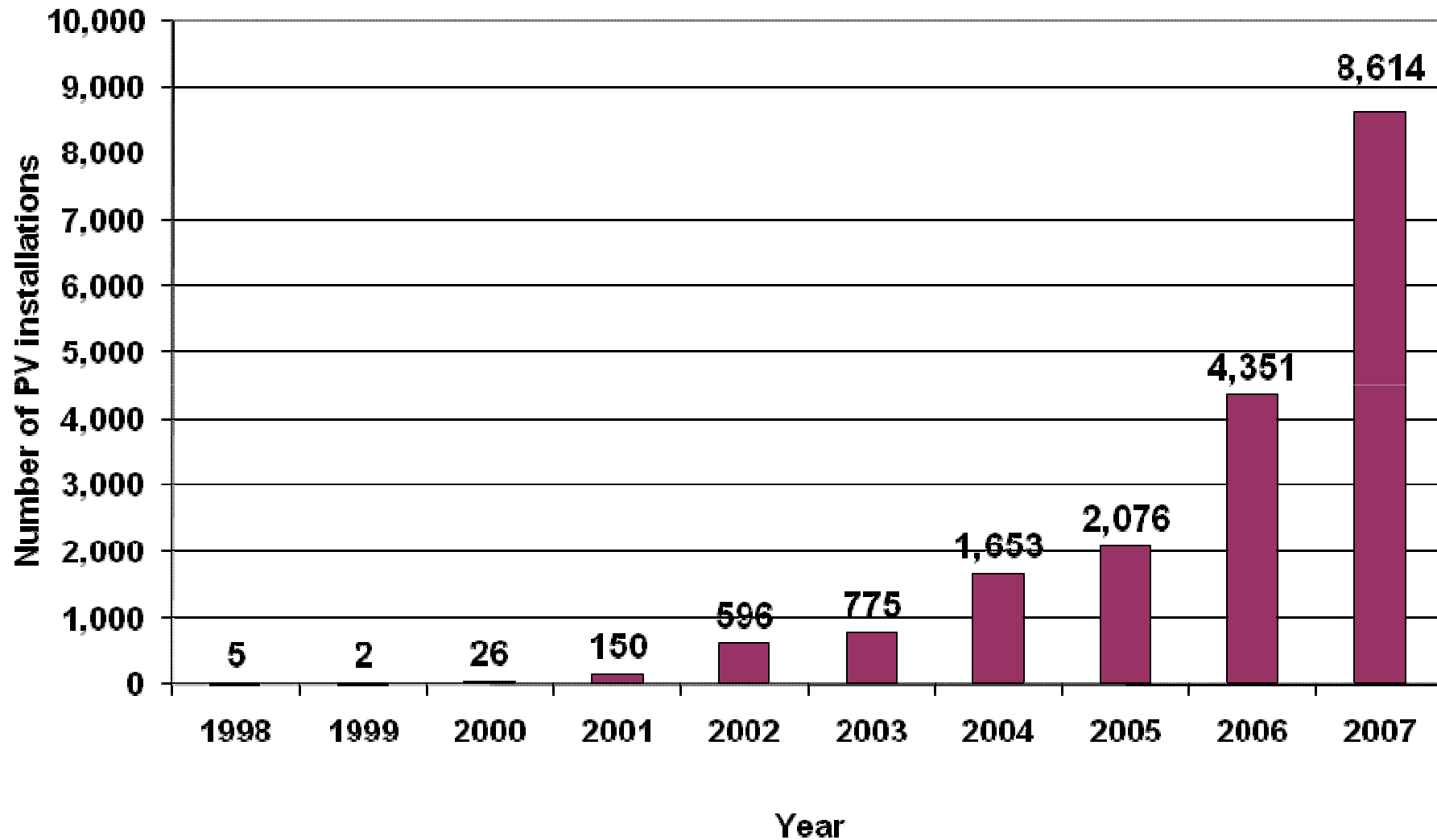
- Current situation of PV energy in Spain
- Why and how has this situation developed?
- is the Spanish PV market sustainable?
- Conclusions

Current situation of PV energy in Spain

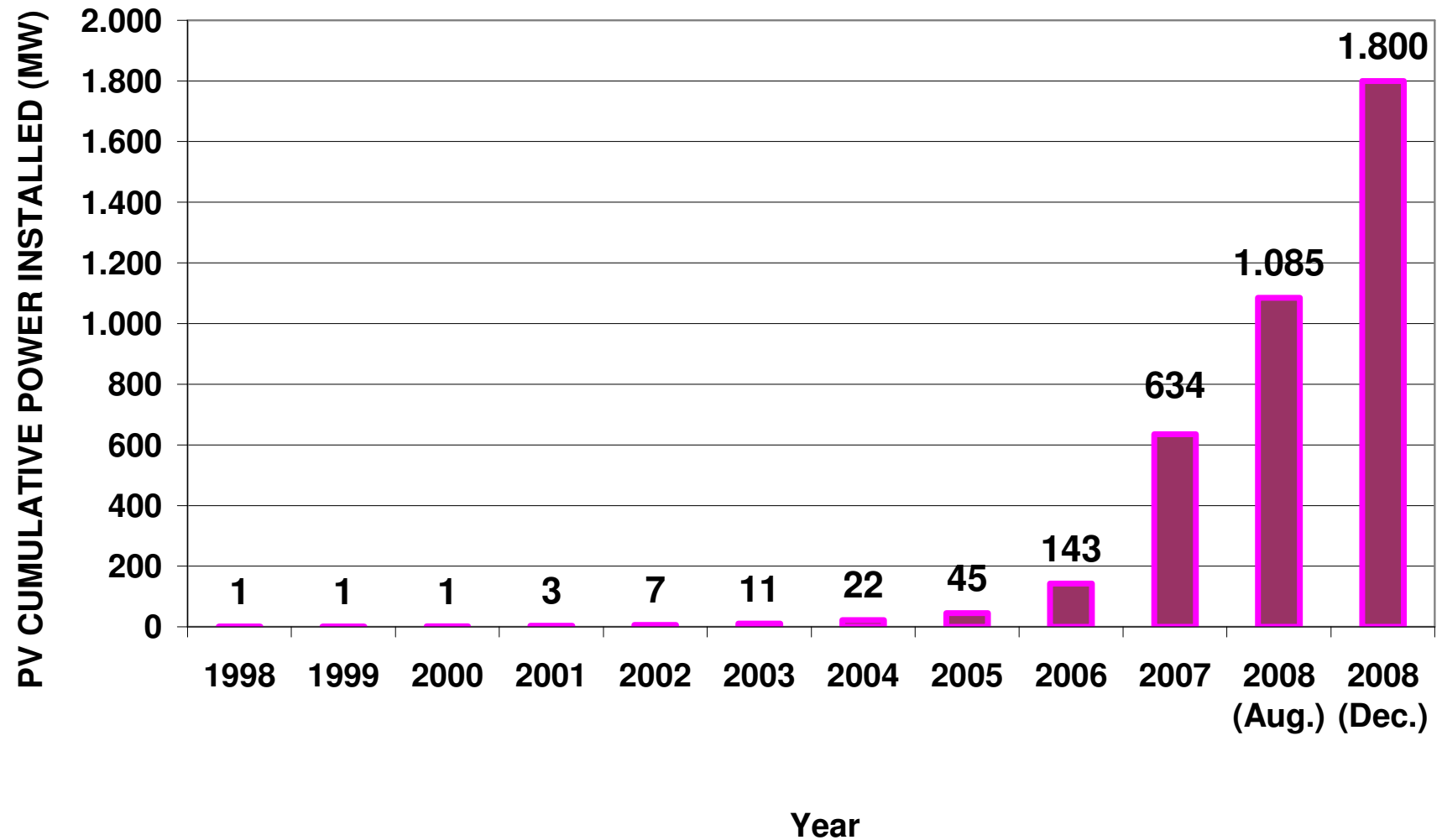
Cumulative amount of PV installations up to 2007



Yearly number of PV installations up to 2007



Cumulative photovoltaic power installed (MW)



Plans for Renewable Energy and Targets

- Plan for Renewable Energy (2000-2005) had 150 MW as its objective
- Plan for Renewable Energy (2005-2010) put 371 MW of PV installations as limit in 2010
- This objective was exceeded in September 2007
- In the new Plan for Renewable Energy (2011-2020) another limit there will be imposed

Why has this PV capacity been reached?

- Support measures
- Initiatives

Spanish PV support measures

- Direct capital subsidies: it is easy to find soft loans in private banking, so in Spain direct subsidies for grid connected plants are not necessary.

- Feed-in-tariff system

LEGAL FRAMEWORK FOR INTERCONNECTION TO THE NETWORK IN SPAIN

| Fiscal Measure | Year |
|-------------------------------|-------------|
| <i>Royal Decree 2266/94</i> | 1994 |
| <i>Royal Decree 2818/1998</i> | 1998 |
| <i>Royal Decree 436/2004</i> | 2004 |
| <i>Royal Decree 661/2007</i> | 2007 |
| <i>New Royal Decree ?</i> | 2008 ? |

LEGAL FRAMEWORK FOR INTERCONNECTION TO THE NETWORK IN SPAIN

- Fiscal measures
 - **Royal Decree 2266/94**
 - **Spanish Power Act 54/1997**, establishing principles for a new model of operation based on free competition, and likewise, boosting the development of energy in special systems
 - **Royal Decree 2818/1998**, regarding fiscal, administrative and corporate measures, promoting the development of facilities under a special legal system through the creation of a favourable framework
 - **Royal Decree 436/2004.**
 - **Royal Decree 661/2007**, the tariff system was divided into three types, depending on size of the installation
 - This no longer applies for new installations
 - As such there are currently no existing support measures in place

Royal Decree 436/2004

- This provided incentives in one of two ways:
- 1) Generators which sell their production to a distributor will receive a fixed tariff that is defined as a percentage of a regulated tariff.
 - The percentage was established on a technology by technology basis.
 - The reference tariff for 2007 had a value of:
 - 0.440381 €/kWh (for PV installations < 100 kW)
 - 0.229764 €/kWh (for PV installations > 100 kW);
- 2) Generators which sell their electricity in the free market will receive the negotiated market price of electricity, an incentive for participating, and a premium, if eligible.

Royal Decree 661/2007

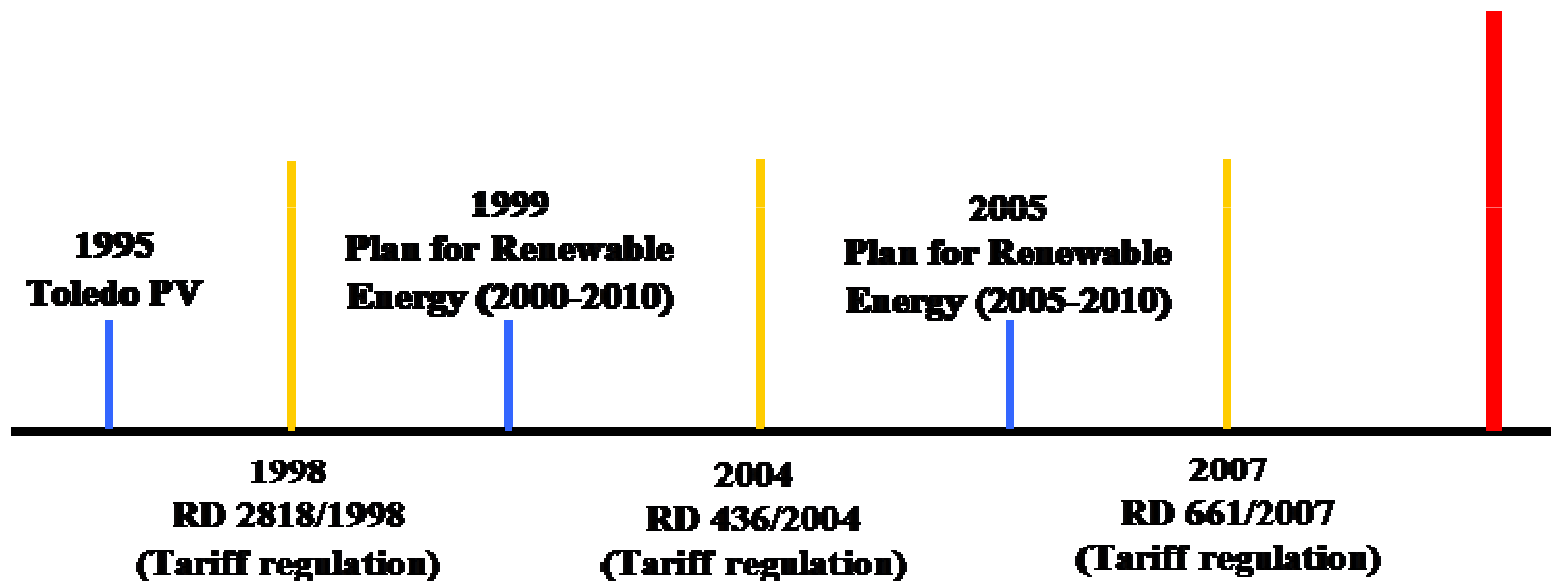
- Two new elements:
 - Guarantee of 500 €/kW
 - Obligation to sell the electricity generated by PV in the electrical market (instead of selling to electrical supplier)

| Power (kW) | Tariff (c€/kWh) |
|--------------------------------|----------------------------------|
| Installations < 100 kW | 44,0381 (for the first 25 years) |
| | 35,2305 (from then on) |
| | |
| 100 kW < Installations < 10 MW | 41,7500 (for the first 25 years) |
| | 33,4000 (from then on) |
| | |
| Installations > 10 MW | 22,9764 (for the first 25 years) |
| | 18,3811 (from then on) |

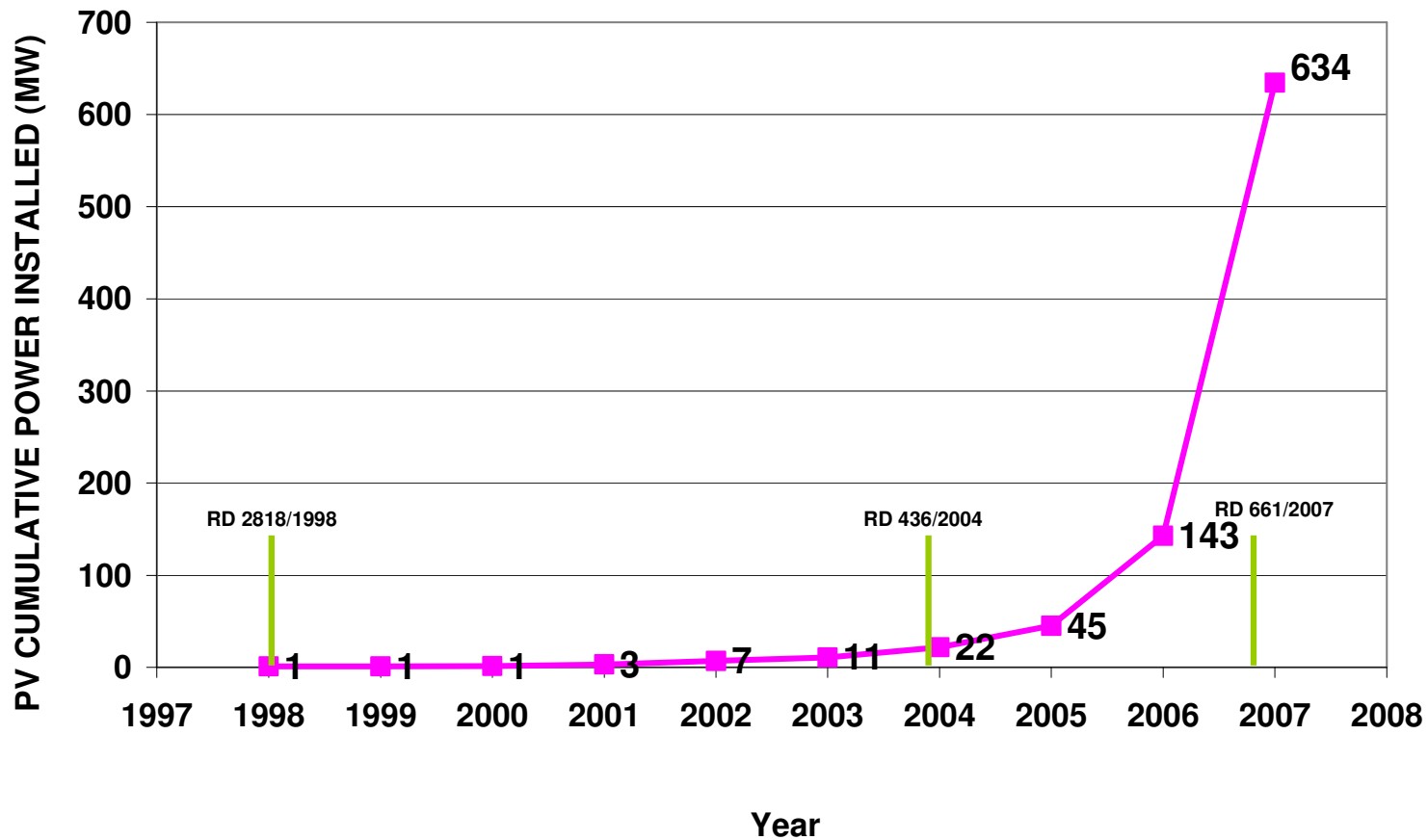
- The tariffs will be updated every year according to the CPI until 2012
- Nowadays, for new installations, **THERE IS NO TARIFF**

Evolution of Spanish Fiscal PV measures

| Phase 1 | Phase 2 | Phase 3 | Phase 4 |
|--|--|--|---|
| Stand alone: Subvention Grid connected: Exceptional | Stand alone: Subvention Grid connected: Subvention + Tariff + Tax deductible | Stand alone: Subvention Grid connected: Tariff + Tax deductible | Stand alone: Subvention Grid connected: Tariff |



Evolution of the Spanish Fiscal PV measures



New Royal Decree ?

I Types of installations:

- Type I (those installations that meet the following requisites, simultaneously):
 - Installations on roof or façades building (for residential, commercial or industrial uses) and with cadastral reference
 - Or fixed installations on covered parking structures or on the roof that provides shade for top level parking

- Type II:
 - Those installations that are not in the previous type

New Royal Decree ?

- To obtain the tariff, every installation must be registered
- The subscription will go associated to a period of time, named “notification”
- There will be a determined number of “notifications” per year
- Power aims:
 - For the first year:
 - For installations Type I: 200/number of notification per year MW
 - For installations Type II: 100/number of notification per year MW
 - Every year the power aim will updated according to algorithm
- Power limit per project:
 - For installations Type I: 10 MW
 - For installations Type II: 20 MW

New Royal Decree ?: Tariffs

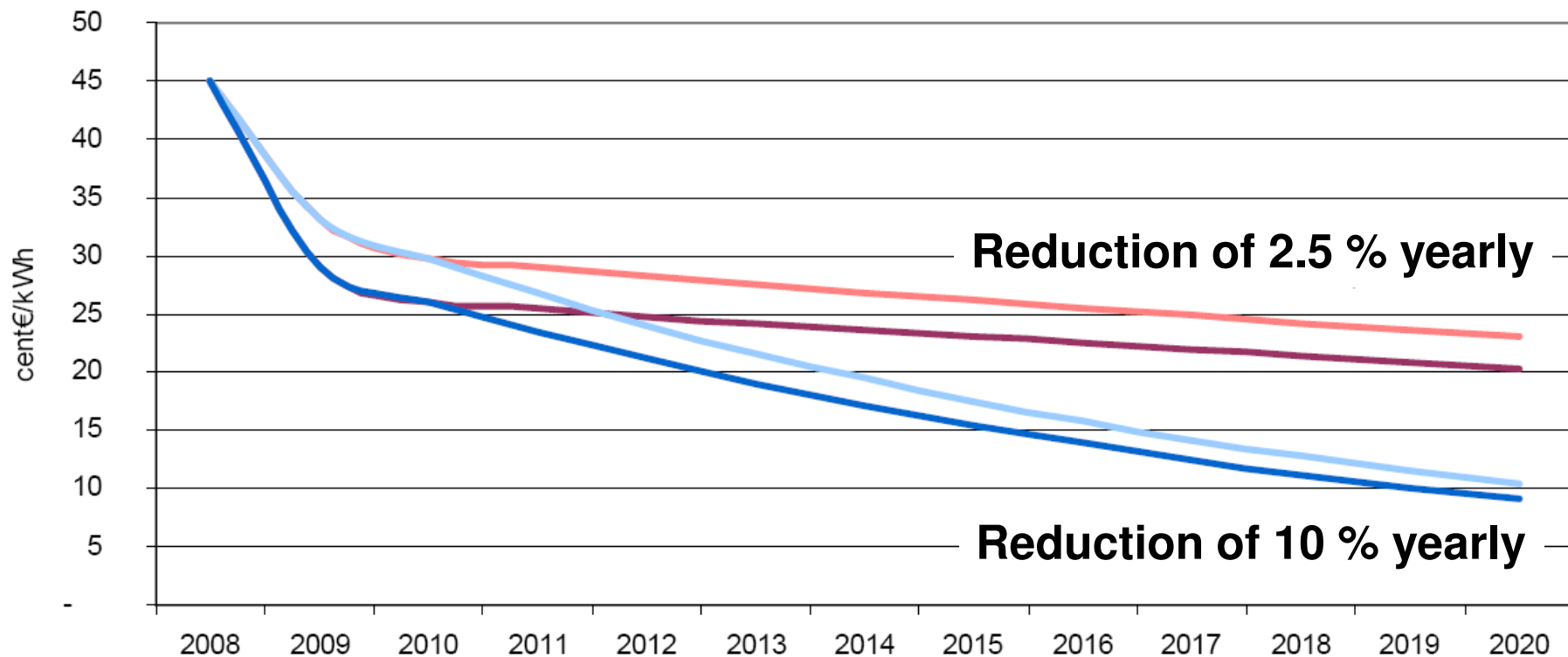
- For the first year:

| Type of installation | Tariff Cent€/kWh |
|----------------------|------------------|
| Type I | 33 |
| Type II | 29 |

- There is a discount 27-36 % with respect the previous feed-in-tariff system
- The tariff will be revised in function of the rhythm of the power that is registered every year

New Royal Decree ?: Tariffs

- The evolution of the tariff is expected to be affected by a reduction of 2.5-10 % per year



Initiatives: Technical Building Code (TBC)

- Its application is currently obligatory
- Section HE5 of the TBC regulates the incorporation of solar PV energy.
- It establishes the demands to be met by buildings
- It enforces the installation of PV on new large buildings, such as offices, government buildings, hospitals, etc...
- The minimum capacity required will depend on:
 - The climatic zone
 - Floor area
 - Kind of building use

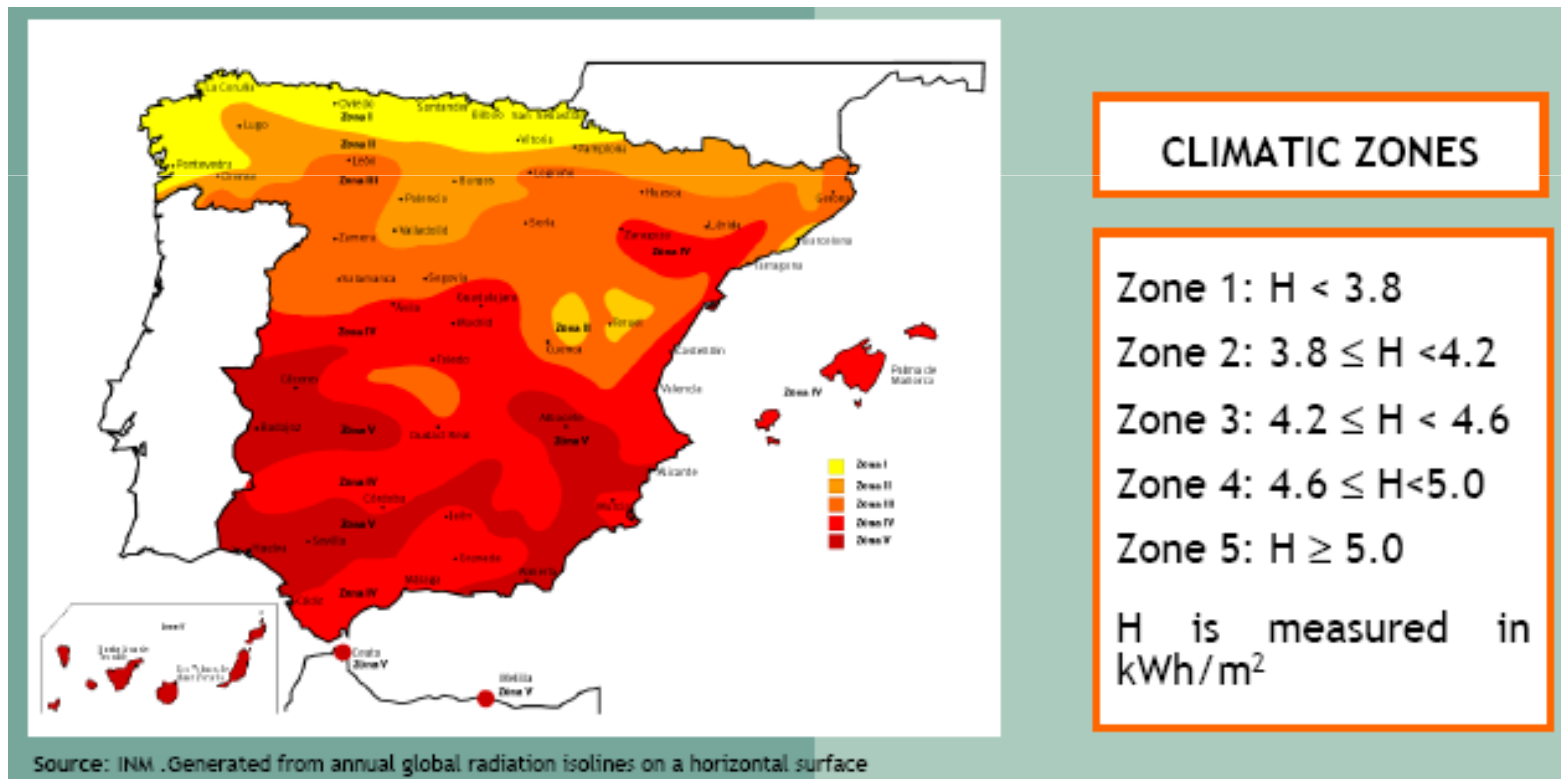
Initiatives: Technical Building Code (TBC)

- **Application field:** It oversees the installation of PV on new large buildings, such as offices, government buildings, hospitals, etc... according to limits

| Kind of use | Limit of application | |
|---------------------------------|----------------------|------------------------------|
| Hypermarkets | 5,000 | Floor area (m ²) |
| Multi-store and leisure centres | 3,000 | Floor area (m ²) |
| Storage warehouses | 10,000 | Floor area (m ²) |
| Administrative | 4,000 | Floor area (m ²) |
| Hotels & hostels | 100 | Rooms |
| Hospitals & private clinics | 100 | Beds |
| Pavilions in exhibition sites | 10,000 | Floor area (m ²) |

Initiatives: Technical Building Code (TBC)

- The climatic zone: The minimum photovoltaic power to be installed is determined by the climatic zone



Initiatives: Technical Building Code (TBC)

- The peak capacity P to be installed is:

$$P \text{ (kWp)} = C * (A * S + B)$$

- C is the defined coefficient for each climatic zone
 - A and B are the coefficients defined for each kind of use
 - S is the floor area built in square metres.
- The minimum PV to be installed will be 6.25 kWp

| Building Use | Coefficient A | Coefficient B |
|----------------------------|---------------|---------------|
| Hypermarkets | 0,001875 | -3,12500 |
| Malls and shopping centers | 0,004688 | -7,81250 |
| Warehouses | 0,001406 | -7,81250 |
| Administrative uses | 0,001223 | 1,35870 |
| Hotels an hostels | 0,003156 | -7,81250 |
| Hospitals and clinics | 0,000740 | 3,28947 |
| Pavilions and trade fairs | 0,001406 | -7,81250 |

| CLIMATE ZONE | C |
|--------------|-----|
| I | 1 |
| II | 1.1 |
| III | 1.2 |
| IV | 1.3 |
| V | 1.4 |

How has been
reached the current situation
of PV energy in Spain?

-
- This growth has occurred by applying models different from those used throughout the European Countries
 - Although PV installations in Spain are very large there are very few of them.
 - There are very few installations in the residential sector

Highlights of the implementation of PV power

■ New solar farms

- Beneixama Solar Farm
- 200 installations: 20 MW
- 500.000 m² (70 football stadium)
- 31.000 MWh
- 100.000 PV modules
- 30.000 ton of CO₂ yearly

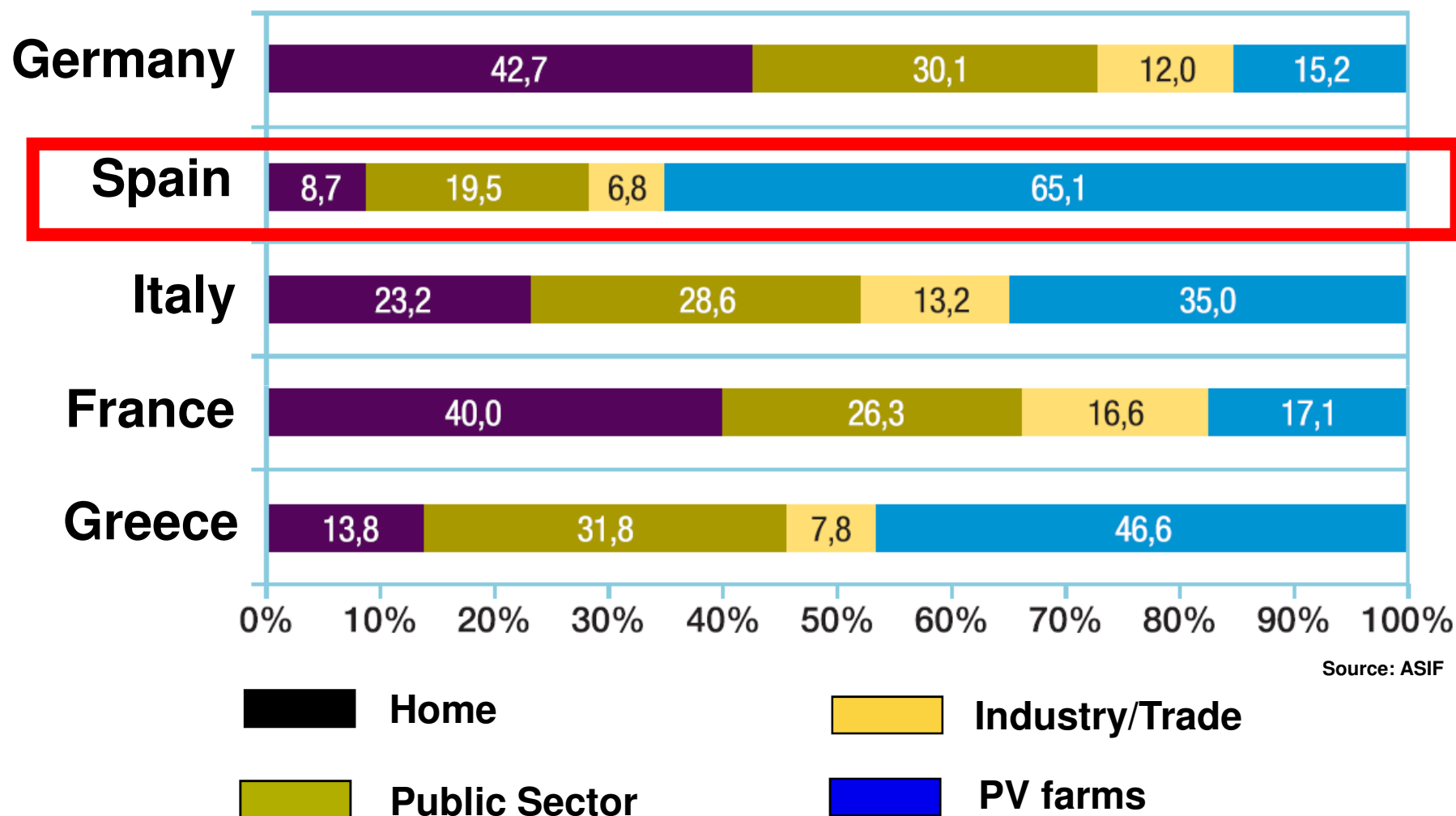


20 MW PV FARM: HOYA DE LOS VICENTES (MURCIA)



- ◆ **100 Hectares**
- ◆ **200 instalations**
- ◆ **100 kW each**
- ◆ **Avoid 42.000 tons/yearly of CO2**
- ◆ **Production 41,6 GWh/year**
- ◆ **Equivalent to 20.000 homes**

Ownership of PV installations



Socio-Economic Structure of the PV Sector in Spain

PV sector in Spain 2007 (I)

- The sector has generated more than 26,000 jobs, all highly qualified and most with a permanent contract

| | Direct | Indirect | Total |
|----------------------|---------------|-----------------|--------------|
| Manufacturers | 3,400 | 3,400 | 6,800 |
| Installation | 11,900 | 5,900 | 17,800 |
| Others | 1,700 | 500 | 2,200 |
| | | | |
| Total | 17,000 | 9,800 | 26,800 |

- In 2007, Spanish PV industrial investment reached 536 mill.€. This is 500 % more than in 2006
- Business turnover in 2007 was approximately 7500 mill

PV sector in Spain 2007 (II)

- Until now, the **Production of feedstocks, ingots and wafers** has been almost null in Spain
- Only 120 MW of PV cells have been manufactured by Spanish companies
- The distribution of the Spanish companies according their activities are:

| Activities | Companies |
|-----------------------------|------------------|
| Installers | 52,4 |
| Maitanance | 21,6 |
| Equipment Trading Companies | 14,7 |
| Projects | 11,1 |

- There are no specific Public budgets for R&D for photovoltaic

Is the rate of growth in the Spanish PV market unsustainable?

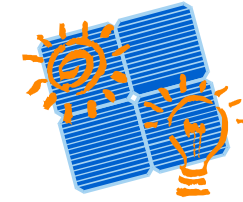
- Why do Spanish PV associations (and not the public sector) try to convince us that **the rate of growth in the Spanish PV market is unsustainable?**
- They say that the new legislation should:
 - adopt a decrease of the tariff over time, in order to encourage the cost reduction
 - establish a stable and durable framework, without power target, to avoid the market distortions
 - Tariffs should be updated yearly that permit adjustment of the Spanish PV market to the evolution of the world PV market

Conclusions

- The previous feed-in tariff system has definitively helped Spain to become the 2nd largest installer of PV power in the world (2007)
- Spanish Technological companies and manufacturers have not been able to take advantage of the favorable circumstances
- The feed-in tariff system is no longer in place
- Some Spanish PV associations are trying to stop the growth of the Spanish PV market
- One thing is clear: Spain must carry out the objectives ordered by the European Union



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**Thank you very much
for your kind attention.
Have a good day!**

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