

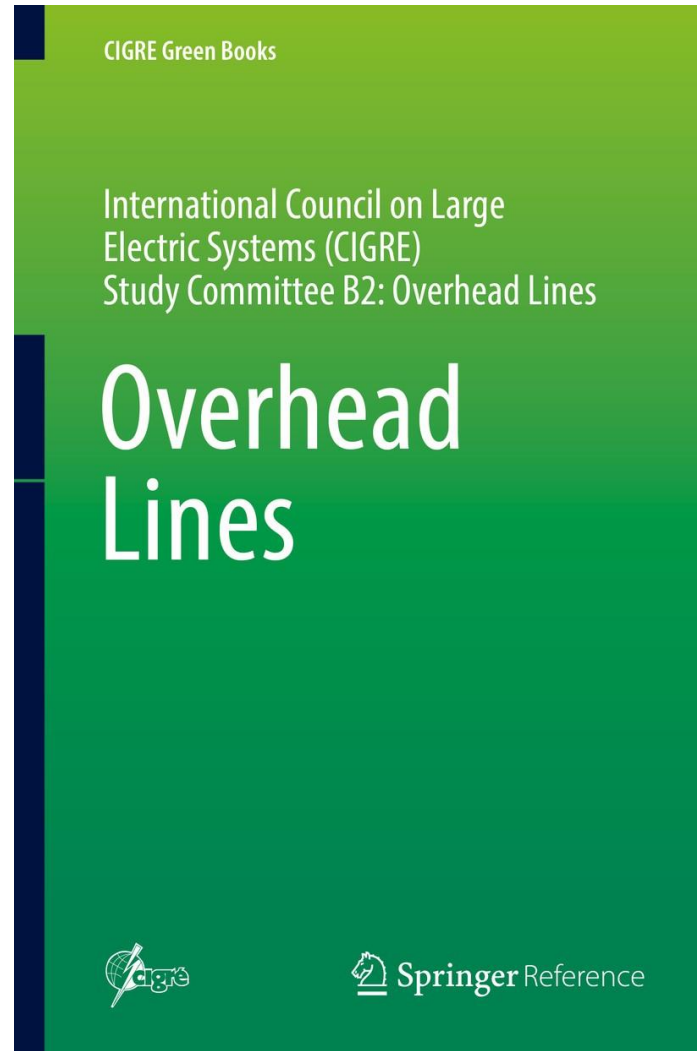
# CIGRE and the energy transition



**cigre**

For power system expertise

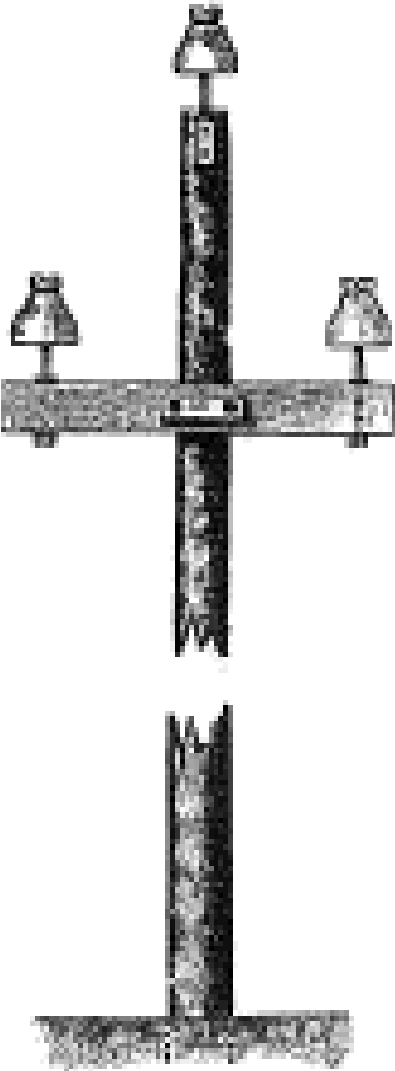
- Why do we need the energy transition?
- Why do we need more electric power for the energy transition?
- What are the biggest challenges in the grid because of the energy transition?
- What are the key technologies we have to develop to achieve the energy transition?
- How will AI, smart technologies, cloud computing, etc. help to achieve fast the energy transition?



- Approximately 20% of the world's population has no access to electrical power.
- Global electricity demand rises between 6000 and over 7000 TWh by 2030, equivalent to adding the current level of demand in the United States and the European Union. Global electricity demand in 2050 is 150% higher in the Net Zero Emissions by 2050 (NZE) Scenario.
- **Electricity networks are the backbone of electricity systems and need to expand and modernise to support energy transitions.** Total grid lengths more than double from 2021 to 2050. Annual investment rises from around USD 300 billion in recent years to around USD 600 billion by 2030 and averages USD 800 billion per year to 2050.

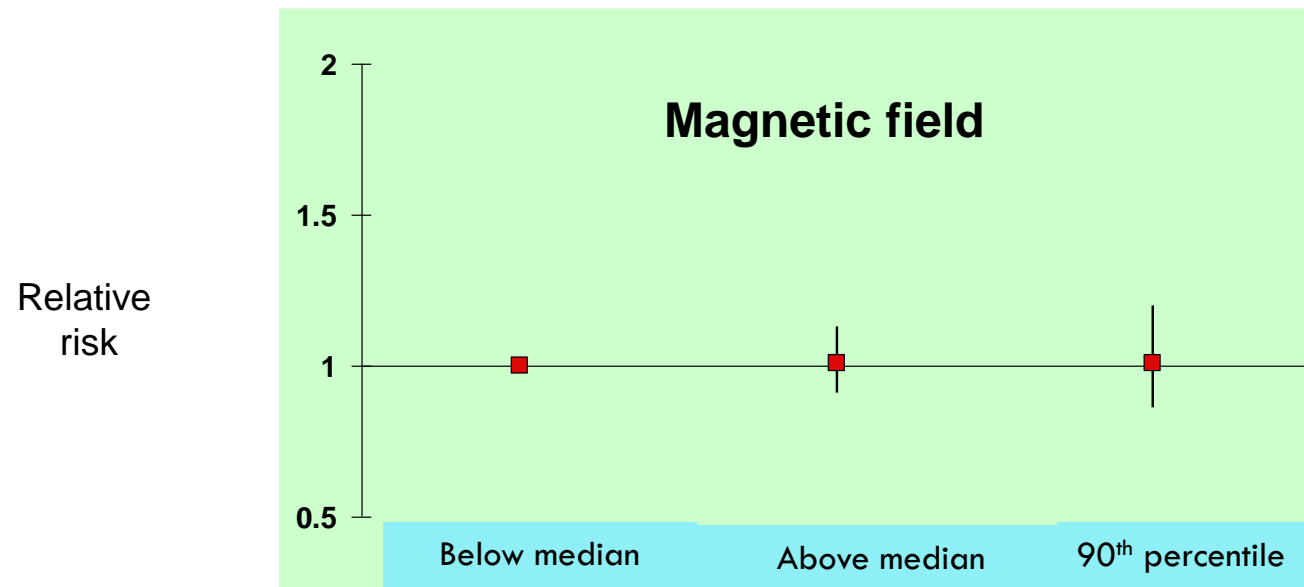


# History of electric power transmission



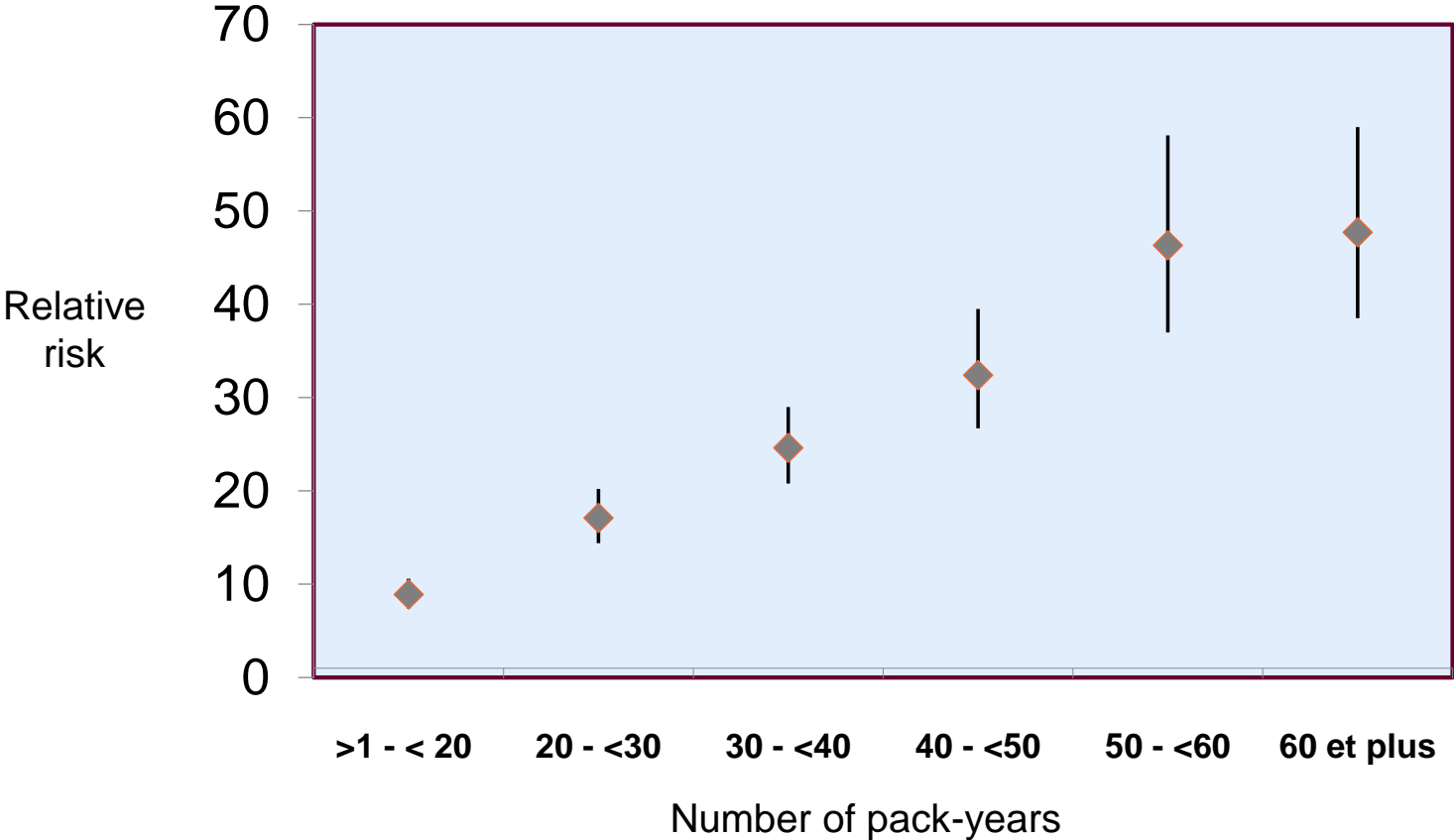
# Cancer among utilities' workers\*

- Électricité de France; Ontario Hydro; Hydro-Québec workers (n = 225 000)
- Based on the analysis of 4151 cases vs 6106 controls



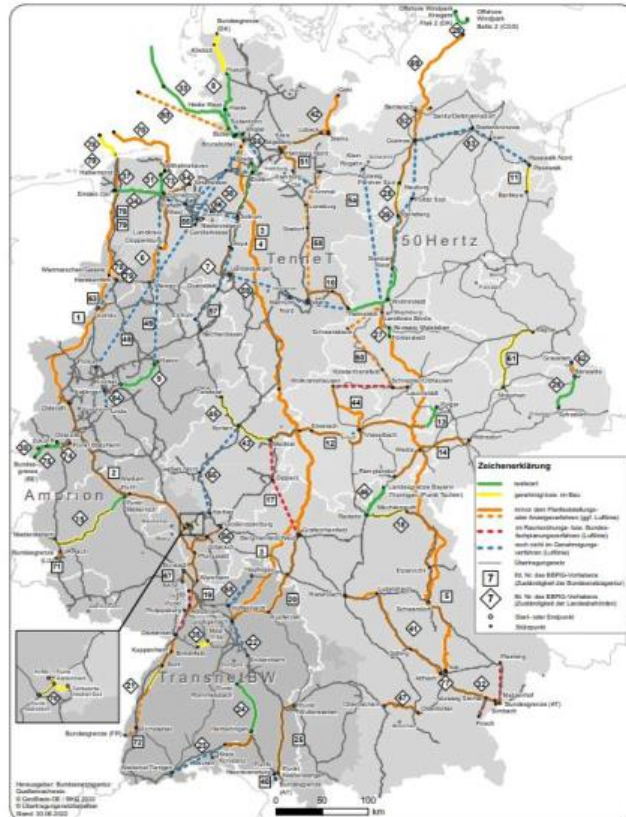
\*Thériault et al. *Cancer Risks Associated with Occupational Exposure to Magnetic Fields among Electric Utility Workers in Ontario and Quebec, Canada, and France: 1970-1989*. Am. J. Epi. 1994

# Smoking and lung cancer



# New HV transmission projects Germany (2022): 12.223 km

Stand BBPIG (Q3/2022)



## BBPIG-Vorhaben:

Gesamtlänge etwa 12.223 km, davon (inklusive Veränderung zum zweiten Quartal 2022):

- etwa 4.447 km vor dem Genehmigungsverfahren (+1.785 km),
- etwa 367 km im Raumordnungs- oder Bundesfachplanungsverfahren (-27 km),
- etwa 5.624 km im oder vor dem Planfeststellungs- oder Anzeigeverfahren (+191 km),
- **831 km genehmigt bzw. im Bau (+175 km),**
- 954 km fertiggestellt (+68 km).

## Planungs- und Baufortschritt in km





# More Underground Cables



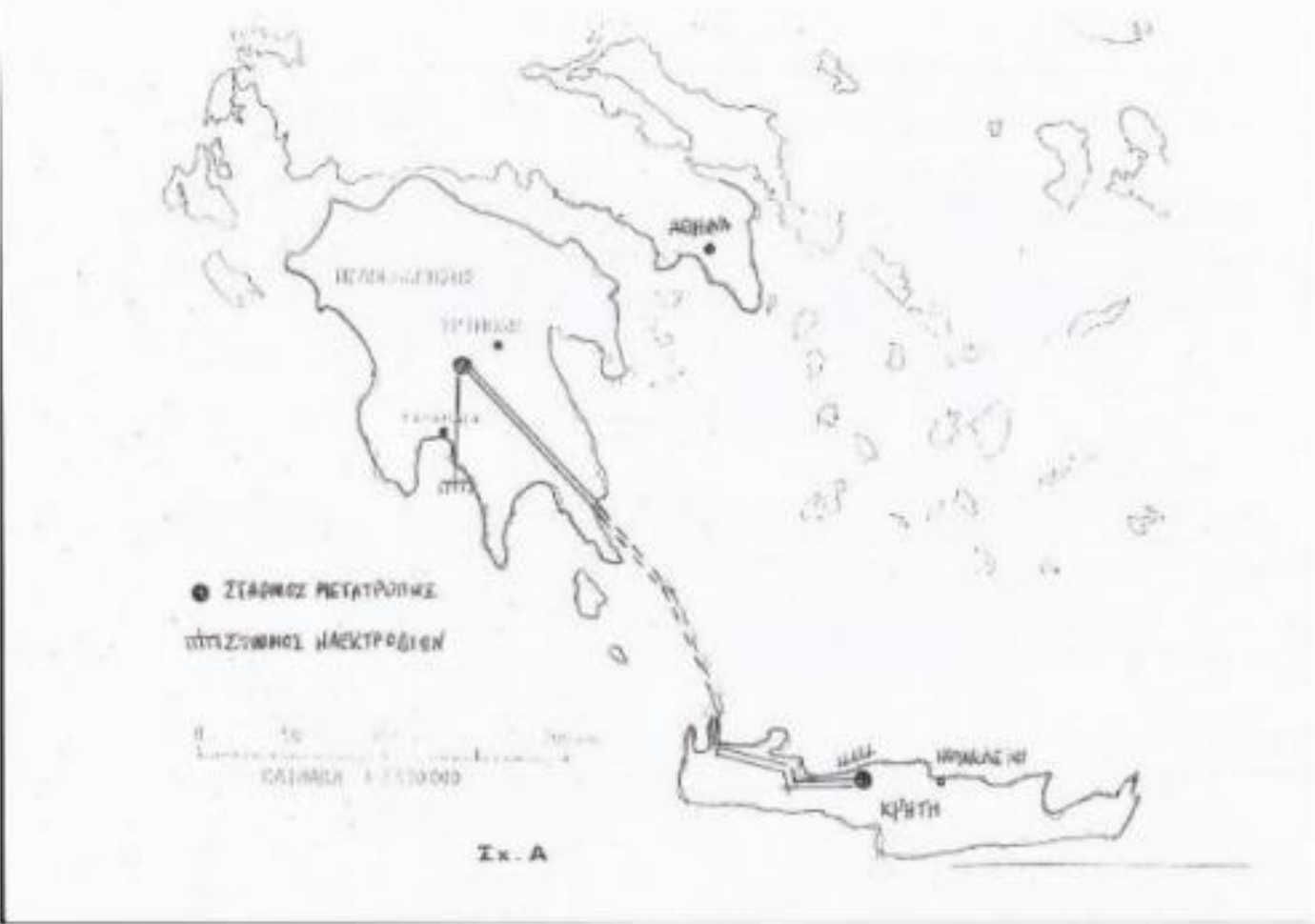
# Much more subsea cables







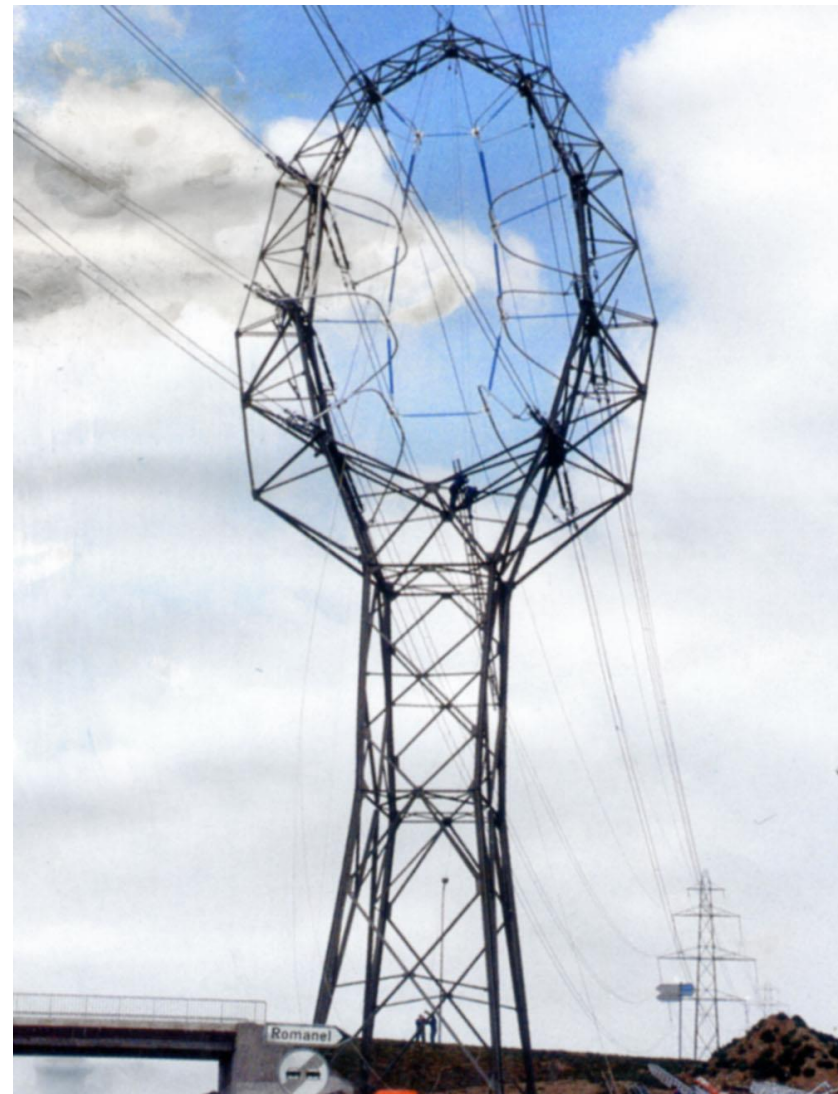
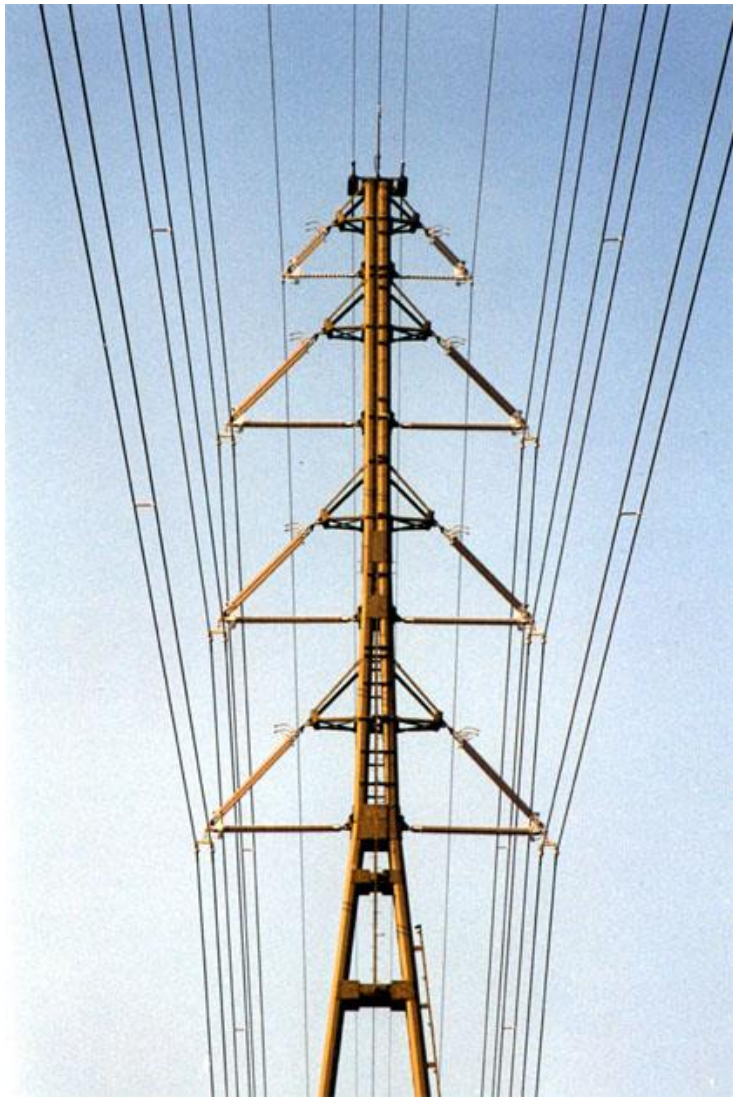
Yannis Voyatzakis



# First 400 kV-DC-OHL in Greece



# More Compact Lines

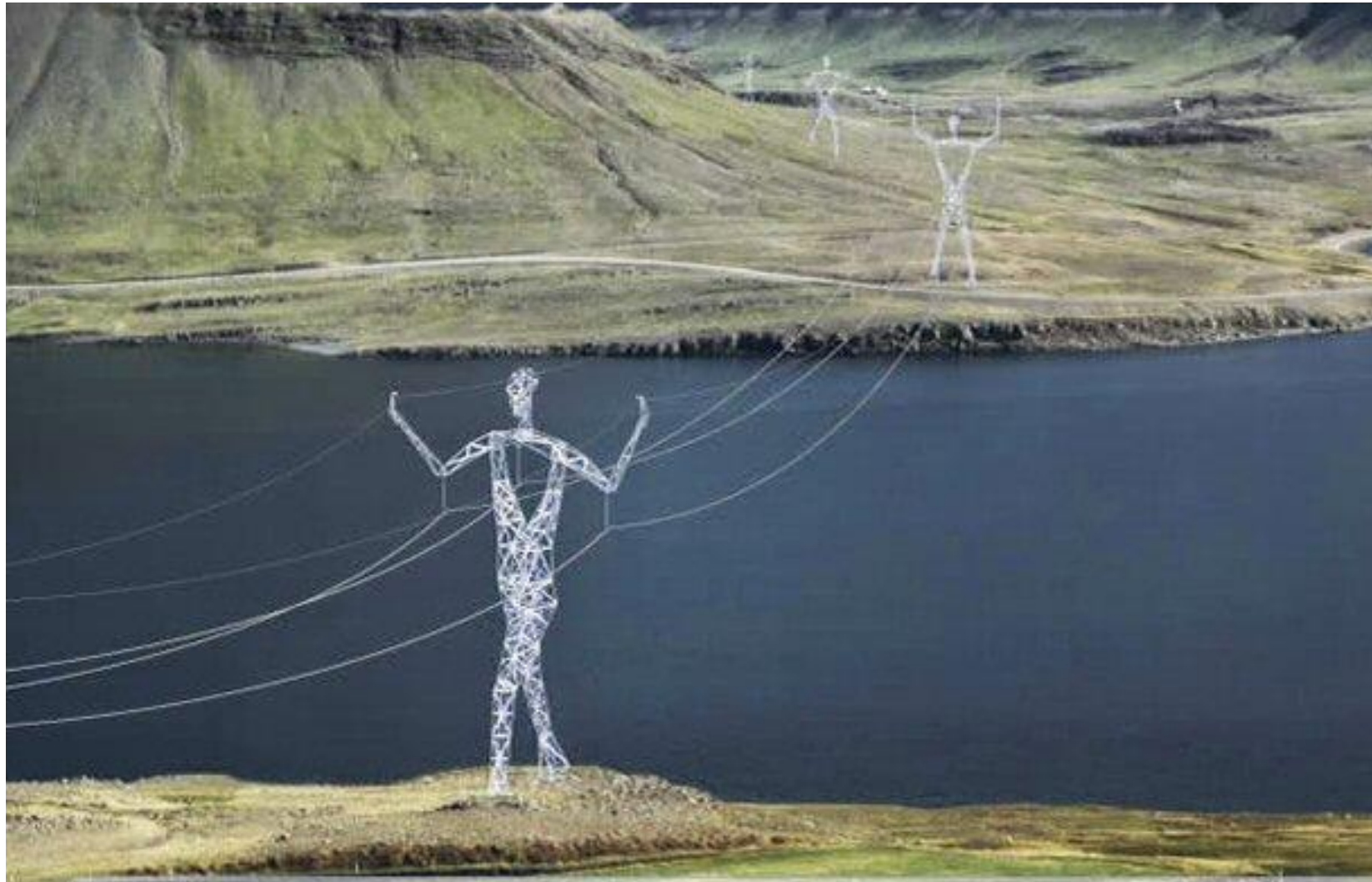




# Classical vs. Compact



# Aesthetic towers

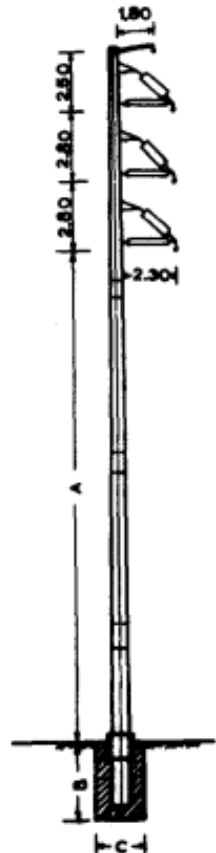


# First compact line in Greece in 1977!

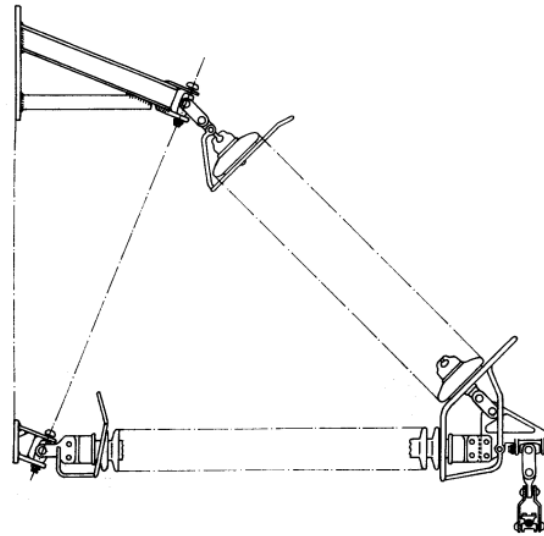
## 150 KV TRANSMISSION LINES ON TAPERED STEEL POLES SUPPORTING INSULATOR CROSSARMS IN GREECE

J Voyatzakis

Public Power Corporation, Greece



A (m)
15,0
17,5
20,0
22,5



## 2. FIRST COMPACT LINE IN GREECE.

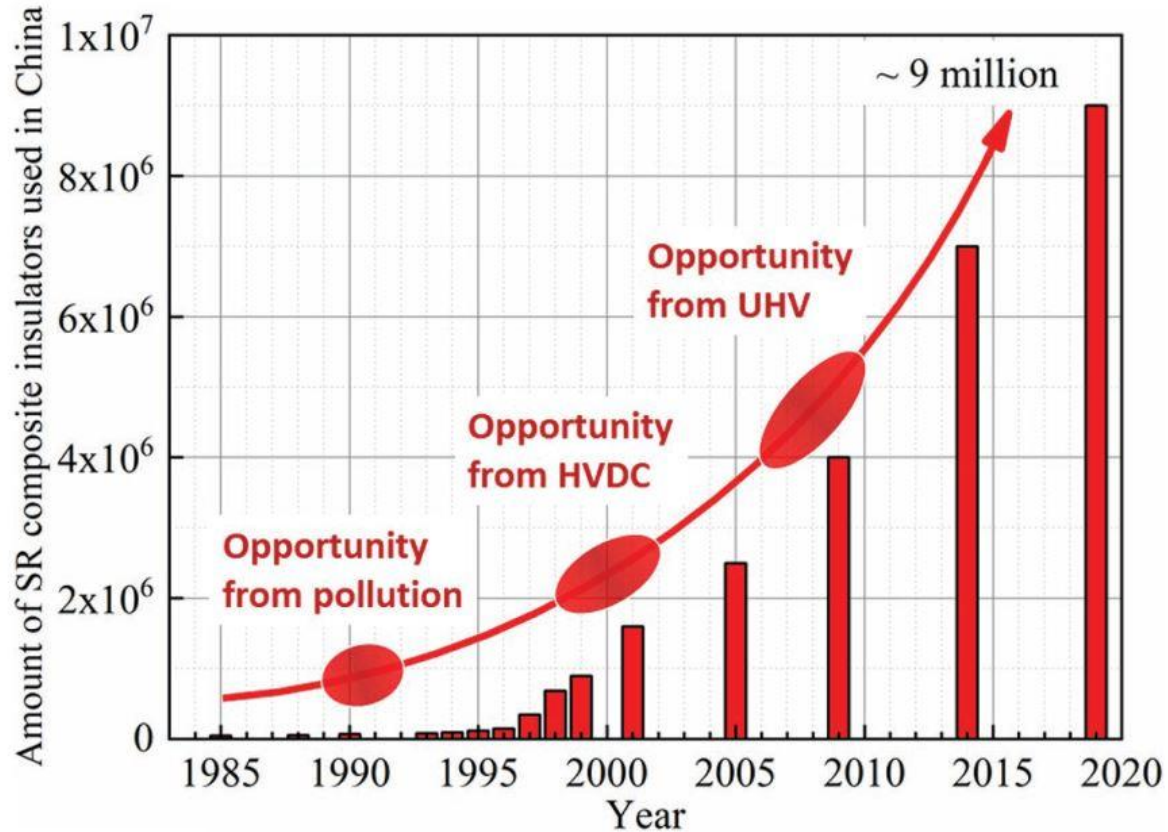
The first compact line was erected in 1977 in the Athens area. The type of support that was selected was a polygonal tapered steel pole, manufactured from cold formed steel plates, equipped with insulator-crossarms that pivot about an axis. It is an O.L. of 150 KV, single circuit, with a length of about 4 Km. The phase conductor is A.C.S.R, code name Grosebeak, of 25,1 mm diam and ultimate tensile strength 100 KN.

What happened in the last 50 years in OHL technology

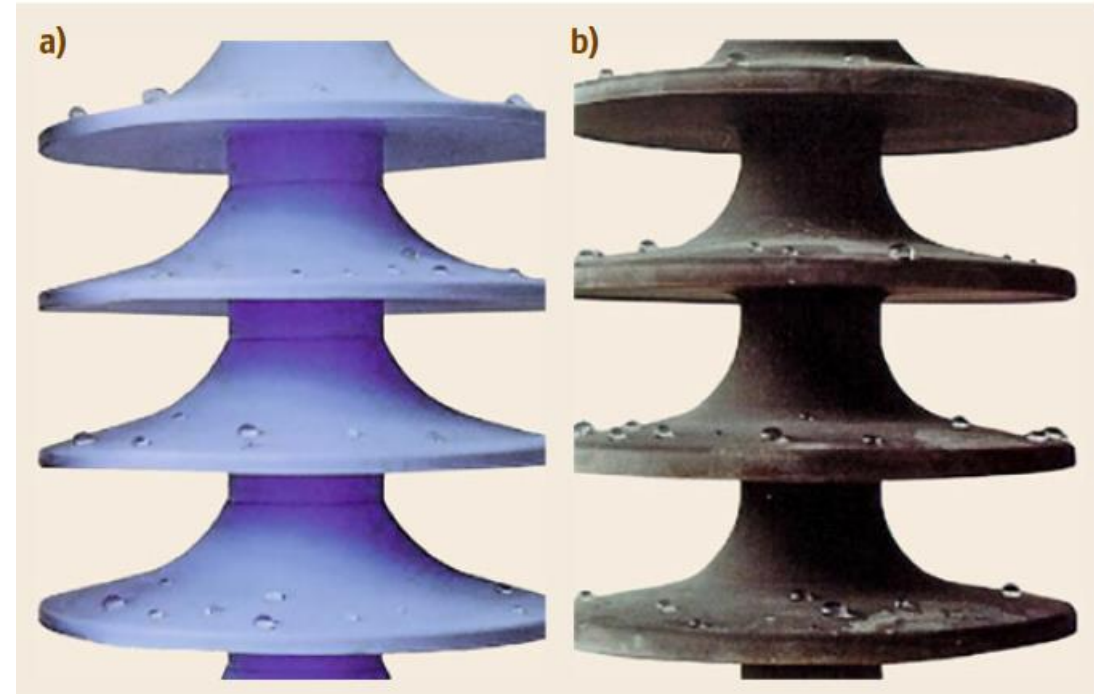


# More composite insulators

Composite Insulators became mature and competitive and thus wide acceptable



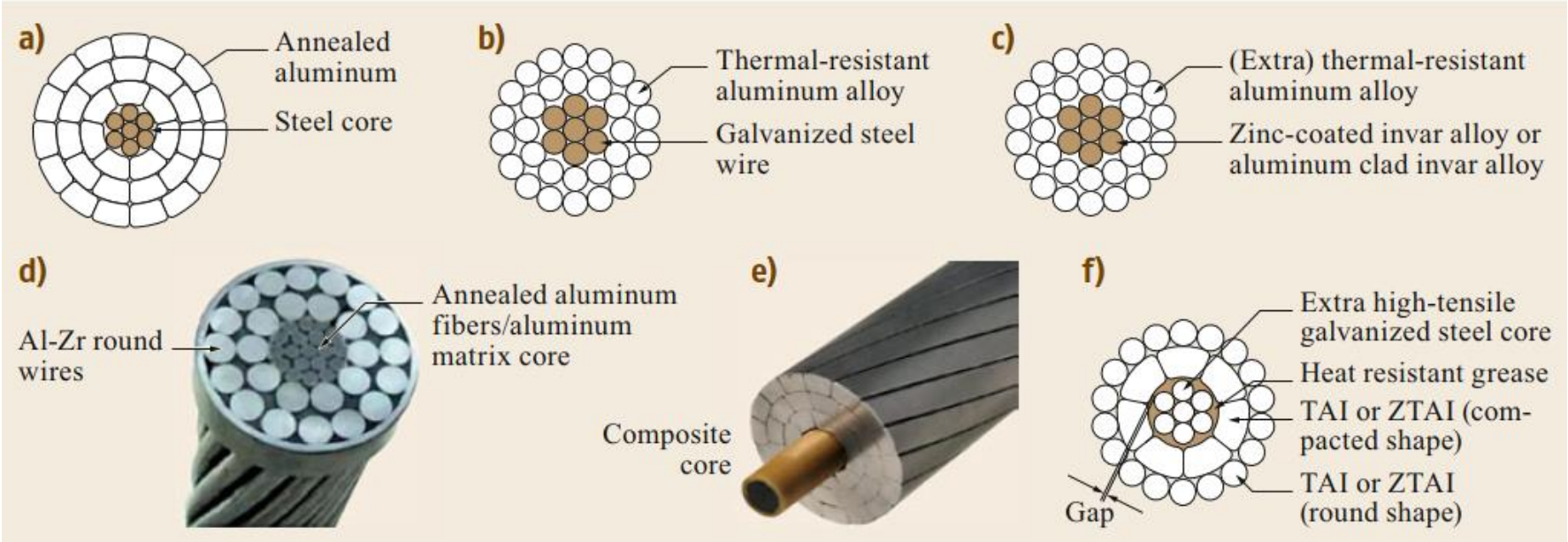
Amount of SR **composite** insulators used in China for OHLs of 110 kV to 1000 kV AC and  $\pm 400$  kV to  $\pm 1100$  kV DC.





# New conductor types and materials

HTLS conductors for line uprating because of problems in building new OHL



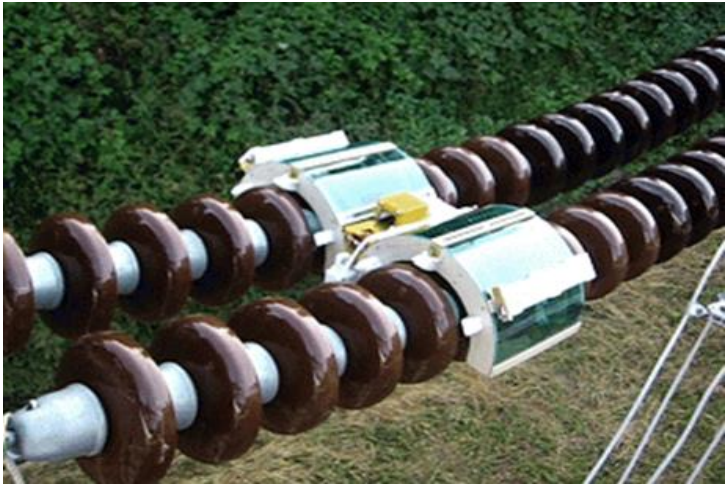
## Vibration recorders



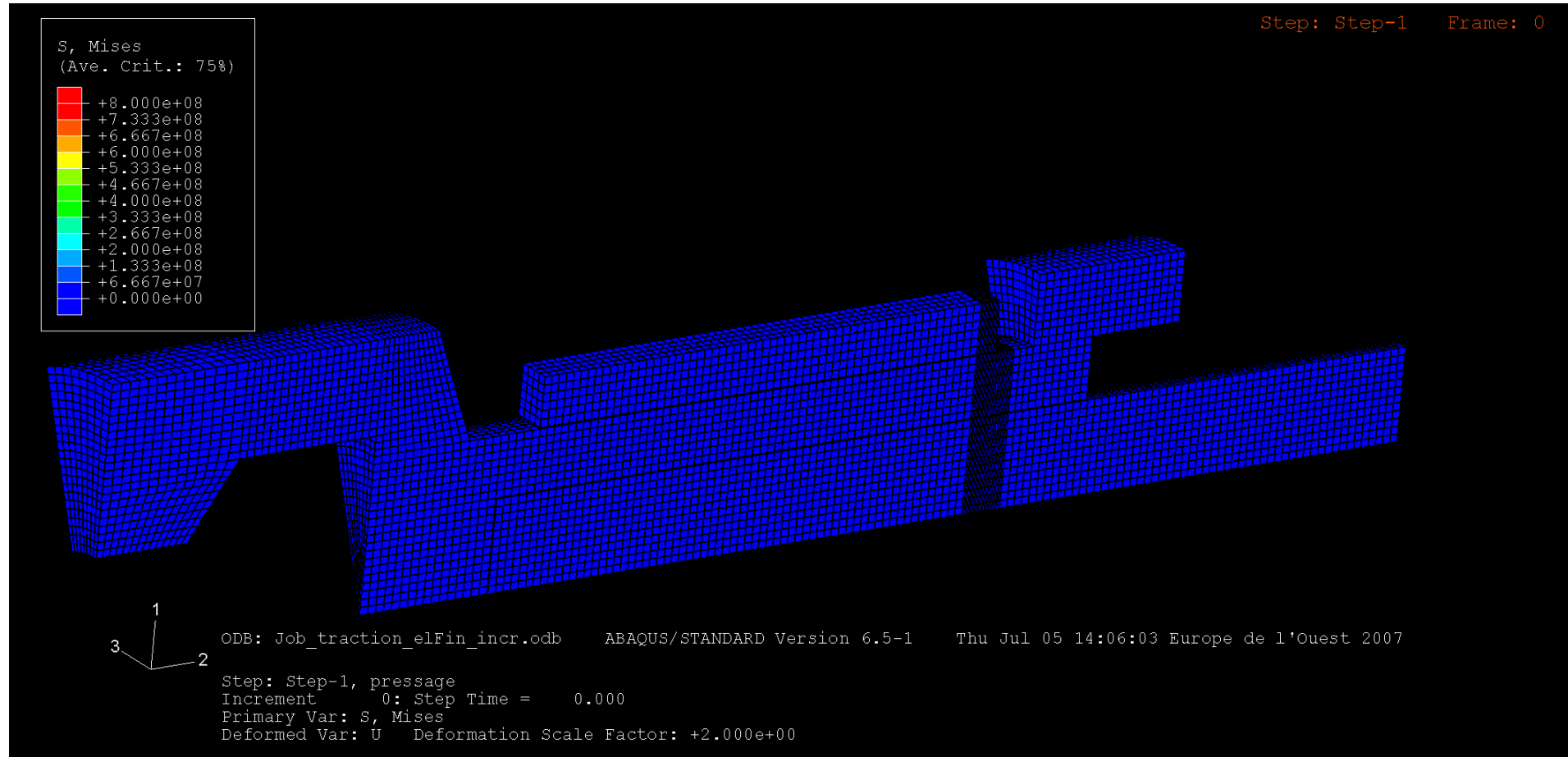
## Monitors for dynamic line rating (DLR)



# UAV and robots for line inspection and maintenance



# More digital applications due to increase in computing power



# What will happen in the next 50 years in OHL technology

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Niels Bohr, Nobel laureate:

*“Predictions are very difficult, especially if it's about the future”*



## Room temperature superconductive materials

- Very high current density
- High mechanical strength
- Low thermal expansion
- Low creep

Mu-metal coating: zero magnetic field

Surface treatment against radio interference and acoustic noise

Integrated vibration sensors with active self-damping

Conductor hardware in 3D-printing with fatigue and temperature sensors

# Insulator of the future



Rod of only one material, which will withstand electrical, mechanical and environmental loads

No need for sheds as material super hydrophobic with negative surface tension

No separate metallic end fittings as they will be from the same material as the rod; insulator with fittings will be produced in high speed compression molding

No corona and arc protection fittings as insulator material insensitive to these

Sensor coating will contain full production and service history with storage and wireless retrieval of data for evaluation of load history (flashovers, mechanical stresses, surface and bulk temperature) but also GPS localisation data for asset management



# OHL are great fun!



# **CIGRE history, structure and membership benefits**

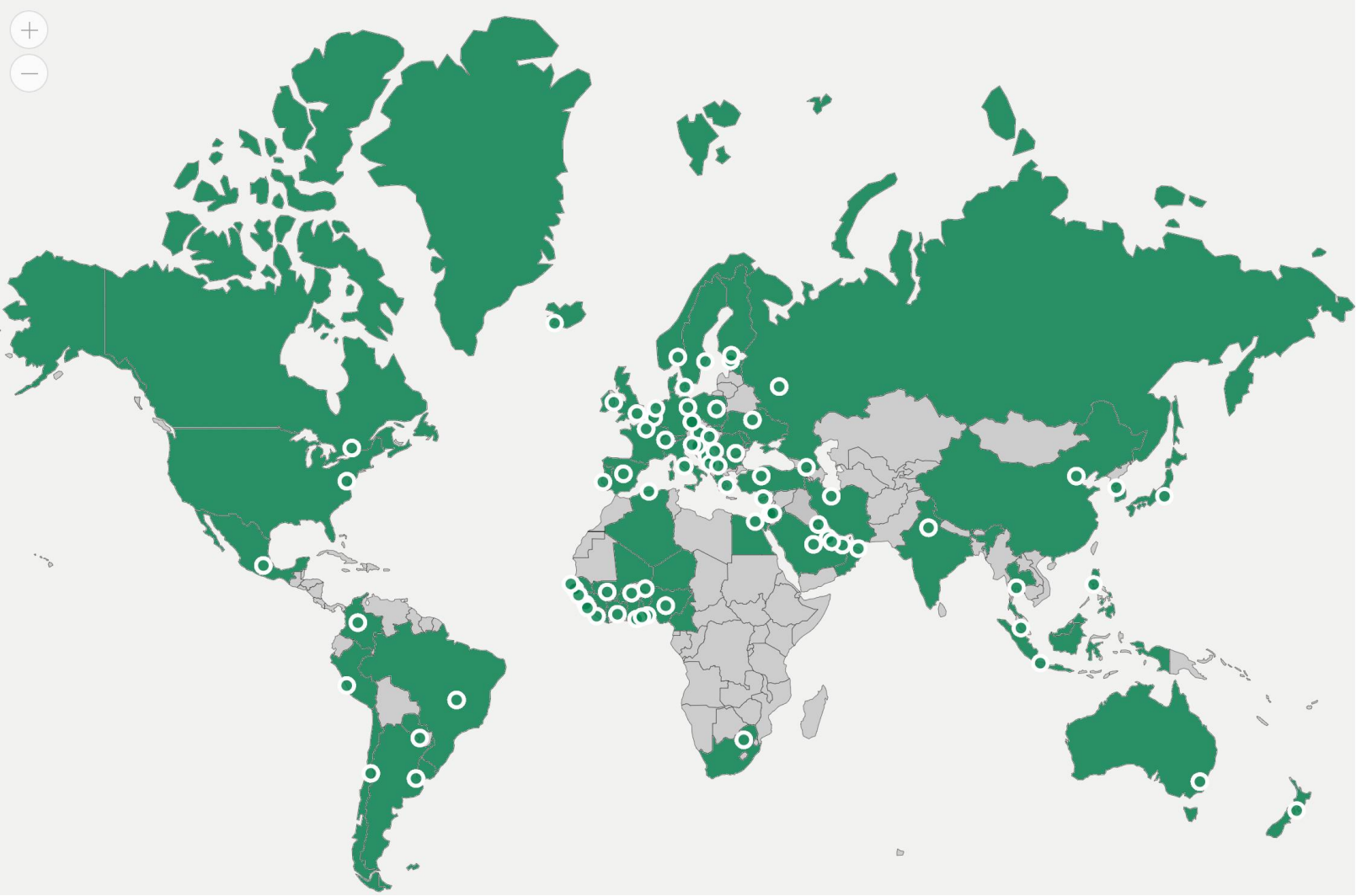
# A brief history of CIGRE from 1921 to now



- 1921 : a **conference**, Conférence Internationale des Grands Réseaux Electriques = CIGRE, (International Conference on Large Electric Systems), created to **prepare for standardisation** in the sector stimulated by the post-war economy,
- 1931 : established by French Law as **non for profit** association
- 2000 : Legal name = International **Council** on Large Electric Systems
- 2018 : branding campaign : CIGRE the **brand name** no longer an acronym
- CIGRE dedicated to “**Power System Expertise**” promoting exchanges and facilitating the collaboration on topical issues,
  - ✓ Electrification of territories (1920 - 1950)
  - ✓ Transmission and interconnection (1950 - 1990)
  - ✓ Electricity markets (1990 - 2010)
  - ✓ **Energy transition** (2010 - 2030)



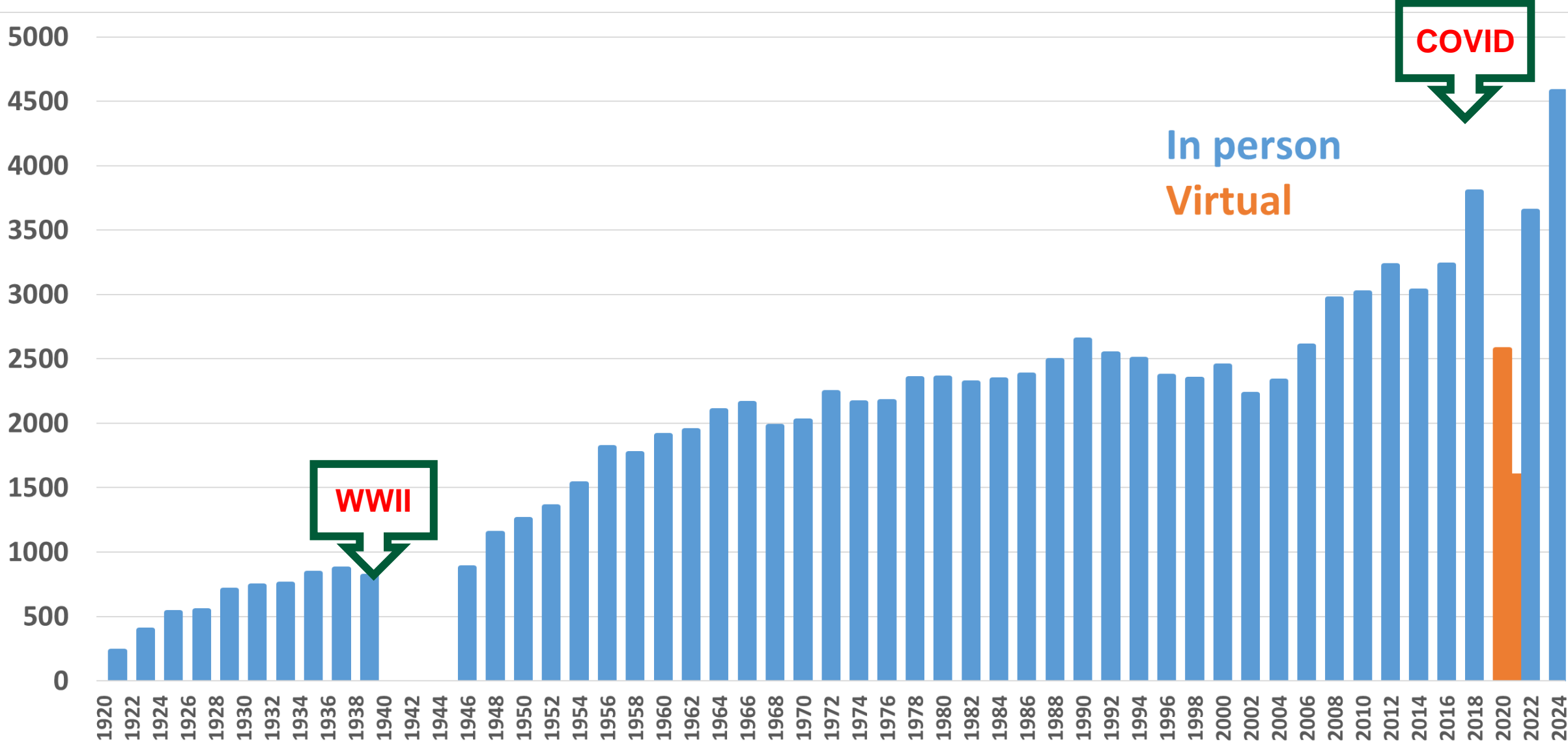
# The CIGRE community in 2024 = 60 National Committees



## More than hundred of CIGRE events per year!

- **Paris Session** in even years, the reference congress for all members organized by the Central Office (CO) (4,575 delegates from 99 countries in August 2024)
- **Symposia**, two per odd years outside of Paris, organised by one National Committee (NC), the Technical Council (TC) and the CO
- **Colloquia** organised by a Study Committee in association with a NC
- **Regional conferences** organised by groups of NCs
- **National Conferences** organised by NCs
- **Webinars** organised by the Study Committees with the CO or by the NCs

# CIGRE Paris Session attendance



# CIGRE and the energy transition



- CIGRE considers that the **energy transition** will have disruptive, challenging, and exciting changes.
- CIGRE sees the power industry on an **expansive track**, in terms of its scope and range of activities.
- CIGRE is a leading platform for **knowledge sharing**, a true on-line laboratory to **assist innovators** in the development of suitable products for a sustainable future of our planet.
- CIGRE is well positioned to meet these challenges with its **fundamental neutrality** for knowledge sharing.
- CIGRE revised in 2023 its Strategic Plan with a horizon of 2030 to ensure its **leadership for power system expertise** for its stakeholders, and for societal needs for electricity.

# Technical challenges of RES integration for CIGRE

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- Coping with RES intermittency
- Coping with fast ramping
- Coping with less rotating masses
- Adaptation of transmission and distribution grids
- Adaptation of electricity markets and regulations
- Coping with an unprecedented volume of data

# CIGRE provides great visibility to the energy transition

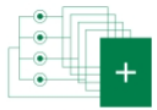
[https://www.cigre.org/GB/knowledge-programme/  
cigre-and-the-energy-transition](https://www.cigre.org/GB/knowledge-programme/cigre-and-the-energy-transition)



# CIGRE membership benefits



# CIGRE membership benefits



## 900+ Technical Brochures

Access to a library of in-depth Technical Brochures growing at around 40 per year and spanning every subject in the power system.

[MORE](#)



## Free downloads of 12000+ technical publications

From e-cigre.org the world's foremost and authoritative source of power system technical reference information.

[MORE](#)



## Collaborate with experts

Participation opportunities for members are extensive within CIGRE's global knowledge development programme. Typically 250 working groups are active at any one time.

[MORE](#)



## Access perspectives and peers from across the globe

Beyond the things your membership qualifies you for there are many benefits to a CIGRE membership. Read about the top nine here.

[MORE](#)



## Energy transition!

Be a part of decarbonising the electricity system. Find out about CIGRE and the energy transition

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## 60+ In country and regional CIGRE organisations.

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Free access to the digital magazine of choice for the power system professional.

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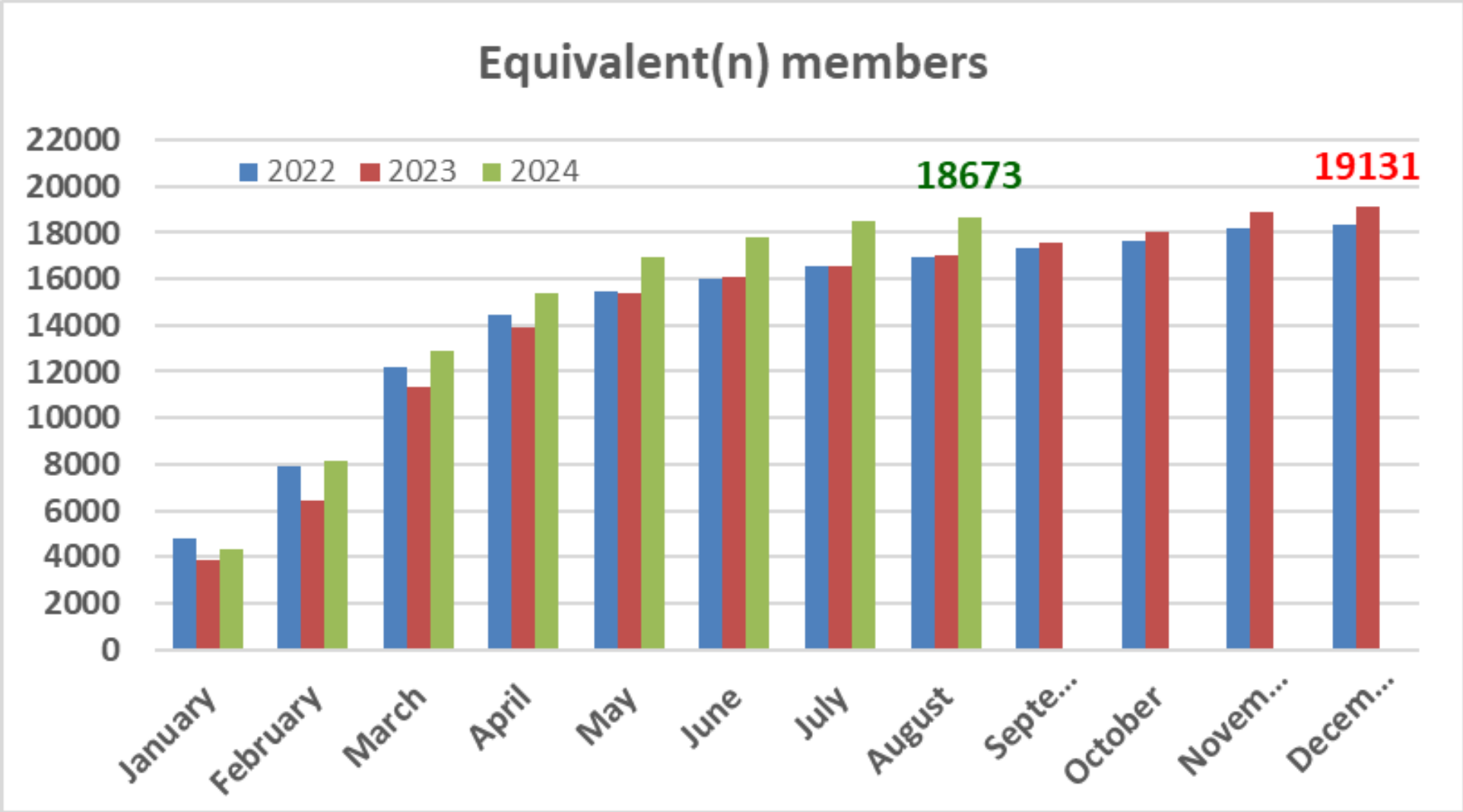


## Save on the Paris Session!

Receive a **special rate** on registration for the leading global event for power system expertise.

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# Our membership is growing strong!



Join CIGRE has been never easier ([www.cigre.org](http://www.cigre.org))



Join



# Greek for survival

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ΓΕΙΑ ΜΑΣ (ΓΙΆΜΑΣ) CHEERS