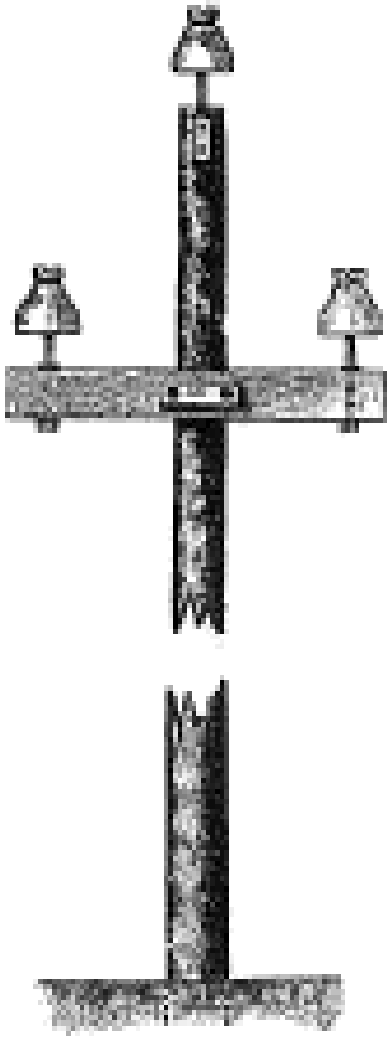
Overhead Lines: Impact and Optimization

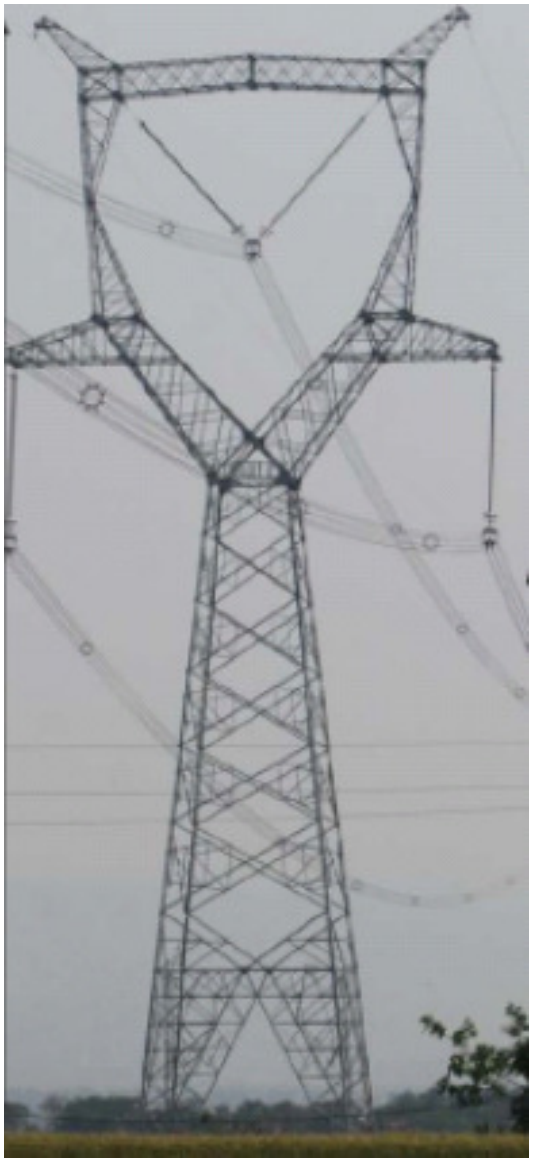
DR. KONSTANTIN O. PAPAILIOU

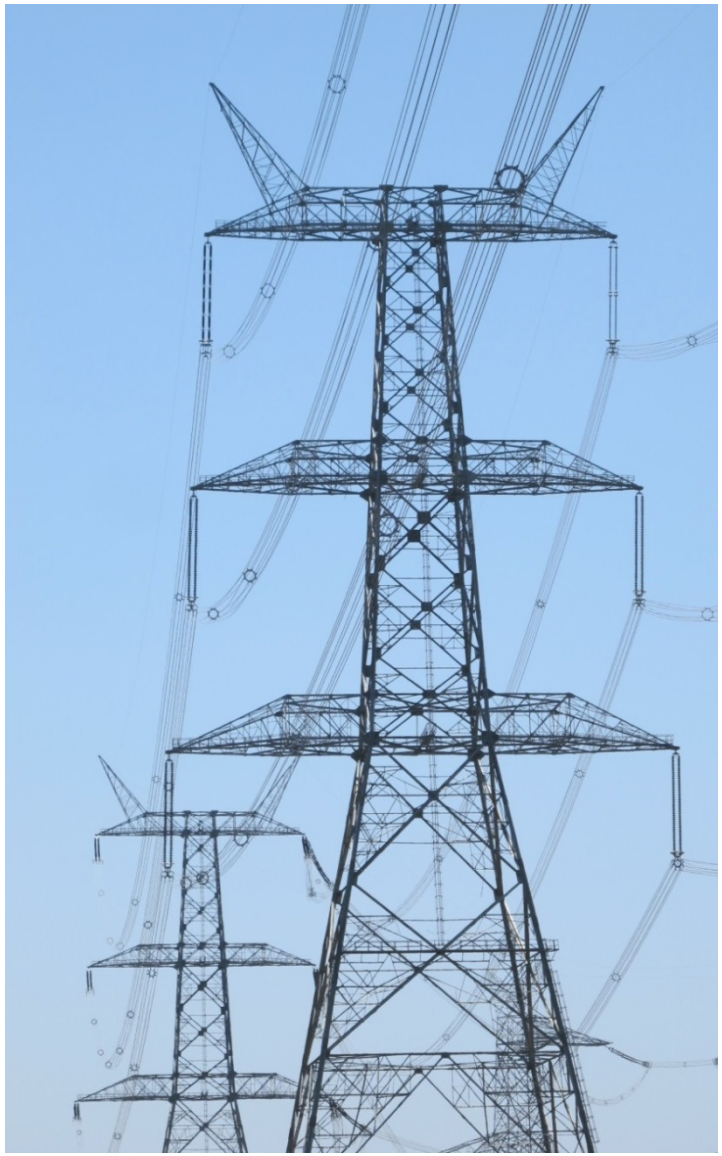
CHAIRMAN CIGRE SC B2 (OVERHEAD LINES)

konstantin@papailiou.ch

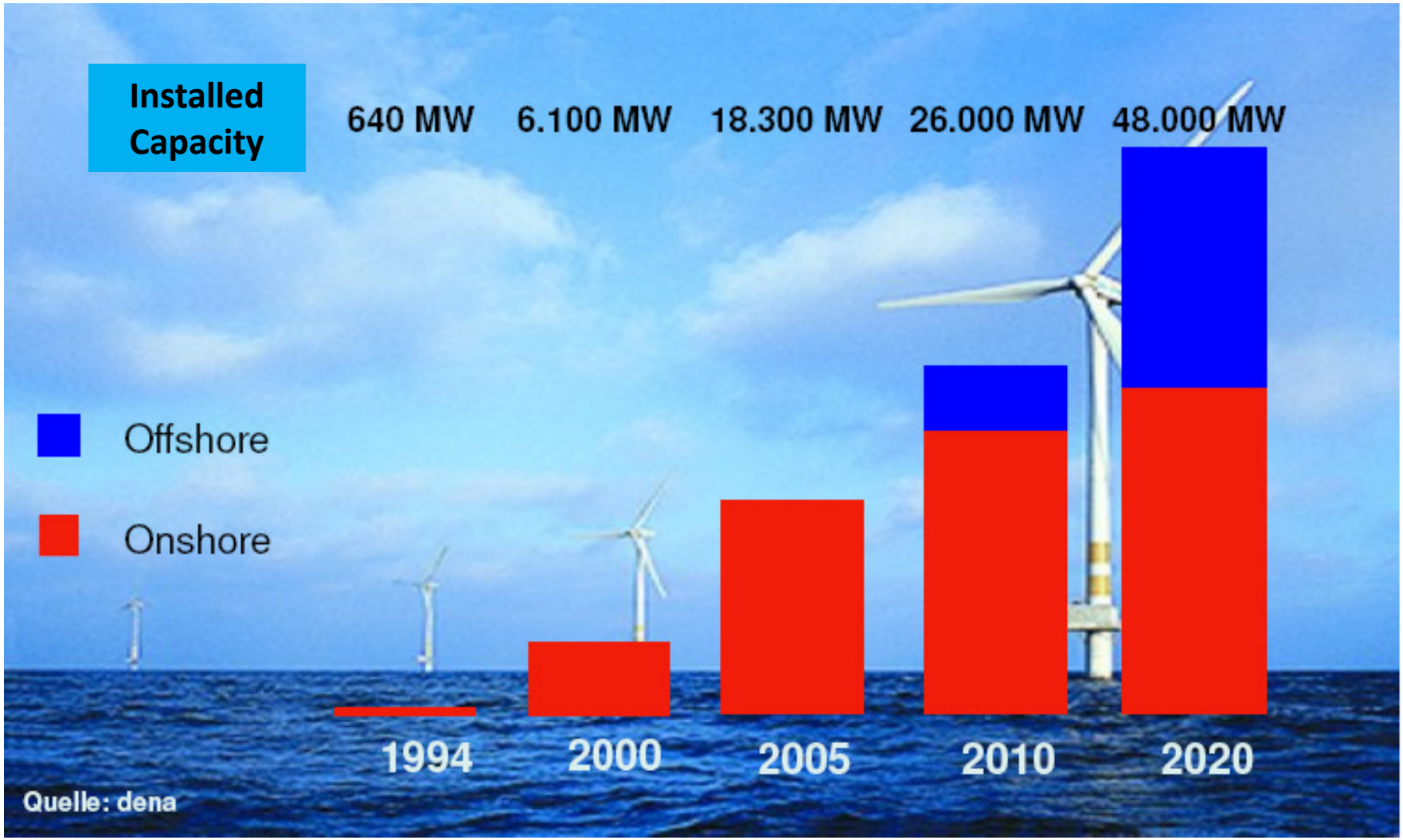
First HV Overhead Line (15&25 kV, 1891, D)





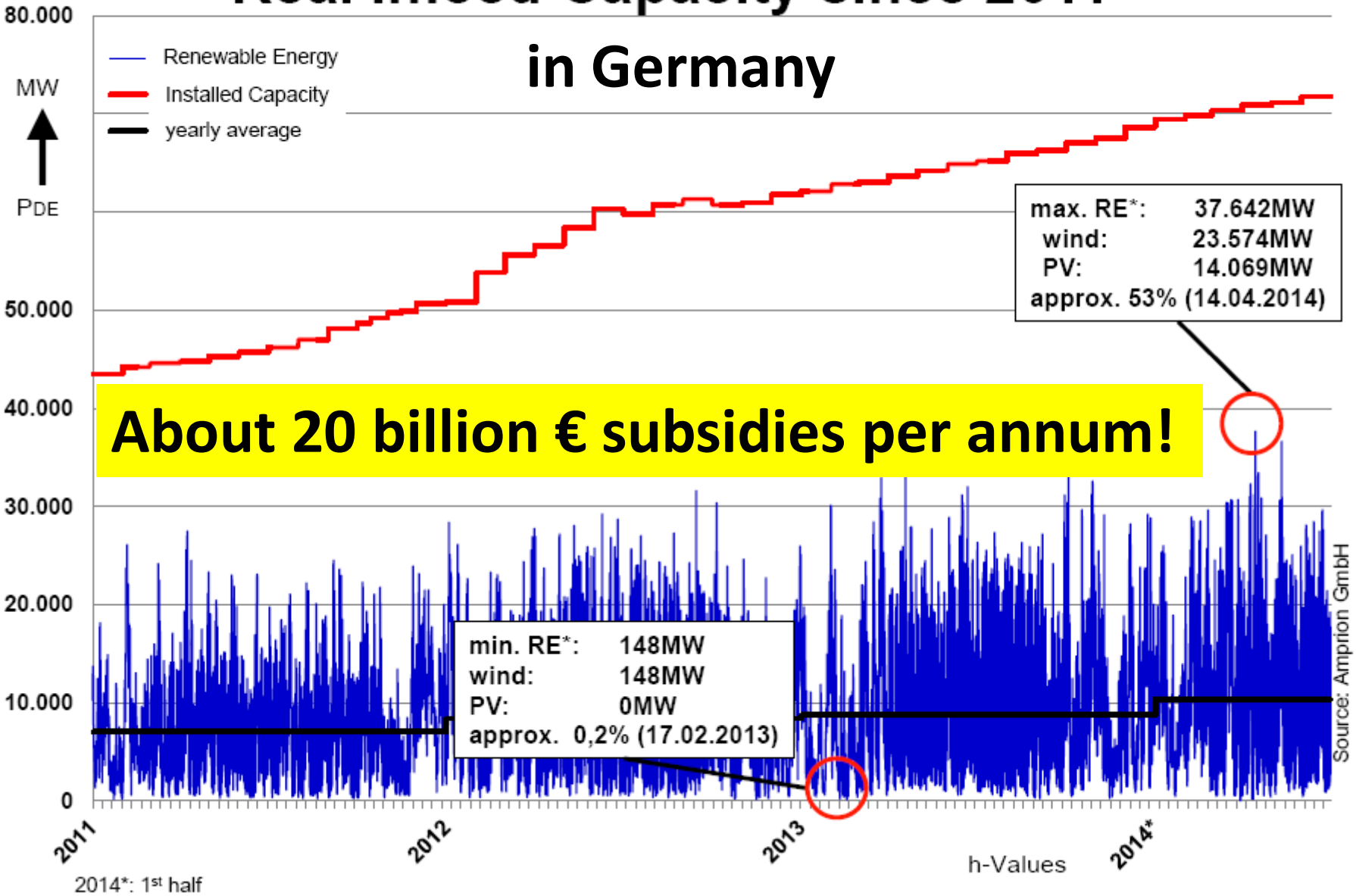


Wind turbines in Germany

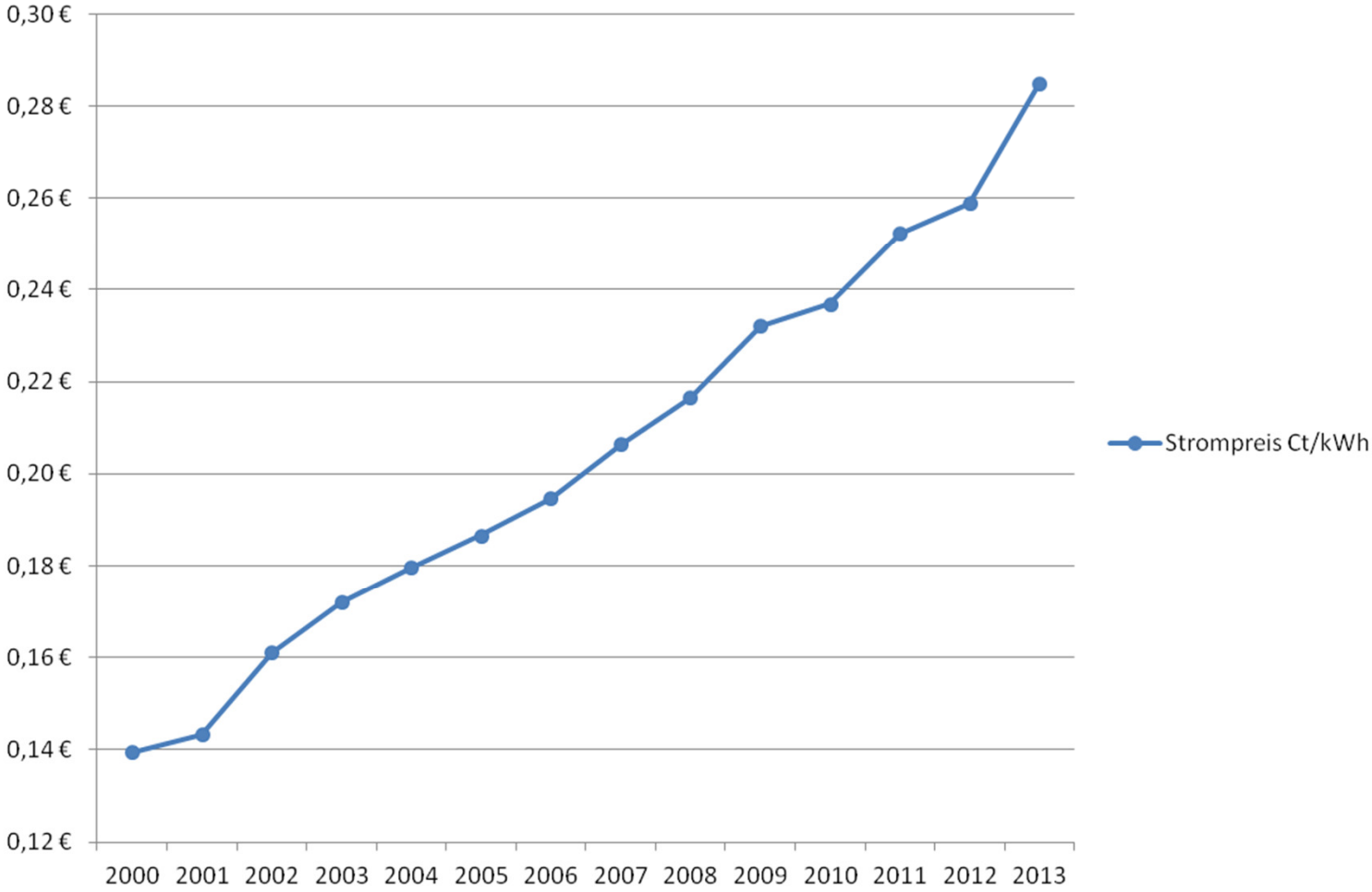


RES: Installed Capacity versus Real Infeed Capacity since 2011

in Germany

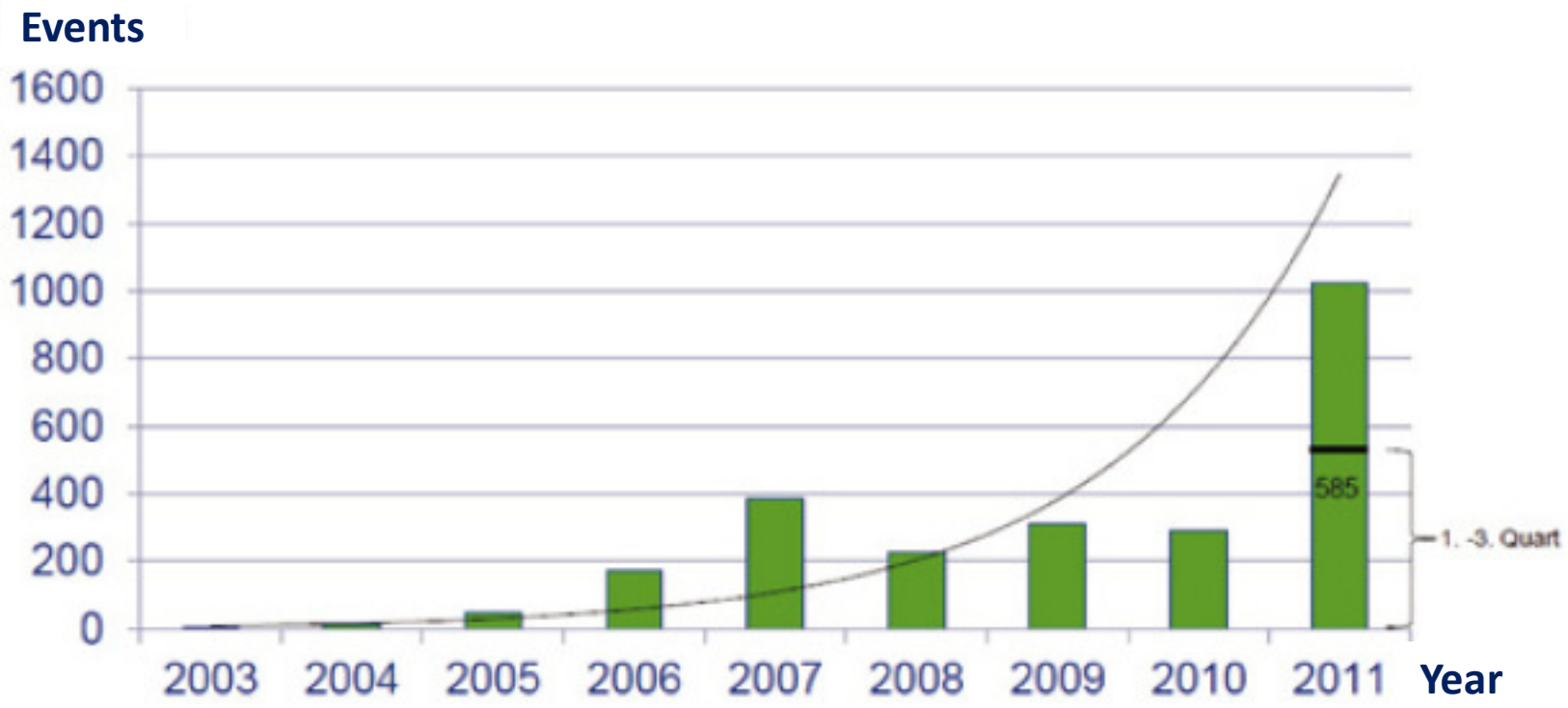


Tarif (residential) in Germany in €/kWh



Control room operator interventions (Germany)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Events	2	15	51	172	387	228	312	290	1024
Days	2	14	51	105	185	144	156	161	308



Cigré Study Committee B2 (Overhead Lines)

The scope of the Study Committee covers all aspects of the design and refurbishment of overhead power lines

The Study Committee's strategic goals include:

- increased acceptance of new overhead lines
- increased utilization of existing overhead lines
- improved reliability and availability of overhead lines

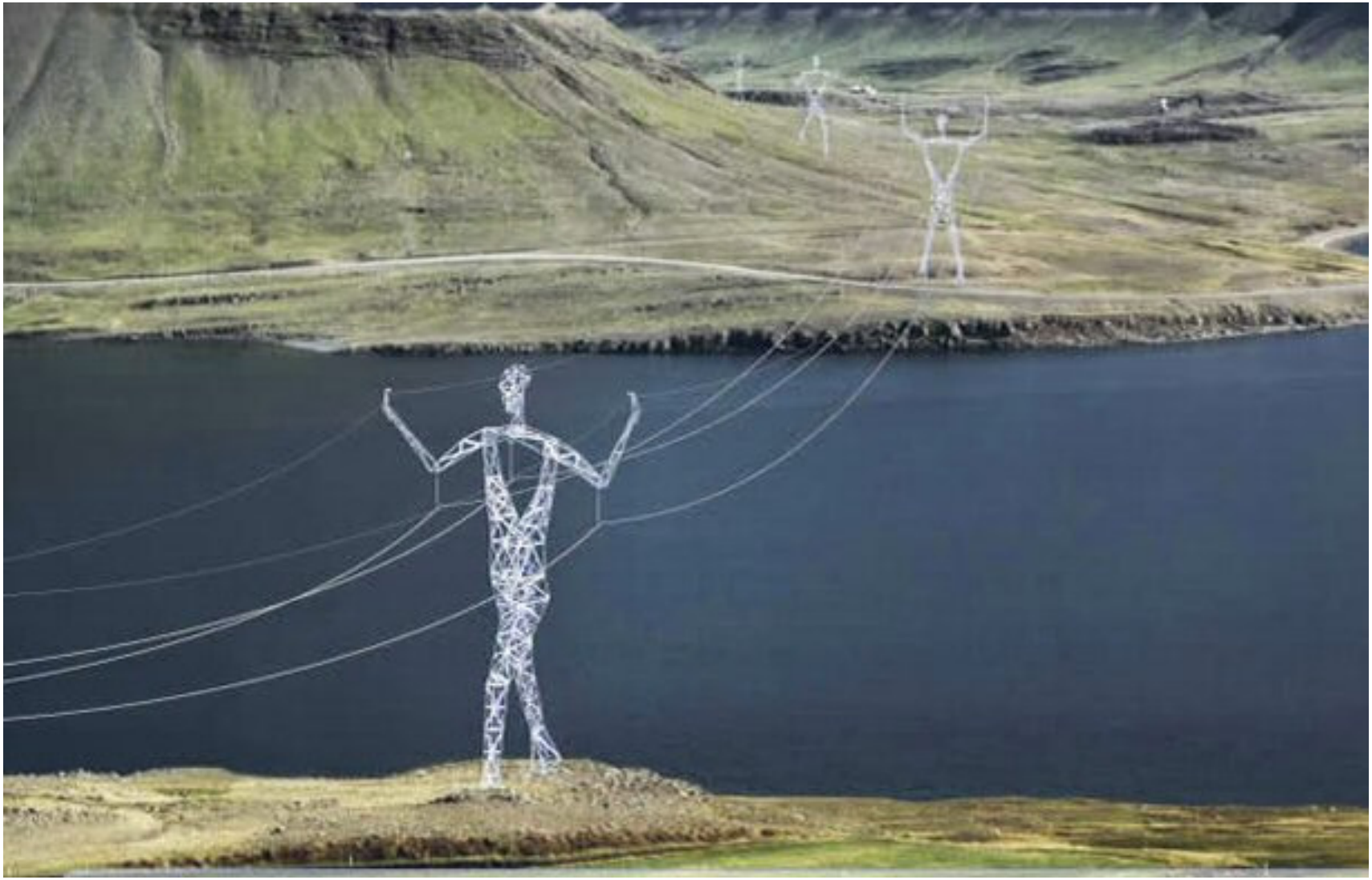
The «bottom line»

- There is a big demand for new lines
- There are many old lines which need refurbishment

But:

- The public, the press -and thus the politicians- do not like lines because of their -supposedly- environmental impact, mainly **aesthetics and EMF**
- and often cry out loud for **replacing lines by underground cables**

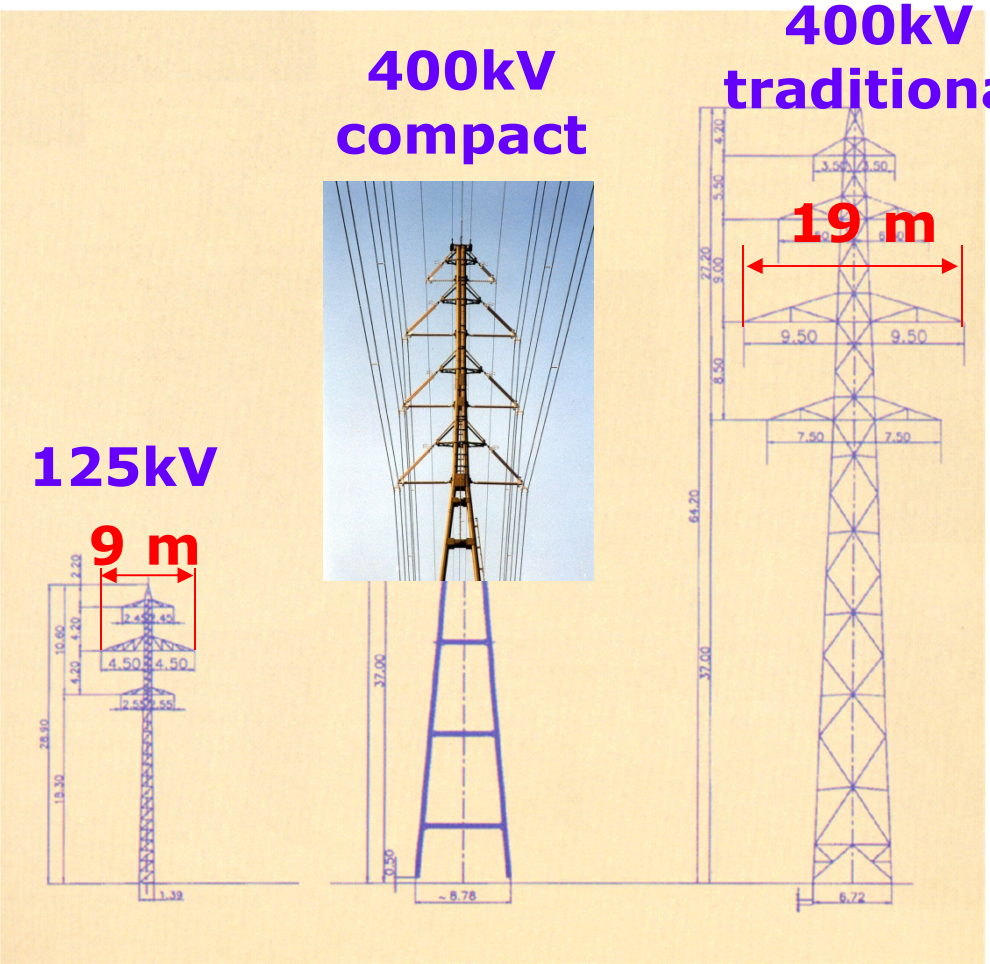
Innovative Electrical Networks for a Sustainable Development in Low Carbon Scenarios



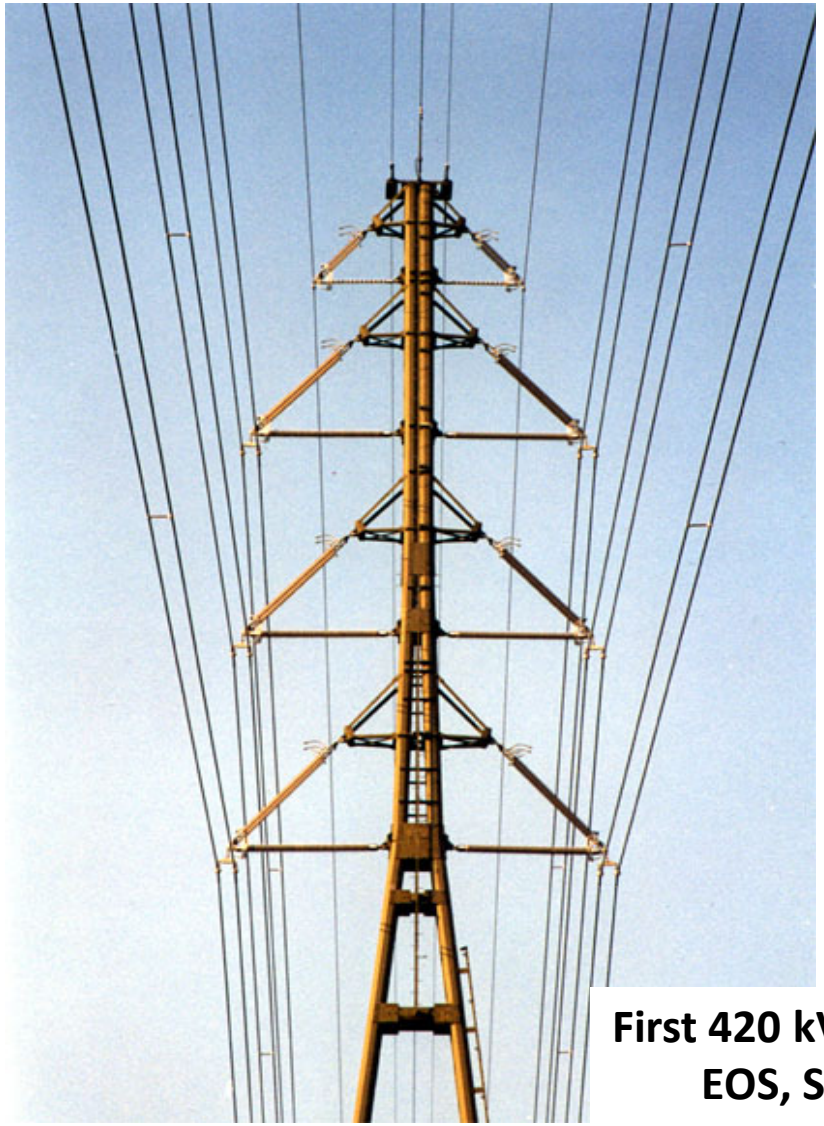
How a new 400 kV got approved in CH


Romanel

First 400 kV Compact Line (CH, 1998)



Steel lattice tower of 125kV-line and Swiss compact tower for 400kV/132kV-line as well as standard design



First 420 kV Compact Line
EOS, Switzerland

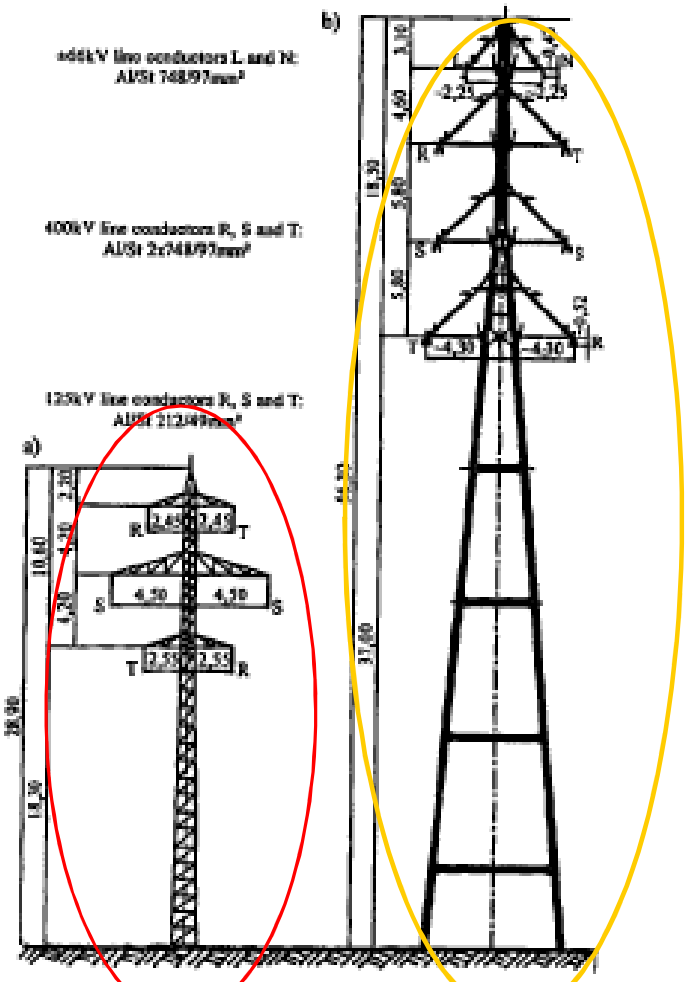


Fig.8 . a) existing 125kV line and b) constructed 400kV line tower.

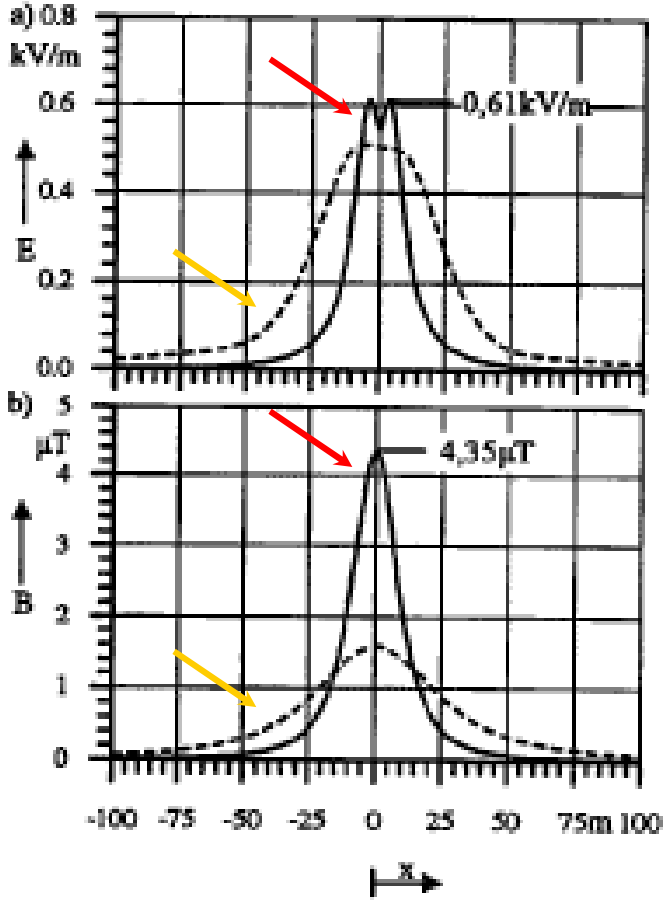


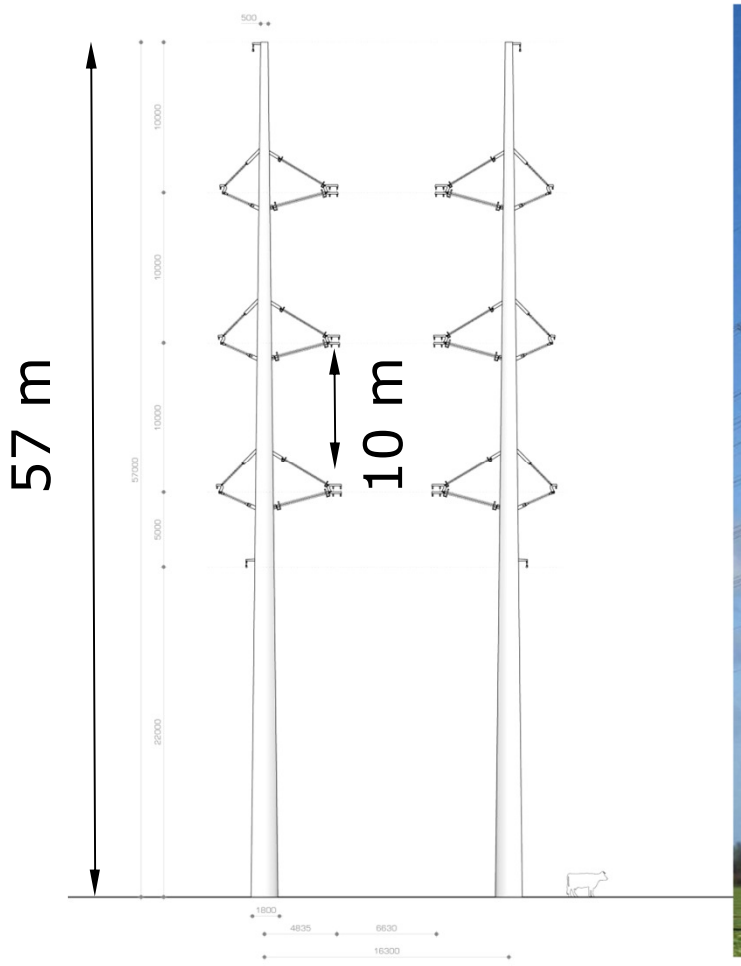
Fig. 9. a) Electric field and b) magnetic field values under the 125kV and the 400kV line as functions of the horizontal distance x from the line axis.

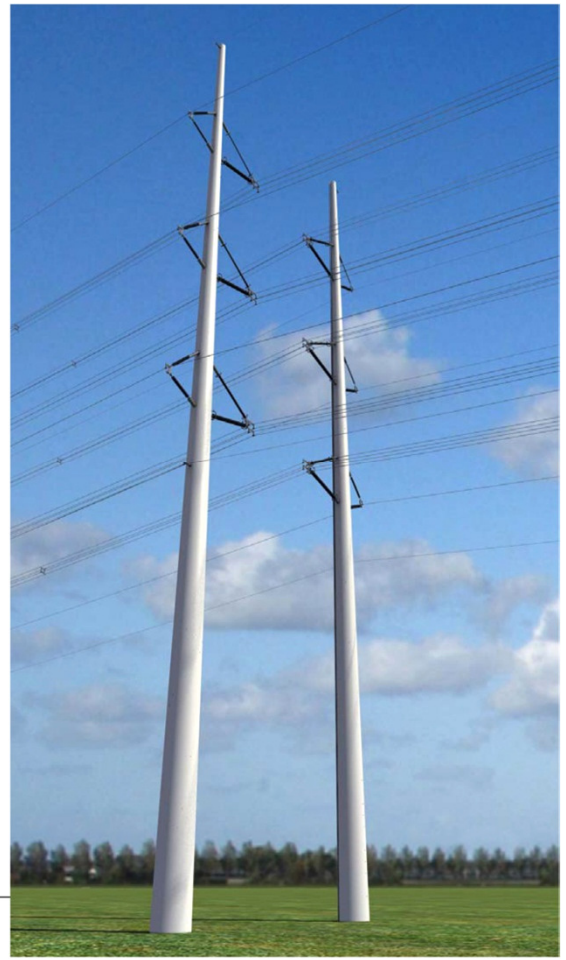
125kV line ------ 400kV line

400 kV Compact Line
DEWA, UAE

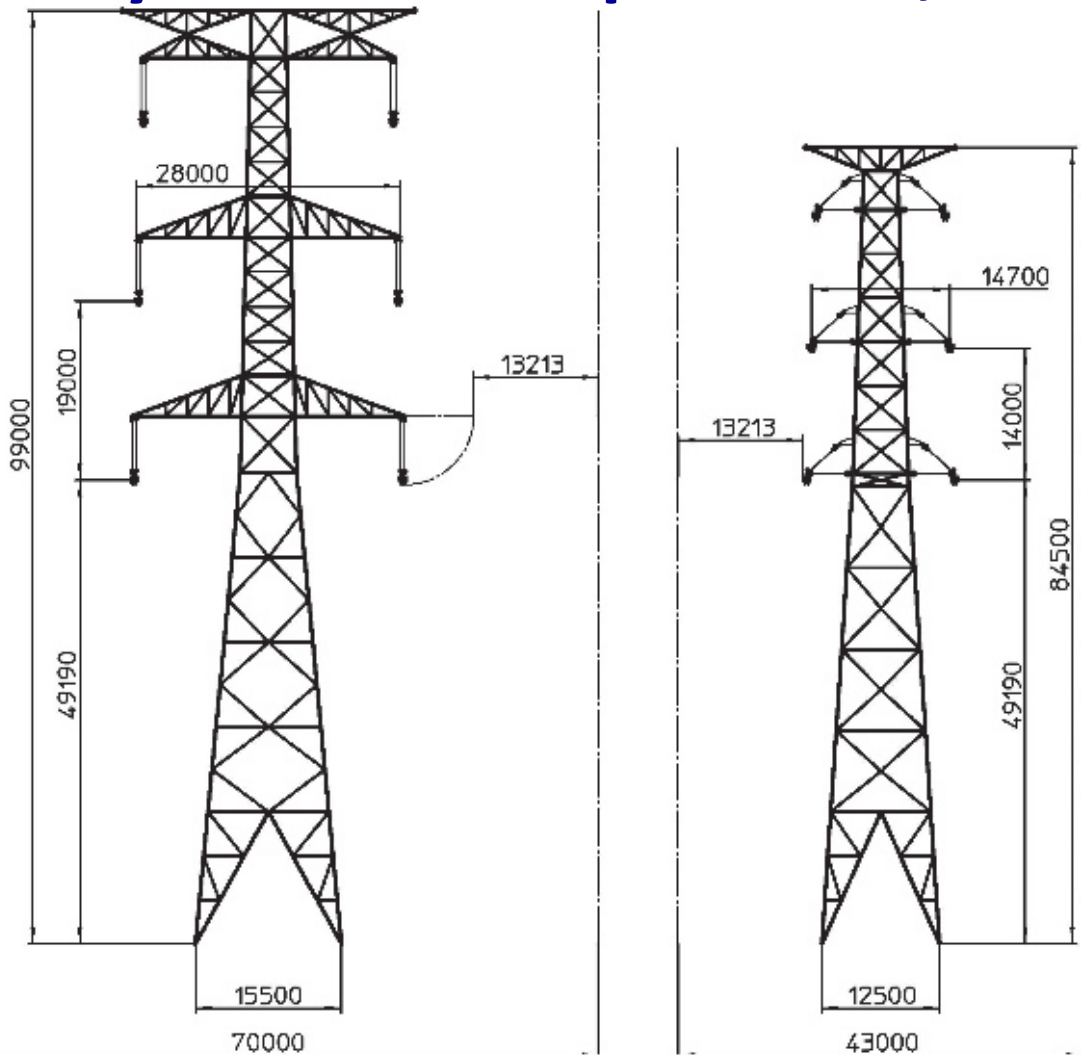
Suspended Line Post

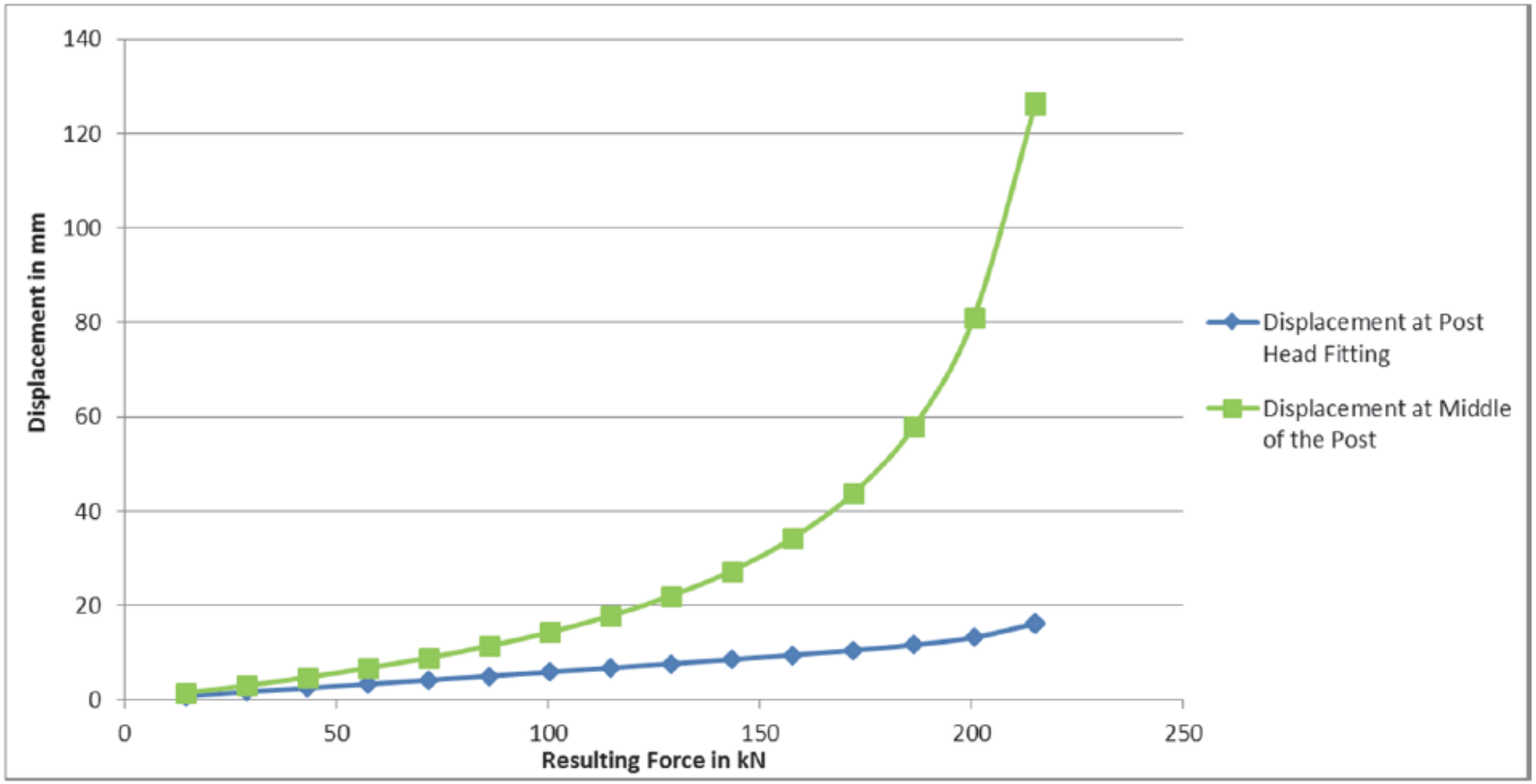
400kV/150kV Wintrack-Line, NL

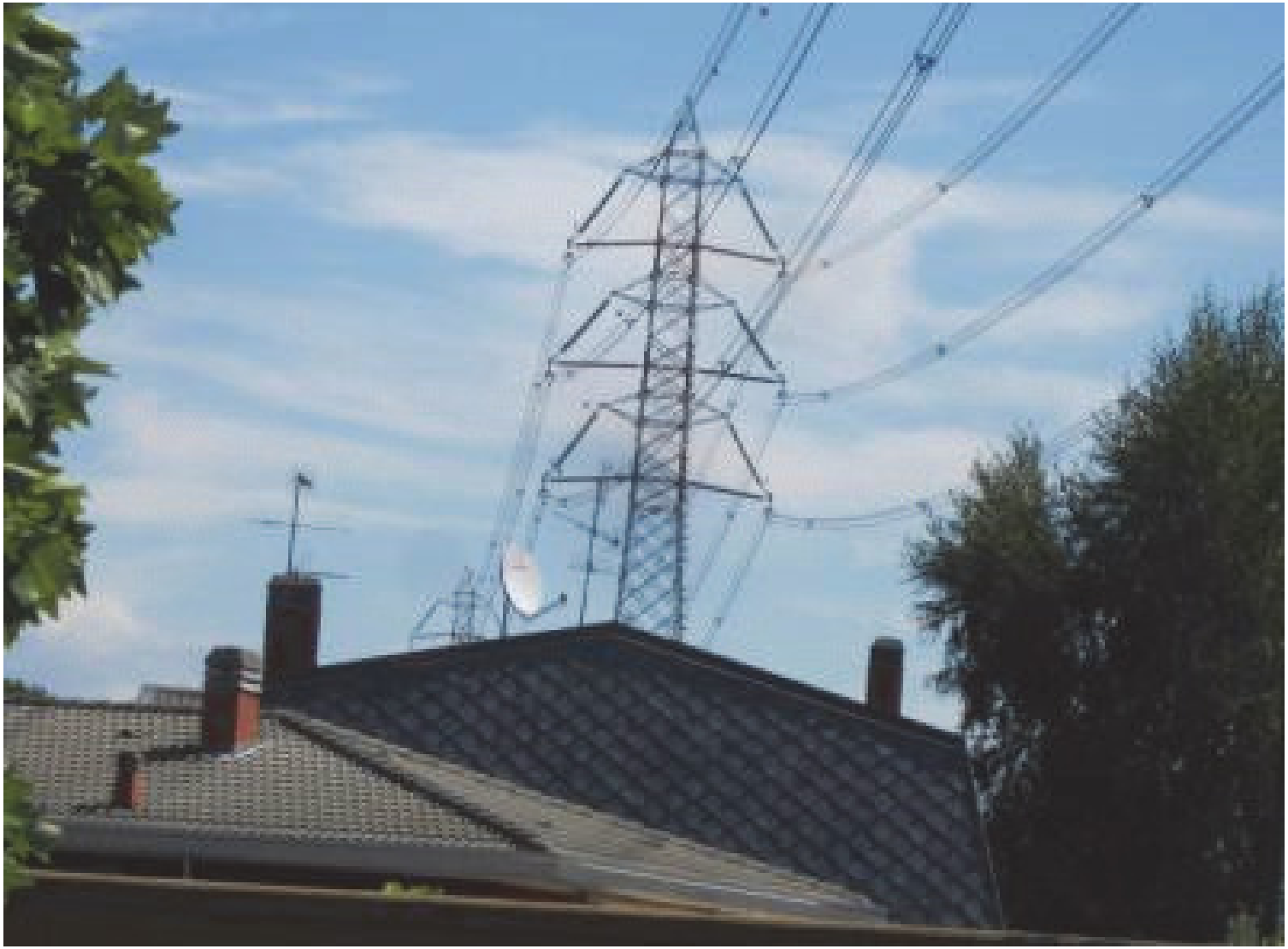




Study 765 kV Compact Line, IN




Displacement in mm
140
120
100
80
60
40
20
0
0
50
100
150
200
250
Resulting Force in kN
Displacement at Post Head Fitting
Displacement at Middle of the Post



SCB2 2014 SESSION

2014 SC B2 CAG Progress Report

2014 Target Group Survey – Industry Challenges

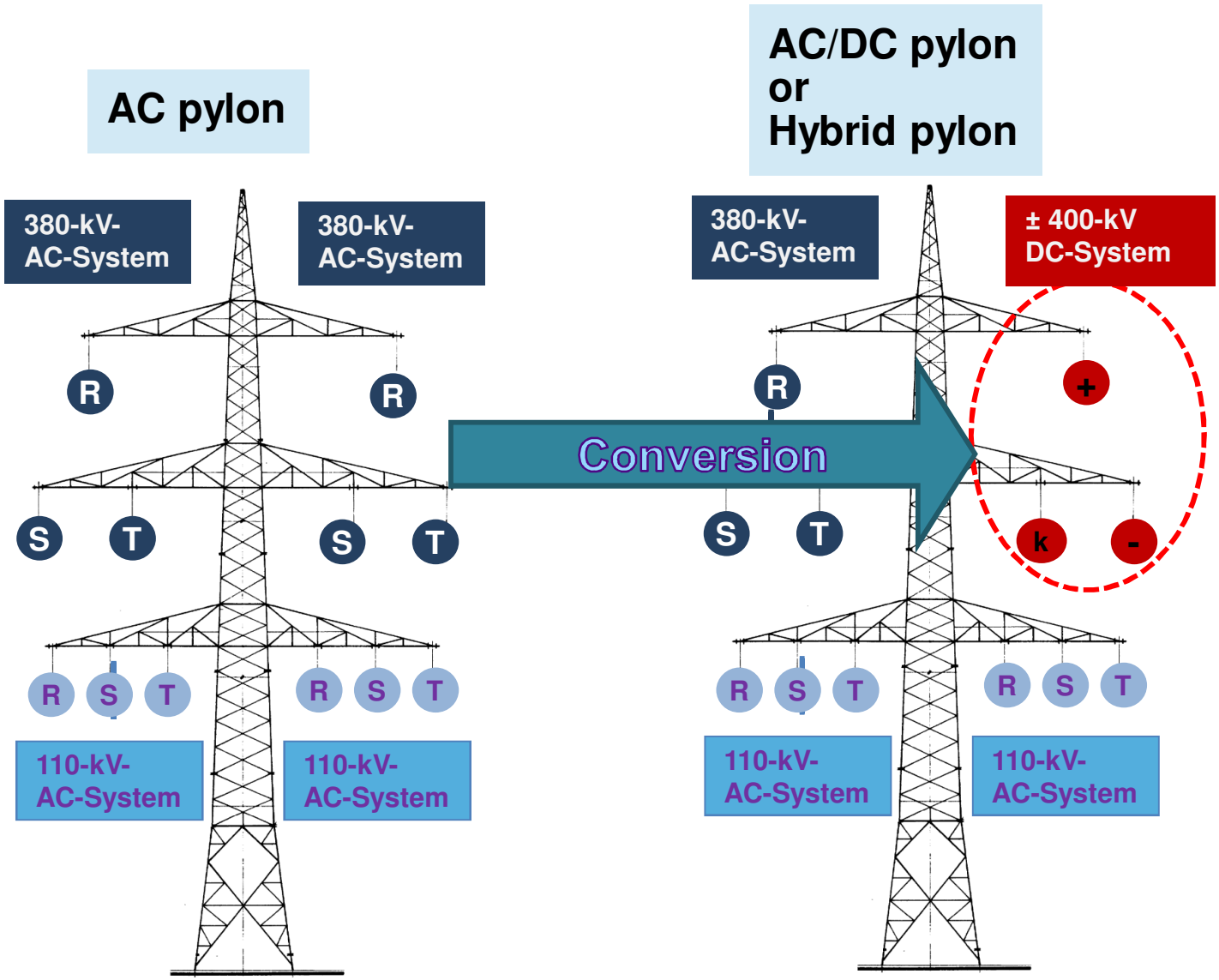
Challenges (from the Survey Pick List):

- Increase Capacity and Reliability Of the Existing Lines: 125
- New Materials For Use With Overhead Lines: 113
- Condition Assessment and Estimating Remaining Asset Life: 110
- Methods to Optimize Design: 108
- Best Construction and Maintenance Techniques and Procedures: 105
- Public Acceptance Of Overhead Lines: 77
- Foundations For Difficult Soil Conditions: 44

SCB2. CAG: Zibby Kieloch (Canada) B2 Technical Meeting 27/28 August 2014 - 23 -

Increase capacity of Overhead Lines: Conversion of an AC to a DC circuit

Innovative Electrical Networks for a Sustainable Development in Low Carbon Scenarios

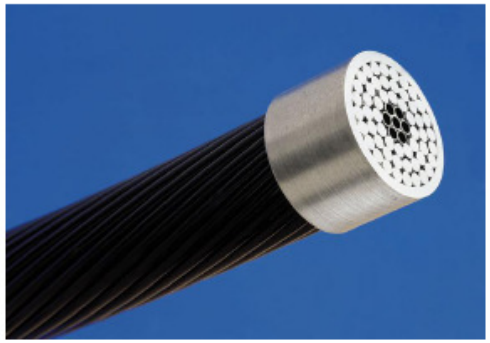


Increase capacity of Overhead Lines: HTLS Conductors

Innovative Electrical Networks for a Sustainable Development in Low Carbon Scenarios

Principle overview on conductor types (not complete)

- AAAC All Aluminium Alloy Conductor
- ACSR Aluminium Conductor Steel Reinforced
- TACSR Thermal resistant Aluminium Conductor Steel Reinforced
- G(Z)TACSR Gap-type (Super) Thermal resistant Aluminium alloy Conductor Steel Reinforced
- (Z)TACIR (Super) Thermal resistant Aluminium alloy conductor Invar Reinforced
- ACAR Aluminium conductor Alloy Reinforced
- ACSS Aluminium Conductor Steel Supported
- ACCC Aluminium Conuctor Composite Core
- ACCR Aluminium Conductor Composite Reinforced

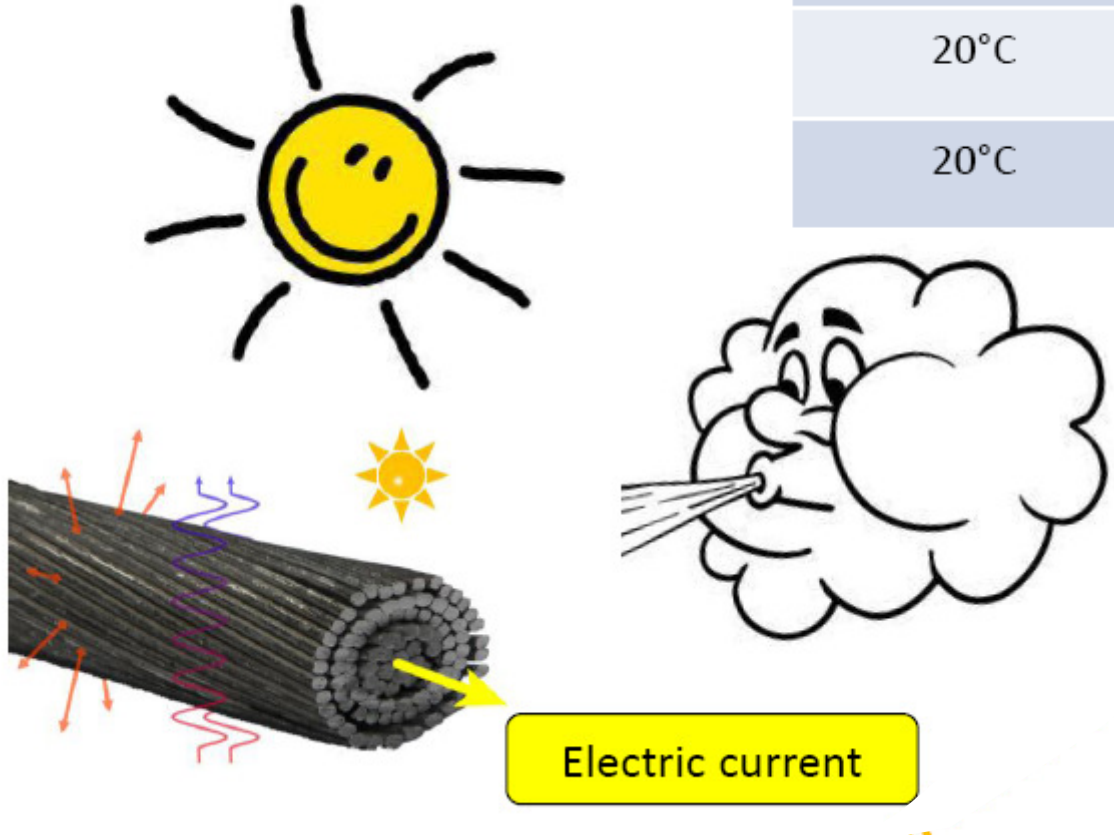


WG B2.42	Guide to Operation of Conventional **Conductor Systems above 100°C**
WG B2.55	Conductors for the **Uprating of existing Overhead Lines**
WG B2.48	Experience with the mechanical performance of **new conductor types**

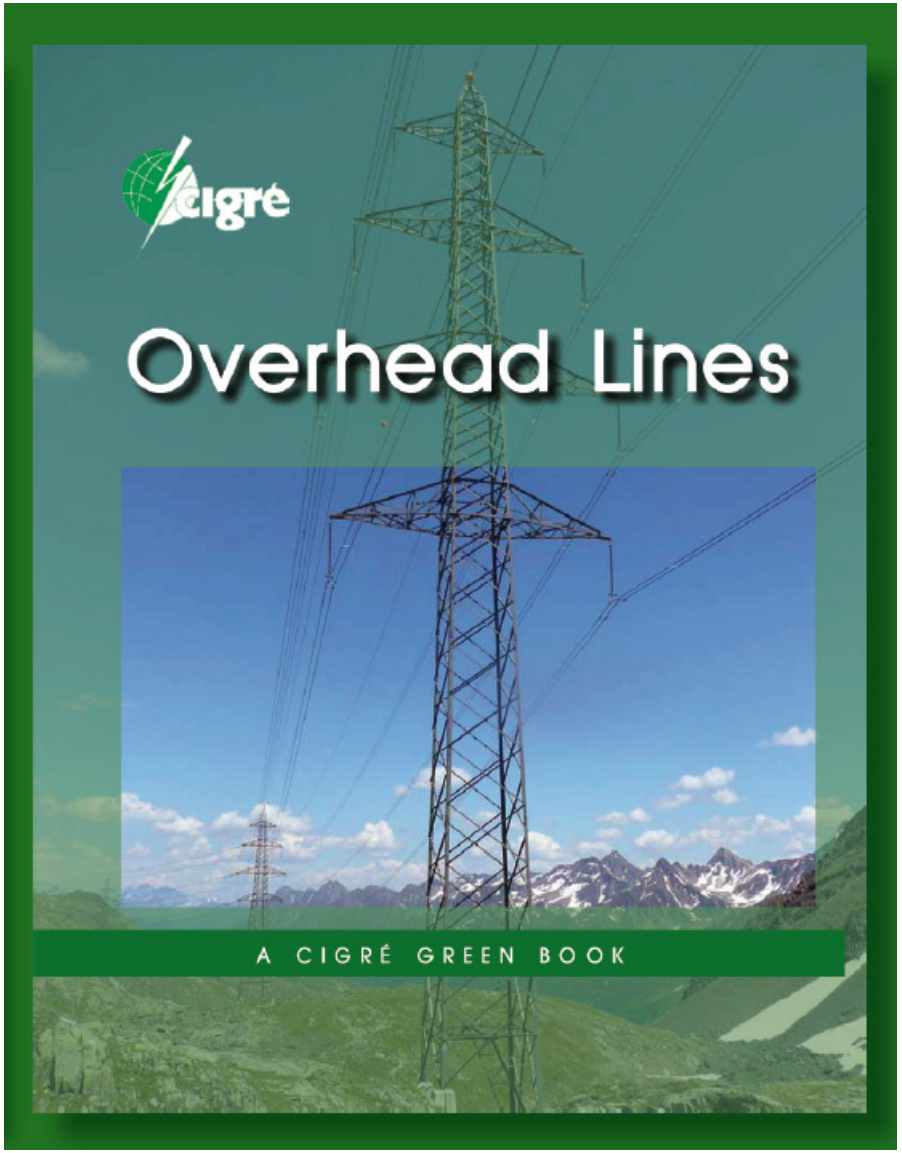
Increase capacity of Overhead Lines: Thermal rating & Real time monitoring

Innovative Electrical Networks for a Sustainable Development in Low Carbon Scenarios

ambient temperature	wind speed (rectangular)	Ampacity
35°C	0,6 m/sec	100 %
20°C	0,6 m/sec	115 %
20°C	2 m/sec	150 %



WG B2.43	Guide for **Thermal Rating Calculations** for Overhead Lines with high temperatures and real-time weather & load data


cigré
Overhead Lines
A CIGRÉ GREEN BOOK