



why upgrade or build new OHL?

- increasing electricity consumption
- changing flows of energy – generation/consumption

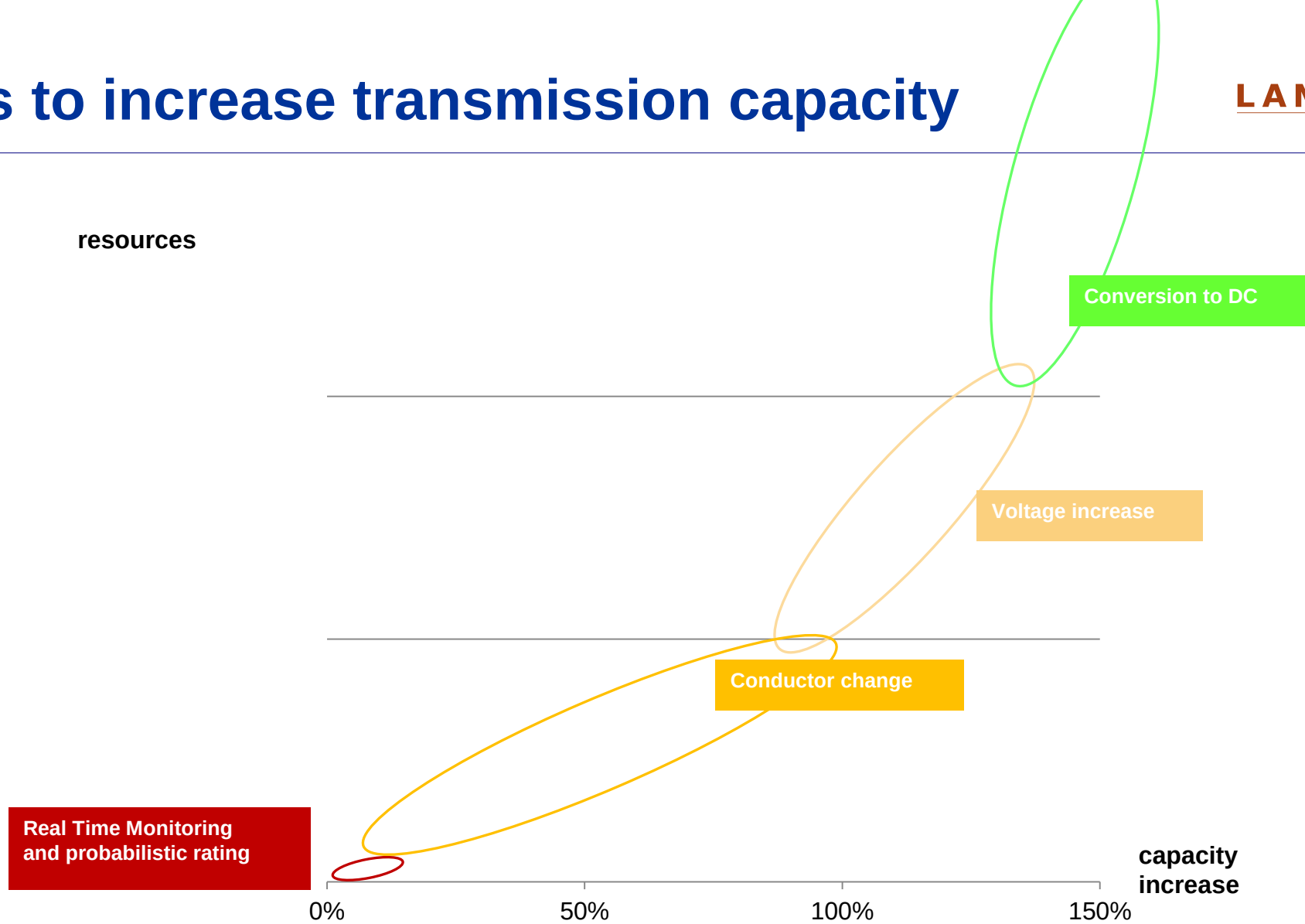
=> existing lines operate beyond the limit of their capacity

- insufficient capacity
- reduced reliability
- sag problems



ways to increase transmission capacity

resources



apply technological evolution in conductor design to

- increase current carrying capacity
- improve sag behavior
- reduce line losses
- realize projects faster and more cost-efficient

- legal regulations
- tower modifications
- conductor weight
- right of way
- capital expenditure
- conductor diameter



conductive material

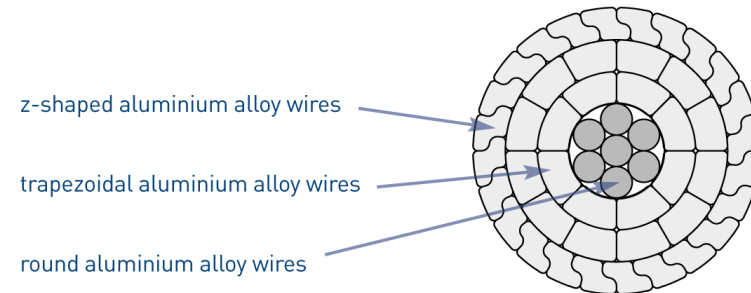
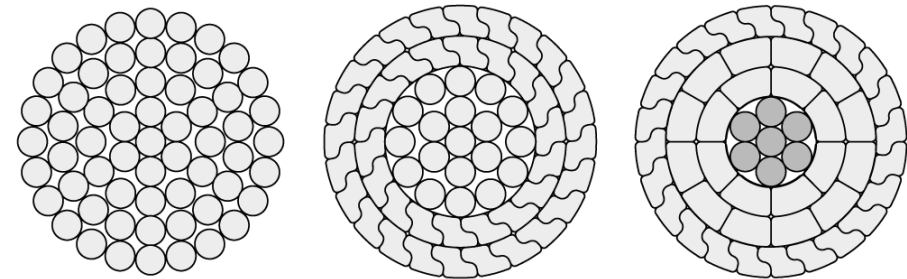
- UHC aluminium alloy (Ultra High Conductivity)
- high temperature resistant alloys
- fully annealed aluminium

core

- EHS, UHS and GHS steel core
- light and low CTE composite core
- low CTE invar core
- no core

design

- closed conductors
- GAP conductor
- ACCC conductor



choosing the right conductor

for efficiency improvements or capacity increase until about 20%

UHC



AAAC UHC

for capacity increase until about 100%:

High Temperature Low Sag Conductors (HTLS), e.g.



G(Z)TACSR

ACCC

AAAC 620 UHC – Netherlands

Tennet TSO bv

new OHL - Wintrack

AAAC 620 UHC

Length: 400km

Voltage: 400 kV

Energized: 2010-2013



AAAC 882 UHC – Netherlands

Tennet TSO bv

**connection of small power
plants and new main
production capacity at
Eemshaven**

AAAC 882 UHC

Length: over 1000km

Voltage: 110 kV

Energized: 2010-2012



AAAC Araucaria – UK

National Grid UK

**various OHL throughout
England and Wales**

AAAC Araucaria EHC

Length: 8000km

Voltage: 400 kV

**Energized: from 1996
onwards**



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UHC



AAAC UHC

for capacity increase until about 100%:

High Temperature Low Sag Conductors (HTLS)



G(Z)TACSR

ACCC

GZTACSR – India

Powergrid Cy. India Ltd

**400kV OHL Gaya - Kodarma
4 circuits twin GZTACSR to
double ACSR Moose
capacity**

**GZTACSR “Gaya”
Length: 1000km
Voltage: 400 kV
Energized: 2014**



GZTACSR Matthew 620 – UK

National Grid UK

**various OHL throughout
England and Wales**

GZTACSR Matthew 620

Length: 3000km

Voltage: 400 kV

**Energized: from 2003
onwards**



choosing the right conductor

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UHC



AAAC UHC

for capacity increase until about 100%:

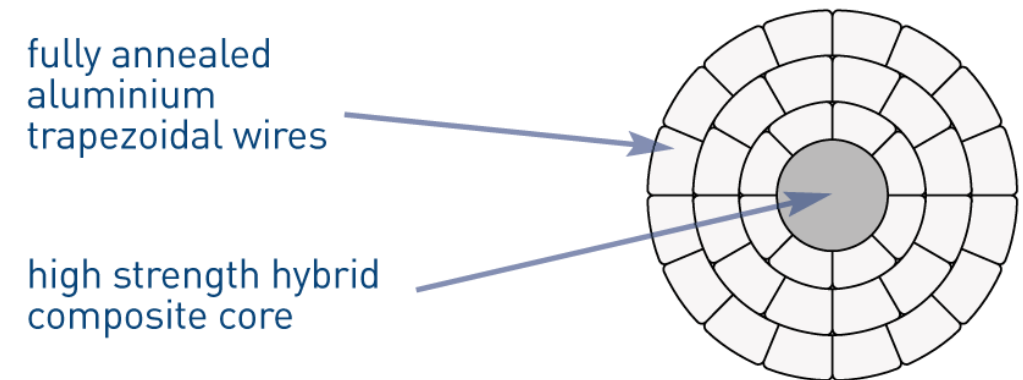
High Temperature Low Sag Conductors (HTLS)



G(Z)TACSR

ACCC

- R&D of carbon fibre core started in the 80s when carbon fibre was recognised as superb strength member for overhead conductors
- Idea abandoned by late 90s due to lack of success and difficulties
- CTC Cable started development of a carbon fibre core in 2001
- ACCC conductors are introduced in 2006
- Lamifil is manufacturing ACCC® since 2006

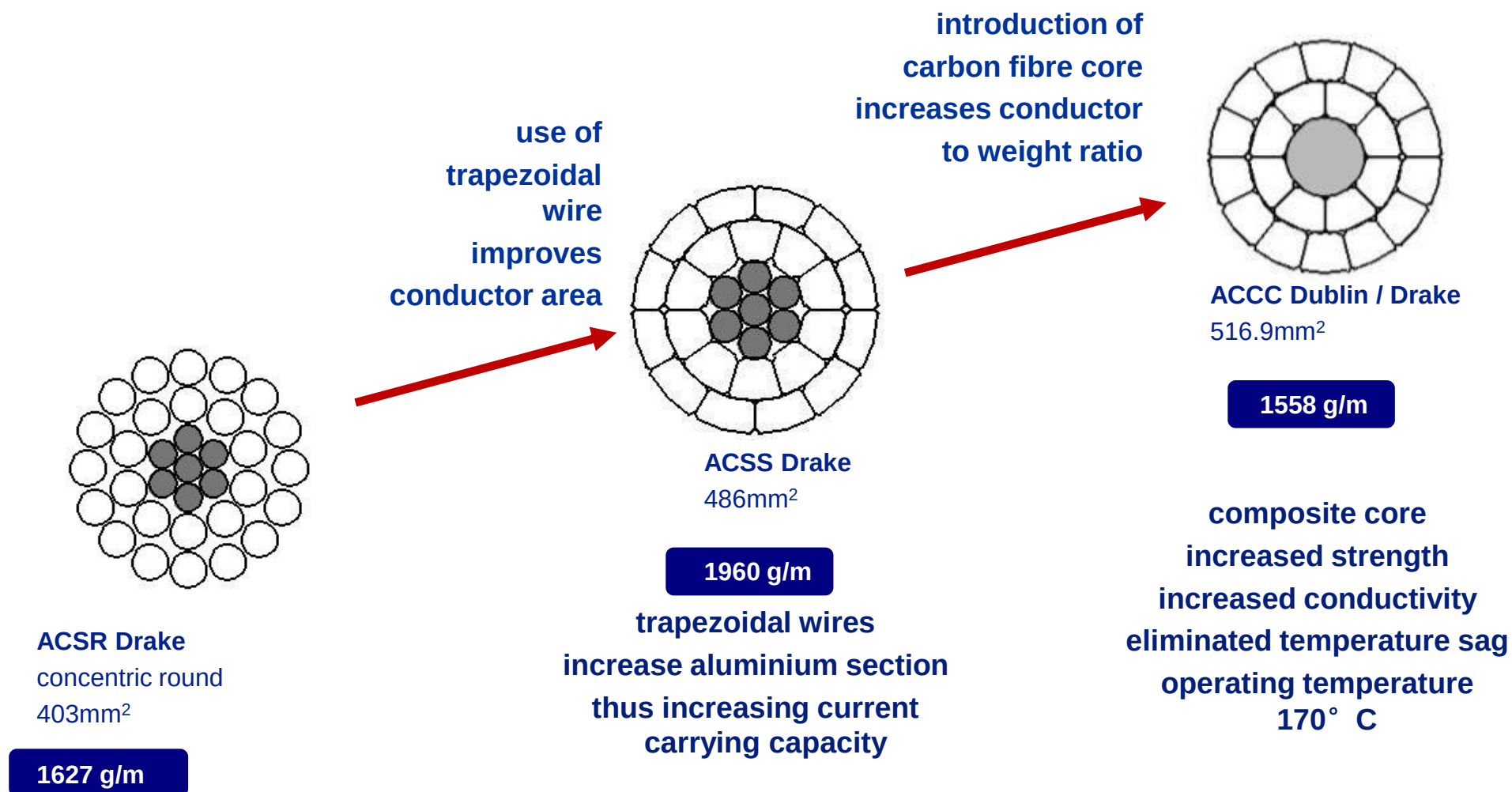


- **High strength carbon fibre composite core**
 - 4 x lighter than steel
 - 50% stronger than standard steel
 - Thermal expansion 7 x lower than steel

- **Most conductive aluminium possible:**
 - closed trapezoidal wire construction
 - fully annealed aluminium wires – 63% IACS conductivity



from ACSR to ACCC



■ Features of ACCC

- Light weight high strength composite core
- Virtually no high temperature elongation
- Fully annealed aluminium trapezoidal wires
- Core surface temperature up to 180°C
- Conductor surface temperature up to 175°C



- **Fittings**
 - ACCC dead ends & splices available from several sources
 - Other fittings as used with other high temperature OHC

- **Installation guidelines**
 - Training prior to the start of the install
 - Conventional installation procedures and equipment
 - Minimum bending radius
 - Normal sheaves



ACCC Amsterdam – Spain

NEO Energia

**increase capacity with
existing structures for wind
farm upgrade**

ACCC Amsterdam

Length: 57 km

Voltage: 66 kV

Energized: 2008



ACCC Oslo – Germany

Amprion

380kV pilot line

ACCC Oslo (bundled)

Length: 8.6 km

Voltage: 400 kV

Energized: 2009



ACCC Amsterdam – Portugal

EDP distribucao

River Mondego crossing

ACCC Amsterdam

Span Length: 475 Meters

Voltage: 60 kV

Energized: 2012

**and 3 other projects 2010-
2014 to Increase Amps -
Reduce Sag**



ACCC Monte Carlo – Congo

SNEL – DRC

new lake crossing
securing power supply to
major copper mine

ACCC Monte Carlo 235 ULS

Length: 4.5km

Voltage: 110 kV

Energized: 2013

1st project with ULS core



ACCC Lisbon – Belgium

Elia - Belgium

**reconductoring of 150kV
line to evacuate power from
new 400 MVA generation
plant T-Power**

ACCC Lisbon 325

Length: 125km

Voltage: 150 kV

Energized: 2008



ACCC Brussels & Lisbon – Netherlands

TenneT TSO

**reduce sag on existing
gantry line**

**ACCC Brussels 430 and
ACCC Lisbon 325**

Length: 60km

Voltage: 110 kV

Energized: 2014



ACCC Reykjavik – UK

UK Power Networks

reconductoring of existing
132kV line near fly corridor
London Heathrow

ACCC Reykjavik 235

Length: 110km

Voltage: 132 kV

Energized: 2012



ACCC Oslo 325 – Scotland

**Scottish and Southern
Energy**

**reconductoring of existing
33V trident line to increase
capacity**

**ACCC Oslo 325
Length: 45km
Voltage: 33 kV
Energized: 2011**



ACCC Brussels 430 – China

State Grid and regional
grids of China

reconductoring of existing
220kV lines to meet
increasing demand

ACCC Brussels 430
Length: 300km
Voltage: 220 kV
since 2006



ACCC Lisbon 325– China

**State Grid and regional
grids of China**

**reconductoring of existing
220kV lines to meet
increasing demand**

**ACCC Lisbon 325
Length: 200km
Voltage: 220 kV
Energized: 2008**



ACCC Oslo 325 – Germany

WestNetz (RWE Group)

**increase current carrying
capacity while reducing sag**

**ACCC Oslo 325
Length: 80km
Voltage: 110 kV
Energized: 2012**



ACCC Lisbon 325 – South Africa

Citypower Johannesburg

**Capacity increase
live reconductoring of
existing 150kV line**

ACCC Lisbon 325

Length: 450km

Voltage: 132 kV

Energized: 2009-2012



ACCC Brussels 430 – Russia

**FSK – Federal Grid
Company**

**reconductoring of 220kV
double circuit line
delivering reliable power to
VW plant in Kaluga**

**ACCC Brussels 430
Length: 210km
Voltage: 220 kV
Energized: 2013**



ACCC Helsinki 165 – Russia

Novosibirskenergo

**reconductoring of existing
110kV line - capacity
increase**

ACCC Helsinki 165

Length: 65km

Voltage: 110 kV

Energized: 2013



ACCC Helsinki – UK

Electricity North West

increase current carrying
capacity and reduce sag

ACCC Helsinki

Length: 180km

Energized: 2015



ACCC Brussels 430 – South Korea

500kV DC research program

**KEPRI – research institute
testing of ACCC six bundle
on 500kV DC**

**ACCC Brussels 430
Length: 50km
Voltage: 500 kV DC
Energized: 2012**



ACCC-Z Antwerp 970 ULS – Belgium

ELIA

**2nd circuit on 380kV line
twin bundle configuration**

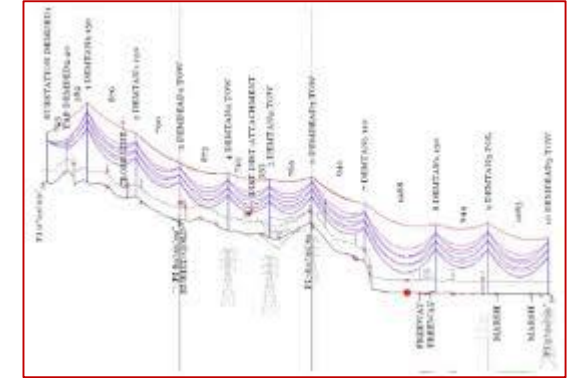
**ACCC-Z Antwerp 970 ULS
Length: 230km
Energized: 2015**

**two more projects to be
constructed in 2016**



helping you to make the right choice

- Evaluation of different conductor technologies based on:
 - current carrying capacity
 - conductor sag at higher temperature
 - line losses
 - efficiency
 - line TCO
 - environmental impact



		ACSR 500/65	ACCC Vienna	ACCC Budapest
Conductor specifications				
Overall diameter	mm	31,05	30,42	31,5
Aluminium or Al alloy section	mm²	504,8	635,8	698,0
Weight	kg/km	1.993,2	1.871,7	2.002,6
Strength (RTS)	kN	157,5	165,9	192,1
DC resistance at 20°C	Ohm/km	0,0575	0,0441	0,0416
Resistivity of Al or Al alloy	nOhmm	28,26	27,35	27,35
Conductor performance and efficiency				
Maximum operating T	°C	80	175	175
Current at 80°C	A	1.044	1.182	1.226
Current at maximum operating T	A	1.044	1.932	2.008
Improvement of current at 80°C	%		13%	17%
Improvement of current at max T	%		85%	92%

Current calculations with environment Temp: 25°C; wind velocity = 0,5m/s;
Emissivity = Absorption coefficient = 0,5; Sun radiation = 1000W/m²

Joule losses				
Joule losses (1000 A, 50Hz, 25°C)	W/km	71.775	54.229	51.019
Temperature at given current	°C	75,9	66,1	63,8
Improvement of Joule losses	%		24%	29%
Joule losses per year	MWh/km	629	475	447
Costs of 1 MWh	€	50 €	50 €	50 €
Total cost Joule losses	€/km	31.438 €	23.752 €	22.346 €
Costs saved	€/km		7.685 €	9.091 €
Yearly cost savings per km (3 phase circuit, single conductor)			23.055 €	27.274 €