

# e-HIGHWAY 2050

## Modular Development Plan of the Pan-European Transmission System 2050

Contract number	308908	Instrument	Collaborative Project
Start date	1st of September 2012	Duration	40 months
WP 3	Technology portfolio to meet the 2050 scenarios		
D3.1	Technology assessment from 2030 to 2050		



### Annex to D3.1 - Technology Assessment Report

#### *Transmission Technologies: FACTS, Shunt and series compensating technologies*

	Organisation	Date
Written by	J. Roos, P. Lundberg (T&D Europe)	17 January 2014
Checked by	Interim version checked by Quality Pool (RSE, KUL, RTE, Technofi). Final version validated by T&D Europe and WP3 leader	29 August 2014
Validated by	G. Sanchis, B. Betraoui (RTE)	

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

## Document information

### General purpose

This document is an annex of deliverable D3.1 focusing on the technology assessment (technical and economic performances) of generation, storage, transmission and demand-side technologies. This report focuses on the key components of the FACTS technologies, i.e. shunt and series compensating technologies. It provides an explanation of the key variables selected, the methodology for the data construction as well as a technical outlook as of today and 2050.

The present document is complemented by an attached Excel file providing the data compiled according to the methodology described in the in the next sections.

### Change log

<b>Revision</b>	<b>Date</b>	<b>Changes description</b>	<b>Authors</b>
V1.0	17 <sup>th</sup> January 2014	Creation	T&D Europe
V1.1	12 <sup>th</sup> May 2014	Comments by Technofi	Technofi
V1.2	9 <sup>th</sup> July 2014	Updated version	T&D Europe
V2.0	29 <sup>th</sup> August 2014	Final version	T&D Europe

## Table of content

<b>DOCUMENT INFORMATION</b> .....	<b>2</b>
<b>TABLE OF CONTENT</b> .....	<b>3</b>
<b>1 INTRODUCTION</b> .....	<b>5</b>
<b>2 TECHNOLOGY PERFORMANCE CHARACTERISTICS</b> .....	<b>9</b>
2.1 Variables selected for FACTS technologies .....	9
2.1.1 Losses -index of losses per converter station in percentage of rated power [%].....	9
2.1.2 Capacity – voltage line to ground for converters.....	9
2.1.3 Capacity – Dynamic reactive power performance range.....	9
2.1.4 Capacity – Current.....	9
2.1.5 Security of supply.....	9
2.2 Assumptions for the expected evolutions of technical data from 2013 to 2050 for FACTS technology .....	9
2.2.1 Technical outlook today (2013) .....	10
2.2.2 Technical outlook at 2050 for FACTS.....	11
2.3 Methodology for data gathering.....	14
2.4 Conclusions on robustness of the produced data.....	15
<b>3 TECHNOLOGY READINESS AND MATURITY</b> .....	<b>16</b>
3.1 Variables selected .....	16
3.1.1 SVC – Static VAR Compensator .....	16
3.1.2 STATCOM – Static Synchronous Compensator .....	16
3.1.3 FSC – Fixed Series Controller .....	16
3.2 Assumptions for the expected evolutions of technical data from 2013 to 2050 for FACTS technology .....	16
3.3 Methodology for data gathering.....	16
3.4 Conclusions on robustness of the produced data.....	16
<b>4 POSSIBLE IMPLEMENTATION CONSTRAINTS</b> .....	<b>17</b>
4.1 Variables selected .....	17
4.1.1 Converter station size for SVC and STATCOM.....	17
4.1.2 Capacitor bank for FSC .....	17
4.2 Context of implementation constraints for FACTS.....	17
4.3 Methodology for data gathering.....	17
4.4 Conclusions on robustness of the produced data.....	17
<b>5 COSTS</b> .....	<b>18</b>
5.1 Variables selected .....	18
5.1.1 CAPEX – Capital investment in Euros per kW installed [€ /kW] .....	18
5.1.2 OPEX – Operational costs in Euros per kWh produced [€ /kWh] .....	18
5.1.3 Lifetime – Economic useful lifetime of converters in [years].....	18
5.2 Underlying assumptions .....	18
5.3 Methodology for data gathering.....	18
5.4 Conclusions on robustness of the produced data.....	18
<b>6 ENVIRONMENTAL IMPACT AND PUBLIC ACCEPTANCE</b> .....	<b>19</b>
6.1 Variables selected .....	19
6.1.1 Land use - surface occupation of the FACTS devices (or any other component) [m2].....	19
6.1.2 Noise generation.....	19
6.1.3 EMC - electromagnetic field generated by the considered component.....	19
6.1.4 CO2 emissions -.....	19
6.1.5 Health and safety - [months on site].....	19
6.2 Environmental impact today and in 2050.....	19
6.3 Methodology for data gathering.....	20