Vía Azul (Europe 10)

Draft Parameters and Key Figures

Estimated Expenses for calculation model (Other providers available!)			
	km	Investments	Published Investment proposal
	1.800	30.000.000 €	
Proposed Hydrogen Highway Germany	One Hydrogen Station installed every xx km	50	
	Number of Hydrogen Stations	36	
	Investment per Hydrogen Station	**666.667 €**	For EU calculations reduced to 80% of German labor costs
Provider available	**Power Electrolyser**	**1.800.000 €**	1 per Hydrogen Station Production of 485 m³(H2)/h Input Energy: 4,3 kWh / m³(H2) => 2.085 kWh = 2,1 MWh => Required capacity 2,1 MW
Provider available	**HYDROSOL (= 1 CSP "Concentrating Solar Thermal Power Plants"**	**260.000.000 €**	One HYDROSL 50 MW is sufficient for ~25 Hydrogen Stations (1 Power Electrolyser each)
Provider available	**High Voltage Cabel (Highway) HVDC (high voltage direct current): 300-800 kV**	**1.000 €**	per km Highway
Provider available	**Price H2 ICE Bus**	**600.000 €**	
Provider available	**Price H2 PEM Bus**	**1.200.000 €**	
Average	**Price H2 PEM/ICE Bus**	**900.000 €**	PEM/ICE
Diesel	Consumtion Turbo Bus	44 €	Liters per 100 km
	CO2 Emission Turbo Bus	2,64	kg CO2 per 1 Liter of Diesel
	CO2 Emission Turbo Bus	464,6	kg CO2 per day (400 km)
Gas Natural	Consumtion Turbo Bus	44 €	Liters per 100 km
	CO2 Emission Turbo Bus	2,75	kg CO2 per 1 kg of Natural Gas
	CO2 Emission Turbo Bus	484,0	kg CO2 per day (400 km)
Mixture	**CO2 Emission Turbo Bus - average**	**474,3**	kg CO2 per day
H2 compared to Diesel	Production per Hydrogen Station	**1.153,0**	kg H2 per day
	Equivalent of Diesel	**6,0**	Liters of Diesel per 1 kg H2
	Equivalent quantity of Diesel per each Hydrogen Station	**6.918,0**	Liters of Diesel per day
	Emission CO2 if the H2 was substituted by Diesel	**18.263,5**	kg CO2 per day and Hydrogen Station

Electrical energy demand and potential local sustainable resources

Hydrosoles requiered	Quantity	Electrical Potencial MW
Andalucia (Pilot area)	1,59	79,36
Madrid extension	0,40	20,00
Via Azul europe 10	24,43	1.221,48
Total	**26,42**	**1.320,84**

Resources of Sustainable	
Parque Eólico Tarifa	74,00
Andasol I	50,00
Abengoa Solúcar	300,00
Total	**424,00**
Andasol II+III (2009-10)	100,00
Total (2009-10)	**524,00**

Capacity sustainable Energies related to projected Via Azul Europe 10 demands	**40%**

Key Investments (Infrastructure + Initial H2 vehicle fleets):

Project Phase	Investment** (Mio Euro)
Pilot Region (Andalucia)	705
Extension Madrid (incl. City)	169
Via Azul Europe 10	11.399

Key Figures from Items involved

Item	Number
Net of H2 fuelling stations* (every 50km) incl. a local Electrolyser CGH2 for FC vehicles	662
Highway cable (km)	32.876
CSPs	26
H2-Autobuses***	830
H2-Cars****	16.600
** Thereof every 2nd H2 fuelling station (every 100km) additionally incl. local Liquefaction ** LH2 for ICE vehicles*	*331,21*

**Local Liquefaction would raise Investments by 5-10%, but will enable FC and ICE vehicles immediately and in parallel!

***Included in investment figures as jump-start investment in clean public transportation

****NOT included in investment figures, but estimated for initial fleets and fuelling capacity planning

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Vía Azul (Europe 10)

Investment Summary (Draft)

Phases	Description	Quantity	Investments H2 stations and vehicles Mio Euro	Investments Services Mio Euro	Costs per Investment Items Mio Euro	CO2 reduction per city / Tones per day	CO2 reduction per city / Mio Tones per year (320 days)	CO2 reduction (produced H2 substitution quantity) / Mio Tones per year (365 days)
Vía Azul Andalucia - Investments and reductions CO2 per Phases								
Total 0-III	Net of Hydrogen Stations	42	102,8	10,3				-0,28
Total 0-III	Smart Grid Hydrosols (CSP)	1,59	412,7	41,3				
Total 0-III	Smart Grid Highway Cable	1.839	2,0	0,2				
	(Autobuses total)	*55*	49,5	14,9		-26	-0,01	
Total 0-III	*(Cars total - factor 20)*	*1.100*	567	67	634			
0	Feasibility study Andal. (9 months)			0,3	0,3			
0	Setup Hydrogen Technology Center Málaga (CTH)			8,0	8,0			
I	Management/realization of the project phases xx months and % of the Total Investment	36	10%	1,0	34,4			
II		24	10%	0,7	16,0			
III		24	10%	0,5	12,4			
	Vía Azul Andalucía Total				705	-26	-0,01	-0,28
Vía Azul Andalucia+Madrid extension - Investments and reductions CO2 per Phases								
IVa1	Net of Hydrogen Stations	10	19,5	2,0				-0,07
IVa2.1	Smart Grid Hydrosols (CSP)	0,40	104,0	10,4				
IVa2.2	Smart Grid Highway Cable	500	0,5	0,1				
IVb	*Autobuses H2 Madrid*	*15*	13,5	4,1		-7	-0,01	
	(Autobuses total)	*15*	138	16	154			
Total IV	*(Cars total - factor 20)*	*300*	Infrastructure and buses MAD					
IV	Management/realization of the project phases xx months and % of the Total Investment			0,6	15,4			
	Vía Azul Andalucía+MAD Total				874	-33	-0,02	-0,34
Vía Azul Consortium Summary - Investments and reductions CO2 per Phases								
0-Va1	Net of Hydrogen Stations	662	1.628,8	162,9	1.791,7			-4,42
0-Va2.1	Smart Grid Hydrosols (CSP)	26,42	6.868,4	686,8	7.555,2			
0-Va2.2	Smart Grid Highway Cable	32.876	32,9	3,3	36,2			
	(Autobuses total)	*830*	747,0	224,1	971,1	-394	-0,13	
Total 0-V	*(Cars total - factor 20)*	*16.600*	Infrastructure and buses Cons.		10.354	-394	-0,13	-4,42
0-V	Feasibility Studies Andalucia + Europe 10			1,5	1,5			
0-V	Setup Hydrogen Technology Center Málaga (CTH)			8,0	8,0			
0-V	Management/realization of the project phases 10% of the Total Investment				1.034,9			
	Vía Azul Europe 10 Consortium Total				11.399	-394	-0,13	-4,42

Vía Azul (Europe 10)

Base Calculations (Draft)

Phases	Description	Quantity	Investments H2 stations and vehicles	Investments Services	Costs per Phases	CO2 reduction per city / Tones per day	CO2 reduction per city / Tones per year (320 days)	CO2 reduction (produced H2 substitution quantity) / Tones per year (365 days)
Vía Azul - Investments and reductions CO2 per Phases								
0	Feasibility study Andal. (6 months)			262.170 €	262.170 €			
0	Setup Hydrogen Technology Center Málaga (CTH)			8.000.000 €	8.000.000 €			
0a1	Net of Hydrogen Stations (MA-City/PTA)	2	4.933.333 €	493.333 €				-13.332
0a2.2	Smart Grid Highway Cable	25	25.000 €	2.500 €				
0b	Autobuses H2 Málaga	5	4.500.000 €	1.350.000 €		-2	-759	
Total 0	*(Autobuses)*	5	9.458.333 €	1.845.833 €	11.304.167 €	-2	-759	-13.332
Ia1	Net of Hydrogen Stations	21	52.638.667 €	5.263.867 €				-142.256
Ia2.1	Smart Grid Hydrosols (CSP)	0,85	221.936.000 €	22.193.600 €				
Ia2.2	Smart Grid Highway Cable	1067	1.067.000 €	106.700 €				
Ib	Autobuses H2 Sevilla	10	9.000.000 €	2.700.000 €		-5	-1.518	
Ic	Autobuses H2 Granada	5	4.500.000 €	1.350.000 €		-2	-759	
Id	Autobuses H2 Córdoba	5	4.500.000 €	1.350.000 €		-2	-759	
Ie	Autobuses H2 Almería	5	4.500.000 €	1.350.000 €		-2	-759	
If	Autobuses H2 Cádiz/Jerez	5	4.500.000 €	1.350.000 €		-2	-759	
Ig	Autobuses H2 Huelva	5	4.500.000 €	1.350.000 €		-2	-759	
Total I	*(Autobuses)*	30	307.141.667 €	37.014.167 €	344.155.833 €	-21	-6.830	-142.256
IIa1	Net of Hydrogen Stations	10	25.702.667 €	2.570.267 €				-69.462
IIa2.1	Smart Grid Hydrosols (CSP)	0,42	108.368.000 €	10.836.800 €				
IIa2.2	Smart Grid Highway Cable	371	521.000 €	52.100 €				
IIb	Autobuses H2 Jaén	5	4.500.000 €	1.350.000 €		-2	-759	
IIc	Autobuses H2 Marbella	5	4.500.000 €	1.350.000 €		-2	-759	
Total II	*(Autobuses)*	10	143.591.667 €	16.159.167 €	159.750.833 €	-5	-1.518	-69.462
IIIa1	Net of Hydrogen Stations	8	19.536.000 €	1.953.600 €				-52.796
IIIa2.1	Smart Grid Hydrosols (CSP)	0,32	82.368.000 €	8.236.800 €				
IIIa2.2	Smart Grid Highway Cable	396	396.000 €	39.600 €				
IIIb	Autobuses H2 Algeciras/Tarifa	5	4.500.000 €	1.350.000 €		-2	-759	
IIIc	Autobuses H2 Antequera	5	4.500.000 €	1.350.000 €		-2	-759	
Total III	*(Autobuses)*	10	111.300.000 €	12.930.000 €	124.230.000 €	-5	-1.518	-52.796
Vía Azul Andalucia - Investments and reductions CO2 per Phases								
Total 0-III	Net of Hydrogen Stations	42	102.810.667 €	10.281.067 €				-277.847
Total 0-III	Smart Grid Hydrosols (CSP)	1,59	412.672.000 €	41.267.200 €				
Total 0-III	Smart Grid Highway Cable	1839	2.009.000 €	200.900 €				
	(Autobuses total)	55	49.500.000 €	14.850.000 €		-26	-8.348	
Total 0-III	*(Cars total - factor 20)*	1100	566.991.667 €	66.599.167 €	633.590.833 €			
0	Feasibility study Andal. (9 months)			262.170 €	262.170 €			
0	Setup Hydrogen Technology Center Málaga (CTH)			8.000.000 €	8.000.000 €			
I	Management/realization of the	36	10%	955.988 €	34.415.583 €			
II	project phases xx months and % of	24	10%	665.628 €	15.975.083 €			
III	the Total Investment	24	10%	517.625 €	12.423.000 €			
	Vía Azul Andalucía Total				704.666.670 €	-26	-8.348	-277.847
Vía Azul Andalucia+Madrid extension - Investments and reductions CO2 per Phases								
IVa1	Net of Hydrogen Stations	10	19.536.000 €	1.953.600 €				-66.662
IVa2.1	Smart Grid Hydrosols (CSP)	0,40	104.000.000 €	10.400.000 €				
IVa2.2	Smart Grid Highway Cable	500	500.000 €	50.000 €				
IVb	Autobuses H2 Madrid	15	13.500.000 €	4.050.000 €		-7	-2.277	
Total IV	*(Autobuses total)*	15	137.536.000 €	16.453.600 €	153.989.600 €			
	(Cars total - factor 20)	300	Infrastructure and buses MAD					
IV	Management/realization of the project phases xx months and % of the Total Investment	24	10%	641.623 €	15.398.960 €			
	Vía Azul Andalucía+MAD Total				874.055.230 €	-33	-10.625	-344.508
Vía Azul Euro 10 - Investments and reductions CO2 per Phases								
V	Feasibility study Europe 10 (12 months)			1.200.000 €	1.200.000 €			
Va1	Net of Hydrogen Stations	611	1.506.492.000 €	150.649.200 €				-4.071.306
Va2.1	Smart Grid Hydrosols (CSP)	24,43	6.351.696.000 €	635.169.600 €				
Va2.2	Smart Grid Highway Cable	30.537	30.537.000 €	3.053.700 €				
Vb	Autobuses Via Azul Europe 10	760	684.000.000 €	205.200.000 €		-360	-115.355	
Total V	*(Autobuses total)*	760	8.572.725.000 €	994.072.500 €	9.566.797.500 €	-360	-115.355	-4.071.306
	(Cars total - factor 20)	15.200	Infrastructure and buses EU					
V	Management/realization of the project phases xx months and % of the Total Investment	24	10%	39.861.656 €	956.679.750 €			
	Vía Azul Europe 10 Total				10.524.677.250 €	-360	-115.355	-4.071.306
	Vía Azul Consortium Total				11.398.732.480 €	-394	-125.979	-4.415.814
Vía Azul Consortium Summary - Investments and reductions CO2 per Phases								
0-Va1	Net of Hydrogen Stations	662	1.628.838.667 €	162.883.867 €	1.791.722.533 €			-4.415.814
0-Va2.1	Smart Grid Hydrosols (CSP)	26,42	6.868.368.000 €	686.836.800 €	7.555.204.800 €			
0-Va2.2	Smart Grid Highway Cable	32.876	32.876.000 €	3.287.600 €	36.163.600 €			
	(Autobuses total)	830	747.000.000 €	224.100.000 €	971.100.000 €	-394	-125.979	
Total 0-V	*(Cars total - factor 20)*	16600	Infrastructure and buses Cons.		10.354.190.933 €	-394	-125.979	-4.415.814
0-V	Feasibility Studies Andalucia + Europe 10			1.462.170 €	1.462.170 €			
0-V	Setup Hydrogen Technology Center Málaga (CTH)			8.000.000 €	8.000.000 €			
0-V	Management/realization of the project phases 10% of the Total Investment				1.034.892.377 €			
	Vía Azul Europe 10 Consortium Total				11.398.545.480 €	-394	-125.979	-4.415.814