

Comparing value chain GHG emissions in the power and transport sectors for selected technologies

Addendum to the study results

11/06/2019

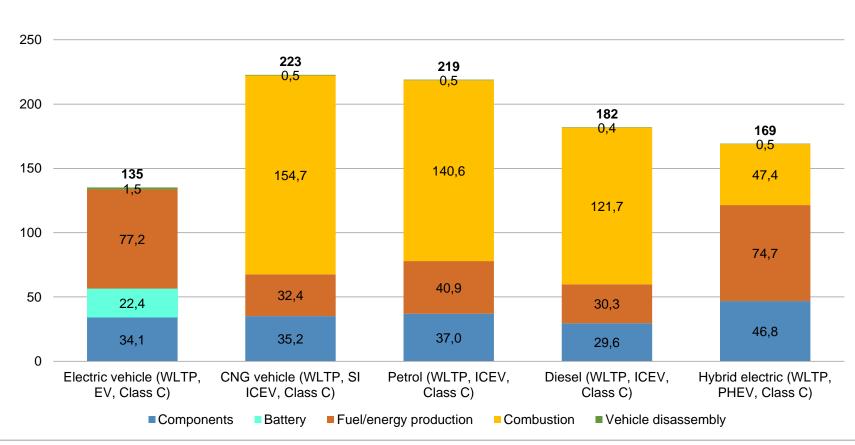
© Copyright 2019 by ERM Worldwide Group Limited and/or its affiliates ('ERM'). All Rights Reserved. No part of this work may be reproduced or transmitted in any form or by any means, without prior written permission of ERM.



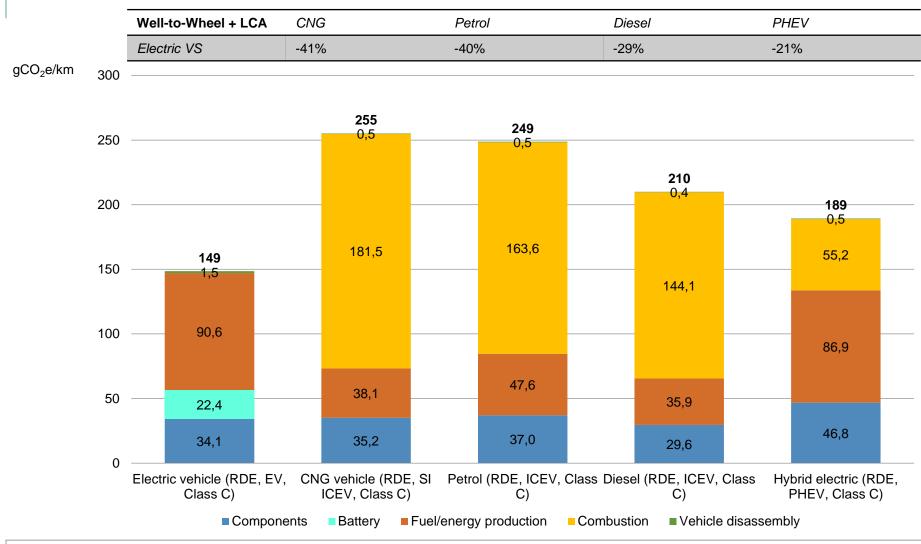
Transport baseline (2015) Italy – Worldwide harmonized Light vehicles Test Procedure (WLTP)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-39%	-39%	-26%	-20%

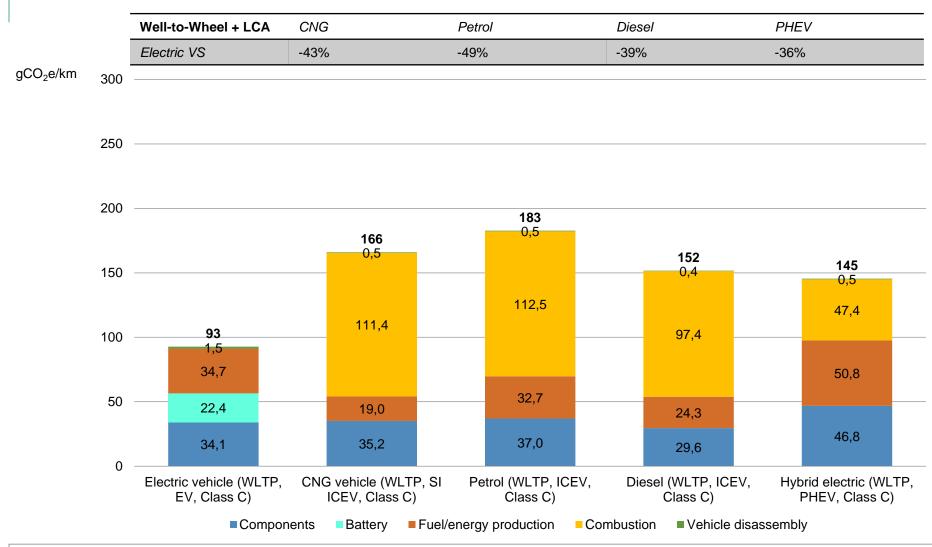
gCO₂e/km



Transport baseline (2015) Italy – Real Driving Emissions (RDE)



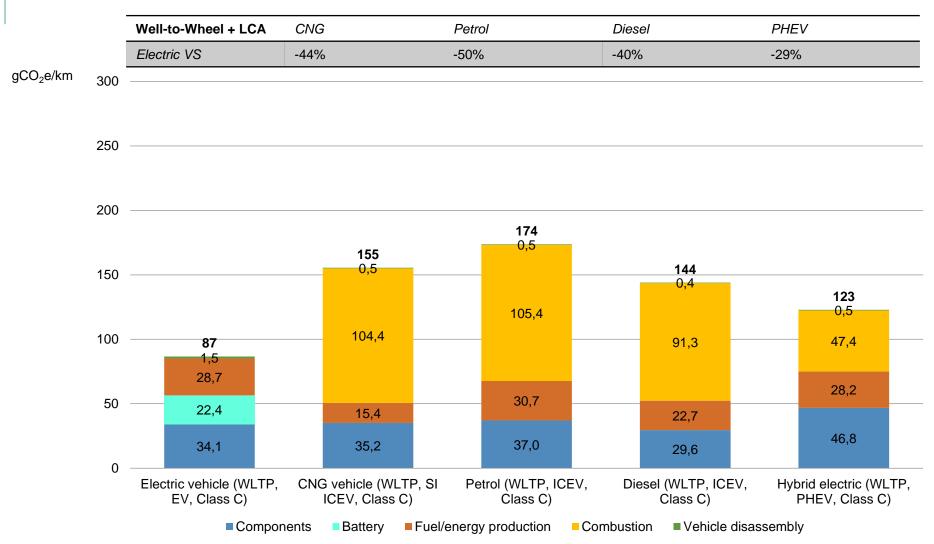
Transport 2030 (EUCO30) Italy – Worldwide harmonized Light vehicles Test Procedure (WLTP)



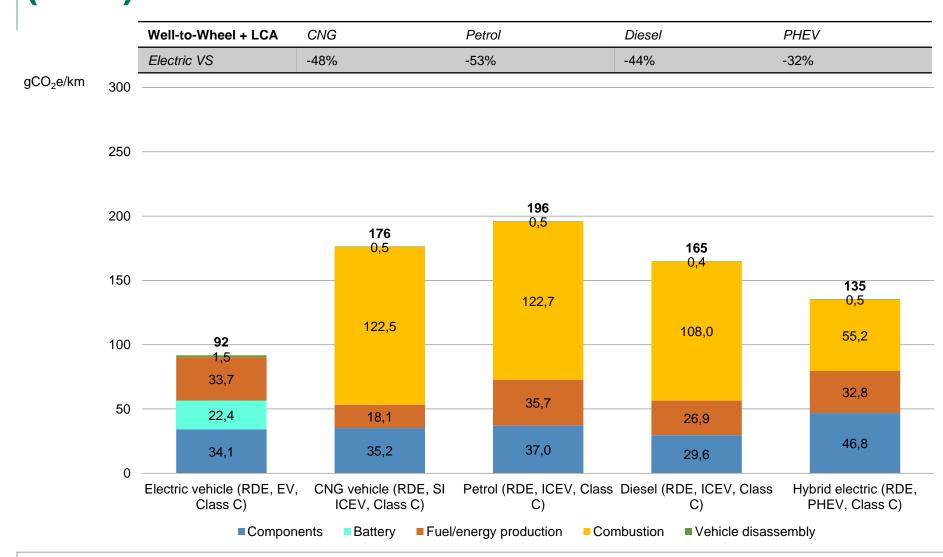
Transport 2030 (EUCO30) Italy – Real Driving Emissions (RDE)

		Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
		Electric VS	-48%	-52%	-43%	-39%
gCO ₂ e/km	300					
	250					
	200		400	206 0,5	_	
	200		189 0,5		174	
					0,4	162
	150			130,9		
			130,7		115,3	55,2
	100	99				
		40,8				59,1
	50	00.4	22.2	38,1		
		22,4	22,3		28,7	40.0
		34,1	35,2	37,0	29,6	46,8
	0	Electric vehicle (RDE, EV Class C)	, CNG vehicle (RDI		, Class Diesel (RDE, ICEV, C)	Class Hybrid electric (RDE, PHEV, Class C)
		■ Compor	ents Battery	Fuel/energy production	■ Combustion ■ Vehicle	disassembly

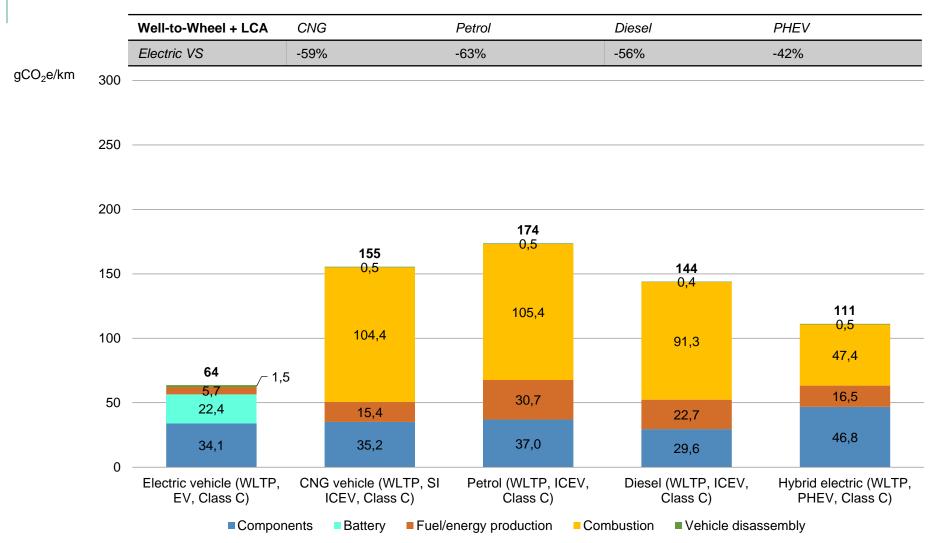
Transport 2050 (NPS) Italy – Worldwide harmonized Light vehicles Test Procedure (WLTP)



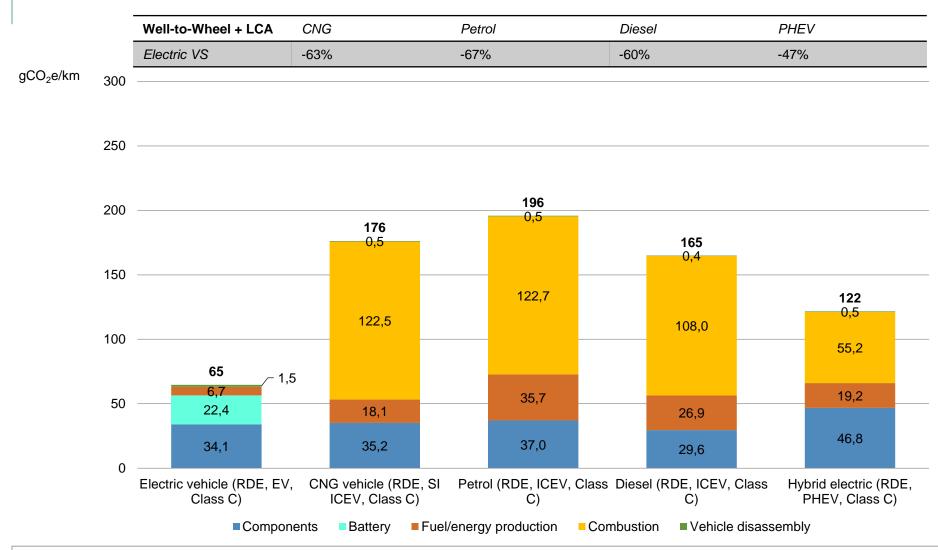
Transport 2050 (NPS) Italy – Real Driving Emissions (RDE)



Transport 2050 (2DS) Italy – Worldwide harmonized Light vehicles Test Procedure (WLTP)



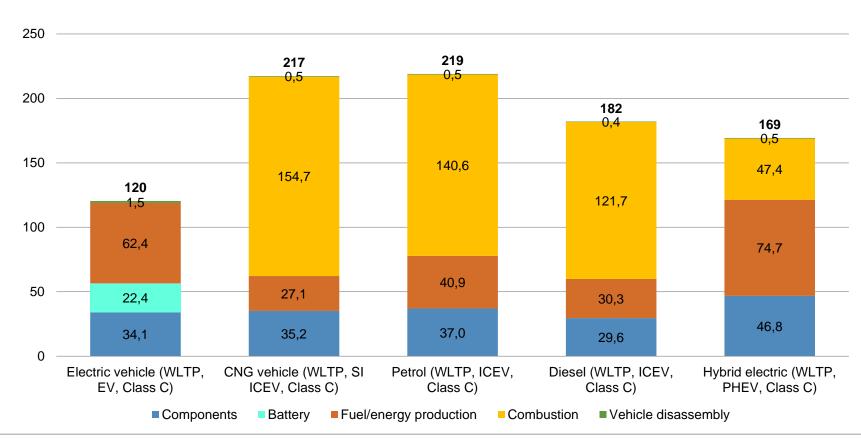
Transport 2050 (2DS) Italy – Real Driving Emissions (RDE)



Transport baseline (2015) Spain – Worldwide harmonized Light vehicles Test Procedure (WLTP)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-45%	-45%	-34%	-29%

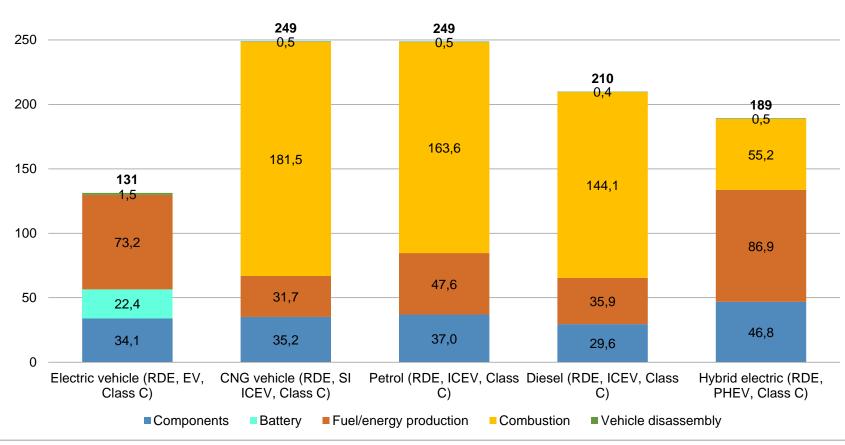
gCO₂e/km



Transport baseline (2015) Spain – Real Driving Emissions (RDE)

,	Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
	Electric VS	-47%	-47%	-38%	-31%
200					

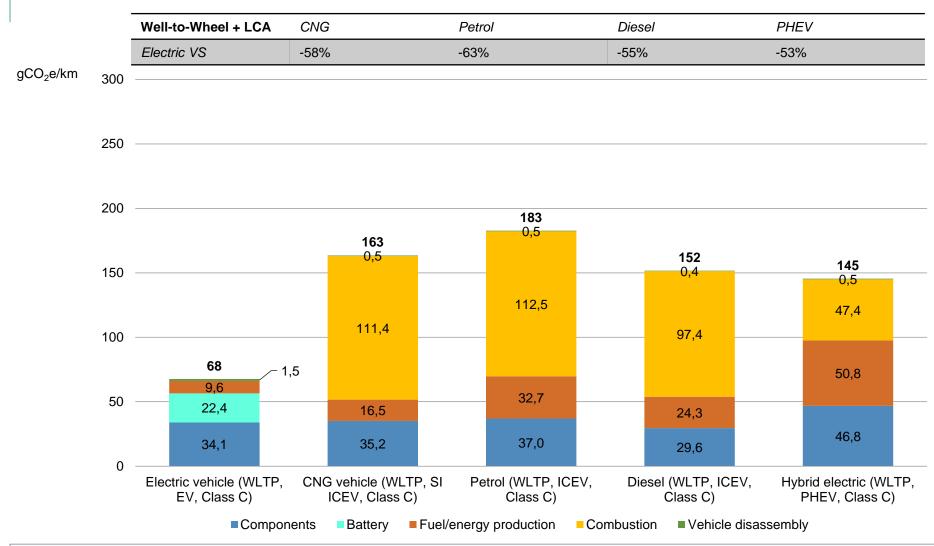
gCO₂e/km



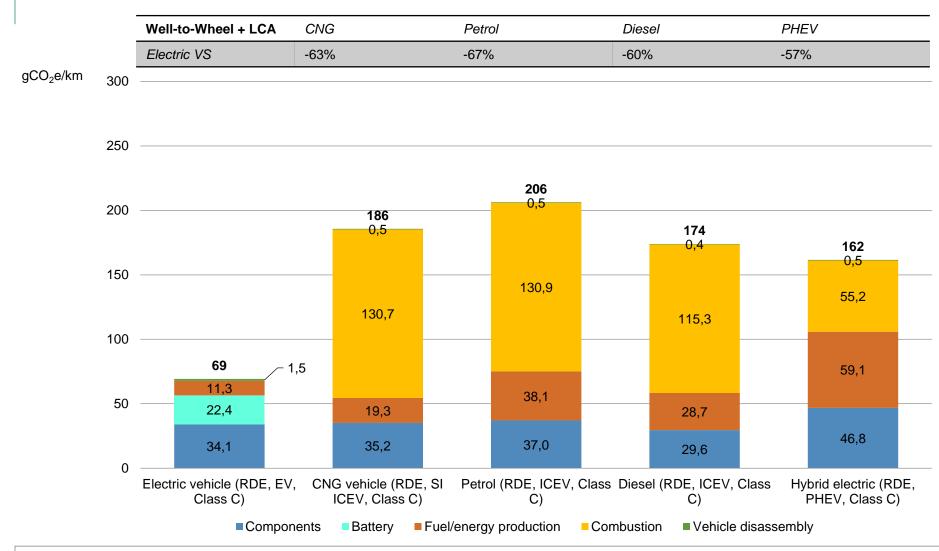
www.erm.com

Upstream, midstream and downstream emissions included. For the purposes of this comparison, calculations consider the power mix in the year indicated. Biofuels 10% in petrol / 7% in diesel.

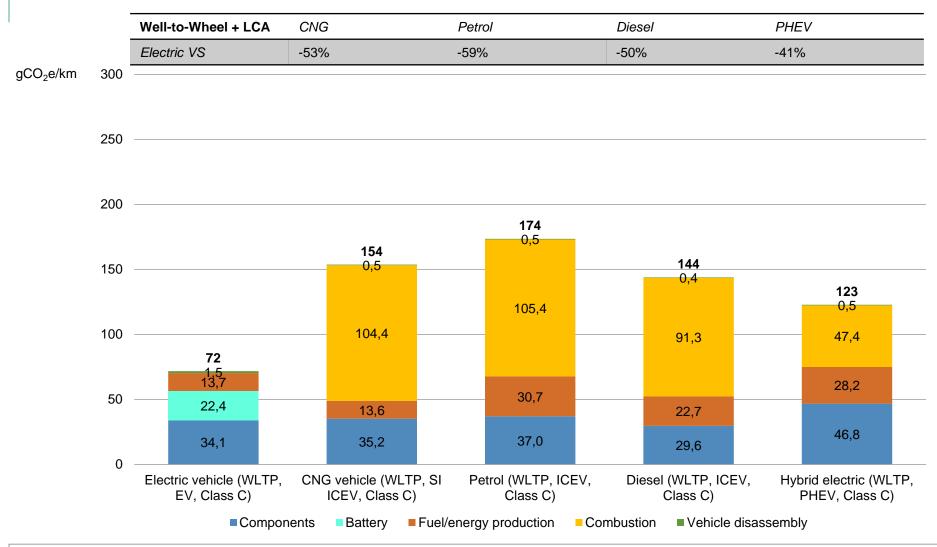
Transport 2030 (EUCO30) Spain – Worldwide harmonized Light vehicles Test Procedure (WLTP)



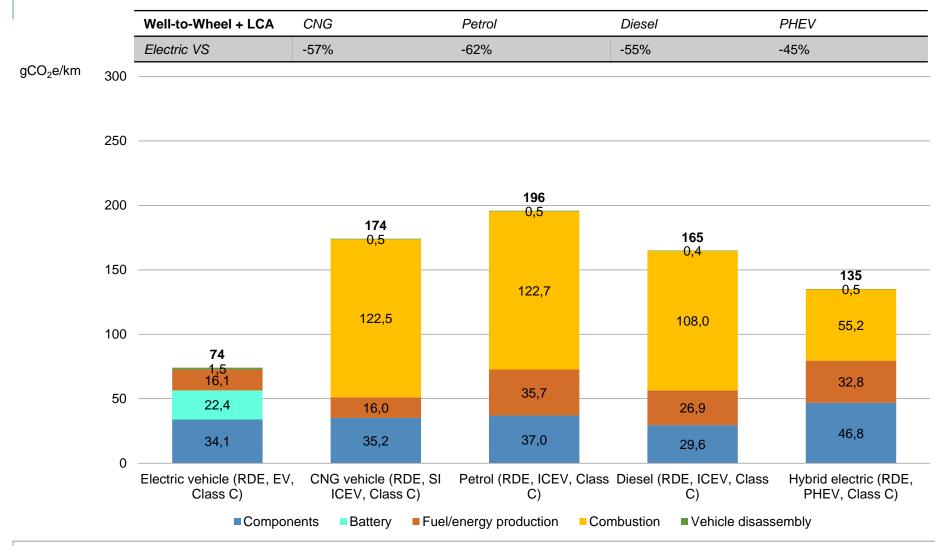
Transport 2030 (EUCO30) Spain – Real Driving Emissions (RDE)



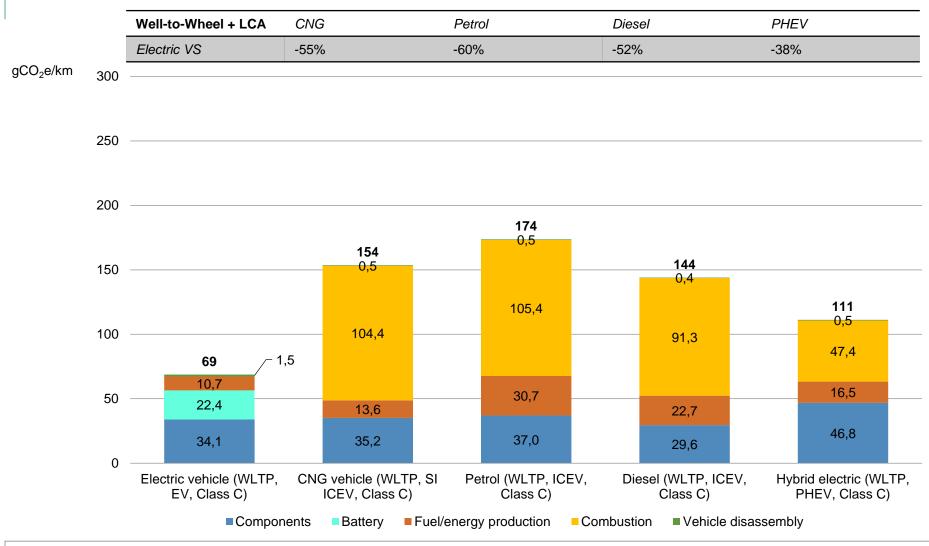
Transport 2050 (NPS) Spain – Worldwide harmonized Light vehicles Test Procedure (WLTP)



Transport 2050 (NPS) Spain – Real Driving Emissions (RDE)



Transport 2050 (2DS) Spain – Worldwide harmonized Light vehicles Test Procedure (WLTP)



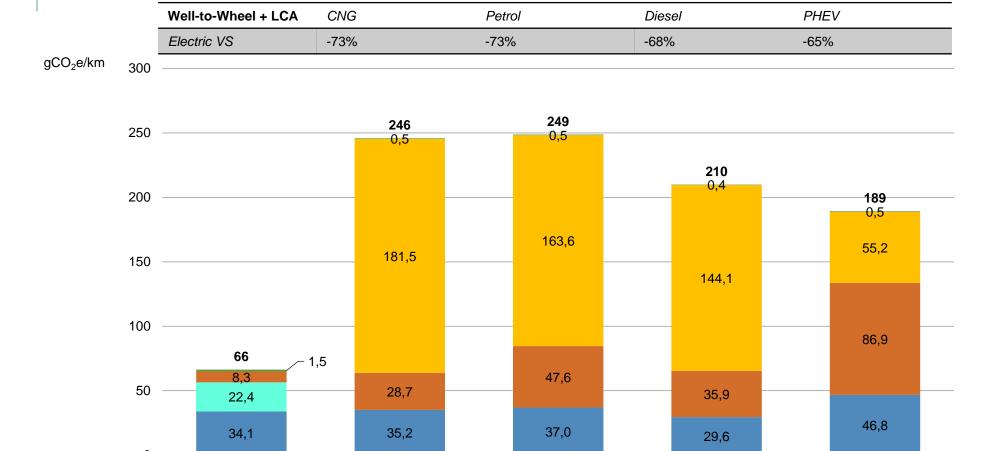
Transport 2050 (2DS) Spain – Real Driving Emissions (RDE)

		Well-to-Wheel + LCA	CNG	Petro	ol	Diesel		PHEV	
		Electric VS	-59%	-64%)	-57%		-42%	
gCO ₂ e/km	300								
	250								
	200				196				
	200		174		0,5		165		
	450		0,5				0,4		
	150				122,7				122
			122,5				108,0		0,5
	100	74 4							55,2
		71	,5						
	50	22,4	16,0		35,7		26.0		19,2
		22,4	10,0				26,9		40.0
	0	34,1	35,2		37,0		29,6		46,8
	0	Electric vehicle (RDE, EV Class C)	, CNG vehicle (FI		l (RDE, ICEV, (C)	Class Diesel (F	RDE, ICEV, CI C)	ass Hybrid PHE	electric (RDE, EV, Class C)
		■ Compor	nents Battery	■ Fuel/energy	production	Combustion	■ Vehicle di	sassembly	

Transport baseline (2015) France – Worldwide harmonized Light vehicles Test Procedure (WLTP)

		Well-to-Wheel + LCA	CNG	P	Petrol	Diesel	PHE	īV
		Electric VS	-70%	-7	70%	-64%	-62%	0
gCO ₂ e/km	300							
	250							
			215 0,5		219 0,5			
	200					182		
						0,4		1 69 0,5
	150		154,7		140,6			47,4
			,			121,7		
	100							74,7
		65 7,1	,5		40.0			, -,,,
	50	22,4	24,5		40,9	30,3		
	0	34,1	35,2		37,0	29,6		46,8
	U	Electric vehicle (WLTP, EV, Class C)	CNG vehicle (VIICEV, Clas		Petrol (WLTP, ICE Class C)	V, Diesel (WLTP Class C	, ICEV, Hyb) l	orid electric (WLTP, PHEV, Class C)
		■ Compo	nents Battery	■ Fuel/ene	ergy production	Combustion ■ Veh	icle disassembl	у

Transport baseline (2015) France – Real Driving Emissions (RDE)



■ Battery ■ Fuel/energy production

CNG vehicle (RDE, SI

ICEV, Class C)

Electric vehicle (RDE, EV,

Components

Class C)

Petrol (RDE, ICEV, Class Diesel (RDE, ICEV, Class

Combustion

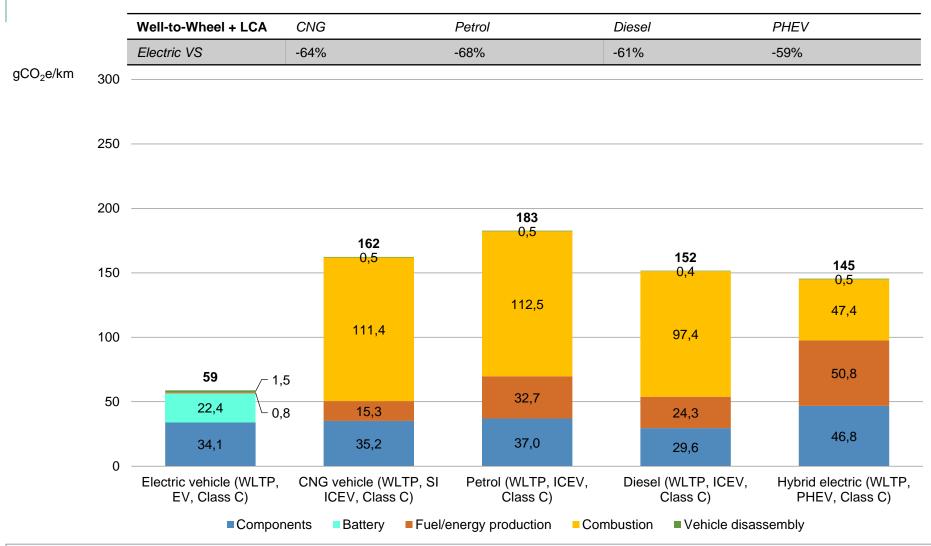
C)

■ Vehicle disassembly

Hybrid electric (RDE,

PHEV, Class C)

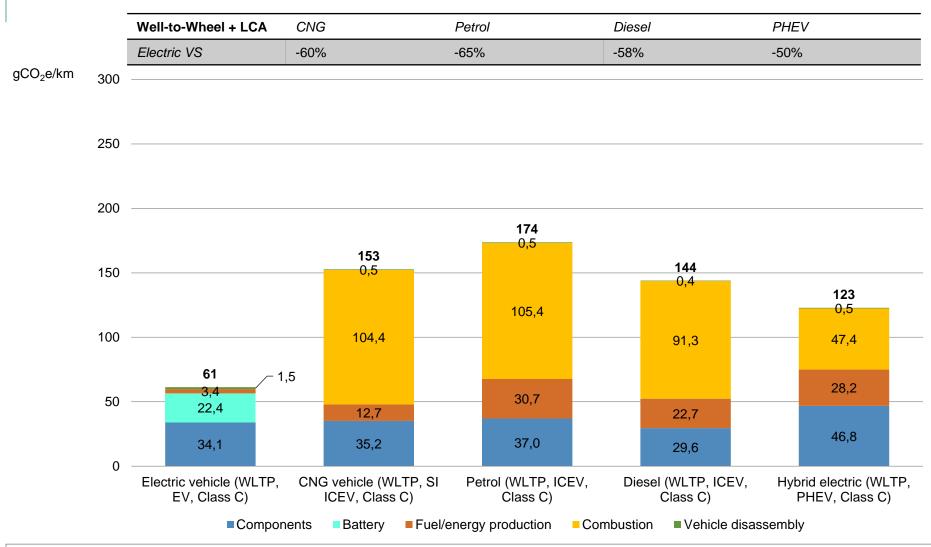
Transport 2030 (EUCO30) France – Worldwide harmonized Light vehicles Test Procedure (WLTP)



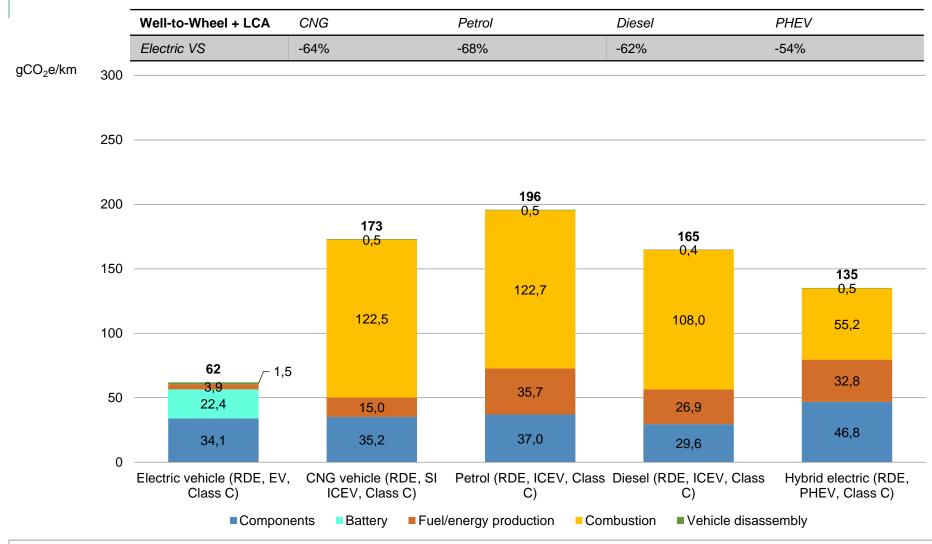
Transport 2030 (EUCO30) France – Real Driving Emissions (RDE)

		Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
		Electric VS	-68%	-71%	-66%	-64%
gCO ₂ e/km	300					
	250					
				206 0,5	_	
	200		184 0,5		174	
			0,0		0,4	162 0,5
	150			130,9		
			130,7	100,0	445.0	55,2
	100		100,7		115,3	
						59,1
	50	59	,5	38,1		
	50	22,4	9 18,0		28,7	
		34,1	35,2	37,0	29,6	46,8
	0	Electric vehicle (RDE, EV	/ CNG vehicle (F	RDE, SI Petrol (RDE, ICEV,	Class Diosal (PDE ICEV	Class Hybrid electric (RDE,
		Class C)	ICEV, Class	s C) C)	C)	PHEV, Class C)
		■ Compo	nents Battery	■ Fuel/energy production	■ Combustion ■ Vehicle	e disassembly

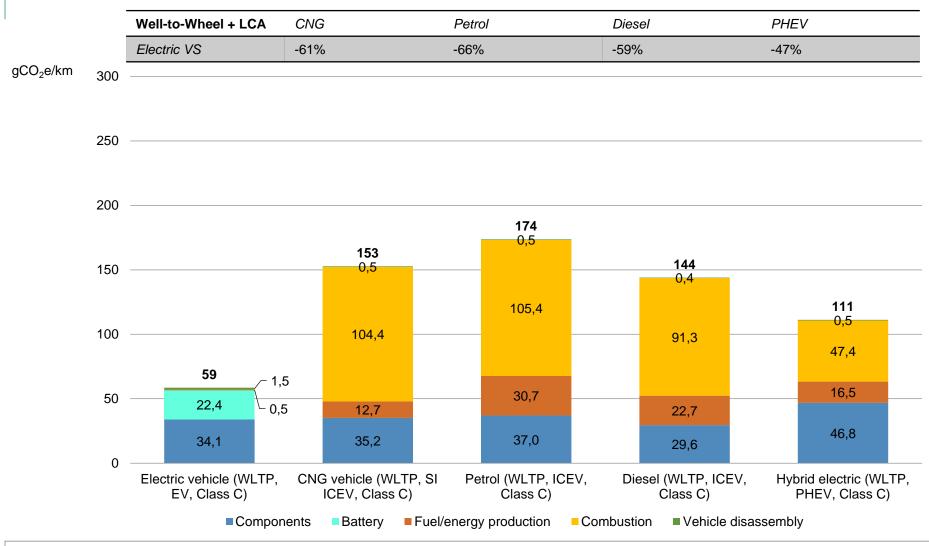
Transport 2050 (NPS) France – Worldwide harmonized Light vehicles Test Procedure (WLTP)



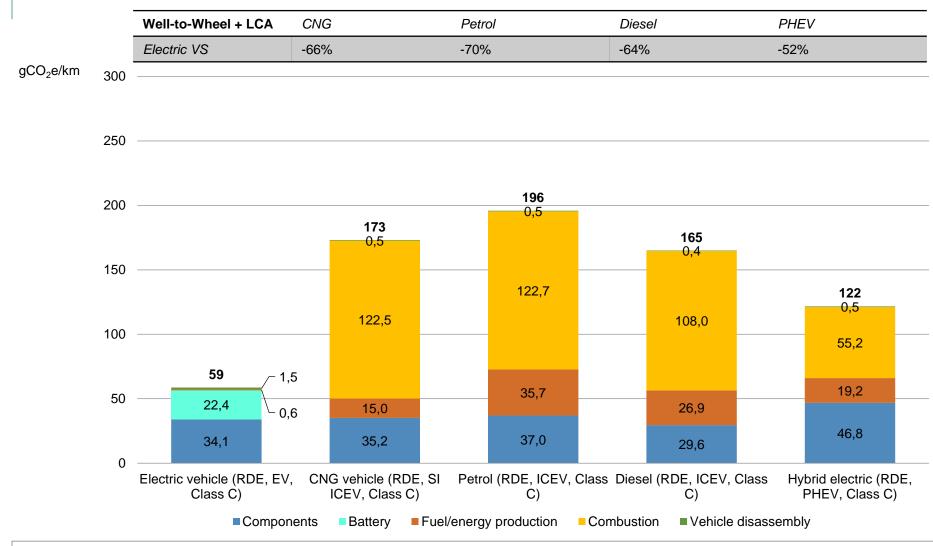
Transport 2050 (NPS) France – Real Driving Emissions (RDE)



Transport 2050 (2DS) France – Worldwide harmonized Light vehicles Test Procedure (WLTP)



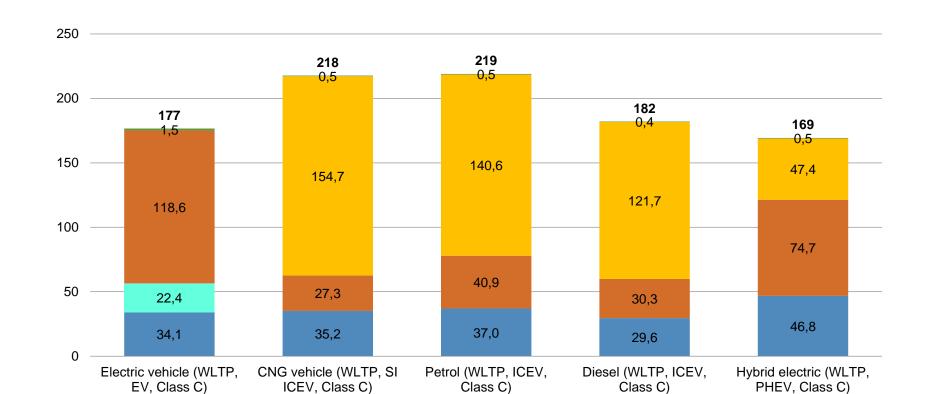
Transport 2050 (2DS) France – Real Driving Emissions (RDE)



Transport baseline (2015) Germany – Worldwide harmonized Light vehicles Test Procedure (WLTP)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-19%	-19%	-3%	5%

gCO₂e/km



Combustion

■ Vehicle disassembly

■ Fuel/energy production

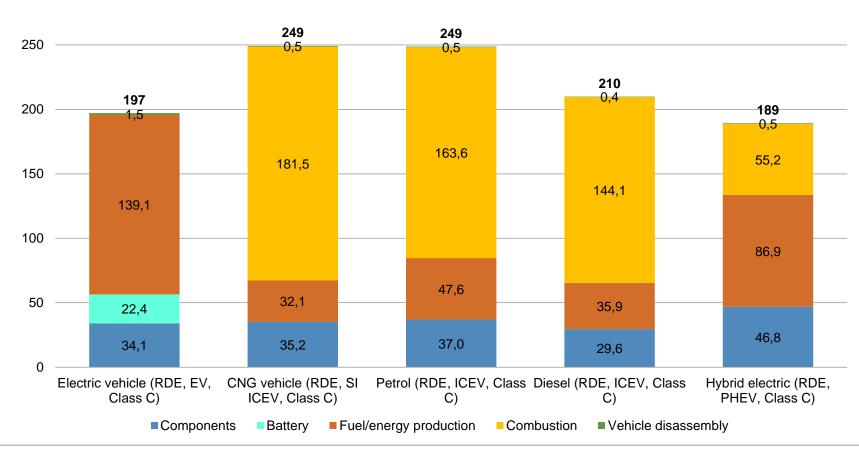
Components

Batterv

Transport baseline (2015) Germany – Real Driving Emissions (RDE)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-21%	-21%	-6%	4%

gCO₂e/km



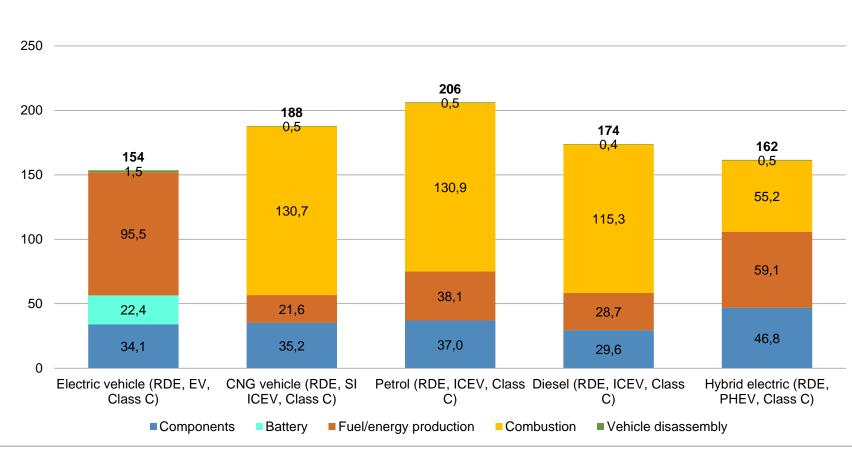
Transport 2030 (EUCO30) Germany – Worldwide harmonized Light vehicles Test Procedure (WLTP)

		Well-to-Wheel +	LCA CI	<i>IG</i>	Petrol	Diesel	PHEV
		Electric VS	-16	6%	-24%	-9%	-4%
gCO ₂ e/km	300						
	250						
	250						
	200				183		
				165	0,5		
	150	139		0,5		152 	145
	100	1,5				3, .	0,5
				111,4	112,5		47,4
	100	81,4				97,4	
							50,8
	50	22.4		10.1	32,7		
		22,4		18,4		24,3	
		34,1		35,2	37,0	29,6	46,8
	0	Electric vehicle EV, Class		NG vehicle (WLT ICEV, Class C		CEV, Diesel (WLTP, IC Class C)	EV, Hybrid electric (WLTP, PHEV, Class C)
			Components	Battery	Fuel/energy production	■ Combustion ■ Vehicle	disassembly

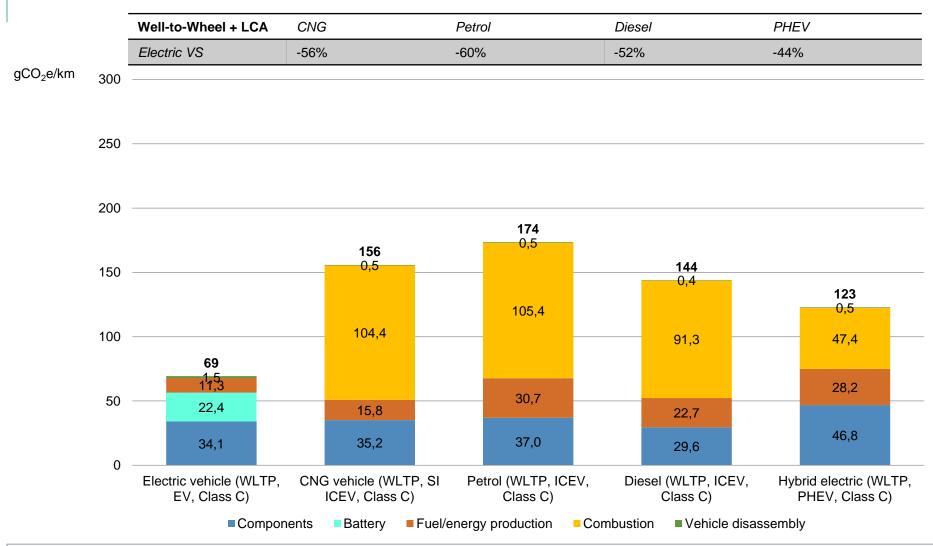
Transport 2030 (EUCO30) Germany – Real Driving Emissions (RDE)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV	
Electric VS	-18%	-25%	-11%	-5%	

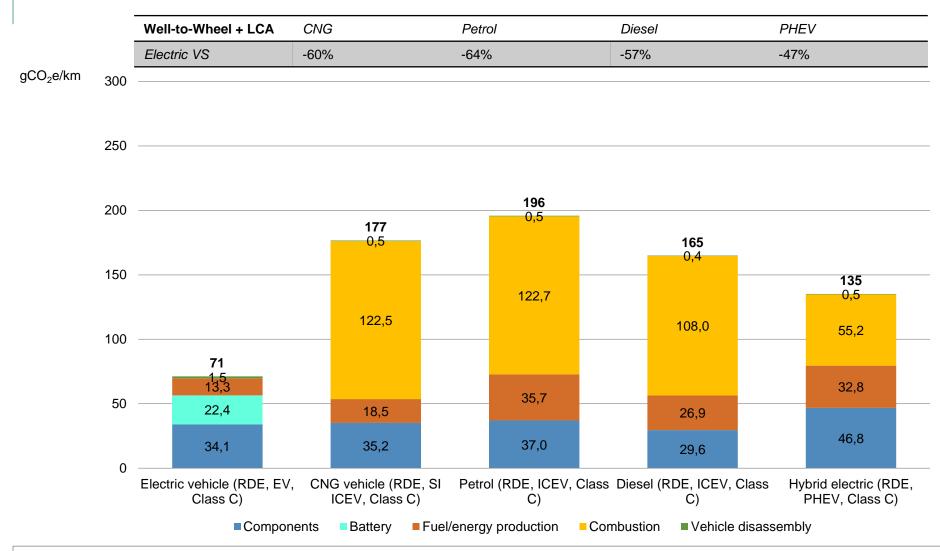
gCO₂e/km



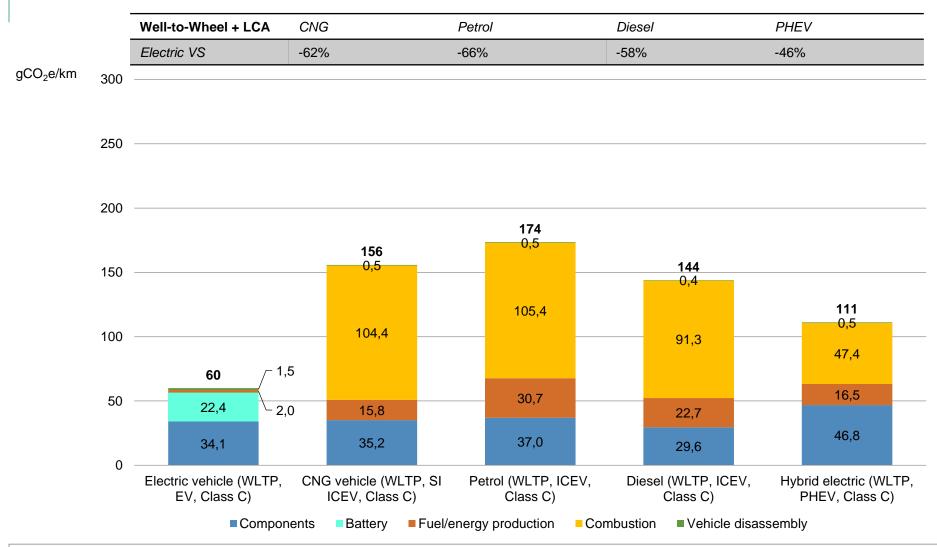
Transport 2050 (NPS) Germany – Worldwide harmonized Light vehicles Test Procedure (WLTP)



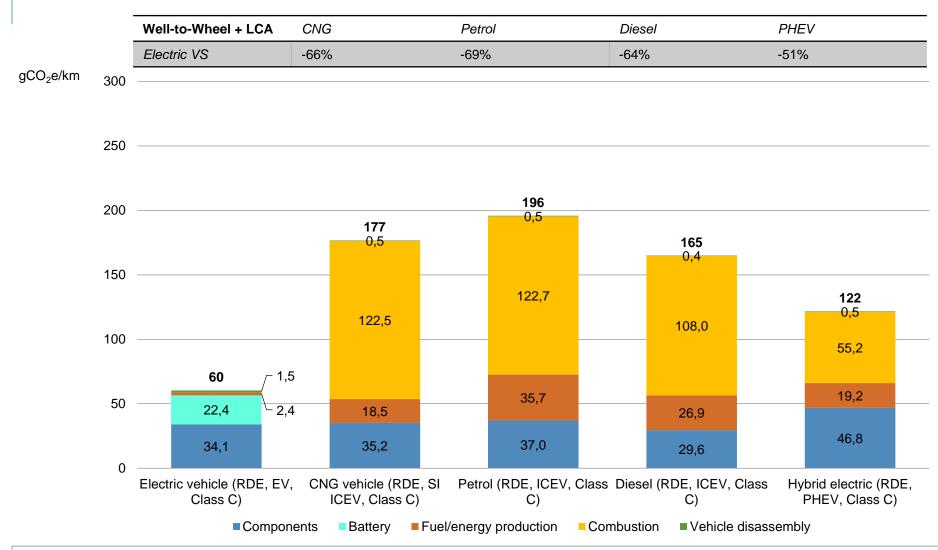
Transport 2050 (NPS) Germany – Real Driving Emissions (RDE)



Transport 2050 (2DS) Germany – Worldwide harmonized Light vehicles Test Procedure (WLTP)



Transport 2050 (2DS) Germany – Real Driving Emissions (RDE)

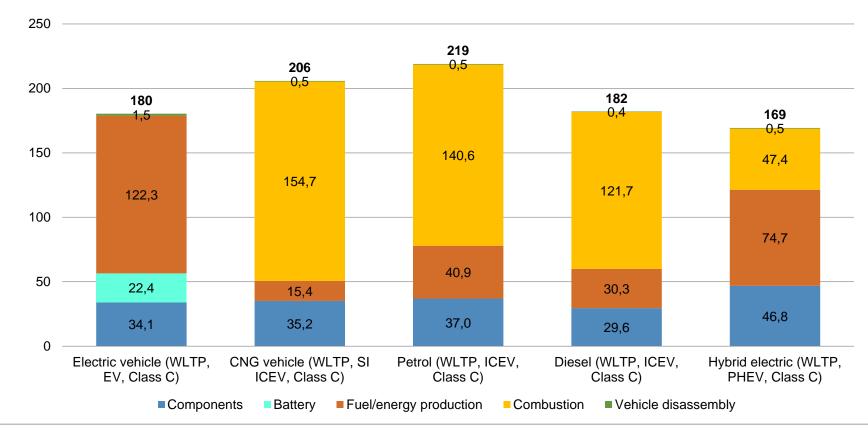


Transport baseline (2015) Romania – Worldwide harmonized Light vehicles Test Procedure (WLTP)

Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-13%	-18%	-1%	7%

gCO₂e/km

300

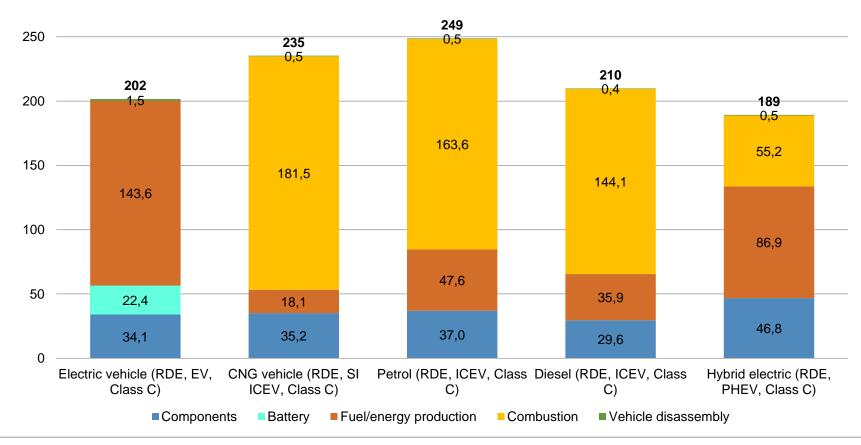


Transport baseline (2015) Romania – Real Driving Emissions (RDE)

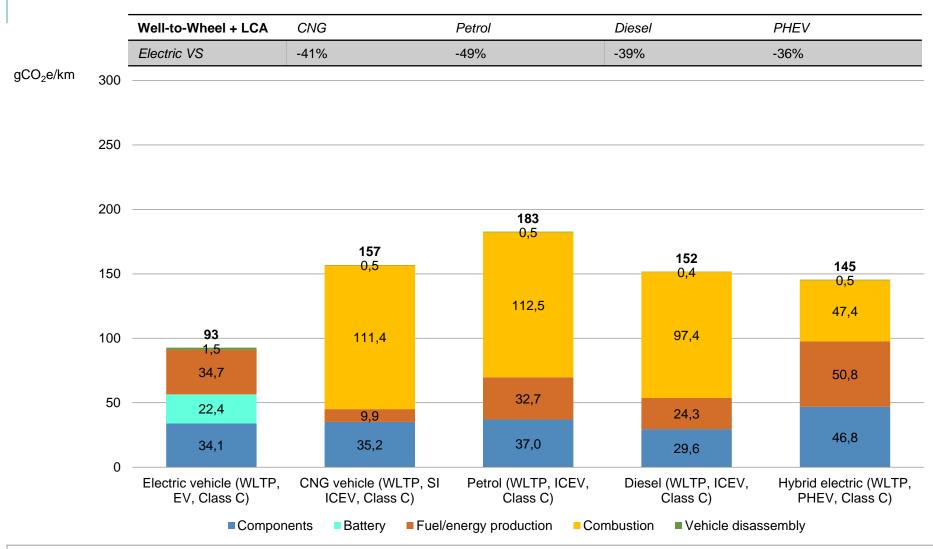
Well-to-Wheel + LCA	CNG	Petrol	Diesel	PHEV
Electric VS	-14%	-19%	-4%	7%

gCO₂e/km

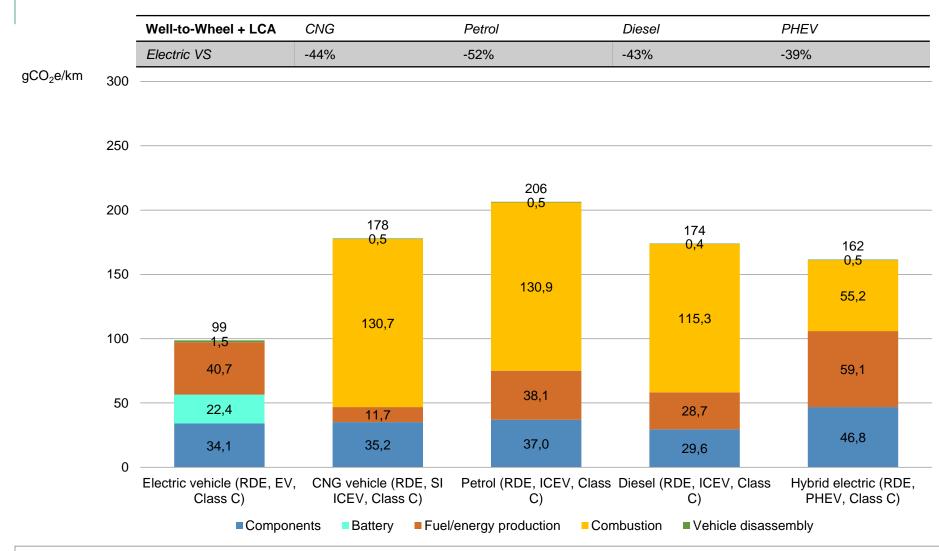
30



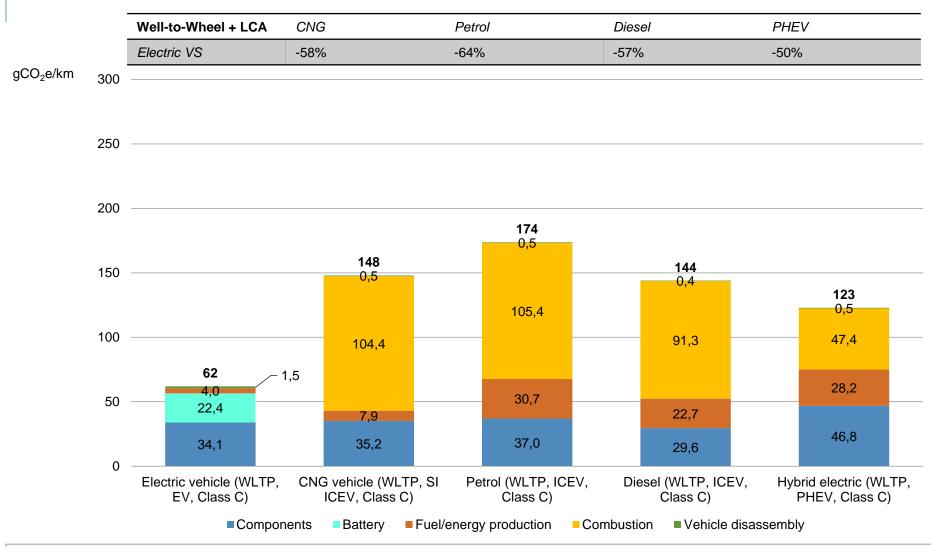
Transport 2030 (EUCO30) Romania – Worldwide harmonized Light vehicles Test Procedure (WLTP)



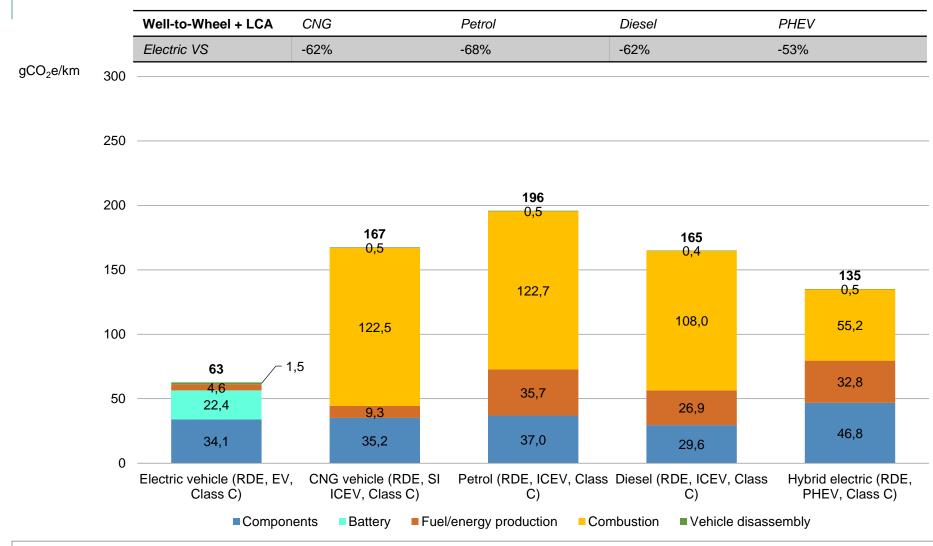
Transport 2030 (EUCO30) Romania – Real Driving Emissions (RDE)



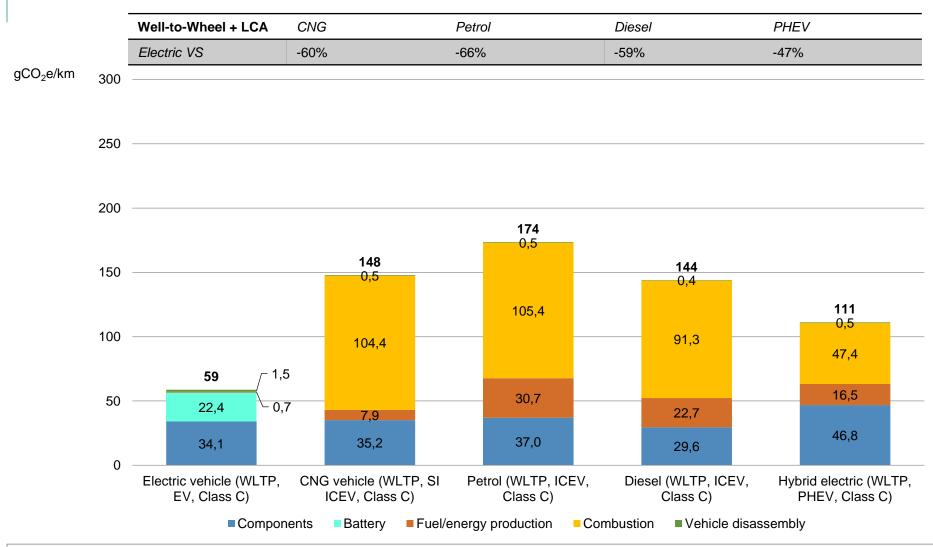
Transport 2050 (NPS) Romania – Worldwide harmonized Light vehicles Test Procedure (WLTP)



Transport 2050 (NPS) Romania – Real Driving Emissions (RDE)



Transport 2050 (2DS) Romania – Worldwide harmonized Light vehicles Test Procedure (WLTP)



Transport 2050 (2DS) Romania – Real Driving Emissions (RDE)

		Well-to-Wheel + LCA CNG Electric VS -65%				Diesel -64%		PHEV -52%	
gCO ₂ e/km	300								
	250								
	200								
					196				
	200				0,5				
			_	167 0,5			1 65 0,4		
	150			- , -					
					122,7			122	
	100			122,5		1	08,0	0,5	
	100							55,2	
			,5					40.0	
	50	22,4),8	9,3	35,7		26,9	19,2	
		34,1		35,2	37,0		20.0	46,8	
	0	J 1 , 1		00,2	01,0		29,6		
		Electric vehicle (RDE, E\Class C)		S vehicle (RDE CEV, Class C	E, SI Petrol (RDE, ICEV,) C)	Class Diesel (RD	E, ICEV, Clas C)	s Hybrid electric (RDE, PHEV, Class C)	
		■ Compo	nents	Battery	Fuel/energy production	Combustion	■ Vehicle disa	ssembly	