Vehicle efficiency - by energy source. © Gavin D. W. Palmer, 08-11-2024.

	Well-to-tank.					Tank-to-wheel.						References:
	Production and conditioning at source.	Transformation at source.	Transportation to market.	Transformation near market.	Conditioning and distribution.	Battery charging losses - A.C. to D.C.	Electric-drive losses.	Parasitic losses.	Weight adjustment - for battery.	Vehicle efficiency.	Comparison with diesel.	Battery-electric vehicles (B.E.V.s), using:
References:	[3].			[1].	[2], p.281.							
Efficiency:				34%	91.2%	[6].	[6].	[6].	Est., from [5].			
MJ spent/MJ fuel:	0.23			1.94	0.10	20.0%	15.5%	3.8%	87.0%			
			30.6%				65.1%		87.0%	17.3%	-31.9%	Coal - average, world, coal plant.
References:	[4], p.30.		[4], p.31.	[1].	[2], p.281.							
Efficiency:	98%		90.4%	40.0%	91.2%	[6].	[6].	[6].	Est., from [5].			
MJ spent/MJ fuel:	0.12		0.11	1.50	0.10	20.0%	15.5%	3.8%	87.0%			
			35.4%				65.1%		87.0%	20.0%	-21.3%	Gas - average, world, gas plant.
References:	[3].			[3].	[3].	[6].	[6].	[6].	Est., from [5].			
MJ spent/MJ fuel:	0.23			1.46	0.12	20.0%	15.5%	3.8%	87.0%			
			35.6%				65.1%		87.0%	20.1%	-20.9%	Coal - E.C., coal plant (EC-KOEL1).
References:	[3].		[3].	[3].	[3].	[6].	[6]	[6].	Est., from [5].			
MJ spent/MJ fuel:	0.06		0.37	0.81	0.12	20.0%	15.5%	3.8%	87.0%			
			42.6%				65.1%		87.0%	24.1%	-5.4%	Gas C.C.G. - E.C., C.C.G. plant (EC-GPEL1a).
References:					[2], p.281.	[6].	[6].	[6].	Est., from [5].			
Losses:					8.8%							
Efficiency:				100%	91.2%	20.0%	15.5%	3.8%	87.0%			
			91.2%				65.1%		87.0%	51.6%	102.8%	Hydro-electric.
						Engine: Brake Thermal Efficiency (BTE).	Mechanical losses (engine, transmission, parasitic).		Weight adjustment - reduction.			Internal combustion engine vehicles (I.C.E.s), using:
References:	[3].		[3].	[3].	[3].	[6].	[6].					
MJ spent/MJ fuel:	0.07		0.01	0.10	0.02	46.3%	15.8%					
			83.3%			30.6%				25.5%		Diesel - (COD1).
						[6].	[6].		Est., from [5].			
						46.3%	15.8%		132.5%			
						30.6%			132.5%	33.7%	32.5%	Diesel - (COD1) - 50% lighter, vehicle weight.
References:	[3].		[3].	[3].	[3].	[6].	[6].					
MJ spent/MJ fuel:	0.07		0.01	0.08	0.02	39.3%	15.8%					
			84.7%			23.6%				20.0%	-21.5%	Gasoline - (COG1).
						[6].	[6].		Est., from [5].			
						39.3%	15.8%		132.5%			
						23.6%			132.5%	26.5%	4.0%	Gasoline - (COG1) - 50% lighter, vehicle weight.
References:	[3].	[3].	[3].	[3].	[3].	[6].	[6].					
MJ spent/MJ fuel:	0.09	1.88	0.09	0.00	0.03	39.3%	15.8%					
			32.4%			23.6%				7.6%	-70.0%	Ethanol - Brazil (SCET1).
						Losses - chemical to current.	Electric-drive losses.	Parasitic losses.	Weight adjustment.			Hydrogen vehicles:
References:	[3].		[3].	[3].	[3].		[6].	[6].	Est., from [5].			
MJ spent/MJ fuel:	0.04		0.10	0.53	0.32	20.0%	15.5%	3.8%	87.0%			
			50.3%				65.1%		87.0%	28.4%	11.7%	Hydrogen - (GMCH1).

Comments:

This is a energy study, comparing battery-electric vehicles (B.E.V.s), internal combustion engine vehicles (I.C.E.s) and hydrogen vehicles.

Mechanical efficiency, for I.C.E. vehicles, is based on front-engine/front-wheel drive.

The B.E.V. is estimated to be 20% heavier, than an I.C.E. vehicle, due to the battery.

This study does not include:

Energy used, in manufacturing.

Energy saved, in recycling.

Energy lost, from lithium batteries, that self-discharge, at around 1% per day.

Energy lost, from replacing and recycling lithium batteries.

Auxillary losses, wind resistance, rolling resistance, braking resistance and re-generative braking.

A weight adjustment - for B.E.V. structures and safety requirements.

Well-to-tank:

[1] - Coal and gas plant efficiency figures come from the world averages, 2001-2005, from ‘Efficiency of Electric Production from Coal in Public Electricity and CHP Plants’ and ‘Efficiency of Electric Production from Natural Gas in Public Electricity and CHP Plants’.

91.2% grid efficiency is derived from [2]: Global electricity transmission and distribution losses, equivalent to 8.8% of total generation, p 281.

Value obtained from [4], p30: 2% median, of processed gas energy lost.

Value obtained from [4], p31: 9.6% median losses, in gas transportation over 4000km.

This work does not necessarily reflect the views of any of the owners of the source data.

References:

[1] - Based on IEA data, from ‘Energy Efficiency Indicators for Public Electricity Production from Fossil Fuels’ © OECD/IEA, July 2008. Peter TAYLOR, with Olivier LAVAGNE d’ORTIGUE, Nathalie TRUDEAU and Michel FRANCOEUR.

This work is partially based on the Efficiency of Electricity production data developed by the International Energy Agency, © OECD/IEA, July 2008 but the resulting work has been prepared by Gavin D. W. Palmer and does not necessarily reflect the views of the International Energy Agency.

[2] - Based on IEA data, from ‘World Energy Outlook 2014’ © OECD/IEA, 2014. Peter TAYLOR, with Olivier LAVAGNE d’ORTIGUE, Nathalie TRUDEAU and Michel FRANCOEUR.

This work is partially based on the ‘World Energy Outlook 2014’ data developed by the International Energy Agency, © OECD/IEA, 2014 but the resulting work has been prepared by Gavin D. W. Palmer and does not necessarily reflect the views of the International Energy Agency.

[3] - Based on data, sourced from: JEC – Joint Research Centre – EUCAR-CONCAWE collaboration, ‘WELL-TO-TANK Appendix 2 – Version 4a’, © European Union, 2014.

[4] - Based on data, sourced from: JEC – Joint Research Centre – EUCAR-CONCAWE collaboration, ‘WELL-TO-TANK Report Version 4.0’, © European Union, 2013.

[5] - Based on data, sourced from: www.theicct.org, ‘Lightweighting Technology Developments’ - Technical Brief No.6, March 2017. © 2017 International Council on Clean Transportation (ICCT).

[6] - Based on Woven Technology Ltd. surveys and work by Gavin D. W. Palmer.