

Veículos Elétricos

Veículos elétricos no Brasil: um panorama

Prof. Tarso Vilela Ferreira



Roteiro



Histórico

Visão estrutural

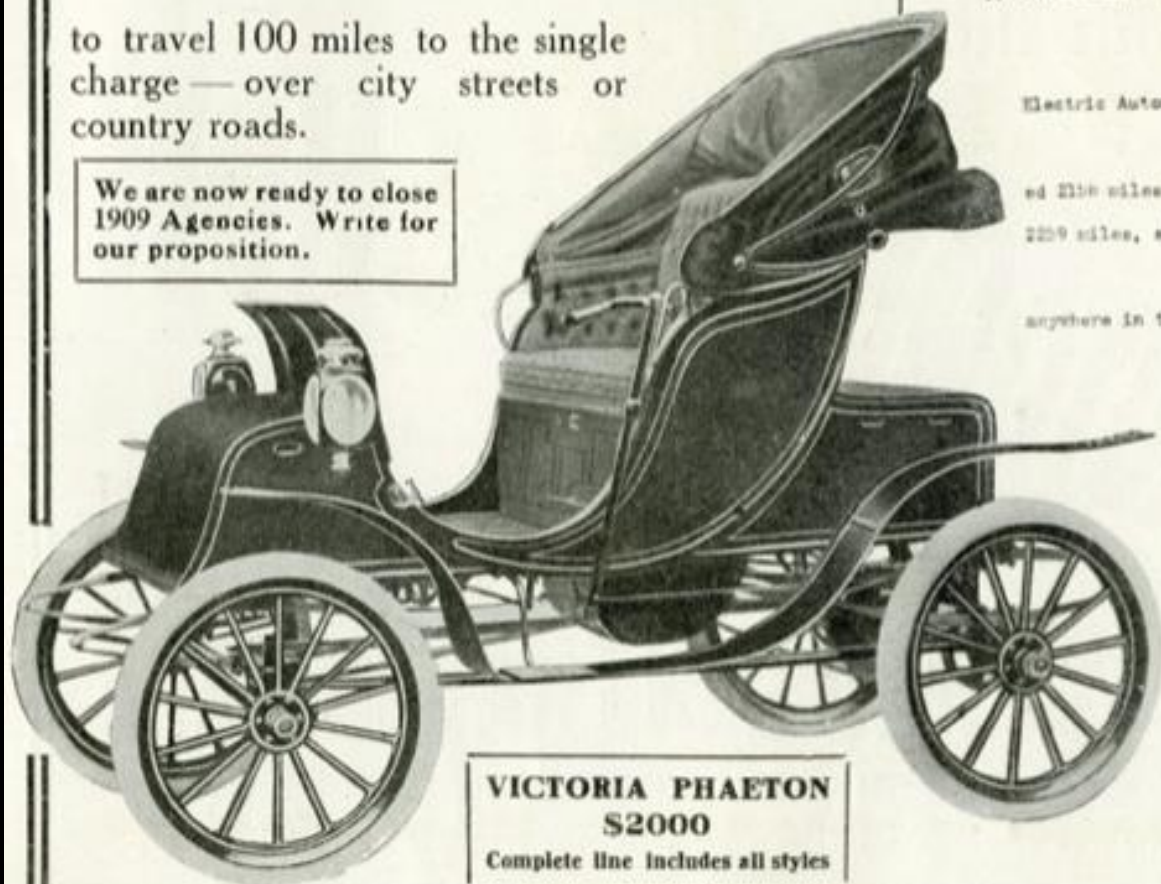
Mercado e realidade brasileira

Desafios

THE 100-MILE Fritchle Electric IS GUARANTEED

to travel 100 miles to the single charge — over city streets or country roads.

We are now ready to close 1909 Agencies. Write for our proposition.



**VICTORIA PHAETON
\$2000**
Complete line includes all styles

STORAGE

CENTRAL GARAGE

1310-12 NEW YORK AVE.

GASOLINE AND ELECTRIC CARS
STORED AND REPAIRED

PHONE, MAIN — 9444

SUPPLIES

WASHINGTON, D. C. December 10, 1908.

TO WHOM IT MAY CONCERN:

This is to certify that we charged Mr. Fritchle's Electric Automobile and assisted in running down the car.

When the car left the garage, the odometer registered 2136 miles and when it returned the next day, it registered 2239 miles, showing that 103 miles had been run on one charge.

We are positive that the car was not recharged anywhere in the meantime.

Roll C. Gungell, Electrician

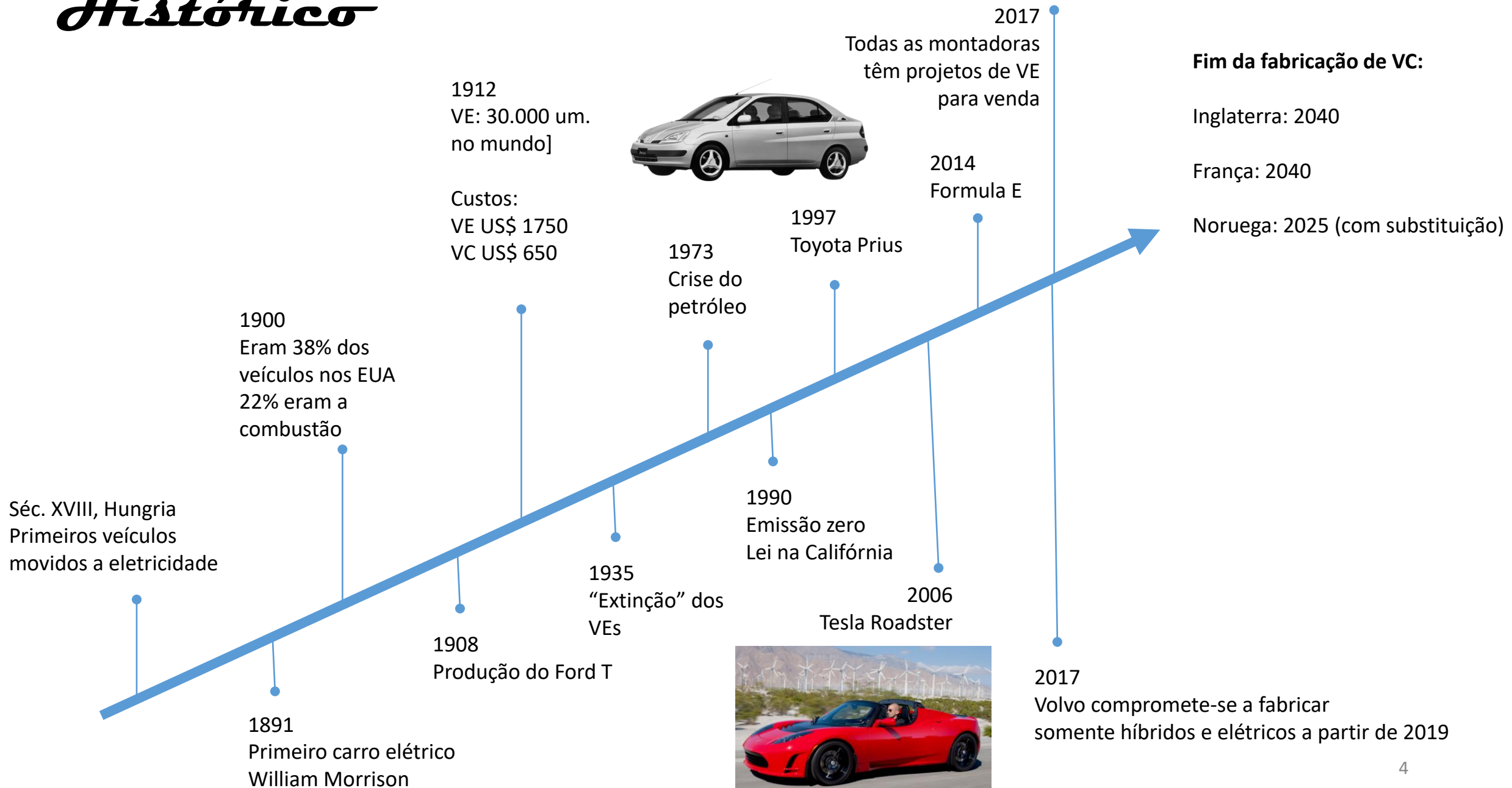
The above letter is respectfully submitted as absolute proof of our "100 mile per charge" claim—in this particular instance, however, the mileage having been made by a Fritchle Electric immediately after the completion of an overland tour from Lincoln, Neb., to New York City, thence to Washington, D. C. through hundreds of miles of mud and over the Allegheny mountains.

Art Catalogue showing entire line of open and closed cars mailed on request

The Fritchle Automobile & Battery Co.

1449-1455 Clarkson St., Denver, Colorado

Histórico



Passenger plug-in market share of total new car sales for selected countries and selected regional markets since 2013

Country	2019 ^[94]	2018	2017	2016 ^{[17][95]}	2015 ^{[96][97]}	2014 ^[98]	2013 ^[99]
 Norway ^{[18][90][89]}	55.9%	49.1%	39.2%	29.1%	22.4%	13.8%	6.1%
 Iceland ^{[100][101][102][103]}	22.6%	19%	14.05%	4.6%	2.93%	2.71%	0.94%
 Netherlands ^{[75][104]}	15.1%	6.5%	2.6%	6.7%	9.9%	3.87%	5.55%
 Sweden ^{[77][105][106]}	11.4%	8.2%	5.2%	3.5%	2.62%	1.53%	0.71%
 Finland ^{[100][107][108]}	6.9%	4.7%	2.57%	1.2%	N/A	N/A	N/A
 Portugal ^[109]	5.7%	3.6%	1.9%	N/A	N/A	N/A	N/A
 Switzerland ^{[100][110][111]}	5.5%	3.2%	2.55%	1.8%	1.98%	0.75%	0.44%
 China ^{[26][98][112][113][114]}	4.9%	4.2%	2.1%	1.31%	0.84%	0.23%	0.08%
 Andorra ^[115]			5.6%	0.81%	N/A	N/A	N/A
 Denmark ^{[116][117][118]}	4.2%	2%	0.4%	0.6%	2.29%	0.88%	0.29%
 Austria ^{[100][119][120][121]}	3.5%	2.6%	2.06%	1.6%	0.90%	N/A	N/A
 Belgium ^{[100][122][123]}	3.2%	2.5%	2.7%	1.8%	N/A	N/A	N/A
 Ireland ^{[124][125]}	3.1%	1.57%	0.72%	0.48%	0.46%	0.27%	N/A
 Germany ^{[73][74][98][112][126]}	3.0%	1.9%	1.58%	1.1%	0.73%	0.43%	0.25%
 Canada ^{[76][127]}	3.0%	2.2%	0.92%	0.58%	0.35%	0.28%	0.18%
 UK ^{[91][128][129]}	2.9%	2.53%	1.86%	1.37%	1.07%	0.59%	0.16%
 France ^{[i][71][72]}	2.8%	2.11%	1.98%	1.4%	1.19%	0.70%	0.83%
 New Zealand ^[130]	2.8%	0.96%	0.72%	0.50%	0.23%	0.21%	N/A
 United States ^{[64][131][132][133]}	2.1%	2.1%	1.13%	0.90%	0.66%	0.72%	0.60%
 Japan ^{[29][67][134]}	0.9%	1.0%	1.1%	0.59%	0.68%	1.06%	0.91%
Global average^{[8][9][135]}	2.5%	2.1%	1.3%	0.86%			
 California ^{[14][136][137]}	7.7%	7.8%	4.8%	3.6%	3.1%	3.2%	2.5%
 Europe ^{[80][100][138][139][140][141][ii][142]}	3.6%	2.5%	1.74%	1.3%	1.41%	0.66%	0.49%
 Hong Kong ^{[143][143][144]}	5%			5%	4.84%		0.39%

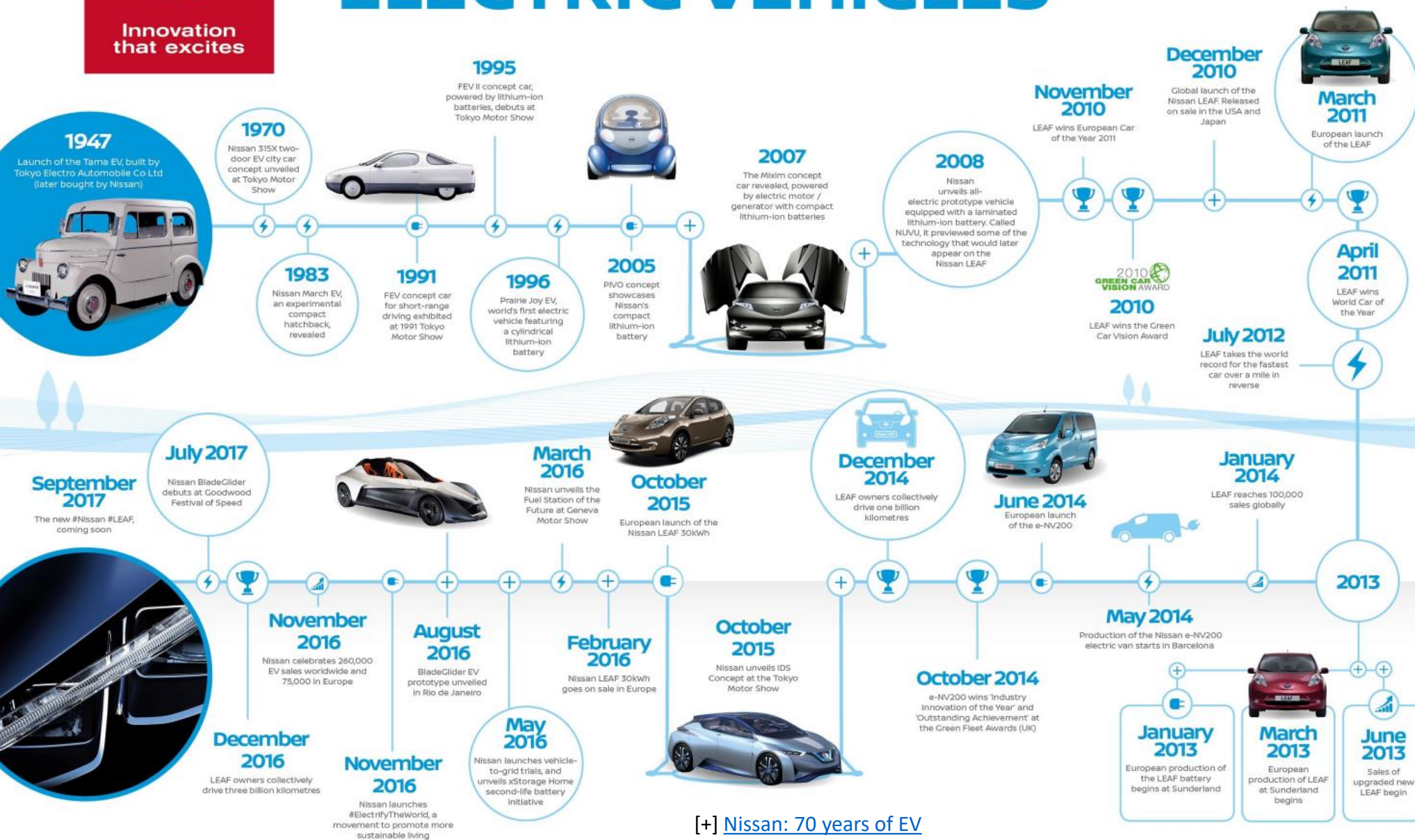
Notes

- i. ^ The French market share corresponds to combined sales BEV passenger cars and utility vans only (PHEVs not included).^[145]
- ii. ^ European figures correspond to [European Union](#) member countries plus two [EFTA](#) countries (Norway and Switzerland)



Innovation
that excites

70 YEARS OF NISSAN ELECTRIC VEHICLES



[+] [Nissan: 70 years of EV](#)

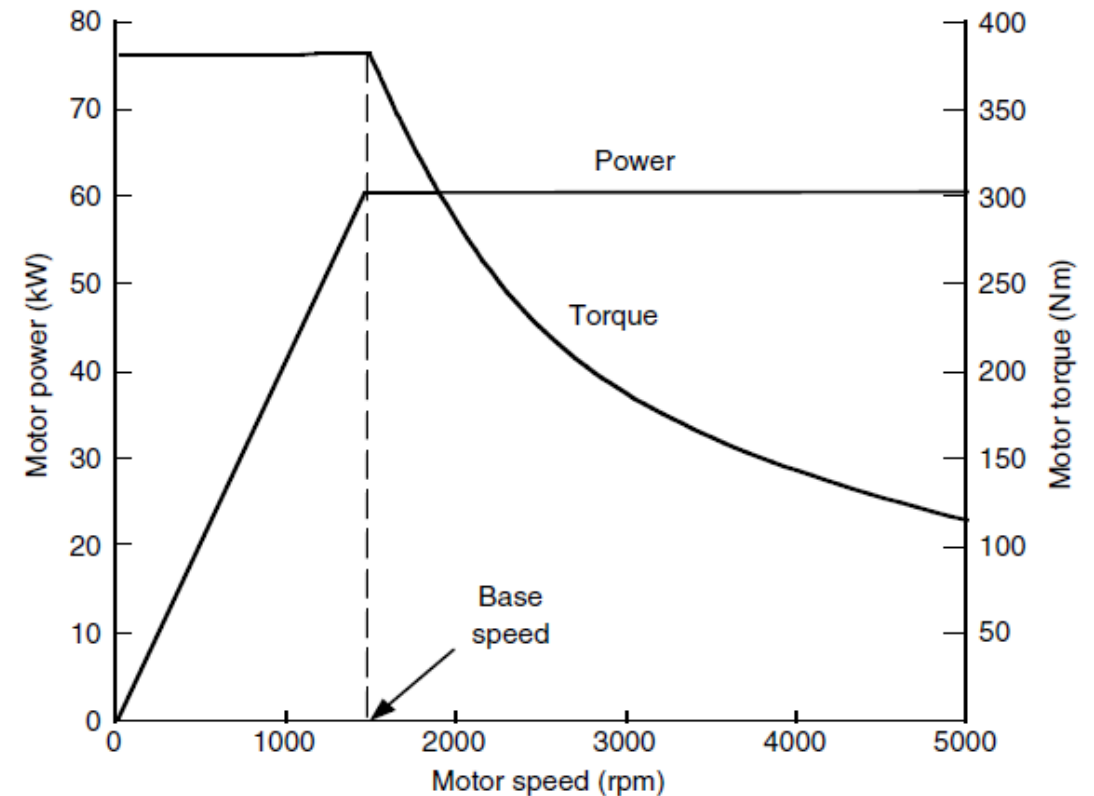
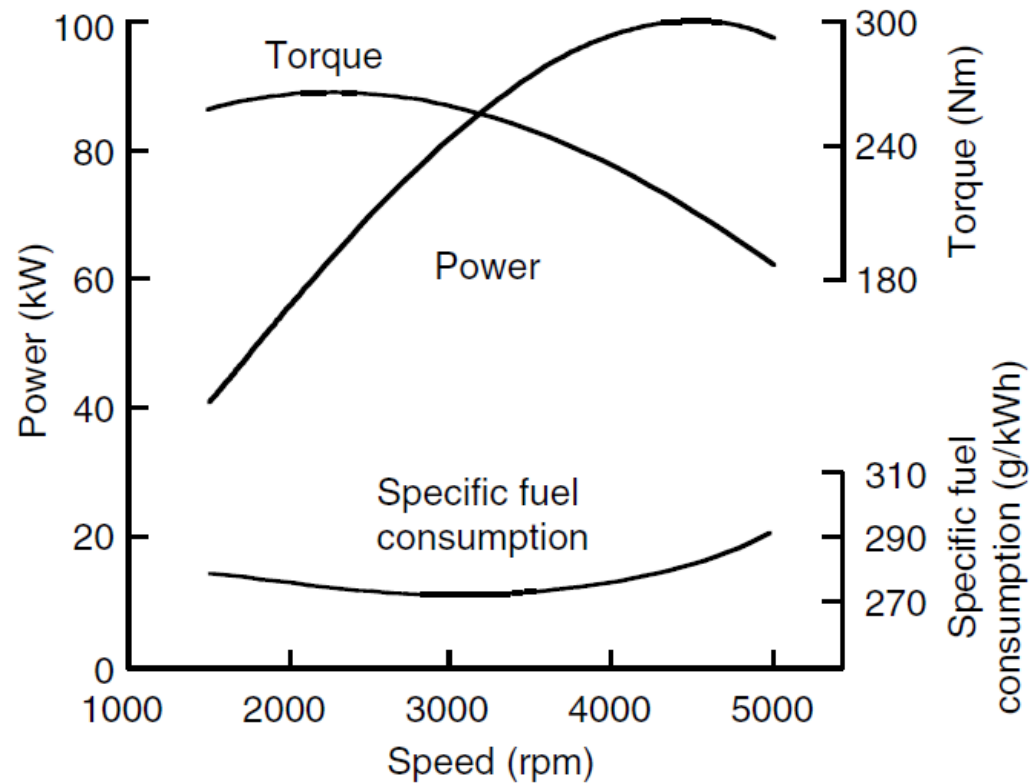
Histórico

- Eles nunca “desapareceram”...



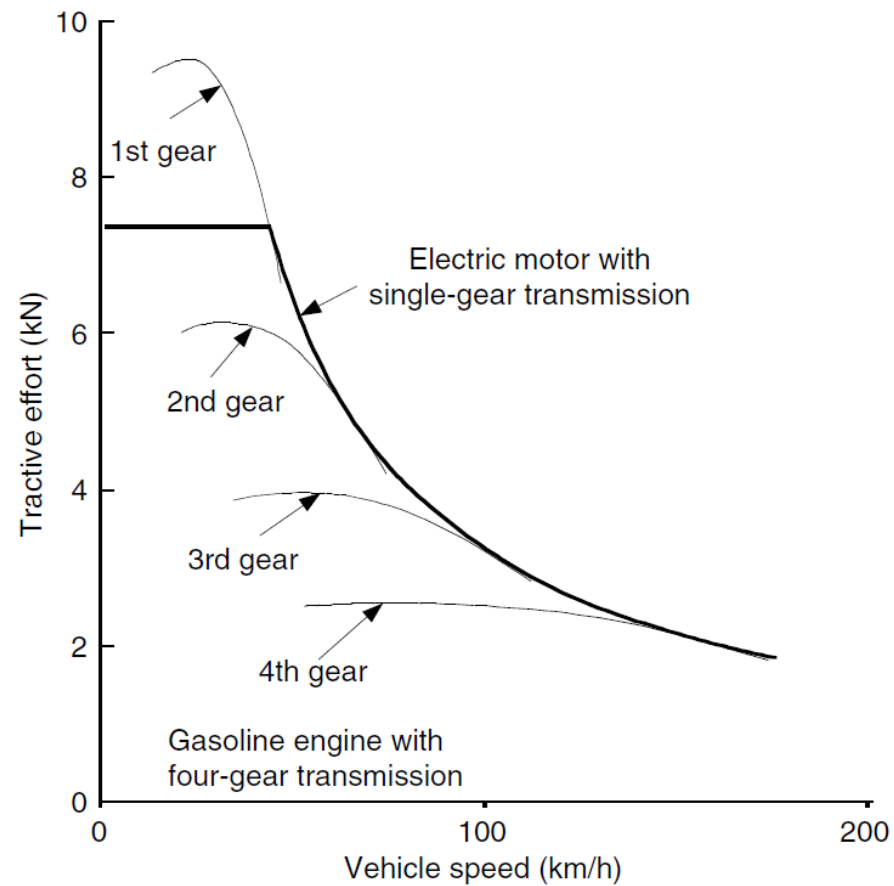
Visão estrutural

Veículos a combustão versus veículos elétricos



Visão estrutural

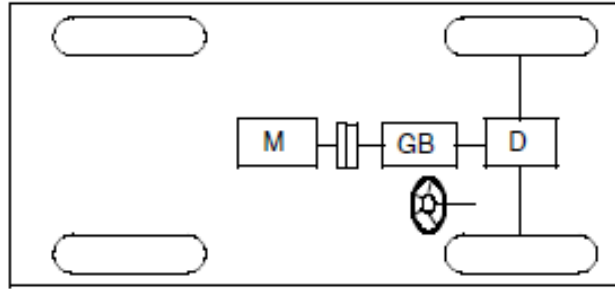
Veículos a combustão versus veículos elétricos



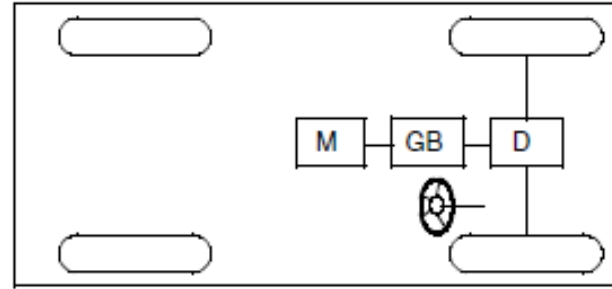
Visão estrutural



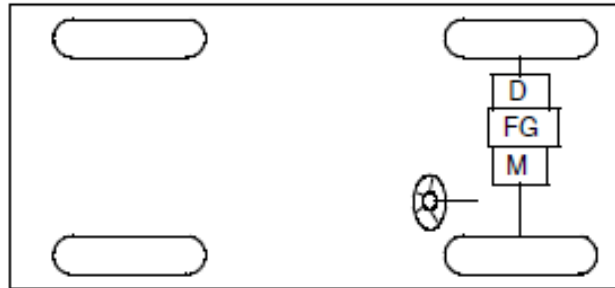
Visão estrutural



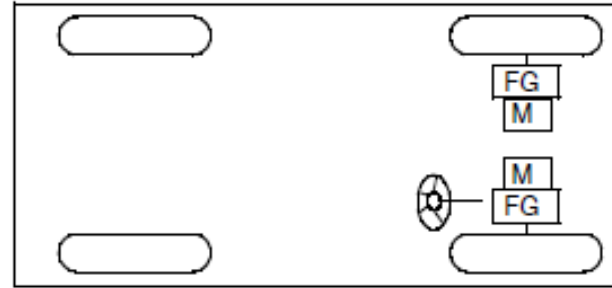
(a)



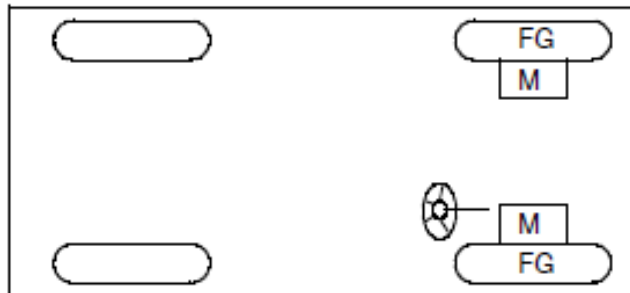
(b)



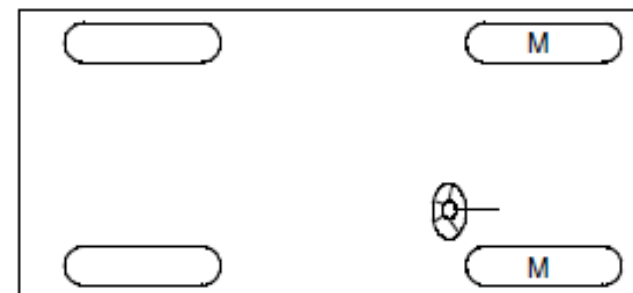
(c)



(d)

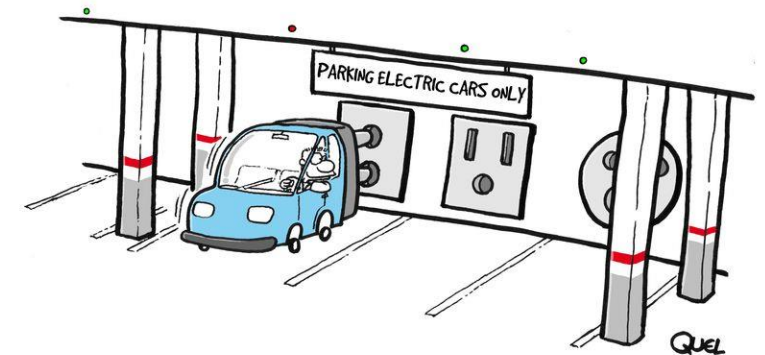


(e)

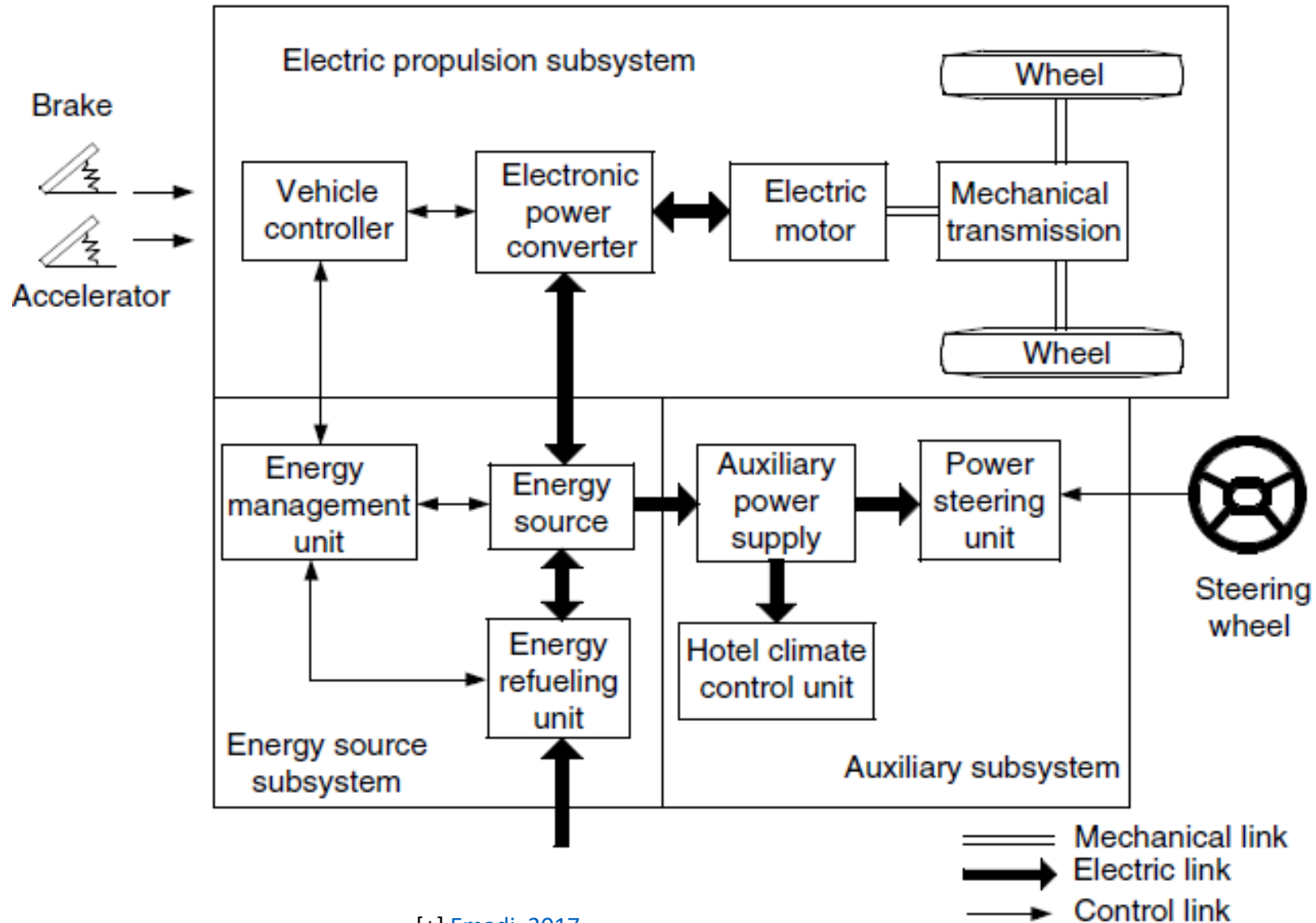


(f)

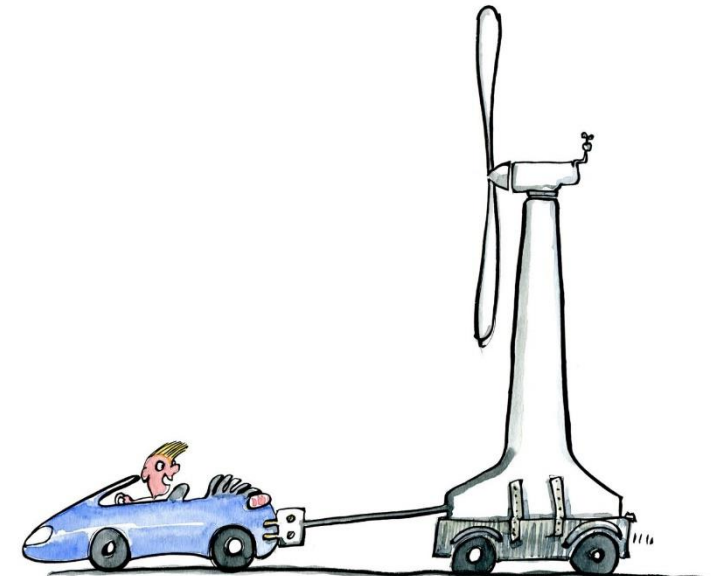
C: Clutch
D: Differential
FG: Fixed gearing
GB: Gearbox
M: Electric motor



Visão estrutural

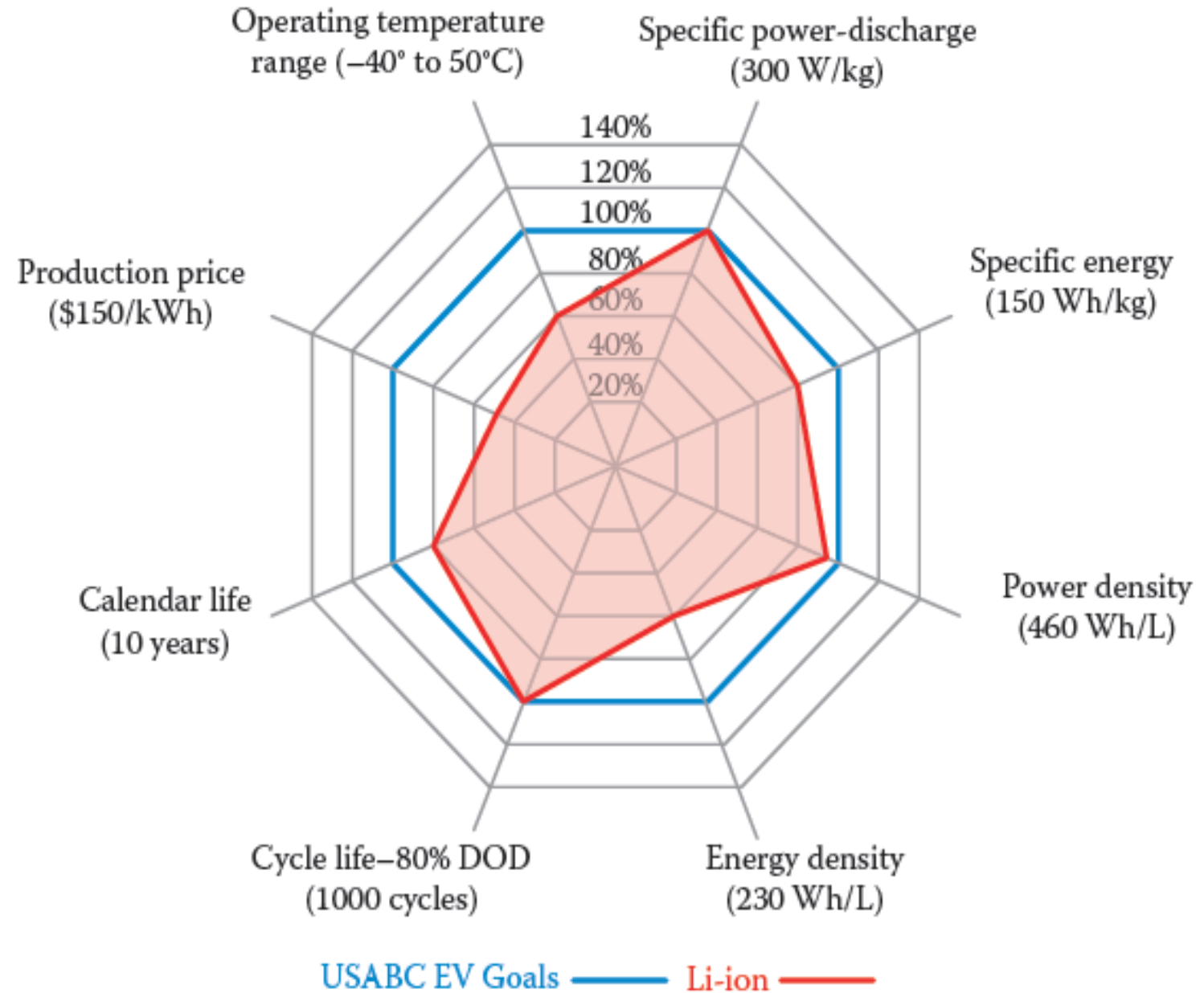


[+] [Emadi, 2017](#)



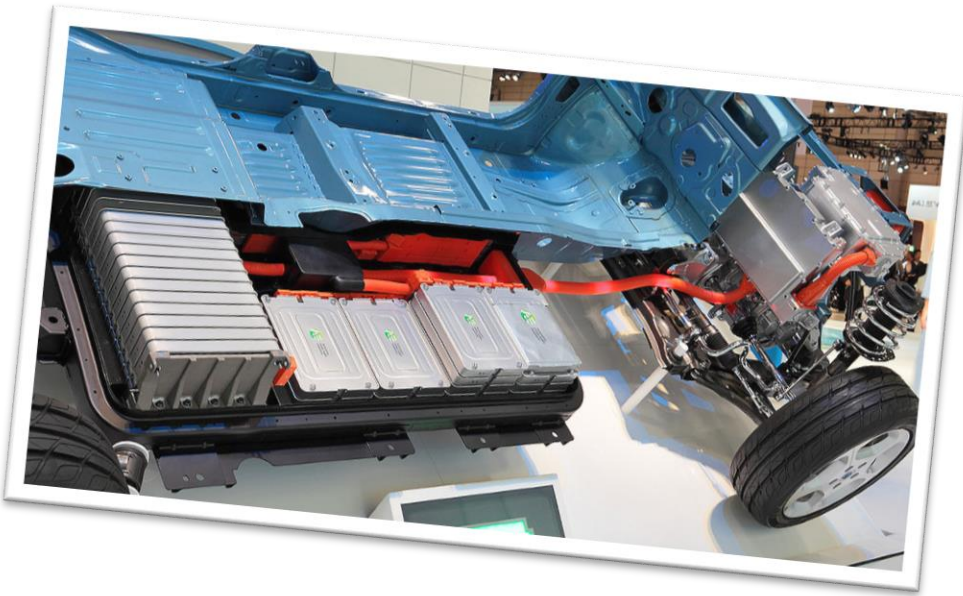
Visão estrutural

Baterias



Visão estrutural

Baterias



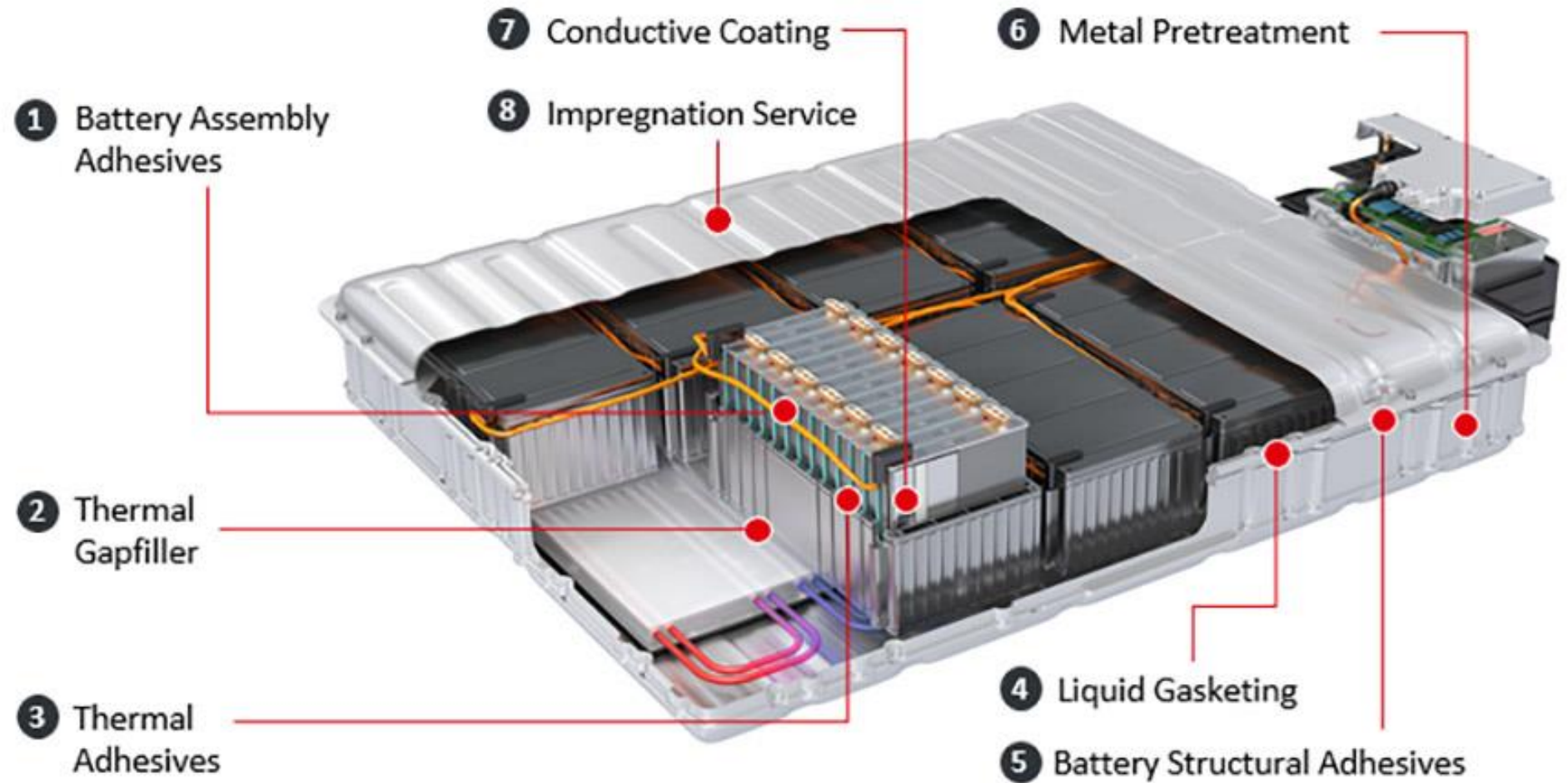
Status of Battery Systems for Automotive Applications

System	Specific Energy (Wh/kg)	Peak Power (W/kg)	Energy Efficiency (%)	Cycle Life	Self-Discharge (% per 48 h)	Cost (US\$/kWh)
<i>Acidic aqueous solution</i>						
Lead/acid	35–50	150–400	>80	500–1000	0.6	120–150
<i>Alkaline aqueous solution</i>						
Nickel/cadmium	50–60	80–150	75	800	1	250–350
Nickel/iron	50–60	80–150	75	1500–2000	3	200–400
Nickel/zinc	55–75	170–260	65	300	1.6	100–300
Nickel/metal hydride	70–95	200–300	70	750–1200+	6	200–350
Aluminum/air	200–300	160	<50	?	?	?
Iron/air	80–120	90	60	500+	?	50
Zinc/air	100–220	30–80	60	600+	?	90–120
<i>Flow</i>						
Zinc/bromine	70–85	90–110	65–70	500–2000	?	200–250
Vanadium redox	20–30	110	75–85	—	—	400–450
<i>Molten salt</i>						
Sodium/sulfur	150–240	230	80	800+	0 ^a	250–450
Sodium/nickel chloride	90–120	130–160	80	1200+	0 ^a	230–345
Lithium/iron sulfide (FeS)	100–130	150–250	80	1000+	?	110
<i>Organic/lithium</i>						
Lithium-ion	80–130	200–300	>95	1000+	0.7	200

^aNo self-discharge, but some energy loss by cooling.

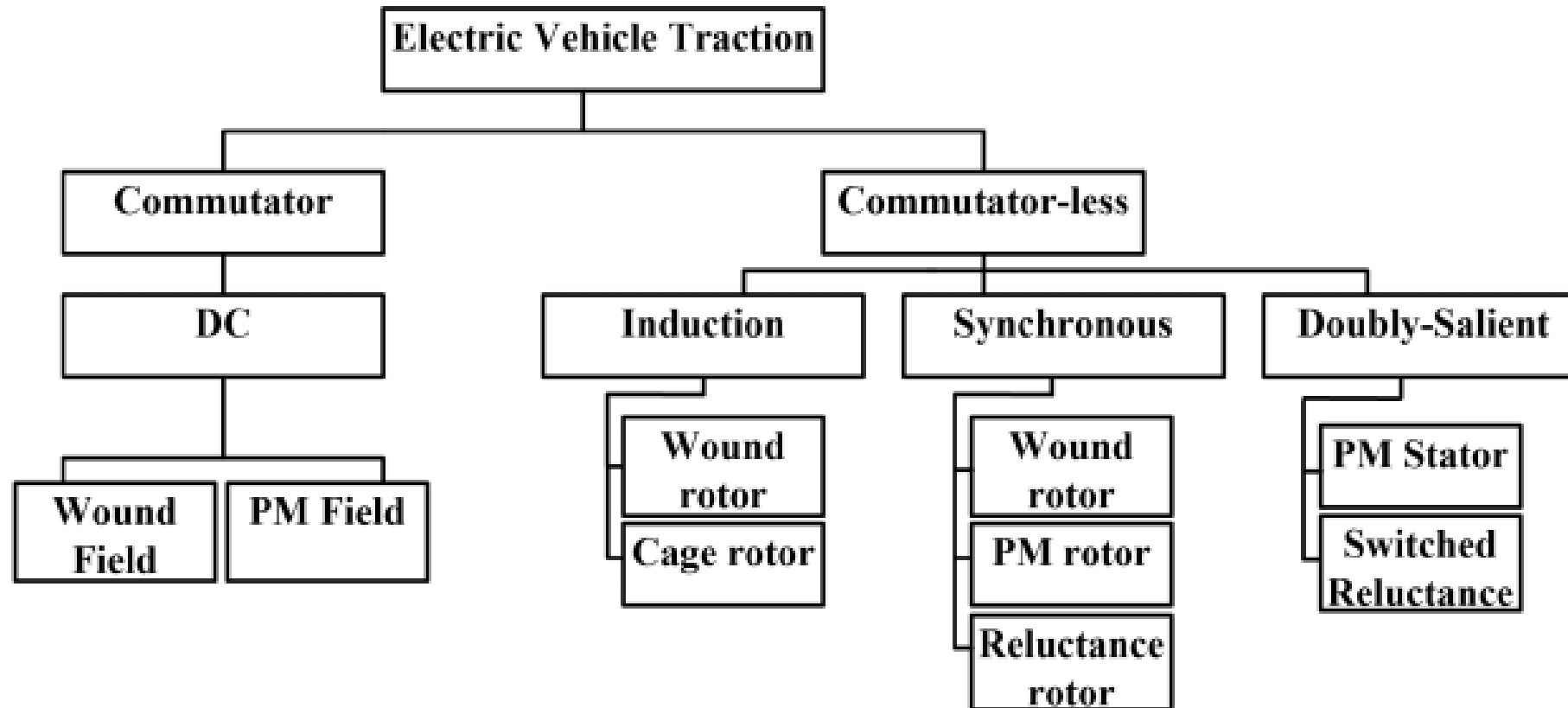
Visão estrutural

Baterias



Visão estrutural

Motores



Visão estrutural

Motores

- CC
 - Controle simples
 - Possuem escovas
 - Relação peso/potência relativamente grande
- CC sem escovas (BLDC)
 - In runner
 - Out runner
- CA
 - Controle complexo
 - Sem escovas
 - Relação peso/potência relativamente pequena
 - Podem ter ímãs permanentes



[Netgain Warp 9](#)

70 kg
25 kW
(2,8 g/W)
US\$ 3074,00

[QS Motors 8 kW](#)

25 kg
8 kW
(3,1 g/W)
US\$ 700,00



[HPEVS AC12 Motor](#)

22 kg
35 kW
(0,77 g/W)
US\$ 3125,00

[AM Racing AMR 250-90](#)

68 kg
156 kW
(0,43 g/W)
US\$ 9.288,00



Motor



[Netgain Warp 9 \(DC\)](#)

70 kg
25 kW
(2,8 g/W)
US\$ 2118,00



[QS Motors 8 kW \(BLDC\)](#)

25 kg
8 kW
(3,1 g/W)
US\$ 700,00



[HPEVS AC12 Motor](#)

22 kg
35 kW
(0,77 g/W)
US\$ 3125,00



[AM Racing AMR 250-90](#)

68 kg
156 kW
(0,43 g/W)
US\$ 9.288,00

Controle



[Curtis 1231C-8601](#)

Tensão: 96-144 V
Corrente (máx.): 500 A
US\$ 775,00



[Curtis 1231C-8601](#)

Tensão: 42-120 V
Corrente (máx.): 600 A/fase
US\$ 524,00



[HPEVS Curtis 1238e-6521](#)

Tensão: 48-80 V
Corrente (máx.): 550 A
US\$ 1535,00



[Rinehart PM150DX](#)

Tensão: 360 V
Corrente (máx.): 450 A
US\$ 9.360,00

Realidade Brasileira

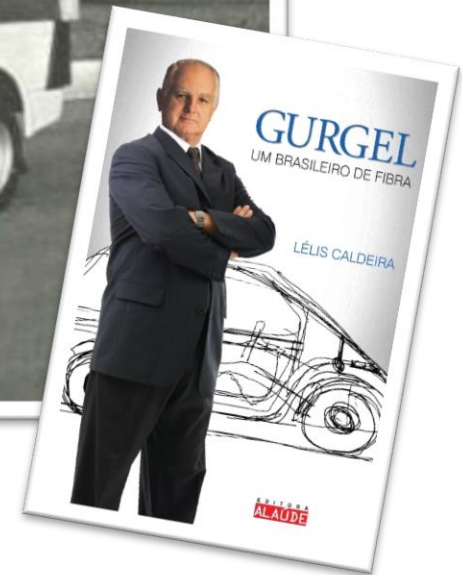
- Itaipu

- 1974
- 2 passageiros
- Potência: 3,2 kW
- Sistema CC
- Bateria de chumbo-ácido
- Autonomia urbana: 80 km
- Tempo de recarga: 10 h
- Plataforma original



Realidade brasileira

- Itaipu E-400
 - 1981
 - 500 kg de capacidade de carga
 - Potência: 10 kW
 - Velocidade máxima: 80 km/h
 - Sistema CC
 - Bateria de chumbo-ácido
 - Autonomia urbana: 127 km
 - Tempo de recarga: 6 a 8 h
 - Plataforma VW



Mercado brasileiro

JAC iEV20 – R\$ 142.990

Autonomia: 400 km



Renault Zoe – R\$ 147.990

Autonomia: 300 km



Chery Arrizo 5e – R\$ 159.990

Autonomia: 322 km



JAC iEV40 – R\$ 189.990

Autonomia: 300 km



Nissan Leaf – R\$ 195.000

Autonomia: 385 km



Chevrolet Bolt – R\$ 209.990

Autonomia: 400 km



JAC iEV60 – R\$ 249.900

Autonomia: 350 km



BMW i3 – R\$ 257.950

Autonomia: 290 km



Jaguar I-Pace – R\$ 466.950

Autonomia: 518 km



Audi e-tron – R\$ 499.990

Autonomia: 436 km



Exemplo

Nissan Leaf e Mitsubishi Miev

Toyota Prius, Ford Fusion e Mercedes S400

Chevrolet Volt, Ford Scape, Suzuki Swift

ALGUNS OBSTÁCULOS

Preço da bateria

As de maior autonomia, de cerca de 300 km, custam US\$ 50 mil. Com autonomia de 150 km custam cerca de US\$ 30 mil

Tecnologia

O país não tem tecnologia de fabricação da bateria de lítio, a mais utilizada pelas montadoras

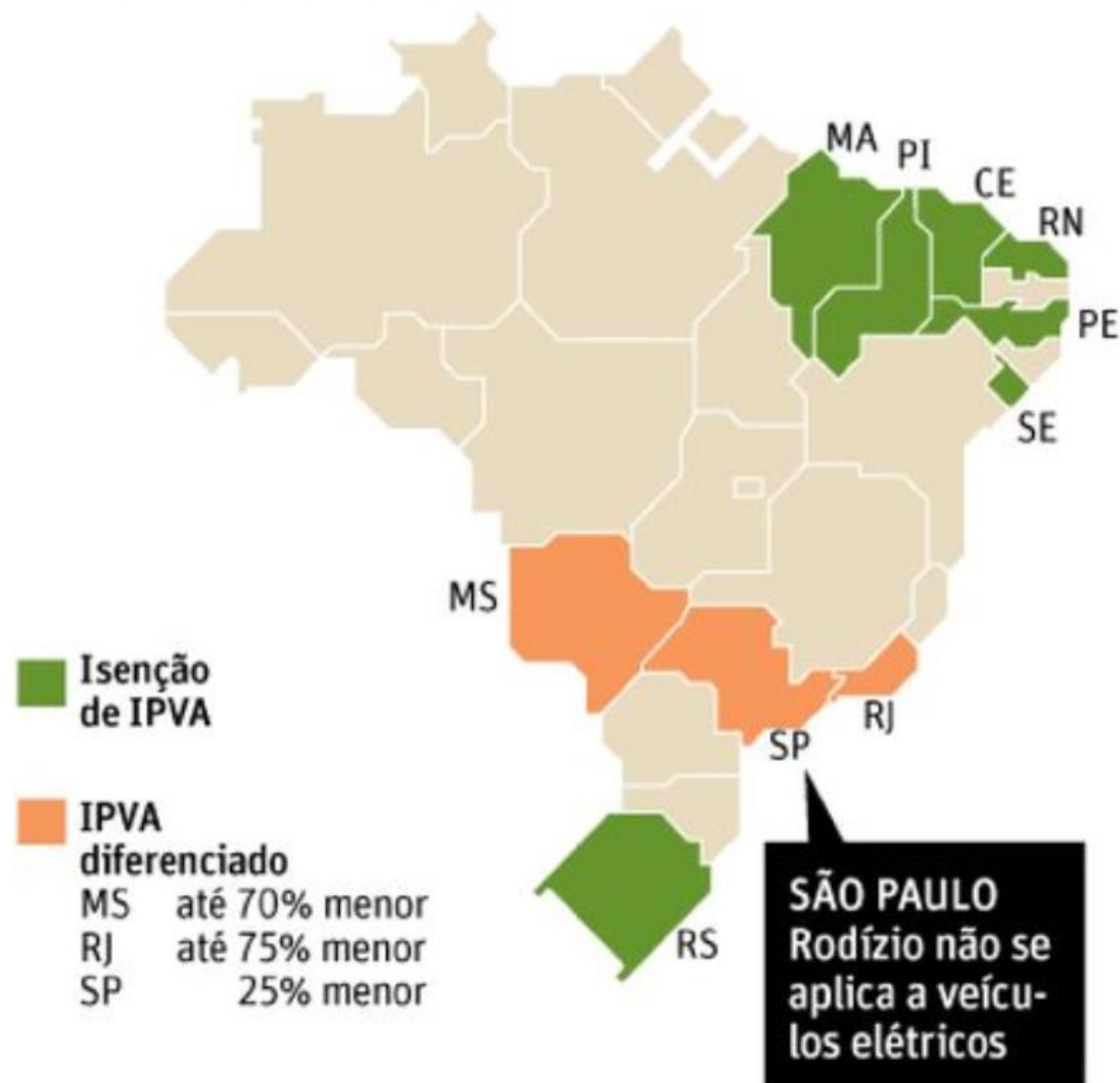
Carga tributária

O IPI (Imposto sobre Produtos Industrializados) é de 25%, enquanto para os outros modelos é 12%

Subsídio

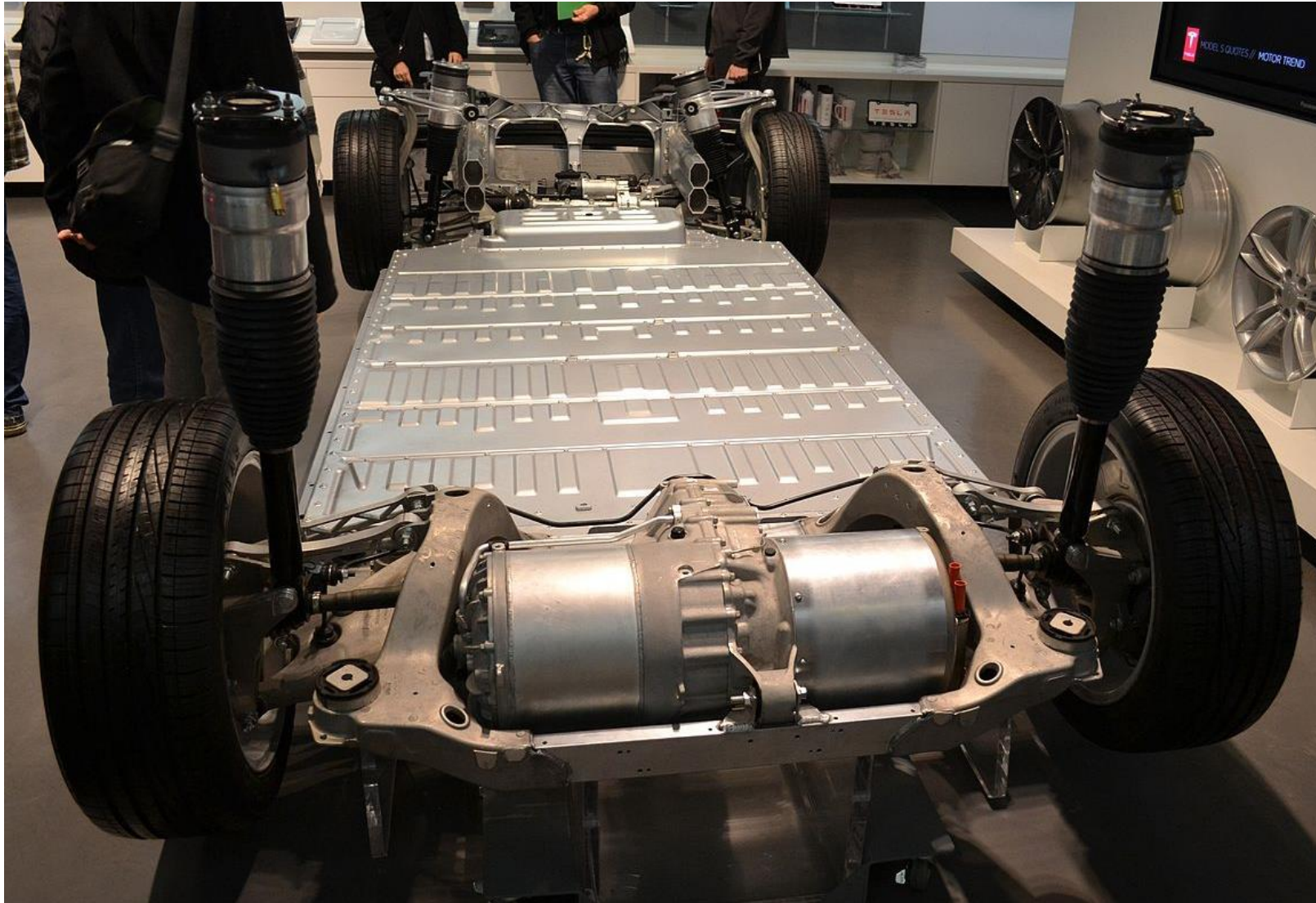
> Não há nenhum subsídio governamental no país, enquanto lá fora é regra

INCENTIVOS NO BRASIL



Mercado e realidade brasileira

Realidade brasileira



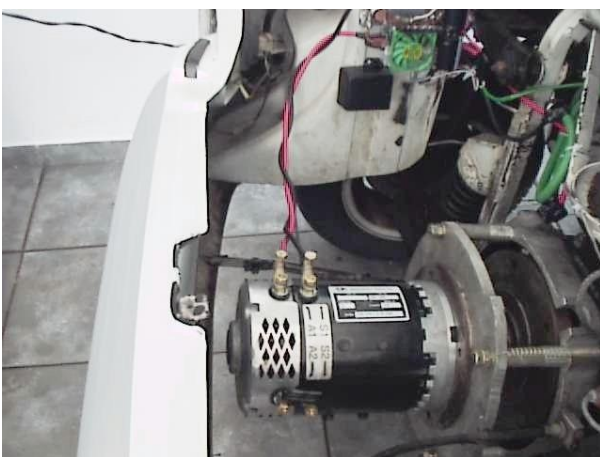
Realidade brasileira

Conversões



Realidade brasileira

Conversões



[+] [Gurgel Supermini "Mini"](#)

Last Updated 11-27-2005

Owner	Luciano
Location	Brazil, Brazil Brazil map
Email	lcamara@gmail.com
Vehicle	Gurgel Supermini
<u>Motor</u>	<u>Advanced DC</u> Series Wound DC
Drivetrain	4 front, 1 rear
<u>Controller</u>	100 Volt, 800 Amp, home built
Batteries	18, 12.00 Volt, 60 Ah
System Voltage	72 Volts
Charger	homemade 72 Volt 15 Amp
Instrumentation	voltmeter, ammeter
Top Speed	60 MPH (96 KPH)
Acceleration	30seg
Range	40 Miles (64 Kilometers)
Seating Capacity	4 adults
Curb Weight	1,400 Pounds (636 Kilograms)
Tires	145x13
Conversion Time	6 months
Conversion Cost	\$1500
Additional Features	None

Realidade brasileira

Conversões



[+] [2009 Volkswagen Gol Generation 4](#)

Last Updated 09-10-2016	
Owner	Elifas Chaves Gurgel do Amaral
Location	Brasilia, Distrito Federal Brazil map
Web/Email	WebPage contato@clubedocarroelettrico.com.br
Vehicle	2009 Volkswagen
Motor	Advanced DC FB1-4001A Series Wound DC
Controller	Curtis 1231C-8601
Batteries	40 CALB/Skyenergy SE180AHA, 133.00 Volt, Lithium Iron Phosphate
Charger	Zivan NG-3
Heater	No
DC/DC Converter	Astrodyne SB-50
Top Speed	87 MPH (139 KPH)
Range	93 Miles (149 Kilometers)
Watt Hours/Mile	112 Wh/Mile
EV Miles	Start: 7 Miles (11 Kilometers) Current: 50 Miles (80 Kilometers) Total: 43 Miles (69 Kilometers) <i>As of 9/10/2016</i>
Curb Weight	2,400 Pounds (1,090 Kilograms)
Tires	Michelin
Conversion Time	4 months
Conversion Cost	US\$ 35,000.00

Realidade brasileira

Conversões



[+] [1992 Gurgel BR800 "EQUETUS"](#)



Last Updated 09-18-2009

Location	Sao Paulo, Sao Paulo Brazil map
Email	equetus@gmail.com
Vehicle	1992 Gurgel BR800
<u>Motor</u>	D&D Motor Systems, Inc. ES15A Series Wound DC
Drivetrain	4 front . 1 rear
<u>Controller</u>	Kelly KD84600
Batteries	7 Tudor 110A Trac., 12.00 Volt, Lead-Acid, AGM
System Voltage	84 Volts
Charger	Homemade
<u>DC/DC Converter</u>	Homemade 84v->24v->12v
Top Speed	65 MPH (104 KPH)
Range	40 Miles (64 Kilometers)
Seating Capacity	4 adults
Tires	145-80-R13

Realidade brasileira

Conversões



[+] [1993 Gurgel Supermini "Gurgel Eletrico"](#)

Last Updated 12-11-2012	
Owner	Luiz Alberto Feijó Junior
Location	Porto Alegre, Rio Grande do Sul Brazil map
Web/Email	WebPage luiz.alberto.fj@terra.com.br
Vehicle	1993 Gurgel Supermini Fiberglass, Brazilian made car.
<u>Motor</u>	<u>Advanced DC</u> L91-4003 Series Wound DC
Drivetrain	manual gear box, cluchless transmission
<u>Controller</u>	<u>Alltrax</u> AXE 7234 300 amps max. controller with serial interface
Batteries	6 Bosch P200, 12.00 Volt, Lead-Acid, AGM 115 A/h (20h)
System Voltage	72 Volts
Charger	Gurgel - Feijo 1 Home made charger, 72V/5A, microcontrolled
Heater	not used
<u>DC/DC Converter</u>	Gurgel01 72V-to-12V volts PWM DC/DC converter based on a PC power supply

Instrumentation	Watt hour, amperage, volts (pack), volts (low voltage), motor temperature, controller temperature, energy used for charge it, instantaneous peak power (both Hp and kW)
Top Speed	50 MPH (80 KPH)
Acceleration	very slow... it takes about 30 seconds to achieve 80 km/h, but enough for city driving
Range	15 Miles (24 Kilometers) Enough for my personal use.
Watt Hours/Mile	450 Wh/Mile I spend 0,3 kWh to drive approx. 2,5 km on a hilly road between my house and my job, driving at 40 km/h .
EV Miles	Start: 37,104 Miles (59,700 Kilometers) Current: 37,538 Miles (60,398 Kilometers) Total: 434 Miles (698 Kilometers)
Seating Capacity	4 adults
Tires	165/80 SR-13
Conversion Time	500+ hours
Conversion Cost	aprox. 13.200 including the car

Realidade brasileira

Conversões



[+] [2009 Volkswagen Gol Generation 4](#)

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Charger	Zivan NG-3
Heater	No
DC/DC Converter	Astrodyne SB-50
Top Speed	87 MPH (139 KPH)
Range	93 Miles (149 Kilometers)
Watt Hours/Mile	112 Wh/Mile
EV Miles	Start: 7 Miles (11 Kilometers) Current: 50 Miles (80 Kilometers) Total: 43 Miles (69 Kilometers) <i>As of 9/10/2016</i>
Curb Weight	2,400 Pounds (1,090 Kilograms)
Tires	Michelin
Conversion Time	4 months
Conversion Cost	US\$ 35,000.00

Realidade brasileira

Custo: R\$ 60 mil

Autonomia: 50 km a 50 km/h

Startup fornece kits a partir de 45 mil



Mercado e realidade brasileira



Desafios

- Temos estrutura?
- Temos energia elétrica?



Obrigado!



Veículos Elétricos

Veículos elétricos no Brasil: um panorama

Prof. Tarso Vilela Ferreira

tarso@ufs.br



[+] [Porsche Taycan](#)