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Brazil Motorcycles Categories and Hybrid Electric Technology Comparison with Powertrain Sizing

By Marcelo Fernandes De Almeida
Rio de Janeiro State University

Abstract- The world is changing and the vehicle technology is changing together to adapt to new customers behaviors, one new customer behavior is to use the electrical powertrain to traction the vehicles and decrease the transport pollution. The electrical powertrain could be detached in two groups: battery electrical vehicles (BEV), its use only an electrical engine on the vehicle, and hybrid electrical vehicle (HEV), its use the electrical engine and the internal combustion engine (ICE) together. Both are very widespread among the cars, but they do not have the same attention for the motorcycles. The BEV technology is under progress for motorcycle, while HEV has a modestly progress among the motorcycles and this study focus on this powertrain. Using the Brazil federation informs and crossing with the electrical powertrain categories definitions, this study define which motorcycle categories is adequate to use the HEV on Brazil and the powertrain specifications of these motorcycle categories.

Keywords: battery electrical vehicle (BEV), hybrid electrical vehicle (HEV), internal combustion engine (ICE), motorcycle.

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I. Introduction

a) Motivation

New times are coming and its means we need adapt to this new times. Thinking in a new world and in the future, the mobility is changing to adapt to new mindset and be healthier.

One of the contributor to pollution is the ICE (internal combustion engine), present in each city in the world, the ICE operation spread a lot of particles in the air and increase the pollution on the cities. According IEA report 2017, "transport sector alone contributes to 24% of CO2 emissions in 2015".

Author: Graduated in a Mechanical production engineering from the Rio de Janeiro State University (UERJ, 2014), Master business administration in project management from Getulio Vargas Foundation (FGV, 2017). Actually a R&D Project engineer in a multinational automotive company from France/Pays-Bas working in wolrdwide projects. e-mail: marc_falm@yahoo.com.br

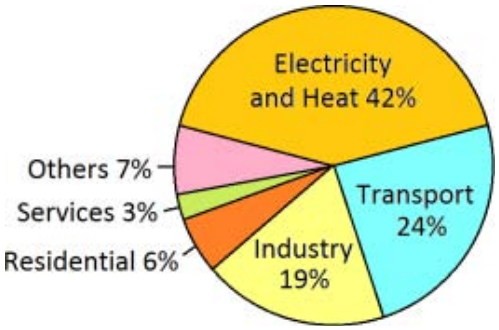

Figure 1: World CO2 Emissions from Fuel Combustion by Sector (IEA Report 2017)

The internal combustion engine was a huge step to society development and their evolution, but to achieve new targets with new mindset, the society are looking to be healthy. To achieve this new healthy target, we are walking to new technologies to decrease the pollution emissions from the transports, as the BEV (Battery Electric vehicles) and the HEV (hybrid electric vehicles).

i. *BEV Definition*

According Vidyanandan (2018), "Battery electric vehicles are propelled by electric motors by using energy stored on board in batteries". Therefore, BEV vehicles does not have a presence of the ICE to help the propulsion system. Basic, the BEV has the Battery, Engine and the Transmission

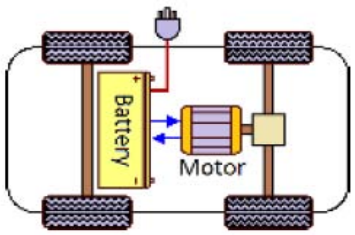

Figure 2: Basic BEV System (Vidyanandan, 2018)

ii. *HEV Definition*

HEV (Hybrid vehicles) have the internal combustion engine with the electric engine and, according Vidyanandan (2018), "Hybrid electric vehicles have the benefits of both ICE vehicles and electric vehicles, and overcome their individual disadvantages".

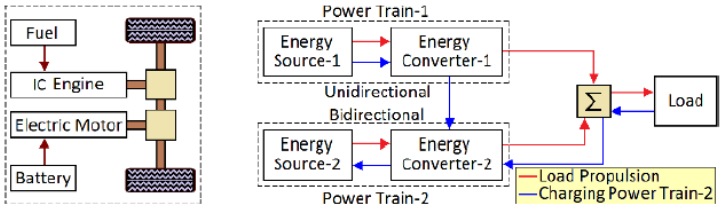

Figure 3: Arrangement of a HEV with Power Flow Paths(Vidyanandan, 2018)

For cars, the BEV or HEV technology are very solid and society has many examples used by the world-renowned brands as:

BEV: BMW i3 (BEV), Nissan Leaf, Chevrolet Bolt, Audi e-Tron and Renault Zoe;

HEV: Toyota Prius, Audi A7 Sportback, Ford Fusion Hybrid, BMW i3 (HEV), Volvo XC60 and many others.

However, the motorcycles category does not have the same scenario for both. The motorcycle world-renowned brands do not have the same presence of BEV or HEV and between both technologies have a difference, the companies have more BEV in comparison than HEV as.

BEV: Voltz EV01, Aima Tiger X6, MUUV Custom S, Magias Italiane Maranello and Energie Mobi Super Soco TC;

HEV: Honda PCX.

In addition, these BEV motorcycles have a low autonomy, being common to have between 60 and 80km.

b) Main Goals

Knowing about the motorcycle technology opportunity for electric vehicle with large area to explore, this present article have as main goals:

- Identify the Brazilian motorcycle customer behavior;
- Identify the best match motorcycle for HEV;
- Define the specifications to sizing the hybrid engine.

II. Comparison between BEV x HEV x ICE

According Vidyanandan (2018), the main difference between BEV and the HEV vehicle is the autonomy. BEV is better when the customer need to drive low distances and do not use the vehicle to travel, otherwise is better use the HEV for long distances.

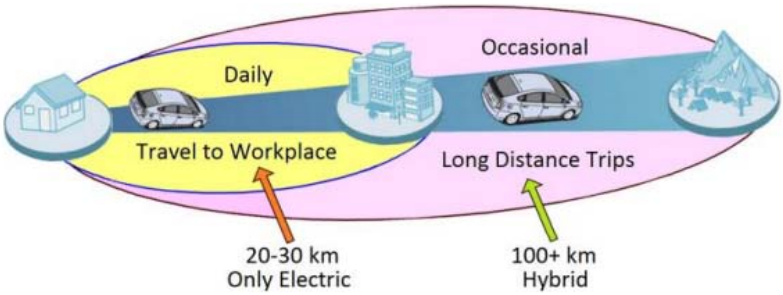

Figure 4: Travel Range of a Typical PHEV in Different Modes (Vidyanandan, 2018)

Mass comparison between ICE x HEV x BEV

Table 1: Mass comparison ICE x BEV x HEV(Sources: Fiat Italy website; Volkswagen Portugal website; Peugeot UK website; Jac China website; Toyota USA website; Mitsubishi North America website; Nissan Japan website; Car and Drive website)

Vehicle	ICE	HEV	BEV	Difference BEV - ICE	Difference HEV - ICE	Difference BEV - HEV
Fiat 500	Rockstar ICE 930 kg	500 Hybrid HEV 980 kg	500e BEV 1351 kg	+421 kg	+50 kg	+371 kg
Volkswagen Golf	Golf 115CV 200Nm ICE 1240 kg		E-Golf 136CV BEV 1615 kg	+375 kg		
Volkswagen up	up 65CV 91Nm ICE 991 kg		e-up 83CV BEV 1235 kg	+244 kg		
Peugeot 208	1220cm³ turbo ICE 1158 kg		136HP 260Nm BEV 1455 kg	+297 kg		
Jac S2 (IEV7S)	112HP 146Nm ICE 1110 kg		270Nm BEV 1495 kg	+385 kg		
Toyota Camry	2.5L 203HP 203HP ICE 1470 kg	2.5L 208HP 149Nm HEV 1610 kg			+140 kg	
Toyota Avalon	205HP 163lbft ICE 1620 kg	215HP 149lbft HEV 1640 kg			+20 kg	
Mitsubishi Outlander	166HP 220Nm ICE 1510 kg	80kW per engine 195Nm HEV 1915 kg			+405 kg	
Nissan Note	142Nm ICE 1090 kg	e-Power 254Nm HEV 1230 kg			+140 kg	
BMW i3		BMW i3 181HP 199Nm HEV 1500 kg	181HP 199Nm BEV 1379 kg			-121 kg

Using the last information, we can define the table below:

Table 2: Categories Main Points

Powertrain	Main points
ICE	Highest in CO2 emission in comparison than HEV / BEV
	High autonomy
	Lighter vehicle in comparison than HEV / BEV
	Quickly fuel (Easy for travels)
HEV	Low CO2 emission

	High autonomy
	Little heaviest
	Quickly fuel (Easy for travels)
BEV	No CO2 emission due to engine
	Low autonomy
	Heaviest than ICE and HEV
	Lengthy fuel

III. Brazilian Motorcycle Categories

According Izo (2019), Brazil has the bellow main motorcycle categories:

Scooter: Scooter has 50cm³ to 150cm³ and aimed at younger customers. Normally, the gearbox is automatic; you have a good driveability inside the cities and have a pocket to keep small things. Scooters does not have the same comfort & safety than the biggest motorcycles and the pilot drive in the sitting position.

Figure 5: Scooter: Yamaha Nmax 160 (Izo, 2019)

Cub: Looks like scooters, but the pilot have a foot pegs to put your feet. The fuel economy is this motorcycle spotlight.

Figure 6: Cub: Honda Biz 125 2018 (Izo, 2019)

Sport: Sport motorcycles were created for strong accelerations. However, this motorcycle do not have a comfortable seat due to design made to optimize the aerodynamic (pilot must to put his chest close the tank to increase the aerodynamic). The suspension is very rigid and the seat usually is uncomfortable. This motorcycle can achieve easily 1200cm³.

Figure 7: Sport: Honda Cbr 1000rr Fireblade (Izo, 2019)

Naked: The customers usually drive in the cities or highways. Naked motorcycles have few fairing, only the necessary. This motorcycle has a large range of sizes (200cm³ - 1000cm³).

Figure 8: Naked: YAMAHA MT-07 ABS 2019 (Izo, 2019)

Custom: Made for roadways. Design for pilot comfort with low seat, long suspensions and high handlebar. Normally have a range of sizes (800cm³ - 1000cm³).

Figure 9: Custo: Harley-Davidson Sportster 883 2018 (Izo, 2019)

Trail: Tall motorcycle with tall seat, suspension and handlebar. Trail motorcycle has a good driveability for city and travels. Normally the customer drive in different roads (dust, asphalt and others). Displacement average close the 1000cm³.

Figure 10: Trail: Triumph Tiger 800 Xrx (Izo, 2019)

Below the table with the motorcycle categories description:

Table 3: Categories Main Points

Category	Main points
Scooter	City usage
	Young customers
	Low displacement (50cm³ - 150cm³)
	Economic
	Uncomfortable (Drive in sitting position)
Cub	City usage
	Young customers
	Low displacement (100cm³ - 125cm³)
	Economic
	Average comfortable (Drive with foot pegs)
Sport	Sport usage
	"Sport" customers
	High displacement (as 1200cm³)
	High consumption
	Uncomfortable
Naked	City / highway usage
	Large range of customers
	Large range of displacement (200cm³ - 1000cm³)

	Large range of consumption
	Average comfort
Custom	Highway / Travel usage
	Traveling Customers
	High displacement (until 1800cm³)
	Average to high consumption
	Very comfortable
Trail	City / Travel / Trail usage
	Daily usage with some travels
	High displacement (average of 1000cm³)
	Average to high consumption
	Comfortable

IV. Comparison between Motorcycle and Powertrains

Below the table crossing the information from motorcycles categories and the engine types:

Table 4: Comparison Between Categories and Engines

	ICEV Highest in CO2 emission in comparison than HEV / BEV High autonomy Lighter vehicle in comparison than HEV / BEV Quickly fuel (Easy for travels)	HEV Low CO2 emission High autonomy Little heaviest Quickly fuel (Easy for travels)	BEV No CO2 emission due to engine Low autonomy Heaviest than ICE and HEV Lengthy fuel
Scooter City usage Young customers Low displacement (50cm³ - 150cm³) Economic Uncomfortable (Drive in sitting position)	3	2	1
Cub City usage Young customers Low displacement (100cm³ - 125cm³) Economic Average comfortable (Drive with foot pegs)	3	2	1
Sport Sport usage “Sport” customers	1	3	2

High displacement (as 1200cm³) High consumption Uncomfortable			
Naked City / highway usage Large range of customers Large range of displacement (200cm³ - 1000cm³) Large range of consumption Average comfort	1	2	3
Custom Highway / Travel usage Traveling Customers High displacement (until 1800cm³) Average to high consumption Very comfortable	2	1	3
Trail and Big Trail City / Travel / Trail usage Daily usage with some travels High displacement (average of 1000cm³) Average to high consumption Comfortable	2	1	3

According the table, Custom and Trail are the most compatible motorcycle categories with HEV technology because they are used to long travels, needed a quickly fuel, high autonomy and use to decrease the pollution.

V. Specification for Custom and Trail

Fenabrave is a national automotive federation from Brazil and the best in class motorcycle for each category could be identify through the Fenabrave informs. Below the Fenabrave informs ranking table from December 2019 for Trail motorcycles and Customs:

Maxtrail

	Modelo	2019 Nov	2019 Dez		2019 Acumulado	Part.
1°	TRIUMPH/TIGER 800	193	316	▲	2.837	20,07%
2°	BMW/F850 GS	166	226	▲	2.134	15,09%
3°	BMW/R1250GS	326	340	▲	1.900	13,44%
4°	BMW/R1200	3	5	▲	1.431	10,12%
5°	TRIUMPH/TIGER 1200	62	77	▲	917	6,49%
6°	SUZUKI/VSTROM650	102	113	▲	899	6,36%
7°	ROYAL ENFIELD/HIMALAYA	77	118	▲	805	5,69%
8°	BMW/F750 GS	63	105	▲	731	5,17%
9°	KAWASAKI/VERSYS	84	82	▼	652	4,61%
10°	HONDA/CRF 1000L	44	36	▼	337	2,38%
	Total	1.229	1.513	▲	14.139	100%

Custom

	Modelo	2019 Nov	2019 Dez		2019 Acumulado	Part.
1°	H.DAVIDSON/FL FB	44	79	▲	820	10,86%
2°	KAWASAKI/VULCAN S	89	75	▼	820	10,86%
3°	H.DAVIDSON/XL 883	134	91	▼	745	9,87%
4°	H.DAVIDSON/XL 1200	16	37	▲	546	7,23%
5°	ROYAL ENFIELD/CLASSIC	43	43	=	537	7,11%
6°	H.DAVIDSON/FXFB	24	44	▲	498	6,60%
7°	H.DAVIDSON/FL FBS	25	36	▲	461	6,11%
8°	TRIUMPH/BONNEVILLE	43	39	▼	373	4,94%
9°	H.DAVIDSON/FX FBS	46	52	▲	367	4,86%
10°	H.DAVIDSON/FL SB	10	10	=	303	4,01%
	Total	648	742	▲	7.548	100%

Figure 11: Ranking Fenabrave December 2019 (Fenabrave, 2020)

Based on the sales ranking from Fenabre, the best sales motorcycles specification will be used to define the motorcycles specification target.

Table 5: Specification table (Sources: Triumph Brazil website; BMW Brazil website; Suzuki Brazil website; Harley Davidson Brazil website; Kawazaki Brazil website; Royal Enfield Brazil website)

Motorcycle	Torque	Power	Energy	Mass
Triumph / Tiger800	79 Nm (8,0 kgf.m) @ 7,850 rpm	95 CV @ 9,250 rpm	70 kW @ 9,250 rpm	199 kg
BMW / F850 GS	88 Nm (9,0 kgf.m) @ 6,250rpm	80 CV @ 6,250 rpm	58 kW @ 6,250 rpm	229 kg
BMW / R1250GS	143 Nm (14,6 kgf.m) @ 6,250 rpm	136 CV @ 7,750 rpm	100 kW @ 7,750 rpm	249 kg
BMW / R1200	125 Nm (12,7 kgf.m) @ 6,500 rpm	92 CV @ 7,750 rpm	92 kW @ 7,750 rpm	232 kg
Triumph / Tiger 1200	122 Nm (12,4 kgf.m) @ 7,600rpm	141 CV @ 9,350 rpm	104 kW @ 9,350 rpm	242 kg
Suzuki / Vstrom650	62 Nm (6,32 kgf.m) @ 6,500RPM	71 CV @ 8,800 rpm	52 kW @ 8,800 rpm	199 kg
H.Davison / FL FB	145 Nm (14,8 kgf.m) @ 3,000 rpm	71 CV @ 4,560 rpm	52 kW @ 4,560 rpm	304 kg
Kawazaki / Vulcan S	63 Nm (6,4 kgf.m) @ 6,600 rpm	61 CV @ 7,500 rpm	45 kW @ 7,500 rpm	228 kg
H.Davison / XL 883	68 Nm (6,9 kgf.m) @ 4,750 rpm	52 CV @ 5,750 rpm	38 kW @ 5,750 rpm	247 kg
H.Davison / XL 1200	96 Nm (9,8 kgf.m) @ 3,500 rpm	66 CV @ 6,000 rpm	49 kW @ 6,000 rpm	248 kg
Royal enfield / Classic	52 Nm (5,3 kgf.m) @ 5,250 rpm	47 CV @ 7,250 rpm	35 kW @ 7,250 rpm	202 kg

Follow the train of thought, below the specification comparison and the analysis to define the targets for Custom and Trail motorcycle categories.

Table 6: Motorcycle Categories Analysis

Motorcycle	Peso	Torque	Torque / kg	Torque/kg variation (Unid / Cat average)
Triumph / Tiger800	199 kg	79 Nm	0,40 Nm/kg	-12%
BMW / F850 GS	229 kg	88 Nm	0,38 Nm/kg	-15%
BMW / R1250GS	249 kg	143 Nm	0,57 Nm/kg	27%
BMW / R1200	232 kg	125 Nm	0,54 Nm/kg	19%
Triumph / Tiger 1200	242 kg	122 Nm	0,50 Nm/kg	12%
Suzuki / Vstrom650	199 kg	62 Nm	0,31 Nm/kg	-31%
H.Davison / FL FB	304 kg	145 Nm	0,48 Nm/kg	43%
Kawazaki / Vulcan S	228 kg	63 Nm	0,28 Nm/kg	-17%
H.Davison / XL 883	247 kg	68 Nm	0,28 Nm/kg	-18%
H.Davison / XL 1200	248 kg	96 Nm	0,39 Nm/kg	16%
Royal enfield / Classic	202 kg	52 Nm	0,26 Nm/kg	-23%
Average MaxTrail	225 kg	103 Nm	0,45 Nm/kg	
Min MaxTrail	199 kg	62 Nm	0,31 Nm/kg	
Max MaxTrail	249 kg	143 Nm	0,57 Nm/kg	
Average Custom	246 kg	85 Nm	0,33 Nm/kg	
Min Custom	202 kg	52 Nm	0,26 Nm/kg	
Max Custom	304 kg	145 Nm	0,48 Nm/kg	
Geral Average	234 kg	95 Nm	0,40 Nm/kg	

According the Table 6. Motorcycle categories analysis, the Trail specifications are:

Weight: Average of 225kg, range between 199Kg and 249Kg;

Torque: Average of 103Nm, range between 62Nm and 143Nm;

Correlation between torque and weight: Average of 0,45Nm/Kg, range between 0,31Nm/kg and 0,57Nm/Kg. And the Custom specification are:

Weight: Average of 246kg, range between 202Kg and 304Kg;

Torque: Average of 85Nm, range between 52Nm and 145Nm;

Correlation between torque and weight: Average of 0,33Nm/Kg, range between 0,26Nm/kg and 0,48Nm/Kg.

VI. Conclusion

According to these work data, the motorcycle categories with best match to hybrid electric vehicle (HEV) technology are Custom and Trail motorcycle categories due the necessities to do travels and, consequently, need more autonomy and a quickly fuel.

Need to consider some points to design the HEV powertrain for motorcycle. Following these work analysis:

- Correlation between torque and weight is important because it demonstrates how much torque the motorcycle needs to meet the customer's behavior;
- Weight demonstrate the range of mass the motorcycle could be to meet the customer's behavior.

For example, the trail motorcycles customer drives in different roads and some roads, as dirt or bumpy roads, the customer need a lighter and taller motorcycle with high torque (as 0,45Nm/Kg), in comparison the custom motorcycle customer basically use on asphalt and needs a heaviest and lower motorcycle with a reasonable torque (0,33Nm/Kg). Therefore, the trail motorcycle must be lighter than custom motorcycle and, normally, the trail motorcycle has more torque than custom motorcycle.

In addition, considering the analysis, the good motorcycle target to apply HEV technology is:

- Trail motorcycles: Triumph/Tiger800 is the motorcycle close the average with 0,40Nm/kg against the average of 0,45Nm/kg and this is the best-selling motorcycle for Trail category;
- Custom motorcycles: H.Davison/XL883 is the motorcycle close the average with 0,28Nm/kg against the average of 0,33Nm/kg and H.Davison is the brand best-selling motorcycles for Custom categories;

Abbreviations:

ICE – Internal combustion engine
HEV – Hybrid electrical vehicle
BEV – Battery electrical vehicle

References Références Referencias

1. CO2 Emissions from Fuel Combustion Highlights - 2017, International Energy Agency (IEA). Link: https://www.iea.org/reports. Access on: September 20, 2020.
2. Dr. K.V. Vidyanandan (2018), Overview of Electric and Hybrid Vehicles, Power Management Institute, NTPC Ltd., India. Link: https: //www.research-gate.net/publication/323497072_Overview_of_Electric_and_Hybrid_Vehicles. Access on: September 20, 2020
3. Izo, Alexandre. GUIA PARA ENTENDER DE VEZ OS TIPOS DE MOTOS. Revista auto esporte, march 23 for 2019.Link: https://revista-autoesporte.globo.com/Noticias/noticia/2019/03/guia-para-en-teder-de-vez-os-tipos-de-motos.html.Access on: September 20, 2020
4. Emplacamentos 2019. Fenabrave, 2020. Link: http://www.fenabrave.org.br/portal/conteudo/emplacamentos. Access on: September 20,2020
5. 2020 hybrid Camry. Automaker Toyota USA website, 2020. Link: https://www.toyota.com/camry/features/mpg/2559/2561/2560. Access on: September 20, 2020.
6. 2020 Camry. Automaker Toyota USA website, 2020. Link: https://www.toyota.com/camry/features/mpg/2550/2549/2514. Access on: September 20, 2020.
7. 2020 Avalon. Automaker Toyota USA website, 2020. Link: https://www.toyota.com/avalon/features/mpg/3544/3555/3504. Access on: September 20, 2020.
8. 2020 Outlander PHEV. Automaker Mitsubishi North America website, 2020. Link: https://www.mitsubishicars.com/outlander-phev/2020/specific-ations. Access on: September 20, 2020.
9. 2020 Outlander. Automaker Mitsubishi North America website, 2020. Link: https://www.mits ubishicars.com/outlander/2020/specifications. Access on: September 20, 2020.
10. Nissan Note. Automaker Nissan Japan website, 2020. Link: https://www3.nissan.co.jp/vehicles/new/note/performance_safety/performance.html. Access on: September 20, 2020.
11. E-Golf. Automaker Volkswagen Portugal website, 2020. Link: https://www.volkswagen.pt/pt/modelos-e-configurador/vw-carro-eletrico-e-golf.html. Access on: September 20, 2020.
12. Golf. Automaker Volkswagen Portugal website, 2020. Link: https://www.volkswagen.pt/pt/modelos-e-configurador/vw-carro-hatchback-golf.html#MOFA. Access on: September 20, 2020.
13. E-up. Automaker Volkswagen Portugal website, 2020. Link: https://www.volkswagen.pt/pt/modelos-e-configurador/vw-citadino-eletrico-e-up.html#CONFIGURE. Access on: September 20, 2020.
14. Up. Automaker Volkswagen Portugal website, 2020. Link: https://www.volkswagen.pt/pt/modelos-e-configurador/vw-citadino-up-beats.html#MOFA. Access on: September 20, 2020.
15. Peugeot 208. Automaker Peugeot United Kingdom website, 2020. Link: https://www.peugeot.co.uk/. Access on: September 20, 2020.
16. Jac IEV7S. Automaker JAC China website, 2020. Link: https://jacen.jac.com.cn/showroom/iev7s.html. Access on: September 20, 2020.
17. Jac S2. Automaker JAC China website, 2020. Link: https://jacen.jac.com.cn/showroom/s2.html. Access on: September 20, 2020.
18. BMW i3. Car and drive website, 2020. Link: https://www.caranddriver.com/bmw/i3/specs. Access on: September 20, 2020.

19. Fiat 500e. Automaker Fiat Italy website, 2020. Link: https://www.fiat.it/500-elettrica-la-prima. Access on: September 20, 2020.
20. Fiat 500 Hybrid. Automaker Fiat Italy website, 2020. Link: https://www.fiat.it/fiat-ibride/500-hybrid-launch-edition. Access on: September 20, 2020.
21. Fiat 500. Automaker Fiat Italy website, 2020. Link: https://www.fiat.it/fiat-500c/500c. Access on: September 20, 2020.
22. Tiger 800. Automaker Triumph Brazil, 2020. Link: https://m.triumphmotorcycles.com.br/motocicletas/adventure-and-touring/tiger/2018/tiger-800. Access on: September 15, 2020.
23. F 850 GS. Automaker BMW Brazil, 2020. Link: https://www.bmw-motorrad.com.br/pt/models/adventure/f850gs.html#/section-motor-bicilindrico-paralelo. Access on: September 15, 2020.
24. R 1250 GS. Automaker BMW Brazil, 2020. Link: https://www.bmw-motorrad.com.br/pt/models/adventure/r1250gs.html#/section-o-design-da-r-1250-gs. Access on: September 15, 2020.
25. R1200. Automaker BMW Brazil, 2020. Link: https://www.bmw-motorrad.com.br/pt/models/roadster/r1200r.html#/section-motor-boxer-bicilindrico. Access on: September 15, 2020.
26. Tiger 1200 XR. Automaker Triumph Brazil, 2020. Link: https://www.triumph-motorcycles.com.br/motocicletas/adventure/tiger-1200/tiger-1200-xr-2018. Access on: September 15, 2020.
27. V-STROM 650 XT ABS. Automaker Suzuki Brazil, 2020. Link: https://suzukimotos.com.br/models/v-strom-650-xt-nova/. Access on: September 15, 2020.
28. Fat Boy 2020. Automaker Harley Davidson Brazil, 2020. Link: https://www.harley-davidson.com/br/pt/motorcycles/fat-boy.html. Access on: September 15, 2020.
29. Vulcan S Grafismo Exclusivo. Automaker Kawasaki Brazil, 2020. Link: https://www.kawasaki-brasil.com/pt-br/moto-cicletas/vulcan/sport-cruiser/vulcan-s/2020-vulcan-s-grafismo-exclusivo. Access on; September 14, 2020.
30. 2020 Iron 883. Automaker Harley Davidson Brazil, 2020. Link: https://www.harley-davidson.com/br/pt/motorcycles/iron-883.html. Access on: September 14, 2020.
31. 2020 Iron 1200. Automaker Harley Davidson Brazil, 2020. Link: https://www.harley-davidson.com/br/pt/motorcycles/iron-1200.html. Access on: September 14, 2020.
32. Interceptor 650. Automaker Royal Enfield Brazil, 2020. Link: https://www.ofer-tasroyalenfield.com.br/saiba-mais/interceptor/23-parcelas?source=Y6RLREF&utm_source=google&utm_medium=search. Access on: September 14, 2020.