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Title: Comparison of Gasoline, Hybrid and Electric Vehicles

Authors: GARCÍA-CONTRERAS, Cecilia Pamela, ONTIVEROS-SÁNCHEZ, Kenneth Arturo, MADRID-CAMACHO, Erick Ernesto and ALVAREZ-MACÍAS, Carlos

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MARVID - Mexico
Park Pedregal Business. 3580-Adolfo Ruiz Cortines Boulevard – CP.01900. San Jerónimo Aculco-Álvaro Obregón, Mexico City
Skype: MARVID-México S.C.
Phone: +52 1 55 6159 2296
E-mail: contact@marvid.org
Facebook: MARVID-México S. C.
Twitter:@Marvid_México

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Introduction.

- Climate change and green house gas emissions.
- In Mexico, 18% of CO_2 emissions come from automobiles. (IMCO, Instituto Mexicano para la Competitividad A.C., 2022)
- Hybrid and Electric vehicles have been alternative options for years, now.
- Mexico has promised to have a 25% reduction of it’s CO_2 emissions by 2030. (Secretaría de Medio Ambiente y Recursos Naturales, 2015)

Introduction.

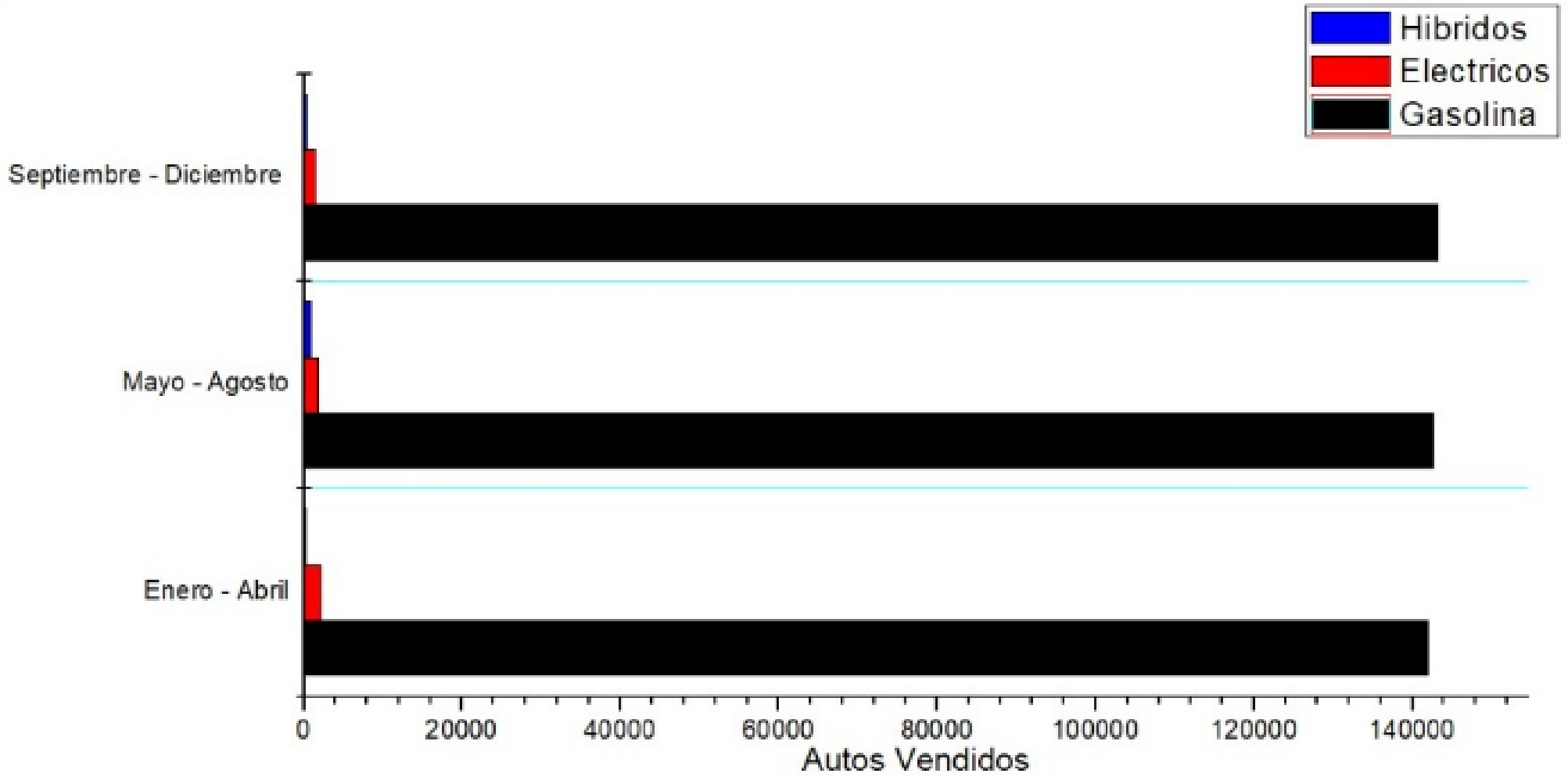

Fig. 1. Amount of lightweight car sold in Mexico, 2022.

Reference: (Statista Research Department, 2023)

Introduction.

- Energy is the ability of bodies to perform work and produce changes in themselves or in other bodies. (Secretaria de Energia de la República de Argentina, 2003)
- Kinetic Energy: $E_K = \frac{1}{2}mV^2$
- Potential Energy: $E_U = mgh$
- Drag Energy: $E_F = F \times d = \frac{1}{2} \times \sigma \times A \times v^2 \times \rho \times d$
- Friction Energy: $E_F = F \times d = \mu \times N \times d = \mu \times mg \times d$
- Total Energy: $E_T = E_K + E_U + E_R + E_F$

Introduction.

- Gasoline Automobile works thanks to a four-time motor that needs a spark to ignite a mix of air and gasoline. (Tippens, 2001)
- Gasoline motors have an efficiency of 25%.
- Diesel motors have an efficiency of 40-45%.
- Gasoline consumption has gone up by 39.3% on an annual basis on the month of June, 2022. (Usla, 2022)

Introduction.

- Electric Autmobile: Electric Motor.
  - Operation: Powered by lithium electric motor.
  - Power Source: Rechargeable battery to the mains.
  - Energy Efficiency: Approximately 75%.
  - Advantages: Eliminate polluting emissions, take advantage of braking energy.
  - Recharge: 6-8 hours for full charge or quick charges of 15-42 minutes.
  - Motors: Synchronous permanent magnets.
  - Performance: Higher efficiency and power density.
  - Regeneration: Regenerative braking for greater efficiency.
  - Fast Charge: Challenge and solutions to avoid battery degradation.

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  - Regeneration: Regenerative braking for greater efficiency.
  - Fast Charge: Challenge and solutions to avoid battery degradation.
- (Díez González, 2019), (Stone, 2021)

Introduction.

- Hybrid Autmobile: Electric Motor + Internal Combustion Motor
  - "Start-Stop" system: Turns the engine on and off as needed.
  - Efficiency: Fuel savings of up to 50% in the city.
  - Emissions: Reduction of polluting emissions of up to 80%.
  - Use of the Electric Motor: Up to 60 km/h, power boost.
  - Regenerative Braking: Energy recovery during braking.
- (Alfaro, 2022), (Antonio, 2022), (Rodríguez, 2023)

Introduction.

- Comparative of Automobile Types
  - Evaluation of best selling cars: Gasoline, Hybrid and Electric.
  - Analysis of costs and travel times.
  - Highlighting strengths and weaknesses of each option.
  - Providing recommendations based on individual needs.
  - Complete vision of the alternatives in the current market.

Methodology.

Tabla 2.1 Tabla Comparativa de Automóviles

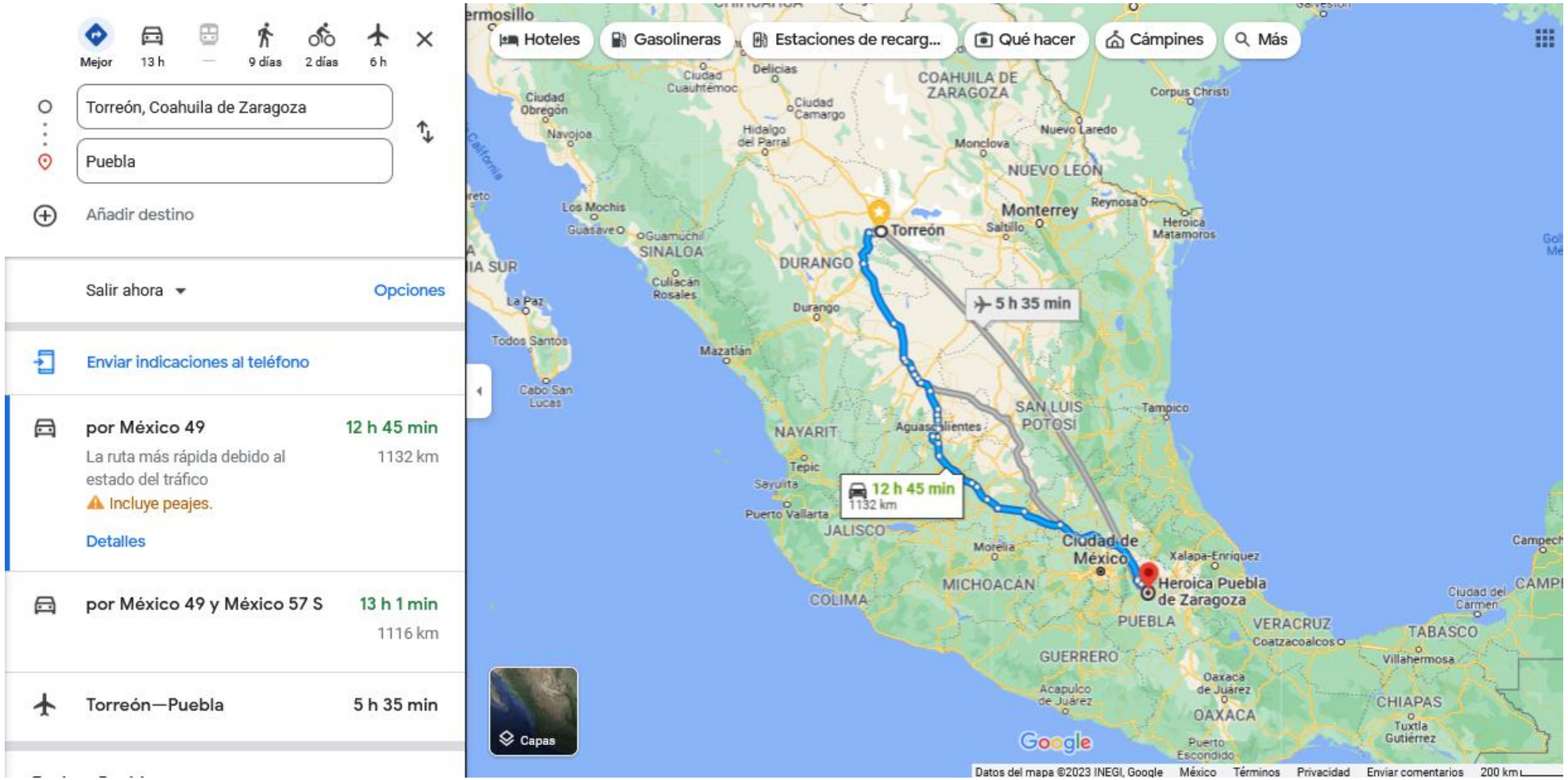
	Eléctrico **JAC e10X**	**Hibrido** **Toyota Prius**	**Gasolina** **Nissan Versa**
Funcionamiento.	Baterías y motor (energía eléctrica a mecánica)	Electricidad, combustible (energía eléctrica y química a mecánica)	Combustible, (energía química a mecánica)
Eficiencia.	75%	11%	25%
Peso (kg).	1555	1380	1104
Área Frontal (m^2).	2.49	2.5	2.55
Tiempo estimado de vida.	180000 km.	200.000 km.	250.000 km.

Fuente de Consulta:

(JAC, 2022), (Toyota, 2022), (Nissan, 2023).

Methodology.

Figure 3.1 Screenshot, Route Torreón to Puebla



Reference:

(Google Maps, 2023)

Results.

Tabla 3.3 Energy required by the each car to analyze, according to the trip section.

Energy Required (kWh)			
Section	**Gasoline**	**Electric**	**Hybrid**
Coahuila to Durango	6.58	8.713	7.88
Durango to Zacatecas	93.70	119.739	109.56
Zacatecas to Aguascalientes	136.83	175.243	160.23
Aguascalientes to Jalisco	54.37	69.784	63.77
Jalisco to Guanajuato	38.99	49.838	45.60
Guanajuato to Querétaro	92.54	117.876	107.97
Querétaro to Tlaxcala	123.61	157.466	144.22
Tlaxcala to Puebla	39.52	51.735	46.98
Totales	586.14	750.39	686.2

Results.

- Objective: Determine the stops necessary for each type of vehicle.
- Considerations: Two possible types of stops:
  - Case 1: Performance exceeds demand without passing minimum fuel/battery limits.
  - Case 2: Power is not enough; stops are needed to recharge.

Results.

- Gasoline Car Analysis:

Table 3.4 Gasoline Car Analysis

Gasoline				
Kilometer	**Stop**	**Location**	**Gasoline Price***	**Expenses**
0	0	Torreón, Coahuila	$ 21.25	$ 871.25
450	1	Lagos de Moreno, Jalisco	$ 21.87	$ 677.97
1049	2	Villa Tezontepec, Hidalgo	$ 21.26	$ 670.27
Total Stops	2		**Total**	$ 1348.24
Total Hours		12.63		**Days in the road**
Start Time	06:00:00 a. m.	**Arrival Time**	06:37:38 p. m.	0.53

Fuente de Consulta:
(Gasolina MX, 2023)

**Gasoline prices may vary each day; however, for this calculation, the prices corresponding to May 15th, 2023 and to each cities, are used.*

Results.

- Hybrid Car Analysis:

Table 3.6. Hybrid car analysis

Hybrid				
Kilometer	**Stop**	**Location**	**Gasoline Price**	**Cost**
0	0	Torreón, Coahuila	$ 21.25	$ 913.75
551	1	Encarnación de Díaz, Jalisco	$ 22.55	$ 855.51
803	2	Apan, Hidalgo	$ 21.26	$ 701.58
Total Stops	2		**Total**	$ 1557.09
Total Hour		13.13		**Days on the road**
Start Hour	06:00:00 a. m.	**Hora de Llegada**	07:07:58 p. m.	0.55

Reference:
(Gasolina MX, 2023)

**Gasoline prices may vary each day; however, for this calculation, the prices corresponding to May 15th, 2023 and to each cities, are used.*

Results.

- Electric Car Analysis:

Table 3.6. Electic car analysis, stops with fast charge

Electric (fast charging stops)				
State	**# Fast Charge Stops**	**Parking Price**	**Parking Expenses**	**Total Hours**
Coahuila	0	$ 22.5	0	56.00
Durango	6	$ 15	$ 90	**Days by the road**
Zacatecas	8	$ 20	$ 160	2.33
Aguascalientes	3	$ 48	$ 144	**Starting Time (1st day)**
Guanajuato	2	$ 42	$ 84	06:00:00 a. m.
Querétaro	11	$ 30	$ 330	**Arrival time (3rd day)**
Tlaxcala	1	$ 30	$ 30	10:36:40 a. m.
Total stops	**31**	**Total, Parking**	$ 838	
Charge at home Price (0%-100%)	$89.77	**Total, Expenses**	$ 927.77	

Reference:

(Comisión Federal de Electricidad, 2023).

Results.

- Electric Car Analysis:

Table 3.7. Electic car analysis, considering fast and slow charges

Electric (stops with slow and fast charge)				
State	**# Fast charge stops**	**Parking Price**	**Parking Costs**	**Total Hours**
Coahuila	1	$ 20.00	$ 20.00	68.43
Durango	8	$ 25.00	$ 200.00	**Days by the road**
Zacatecas	4	$22.00	$ 88.00	2.85
Aguascalientes	3	$ 21.00	$ 63.00	**Price Charging at Home (0%-100%)**
Guanajuato	3	$ 20.00	$ 60.00	89.77
Querétaro	11	$ 50.00	$ 550.00	**Starting time (1st day)**
Tlaxcala	2	$ 30.00	$ 60.00	06:00:00 a. m.
Total Stops	32	**Total, Estacionamiento**	$ 1,041.00	**Arrival time (3rd day)**
Slow charge stops				10:51:23 p. m.
Kilometer	**Location**	**Hotel Price**	**Nights in hotel**	
335	Fresnillo, Zacatecas	$1,200.00	1	**Gasto Total**
709	San Luis de la Paz, Guanajuato	$940.00	1	$ 3,181.00

Results.

- Electric Car Analysis:

Table 3.8. Final Comparison

Car Analysis	Gasoline	Hybrid	Electric (fast charge stops)	Electric (fast and slow charge stops)	
Complete charge performance(kWh)	369.00	387.00	31.40		
Total energy required (kWh)	586.14	686.21	750.39		
Driving hours	12.63	13.13	56.00	68.43	
Time of charge per stop (min)	20.0		1.0	360.0	
Days on the road	0.5	0.5	2.3	2.9	
Number of Stops	2.0	2.0	31.0	31 (rápidas)	2 (lentas)
Charge at the end (litres, battery percentage)	26.3	11.0	38%	44%	
Total Expenses	$ 1,348.24	$ 1,557.09	$ 838	$ 3,181.00	
Sale Value	$ 326,900.00	$ 448,100.00	$ 439,000.00		

Results.

- Electric car is efficient on urban journeys and with charges at home.
- Fast charges can limit the effectiveness of the electric car.
- Hybrid car offers gasoline-like performance with higher cost.
- Gasoline car is cheaper and faster for this route..

Annexes.

Tabla 4.1 Cálculo de energía requerida por los vehículos en cada tramo

Energía Requerida									
	Gasolina			**Eléctrico**			**Híbrido**		
Tramo	**Joules**	**kWh**	**km/kWh**	**Joules**	**kWh**	**km/kWh**	**Joules**	**kWh**	**km/kWh**
Coahuila a Durango	2.37E+07	6.58	1.22	3.14E+07	8.713	0.92	2.84E+07	7.88	1.01
Durango a Zacatecas	3.37E+08	93.70	1.86	4.31E+08	119.739	1.45	3.94E+08	109.56	1.59
Zacatecas a Aguascalientes	4.93E+08	136.83	1.96	6.31E+08	175.243	1.53	5.77E+08	160.23	1.67
Aguascalientes a Jalisco	1.96E+08	54.37	1.86	2.51E+08	69.784	1.45	2.30E+08	63.77	1.58
Jalisco a Guanajuato	1.40E+08	38.99	2.05	1.79E+08	49.838	1.61	1.64E+08	45.60	1.75
Guanajuato a Querétaro	3.33E+08	92.54	1.86	4.24E+08	117.876	1.46	3.89E+08	107.97	1.59
Querétaro a Tlaxcala	4.45E+08	123.61	1.85	5.67E+08	157.466	1.45	5.19E+08	144.22	1.59
Tlaxcala a Puebla	1.42E+08	39.52	2.13	1.86E+08	51.735	1.62	1.69E+08	46.98	1.79
Totales		586.14	1.85		750.39	1.44		686.2	1.57

Annexes.

Tabla 4.2 Trayecto del vehículo a gasolina.

Gasolina												
Tramo	Km Inicial	Km final	Litros Iniciales	Consumo de Gasolina	Litros Finales	Energía Inicial (kWh)	Consumo (kWh)	Energía Final (kWh)	No. de Paradas	Tiempo (horas)	Hora Inicio	Hora Final
Coahuila a Durango	0	8	41.00	0.7	40.3	369.00	6.58	362.4	0	0.2	06:00:00 a. m.	06:10:40 a. m.
Durango a Zacatecas	8	182	40.27	0.7	39.5	362.42	93.70	268.7	0	1.8	06:10:40 a. m.	08:00:06 a. m.
Zacatecas a Aguascalientes	182.00	450	39.54	29.5	10.0	355.84	136.83	219.0	1	3.0	08:00:06 a. m.	10:57:59 a. m.
Aguascalientes a Jalisco	450.00	557	41.00	15.2	25.8	369.00	54.37	314.6	0	1.2	10:57:59 a. m.	12:08:40 p. m.
Jalisco a Guanajuato	556.50	629	25.80	6.0	19.8	232.17	38.99	193.2	0	0.8	12:08:40 p. m.	12:56:44 p. m.
Guanajuato a Querétaro	628.92	819	19.76	10.3	9.5	177.80	92.54	85.3	1	2.1	12:56:44 p. m.	03:02:46 p. m.
Querétaro a Tlaxcala	818.81	1049	41.00	10.3	30.7	369.00	123.61	245.4	0	2.3	03:02:46 p. m.	05:22:05 p. m.
Tlaxcala a Puebla	1048.55	1122	30.72	4.4	26.3	276.46	39.52	236.9	0	1.3	05:22:05 p. m.	06:37:38 p. m.
						Totales	586.14	**Totales**	2	12.6		

Annexes.

Tabla 4.3 Trayecto del vehículo híbrido.

Híbrido												
Tramo	Kilometro Inicial	Kilometro final	Litros Iniciales	Consumo de Gasolina	Litros Finales	Energía Inicial (kWh)	Consumo (kWh)	Energía Final (kWh)	No. de Paradas	Tiempo (horas)	Hora Inicio	Hora Final
Coahuila a Durango	0	8	43	0.9	42.1	387.00	7.88	379.1	0	0.2	06:00:00 a. m.	06:10:40 a. m.
Durango a Zacatecas	8	182	42.1	12.2	30.0	379.12	109.56	269.6	0	1.8	06:10:40 a. m.	08:00:06 a. m.
Zacatecas a Aguascalientes	182	450	30.0	17.8	12.1	269.55	160.23	109.3	0	3.0	08:00:06 a. m.	10:57:59 a. m.
Aguascalientes a Jalisco	450	551	12.1	7.1	5.1	109.32	63.77	45.6	1	1.5	10:57:59 a. m.	12:25:01 p. m.
Jalisco a Guanajuato	551	631	43.0	5.1	37.9	387.00	45.60	341.4	0	0.9	12:25:01 p. m.	01:18:07 p. m.
Guanajuato a Querétaro	631	803	37.9	27.9	10.0	341.40	107.97	233.4	1	2.1	01:18:07 p. m.	03:22:25 p. m.
Querétaro a Tlaxcala	803	1032	43.0	16.0	27.0	387.00	144.22	242.8	0	2.3	03:22:25 p. m.	05:41:17 p. m.
Tlaxcala a Puebla	1032	1116	27.0	16.0	11.0	242.78	46.98	195.8	0	1.4	05:41:17 p. m.	07:07:58 p. m.
						Totales	686.21	**Totales**	2	13.1		

Annexes.

Tabla 4.4 Trayecto del vehículo eléctrico, cargas rápidas.

Eléctrico (Carga rápida)												
Tramo	Kilometro Inicial	Kilometro final	Carga Inicial	Consumo de Batería	Carga Final	Energía Inicial (kWh)	Consumo (kWh)	Energía Final (kWh)	No. de Paradas	Tiempo (horas)	Hora Inicio	Hora Final
Coahuila a Durango	0	8	100%	28%	72%	31.40	8.71	22.69	0	0.18	06:00:00 a. m.	06:10:40 a. m.
Durango a Zacatecas	8	13	72%	62%	10%	22.69	19.55	3.14	1	0.98	06:10:40 a. m.	07:09:10 a. m.
	13	45	80%	70%	10%	25.12	21.98	3.14	1	1.69	07:09:10 a. m.	08:50:34 a. m.
	45	77	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:50:34 a. m.	10:31:57 a. m.
	77	108	80%	70%	10%	25.12	21.98	3.14	1	1.69	10:31:57 a. m.	12:13:20 p. m.
	108	140	80%	70%	10%	25.12	21.98	3.14	1	1.69	12:13:20 p. m.	01:54:43 p. m.
	140	172	80%	70%	10%	25.12	21.98	3.14	1	1.69	01:54:43 p. m.	03:36:07 p. m.
	172	182	80%	21%	59%	25.12	6.59	18.53	0	0.21	03:36:07 p. m.	03:48:53 p. m.
Zacatecas a Aguascalientes	182	205	59%	49%	10%	18.53	15.39	3.14	1	1.21	03:48:53 p. m.	05:01:25 p. m.
	205	239	80%	70%	10%	25.12	21.98	3.14	1	1.73	05:01:25 p. m.	06:45:02 p. m.
	239	273	80%	70%	10%	25.12	21.98	3.14	1	1.73	06:45:02 p. m.	08:28:39 p. m.
	273	306	80%	70%	10%	25.12	21.98	3.14	1	1.73	08:28:39 p. m.	10:12:17 p. m.
	306	340	80%	70%	10%	25.12	21.98	3.14	1	1.73	10:12:17 p. m.	11:55:54 p. m.
	340	374	80%	70%	10%	25.12	21.98	3.14	1	1.73	11:55:54 p. m.	01:39:31 a. m.
	374	407	80%	70%	10%	25.12	21.98	3.14	1	1.73	01:39:31 a. m.	03:23:08 a. m.
	407	441	80%	70%	10%	25.12	21.98	3.14	1	1.73	03:23:08 a. m.	05:06:45 a. m.
	441	450	80%	19%	61%	25.12	6.00	19.12	0	0.21	05:06:45 a. m.	05:19:03 a. m.
Aguascalientes a Jalisco	450	473	61%	51%	10%	19.12	15.98	3.14	1	1.23	05:19:03 a. m.	06:32:39 a. m.
	473	505	80%	70%	10%	25.12	21.98	3.14	1	1.69	06:32:39 a. m.	08:13:52 a. m.
	505	537	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:13:52 a. m.	09:55:05 a. m.
	537	551	80%	31%	49%	25.12	9.84	15.28	0	0.32	09:55:05 a. m.	10:14:05 a. m.
Jalisco a Guanajuato	551	570	49%	39%	10%	15.28	12.14	3.14	1	0.97	10:14:05 a. m.	11:12:32 a. m.
	570	606	80%	70%	10%	25.12	21.98	3.14	1	1.76	11:12:32 a. m.	12:58:22 p. m.
	606	631	80%	50%	30%	25.12	15.72	9.40	0	0.56	12:58:22 p. m.	01:32:01 p. m.
Guanajuato a Querétaro	631	640	30%	20%	10%	9.40	6.26	3.14	1	0.48	01:32:01 p. m.	02:00:56 p. m.
	640	672	80%	70%	10%	25.12	21.98	3.14	1	1.69	02:00:56 p. m.	03:42:30 p. m.
	672	704	80%	70%	10%	25.12	21.98	3.14	1	1.69	03:42:30 p. m.	05:24:04 p. m.
	704	736	80%	70%	10%	25.12	21.98	3.14	1	1.69	05:24:04 p. m.	07:05:38 p. m.
	736	768	80%	70%	10%	25.12	21.98	3.14	1	1.69	07:05:38 p. m.	08:47:12 p. m.
	768	800	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:47:12 p. m.	10:28:45 p. m.
	800	803	80%	5%	75%	25.12	1.72	23.40	0	0.06	10:28:45 p. m.	10:32:06 p. m.
Querétaro a Tlaxcala	803	833	75%	65%	10%	23.40	20.26	3.14	1	1.56	10:32:06 p. m.	12:05:44 a. m.
	833	865	80%	70%	10%	25.12	21.98	3.14	1	1.69	12:05:44 a. m.	01:47:17 a. m.
	865	897	80%	70%	10%	25.12	21.98	3.14	1	1.69	01:47:17 a. m.	03:28:51 a. m.
	897	929	80%	70%	10%	25.12	21.98	3.14	1	1.69	03:28:51 a. m.	05:10:25 a. m.
	929	961	80%	70%	10%	25.12	21.98	3.14	1	1.69	05:10:25 a. m.	06:51:59 a. m.
	961	993	80%	70%	10%	25.12	21.98	3.14	1	1.69	06:51:59 a. m.	08:33:32 a. m.
	993	1025	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:33:32 a. m.	10:15:06 a. m.
	1025	1032	80%	17%	63%	25.12	5.32	19.80	0	0.16	06:51:59 a. m.	07:01:19 a. m.
Tlaxcala a Puebla	1032	1056	63%	53%	10%	19.80	16.66	3.14	1	1.28	07:01:19 a. m.	08:18:17 a. m.
	1056	1088	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:18:17 a. m.	09:59:51 a. m.
	1088	1116	80%	42%	38%	25.12	13.10	12.02	0	0.61	09:59:51 a. m.	10:36:40 a. m.
								Total, Cargas				

Annexes.

Tabla 4.5 Trayecto del vehículo eléctrico, cargas lentas y rápidas.

Eléctrico (Cargas rápidas y lentas)												
Tramo	Kilometro Inicial	Kilometro final	Carga Inicial	Consumo de Batería	Carga Final	Energía Inicial (kWh)	Consumo (kWh)	Energía Final (kWh)	No. de Paradas	Tiempo (horas)	Hora Inicio	Hora Final
Coahuila a Durango	0	8	100%	72%	28%	31.40	8.71	22.69	1	1.19	06:00:00 a. m.	07:11:22 a. m.
Durango a Zacatecas	8	40	80%	70%	10%	25.12	21.98	3.14	1	1.69	07:00:00 a. m.	08:41:23 a. m.
	40	72	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:41:23 a. m.	10:22:46 a. m.
	72	104	80%	70%	10%	25.12	21.98	3.14	1	1.69	10:22:46 a. m.	12:04:10 p. m.
	104	136	80%	70%	10%	25.12	21.98	3.14	1	1.69	12:04:10 p. m.	01:45:33 p. m.
	136	168	80%	70%	10%	25.12	21.98	3.14	1	1.69	01:45:33 p. m.	03:26:56 p. m.
	168	182	80%	31%	49%	25.12	9.84	15.28	0	0.32	03:26:56 p. m.	03:46:00 p. m.
Zacatecas a Aguascalientes	182	201	49%	39%	10%	15.28	12.14	3.14	1	0.95	03:46:00 p. m.	04:43:14 p. m.
	201	234	80%	70%	10%	25.12	21.98	3.14	1	1.73	04:43:14 p. m.	06:26:51 p. m.
	234	268	80%	70%	10%	25.12	21.98	3.14	1	1.73	06:26:51 p. m.	08:10:28 p. m.
	268	301	80%	70%	10%	25.12	21.98	3.14	1	1.73	08:10:28 p. m.	09:54:05 p. m.
	301	335	80%	70%	10%	25.12	21.98	3.14	2	8.00	09:54:05 p. m.	05:54:05 a. m.
	335	378	100%	90%	10%	31.40	28.26	3.14	1	2.22	05:54:05 a. m.	08:07:19 a. m.
	378	412	80%	70%	10%	25.12	21.98	3.14	1	1.73	08:07:19 a. m.	09:50:56 a. m.
	412	445	80%	70%	10%	25.12	21.98	3.14	1	1.73	09:50:56 a. m.	11:34:33 a. m.
	445	450	80%	9%	71%	25.12	2.96	22.16	0	0.10	11:34:33 a. m.	11:40:36 a. m.
Aguascalientes a Jalisco	450	478	71%	61%	10%	22.16	19.02	3.14	1	1.46	11:40:36 a. m.	01:08:10 p. m.
	478	509	80%	70%	10%	25.12	21.98	3.14	1	1.69	01:08:10 p. m.	02:49:23 p. m.
	509	541	80%	70%	10%	25.12	21.98	3.14	1	1.69	02:49:23 p. m.	04:30:36 p. m.
	541	551	80%	22%	58%	25.12	6.81	18.31	0	0.22	04:30:36 p. m.	04:43:44 p. m.
Jalisco a Guanajuato	551	575	58%	48%	10%	18.31	15.17	3.14	1	1.22	04:43:44 p. m.	05:56:48 p. m.
	575	611	80%	70%	10%	25.12	21.98	3.14	1	1.76	05:56:48 p. m.	07:42:39 p. m.
	611	631	80%	40%	40%	25.12	12.69	12.43	0	0.45	07:42:39 p. m.	08:09:48 p. m.
Guanajuato a Querétaro	631	645	40%	30%	10%	12.43	9.29	3.14	1	0.72	08:09:48 p. m.	08:52:45 p. m.
	645	677	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:52:45 p. m.	10:34:18 p. m.
	677	709	80%	70%	10%	25.12	21.98	3.14	2	8.00	10:34:18 p. m.	06:34:18 a. m.
	709	741	80%	70%	10%	25.12	21.98	3.14	1	1.69	06:34:18 a. m.	08:15:52 a. m.
	741	773	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:15:52 a. m.	09:57:26 a. m.
	773	803	10%	0%	10%	3.14	20.66	-17.52	1	0.67	09:57:26 a. m.	10:37:38 a. m.
Querétaro a Tlaxcala	803	835	80%	70%	10%	25.12	21.98	3.14	1	1.69	10:37:38 a. m.	12:19:12 p. m.
	835	867	80%	70%	10%	25.12	21.98	3.14	1	1.69	12:19:12 p. m.	02:00:45 p. m.
	867	899	80%	70%	10%	25.12	21.98	3.14	1	1.69	02:00:45 p. m.	03:42:19 p. m.
	899	931	80%	70%	10%	25.12	21.98	3.14	1	1.69	03:42:19 p. m.	05:23:53 p. m.
	931	963	80%	70%	10%	25.12	21.98	3.14	1	1.69	05:23:53 p. m.	07:05:27 p. m.
	963	995	80%	70%	10%	25.12	21.98	3.14	1	1.69	07:05:27 p. m.	08:47:00 p. m.
	995	1028	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:47:00 p. m.	10:28:34 p. m.
	1028	1032	80%	11%	69%	25.12	3.61	21.51	0	0.10	07:05:27 p. m.	07:11:26 p. m.
Tlaxcala a Puebla	1032	1059	69%	59%	10%	21.51	18.37	3.14	1	1.41	07:11:26 p. m.	08:36:13 p. m.
	1059	1091	80%	70%	10%	25.12	21.98	3.14	1	1.69	08:36:13 p. m.	10:17:38 p. m.
	1091	1116	80%	36%	44%	25.12	11.38	13.74	0	0.56	10:17:38 p. m.	10:51:23 p. m.
						Total kWh	750.39	**Total Cargas Rápidas**	32	68.43		
								Total Cargas Lentas	2			
								Total Cargas	34			

Conclusions.

- This study compared gasoline, hybrid, and electric cars to offer tailored purchase recommendations.
- Hybrid vehicles displayed similar long-distance performance to gasoline cars, while electric cars faced limitations.
- The research involved detailed analysis of top-selling car models in Mexico, focusing on efficiency, range, and costs.
- Consumers can make informed decisions based on mobility needs and environmental considerations.
- Future research could explore the evolving technology of electric vehicles and their infrastructure requirements for long-distance travel.