

# COMPLICATIONS WITH USING AFFORDABILITY EFFICIENCY MEASURES

$\$/FH$  TELLS YOU HOW MUCH A FLIGHT HOUR COSTS, NOT WHAT YOU GET FOR IT

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# ABSTRACT

Affordability efficiency measures are supposed to help us make informed decisions about buying things. For example, we can compare unit acquisition costs, annualized sustainment costs or even miles per gallon. This presentation uses publicly available data about cars to explore some complications in using these kinds of measures. Using simple models, we'll look at a typical "next generation" analysis of alternatives. You'll see how a 5th generation truck can be worse than a 4th generation car on all affordability efficiency measures, while actually being much cheaper at completing the mission when all factors are considered.

# AGENDA

- Use Cars as an Alternative to Aircraft
  - Public Data = Unclassified, Not Export Controlled Information
  - Source: <http://www.kbb.com>
- 5-Year Cost to Own
  - Explore Some Data
- Apply to 4<sup>th</sup> Gen vs 5<sup>th</sup> Gen Discussion
  - Simple Models
- Highlight Counterintuitive Results
  - 5<sup>th</sup> Gen Worse than 4<sup>th</sup> Gen on all Affordability Efficiency Measures, Yet...
  - 5<sup>th</sup> Gen Much Cheaper Than 4<sup>th</sup> Gen When All Factors Are Considered

AFFORDABILITY EFFICIENCY  
MEASURES CAN BE  
MISLEADING

# 10 Most Affordable New Cars

Posted 2/13/2018 3:09 PM

## Overview

◀ Prev

Start the list ▶

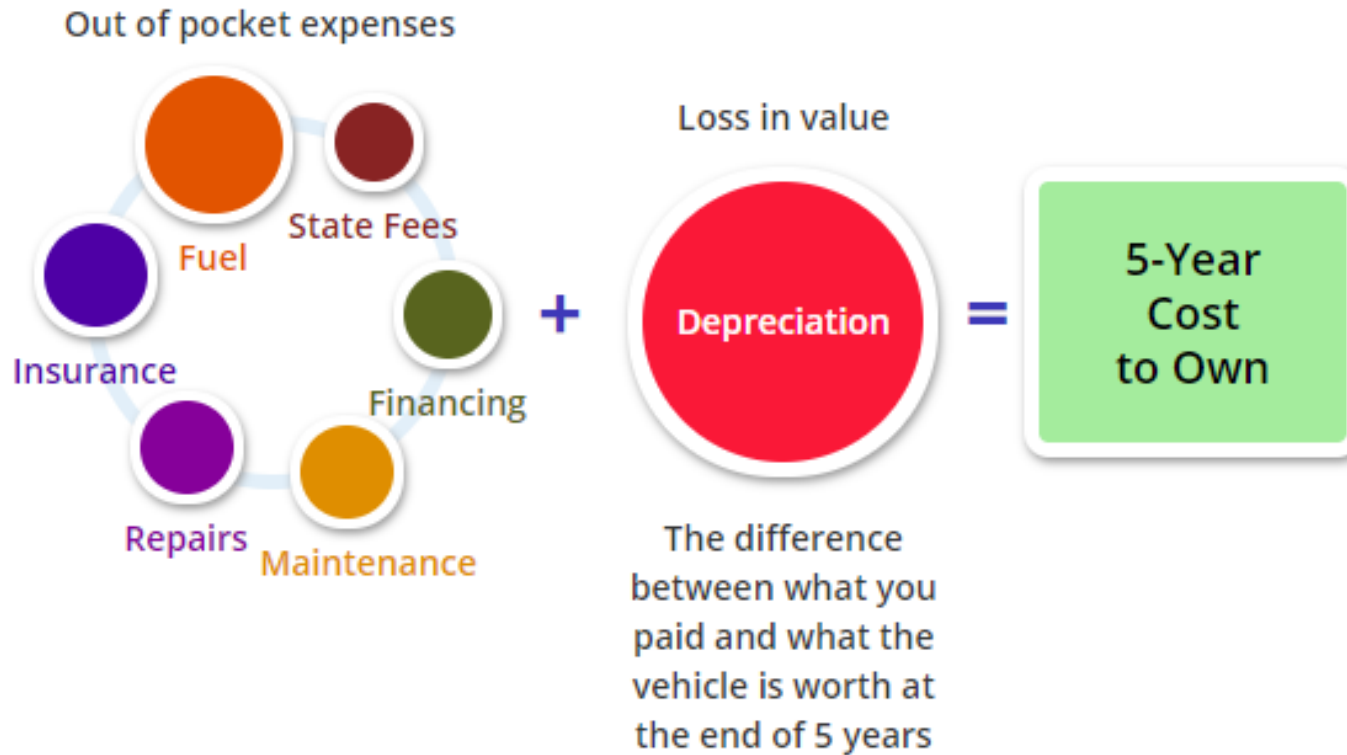


Paying a fair price is always important, but if you really want to get the cheapest new car you have to look beyond purchase price. Our 5-Year Cost to Own figures combine depreciation with fuel, financing and insurance costs to help you make a more informed decision when choosing an affordable new car.

Based on a full buy-drive-sell ownership cycle, here are the 10 cheapest new cars of 2018:

# What Is 5-Year Cost to Own?

The 5-Year Cost to Own is the total amount of vehicle-related costs you will likely have to cover during the first 5 years of owning a car. This includes out-of-pocket expenses like fuel and insurance, and vehicle depreciation (loss in value).



Hover to see more detail

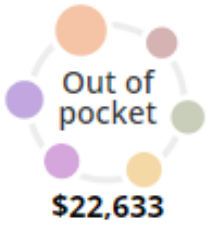
# How Does It Help You Compare?

Even if two vehicles are priced the same, that doesn't mean they will cost the same over time. Knowing the 5-Year Cost to Own ahead of time can help you save money in the long run.

Sample Sedan A



**Purchase Price: \$19,272**



+



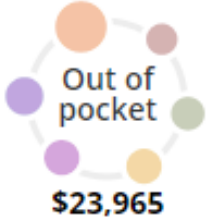
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Sample Sedan B



**Purchase Price: \$19,272**



+



=



# See the Lowest 5-Year Cost to Own for: Subcompact Car

Search the standouts by class or compare your favorites.

## See Other Classes

- Subcompact Car
- Compact Car
- Mid-size Car
- Full-size Car

- Compact SUV/Crossover
- Mid-size SUV/Crossover
- Full-size SUV/Crossover

- Entry-level Luxury Car
- Luxury Car
- Sports Car

- Mid-size Pickup Truck
- Full-size Pickup Truck
- Minivan

2018 Chevrolet Spark LS



5 year = \$27,887

[See breakdown](#)

2018 Nissan Versa S



5 year = \$27,947

[See breakdown](#)

2018 Hyundai Accent SE



5 year = \$28,733

[See breakdown](#)

2018 Kia Rio LX



5 year = \$29,192

[See breakdown](#)

# 2018 Chevrolet Spark 5-Year Cost To Own

The Fair Market Range for this car in your area is **\$13,019 - \$13,584**.

[2017](#) [2018](#) [L S, Manual, 5-Spd](#) [look up another car](#) [Save Vehicle](#)



<b>Fair Market Range</b> <b>\$13,019 - \$13,584</b>	<b>Invoice</b> <b>\$13,468</b>	<b>MSRP</b> <b>\$13,925</b>
<b>Fair Purchase Price</b> <b>\$13,302</b>		



[1 available '17 models](#) [Details](#)

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Valid for ZIP Code 76132 through 04/19/2018





## 2018 Chevrolet Spark LS Hatchback 4-door

Compare This Car [Add](#)

### Out of Pocket Expenses

<span style="color: orange;">●</span> Fuel:	\$6,018
<span style="color: purple;">●</span> Insurance:	\$4,780
<span style="color: olive;">●</span> Financing:	\$1,056
<span style="color: brown;">●</span> State Fees:	\$1,565
<span style="color: gold;">●</span> Maintenance:	\$2,081
<span style="color: purple;">●</span> Repairs:	\$1,869

**Total: \$17,370**

+

### Loss in Value

● Depreciation: **\$10,517** =

The difference between what you paid and what the vehicle is worth at the end of 5 years

### 5-Year Cost to Own

(Based on 15,000 miles per year, and 3.19% APR for 60 months with a \$1,330.20 down payment.)

**\$27,887**

Cost Per Mile ⓘ: **\$0.37**

[See more details](#)

## Vehicle Highlights



Fuel Economy:  
City 29/Hwy  
39/Comb 33 MPG



Max Seating: 4



Doors: 4



Engine: 4-Cyl,  
ECOTEC, 1.4 Liter



Drivetrain: FWD



Transmission:  
Manual, 5-Spd



EPA Class: Sub  
Compact Cars



Body Style:  
Hatchback



Country of Origin:  
United States



Country of  
Assembly: Korea

Curb Weight	2246 lbs.
Tires / Wheel Size	P185/55R15
Rear Tires / Wheel Size	-
Turning Diameter	33.8 feet
Standard Axle Ratio	3.91
Minimum Ground Clearance	-
Maximum Ground Clearance	-
Maximum GVWR	-
Maximum Towing	Not Recommended
Payload Base Capacity	-
Head Room: Front	39.0 inches
Head Room: Rear	37.0 inches
Leg Room: Front	41.7 inches
Leg Room: Rear	33.0 inches
Shoulder Room: Front	50.8 inches
Shoulder Room: Rear	49.8 inches
EPA Passenger	83.0 cu.ft.
EPA Trunk or Cargo	27.2 cu.ft.
EPA Total Interior	-
Truck Bed Volume	-

# 2018 Nissan Versa Specs

The Fair Market Range for this car in your area is **\$11,508 - \$12,591**.



Invoice  
N/A  
Why?

Fair Market Range  
**\$11,508 - \$12,591**

Fair Purchase Price  
**\$12,050**

MSRP  
**\$12,995**



305 nearby '18 models  
Starting at **\$11,098**

Valid for ZIP Code 76132 through 04/19/2018



## 2018 Nissan Versa S Sedan 4-door

Compare This Car [Add](#)

### Out of Pocket Expenses

Fuel:	\$6,487
Insurance:	\$5,895
Financing:	\$957
State Fees:	\$1,439
Maintenance:	\$2,448
Repairs:	\$1,659

**Total: \$18,885**

+

### Loss in Value

● Depreciation: **\$9,062** =

The difference between what you paid and what the vehicle is worth at the end of 5 years

### 5-Year Cost to Own

(Based on 15,000 miles per year, and 3.19% APR for 60 months with a \$1,205.00 down payment.)

**\$27,947**

Cost Per Mile ⓘ: **\$0.37**

[See more details](#)



2018 Chevrolet Spark  
LS Hatchback 4-door



2018 Nissan Versa  
S Sedan 4-door

### Out of Pocket Expenses

Fuel:	\$6,018
Insurance:	\$4,780
Financing:	\$1,056
State Fees:	\$1,565
Maintenance:	\$2,081
Repairs:	\$1,869

+

Total: \$17,370

### Out of Pocket Expenses

Fuel:	\$6,487
Insurance:	\$5,895
Financing:	\$957
State Fees:	\$1,439
Maintenance:	\$2,448
Repairs:	\$1,659

+

Total: \$18,885

### Delta

+ \$469  
+ \$1115  
- \$99  
- \$126  
+ \$367  
- \$210  
+ \$1515

## What is the Projected Cost to Own?

5-Year Cost:

**\$27,947\***

(\$0.37 per mile) ⓘ

How Does It Compare  
to Similar Cars? ⓘ

**Among the best**

(Comparison based on values  
before customization)

### Yearly Breakdown

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
 Fuel	\$1,341	\$1,272	\$1,267	\$1,291	\$1,316	<b>\$6,487</b>
 Insurance	\$1,179	\$1,179	\$1,179	\$1,179	\$1,179	<b>\$5,895</b>
 Financing	\$336	\$266	\$194	\$119	\$42	<b>\$957</b>
 State Fees	\$928	\$134	\$144	\$113	\$120	<b>\$1,439</b>
 Maintenance	\$214	\$544	\$214	\$795	\$681	<b>\$2,448</b>
 Repairs	\$0	\$0	\$553	\$553	\$553	<b>\$1,659</b>
 Depreciation	\$4,903	\$1,170	\$1,169	\$910	\$910	<b>\$9,062</b>
<b>Year Total</b>	<b>\$8,901</b>	<b>\$4,565</b>	<b>\$4,720</b>	<b>\$4,960</b>	<b>\$4,801</b>	<b>\$27,947</b>

# See the Lowest 5-Year Cost to Own for: Full-size Pickup Truck

Search the standouts by class or compare your favorites.

## See Other Classes


- Subcompact Car
- Compact Car
- Mid-size Car
- Full-size Car

- Compact SUV/Crossover
- Mid-size SUV/Crossover
- Full-size SUV/Crossover

- Entry-level Luxury Car
- Luxury Car
- Sports Car

- Mid-size Pickup Truck
- Full-size Pickup Truck
- Minivan


2017 Chevrolet Silverado 1500 Regular Cab Work Truck

**BEST IN CLASS**  **5 year = \$39,526**  
[See breakdown](#)


2018 Ford F150 Regular Cab XL

 **5 year = \$39,964**  
[See breakdown](#)

2017 Toyota Tundra Double Cab SR5

 **5 year = \$41,061**  
[See breakdown](#)

2017 Toyota Tundra CrewMax SR5

 **5 year = \$41,396**  
[See breakdown](#)

# 2017 Chevrolet Silverado 1500 Regular Cab 5-Year Cost To Own

The Fair Market Range for this car in your area is **\$25,596 - \$27,188**.

2017 2018 Work Truck, Two-Wheel Dr [look up another car](#) [Save Vehicle](#)



<b>Fair Market Range</b> <b>\$25,596 - \$27,188</b>	Invoice <b>\$27,443</b>	MSRP <b>\$28,680</b>
Fair Purchase Price <b>\$26,239</b>		



Call for availability  
**844-753-8340**

[Details](#)

VERNON AUTO GROUP

[Transaction data](#)

[Important Info & Definitions](#)  
Valid for ZIP Code 76132 through 04/19/2018





## 2017 Chevrolet Silverado 1500 Regular Cab Work Truck Pickup 2-door

Compare This Car

Add

### Out of Pocket Expenses

Fuel:	\$9,730
Insurance:	\$5,895
Financing:	\$2,085
State Fees:	\$2,667
Maintenance:	\$2,937
Repairs:	\$1,731

**Total: \$25,045**

+

### Loss in Value

● Depreciation: **\$14,481** =

The difference between what you paid and what the vehicle is worth at the end of 5 years

### 5-Year Cost to Own

(Based on 15,000 miles per year, and 3.19% APR for 60 months with a \$2,623.90 down payment.)

**\$39,526**

Cost Per Mile ⓘ: **\$0.52**

[See more details](#)

# Vehicle Highlights



Fuel Economy:  
**City 18/Hwy  
 24/Comb 20 MPG**



Max Seating: **3**



Doors: **2**



Engine: **V6, EcoTec3,  
 Flex Fuel, 4.3 Liter**



Drivetrain: **2WD**



Transmission:  
**Automatic, 6-Spd  
 HD w/Overdrive**



EPA Class:  
**Standard Pickup  
 Trucks**



Body Style: **Pickup**



Country of Origin:  
**United States**



Country of  
 Assembly: **United  
 States**

Curb Weight	4510 lbs.
Tires / Wheel Size	P255/70R17
Rear Tires / Wheel Size	P255/70R17
Turning Diameter	40.0 feet
Standard Axle Ratio	3.23
Minimum Ground Clearance	8.2 inches
Maximum Ground Clearance	-
Maximum GVWR	6500 lbs.
Maximum Towing	8900 lbs.
Payload Base Capacity	1960 lbs.
Head Room: Front	42.4 inches
Head Room: Rear	-
Leg Room: Front	45.3 inches
Leg Room: Rear	-
Shoulder Room: Front	66.0 inches
Shoulder Room: Rear	-
EPA Passenger	-
EPA Trunk or Cargo	-
EPA Total Interior	-
Truck Bed Volume	61 cu.ft.

# 5TH GEN COSTS MORE TO BUY AND SUSTAIN

## 4<sup>th</sup> Gen

### Chevy Spark

- Fair Purchase Price = \$13,302
- Fuel Efficiency = 33 MPG
- 5 yr O&S = \$17,370
- Cost per mile = \$0.37/mile

## 5<sup>th</sup> Gen

### Chevy Silverado

- Fair Purchase Price = \$26,239
- Fuel Efficiency = 20 MPG
- 5 yr O&S = \$25,045
- Cost per mile = \$0.52/mile

# COST PER MISSION (SIMPLE)

## 4<sup>th</sup> Gen

### Chevy Spark

- Cargo Capacity = 27.2 ft<sup>3</sup>
- Trips =
  - $1,000,000 / 27 = 36,765$  trips
- Cost of mission =
  - trips \* miles/trip \* cost/mile
  - $36,765 * 400 * \$0.37$
  - = \$5,467,843

## 5<sup>th</sup> Gen

### Chevy Silverado

- Cargo Capacity = 61 ft<sup>3</sup>
- Trips =
  - $1,000,000 / 61 = 16,393$  trips
- Cost of mission =
  - trips \* miles/trip \* cost/mile
  - $16,393 * 400 * \$0.52$
  - = \$3,455,825 / mission

# FLEET SIZE

## 4<sup>th</sup> Gen

### Chevy Spark

- Cargo Capacity = 27.2 ft<sup>3</sup>
- Trips =
  - $1,000,000 / 27 = 36,765$  trips
- Fleet Size =
  - Trips \* miles /trip / 75000 miles
  - $36,765 * 400 / 75,000$
  - = 196 vehicles

## 5<sup>th</sup> Gen

### Chevy Silverado

- Cargo Capacity = 61 ft<sup>3</sup>
- Trips =
  - $1,000,000 / 61 = 16,393$  trips
- Fleet Size =
  - Trips \* miles /trip / 75000 miles
  - $16,393 * 400 / 75,000$
  - = 87 vehicles

# EFFECT OF AVAILABILITY ON FLEET SIZE

If the vehicles are not available for tasking, the fleet size must be increased to cover the lack of availability

Vehicle Inventory Required =

- Vehicles Available (Needed) / Vehicle Availability %

Example: 100 Vehicles Needed

- For 80% Availability,  $100 / 0.80 = 125$  Vehicles Inventory
- For 60% Availability,  $100 / 0.60 = 167$  Vehicles Inventory
- For 40% Availability,  $100 / 0.40 = 250$  Vehicles Inventory

Unavailable vehicles cost the same as Available vehicles except

- Unavailable vehicles do not consume fuel

$$\text{VEHICLE AVAILABILITY \%} = \frac{\text{VEHICLES AVAILABLE}}{\text{VEHICLE INVENTORY}}$$

# COST OF UNAVAILABILITY

## 4<sup>th</sup> Gen

### Chevy Spark

- Availability = 80%
- Unavailable Fleet =
  - Available Fleet / (1 – Availability)
  - = 196 / (1 - 0.80)
  - = 49
- Cost of Unavailability
  - Unavailable Fleet \* Sustainment Cost (Less Fuel)
  - = 49 \* 11,351
  - \$556,422

## 5<sup>th</sup> Gen

### Chevy Silverado

- Availability = 60%
- Unavailable Fleet =
  - Available Fleet / (1 – Availability)
  - = 87 / (1 - 0.60)
  - = 58
- Cost of Unavailability
  - Unavailable Fleet \* Sustainment Cost (Less Fuel)
  - = 58 \* 15,315
  - \$892,678

# EFFECT OF EXCHANGE RATE

Not all missions can be completed due to many factors

- Lethality
- Survivability
- Vulnerability

Such information tends to be very sensitive

Using public numbers

- F-35 Exchange Rate ~ 20:1 (5% attrition)
- F-16 Exchange Rate ~ 4:1 (25% attrition)

FLEET SIZE MUST BE  
INCREASED TO ACCOUNT  
FOR ATTRITION



# ATTRITION/RESERVE

## 4<sup>th</sup> Gen

### Chevy Spark

- Exchange Rate ~ 4:1
- Attrition = 25%
- Reserve Fleet =
  - Available Fleet – Available Fleet / (1 + Attrition)
  - = 196 – 196/ (1.25)
  - = 39
- Cost of reserve fleet
  - = size of reserve fleet \* acquisition cost
  - = 39 \* \$13,302
  - = \$521,647

## 5<sup>th</sup> Gen

### Chevy Silverado

- Exchange Rate ~ 20:1
- Attrition = 5%
- Reserve Fleet =
  - Available Fleet – Available Fleet / (1 + Attrition)
  - = 87 – 87/ (1.05)
  - = 4
- Cost of reserve fleet
  - = size of reserve fleet \* acquisition cost
  - = 4 \* \$26,239
  - = \$109,244

# TOTALS

## 4<sup>th</sup> Gen

### Chevy Spark

- Total Fleet Size
  - Available Fleet = 196
  - + Unavailable Fleet = 49
  - + Reserve Fleet = 39
  - = 284
- Total Cost of Fleet
  - Cost of Mission = \$5,467,843
  - + Cost of Unavailable Fleet = \$556,422
  - + Cost of Reserve Fleet = \$521,647
  - = \$6,545,912

## 5<sup>th</sup> Gen

### Chevy Silverado

- Total Fleet Size
  - Available Fleet = 87
  - + Unavailable Fleet = 58
  - + Reserve Fleet = 4
  - = 150
- Total Cost of Fleet
  - Cost of Mission = \$3,455,825
  - + Cost of Unavailable Fleet = \$892,678
  - + Cost of Reserve Fleet = \$109,244
  - = \$4,457,747

# OBJECTIONS/LIMITATIONS

- Aircraft production is much lower than car production
- Aircraft complexity is much higher than car complexity
- Aircraft availability is much lower than car availability
- Aircraft sustainment is a larger percentage of total cost than for cars
- Aircraft have negligible/no residual value at the end of service life
- Aircraft availability tends to use an end-user perspective (availability of possessed fleet) which obscures costs of total fleet
- Aircraft are actively targeted for attrition
- For aircraft, costs associated with failed missions (leakers) can be very high
- An aircraft “mission” is more complex than delivering medical supply boxes

# OBJECTIONS/LIMITATIONS

# OBSERVATIONS

- 4<sup>th</sup> Gen Chevy Spark was cheaper than 5<sup>th</sup> Gen Chevy Silverado on typical measures of comparison
  - Acquisition cost per unit
  - 5 year ownership cost per unit
  - Annualized sustainment cost per unit
  - Miles per gallon
  - Cost per mile
  - Availability
- 5<sup>th</sup> Gen Chevy Silverado was cheaper than 4<sup>th</sup> Gen Chevy Spark on mission-level measures of comparison, even when including lower availability
  - Smaller fleet size
  - Cheaper overall to complete mission

# OBSERVATIONS

# OBSERVATIONS

- Observation - Typical measures for comparison
  - Only work when “other things are equal”
  - Can suboptimize at the mission level
  - Can lead to incorrect conclusions due to incomplete context
- Observation – compounding over long periods of time
  - Inhibits meaningful comparisons

OBSERVATIONS

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# CHEVY SILVERADO, TOTAL COSTS FOR 55 YEARS

- Acquisition Cost = \$26,239/unit
- Service Life = 5 years (no residual value)
- Usage = 15,000 miles per year = 75,000 miles
- Annualized Sustainment Costs = \$5009/year
- 2017 sales = 585,564 units
- Years of Production = 50 years
- Total Production =  $50 * 585,564 = 29,278,200$  units
- Total Acquisition Cost =  $29,278,200 * \$26,239 = \$768,230,689,800$
- Years of Operation = 55 years
- Cost of sustainment =  $55 * 585,564 * \$5009 = \$161,319,954,180$
- Total Program Cost (unescalated) = acquisition + sustainment =  $\$929,550,643,980$
- Yearly Inflation (Net) = 3%
- 50 year escalation factor = 2.3
- Total Cost (escalated) =  $2.3 * \$929,550,643,980 = \$2,097,008,012,571 = \sim \$2.1T$

CHEVY SILVERADO  
IS THE  
MOST EXPENSIVE  
VEHICLE?