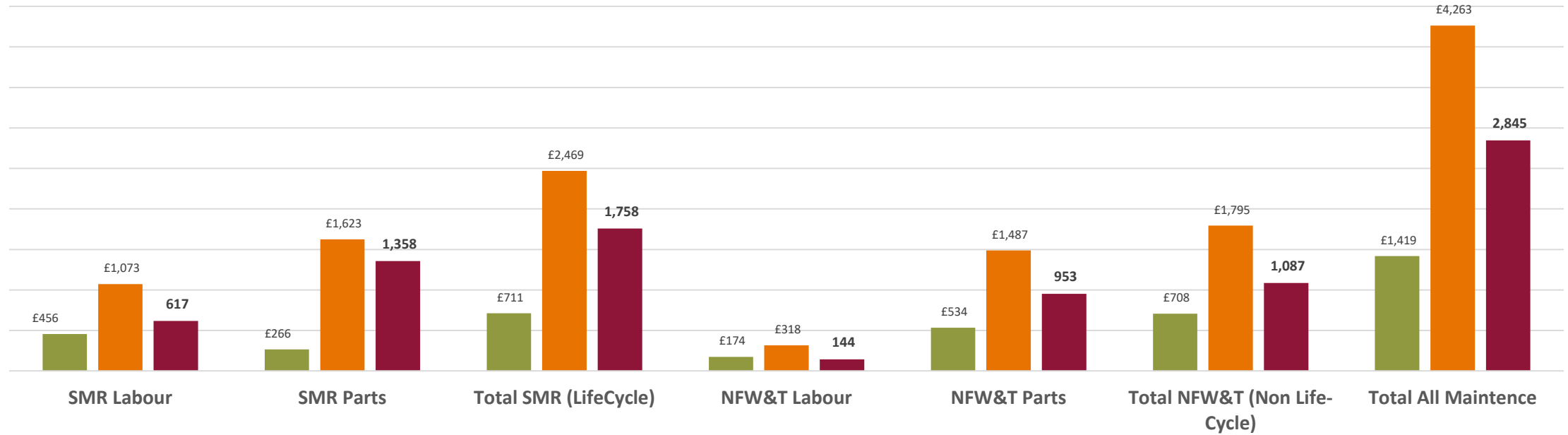


# EV Life-Cycle Cost Analysis

Sustainable Fleet Technology Conference  
September 1, 2022

## BEV vs ICE Maintenance Costs & Benefits Combined Average Per Vehicle Category Over Four Years

■ BEV ■ ICE ■ Benefits



### Royal Mail ICE v BEV maintenance cost analysis case study

Tracking 160+ EV models of same size mail delivery vans against diesel models  
1,758 savings per unit in standard M&R costs over 4 years. 2,845 total savings

Model Setup

Model type:  Category group:

Measure type:  Category type:

Inflation adjusted cost:  Category subtype:

Category:

Maintenance Rate Card											
Values	0 Years	1 Years	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10 Years
Sum of Target Labor	£81.09	£191.94	£362.68	£437.09	£476.76	£475.00	£489.15	£468.23	£429.77	£406.53	£389.92
Sum of Target Parts	£104.01	£274.33	£558.89	£686.16	£749.84	£687.78	£678.34	£678.18	£557.81	£497.95	£453.93
Sum of Target Commercial	-£19.21	-£35.06	-£131.35	-£41.85	-£4.40	-£2.42	-£0.79	-£1.00	-£0.18	-£0.12	-£0.10
<b>Sum of Target</b>	<b>£165.90</b>	<b>£431.21</b>	<b>£790.22</b>	<b>£1,081.41</b>	<b>£1,222.20</b>	<b>£1,160.36</b>	<b>£1,166.70</b>	<b>£1,145.41</b>	<b>£987.39</b>	<b>£904.37</b>	<b>£843.76</b>
Sum of Non-Target Labor	£38.21	£53.05	£103.00	£123.25	£111.69	£114.05	£106.38	£98.74	£80.03	£63.81	£60.23
Sum of Non-Target Parts	£243.14	£349.49	£437.83	£456.28	£475.49	£440.20	£424.30	£350.68	£284.07	£243.48	£223.08
Sum of Non-Target Commercial	£0.00	-£0.00	-£1.57	-£8.05	-£0.11	-£0.10	-£0.03	-£0.03	£0.00	£0.00	£0.00
<b>Sum of Non-Target</b>	<b>£281.35</b>	<b>£402.53</b>	<b>£539.26</b>	<b>£571.48</b>	<b>£587.07</b>	<b>£554.14</b>	<b>£530.65</b>	<b>£449.39</b>	<b>£364.09</b>	<b>£307.29</b>	<b>£283.32</b>
<b>Sum of Target and Non-Target</b>	<b>£447.25</b>	<b>£833.75</b>	<b>£1,329.48</b>	<b>£1,652.89</b>	<b>£1,809.26</b>	<b>£1,714.50</b>	<b>£1,697.35</b>	<b>£1,594.80</b>	<b>£1,351.49</b>	<b>£1,211.66</b>	<b>£1,127.07</b>
Sum of Target Labor Hours	3.47	8.22	15.53	18.72	20.42	20.34	20.95	20.05	18.41	17.41	16.70
Sum of Non-Target Labor Hours	1.64	2.27	4.41	5.28	4.78	4.88	4.56	4.23	3.43	2.73	2.58
<b>Sum of Target and Non-Target Labor Hours</b>	<b>5.11</b>	<b>10.49</b>	<b>19.94</b>	<b>24.00</b>	<b>25.20</b>	<b>25.23</b>	<b>25.50</b>	<b>24.28</b>	<b>21.83</b>	<b>20.14</b>	<b>19.28</b>

- ⚙ Maintenance life cycle costs compiled by year in service
- ⚙ Target – Standard Maintenance & Repair (SMR) life cycle costs
- ⚙ Non-Target – Non-Fair Wear & Tear (NFWT) non-life cycle costs

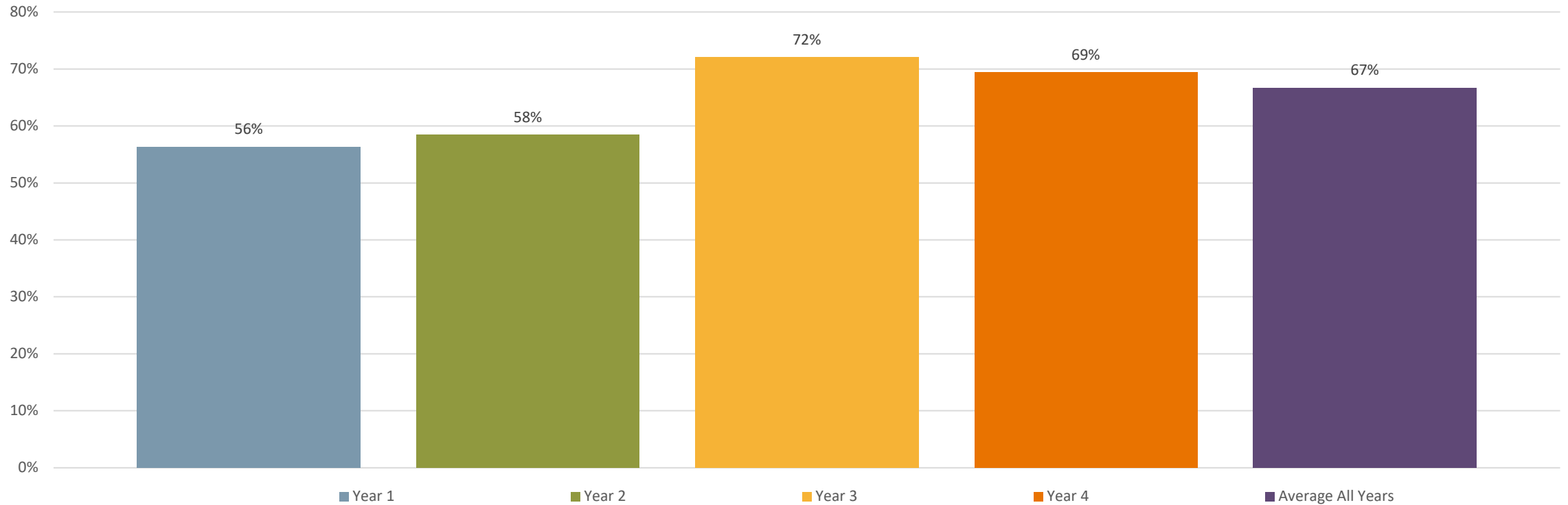
### Model Setup

Model type:	<input type="text" value="Rate Card"/>	Category group:	<input type="text" value="FLEET"/>
Measure type:	<input type="text" value="Average"/>	Category type:	<input type="text" value="LCV"/>
Inflation adjusted cost:	<input type="text" value="Yes"/>	Category subtype:	<input type="text" value="CDV"/>
		Category:	<input type="text" value="CAPVEAB"/>

Maintenance Rate Card						
Values	0 Years	1 Years	2 Years	3 Years	4 Years	
Sum of Target Labor	£71.01	£99.02	£149.31	£136.25	£9.79	
Sum of Target Parts	£8.59	£44.68	£72.95	£139.31	£41.17	
Sum of Target Commercial	-£1.30	-£7.65	-£1.22	£0.00	£0.00	
<b>Sum of Target</b>	<b>£78.31</b>	<b>£136.04</b>	<b>£221.04</b>	<b>£275.56</b>	<b>£50.96</b>	
Sum of Non-Target Labor	£46.05	£41.48	£44.38	£42.09	£5.27	
Sum of Non-Target Parts	£70.99	£169.06	£106.36	£187.29	£21.28	
Sum of Non-Target Commercial	£0.00	£0.00	£0.00	£0.00	£0.00	
<b>Sum of Non-Target</b>	<b>£117.03</b>	<b>£210.54</b>	<b>£150.75</b>	<b>£229.38</b>	<b>£26.55</b>	
<b>Sum of Target and Non-Target</b>	<b>£195.34</b>	<b>£346.58</b>	<b>£371.79</b>	<b>£504.94</b>	<b>£77.51</b>	
Sum of Target Labor Hours	3.04	4.24	6.39	5.84	0.42	
Sum of Non-Target Labor Hours	1.97	1.78	1.90	1.80	0.23	
<b>Sum of Target and Non-Target Labor Hours</b>	<b>5.01</b>	<b>6.02</b>	<b>8.30</b>	<b>7.64</b>	<b>0.65</b>	

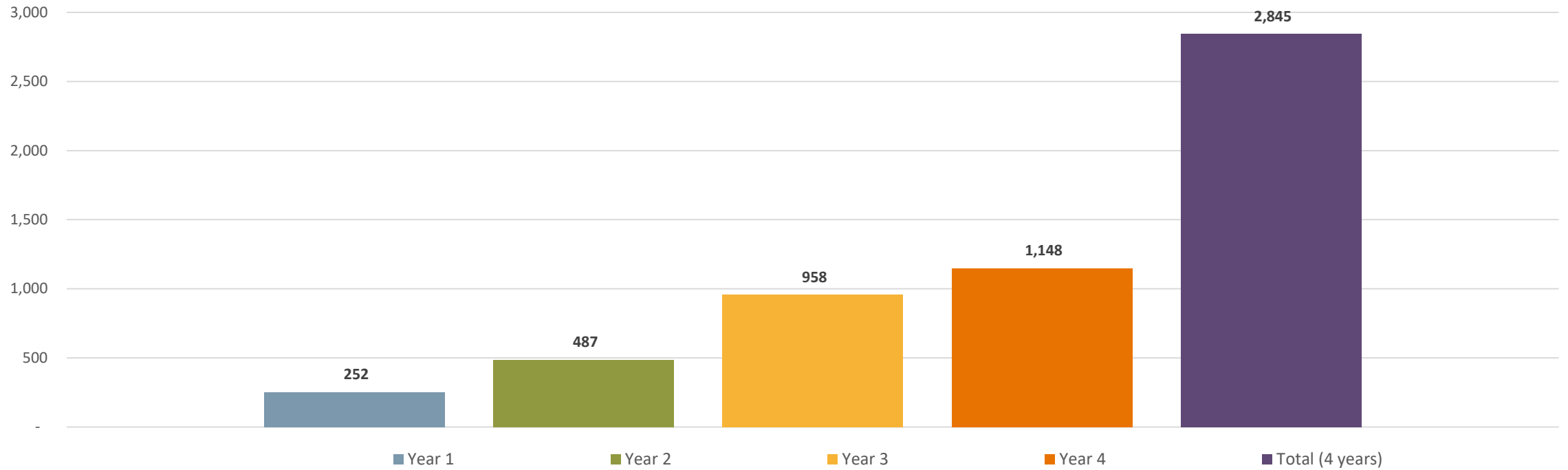
⚙ Same breakdown for BEV – 1<sup>st</sup> delivered in 2017/2018

## BEV Vehicle Category Maintenance Cost Reduction % by Year



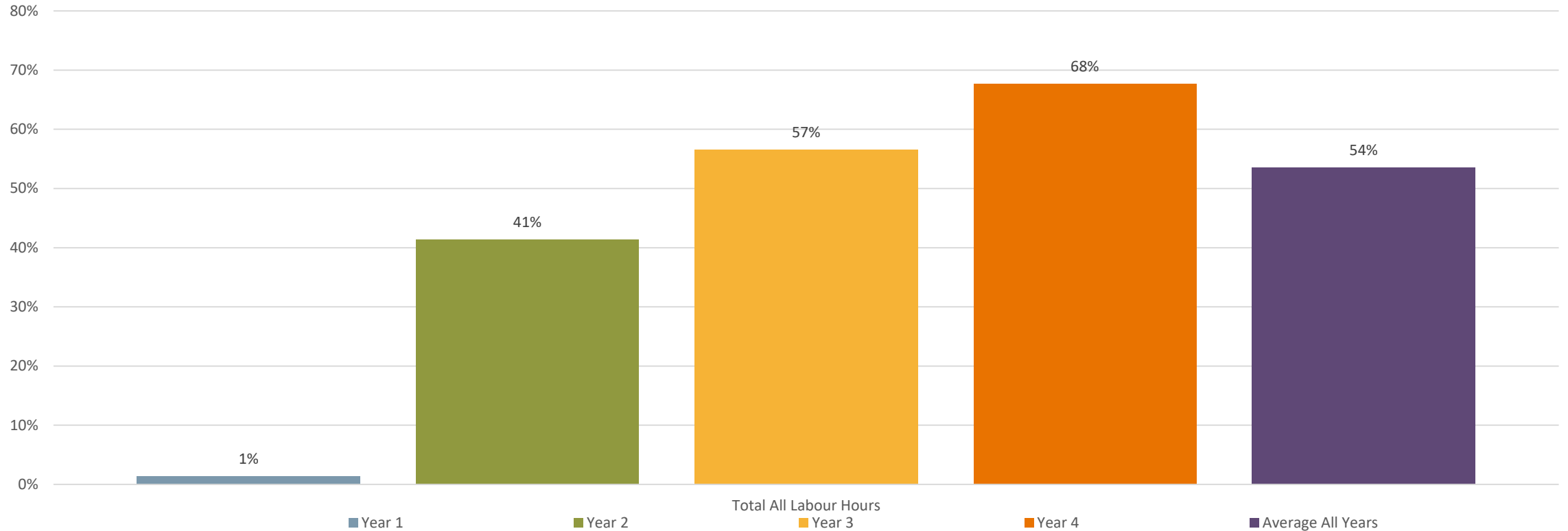
Savings have increased as the BEV vehicles age  
Preventive maintenance costs for ICE vehicles not seen in BEV

## All Maintenance BEV Benefit by Vehicle Category - Average saving by year and 4 year total



4-year savings for all maintenance = 2,845 per unit

BEV Vehicle Category Labour Hours Reduction % by Year



Labor hours have been reduced by over half and decreasing each year in service

Will have significant impact on number of technicians needed

**Scheduled LDV Maintenance Costs**

Item	ICEV	HEV	PHEV	BEV
Multi-Point Inspection	\$0.006	\$0.006	\$0.006	\$0.006
Starter Battery	\$0.004	\$0.004	\$0.004	\$0.004
Wiper Blades	\$0.003	\$0.003	\$0.003	\$0.003
Accessory Drive Belt*	\$0.002	\$0.002	\$0.002	#N/A
Headlight Bulbs	\$0.001	\$0.001	\$0.001	\$0.001
HVAC Service	\$0.001	\$0.001	\$0.001	\$0.001
Tires Replaced	\$0.011	\$0.011	\$0.011	\$0.011
Tire Rotation	\$0.007	\$0.007	\$0.007	\$0.007
Shocks and Struts	\$0.010	\$0.010	\$0.010	\$0.010
Brake Pads*	\$0.007	\$0.005	\$0.005	\$0.005
Brake Calipers*	\$0.007	\$0.005	\$0.004	\$0.004
Brake Rotors*	\$0.005	\$0.004	\$0.003	\$0.003
Engine Oil*	\$0.009	\$0.009	\$0.007	#N/A
Brake Fluid	\$0.004	\$0.004	\$0.004	\$0.004
EV Battery Coolant*	#N/A	\$0.002	\$0.002	\$0.002
Engine Coolant*	\$0.002	\$0.002	\$0.002	#N/A
Cabin Air Filter	\$0.003	\$0.003	\$0.003	\$0.003
Oil Filter*	\$0.003	\$0.003	\$0.002	#N/A
Engine Air Filter*	\$0.001	\$0.001	\$0.000	#N/A
Fuel Filter*	\$0.001	\$0.001	\$0.001	#N/A
Timing Belt*	\$0.008	\$0.007	\$0.007	#N/A
Oxygen Sensor*	\$0.004	\$0.004	\$0.004	#N/A
Spark Plugs*	\$0.004	\$0.002	\$0.002	#N/A
Transmission Service*	\$0.002	\$0.002	\$0.002	#N/A
[Null row]	0	0	0	0
<b>Total Cost per Mile</b>	<b>\$0.101</b>	<b>\$0.094</b>	<b>\$0.090</b>	<b>\$0.061</b>

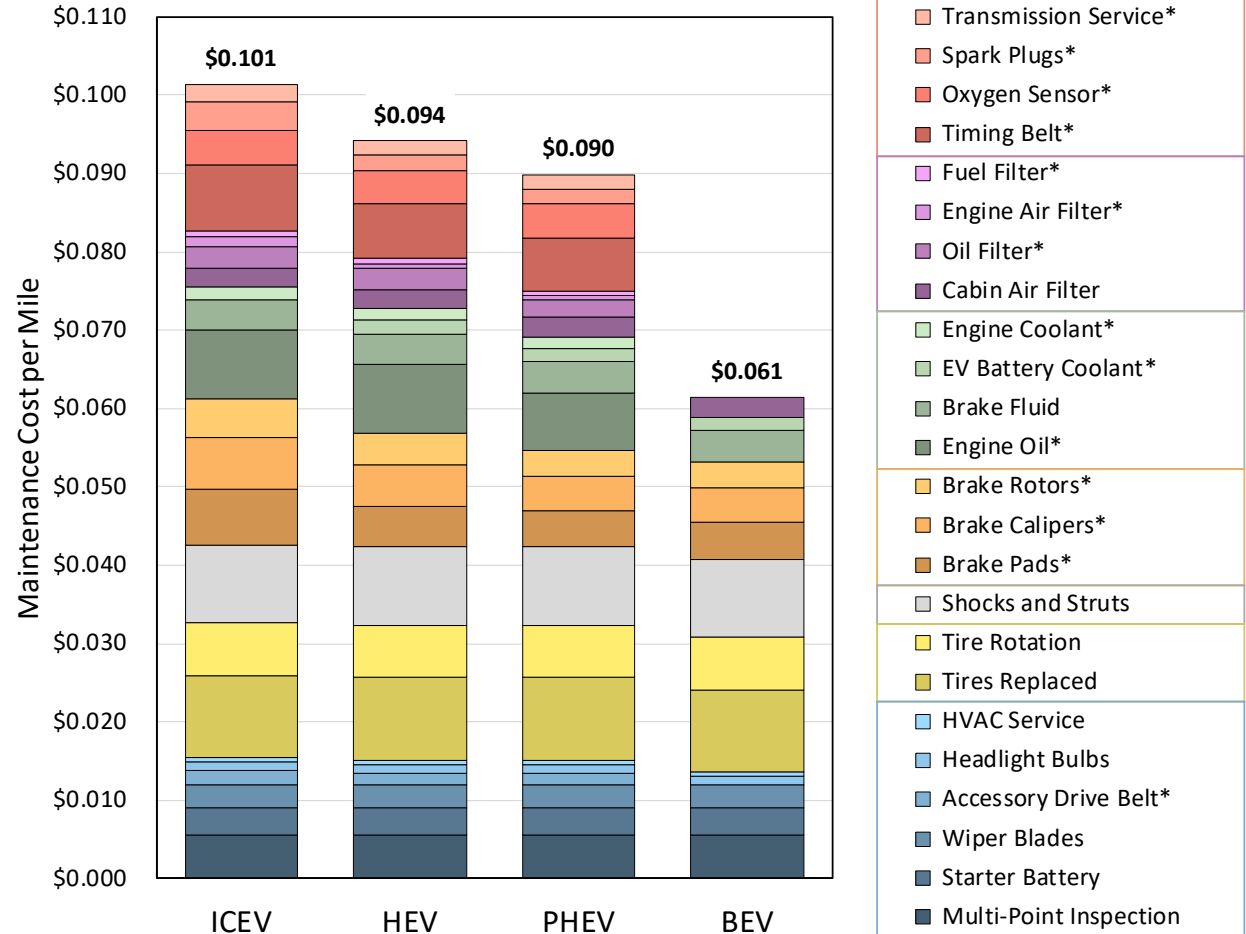
\* Service interval varies by powertrain.

**Note:** LDV = light-duty vehicle.

**Source:** Burnham, Andrew, Gohlke, David, Rush, Luke, Stephens, Thomas, Zhou, Yan, Delucchi, Mark A., Birky, Alicia, Hunter, Chad, Lin, Zhenhong, Ou, Shiqi, Xie, Fei, Proctor, Camron, Wiryadinata, Steven, Liu, Nawei, and Bolor, Madhur. Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains. United States: N. p., 2021. Web. doi:10.2172/1780970.

<https://www.osti.gov/biblio/1780970/>

**Scheduled LDV Maintenance Costs**





# EV Life Cycle Cost Analysis Challenges

- ⊛ Complete cost capture
  - Costs are often not recorded in one system
- ⊛ Capital costs
  - Account for tax benefits, grants, and other incentives
- ⊛ Maintenance costs
  - Accurate system and reason identification is important
  - Capture of BEV warranty costs and events - \$0 cost invoices
- ⊛ Downtime
  - Shift setup and configuration and open/close procedures
- ⊛ EV Kwh and costs
  - Without a charge management solution most fleets cant determine energy usage and costs
- ⊛ Allocation of new facility and charger costs
  - Costs should become part of overheads and captured through markups
- ⊛ Battery replacement cost and resale not documented