



## STATE OF CALIFORNIA

### Enhanced Efficiency Factor Costing Methodology

#### Passenger Car and Light Duty Vehicles

#### 1.0 **Scope:**

In an attempt to reduce petroleum consumption and vehicle related emissions of criteria pollutants, the State of California has developed a purchase methodology to factor in efficiency savings for vehicles achieving enhanced operational efficiencies that exceed the minimums already established by the state. In addition to a vehicle's purchase price (PP), this enhanced efficiency factor costing methodology used by the State will also compute and evaluate the discounted present value (DPV) of the following cost objectives:

**Operation:** The cost of fuel to operate the vehicle over its useful life.

**Pollution:** The cost of criteria pollutants emitted by the vehicle over its useful life.

The projected total cost of each vehicle will be the sum of the purchase price and the DPV of each cost objective when calculated annually over the vehicle's useful life. This projected total cost will be used to evaluate and select the vehicle achieving the lowest projected total cost to own and operate.

#### 2.0 **Enhanced Efficiency Factor Evaluation Methodology:**

The enhanced efficiency factor evaluation methodology is based on the projected total cost (PTC) of each vehicle. The PTC of each vehicle will be determined using the following formula:

$$PTC = PP + DPV_{\text{Reoccurring Annual Costs}} (\textit{Operation} + \textit{Pollution})$$

Where: PP = Bid Price – Cash Discounts

$DPV_{\text{Reoccurring Annual Costs}} (\textit{Operation} + \textit{Pollution}) = DPV$  (sum of annual fuel and pollution costs)

The State of California will evaluate each vehicle bid on each line item based on the PTC of the vehicle. The projected total cost (PTC) will be determined for each vehicle after cost adjustments are applied for cash discounts. The award will be made by line item to the responsible bidder meeting specifications with the lowest projected total cost (PTC). Small business (SB) preferences will be applied after the projected total cost (PTC) has been calculated.

#### 3.0 **Definitions:**

1. **Annualized Criteria Pollutants Emitted (lb./year):** The total criteria pollutants emitted by a vehicle annualized over its useful life (i.e., total pollution/years in service). The total criteria pollutants emitted by a vehicle is determined by the California Air Resources Board's (CARB) mobile source emissions model and based on the vehicle's emissions certification. (See Annualized Criteria Pollutant Emissions Table, page 3) Criteria pollutants used in this enhanced efficiency factor costing methodology include non-methane organic gases (NMOG)

and oxides of nitrogen (NO<sub>x</sub>). All emissions output data used for calculating the Projected Total Cost of the Enhanced Efficiency Factor Evaluation Methodology, shall be taken from the "Annualized Criteria Pollutant Emissions Table" on page 3 of this specification. No other source of emissions output is relevant to this calculation.

2. **Average Actual Usage:** The average actual usage of a passenger car and light duty vehicle with a gross vehicle weight rating (GVWR)  $\leq$  8,500 lb. as determined by the Department of General Services, Office of Fleet Administration is 14,000 miles per year over an average useful life of 7 years.
3. **Cost of Criteria Pollutant Emissions (\$/lb):** Cost of criteria pollutants as determined by the cost-effectiveness limits allowed under the CARB's Carl Moyer Memorial Air Quality Standards Attainment Program for oxides of nitrogen (NO<sub>x</sub>).
4. **Discounted Present Value (DPV):** The present worth of costs occurring in future years using a real discount rate to incorporate the time value of money. DPV is calculated based on the following equation:

$$DPV_{\text{Reoccurring Annual Costs}} = A \left\{ \frac{(1 + i)^n - 1}{i(1 + i)^n} \right\}$$

Where:        A = Annual cost  
                   i = Real discount rate  
                   n = Number of years

5. **Emissions Certification:** The vehicle's emissions certification as determined by the CARB by an Executive Order. The following emissions certifications shall apply to this enhanced efficiency factor costing methodology analysis:

CARB Certification	Acronym
LEV I - Ultra Low Emissions Vehicle	ULEV I
LEV II - Low Emissions Vehicle	LEV II
LEV II - Ultra Low Emissions Vehicle	ULEV II
Super Ultra-Low Emissions Vehicle	SULEV
Partial Zero Emissions Vehicle	PZEV

Vehicles certified to a Federal Bin certification will be assigned a CARB emissions certification that most closely matches the Federal Bin certification. Cleaner Federal Bin certifications will fall back to the nearest CARB certification for analysis purposes. In no event will a more polluting Federal certification be assigned a less polluting CARB certification.

6. **EPA Estimated Miles-Per-Gallon (MPG):** The MPG as published by the Federal Environmental Protection Agency (EPA) in the 2007 Model Year Fuel Economy Guide. The combined EPA MPG will be based on a combination of 55% city driving and 45% highway driving. The formula to determine the combined MPG rating is as follows:  

$$EPA \text{ MPG}_{\text{Combined}} = 1 / (0.55 / \text{MPG}_{\text{City}} + 0.45 / \text{MPG}_{\text{Highway}})$$
7. **Price of Gasoline (\$/gal):** Price of regular unleaded, 87 octane, gasoline as determined by the California Energy Commission based on a 12-month average for the State of California as a whole. Price of gasoline excludes Federal Excise tax and State sales tax amount on the Federal Excise tax.

8. **Real Discount Rate (*i*):** The forecast of real interest rates from which the inflation premium has been removed. The real discount rate is based on the most recent publication of the US Office of Management and Budget (OMB) circular No. A-94.

#### 4.0 **Evaluation Determinants:**

Evaluation determinants used in this methodology include the price of fuel, the number of miles driven per year, the real discount rate, the cost of criteria pollutants and the average pollution output based on the vehicle's emissions certification. These determinants are valid for use on the 2007 model year vehicles only. These determinants may change annually and will be readjusted for future vehicle analyses. Evaluation determinants for the 2007 model year vehicles are as follows:

<b>Determinant</b>	<b>Value</b>
Price of gasoline	\$2.57/gallon
Number miles driven per year	14,000 miles/year
Cost of NMOG	\$7.15/lb.
Cost of NOx	\$7.15/lb.
7 year real discount rate ( <i>i</i> )	2.7%
Annual criteria pollutants emitted	See "Annualized Criteria Pollutant Emissions Table"

#### **Annualized Criteria Pollutant Emissions Table (lb./year)**

<b>Certification</b>	<b>Annual Emissions</b>
ULEV I	2.353 lb. NMOG
	5.457 lb. NOx
LEV II	1.357 lb. NMOG
	2.223 lb. NOx
ULEV II	1.060 lb. NMOG
	1.737 lb. NOx
SULEV	0.729 lb. NMOG
	0.826 lb. NOx
PZEV	0.613 lb. NMOG
	0.691 lb. NOx

**5.0 Example:**

The following is an example illustrating the enhanced efficiency factor evaluation methodology.

	<b>Vehicle A</b>	<b>Vehicle B</b>
Vehicle Classification	Passenger Car	Passenger Car
Bid Price	\$13,500	\$14,000
Cash Discounts	None	None
EPA Estimated Mileage	23city/31highway	25city/33highway
CARB Emissions Certification	ULEV II	PZEV

Based on the above information, the evaluation determinants are as follows:

	<b>Vehicle A</b>	<b>Vehicle B</b>
EPA MPG <sub>Combined</sub>	≈26.0219 MPG	≈28.0612 MPG
Annual Driving Mileage	14,000 miles/year	14,000 miles/year
Annual Fuel Cost ( <i>Operation</i> )	\$1,382.68	\$1,282.20
Annualized NMOG Emissions	1.060 lb. NMOG	0.613 lb. NMOG
Annualized NOx Emissions	1.737 lb. NOx	0.691 lb. NOx
Annual NMOG Cost ( <i>Pollution</i> )	\$7.58	\$4.38
Annual NOx Cost ( <i>Pollution</i> )	\$12.42	\$4.94
Total Annual Cost (A)	\$1,402.68	\$1,291.52
Useful Life (n)	7 years	7 years
Real Discount Rate (i)	2.7%	2.7%

Where:

$$\text{EPA MPG}_{\text{Combined}} = 1/(0.55/\text{MPG}_{\text{City}} + 0.45/\text{MPG}_{\text{Highway}})$$

$$\text{Annual Fuel Cost} = (\text{Annual driving mileage} \times \text{Price of gasoline}) / \text{EPA MPG}_{\text{Combined}}$$

$$\text{Annual NMOG Cost} = \text{Annualized NMOG Emissions} \times \text{Cost of NMOG}$$

$$\text{Annual NOx Cost} = \text{Annualized NOx Emissions} \times \text{Cost of NOx}$$

$$\text{Total Annual Cost (A)} = \text{Sum of Annual Costs (Operation + Pollution)}$$

$$= \text{Annual Fuel Cost} + \text{Annual NMOG Cost} + \text{Annual NOx Cost}$$

Calculations:

**Vehicle A:** EPA MPG<sub>Combined</sub> = 1/(0.55/23 MPG + 0.45/31 MPG) ≈ 26.0219 MPG  
 Annual Fuel Cost = 14,000 miles/year x \$ 2.57/gallon/ 26.0219 MPG  
 = \$1,382.68

$$\text{Annual NMOG Cost} = 1.060 \text{ lb.} \times \$7.15/\text{lb.} = \$7.58$$

$$\text{Annual NOx Cost} = 1.737 \text{ lb.} \times \$7.15/\text{lb.} = \$12.42$$

$$\text{Total Annual Cost (A)} = \$1,382.68 + \$7.58 + \$12.42 = \$1,402.68$$

**Vehicle B:** EPA MPG<sub>Combined</sub> = 1/(0.55/25 MPG + 0.45/33 MPG) ≈ 28.0612 MPG  
 Annual Fuel Cost = 14,000 miles/year x \$ 2.57/gallon/ 28.0612 MPG  
 = \$1,282.20

$$\text{Annual NMOG Cost} = 0.613 \text{ lb.} \times \$7.15/\text{lb.} = \$4.38$$

$$\text{Annual NOx Cost} = 0.691 \text{ lb.} \times \$7.15/\text{lb.} = \$4.94$$

$$\text{Total Annual Cost (A)} = \$1,282.20 + \$4.38 + \$4.94 = \$1,291.52$$

Therefore, the PTC methodology costs are as follows:

	<b>Vehicle A</b>	<b>Vehicle B</b>
Purchase Price (PP)	\$13,500.00	\$14,000.00
DPV <sub>Reoccurring Annual Costs</sub> ( <i>Operation + Pollution</i> )	≈\$8,838.76	≈\$8,138.30
PTC Evaluation Cost	\$22,338.76	\$22,138.30

Where: PP = Bid Price – Cash Discounts

$$DPV_{\text{Reoccurring Annual Costs}} = A \left\{ \frac{[(1 + i)^n - 1]}{i(1 + i)^n} \right\}$$

$$PTC = PP + DPV_{\text{Reoccurring Annual Costs}} (\textit{Operation} + \textit{Pollution})$$

Calculations:

**Vehicle A:** PP = \$13,500 - \$0.00 = \$13,500

$$DPV_{\text{Reoccurring Annual Costs}} = \$1,402.68 \left\{ \frac{[(1 + .027)^7 - 1]}{.027(1 + .027)^7} \right\}$$

$$DPV_{\text{Reoccurring Annual Costs}} \approx \$8,838.76$$

$$PTC = \$13,500 + \$8,838.76 = \$22,338.76$$

**Vehicle B:** PP = \$14,000 - \$0.00 = \$14,000

$$DPV_{\text{Reoccurring Annual Costs}} = \$1,291.52 \times \left\{ \frac{[(1 + .027)^7 - 1]}{.027(1 + .027)^7} \right\}$$

$$DPV_{\text{Reoccurring Annual Costs}} \approx \$8,138.30$$

$$PTC = \$14,000 + \$8,138.30 = \$22,138.30$$

**Conclusion:** In this example, vehicle B has a lower projected total cost (PTC) than vehicle A.